The Plague Cemetery of Alghero, Sardinia (1582-1583)

The bioarchaeological study

Valentina Giuffra

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Archaeopress Archaeology

Archaeopress Publishing Ltd
Summertown Pavilion
18-24 Middle Way
Summertown
Oxford OX2 7LG

www.archaeopress.com

ISBN 978-1-80327-076-0
ISBN 978-1-80327-077-7 (e-Pdf)

Cover: Aerial view of trenches 2, 3 and 4 of the Alghero cemetery

Contents

List of Figures iii

Preface vi

Acknowledgements viii

Chapter 1 Introduction 1

1 Introduction 1

1.1 The Plague: historical and biological aspects 1

1.2 The history of Alghero from the origins to the plague of 1582-83 2

1.3 The site of Lo Quarter 4

1.4 The cemetery (end of 13th-beginning of 17th centuries) 4

1.4.1 Phase 1. End of 13th-first half of 14th century 4

1.4.2 Phase 2 and 3. Half of 14th-beginning of 16th centuries 5

1.4.3 Phase 4. The plague cemetery of 1582-83 5

1.4.4 Phase 5. Late 16th-beginning of 17th centuries 7

1.5 The collective burials of Alghero: the trenches 7

1.5.1 Sector 2100 9

1.5.2 Sector 2500 10

1.6 Aims of the study 11

Chapter 2 Materials and methods 13

2.1 Materials 13

2.2 Biological sex estimation 13

2.3 Age at death estimation 13

2.3.1 Methods for adult individuals 14

2.3.2 Methods for non-adults 14

2.4 Taphonomy 15

2.5 Stature estimation 15

2.6 Non-metric traits 16

2.7 Dental pathologies 16

2.7.1 Caries and abscesses 16

2.7.2 Dentoalveolar diseases 16

2.7.3 Dental wear 17

2.7.4 Dental calculus 17

2.7.5 Dental malpositions 17

2.8 Stress indicators 17

2.8.1 Dental enamel hypoplasia 17

2.8.2 **Cribra cranii** and **cribra orbitalia** 18

2.8.3 Periosteal reaction 18

2.9 Degenerative joint disease (osteoarthritis) 19

2.10 Entheseal changes 19

2.11 Pathologies 20

2.11.1 Traumatic conditions 20

2.11.2 Auricular exostosis and osteophytosis 20

2.11.3 Other pathologies 20

2.12 Statistical analysis 21

Chapter 3 Results and discussion 22

3.1 Demography 22

3.2 Taphonomic analysis 25

3.2.1 Position of the corpses 25

3.2.2 Grave goods 33

3.3 Stature 34

3.4 Non-metric traits 36

3.5 Dental pathologies 39

3.5.1 Caries and abscesses....39
3.5.1.1 Adults....39
3.5.1.2 Non-adults....43
3.5.2 Dentoalveolar diseases....45
3.5.3 Tooth wear....47
3.5.4 Dental calculus....48
3.5.5 Dental malpositions....49
3.6 Stress indicators....49
3.6.1 Dental enamel hypoplasia....49
3.6.2 Cribra cranii **and** cribra orbitalia....51
3.6.3 Periosteal reaction....54
3.6.4 The 'Osteological Paradox'....57
3.7 Degenerative joint disease....57
3.8 Entheseal changes....62
3.9 Pathologies....66
3.9.1 Traumatic conditions....66
3.9.2 Osteochondritis dissecans....67
3.9.3 Auricular exostosis and osteophytosis....69
3.9.4 Infectious diseases....69
3.9.4.1 Osteomyelitis....69
3.9.4.2 Mercurial teeth....70
3.9.4.3 Brucellosis....71
3.9.4.4 Enlarged foramina on the anterior portion of the vertebral bodies....72
3.9.5 Rheumatoid arthritis....73
3.9.6 Tumors....75
3.9.7 Congenital diseases....75
3.9.7.1 Craniosynostosis....75
3.9.7.2 Atlas occipitalisation....75
3.9.7.3 Posterior arch defect of the atlas....76
3.9.7.4 Klippel-feil syndrome....77
3.9.7.5 Other congenital defects of the spine....78
3.9.7.6 Possible Camurati-Engelmann disease....78
3.9.7.7 Subluxation of the hip....79
3.9.8 Diffuse idiopathic skeletal hyperostosis....79

Chapter 4 Conclusions and future perspectives....81
1. Methods....84
2. Age and sex of the individuals....86
3. Taphonomy....91
4. Stature data....92

Chapter 5 The catalogue of the individuals of each trench....94
Trench 1....94
Trench 2....99
Trench 3....114
Trench 4....130
Trench 5....151
Trench 6....161
Trench 7....164
Trench 8....180
Trench 9....191
Trench 10....204
Trench 11....238
Trench 12....254
Trench 13....272
Trench 14....292
Trench 16....299

References....304

List of Figures

Chapter 1 **Introduction**

Figure 1. Satellite photo of the site of Lo Quarter and, in detail, of the Church of San Michele ... 5
Figure 2. The excavation area of San Michele ... 6
Figure 3. The courtyard of the Jesuit's college of San Michele (area 2000) in which the trenches were found ... 7
Figure 4. Map of the area 2000 with the trenches ... 8
Figure 5. Detailed map of area 2000 ... 9
Figure 6. A view of the excavation of area 2000 with trenches 2, 3 and 4 ... 9
Figure 7. Trench 4 ... 11
Figure 8. Trench 9 ... 11
Figure 9. Trench 12 ... 12
Figure 10. Trench 13 ... 12
Table 1. The trenches and number of individuals they contained ... 13

Chapter 2 **Materials and methods**

Table 2. Age categories used for paleodemographic data from Alghero ... 14

Chapter 3 **Results and discussion**

Figure 11. General mortality of the population of Alghero ... 22
Figure 12. Mortality of non-adult individuals ... 23
Figure 13. Mortality of adult individuals ... 23
Figure 14. The fetus associated SU 5123 bis (trench 13) ... 24
Figure 15. Proportion of non-adult/adult individuals in Alghero and in other two 16th century plague samples ... 25
Figure 16. Adult sex distribution in Alghero and other two 16th century plague samples ... 25
Figure 17. Modality of deposition of the skull ... 26
Table 3. Orientation of the trenches and number of bodies (total = 183) in each trench ... 26
Figure 18. Position of the skull ... 27
Figure 19. Position of the upper limbs ... 27
Figure 20. SU 2237 (trench 4) with both arms hyper-flexed ... 28
Figure 21. SU 2208 (trench 2) with both arms hyper-flexed under the chin ... 28
Figure 22. SU 2280 (trench 7) with one arm hyper-flexed and the other extended ... 29
Figure 23. SU 2285 (trench 7) with arms over the skull ... 29
Figure 24. SU 2412 (trench 12) with one arm on the thorax, the other hyper-flexed over the skull ... 30
Figure 25. Possible family group composed of SU 2309, 2299, 2312 (trench 9) ... 30
Figure 26. Position of the lower limbs ... 31
Figure 27. Position of the knees ... 31
Figure 28. Position of the ankles ... 31
Figure 29. Individuals subjected to the wall effect ... 32
Figure 30. Verticalization of the clavicles ... 32
Table 4. Cases of verticalization of the clavicles in the trenches ... 32
Figure 31. Distribution of the equipment in the trenches by age ... 33
Table 5. Objects recovered in association with burials from the trenches ... 33
Figure 32. SU 2523 (trench 10) ... 34
Figure 33. Pendant depicting St Giacomo ... 34
Figure 34. SU 2514 (trench 10) with the hoard of coins *in situ* ... 35
Table 6. Adult stature ... 35
Figure 35. Adult stature distribution ... 35
Table 7. Frequency of non-metric traits of the cranium in both sexes and in total ... 36
Table 8. Frequency of non-metric traits of the post-cranial skeleton in both sexes and in total ... 37
Table 9. Non-metric traits of the cranium in non-adults ... 38
Table 10. Non-metric traits of the post-cranial skeleton in non-adults ... 38
Table 11. Demographic distribution of the individuals considered for the dental pathologies ... 39
Table 12. Caries on adult individuals ... 39
Table 13. Caries on adult individuals distributed in maxilla and mandible ... 39
Table 14. Teeth with more than 1 caries ... 40
Table 15. Distribution of caries by sex in age ranges in adult individuals ... 40
Figure 36. Caries frequency by sex in age categories in adult individuals ... 40
Table 16. Distribution of caries by sex and tooth type ... 41
Table 17. Localisation and severity of the caries in maxillary teeth in females, males and individuals of undeterminable sex ... 41
Table 18. Localisation and severity of the caries in mandibular teeth in females, males and individuals of undeterminable sex ... 42
Table 19. Localisation and severity of the caries in maxillary and mandibular teeth combined in females, males and individuals of undeterminable sex ... 42
Figure 37. Maxilla of SU 2309 (trench 9), a male aged 30-40 years, showing several caries of different grades affecting right PM2, left PM1, M2 and M3, ante mortem loss of right and left M1, and dental wear of anterior teeth ... 43

Table 20. Frequency of abscesses calculated on alveoli 43
Table 21. Frequency of abscesses calculated on individuals 43
Table 22. Caries on teeth in non-adults divided in age classes 44
Table 23. Frequency of caries in non-adults on individuals 44
Table 24. Frequency of caries on teeth in non-adults 44
Table 25. Teeth with more than 1 caries 44
Figure 38. Frequency of caries in non-adults per age classes 44
Figure 39. Frequency of caries on teeth in non-adults in deciduous and permanent teeth 44
Table 26. Localisation and severity of the caries in deciduous and permanent teeth in non-adults 45
Table 27. Frequency of alveolar resorption in both sexes and in total 45
Table 28. Frequency and severity of alveolar resorption in females divided by age range 46
Table 29. Frequency and severity of alveolar resorption in males divided per age ranges 46
Table 30. Distribution of ante-mortem tooth loss 46
Figure 40. Frequency of ante-mortem tooth loss on alveoli divided per sexes 46
Figure 41. Frequency of ante-mortem tooth loss on individual divided per sexes 47
Table 31. Average wear scores for males and females calculated for each tooth category 47
Table 32. Average wear scores for males and females according to age groups 48
Table 33. Frequency of calculus considering maxillary and mandibular teeth separately in females, males, individuals of undeterminable sex and non-adults 48
Table 34. Overall frequency of calculus (maxillary + mandibular teeth) in females, males, individuals of undeterminable sex and non-adults 48
Figure 42. Frequency of mild and strong calculus on individuals considering males, females, individuals with undeterminable sex and non-adults between 3 and 17 years 48
Table 35. Frequency of crowding and rotation on teeth divided per sexes 49
Figure 43. Mandible of SU 2858 (trench 11), a male aged 30-40 years, showing strong calculus, particularly on the posterior teeth, along with alveolar resorption 49
Table 36. Frequency of crowding and rotation on individuals divided per sexes 49
Table 37. LEH in the population of Alghero calculated on teeth and on individuals 49
Figure 44. Chronological distribution of the age of onset of LEH 50
Table 38. Distribution of defects in males, females and non-adults by age of onset 50
Table 39. Severity of enamel defects 50
Figure 45. Comparison of the frequency of linear enamel hypoplasia on individual in Alghero and in two contemporary samples 51
Table 40. *Cribra cranii* in adult and non-adults individuals 51
Figure 46. Frequency of *cribra cranii* in adult and non-adult individuals 51
Table 41. *Cribra orbitalia* in adult and non-adults individuals 52
Figure 47. Frequency of *cribra orbitalia* in females, males and non-adults 52
Figure 48. *Cribra orbitalia* the left orbit of SU 2763 (trench 10), a female aged 40-50 years 52
Figure 49. Comparison of the frequency of *cribra cranii* on individual in Alghero and in another contemporary sample 53
Figure 50. Comparison of the frequency of *cribra orbitalia* on individual in Alghero and in other contemporary samples 53
Table 42. Frequency and typology of periosteal reaction 54
Figure 51. Sex-specific frequency of periosteal reaction in the long bones of the lower limbs 55
Figure 52. Sex-specific localization of PR 55
Figure 53. Localized periosteal reaction of grade 3 on the diaphysis of the tibia of SU 2289 (trench 8), a female aged 35-45 years 55
Figure 54. Sex-specific severity of PR 56
Figure 55. Comparison of the frequency of tibial periosteal reaction on individual in Alghero and in another contemporary sample 56
Table 43. Number of affected joints on observable joints in both sexes and individuals with indeterminable sex 57
Figure 56. Frequency of affected joints 58
Figure 57. Frequency of affected joints divided per grades on individuals 58
Figure 58. Frequency of individuals with osteoarthritis of grade 2 and 3 58
Figure 59. Frequency of degenerative joint disease on joints 59
Figure 60. Severity of degenerative joint disease on joints 59
Figure 61. Frequency of degenerative joint disease in female individuals divided per age ranges 60
Figure 62. Degenerative changes in the knee of SU 2278 (trench 7), a male aged 35-45 years 60
Table 44. Distribution of degenerative joint disease in females divided in three age ranges (20-29, 39-39 and >40 years) 60
Table 45. Distribution of degenerative joint disease in males divided in three age ranges (20-29, 39-39 and >40 years) 61
Figure 63. Frequency of degenerative joint disease in male individuals divided per age ranges 61
Table 46. Distribution of Schmorl's nodes in females (F), males (M), adult individuals with undeterminate sex (ND) and total (Total) 61
Figure 64. Frequency of Schmorl's nodes in females and males in the three segments of the spine 62
Figure 65. Schmorl's nodes on thoracic vertebrae of SU 5125 (trench 13), a male aged 40-50 years 62
Table 47. Entheseal changes in females considered per ages 63
Table 48. Entheseal changes in males considered per ages 64
Figure 66. Enthesopathy in correspondence of the costo-clavicular ligament of the clavicle of SU 2247 (trench 2), a male aged 30-40 years 65
Figure 67. Enthesopathy in correspondence of the patellar ligament of both patellae of SU 2185 (trench 2), a male aged 35-45 years 65

Table 49. Fractures in the population of Alghero 66
Figure 68. Unhealed fracture of one rib of SU 2235 (trench 3), a male aged 25-32 years 67
Figure 69. Healed blunt force trauma on the frontal bone of SU 5125 (trench 13), a male aged 40-50 years 67
Table 50. Microtrauma in the population of Alghero 68
Table 51. Osteochondritis dissecans in the Alghero sample 68
Figure 70. Osteochondritis dissecans on the lunate, (a), distal tibiae (b), distal left fibula (c), first left cuneiform (d), proximal epiphysis of the first toe phalanges (e) of SU 2278 (trench 7), a male aged 35-45 years 68
Table 52. Auricular osteophytosis in adult and non-adult individuals 69
Figure 71. Frequency of auricular osteophytosis in adult and non-adult individuals 69
Figure 72. SU 2310 (trench 9), a non-adult aged 8-9 years, showing auricular osteophytosis 69
Figure 73. Osteomyelitis of the right tibia of SU 2201 (trench 4), a non-adult aged 12-15 years 70
Figure 74. Maxillary first incisors (a) and canines (b), buccal view, and mandibular (c) and maxillary molars (d) of SU 2234 (trench 4), a non-adult aged 4-5 years 71
Figure 75. SU 2765 (trench 10), a female aged 35-45 years, showing lytic lesions on the antero-superior margins of L2 and L3, suggesting a possible diagnosis of brucellosis 72
Table 53. Individuals with lytic lesions on the anterior portion of the vertebral bodies 73
Figure 76. SU 2557 (trench 10), a non-adult aged 10-12 years, showing lytic lesions on the thoracic vertebrae and sacrum 73
Figure 77. SU 5125 (trench 13), a male aged 40-50 years, showing lytic lesions on the anterior portion of the thoracic and lumbar vertebrae: T6 with no external lesions (a) but internal erosions on CT (b); T10 with a cavitation visible externally (c) and CT showing the internal aspect of the bone (d); L1 with a lateral lytic lesion (d) and CT view (e) 74
Figure 78. SU 2528 (trench 10), a female aged 35-45 years, with lytic lesions on the head of the metacarpals 75
Figure 79. SU 2189 (trench 5), a non-adult aged 13-15 years. Osteoma of the right zygomatic process 75
Figure 80. SU 2762 (trench 10), a non-adult aged 9 years. Premature bilateral closure of the coronal suture 76
Figure 81. SU 5125 (trench 13), a male aged 40-50 years. Fusion of C1 with cranial basis 76
Figure 82. SU 2219 (trench 4), a male aged 20-30 years. Posterior arch defect of the atlas. Anterior and posterior view 77
Figure 83. SU 2309 (trench 9), a male aged 30-40 years. Fusion of C2 and C3 77
Figure 84. SU 2179 (trench 4), a male aged 45-55 years. Macroscopic (a) and radiologic (b) image of the left humerus, radius and ulna 78
Figure 85. SU 2179. Macroscopic (a) and radiologic (b) image of the left femur, tibia and fibula 79
Figure 86. SU 2217 (trench 4), a male aged 50-60 years. DISH 80

Appendix

Table 1. Non-metric traits of the skull 84
Table 2. Non-metric traits of the post-cranial skeleton 84
Table 3. List of muscle and ligament attachment site examined in this study 85
Table 4. The 183 individuals from the 16 trenches 86
Table 5. Variants observed in individuals with different positions of upper limbs 91
Table 6. Stature of female individuals 92
Table 7. Stature of male individuals 93

Preface

This volume, authored by Valentina Giuffra, presents the detailed bioarchaeological analysis of a large post-medieval population from Alghero (Sardinia) dating to the end of the 16th century.

The study focuses on a sample from an important plague cemetery, where emergency excavations were carried out by a research team of medieval archaeologists and anthropologists under my direction between 2008 and 2009.

To better contextualize the research, the initial pages of the volume briefly illustrate the archaeological background and various cemetery phases identified within the stratigraphic sequence of the site, topics that formed the subject of a book I edited in 2010, immediately after the end of the excavations. Building on this previous research, Valentina Giuffra explores the bioarchaeological aspects of this important archaeological discovery in an original way, also referring to numerous papers published in scientific journals between 2010 and 2020 for the synthesis and interpretation of data.

A fundamental element to take into account for bioarchaeological considerations on the population of Alghero is represented by the migratory flows and repopulation events that characterized this port city in the medieval and post-medieval periods, and particularly during the 16th century, that is the time when the plague cemetery was in use. The city of Alghero was born from the initiative of Ligurian (Genoese in particular) and Sardinian noble groups in the 13th century. In the mid-14th century, the Catalan-Aragonese conquest of Alghero led to its repopulation by Iberian pobladors, radically changing the soul of this city, where a dialect variant of the Catalan language is still spoken today in place of Sardinian.

The plague cemetery (1582-1583), whose bioarchaeological study is at the heart of this volume, reflects a specific phase of use (the most important, in fact) of the vast and multi-layered cemetery of San Michele in Alghero. The excavation of the cemetery of San Michele allowed to document numerous phases of cemetery use, from the 13th century to the 17th century; however, this research focuses specifically on the bioarchaeology of individuals from the plague phase, certainly the most intriguing and informative of the whole stratigraphic sequence.

The plague cemetery of Alghero is unique in Europe due to peculiarities in the organization and management of the burial area during the plague epidemic that decimated the inhabitants of the city. Burial workers (fossadors) dug numerous long and narrow trenches, inside which the bodies of the deceased were carefully deposited in collective burials.

The archaeological excavation of these burials has revealed a picture of high mortality, with the simultaneous death of large numbers of individuals and, in several cases, with multiple deaths occurring within the same family unit. Despite the health emergency and the consequent rush in burial operations, care was taken to maintain connections within family units at the time of interment. Indeed, family members were buried close to one another, with the children protectively placed between the legs of their parents and adult relatives. To carry out this delicate and risky operation, the fossadors are believed to have been paid well by the surviving families. Knowledge of these particular circumstances has allowed an extremely precise archaeological and bioarchaeological study of the buried individuals, with the possibility of recognizing familial groups.

Accordingly, in consideration of the chronological span covered by the different cemetery phases (13th-17th centuries), the high number of buried individuals, the fair state of preservation of the skeletal remains, and the limited impact of post-depositional processes, the cemetery of San Michele in Alghero can be considered as an extraordinary biological archive of the site, the place that, more than any other, bears the material traces of the troubled ethnic history of the city and its inhabitants, including Sardinian, Genoese, and Catalan people.

The phase of the plague cemetery of Alghero studied by Valentina Giuffra captures quite a faithful snapshot of society and its social composition (relations between the sexes and between various age groups and the infant population) at a precise time, circumscribed to the few months of the epidemic.

An anthropological sample obtained from a catastrophic cemetery in use during an epidemic provides more reliable information than samples originating from attritional cemeteries and reflecting ordinary mortality profiles, in which stratigraphy can offer only limited insights into the precise

chronological relationships between different burials within each phase. Nevertheless, the possible and perhaps non-negligible impact of a certain selectivity of death toward the most fragile individuals should also not be underestimated in cemeteries linked to catastrophic events.

A broad objective of the book is the characterization of the health status of the Alghero population at the end of the 16th century based on analytical data collected on a large number of individuals. In a truly extensive catalogue, which occupies a substantial part of the volume, anthropological records are presented for each trench and for each individual, with indication of the results of anthropological assessments and paleopathological observations.

The Author provides a detailed picture of the pathologies she identified in the analysis of the skeletal remains from the plague cemetery. Among the various pathologies illustrated and discussed by the Author are those affecting the spine (DISH), which are not necessarily to be associated with ergonomic causes and occupation, but can also be ascribed to metabolic disorders (obesity, diabetes).

Furthermore, evidence of mild periosteal reaction can be seen as indicative of living and working conditions without an excessively heavy workload, while traces of *cribra* (cranial and orbital) can be related to forms of malaria that are more frequent in males than in females and can be interpreted in terms of a greater involvement of the former in occupational activities performed in extra-urban and, possibly, swampy areas. As pointed out by the Author, a high prevalence of dental pathologies is suggestive of overall poor oral hygiene, but can also be linked to the quality of nutrition.

Lastly, there are very particular paleopathological cases, such as that of a child of about four years of age who was subjected to mercury treatment, probably to cure congenital syphilis, which had been passed on to him by his mother.

The Author interprets this set of paleopathological data as reflective of a physically active population, not engaged in excessively strenuous work and living in a fairly healthy environment.

The case of the cemetery of San Michele in Alghero is particularly significant from a contextual perspective, also at a European level, as it is very rare to find burial sites with a high number of individuals that can reflect the health status of a population over an extremely short period of time. Indeed, most large cemeteries are characterized by multiple phases, which are often less stratigraphically distinguishable and can therefore encompass and conflate different burials spanning many decades or even centuries, weakening the chronological reliability of anthropological records and hindering the interpretation of the biological history of specific populations from given sites.

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Acknowledgements

I want to thank Prof. Marco Milanese of the University of Sassari and the Soprintendenza Archeologia, belle arti e paesaggio per le province di Sassari e Nuoro for giving me the permission to study the skeletal material coming from the plague cemetery of Alghero. I also thank Prof. Andrea Costantino Mario Montella, Prof. Eugenia Tognotti and Prof. Pasquale Bandiera for the support in the research.

I thank Prof. Davide Caramella, Director of the Diagnostic and Interventional Radiology Unit of the University of Pisa, for the support in the radiological analysis, Prof. Gino Fornaciari for his suggestions about the diagnoses, and Dr. Simona Minozzi for her support in the data elaboration. I thank the external reviewers, Prof. Elizabeth Craig-Atkins of the University of Sheffield, Prof. Sabrina Agarwal of the University of Berkeley and Prof. Ana Luisa Santos of the University of Coimbra for their precious suggestions, which improved the manuscript.

I thank the students who worked on the skeletal material from the plague cemetery of Alghero: Giulia Giovannetti, Chiara Spiga, Eva Bernardeschi, Zoe Bonuccelli, Ileana Buzic, Elena Varotto, Giulia Bonna, Elena Ferraloro and Eleni Bartolotta.

Finally, I thank the Institutions that financially supported the research, the University of Sassari, the Regione Autonoma della Sardegna, the Banco di Sardegna and the University of Pisa.

Chapter 1

Introduction

1 Introduction

Society has always understood the importance of historical memory enclosed in archives and monuments. However, the construction of historical memory can be assisted not only by written texts and material culture, but also by information that can be inferred from the biological history of a society. Therefore, the research in this field benefits greatly from the study of ancient cemeteries, which can preserve crucial data on lifestyle, disease, work activities, economic and environmental conditions of past populations.

In our case, the San Michele cemetery of Alghero in Sardinia (Italy), used for 350 years, from the 13th to the beginning of 17th century, can be considered as a source of biological information about the population which lived in that period in Alghero; this community was composed of several different ethnicities, including Sardinian, Genovese and Catalan people. San Michele's cemetery was rediscovered in 2008 by a team led by Prof. Marco Milanese of the University of Sassari during the urban redevelopment of the Jesuit complex in Alghero; this site represents by size and burial rite a unique find in the Mediterranean basin and one of the most important Italian medieval and post-medieval cemeteries documented so far, as it contains about 600 individuals. In fact, the cemetery is large in terms of total sample size, thus representing a wider section of the population than other sites, and the preservation of the remains is advantageous, as the skeletons are articulated. Initially, the archaeological investigation, in the form of an emergency excavation, was concentrated in the most ancient internal rooms of the structure of the former Jesuit Convent, where a portion of the medieval cemetery was found. Subsequently, the central part of the garden of the complex was investigated. The total excavated area was about 1000 square meters.

The area corresponding to the courtyard of the Jesuit college revealed a particular burial typology, consisting in 16 long and narrow trenches, rarely documented in the Mediterranean region. Archaeological elements, based on the analysis of the pottery and objects associated with the skeletal remains, allowed to date the trenches back to the second half of the 16th century (Milanese 2010). For this period the written sources document a plague episode that ravaged the town of Alghero in 1582-1583.

During this work, 181 individuals exhumed from the plague cemetery, recovered from 15 trenches, have been studied from the anthropological and paleopathological point of view, providing insight into the health conditions and lifestyle of the population of the late 16th century Alghero. The aim of this book is in fact to examine all the individuals recovered from the trenches of Alghero referable to the plague outbreak, in order to reconstruct as much as possible the health status and the life conditions of this population. For this purpose, the burial modalities adopted in this site will be analysed, the biological profile of the inhabitants of Alghero will be determined, and all the dental and bone pathologies observable on the skeletal remains will be evaluated.

1.1 The Plague: historical and biological aspects

Plague is an infectious disease caused by the bacterium *Yersinia pestis*, a Gram-negative bacterium, belonging to the family *Enterobacteriaceae*. Most mammals can be infected by *Y. pestis*, but rodents are the most common hosts. Many species of fleas are likely to be vectors of plague, but the most effective vector is *Xenopsylla cheopis*, the oriental rat flea. In particular, the plague passes from the rat to the flea through the blood; at this point the cells multiply within the intestine of the flea and can be transmitted to a healthy animal through the bite. When the disease begins to spread, rat mortality becomes so great that fleas are forced to find new hosts, including humans (Raoult *et al.* 2013; Yang 2017).

Plague is divided into three main types, bubonic, septicemic and pneumonic, depending on which part of the body is involved. Bubonic plague is the most common variety of the disease. It is named after the swollen lymph nodes (buboes) that typically develop in the first week after the infection; other symptoms of bubonic plague are fever and chills, headache, fatigue, muscle aches. Septicemic plague occurs when plague bacteria multiply in the bloodstream; other symptoms beside those typical of the bubonic form are abdominal pain, diarrhea and vomiting, bleeding from the mouth, nose or rectum, and gangrene of the extremities. The least common form of plague is the pneumonic one, which can be transmitted from human to human via cough droplets; it is the most dangerous form of plague and symptoms include cough with bloody mucus, difficult breathing, high fever, headache, nausea and vomiting, weakness and chest pain. In the bubonic form

the mortality rate is of 40-70% of cases, if left untreated; the septicemic and pulmonary forms are lethal in 100% of cases in absence of antibiotic therapy (Raoult *et al.* 2013; Stenseth *et al.* 2008).

Plague has evolved quite rapidly and has decimated the European population for centuries. The first pandemic clearly attested by molecular studies is the so-called Justinian plague (541-767 AD) that, coming from Asia, soon spread to all the Mediterranean cities (Wagner *et al.* 2014). Then the great pandemic, known as the 'Black Death', began around 1346 around the coasts of the Caspian Sea and, through successive waves, ravaged Europe for more than four centuries at regular intervals of about half a century (Spyrou *et al.* 2019). Finally, a third pandemic occurred in 1894 in Hong Kong quickly reaching all the world, particularly in areas previously excluded from the bacillus attack, such as North and South America, South Africa and Madagascar, while Europe managed to keep the event under control (Bramanti *et al.* 2019). It was during the third pandemic (1894) that the aetiologic agent of the disease, *Yersinia pestis,* was firstly isolated by Alexander Yersin in Hong Kong.

During the 19th and 20th centuries progress in medicine and scientific discoveries made it possible to stem the number of catastrophic episodes linked to *Yersinia pestis*. In particular, in addition to the work done by the physician Yersin, we must remember that of the French physiologist Emile Roux, who understood the role of mice and fleas in the spread of the disease. Finally, with the arrival of antibiotics and the improvement of socio-economic conditions and hygiene, mortality has been greatly reduced, although the disease cannot be considered to be completely eradicated. In fact, since 2001, 14 major outbreaks have been reported to the World Health Organization (WHO), mainly from Africa and Asia (Butler 2014; Yang 2017).

Plague, like other epidemic diseases, leaves no pathognomonic signs on the skeletal remains, because its evolution is very rapid and frequently mortal, in the absence of an adequate antibiotic therapy. Therefore, the development of new techniques to identify biological traces of the bacillus (proteins, ancient ADN) in the skeletal remains of plague victims is particularly important, and in the last years several molecular studies have been focused on the evidence of past plague occurrences (i.e. Andreades Valtuena *et al.* 2017; Bos *et al.* 2011; Feldman *et al.* 2016; Rasmussen *et al.* 2015; Scheuenemann *et al.* 2011; Seifert *et al.* 2016; Spyrou *et al.* 2016; Wagner *et al.* 2014).

It is out of doubt that the trenches brought to light in Alghero should be referred to an epidemic outbreak. The presence of ceramic fragments and other objects associated to the burials and surely referable to the second half of the 16th century permits to associate the trenches to the plague outbreak of 1582-1583 reported by historical sources. However, the confirmation of the *Yersinia pestis* infection as the etiological agent of the epidemic should be obtained through molecular analyses. Up until now, bone samples taken from four individuals exhumed from four distinct trenches were tested through palaeoimmunological techniques. The analysis was carried out using the Rapid Plague Diagnosis Test (RDT), an immunochromatographic test developed and validated by the Pasteur Institutes of Madagascar and Paris. This test recognizes Y. pestis specific immunogenic F1 capsular glycoprotein (Bianucci *et al.* 2007). The Yersinia pestis F1 antigen was identified in all four tested samples with concentrations between 2.5 ng / ml and 0.625 ng / ml. However, to be considered valid, the results of the palaeoimmunological analysis should have be confirmed by molecular analysis. Two different laboratories worked on samples from the trenches of Alghero but, unfortunately, no positive results have been obtained so far, as for the poor state of preservation of aADN. It cannot be ruled out that in the future the refinement of the molecular techniques could offer positive results of the presence of plague in the skeletons from the trenches of Alghero, which at the moment remains the most likely option.

1.2 The history of Alghero from the origins to the plague of 1582-83

Alghero is a city of medieval foundation, born under the influence of the powerful Genoese family of the Doria and then impacted by an intense process of Catalan colonization, and therefore characterized by a distinct set of traits to the rest of Sardinia. The historical sources attest in fact that the original Sardinian-Ligurian population was integrated with the Catalan settlers since the half of the 14th century, when the city was under the control of the Spanish Aragonese crown. Other episodes of resettlements are recorded, also conducted attracting people from other regions of Sardinia (Budruni 2010). Therefore, unlike other sites of Sardinia, which were characterized by a stationary population of prevalently local origin, Alghero represents a distinct situation, characterized by a mixed composition of its population.

The history of the origins of the town is not entirely known; in fact, documentary sources are unclear in this respect. According to the bishop of Bosa, Giovanni Francesco Fara, a historian, geographer and Sardinian humanist of the 16th century, the city was founded between 1102 and 1112, when the area was yielded to the Genovese family of the Doria, in origin D'oria, a Genovese family emerged around 941. However, the date of foundation of Alghero has been questioned in light of the earliest written record of a human settlement attested about 150 years later, and has been proposed to

be dated back to the second half of the 13th century. In particular, Bertino relies on a document dated February 26, 1281: an act of the notary Leonardo Negrino where the name Alegerium appears for the first time. Instead, the first reference to the city dates back to 1288 in a diplomatic document, a peace treaty between Pisa and Genoa, which provided compensation to the Genovese for the damage done by an incursion onto Alghero by a Pisa and Arboretum navy (Bertino 1989; Bertino 1994; Brown 1994).

The Doria founded the first historical settlement in that area of the Giudicato di Torres and, at the same time, around 1270 built the fortress of Castelgenovese, located in the present Castelsardo. It is not known if formerly there was a settlement defending that part of the northwest coast from Saracen raids (Casula 1998).

Regardless of debates about the precise dating of the city's origins, it is clear that the city of Alghero entered, from 1260 onwards, into the wide network of Sardinian settlements with which the powerful family of Doria implemented a project of centralization of the local population (Milanese 2013). Under the control of the Genovese family, the city of Alghero underwent a vast development, as its port became one of the most important of the island and for two centuries it remained under the influence of the maritime republic of Genoa (Meloni 1994). The life of the community was based on commercial activities exploiting the port that was constantly connected with Genoa and Marseille.

In the meantime, the Republic of Pisa raised as maritime nation reaching the supremacy in the Thyrrenian Sea. Alghero was destroyed and conquered by the Pisans in 1283, but the Doria regained the possession of the city of Alghero in 1284 with the battle of Meloria, which resulted in the defeat of Pisan power (Budruni 1981; Ferretto 1903). This naval battle between the Republic of Genoa and the Republic of Pisa took place off the coast of Porto Pisano.

Following the plague that struck in Europe in 1347, which also hit the Sardinian city, some of the Doria descendants gave their rights to Peter IV of Aragon, who at that time was intent on creating the Kingdom of Sardinia. Other descendants of the family, however, granted the rights to the Republic of Genoa (1353), and this inevitably created a clash between the Catalan-Aragonese and the Judicate of Arborea, an independent local kingdom which occupied the central-western portion of the island (Casula 1998), and which in this occasion was assisted by the Genovese. Thus, on August 27, 1353, Peter IV organized a naval expedition, commanded by General Bernardo of Cabrera, and defeated enemy forces near Porto Conte, not far from Alghero. With the Catalan control over the city a large part of the inhabitants was deported to the Balearic Islands and to the Iberian Peninsula, whereas a group of colonists, the pobladors, was sent to Alghero to oppose the local population. The city grew and became an important commercial center of the island, until in 1412 the last Judge of Arborea, William III of Narbonne (1370-1424), tried, without success, to conquer the city.

Subsequently, with the Decree of Alhambra of 1492, the Jewish community was expelled from the city and, three years later (1495), King Ferdinand the Catholic (1452-1516) granted citizenship to the non-Catalan inhabitants of Alghero, thus promoting the arrival of Sardinians, Ligurians, Corsicans and Provencals that changed the ethnic structure of the city. From the political and economic point of view, the crown of Aragon granted Alghero a series of advantages and privileges, and on August 28, 1501 the rulers Ferdinand II of Aragon and Isabella I of Castile, with a decree issued in Granada, conferred the title of Royal City to Alghero (Budruni 1989). Furthermore, only two years later (1503), a pontifical edit of Pope Julius II named the city a bishop's office with the name Diocesis de l'Alguer y Unions (Sechi Copello 1984). At this point Alghero became a center of great importance in Sardinia both from an economic and cultural point of view.

In November 1582, at the hight of the city's power, a violent plague epidemic broke out, stopping its development and making it difficult to recover. The estimation of deaths from this epidemic wave appears to have been disastrous: the sources report about 6,000 deaths, and 150 survivors for the city of Alghero (Manconi 1994). Even if the number reported by the sources could not be considered reliable, it provides an idea about the catastrophic impact of the plague on the demographic structure of the city and therefore on its economy. It was possible to circumscribe the epidemic outbreak and preserve Sassari and its district, thanks to the intervention of the Neapolitan court doctor Quinto Tiberio Angelerio, hired by the municipality of Alghero (Bianucci *et al.* 2013), who recognized that the outbreak reached epidemic levels and declared the state of the epidemic of the city imposing on citizens the prohibition of leave the area (Manconi 1994). During epidemic waves, such as that of the plague of 1582, in Sardinia, as well as in Spain, special boards with extraordinary powers of political and administrative government were established; these institutions were headed by the Protomedical Bureau, which imparted the prophylactic and therapeutic directives.

Angelerio worked at the services of the Alghero City Council for four years, from 1581 to 1584. The Neapolitan physician has left important writings (Angelerio 1598) on the treatment of the infected and prophylactic measures to be implemented during plague outbreaks.

He resumed the model proposed by another relevant a physician of 16th century epidemiology, the Sicilian Gian Filippo Ingrassia (1576). His purpose was to preserve public health, in addition to treat the individual ill persons, thus implementing a healthcare protocol based on models that had already been tested in the rest of Italy. This standard represented the start of a new strategy for epidemiological defense that was then widely applied during the 17th century in the Kingdom of Sardinia. According to this protocol, the city was divided into areas within which specialized personnel enforced prohibitions against citizens meeting, the isolation of suspected cases and the rapid identification of new cases. This series of measures were accompanied by others aimed at assisting the aforementioned guards, but also the poor and the sick, and by special arrangements made for the maintenance of the city's hygiene, including the invention of the dry heat sterilization process, which gave Angelerio a prominent role among the active plague physicians between Italy and Spain. In addition, the medical staff also had the power to perform forced treatments (Bianucci *et al.* 2013; Manconi 1994).

It is not possible to determine the mortality rate of the Alghero outbreak of 1582-83, as death registers were kept only from 1677 onward. Toda y Güell (1888) claims that plague caused 6,000 death and only 150 people survived. According to other authors, it is unlikely that Alghero counted 6,000 inhabitants at the end of the 16th century; probably the mortality rate (97.6%) was inflated by local authorities in order to obtain a tax reduction (Budruni 1986; Serri 1980). The only reliable documents of that time which permit a partial or rudimentary reconstruction of the population's demographic structure are represented by the baptismal registers (Nughes 1980; 1994). These sources indicate that 1582 was demographically quite a normal year, with 158 children baptized, a number close to the annual average of baptisms (154 baptisms) for the previous five years (1577-1581). As for 1583, when plague reached the city, the number of baptism decreased to 62 or by around 60%, whereas in 1584 there was a strong increase in the number of baptisms (173 baptisms), as expected after the end of epidemic; this was likely due to the great upsurge in marriages among young adults who suddenly had easy access to good work and housing.

However, after the end of the epidemic, it was necessary to repopulate the city, partly with Sardinian and partly with Ligurian inhabitants (Budruni 1986; Manconi 1994); this action led to the gradual reduction of the Catalan population within the city, although the Catalan minority continued to hold power. Thus, Alghero was able to overcome this period of crisis, even if the city did not reach the same level of economic and social development of the previous periods.

1.3 The site of Lo Quarter

The San Michele cemetery is located in the area of the city, which in the 19th century was called 'Lo Quarter', that is the 'barracks', as the spaces of the former College of Jesuits were re-used with other destinations. This area is located on a low relief, inside the walls, in the southeast area of the city, between Largo San Francesco and via Carlo Alberto (Figure 1).

This area was occupied in the medieval period by the complex of the Church of San Michele and by the associated cemetery; the date of the construction of the church is unknown, but the first reference to a place of worship in the area is reported in a Catalan document of 1364, which mentions the tower of St. Michael, named after the church nearby. Over time the area was subject to several functional and architectural changes. In particular, from 1589 to 1773 the site was used by the Jesuits for the establishment of a college. They arrived in the city in 1585 and were granted by the Bishop the use of the medieval church of San Michele and its cemetery. In 1661 San Michele was replaced with the present church and in 1625 the cemetery was moved in a neighboring area. This event marked the end of the use of the cemetery for burials. In 1773 the Jesuits abandoned the city and, therefore, the College was closed.

In the 19th century, from 1822, the Barracks of the Carabinieri Royal Corps of Sardinia, which gave the name of the Quarter to the area, were established here (Milanese 2010). Currently, part of the structure is used as a Civic Library.

1.4 The cemetery (end of 13th-beginning of 17th centuries)

The San Michele cemetery occupies an area of about 1000-1300 square meters. It remained in use from about 1280 to 1590-1620, from the establishment of the church to the arrival of the Jesuits. Five well-distinguished chronological phases have been identified within the site, some of which are attributable to the medieval period and others to the post-medieval era. Archaeological excavations were carried by the team of Prof. Marco Milanese of the University of Sassari between 2008 and 2009.

1.4.1 Phase 1. End of 13th-first half of 14th century

With regard to the medieval phases, the archaeological investigations carried out in a group of ajoining rooms of the Jesuit's college (areas 1000, 3000 and 4000) (Figure 2) have brought to light the graves of about 120 individuals exhibiting retained anatomical connection; they were dated back to the late 13th – early 14th century on the base of archeological elements, such as pottery and objects

Figure 1. Satellite photo of the site of Lo Quarter and, in detail, of the Church of San Michele (from Google Earth)

associated with the skeletal remains. These are single burials, west-east oriented, sometimes marked by the presence of tomb markers, which are preserved in the rocky bench. The presence of some wooden coffins and grave goods of modest value could suggest that they were individuals of medium social class within Alghero society of that time. The alignment of these burials with each other clearly indicates a topographic planning of the burial space (Milanese 2010). The period to which this phase is related is marked by the presence of Sardinian-Ligurian population, under the dominion of the Doria.

1.4.2 Phase 2 and 3. Half of 14th-beginning of 16th centuries

This phase is distinguished from phase 1 by a rise in the ground level, probably due to lack of cemetery space, which resulted of intentional building up of the ground to create new burial plots. The burials attributable to the second phase of use of the cemetery are located in the area 2000 and have a south-west/north-east orientation. The burials of the third phase, scarcely represented, are oriented north-south. Many of them are intercut by the burials of later periods (Milanese 2010).

It is hypothesized that most of the burials of phases 2 and 3 precede the edict of August 27, 1495, in which Ferdinand the Catholic granted citizenship to all the inhabitants of the city, then attracting groups of different origins, including Corsicans, Provencals and Italians. For this reason it is possible that the cemetery of these phases was mainly associated with the Catalan pobladors. At the moment no other cemeterial areas of the same periods are known in Alghero.

1.4.3 Phase 4. The plague cemetery of 1582-83

Sixteen trench burials belong to this phase, located within the area 2000 (the courtyard of the Jesuit's college of San Michele) (Figure 3), and their excavation was delimited by the West wall of the graveyard. The orientation of these burials is different from that of previous phases, as the skulls are oriented northwest.

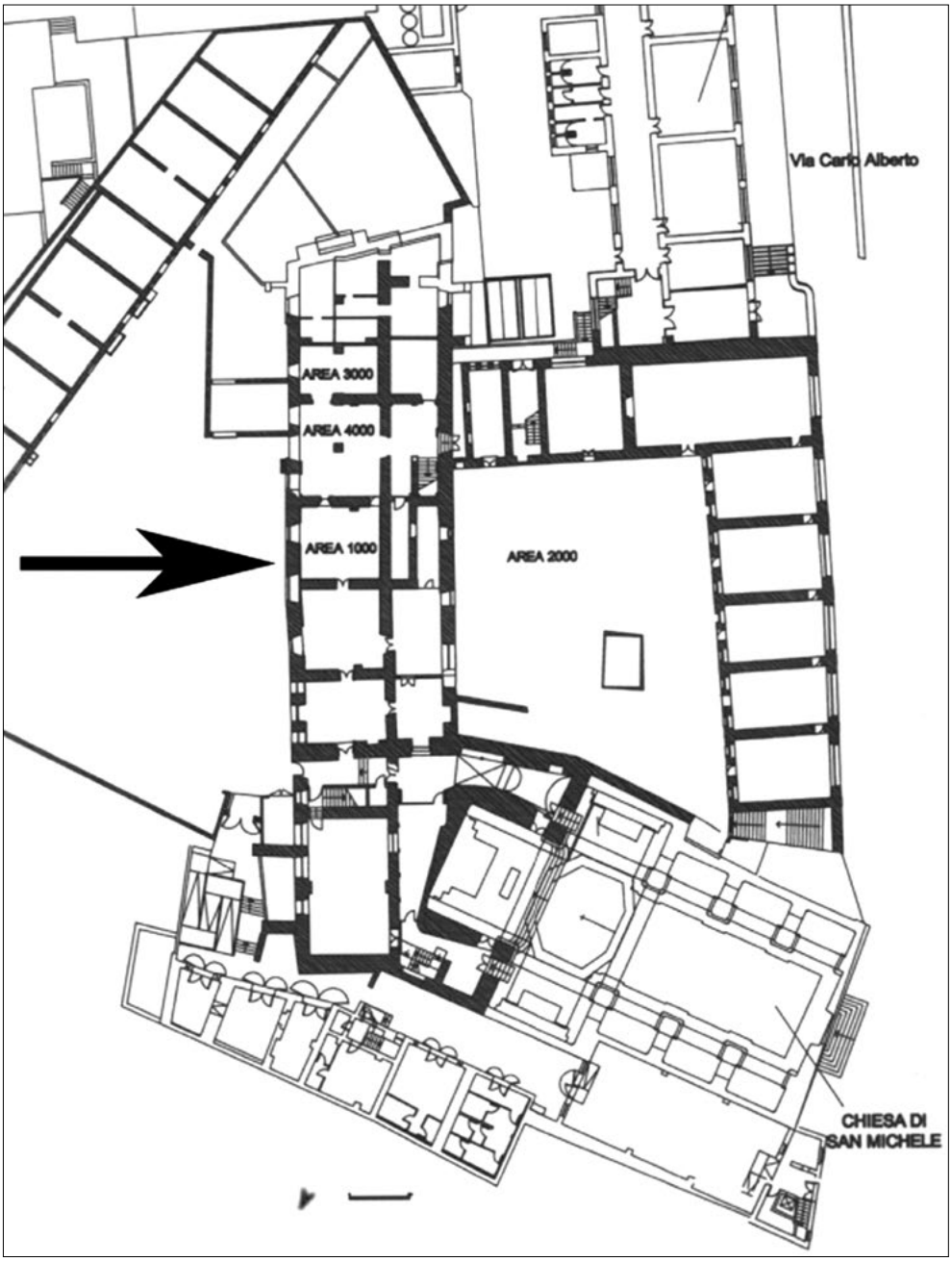


Figure 2. The excavation area of San Michele (from Milanese 2010, p. 35)

The trenches show that they were created with a precise planning, since they do not intercept each other; the deceased were interred in two rows, with the head placed on the pelvis of the previously inhumed person. The burial structure is a proof of their contemporaneity and of the catastrophic course of the epidemic event that, within a few days, killed a large number of people. Nevertheless, the requirement for rapid burials of a high number of persons did not prevent to maintain a regular order and the individuality of the deceased. The dating of this phase of burial was indicated by pottery in the grave fills. For example, in trenches 8 and 10, Catalan majolica lustre ware and Ligurian majolica ware were discovered, which date to the second half of the 16th century (Milanese 2010).

The city of Alghero, as well as the whole island, was affected by several waves of plague epidemics beginning in the 14th century. The historian Giovanni Francesco Fara, in his De rebus sardois (1835), informs us of an epidemic of 'Black Plague' in 1347-48, which first touched Cagliari and then extended to the entire region. A second wave, which seems to have been the most violent of the medieval period, ravaged the island in 1376, then in 1398 and 1403. In 1424 the city of Alghero suffered an epidemic that caused such a demographic decline that a repopulation of the city with a hundred new settlers was needed (Fara 1835). In 1477 the plague reappeared and from Alghero soon spread to Spain through commercial routes that favored the displacement of fleas-bearing rats affected by the

Figure 3. The courtyard of the Jesuit's college of San Michele (area 2000) in which the trenches were found (photo courtesy of Prof. Marco Milanese©, University of Sassari)

disease. For this reason, outbreak cities were usually cities along the coast. Plague epidemics returned cyclically throughout the 16th century: in 1522, in 1528-29 until the outbreak of 1582-83, documented by the tombs of the San Michele cemetery, as confirmed by archaeological dating.

This last plague attack started in 1580 in the city of Sassari and reached Alghero, which is far about 35 km, two years later (Biraben 1975). The city of Sassari was heavily affected by the catastrophic event, with a human loss evaluated around twenty thousand people (Loddo Canepa 1974). The epidemic wave appears to have been disastrous also for Alghero, as previously mentioned. This massive demographic loss for the two cities could be solved by the government through repopulation with inhabitants of the cities of the Catalan coast and of the Genoese Riviera or of Sardinian villages from the internal areas of the island. This event strongly undermined the economy of the northern region of Sardinia. Thus, the Alghero government requested the intervention of the Viceroy, who, in order to stimulate the economic recovery of the city, devoted to it a part of the Parliament's budget. However, this intervention was not sufficient to restore the economic situation and therefore the repopulation plan, formulated by the government, was accompanied by a system of public reforms necessary to restore the economic activity of the city.

1.4.4 Phase 5. Late 16th-beginning of 17th centuries

This phase of the cemetery is represented by a series of single, double or multiple burials, belonging to the last period of use of the cemetery. The dating is based on the presence of Ligurian majolica found in grave 233. It is possible that a group of tombs located in the 1000 and 4000 areas can be attributed to the period when the Jesuit College was already under construction and could reflect an occasional, emergency, use of the cemetery (Milanese 2010).

1.5 The collective burials of Alghero: the trenches

The 'trenches' are burials characterized by long and narrow pits, each containing multiple inhumations. The use of large, collective burial trenches is usually related to catastrophic events, such as epidemics which result in high mortality in a short period of time. Multiple interment in trenches is not a normative form of burial for Italy and Sardinia in the medieval period and, therefore, its use in Alghero suggests that an extraordinary event occurred, in this case an epidemic disease, which required an unusual burial modality. In fact, use of trenches indicates that there was not time or manpower available to dig individual graves quickly enough for the large number of dead. These specific features make the trenches a form of organization of cemetery space rarely found in the ancient world, not only in Sardinia and Italy, but throughout the Mediterranean area. The only exception is represented by similar burials excavated in southern France, although more recent than those of Alghero (17th-18th centuries BC) (Signoli *et al.* 1995; Tzortzis and Signoli 2009).

Specifically, in Alghero sixteen trenches were excavated in area 2000 (Figure 4), with a width of about 60 centimeters and a variable length ranging from a minimum of 2 to a maximum of 11 meters, while the average depth is around 50 centimeters. The trenches were dug in parallel rows and are mainly oriented on

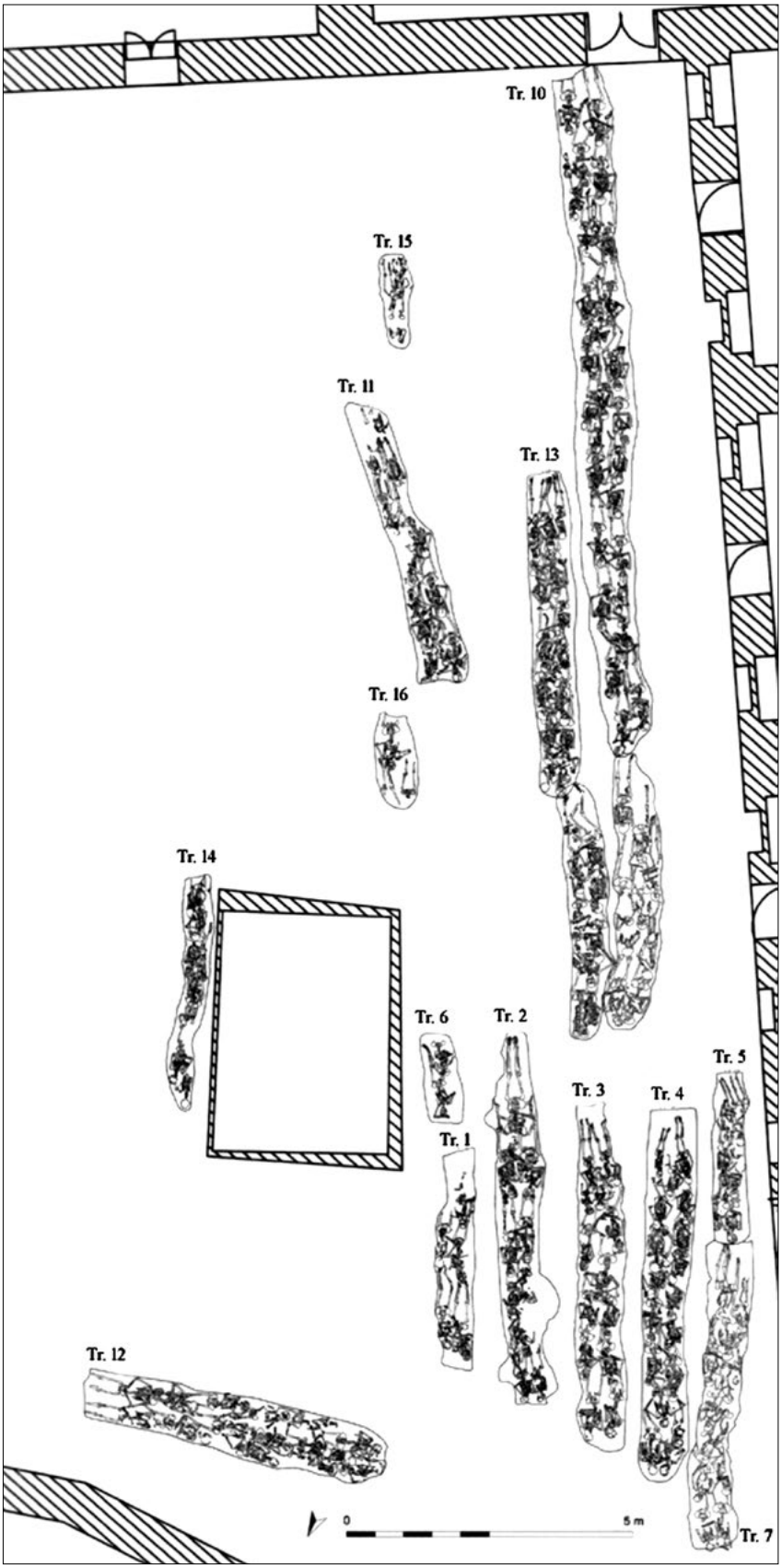


Figure 4. Map of the area 2000 with the trenches (modified from Milanese 2010, p. 39)

a northwest-southeast axis. They contain a total of 183 individuals, with the number of individuals per trench ranging from a minimum of 2 to a maximum of 30.

Two sectors were identified in area 2000, sector 2100 and sector 2500 (Figure 5).

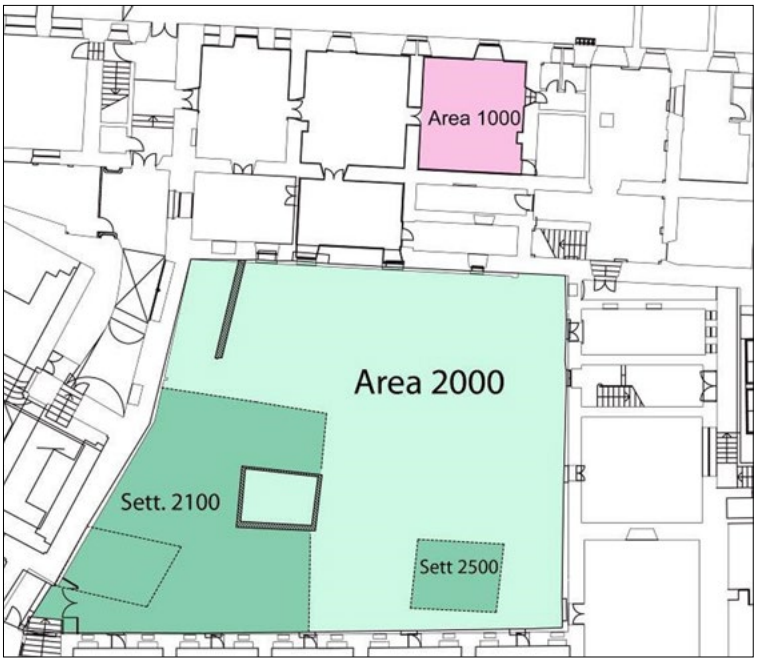


Figure 5. Detailed map of area 2000 (modified from Milanese 2010, p. 195)

1.5.1 Sector 2100

In the sector 2100, which is part of area 2000, 11 trenches (trench 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 14) have been identified and can be grouped based on their peculiar elongated shape (Figure 6). These are long and narrow pits, placed parallel to the NW-SE axis and each containing 2 to 30 skeletons, for a total of 116 individuals.

The bodies were deposited at the same time and according to a well-defined pattern, which was repeated systematically in each trench: the skull of all individuals was lying on the pelvis of the individual previously interred and are disposed in two parallel rows. Based on this arrangement, it was possible to reconstruct quite accurately the deposition dynamics and the chronological relationships between the various statigraphic units (SU). This care in the deposition was observed also in other multiple burials related to epidemic events, as in the examples of 17th century France. The trenches can be dug rapidly, as required by the large number of victims to be

Figure 6. A view of the excavation of area 2000 with trenches 2, 3 and 4 (from the top down) (photo courtesy of Prof. Marco Milanese©, University of Sassari)

managed. This necessity, coupled with the fear of contagion, usually leads to a haphazard deposition of the bodies (Tzortzis and Signoli 2009). In this case, however, we are faced with very accurate burials aimed at maintaining a certain individuality of the deceased, despite the collective character of these pits. In some cases, there is also the need to recreate close relationships, probably of kinship, between some individuals; this can be supposed when an adult has their arms around the body of another individual and infants are positioned between their legs, indicating perhaps a family group. The bodies have been deposited in a filled space, but in some cases shrouds have created some secondary empty spaces that caused the disconnection of some anatomical districts, which therefore resulted in a loose connection. In other cases, this effect was caused by the decomposition of adjacent bodies. The trenches are also well separated and do not intersect each other, which suggests that they were excavated at the same moment. Particularly the trenches 1-7, made in a very narrow space, had probably been dug at the same time.

Trench 1
Trench 1 is located northwest of the central cistern, is a little longer than 3.6 m. and contains 5 individuals, oriented with the skull at north-west and the feet at south-east.

Trench 2
Located northwest of the trench 1, it is 6.50 m. long and contains 12 individuals with orientation northwest -southeast. This is the longest trench of the area.

Trench 3
Located northwest of the trench 2, it is a little longer than 6 m. and 1 m. wide, and contains 13 individuals with the orientation northwest – southeast.

Trench 4
Located northwest of the trench 3, it is 6.40 m long and 1.80 m wide, and contains 18 individuals with the same orientation of the other trenches (Figure 7).

Trench 5
Located southwest of trench 4 and south of trench 7, it is a little longer than 3 m., and contains 10 individuals oriented northwest – southeast.

Trench 6
Located south of trench 1, close to the cistern, it is a little longer than 2 m. and contains only 2 individuals. This trench is anomalous in comparison to the others and can be considered also as a double burial.

Trench 7
Close to the external wall, it is cut by trench 5; 5.50 m long, it contains 13 individuals.

Trench 8
Trench 8 is located south of the previous trenches, and west of trench 9; it is 4.9 m. long and contains 9 individuals.

Trench 9
Located east of trench 8 and south of trench 3, it is 4.5 m. long and contains 10 individuals (Figure 8).

Trench 12
Positioned in the northeast area of the sector 2100, this is the only trench with a different orientation: southwest-northeast instead of northwest-southeast. It is 5.5 m. long and 1 m. large and contains 17 individuals. The trench is cut by the foundation of a wall, and therefore it is not possible to establish its originary length (Figure 9).

Trench 14
Located east of the cistern, it is 4 m. long and contains 7 individuals.

1.5.2 Sector 2500

This enlargement of sector 2500 is located between the walls which delimit the courtyard of the Jesuit College respectively to the west and to the south. In this sector 5 of the 16 total trenches were excavated (trench 10, 11, 13, 15, 16), arranged according to the north-south axis, containing a total of 67 individuals and a fetus.

Trench 10
Located east of trench 13 and south of trench 8, it is 11.50 m. long and 0.80 m. large; this is the longest trench of the cemetery and contains 30 individuals.

Trench 11
Located east of trench 13, it is 5 m. long and contains 14 individuals. The final part of the trench is cut by a pit and therefore it is not possible to determine its original length.

Trench 13
Located east of trench 10 and south of trench 9, it is 5.5 m. long and 0.70 m. large, and contains 16 individuals and a fetus (Figure 10).

Trench 15
It is a multiple burial containing 3 individuals. The trench is cut by a pit excavated in more recent times and the skeletal remains were largely missing and poorly preserved. For this reason, the 3 individuals were not included in this study.

Trench 16
Located east to trench 13 and north to trench 11, it is 2 m. long and contains 4 individuals.

Figure 7. Trench 4 (photo courtesy of Prof. Marco Milanese©, University of Sassari)

Figure 8. Trench 9 (photo courtesy of Prof. Marco Milanese©, University of Sassari)

1.6 Aims of the study

The present study is aimed at examining the individuals exhumed from the trenches of Alghero (Sardinia) attributed to the plague outbreak of 1582-83 from an anthropological and paleopathological point of view. Given the rarity of human remains from epidemic contexts and buried in trenches, the skeletal sample from Alghero represents valuable material that offers a bioarchaeological picture of a post-medieval population which faced a plague epidemic. In particular, no other Italian plague cemeteries have been examined through a detailed bioarchaeological analysis, representing a model and a comparison for future researches.

The objective of this study is to examine a series of parameters, starting from the demographic profile of the sample, constituted by 181 individuals from

Figure 9. Trench 12 (from Milanese, 2010, p. 125)

Figure 10. Trench 13 (photo courtesy of Prof. Marco Milanese©, University of Sassari)

15 trenches, and the taphonomic analysis, and then analyzing stature, dental pathologies, stress indicators, degenerative joint disease, entheseal changes and other pathologies. The study is intended to illuminate a cross section of the Sardinian society during the 16th century in a coastal city through a holistic view, which interweaves the documentary evidence for plague, funerary responses and population health status at the time. The main objective is therefore to examine a population which lived during a period of plague, revealing its lifestyle, activity pattern and illnesses and providing a significant contribution to bioarchaeology, paleopathology, and archaeology of the Italian territory.

Comparisons with other samples from plague cemeteries of the same period from other countries will be performed, by analyzing the available parameters. In particular, the most suitable plague cemetery samples to be compared with Alghero are those of Les Fedons (France) and Dendermonde (Belgium), both dated the 16th century, composed of 133 and 99 individuals respectively (Kacki 2016).

Chapter 2

Materials and methods

2.1 Materials

In this study, 181 individuals exhumed from 15 trenches excavated from the cemetery of Alghero and dated back to the second half of 16th century, referable to the plague outbreak of 1582-1583, were examined (Table 1). The three individuals found in trench 15 were excluded from the analysis as they were not accessible for the anthropological study.

Trench	N. of individuals
1	5
2	12
3	13
4	18
5	10
6	2
7	13
8	9
9	10
10	30
11	14
12	17
13	16+fetus
14	7
16	4

Table 1. The trenches and number of individuals they contained

2.2 Biological sex estimation

Sex estimation is based on the analysis of the features that characterize sexual dimorphism. Our species, as well as many others in the primate order, is characterized by a morphological difference between male and female individuals. This type of analysis is strongly influenced by factors such as the degree of bone preservation and the age of the individual, since sex-specific characteristics express themselves fully only with the attainment of skeletal maturity. In particular, sexual dimorphism becomes marked at puberty as a result of hormonal changes (Hall 1982). Therefore, it is extremely difficult to perform a sex assessment in non-adult individuals and, as such, in this work individuals younger than 20 years were not assigned a biological sex.

For the study of the remains of the San Michele cemetery, morphological features of the skull and pelvis were examined. In particular, the method used in this research was that of Ferembach *et al.* (1977-1979). The skull and the pelvis do not provide equivalent degrees of reliability: the latter has long been considered the best indicator of sex due to sexual dimorphism in morphology related to parturition and, therefore, is more diagnostic than the skull (Krogman and Iscan 1986). It should also be considered that only one morphological character is not sufficient to provide a reliable assessment. Therefore, when only a few features were observable, or the outcome of the overall assessment indicated an intermediate result, post-cranial analysis was performed: the long bones of males, in fact, are generally longer, more robust and with more marked muscular insertions than those of females. In particular, metric data obtained from postcranial bones were used in certain cases for sex assessment, as the metric approach relies on size-based differences, with males being generally larger than females (Krogman and Iscan 1986); these metric methods rely on robusticity, particularly at the joints, of the radius (Berrizbeitia 1989), patella (Afrianty 2013), calcaneus and talus (Silva 1995).

In this work sex has been estimated only from individuals above 20 years of age. Sex determination of adult individuals has been divided into three categories: male (M), female (F) and undetermined/unknown (ND) when the state of fragmentation of the osteological material or lack of skeletal dimorphism did not provide a conclusive sex assessment.

2.3 Age at death estimation

Skeletal analysis allows the establishment, with a certain degree of approximation, of the biological age of the individual at the time of death, on the basis of the recognition of the different stages of skeletal and dental development that vary during growth for non-adults and of the degenerative changes to the immobile joint for adults (Acsadi and Nemeskeri 1970).

A range of different methods are used and, as for sex analysis, a combination of different indicators is considered more reliable (Lovejoy *et al.* 1985a). It is necessary to bear in mind that these methods have been calibrated on modern populations; therefore, they have limitations determined by population variability

and by the fact that it is not possible to ascertain a precise correspondence between current and past growth rates.

The assessment of age in non-adults is more accurate and reliable, as immature life is characterized by a large number of skeletal changes occurring in rapid succession, while with the adult age these processes become much less diagnostic because they are much slower and less regular (Brothwell 1981).

In this work the more reliable methods for adult age estimation were applied; the methods used for the necropolis of Alghero are explained in detail below.

A mean age at death was calculated in order to assign the estimated age of the individuals to a single age category for statistical representation.

2.3.1 Methods for adult individuals

The degree of dental wear of the occlusal surface, which progressively manifests itself with age as a result of the chewing activity, was analyzed. Various methods have been developed and for this study the method of Lovejoy (1985b) was used. In this type of analysis the most diagnostic teeth are the molars; however, it is worth noting that dental wear can also be influenced by other factors, such as the type of diet adopted, the presence of dentoalveolar pathologies and the extramasticatory activity (Hillson 1996). The extramasticatory activity consists of the use of teeth for working and functional purposes. Generally, this type of activity causes very marked wear and localization only to some teeth, and so can be differentiated from cumulative wear associated with advancing age (Molnar 2011).

The auricular surface of the ilium is the part of the coxal bone that is articulated with the sacrum, forming together the sacroiliac joint. This surface is subject to degenerative changes with progressing age. In particular, it should be noted that, over time, the transverse grooves typical of this area in young adulthood tend to disappear and, in their place, porosity and granularity can be observed. In addition, in advanced age new bone formation can occur, and over 60 years of age there are marked osteophytes (Minozzi and Canci 2015). These modifications have been analyzed by various scholars; in our case, the method of Lovejoy *et al.* (1985c) has been chosen.

The pubic symphysis is a semi-mobile joint and is subject to alterations and modifications with age. In the present analysis, the method of Brooks and Suchey (1990), which analyses the morphology of the pubic symphysis, was selected. Nevertheless, this method was rarely applied, as the pubic symphysis in the individuals from the San Michele cemetery was often not preserved.

Finally, the method based on the morphological changes of the sternal end of the ribs was also used (Burns 1999; Iscan *et al.* 1984; Iscan and Loth 1985).

2.3.2 Methods for non-adults

For fetuses, age estimation was performed using the methods of Fazekas and Kósa (1978), based on cranial and postcranial osteometric data, and Olivier and Pineau (1960), based on regression equations for stature estimation, in order to obtain a fetal age expressed in gestational weeks.

For child and adolescents, several methods were applied.

The stages of dental development and eruption were analyzed, since the eruption is rather constant and regular from the time of birth to an age of about 14 to 16 years; this is the period during which the eruption and the replacement of deciduous with permanent teeth occur. This method provides a good approximation and represents a better proxy for chronological age compared to methods based on skeletal development. The two methods developed by Ubelaker (1989) and Stermer Beyer-Olsen and Risnes (1994) have been used. Ubelaker identified 21 stages of dental eruption ranging from 5 months of intrauterine age to 35 years, on the basis of development of crowns and roots of deciduous and permanent teeth; range is provided for each stage. The second method is based on the analysis of permanent teeth development by using a diagram of chronological development.

The fusion between diaphyses and epiphyses is complete around 20-23 years of age and varies according to the location of the various skeletal joints. The method used here was developed by Schaefer *et al.* (2009).

Age category	Age range (years)
Fetus	Before birth
Infancy	0-1
Early childhood	2-6
Late childhood	7-12
Adolescence	13-19
Young adulthood	20-25
Middle adulthood	26-35
Mature adulthood	36-45
Old/senile adulthood	46-55

Table 2. Age categories used for paleodemographic data from Alghero

The method based on the measurement of long bone diaphyses can be considered more reliable when reference is made to the long bone of individuals with biological affinities to the sample under study (Danforth *et al.* 2009). The tables of Stloukal and Hanakova (1978), measured on a medieval Slavic population, were taken into account for this analysis. The age categories used in this bioarchaeological research are those summarized by Iscan and Steyn (2013) (Table 2). Therefore, all the individuals aged more than 20 years were included in the category of adults, whereas the individuals younger than 20 years were considered as non-adults.

2.4 Taphonomy

Through the study of taphonomy, it is possible to reconstruct the phenomena that affected the bones from the time of deposition until they are excavated. As decomposition is closely related to certain conditions, such as the original position of the corpse, and the deposition in an empty or in a full space, it is possible to use taphonomic analysis to reconstruct features of the grave and burial conditions.

A first distinction is between primary and secondary deposition. A primary deposition occurs when the burial of the corpse is made, within a short time after the death, in a permanent place; this is the location where decomposition will occur. A secondary burial takes place in two or more stages: the corpse is firstly deposed in a place and then, after the decomposition has occurred, it is moved in a different place as a final deposition (Duday 2006; Duday *et al.* 2014). It is possible to determine whether a burial is a primary or secondary from the maintenance or absence of joint connections, and from the anatomical position of different skeletal districts (Minozzi and Canci 2015).

Another fundamental distinction is between depositions in a full or empty space. Deposition in full space occurs when at the time of the burial the body is covered with material, usually earth; in this case there is a progressing filling, as the spaces left empty by the decomposition of the tissues are occupied by earth. This prevents the bones from falling due to the effect of gravity, maintaining their physiological position. However, in the case of bandages or garments, as a shroud, the fabric protects the body from contact with the ground and the bones in imbalance fall. This is a deferred burial, which can be identified by the presence of both elements of the burial in full and empty spaces. Decomposition in empty space occurs when the body is deposited in an empty space, such as in a coffin, without direct contact with the ground. It is recognisable from the downfall of the bones in imbalance (Duday 2006). According to Duday and Guillon (2006), a paradox may exist between the archaeothanatological analysis and evidence of a burial container, coffin, or architecture that can create void spaces. This paradoxical chronology takes place when a very rapid demolition of a container (e.g. made of wood) occurred before the decomposition of the soft tissues that causes rapid filling and thus simulation of a burial in a filled space.

Another factor to be taken into consideration is the wall effect, a phenomenon caused by linear delimitations in the burial, such as a pit wall: the bones in contact with the possible delimiting element remain in position and do not fall down.

At the cemetery of Alghero it was possible to identify the taphonomic evidence that was necessary to provide important information about funeral practices through the examination of excavation documentation (Milanese 2010).

Several parameters will be evaluated, including: modality of deposition of the skull, position of the skull, of the upper and lower limbs, of the knees and ankles, wall effect and presence of the equipment.

In situ archaeothanatological evaluation was made following the recommendations of Duday and Guillon (2006) and Duday (2009), according to whom the analysis of labile joints (e.g. cervical vertebrae, acromion-clavicular, costo-sternal, coxo-femoral joint, patella, hands, feet) and persistent articulations (e.g. atlanto-occipital joint, humero-ulnar, lumbar vertebrae, lumbo-sacral, sacro-iliac joint, knee, ankle, tarsal and metatarsal) can provide information about the conditions in which the decomposition of the body occurred.

2.5 Stature estimation

Stature is often influenced by several factors and can be an indicator of stress or evolutionary success, as it is considered an expression of environmental adaptation (Larsen 2015). By measuring long bones and applying the necessary regression formulas it is possible to obtain the individual's stature.

In this study we refer to the formulae elaborated by Sjøvold's (1990), as they can be applied regardless the sex of the individual. As the method is more precise if calculated on the bones of the lower limb, these were preferred; when no bones of the lower limbs were available, bones of the upper limbs were used. If more than one bone was used to calculate stature, all collected lengths were used to obtain a mean stature. Adult male and female statures were also classified in the nine stature classes proposed by Martin and Saller (1957).

2.6 Non-metric traits

The non-metric traits, or discontinuous characters, are anatomical variants that can be occasionally observed and that are transmitted by inheritance. Therefore, they can provide information on genetic relatedness within a population. However, it should be kept in mind that non-metric traits are also influenced to some extent by environmental factors and as such are not a totally reliable proxy for genetic inheritance patterns. Some characters are considered occupational, as they have been suggested as useful indicators of past activities (Capasso *et al.* 1999).

Several non-metric traits, included those of genetic inheritance and as well as some occupational markers, were included in this study (Berry and Berry 1967; Capasso 1999; Coppa *et al.* 1996; Finnegan 1978). In total, nineteen characteristics were selected for the skull and thirty-three for the post-cranial skeleton (Tables 1 and 2 of the Appendix).

The adult individuals with undeterminable sex were excluded, as their number is very low; as for the frequency of non-metric traits with a laterality (right and left), they were considered observable if at least one side was present, and they were considered present if at least one side was present (Cvrcek *et al.* 2018).

2.7 Dental pathologies

The study of teeth is fundamental in anthropological analysis, since they are often preserved better than bones; in fact, the crown is covered by dental enamel, the hardest tissue of the body. In addition, the teeth constitute a major source of information about the lifestyle of past populations, since dental morphology, after the period of growth, does not change over the course of life. In particular, teeth provide useful information about childhood lifestyle as perturbations in their growth are visible into adulthood, and provide useful information about adult lifestyles as they are related to diet and sometimes they were used as tools. Dental caries and calculus were recorded both on adults and non-adults, whereas the other indicators only on adults, as no evidence of periodontal disease, abscesses, ante-mortem tooth loss, and tooth wear were found in children.

The distribution of caries, abscesses, and ante-mortem tooth loss was calculated per element (tooth/alveolus) and per individual: the frequencies were calculated as the number of affected teeth/alveoli divided by the number of observable teeth/alveoli (true prevalence rate), as well as the number of affected individuals divided by the number of observable individuals (crude prevalence rate). The distribution of periodontal disease and calculus were examined as crude prevalence rate. An individual was considered observable if at least 14 teeth/alveoli were preserved.

2.7.1 Caries and abscesses

Caries is a degenerative pathology caused by the demineralization of dental tissues to the acidic oral environment produced by some species of bacteria normally living in the microbial flora (Moore *et al.* 1998). The consumption of simple carbohydrates and sugars, a poor oral hygiene and periodontal diseases may favor the attack of enamel and dentine by cariogenic bacteria (Giuffra *et al.* 2020). The caries originates from the surface of the tooth and, over time, penetrates into the canal of the tooth causing the spread of bacteria within the alveolar tissues with the consequent presence of abscesses, until the tooth is lost (Hillson 1996).

In this study, the degree of severity of the caries was determined according to the following characteristics (Minozzi and Canci 2015):

- Grade 1: small and superficial cavitation mostly affecting the enamel and only partially reaching the dentine;
- Grade 2: larger lesion affecting the dentine;
- Grade 3: deeper lesion with involvement of the dental pulp;
- Grade 4: complete destruction of the crown.

Moreover, the localization of the caries on the tooth has been recorded: at the crown, at the cemento-enamel junction, and at the root; the side of the affected tooth has been observed as well: occlusal, buccal, lingual, and interproximal (Minozzi and Canci 2015).

Abscesses are acute infections affecting the bone through a carious tooth or as consequence of a deep alveolar pocket. The presence of an abscess is indicated by perforations in the maxillary or mandibular bone.

2.7.2 Dentoalveolar diseases

The bacteria present in the oral cavity can cause inflammation of the tissues surrounding the tooth. Inflammation can be superficial and affect the gingiva, this is the case of gingivitis, or it may extend to the underlying tissues until the alveolar bone, a condition called periodontitis. Inflammation causes dental root exposure following the onset of gingival pockets, which can lead to abscesses and to retraction of the gingiva and of the alveolar bone (Hillson 1996).

In this work, periodontal disease is recorded by analyzing the absorption of the alveolar margin of maxilla and mandible, using the 4 grades indicated by Brothwell, 1981, based on the distance of the alveolar margin from the cemento-enamel junction (0 = absence;

1 = slight, 2-3 mm; 2 = moderate, 3-5 mm; 3 = severe, >5 mm).

For data analysis, the maxilla and mandible were considered together; in those cases in which the severity of alveolar resorption is different between maxilla and mandible, the highest value was attributed to the individual.

In addition, ante-mortem tooth loss has been reported, as this may be the result of dentoalveolar diseases. Ante-mortem tooth loss was recorded by alveolus; a tooth was considered as lost ante-mortem if the socket showed signs of partial or complete remodelling. Teeth found *in situ* despite destruction or loss of associated jaw were counted as observable; therefore, the frequency was calculated as the number of ante-mortem tooth losses divided by the number of observable alveoli plus the isolated teeth. Isolated teeth were included in the total number of observable alveoli because they were all attributed to each mandible or maxilla. Therefore, a tooth present and in isolation was not considered lost ante-mortem, even if the alveolar bone was missing.

2.7.3 Dental wear

Occlusal tooth wear is the gradual loss of tooth substance, enamel and then dentine, as a consequence of natural mastication, due to a combination of attrition (inter-tooth friction) and abrasion (friction from food). Patterns of tooth wear can provide information on the types of diet and on food processing techniques; in general, hard and abrasive food cause more occlusal dental wear, while soft, grit-free food should result in lower rates of wear (Hillson 1996; Larsen 1997). Wear is also related to caries frequencies, as the loss of the occlusal surfaces can obliterate caries at initial stages, but it can also increase the risk of abscesses and ante-mortem tooth loss as a result of pulp exposure (Hillson 1996). Tooth wear was recorded according to Smith (1984), which scores from grades 1 to 8 to quantify occlusal wear by incisors, premolars and molars. The third molar was not scored due to its wide variability in the eruption time across human populations (Harris 2007; Schour and Massler 1941).

Average wear scores for males and females were calculated for each tooth category with left and right sides and upper and lower dentitions combined, if at least one element was present for each tooth category. The individual index is the average of all teeth recorded. The analysis was performed on all individuals overall.

2.7.4 Dental calculus

Calculus is calcified deposits of bacterial plaque on the dental surface, particularly on the teeth closest to the salivary ducts, as the saliva facilitates this mineralization. Calculus is generally located on the crown of the tooth, but can reach the root, if this is exposed due to periodontal disease (Hillson 1996).

The severity of calculus was recorded according to Brothwell's method (1981), which considered three grades: slight, medium and considerable. In this work the grades medium and considerable were merged so as to obtain a subdivision into mild and strong.

Calculus was evaluated on each individual and the score was made from the median value of all observable teeth, considering separately maxilla and mandible. In the cases in which the severity between the two bones was different, the most severe was taken for the elaboration of the data.

2.7.5 Dental malpositions

Malpositions can be influenced by genetic or environmental factors and are distinguished into two types:

- crowding, or malpositions due to lack of space;
- rotations.

There is a strong correlation between the consumption of soft and complex foods and the presence of dental crowding (Corruccini 1991). This could be determined by the fact that, while the bones, in this case jaw and mandible, respond very quickly to external stimuli and thus decrease their development with the decrease of mechanical chewing activity, the size of the teeth, which is genetically determined, does not correspond to the same degree of development (Corruccini 1991). In this work malpositions were evaluated only for adult individuals with permanent dentition.

2.8 Stress indicators

In bioarchaeology 'stress' can be considered the physiological disruption resulting from impoverished environmental circumstances; it is the product of three main components: a) environmental constraints; b) cultural buffering system; c) host resistance. Stress indicators are skeletal and dental alterations caused by nonspecific environmental stress, which can help reconstructing and understanding of health, adaptation, and behavior of past human populations. Stressors may be of nutritional, traumatic, functional or pathological origin (Larsen 2015). In this study the following stress markers will be examined: dental enamel hypoplasia, *cribra cranii*, *cribra orbitalia*, and periosteal reaction.

2.8.1 Dental enamel hypoplasia

Dental enamel hypoplasia is characterized by the presence of lines or pits on the buccal surface of

the teeth that result from an alteration of enamel development during odontogenesis as a result of nonspecific stresses, such as nutritional deficiencies (i.e. avitaminosis A and D) and infantile pathologies, which are of limited duration (Hillson 1996).

In this research, hypoplastic episodes were identified on the buccal side of the incisive and canine teeth, and the distance between the lines or the pits and the cemento-enamel junction was measured with a caliper in order to calculate the age at which the episode occurred (Corruccini *et al.* 1985). In addition, the severity of the hypoplasic defects has been reported, based on their depth, distinguishing between two grades of severity, mild (M) and severe (S) based on the depth of the linear defects (Corruccini *et al.* 1985). Finally, using parameters derived from the study of Goodman and Rose (1990), it was possible to establish an age range in which the stress episodes occurred.

2.8.2 Cribra cranii *and* cribra orbitalia

The presence of a fine porosity on the surface of the skull (*cribra cranii*), and on the orbital roofs (*cribra orbitalia*) may be indicative of a wide range of pathologies and is therefore considered as a nonspecific stress indicator (Walker *et al.* 2009).

In fact, *cribra cranii* can represent the outcome of an inflammatory process of the bone (periostitis) or of the scalp and also of hemorrhagic processes in correspondence with the external lamina, such as ectocranial hematoma. Even in some types of tumors, such as hemangioma and meningioma, a porotic appearance of the cranial vault can be observed. In scurvy, a disease caused by a vitamin C deficiency, very painful subperiosteal and intra-articular hemorrhages occur, in which the irritated periosteum reacts by producing a periosteal reaction similar to porotic hyperostosis. The same feature is for rickets, caused by a vitamin D deficiency (Buikstra 2019; Mays 2018).

As for *cribra orbitalia*, their etiology can also be related to a plurality of conditions (Brickley and Ives 2008; Walker *et al.* 2009). It is now clear that in many cases *cribra orbitalia* are associated with periosteal inflammation and not with medullary hypertrophy. Only in cases where medullary hypertrophy is found they can be related to anemia; in the other cases it is necessary to evaluate other etiologies. In particular, vitamin C and D deficiency and hematomas caused by trauma can cause inflammation. Scurvy makes the orbit more subject to minor trauma caused by normal movement of the eye muscles; consequently there is a detachment of the periosteum at the level of the orbital roofs with bleeding and the formation of new periosteal bone. Inadequate mineralization of the osteoid caused by rickets can cause this type of injury. Other causes of inflammation with orbital involvement can include sinusitis, oral infections, nasopharyngeal infections, dermatological inflammations, dacryoadenitis and conjunctivitis (Wapler *et al.* 2004).

If the porosity of the cranial vault is accompanied by a hypertrophy of the diploe layer and a thinning of the cortical tissue the condition is referred to as porotic hyperostosis and is related to an anemic condition. The cause of anemia can be genetic or acquired; it is not always possible to distinguish, through the skeletal analysis, between these two different conditions, although generally genetic anemia presents more pronounced porotic manifestations, giving the skull the classic 'hair-on-end' appearance (Buikstra 2019). In order to diagnose porotic hyperostosis a radiological examination should be performed to evaluate the cranial thickness, unless the skull is fragmented permitting a macroscopic observation of the section.

In this study no radiological examination of the skulls was performed, and therefore porotic hyperostosis was not evaluated. Only *cribra cranii* and *cribra orbitalia*, as stress indicators, were observed.

We have used the methods of Brothwell (1981) and Robledo *et al.* (1995) who propose three different degrees of severity for the cranial vault and for the orbital roof porosity:

- grade 1: porotic: scattered and isolated small holes (< 1 mm);
- grade 2: cribrotic: coalescing and bigger holes, but still isolated (ca 1-2 mm);
- grade 3: trabecular: the holes coalesce creating an appearance of trabecular bone.

In this work, *cribra cranii* were considered observable if at least one parietal bone was preserved; if only a portion of the frontal or occipital bones was preserved, the condition was considered not observable. As for *cribra orbitalia*, individuals were considered observable if at least one orbital roof was preserved.

2.8.3 Periosteal reaction

Periosteal reaction is a condition characterized by the inflammation of the periosteum, the outer membrane of the bone. Indeed, in the case of unspecified inflammation, the periosteum reacts through the production of new bone and therefore fine porosity or longitudinal streaks appear on the surface of the bone; in the most severe cases there is the formation of

true bony plaques, resulting in thickening of the bone (Weston 2012).

The presence of periosteal reaction was recorded on the surface of the long bones of the lower limbs (femurs, tibiae and fibulae) and a grade was attributed on the base of the method proposed by Stothers and Metress (1975):

- grade 1: thin longitudinal streaks often associated with small holes;
- grade 2: increase in the number of holes and appearance of thin plaques of relieved bone;
- grade 3: plaques of more extensive new bone, always associated with holes;
- grade 4: thickening of the surface; this is the reparative phase with more dense and compact tissue.

In addition, also the degree of diffusion was evaluated: diffuse, when the periosteal reaction is spread over a large part of the diaphysis; localized, when it affects only a small area of the diaphysis.

2.9 Degenerative joint disease (osteoarthritis)

Arthropathies ca be due to biomechanical stress and from normal degeneration that occurs with advancing age (Buikstra 2019).

In particular, osteoarthritis was assessed on 30 articular surfaces; the degrees of intensity are those elaborated by the Steckel *et al.* 2005:

- grade 0: no evidence of degenerative changes;
- grade 1: slight marginal lipping (osteophytes less than about 3 mm) and slight degenerative/productive changes;
- grade 2: severe marginal lipping (osteophytes greater than about 3 mm) and severe degenerative/productive changes; eburnation;
- grade 3: complete or near complete destruction of articular surface, including ankylosis.

As for the frequency calculated on individual, an individual is considered observable if it preserves at least 10 observable joints not affected; an individual with less than 10 joint observable not affected was excluded. If an individual preserved at least 1 affected joint, it was included.

Demanding biomechanical activities on the spine can cause pathologies such as Schmorl's nodes. Schmorl's nodes are cavities located on the vertebral plates, especially in the thoracic and lumbar vertebrae, caused by a protrusion of the nucleus pulposus of the intervertebral disc (Waldron 2008). Bioarchaeological studies suggest that the occurrence and patterning of Schmorl's nodes in past populations is mainly related to long-term mechanical loading and trauma (Jiménez-Brobeil *et al.* 2010; Stirland and Waldron 1997). In this study the column was divided into three segments, cervical, thoracic and lumbar, and for each one the number of vertebrae affected in relation to the number of vertebrae preserved was reported.

2.10 Entheseal changes

Muscular insertions can leave a variety of marks on the bones that can give us information about the lifestyle and type of working activities of past populations. This type of analysis is only performed on adult individuals, as for non-adults muscle insertions are not well developed. The method we used was that proposed by Mariotti *et al.* (2004; 2007), who identified the different degrees of development of 23 muscular insertion from both upper and lower extremities in adults (Table 3 of the Appendix).

Entheseal changes were graded on a scale from 1 to 3, based on their degree of severity (Mariotti *et al.* 2004, 2007). The degrees are as follows:

- grade 1a: slight impression;
- grade 1b: low development;
- grade 1c: medium development;
- grade 2: high development;
- grade 3: very high development.

Enthesopathies are alterations that could be present at entheses. They can be proliferative, 'osteophytic' enthesopathies (OF), characterized by the presence of enthesophytes, or erosive, osteolytic enthesopathies (OL), characterized by pitting or eroded areas, according to this score:

- OF/OL 1: minimal enthesopathy (>1 mm);
- OF/OL 2: clear enthesopathy (1-4 mm);
- OF/OL 3: substantial enthesopathy (>4 mm).

Scores were converted into two categories: mild expression of entheseal changes, combining grades 1a, 1b and 1c, and strong expression of entheseal changes, combining grades 2 and grade 3; enthesopathies were considered separately.

Entheseal changes were evaluated considering both sex and age, according to Schrader (2015).

Only adult individuals were selected for assessment of entheseal changes and individuals were categorized into two age groups for analysis: young adults (20-35 years old) and mature adults (36-55 years old), based on their median age (Al-Oumaoui *et al.* 2004).

2.11 Pathologies

2.11.1 Traumatic conditions

The study of skeletal traumas can provide important information about the lifestyle, physical and work activities of the past human groups (Buikstra 2019).

Signs of trauma, whether accidental or intentional, are common findings on human remains. The interest of trauma lies in the study of general incidence, type and location of traumas within a human group. In fact, the analysis of the frequency, severity and morphology of the lesions contributes to investigate the cultural aspects and lifestyles of past populations (Lovell 1997).

Determining whether a lesion was the result of accidental trauma or intentional violence is reliant on identifying the contextual evidence (Jurmain 2005). Accidental injuries help to provide information about the lifestyle of a population. Traditionally, males are considered more exposed to the risk of accidental fractures occurring during dangerous occupational activities, such as military tasks, agriculture, animal husbandry, mining, forestry, and construction. Intentional traumatic injuries provide direct information regarding the level of violence of a human group and also reflect the patterns of interpersonal aggression.

Fractures are the most frequent form of trauma. The skeletal trauma occurred *ante-mortem* if there are signs of healing of the margins; *peri-mortem* trauma, occurred at the moment of death, do not present signs of healing; *post-mortem* trauma are characterized by absence of signs of healing as well, but they could be recognized by the lighter colour of the lesions when comparing the inner and outer surfaces of the bones (Sauer 1998). When a fracture heals the bone production occurring during the reparative phase continues until the initial woven bone is substituted with lamellar bone and the formation of a callus. The callus can be remodeled potentially leaving no signs of the fracture. If a fracture fails to heal, there is a non-union of the two broken ends of the bones and the fibrous joint formed between them is known as a pseudarthrosis (Buikstra 2019). In the case of traumas produced by weapons, prevalently intentional, sharp force trauma are caused by bladed instruments, which produce linear lesions with clean well-defined edges and flat and smooth cut surfaces; blunt force fractures are produced by blunt instruments, which leave concentric or radiating fractures with an internal bevel; projectile force trauma are inflicted by projectile weapons.

The possible presence of trauma has been reported and documented through macroscopic and radiological investigation.

2.11.2 Auricular exostosis and osteophytosis

Auricular exostoses are bone formations found at the level of external acoustic meatus and they are considered mostly non-pathological anatomical variants. However, recent studies have linked this type of bone formations with aquatic activities, particularly with diving in cold water. It could therefore be an inflammatory reaction caused by a state of chronic hypothermia. In the paleopathological study, therefore, these manifestations may be indicative of certain social habits or subsistence activities (Okumura *et al.* 2007; Standen *et al.* 1997; Villotte *et al.* 2014).

The analysis was carried out at a macroscopic level: auricular exostosis is a compact bone formation within the acoustic meatus, with globular, pedunculated or sessile shape, which may, in the most serious cases, completely occlude the meatus. Auricular osteophytosis, on the other hand, is characterized by the formation of bone spicules (osteophytes) on the margins of acoustic meatus (Graham 1979).

The four grade scale of Cooper *et al.* (2010) and Villotte *et al.* (2014) was used: grade 0 = absence; grade 1 = occlusion of the meatus by up to one-thirds; grade 2 = occlusion of the meatus by up to two-thirds; grade 3 = occlusion of the meatus by more than two-thirds. For both auricular exostosis and osteophytosis individuals were considered observable if at least one side was preserved.

2.11.3 Other pathologies

The identification of ancient diseases represents one of the most relevant challenges in the study of human health in the past. In fact, diverse pathological processes can produce overlapping or even indistinguishable patterns of abnormal bone formation or destruction, making it difficult to reach a reliable diagnosis.

To overcome these difficulties, paleopathology must employ a rigorous approach toward a properly conducted differential diagnosis, which should be essentially based on clear and detailed description of the observed lesions, analogies with clinical literature, and a multidisciplinary analysis, which takes advantage of the most modern medical technologies, primarily radiology (X-rays and computed tomography), but also histology, and molecular techniques (Ortner 2012).

In the present work the skeletal pathologies encountered in the skeletal remains from Alghero were examined through the macroscopic examination, which remains the starting point for any paleopathological study. In several cases the visual observation was supported by radiological analysis, carried out at the Radiology Unit of the University of Pisa. The differential diagnosis

was conducted by using standardized protocols for observation and documentation of skeletal features (Buikstra and Ubelaker 1994) and the most credited texts about skeletal diseases (Aufderheide and Rodriguez-Martin 1998; Buikstra 2019; Ortner 2003; Waldron 2008). The diagnosis was systematically established by evaluating all the diagnostic options, ruling out the candidate conditions which did not respond to the requisites.

2.12 Statistical analysis

The Chi-square test was used to determine the statistical significance of associations between the frequencies of sexes. Fisher's exact test was used for smaller samples (<5). In all cases the result was considered significant if the p-value was lower than 0.05. All statistical analyses were conducted using the free program PAST version 4 (Hammer *et al.* 2001).

Chapter 3

Results and discussion

In the following section the results of the analysis of the individuals exhumed from the trenches of Alghero are elaborated so as to present a global picture of the parameters considered in this study. The bioanthropological data of each single individual is presented in detail in the 'catalogue of the individuals of each trench' in the Appendix.

3.1 Demography

All the individuals from the trenches are listed in Table 4 of the Appendix.

The sample of Alghero is represented by 181 individuals exhumed from 15 trenches. The sample includes a fetus associated with SU 5123, but excludes three individuals from trench 15 (SU 5242, 5248 and 5249) that were not accessible for the anthropological study. The population included 51 females (28.3%), 36 males (20.0%), and 91 individuals of undetermined sex (50.6%), of which 86 were non-adults (47.7%).

Regarding the demographic analysis (Figure 11), all the age classes are represented, with peaks in the late childhood, with 35 individuals of undetermined sex, and in the middle adulthood, with 16 males, 16 females and 4 indeterminate individuals. The adolescence, with 26 individuals, the young adulthood, with 6 males, 17 females and 2 undetermined, and the mature adulthood, with 11 males, 16 females and 1 undetermined, show similar values. The less represented age classes are the early childhood, with 16 undetermined, the infancy, with 8 undetermined, and the old/senile adulthood with 3 males and 2 females. Only 1 fetus was brought to light.

Figure 12 shows the mortality of the non-adults, in total 87 individuals. In the cemetery of Alghero the number of immatures is 47.7% of the total. Among the non-adults, the age range with the highest percentage of individuals (41.4%) is between 7 and 12 years of age (36 non-adults); 29.9% are represented by 26 individuals between 13 and 19 years, while 16 individuals (18.4%) are between 2 and 6 years. Finally, the smallest cohort, aged between 0 and 1 years, is represented by 8 individuals with 9.2%. Only 1 fetus (1.1%) was found.

Biological sex could be determined for 87 adult individuals. As Figure 13 demonstrates, the number of female individuals is higher than the male for young and mature adults, whereas in the middle adult category both sexes are equally represented. Finally, the oldest category contains the smallest number of individuals, with a slight over-representation of males. Among the

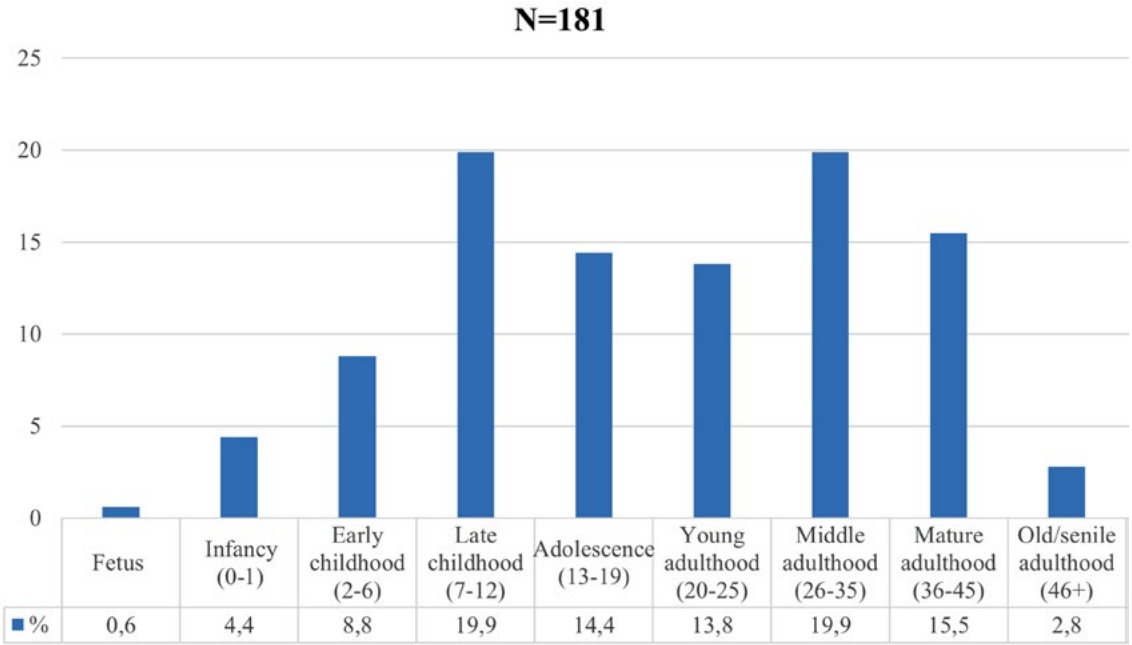


Figure 11. General mortality of the population of Alghero

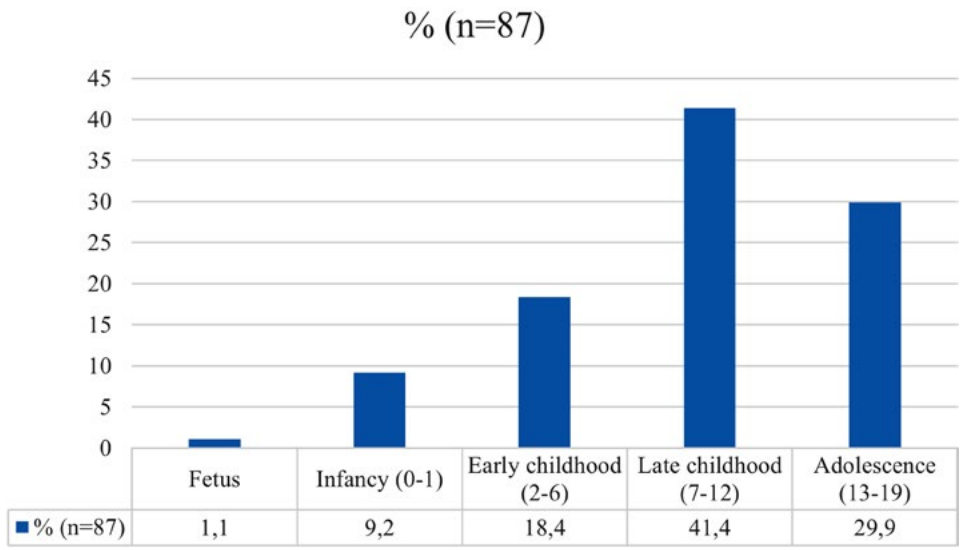


Figure 12. Mortality of non-adult individuals

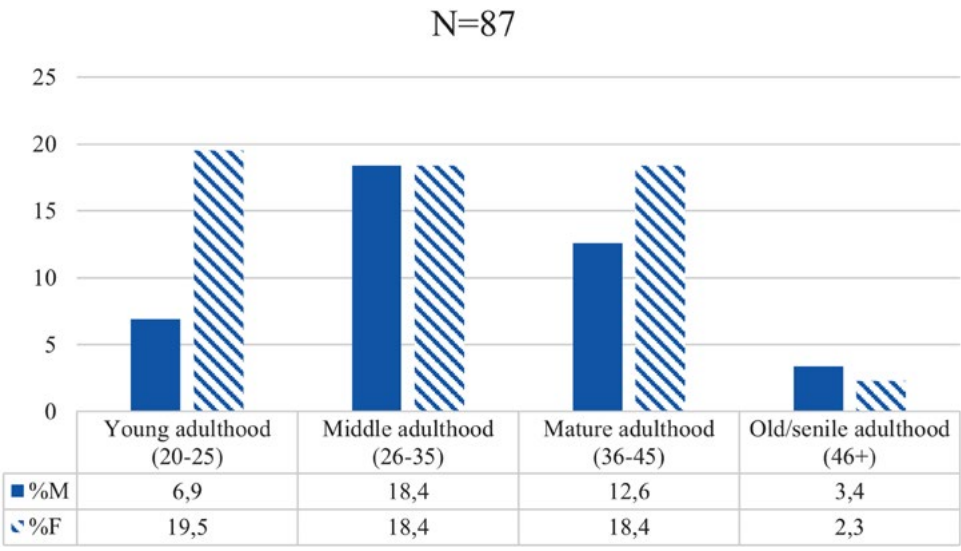


Figure 13. Mortality of adult individuals

females, a woman (SU 5123) aged 20-22 years was buried with a fetus of 14-16 weeks in utero (Figure 14). There is statistically significant difference between males and females only for the young adulthood (p=0.01), with a prevalence of females.

Attritional mortality profiles generally exhibit peaks during infancy and early childhood, with a gradual increase in mortality throughout adulthood (Margerison and Knusel 2002). The demographic profile of the cemetery of Alghero does not represent a classic attritional mortality profile, but rather reflects a catastrophic mortality trend; in fact, the mortality profile matches what it would expect from a living population, as a result of an equal risk of death across age groups. This fact is particularly evident for the non-adult population, because young individuals and many older children are present in the trenches of Alghero, in contrast with the model of an attritional cemetery (Margerison and Knusel 2002). As to the adults, the peak corresponds to the middle adulthood, with the other age ranges almost equally represented. As for sex distribution, a slight prevalence of females was observed in the demographic composition of the Alghero sample. Therefore, the demographic evidence suggests a catastrophic mortality profile, which is consistent with the historical and funerary evidence for this being a cemetery associated with a plague epidemic.

Several archaeological sites uncovered in the last decades have been related to plague epidemics and the skeletal remains have undergone bioarchaeological study, which evaluated the demographic profile of the population. Some of the largest plague cemeteries include hundreds of individuals, such as the East Smithfield Black Death cemetery in London dating to the outbreak of 1348-1349 (Grainger *et al.* 2008), the Hereford cathedral, which also dates to the 14th century plague wave (Kacki 2016), the Lazzaretto

Figure 14. The fetus associated SU 5123 bis (trench 13) (photo courtesy of Prof. Marco Milanese©, University of Sassari)

Vecchio near Venice, dating to between the 14th and the 17th century (Gambaro *et al.* 2001), and the French cemeteries of Les Fedons, Lambesc (Kacki 2016), and of Le Delos and Les Ferrieres, Martigues (Tzortzis and Signoli 2009), which are datable respectively to the 16th and the 18th century. Many other assemblages, with lower number of individuals, have also been examined (for a review see Bramanti *et al.* 2018).

Previous studies have investigated if plague was selective or not with regard to sex or age of the population sample. The majority of studies evidenced that plague was not selective in respect to these parameters and that this disease killed indiscriminately (Castex 2008; Castex and Kacki 2016; DeWitte 2009). However, some recent studies have identified elements of selectivity for age of the victims; for example, the results of the analysis on the East Smithfield cemetery in London indicate that the risk of mortality increased with adult age (DeWitte 2010a). As for sex, a study regarding the London Black Death cemetery in 1349-1350, aimed at evaluating the effects of sex on mortality risk during the plague epidemic, suggested that there was a higher excess of mortality in males than in females. This was the effect of a previous physiological stress on risk of death that was stronger in males (De Witte 2010b). On the other hand, another study based on the analysis of mortmain records from Belgium in the period 1349-1450 demonstrates that Black Death had often a sex-selective effect killing more women (Curtis and Roosen 2017). However, a critical review analysis carried out on a large number of anthropological studies published in the literature from plague cemeteries in Europe concluded that there is no evidence for a selectivity based on the biological features and that differences in sex ratio are more likely due to the original composition of the populations or to distinct cultural behaviours of the two genders (Bramanti *et al.* 2018).

If we compare the demographic patterns observed in the Alghero sample with those from other contemporary plague cemeteries (Les Fedons, France: N=133; Dendermonde, Belgium: N=99) several similarities are evident (Figure 15). As for the proportion of non-adult individuals, the pattern of Alghero samples, containing 47.7% of children, is in accordance with the other plague cemetery assemblages of 16th century, in particular Les Fedons (54.9%) and Dendermonde (55.6%) (Castex and Kacki 2016). Another common feature of Alghero and the other two post-medieval cemeteries is the low number of children younger than 5 years and conversely the over-representation of older children and adolescents.

As for the adult sex distribution, Alghero exhibits a prevalence of females (58.6%), whereas the samples of Les Fedons and Dendermonde are characterized by a larger proportion of males (53.6% and 52.6% respectively) (Figure 16) (Castex and Kacki 2016). However, as previously stated, it seems that plague did not kill discriminately with respect to sex, and therefore the slight prevalence of females observed in the cemetery of Alghero could indicate a prevalence of females in the living population or also that more males left the city during the epidemic rather that a major susceptibility of females to plague in this population. As a conclusion, since the osteoarchaeological material of Alghero comes from a catastrophic cemetery, it can

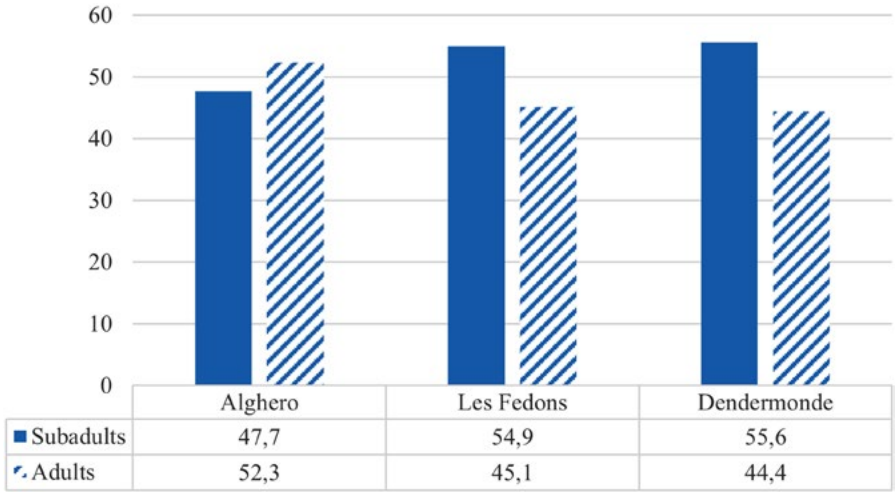


Figure 15. Proportion of non-adult/adult individuals in Alghero and in other two 16th century plague samples

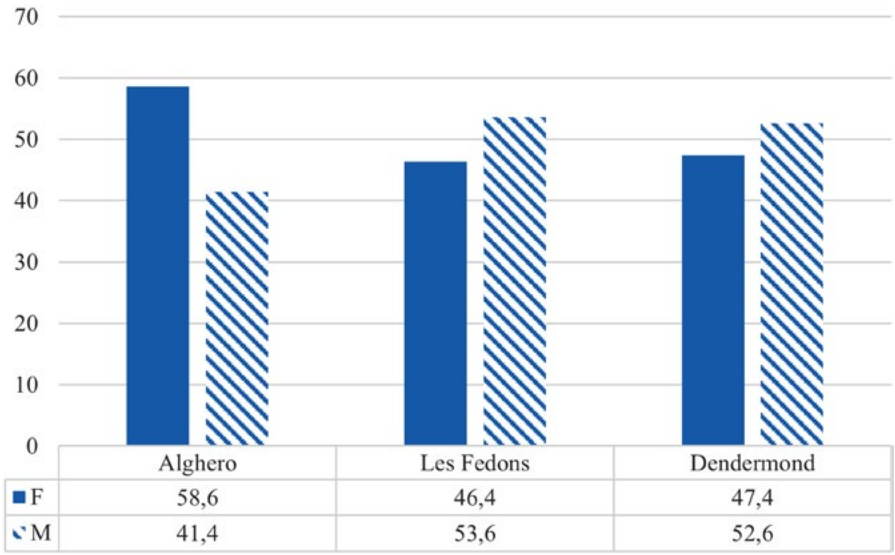


Figure 16. Adult sex distribution in Alghero and other two 16th century plague samples

be considered representative of the original living population.

3.2 Taphonomic analysis

All the trenches were primary deposition in full space, as demonstrated by the anatomical position of different skeletal districts and by the maintenance of joint connections, particularly of the labile joints; some burials resulted deferred, as it presented both elements of the burial in full and empty spaces and therefore the use of a shroud can be supposed.

The data were analyzed for the 16 trenches. In general, all individuals of this cemetery are buried in the supine position.

As regard to the orientation of the trenches, in Table 3 it can be observed that:

- 14 are oriented northwest-southeast;
- 1 is oriented southwest-northeast;
- 1 is oriented north-south.

The corpses follow the orientation of the trenches.

3.2.1 Position of the corpses

A total of 127 individuals (69.4%) showed the skull in its original position, while the remaining 38 (20.8%) had the skull displaced, due to taphonomic processes, as the separation of the occipital condyles from the cervical vertebrae indicates; it has not been possible to determine the modality of deposition of 18 individuals (9.8%) (Figure 17).

Figure 18 shows the various positions of the skull found in the skeletons of the trenches.

Several positions are documented: 41 individuals (22.4%) show the skull slightly turned on the side; 40 individuals present the skull raised and rotated on

Trench	Orientation	N. Individuals (N=183)	N. F	N. M	N. ND	N. non-adults
1	NW-SE	5	1	0	0	5
2	NW-SE	12	3	3	1	5
3	NW-SE	13	4	3	0	6
4	NW-SE	18	7	4	0	7
5	NW-SE	10	2	0	0	8
6	NW-SE	2	2	0	0	0
7	NW-SE	13	4	4	0	5
8	NW-SE	9	5	0	0	4
9	NW-SE	10	3	4	0	3
10	NW-SE	30	11	3	1	15
11	NW-SE	14	5	2	1	6
12	SW-NE	17	1	4	4	8
13	NW-SE	16	3	4	0	9
14	N-S	7	1	3	0	3
15	NW-SE	3	1	0	0	2
16	NW-SE	4	1	2	0	1

Table 3. Orientation of the trenches and number of bodies (total = 183) in each trench. Legend: F = females, M = males, ND = individuals of undeterminate sex

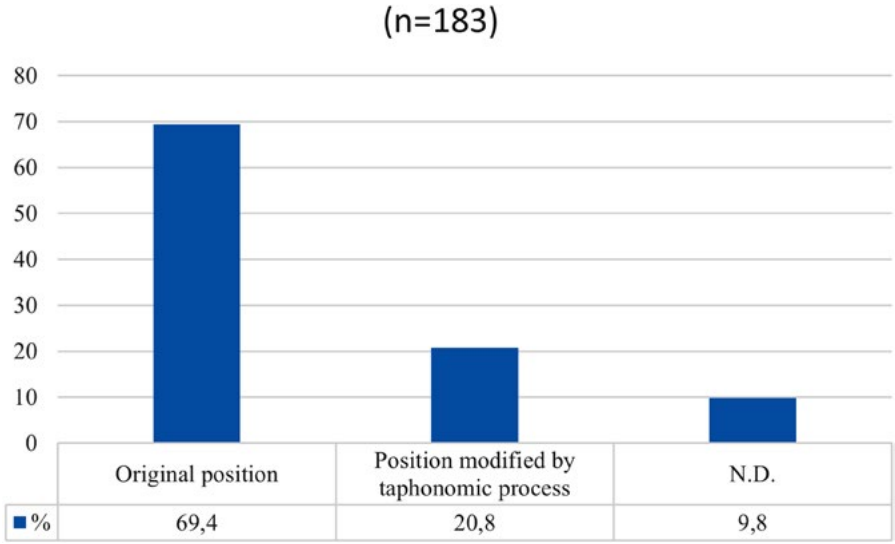


Figure 17. Modality of deposition of the skull

the side (21.9%); in 20.8% of cases the skull is face upward; 29 individuals (15.8%) show the skull raised and face upward. In 3.8% of cases the skull is raised and flexed forward; in 2.7% it is flexed back. In a much smaller number of cases the skull is overturned onto bregma (6 individuals). For 17 individuals it has not been possible to determine the position of the skull.

With regard to the upper limbs, from Figure 19 it can be seen that in most cases the skeletons from the trenches have flexed or hyper-flexed upper limbs (69.9%); in 13.1% of the cases the bodies have one flexed limb and the other that cannot be determined because it is missing; 7 individuals (3.8%) have a limb extended and the other flexed; in one case they are both extended; one case only presents a limb extended and the other not determinable; for 22 individuals it was not possible to observe the position of both upper limbs (12.0%).

The upper limbs were found in a range of different positions which resulted in their positioning on or over a wide variety of body parts; Table 5 of the Appendix summarizes the various positions observed in the individuals presenting both limbs flexed (Figures 20-25). In general, the majority of individuals presents both the flexed upper limbs on the abdomen

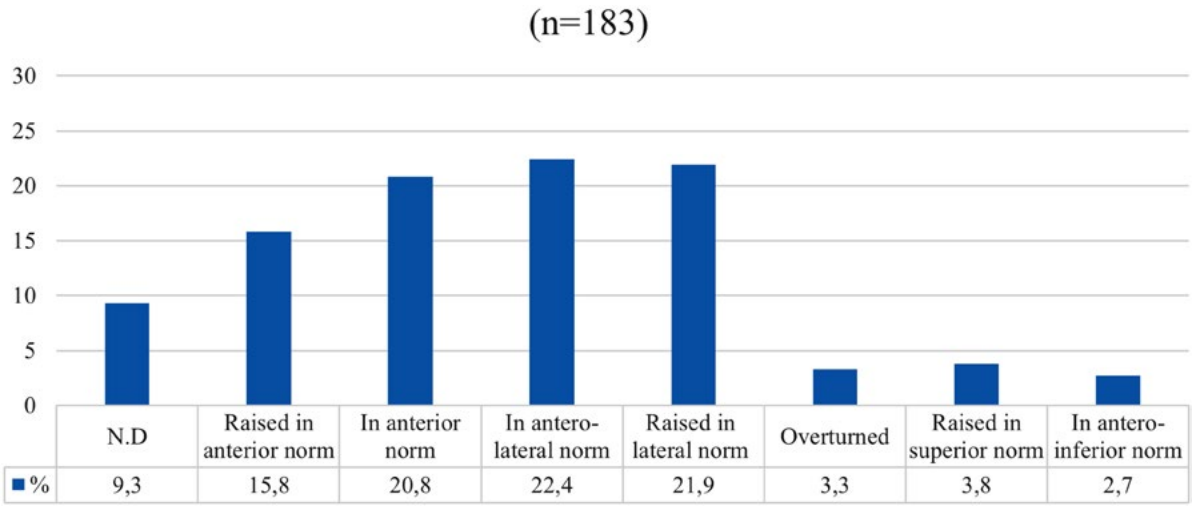


Figure 18. Position of the skull

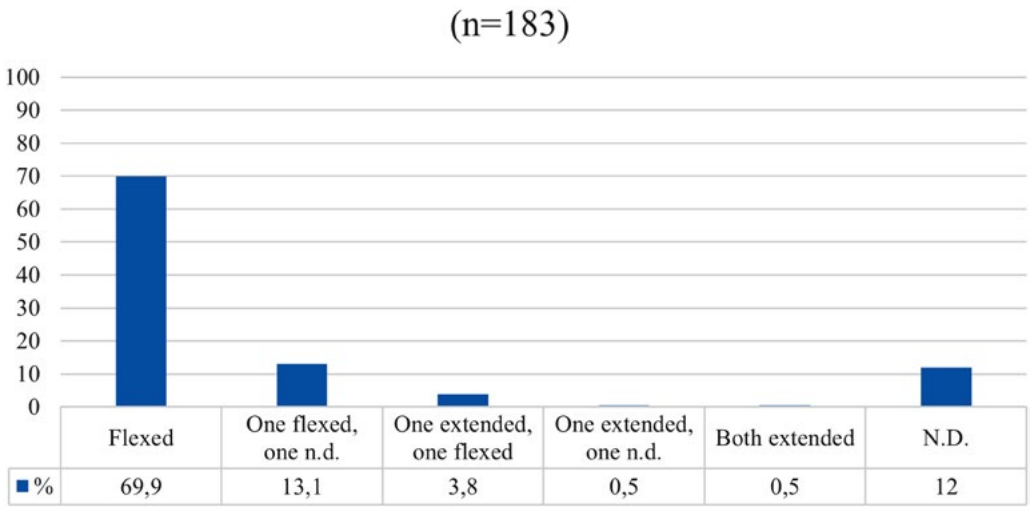


Figure 19. Position of the upper limbs

(22.6%), followed by those presenting them on the thorax (18.0%) and on the pubis (10.9%); a variety of other positions are also attested.

In one case, the position of three skeletons could indicate a possible family group: a male of about 35 years of age (SU 2309) seems to wrap with his arms an adolescent of about 17 years of age (SU 2299), which has a child between his legs (Figure 25).

Tables 5 of the Appendix also shows the positions of the limbs found in the other cases: individuals with a flexed limb and one extended along the body, and individuals in which one limb is flexed and the other is not determinable because it was missing at the time of the discovery. Even in these cases the flexed arm sometimes assumes unusual positions.

Considering the lower limbs, from Figure 26 it can be deduced that in 73.8% of cases the individuals have the lower limbs extended. In 5.5% of the cases one limb was flexed and the other extended; 8 individuals have both legs slightly flexed; 5 individuals (2.7%) have both limbs flexed, 3 (1.6%) have one leg flexed and the other in a position not determinable, 2 (1.1%) have one leg distended and the other in a position not determinable. It was not possible to observe this parameter in 10.9% of cases.

Again with regard to the lower limbs it was possible to verify the position of knees and ankles. Figure 27 shows that 123 individuals (67.2%) had the knees separated at the time of their discovery and 25 individuals (13.7%) had them adjacent. In 33 cases (18%) it was not possible to observe this parameter. Then there are two particular cases: SU 2237 (Trench 4) and SU 2283 (Trench 7) show overlapping knees.

Figure 28 shows the positions of the ankles: as for the knees, 105 individuals (57.4%) have the ankles separated; 28 (15.3%) have them adjacent; for 49 (26.8%) it was not possible to observe this parameter due to the absence of the anatomical district. A particular case is

Figure 20. SU 2237 (trench 4) with both arms hyper-flexed (photo courtesy of Prof. Marco Milanese©, University of Sassari)

Figure 21. SU 2208 (trench 2) with both arms hyper-flexed under the chin (photo courtesy of Prof. Marco Milanese©, University of Sassari)

represented by SU 2280 (trench 7) which has overlapped ankles.

As it can be seen in Figure 29, the wall effect was found in 63 individuals (34.05% of the total). This is a partial phenomenon: in the case of the individuals in the trenches it affects above all the upper part of the skeleton (in fact the verticalization of the clavicles is observed) and the lower limbs, and it is caused by the contact with the adjacent skeletons.

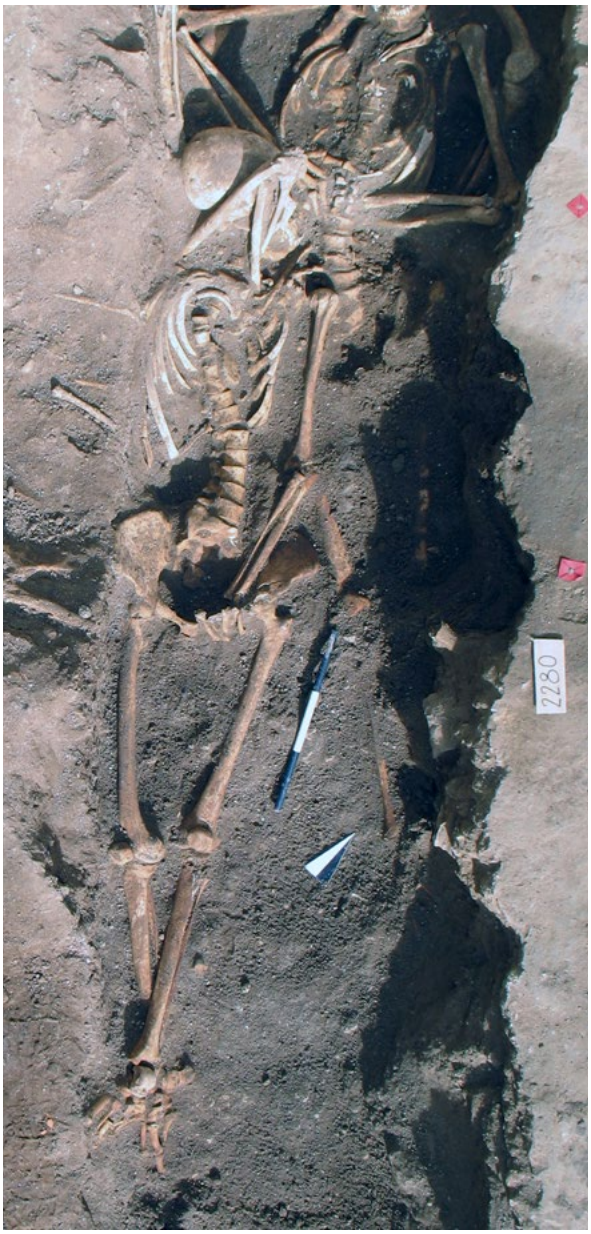


Figure 22. SU 2280 (trench 7) with one arm hyper-flexed and the other extended (photo courtesy of Prof. Marco Milanese©, University of Sassari)

Figure 23. SU 2285 (trench 7) with arms over the skull (photo courtesy of Prof. Marco Milanese©, University of Sassari)

The verticalization of the clavicles was found in 102 individuals (55.7% of the total); in 52 cases (28.4%) it was absent and in 29 (15.8%) it was not possible to observe this parameter (Figure 30). Table 4 shows the different cases of verticalization found: in most cases the phenomenon affects both the right and the left side (65.7%); 21 individuals (20.6%) present one clavicle verticalized and the other in anatomical position, while the remaining 14 (13.7%) show one verticalized clavicle and the other in a position not determinable.

The large variety of body positions, especially of upper limbs, observed in the trenches from Alghero can be attributed to the circumstances of the burial, which occurred during an epidemic event; it is possible to suppose that no great attention was paid to the exact positioning of corpses, even if they were arranged with a certain order.

Direct comparison with the trenches of Alghero can be made with the Fédons cemetery in Lambesc (France) (Bizot *et al.* 2005; Bizot *et al.* 2007), discovered in 1996 during the construction of the new TGV-Méditerranée railway line. The study of written documentation revealed the cemetery was linked to a plague infirmary dating from April to September 1590 which was situated in a peasant community. The burials consisted of earth-cut pits, organized in parallel rows and spaced at a regular distance, of two types, 75 single and 26 multiple (21 double, 4 triple and 1 quadruple). This organization

Figure 24. SU 2412 (trench 12) with one arm on the thorax, the other hyper-flexed over the skull (photo courtesy of Prof. Marco Milanese©, University of Sassari)

Figure 25. Possible family group composed of SU 2309, 2299, 2312 (trench 9) (photo courtesy of Prof. Marco Milanese©, University of Sassari)

clearly shows that also during an epidemic event the deceased could be buried in individual graves, and that only when higher rates of mortality were reached, double or multiple graves were dug.

Another example is the cemetery of Lariey (Bianucci *et al.* 2010; Signoli *et al.* 2007), located in the municipality of Puy-Saint-Pierre (France), containing burials relating to an epidemic plague event dating from 1628 to 1632. Here it is evident that there was an attempt to maintain the individuality of the dead in burial practices where possible; burials were initially single, then double and finally, probably due to an increasing need, multiple interments started to be used. It was hypothesized that the cemetery was accompanied by a temporary infirmary set up during the epidemic wave.

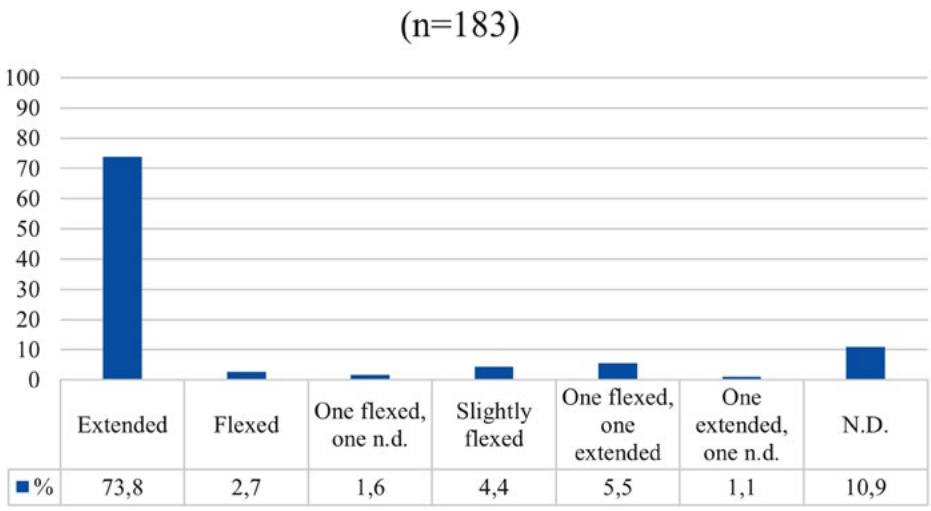


Figure 26. Position of the lower limbs

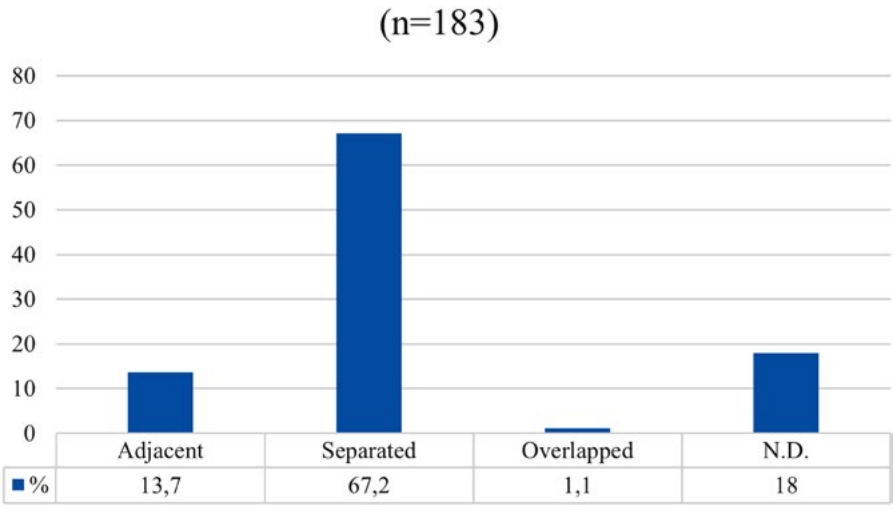


Figure 27. Position of the knees

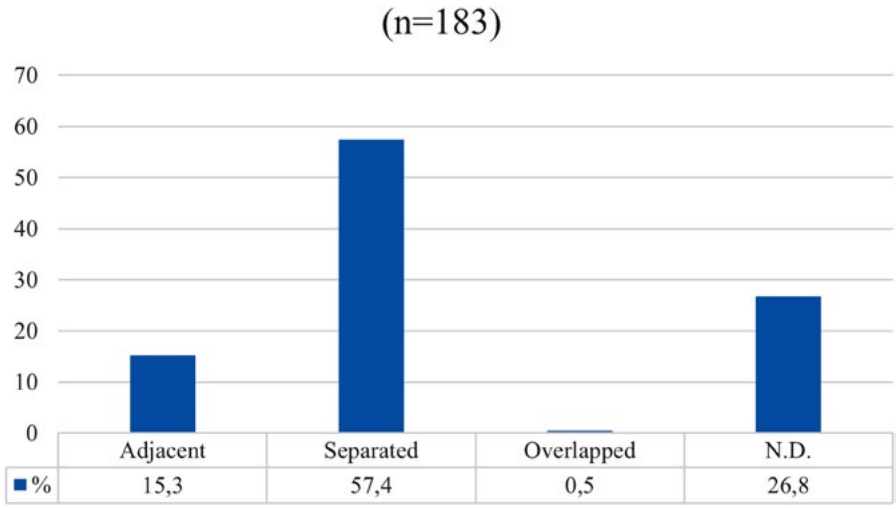


Figure 28. Position of the ankles

Two other burial sites related to a wave of plague were found in the French town of Martigues in the Provence-French Riviera and dated between November 1720 and June 1721, where the historical sources refer to 2,000 victims. One of these is the site of Délos (Bianucci *et al.* 2010; Signoli *et al.* 1995), found during public works in the Jonquières district, which consists of three parallel trenches, of about 1 meter in depth and width, containing 39 individuals. The deceased were laid down hastily and often one over the other.

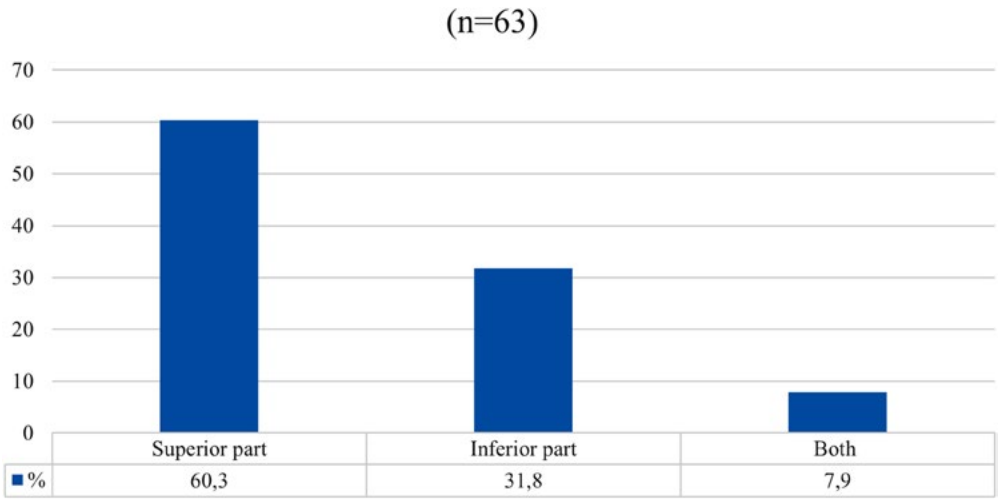


Figure 29. Individuals subjected to the wall effect

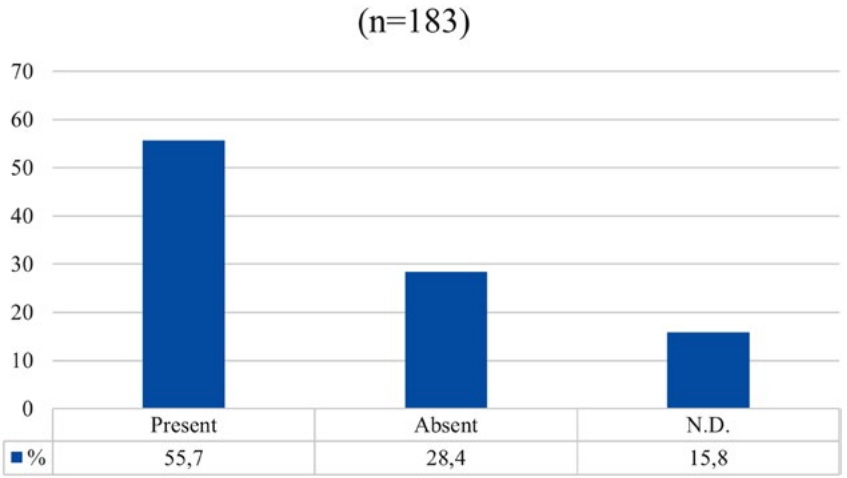


Figure 30. Verticalization of the clavicles

Cases of verticalization	Individuals	% (N=102)
Both verticalized	67	65.7%
One verticalized and the other in anatomical position	21	20.6%
One verticalized and the other not determinable	14	13.7%
Total	103	100%

Table 4. Cases of verticalization of the clavicles in the trenches

The second site is the funerary area called 'Les Capucins' because it was located in the old farmland of the 'Grand Couvent des Capucins'. This catastrophic cemetery, dated back to the first half of the 18th century, was arranged in five parallel trenches in which 210 individuals were buried (Tzortzis and Signoli 2009). A detailed analysis of the positions of the corpses was not performed, but various and even atypical postures were recorded, reflecting the urgency linked to the epidemic context attested by a precipitous appearance of funeral gestures. Differences in the deposition modalities were observed between one trench and another and even within the same trench, with an observable order in some cases and a manifest absence of any organization in other cases; the authors explain this change in *modus operandi* as the consequence of the increase in the epidemic crisis, and it reflects an adaptive response facing the upsurge of corpses to be interred (Tzortzis and Signoli 2009). Observing the pictures of the trenches, a larger variations of the body positions with respect to Alghero can be deduced. Evidently, whereas at Martigues the positions of the corpses suggest a fluctuation of the epidemic intensity, with a worsening of the situation reflected by a less organized deposition, in Alghero the analysis of the body positions seems to reveal a homogeneous situation, in which the epidemic intensity remained likely similar during the period in which the trenches were used.

In any case, the site of Alghero, with the 16 trenches referable to the second half of the 16th century, represents a *unicum* for the use of this type of burial in

response to an epidemic event, as similar arrangements in the Mediterranean area were attested only later during the 17th century.

3.2.2 Grave goods

Grave goods were identified in association with 22 individuals out of 183 (12.0%). As it can be seen from Figure 31, 31.8% of individuals with grave goods are aged between 20 and 29 years and are 5 females and 2 males. For the other age groups, however, the relationship is more balanced. Among the individuals aged 30-39 years 2 were females, 2 males and 1 of undetermined sex; in the age range 40+ the only individual with grave good was a male. Table 5 shows the types of objects found, which include pins, jewelry, dress items, coins and mementoes.

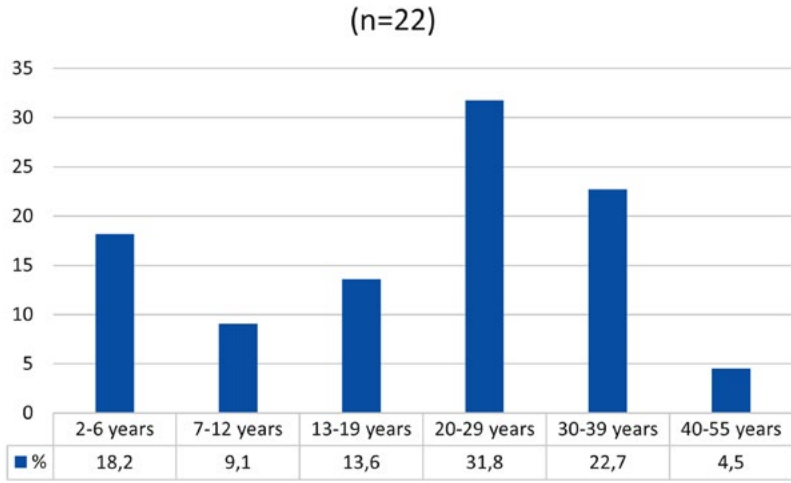


Figure 31. Distribution of the equipment in the trenches by age

Trench	SU	Sex	Age (years)	Objects of equipment
2	2248	N.D.	12	Bronze pins on the vertebrae
2	2247	M	35	Bronze pin in correspondence of the right mastoid
6	2214	F	32	Bronze pin between the second and third right ribs
6	2216	N.D.	18	Earrings
7	2284	M	40	2 bronze buckles on the thorax; 6 bronze coins; 2 nails, perhaps contained in a box of perishable material
9	2300	M	28	Bronze coin at the left fibula
9	2309	M	35	Necklace in bone and coral, a round red faceted stone and a round worked black stone
9	2298	F	21	15 square-shaped jet buttons placed behind the spine
10	2560	N.D.	18	Jet buttons
10	2529	F	21	A pin under the left mastoid
10	2521	M	25	8 square-shaped necklace elements
10	2523	F	25	A bronze pin at the left shoulder and a jet pendant depicting Saint James behind the right shoulder
10	2513	N.D.	12	Ring under the left elbow
10	2514	F	33	Coins enclosed in a strip of cloth placed at the level of the pubis
11	2555	N.D.	2.5	Coral fragment found under the chin; necklace elements in coral on the ribs
11	2551	F	29	Bronze earrings
11	2553	N.D.	6	Pin on the thorax
12	2419	N.D.	3.5	6 steatite beads at the level of the cervical vertebrae
12	2416	N.D.	32	2 bronze pins at the level of the last thoracic vertebrae
12	2413	N.D.	4	Necklace beads at the level of the cervical vertebrae and a small bronze pin
12	2412	F	22	Steatite pyramid-shaped beads and small beads under the entire vertebral column, part of the pelvis and at the sides of the shoulders
16	2979	N.D.	18	9 jet beads die-shaped

Table 5. Objects recovered in association with burials from the trenches

The presence of personal objects in the grave in association with the skeleton can sometimes help reconstructing individual stories; in the cemetery of San Michele there are some interesting cases: one, for example, is that of the individual SU 2523 in the trench 10. The skeleton belongs to a woman of about 25 years who was buried with a pendant depicting St. Giacomo the pilgrim, with his large cloak, wide-brimmed hat, the traveler's cane and a book in his left hand (Figures 32-33). This object was recovered from behind the right shoulder. During the late medieval and post-medieval age, pilgrimages became a very frequent phenomenon, and those returning from experiences of this kind brought with them devotional medals or rosaries, which were then placed in burial (Blick 2019); it can be therefore hypothesized that the woman travelled to Spain, probably to fulfill a vow, and that she returned to Alghero with this memento of her journey.

Figure 32. SU 2523 (trench 10) (photo courtesy of Prof. Marco Milanese©, University of Sassari)

Figure 33. Pendant depicting St Giacomo (photo courtesy of Prof. Marco Milanese©, University of Sassari)

Another case is that of the individual SU 2514, again deposed in trench 10. The skeleton belongs to a woman of about 35 years who was buried with hoard of coins (Figure 34) located above the pubis.

3.3 Stature

The stature of female and male individuals and the long bones from which it was calculated are reported in Tables 6 and 7 of the Appendix.

Male stature varies from a minimum of 146.7 cm to a maximum of 174.9 cm, while female stature varies from a minimum of 137.0 cm to a maximum of 166.9 cm. The mean male stature (n=32) is 162.5 cm, while the mean female stature (n=50) is 154.9 cm. The difference between male and female mean stature is 7.6 cm.

Table 6 and Figure 35 show the stature distribution for the male and female individuals according to the Martin and Saller stature categories (1957), which were used as the expressed values are more reliable for past populations respect to contemporary skeletal populations, considering the increase patterns in stature in the last century. The male stature fits in the

Figure 34. SU 2514 (trench 10) with the hoard of coins *in situ* (photo courtesy of Prof. Marco Milanese©, University of Sassari)

Stature categories (cm)	Martin & Saller (1957) stature classification	nM	% nM	Martin & Saller (1957) stature classification	nF	% nF
Very short stature	130-149.9	2	6.3	121-139.9	0	0
Short stature	150.0-159.9	9	28.1	140.0-148.9	9	18
Below medium stature	160.0-163.9	8	25	149.0-152.9	14	28
Medium stature	164.0-166.9	5	15.6	153.0-155.9	10	20
Above medium stature	167.0-169.9	4	12.5	156.0-158.9	6	12
Tall stature	170.0-179.9	4	12.5	159.0-167.9	11	22
Very tall stature	180.0-199.9	0	0	168.0-186.9	0	0
Total		32			50	

Table 6. Adult stature

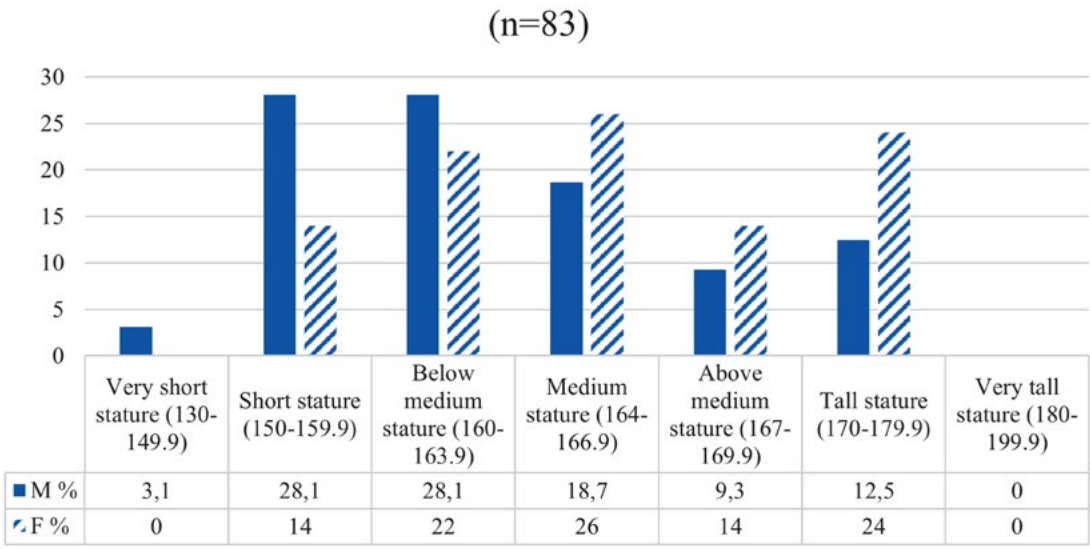


Figure 35. Adult stature distribution

Martin and Saller 'short' and 'below medium stature' categories for 53.1% of the sample, while 28% of the female subsample fits in the 'below medium stature' category and 22% in the 'tall stature' category.

If we compare this stature data with studies carried out on skeletal material from Sardinia from the Neolithic to the second half of the 20th century (Floris *et al.* 2012), the results are similar to the averages recorded for the

Modern Age, which are 163.2 cm for males and 149.9 cm for females (Maxia and Fenu 1963), However, it should be noted that the average stature for females in the Alghero samples is closer to the height value recorded for the second half of the 20th century, which is 155.7 cm (Floris *et al.* 2012).

3.4 Non-metric traits

Among the adult individuals, the non-metric traits of the cranium (Table 7) with the highest frequency are: the lambdoid ossicles (54.4%), the parietal foramen (54.2%), the zygomatic foramen (48.4%), the mastoid foramen extrasutural (44.3%) and the supraorbital foramen (40.0%). Among these four traits, none showed a statistically significant difference between males and females (p=0.98; p=0.08; p= 0.55; p=0.88; p=0.72 respectively).

As for non-metric traits of the post-cranial skeleton (Table 8), the highest frequency is noted for the accessory transverse foramen of C6 (64.6%), followed by the double calcanear facet of the calcaneus (55.6%), squatting facet of the tibia (41.4%), and accessory transverse foramen of C5 (38.2%). Among these four traits, none showed a statistically significant difference between males and females (p=0.31; p=0.95; p= 0.95; p=0.56 respectively).

The data for non-adults are reported in Table 9, although some traits are underrepresented, since they would not have been completely developed, depending on the age of the individuals. Among the non-adults, the non-metric traits of the cranium with the highest frequency are the lambdoid ossicles (59.5%), the condylar canal (52.9%), the parietal foramen (51.2%), and the mastoid foramen extrasutural (48.6%).

Among the non-adults, the non-metric traits of the post-cranial skeleton (Table 10) with the highest frequency are the accessory transverse foramen of C6 (66.7%), of C5 (36.0%), the double calcanear facet (33.3%), and the throclear extension of the talus (29.2).

	F			M			Total		
	P	Obs	%	P	Obs	%	Total P	Total obs	**%**
Metopic suture partial	0	36	0	1	18	5.6	1	54	**1.9**
Metopic suture complete	9	36	25.0	2	18	11.1	11	54	**20.4**
Supraorbital foramen	13	31	41.9	7	19	36.8	20	50	**40.0**
Infraorbital suture partial	2	19	10.5	0	10	0	2	29	**6.9**
Infraorbital suture complete	2	19	10.5	2	10	20.0	4	29	**13.8**
Multiple infraorbital foramen (2)	0	17	0	0	10	0	0	27	**0**
Multiple infraorbital foramen (> 2)	3	17	17.6	0	10	0	3	27	**11.1**
Zygomatic foramen (> 1)	20	39	51.3	10	23	43.5	30	62	**48.4**
Parietal foramen	18	39	46.2	14	20	70.0	32	59	**54.2**
Parietal foramen on the suture	6	39	15.4	3	20	15.0	9	59	**15.3**
Epipteric bone	0	16	0	0	8	0	0	24	**0**
Coronal ossicles	5	35	14.3	0	15	0	5	50	**10.0**
Bregmatic bone	1	31	3.2	0	18	0	1	49	**2.0**
Sagittal ossicles	3	35	8.6	1	19	5.3	4	54	**7.4**
Apical bone	4	36	11.1	3	21	14.3	7	57	**12.3**
Inca bone	0	36	0	0	22	0	0	58	**0**
Lambdoid ossicles	19	35	54.3	12	22	54.5	31	57	**54.4**
Asterionic bone	4	28	14.3	0	15	0	4	43	**9.3**
Parietal notch bone	5	28	17.9	3	14	21.4	8	42	**19.0**
Mastoid foramen extrasutural	17	39	43.6	10	22	45.5	27	61	**44.3**
Condylar canal	5	17	29.4	1	1	100	6	18	**33.3**
Double occipital condylar facet	0	29	0	0	7	0	0	36	**0**
Precondylar tubercle	2	19	10.5	3	7	42.9	5	26	**19.2**

Table 7. Frequency of non-metric traits of the cranium in both sexes and in total

	F			M			Total		
	P	Obs	%	P	Obs	%	P	Obs	%
Sternum									
Sternal perforation	0	17	0	0	6	0	0	23	**0**
Xiphoid perforation	1	11	9.1	0	3	0	1	14	**7.1**
Vertebrae									
Atlas: double facet	4	32	12.5	4	22	18.2	8	54	**14.8**
C3: accessory transverse foramen	2	31	6.5	0	20	0	2	51	**3.9**
C4: accessory transverse foramen	2	32	6.3	3	19	15.8	5	51	**9.8**
C5: accessory transverse foramen	14	34	41.2	7	21	33.3	21	55	**38.2**
C6: accessory transverse foramen	21	30	70.0	10	18	55.6	31	48	**64.6**
C7: accessory transverse foramen	4	18	22.2	3	16	18.8	7	34	**20.6**
Scapula									
Circumflex sulcus	2	36	5.6	2	19	10.5	4	55	**7.3**
Suprascapular foramen	1	7	14.3	2	4	50.0	3	11	**27.3**
Unfused acromial epiphysis	7	41	17.1	5	23	21.7	12	64	**18.8**
Supraglenoid articular facet*	4	28	14.3	1	17	5.9	5	45	**11.1**
Humerus									
Septal aperture (small)	9	46	19.6	4	29	13.8	13	75	**17.3**
True perforation	6	46	13.0	0	0	0	6	46	**13.0**
Supracondiloid process	0	39	0	1	25	4.0	1	64	**1.6**
Os coxae									
Acetabular crease	2	24	8.3	0	14	0	2	38	**5.3**
Accessory sacral facets*	0	16	0	0	4	0	0	20	**0**
Sacrum									
Accessory sacral facets*	0	13	0	0	10	0	0	23	**0**
Sacralization of L5-S1	1	15	6.7	0	8	0	1	23	**4.3**
Femur									
Poirier's facet	2	26	7.7	7	16	43.8	9	42	**21.4**
Allen's fossa	0	26	0	1	18	5.6	1	44	**2.3**
Exostosis in trochanteric fossa	5	29	17.2	4	17	23.5	9	46	**19.6**
Exostosis fovea capitis	1	33	3.0	4	18	22.2	5	51	**9.8**
Patella									
Vastus notch	5	44	11.4	7	30	23.3	12	74	**16.2**
Patella emarginata	0	43	0	1	30	3.3	1	73	**1.4**
Tibia									
Squatting facets	15	36	41.7	9	22	40.9	24	58	**41.4**
Foot									
Double calcaneal facet (calcaneus)	24	43	55.8	16	29	55.2	40	72	**55.6**
Trochlear extension (talus bone)	11	44	25.0	11	29	37.9	22	73	**30.1**
Accessory facet head of 1° metatarsal	2	45	4.4	2	28	7.1	4	73	**5.5**

Table 8. Frequency of non-metric traits of the post-cranial skeleton in both sexes and in total

Non-metric traits may reflect genetic differences between populations and can be used to compare them, thus being useful to trace genetic relationships among ancient populations. The results from the population of 16th century Alghero can be compared with data available for other Sardinian samples. In

	ND		
	P	Obs	%
Metopic suture partial	0	27	0
Metopic suture complete	4	27	14.8
Supraorbital foramen	5	27	18.5
Infraorbital suture partial	2	11	18.2
Infraorbital suture complete	4	11	36.4
Multiple infraorbital foramen (2)	0	14	0
Multiple infraorbital foramen (> 2)	3	14	21.4
Zygomatic foramen (1)	18	45	40.0
Zygomatic foramen (> 1)	20	46	43.5
Parietal foramen	22	43	51.2
Parietal foramen on the suture	3	45	6.7
Epipteric bone	1	7	14.3
Coronal ossicles	1	24	4.2
Bregmatic bone	1	25	4.0
Sagittal ossicles	5	32	15.6
Apical bone	8	34	23.5
Inca bone	0	38	0
Lambdoid ossicles	22	37	59.5
Asterionic bone	3	12	25.0
Parietal notch bone	1	10	10.0
Mastoid foramen extrasutural	18	37	48.6
Condylar canal	9	17	52.9
Double occipital condylar facet	2	20	10.0
Precondylar tubercle	0	13	0

Table 9. Non-metric traits of the cranium in non-adults

particular, a study was conducted on a large skull sample from northern Sardinia dated back to the beginning of the 20th century; this sample included 65 males and 32 females from Alghero (Brasili *et al.* 1999). The traits with the highest frequency in the Alghero sample of 20th century are the lambdoid ossicle and parietal foramen, followed by palatine torus, which was not considered in the present study, and supraorbital foramen, with no great differences between the sexes. These are the same results observed in the Alghero population of 16th century, even if two traits with high occurrence, the zygomatic foramen and the mastoid foramen extrasutural, were not considered in the sample of 20th century. In particular, the frequency of the lambdoid ossicle and parietal foramen are the highest in both samples with very similar values, corresponding the former to 54.4% and 55.3% and the latter 54.2% and 43.8% in the Alghero of 16th and of 20th century respectively (Brasili *et al.* 1999). This seems to confirm a genetic proximity of the two populations of the same

	ND		
	P	Obs	%
Sternum			
Sternal perforation	0	16	0
Xiphoid perforation	0	10	0
Vertebrae			
Atlas: double facet	5	34	14.7
C3: accessory transverse foramen	3	27	11.1
C4: accessory transverse foramen	2	27	7.4
C5: accessory transverse foramen	9	25	36.0
C6: accessory transverse foramen	12	18	66.7
C7: accessory transverse foramen	4	15	26.7
Scapula			
Circumflex sulcus	0	23	0
Suprascapular foramen	0	4	0
Unfused acromial epiphysis	1	4	25.0
Supraglenoid articular facet*	0	11	0
Humerus			
Septal aperture (small)	5	48	10.4
True perforation	2	48	4.2
Supracondiloid process	0	36	0
Os coxae			
Acetabular crease	0	10	0
Accessory sacral facets*	0	2	0
Sacrum			
Accessory sacral facets*	0	3	0
Sacralization of L5-S1	0	9	0
Femur			
Poirier's facet*	0	11	0
Allen's fossa*	0	11	0
Exostosis in trochanteric fossa	1	9	11.1
Exostosis fovea capitis	0	14	0
Patella			
Vastus notch	0	22	0
Patella emarginata	0	22	0
Tibia			
Squatting facets	2	12	16.7
Foot			
Double calcaneal facet (calcaneus)	7	21	33.3
Trochlear extension (talus bone)	7	24	29.2
Accessory facet head of 1° metatarsal	0	25	0

Table 10. Non-metric traits of the post-cranial skeleton in non-adults

Age category	M	F	ND	Total	%
Early childhood (2-6)	–	–	17	17	10.6
Late childhood (7-12)	–	–	39	39	24.4
Adolescence (13-19)	–	–	23	23	14.4
Young adulthood (20-25)	6	16	2	24	15.0
Middle adulthood (26-35)	12	15	2	29	18.1
Mature adulthood (36-45)	10	13	1	24	15.0
Old/senile adulthood (46-55)	2	2	0	4	2.5
Total	30	46	84	160	100

Table 11. Demographic distribution of the individuals considered for the dental pathologies

	F	M	ND	Total
Teeth with caries	159	103	22	284
Observable teeth	1079	699	167	1941
% on teeth	**14.7**	**14.7**	**13.2**	**14.6**
Individuals affected	36	23	7	66
Individuals with observable teeth*	45	29	9	83
% on individuals	**80.0**	**79.3**	**77.8**	**79.5**

Table 12. Caries on adult individuals. * Individuals with at least 14 teeth not affected are considered observable

geographic area but of different chronological context, demonstrating the maintenance of a genetic uniformity through time.

Finally, the results about the 16th century sample could provide a basis for the study of other Sardinian groups for a broader and more complete evaluation of the relationships among the populations of the different regions of the island and even outside Sardinia.

3.5 Dental pathologies

Out of 180 individuals studied, for 12 individuals the dentition was completely or largely not preserved and 8 children were excluded as they belong to the age range 0-2 years with no erupted dentition; therefore, 160 individuals were suitable for examination of dental pathology: 81 adults and 79 non-adults. Among adults the sample comprises 30 males, 46 females, and 5 of undetermined sex, as reported in Table 11.

3.5.1 Caries and abscesses

3.5.1.1 Adults

In the population from Alghero, 14.6% of teeth are affected by caries, equally distributed in both sexes (Giuffra *et al.* 2020). In fact, as shown in Table 12 the frequency of caries on teeth is almost the same in females, males and individuals of undeterminable sex. The Chi-square test suggested that there is no statistical difference in the presence of caries between the two sexes (p=1.00).

Examining the frequency of caries on individuals, also in this case the values are very similar in both sexes, with a total frequency of 79.5% of affected individuals; the Chi-square test showed no statistical difference between the two sexes (p=0.94).

In females the mandibular teeth are slightly more affected than the maxillary ones, whereas among males an opposite trend is observed although the difference is minimal (Table 13).

Among the affected teeth, the majority present 1 caries, but some teeth are affected by 2 or more caries, as showed in Table 14.

As for the distribution of caries in age categories, the adult individuals were divided into three age groups to fit the sample in homogenous and comparable sub-

	F	M	ND	Total
Caries maxilla	72	51	11	134
Observables	531	335	83	949
% caries maxilla	**13.6**	**15.2**	**13.3**	**14.1**
Caries mandible	87	52	11	150
Osservables	545	364	83	992
% caries mandible	**16.0**	**14.3**	**13.3**	**15.1**
Total caries	159	103	22	284
Total observables	1076	699	166	1941

Table 13. Caries on adult individuals distributed in maxilla and mandible

Teeth with 2 caries	39
Teeth with 3 caries	3
Teeth with 4 caries	7
Teeth with 5 caries	2
Teeth with 6 caries	1

Table 14. Teeth with more than 1 caries

	Carious teeth	Observables	%
Females			
20-29	42	517	8.1
30-39	51	248	20.6
40+	66	314	21.0
Total	159	1079	14.7
Males			
20-29	37	248	14.9
30-39	28	190	14.7
40+	38	261	14.6
Total	103	699	14.7
Not determinable			
20-29	12	144	8.3
30-39	8	20	40.0
40+	2	3	66.7
Total	22	167	13.2
Total sample			
20-29	91	909	10.0
30-39	87	458	19.0
40+	106	578	18.3
Total	284	1945	14.6

Table 15. Distribution of caries by sex in age ranges in adult individuals

samples. In general, an increase in the frequency of caries can be observed between the 20-29 age range (10%) and the 30-39 and 40+ age ranges (19% and 18.3% respectively), as shown in Table 15 and Figure 36. A statistically significant difference ($p<0.001$) was observed only between the first two age range classes (29-29 vs 30-39). This difference is exclusively due to the contribution of the variability in carious frequencies by age in the female sample, since the male frequencies are very similar in all age categories.

If we analyse the frequency of caries per tooth type (Table 16), as a general trend it could be observed an increasing frequency of carious lesions from anterior teeth to premolar and molars, which exhibited the highest values. Considering the differences among sexes, females showed higher frequency of caries in anterior teeth and first premolar compared to males; on the contrary, females showed lower incidence of caries for the second premolar and molars than males.

As for the position of the caries in maxillary teeth (Table 17), the majority affect the crown, followed by the cemento-enamel junction, whereas the roots are rarely affected. Furthermore, the interproximal caries are the most diffuse in all the three sex categories, followed by the occlusal surface, whereas the lingual and buccal caries are very rare. As for the severity of the carious lesions (Table 17), the majority are of grade 1 and grade 3, followed by grade 2 and grade 4.

As for the position of the caries in mandibular teeth (Table 18), also in this case the majority of them affects the crown, with highest values in comparison with the maxillary teeth, followed by the cemento-enamel junction, whereas the roots are slightly more affected that in the maxillary teeth. In addition, in the mandibular teeth the interproximal and the occlusal caries show a similar distribution in all the three sex

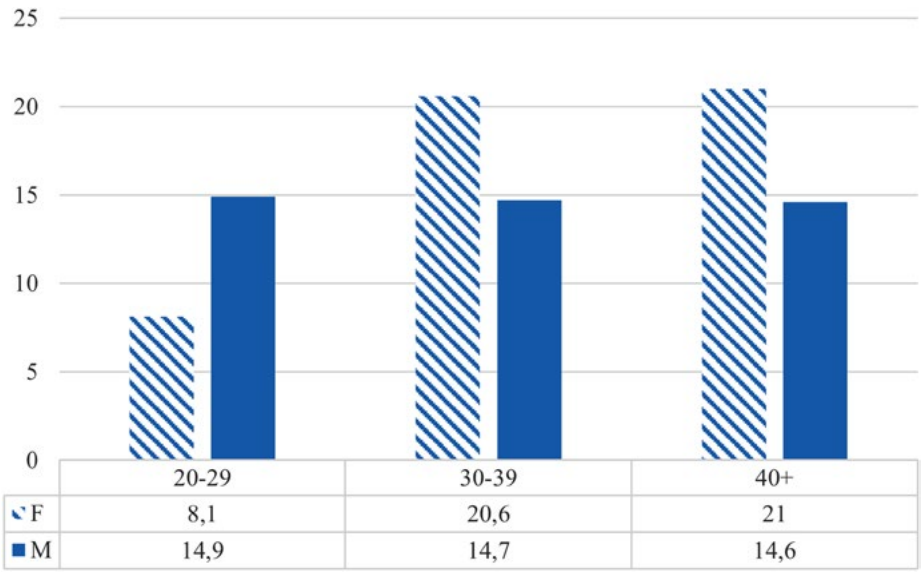


Figure 36. Caries frequency by sex in age categories in adult individuals

	F			M			ND			Total		
Tooth	N	Obs	%	N	Obs	%	N	Obs	%	N	Obs	%
I1	8	140	5.7	1	89	1.1	2	20	10	11	249	4.4
I2	8	138	5.8	2	94	2.1	0	18	0	10	250	4.0
C	18	154	11.7	4	96	4.2	0	17	0	22	267	8.2
P3	17	142	12.0	7	90	7.8	1	20	5	25	252	9.9
P4	8	143	5.6	12	90	13.3	1	18	5.6	21	251	8.4
M1	33	129	25.6	25	84	29.8	6	23	26	64	236	27.1
M2	42	138	30.4	34	93	36.6	7	28	25	83	259	32.0
M3	25	95	26.3	18	63	28.6	5	23	2.2	48	181	26.5

Table 16. Distribution of caries by sex and tooth type. Legend: N = number of teeth affected by caries; Obs = observable teeth; I = incisor; C = canine; PM = premolar; M = molar

Maxilla localisation	**F**	**%**	**M**	**%**	**ND**	**%**	**Total**	**%**
Crown	51	60.7	40	67.8	7	53.8	98	62.8
Cemento-enamel junction	32	38.1	17	28.8	6	46.2	55	35.3
Root	1	1.2	2	3.4	0	0	3	1.9
Total	84	100	59	100	13	100	156	100
Maxilla surface								
Occlusal	17	25.8	14	26.4	2	16.7	33	25.2
Buccal	0	0	5	9.4	1	8.3	6	4.6
Lingual	1	1.5	0	0	1	8.3	2	1.5
Interproximal	48	72.7	34	64.2	8	66.7	90	68.7
Total	66	100	53	100	12	100	131	100
Maxilla severity								
Grade 1	23	27.4	19	32.2	7	53.8	49	31.5
Grade 2	25	29.8	11	18.6	0	0	36	23.0
Grade 3	19	22.6	23	39.0	4	30.8	46	29.5
Grade 4	17	20.2	6	10.2	2	15.4	25	16.0
Total	84	100	59	100	13	100	156	100

Table 17. Localisation and severity of the caries in maxillary teeth in females, males and individuals of undeterminable sex

categories, the buccal caries are more diffuse than in the maxilla, whereas the lingual localisation remains very rare. As for the severity of the carious lesions (Table 18), the majority are of grade 1, whereas in decreasing frequency are the caries of grade 2, 3 and 4.

If we consider the results from maxillary and mandibular teeth combined (Table 19), the majority of caries affects the crown with 69.7%, followed by the cemento-enamel junction with 26.2%, whereas the roots are rarely affected (4.1%). As for the differences between sexes, in females the crown is slightly less affected than in males (67.5% vs 73.4%), and the cemento-enamel junction is slightly more affected (30% vs 19.4%). Considering the affected surface, the interproximal caries are the most diffuse in all the three sex categories (49.2%), followed by the occlusal surface (34.3%), whereas the buccal and lingual caries are very rare (14.4% and 2.1% respectively). Both sexes exhibit similar values in all surfaces. As for the severity (Table 19), the majority of carious lesions are superficial (grade 1) (42.3%), followed by those with the dentine involvement (grade 2) and with dental canal involvement (grade 3), exhibiting 23.2% and 22.7% respectively, and by caries that caused crown destruction (grade 4) with 11.7%. With regard to the differences in severity between sexes, caries of grade 1 and grade 3 are similarly distributed with minimal difference; males were slightly more affected by caries of grade 2 in comparison to females (25.9% and 23% respectively) and females were slightly more affected by caries of grade 4 in comparison to males (13% and 9.4% respectively).

Mandible position	F	%	M	%	ND	%	Total	%
Crown	84	72.4	62	77.5	11	78.6	157	74.8
Cemento-enamel junction	28	24.1	10	12.5	3	21.4	41	19.5
Root	4	3.5	8	10	0	0	12	5.7
Total	116	100	80	100	14	100	210	100
Mandible surface								
Occlusal	42	38.9	28	37.8	9	64.3	79	40.3
Buccal	23	21.3	16	21.6	2	14.3	41	20.9
Lingual	3	2.8	2	2.7	0	0	5	2.6
Interproximal	40	37.0	28	37.9	3	21.4	71	36.2
Total	108	100	74	100	14	100	196	100
Mandible severity								
Grade 1	60	51.7	40	50.0	6	42.9	106	50.5
Grade 2	21	18.1	25	31.3	3	21.4	49	23.3
Grade 3	24	20.7	8	10.0	5	35.7	37	17.6
Grade 4	11	9.5	7	8.7	0	0	18	8.6
Total	116	100	80	100	14	100	210	100

Table 18. Localisation and severity of the caries in mandibular teeth in females, males and individuals of undeterminable sex

Localisation	F	%	M	%	ND	%	Total	%
Crown	135	67.5	102	73.4	18	66.7	255	69.7
Cemento-enameljunction	60	30	27	19.4	9	33.3	96	26.2
Root	5	2.5	10	7.2	0	0	15	4.1
Total caries	200	100	139	100	27	100	366	100
Surface								
Occlusal	59	33.9	42	33.1	11	42.3	112	34.3
Buccal	23	13.2	21	16.5	3	11.6	47	14.4
Lingual	4	2.3	2	1.6	1	3.8	7	2.1
Interproximal	88	50.6	62	48.8	11	42.3	161	49.2
Total caries	174	100	127	100	26	100	327	100
Severity								
Grade 1	83	41.5	59	42.4	13	48.2	155	42.3
Grade 2	46	23.0	36	25.9	3	11.1	85	23.2
Grade 3	43	21.5	31	22.3	9	33.3	83	22.7
Grade 4	26	13.0	13	9.4	2	7.4	43	11.7
Total caries	200	100	139	100	27	100	366	100

Table 19. Localisation and severity of the caries in maxillary and mandibular teeth combined in females, males and individuals of undeterminable sex

The patterns of caries in the Alghero population (Figure 37) are typical of the post-medieval period. As a general trend, an increase in rates of dental caries through time has been observed, with higher values in the post-medieval period, and associated with a change in carious lesion locations from the cemento-enamel junction to interproximal and occlusal surfaces (Brothwell 1959; Hardwick 1960; Hillson 2005; Moore and Corbett 1975). This trend is attributed to a change in dietary habits after the Middle Ages, when an increase in the consumption of soft foodstuffs and, most of all, of refined carbohydrates and other cariogenic food occurs.

Similarly, the homogeneity in the frequency of caries between males and females was observed also in other post-medieval series (Corbett and Moore 1976; Saunders *et al.* 1997). This is in contrast to general trends revealed by studies of past populations, in which women appear to be more affected by caries than men (Hillson 2000; Larsen 1997; Lukacs and Thompson 2008). This difference could be explained by different dietary habits, as males are more likely to have eaten more meat and females more vegetables and carbohydrates, along with differences in hormonal fluctuations during events such as puberty, menstruation and pregnancy, making the oral environment significantly more cariogenic for women (Lukacs 2011; Lukacs and Largaespada 2006). The post-medieval data highlights the central role of the diet in the onset of caries; in fact, independently from the physiological differences predisposing females to develop this pathology, the consumption of cariogenic foods may increase the chances of males to suffer from caries. The results from Alghero suggest similar diets between sexes (Giuffra *et al.* 2020).

As for the abscesses, both the frequency calculated per alveolus (Table 20) and per individual (Table 21) reveal that this pathology was not particularly common in the population of Alghero; only 1% of alveoli and 17.5% of individuals were affected (Giuffra *et al.* 2020). If we compare the frequency between sexes, it is evident that males were more affected than females. However, the Chi-square test indicated a statistical difference between the two sexes (p=0.02) if calculated on alveoli, while the Fisher's exact test suggested no statistical difference between the two sexes (p=0.16) if calculated on individuals. This implies that, overall, males are not more affected, but tend to have more locations (alveoli)

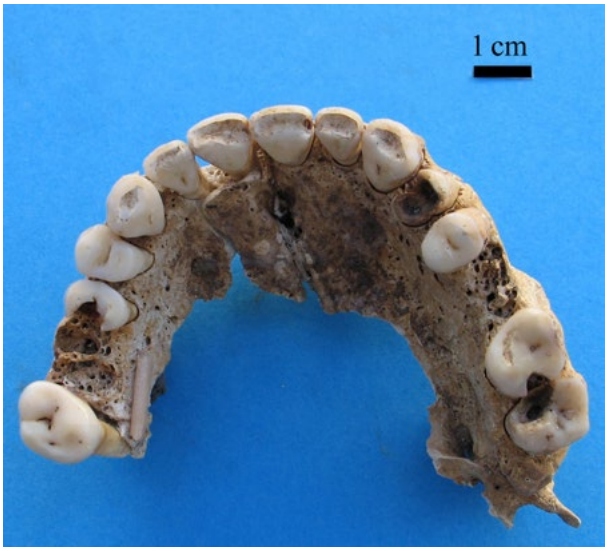


Figure 37. Maxilla of SU 2309 (trench 9), a male aged 30-40 years, showing several caries of different grades affecting right PM2, left PM1, M2 and M3, ante mortem loss of right and left M1, and dental wear of anterior teeth

	F	M	Total
Abscesses	5	10	15
Observable alveoli	938	590	1568
% on alveoli	**0.5**	**1.7**	**1.0**

Table 20. Frequency of abscesses calculated on alveoli

	F	M	Total
Abscesses	4	6	10
Observables	34	22	57
% on individuals	**11.8**	**27.3**	**17.5**

Table 21. Frequency of abscesses calculated on individuals

affected; this trend cannot be explained with a major severity of caries in males, as Table 19 demonstrates similar grades of severity between sexes. A possible explanation could be a major susceptibility of males to infections due to minor attention to dental care, in particular tooth extraction.

The low prevalence of abscesses in the population of Alghero is probably linked to the low aggressiveness of caries: in fact, the majority of lesions in adults are superficial (42.3%), whereas perforations involving the dental canal are the 22.7% and those causing a complete destruction of the crown 11.7%. In addition, it should be considered that the most severe carious lesions were likely treated with tooth extraction, thus preventing the development of infection.

3.5.1.2 Non-adults

Like adults, the non-adult individuals in the Alghero population are also affected by caries (Giuffra *et al.* 2020). As it can be seen in Table 22 and Figure 38, 9.4% of teeth in non-adults are affected by caries. It is noteworthy that also in the younger age range, between 2 and 6 years, when teeth are erupted for less time with a minor risk to develop caries, 6.8% of teeth are affected by this pathology. The highest rate of 11.1% in 7-12 years old children can be likely related to caries affecting deciduous molars that have yet to be changed.

As for the frequency of caries per individual, 69.8% of non-adults are affected (Table 23). A significant increase can be observed from the youngest age range between 2 and 6 years to the age range between 7 and 12 years, with a doubling of the individuals affected; the values remain similar during the adolescence.

As for the differences between deciduous and permanent dentition, the 9.4% of teeth in non-adults are affected by caries, of which 59.5% are deciduous and 40.5% are permanent teeth. Therefore, 21.2% of deciduous teeth and 5.2% of permanent teeth are affected, as seen in Table 24 and Figure 39.

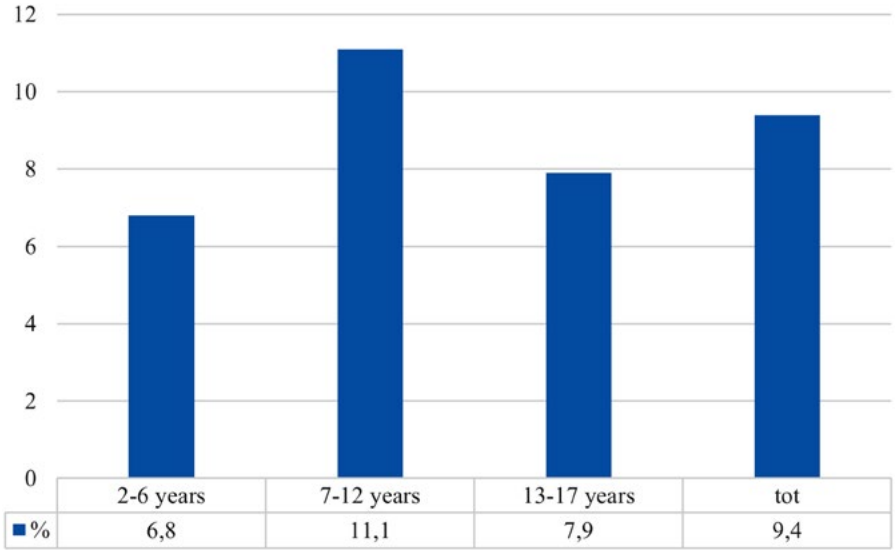


Figure 38. Frequency of caries in non-adults per age classes

Age range	Affected teeth	Observable teeth	% caries
2-6 years	9	132	6.8
7-12 years	68	615	11.1
13-17 years	34	432	7.9
Total	111	1179	9.4

Table 22. Caries on teeth in non-adults divided in age classes

Age range	Affected individuals	Observable individuals	%
2-6 years	3	8	37.5
7-12 years	22	28	78.6
13-17 years	12	17	70.6
Total	37	53	69.8

Table 23. Frequency of caries in non-adults on individuals

	Permanent	Deciduous	Total
Caries	45	66	111
Observables	868	311	1179
% on teeth	**5.2**	**21.2**	**9.4**

Table 24. Frequency of caries on teeth in non-adults

Among the affected teeth, the majority present 1 caries, but some teeth are affected by 2 or more caries, as showed in Table 25.

	Deciduous	Permanent
Teeth with 2 caries	6	8
Teeth with 3 caries	1	6
Teeth with 4 caries	0	1

Table 25. Teeth with more than 1 caries

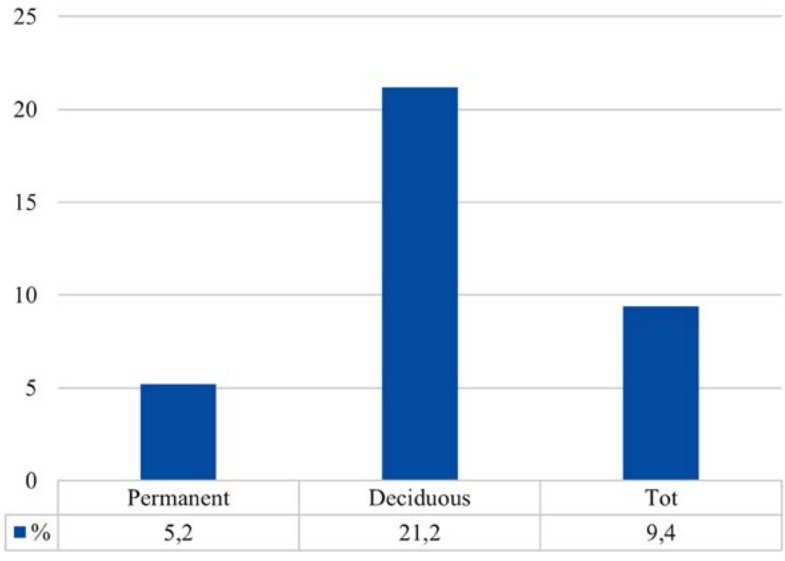


Figure 39. Frequency of caries on teeth in non-adults in deciduous and permanent teeth

Position	Deciduous	%	Permanent	%	Total	%
Crown	57	80.3	61	92.4	118	86.1
Cemento-enamel junction	13	18.3	5	7.6	18	13.2
Root	1	1.4	0	0	1	0.7
Total	71	100	66	100	137	100
Surface						
Occlusal	7	10.1	50	75.8	57	42.2
Buccal	2	2.9	4	6.1	6	4.4
Lingual	0	0	2	3.0	2	1.5
Interproximal	60	87.0	10	15.1	70	51.9
Total	69	100	66	100	135	100
Severity						
Grade 1	21	29.6	53	80.3	74	54.0
Grade 2	23	32.4	6	9.1	29	21.2
Grade 3	24	33.8	7	10.6	31	22.6
Grade 4	3	4.2	0	0	3	2.2
Total	71	100	66	100	137	100

Table 26. Localisation and severity of the caries in deciduous and permanent teeth in non-adults

As for the location of the caries in non-adults (Table 26), the majority affects the crown, followed by the cemento-enamel junction, whereas the roots are rarely affected, with similar trend for deciduous and permanent dentition. A marked difference can be observed for the surface: interproximal caries are the most common in the deciduous teeth, whereas the occlusal surface shows the highest frequency of caries for the permanent teeth. Lingual and buccal caries are very rare in both deciduous and permanent teeth. As for the severity of the carious lesions (Table 26), in the deciduous teeth similar proportions are observed for caries of grade 1, 2 and 3, whereas in the permanent teeth the majority of caries are of grade 1, followed by grade 2 and 3. In both dentitions caries of grade 4 are rare.

Studies on dental caries in children in Medieval and post-Medieval English samples evidenced that the prevalence of caries is usually low in the early and later Medieval periods, whereas it begins to rise in the 15th century, with widespread availability of refined foods (Moore and Corbett 1973).

The frequency of caries in non-adults from Alghero may suggest that they had access to the same cariogenic diet as adults.

3.5.2 Dentoalveolar diseases

Alveolar resorption was common in the population of Alghero (Table 27). In total, 85.9% of the adult individuals presented this pathology, of which 50.7% was of grade 2-3 (Giuffra *et al.* 2020). As for the differences between sexes, there is no statistically significant difference between females and males in the most severe form of the disease (grade 2-3) (p=0.41).

In females a significant increase of the condition is observable with increasing age, particularly above c.

	F	M	ND	Total
Alveolar resorption (grade 0)	6	2	2	10
Alveolar resorption (grade 1)	16	9	0	25
Alveolar resorption severe (grades 2-3)	20	15	1	36
Observables	42	26	3	71
% Alv res (1)	38.1	34.6	0	35.2
% Alv res (2-3)	47.6	57.7	33.3	50.7
% Total Alv res (1-3)	85.7	92.3	33.3	85.9

Table 27. Frequency of alveolar resorption in both sexes and in total

Females	0	1	2	3	Total	% grades 2-3
20-29 years	5	10	3	1	19	21.2
30-39 years	1	2	5	2	10	70.0
40+	0	4	8	1	13	69.9
Total	6	16	16	4	42	47.6

Table 28. Frequency and severity of alveolar resorption in females divided by age range

Males	0	1	2	3	Total	% grades 2-3
20-29 years	2	4	1	1	8	25.0
30-39 years	0	1	6	1	8	87.5
40+	0	4	4	3	11	63.6
Total	2	9	11	4	26	57.7

Table 29. Frequency and severity of alveolar resorption in males divided per age ranges

30 years of age, after which there are similar values for the 30-39 and 40+ age ranges. In total, 47.6% of females with maxilla and/or mandible observable are affected by alveolar resorption of grade 2-3 (Table 28).

Males also show a significant increase of the condition with increasing age, with the age range 30-39 years showing higher values in comparison to the 40+ age range. In total, 57.7% of males whose maxilla and/or mandible are preserved are affected by alveolar resorption of grade 2-3 (Table 29).

Previous studies report sex differences in alveolar resorption, with higher frequencies and greater severity in males compared to females, explained by physiological and behavioural differences between the sexes (DeWitte and Bekvalac 2011; Shiau and Reynolds 2010). In Alghero uniformity between sexes was observed. Alveolar resorption can be associated to poor oral hygiene; in fact, plaque deposits favour the onset of gingivitis, which may lead to alveolar resorption.

As for *ante-mortem* tooth loss, 195 teeth from a total of 2303 observable were lost during life. The prevalence of *ante-mortem* tooth loss for both sexes is similar, with 9.3% in females and 8.4% in males, for a total of 8.5% for the whole population (Table 30 and Figure 40) (Giuffra *et al.* 2020). The Chi-square test suggested no statistical difference in *ante-mortem* tooth loss between the two sexes (p=0.98).

	F	M	ND	Total
1 Teeth lost during life	120	70	5	195
2 Teeth lost after death	97	61	10	168
3 Teeth isolated	230	170	140	540
4 Teeth in situ	841	529	30	1400
1+2+4= total alveoli	1058	660	45	1763
3+4= total teeth	1071	699	170	1940
Total alveoli + teeth	1288	830	185	2303
% on alveoli	**9.3**	**8.4**	**2.7**	**8.5**
affected	23	17	2	42
osservables*	43	29	6	78
% on individual	**53.5**	**58.6**	**33.3**	**53.8**

Table 30. Distribution of ante-mortem tooth loss

As for the frequency per individual, males appear slightly more affected with 58.6%, whereas 53.5% of females are affected, as showed in Table 30 and Figure 41, with no statistical difference between sexes (p=0.98).

It is difficult to establish the exact cause of *ante-mortem* tooth loss in skeletal material; however, the high rates of caries in the population of Alghero may suggest that complications of caries could represent the main cause for this condition. In fact, caries showed the same trend as ante-mortem tooth loss in the distribution by age, with a significant increase in the middle and mature

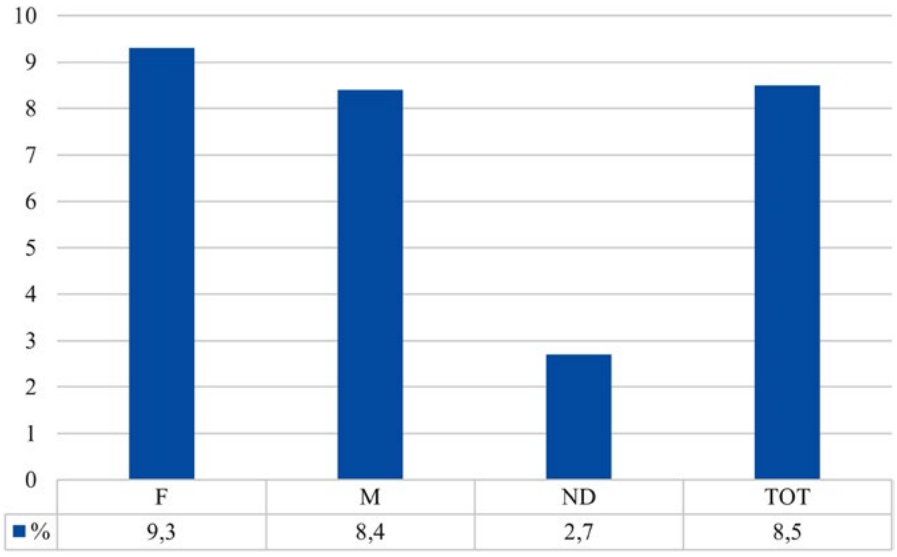


Figure 40. Frequency of ante-mortem tooth loss on alveoli divided per sexes

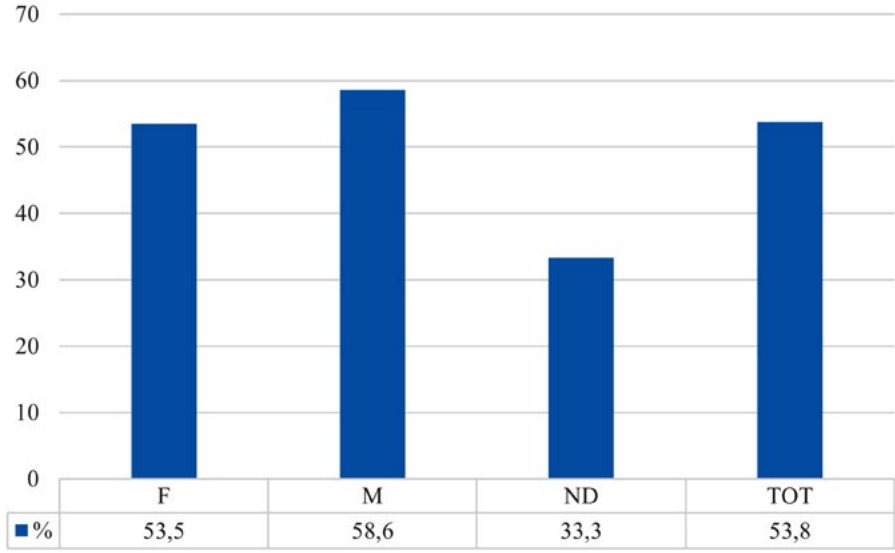


Figure 41. Frequency of ante-mortem tooth loss on individual divided per sexes

adults. Moreover, alveolar resorption caused by strong calculus deposits may have ultimately resulted in *ante-mortem* tooth loss. On the other hand, extraction was the only effective way to treat a tooth-ache during the period in question, so an unknown number of cases of ante-mortem tooth loss may be associated with dental treatment (Hussain and Khan 2016).

3.5.3 Tooth wear

In the population of Alghero dental wear is moderate, with total average score of 4 among both sexes (Giuffra *et al.* 2020). Chi-square test and Fisher's exact test were applied to verify differences between sexes among the low grades (1-3), moderate grades (4-5) and high grades (6-8) (Table 31) and, even though males exhibit patterns of wear slightly higher than females, no statistically significant sex differences in dental wear were found (p=0.16; p=0.50; p=0.30 respectively).

Tooth wear increased with age in all teeth groups, suggesting equal masticatory use of all teeth (Table 32).

When considering the data by tooth type, on both mandible and maxilla, average wear slightly increases from anterior toward posterior teeth. The molars demonstrate the heaviest wear rates; considering only molars, in females and males the proportion of unaffected teeth or slightly affected by attrition (grades 1-3) was 42.2% and 26.7% respectively; 48.9% and 56.7% respectively were moderately affected (grades 4-5), whereas 8.9% and 16.7% respectively exhibited severe degrees of dental wear (grades 6-7); no individuals in both sexes showed molars with grade 8. If we consider the data at pooled sexes 36% of adult population exhibits low rates of attrition, 52% moderate and 12% severe.

The patterns of dental wear confirm that the overall population were consuming similar diets, and the population had access to highly processed and refined food instead of abrasive diet (Larsen 1997). The increase of tooth wear with age in all teeth groups suggests an equal masticatory use of all teeth. At the same time, the moderate wear can be correlated to the high frequency of caries observed in the Alghero population: in fact, the abrasiveness of food naturally cleans the teeth removing both food and bacteria and thus helping to reduce the number of occlusal caries (Larsen 1997). The increase in the consumption of refined carbohydrates and other cariogenic food attested in the passage between the Middle Ages and the Modern Age caused a decrease in molar attrition rate (Maat 2001) and an increase of prevalence of carious lesions (Kerr 1998; Vodanovic *et al.* 2005).

Sex	Anterior teeth	N. Obs	Premolars	N. Obs	Molars	N. Obs	Average
F maxilla	3.3	39	3.5	41	3.5	40	3.5
F mandible	3.5	40	3.8	39	4.1	41	3.8
F max + mand	3.4	40	3.7	41	3.8	41	3.7
M maxilla	4.2	28	4.3	27	4.4	28	4.3
M mandible	4.3	29	4.4	29	4.5	28	4.4
M max + mandible	4.3	29	4.4	29	4.5	28	4.4

Table 31. Average wear scores for males and females calculated for each tooth category

Age range	F	N. observable	M	N. observable
20-29	2.7	19	3.5	10
30-39	3.9	13	4.3	8
40+	5.1	13	5.3	12

Table 32. Average wear scores for males and females according to age groups

3.5.4 Dental calculus

Calculus was very prevalent in the population of Alghero (Giuffra *et al.* 2020). Considering the frequency of mild calculus in maxillary and mandibular teeth, in the females the two show similar frequencies, whereas in the males the maxillary teeth are more affected than the mandibular ones; in the individuals of undeterminable sex and non-adults the mandibular teeth appears more affected by calculus (Table 33). Strong calculus is present significantly more in mandibular teeth than in maxillary ones in all categories.

If we consider the overall frequency of calculus, on maxillary and mandibular teeth, in the two grades of severity, 93.3% of females and 96.7% of males are affected, with an equal distribution for the mild and strong form; non-adults show a lower frequency, with 52.2% of individuals affected, the majority of which in mild form (Table 34 and Figure 42). The Chi-square test suggested that no statistical difference is observed in the presence of calculus between the two sexes (p=0.67).

% MX+MD	F	M	ND	Total	Sub (3-17)
Mild	22	13	3	38	21
Strong	20	16	2	38	3
Absent	3	1	4	8	22
Total	45	30	9	84	46
% mild	48.9	43.3	33.3	45.2	45.7
% strong	44.4	53.3	22.2	45.2	6.5
% mild + strong	93.3	96.7	55.6	90.5	52.2

Table 34. Overall frequency of calculus (maxillary + mandibular teeth) in females, males, individuals of undeterminable sex and non-adults

A generally high prevalence of calculus in the population of Alghero (Figure 43) indicates a poor oral hygiene and can explain the high rates of *ante-mortem* tooth loss (Hillson 2005). Some studies postulate that high calculus combined with high caries suggests a diet

	F		M		ND		Sub (3-17 years)	
	MX	MD	MX	MD	MX	MD	MX	MD
Mild	22	23	18	14	2	3	16	21
Strong	13	18	7	15	1	2	1	2
Absent	9	3	4	1	6	4	25	21
Observables	44	44	29	30	9	9	42	44
% mild	50.0	52.3	62.1	46.7	22.2	33.3	38.1	47.7
% strong	29.5	40.9	24.1	50.0	11.1	22.2	2.4	4.5

Table 33. Frequency of calculus considering maxillary and mandibular teeth separately in females, males, individuals of undeterminable sex and non-adults

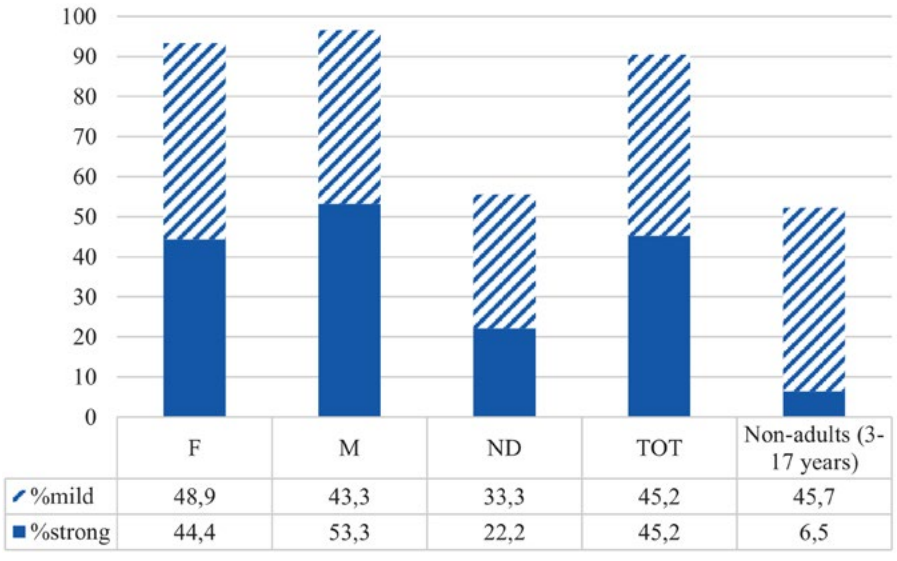


Figure 42. Frequency of mild and strong calculus on individuals considering males, females, individuals with undeterminable sex and non-adults between 3 and 17 years

Figure 43. Mandible of SU 2858 (trench 11), a male aged 30-40 years, showing strong calculus, particularly on the posterior teeth, along with alveolar resorption

rich in carbohydrates and low in protein (Griene *et al.* 2005; Slaus *et al.* 2011).

3.5.5 Dental malpositions

Tooth crowding was not very frequent in the population of Alghero. In total 0.6% of teeth *in situ* were crowded (Table 35), and 6.7% of observable individuals were affected (Table 36), with it being more prevalent in males.

Rotation is slightly more common, as 2.9% of teeth are affected, with similar rates for both sexes (Table 35), and 30% of individuals with at least 1 tooth rotated, with females affected twice than males (Table 36).

	F	M	ND	Total
Crowding	1	7	0	8
Rotation	23	17	0	40
Teeth in situ	841	529	30	1400
% crowding	0.1	1.3	0.0	0.6
% rotation	2.7	3.2	0.0	2.9

Table 35. Frequency of crowding and rotation on teeth divided per sexes

	F	M	ND	Total
Crowding	1	3	0	4
Rotation	10	8	0	18
Observable individuals	20	31	9	60
% crowding	5	9.7	0.0	6.7
% rotation	50	25.8	0.0	30

Table 36. Frequency of crowding and rotation on individuals divided per sexes

3.6 Stress indicators

3.6.1 Dental enamel hypoplasia

Linear enamel hypoplasia was evaluated in terms of frequency calculated per affected tooth and by affected individuals, as shown in Table 37. In the population of Alghero 86.4% of the observed teeth (N=1119) are affected by enamel hypoplasia; 97.7% of the observed individuals (N=128) are affected by hypoplastic defects.

A detailed assessment aimed at identifying the mean number of defects per tooth shows that the teeth exhibit an average of 2.0 in the male subsample and 2.3 in the female subsample; among the non-adults, the individuals between 5 and 11 years showed an average of 2.1 and those between 12 and 18 years 2.4. The overall mean number of defects is 2.2.

Table 38 and Figure 44 show the distribution of defects by age at onset. Male, female and non-adults all tend to exhibit increasing prevalence of defects with increasing age, which reach the highest frequencies at 3-3.4 years in females, at 3.5-3.9 years in males, and at 2.5-2.9 years among non-adults. After these peaks the prevalence decreases in all subsamples. The lowest frequencies are recorded at the extremities of the chronological interval, approximately before 1.5 years and after 5 years. Table 39 shows the severity of enamel defects, which result prevalently slight in both sexes and in non-

Number of events	**F**	**M**	**S 5-11**	**S 12-18**	**Total**
N° observed individuals	44	30	30	24	128
Total lines	797	417	483	481	2178
Observed teeth	387	245	265	222	1119
Average N lines	2.3	2.0	2.1	2.4	2.2
Affected teeth	352	209	229	202	992
Not affected teeth	35	36	36	20	127
% affected teeth	91.0	85.3	86.4	91.0	86.4
% affected MD canine	94.3	93.3	76.3	97.2	92.7
Affected individuals	43	29	30	23	125
Observable individuals*	44	30	30	24	128
% affected individuals	**97.7**	**96.7**	**100.0**	**95.8**	**97.7**

Table 37. LEH in the population of Alghero calculated on teeth and on individuals

Age	F	% F	M	% M	ND	% ND	SUB	% SUB
1-1.4	3	1.3	1	0.8	0	0.0	10	3.8
1.5-1.9	21	9.4	8	6.7	2	10.5	28	10.6
2-2.4	32	14.3	20	16.8	2	10.5	33	12.5
2.5-2.9	40	17.9	20	16.8	2	10.5	51	19.4
3-3.4	42	18.8	20	16.8	4	21.1	45	17.1
3.5-3.9	32	14.3	27	22.7	3	15.8	34	12.9
4-4.4	31	13.9	16	13.4	2	10.5	29	11.0
4.5-4.9	17	7.6	6	5.0	2	10.5	27	10.3
5-5.4	4	1.8	0	0.0	0	0.0	5	1.9
5.5-6.2	1	0.4	1	0.8	2	10.5	0	0.0
Number of events	223		119		19		263	

Table 38. Distribution of defects in males, females and non-adults by age of onset

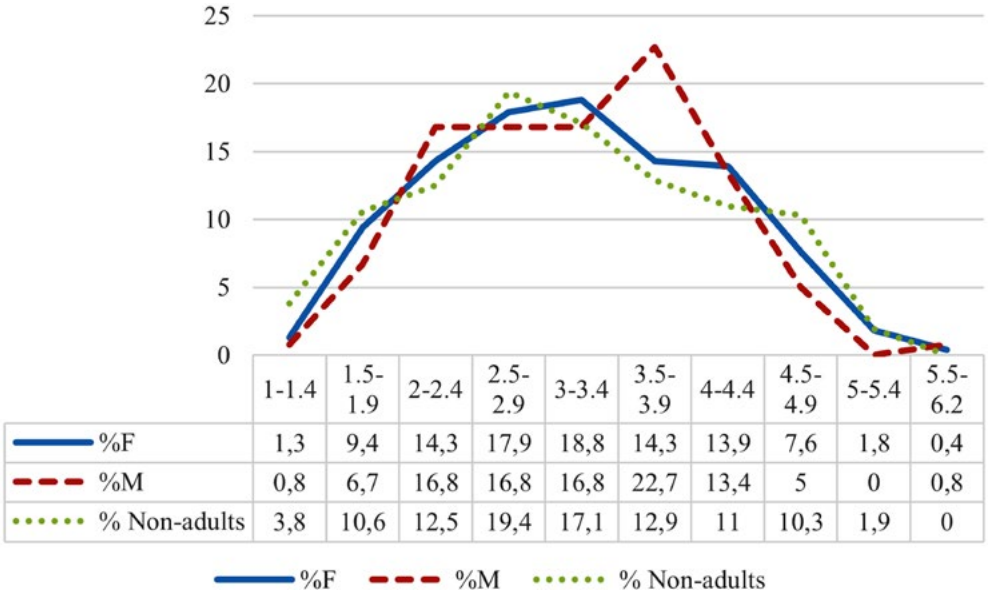


Figure 44. Chronological distribution of the age of onset of LEH

	F	% F	M	% M	ND	% ND	SUB	% SUB
1M	710	92.7	376	93.8	50	100.0	826	88.3
1S	56	7.3	24	6.0	0	0.0	106	11.3
Total episodes	**766**		**400**		**50**		**932**	
Slight episodes	710	92.7	376	93.8	50	100.0	826	88.3
Medium/severe episodes	56	7.3	24	6.0	0	0.0	106	11.3

Table 39. Severity of enamel defects (legend: M=mild; S=severe)

adults. As a result, in the population of Alghero a high prevalence of defects around 3 years clearly emerges.

A correlation between enamel hypoplasia and weaning was suggested by several authors (i.e. Dabrowski *et al.* 2020; Goodman *et al.* 1987). In fact, the period following the introduction of solid food was critical for non-adults. During weaning the protective role of breast milk against infectious diseases disappeared, and the consumption of bread and cereals, which lack some important elements such as vitamins C and D, exposed infants to greater risk of nutritional deficiencies. Furthermore, food was usually contaminated by various microorganisms that could cause frequent diarrheal infections (Dittmann and Grupe 2000). Contrarily to contemporary Western societies where weaning is practiced early, in Modern Age non-industrialised communities it was common opinion that children should be weaned between 2 and 3 years (Dettwyler 1995; Sellen 2001). Use of wet-nurses was very common among high and middle classes; in the lower classes children were most commonly breast-fed by their mothers because the family could

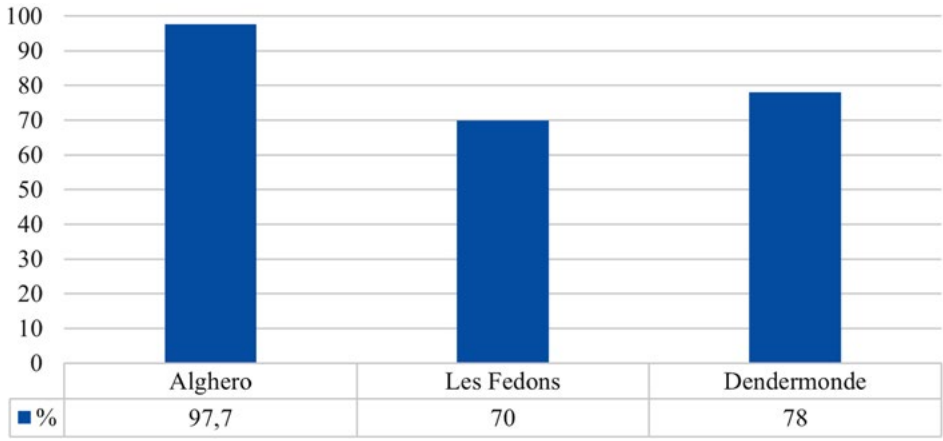


Figure 45. Comparison of the frequency of linear enamel hypoplasia on individual in Alghero and in two contemporary samples

not afford the costs of engaging a wet nurse (Osborn 1979). Documentary sources from the Late Middle Ages onwards attest that weaning was a gradual process and several authors advised to wait until the child was healthy and able to eat solid food before weaning was attempted (Giuffra and Fornaciari 2013; Haas 1998).

The high prevalence of defects that form around 3 years in the population of Alghero could reasonably be the result of stress arising from cessation of breastfeeding and probably reflects the timing of weaning, which occurred between 2 and 3 years and was the more stressful and dangerous period for children.

In the comparison of the frequency of enamel hypoplasia in the Alghero sample with other contemporary plague cemeteries some differences emerge (Figure 45). In Alghero 97.7% of individuals (N=128) were affected, whereas in Les Fedons, France (N=121), and Dendermonde, Belgium (N=58), both dated to 16th century, a lower frequency, of 70% and 78% respectively, is observed (Kacki 2016). The variations can be likely attributed to inter-population differences, with the population of Alghero evidently more stressed during infancy.

No sex differences were statistically observed in any of the three contemporary samples. Frequency peaks such as those commonly reported in the anthropological literature and observed in Alghero around 3 years could not be detected in the two contemporary plague samples due to different age ranges considered for the estimation of the age of formation of defects in these studies, grouped in major chronological phases for the sake of reliability (Kacki 2016).

3.6.2 *Cribra cranii* and *cribra orbitalia*

Cribra cranii were recorded with higher rates in male individuals with 29.4% observed, whereas in females and non-adults this condition showed lower frequencies, respectively of 7% and 5.2% (Table 40 and Figure 46). All

	P	Obs	%
F	3	43	7.0
M	5	17	29.4
ND	1	5	20.0
Non-adults	3	58	5.2
Total	12	123	9.8

Table 40. *Cribra cranii* in adult and non-adults individuals

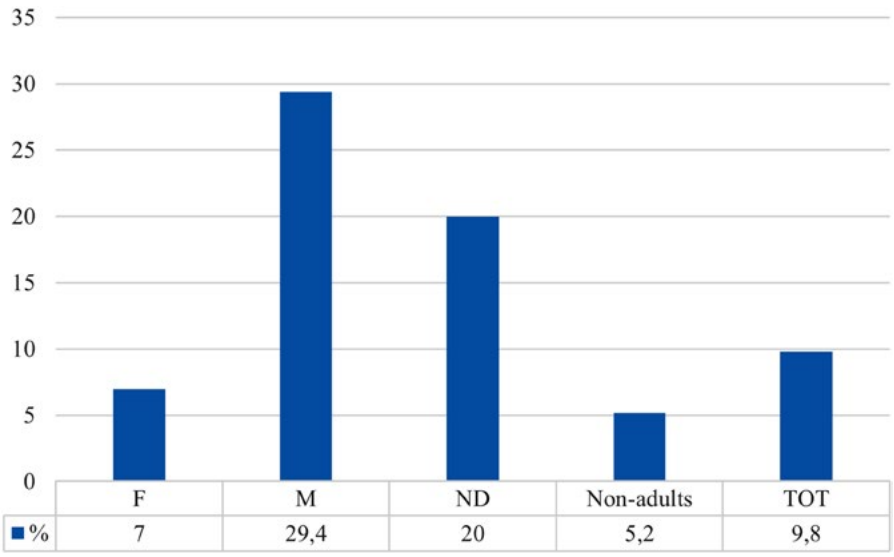


Figure 46. Frequency of *cribra cranii* in adult and non-adult individuals

cases of *cribra cranii* were of grade 1. The Fisher's exact test suggested that there is a statistical difference in the presence of *cribra cranii* between the two sexes (p=0.03), with a higher prevalence among the males.

As for *cribra orbitalia*, males and non-adults show similar frequencies, 50% and 48.3% respectively, whereas females exhibit lower rates (18.2%) (Table 41 and Figure 47). Among them, all the individuals manifested a grade 1 of *cribra orbitalia* (Figure 48), the only exception is a non-adult with grade 2. None of the adult individuals with undeterminable sex were able to be assessed. The Fisher's exact test suggested a statistical difference between the two sexes (p=0.04) with a higher prevalence among the males.

	P	Obs	%
F	4	22	18.2
M	7	14	50.0
Non-adults	14	29	48.3
Total	25	56	44.6

Table 41. *Cribra orbitalia* in adult and non-adults individuals

The data from Alghero relating to *cribra cranii* and *cribra orbitalia* contrast with results reported from previous studies in which no significant differences between the sexes or a slightly elevated prevalence in females were observed (Facchini *et al.* 2004; Gerven 1994; Jatautis *et al.* 2011; Mittler and Van Salvadei *et al.* 2001). In fact, females are more predisposed to develop iron deficiency anemia due to differences in physiology, as menstruation, pregnancy, childbirth and lactation reduce the level of iron (Stuart-Macadam 1998).

Additionally, the presence of anemia in some areas of the Mediterranean world has been related to malaria (Angel 1966); this can be explained by balanced polymorphism,

Figure 48. *Cribra orbitalia* the left orbit of SU 2763 (trench 10), a female aged 40-50 years

where heterozygous individuals develop anemia as a protection against malaria in marshy regions. Malaria was well-attested in Sardinia until eradication efforts were conducted from 1946 to 1950. Therefore, a high frequency of *cribra cranii* and *cribra orbitalia* could be expected from the sample of Alghero. However, the maps showing the diffusion of malaria in Sardinia in the late 19th and beginning of 20th century show that the area of Alghero was relatively free from the disease (Tognotti 2008); it is possible that the situation would have been similar three centuries earlier. This could explain the overall low frequencies of the two conditions in the skeletons from the city.

On the other hand, the difference in prevalence of *cribra cranii* and *cribra orbitalia* between sexes with higher values in males at Alghero is certainly anomalous, but could be explained by differences in gender activities and labor which affected exposure to malaria. Males were likely more occupied with work in the countryside, which was rich in marshes, pools, and stagnant water, exposing them to a higher risk of contracting malaria in comparison to females,

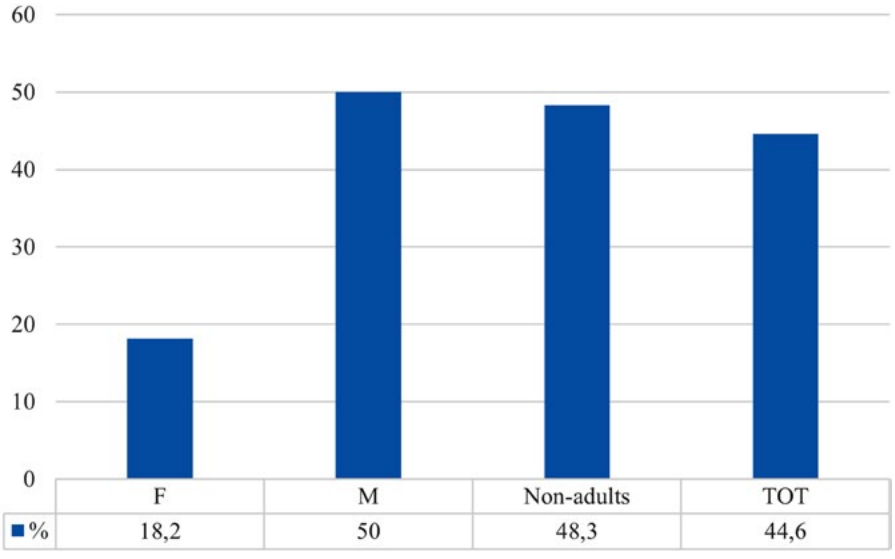


Figure 47. Frequency of *cribra orbitalia* in females, males and non-adults

who remained more often in the city caring for the household and children.

As for the high frequency of *cribra orbitalia* in non-adults (48.3%), this result is in accordance with other osteoarchaeological studies (Facchini *et al.* 2004; Salvadei *et al.* 2001). Children are exposed to a higher risk of developing anemia, as breast milk is very poor in iron and risk of anaemia occurs after the first few months of life. Moreover, a weaning diet rich in carbohydrates provides low levels of iron and also includes phosphorus and phytates, which inhibit the intestinal absorption of iron. Finally, the diarrhoeal infections that children can contract during weaning due to the contamination of food and water by microorganisms can also contribute to the development of anaemia (Facchini *et al.* 2004). However, it should be kept in mind that *cribra orbitalia* is also associated with other conditions, in particular scurvy, rickets, hemangiomas and traumatic injuries; therefore, the causes of these lesions in the children of Alghero could be related to other stressors, in particular multiple nutritional deficiencies (Walker *et al.* 2009).

The comparison in the frequency of *cribra cranii* (Figure 49) and *cribra orbitalia* (Figure 50) between the sample of Alghero and that of other two contemporary plague cemeteries showed local variations. As for the first condition, Alghero (N=123) exhibited considerably lower frequencies both in non-adults and adults (5.2% and 13.8% respectively), in comparison with Dendermonde (N=59) (26.6% and 24.1% respectively); the assemblage from Les Fedons was not comparable as *cribra cranii* was not recorded due to the poor state of preservation of the cranial surfaces, which prevented the observation of the condition (Kacki 2016).

As for *cribra orbitalia*, the frequencies between the three sites are quite similar, with a prevalence among the non-adults respect to adults: in Alghero (N=56) 48.3% and 30.6% respectively, Les Fedons (N=75) 43% and

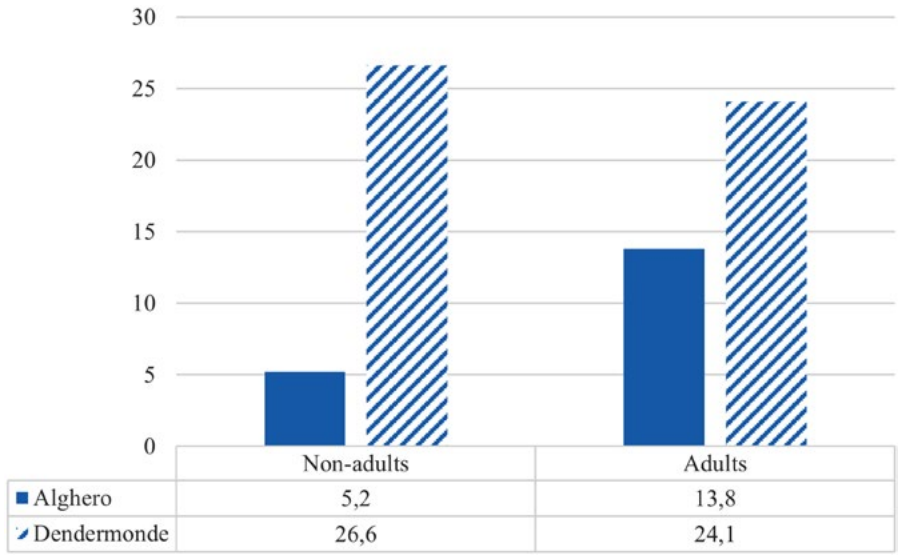


Figure 49. Comparison of the frequency of *cribra cranii* on individual in Alghero and in another contemporary sample

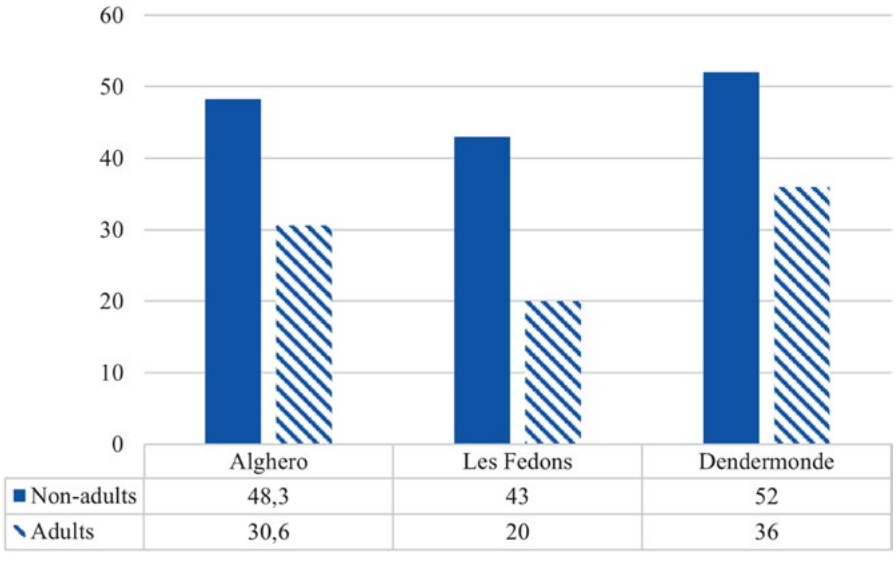


Figure 50. Comparison of the frequency of *cribra orbitalia* on individual in Alghero and in other contemporary samples

20% respectively, Dendermonde (N=48) 52% and 36% respectively (Kacki 2016).

3.6.3 Periosteal reaction

The frequency and prevalence of periosteal reaction in the long bones of the lower limbs (femurs, tibiae and fibulae) is shown in Table 42: in total, 193 (54.8%) of the observed long bones (n=352) were affected by periosteal reaction. The bone with the highest frequency of periosteal reaction is the tibia (69.6%), followed by the femur (60.5%) and the fibula (35.8%).

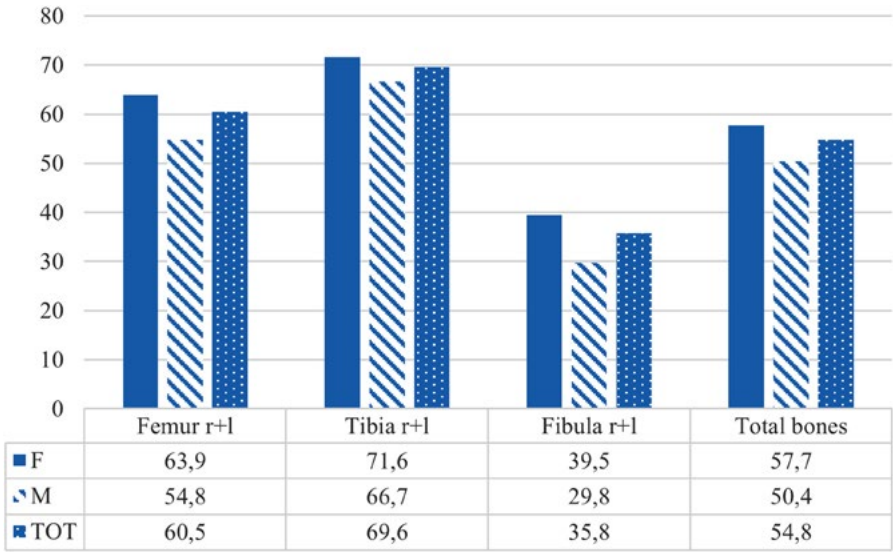
Figure 51 presents the sex-specific frequencies of the condition in the femur, tibia and fibula. The true

Sex	Periosteal reaction	Femurs r+l	Tibia r+l	Fibula l	Total bones
F	1 localised	1	3	9	13
	1 diffuse	45	42	18	105
	2 localised	0	3	3	6
	2 diffuse	0	0	0	0
	absent	26	19	46	91
	Total affected bones	46	48	30	124
	Total bones	72	67	76	215
	% affected bones	**63.9**	**71.6**	**39.5**	**57.7**
	mild	46	45	27	118
	strong	0	3	3	6
	localised	1	6	12	19
	diffuse	45	42	18	105
M	1 localised	0	2	4	6
	1 diffuse	23	26	6	55
	2 localised	0	3	4	7
	2 diffuse	0	1	0	1
	absent	19	16	33	68
	Total affected bones	23	32	14	69
	Total bones	42	48	47	137
	% affected bones	**54.8**	**66.7**	**29.8**	**50.4**
	mild	23	28	10	61
	strong	0	4	4	8
	localised	0	5	8	13
	diffuse	23	27	6	56
Total	1 localised	1	5	13	19
	1 diffuse	68	68	24	160
	2 localised	0	6	7	13
	2 diffuse	0	1	0	1
	absent	45	35	79	159
	Total affected bones	69	80	44	193
	Total bones	114	115	123	352
	% affected bones	**60.5**	**69.6**	**35.8**	**54.8**
	mild	69	73	37	179
	strong	0	7	7	14
	localised	1	11	20	32
	diffuse	68	69	24	161

Table 42. Frequency and typology of periosteal reaction

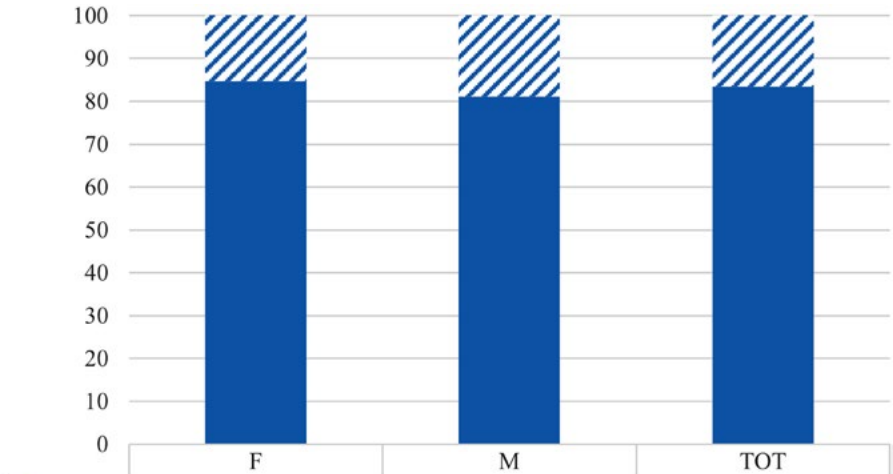
prevalence of periosteal reaction was calculated considering the number of affected bones as a proportion of observed bones in females (124/215) and males (69/137). The Chi-square test suggests that there is no statistical difference in the presence of periosteal reaction between the two sexes (p=0.17).

With regard to the location of periosteal reaction, as it can be seen in Figure 52 females and males exhibit the same trend, as the condition is mostly observed in the diffuse form (84.7% and 81.2% respectively), and only a minor portion of cases is represented by the localised form (Figure 53).



	Femur r+l	Tibia r+l	Fibula r+l	Total bones
F	63,9	71,6	39,5	57,7
M	54,8	66,7	29,8	50,4
TOT	60,5	69,6	35,8	54,8

Figure 51. Sex-specific frequency of periosteal reaction in the long bones of the lower limbs



	F	M	TOT
Localised	15,3	18,8	16,6
Diffuse	84,7	81,2	83,4

Figure 52. Sex-specific localization of PR

Figure 53. Localized periosteal reaction of grade 3 on the diaphysis of the tibia of SU 2289 (trench 8), a female aged 35-45 years

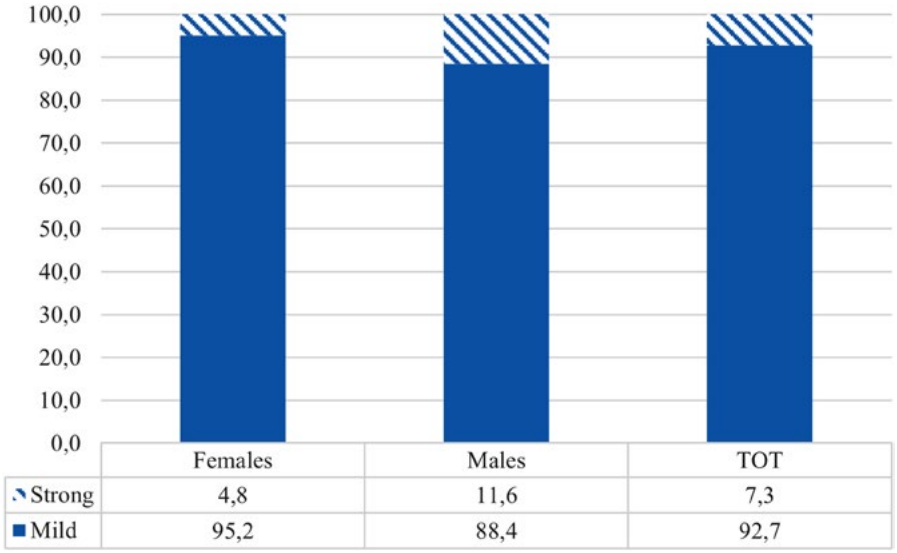


Figure 54. Sex-specific severity of PR

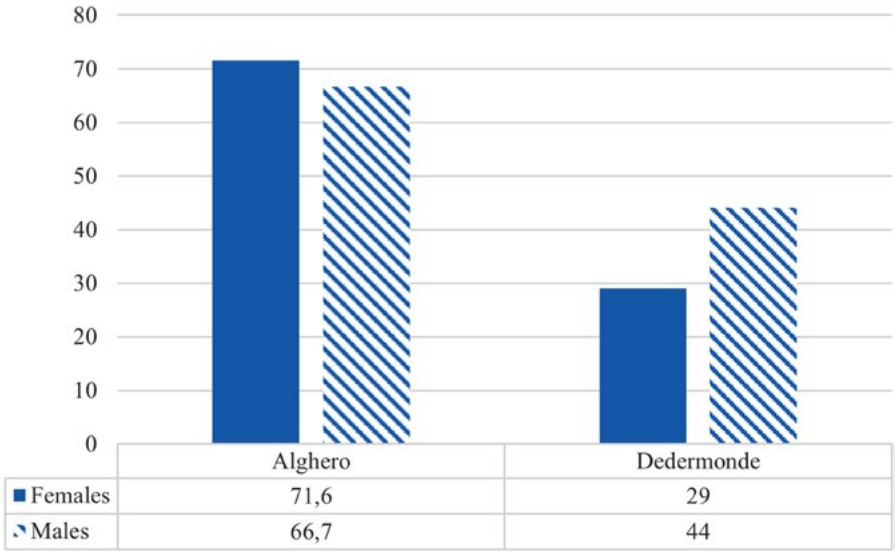


Figure 55. Comparison of the frequency of tibial periosteal reaction on individual in Alghero and in another contemporary sample

As for the degree of severity, as seen in Figure 54, the sex-specific prevalence suggests a uniform distribution of the periosteal reaction, as almost the whole female and male subsamples present a mild form of the condition (88.4% and 95.2% respectively).

Several paleopathological studies suggest that males were generally more predisposed to develop periosteal reaction than females as a result of a more varied workload and more infections (Larsen 1997; Weston 2012). In the present research, both sexes showed similar patterns of this stress indicator, evidencing the same sensitivity to life conditions, physical activities and exposure to pathogens. The prevalence of the diffuse and mild form of the condition suggests that the population was not exposed to a great pathogen load and probably lived in a quite healthy environment not associated to particularly dangerous physical activities and trauma. The higher susceptibility of the tibiae to periosteal reaction is in accordance with what is commonly seen in paleopathological literature (DeWitte 2014; Marques *et al.* 2019). No cases of hypertrophic osteoarthropathy, a condition characterized by abnormal periosteal new bone formation involving the extremities, which has been related with pulmonary diseases, primarily tuberculosis (Flohr *et al.* 2018), has been observed.

The frequency of periosteal reaction in the Alghero sample can be compared with other contemporary plague cemetery on the tibiae (Figure 55). In Alghero 71.6% of females and 66.7% of males showed tibial periosteal reaction with similar values between the two sexes. Data from Les Fedons was not available as the tibial bone surface was damaged preventing the observation of this parameter; at Dedermonde both females and males exhibited lower values (29% and 44% respectively) (Kacki 2016). Evidently, the lifestyle in Alghero exposed both sexes to a higher stress related to periosteal reaction than in the other context, probably for the similar field working activities in which both females and males were engaged.

3.6.4 The 'Osteological Paradox'

In any bioarchaeological study, it is necessary take into account the limits of the 'Osteological Paradox' (Wood *et al.* 1992). There are three issues that complicate the analysis of the demographic data and should be considered here: the potential that Alghero was a nonstationary population, the impact of selective mortality, and hidden heterogeneity in risk.

The first issue implies that populations are not stable nor constant in size, as they are influenced by migratory processes as well as possible changes in fertility and mortality rates. The population of Alghero was certainly non-stationary, as there were several documented episodes of city repopulation, with groups moving not only from the rest of the island but also from different areas of the continent. Moreover, the presence of the harbour certainly favoured the movement of several categories of people, such as merchants and soldiers. However, in the Figure 13 which shows the mortality of adults with sexes separated, these categories are not demographically representative, as in the young adult category males are considerably less represented than females, and therefore this issue is unbiased.

The second issue raised by the Osteological Paradox implies that the skeletal remains are not representative of the entire population but include only the individuals with the highest frailty. Samples from catastrophic contexts, as that of Alghero, can provide an unbiased picture of the demographic and epidemiological characteristics of past populations, as catastrophic mortality is less selective for health characteristics, age, or sex than the attritional mortality model. Nevertheless, a study carried out on a sample from the mid-14th-century Black Death demonstrated that plague did not kill indiscriminately and, on the contrary, was selective with respect to frailty, although probably not as strongly as normal mortality (DeWitte and Wood 2008). As a consequence, it should be noted that cemeteries associated with plague do not provide a perfect cross-section of the living population immediately before the outbreak.

Finally, the third limit outlined by the Osteological Paradox refers to the idea that individuals of the original population may had variable susceptibility to disease and/or death which are difficult or impossible to assess. In the sample of Alghero a particularly high frequency of LEH and periosteal reaction were observed, also in comparison with other plague population of the same period; this could indicate that the inhabitants of Alghero were exposed to major stress and that therefore they were more frail. Nevertheless, several studies suggested that stress markers may signal relatively low frailty, as only individuals with relatively low frailty could survive physiological insults (sufficient to cause for example periosteal lesions) that proved lethal to frailer individuals (e.g., Grauer 1993; Yaussy *et al.* 2016). In other words, weaker individuals may have died quickly in the presence of severe stress and therefore will show no indicators, while stronger individuals may have survived the stress and then developed skeletal injuries. Therefore, the key concept of the osteological paradox is that skeletal stress markers can reflect both frailty and resilience and they should be interpreted with caution.

3.7 Degenerative joint disease

The data concerning osteoarthritis are reported in Table 43.

Degenerative joint disease	F	M	ND	Total
Grade 1	215	158	9	382
Grade 2	19	46	0	65
Grade 3	6	11	0	17
Observed joints	1551	759	68	2378
% on joint	15.5	28.3	13.2	19.5

Table 43. Number of affected joints on observable joints in both sexes and individuals with indeterminable sex

If we consider the frequency of degenerative joint disease on observable joints (N=2378), 15.5% of joints in females, 28.3% in males and 13.2% in individuals with undeterminable sex were affected, for a total of 19.5%, as seen in Figure 56. The Chi-square test suggested that a significant statistical difference is observable in the presence of osteoarthritis (grades 2-3) between the two sexes ($p \leq 0.001$), with males presenting a significantly greater prevalence.

Considering the severity of degenerative joint disease (Figure 57), the majority of affected individuals (68.4%) presented a grade 1, whereas only 26% exhibited a grade 2 and 8.2% a grade 3.

As for the frequency of individuals with clear manifestations of degenerative joint disease, that is with grade 2 and 3, 53.8% of the observable male individuals have one or more joints affected, compared to only 25.0% of females and 0% of the individuals with undetermined sex, as seen in Figure 58.

With regard to the frequency of degenerative joint disease in the different joints, females exhibited an equal distribution of osteoarthritis both in the upper and lower limbs, whereas males showed a higher frequency in the upper limbs (Figure 59). Among the females, the most affected joint is the coxo-femoral, followed by the gleno-humeral, knee, acromio-clavicular and sacro-iliac joint; among the males, the more affected joints

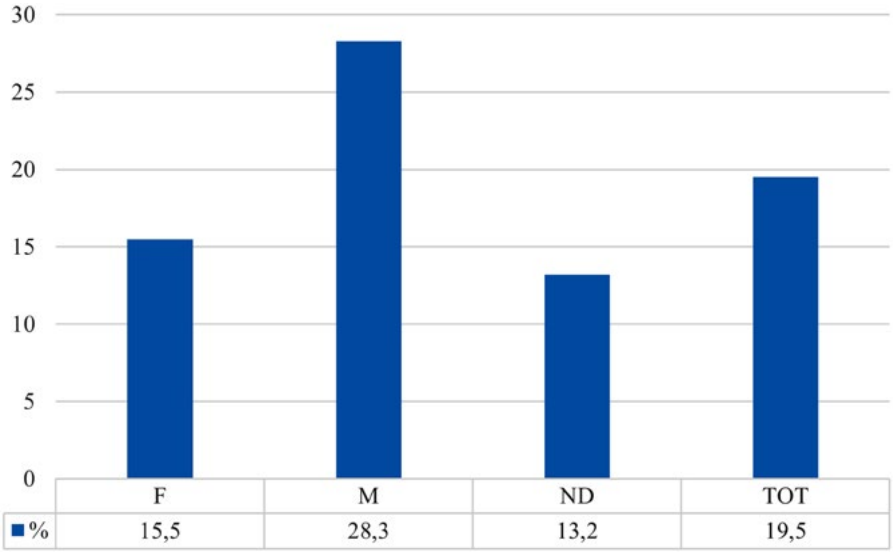


Figure 56. Frequency of affected joints

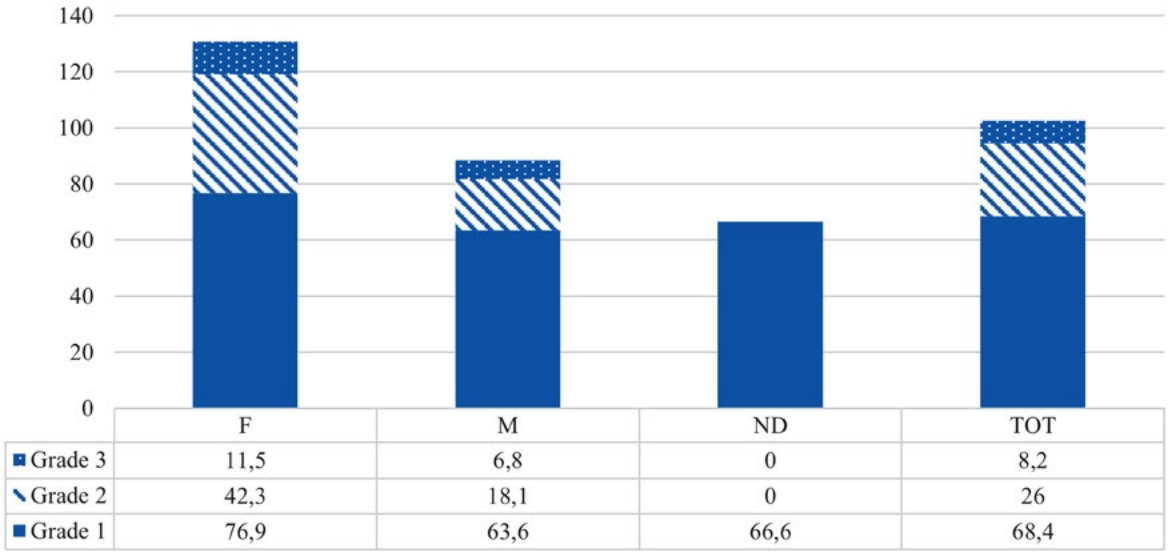
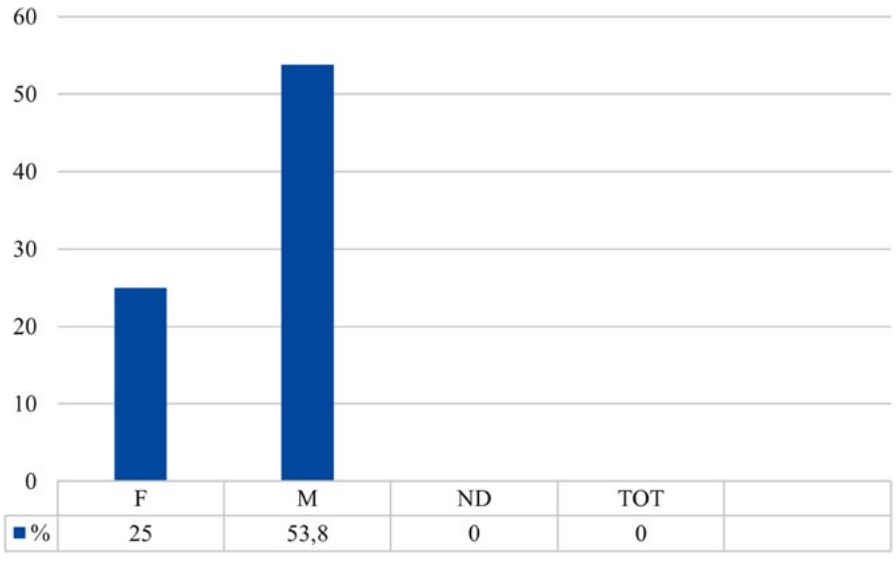
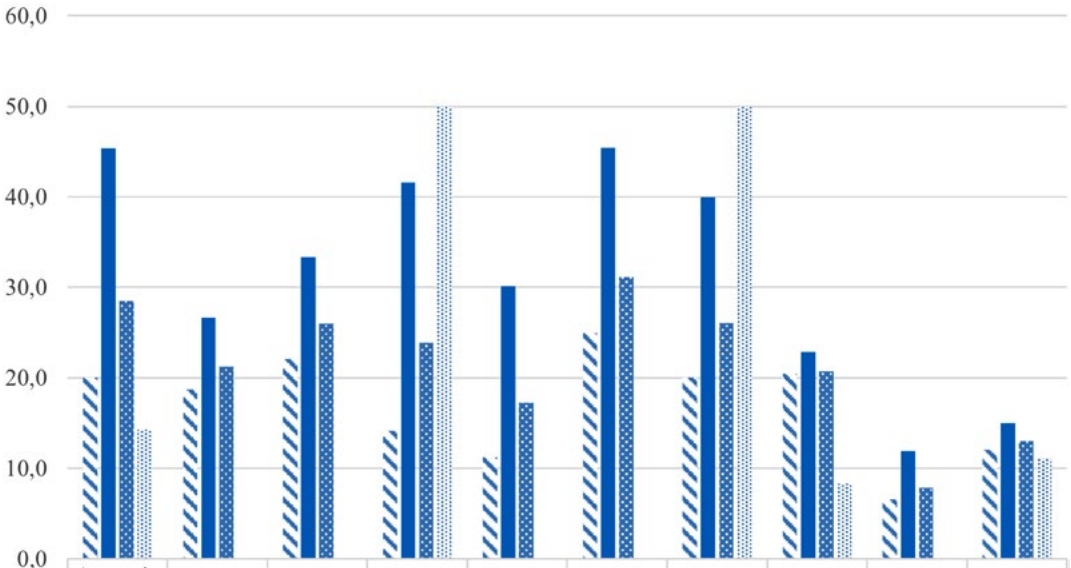


Figure 57. Frequency of affected joints divided per grades on individuals

Figure 58. Frequency of individuals with osteoarthritis of grade 2 and 3

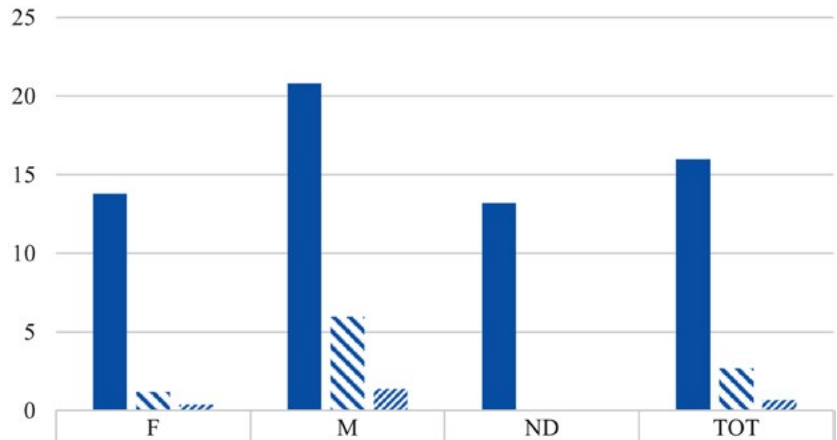




	Acromio clavicular	Sternoclavicular	Glenohumeral	Elbow	Wrist	Coxo-femoral	Sacro-iliac	Knee	Ankle	Foot
%F affected joints	20,0	18,8	22,1	14,1	11,2	25,0	20,0	20,5	6,6	12,1
%M affected joints	45,4	26,7	33,3	41,6	30,1	45,5	40,0	22,8	11,9	15,0
%TOT affected joints	28,5	21,3	26,0	23,9	17,3	31,1	26,1	20,7	7,9	13,0
%ND affected joints	14,3			50,0	0,0	0,0	50,0	8,3	0,0	11,1

Figure 59. Frequency of degenerative joint disease on joints

Figure 60. Severity of degenerative joint disease on joints



	F	M	ND	TOT
Grade 1	13,8	20,8	13,2	16
Grade 2	1,2	6	0	2,7
Grade 3	0,4	1,4	0	0,7

are the coxo-femoral and acromio-clavicular, followed by elbow and wrist.

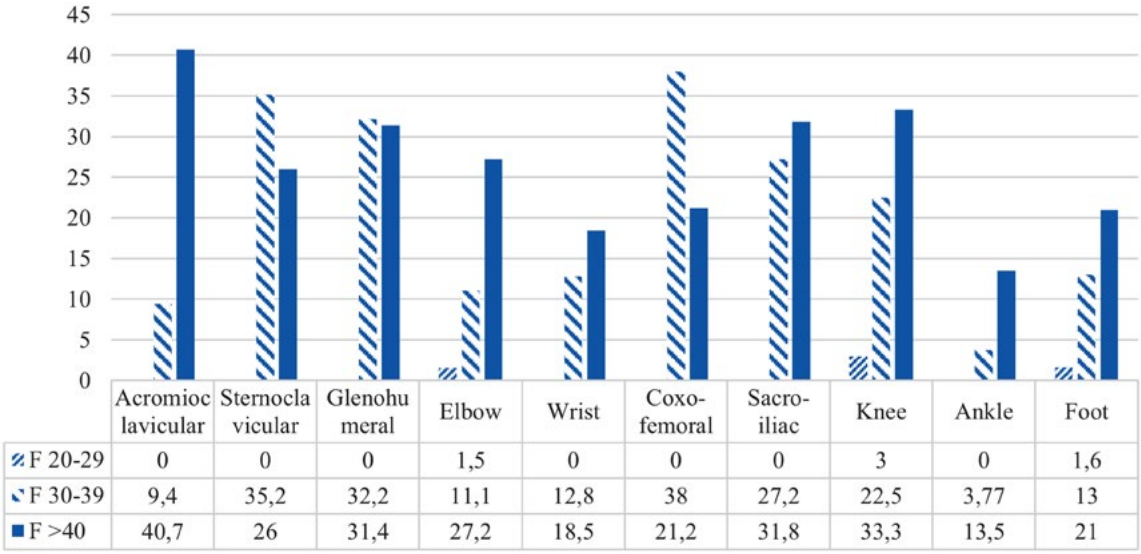
If we consider the severity of osteoarthritis on joints, the majority of them showed a grade 1 (16%), 2.7% of affected joints had a grade 2 and only 0.7 showed a grade 3 (Figure 60).

Finally, the frequency of degenerative joint disease in females and males considering the age range shows an increase of the condition with progressing age. In females, the individuals aged between 20 and 29 years exhibit absence or a low frequency of osteoarthritis; the 30 and 39, and over 40 years age ranges show an increase in the frequency of the condition, with quite similar values (Table 44 and Figure 61).

As for the male individuals, in young adulthood the condition is absent in some joints but higher than in females in other joints, including the knee (Figure 62), coxo-femoral and acromio-clavicular; in the subsequent age ranges the frequency progressively increases, with

N. individuals	n=14			n=14			n=16		
Age range	20-29			30-39			>40		
	N. affected joints	n. observ-able	%	N. affected joints	n. observ-able	%	N. affected joints	n. observ-able	%
Acromio-clavicular	0	51	0.0	5	53	94	31	76	40.8
sterno-clavicular	0	24	0.0	6	17	35.3	6	23	26.1
Gleno-humeral	0	29	0.0	10	31	32.3	11	35	31.4
elbow	1	65	1.5	7	63	11.1	21	77	27.3
wrist	0	41	0.0	5	39	12.8	10	54	18.5
coxo-femoral	0	19	0.0	8	21	38.1	10	32	31.3
sacro-iliac	0	21	0.0	6	22	27.3	7	22	31.8
knee	2	65	3.1	14	62	22.6	26	78	33.3
ankle	0	56	0.0	2	53	3.8	10	74	13.5
foot	2	120	1.7	13	100	13.0	27	128	21.1

Table 44. Distribution of degenerative joint disease in females divided in three age ranges (20-29, 39-39 and >40 years)



	Acromioclavicular	Sternoclavicular	Glenohumeral	Elbow	Wrist	Coxo-femoral	Sacro-iliac	Knee	Ankle	Foot
F 20-29	0	0	0	1,5	0	0	0	3	0	1,6
F 30-39	9,4	35,2	32,2	11,1	12,8	38	27,2	22,5	3,77	13
F >40	40,7	26	31,4	27,2	18,5	21,2	31,8	33,3	13,5	21

Figure 61. Frequency of degenerative joint disease in female individuals divided per age ranges

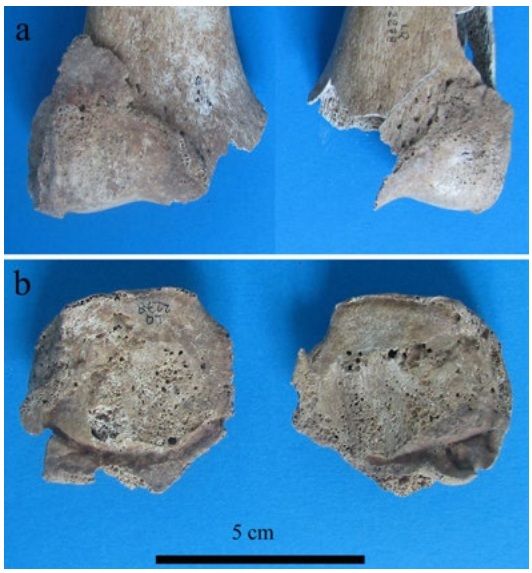


Figure 62. Degenerative changes in the knee of SU 2278 (trench 7), a male aged 35-45 years

the highest values for the mature adults (Table 45 and Figure 63).

Degenerative joint disease has a multifactorial aetiology, being related with genetic, anatomical and body mass index influences (Weiss and Jurmain 2007), besides biomechanical stress due to physical activities and in particular repetitive mechanical loading (Larsen 1997). In general, a cautious approach is necessary in attempting to reconstruct specific activities from the analysis of degenerative joint disease. However, the patterns of osteoarthritis can reflect the division of labor between sexes. The distribution of the degenerative changes in the Alghero skeletons suggests that the males experienced more demanding physical activity than to females; and that the activities of males resulted in greater use of the shoulders and upper limbs. The high prevalence

N. individuals	n=6			n=8			n=13		
Age range	20-29			30-39			>40		
	N. affected joints	n. observ-able	%	N. affected joints	n. observ-able	%	N. affected joints	n. observ-able	%
Acromio-clavicular	2	17	11.8	8	27	29.6	34	53	64.2
sterno-clavicular	0	0	0.0	0	7	0.0	8	23	34.8
Gleno-humeral	0	9	0.0	5	15	33.3	12	27	44.4
elbow	1	21	4.8	8	26	30.8	33	54	61.1
wrist	0	11	0.0	4	22	18.2	18	40	45.0
coxo-femoral	1	6	16.7	1	4	25.0	13	23	56.5
sacro-iliac	0	0	0.0	0	1	0.0	10	24	41.7
knee	3	16	18.8	0	29	0.0	18	47	38.3
ankle	0	14	0.0	0	32	0.0	10	38	26.3
foot	0	30	0.0	5	61	8.2	21	82	25.6

Table 45. Distribution of degenerative joint disease in males divided in three age ranges (20-29, 39-39 and >40 years)

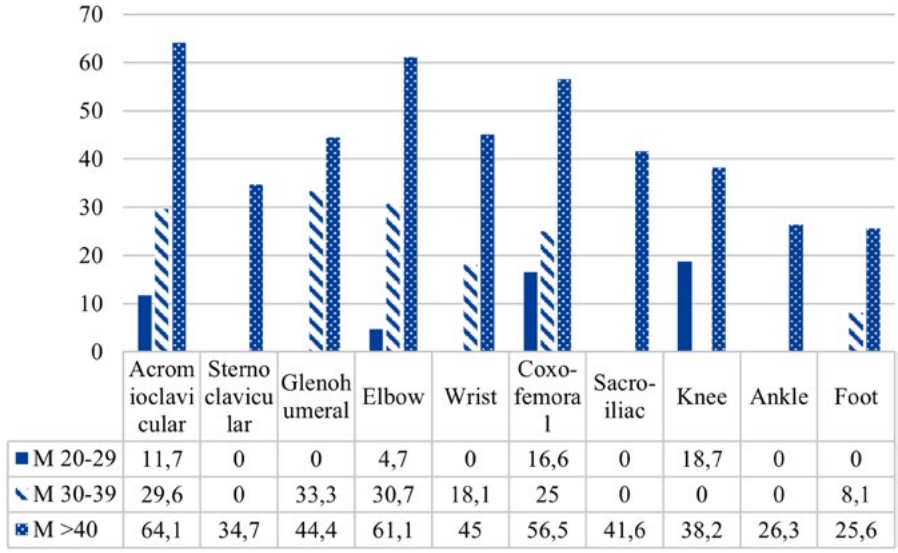


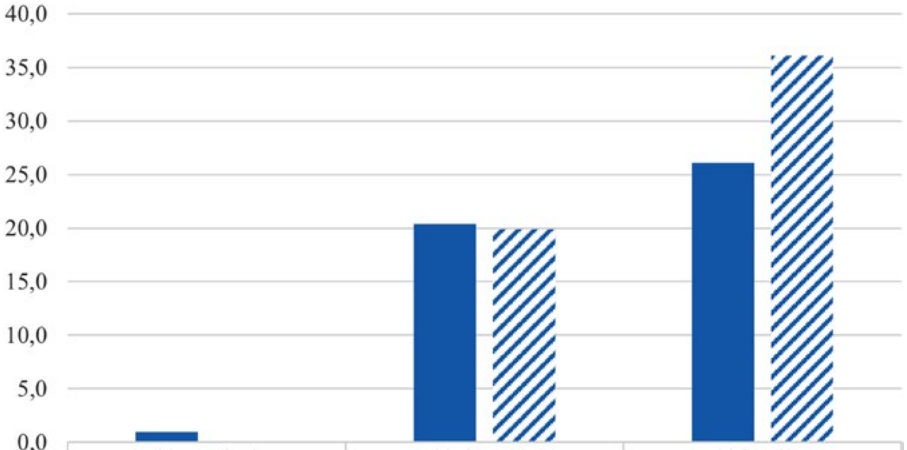
Figure 63. Frequency of degenerative joint disease in male individuals divided per age ranges

of osteoarthritis of the coxo-femoral joint, present in both sexes, may suggest the transport of heavy loads or terrestrial mobility (Buikstra 2019; Robin 2008; Waldron 2008).

Considering the stress on the vertebral column, as it can be seen from Table 46 and Figure 64 Schmorl's nodes rarely affect the cervical spine, whereas the thoracic segment (Figure 65) is equally affected in both sexes, with a total incidence of 20.2%; the most affected tract is the lumbar spine, with a total frequency of 29.1%. In the lumbar segment males are affected more than females, but with no statistically significant difference (p=0.13).

	Cervical			Thoracic			Lumbar		
Schmorl's node	N affected	N observable	%	N affected	N observable	%	N affected	N observable	%
F	2	203	1.0	73	358	20.4	35	134	26.1
M	0	141	0.0	40	201	19.9	26	72	36.1
ND	0	11	0.0	3	14	21.4	1	7	14.3
Total	2	355	0.6	116	573	20.2	62	213	29.1

Table 46. Distribution of Schmorl's nodes in females (F), males (M), adult individuals with undeterminate sex (ND) and total (Total)



	% cervical	% thoracic	% lumbar
F	1,0	20,4	26,1
M	0,0	19,9	36,1

Figure 64. Frequency of Schmorl's nodes in females and males in the three segments of the spine

Figure 65. Schmorl's nodes on thoracic vertebrae of SU 5125 (trench 13), a male aged 40-50 years

3.8 Entheseal changes

In the females aged between 20 and 35 years, the majority of entheses showed a mild development (grades 1a-c); the insertions with the highest frequency of strong development (grades 2-3) were, in decreasing order, the gluteus maximus of the right femur (28.0%), the conoid ligament of the left clavicle (27.6%), the deltoid of the right clavicle (26.9%), and the Achilles tendon of the right calcaneus (27.3%); enthesopathies were observed only in association with of a few entheses (Table 47).

In the females aged 35-55 years, a considerable increase in the frequency of entheses with strong development can be observed, with the highest values exhibited, in decreasing order, by the gluteus maximus of the right femur (53.3%) and of the left femur (52.9%), the deltoideus of the right clavicle (50.0%), the conoid ligament of the right clavicle (50.0%), and the trapezoid ligament of the right clavicle (47.1%); the enthesopathies were present in more entheses in comparison to the previous age category (Table 47).

In the male subsample aged between 20 and 35 years, the majority of entheses showed a mild development (grades 1a-c); the insertions with the highest frequency of strong development (grades 2-3) were, in decreasing order, the trapezoid ligament of the left clavicle (42.9%), the conoid ligament of the left clavicle (41.2%), the costo-clavicular ligament of the right and left clavicle (30.8%), the brachioradialis of the right humerus (38.5%), and the brachialis of the right ulna (33.3%). Enthesopathies were observed only in correspondence of some entheses of the upper limbs (Table 48).

In the males aged 35-55 years, a moderate increase in the frequency of entheses with strong development can be observed, with the highest values exhibited, in decreasing order, by the gluteus maximus of the right

		F 20-35				F 35-55			
		% mild	% strong	% enthes	N. obs	% mild	% strong	% enthes	N. obs
Clavicle	Deltoideus R	73.1	26.9	0.0	26	43.8	50.0	6.3	16
	Deltoideus L	85.2	11.1	3.7	27	62.5	37.5	0.0	16
	Costoclavicular ligament R	95.8	4.2	0.0	24	75.0	18.8	6.3	16
	Costoclavicular ligament L	95.8	4.2	0.0	24	93.3	6.7	0.0	15
	Conoid ligament R	80.8	19.2	0.0	26	50.0	50.0	0.0	16
	Conoid ligament L	72.4	27.6	0.0	29	62.5	37.5	0.0	16
	Trapezoid ligament R	77.3	22.7	0.0	22	47.1	47.1	5.9	17
	Trapezoid ligament L	96.0	4.0	0.0	25	66.7	26.7	6.7	15
	Pectoralis major R	82.6	17.4	0.0	23	75.0	25.0	0.0	16
	Pectoralis major L	80.0	20.0	0.0	25	73.3	26.7	0.0	15
Scapula	Triceps brachii R	94.1	5.9	0.0	17	76.9	15.4	7.7	13
	Triceps brachii L	94.4	5.6	0.0	18	100.0	0.0	0.0	11
Humerus	Pectoralis major R	95.5	4.5	0.0	22	80.0	20.0	0.0	15
	Pectoralis major L	84.6	15.4	0.0	26	75.0	25.0	0.0	16
	Latissimus dorsi/teres major R	100.0	0.0	0.0	21	80.0	20.0	0.0	15
	Latissimus dorsi/teres major L	96.2	3.8	0.0	26	68.8	31.3	0.0	16
	Deltoideus R	96.2	3.8	0.0	26	68.8	31.3	0.0	16
	Deltoideus L	96.2	3.8	0.0	26	81.3	18.8	0.0	16
	Brachioradialis R	85.7	14.3	0.0	21	86.7	13.3	0.0	15
	Brachioradialis L	79.2	20.8	0.0	24	93.3	6.7	0.0	15
Radius	Biceps brachii R	89.7	3.4	6.9	29	80.0	20.0	0.0	15
	Biceps brachii L	84.6	11.5	3.8	26	81.3	12.5	6.3	16
	Pronator teres R	100.0	0.0	0.0	27	86.7	13.3	0.0	15
	Pronator teres L	100.0	0.0	0.0	29	87.5	12.5	0.0	16
	Interosseous membrane R	96.4	3.6	0.0	28	93.8	6.3	0.0	16
	Interosseous membrane L	89.7	6.9	3.4	29	88.2	11.8	0.0	17
Ulna	Triceps brachii R	100.0	0.0	0.0	21	92.9	7.1	0.0	14
	Triceps brachii L	87.0	13.0	0.0	23	78.6	14.3	7.1	14
	Brachialis R	88.0	12.0	0.0	25	85.7	14.3	0.0	14
	Brachialis L	84.0	16.0	0.0	25	78.6	21.4	0.0	14
	Supinator R	95.8	4.2	0.0	24	80.0	20.0	0.0	15
	Supinator L	95.7	4.3	0.0	23	84.6	15.4	0.0	13
Femur	Gluteus maximus R	72.0	28.0	0.0	25	40.0	53.3	6.7	15
	Gluteus maximus L	74.1	25.9	0.0	27	41.2	52.9	5.9	17
	Ileopsoas R	94.7	5.3	0.0	19	75.0	25.0	0.0	12
	Ileopsoas L	95.2	4.8	0.0	21	83.3	16.7	0.0	12
	Vastus medialis R	91.3	8.7	0.0	23	100.0	0.0	0.0	14
	Vastus medialis L	96.0	4.0	0.0	25	93.3	6.7	0.0	15
Tibia	Quadriceps tendon R	91.7	8.3	0.0	12	66.7	33.3	0.0	9
	Quadriceps tendon L	86.7	13.3	0.0	15	70.0	30.0	0.0	10
	Soleus R	94.7	5.3	0.0	19	81.8	18.2	0.0	11
	Soleus L	91.7	8.3	0.0	24	93.3	6.7	0.0	15

Table 47. Entheseal changes in females considered per ages

		F 20-35				F 35-55			
		% mild	% strong	% enthes	N. obs	% mild	% strong	% enthes	N. obs
Patella	Quadriceps tendon R	100.0	0.0	0.0	26	73.3	26.7	0.0	15
	Quadriceps tendon L	100.0	0.0	0.0	26	80.0	20.0	0.0	15
Calcaneus	Achilles tendon R	72.7	27.3	0.0	22	77.8	11.1	11.1	9
	Achilles tendon L	84.2	15.8	0.0	19	72.7	9.1	18.2	11

Table 47. Continued

femur (80%), of the left femur (61.5%), the triceps brachii of the left scapula (50.0%), the pectoralis major of the left (50.0%) and the right humerus (44.4%), the brachioradialis of the left humerus (45.5%), the Achilles tendon of both calcanei (44.4%), and the brachialis of both ulnae (40.0%). Enthesopathies were present in correspondence of more entheses and with higher percentage in comparison to the previous age category (Table 48 and Figures 66-67).

In the analysis of entheseal changes some limits and pitfalls should be considered. Several studies evidenced that exuberant bone production at entheseal sites is mainly seen in older individuals, in individuals with systemic diseases or in cases of trauma. Therefore, entheseal changes should be cautiously interpreted as activity markers or directly related to physical activity, as their appearance is linked to multiple factors (Jurmain *et al.* 2012; Villotte and Knusel 2013).

		M 20-35				M 35-55			
		% mild	% strong	% enthes	N. obs	% mild	% strong	% enthes	N. obs
Clavicle	Deltoideus R	80.0	13.3	6.7	15	61.5	38.5	0.0	13
	Deltoideus L	88.2	11.8	0.0	17	58.3	33.3	8.3	12
	Costoclavicular ligament R	61.5	30.8	7.7	13	50.0	33.3	16.7	12
	Costoclavicular ligament L	69.2	30.8	0.0	13	63.6	18.2	18.2	11
	Conoid ligament R	71.4	28.6	0.0	14	50.0	33.3	16.7	12
	Conoid ligament L	58.8	41.2	0.0	17	75.0	8.3	16.7	12
	Trapezoid ligament R	76.9	23.1	0.0	13	61.5	38.5	0.0	13
	Trapezoid ligament L	57.1	42.9	0.0	14	70.0	30.0	0.0	10
	Pectoralis major R	68.8	31.3	0.0	16	100.0	0.0	0.0	10
	Pectoralis major L	66.7	33.3	0.0	15	91.7	8.3	0.0	12
Scapula	Triceps brachii R	90.0	10.0	0.0	10	50.0	33.3	16.7	6
	Triceps brachii L	84.6	7.7	7.7	13	50.0	50.0	0.0	6
Humerus	Pectoralis major R	63.6	27.3	9.1	11	44.4	44.4	11.1	9
	Pectoralis major L	92.9	0.0	7.1	14	50.0	50.0	0.0	10
	Latissimus dorsi/teres major R	90.9	0.0	9.1	11	85.7	14.3	0.0	7
	Latissimus dorsi/teres major L	100.0	0.0	0.0	12	75.0	25.0	0.0	8
	Deltoideus R	100.0	0.0	0.0	14	70.0	30.0	0.0	10
	Deltoideus L	100.0	0.0	0.0	16	72.7	18.2	9.1	11
	Brachioradialis R	61.5	38.5	0.0	13	62.5	37.5	0.0	8
	Brachioradialis L	69.2	30.8	0.0	13	54.5	45.5	0.0	11
Radius	Biceps brachii R	80.0	20.0	0.0	15	50.0	37.5	12.5	8
	Biceps brachii L	81.3	18.8	0.0	16	50.0	30.0	20.0	10
	Pronator teres R	88.2	11.8	0.0	17	77.8	22.2	0.0	9
	Pronator teres L	94.4	5.6	0.0	18	91.7	8.3	0.0	12
	Interosseous membrane R	94.1	5.9	0.0	17	54.5	36.4	9.1	11
	Interosseous membrane L	94.4	5.6	0.0	18	77.8	22.2	0.0	9

Table 48. Entheseal changes in males considered per ages

		M 20-35				M 35-55			
		% mild	% strong	% enthes	N. obs	% mild	% strong	% enthes	N. obs
Ulna	Triceps brachii R	76.9	15.4	7.7	13	66.7	11.1	22.2	9
	Triceps brachii L	81.3	12.5	6.3	16	70.0	30.0	0.0	10
	Brachialis R	66.7	33.3	0.0	15	60.0	40.0	0.0	10
	Brachialis L	70.6	29.4	0.0	17	60.0	40.0	0.0	10
	Supinator R	78.6	21.4	0.0	14	75.0	12.5	12.5	8
	Supinator L	93.3	6.7	0.0	15	55.6	44.4	0.0	9
Femur	Gluteus maximus R	71.4	28.6	0.0	14	10.0	80.0	10.0	10
	Gluteus maximus L	81.8	18.2	0.0	11	30.8	61.5	7.7	13
	Ileopsoas R	87.5	12.5	0.0	8	71.4	14.3	14.3	7
	Ileopsoas L	100.0	0.0	0.0	3	70.0	30.0	0.0	10
	Vastus medialis R	91.7	8.3	0.0	12	70.0	20.0	10.0	10
	Vastus medialis L	91.7	8.3	0.0	12	91.7	8.3	0.0	12
Tibia	Quadriceps tendon R	87.5	12.5	0.0	8	57.1	28.6	14.3	7
	Quadriceps tendon L	100.0	0.0	0.0	7	71.4	28.6	0.0	7
	Soleus R	92.3	7.7	0.0	13	85.7	14.3	0.0	7
	Soleus L	85.7	14.3	0.0	7	75.0	25.0	0.0	8
Patella	Quadriceps tendon R	93.3	6.7	0.0	15	66.7	33.3	0.0	9
	Quadriceps tendon L	100.0	0.0	0.0	13	72.7	18.2	9.1	11
Calcaneus	Achilles tendon R	91.7	8.3	0.0	12	33.3	44.4	22.2	9
	Achilles tendon L	84.6	15.4	0.0	13	55.6	44.4	0.0	9

Table 48. Continued

Figure 66. Enthesopathy in correspondence of the costo-clavicular ligament of the clavicle of SU 2247 (trench 2), a male aged 30-40 years

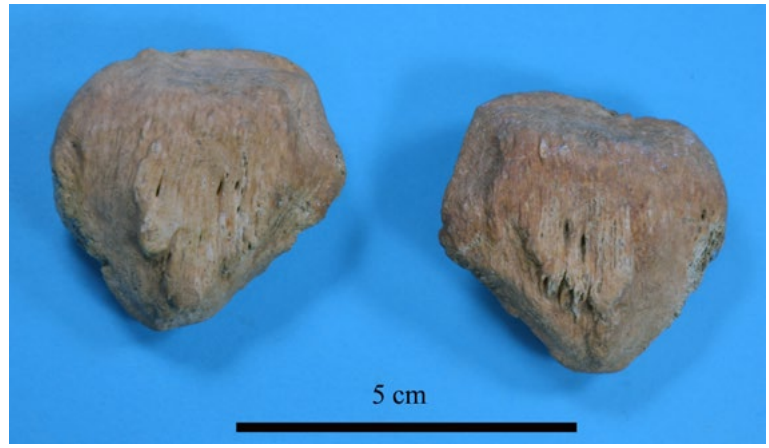


Figure 67. Enthesopathy in correspondence of the patellar ligament of both patellae of SU 2185 (trench 2), a male aged 35-45 years

In general, the data allow us to hypothesize that the individuals examined constituted a physically active human group, who carried out physically demanding and non-sedentary work, and that these working activities involved the division of labor between the two sexes. It is possible that these individuals often traveled on foot, since the muscles employed when walking, such as the gluteus maximus and the Achilles tendon, are well developed in both sexes. In addition, the development of muscles used during abduction, flexion and extension of the arm, and all the movements of the scapulo-clavicular joint, suggests that both males and females carried out more activities involving the use of the upper limbs. However, from the analysis of entheseal changes in the population of Alghero, it is evident that the muscle development of male individuals is greater than that of female individuals. This supports the data evidenced by degenerative joint disease, which suggested more demanding physical activities for the male subsample.

3.9 Pathologies

Several skeletal pathologies have been identified in the skeletons from Alghero.

3.9.1 Traumatic conditions

All the traumas recorded in the individuals from Alghero (Table 49) are fractures, which are well-healed in the majority of cases, with only two exceptions, in skeletons 2208 and 2235, which presented fractures which presented a non-union. 33 individuals out of 180 presented a fracture (18.5%): 14 out of 53 females (26.4%) presented fractures, 11 out of 37 males (29.7%) and 5 out of 81 non-adults (6.1%); 2 individuals are of undeterminable sex.

The total number of fractures is 40, of which 8 are located in the skull (20%), 13 in the axial skeleton (32.5%) and 19 in the upper or lower limbs (47.5%).

The location of the fractures, particularly those involving the upper and lower limbs, suggests that they mainly occurred as a consequence of accidental traumas. The fractures of the clavicles are limited to non-adults or young adults, and could be attributed to falls onto the shoulder or also to trauma during childbirth, produced as the biacromial breath of the child is too large to pass through the pelvic outlet of the mother (Lovell 1997). There are some possible cases of intentional trauma, the blunt force lesions on the skull of skeletons SU 2307, 2529, 2763, and 2857, all females, and 5125, a male with two traumas; also two non-adults exhibit blunt force traumas, skeletons SU 2221 and 2515.

There are also cases of microtraumas (Table 50), evidenced by the presence of localized new bone formation, produced by mild traumatic lesions in localized areas of the bones or by traumas to the soft tissues, such as musculotendinous lesions.

SU	Trench	Sex	Age	Localisation	Type
2208	2	F	17-22	ischio-pubic ramus of the right coxal bone	unhealed fracture with pseudoarthrosis, degenerative changes at the right ankle
2224	3	ND	12-14	distal portion of the left humerus	green-stick fracture occurred during the young age
2235	3	M	25-32	rib	unhealed fracture with pseudoarthrosis (fig. 68)
2201	4	F	12-15	right clavicle	healed fracture
2217	4	M	60-70	right elbow	healed fracture
2219	4	M	20-30	lower third of the diaphysis of the left femur	healed fracture
2221	4	ND	9-11	right parietal bone	healed blunt force trauma
2188	5	F	25-35	fourth metatarsal of the right foot	healed fracture
2214	6	F	25-40	distal metaphysis of the right fibula	healed fracture
2279	7	M	35-45	styloid process of the left ulna, the diaphysis of the right radius and the distal metaphysis of the left ulna	healed fractures
2285	7	F	20-30	right clavicle and scapula	healed fractures
2289	8	F	35-45	diaphysis of the left tibia	healed fracture
2301	9	M	40-50	distal epiphysis of the humerus and the proximal epiphysis of radius and ulna	healed fractures
2307	9	F	40-45	left frontal bone	healed blunt force trauma

Table 49. Fractures in the population of Alghero

SU	Trench	Sex	Age	Localisation	Type
2308	9	F	30-40	proximal metaphysis of the left tibia	healed fracture
2311	9	M	30-40	rib, crushing of vertebral bodies from C5 to C7	healed fractures
2515	10	ND	10-11	frontal bone over the right orbit	healed blunt force trauma (?)
2518	10			head and capitulum of the right radius	healed fracture
2521	10	M	25-30	left fibula	healed fracture
2524	10	ND	10-12	diaphysis of the left clavicle	healed fracture
2528	10	F	35-45	coccyx	healed fracture
2529	10	F	18-22	right side of the frontal bone	healed blunt force trauma
2559	10	ND	35-45	proximal third of the left fibula and of the fourth metatarsal of the left foot	healed fractures
2763	10	F	40-50	right parietal bone	healed blunt force trauma
2857	11	F	18-22	right parietal bone near the sagittal suture	3 healed blunt force traumas
2422	12	ND	35-40	proximal epiphysis of the right femur, with the involvement of the corresponding acetabular cavity	healed fracture
5113	13	M	14-16	diaphysis of the left clavicle	healed fracture
5118	13	F	40-50	rib	healed fracture
5119	13	ND	9-11	head of the right humerus	healed fracture
5125	13	M	40-50	center of the frontal bone and center of the left parietal	two healed blunt force traumas (fig. 69)
2959	14	F	14-16	distal metaphyseal portion of the left femur	healed fracture
2978	16	M	50-60	two ribs	healed fractures
5075	16	M	25-30	half diaphysis of the left tibia	healed fracture

Table 49. Continued

Figure 68. Unhealed fracture of one rib of SU 2235 (trench 3), a male aged 25-32 years

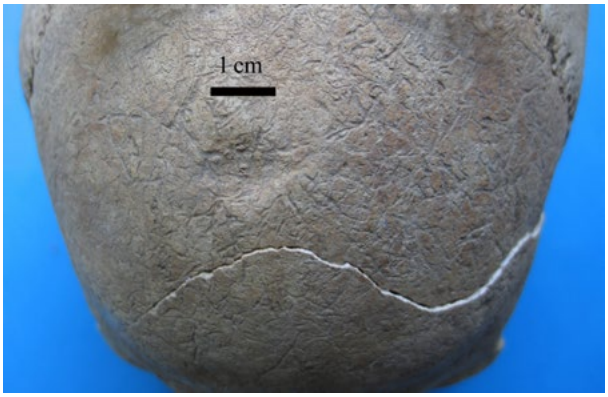


Figure 69. Healed blunt force trauma on the frontal bone of SU 5125 (trench 13), a male aged 40-50 years

3.9.2 Osteochondritis dissecans

Osteochondritis dissecans is a benign, non-inflammatory condition characterized by areas of necrosis localized in the joint surfaces with possible detachment of a segment of cartilage and subchondral bone (Schenk and Goodnight 1996). The condition occurs more commonly in males than in females and tends to be present in children over 5 years of age and adolescents, although an adult form is known in patients up to 50 years of age (Schenk and Goodnight 1996). There is widespread agreement that osteochondritis dissecans is related to repetitive trauma; as a matter of fact, a prevalence higher than average has been observed in athletes and

SU	Trench	Sex	Age	Location
2225	1	F	25-30	half diaphysis, lateral portion of the left tibia
2252	2	F	30-40	posterior surface at the midshaft of the right tibia and fibula
2213	3	F	35-45	posterior side of the left tibia at half diaphysis
2214	6	F	25-40	proximal metaphysis of the left radius
2297	8	F	18-22	a probable muscular trauma in form of enthesopathy is visible on the diaphysis of the left femur
2301	9	M	40-50	facet for the cuboid of the left calcaneus cube present a bony spur
2864	11	ND	12-14	right tibia and fibula
5123	13	F	20-22	1 on the posterior portion of the distal third of the right femur and 1 in correspondence of the soleus of the left tibia
2926	14	F	17-23	metaphyseal portion of the right fibula

Table 50. Microtrauma in the population of Alghero

in those engaged in other vigorous physical activities (Orava and Virtanen 1982). However, the lesion is probably caused by factors that vary depending on the specific joint involved and on the specific site within that joint (Schenk and Goodnight 1996). It is found primarily in the ankle, knee, and elbow joints, whereas involvement of other bones is considered quite unusual but can includes the shoulder, patella, first metatarsal head and hip.

In the Alghero sample (Table 51 and Figure 70), the majority of lesions are seen in common skeletal

SU	Trench	Sex	Age	Location
2208	2	F	17-22	lateral plate of the right tibia
2177	4	F	25-35	sternal end of the right clavicle
2238	4	F	22-28	olecranon of the left ulna
2278	7	M	35-45	left lunate, distal epiphysis of the tibiae and left fibula, proximal epiphysis of the first toe phalanges, and first left cuneiform
2516	10	F	20-30	proximal articular surface of the first phalanx of the first finger of the left foot
2518	10	M	35-45	triquetral and capitate bone
2526	10	M	25-35	proximal epiphysis of the first right metatarsal
5115	13	M	20-30	medial epicondyle of the right humerus
2496	14	M	25-35	distal epiphysis of the right radius and ulna
2978	16	M	50-60	right acetabular cavity

Table 51. Osteochondritis dissecans in the Alghero sample

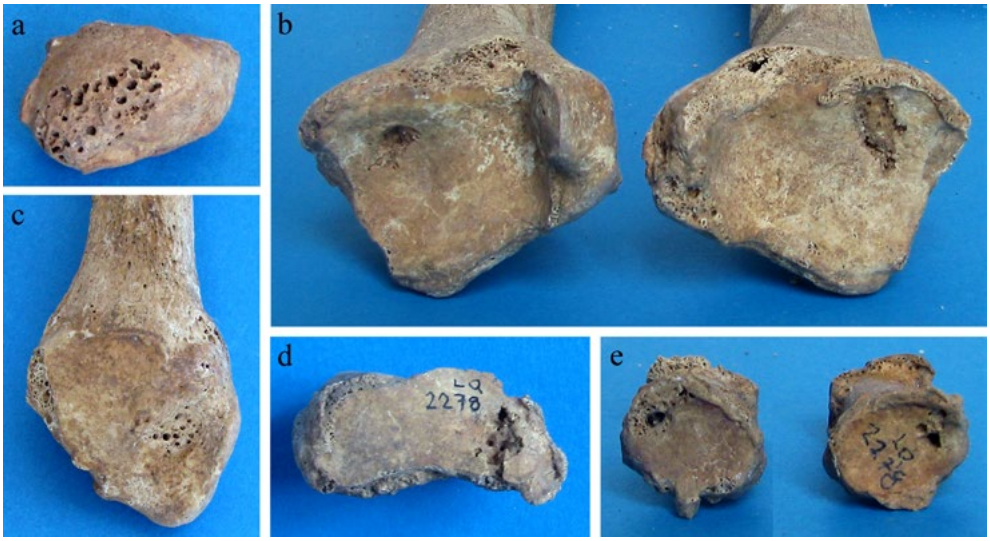


Figure 70. Osteochondritis dissecans on the lunate, (a), distal tibiae (b), distal left fibula (c), first left cuneiform (d), proximal epiphysis of the first toe phalanges (e) of SU 2278 (trench 7), a male aged 35-45 years

locations; the most frequent are the elbow, knee and ankle, suggesting use of the feet during heavy work, including weight bearing and thrusting movements (Waldron 2009; Wells 1974). Other atypical sites, such as the hand and feet bones, can be interpreted as the result of abnormal strain and stress of the involved joints; therefore, unusual localization of osteochondritic defects in the Alghero skeletons can be associated with chronic peculiar occupational trauma.

3.9.3 Auricular exostosis and osteophytosis

In the 133 individuals (44 females, 26 males and 58 non-adults) with preserved auricular canal, no cases of auricular exostosis were observed both in adult and non-adults individuals.

Auricular osteophytosis was observed only in female individuals, with a frequency of 13.3%, and in non-adults, with a frequency of 3.4% (Table 52 and Figures 71-72). The Fisher's exact test suggested that there is no statistical difference between the two sexes (p=0.08).

	P	Obs	%
F	6	45	13.3
M	0	25	0
ND	0	5	0
Non-adults	2	58	3.4
Total	8	133	6.0

Table 52. Auricular osteophytosis in adult and non-adult individuals

Figure 72. SU 2310 (trench 9), a non-adult aged 8-9 years, showing auricular osteophytosis

3.9.4 Infectious diseases

3.9.4.1 Osteomyelitis

Osteomyelitis is an inflammatory process caused by pyogenic germs, such as *Staphylococcus*, *Streptococcus* and *Pneumococcus* that can affect all skeletal segments (Resnick and Niwayama 1995). The disease is characterized by the sequestrum of the original diaphysis with sclerosis, with large areas of osteolysis surrounding the sequestrum and irregular enlargement of the sclerotic bone, due to the succession of periosteal reactions to persistent infectious stimuli. The production of new formed bone can also produce obliteration of the medullary canal (Buikstra 2019).

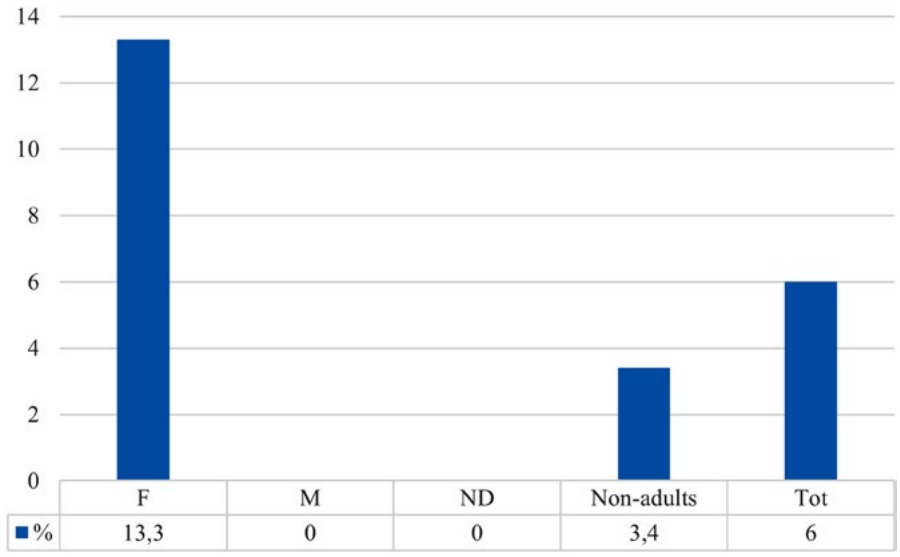


Figure 71. Frequency of auricular osteophytosis in adult and non-adult individuals

Figure 73. Osteomyelitis of the right tibia of SU 2201 (trench 4), a non-adult aged 12-15 years

In the Alghero population, there are 3 cases of this severe form of bone infection: in skeleton 2201 from trench 4, a female aged 12-15 years, an osteomyelitis affecting the left tibia can be observed (Figure 73); the state of preservation of the bone does not permit to ascertain if the infection was a consequence of a trauma. In skeleton 2285 from trench 7, a female aged 20-30 years, both tibiae and the distal epiphysis of the left femur were involved; in this case the left tibia is very fragmented, but in the right tibia and left femur no signs of fractures are visible. Skeleton 2496 from trench 14, a probable male aged 25-35 years, presents an infection of the distal third of the right tibia and fibula, consequent to a healed fracture.

3.9.4.2 Mercurial teeth

Skeleton 2234, exhumed from trench 4 and belonging to a child aged 4-5 years, showed several dental anomalies, besides a slight periosteal reaction limited to the lower parts of the diaphyses of the right humerus, radius and ulna, as well as left radius and ulna, and the distal half of the posterior surfaces of the diaphyses of both tibiae.

The deciduous dentition is quite complete (the maxillary second left incisor and mandibular second left incisor are missing) and appears to be normal. As for the permanent dentition, several teeth are lost *post-mortem*, in particular the maxillary right second molar, second and third left and right premolar, and right canine, and the mandibular right second molar, right first premolar, right canine, first and second left premolar, left canine, first and second left incisor. In the permanent dentition notable pathological changes were observed. Left and right upper central incisors display two transverse encircling furrows that divide the crown into thirds; the mid-part of the crown is pitted on the labial aspect (Figure 74a). The upper canines resemble fangs by their decreased tips with thin and tapered enamel (Figure 74b). All the permanent first molars are marked by a sharp circumferential groove at mid-crown level; the crown surface is finely pitted and the occlusal crown level is reduced in all its diameters to form atrophic cusps (Figures 74c and d).

The dental anomalies observed in this child suggest a disturbance of enamel development during the perinatal period and early infancy; in fact, the crown of the permanent first incisors generally forms within the fourth to fifth year of age, the crown of the canines within the fifth to sixth years and that of the first molar within the fourth year (Ubelaker 1989). These lesions are compatible with a diagnosis of a treatment with mercury. One of the most common treatments for skin diseases, including syphilis, in ancient medicine was mercury (Beers and Mousavi 2013; Norn *et al.* 2008). With the epidemic advent of venereal syphilis in Europe at the end of the 15th century and beginning of the 16th century, mercury unguents and solutions were directly used (Claiborne 1911). By the 16th century, mercury was largely suggested as the main therapy for syphilis and was generally used, despite frequently horrible consequences of its side effects, which included death (O'Shea 1990; Weatherill 1833).

Treatments with mercury cause pronounced enamel defects and, to a lesser degree, involve the dentine. In particular, Hutchinson (1858, 1878, 1887) evidenced that mercurial poisoning is responsible of abnormalities in enamel formation, interfering with the classic dental manifestations of congenital syphilis. The damage to the tooth inflicted by mercury was not restricted to a small area, as with syphilis, but involves larger areas of deficient enamel that results pitted and rugged ultimately producing an appearance of a dirty grey honey combed tooth (Hutchinson 1878, 1887, 1909). Wide areas of enamel could also be entirely missing, especially on occlusal surfaces. In the diagnosis of mercurial teeth, the first upper and lower permanent molars are considered pathognomonic: indeed wide enamel defects, such as furrowing, honeycombing and pitting, appear (Hutchinson 1878, 1909). Moreover, Hutchinson (1878) also observed the effect of mercury on the incisors and canines: in maxillary incisors and canines there was a severe hypoplastic linear defect separating the lower (closer to the tip) part of the crown from the rest of the crown. The enamel below that line, closer to the tip, was deficient and unevenly formed; similar changes occurred on mandibular teeth. Moon (1884) also noted the same phenomenon caused by mercury on enamel, labeling molars as 'honeycombed' or 'rocky.'

The changes seen in the dentition of child 2234 from Alghero suggest that a mercurial therapy may have

Figure 74. Maxillary first incisors (a) and canines (b), buccal view, and mandibular (c) and maxillary molars (d) of SU 2234 (trench 4), a non-adult aged 4-5 years

been administered, probably to treat some systemic disease. Even if the dental abnormalities are not pathognomonic for congenital syphilis, it cannot be excluded that the child was affected by this disease (Ioannou *et al.* 2015). The child did not survive into adulthood, which is consistent with the poor efficacy and deleterious effects of mercurial therapy.

3.9.4.3 Brucellosis

Brucellosis is a common zoonosis found worldwide and endemic in many regions, including the Mediterranean basin, the Middle East and part of central and south America. It is caused by microorganisms of the genus *Brucella* (Buikstra 2019). These microorganisms are coccobacilli affecting animals such as sheep, goats, cattle, cows and pigs. Humans are just one of the possible hosts and become infected following consumption of unpasteurized milk and fresh cheese; brucellosis is also an occupational disease acquired in consequence of contact with infected animals, in particular when workers assist with birth of baby animals, in which cases the infection arrives through skin lesions or, more rarely, inhalation of aerosols (Chelli Bouaziz *et al.* 2008). The disease affects the lymph nodes and then reaches the bone marrow, liver and spleen; from clinical studies it seems that the skeleton is involved in 20-25% of cases (Geyik *et al.* 2002), in particular it can cause spondylitis in the thoracic and lumbar vertebrae, osteomyelitis in long bones and in the pelvis and arthritis. Osteoarticular involvement of the column is the most common skeletal feature, including spondylodiscitis of the lumbar spine accompanied by sacroiliitis (Bodur *et al.* 2004; Geyik *et al.* 2002). The lumbar segment is the most commonly involved region in brucellar spondylitis, in particular L4 and L5; more than one vertebra can be affected. The defect appears as a cavitation involving the superior angle of the vertebral body, restricted anteriorly to the region of the *annulus fibrosus* and, for this reason, the typical brucellar spondylitis is known as anterior epiphysitis. The erosive phenomena are frequently associated with sclerotic reactions occurring during bone recovery, with osteophytes formation (Glasgow 1976; Pourbagher *et al.* 2006).

The diagnosis of brucellosis is a difficult task in paleopathology, as the bone lesions are similar to those of other pathologies (D'Anastasio *et al.* 2011). Among the skeletons from Alghero two possible cases were identified: SU 2291 presented an area of osteolysis on the superior vertebral plate of L5, even if the lesion is not pathognomonic. SU 2765, a female aged 30-40 years, presents more convincing changes, in particular lytic lesions on the antero-superior margin of L2 and L3; at the level of L2 the defect consists of an irregular surface with fine perforations in continuity with the surface of the vertebral body, whereas in L3 the defect presents the same localization, but is larger, with an irregular and deep osteolytic lesion; a slight periosteal response with new bone formation can be observed (Figure 75).

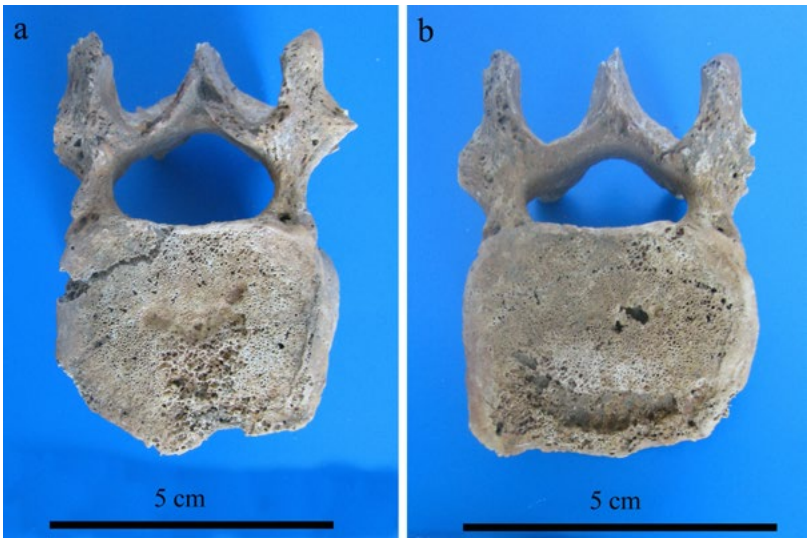


Figure 75. SU 2765 (trench 10), a female aged 35-45 years, showing lytic lesions on the antero-superior margins of L2 and L3, suggesting a possible diagnosis of brucellosis

In the differential diagnosis also trauma should be considered, in particular anterior herniations of the intervertebral disc, the so-called 'limbus vertebra', caused by excessive mechanical stresses on the back of immature skeletons. If the anterior wall of the vertebral body is injured, this lesion can detach bone fragments at the antero-superior and antero-inferior body margin. Sclerotic reactions are possible due to remodeling of the lesion margins. Lesions resulting from brucellar spondylitis and traumatic anterior disc herniation are very similar and in presence of vertebral marginal lesions it could be difficult to differentiate these possibilities (Mays 2007). Nevertheless, in anterior herniation of the intervertebral disc the bony defect can be located both on superior and inferior margin, whereas in the case under study this is limited to antero-superior body margin; therefore the lesions observed in SU 2765 are highly compatible with brucellosis.

The breeding of sheep and goats was one of the most important activities in post-medieval Sardinia. In the second half of the 16th century, the internal composition of cattle-breeding in the north-central area of the island was constituted by 76% of sheep and goats and by 18.7% of cattle and equines (Guidetti 1989). Contact with ovines and the consumption of milk and fresh cheese certainly exposed the population to high risks of contracting brucellosis.

3.9.4.4 Enlarged foramina on the anterior portion of the vertebral bodies

Several individuals, mainly non-adults, showed lytic lesions localised on the anterior portion of the vertebral bodies of the thoracic and lumbar segment; on the same body several lesions are generally present. In a few cases also the sacrum is involved (Table 53).

The changes can be interpreted as enlarged vascular foramina, with the aspect of sharp-edged and irregular-shaped pits found on the lateral and ventral vertebral bodies, which are related to normal bone development, especially when seen in children and young adults (Roberts and Buikstra 2003: 127), as in the case of Alghero.

However, some cases of particular severity in non-adults (Figure 76) and the lytic lesions seen in adult individuals (Figures 77) could also be suggestive of other diagnoses. Some authors relate the hypervascularization of the anterior portion of the vertebral bodies with an early phase of tuberculous spondylitis, or Pott's disease (Baker 1999; Maczel *et al.* 2001; Mariotti *et al.* 2015; Palfi *et al.* 2012; Pedersen *et al.* 2019). It is a form of extrapulmonary tuberculosis, caused by the infiltration, through the bloodstream, of the *Mycobacterium tuberculosis* in the vertebrae, and is the most frequent form of bone tuberculosis. Generally, the pathology initially affects a vertebra, forming circular lesions on the anterior aspect of the vertebral body, and only subsequently extends to the ligaments and to the neighboring soft tissues, causing a collapse of the column.

Mutolo (2012), on the other hand, relates this type of lesions to brucellosis infection. Vertebral brucellosis can in fact manifest either with a focal or a diffuse pattern. The former involves only one vertebra, with lesions occurring primarily along its superior edge, as in the case seen in paragraph 3.9.4.3, whereas the diffuse pattern shows lytic lesions on the anterior and lateral surfaces of the bodies in several adjacent vertebrae. Because of this variability in skeletal manifestation brucellosis remains difficult to diagnose in paleopathology on the basis of the sole macroscopic analysis.

SU	Trench	Sex	Age	Involved segment
2175	1	ND	11-13	T, L
2183	1	ND	5-7	T
2229	1	ND	12-13	T, L
2209	2	ND	0-5 months	T
2248	2	ND	11-12	T (?)
2249	2	ND	12-14	T, L
2186	3	ND	12-14	T (?)
2205	3	ND	3-4	T
2206	3	ND	12-14	T (?)
2224	3	ND	12-14	T, L
2234	4	ND	3-5	T (?)
2187	5	ND	12-14	T (?)
2189	5	ND	13-15	T, L
2257	5	ND	12-14 months	T
2259	5	ND	5	T
2216	6	F	16-10	T, L
2294	8	F	15-17	T
2557	10	ND	10-12	T, L
2552	11	F	13-15	T (?)
2553	11	ND	6-7	T (?)
2555	11	ND	2-3	T, sacrum
2413	12	ND	4	T (?)
5125	13	M	40-50	T, L
5126	13	ND	6-8	T, L
5127	13	ND	10-12	T (?)
5128	13	ND	9-11	T, L, sacrum
2946	14	ND	10-11	T (?)

Table 53. Individuals with lytic lesions on the anterior portion of the vertebral bodies

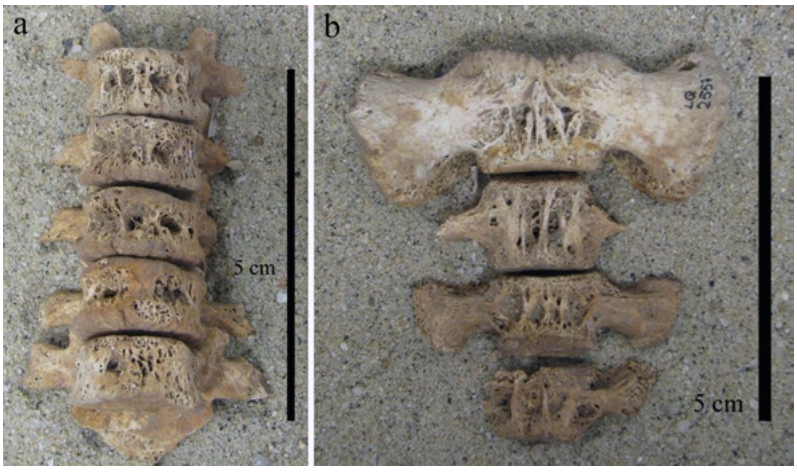


Figure 76. SU 2557 (trench 10), a non-adult aged 10-12 years, showing lytic lesions on the thoracic vertebrae and sacrum

Another study carried out on the skeletal manifestation of malaria in a modern reference sample from Modern Uganda demonstrated that the lytic cavitations of the vertebral bodies are present in anemic patients, with a morphology similar to the lesions observed in brucellosis infection; the differences consists in the dimensions of the pores, which are smaller in anemia, and in their localization, tending to be seen in the lateral aspect of the vertebral bodies in anemia and in the anterior portion in brucellosis (Smith-Guzman 2015).

Therefore, the nature of these lesions remains unclear, as it is not sure if they should be referred to tuberculosis, brucellosis, malaria, or other pathological conditions, such as hemolytic anemias (e.g. thalassemia), lymphomas, multiple myeloma and infection by Echinococcus. Only future molecular analyses could eventually clarify the etiology of these lesions.

3.9.5 Rheumatoid arthritis

Rheumatoid arthritis is a chronic, inflammatory, autoimmune disorder affecting the joints, in particular both upper and lower extremities, in asymmetric manner. The inflammatory process begins with erosive features and can progress until the destruction of the joint and the ankylosis. Rheumatoid arthritis has a sexual predilection for the females; the current incidence is of approximately 1-2% in males and 2-4% in females. The onset of RA can occur at any age, although is more common after the fourth decade of life (MacGregor and Silman 1998).

The most commonly and firstly involved joints are hand fingers, wrists, feet, then followed by the more proximal joints of the extremities, such as knee, elbow, ankle, shoulder joints, hip, cervical spine, temporo-mandibular, sternoclavicular and manubriosternal joints. The symmetrical involvement of the wrists is almost invariably present in rheumatoid arthritis; in fact, the carpus is one of the sites where the ankylosis is more frequent and precocious. Lesions in the metacarpophalangeal and proximal interphalangeal joints are typical of rheumatoid arthritis as well, whereas in the distal interphalangeal involvement is rarer (Buikstra 2019).

In the population of Alghero some possible cases of rheumatoid arthritis at initial stages can be suspected.

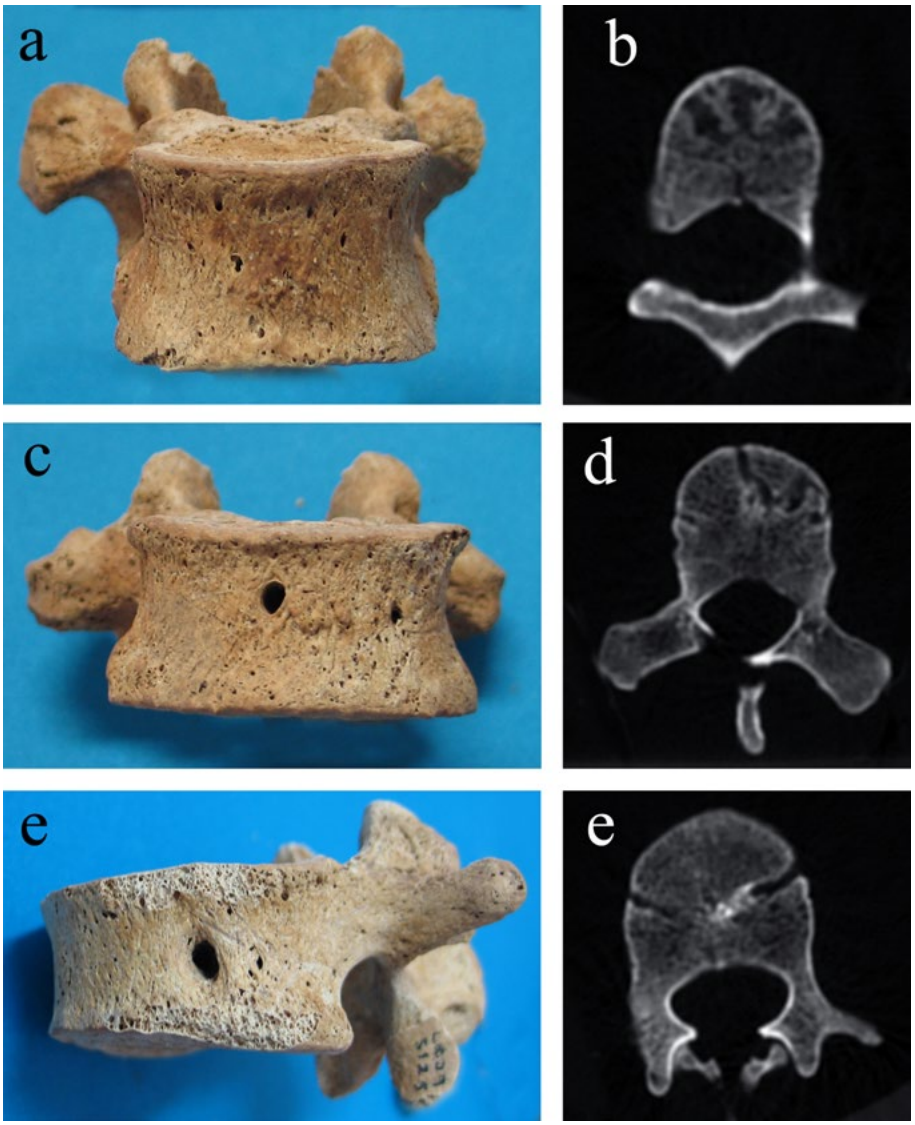


Figure 77. SU 5125 (trench 13), a male aged 40-50 years, showing lytic lesions on the anterior portion of the thoracic and lumbar vertebrae: T6 with no external lesions (a) but internal erosions on CT (b); T10 with a cavitation visible externally (c) and CT showing the internal aspect of the bone (d); L1 with a lateral lytic lesion (d) and CT view (e)

Skeleton 2279, a male aged 35-45 years, presented lytic inflammatory lesions, particularly on the proximal epiphyses of humeri and ulnae, and on some carpal and metacarpal bones, suggesting a possible rheumatoid arthritis with active phase lesions covered by a thin layer of new bone. A recent review on the features typical of arthropathies indicates the involvement of shoulder joint as present only in rheumatoid arthritis and ankylosing spondylitis, whereas the elbow joint is affected only in rheumatoid arthritis (Ventades *et al.* 2018); therefore, for SU 2279, which presents another typical feature of rheumatoid arthritis, that is the involvement of metacarpo-phalangeal joint in hands, can be considered suggestive, and the lesions are similar to a recent case coming from Medieval northern Italy (Tesi *et al.* 2019).

Skeleton 2528, a female aged 35-45 years, exhibited osteolythic lesions on the head of the metacarpals, suggesting a possible inflammatory disease in an initial stage (Figure 78). The localization of osteolysis to the head of some metacarpals is a typical feature in rheumatoid arthritis (Ventades *et al.* 2019), but the mild manifestation and the involvement of a few bones make this diagnosis less confident. Another possible diagnosis is calcium pyrophosphate deposition, a type of arthritis caused by the deposition in the cartilage of crystal deposits, which can mimics osteoarthritis or rheumatoid arthritis (Filippou *et al.* 2020).

Other cases of fusion observed in hands and feet bones are probably related to other conditions, for example traumas or congenital diseases, as the ankylosis is unilateral or in atypical sites. In skeleton 5116, a male aged 40-50 years, the fusion of the right trapezoid with the second metacarpal and of the second and third phalanges of the fifth finger of the right and left foot were observed. Skeleton 5118, a female aged 40-50 years, showed fusion of the first metacarpal with the first phalanx of the right hand.

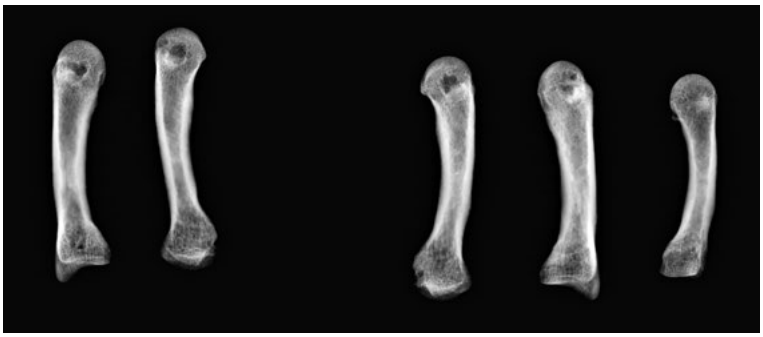


Figure 78. SU 2528 (trench 10), a female aged 35-45 years, with lytic lesions on the head of the metacarpals

3.9.6 Tumors

The diagnosis of tumors in paleopathology is particularly difficult as several diagnostic instruments at disposal of modern clinicians are not available (i.e. medical records, microbiological culture results, etc.). Therefore, a detailed differential diagnosis should be performed (Ragsdale *et al.* 2018).

In the population of Alghero no cases of malignant tumors were detected. Only two benign tumors were diagnosed, both of which were osteomas. Osteomas are the most common slow-growing benign neoplasia that affect almost exclusively the craniofacial and jaw bones (Spjut *et al.* 1970). They usually arise from the cranial vault and more rarely from the inner cranial table (Aufderheide and Martin 1998). Osteomas also represent the most common fibro-osseous lesions of the paranasal sinus, pneumatic cavities characteristic of the frontal, ethmoid, sphenoid and maxillary bones. Clinically they appear circumscribed, usually rounded and protuberant, and are characterized by very slow growth. Osteomas are generally small in size and asymptomatic (Chae *et al.* 2015).

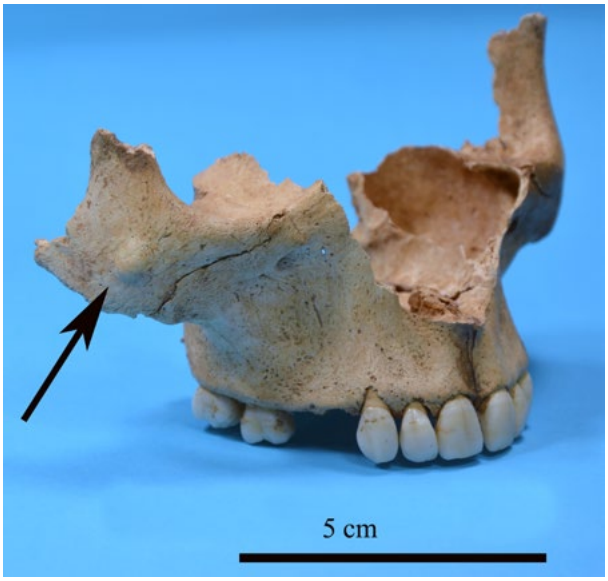


Figure 79. SU 2189 (trench 5), a non-adult aged 13-15 years. Osteoma of the right zygomatic process

Skeleton 2189, a non-adult aged 13-15 years, showed an osteoma localized on the right zygomatic bone (Figure 79). Skeleton 2528, a female aged 35-45 years exhibited an osteoma on the frontal bone. The frontal bone is the most common localization, whereas among the maxillofacial osteoma, the zygomatic bone is very uncommon (Horikawa *et al.* 2012; Kim and Oh 2015).

3.9.7 Congenital diseases

3.9.7.1 Craniosynostosis

Skeleton 2762, belonging to a 9-10-year-old child, showed a malformation of the skull, due to the premature bilateral closure of the coronal suture, a form of craniosynostosis named as brachycephaly (Giuffra *et al.* 2013). The skull shows deformation with a slight reduction of the antero-posterior diameter, an increase in the bi-parietal diameter and marked frontal and parietal bosses. In the internal table, on both fronto-parietal regions, digitated impressions are clearly detectable (Figure 80). No skeletal defects or other anomalies are evident in the post-cranial skeleton. Unilateral (anterior plagiocephaly) or bilateral (brachycephaly) closure of the coronal suture is the second most common form of craniosynostosis after sagittal suture fusion (Boyadjiev 2007). Unilateral/ bilateral coronal craniosynostoses represent the 20-30% of all non-syndromic craniosynostosis and have an estimated incidence of 0.8-1 in 10,000 live births, with 60-75% of those affected being females (Lajeunie *et al.* 1995). Non-syndromic craniosynostosis has a multifactorial aetiology, but recent advances in molecular genetics have led to a better understanding of the role of specific genes implicated in different craniosynostosis syndromes. In people displaying coronal non-syndromic craniosynostosis (sporadic or familial) there is a P250R mutation in fibroblast growth factor receptor 3 (FGFR3) (Boyadjiev 2007).

When brachycephaly is associated with other skeletal anomalies, mainly in hands and feet the condition is defined as syndromic craniosynostosis. As no other skeletal anomalies were observed in the skeleton 2762, it is possible to suggest a diagnosis of non-syndromic craniosynostosis.

3.9.7.2 Atlas occipitalisation

Skeleton 5125, exhumed from trench 13 and belonging to a male aged 35-45 years, showed anomalies of the atlas (Giuffra *et al.* 2017b). There is complete fusion of the superior articular facets of the first cervical vertebra

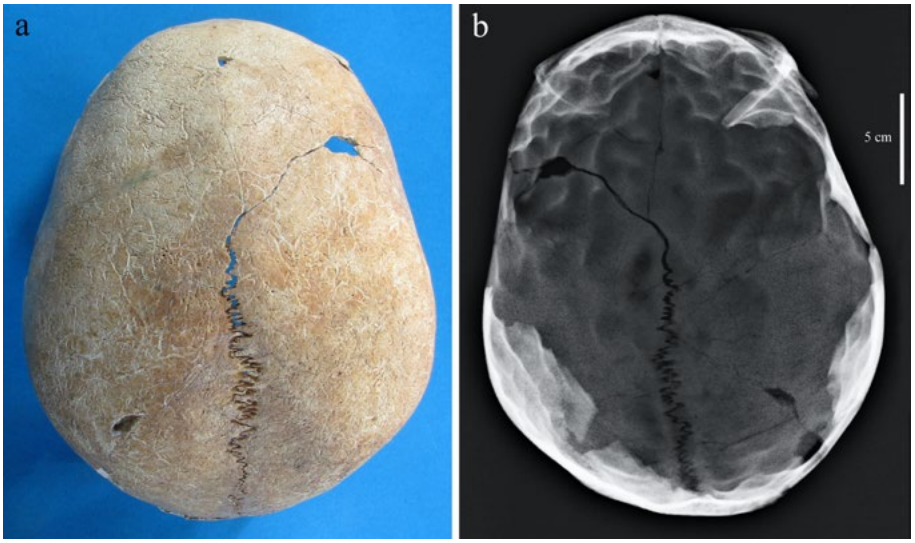


Figure 80. SU 2762 (trench 10), a non-adult aged 9 years. Premature bilateral closure of the coronal suture

with the occipital condyles, and of the anterior arch with the anterior rim of the foramen magnum; the left posterior arch presents no evidence of fusion with the posterior margin of the foramen magnum. Slight tilting of the atlas toward the left side is observed (Figure 81). In addition to occipitalization, absence of the costal element of the left foramen trasversarium, resulting in an open anterior foramen trasversarium, and posterior arch defect are observed. Therefore, there is an association of congenital anomalies of the atlanto-occipital junction, a condition rarely documented in ancient human skeletal remains.

Congenital bony fusion of the first cervical vertebra with the occipital bone is referred to as occipitalization of the atlas, as well as assimilation of the atlas, atlanto-occipital fusion, and occipito-cervical synostosis (Al-Motabagani and Surendra 2006). Congenital causes of atlar occipitalization are due to disorders in the development of occipital and cervical sclerotomes in the third and fourth weeks of fetal life (Saini *et al.* 2009). The congenital anomaly has a current incidence of 0.67 to 3.63% in Asian populations, without a sex predilection (Mudaliar *et al.* 2013); in Caucasians the incidence is lower, being 0.5 to 1% (Esses 1995). Assimilation of the atlas to the occipital bone has a clinical relevance due to its proximity to the spinomedullary region. This anomaly generally results in the immobility of the craniovertebral joint and is generally associated with restricted head and neck movements and torticollis.

3.9.7.3 Posterior arch defect of the atlas

Skeleton 2219, exhumed from trench 4 and belonging to a male aged 20-30 years, showed anomalies of the atlas (Giuffra *et al.* 2016b). The first cervical vertebra shows a congenital defect of the posterior arch. A failure of the midline fusion of the two hemiarches with a small gap is evident. The vertebra shows a post-mortal breakage in correspondence of the left articular facet and therefore it is difficult to exactly measure the gap. However, the two parts of the posterior arch are almost completely developed and therefore only a small defect of a few millimetres is detectable (Figure 82).

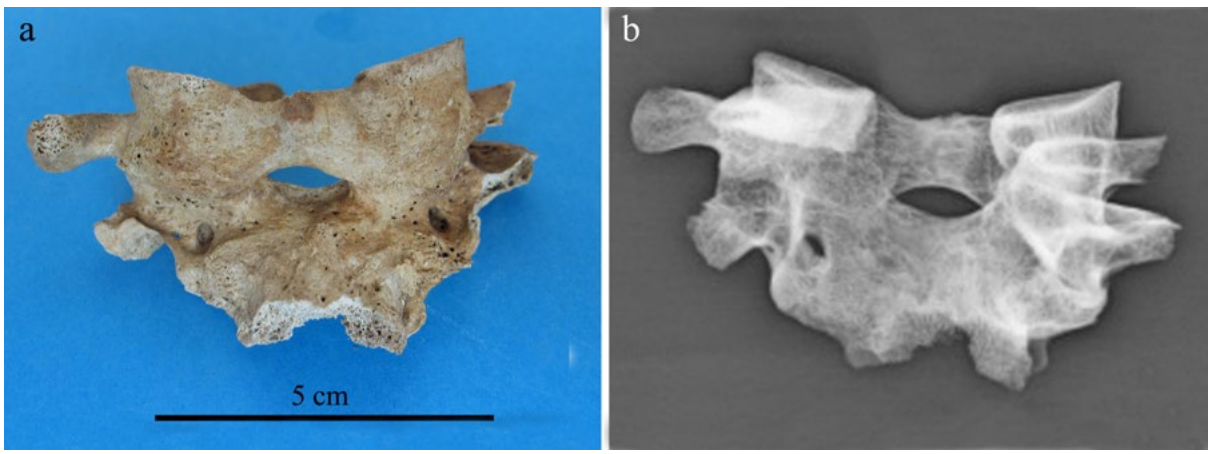


Figure 81. SU 5125 (trench 13), a male aged 40-50 years. Fusion of C1 with cranial basis

Figure 82. SU 2219 (trench 4), a male aged 20-30 years. Posterior arch defect of the atlas. Anterior and posterior view

According to the classification of Currarino *et al.* (1994) this is a Type A arch defect.

In a clinical study carried out on 1104 patients, 3.35% showed congenital defect of the posterior arch and among them, 2.6% were represented by type A defect (Senoglu *et al.* 2007). Another clinical study demonstrated similar results, as on 1069 patients, 3.8% showed atlas arch defect, and among them, 3.2% were represented by type A defect (Guenkel *et al.* 2013).

The pathogenesis of atlas defects are not yet fully understood. Posterior arch defects are attributed to the defective or absent development of the cartilaginous preformation of the arch rather than a disturbance of the ossification (Kwon *et al.* 2009). Congenital posterior arch defects are generally asymptomatic and are considered benign anatomical variations; however, in asymptomatic individuals, they may become dangerous in the context of trauma (Klimo *et al.* 2003).

3.9.7.4 Klippel-feil syndrome

Klippel-Feil syndrome is a rare type of complex congenital condition characterized by the congenital fusion of cervical vertebrae. It results from a failure in the normal segmentation of the mesodermal somites between the third and eighth week of gestation (Samartzis *et al.* 2006).

The presence of fusion of only two cervical vertebrae is insufficient for a sure Klippel-Feil syndrome diagnosis in skeletal material; in fact, the presence of other vertebral column anomalies, associated to the synostosis of one or more spinal segments, is necessary for the diagnosis (Pany and Teschler-Nicola 2007).

Three examples of fusion of the cervical vertebrae were observed in the Alghero population (Giuffra *et al.* 2017a). Skeleton 2291, a non-adult aged 7-8 years, exhibited a significant number of anomalies of the vertebral column: posterior arch defect of the atlas, fusion of C2 and C3, thoracic and lumbar supernumerary vertebrae, posterior arch defect of S2; there is also bifurcation of one rib. In this case these anomalies lead us to a certain diagnosis of Klippel-Feil syndrome.

In other two cases the cervical fusion is not accompanied by other anomalies: skeleton 2284, a male aged 35-45, showed the fusion of C3 and C4, skeleton 2309, a male aged 20-25 years, the synostosis of C2 and C3 (Figure 83). In these cases the most probable diagnosis is the

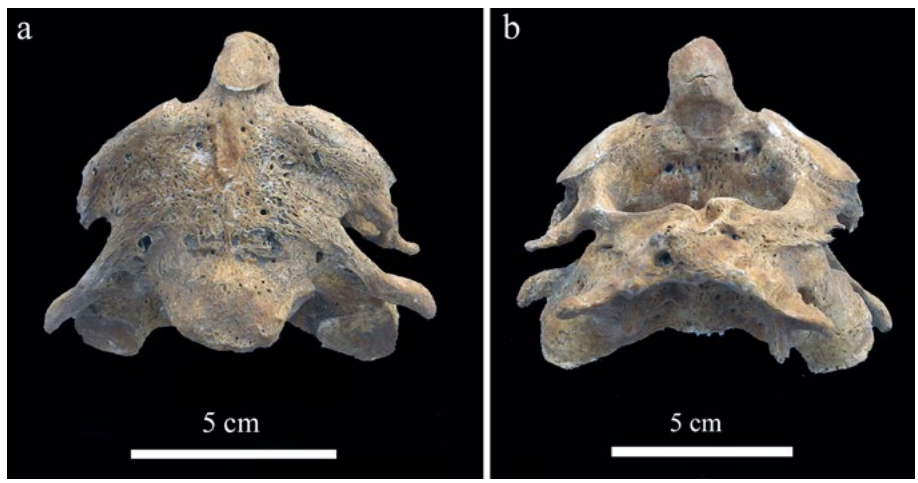


Figure 83. SU 2309 (trench 9), a male aged 30-40 years. Fusion of C2 and C3

congenital fusion of cervical vertebrae, a congenital synostosis of one or more continuous segments of cervical spine, due to embryological failure of normal spinal segmentation (Sutton 1993).

3.9.7.5 Other congenital defects of the spine

Coccyx sacralisation, the fusion of the coccyx to the sacrum, was observed in 3 individuals: SU 2185; SU 2235 and SU 2794; lumbarisation of the first sacral vertebra was present in SU 2763. Spondylolysis affected the fifth lumbar vertebra of SU 2208.

3.9.7.6 Possible Camurati-Engelmann disease

Skeleton 2179, exhumed from trench 4 and belonging to a male aged 45-55 years, showed several anomalies (Giuffra *et al.* 2016a). The skeleton presents a bilateral hyperostosis with increased diameter of the diaphyses of all the long bones of the upper and lower limbs; the metaphyses appear to be involved, while the epiphyses are spared. The surface of the long bones presents alterations, with periosteal reaction and bony spurs. Marked thickening of the cranial vault is also evident, whereas the mandible is normal. Radiological study showed irregular cortical thickening and massive endoperiosteal bone apposition; sclerotic changes are observed in the diaphysis of some metacarpals (Figures 84-85). Computed Tomography (CT) cross sections of the long bones displayed a thickening of the cortical portion and endoperiosteal bone apposition. Ligament and tendon insertion sites reveal a high degree of expression; preserved joint surfaces showed osteoarthitic changes.

The individual was affected by a sclerosing bone dysplasia, a genetic disease characterised by increased bone density. In differential diagnosis, several sclerosing bone dysplasias, such as hyperostosis corticalis generalisata, craniodiaphyseal dysplasia, craniometadiaphyseal dysplasia, pachydermoperiostosis, and Camurati-Engelmann disease, as well as other disorders characterized by sclerosing manifestations, such as Erdheim-Chester disease, mehloreostosis and skeletal fluorosis, need to be considered. The anomalies observed in skeleton 2179 fit with the features of Camurati-Engelmann disease, which is the most likely candidate for final diagnosis. Camurati-Engelmann disease, also known as progressive diaphyseal dysplasia, generalized hyperostosis and endostosis, congenital multiple hyperostotic disease, sclerosing dysplasia and symmetrical osteosclerosis, is a rare genetic disorder. Camurati-Engelmann disease is an autosomal-dominant condition caused by mutations within the transforming growth factor-β1 (TGFβ1) gene on chromosome 19q13 (Janssens *et al.* 2000); it is characterized by anomalies in intramembranous bone formation. The reported incidence of this disorder is one in 1,000,000 (Bhadada *et al.* 2014) and approximately 200 cases have been reported in the English literature so far (Jadhav and Ghanekar 2013).

It is highly challenging to evaluate how such a condition may have influenced the individual's lifestyle in terms

Figure 84. SU 2179 (trench 4), a male aged 45-55 years. Macroscopic (a) and radiologic (b) image of the left humerus, radius and ulna

Figure 85. SU 2179. Macroscopic (a) and radiologic (b) image of the left femur, tibia and fibula

of development, mobility and quality of life. This individual was probably symptomatic, and must have experienced common clinical symptoms, such as pain in the limbs and fatigue (Janssens *et al.* 2006). However, the strong development of the muscular insertions and the degenerative changes in the upper limbs suggest that the mobility problems should not have prevented him from reaching a mature age and from performing essential daily activities. The case from Alghero is unique evidence of Camurati-Engelmann disease, being the only case so far diagnosed in the paleopathological literature.

3.9.7.7 Subluxation of the hip

Developmental dysplasia of the hip includes a spectrum of anatomical abnormalities of the hip joint in which the femoral head has an abnormal relationship with the acetabulum. Acetabular dysplasia consists in a shallow acetabulum with increased obliquity and reduced concavity, but in this condition the femoral head continues to articulate normally within the hip joint (Mitchell and Redfern 2010). The acetabular dysplasia seen in skeleton 2514, a female aged 30-35, is limited to a deformation in the roof of both acetabula.

3.9.8 Diffuse idiopathic skeletal hyperostosis

Diffuse idiopathic skeletal hyperostosis (DISH) is a systemic disorder, whose main characteristic is the ossification of the anterior longitudinal spinal ligament, with large osteophytes that flow down the spine, producing a typical candle wax appearance (Buikstra 2019). These lesions occur most commonly in the thoracic portion of the column, although they may involve all the spinal segments. In the thoracic spine the limitation of the changes to the right side is attributed to the presence of the descending aorta on the left, that would prevent the ossification. For the diagnosis of DISH is necessary the fusion of at least four contiguous vertebrae, but some authors estimate three vertebrae as sufficient diagnostic criteria (Rogers and Waldron 2001). The ossification leads to ankylosis of the involved vertebrae, but intervertebral discs spaces and apophyseal joints are preserved. DISH is known to be commonly associated with ossification of other ligaments of the vertebral column and of the ligaments and tendons attachments of the appendicular skeleton (Mader *et al.* 2017).

The aetiology of DISH remains uncertain, although it has been related to metabolic disorders, in particular obesity and type II diabetes mellitus (Denko and Malemud 2006).

In Alghero only one case of DISH was identified. Skeleton 2217, from trench 4, is a male aged 50-60 years, who presents fusion of 7 thoracic vertebrae out of 8 and diffuse enthesopathies (Figure 86). Paleopathological investigations associated the

Figure 86. SU 2217 (trench 4),
a male aged 50-60 years. DISH

incidence of DISH with a high social status and lifestyle, in particular with good nutritional patterns (Rogers and Waldron 2001; Verlaan *et al.* 2007). The low incidence of the disease in the Alghero sample fits well with the social status of the population which had not access to a rich diet.

Chapter 4

Conclusions and future perspectives

This report has presented a bioarchaeological analysis of the individuals exhumed from the cemetery of Alghero, which is associated with the plague outbreak that ravaged the city in 1582-1583.

Archaeological excavation carried out in Alghero by the University of Sassari brought to light sixteen trenches containing the burials of 183 individuals. The trenches were of variable length ranging from a minimum of 2 to a maximum of 11 meters, and containing on average 10-15 individuals (ranging from a minimum of 2 to a maximum of 30 burials). The trenches were parallel and mainly oriented according to the northwest-southeast axis. This modality of burial, related to an epidemic episode, is rarely attested in the ancient world, not only in Sardinia and Italy, but throughout the Mediterranean area. The only exception is represented by similar burials excavated in southern France, although more recent than those of Alghero (17th-18th centuries).

The trenches of Alghero testify to a catastrophic event, which created the necessity to bury in a short period of time a large number of victims. The taphonomic analyses revealed a variety of positions of the head, upper and lower limbs, attesting a hasty deposition. However, the bodies were deposited according to a well-defined pattern, which was repeated systematically in each trench: the skull of all individuals was lying on the pelvis of the individual previously inhumated and the body is next to that deposited immediately afterwards. This demonstrates an attention to detail in the placement of the bodies of the deceased, which was aimed at maintaining a certain order and in some cases may have referenced relationships between the deads.

The anthropological and paleopathological study was conducted on 180 individuals, as the three individuals from trench 15 were not accessible for study. The population of Alghero included 51 females (28.3%), 36 males (20.0%), and 91 individuals of undetermined sex (50.6%), of which 86 were non-adults (47.7%). The paleodemographic profile demonstrated that the highest peak of mortality corresponds to the age range between 7 and 12 years, followed by the age group between 20 and 29 years, and this trend has been highlighted as peculiar to epidemic cemeteries. In contrast to attritional cemeteries, where there is a greater presence of infants and the elderly, in catastrophic burials, including those resulting from epidemics, mortality shows greater homogeneity across the age groups; this supports the idea that the plague acts in a non-selective way and therefore all individuals have the same risk of death, even if recent studies evidenced elements of selectivity, for example a risk of mortality increasing with age. In the demographic composition of the sample a slight prevalence of females was observed; this could reflect the original composition of the Alghero population, in which the female group was prevalent. The demographic patterns of Alghero present similarities with those of other contemporary plague cemeteries, such as that of Les Fedons in France and Dendermonde in Belgium, in particular the large proportion of non-adult individuals, among which the children older than 5 years and the adolescents are overrepresented.

The mean male stature (n=32) is 162.5 cm, while the mean female stature (n=50) is 154.9 cm. The results are similar to the averages recorded for the post-medieval age for Sardinian populations.

The analysis of non-metric traits revealed a high frequency of lambdoid ossicles (54.4%), parietal foramen (54.2%), zygomatic foramen (48.4%), mastoid foramen extrasutural (44.3%) and supraorbital foramen (40.0%) in the skull, and accessory transverse foramen of C6 (64.6%), double calcanear facet of the calcaneus (55.6%), squatting facet of the tibia (41.4%), and accessory transverse foramen of C5 (38.2%) for the post-cranial skeleton.

As for dental pathologies, 160 subjects were suitable for dental examination, as for 12 individuals the dentition was completely or largely not preserved and 8 children were excluded as they belong to the age range 0-2 years.

Caries were equally distributed in both sexes in the population of Alghero, with a frequency of 14.6% calculated on teeth and of 79.5% calculated on individuals, with no statistical difference between the two sexes. The majority of caries affects the crown, followed by the cemento-enamel junction, whereas the roots are rarely affected. Considering the affected surface, the interproximal caries are the most common, followed by the occlusal surface, whereas the buccal and lingual caries are very rare. As for the severity, the majority of carious lesions are superficial. Also non-

adults were affected by caries, observed in 9.4% of teeth and 69.8% of individuals. The patterns of caries in the Alghero population are typical of the post-Medieval period. This trend is attributed to a change in dietary habits after the Middle Ages, when an increase in the consumption of soft foodstuffs and, most of all, of refined carbohydrates and other cariogenic food occurs. The homogeneity in the frequency of caries between males and females suggests an equal alimentation between sexes.

Dental abscesses were not particularly common in the population of Alghero, with 1% of alveoli and 17.5% of individuals affected. The low prevalence of abscesses in the population of Alghero is probably linked to the low aggressiveness of caries: in fact the majority of lesions in adults are superficial. In addition, it is likely that the most severe carious lesions were treated with tooth extraction, thus preventing the development of infection.

Alveolar resorption, associated to poor oral hygiene, was diffuse, with 85.9% of the adult individuals affected, of which 50.7% was of grade 2-3. Ante-mortem tooth loss, related to complication of caries, tooth extraction and calculus deposits, was observed with a frequency on teeth of 8.5% and on individual of 53.8%. A high general prevalence of calculus in the population of Alghero, observed on 90.5% of individuals, with 45.2% in the strong form, indicates a poor oral hygiene and can explain the high rates of ante mortem tooth loss. No sexual differences are observed in all these dental indicators, evidencing equal and uniform access to diet and absence of dental hygiene for both males and females.

As for dental wear, in this population it was moderate with total average score of 4 among both sexes. The patterns of dental wear confirm that the population consumed the same type of food and had access to highly processed refined food instead of abrasive diet. The moderate wear can be also be correlated to the high frequency of caries observed in the Alghero population: in fact, the abrasiveness of food naturally cleans the teeth removing both food and bacteria and thus helping reducing the number of occlusal caries.

Considering the stress indicators, in the population of Alghero enamel hypoplasia exhibits high frequency, with 86.4% of the observed teeth and 97.7% of the observed individuals affected, with an overall mean number of defects of 2.2 per individual. The chronological distribution of the defects by age class demonstrates increasing values with increasing age, which reach the highest frequencies between 3 and 4 years, corresponding with the phase after weaning, which in Modern Age non-industrialised communities occurred between 2 and 3 years. Weaning was a critical period for non-adults, as it exposed them to deficiencies in nutrients and to frequent diarrheal infections. The population of Alghero appears to have suffered from major stress during infancy in comparison to other plague populations of the same period, in particular Les Fedons (France) and Dendermonde (Belgium), which exhibit lower frequency of enamel hypoplasia.

Cribra cranii was prevalent on the male individuals (29.4%) in comparison to females (7%) and non-adults (5.2%), but in all cases the condition was of grade 1. Also *cribra orbitalia* were more frequent in males (50%) and children (48.3%) than in females (18.2%), and was prevalently of grade 1 as well. The prevalence of *cribra cranii* and *cribra orbitalia* in males is anomalous, but could be explained by differences in gender activities and labor. Males were likely more occupied with work in the countryside, which was rich in marshes, pools, and water stagnations, exposing them to a higher risk of contracting malaria in comparison to females, who remained more often in the city caring for the house and children. *Cribra orbitalia* in non-adults can be explained with the presence of multiple nutritional deficiencies. The population of Alghero exhibited lower frequency of *cribra cranii* when compared to the assemblage of Dendermonde (Belgium), whereas as *cribra orbitalia* similar values were observed in comparison with the same population of Dendermonde and that of Les Fedons.

Periosteal reaction was observed in 54.8% of the observed long bones of the lower limbs, mostly in the diffuse and mild form, attesting that the population was not exposed to a great pathogen load and probably lived in a quite healthy environment not associated to particularly dangerous physical activities and trauma. Both sexes showed similar patterns of this stress indicators, evidencing the same sensitivity to life conditions, physical activities and exposure to pathogens. The frequency of periosteal reaction in the Alghero population was higher in comparison to that of the samples of Dendermonde, reflecting a lifestyle exposed to major stress, probably related to the agrarian works in which both females and males were engaged.

The analysis of degenerative joint disease revealed that 15.5% of joints in females and 28.3% in males were affected, with a significant statistical difference among sexes, with an increase of the condition with progressing age. However, the majority of affected individuals (68.4%) presented a grade 1 osteoarthritis. Females exhibited an equal distribution of osteoarthritis both in the upper and lower limbs, whereas male showed a higher frequency in the upper limbs. The distribution of the degenerative changes in the Alghero skeletons suggests that the males underwent a more

demanding physical activity in comparison to females; the occupation of males resulted in an overuse of the shoulders and upper limbs.

The study of entheseal changes demonstrated that the population of Alghero constituted a physically active human group, who carried out physically demanding and non-sedentary work and that these working activities involved the division of labor between the two sexes. In general, the muscle development of male individuals is greater than that of female individuals, suggesting more demanding physical activities for the male subsample. The high development of the gluteus maximus and the Achilles tendon in both sexes suggests that these individuals often traveled on foot, whereas the development of muscles of the arm in females seems to be related with activities involving the use of the upper limbs.

The paleopathological study of the sample from Alghero revealed a variety of conditions. All the traumas are represented by fractures, healed in the majority of cases. Their localization, particularly involving upper and lower limbs, permits to hypothesize accidental traumas, with only a few cases of blunt force traumas, interpretable as intentional lesions. The active life of this populations is also attested by the presence of osteochondritis dissecans, even in atypical sites. Among infectious diseases, 3 cases of osteomyelitis were recorded.

A child aged 4-5 years presented dental anomalies in the permanent dentition demonstrating a disturbance of enamel development during the perinatal period and early infancy. These stigmata are compatible with the use of mercury to treat some systemic disease.

Among the skeletons from Alghero two possible cases of brucellosis were identified, of which that observed in a female aged 30-40 years is more convincing. This infectious disease is likely in this area, where the breeding of sheep and goats was one of the most important economic activities.

Several individuals, prevalently non-adults, presented lytic lesions localised on the anterior portion of the vertebral bodies of the thoracic and lumbar segment. The nature of these lesions remains unclear; however, if in some cases these changes can be interpreted as enlarged vascular foramina, related to normal bone development, in the most severe cases they could be considered pathological and should be referred to tuberculosis, brucellosis, malaria, or other pathological conditions.

A possible case of rheumatoid arthritis is suspected, at the initial stage.

In the population of Alghero no cases of malignant tumors were detected; only two benign tumors were diagnosed, two osteomas, one on the zygomatic process and one on the frontal bone.

Several congenital diseases were diagnosed in this population, including brachycephaly, atlas occipitalisation, posterior arch defect of the atlas, Klippel-Feil syndrome and congenital fusion of cervical vertebrae, coccyx sacralization, lumbarisation of the first sacral vertebra, spondylolysis, and acetabular dysplasia. It is noteworthy the diagnosis of a case of Camurati-Engelman disease, which represents the unique evidence of this rare genetic condition in the paleopathological literature.

Finally, a case of DISH was identified.

Future perspectives will include further attempts to obtain molecular results from this samples, which could provide biological traces of the bacterium responsible of the plague outbreak that ravaged Alghero at the end of the 16th century. It will be critical to determine the clade of this epidemic wave in order to reconstruct the phylogenetics of the infective agent and to compare it with the organisms ascertained for earlier and later epidemics. Furthermore, additional specialist analysis could be made on this skeletal material by using different techniques. For example, the analysis of dental calculus through scanning electron microscopy (SEM) or light microscopy will allow the detection of phytoliths, vegetal and animal fibers, which can provide information about the diet and occupational activities of this group. Similarly, the stable isotope analysis of oxygen could be performed in order to ascertain the geographical provenance of the inhabitants of the city, giving evidence of the repopulation movements attested by historical sources. The paleonutritional analysis through the stable isotopes of carbon and nitrogen can reconstruct more in detail the diet of this population, and can be used to integrate the information from historical sources.

The rarity of human remains from epidemic contexts and buried in trenches makes the skeletal sample from Alghero a valuable material offering a detailed bioarchaeological picture of a population of post-medieval age which has faced a plague epidemics. This sample could also be used in the future for comparison with other populations of different geographical and chronological plague contexts.

Appendix

1. Methods

Skull
Metopic suture
partial
complete
Supraorbital foramen
Infraorbital suture
partial
complete
Multiple infraorbital foramen
with a division within
two distinct foramina
more than two
Zygomatic foramina
one
more than one
Parietal foramen
present on the parietal bone
present on the suture
Epipteric bone
Coronal ossicle
Bregmatic bone
Sagittal ossicle
Apical bone
Inca bone
Lambdoid ossicles
Asterionic bone
Parietal notch bone
Mastoid foramen extrasutural
Condylar canal
Double occipital condylar facet
Precondylar tubercle

Table 1. Non-metric traits of the skull

Sternum
Sternal perforation
Xiphoid perforation
Vertebrae
Atlas: double facet
C3: accessory transverse foramen
C4: accessory transverse foramen
C5: accessory transverse foramen
C6: accessory transverse foramen
C7: accessory transverse foramen
Scapula
Circumflex sulcus
Suprascapular foramen
Unfused acromial epiphysis
Supraglenoid articular facet
Humerus
Septal aperture
Small (pinhole)
True perforation
Supracondiloid process
Os coxae
Acetabular crease
Accessory sacral facets
Sacrum
Accessory sacral facets
Sacralization of L5-S1
Femur
Poirier's facet
Allen's fossa
Exostosis in trochanteric fossa
Exostosis fovea capitis
Patella
Vastus notch
Patella emarginata
Tibia
Squatting facets
Foot
Double calcaneal facet (calcaneus)
Trochlear extension (talus bone)
Accessory facet head of 1st metatarsal

Table 2. Non-metric traits of the post-cranial skeleton

Enthesis	Movement	Functional complex
M. deltoideus (clavicle)	Abduction, flexion and extension of the arm	Shoulder
Costoclavicular ligament (clavicle)	All the movements of the shoulder	Shoulder
Conoid ligament (clavicle)	All the movements of the scapulo-clavicular joint	Shoulder
Trapezoid ligament (clavicle)	All the movements of the scapulo-clavicular joint	Shoulder
M. pectoralis major (clavicle)	Adduction and anteversion of the arm	Shoulder
M. triceps brachii (scapula)	Extension of the forearm on the arm	Elbow
M. pectoralis major (humerus)	Adduction and flexion of the arm	Shoulder
M. lat. dorsii/teres major (humerus)	Adduction and external rotation of the arm	Elbow
M. deltoideus (humerus)	Abduction of the arm	Shoulder
M. brachioradialis (humerus)	Flexion of the forearm on the arm	Elbow
M. biceps brachii (radius)	Flexion of the forearm on the arm	Elbow
M. pronator teres (radius)	Pronation and flexion of the forearm	Forearm
Interosseous membrane (radius)	Supination and pronation of the forearm	Forearm
M. triceps brachii (ulna)	Extension of the forearm on the arm	Elbow
M. brachialis (ulna)	Flexion of the forearm on the arm	Elbow
M. supinator (ulna)	Supination of the forearm	Forearm
M. gluteus maximus (femur)	Extension and external rotation of the femur	Hip
M. ileopsoas (femur)	Flexion of the thigh on the pelvis	Hip
M. vastus medialis (femur)	Extension of the leg on the thigh	Knee
Quadriceps tendon (tibia)	Extension of the leg on the thigh	Knee
M. soleus (tibia)	Extension of the foot	Foot
Quadriceps tendon (patella)	Extension of the leg on the thigh	Knee
Achilles tendon (calcaneus)	Extension of the foot	Foot

Table 3. List of muscle and ligament attachment sites examined in this study

2. Age and sex of the individuals

	Trench	SU	Sex	Age range (years, unless specified otherwise)	Mean age
1.	1	2175	ND	11-13	12
2.		2183	ND	5-7	6
3.		2225	F	25-30	28
4.		2228	ND	10-12	11
5.		2229	ND	12-13	12
6.	2	2176	ND	15-20	17
7.		2181	F	30-40	35
8.		2185	M	35-45	40
9.		2207	M	19-22	20
10.		2208	F	17-22	19
11.		2209	ND	0-5 months	1 month
12.		2247	M	30-40	35
13.		2248	ND	11-12	12
14.		2249	ND	12-14	13
15.		2250	ND	2-3	2.5
16.		2251	ND	30-40	35
17.		2252	F	30-40	35
18.	3	2178	F	35-45	40
19.		2182	ND	2-3	2.5
20.		2186	ND	12-14	13
21.		2202	M	20-30	24
22.		2204	ND	12-14	13
23.		2205	ND	3-4	3.5
24.		2206	ND	12-14	13
25.		2212	F	30-35	32
26.		2213	F	35-45	40
27.		2215	M	30-35	33
28.		2224	ND	12-14	13
29.		2235	M	25-32	29
30.		2254	F	35-45	40
31.	4	2177	F	25-35	30
32.		2179	M	45-55	50
33.		2201	ND	12-15	14
34.		2211	F	25-35	30
35.		2217	M	50-60	55
36.		2218	ND	9-11	10
37.		2219	M	20-30	25
38.		2220	ND	6-8	7
39.		2221	ND	9-11	10
40.		2222	ND	6-8	7
41.		2223	ND	7-9	8

Table 4. The 183 individuals from the 16 trenches

	Trench	SU	Sex	Age range (years, unless specified otherwise)	Mean age
42.		2230	F	18-22	20
43.		2231	F	18-22	20
44.		2232	M	25-35	30
45.		2234	ND	3-5	4
46.		2236	F	30-35	30
47.		2237	F	45-55	50
48.		2238	F	22-28	25
49.	5	2180	ND	9-10	9
50.		2187	ND	12-14 months	18 months
51.		2188	F	25-34	29
52.		2189	ND	13-15	14
53.		2255	F	40-50	45
54.		2256	ND	7-8	7.5
55.		2257	ND	12-24 months	18 months
56.		2258	ND	6-8	7
57.		2259	ND	5	5
58.		2260	ND	6-8	7
59.	6	2214	F	25-40	32
60.		2216	F	16-20	18
61.	7	2274	ND	7-9	8
62.		2275	ND	4-5	4
63.		2276	F	18-22	20
64.		2277	ND	5-6 months	5-6 months
65.		2278	M	35-45	40
66.		2279	M (?)	35-45	40
67.		2280	F?	35-45	40
68.		2281	F	18-26	22
69.		2282	ND	15-20	18
70.		2283	ND	8-9	8
71.		2284	M	35-45	40
72.		2285	F	20-30	25
73.		2286	M	20-25	23
74.	8	2289	F	35-45	40
75.		2290	ND	9	9
76.		2291	ND	9-10	9
77.		2292	F	25-30	27
78.		2293	F	40-50	45
79.		2294	ND	15-17	16
80.		2295	F	40-50	45
81.		2296	ND	14-15	14
82.		2297	F	18-22	20
83.	9	2298	F	20-24	21

Table 4. Continued

	Trench	SU	Sex	Age range (years, unless specified otherwise)	Mean age
84.		2299	ND	15-18	17
85.		2300	M	25-30	28
86.		2301	M	40-50	45
87.		2307	F	40-45	43
88.		2308	F	30-40	35
89.		2309	M	30-40	35
90.		2310	ND	8-9	8
91.		2311	M	30-40	35
92.		2312	ND	9-12 months	10 months
93.	10	2513	ND	12-13	12
94.		2514	F	30-35	33
95.		2515	ND	9-11	10
96.		2516	F	20-30	24
97.		2517	ND	10-12	11
98.		2518	M	35-45	40
99.		2519	F	35-45	40
100.		2520	ND	1-2	1.5
101.		2521 (?)	M	20-30	25
102.		2522	ND	9-10	9
103.		2523	F	20-30	25
104.		2524	ND	10-12	11
105.		2525	ND	0.5-1	1
106.		2526	M	25-35	30
107.		2527	ND	2-3	2.5
108.		2528	F	35-45	40
109.		2529	F	18-22	21
110.		2557	ND	10-12	11
111.		2558	ND	12-14	13
112.		2559	ND	35-45	40
113.		2560	ND	16-20	18
114.		2760	F	45-55	50
115.		2761	ND	1.5-3	2
116.		2762	ND	9	9
117.		2763	F	40-50	45
118.		2764	ND	5-7	6
119.		2765	F	35-45	40
120.		2792	ND	newborn	newborn
121.		2793	F	40-50	45
122.		2794	F	30-40	35
123.	11	2550	F	18-22	20
124.		2551	F	25-35	30
125.		2552	ND	13-15	14

Table 4. Continued

	Trench	SU	Sex	Age range (years, unless specified otherwise)	Mean age
126.		2553	ND	6-7	6
127.		2554	F	30-35	33
128.		2555	ND	2-3	2.5
129.		2857	F	18-22	20
130.		2858	M	30-40	35
131.		2859	M	40-50	45
132.		2860	ND	14-15	15
133.		2861	F	35-40	37
134.		2862	ND	>30	>30
135.		2863	ND	13-15	14
136.		2864	ND	12-14	13
137.	12	2386	ND	13-15	14
138.		2396	M	25-30	27
139.		2412	F	18-24	22
140.		2413	ND	4	4
141.		2414	ND	15-20	17
142.		2415	ND	7-9	8
143.		2416	ND	30-35	32
144.		2417	ND	2-4	3
145.		2418	ND	8-9	9
146.		2419	ND	3-4	3.5
147.		2420	ND	20-25	23
148.		2421	ND	9-10	9
149.		2422	M	35-40	37
150.		2423	ND	20-30	25
151.		2424	ND	25-35	30
152.		2425	M	25-35	30
153.		2426	M	40-50	45
154.	13	5112	ND	1.5-2	1.5
155.		5113	ND	14-16	15
156.		5114	ND	14-15	15
157.		5115	M	20-30	25
158.		5116	M	40-50	45
159.		5117	M	25-30	27
160.		5118	F	40-50	45
161.		5119	ND	10-12	11
162.		5120	F	30-40	35
163.		5121	ND	12-15	14
164.		5123	F + feto	20-22 + foetus	21 + foetus of 14-16 weeks
165.		5124	ND	5-6	5.5
166.		5125	M	40-50	45

Table 4. Continued

	Trench	SU	Sex	Age range (years, unless specified otherwise)	Mean age
167.		5126	ND	6-8	7
168.		5127	ND	10-12	11
169.		5128	ND	9-11	10
170.	14	2496	M?	25-35	30
171.		2909	M	28-35	30
172.		2926	F	17-23	20
173.		2946	ND	10-11	10
174.		2959	ND	14-16	15
175.		5089	ND	11-15	12
176.		5108	M?	25-30	27
177.	15	5242	ND	–	–
178.		5249	ND	–	–
179.		5249	F	–	–
180.	16	2978	M	50-60	55
181.		2979	F	16-21	18
182.		5074	ND	7-9	8.5
183.		5075	M?	25-30	27

Table 4. Continued

3. Taphonomy

Positions with both flexed upper limbs	**N. IND**	**% (n=128)**
On the thorax	23	18.0
On the abdomen	29	22.6
On the pubis	14	10.9
One on the thorax, the other on the abdomen	9	7.0
One on the thorax, the other on the opposite scapula	3	2.3
One on the abdomen, the other on the pubis	6	4.7
One on the thorax, the other on the pubis	6	4.7
Both on the thorax, the right hand under the left elbow, the left hand under the right elbow	3	2.3
One at the side of the body at the level of the thorax, the other on the thorax	4	3.1
One at the side of the body at the level of the pubis, the other on the pubis	3	2.3
One at the side of the body at the level of the thorax, the other on the abdomen	1	0.8
One at the side of the body at the level of the pubis, the other on the abdomen	6	4.7
Hyper-flexed, at the side of the body with the hands on the corresponding scapulae (figure 12)	1	0.8
One on the pubis, the other hyper-flexed with the hand on the corresponding scapula	1	0.8
One on the thorax, the other far from the body with the hand on the corresponding scapula	1	0.8
One far from the body with the hand at the level of the abdomen, the other on the pubis	4	3.1
Both hyper-flexed under the chin (fig. 13)	1	0.8
One on the thorax, the other under the chin	3	2.3
One on the abdomen, the other hyper-flexed at the level of the skull	1	0.8
Flexed on themselves with the hands on the corresponding scapulae	1	0.8
One hyper-flexed with the hand on the opposite scapula, the other on the abdomen with the hand under the opposite elbow	1	0.8
One hyper-flexed with the elbow on the skull, the other on the pubis (fig. 14)	1	0.8
Hyper-flexed, both over the skull	1	0.8
Both far from the body, along the thorax	1	0.8
Hyper-flexed, both over the skull with the hands on the face	1	0.8
Both over the skull (fig. 15)	1	0.8
Hyper-flexed, one on the skull and the other on the face	1	0.8
One on the thorax, the other hyper-flexed over the skull (fig. 16)	1	0.8
Position with an arm flexed and the other extended	**N. IND**	**% (n=7)**
Flexed with the hand on the abdomen	2	28.6%
Flexed with the hand near the pubis	3	42.8%
Flexed on the thorax	1	14.3%
Hyper-flexed with the hand under the chin	1	14.3%
Total	7	100%
Position with an arm flexed and the other not determinable	**N. IND**	**% (n=24)**
Flexed with the hand on the abdomen	6	25.0%
Flexed with the hand on the pelvis	6	25.0%
Flexed with the hand on the thorax	8	33.3%
Hyper-flexed with the hand over the skull	3	12.5%
Flexed with the hand under the chin	1	4.2%
Total	24	100%

Table 5. Variants observed in individuals with different positions of upper limbs

4. Stature data

SU	Median age	Stature (cm)	Error ranges (cm)	Long bone
2208	17-22	166.6	± 5	Radius
2230	18-22	151.2	± 5	Humerus, radius, ulna
2231	18-22	155.6	± 5	Radius
2276	18-22	163.0	± 4	Fibula
2550	18-22	151.2	± 4	Fibula
2857	18-22	145.8	± 4	Fibula
2926	17-23	158.2	± 4	Tibia
5123	20-22	156.6	± 4.5	Femur, tibia, fibula
2979	16-21	148.3	± 5	Ulna
2298	20-24	152.1	± 4.5	Femur
2529	18-22	146.6	± 4.5	Femur, tibia, fibula
2281	18-26	151.0	± 5	Humerus, radius, ulna
2516	20-30	150.3	± 4	Tibia, fibula
2238	22-28	152.8	± 5	Humerus, radius
2285	20-30	159.9	± 4	Tibia
2523	20-30	152.2	± 4.5	Femur, fibula
2292	25-30	155.9	± 4	Fibula
2225	25-30	149.4	± 4	Tibia, fibula
2188	25-34	166.3	± 4	Tibia, fibula
2177	25-35	160.8	± 5	Humerus
2211	25-35	155.1	± 4	Fibula
2236	30-36	166.8	± 4	Tibia
2551	25-35	155.5	± 4	Tibia, fibula
2212	30-35	155.2	± 5	Radius
2214	25-40	159.4	± 4.5	Femur, tibia
2514	30-35	164.3	± 4	Tibia, fibula
2554	30-35	150.5	± 5	Radius, ulna
2181	30-40	152.9	± 5	Humerus, radius, ulna
2252	30-40	154.4	± 4	Fibula
2308	30-40	163.4	± 4	Fibula
2794	30-40	146.0	± 5	Humerus, radius, ulna
5120	30-40	150.1	± 4.5	Femur, fibula
2861	35-40	157.4	± 4.5	Femur, tibia
2528	35-45	148.3	± 4	Tibia, fibula
2178	35-45	153.7	± 4	Fibula
2213	35-45	151.5	± 5	Radius, ulna
2254	35-45	155.5	± 5	Humerus, radius
2289	35-45	156.6	± 4	Fibula
2519	35-45	148.8	± 4.5	Femur
2765	35-45	157.6	± 4.5	Femur, tibia, fibula
2307	40-45	148.7	± 4	Fibula
2255	40-50	150.5	± 4	Fibula

Table 6. Stature of female individuals

SU	Median age	Stature (cm)	Error ranges (cm)	Long bone
2293	40-50	154.4	± 5	Radius, ulna
2295	40-50	137.5	± 4	Fibula
2763	40-50	162.3	± 4	Tibia, fibula
2793	40-50	152.7	± 4.5	Femur, tibia, fibula
5118	40-50	159.4	± 4	Fibula
2760	45-55	154.8	± 4.5	Femur
2237	45-55	166.9	± 4	Tibia, fibula
2280	35-45	157.8	± 4.5	Femur

Table 6. Continued

SU	Age	Stature (cm)	Error ranges (cm)	Long bone
2207	19-22	162.4	± 5	Radius
2286	20-25	155.1	± 4	Fibula
2202	20-30	149.4	± 4	Fibula
2219	20-30	156.8	± 5	Humerus, radius, ulna
5115	20-30	159.3	± 4.5	Femur, fibula
5117	25-30	166.1	± 4	Fibula
2300	25-30	146.7	± 4	Tibia, fibula
2235	25-32	167.1	± 5	Humerus, radius, ulna
2232	25-35	166.3	± 4	Fibula
2425	25-35	169.1	± 5	Radius, ulna
2526	25-35	170.5	± 4.5	Femur, tibia, fibula
2909	28-35	164.8	± 5	Ulna
2215	30-35	160.3	± 5	Radius, ulna
2247	30-40	174.9	± 4.5	Femur, fibula
2309	30-40	168.4	± 4	Fibula
2311	30-40	163.1	± 5	Humerus, radius, ulna
2858	30-40	156.9	± 4.5	Femur, tibia, fibula
2422	35-40	157.3	± 4	Fibula
2185	35-45	163.7	± 5	Humerus, radius, ulna
2278	35-45	174.4	± 4.5	Femur, tibia
2284	35-45	160.1	± 5	Radius
2518	35-45	154.7	± 4.5	Femur, tibia
2301	40-50	165.4	± 5	Radius
2859	40-50	173.0	± 4.5	Femur, tibia
5116	40-50	168.4	± 4.5	Femur
5125	40-50	164.8	± 4.5	Femur, tibia, fibula
2179	45-55	161.4	± 5	Radius, ulna
2978	50-60	163.8	± 5	Humerus, radius, ulna
2521	20-30	157.2	± 5	Humerus, radius, ulna
5075	25-30	156.0	± 4	Tibia, fibula
2496	25-35	162.4	± 4	Tibia, fibula
2279	35-45	159.8	± 5	Ulna

Table 7. Stature of male individuals

Chapter 5

The catalogue of the individuals of each trench

Trench 1

SU 2175

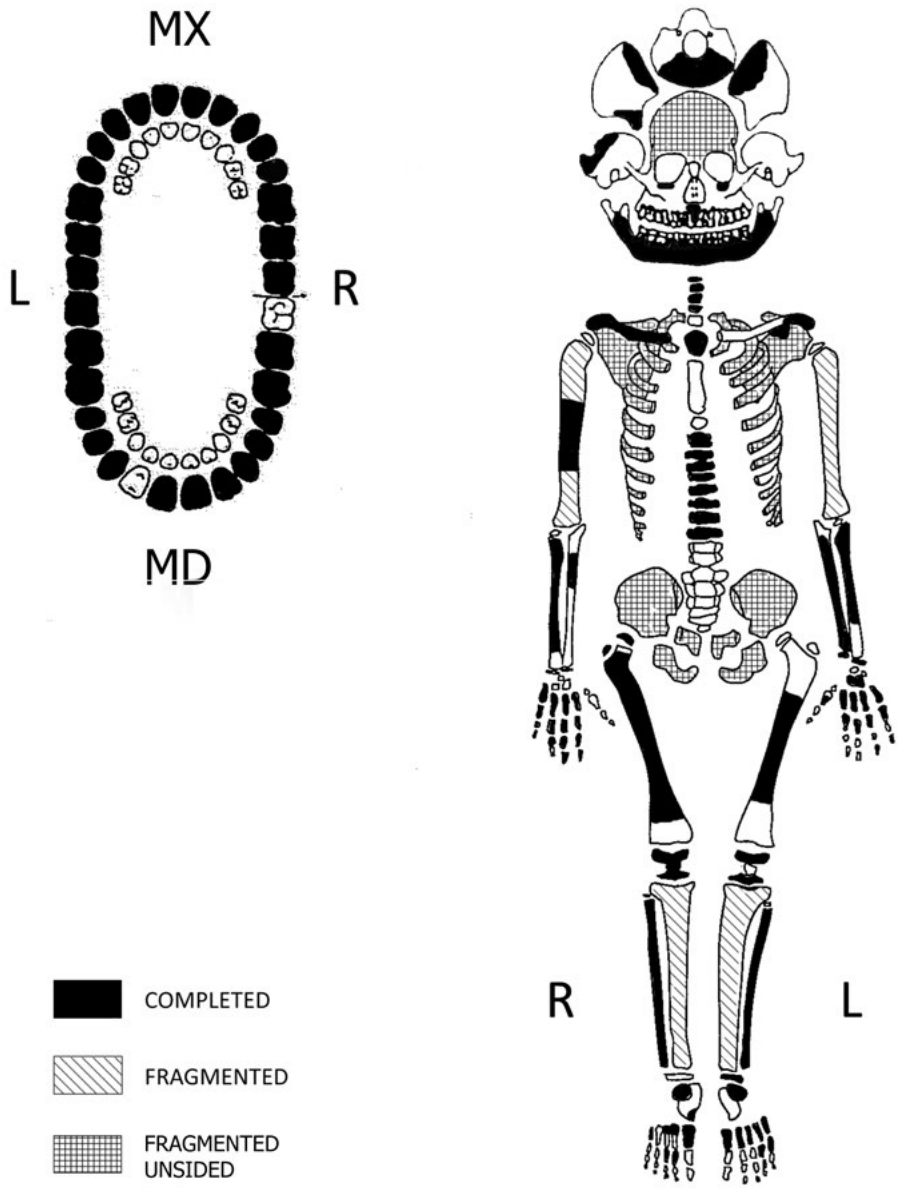


Figure 1

Sex: undeterminable

Age: 11-13 years
Age at death was determined on the basis of dental eruption, stage of development of permanent teeth, and degree of fusion between diaphyses and epiphyses.

Dental pathologies
All of the preserved maxillary teeth are isolated, except for the left second incisor, which was lost post-mortem; the mandibular teeth are in situ, except for the left incisors, canine, premolars and first and second molar, which are isolated. The maxillary right third molar and the mandibular molars are in form of germs.
This individual had six caries, all occlusal and of grade 1, which are as follows: one caries on the left maxillary left first molar, one on the right maxillary first molar, two on the mandibular left first molar, one on the mandibular first right molar and one on the mandibular second right molar.

Enamel hypoplasia occurred between 2 and 4 years, with four episodes.
Mild calculus affects the mandibular teeth. There is no alveolar resorption.

Anatomical variants
In the skull the complete supraorbital foramen on the left, one zygomatic foramen on the right and multiple foramina on the left, and the parietal foramen on both sides are present; in the post-cranial skeleton the double anterior facet is present on the left calcaneus.

Pathologies
Lytic lesions are visible on the anterior portion of the thoracic and lumbar vertebrae. Diffuse grade 1 periosteal reaction affects both femurs.

SU 2183

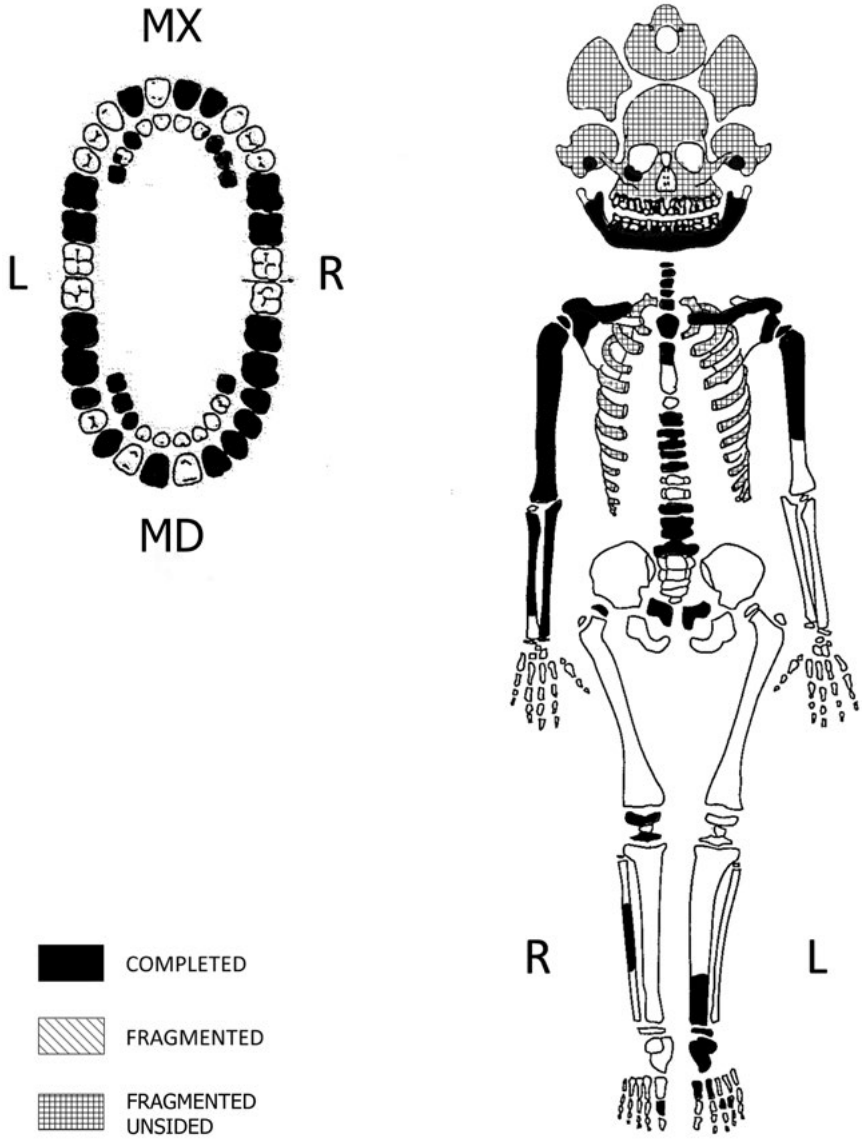


Figure 2

Sex: undeterminable

Age: 5-7 years
Age at death was determined on the basis of dental eruption, degree of development of permanent teeth, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
In this individual, the maxillary teeth are isolated, while the mandibular ones are in situ. Some deciduous teeth are still present, which are the maxillary left canine and molars, the right second molar, and the mandibular canines and molars. The permanent teeth are all present, except for the maxillary incisor and first premolar, the right first incisor, the mandibular incisor, canine, premolars, and the right canine and premolars.
Enamel hypoplasia occurred between 1.5 and 4 years, with four episodes.
This individual had four caries affecting the deciduous teeth: one distal grade 3 caries on the maxillary left

first and second molar both at the cemento-enamel junction, one grade 2 mesial on the maxillary right second molar at the cemento-enamel junction, and one grade 1 buccal on the mandibular canine.
Mild calculus affects the mandibular teeth.

Anatomical variants
In the skull a zygomatic foramen is present on the right.

Pathologies
Lytic lesions are visible on the anterior portion of the bodies of the thoracic vertebrae; periosteal reaction is present on the external side of the ribs.

SU 2225

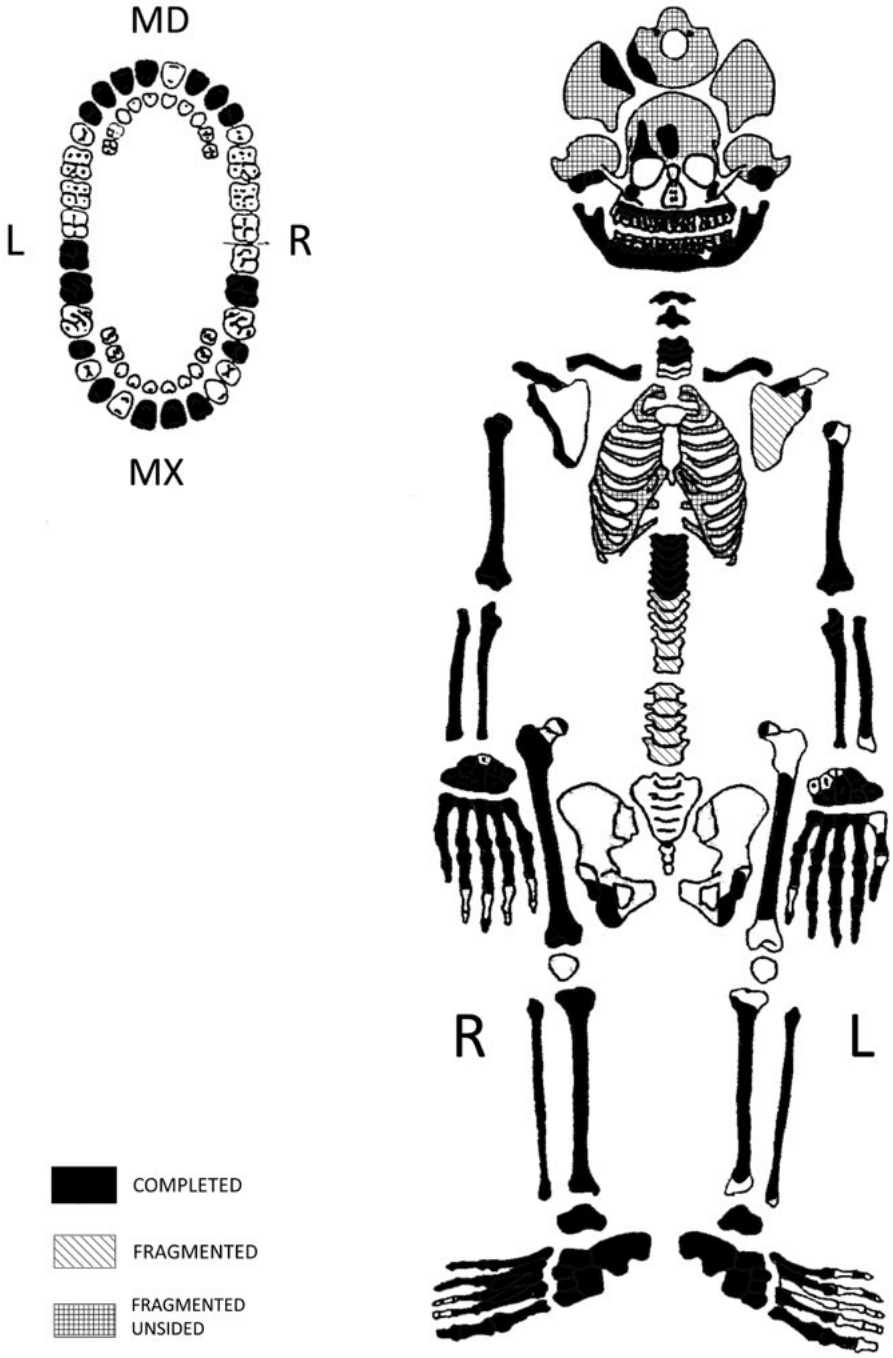


Figure 3

Sex: female
Sex was determined through the analysis of eleven morphological features of the skull, with a sexual index of -1.2.

Age: 25-30 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, and vertebral stage of fusion.

Stature: 145.4 cm

Dental pathologies

All maxillary and mandibular teeth are present in situ, except for the mandibular left incisors, which are isolated. The maxillary left first premolar and first molar, right first and third molar, mandibular left second premolars and all right and left molars were lost during life. The maxillary left second incisor, right canine and first premolar, and mandibular incisor and second premolar were lost post-mortem.

Grade 3 caries are observed at the cemento-enamel junction: one distal on the maxillary second molar and on the right first incisor, one buccal on the mandibular left canine and on the left first premolar; one grade 4 caries affects the maxillary left third molar and right premolar.

Alveolar resorption of grade 3 affects the maxilla.

Mild calculus is visible on the maxillary teeth and strong calculus on the mandibular teeth. Enamel hypoplasia occurred between 2 and 4.5 years, with five episodes.

Anatomical variants

In the skull the complete metopic suture, one zygomatic foramen on the left and multiple on the right, and the extrasutural mastoid foramen on the right are present. In the post-cranial skeleton the facet on the distal epiphysis of the right tibia and the anterior double facet on both calcanei are present.

Ergonomy

The individual shows a low-medium development of the muscular insertions, except for the trapezoid ligament of the clavicles and the pectoralis major of the humeri, which show a strong development.

Pathologies

Diffuse grade 1 periosteal reaction is visible on both femurs, right tibia and proximal portion of fibulae; localised grade 2 periosteal reaction is present on the half diaphysis, lateral portion of the left tibia, due probably to a microtrauma.

SU 2228

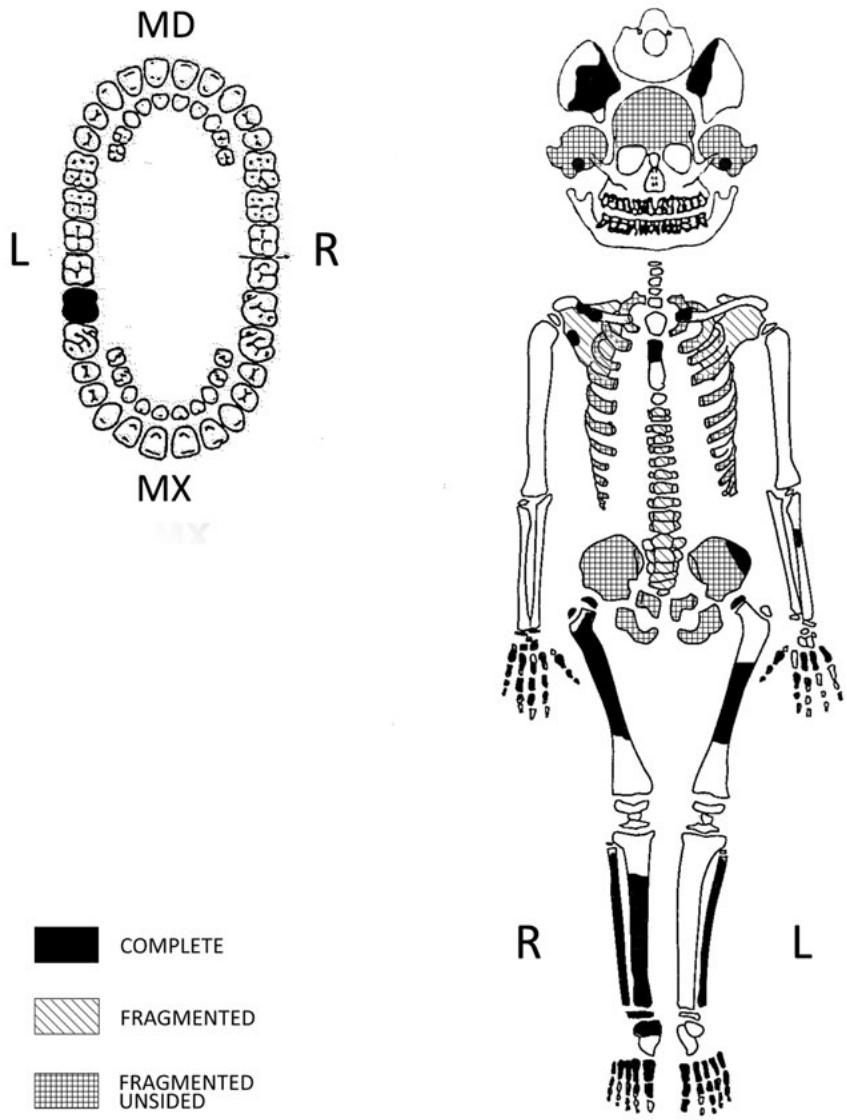


Figure 4

Sex: undeterminable

Age: 10-12 years
Age at death was determined on the basis of stage of fusion between diaphyses and epiphyses and stage of development of permanent teeth.

Dental pathologies
Only the maxillary left second molar is preserved isolated.

Pathologies
Lytic lesions are present on the anterior portion of the vertebral bodies.

SU 2229

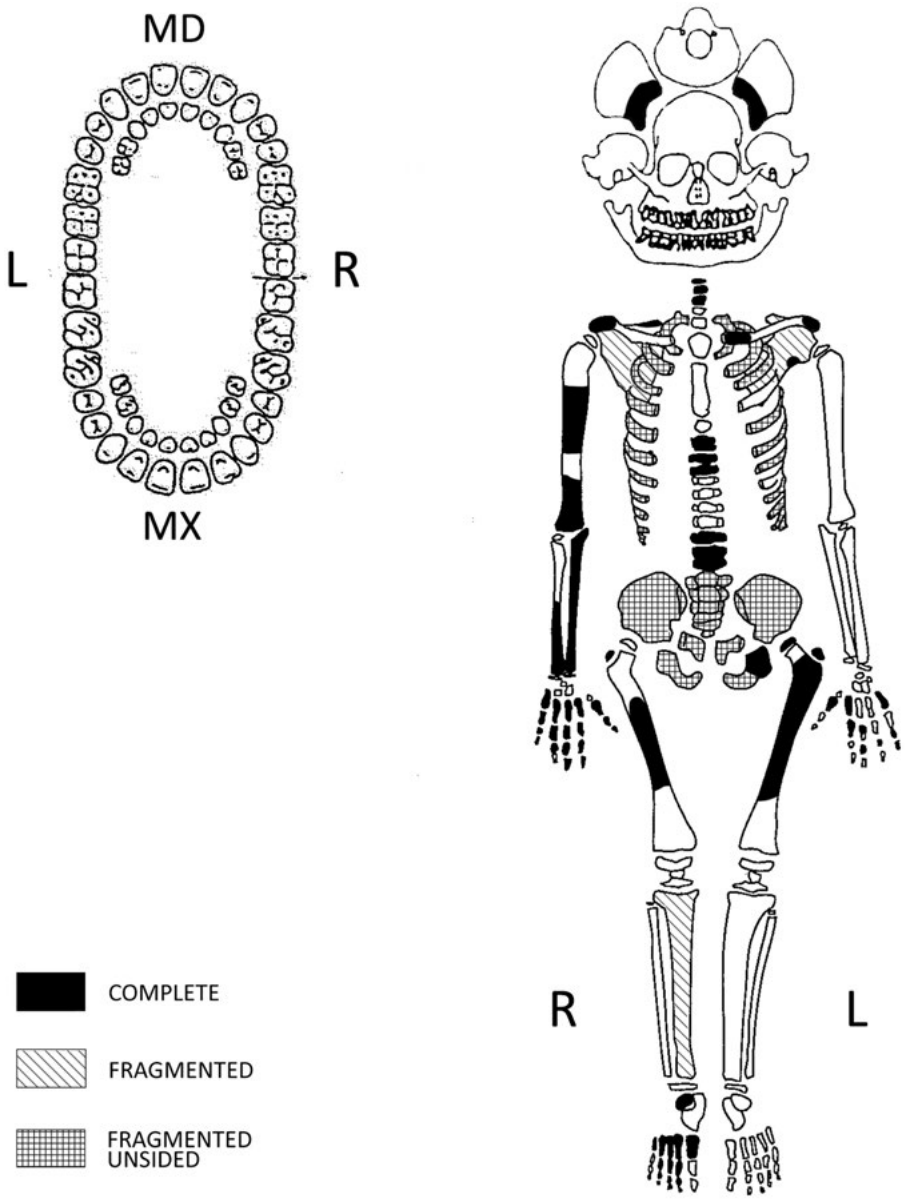


Figure 5

Sex: undeterminable

Age: 12-13 years
Age at death was determined on the basis of the degree of fusion between diaphyses and epiphyses and long bone length (right ulna).

Dental pathologies
No teeth are preserved.

Anatomical variants
In the skull the apical bone and the lambdoid ossicles on the right are present.

Pathologies
Lytic lesions are present on the anterior portion of the vertebral bodies of four thoracic and two lumbar vertebrae. Diffuse grade 1 periosteal reaction is visible on both femurs.

Trench 2

SU 2176

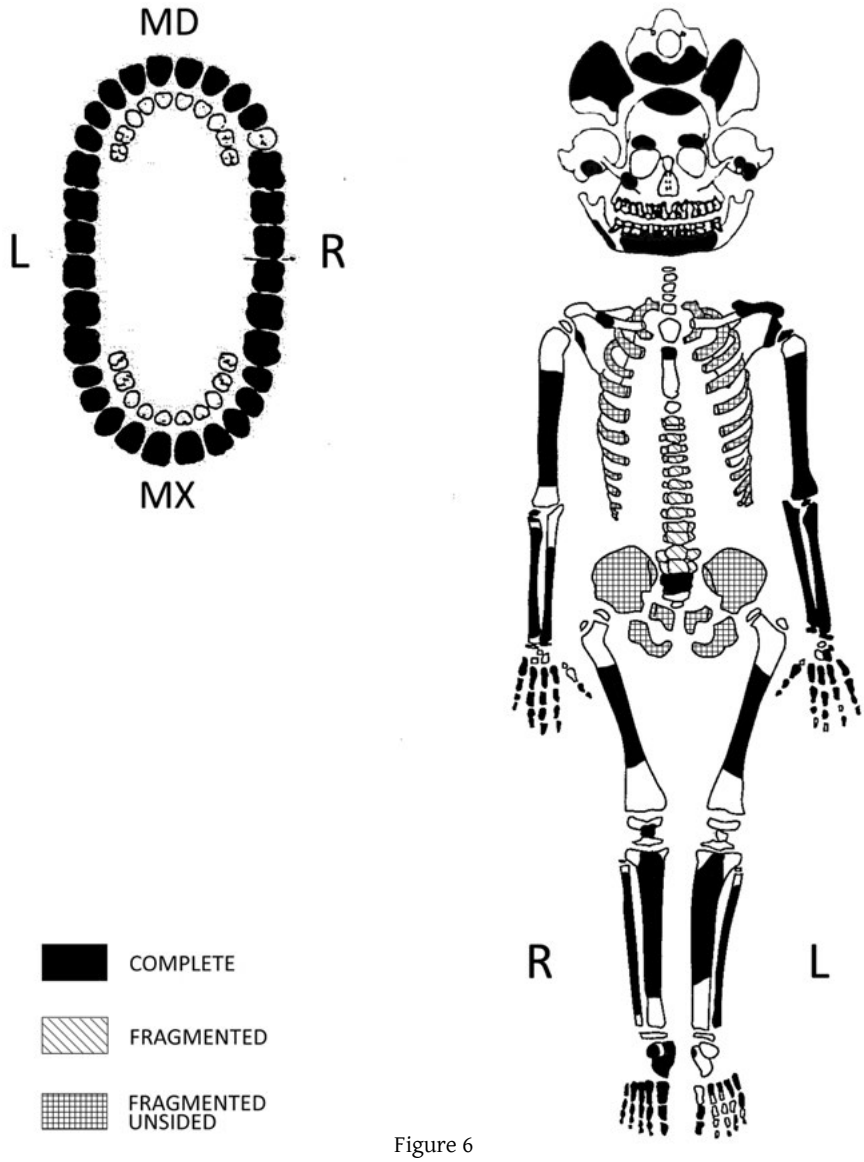


Figure 6

Sex: undeterminable

Age: 15-20 years
Age at death was determined on the basis of the dental wear, stage of dental eruption, stage of fusion between diaphyses and epiphyses, and sternal rib end modifications.

Stature: 163.5 cm

Dental pathologies
All the maxillary teeth are present isolated; all the mandibular teeth are present in situ, except for the right second premolar, which was lost post-mortem and the left third molar, which is isolated. The mandibular right third molar is in eruption.
Enamel hypoplasia occurred between 1.5 and 4.5 years, with six episodes.
Several occlusal grade 1 caries were observed: one on the maxillary second molar, three on the mandibular first left molar, two on the mandibular right first molar, and three on the mandibular molar.
The left mandibular canine is rotated.
Mild calculus affects the mandibular anterior teeth.

Anatomical variants
In the skull the zygomatic foramina on the right, parietal foramen on the right, as well as the apical bone, and some lambdoid ossicles on both sides are present; in the post-cranial skeleton the double anterior facet is visible on the right calcaneus.

Ergonomy
The individual shows a low development of the muscular insertions, except for the trapezoid ligament of the left clavicle and the brachialis of the right ulna which show a medium development.

Pathologies
Diffuse grade 1 periosteal reaction of affects both femurs.

SU 2181

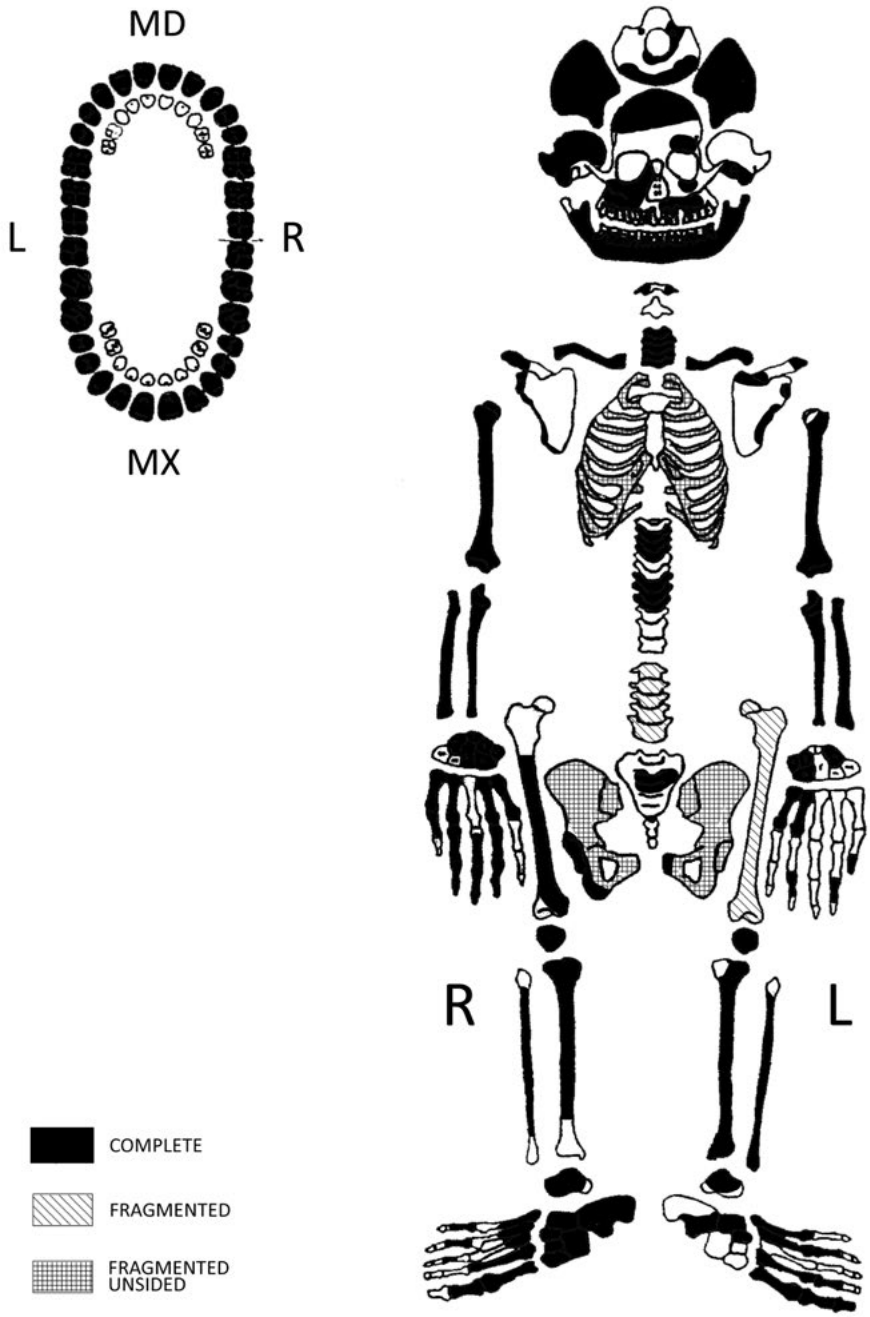


Figure 7

Sex: female
Sex was determined through the observation of fifteen morphological features of the skull and one of the pelvis, which provided a total sexual index of -1.30.

Age: 30-40 years
Age at death was determined on the basis of dental wear, stage of fusion of the vertebrae, and sternal rib end modifications.

Stature: 152.9 cm

Dental pathologies
All teeth are preserved and in situ, except for the maxillary left third molar, which is isolated.
There are several caries: one grade 1 occlusal caries on the mandibular left second molar, one grade 3 buccal caries on the mandibular left third molar, two grade 1 occlusal caries of the mandibular right second molar and one grade 4 caries of the maxillary right second molar.
Enamel hypoplasia occurred between 2 and 5 years, with seven episodes.
Mild calculus affects both the maxillary and the mandibular teeth.
Grade 1 alveolar resorption affects both the maxilla and the mandible.

Anatomical variants
In the skull the complete supraorbital foramen on the left, several zygomatic foramina on the left, lambdoid

ossicles on the left, and right parietal notch are present. In the post-cranial skeleton the transverse accessory foramen, complete on the left and partial on the right of C6, the exostosis of the fovea in the left femur, the squatting facet on the left tibia and the anterior double facet of the right calcaneus are present.

Ergonomy
The individual shows a low-medium development of the muscular insertions, except for the conoid ligament of both clavicles, triceps brachii of the left ulna, and brachialis of both ulnae, which present a strong development.

Pathologies
Grade 1 osteoarthritis affects the thoracic and lumbar vertebrae, with ossification of the yellow ligaments. Diffuse grade 1 periosteal reaction affects the left femur and both tibiae.

SU 2185

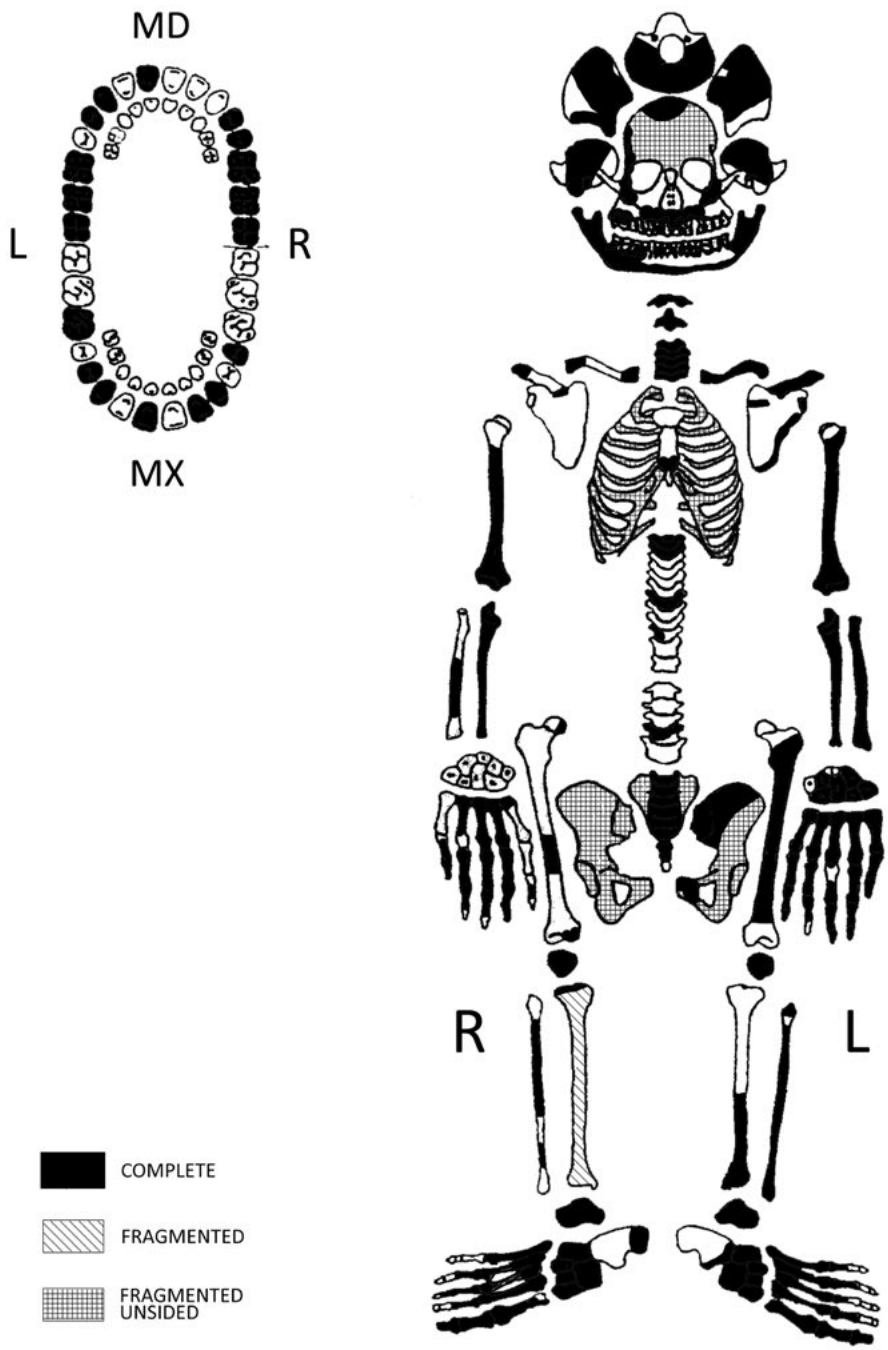


Figure 8

Sex: male
Sex was determined through the observation of thirteen morphological features of the skull and one of the pelvis, which provided a total sexual index of 0.8.

Age: 35-45 years
Age at death was determined on the basis of dental wear, stage of dental eruption, stage of fusion of the vertebrae, morphology of the auricular surface of the ilium, and sternal rib end modifications.

Stature: 163.7 cm

Dental pathologies
All preserved maxillary teeth are isolated, except for the first right premolar and first right molar, which were lost during life, and the left second incisor, second premolar, second and third molars, right first incisor, second and third molars, which were lost post-mortem. The mandibular teeth are in situ, except for the left first incisor, canine, first premolar and first molar, which are isolated, and the left second incisor, second premolar and right incisors and canine, which were lost post-mortem.
Enamel hypoplasia occurred between 2.5 and 4 years, with five episodes.
The maxillary canines are rotated and the maxillary right second incisor is affected by crowding.
Several caries are observed. In the maxillary teeth there is one grade 1 distal caries on the left first premolar, one grade 3 mesial and one grade 1 occlusal caries on the left first molar, one grade 1 occlusal and one grade 3 mesial caries on the right second premolar. In the mandibular teeth there is one grade 3 mesial caries on the left canine, one grade 2 mesial, one grade 3 distal, one grade 2 occlusal, one grade 2 distal on the left first molar, one grade 3 mesial, three grade 1 occlusal and one grade 1 buccal at the cemento-enamel junction, on the right second molar; four grade 1 occlusal, one grade 1 distal and one grade 2 mesial caries on the right first molar, four grade 1 occlusal and one grade 2 mesial caries on the right second molar, one grade 2 mesial and one grade 2 lingual caries on the right third molar.
Strong calculus affects the maxillary teeth, mild calculus the mandibular teeth.
Grade 2 alveolar resorption affects the mandible.

Anatomical variants
In the skull, the zygomatic foramen on the left and several foramina on the right, the parietal foramina on both sides, the lambdoid ossicles on the right, and the extrasutural mastoid foramen on the right are present.
In the post-cranial skeleton the squatting facet on the left tibia, the anterior double facet of the left calcaneus and the throclear extension of both talii are observed.

Ergonomy
The individual shows a very strong development of the muscular insertions. Several enthesopathies are present, in particular at the level of the costo-clavicular ligament of the both clavicles, the triceps brachii of the right scapula, the vastus medialis of the left femur, and the patellar ligament of the left patella.

Pathologies
Grade 1 cribra orbitalia are visible on both orbital roofs.
Grade 1 osteoarthritis affects the acromial facet of the left clavicle, the acromial facet of the left scapula, the proximal articular surface of the left ulna, the bodies of the cervical, thoracic and lumbar vertebrae; grade 2 osteoarthritis affects the proximal articular surface of the right ulna.
Diffuse grade 1 periosteal reaction is present on both femurs and left tibia; localised grade 1 periosteal reaction is present on the metaphyseal area of the left fibula. A Schmorl's node affects one lumbar vertebra.
The sacrum is fused with the coccyx.

SU 2207

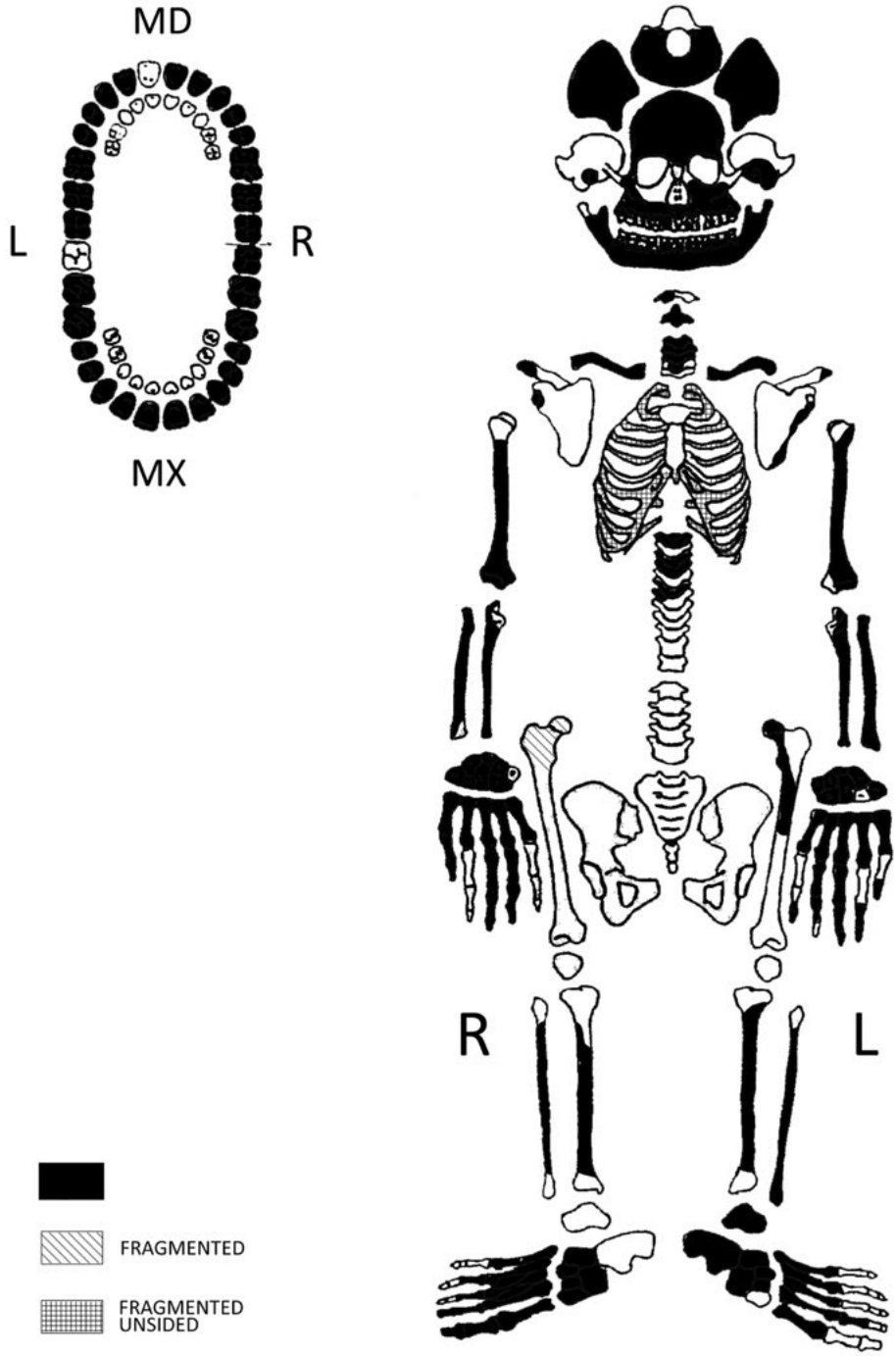


Figure 9

Sex: male
Sex was determined through the observation of sixteen morphological features of the skull, which provided a sexual index of 0.2.

Age: 19-22 years
Age at death was determined on the basis of dental wear, stage of dental eruption, stage of fusion between the diaphyses and epiphyses, of the vertebrae, and sternal rib end modifications.

Stature: 162.4 cm

Dental pathologies
All the preserved teeth are in situ, except for the mandibular left first incisor, which was lost post-mortem.
Enamel hypoplasia occurred between 1.5 and 4.5 years, with six episodes.
Several grade 2 caries were observed: one occlusal on the maxillary left second molar, one distal on the maxillary right second premolar, one buccal on the mandibular left first molar, one buccal on the mandibular left second molar and one buccal on the mandibular right second molar; finally a grade 1 occlusal caries is present on the mandibular left second molar.

Grade 1 alveolar resorption affects the mandible.
Mild calculus is present on both the maxillary and the mandibular teeth.

Anatomical variants
In the skull the supraorbital foramen on the right and several zygomatic foramina on the right are present.

Ergonomy
The individual shows a medium/low development of the muscular insertions, except for the costo-clavicular ligament of the clavicles, which demonstrate a strong development.

Pathologies
Diffuse grade 1 periosteal reaction affects both tibiae and the external side of the ribs.

SU 2208

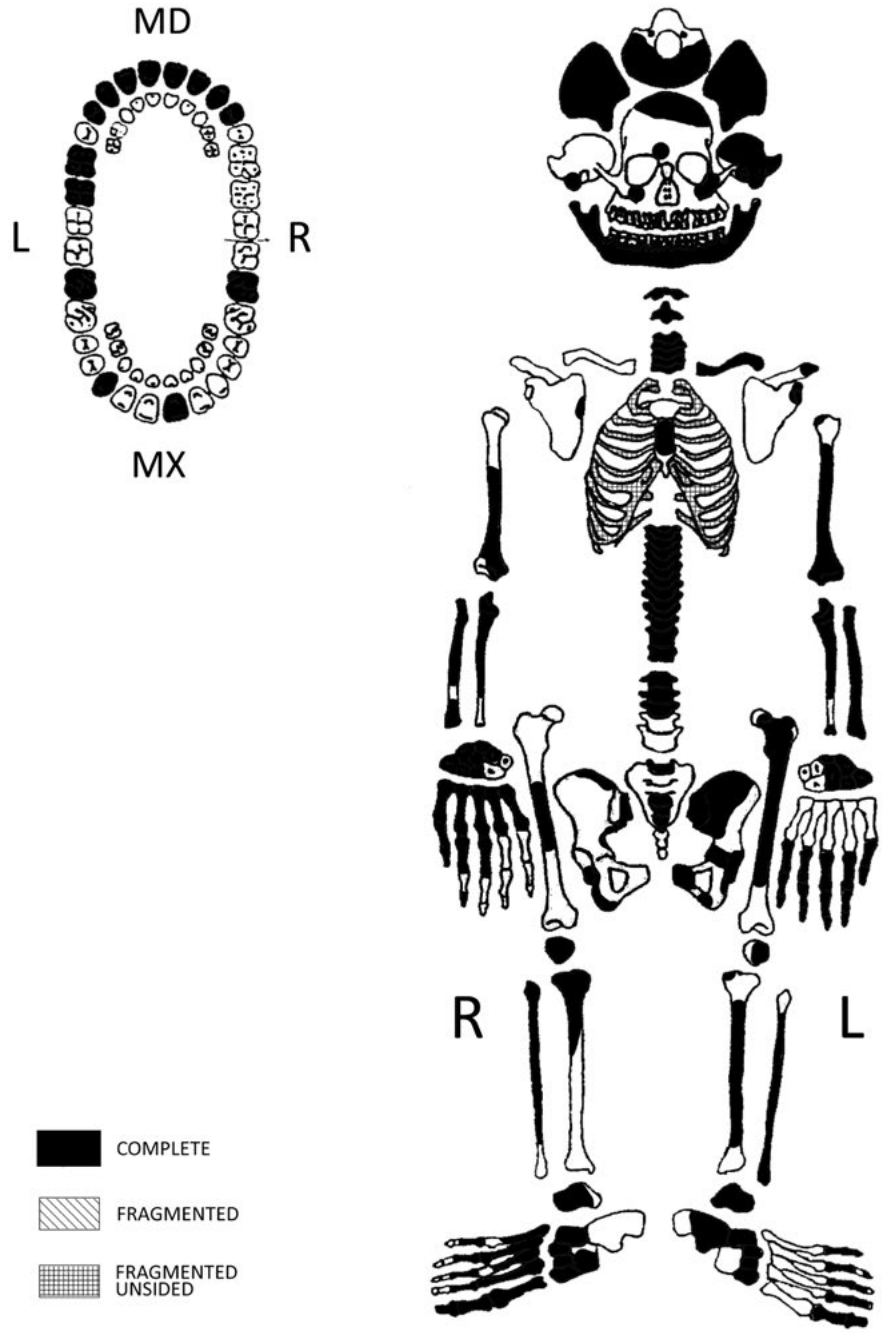


Figure 10

Sex: female
Sex was determined through the observation of ten morphological features of the skull and four of the pelvis, which provided a total sexual index of -0.8.

Age: 17-22 years
Age at death was determined on the basis of the stage of fusion between diaphyses and epiphyses, dental wear, stage of dental eruption, morphology of the auricular

surface of the ilium and of the pubic symphysis, and sternal rib end modifications.

Stature: 166.6 cm

Dental pathologies
The maxillary teeth are present isolated, except for the left incisors, premolars, first and third molar, and the right second incisor, canine, premolars, first and third molar, which were lost post-mortem. The mandibular teeth are present in situ, except for the second premolars, which were lost during life.
Enamel hypoplasia occurred between 2 and 4 years of age, with three episodes.
A grade 1 occlusal caries affects the mandibular left first molar.
A grade 2 alveolar resorption affects the mandible. Mild calculus is present on both the maxillary and the mandibular teeth.

Anatomical variants
In the skull the zygomatic foramen and the parietal foramina on both sides, the apical bone, the lambdoid ossicles and the asterionic bone on both sides, the parietal notch bone on the left and the condylar canal on both sides are present. In the post-cranial skeleton the unfused acromial epiphysis of the left scapula and the septal aperture of both humeri are observed.

Ergonomy
The individual shows a medium/low development of the muscular insertions, except for the pectoralis major of the left humerus, the brachialis of the left ulna, the supinator of both ulnae and the soleus of the left tibia, which have a strong development.

Pathologies
An unhealed fracture affects the right coxal bone, in particular the ischio-pubic ramus, with pseudoarthrosis. Localised grade 2 periosteal reaction affects the distal portion of the right tibia and fibula; the right talus shows osteo-arthritic alterations of the trochlea and of the calcanear articular surface. These lesions are probably referable to a unique traumatic event. Osteochondritis dissecans can be observed on the lateral plate of the right tibia, and spondylosis of the fifth lumbar vertebra is evident.
Grade 1 osteoarthritis affects most of the major joints and the cervical, thoracic and lumbar vertebrae in the bodies and facets. Diffuse grade 1 periosteal reaction affects the femurs and the left tibia.

SU 2209

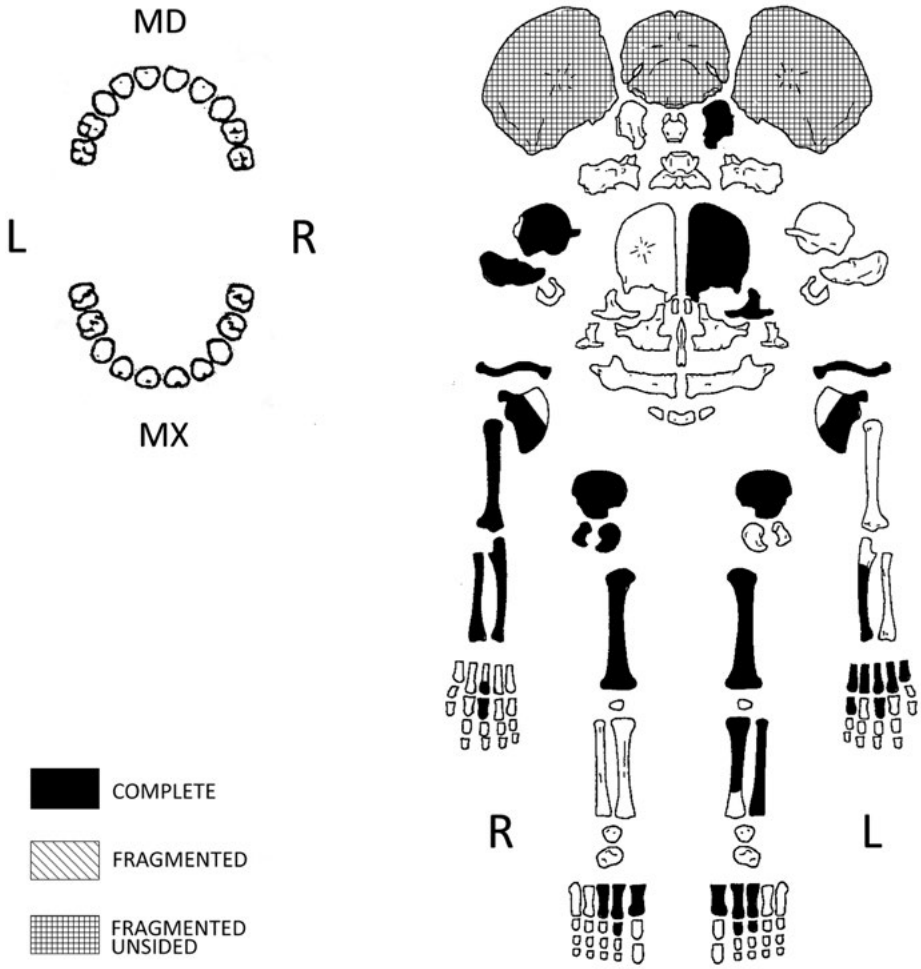


Figure 11

Sex: undeterminable

Age: 0-5 month
Age at death was determined on the basis of the degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
No teeth are preserved.

Anatomical variants
In the skull a zygomatic foramen on the left is present.

Pathologies
Lytic lesions affect the anterior portion of the vertebral bodies.

SU 2247

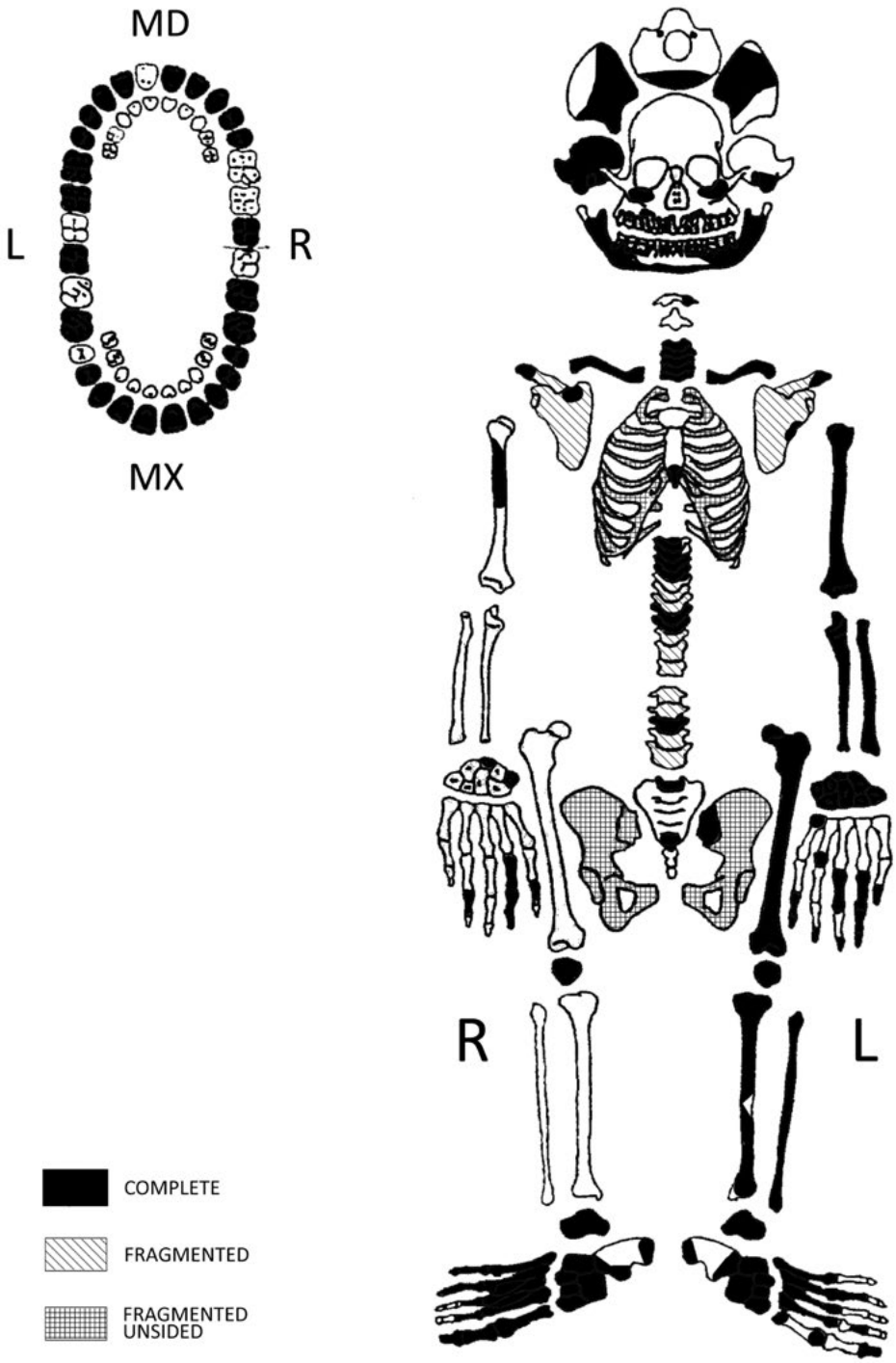


Figure 12

Sex: male
Sex was determined through the analysis of eleven morphological features of the skull and two of the pelvis with a total sexual index of +1.2.

Age: 30-40 years
Age at death was determined on the basis of dental wear, morphology of the auricular surface of the ilium, sternal rib end modifications, and vertebral stage of fusion.

Stature: 172.5 cm

Dental pathologies
The mandibular right second molar was lost during life; maxillary left second premolar and second molar, right third molar, mandibular left first incisors and right first molar were lost post-mortem. The other teeth are preserved, mostly isolated, except for the maxillary left second incisor, premolars, and right premolars, mandibular left first and second molar, right third molar, which are in situ.
Enamel hypoplasia occurred between 2 and 5 years of age, with six episodes.
Several caries were detected: one grade 3 distal on the maxillary left third molar, two grade 1 occlusal on the maxillary right second molar, one grade 1 buccal on the mandibular left first molar and two grade 1 occlusal on the mandibular right third molar.
Mild calculus affects the mandibular and the maxillary teeth. Alveolar resorption of grade 2 affects the maxilla and of grade 1 the mandible.

Anatomical variants
In the skull the parietal foramen on both sides, the lambdoid ossicles on both sides and the extrasutural mastoid foramen on the right are present. In the post-cranial skeleton the exostosis of the trochanteric fossa and the double anterior facet on both calcanei are visible.

Ergonomy
The individual shows a general strong development of the muscular insertions, in particular of the deltoid of the right clavicle, the conoid ligament of the left clavicle, the iliopsoas of the left femur, the patellar ligament of the left tibia, and the Achilles' tendon of the left calcaneus. The deltoid, the latissimus dorsi/teres major of both humeri, the brachioradialis of the left humerus, and the Achilles' tendon of the right calcaneus show a very strong development. Enthesopathies are present in correspondence of the costo-clavicular ligament of both clavicles and of the gluteus maximus of the left femur.

Pathologies
Grade 1 osteoarthritis affects the sternal end of both clavicles. Diffuse grade 1 periosteal reaction is present on the left femur and both tibiae. Schmorl's nodes affect five thoracic and one lumbar vertebra.

SU 2248

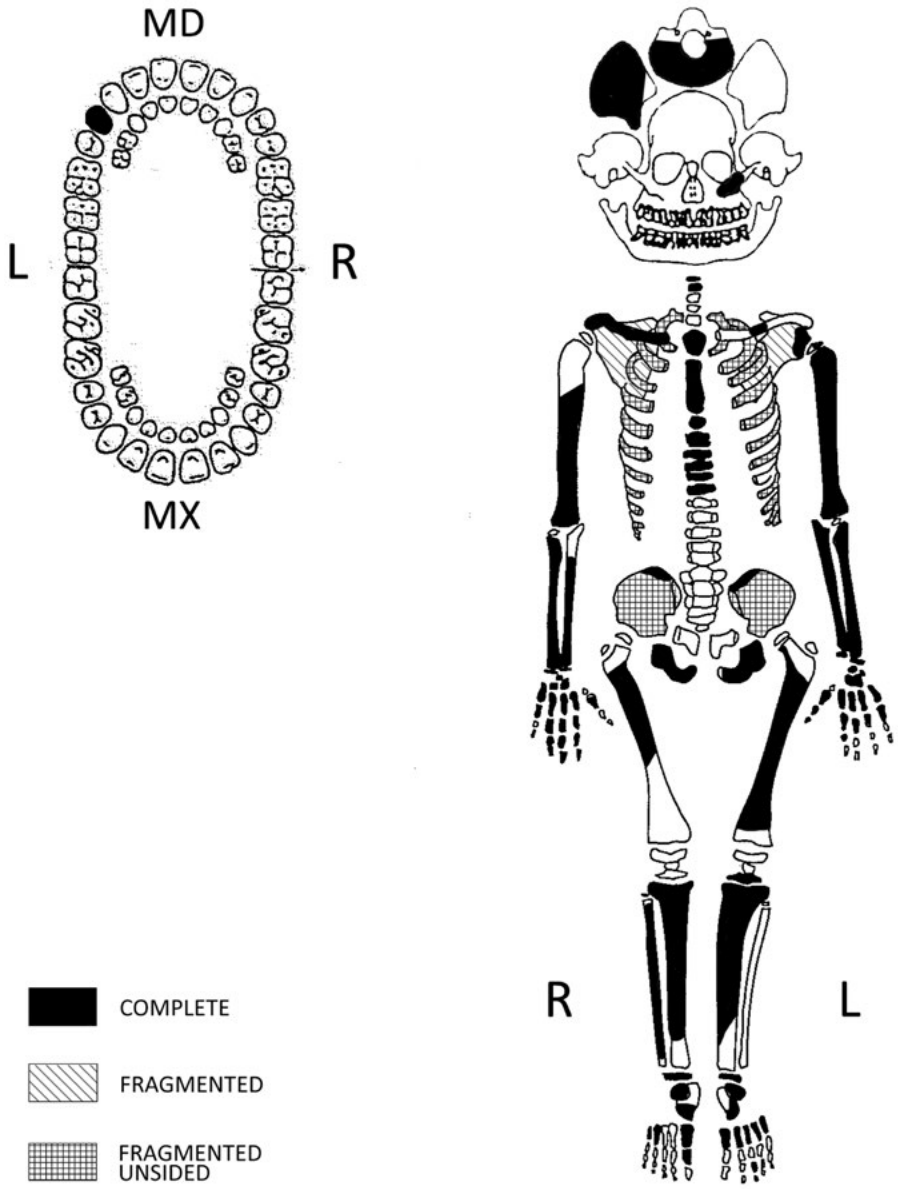


Figure 13

Sex: undeterminable

Age: 11-12 years
Age at death was determined on the basis of the stage of dental eruption, degree of development of permanent teeth, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
Only the mandibular left first molar is preserved. No dental pathologies were observed.

Anatomical variants
In the skull the zygomatic foramina on the left and the lambdoid ossicles on the left are present; in the post-cranial skeleton the septal aperture in both humeri is observed.

Pathologies
Lytic lesions are present on the anterior portion of the vertebral bodies. Diffuse periosteal reaction of grade 1 affects both femurs.

SU 2249

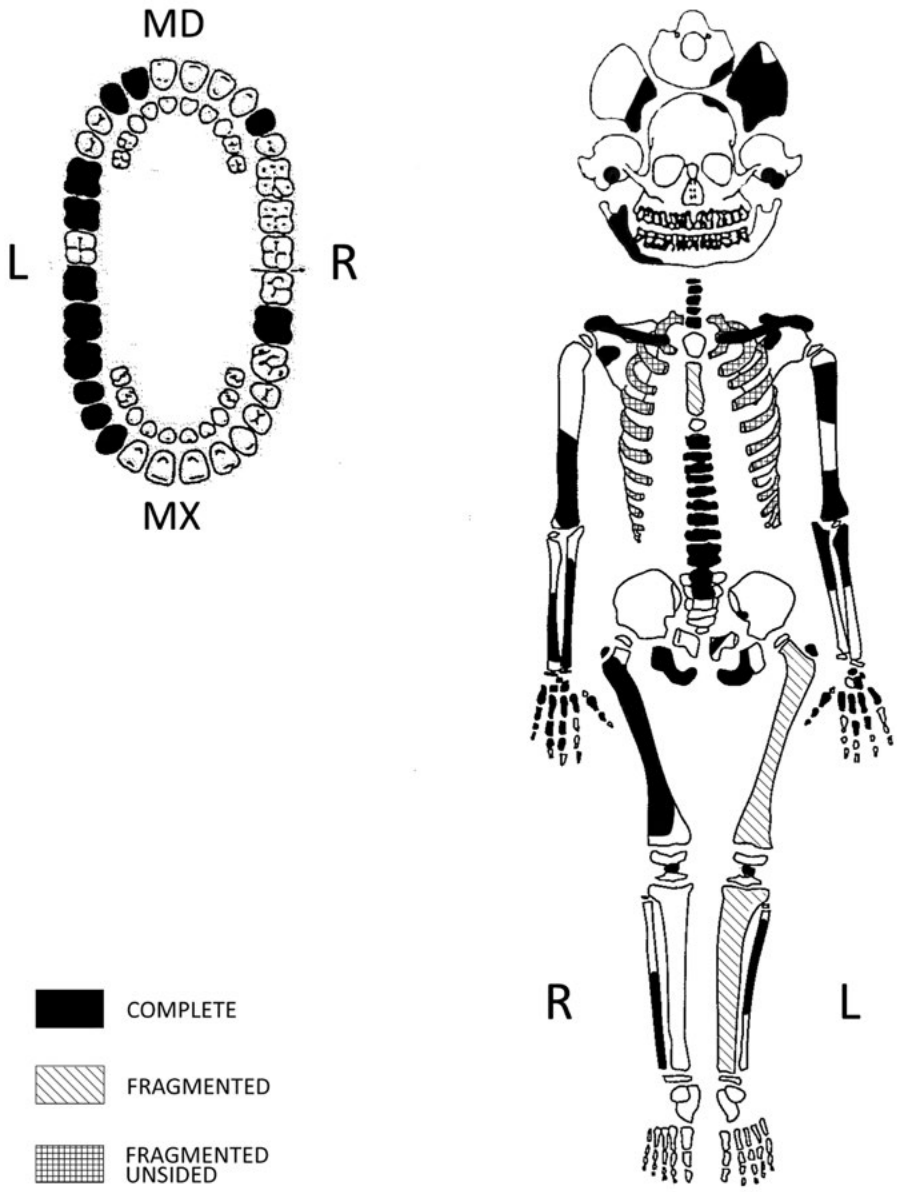


Figure 14

Sex: undeterminable

Age: 12-14 years
Age at death was determined on the basis of the stage of dental eruption, degree of development of permanent teeth, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
All preserved teeth are isolated. The maxillary incisors, the right canine, premolars and first and third molars, and the mandibular first incisors, right second incisor, canine, left first premolar, second premolars, right second molar and third molars were lost post-mortem.
Enamel hypoplasia occurred between 2.5 and 4.5 years, with three episodes.
Grade 1 caries were observed: two occlusal and one buccal on the mandibular right first molar, one occlusal on the mandibular left second molar.
Mild calculus is present on the mandibular and the maxillary teeth.

Anatomical variants
In the skull the parietal foramen on the left, the apical bone and the extrasutural mastoid foramen on the left are present. In the post-cranial skeleton the septal aperture is present in the left humerus.

Pathologies
Lytic lesions are present on the anterior portion of the vertebral bodies of the thoracic and of one lumbar vertebra. Diffuse grade 1 periosteal reaction affects the right femur.

SU 2250

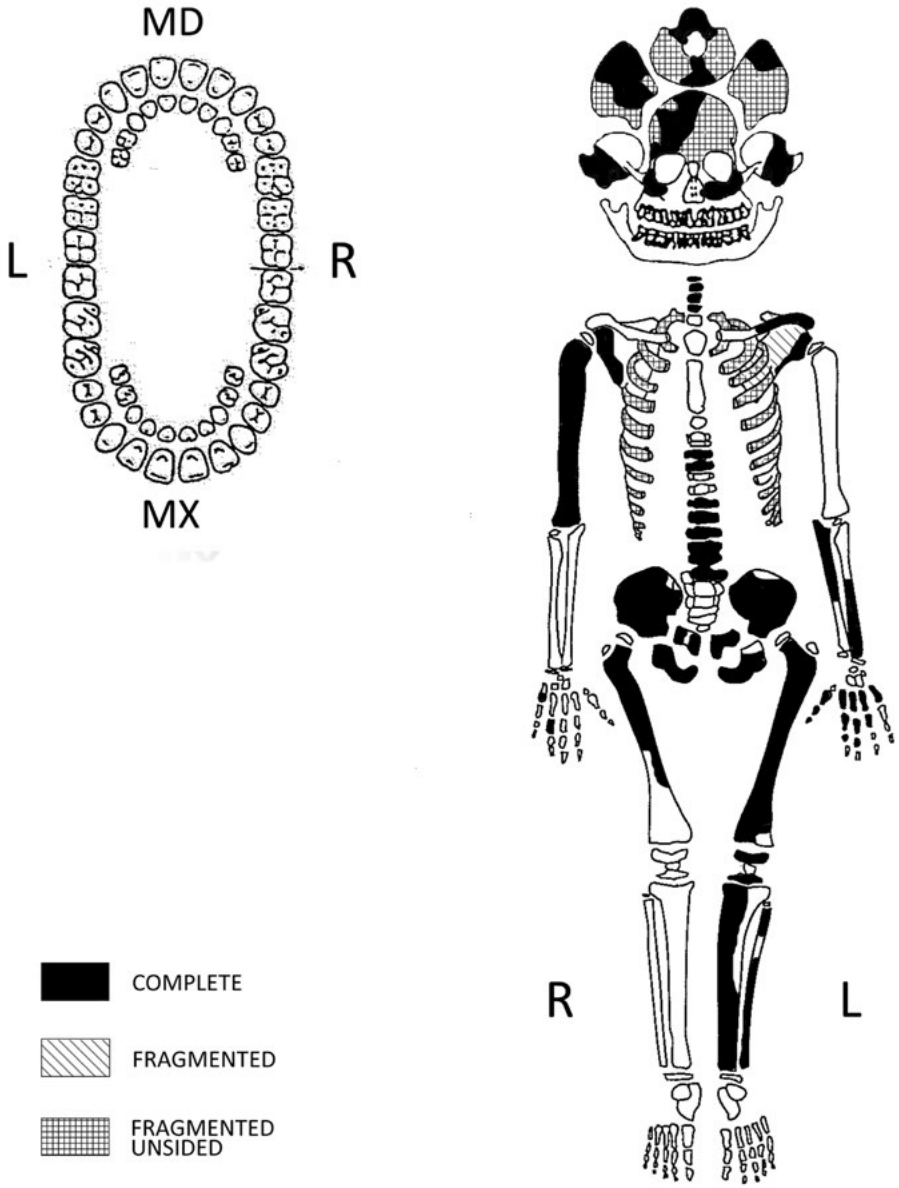


Figure 15

Sex: undeterminable

Age: 2-3 years
Age at death was determined on the basis of the degree of fusion between diaphyses and epiphyses and long bone length.

Dental pathologies
No teeth were preserved.

Anatomical variants
In the skull one zygomatic foramen on both sides, extrasutural mastoid foramen on the right and condylar canal on both sides are present.

Pathologies
Periosteal reaction affects the external side of the ribs; diffuse grade 1 periosteal reaction affects the left tibia and fibula.

SU 2251

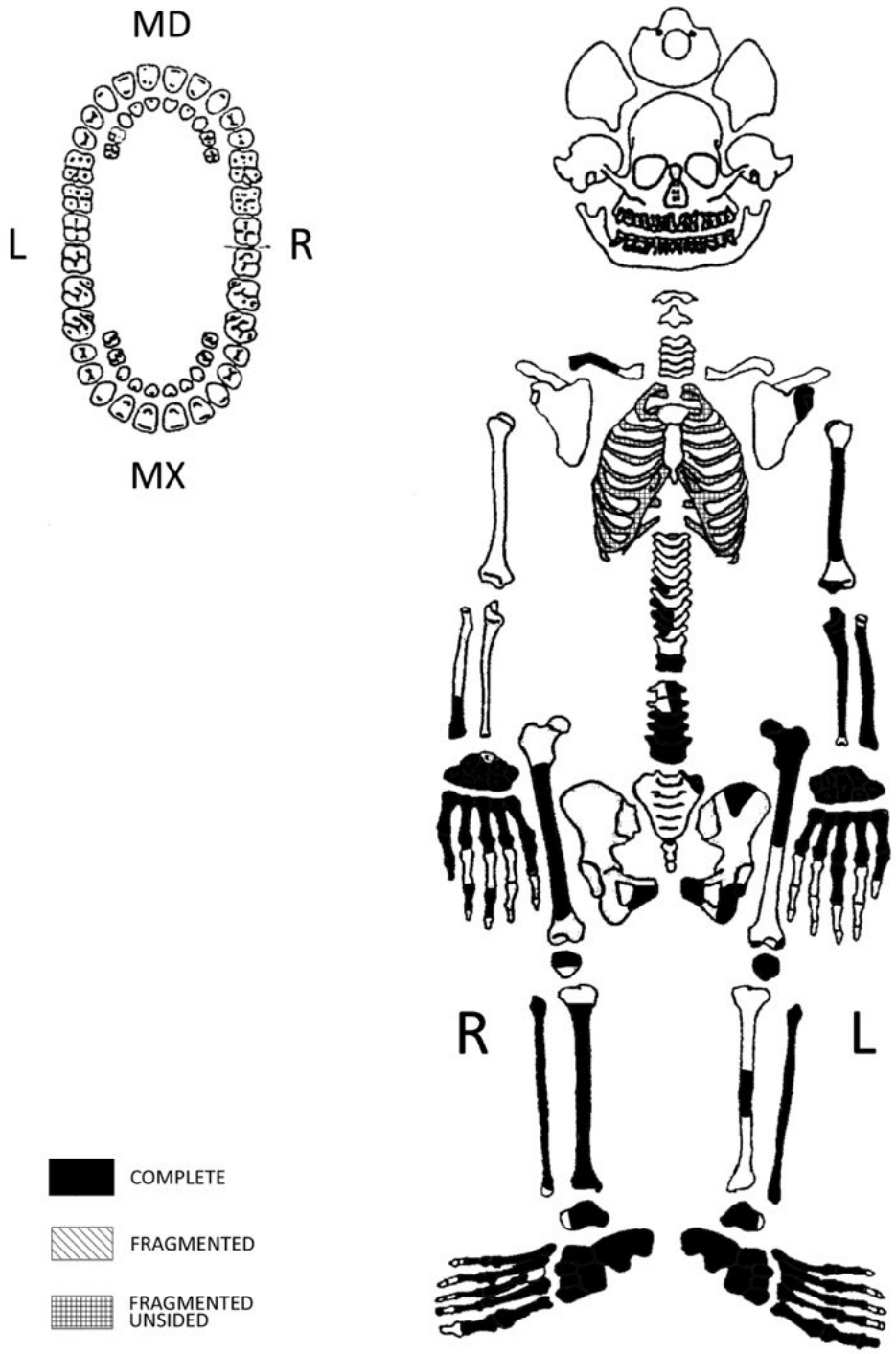


Figure 16

Sex: undeterminable

Age: 30-40 years
Age at death was determined on the basis of the pubic symphysis morphology, stage of fusion of the vertebrae, and sternal rib end modifications.

Stature: 156.0 cm

Dental pathologies
None found.

Anatomical variants
In the post-cranial skeleton the supraglenoid facet of the left scapula, the Poirier's facet of the left femur, the vastus notch of the right patella and the anterior double facet of the left calcaneus are present.

Ergonomy
The individual shows a strong development of a few observable muscular insertions, in particular the deltoid of the right clavicle, the latissimus dorsi/teres major of the left humerus, the brachialis of the left ulna

and the Achilles' tendon of the right calcaneus; the conoid ligament of the right clavicle and the triceps brachii of the left ulna show a very strong development.

Pathologies

Grade 1 osteoarthritis affects the glenoid cavity of the left scapula, the left auricular facet of the sacrum, the bodies of the thoracic and lumbar vertebrae, the facets and spinous processes of the lumbar vertebrae. Diffuse grade 1 periosteal reaction is present on both femurs. Schmorl's nodes affects two lumbar vertebrae.

SU 2252

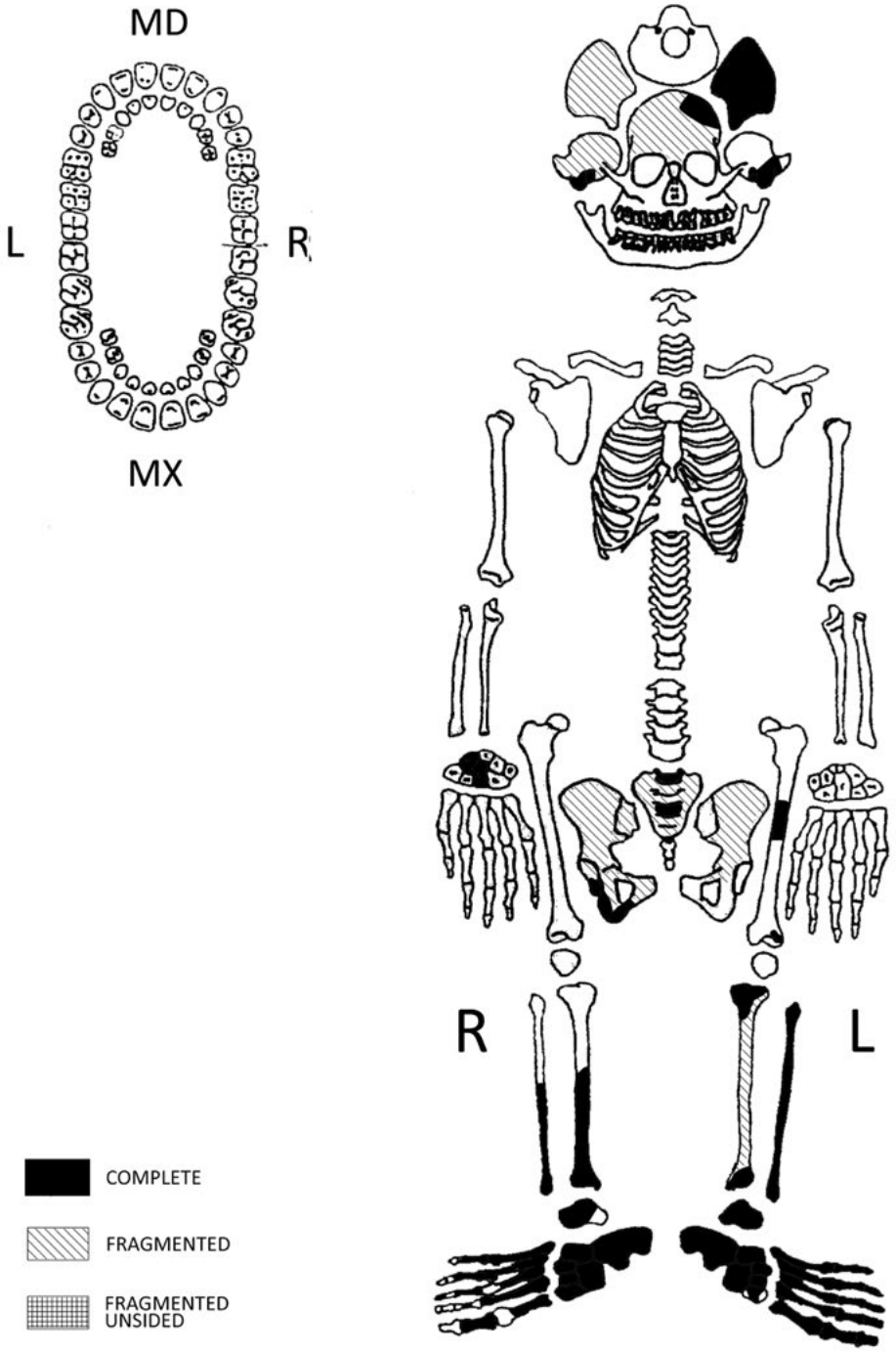


Figure 17

Sex: female
Sex was determined through the analysis of three morphological features of the skull, with a sexual index of -0.4.

Age: 30-40 years
Age at death was determined on the basis of suture closure degree.

Stature: 154.4 cm

Dental pathologies
No teeth were found.

Anatomical variants
In the post-cranial skeleton the anterior double facet of both calcanei is observed.

Ergonomy
The individual shows a medium/strong development of a few observable muscular insertions; in particular, the gluteus maximus of the left femur and the Achilles's tendon of the right calcaneus have a strong development, while the Achilles' tendon of the left calcaneus has a medium development.

Pathologies
Diffuse grade 1 periosteal reaction affects the right tibia. A localised grade 1 periosteal reaction is present in the posterior surface at the midshaft of the right tibia and fibula; this is probably due to a trauma.

Trench 3

SU 2178

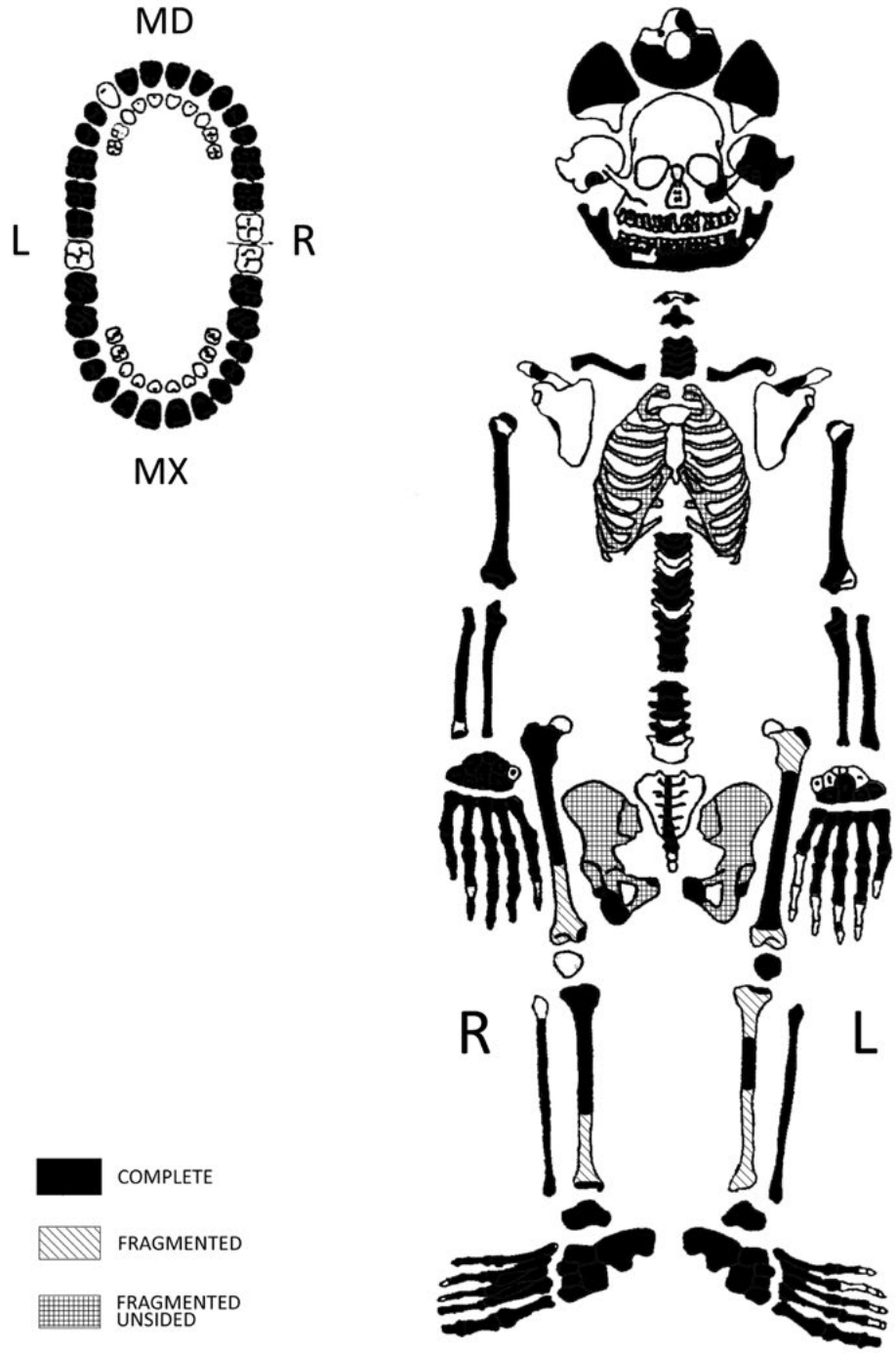


Figure 18

Sex: female
Sex was determined through the analysis of thirteen morphological features of the skull and one of the pelvis, which provided a total sexual index of -1.15.

Age: 35-45 years
Age at death was determined on the basis of dental wear, stage of fusion of the vertebrae, morphology of the pubic symphysis, and sternal rib end modifications.

Stature: 154.0 cm

Dental pathologies
All maxillary teeth are present and in situ, except for the left second premolars and molars, right molars, which are isolated. All mandibular teeth are present and in situ, except the right premolars and first molar, which are isolated. The mandibular left canine was lost during life.
Several caries are present. In the maxilla, one grade 4 on the maxillary left first premolar, second premolar, and second molar, two grade 2 mesial on the left first molar, one grade 2 mesial at the cemento-enamel junction

on the right second premolar, one grade 2 occlusal on the right second molar, and one grade 2 distal at the cemento-enamel junction on the right second molar. In the mandible: three grade 1 occlusal, one grade 1 mesial on the left first molar, four grade 1 occlusal on the left second molar, one grade 3 lingual, one grade 2 mesial at the cemento-enamel junction, one grade 1 buccal at cemento-enamel junction and one grade 3 occlusal on the left third molar, one grade 3 mesial and one grade 1 occlusal on the right first molar, and two grade 1 occlusal on the right second molar.
Mild calculus is present on maxillary and mandibular teeth.
Enamel hypoplasia occurred between 1.5 and 4.5 years, with six episodes.
Alveolar resorption of grade 2 affects both maxilla and mandible.

Anatomical variants
In the skull several zygomatic foramina on the left and lambdoid ossicles on the right are present. In the post-cranial skeleton the squatting facet on the right tibia and the throclear extension on both talii are observed.

Ergonomy
The individual shows a medium development of the muscular insertions, except for the costo-clavicular ligament and the pectoralis major of both clavicles, the triceps brachii of the left ulna, and the gluteus maximus of the left femur, which showed a strong development.

Pathologies
Grade 1 osteoarthrosis affects the bodies and facets of the cervical, thoracic and lumbar vertebrae, and the calcanear articular surface of both talii. Diffuse grade 2 periosteal reaction affects femurs and tibiae, and a localised grade 1 periosteal reaction is visible on the distal portion of the right fibula. Schmorl's nodes affect four thoracic vertebrae. T12 presents a collapse of the body. The second and third phalanges of the fifth finger of the left foot are fused. Mild osteophytosis of the acoustic meatus on both sides is present.

SU 2182

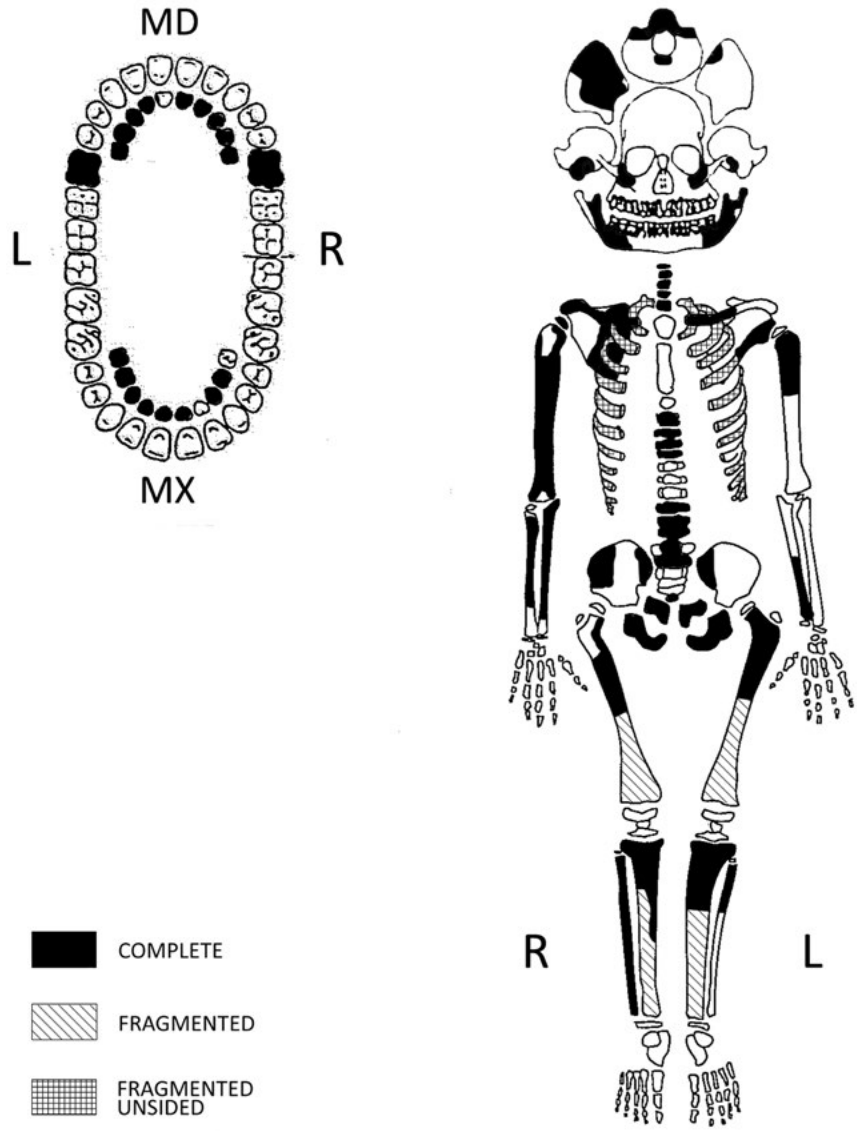


Figure 19

Sex: undeterminable

Age: 2-3 years
Age at death was determined on the basis of the dental eruption, development of permanent dentition, stage of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
Deciduous teeth are preserved isolated, except for the maxillary right canine and first molar, and mandibular right canine and molars, which are in situ; the maxillary right second incisor and second molar, and the mandibular left first incisor were lost post-mortem. The buds of the permanent mandibular first molars are isolated.

Some grade 1 caries were observed: one distal caries on the maxillary left first incisor, one distal on the maxillary right first molar, one mesial on the mandibular left second incisor and one mesial on the mandibular right second incisor.

Anatomical variants
In the skull the parietal foramen on both sides and the extrasutural mastoid foramen on the right are present.

Pathologies
Periosteal reaction is visible on the external side of the ribs. Localised grade 2 periosteal reaction is present in the proximal metaphyseal area of both tibiae.

SU 2186

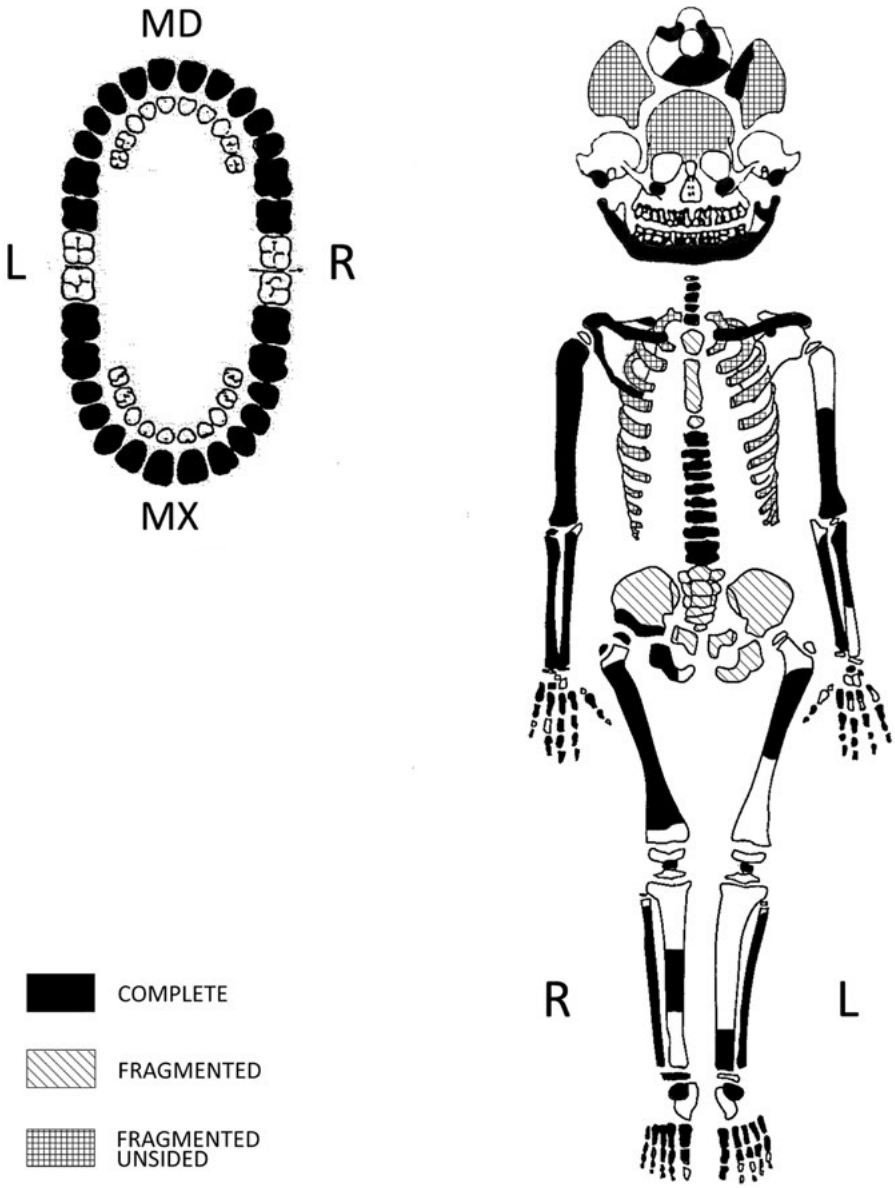


Figure 20

Sex: undeterminable

Age: 12-14 years
Age at death was determined on the basis of dental eruption, development of permanent dentition, stage of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
The maxillary teeth are all preserved and in situ, except for the left incisors, canine, premolars, molars, and right first incisor, which are isolated. All the mandibular teeth are preserved and are isolated.
Enamel hypoplasia occurred between 2 and 4.5 years, with five episodes.
One grade 1 occlusal caries affects the mandibular left second molar.
Mild calculus is present on the maxillary and the mandibular teeth.

Anatomical variants
In the skull a zygomatic foramen on the right, several zygomatic foramina on the left, the apical bone, and the extrasutural mastoid foramen on both sides are present.

Pathologies
Diffuse grade 1 periosteal reaction is visible on the left tibia and localised grade 1 periosteal reaction on the diaphysis of the right tibia. Lytic lesions are present on the anterior portion of the vertebral bodies.

SU 2202

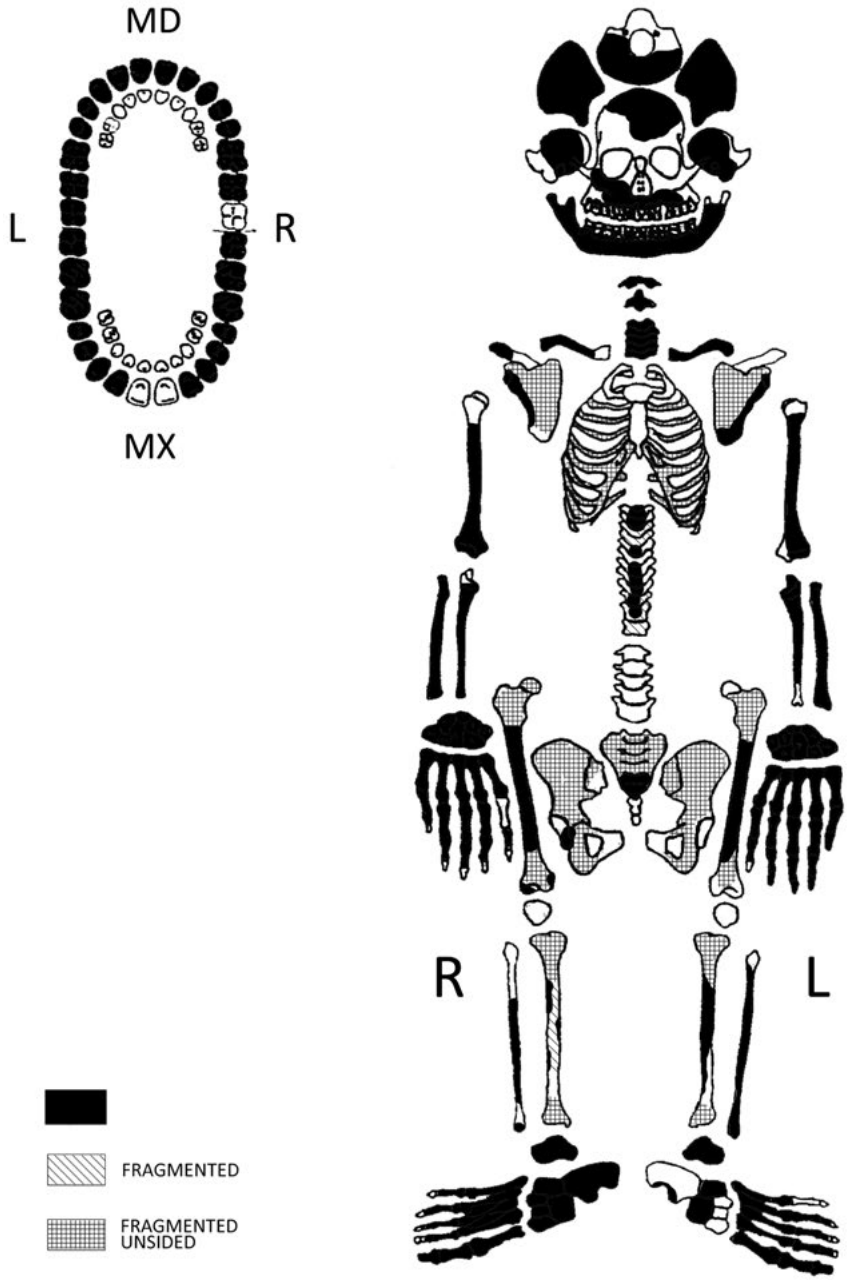


Figure 21

Sex: male
Sex was determined through the observation of fourteen morphological features of the skull, which provided a sexual index of +1.1.

Age: 20-30 years
Age at death was determined on the basis of dental wear, stage of fusion between diaphyses and epiphyses, and sternal rib end modifications.

Stature: 154.7 cm

Dental pathologies
In the maxilla all the teeth are preserved in situ, except for the first right incisor, which was lost post-mortem, the left first incisor, which is preserved as root, and the second and third molars, which are isolated. In the mandible all the teeth are preserved and in situ, except for the right premolars, which are isolated.
Enamel hypoplasia occurred between 1 and 5 years, with eight episodes.
Grade 1 alveolar resorption affects both maxilla and mandible.
Mild calculus is present on both the maxillary and the mandibular teeth.

Anatomical variants
In the skull, the metopic suture, a zygomatic foramen on the right, and the parietal foramen on the right are present. In the postcranial skeleton the transverse accessory foramen on the left of C4 (complete), on the right of C5 (complete), on the left of C7 (partial), the unfused acromial epiphysis of the right scapula, and the anterior double facet on the left calcaneus are present.

Ergonomy
The individual shows a low-medium development of the muscular insertions.

Pathologies
Cribra cranii of grade 1 are present on the parietal bones. Diffuse grade 1 periosteal reaction is visible on the femurs; localised grade 1 periosteal reaction is present on the proximal third of the left fibula. A Schmorl's node affects one thoracic vertebra.

SU 2204

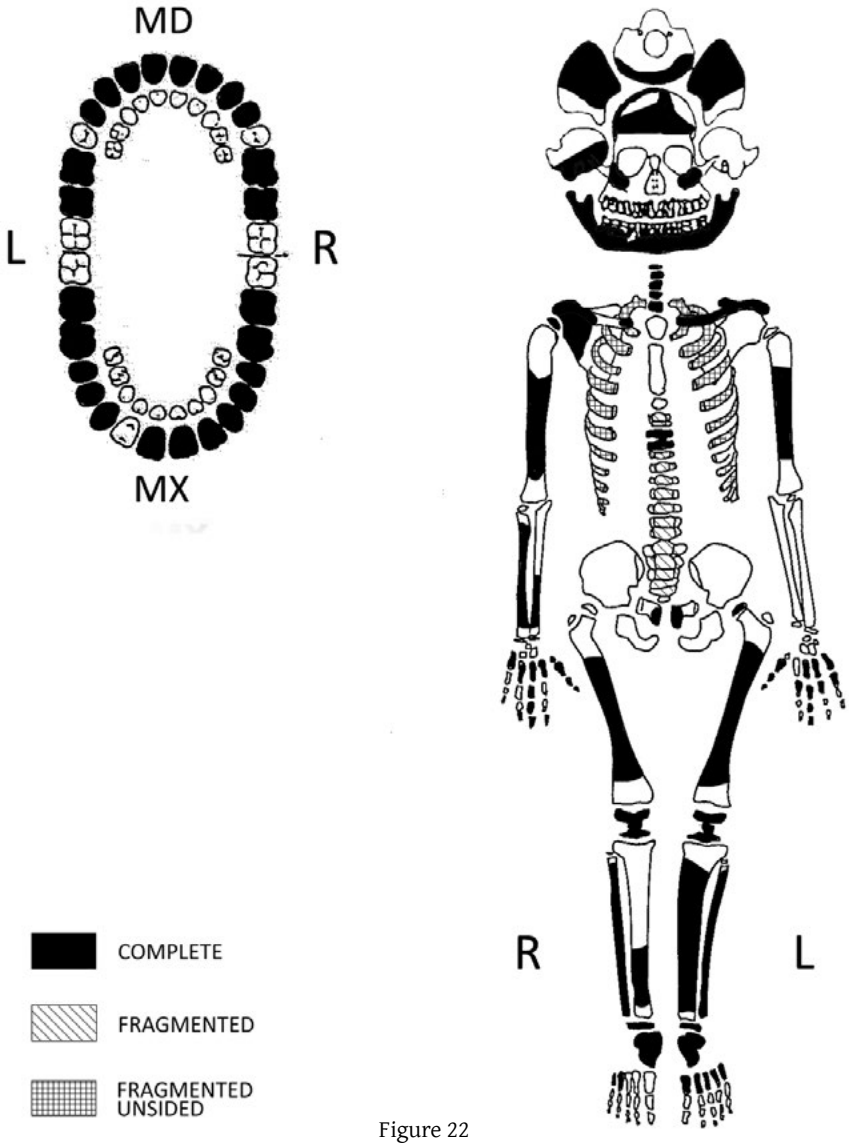


Figure 22

Sex: undeterminable

Age: 12-14 years
Age at death was determined on the basis of dental eruption, development of permanent dentition, stage of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
The permanent mandibular teeth are preserved in situ, except for the right second incisor, canine and first premolar, which are isolated, and the second premolars, which were lost post-mortem. All the maxillary teeth are preserved and isolated, except for the left second incisor, which was lost post-mortem.
Enamel hypoplasia occurred between 1.5 and 4.5 years, with seven episodes.
One grade 2 lingual caries affects the mandibular right second molar.

Anatomical variants
In the skull a zygomatic foramen on both sides, the parietal foramen on the right, and the extrasutural mastoid foramen on both sides are present. In the post-cranial skeleton the complete accessory transverse foramen on C4 on the right and the anterior double facet on both calcanei are visible.

Pathologies
Diffuse grade 1 periosteal reaction affects the femurs and left tibia. An osteolityc lesion is visible on the superior plate of one thoracic vertebra.

SU 2205

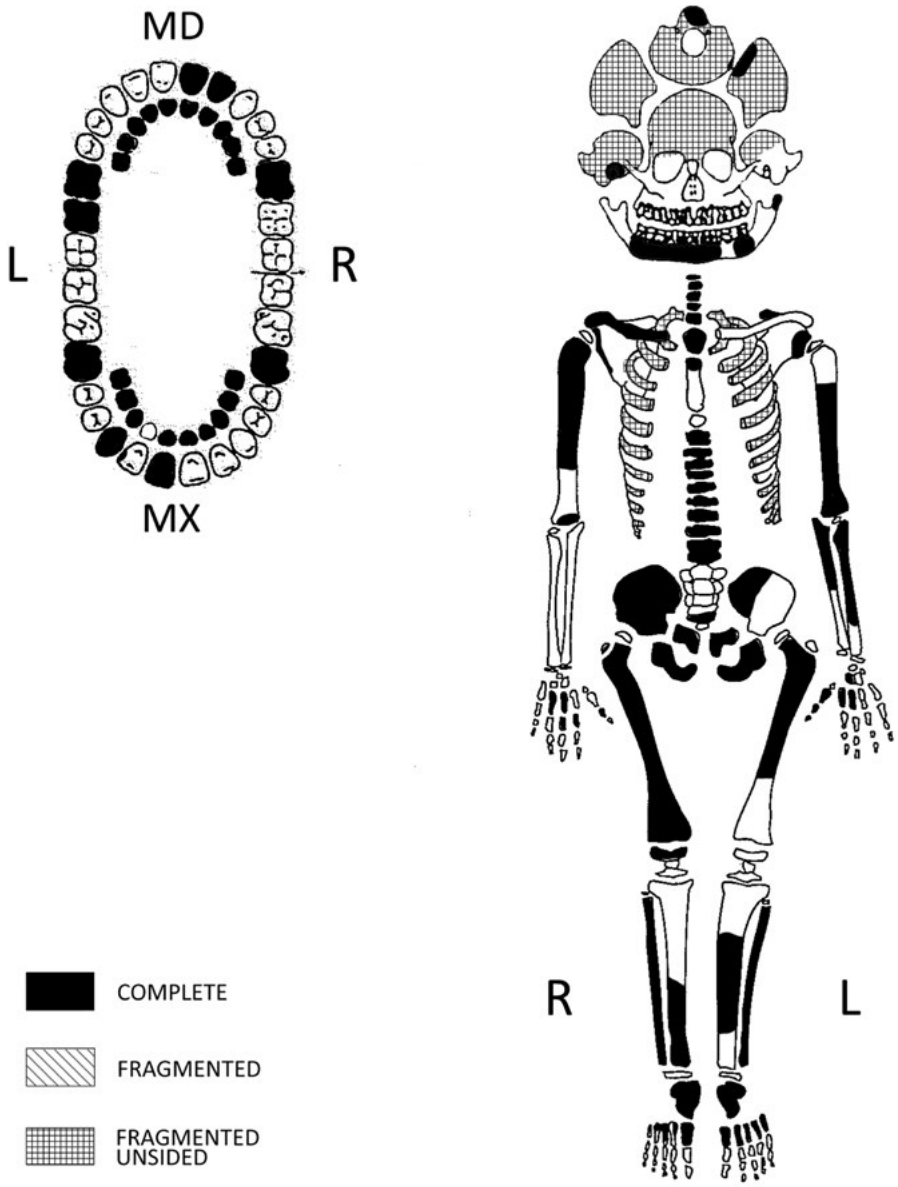


Figure 23

Sex: undeterminable

Age: 3-4 years
Age at death was determined on the basis of dental eruption, development of permanent dentition, stage of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
Nineteen deciduous teeth are present. In the mandible the left incisors, canine and second molar, and the right canine, and molars are in situ; all the other are isolated; the maxillary left second incisor was lost post-mortem. The permanent maxillary left first incisor, canine, and first molar, and the right first molar are present isolated in form of germs; the permanent mandibular left molars, mandibular right incisors and first molar are present in situ in form of germs.
One grade 1 mesial caries affects the deciduous maxillary left canine at the cemento-enamel junction.

Anatomical variants
In the skull the parietal foramen on the left is present.

Pathologies
Periosteal reaction affects the external sides of the ribs. Lytic lesions are present on the anterior portion of the bodies of the thoracic vertebrae. Diffuse grade 1 periosteal reaction is visible on tibiae and fibulae.

SU 2206

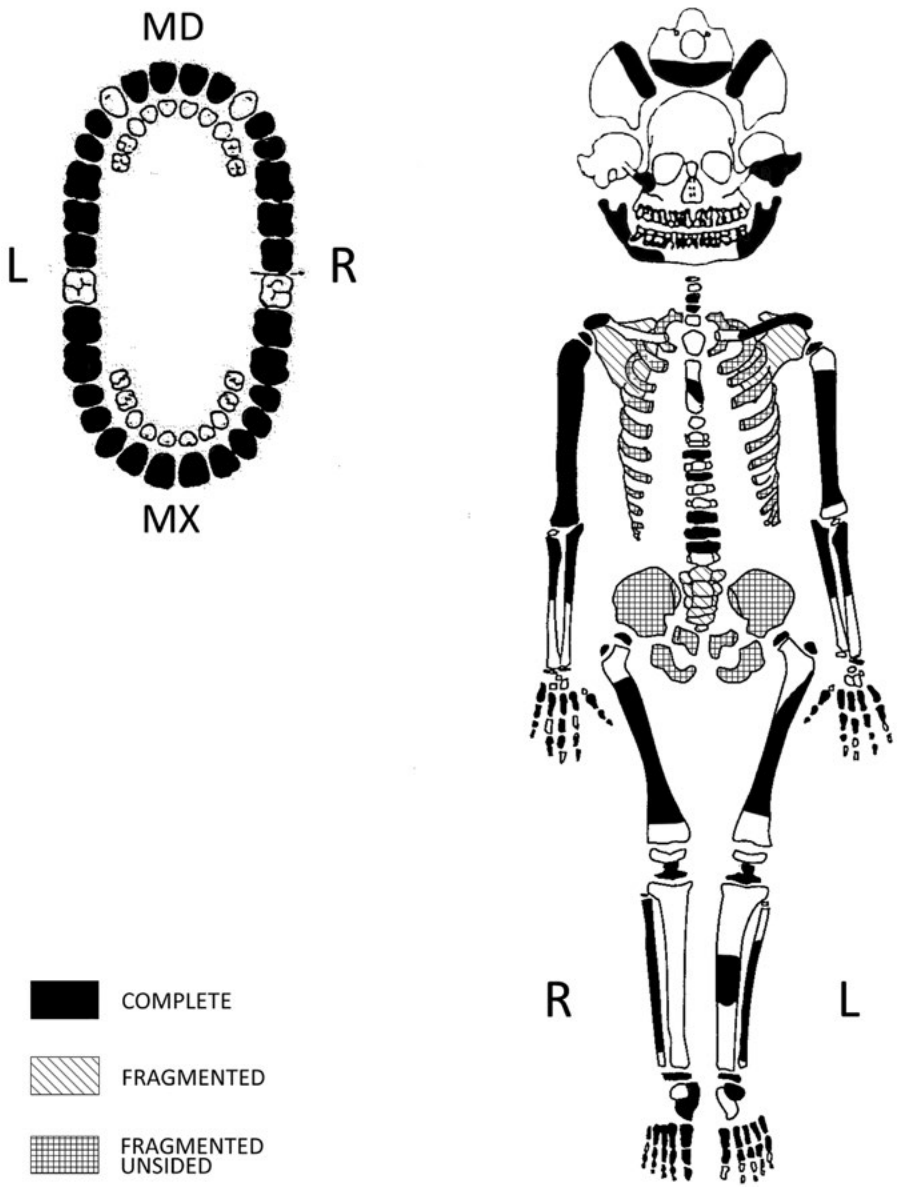


Figure 24

Sex: undeterminable

Age: 12-14 years
Age at death was determined on the basis of dental eruption, development of permanent dentition, stage of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
All preserved teeth are isolated, except for the mandibular left second and third molar, which are in situ; the mandibular canines are lost post-mortem. The mandibular third molars are in form of germs.

Mild calculus affects the maxillary and mandibular teeth.
Enamel hypoplasia occurred between 1 and 3.5 years, with five episodes.

Anatomical variants
In the skull several zygomatic foramina on the right, the apical bone and the lambdoid ossicles on both sides are present. In the post-cranial skeleton the anterior double facet is visible on the right calcaneus.

Pathologies
Diffuse grade 1 periosteal reaction is present on the femurs and left tibia. Lytic lesions affect the anterior portion of the vertebral bodies.

SU 2212

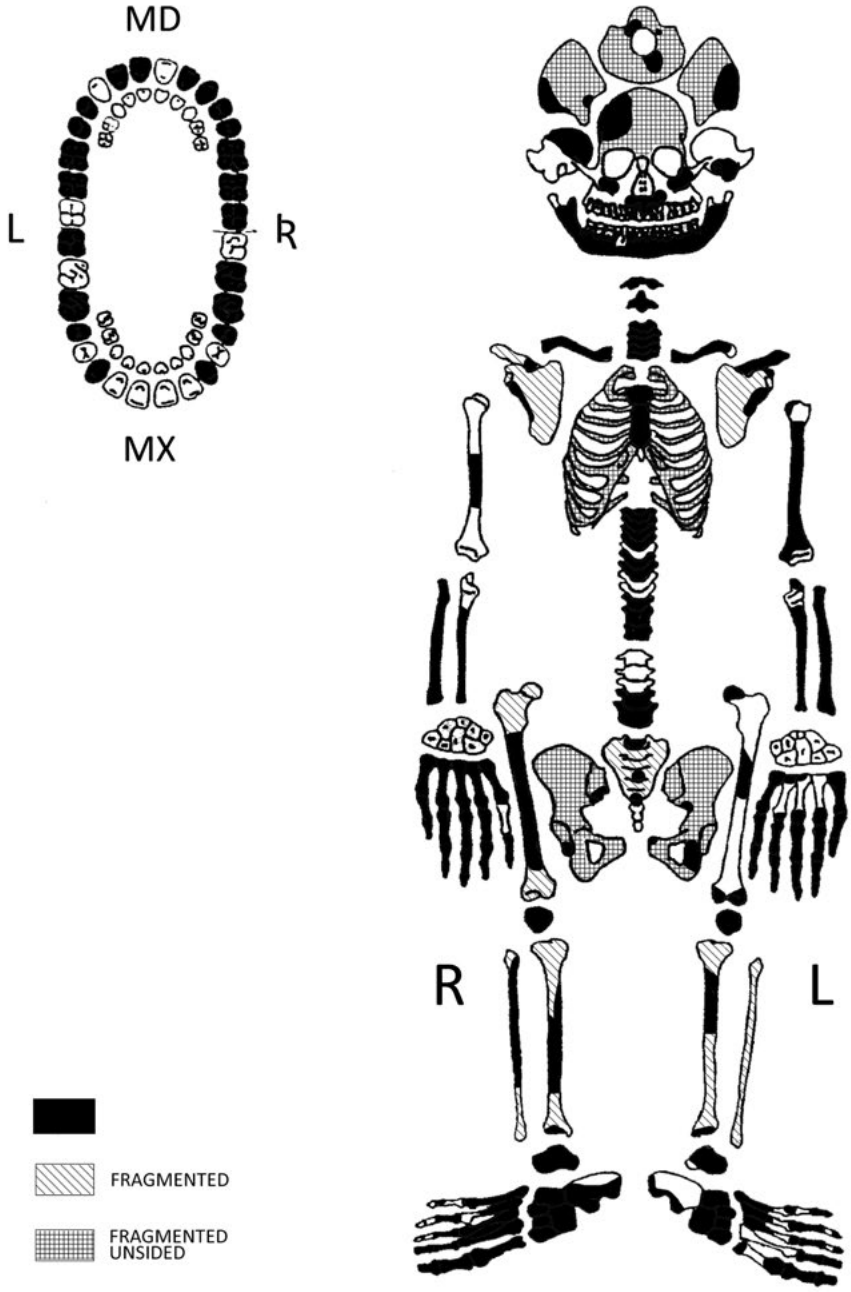


Figure 25

Sex: female
Sex was determined through the analysis of nine morphological features of the skull and one of the pelvis, which provided a total sexual index of -0.93.

Age: 30-35 years
Age at death was determined on the basis of dental wear, stage of fusion of the vertebrae, and sternal rib end modifications.

Stature: 155.2 cm

Dental pathologies
The mandibular teeth are all present and in situ, except for the left right first incisor, which was lost post-mortem, and the left canine, which was lost during life, and for the right second premolar, which is isolated. The maxillary teeth are present and isolated, except for the left incisors, first premolar, and right first premolar, which were lost post-mortem, the left second molar and right first incisor, which were lost during life, and the second premolars, left third molar and right first molar, which are in situ. The maxillary canines are retained in the maxilla; there is agenesis of the mandibular left third molar.
The mandibular left incisors and first premolars are rotated.
There are five caries: one grade 3 mesial at the cemento-enamel junction on the maxillary left third molar, one grade 1 distal on the mandibular left first premolar, one grade 1 occlusal on the mandibular right second molar, and one grade 4 buccal on the mandibular right third molar.
Enamel hypoplasia, observable only on the mandibular right canine for the presence of calculus, occurred between 2.5 and 5 years, with five episodes.
Alveolar resorption of grade 1 affects the maxilla, of grade 2 the mandible.
Mild calculus is visible on the maxillary and mandibular teeth.

Anatomical variants
In the skull the zygomatic foramina are present on both sides. In the post-cranial skeleton the vastus notch on both patellae and the double anterior facet on both calcanei are visible.

Ergonomy
The individual shows a medium-low development of the muscular insertions, except for the trapezoid ligament of the right clavicle and the triceps brachii of the left ulna, which present a strong development.

Pathologies
Grade 1 osteoarthritis affects the distal joint of the radii, the acetabular cavities, the articular facets of the patellae, the calcanear articular facet of the calcanei, the distal articular surface of the first metatarsal bones, the bodies and articular facets of the thoracic and lumbar vertebrae. Diffuse grade 1 periosteal reaction affects femurs and tibiae, localised grade 1 periosteal reaction is present on the half diaphysis of the right fibula, and localised grade 2 periosteal reaction is visible on both tibiae. Schmorl's nodes affects one lumbar vertebra. There is the fusion of the second and third phalanges of the fifth finger of the foot.

SU 2213

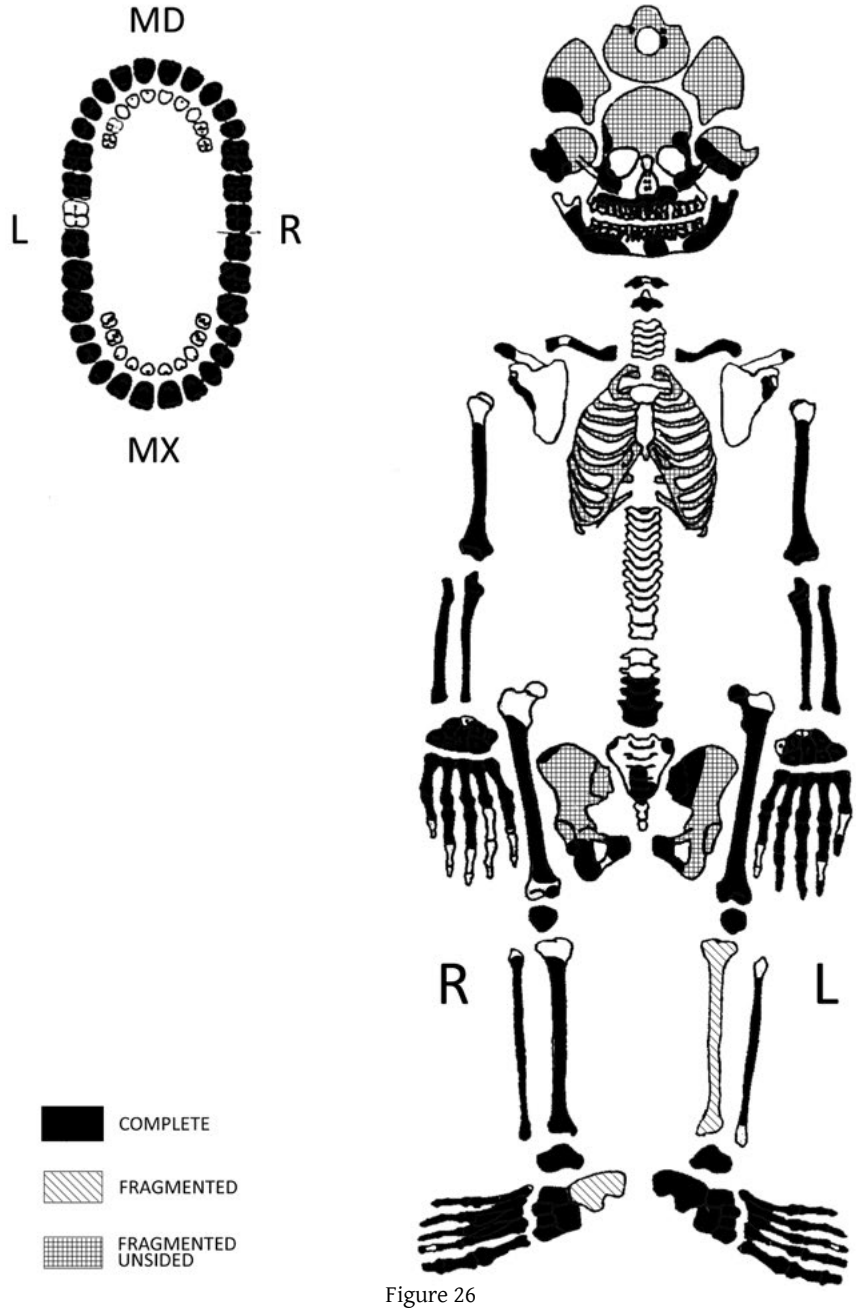


Figure 26

Sex: female
Sex was determined through the analysis of thirteen morphological features of the skull and six of the pelvis, which provided a total sexual index of -1.5.

Age: 35-45 years
Age at death was determined on the basis of dental wear, stage of fusion of the vertebrae, morphology of the auricular surface of the ilium and of the pubic symphysis, and sternal rib end modifications.

Stature: 151.5 cm

Dental pathologies
The maxillary teeth are all present and in situ, except for the left second molar, right incisors, canine and molars, which are isolated. The mandibular teeth are present and in situ, except for the left premolars, first molar, right canine and first premolar, which are isolated. The left second molar was lost during life.
Several caries were observed. In the maxilla, one grade 3 distal on the right second premolar, one grade 2 distal on the right second molar; in the mandible, one grade 4 on the left first molar, one grade 1 occlusal and a one grade 1 buccal on the left third molar, one grade 3 buccal on the right first premolar at the cemento-emanel junction, three grade 1 occlusal and one grade 1 buccal on the right first molar, one grade 2 occlusal and one grade 1 buccal on the right second molar, and one grade 1 occlusal on the right third molar.
Mild calculus is present on the maxillary and the mandibular teeth.

Enamel hypoplasia occurred between 1.5 and 4 years, with five episodes.
Alveolar resorption of grade 1 affects the maxilla in correspondence of the molars.

Anatomical variants
In the skull the complete supraorbital foramen, a zygomatic foramen on the left, the extrasutural mastoid foramen on both sides are present. In the post-cranial skeleton the Poirier's facet on the left femur, the squatting facet on the left tibia, the anterior double facet on both calcanei and the accessory facet head on both first metatarsal bones are present.

Ergonomy
The individual shows a medium-low development of the muscular insertions, except for the trapezoid ligament of the right clavicle, which shows a strong development, and the ileopsoas of both femur, which presents a very strong development.

Pathologies
Grade 1 osteoarthritis affects the sternal facet of the right clavicle, the acromial facet of both clavicles, the acromial facet of both scapulae, the proximal articular surface of both ulnae, the head of the femurs, the articular facet of the left patella, the articular facet of both calcanei, and the bodies of thoracic and lumbar vertebrae. Grade 2 osteoarthritis affects the articular surface for cuboid bone of the left calcaneus. Diffuse grade 1 periosteal reaction is present on both femurs, tibiae and fibulae. A microtrauma is visible on the posterior side of the left tibia at half diaphysis. Schmorl's nodes affect two lumbar vertebrae. Cribra orbitalia of grade 1 are visible on the left orbit.

SU 2215

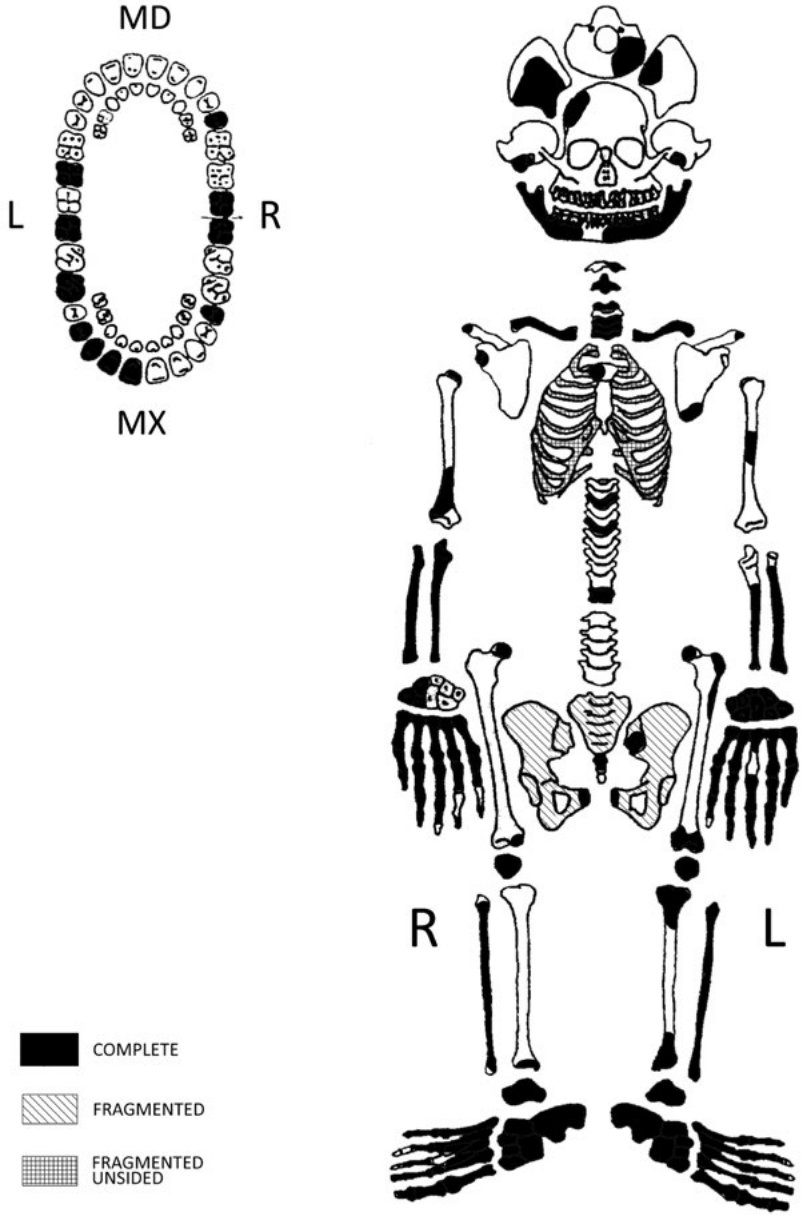


Figure 27

Sex: male
Sex was determined through the analysis of eight morphological features of the skull and two of the pelvis, which provided a total sexual index of 0.4.

Age: 30-35 years
Age at death was determined on the basis of dental wear, stage of fusion of the vertebrae, morphology of the pubic symphysis, and sternal rib end modifications.

Stature: 160.3 cm

Dental pathologies
The maxillary teeth are preserved, except for the left second premolar and second molar, right incisors, first premolar, first and second molar, which are missing; the right canine was lost during life and only the left incisors are in situ. In the mandible only the left second molar and right second premolar and third molar are preserved and are in situ; the other teeth were all lost during life, except for the right incisors, which were lost post-mortem.
Mild calculus affects the maxillary teeth and strong calculus the mandibular teeth.
Enamel hypoplasia occurred between 3 and 4.5 years, with three episodes.
Alveolar resorption of grade 2 affects the mandibular teeth.

Anatomical variants
In the skull the zygomatic foramen is present on the left; in the post-cranial skeleton the unfused acromial epiphysis of both scapulae and the anterior double facet on both calcanei are present.

Ergonomy
The individual shows a medium-low development of the muscular insertions, except for the deltoid of the left clavicle, the costo-clavicular ligament and the trapezoid ligament of the left clavicle, the brachialis of the right ulna, which present a strong development, and the conoid ligament of both clavicles, which presents a strong/very strong development.

Pathologies
Grade 1 osteoarthrosis affects the sternal facet of both clavicles, the proximal articular surface of the left femur, the calcaneal articular surface of both talii, the distal articular surface of the first metatarsal, the mandibular condyles, and the bodies of lumbar vertebrae. Grade 2 osteoarthrosis affects the proximal articular surface of the left tibia. Diffuse grade 1 periosteal reaction is present on the right femur; localised grade 2 periosteal reaction is present on the right fibula. The second and third phalanges of the fifth finger of both feet are fused. The fibulae are bended.

SU 2224

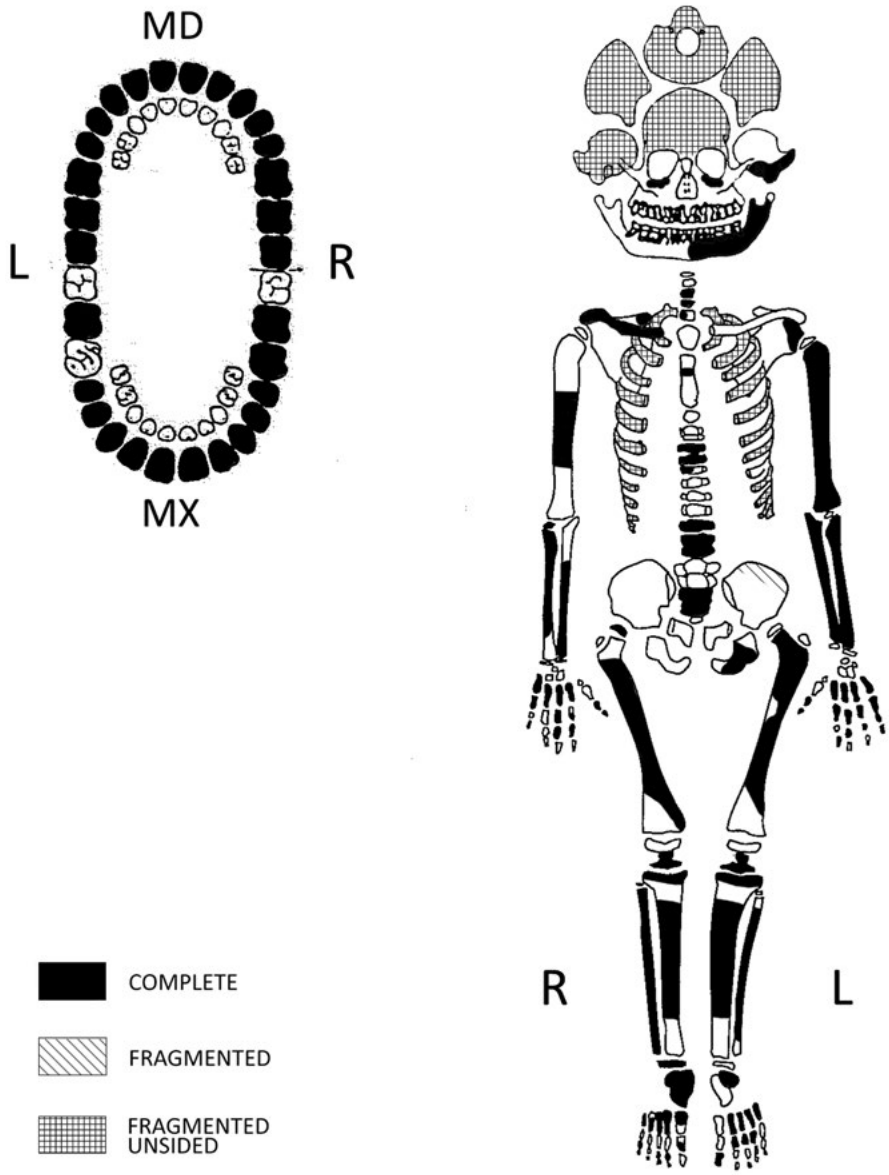


Figure 28

Sex: undeterminable

Age: 12-14 years

Age at death was determined on the dental eruption, development of permanent teeth, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies

All maxillary teeth are isolated, except for the left first molar, which is missing; the mandibular teeth are all preserved, but the right second incisors, canine, premolars and molars are isolated. The third molars are in form of germs.

Enamel hypoplasia occurred between 1.5 and 4.5 years, with six episodes.

Several caries were observed. In the maxillary teeth: one grade 3 mesial on the left second premolar, one grade 2 distal on the right second premolar, two grade 2 occlusal on the right first molar and one grade 1 occlusal on the right second molar. In the mandibular teeth: two grade 2 occlusal caries on the left first molar, one grade 2 occlusal and one grade 1 mesial on the right first molar, one grade 2 buccal on the right second molar.

Mild calculus affects the maxillary and the mandibular teeth.

Anatomical variants

In the post-cranial skeleton the partial transverse accessory foramen on the left of C3 and complete on the right of C7 are present.

Pathologies

Lytic lesions are present on the anterior surface of the thoracic and lumbar vertebrae. A slight deformity of the distal portion of the left humerus can be attributed to a green-stick fracture occurred during the young age.

SU 2235

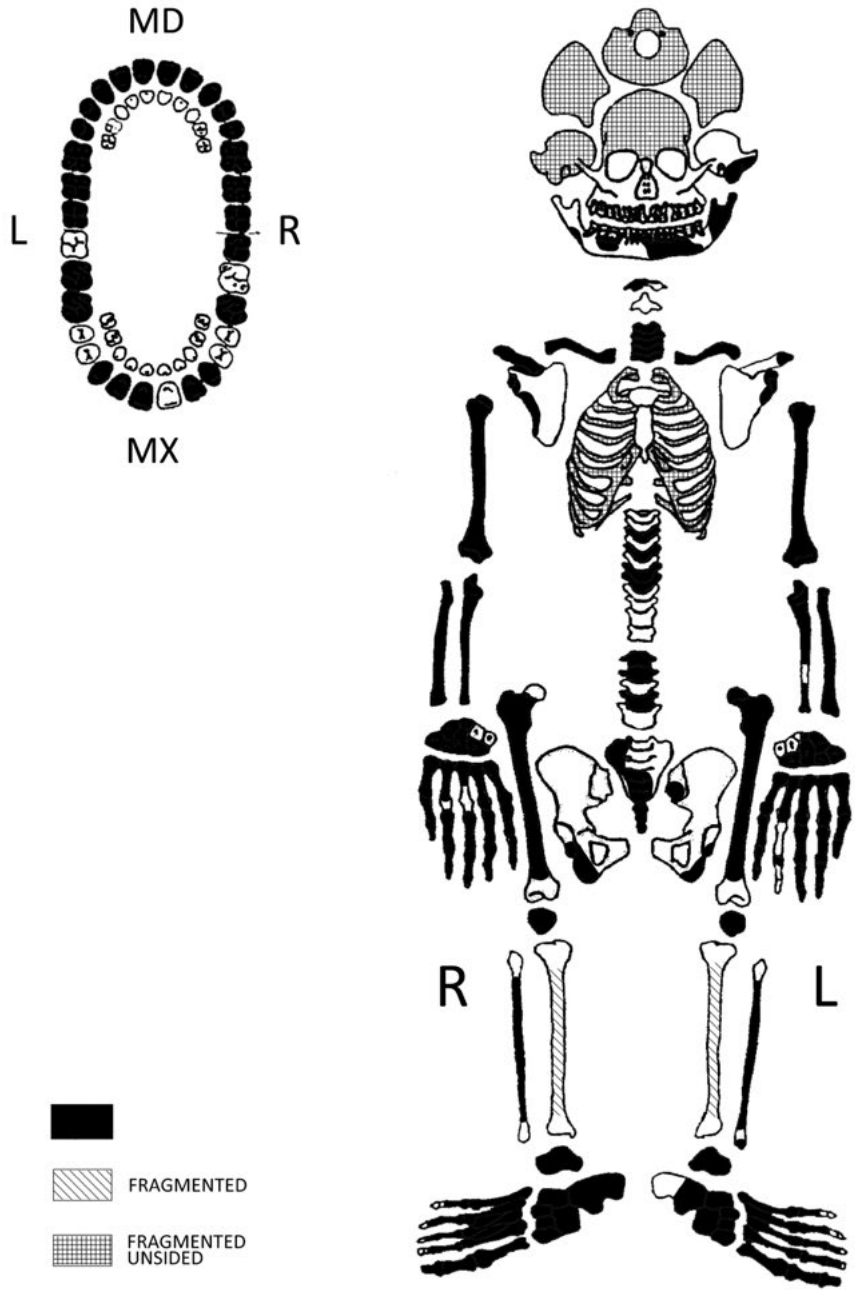


Figure 29

Sex: male
Sex was determined through the analysis of seven morphological features of the skull and one of the pelvis, which provided a total sexual index of 1.07.

Age: 25-32 years
Age at death was determined on the basis of dental wear, stage of fusion of the vertebrae, morphology of the auricular surface of the ilium and of the pubic symphysis, and sternal rib end modifications.

Stature: 167.1 cm

Dental pathologies
All mandibular teeth are preserved and are in situ, except for the left incisors and the right first incisor, premolars and third molar, which are isolated. The maxillary teeth are isolated, except for the left premolars and third molar, right first incisor, premolars and second molar, which were lost post-mortem.
Several caries are observed. In the maxillary teeth one grade 4 on the left first molar, one grade 2 mesial at the root of left second molar, one grade 1 buccal and one grade 1 occlusal on the right first molar. In the mandibular teeth: one grade 1 buccal caries at the root of the left second premolar, one grade 2 buccal and one grade 1 distal at the root of the left first molar, one grade 1 distal on the right second incisor, one grade 1 lingual on the right canine, one grade 2 buccal at the root and one grade 2 buccal on the right first premolar, one grade 1 buccal at the root of the right second premolar, two grade 2 buccal and one grade 2 distal both at the

root of the right first molar, one grade 2 buccal at the root on the right second molar and one grade 1 occlusal on the right third molar.
Alveolar resorption of grade 3 affects the mandible.
Mild calculus affects the mandibular and maxillary teeth.
Enamel hypoplasia occurred between 2 and 5 years, with six episodes.

Anatomical variants
In the skull the extrasutural mastoid foramen is present on the left; in the post-cranial skeleton the complete transverse accessory foramen on the left of C5 and partial on the left of C6, and the Poirier's facet on the left femur are present.

Ergonomy
The individual shows a low-medium development of the muscular insertions, except for the brachioradialis of both humeri, which show a strong development, and the pectoralis major and the latissimus dorsi/ teres major of the right humerus, which show an enthesopathy.

Pathologies
Diffuse grade 1 periosteal reaction affects the tibiae. An unhealed fracture with pseudoarthrosis affects a rib. The sacrum is fused with the coccyx.

SU 2254

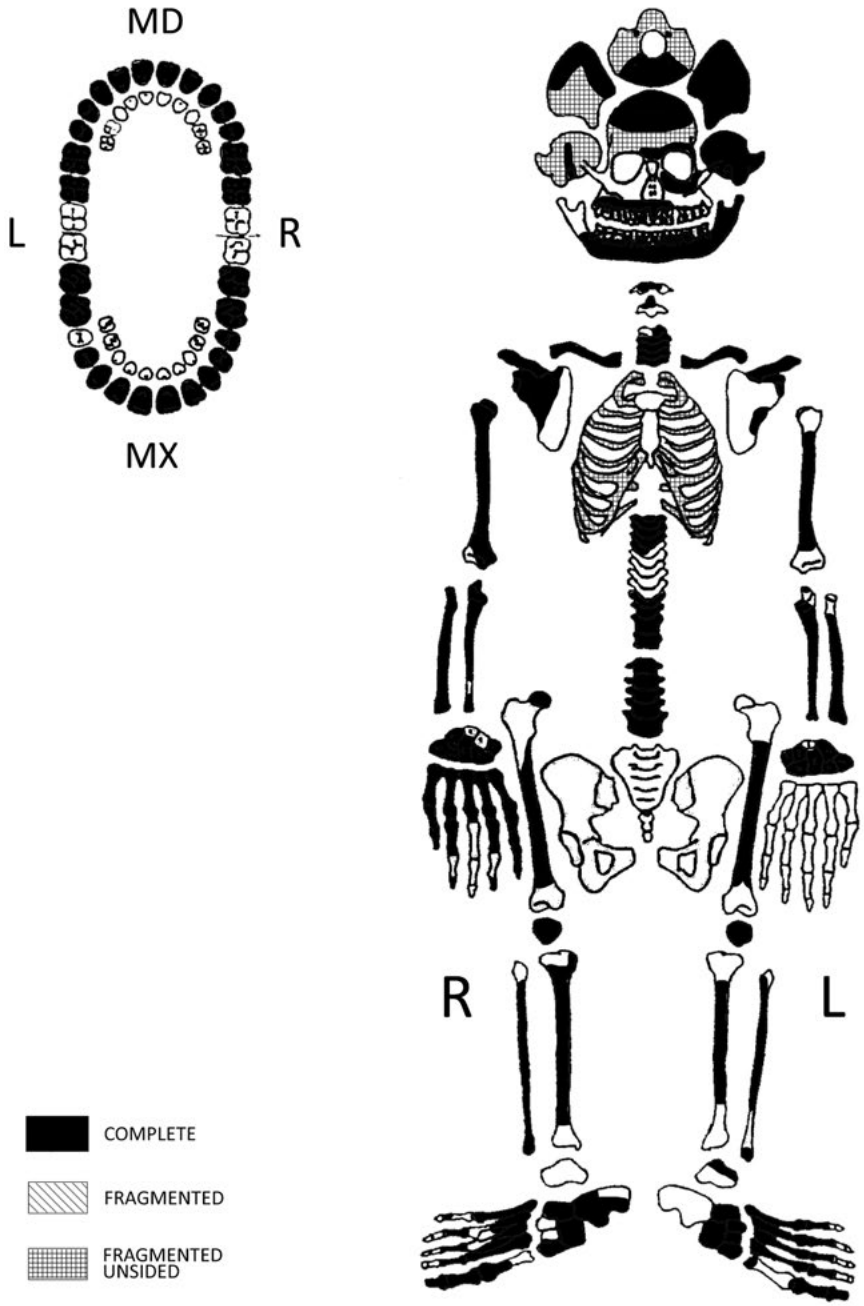


Figure 30

Sex: female
Sex was determined through the analysis of fifteen morphological features of the skull and eleven of the pelvis, which provided a total sexual index of -0.7.

Age: 35-45 years
Age at death was determined on the basis of dental wear, stage of fusion of the vertebrae, morphology of the pubic symphysis, and sternal rib end modifications.

Stature: 155.5 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the left canine, first incisor, molars, which are isolated; the left second premolar was lost post-mortem. All the mandibular teeth are preserved and are in situ. There is agenesis of the third molars.
The mandibular second premolars are rotated.
Mild calculus affects the maxillary and the mandibular teeth.
Enamel hypoplasia occurred between 1.5 and 5 years, with six episodes.
Grade 1 alveolar resorption affects the maxilla, grade 2 the mandible.

Anatomical variants
In the skull the zygomatic foramen on the left, the epipteric bone on the right and the asterionic bone on both sides are present. In the post-cranial skeleton the anterior double facet is visible on the left calcaneus.

Ergonomy
The individual shows a medium development of the muscular insertions of the superior limbs, except for the deltoid, conoid ligament and trapezoid ligament of both clavicles, the deltoid of both humeri, and the latissimus dorsii/teres major of both humeri, which show a strong development. The muscular insertions of the lower limbs show a medium-low development, except for the soleus of the right tibia, which shows a strong development.

Pathologies
Cribra orbitalia of grade 1 are visible on the left orbit. Grade 1 osteoarthrosis affects the bodies of thoracic vertebrae, the right acetabular cavity, the articular facet of the right patella and the distal articular surface of the first metatarsal bone. Diffuse grade 1 periosteal reaction affects the femurs and tibiae. Localised grade 2 periosteal reaction is visible on the proximal diaphysis of the right fibula, localised grade 1 periosteal reaction affects the metaphyseal portion of the left fibula. Schmorl's nodes affects two thoracic vertebrae.
Porosity is visible on the external margin of the right and left acoustic meatus.

Trench 4

SU 2177

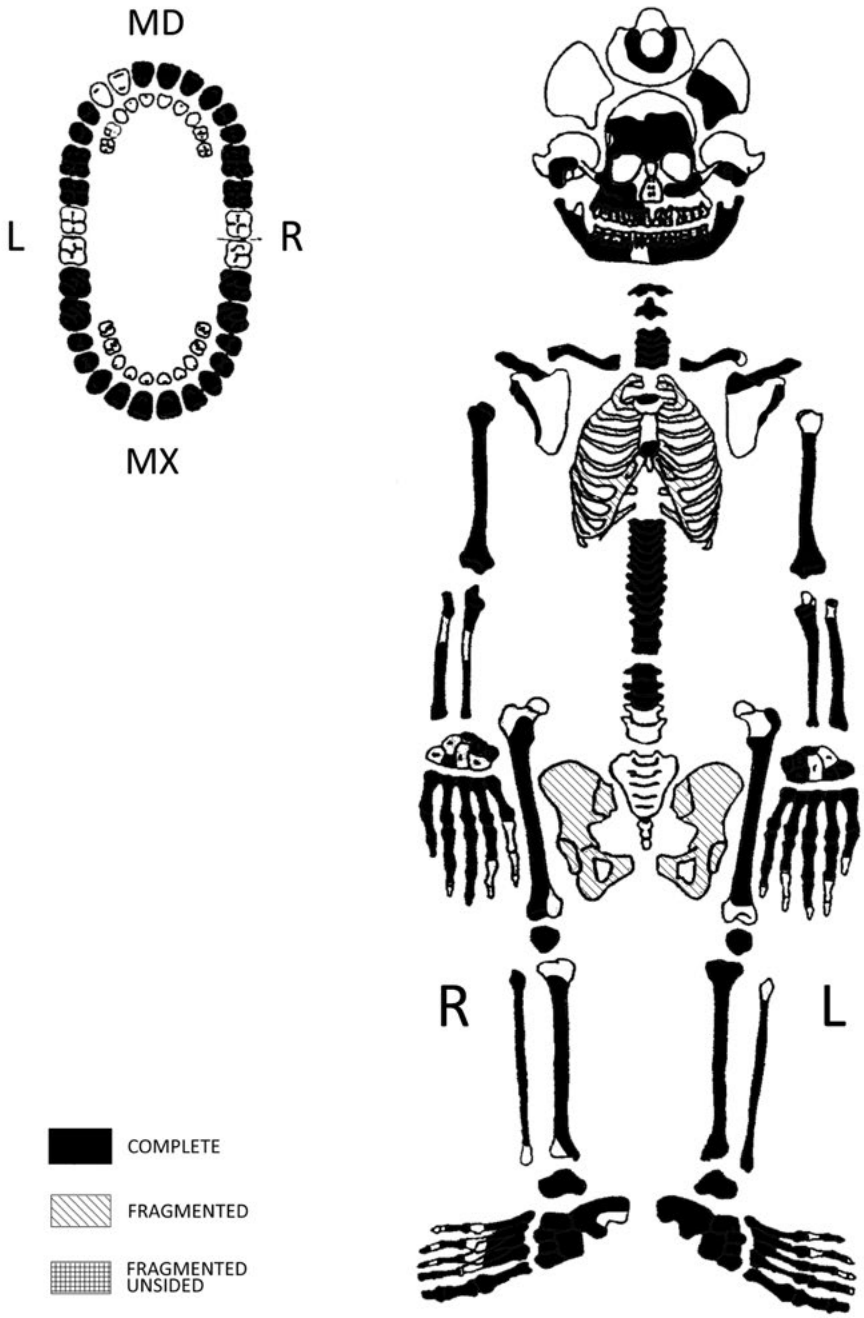


Figure 31

Sex: female
Sex was determined through the analysis of eleven morphological features of the skull, with a sexual index of -1.3.

Age: 25-35 years
Age at death was determined on the basis of dental wear and sternal rib end modifications.

Stature: 160.8 cm

Dental pathologies
Almost all the right maxillary teeth are in situ, except for the first incisor, which is isolated, while the left maxillary teeth are all present and isolated. As for the mandible, most of the teeth are present isolated, except for the right premolars and second molar, left incisors and canine, which are in situ; the left first molar was lost during life. All four third molars are absent (perhaps agenesic).
Alveolar resorption of grade 1 affects both the maxilla and mandible. Some caries were detected: on the left maxilla, one of grade 1 mesial interproximal on the canine, one of grade 2 mesial interproximal on the first molar and one of grade 2 distal interproximal on the second molar, all at cemento-enamel junction. On the right mandible, there is one caries of grade 2 buccal on the first molar and one caries at the cemento-enamel

junction of grade 2 mesial interproximal on the second molar.
Mild calculus is present in both the maxillary and mandibular teeth.
Enamel hypoplasia occurred between the ages of 2 and 5 years, with six episodes.

Anatomical variants
In the skull the metopic suture is present, while in the post-cranial skeleton the complete accessory foramen on C6 on both sides is visible.

Ergonomy
The individual shows a medium-strong development of the muscular insertions in all skeletal districts, except for the right pectoralis major and the brachioradialis of the humeri, which have a very strong development.

Pathologies
Diffuse grade 1 periosteal reaction is present on the left femur and on the tibiae, while localized grade 1 periosteal reaction affects the third upper portion of the diaphysis of the fibulae. Schmorl's nodes affect eight out of twelve thoracic vertebrae and all the three preserved lumbar vertebrae.
There is fusion of the second and third phalanx of the fifth finger of the left foot. Strong thickening of the skull and osteochondritis dissecans on the sternal end of the right clavicle were observed.

SU 2179

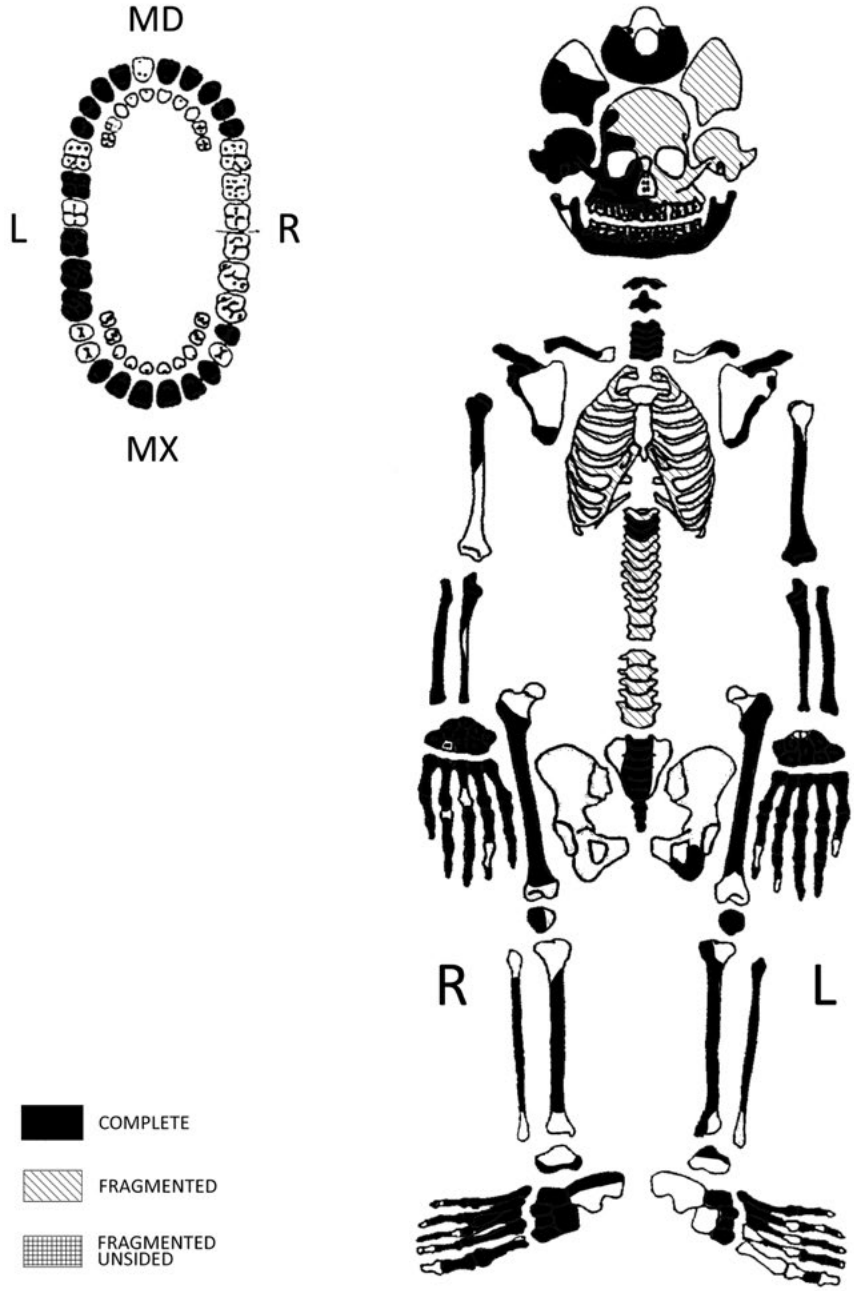


Figure 32

Sex: male
Sex was determined through the analysis of fifteen morphological features of the skull, which provided a sexual index of 1.1.

Age: 45-55 years
Age at death was determined on the basis of dental wear, morphology of the pubic symphysis, and sternal rib end modifications.

Stature: 161.4 cm

Dental pathologies
All the maxillary teeth are present and in situ, except for the left molars, which are isolated, the left premolars, which was lost post-mortem, and the right first and third molars, which were lost during life. The right second molar is preserved as a root. All the mandibular teeth are preserved and in situ, except for the left first incisor, which was lost post-mortem, and the left first and third molar, and right molars, which were lost during life.
Alveolar resorption of grade 2 affects the maxilla and grade 3 the mandible.
Enamel hypoplasia occurred at 3.5 years, with one episode.
Mild calculus affects the maxillary teeth, strong the mandibular teeth. There is a malformation of the roots of some teeth, in particular: the canines have a double root; the maxillary left second molar has four roots, one of which hypoplastic; the left maxillary third molar has three very curved roots. In addition, the two second incisors are 'shovel teeth'. Maxillary prognatism was observed.

Anatomical variants
On the skull the complete supraorbital foramen on the right and a zygomatic foramen bilaterally are present. In the post-cranial skeleton, the complete accessory foramen on C6 bilaterally and the exostosis of the trochanteric fossa on the left femur are present.

Ergonomy
The individual shows a very strong development of the muscular insertions, with the presence of entesopathies of osteophytic type of grade 1 at the level of the conoid ligament of the clavicle, deltoid of left humerus, and grade 2 at the level of the latissimus dorsi/teres of both humeri, of the interosseous tubercle of the left radius, and of the supinator of the right ulna.

Pathologies
Osteoarthritis of grade 1 is visible on the two joints of the scapulae and radii, on the distal articular surface of the ulnae and the posterior face of the patellae; grade 2 osteoarthritis affects the acromial end of the clavicles, proximal articular surface of the ulnae and on thoracic vertebrae. The presence of an osteophytic bridge between C6 and C7, on the left side of the body, is observed. The skeleton of the individual shows a sclerosing dysplasia affecting all the long bone, referable to the Camurati-Engelmann disease.

SU 2201

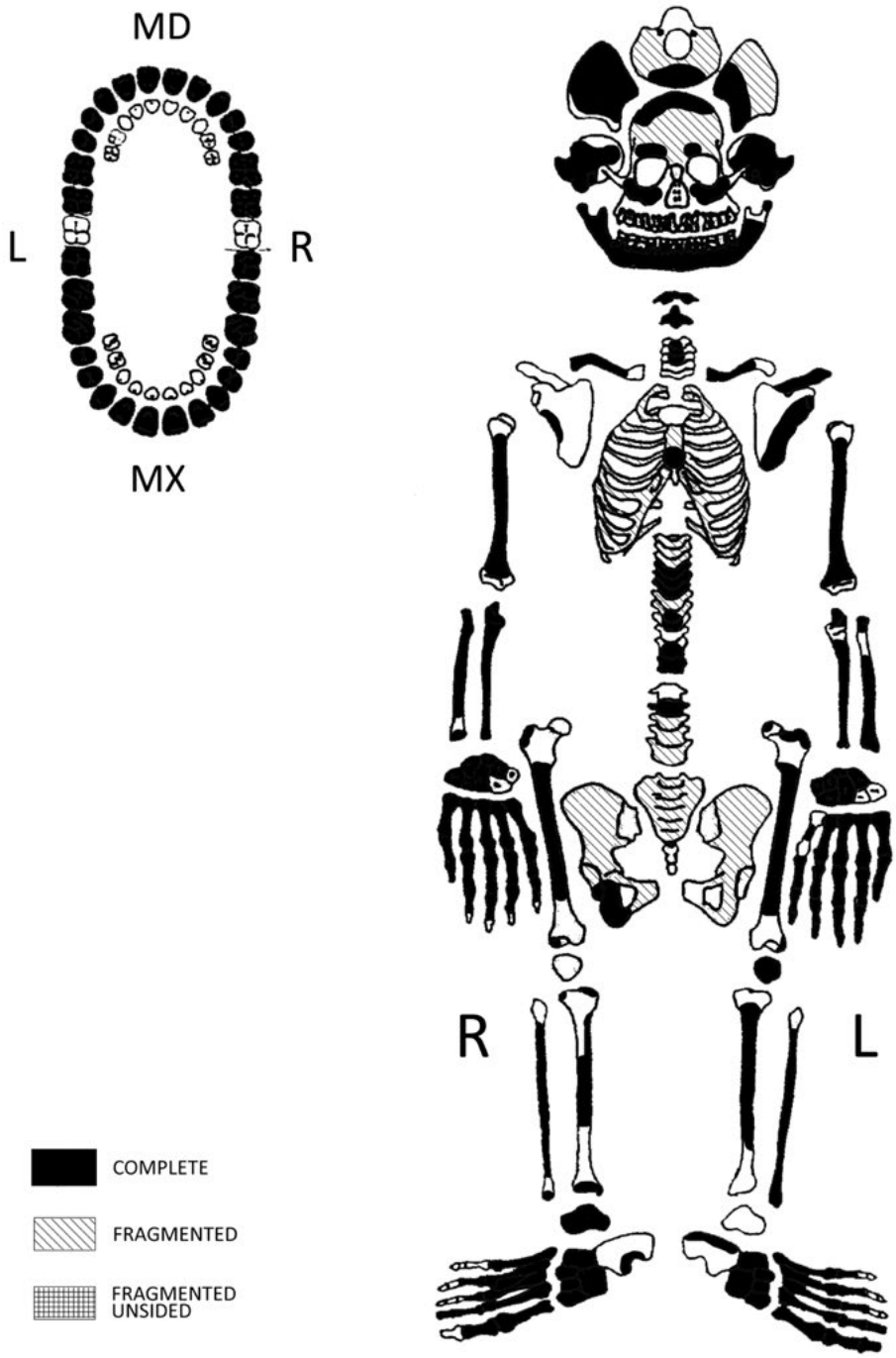


Figure 33

Sex: undeterminable

Age: 12-15 years
Age at death was determined on the basis of dental eruption, degree of fusion between diaphyses and epiphyses, and sternal rib end modifications.

Dental pathologies
All the maxillary teeth are present and isolated. All the mandibular teeth are preserved and in situ; the mandibular third molars are in form of germs.

Enamel hypoplasia occurred between 2.5 and 5 years, with five episodes.

Anatomical variants
In the skull the parietal foramina on both sides and the bregmatic bone are present.

Pathologies
Diffuse grade 1 periosteal reaction is present on the femurs, right tibia and fibulae. A healed fracture is visible in the right clavicle. The left tibia is affected by osteomyelitis.

SU 2211

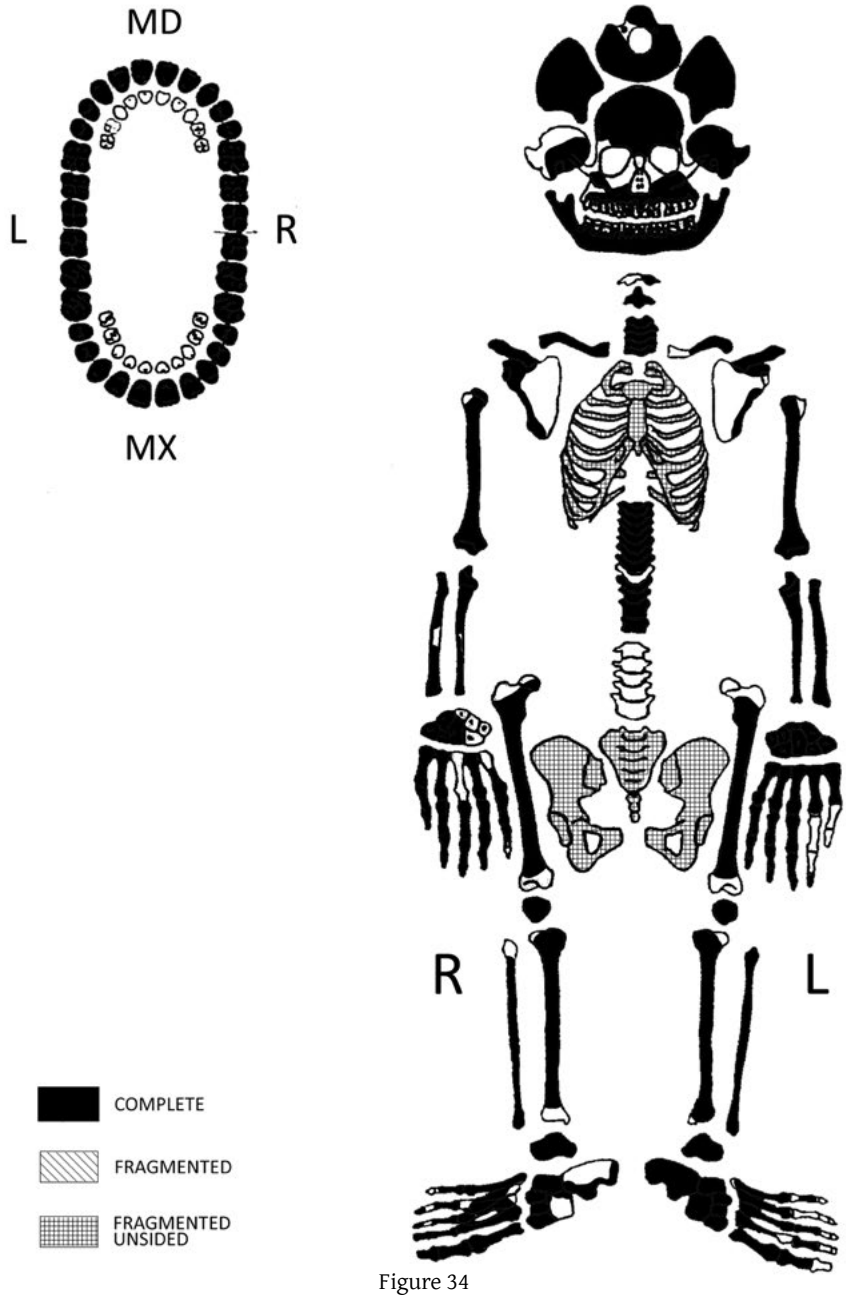


Figure 34

Sex: female
Sex was determined through the analysis of sixteen morphological features of the skull, which provided a sexual index of -0.1.

Age: 25-35 years
Age at death was determined on the basis of dental wear and sternal rib end modifications.

Stature: 158.2 cm

Dental pathologies
All the teeth are present in situ, except for the right maxillary molars, which are isolated.
Alveolar resorption of grade 2 affects the maxilla and of grade 1 the mandible.
No caries were observed.
Mild calculus is present on the maxillary teeth and strong on the mandibular ones.
Enamel hypoplasia occurred between 2 to 5 years of age, with five episodes.

Anatomical variants
In the skull a zygomatic foramen, the parietal foramen bilaterally, and a lambdoid bone on the left are present. In the post-cranial skeleton a large septal aperture in both the humeri, the accessory facet in the distal epiphysis of the left tibia, the double calcanear facet on the right and the accessory facet on the neck of both talii are visible.

Ergonomy
The individual shows a medium-strong development of the muscular insertions, except for the right deltoid

and conoid ligament of the right clavicle, the gluteus maximus of both femurs and the Achilles' tendon of both calcanei, which show a very strong development, and the deltoid of the left clavicle, which shows an osteophytic enthesopathy of grade 1.

Pathologies
Cribra cranii are present on the occipital bone. Diffuse grade 1 periosteal reaction is observed on both tibiae and fibulae. Schmorl's nodes affect five out of eleven thoracic vertebrae. Osteoarthritis of grade 1-2 affects the thoracic vertebrae. Osteoarthritis of grade 1 is also observed at the level of the sternal facet of the left clavicle, the glenoid cavity of the right scapula, the proximal joint of both humeri, the distal joint of the right humerus, both the femoral heads, the proximal joints of the ulnae, the throclea and articular facet for the calcaneus of both talii, two joints of the left calcaneus, and the proximal articular surface of both first metatarsals.

Observations
Lytic lesions are present on the upper portion of the glenoid cavity of the right shoulder.

SU 2217

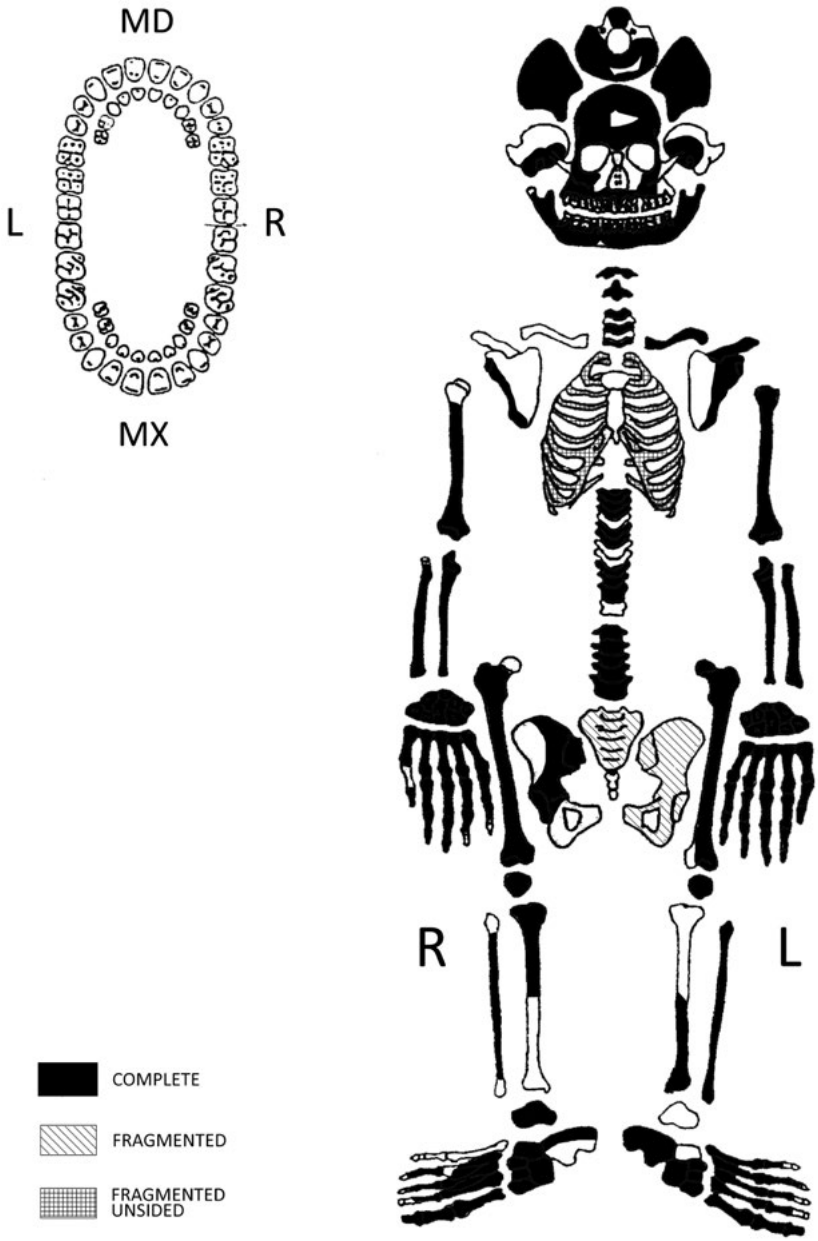


Figure 35

Sex: male
Sex was determined through the analysis of fourteen morphologic features of the skull and five of the pelvis, which provided a total sexual index of -0.6.

Age: 50-60 years
Age at death was determined on the basis of morphology of the pubic symphysis and sternal rib end modifications.

Stature: 156.87 cm

Dental pathologies
The individual was completely edentulous.

Anatomical variants
In the skull the metopic suture, the zygomatic foramina, the parietal foramina bilaterally, and the extrasutural mastoid foramen on the left are present. In the post-cranial skeleton the Poirier's facet, the exostosis of the trochanteric fossa and of the fovea on both femurs, the vastus notch of the patellae, the double anterior facet on both calcanei and the facet on the neck of the right talus are present.

Ergonomy
The individual shows a very strong muscular development, with the presence of several enthesopathies. In particular, a grade 3 osteolytic enthesopathy is localized at the level of the costo-clavicular ligament of the left clavicle, an osteophytic enthesopathy of grade 1 on the conoid ligament of the right clavicle and of grade 2 on the left. Finally, a grade 1 osteophytic enthesopathy affects the triceps brachii of the right ulna, the biceps brachii of the left radius, and the gluteus maximus of both femurs, and the Achilles' tendon of both calcanei.

Pathologies
There are cribra orbitalia on the left orbit. Schmorl's nodes affects 2 out on 8 thoracic vertebrae. All the preserved joints are affected by osteoarthritis of grade 1, except for the acromial end of the left scapula, glenoid cavity of both scapulae, distal articular surface of the left humerus, proximal articular surface of the left ulna, distal articular surface of both ulnae, which show osteoarthritis of grade 2. The sternal end of both clavicles, distal articular surface of the right humerus, proximal articular surface of the right ulna, vertebrae, carpal bones, metacarpals and phalanges of both hands show osteoarthritis of grade 3.
A healed fracture of the right elbow can be observed.
Fusion of seven thoracic vertebrae out of eight and diffuse enthesopathies suggest that the individual was affected by diffuse idiopathic skeletal hyperostosis (DISH).

SU 2218

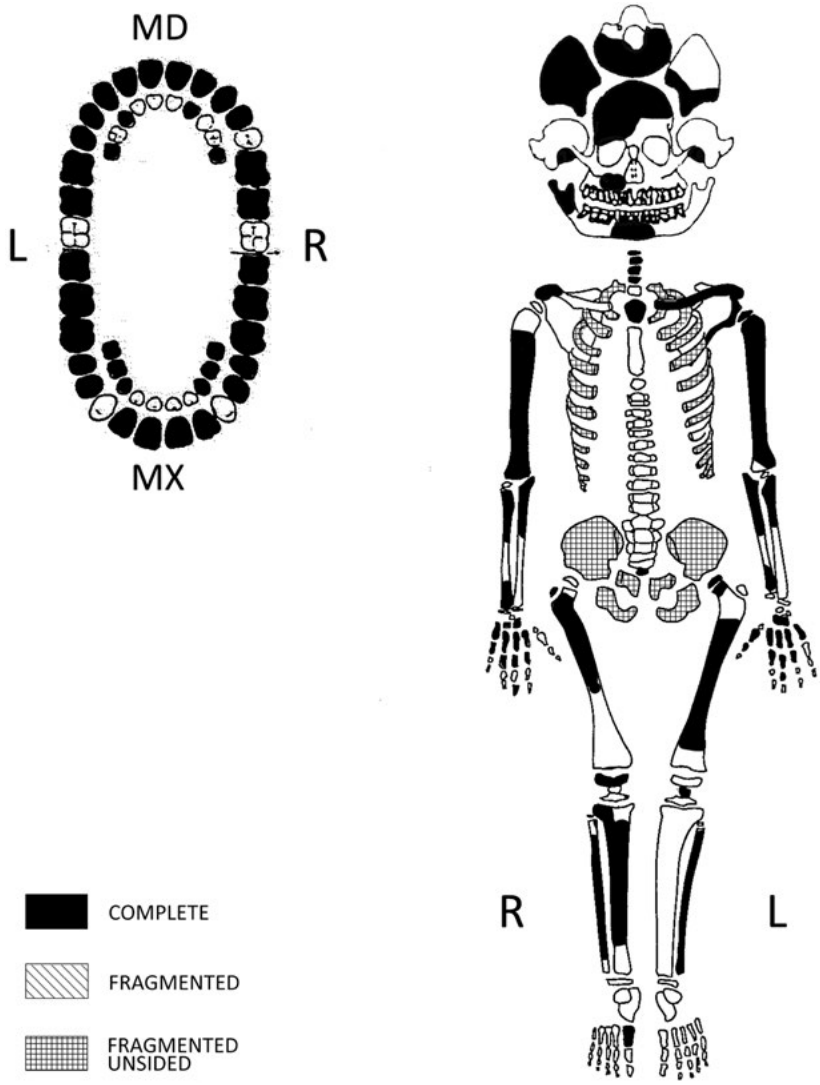


Figure 36

Sex: undeterminable

Age: 9-11 years
Age at death was determined on the basis of dental eruption, permanent teeth development, and long bone length.

Dental pathologies
Both deciduous and permanent teeth are present, some of which are still germs (the maxillary canines and the second molars, the mandibular premolars, the second, and the third molars). Due to the extremely fragmentary state of maxilla and mandible, most of the preserved teeth are isolated, except for the permanent maxillary right first premolar and the permanent mandibular incisors, which are in situ; also the deciduous maxillary right canine, the mandibular canines and first molars are in situ. The maxillary right second premolar is in eruption.
There are no caries on the permanent teeth; on deciduous maxillary teeth caries are all at the cemento-enamel junction: one distal interproximal caries of grade 3 on the maxillary left second molar, one grade 2 mesial interproximal caries of grade 2 on the maxillary right canine, and one distal interproximal caries of grade 3 on the maxillary right second molar. Caries are also present on deciduous mandibular teeth, all at cemento-enamel junction: one mesial interproximal of grade 3 on the left canine, one distal interproximal of grade 3 on the left first molar, one mesial interproximal of grade 2 on the right canine, and one distal interproximal of grade 2 on the right first molar.
Enamel hypoplasia occurred between 1 and 4.5 years, with seven episodes.

Anatomical variants
In the skull the infraorbital suture and the zygomatic foramen on the right are present.

Pathologies
No skeletal pathologies are observed.

SU 2219

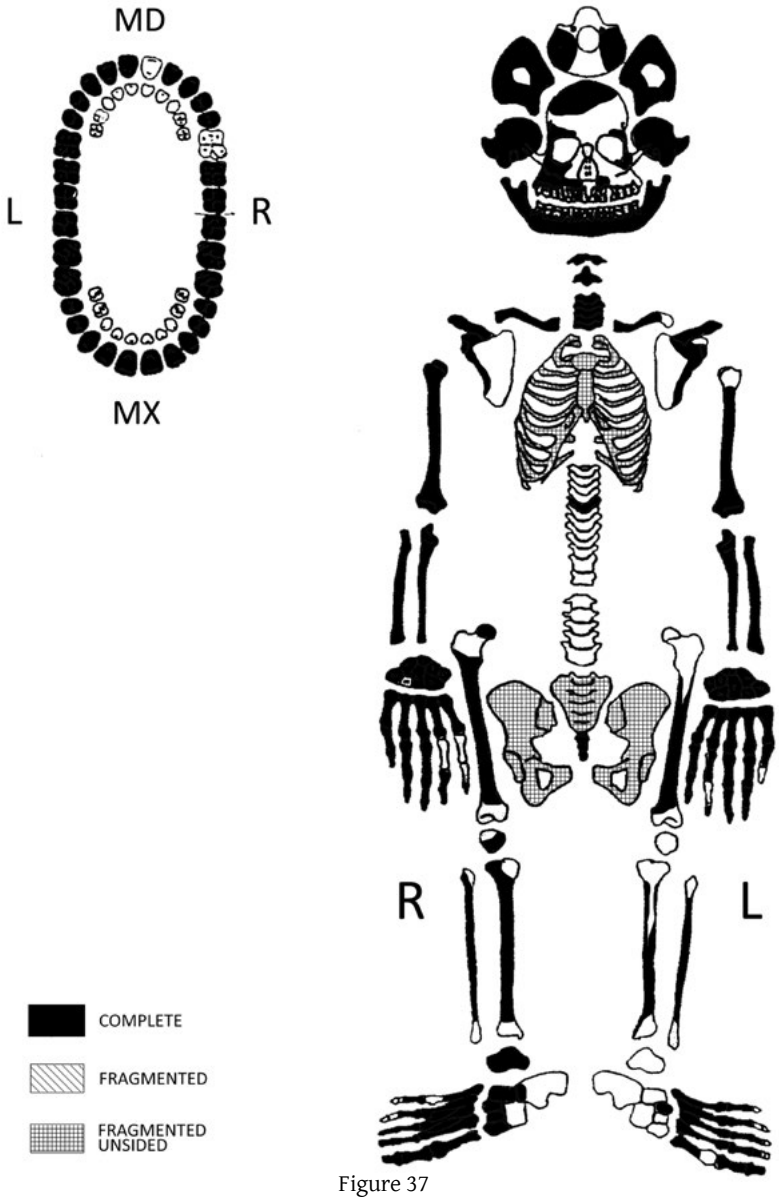


Figure 37

Sex: male
Sex was determined through the analysis of twelve morphological features of the skull and two of the pelvis, with a total sexual index of 0.1.

Age: 20-30 years
Age at death was determined on the basis of dental wear and the sternal rib end modifications.

Stature: 156.8 cm

Dental pathologies
All maxillary teeth are preserved and are almost all in situ, except for the left incisors and molars, which are isolated. All mandibular teeth are preserved and in situ, except for the left third molar, and the right second incisor, canine, and premolars, which are isolated, the right first incisor, which was lost post-mortem, and the right first molar, which was lost during life.
In the maxilla there are caries located on the molars: one mesial caries of grade 2 on the left first molar, one mesial of grade 3 on the left second molar, one distal of grade 2 on the left third molar, one mesial of grade 2 at the cemento-enamel junction of the right first molar, and one mesial of grade 1 at the cemento-enamel junction of the right second molar. In the left mandible, one distal caries of grade 2 at the cemento-enamel junction on the first molar and one occlusal caries of grade 1 on the second molar are observed. On the right side of the mandible there are two caries on the second molar, one distal of grade 1, and the other mesial of grade 2.
Enamel hypoplasia occurred between 2 and 4.5 years, with 5 episodes.
Alveolar resorption of grade 1 affects the maxilla and mandible.

Anatomical variants
In the skull the complete supraorbital foramen on the left side, two zygomatic foramen on the right side and one on the left, the parietal forearm on the left and the extrasutural mastoid foramen on the right are present. In the postcranial skeleton a complete right accessory transverse foramen on C4 and a partial left accessory foramen on C5 left, and the large aperture of the septum in both humeri are visible.

Ergonomy
The individual shows a medium-strong muscular development, except for the gluteus maximus, which has a very strong development.

Pathologies
Cribra orbitalia are present on both sides. Diffuse grade 1 periosteal reaction affects both femurs and tibiae. Localized grade 2 periosteal reaction is visible on the left femur, together with a healed fracture located on the medial side, in the lower third of the diaphysis.
Osteoarthritis of grade 1 affects the proximal joint of the right femur, of the posterior face of the right patella, of the proximal joint of the right tibia and of the right fibula. Osteoarthritis of grade 2 affects the right mandibular condyle.
A healed fracture is present in the distal epiphysis of the left femur. C1 is affected by posterior arch defect of type A.

SU 2220

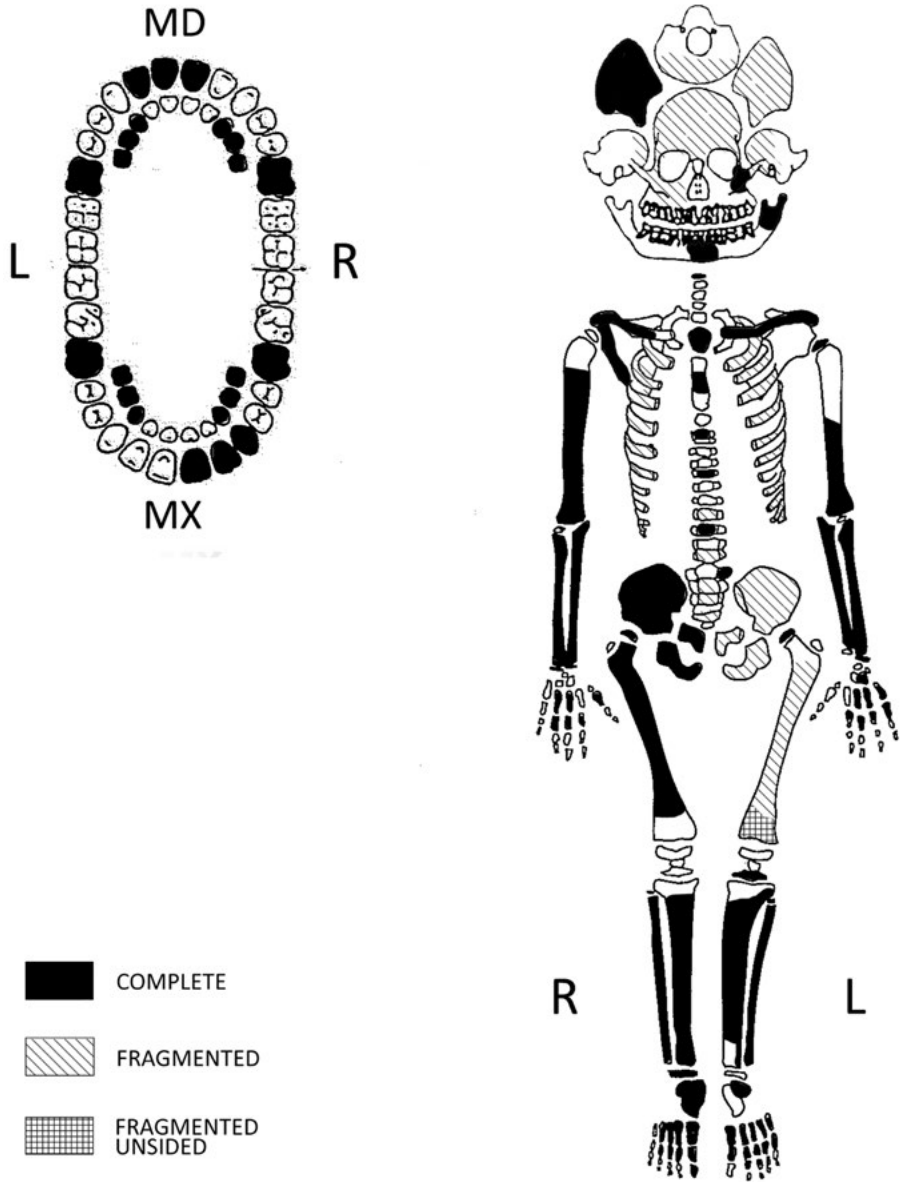


Figure 38

Sex: undeterminable

Age: 6-8 years
Age at death was determined on the basis of the dental eruption, development of permanent dentition, stage of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
Deciduous maxillary left canine and first molar, maxillary first molars are present in situ; deciduous maxillary right canine, first molar and both second molars, mandibular canines and second molars are present isolated. Permanent teeth are preserved isolated; the canines, premolars and second molars are in form of germ.
A grade 1 distal caries affects the deciduous mandibular left canine.
Enamel hypoplasia occurred between 3 and 4 years, with three episodes.

Anatomical variants
In the skull multiple zygomatic foramina are present.

Pathologies
Diffuse grade 1 periosteal reaction is present on the femurs, tibiae and right fibula.

SU 2221

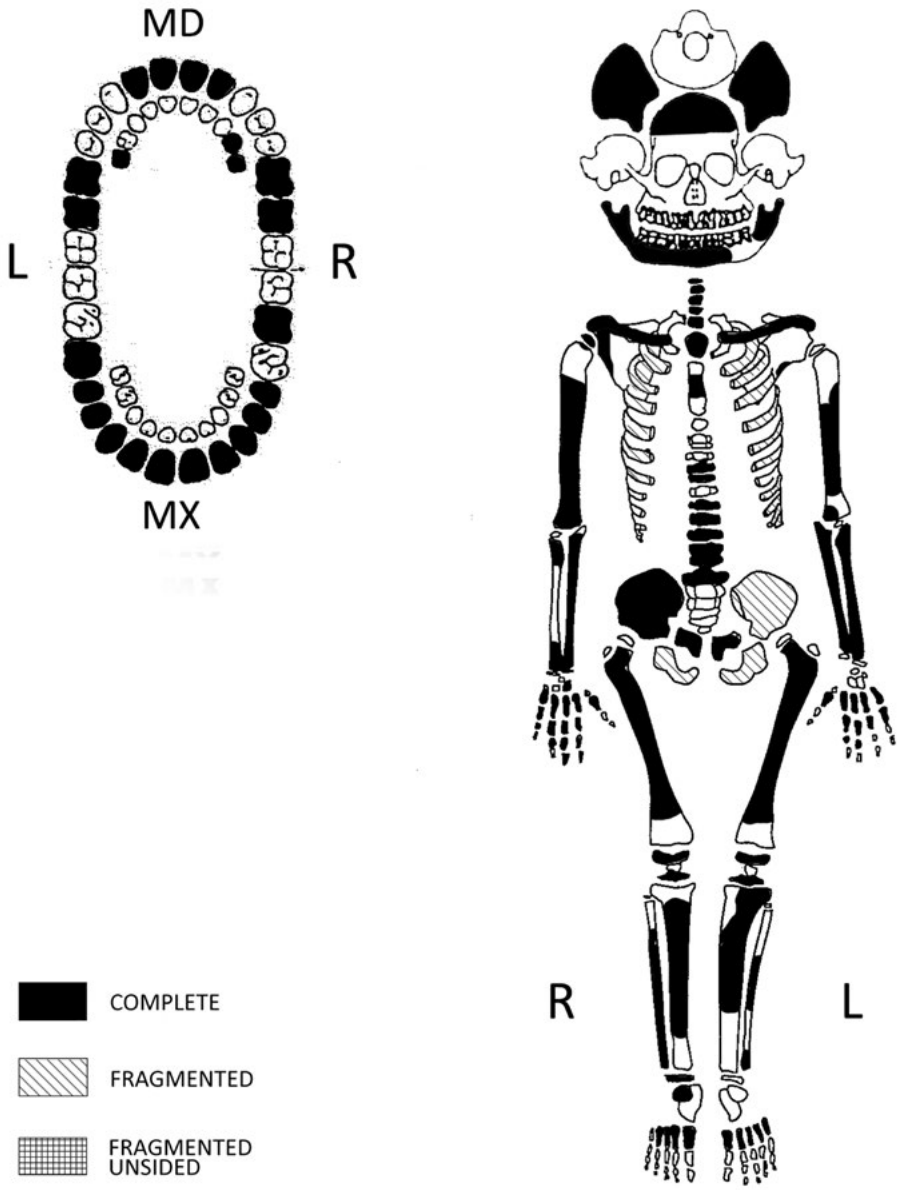


Figure 39

Sex: undeterminable

Age: 9-11 years
Age at death was determined on the basis of the dental eruption, development of permanent dentition, stage of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
Deciduous mandibular right first molar and second molars are present isolated. Permanent teeth are preserved in situ, except for the maxillary left incisors, canine, first molar and the mandibular first and second molars, which are isolated, and the maxillary right first molar, which was lost during life. The maxillary left second molar was lost post-mortem. The maxillary third molars, and mandibular canines and premolars are in eruption. The mandibular third molars are in form of germ.
Enamel hypoplasia occurred between 2.5 and 4.5 years, with four episodes.

Anatomical variants
In the skull the parietal foramen on the right is present.

Pathologies
Diffuse grade 1 periosteal reaction affects the tibiae and fibulae. A healed blunt force trauma, of 4 cm in diameter, is visible on the right parietal bone.

SU 2222

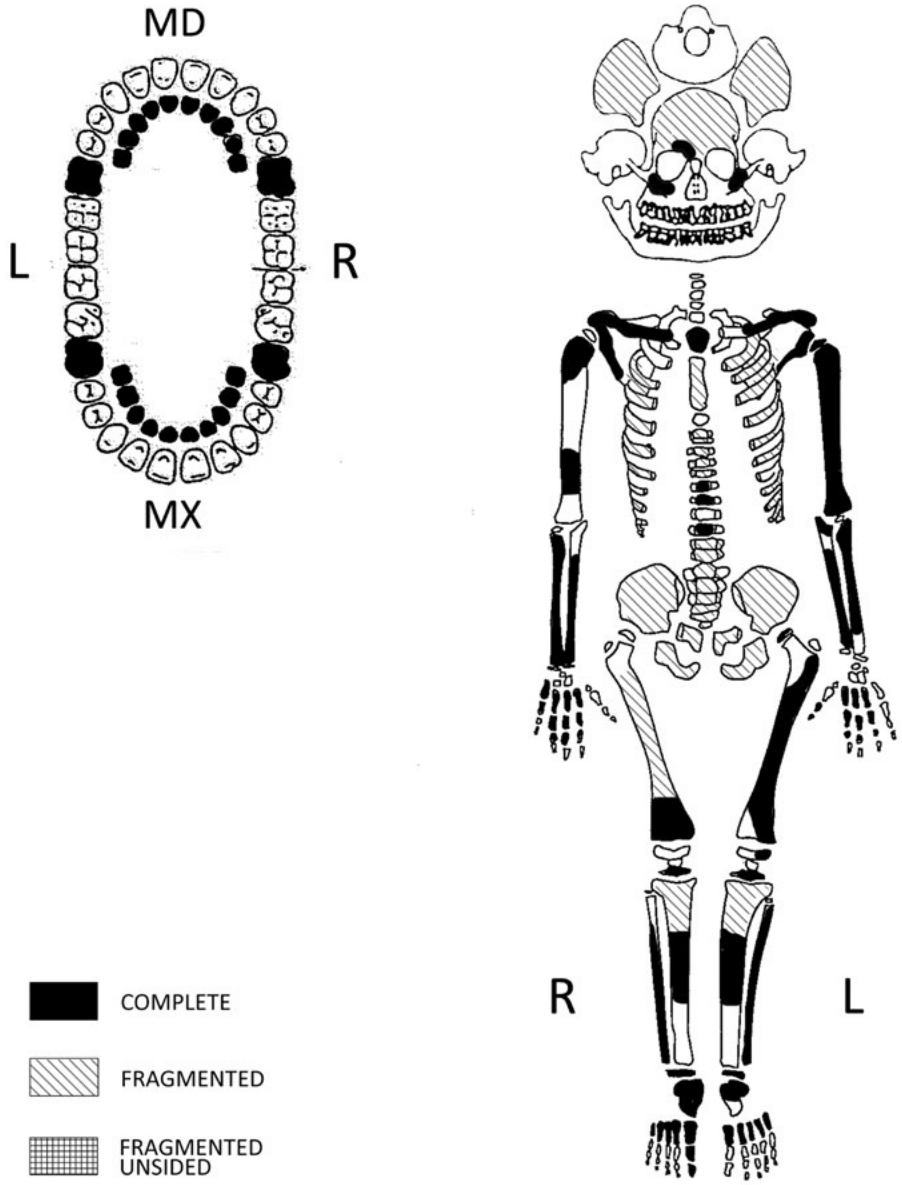


Figure 40

Sex: undeterminable

Age: 6-8 years
Age at death was determined on the basis of dental eruption, development of permanent dentition, stage of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
All deciduous teeth are present and isolated, except for the maxillary left first incisor, canine, first and second molar, mandibular right canine and molars, which are in situ. Permanent teeth are all in form of germs and isolated.
Enamel hypoplasia occurred between 4.5 and 5 years, with two episodes.

Anatomical variants
In the skull multiple zygomatic foramina on both sides are present.

Pathologies
Diffuse grade 1 periosteal reaction is visible on the tibiae and fibulae.

SU 2223

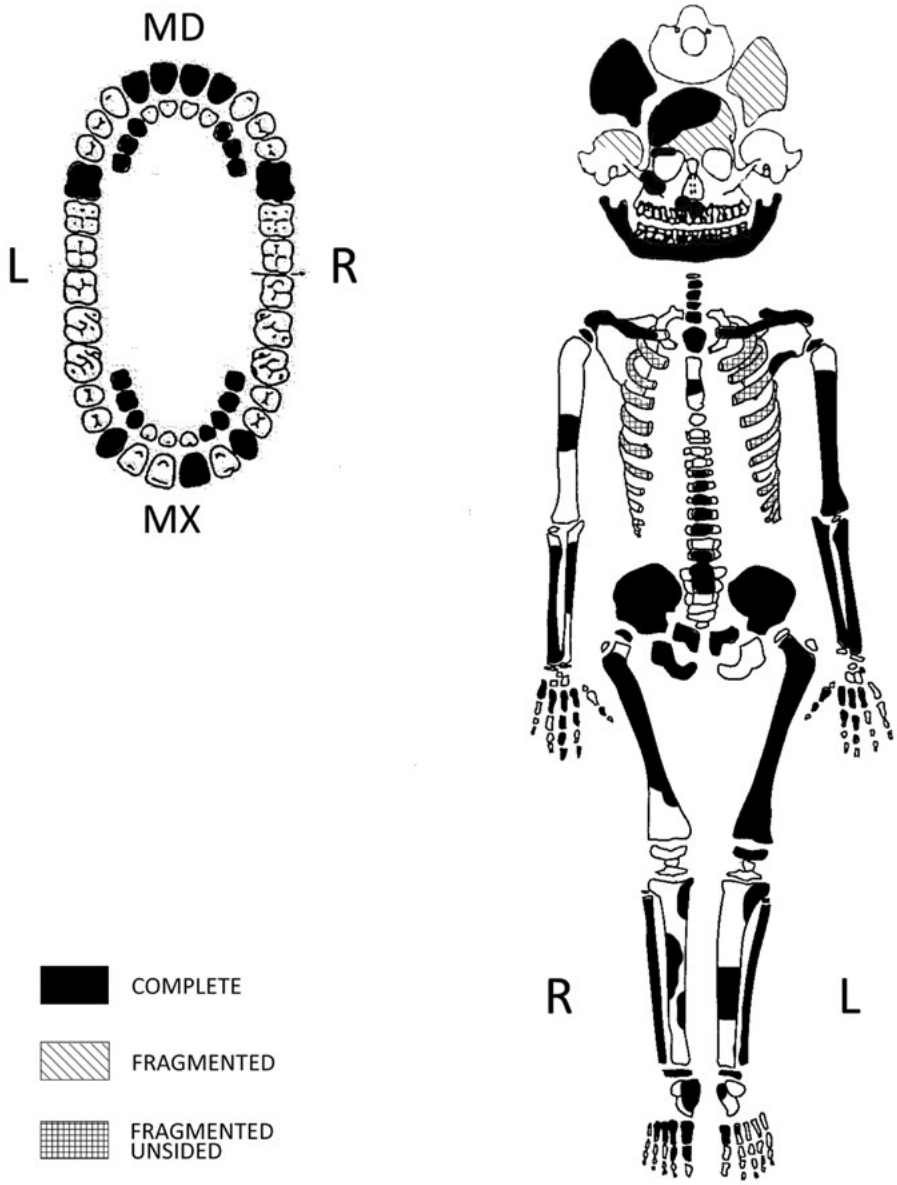


Figure 41

Sex: undeterminable

Age: 7-9 years
Age at death was determined on the basis of the dental eruption, development of permanent dentition, stage of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
The deciduous teeth are preserved in situ, except for the maxillary first incisors and left second incisor, mandibular incisors, which were lost during life, and maxillary second molar and mandibular left second molar, which are isolated. Permanent first incisors are present in situ, except for the maxillary left one, which was lost post-mortem; second incisors are in eruption. First molars are erupted and isolated, except for the mandibular right one, which is in situ; the maxillary right premolars, left first premolar, and mandibular left premolars are in form of germ.
Enamel hypoplasia occurred between 2.5 and 3.5 years, with three episodes.

Anatomical variants
In the skull a zygomatic foramen on the right and the extrasutural mastoid foramen on both sides are present. In the postcranial skeleton the transverse accessory foramen complete on the right of C4 and C6, and on the left of C5 are visible.

Pathologies
Cribra cranii of grade 1 affect the occipital bone; cribra orbitalia are visible on the left orbit. Localised grade 1 periosteal reaction is present on the diaphysis of the right femur and fibulae.

SU 2230

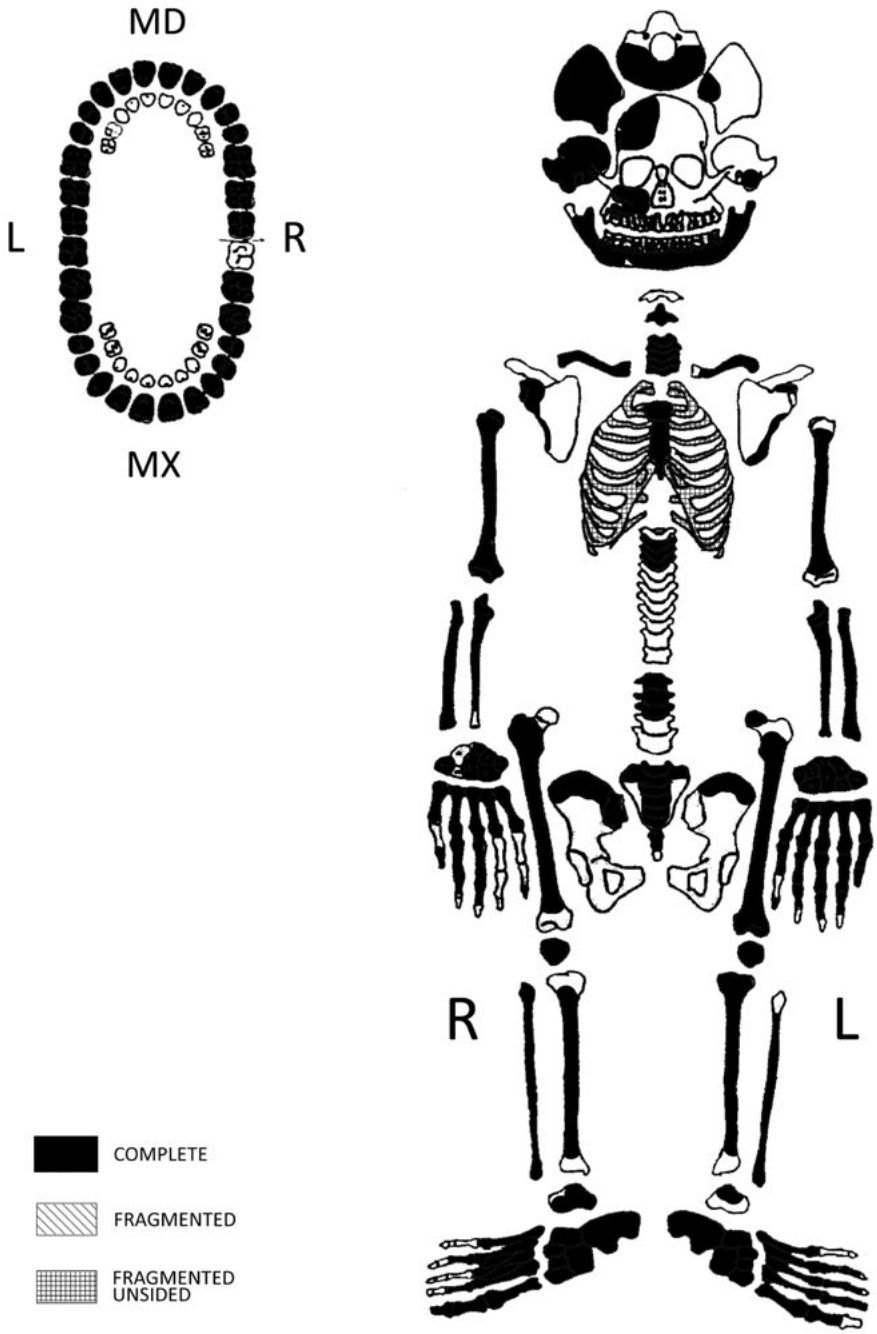


Figure 42

Sex: female
Sex was determined through the analysis of thirteen morphological features of the skull, which provided a sexual index of -0.9.

Age: 18-22 years
Age at death was determined on the basis of dental wear and sternal rib end modifications.

Stature: 154.0 cm

Dental pathologies
The right maxillary teeth are all in situ, except for the third molar, which is isolated. The left maxillary teeth are all isolated. In the mandible all the teeth are isolated, except for the right canine, premolars and molars, and left second and third molar, which are in situ. There is no alveolar resorption.
One distal caries of grade 2 at the cemento-enamel junction affects the mandibular left second premolar.
Enamel hypoplasia occurred between 2 and 4.5 years, with five episodes.
Mild calculus affects both maxillary and mandibular teeth.

Anatomical variants
In the skull a zygomatic foramen bilaterally, the right parietal foramen and a lambdoid bone on the right are

present. In the postcranial skeleton the sacralization of L5 is observed.

Ergonomy
The individual shows a low muscular development.

Pathologies
Diffuse grade 1 periosteal reaction affects the tibiae and the fibulae.

SU 2231

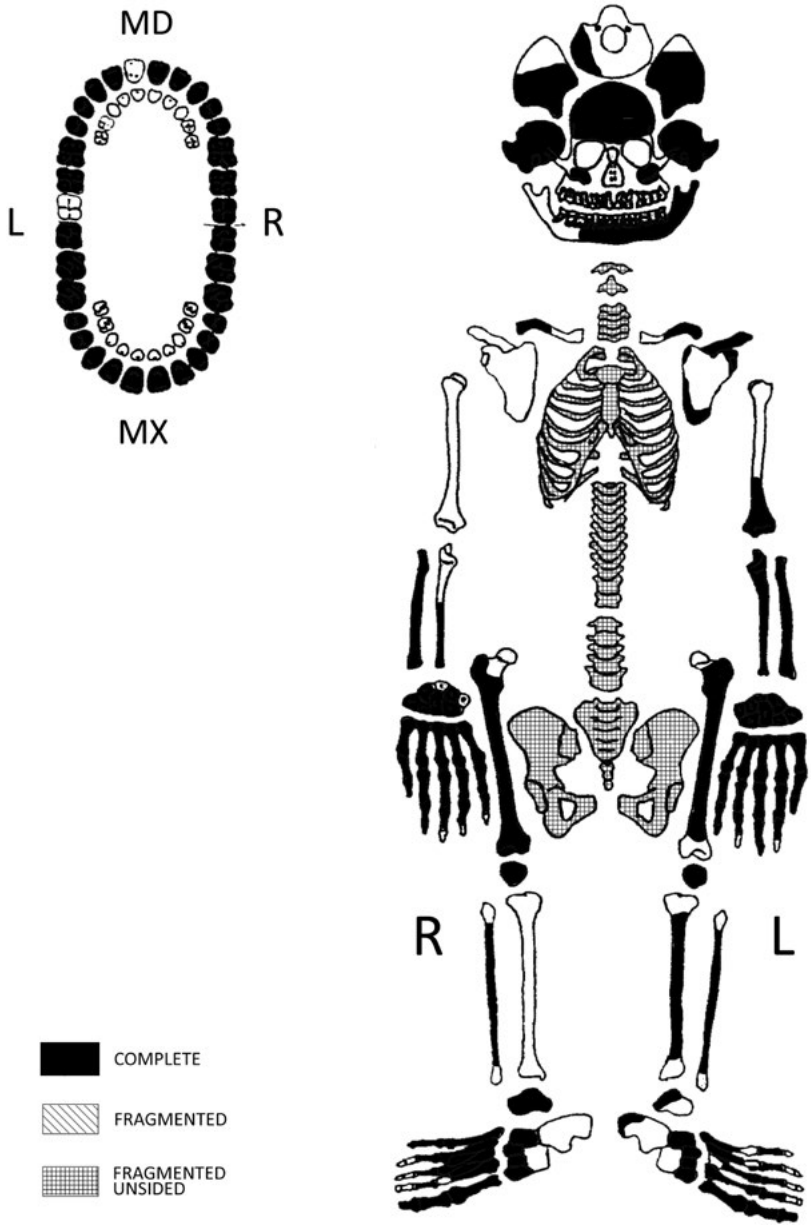


Figure 43

Sex: female
Sex was determined through the analysis of fourteen morphological features of the skull, which provided a sexual index of -0.2.

Age: 18-22 years
Age at death was determined on the basis of dental wear, dental eruption, sternal rib end modifications, and stage of fusion between diaphyses and epiphyses.

Stature: 155.6 cm

Dental pathologies
All the teeth are in situ, except for all the maxillary left teeth and mandibular molars, which are isolated, the maxillary right third molar, which is isolated, and the mandibular third molar, which is probably agenesic. The mandibular left second incisor was lost post-mortem.
There is no evidence of alveolar resorption.
Enamel hypoplasia occurred between 1.5 and 4.5 years, with five episodes.
No dento-alveolar disease, caries nor calculus have been observed.

Anatomical variants
In the skull multiple zygomatic foramina and the extrasutural mastoid foramen on the right side are present. In the postcranial skeleton there is the double facet of both calcanei.

Ergonomy
The individual shows low muscular development in all skeletal districts.

Pathologies
Diffuse grade 1 periosteal reaction affects the femurs and the tibiae.
The fusion of the second and third phalanxes of the fifth finger of the right foot and the presence of an osteolytic area at the level of the proximal joint margin of the first phalanx of the fourth finger of the left hand are observed.

SU 2232

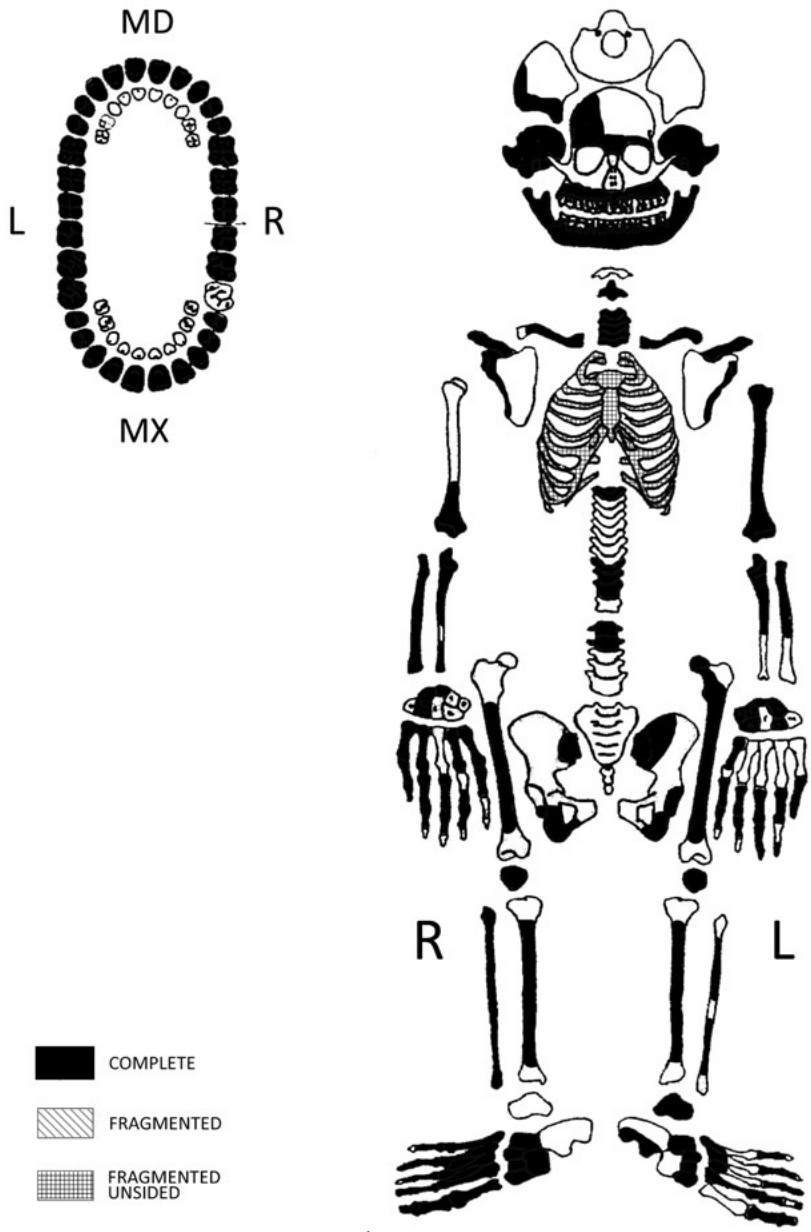


Figure 44

Sex: male
Sex was determined through the analysis of eleven morphological features of the skull and one of the pelvis, which provided a total sexual index of 1.6.

Age: 25-35 years
Age at death was determined on the basis of dental wear and sternal rib end modifications.

Stature: 165.5 cm

Dental pathologies
All the upper and lower teeth are in situ, except for the maxillary right canine, which is preserved as a root, and the maxillary right first molar, which was lost during life.

Alveolar resorption is of grade 1 in the maxilla and grade 2 in the mandible.
A more marked wear of the anterior teeth is observed, especially those of the maxilla, probably due to extramasticatory activity.
Strong calculus affects both the maxillary and the mandibular teeth, so that the detection of enamel hypoplasia is partially prevented; two episodes are recorded, between 2.5 and 3.5 years. The first incisors, both the maxillary and the mandibular, have a slight line which occurred at the age of about 4 years. There are no caries in the mandibular teeth, while in the maxillary there are two caries on the first left incisor, one interproximal at the cemento-enamel junction of grade 2, and one interproximal of grade 1, and one caries on the right first molar, interproximal at the cemento-enamel junction of grade 3.

Anatomical variants
In the skull a complete supraorbital foramen on both sides, the transverse accessory foramen on the C5 (complete on the right and partial on the left left) and C6 (both complete), the bipartite acromion of the left scapula, the Poirier's facet on the left femur, and the accessory facet on the neck of the left talus are present.

Ergonomy
The individual shows strong/very strong muscular development, with the presence of enthesopathies of osteolithic type of grade 2 at the level of the costo-clavicular ligament of the right scapula and of osteophytic type grade 2 at the level of triceps brachii on both ulnae. Moreover, the pectoralis major and supinator show a grade 3 development.

Pathologies
A diffuse grade 1 periosteal reaction is observed on both tibiae and fibulae. Schmorl's nodes affects three out of the four preserved thoracic vertebrae and 1 out of the 2 lumbar vertebrae. Osteoarthritis of grade 2 affects the lower thoracic and lumbar vertebrae. Grade 1 osteoarthritis has also been observed on the proximal articular surface of both ulnae.

SU 2234

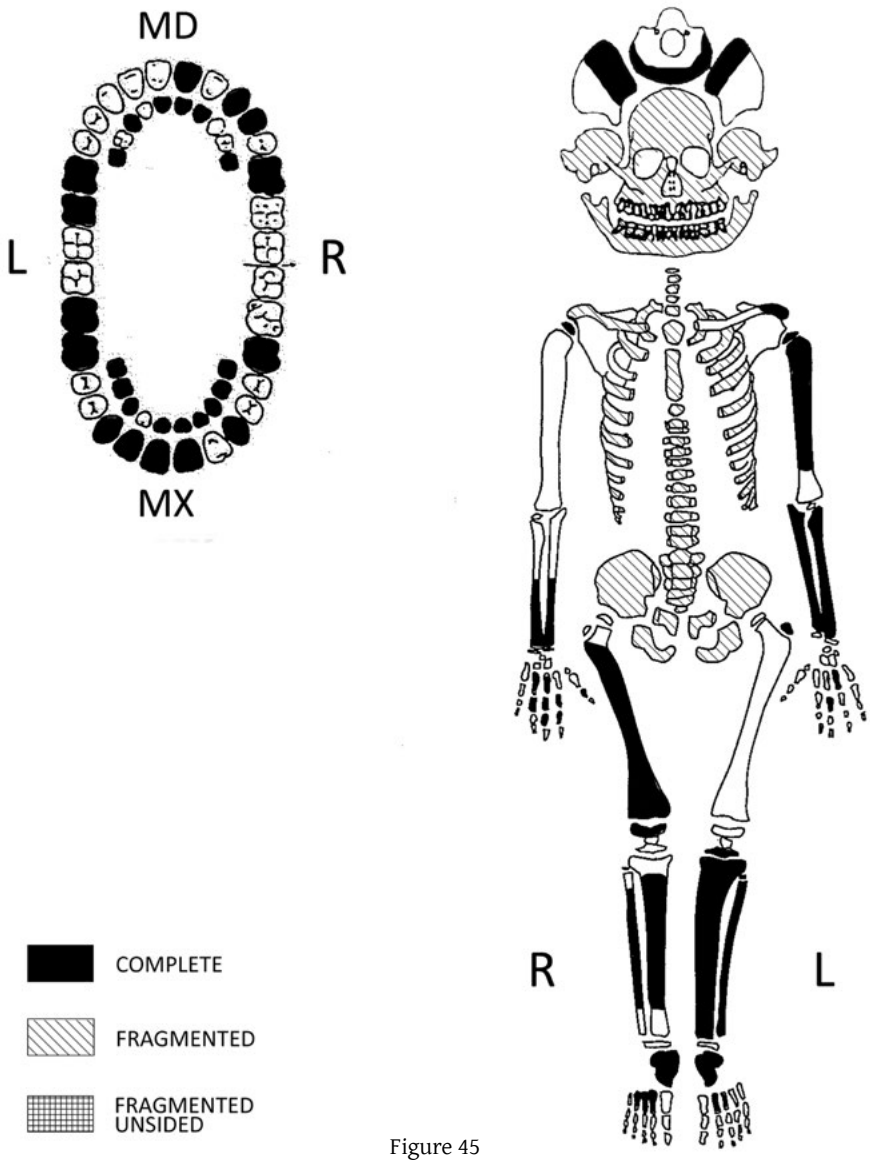


Figure 45

Sex: undeterminable

Age: 3-5 years
Age at death was determined on the basis of long bone length, of the fusion lines of the vertebral arches and arches and bodies, and dental eruption.

Dental pathologies
All the deciduous teeth are preserved and isolated except for the left mandibular and maxillary second incisor, which are lost post-mortem. Permanent teeth are preserved in form of germs and are isolated: maxillary first incisors, left second incisor, canine, first and second molar, right canine and first molar; mandibular right first incisor, canine, first premolar, first molar and left first and second molar. There is no evidence of enamel hypoplasia in deciduous teeth, whereas the permanent ones cannot be analyzed due to an alteration of the enamel. There are no caries on deciduous dentition.

Anatomical variants
No anatomical variants were observable.

Pathologies
Grade 1 periosteal reaction affects the metaphyseal and diaphyseal areas of long bones; lytic lesions are present on the anterior portion of the vertebral bodies.
The germs of permanent teeth show enamel abnormalities, which can be attributed to mercurial treatment.

SU 2236

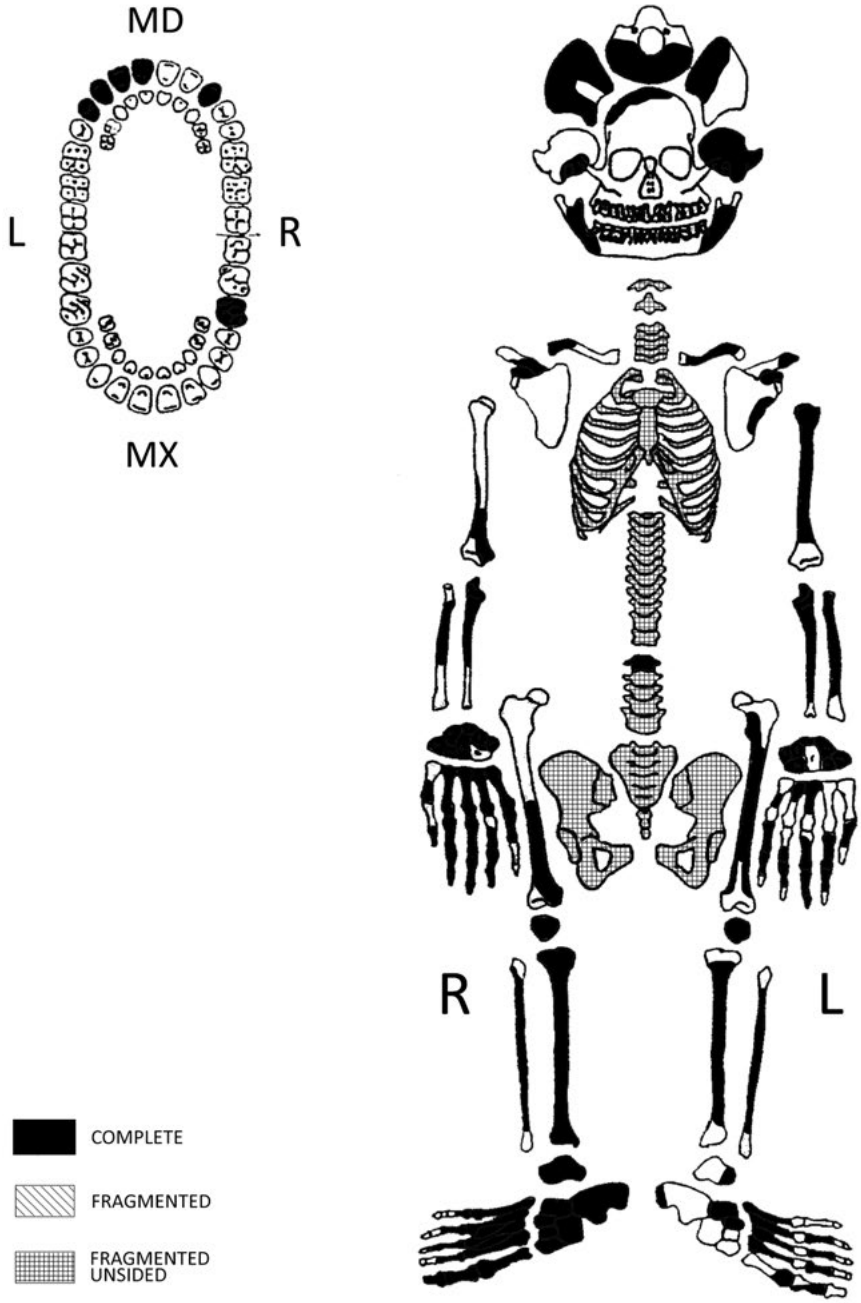


Figure 46

Sex: female
Sex was determined through the analysis of five morphological features of the skull, with a sexual index of -1.1.

Age: 30-35 years
Age at death was determined on the basis of sternal rib end modifications. Dental wear seems to indicate an age of about 18-22 years, but probably this result is distorted by the intra vitam loss of several teeth.

Stature: 166.8 cm

Dental pathologies
In the maxilla only the first right molar is preserved and is isolated. In the mandible five teeth are preserved, all isolated, the left incisors, canine and first molar, and the right canine. Alveolar resorption is not recordable.
Mild calculus affects both the maxillary and the mandibular teeth.
Enamel hypoplasia occurred between 2.5 and 4.5 years, with five episodes.

Anatomical variants
In the postcranial skeleton the circumflex sulcus in the left scapula, the anterior doubled facet on the right calcaneus and the accessory facet on the neck of the right talus are present.

Ergonomy
The individual shows low-medium muscular development, except for the deltoid of the right clavicle, the brachioradialis of both humeri, the biceps brachii of the left radius, the brachialis of the left ulna and the soleus of both tibiae, which have a strong development, and the biceps brachii of the right radius and the brachialis of the right ulna, which have a very strong development.

Pathologies
There is the presence of cribra cranii on the parietals and on the frontal bones. The right tibia shows a localized grade 1 periosteal reaction on the centro-lateral portion of the diaphysis. Osteoarthritis of grade 1 is observed on the unique preserved lumbar vertebra and on the right acromial face of the clavicle.

SU 2237

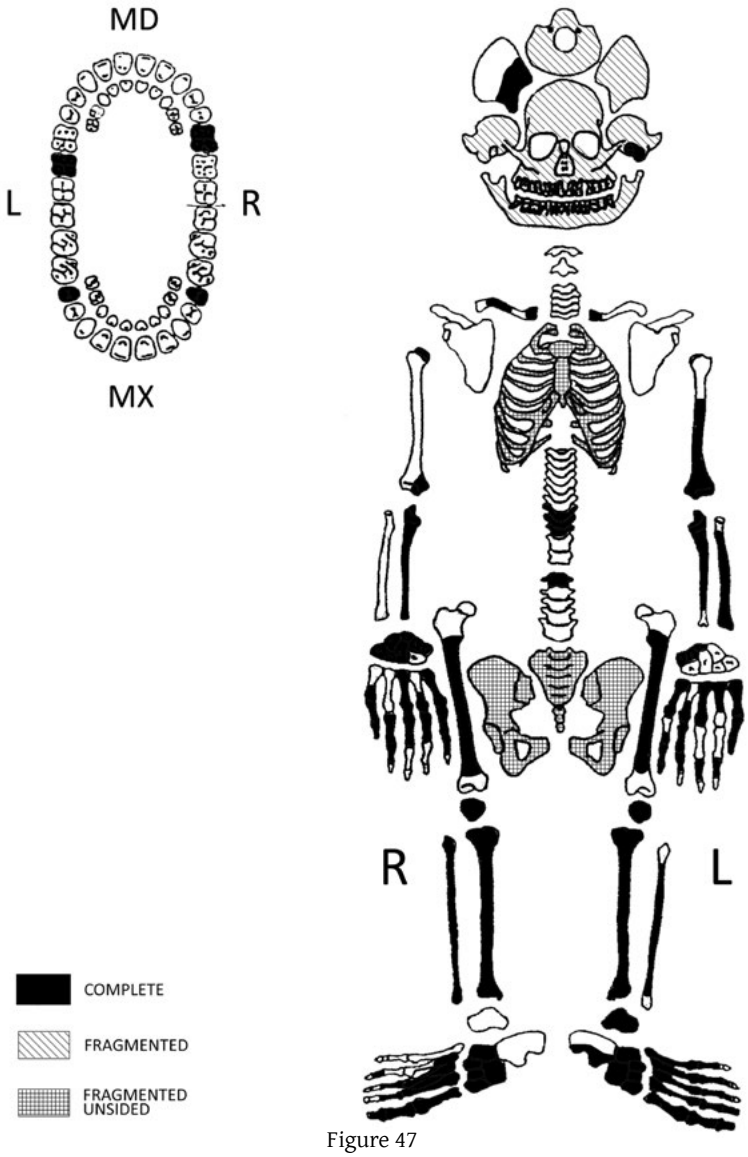


Figure 47

Sex: female
Sex was determined through the analysis of one morphological features of the skull and one of the pelvis, with a total sexual index of -1.5.

Age: 45-55 years
Age at death was determined on the basis of dental wear and morphology of the pubic symphysis.

Stature: 166.9 cm

Dental pathologies
Only the two maxillary second premolars, the mandibular first right molar and the mandibular second left molar have been preserved, but are isolated. In the mandibular teeth, however, there is one occlusal caries of grade 2 on the left second molar, and one grade 2 caries at the root in the right first molar.
Mild calculus affects the maxillary and the mandibular teeth.

Anatomical variants
In the postcranial skeleton the exostosis of the trochanteric fossa in both femurs and the double facet of the left calcaneus are present.

Ergonomy
The individual shows low-medium muscular development, except for the interosseous tubercle of the left radius, the brachialis of both ulnae, the ileopsoas and vastus medialis of both femurs, and the Achilles' tendon of the right calcaneus, which have a strong development, and the gluteus maximus of both femurs, which have a very strong development.

Pathologies
Diffuse grade 1 periosteal reaction affects both tibiae. Osteoarthritis of grade 1 is present on the sternal end of the left clavicle, the patellae and proximal articular surface of the tibiae; osteoarthritis of grade 2 is present on the sternal end of the right clavicle and on the acromial joint of the right scapula; osteoarthritis of grade 3 affects the glenoid cavity of the right scapula and the distal articular surface of the right ulna.

SU 2238

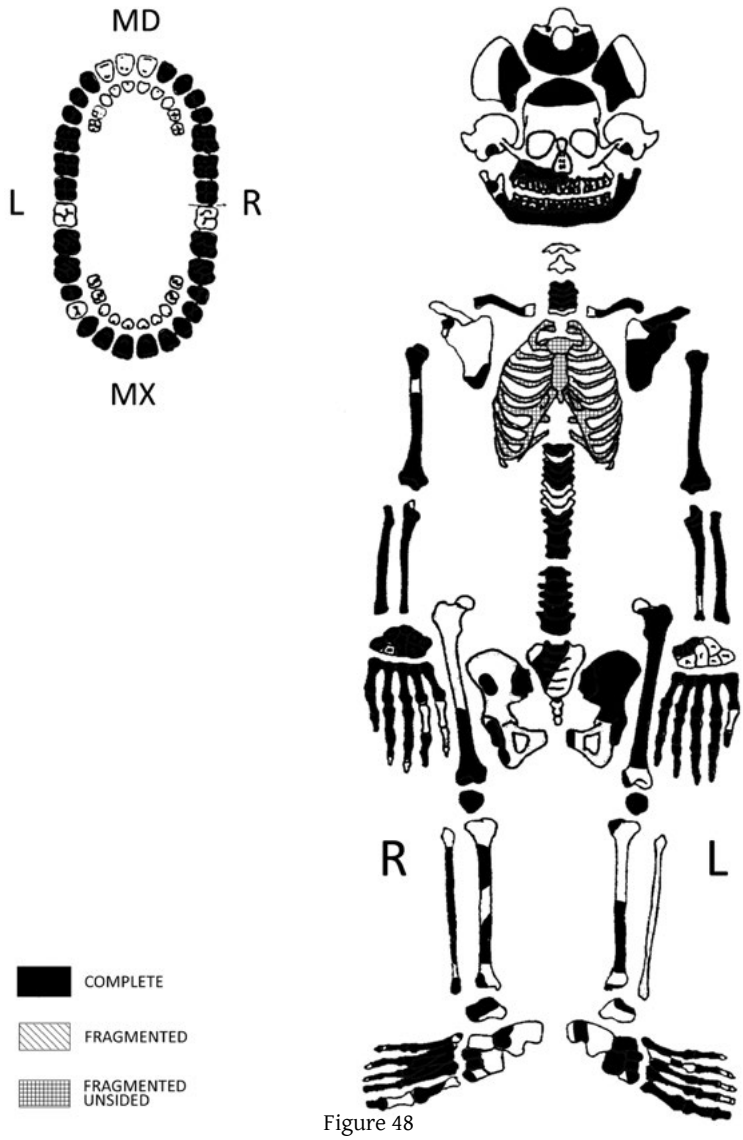


Figure 48

Sex: female
Sex was determined through the analysis of nine morphological features of the skull and ten of the pelvis, which provided a total sexual index of -0.9.

Age: 22-28 years
Age at death was determined on the basis of dental wear, morphology of the pubic symphysis, morphology of the auricular surface of the ilium, and sternal rib end modifications.

Stature: 152.8 cm

Dental pathologies
The maxillary teeth are all preserved and isolated, except for the right canine, premolars and third molar, which are in situ, and the left first premolar, which was lost post-mortem. There is agenesis of the third molars.
The mandibular teeth are preserved and in situ, except for the two left incisors, which were lost post-mortem; the two third molars are in eruption.
There is no alveolar resorption.
Enamel hypoplasia occurred between 2 and 5 years of age, with five episodes.
Mild calculus affects both the maxillary and the mandibular teeth.

Anatomical variants
In the skull two zigomatic foramina on the left and the parietal foramen on the right side are observed. In the postcranial skeleton the transverse accessory foramina (complete on the right and partial on the left) on C5, the bipartite acromion on the left scapula, and the septal aperture in both humeri are present.

Ergonomy
The individual shows low-medium muscular development.

Pathologies
Osteochondritis dissecans is observed on the olecranon of the left ulna.
Osteoarthrosis of grade 1 affects the proximal articular surface of the first left metatarsal. Diffuse grade 1 periosteal reaction is visible on both tibiae and a marked bending of the humeral diaphyses is also present.

Trench 5

SU 2180

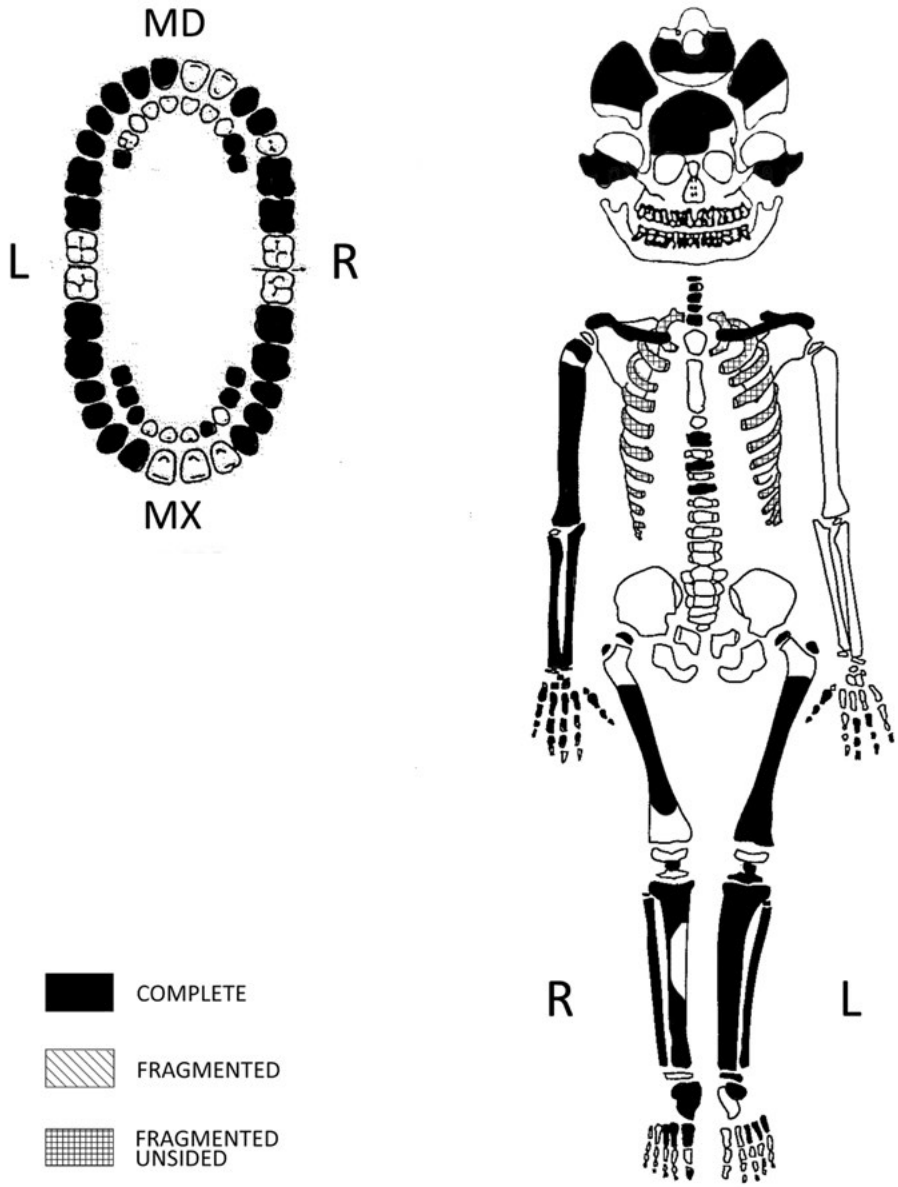


Figure 49

Sex: undeterminable

Age: 9-10 years
Age at death was determined on the basis of dental eruption, development of permanent teeth, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
All preserved teeth, both deciduous and permanent, are isolated. The permanent maxillary right incisors, left first incisor, and the mandibular right incisors, and second premolar are lost post-mortem. The deciduous maxillary left incisors, first right incisor and right canine, and mandibular incisors, canines and left first molar are missing.

Enamel hypoplasia, observable on the permanent teeth, occurred between 1.5 and 5 years, with seven episodes.
One grade 1 mesial caries and one grade 3 distal caries affect the deciduous maxillary left first molar.

Anatomical variants
In the skull several zygomatic foramen on the left, the parietal foramen on the right side, the extrasutural mastoid foramen on the left, and the condylar canal on the right are present. In the postcranial skeleton the septal aperture in the right humerus is visible.

Pathologies
None observed.

SU 2187

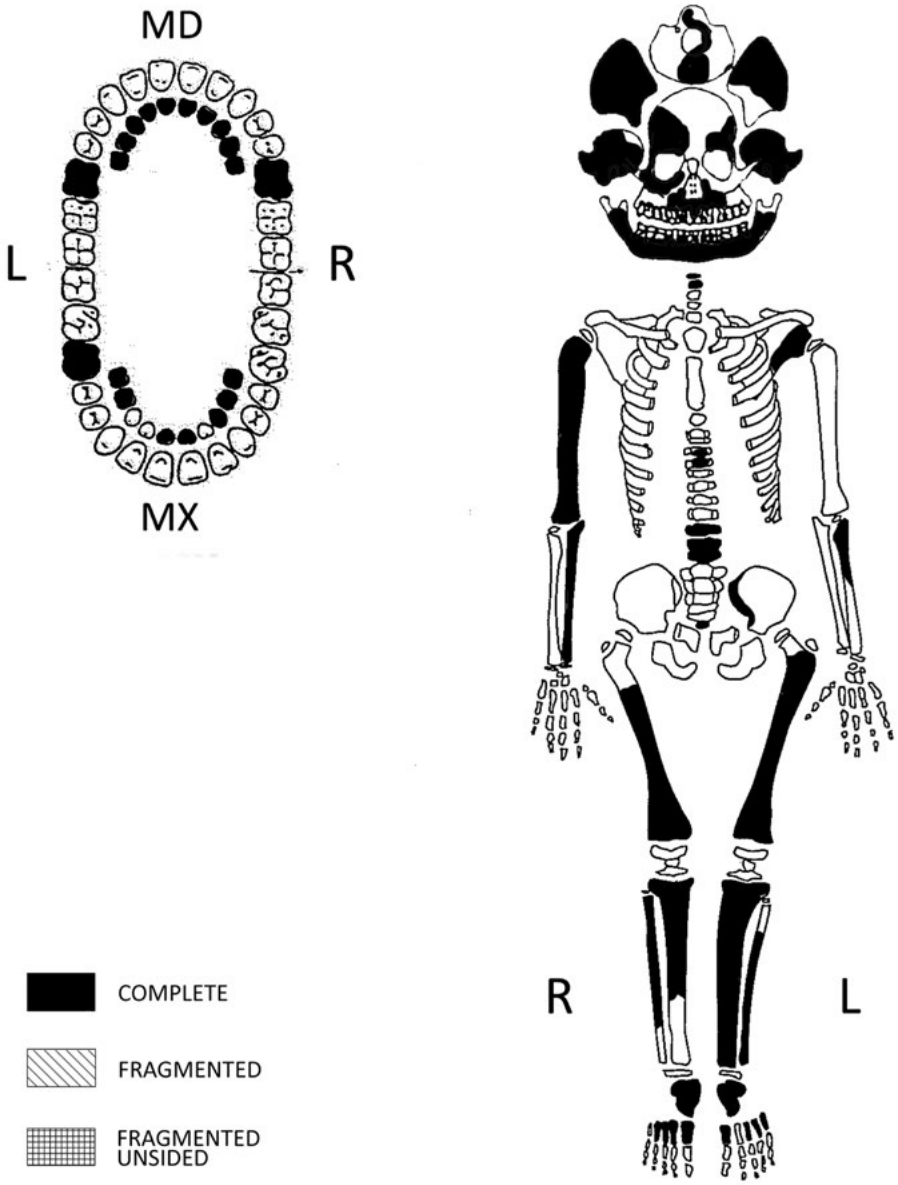


Figure 50

Sex: undeterminable

Age: 12-14 months
Age at death was determined on the basis of dental eruption, development of permanent teeth, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
All deciduous teeth are preserved and are in situ, except for the maxillary second incisors and right canine, which are lost post-mortem, and the maxillary right first incisor and molars, which are isolated. The permanent maxillary left first molar and mandibular first molars are in form of germs.

None dental pathologies were observed.

Anatomical variants
In the skull the zygomatic foramen on the right side and the condylar canal on the left are observed.

Pathologies
Cribra cranii of grade 1 are present on the parietals and frontal bone. Localised grade 1 periosteal reaction affects the external side of the ribs, the proximal half of the femurs and the medial side of the half diaphysis of both tibiae and left fibula. Lytic lesions are observable on anterior portion of the vertebral bodies.

SU 2188

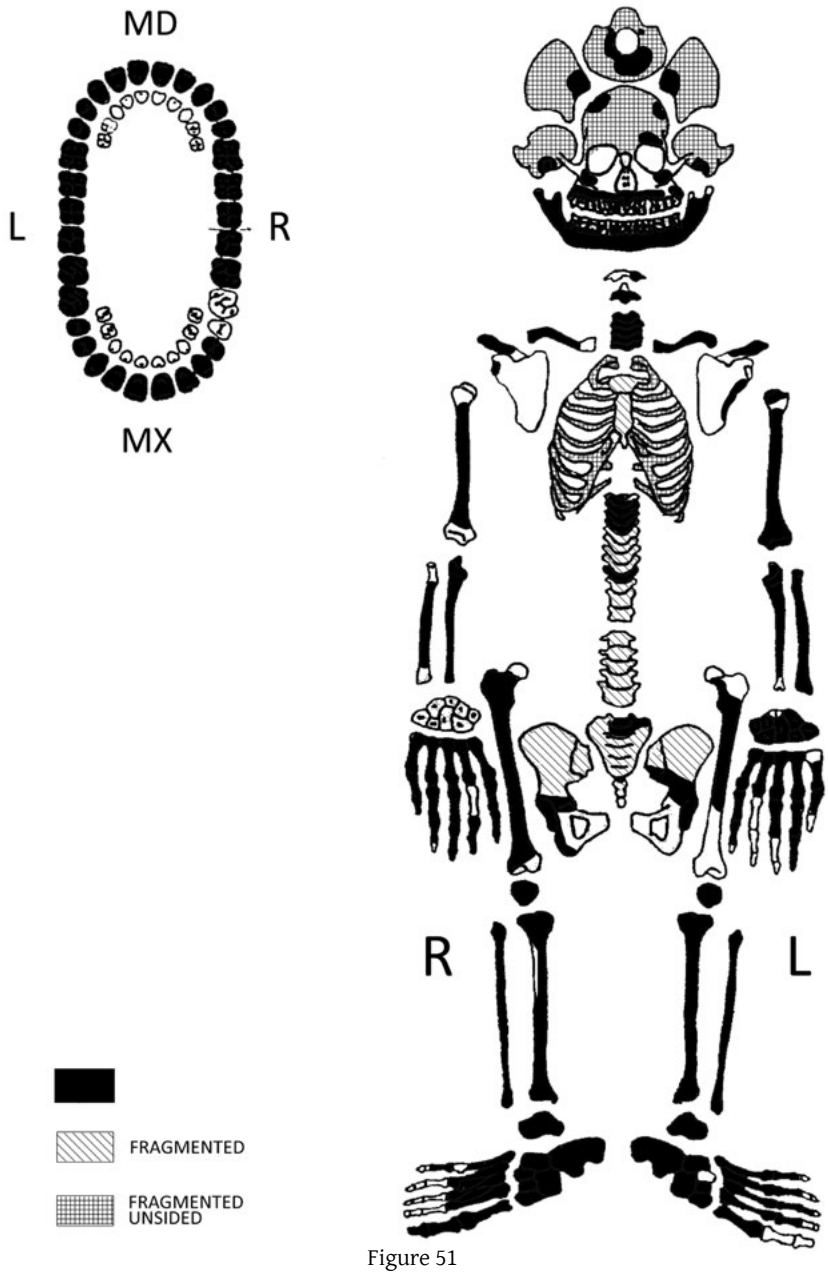


Figure 51

Sex: female
Sex was determined through the observation of twelve morphological features of the skull and three of the pelvis, which provided a sexual index of -0.2.

Age: 25-35 years
Age at death was determined on the basis of dental wear, stage of fusion of the vertebrae, and sternal rib end modifications.

Stature: 167.3 cm

Dental pathologies
All teeth are preserved and are in situ, except for the maxillary right second premolar and first molar, which were lost during life. The maxillary left third molar and mandibular left third molar are in eruption.

Several caries were observed: one grade 2 occlusal and one grade 1 occlusal on the maxillary right second molar, one grade 4 distal on the mandibular left first molar, one grade 3 buccal and one grade 1 occlusal on the mandibular right third molar.
The mandibular right second incisor is rotated.
Strong calculus affects both the maxillary and the mandibular teeth, particularly on the left side.
Enamel hypoplasia, observable only on the maxillary teeth, occurred between 1.5 and 5 years, with eight episodes.
Alveolar resorption of grade 1 affects the maxilla and mandible, of grade 2 in correspondence of the mandibular left molars.

Anatomical variants
In the skull a zygomatic foramen on the left and several

foramina on the right, are present. In the post-cranial skeleton the accessory facet on the head of the first right metatarsal is visible.

Ergonomy
The individual shows a medium-low development of the muscular insertions, except for the brachioradialis of the left humerus, the patellar ligament of the left tibia and the Achilles' tendon of the right calcaneus, which present a strong development, the biceps brachii of the left radius, which has a very strong development, and the biceps brachii of the right radius, which presents an enthesopathy.

Pathologies
Diffuse grade 1 periosteal reaction is visible on femurs and tibiae. A healed fracture affects the fourth metatarsal of the right foot. A Schmorl's node is present on a thoracic vertebra.

SU 2189

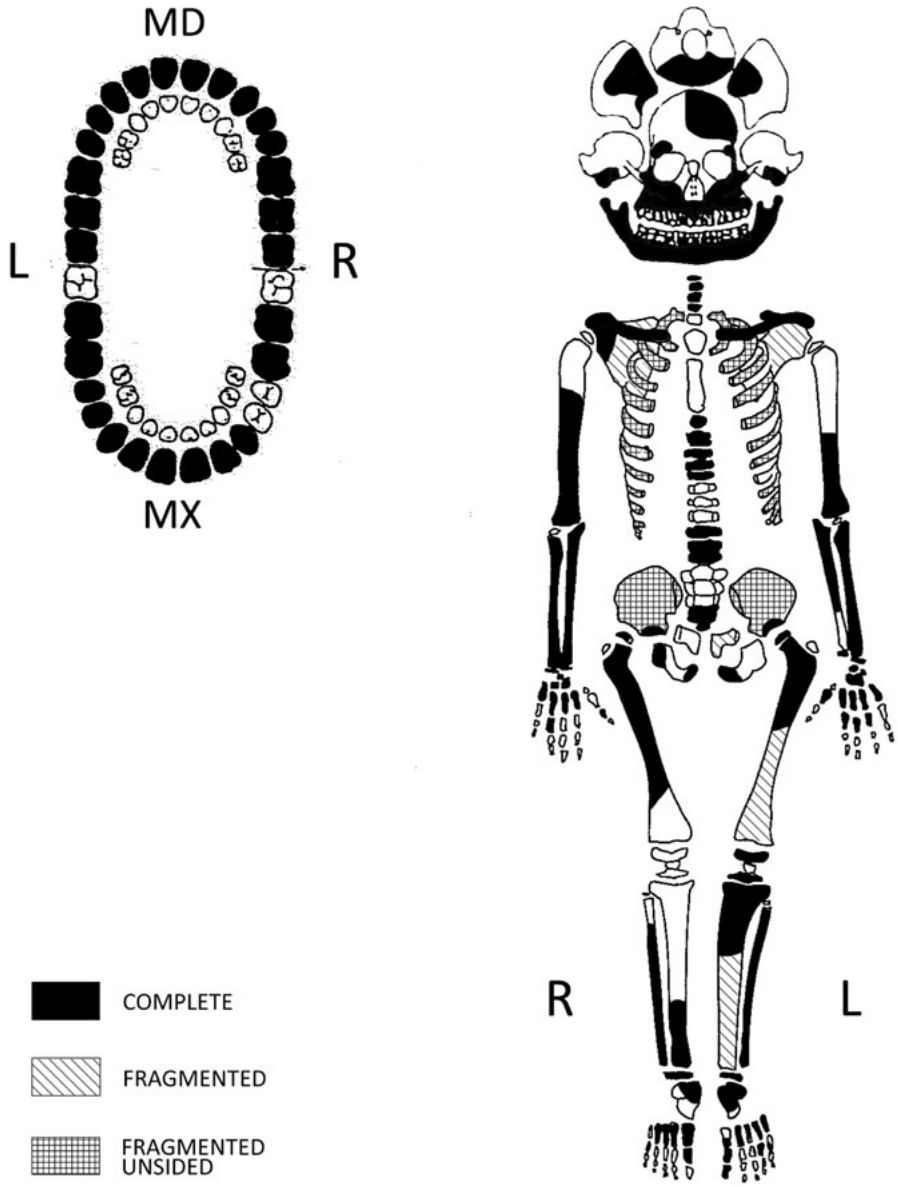


Figure 52

Sex: undeterminable

Age: 13-15 years
Age at death was determined on the basis of dental eruption, development of permanent teeth, dental wear, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
All preserved teeth are present and in situ, except for the maxillary right premolars, which were lost post-mortem. The mandibular third molars are in form of germs.
Enamel hypoplasia occurred between 1.5 and 5 years, with six episodes.

One grade 1 occlusal caries affects the maxillary right first molar and one grade 1 occlusal caries affects the mandibular left second molar.
Mild calculus is visible on the mandibular teeth.

Anatomical variants
In the skull the extrasutural mastoid foramen on the left is present; in the post-cranial skeleton the anterior double facet on the left calcaneus is visible.

Pathologies
Cribra orbitalia of grade 1 are present on both orbits. Diffuse grade 1 periosteal reaction is visible on the femurs, right tibiae and fibulae. Periosteal reaction affects the internal side on the ribs. Lytic lesions are present on the anterior portion of the bodies of the thoracic and lumbar vertebrae. An osteoma is present on the right zygomatic process.

SU 2255

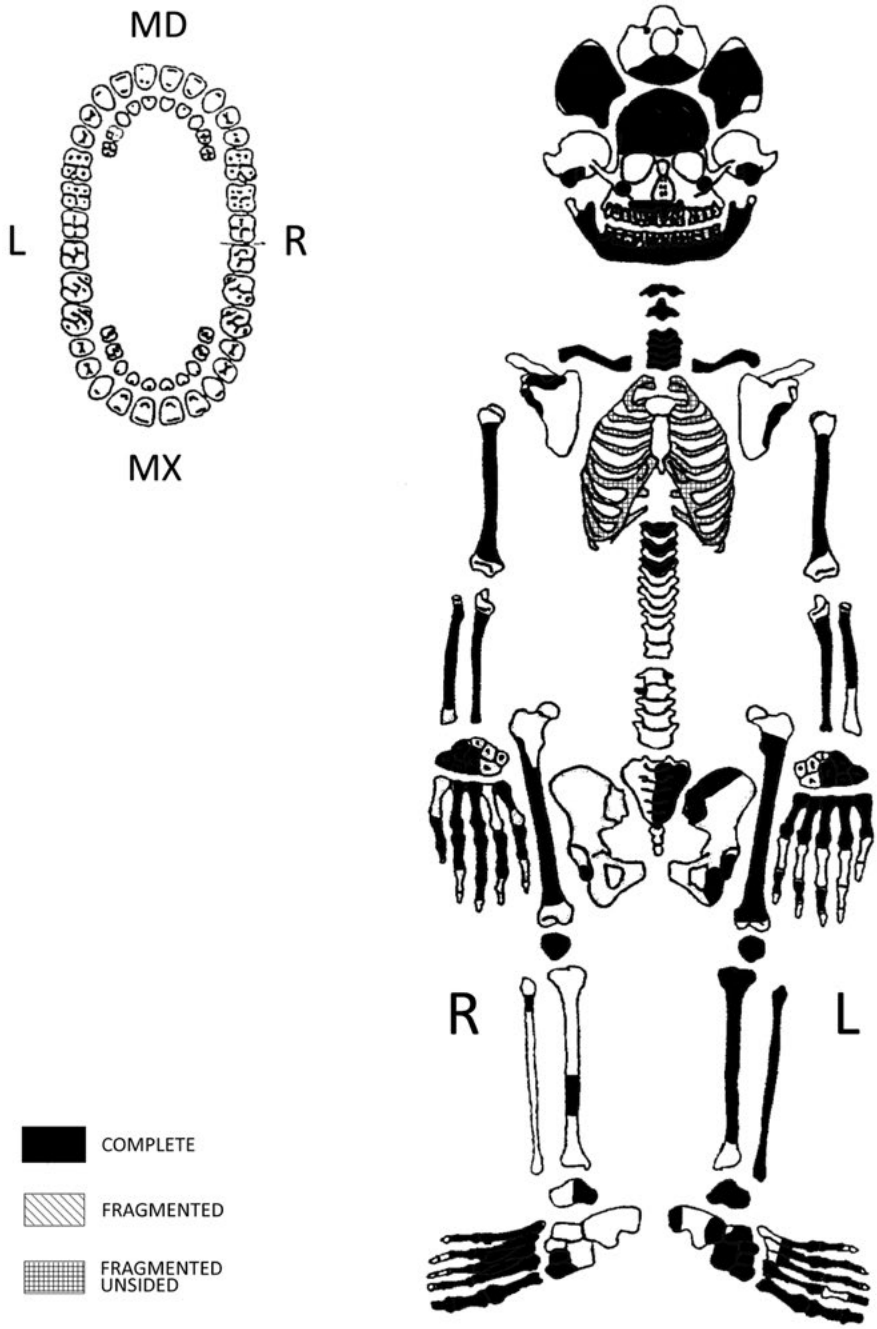


Figure 53

Sex: female
Sex was determined through the analysis of fifteen morphological features of the skull and one of the pelvis, which provided a total sexual index of -1.4.

Age: 40-50 years
Age at death was determined on the basis of degree of closure of cranial sutures and sternal rib end modifications.

Stature: 150.5 cm

Dental pathologies
No teeth are preserved.

Anatomical variants
In the skull the complete metopic suture, the complete supraorbital foramen on the left, the zygomatic foramen on both sides, the parietal foramen on the left parietal and the bregmatic bone are present. In the post-cranial skeleton the double facet of the atlas on the right and the exostosis of the fovea of the left femur are observed.

Ergonomy
The individual shows a medium-strong development of the muscular insertions, except for the pectoralis major of the right humerus, the latissimus dorsi/teres major of both humeri, the iliopsoas of the left femur, the vastus medialis of the left femur, the patellar ligament of both tibiae and patellae, which show a very strong development, and the gluteus maximus of both femurs, which presents an enthesopathy.

Pathologies
Cribra cranii of grade 1 are visible on the parietal bones. Grade 1 osteoarthrosis affects the left acetabular cavity, the distal articular joint of the left femur, the articular facet of both patellae, the proximal articular surface of the left fibula, the proximal articular surface of the metatarsal bones, and the cervical vertebral bodies. Grade 2 osteoarthrosis affects the sternal facet of the left clavicle, the acromial facet of the right scapula, the superior margin of the first vertebra of the sacrum, and the thoracic and lumbar vertebral bodies; grade 3 osteoarthritis is visible on the sternal facet of the right clavicle and the proximal articular facet of the right femur.
Diffuse grade 1 periosteal reaction is observable on the right femur, localised grade 1 periosteal reaction is present on the proximal metaphysis of the left fibula.
The left sacro-iliac joint is fused, probably as a degenerative phenomenon due to advanced age.

SU 2256

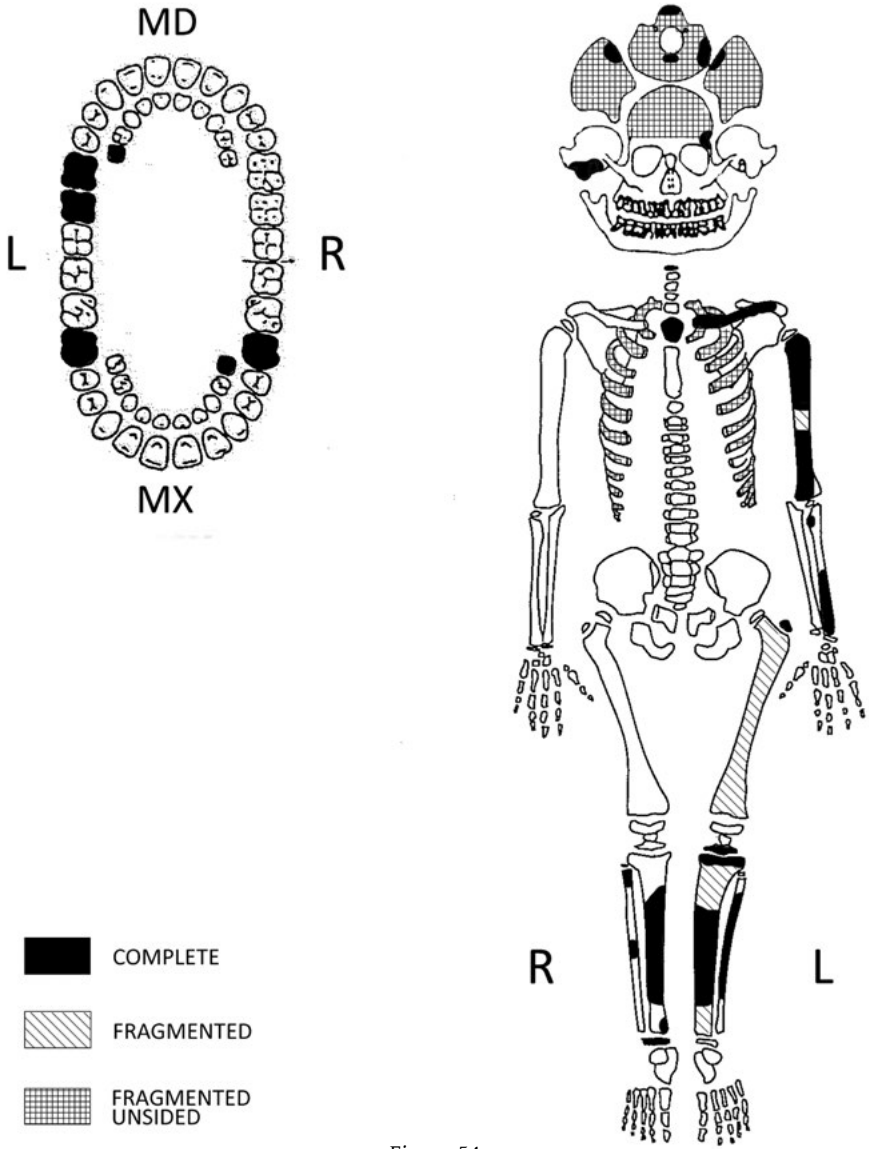


Figure 54

Sex: undeterminable

Age: 7-8 years
Age at death was determined on the basis of dental eruption, development of permanent teeth, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
Only the deciduous maxillary right and mandibular left second molar, and permanent maxillary first molars and mandibular left second molar, which is in form of germ, are preserved and are isolated.
Mild calculus affects the deciduous teeth.

Anatomical variants
In the skull the parietal foramen on both sides is present.

Pathologies
Diffuse grade 1 periosteal reaction is visible on the tibiae and left fibula.

SU 2257

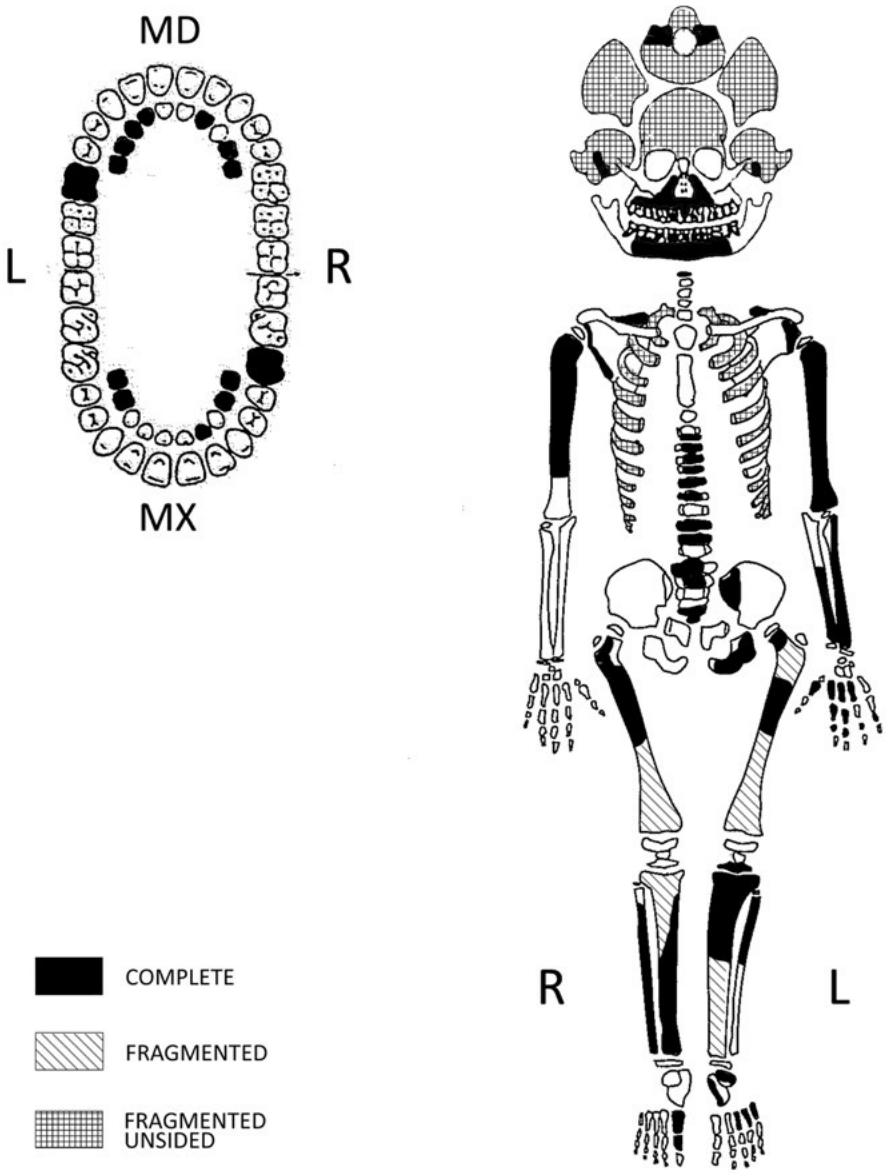


Figure 55

Sex: undeterminable

Age: 12-24 months
Age at death was determined on the basis of dental eruption, development of permanent teeth, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
The deciduous teeth are present and in situ, except for the maxillary left incisors and canine, right first incisor and canine, mandibular left first incisor and right first incisor and canine, which were lost post-mortem, and the maxillary second molars, which are isolated. The mandibular left canine and right second molar are in

eruption. The permanent maxillary right first molar and mandibular right first molar are present isolated and in form of germ.
Two hypoplastic lines are visible on the deciduous mandibular second incisors.

Anatomical variants
In the skull the complete infraorbital suture on both sides and two infraorbital foramen on the left are present.

Pathologies
Lytic lesions are present on the anterior portion of the bodies of the thoracic vertebrae.

SU 2258

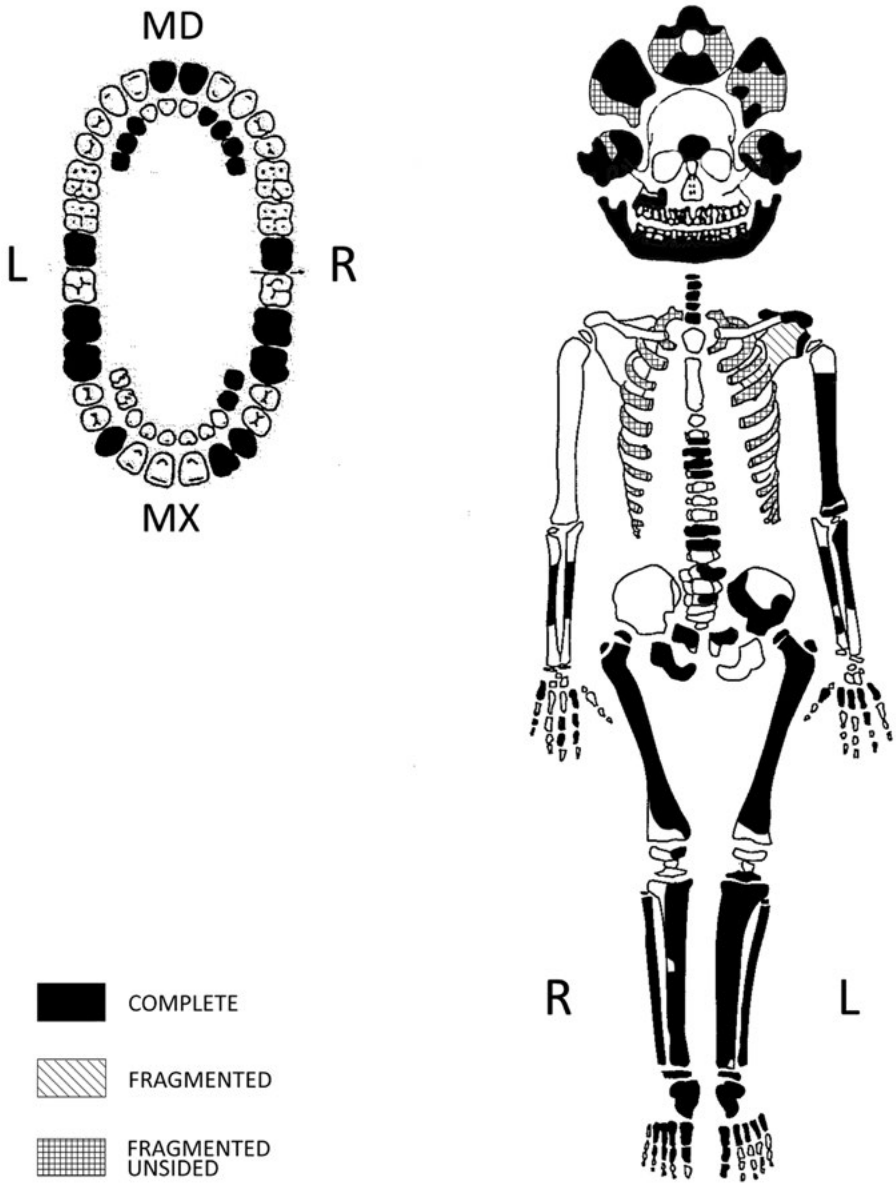


Figure 56

Sex: undeterminable

Age: 6-8 years
Age at death was determined on the basis of dental eruption, development of permanent teeth, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
The deciduous maxillary teeth are missing except for the right molars, which are in situ; deciduous mandibular teeth are present and in situ, except for the left incisors, and right first incisor, which are missing. The maxillary first incisors were lost intra vitam. Permanent teeth are present and isolated, except for the maxillary incisors, premolars, first molar, right first incisor, premolars, mandibular left and right second incisor, canine, premolars and first molar, which are missing, and the maxillary right molars, which are in situ; permanent teeth are in form of germ, except for the mandibular first incisors which are in eruption.

Enamel hypoplasia, present only in the permanent teeth, occurred between 2.5 and 4 years, with four episodes.
Some caries are observed on deciduous teeth: one grade 2 distal on the maxillary right first molar, one grade 2 distal on the maxillary right second molar, one grade 1 distal on the mandibular left first molar and one grade 1 mesial on the mandibular left second molar.
Mild calculus is present on the deciduous teeth.

Anatomical variants
In the skull the extrasutural mastoid foramen on both sides and the condylar canal on both sides are present.

Pathologies
Diffuse grade 1 periosteal reaction is visible on both femurs, tibiae and fibulae.

SU 2259

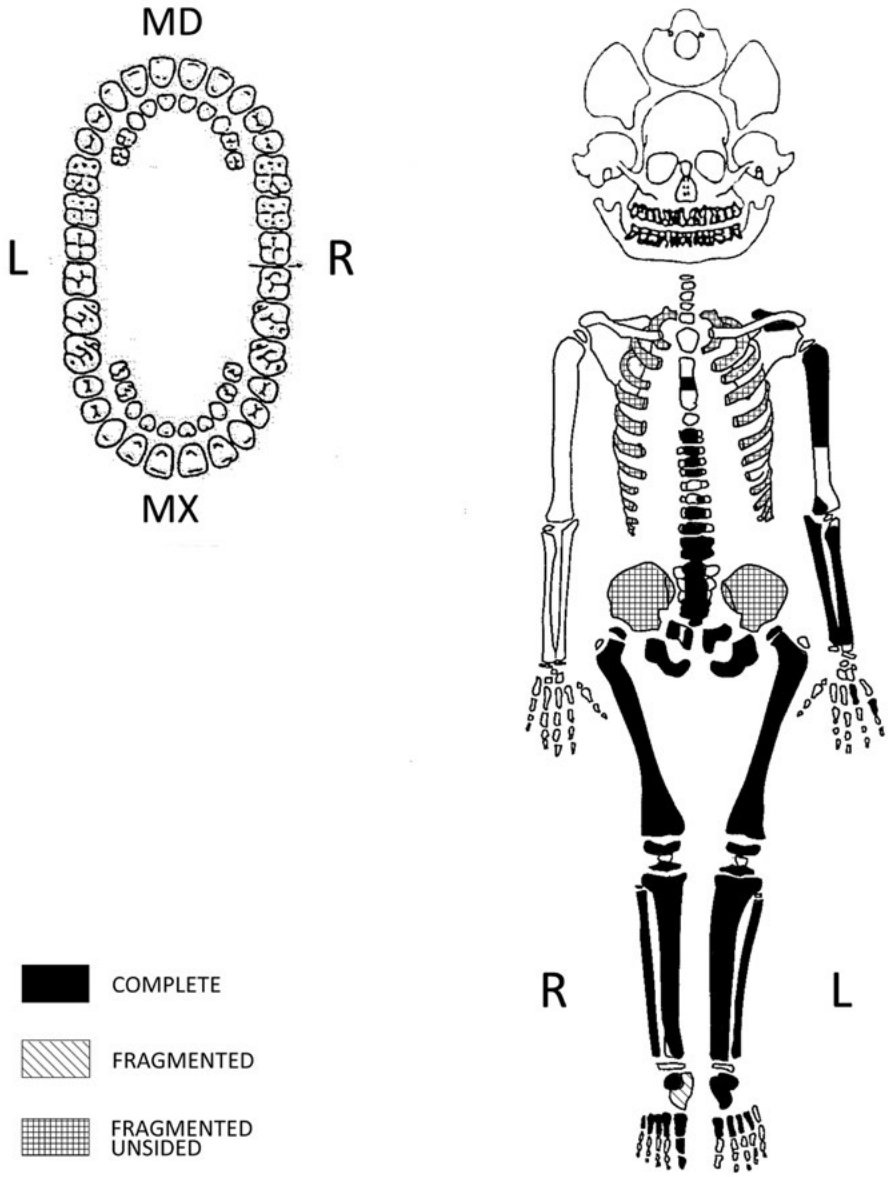


Figure 57

Sex: undeterminable

Age: 5 years
Age at death was determined on the basis of degree of fusion between diaphyses and epiphyses and long bone length.

Dental pathologies
No teeth are preserved.

Anatomical variants
None observed.

Pathologies
Localised grade 1 periosteal reaction is visible on the metaphyseal distal portion of the femurs, anterior crest of both tibiae and lateral fibulae. Lytic lesions are present on the anterior portion of the bodies of the thoracic vertebrae.

SU 2260

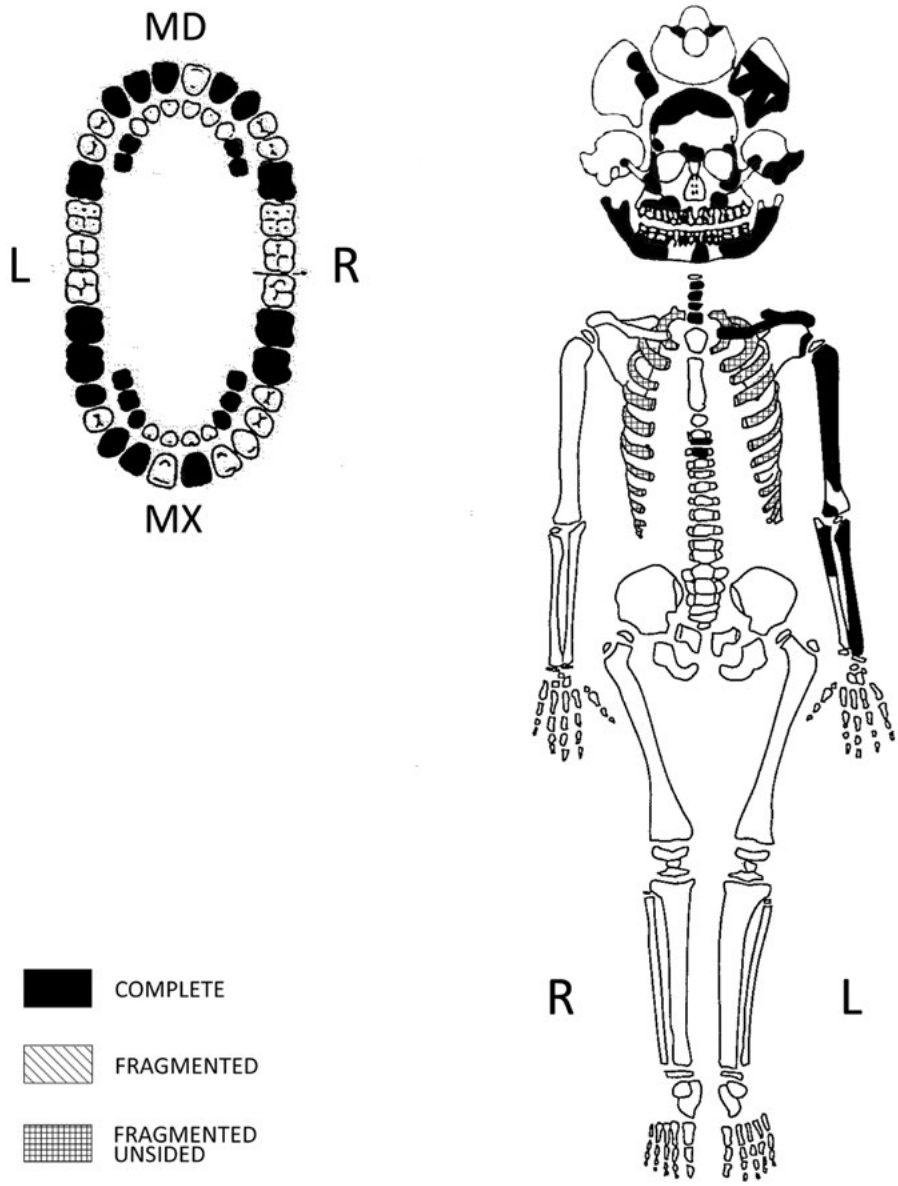


Figure 58

Sex: undeterminable

Age: 6-8 years
Age at death was determined on the basis of dental eruption, development of permanent teeth, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
Deciduous teeth are preserved and are in situ, except for the maxillary incisors, mandibular incisors and canines, which were lost during life. Permanent teeth are present and isolated, except for the mandibular first molars, which are in situ, and maxillary left first incisor, first premolar, right second incisor, canine, premolars, mandibular first right incisor, and premolars, which are missing; the permanent teeth are in eruption or in form of germ.
Enamel hypoplasia occurred between 1 and 4.5 years, with six episodes.
Several caries affects the deciduous teeth: one grade 3 mesial and one grade 2 distal on the maxillary right first molar, and three grade 1 occlusal on the mandibular left first molar.
Mild calculus is visible on the deciduous teeth.

Anatomical variants
In the skull the complete supraorbital foramen on the right, a zygomatic foramen on both sides, and the condylar canal on both sides are visible.

Pathologies
None observed.

Trench 6

SU 2214

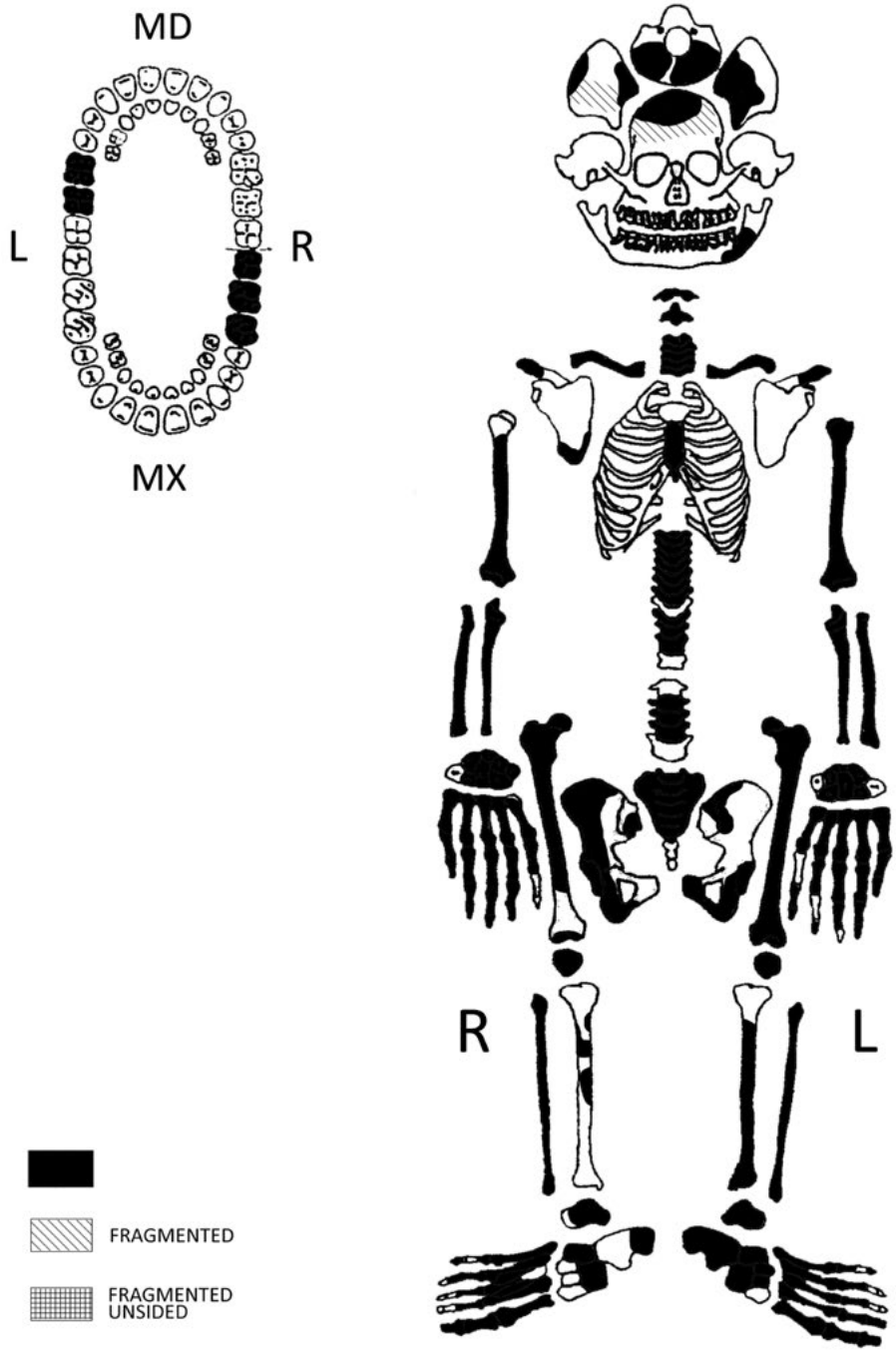


Figure 59

Sex: female
Sex was determined through the analysis of seven morphological features of the skull and five of the pelvis, which provided a total sexual index of -0.8.

Age: 25-40 years
Age at death was determined on the basis of dental wear, morphology of the pubic symphysis and of the auricular surface, and sternal rib end modifications.

Stature: 159.7 cm

Dental pathologies
Both maxilla and mandible are not preserved. Only the three maxillary right molars and the mandibular left first and second molars are preserved isolated.
Strong calculus is visible on all the preserved teeth.
A distal interproximal caries of grade 3 affects the maxillary right second molar; two occlusal caries of grade 1 are visible on the mandibular left first molar, and an occlusal caries of grade 3 is present on the mandibular left second molar.
The absence of anterior teeth prevented to observe the presence of enamel hypoplasia.

Anatomical variants
On the skull the complete metopic suture, the apical bone, the parietal foramen and some lambdoid ossicles on the right side are present. On the post-cranial skeleton there are the double facet of the atlas on both sides, the partial transverse accessory foramen on C5 on the left, on C7 on the right, and the complete transverse accessory foramen on C6 on both sides, the septal aperture on the humeri, the double anterior facet on the left calcaneus and the accessory facet on the right talus.

Ergonomy
The individual shows a medium development of the muscular insertions, except for the deltoid and costo-clavicular ligament of the clavicles, the pectoralis major, the deltoid and the right brachioradialis of the humeri, which shows a strong development; the brachioradialis of the right humerus shows a very strong development, whereas an osteophytic enthesopathy of grade 1 is present at the level of the interosseous tubercle of the left radius.

Pathologies
Diffuse grade 1 periosteal reaction is present on the femurs, localised on the distal metaphyses of the tibiae and fibulae. A healed fracture affects the distal metaphysis of the right fibula. A possible muscular trauma is present on the proximal metaphysis of the left radius. There are also new bone plaques on the proximal metaphysis of the left ulna. A possible bone cyst of 1 cm in diameter is present on the diaphysis of the right radius. Schmorl's nodes are present on two out of three lumbar vertebrae.

SU 2216

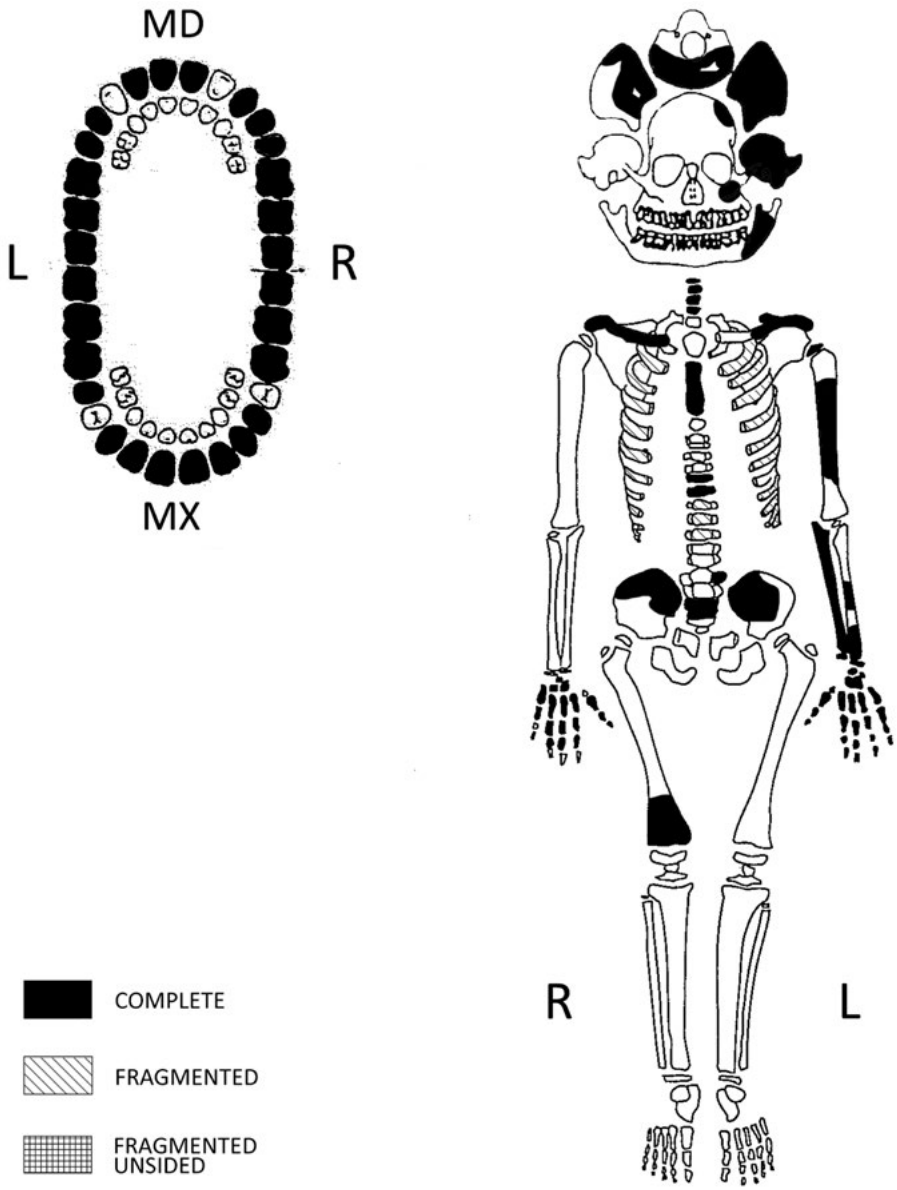


Figure 60

Sex: female
Sex was determined through the analysis of four morphological features of the skull and four of the pelvis, resulting in a total sexual index of -0.1.

Age: 16-20 years
Age at death was determined on the basis of dental wear, dental eruption, and degree of fusion between diaphyses and epiphyses.

Stature: 156.8 cm

Dental pathologies
All teeth are preserved isolated except for the second maxillary premolars, the mandibular second right incisor and left canine.
Alveolar resorption is not detectable due to the absence of maxillary and mandibular bones; calculus is absent.
An occlusal caries of grade 1 on the maxillary right third molar is present; several occlusal caries are observed on mandibular molars: on the left side, two caries of grade 1 and grade 2 on the first molar, one caries of grade 1 on the second molar and two caries of grade 1 and 2 on the third molar; on the right side, two caries of grade 1 on the first molar, one caries of grade 1 on the second molar and one caries of grade 2 on the third molar.
Enamel hypoplasia occurred between 2.5 and 5 years, with five episodes.

Anatomical variants
In the skull a zygomatic foramen on the left, the parietal foramen on the right and some lambdoid ossicles on both sides are present. In the postcranial skeleton the complete transverse foramen on C6 on the right is present.

Ergonomy
The individual shows a low-medium development of the muscular insertions, except for the conoid ligament of both clavicles, which shows a strong development, the trapezoid ligament of the left clavicle, which shows a very strong development; an enthesopathy of grade 1 is visible at the level of the trapezoid ligament of the right clavicle.

Pathologies
Diffuse grade 1 periosteal reaction is visible on the only preserved portion of the lower limbs, the distal right femur. Schmorl's nodes affect two out of two lumbar vertebrae. Lytic lesions are visible on the thoracic and lumbar vertebral bodies.

Trench 7

SU 2274

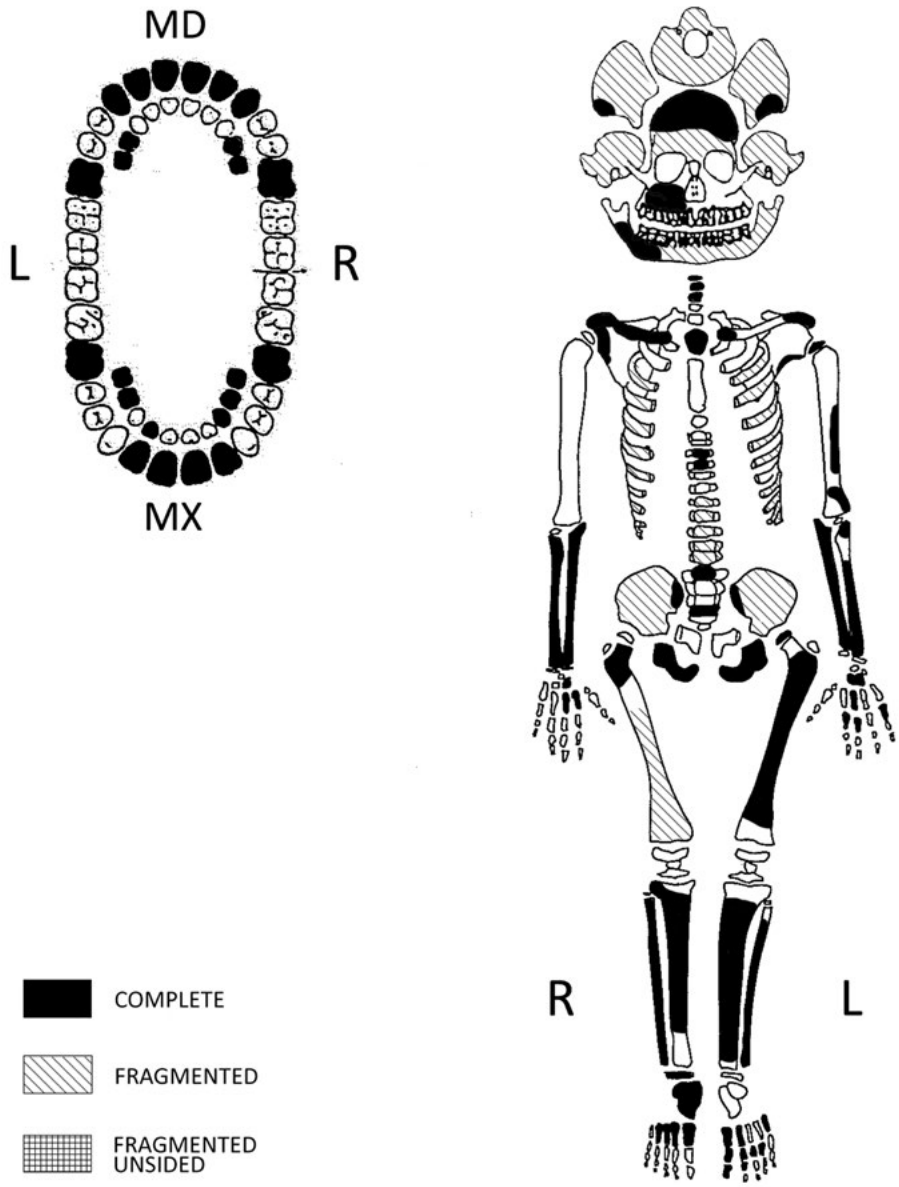


Figure 61

Sex: undeterminable

Age: 7-9 years
Age at death was determined on the basis of dental eruption, development of permanent teeth, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
The deciduous teeth are preserved and isolated, except for the maxillary first incisors, right second incisor, mandibular incisors and canines, which are lost intra vitam; the maxillary right canine and molars are present in situ. The permanent maxillary right incisors and first molar, mandibular first incisors are present in situ; the maxillary left incisors and first molar, mandibular first molars are present isolated. The other permanent teeth are in eruption or in form of germ.
Enamel hypoplasia occurred between 2 and 4.5 years, with five episodes.

Anatomical variants
In the skull the apical bone is present.

Pathologies
Diffuse grade 1 periosteal reaction is visible on the right tibia, and grade 2 is visible on the left tibia.

SU 2275

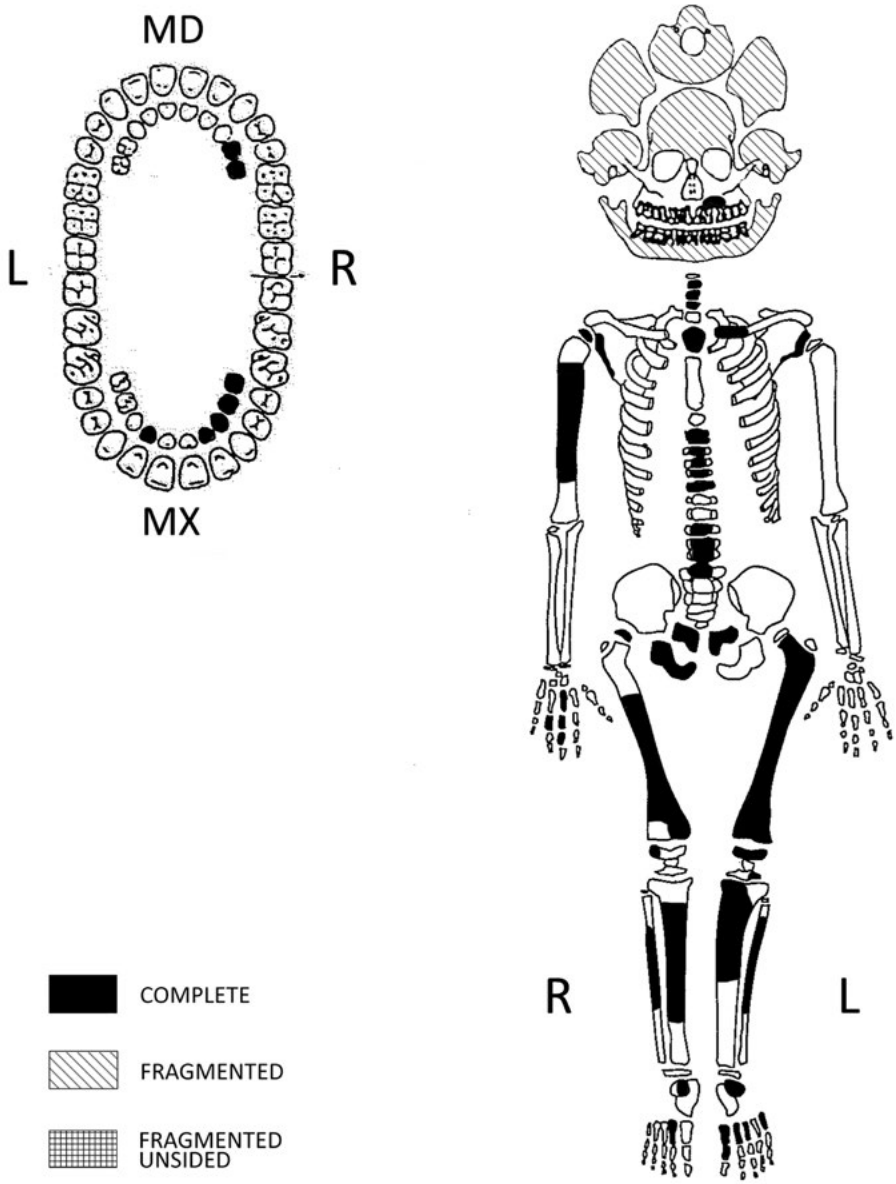


Figure 62

Sex: undeterminable

Age: 4-5 years
Age at death was determined on the basis of dental eruption, development of permanent teeth, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
The deciduous teeth are present in situ, except for the maxillary first incisors and left molars, mandibular right first incisor, which were lost post-mortem, and maxillary left second incisor, mandibular canines and left molars, which are isolated. Permanent anterior teeth and first molars are in form of germs.

Anatomical variants
None observed.

Pathologies
Diffuse grade 1 periosteal reaction is visible on the femurs, and localised grade 2 periosteal reaction is visible on the anterior portion of both tibiae.

SU 2276

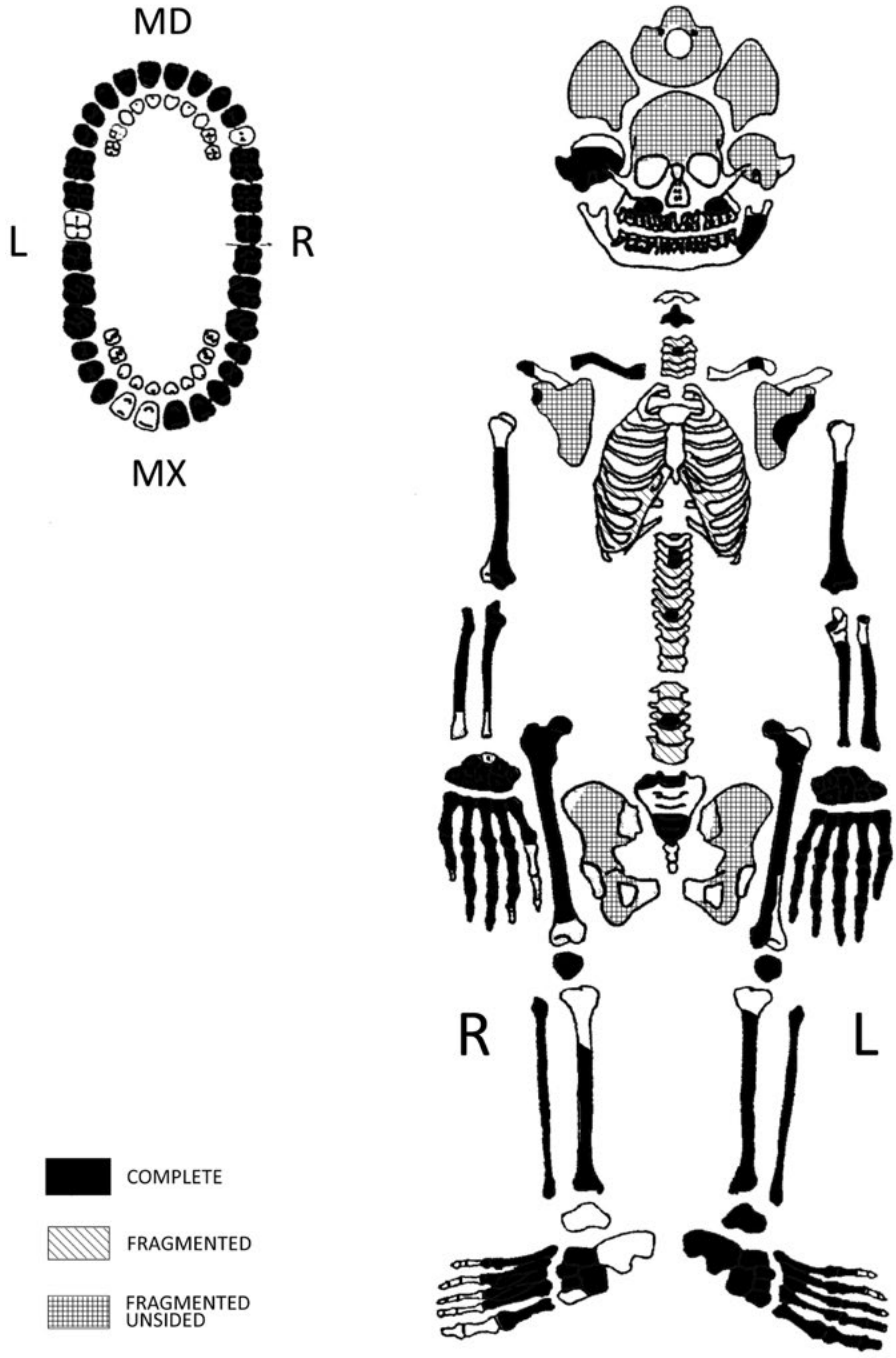


Figure 63

Sex: female
Sex was determined through the analysis of nine morphological features of the skull, which provided a sexual index of -1.

Age: 18-22 years
Age at death was determined on the basis of degree of fusion between diaphyses and epiphyses, morphology of the pubic symphysis and of the auricular surface of the ilium, and sternal rib end modifications.

Stature: undeterminable

Dental pathologies
The maxillary teeth are present and in situ, except for the left incisors, which are missing, right incisors and third molar, which are isolated. The mandibular teeth are present isolated, except for the left incisors, canine, and premolars, which are in situ, and the right second premolar, which was lost post-mortem.
One grade 1 distal caries affects the maxillary right first molar at the cemento-enamel junction, and one grade 2 distal caries affects the maxillary right second molar at the cemento-enamel junction.
Enamel hypoplasia occurred between 1.5 and 4 years, with five episodes.

Alveolar resorption of grade 1 affects both maxilla and mandible.
Strong calculus is present on the maxillary and the mandibular teeth.

Anatomical variants
In the skull the complete supraorbital foramen on the left and a zygomatic foramen on the right are present. In the post-cranial skeleton the partial transverse accessory foramen on the left of C6 is visible.

Ergonomy
The individual shows a low development of the muscular insertions.

Pathologies
Cribra cranii on the left parietal bone, diffuse grade 1 periosteal reaction on the femurs and left tibia, localised grade 2 periosteal reaction on the distal diaphysis of the right tibia, and mild osteophytosis of the external acoustic meatus are present. Osteoarthritis of grade 1 affects the dens of the axis.

SU 2277

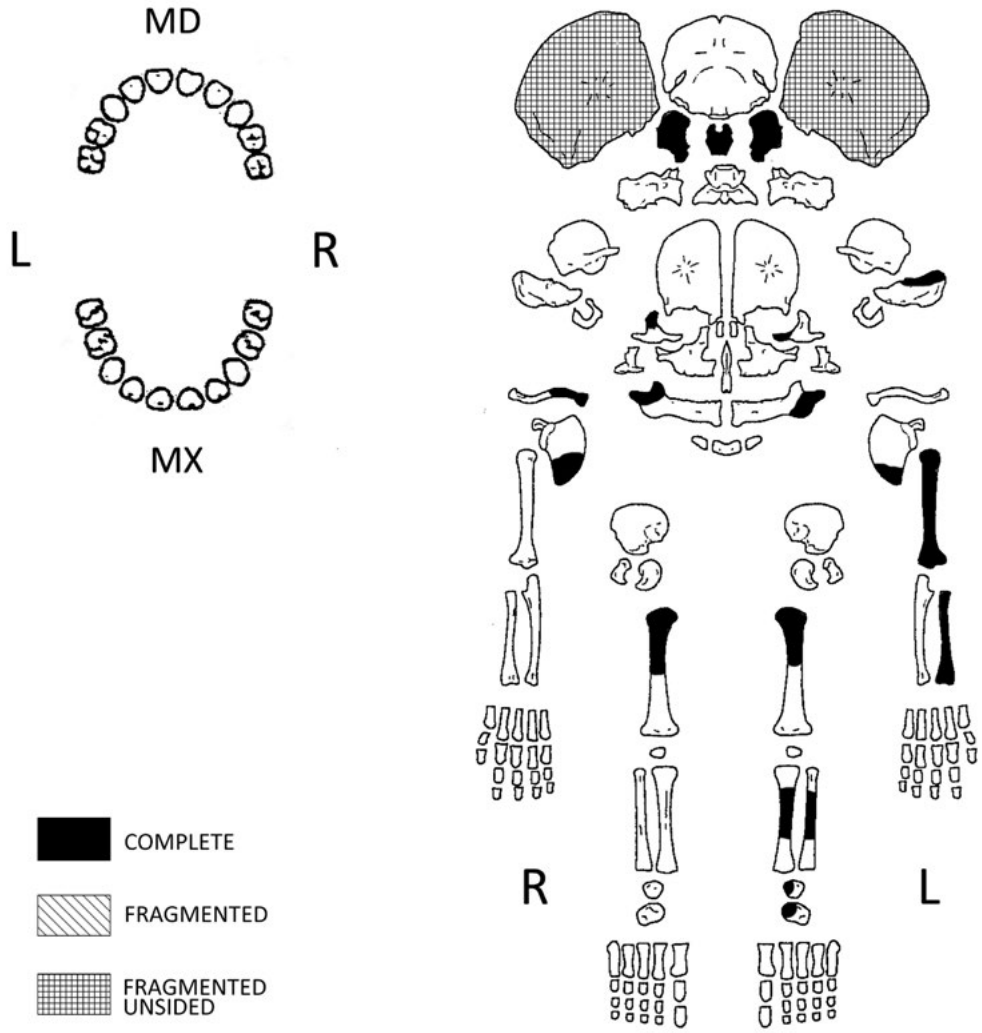


Figure 64

Sex: undeterminable

Age: 5-6 months
Age at death was determined on the basis of dental eruption and long bone length.

Pathologies
There is porosity on the external cranial surface.

SU 2278

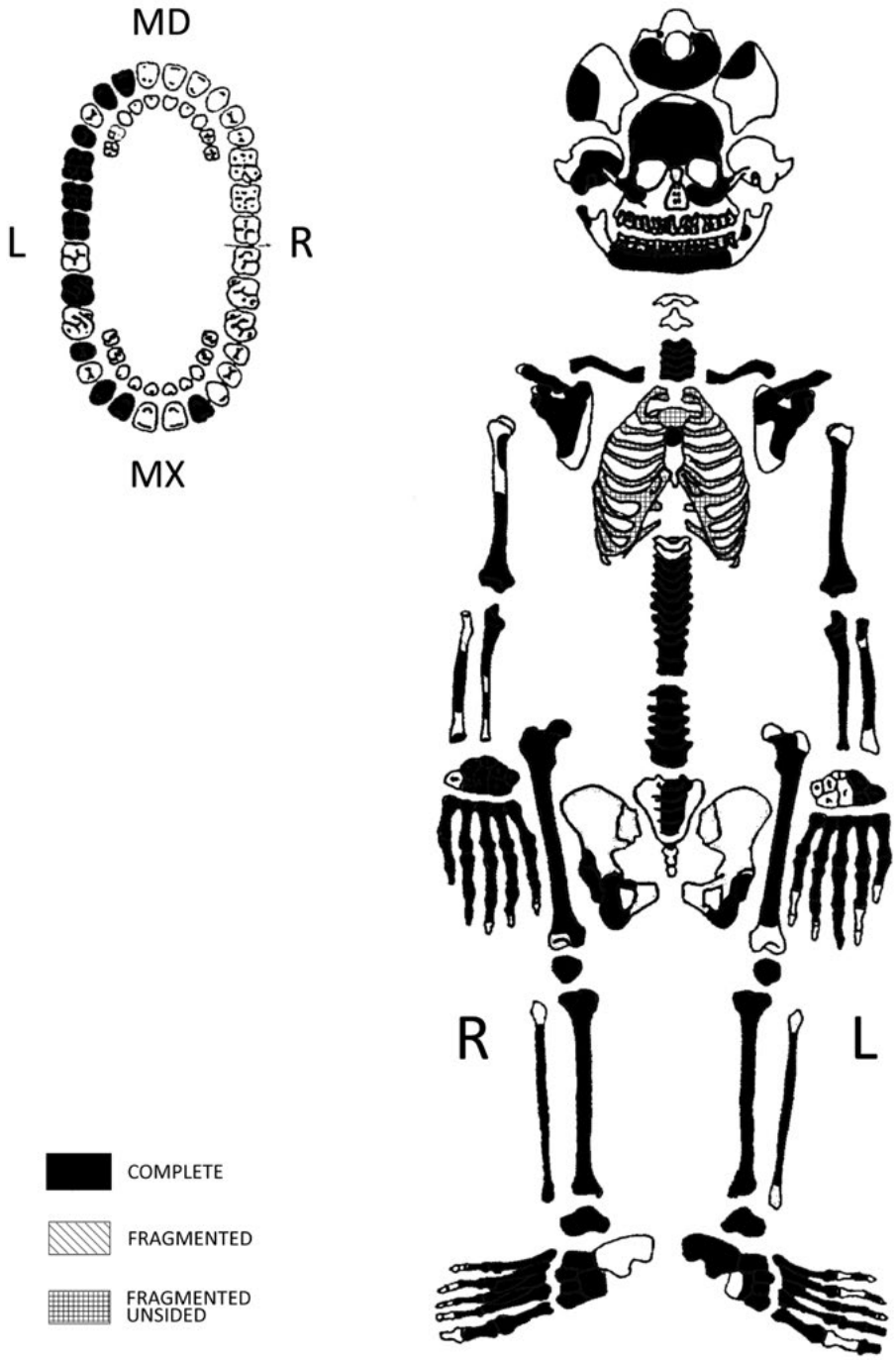


Figure 65

Sex: male
Sex was determined through the analysis of thirteen morphological features of the skull and two of the pelvis, which provided a total sexual index 0.59.

Age: 35-45 years
Age at death was determined on the basis of dental wear and sternal rib end modifications.

Stature: 175.8 cm

Dental pathologies
The maxillary teeth are preserved isolated, except for the left first incisor, first premolar, right first incisor, canine, premolars and first molar, which are missing. The mandibular teeth are preserved in situ, except for the right canine, second premolar, first and second molar, which were lost during life, and the left first incisor, first premolar, right incisors, first premolar and third molar, which were lost post-mortem. The mandibular left second premolar is preserved as root.

Alveolar resorption is not detectable in the maxilla as the bone is not preserved; in the mandible alveolar resorption is of grade 2.
Mild calculus affects the maxillary teeth and strong the mandibular teeth.
No enamel hypoplasia is visible.
As for the maxilla, the left first molar has two caries, one of grade 3 distal, and one of grade 1 mesial at the cemento-enamel junction; on the right side, one caries of grade 4 was identified on the second incisor. On the left side of the mandible four teeth have caries: the canine has a distal caries of grade 1; the crown of second premolar is destroyed by a grade 4 caries, while on the first molar a mesial caries of grade 1 was detected; the second molar has two caries of grade 2, one distal and one occlusal.
There is an extramasticatory dental wear on the incisors and mandibular canines.

Anatomical variants
In the skull the extrasutural mastoid foramen is present on both sides.
In the post-cranial skeleton, there are the right accessory transverse foramen on C5 and C7, the circumflex sulcus on the right scapula, the septal aperture on the humeri, the Poirier's facet, the exostosis of the trochanteric fossa and the exostosis of the fovea on the right femur, the vastus notch on both patellae, and the double facet of the left talus neck.

Ergonomy
The individual shows a strong/very strong development of muscular attachments; an osteophytic enthesopathy of grade 3 at the level of patellar ligament on the right tibia and of grade 1 on the ileopsoas of the right femur are present.

Pathologies
Diffuse grade 1 periosteal reaction affects the femurs, right tibia and left fibula, grade 2 the right tibia.
Schmorl's nodes are present on three out of ten thoracic and three out of five lumbar vertebrae.
Osteoarthritis occurs at all joints, in particularly of grade 1 on the distal articular surface of the humeri, the proximal articular surface of the right radius and left ulna, distal articular surface of the left ulna, acetabular cavities, head of the right femur, distal articular surface of the femurs, tibiae and of the right fibula, joints of the left calcaneus and talus, proximal articular surface of the right first metatarsal and distal of the left metatarsal. Osteoarthritis of grade 2 occurs on the clavicles, scapulae, proximal articular surface of the left humerus and right ulna, sacrum, proximal joint of the right tibia, first left metatarsal and vertebral bodies. In addition, osteoarthritis of grade 3 is observed on the distal joint surface of both femurs and on both patellae. On the hands there is a grade 2 and 3 osteoarthritis on the heads of the first and third metacarpals and on the first and third phalanges of the first finger, bilaterally.
Osteochondritis dissecans is detected on the left lunate, distal epiphysis of the tibiae and left fibula, proximal epiphysis of the first toe phalanges, and first left cuneiform. There is also plantar aponeurosis on the left calcaneus.

SU 2279

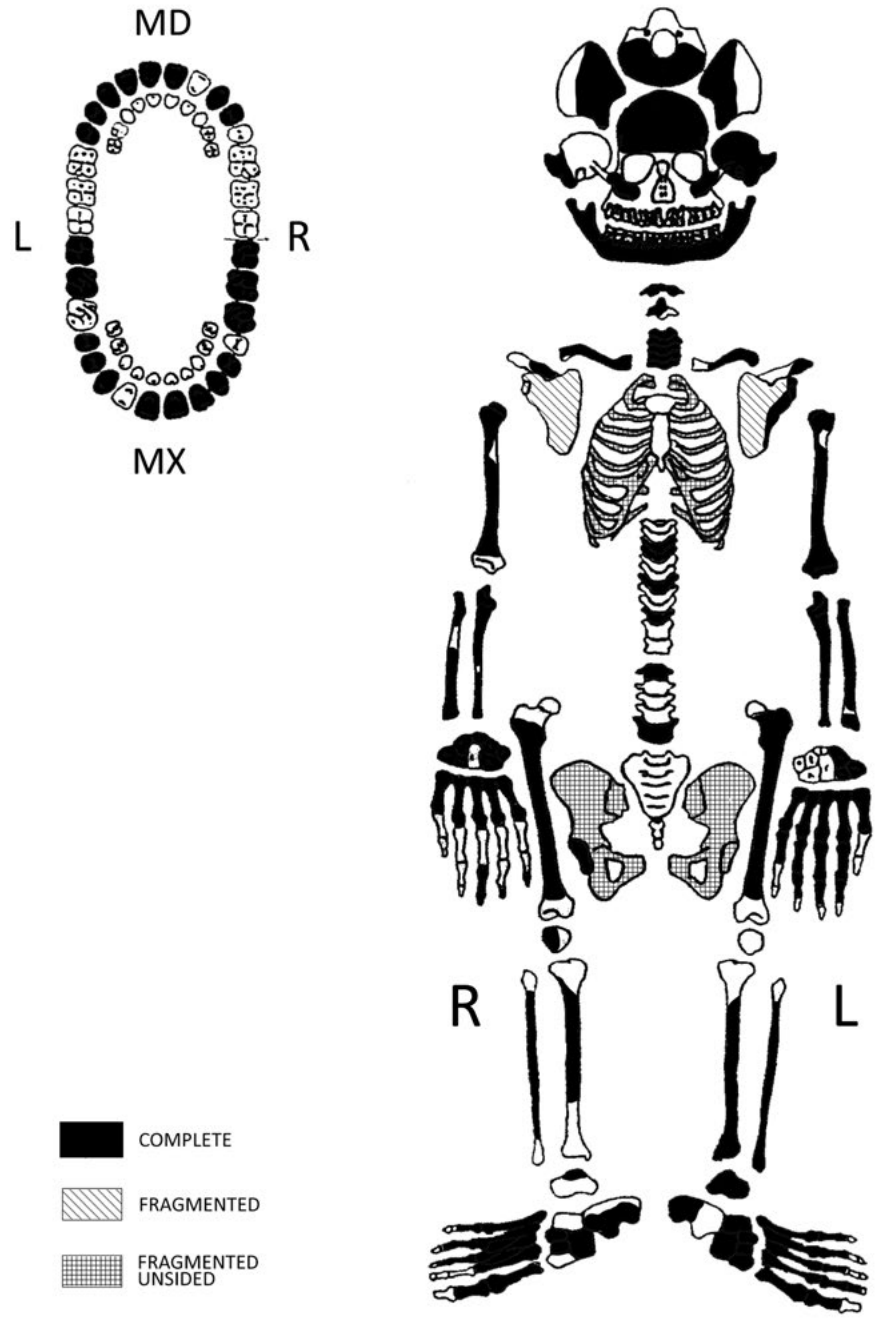


Figure 66

Sex: male (?)
Sex was determined through the analysis of twelve features of the skull, which provided a sexual index of 0.04.

Age: 35-45 years
Age at death was determined on the basis of dental wear and sternal rib end modifications.

Stature: 159.8 cm

Dental pathologies
The maxillary teeth are preserved isolated, except for the left second incisor and right second premolar, which were lost during life, the left canine and first premolar, which are in situ, and the left molars and right second and third molar, which are missing. The mandibular teeth are preserved isolated, except for the left molars, right second premolar and molars, which are missing.
Grade 3 alveolar resorption affects both the maxilla and the mandible.
On the mandibular teeth it was not possible to detect the enamel hypoplasia due to calculus, while on the maxilla it occurred between 2.5 and 4 years, with three episodes. No caries are observed in the maxillary and mandibular teeth, while two apical abscesses are in correspondence of the mandibular right first and left molars. Strong calculus affects the maxillary and the mandibular teeth, mainly the molars.

Anatomical variants
In the skull a zygomatic foramen on both sides, the parietal foramen on both sides, the apical bone, some lambdoid ossicles on the left side, and the extrasutural mastoid foramen on the left are present.
In the post-cranial skeleton the complete accessory foramen on the left C7, the accessory facet of the distal epiphysis on the right tibia and the double anterior facet of the right calcaneus are present.

Ergonomy
The individual shows a low-medium development of muscular insertions, except for the right deltoid and the gluteus maximus of the right femur, which show a strong development, and the left deltoid of the clavicle, which has a grade 2 osteophytic enthesopathy.

Pathologies
The individual has lytic inflammatory lesions, particularly on the proximal epiphyses of humeri and ulnae, and on some carpal and metacarpal bones: it may be rheumatoid arthritis with active phase lesions covered by a thin layer of new bone.
Osteoarthritis of grade 1 is also observed on the vertebral bodies, especially on the cervical spine.
There is a healed fracture of the styloid process of the left ulna, a possible fracture at the diaphysis of the right radius and another fracture at the distal metaphysis of the left ulna.
Localized grade 1 periosteal reaction affects the proximal epiphysis of the left ulna and grade 2 affects the central diaphysis of the right fibula; diffuse grade 2 periosteal reaction affects the femurs, right tibia and right fibula. There is also periosteal reaction on some rib fragments.

SU 2280

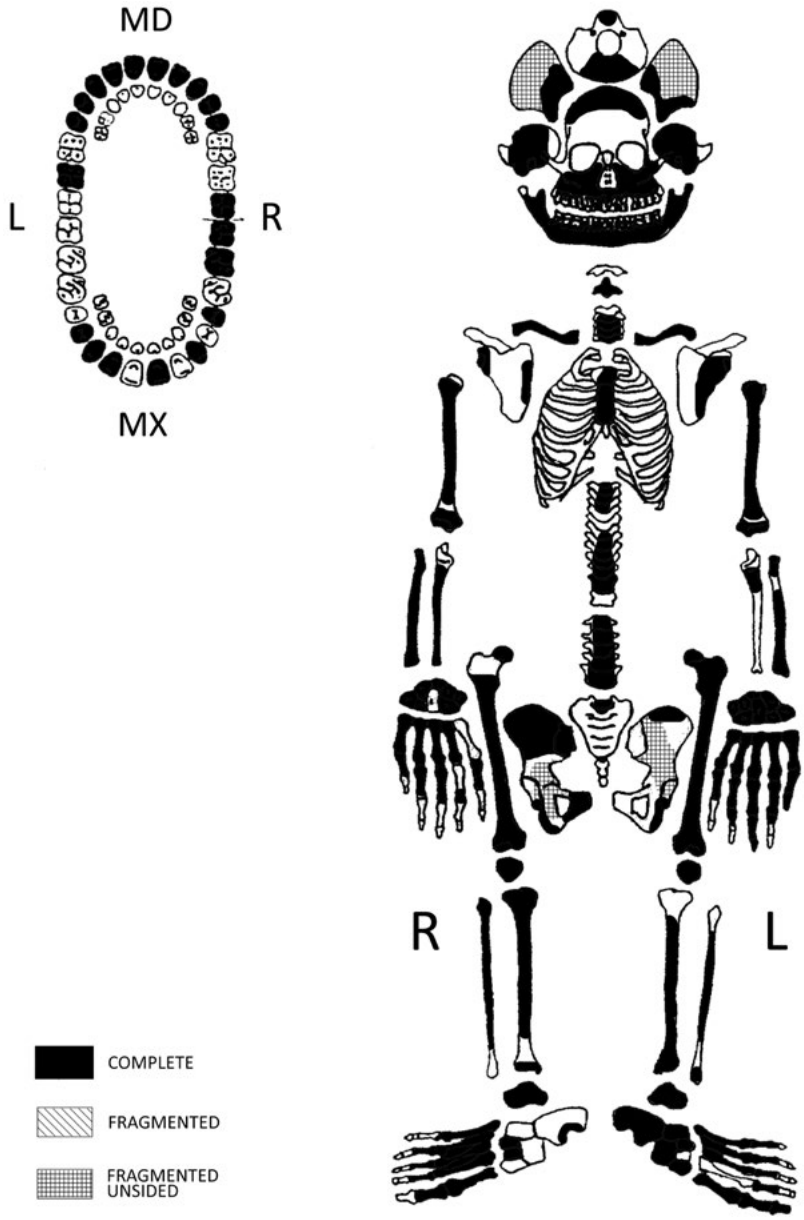


Figure 67

Sex: female (?)
Sex was determined through the analysis of nine features of the skull and five of the pelvis, which provided a total sexual index of -0.07.

Age: 35-45 years
Age at death was determined on the basis of dental wear, sternal rib end modifications and morphology of the pubic symphysis.

Stature: 159.7

Dental pathologies
The maxillary teeth are preserved is situ, except for the left first incisor, second premolar, molars, and right second incisor, first premolar and first molar which are missing. The mandibular teeth are preserved in situ, except for the left first and third molars, and right first and second molars, which are lost during life.
Grade 2 alveolar resorption affects both the maxilla and the mandible.
Enamel hypoplasia occurred between 2 and 5 years, with six episodes.
As for the maxilla, on the left side, one grade 3 interproximal distal caries affects the canine and the first premolar; on the right side one grade 4 caries destroyed the crowns of the second premolar, second and third molar. As for the mandible, on the left side one grade 1 buccal caries affects the canine at cemento-enamel junction, one grade 3 buccal caries affects the first premolar at the cemento-enamel junction; on the right side there is one grade 2 buccal caries on the canine at the cemento-enamel junction.
Mild calculus affects the maxillary and the mandibular teeth.

Anatomical variants
In the skull the infraorbital suture and the zygomatic foramina on both sides, the parietal foramen on the left, and the extrasutural mastoid foramen on the right are present.
In the post-cranial skeleton the septal aperture of the humerus on both sides, the vastus notch on the right patella and the accessory facet on the distal epiphysis of the right tibia are present.

Ergonomy
The individual shows a low-medium development of muscular insertions.

Pathologies
Grade 1 diffuse periosteal reaction is visible on the femurs and left tibia; a Schmorl's nodes affect one out of five lumbar vertebrae. Osteoarthritis of grade 1 is observed on the distal joint surface of left tibia and on the joints of the left talus. Osteoarthritis of grade 2 is observed on the acromial end of the left clavicle and of grade 3 on the acromial end of the right clavicle.

SU 2281

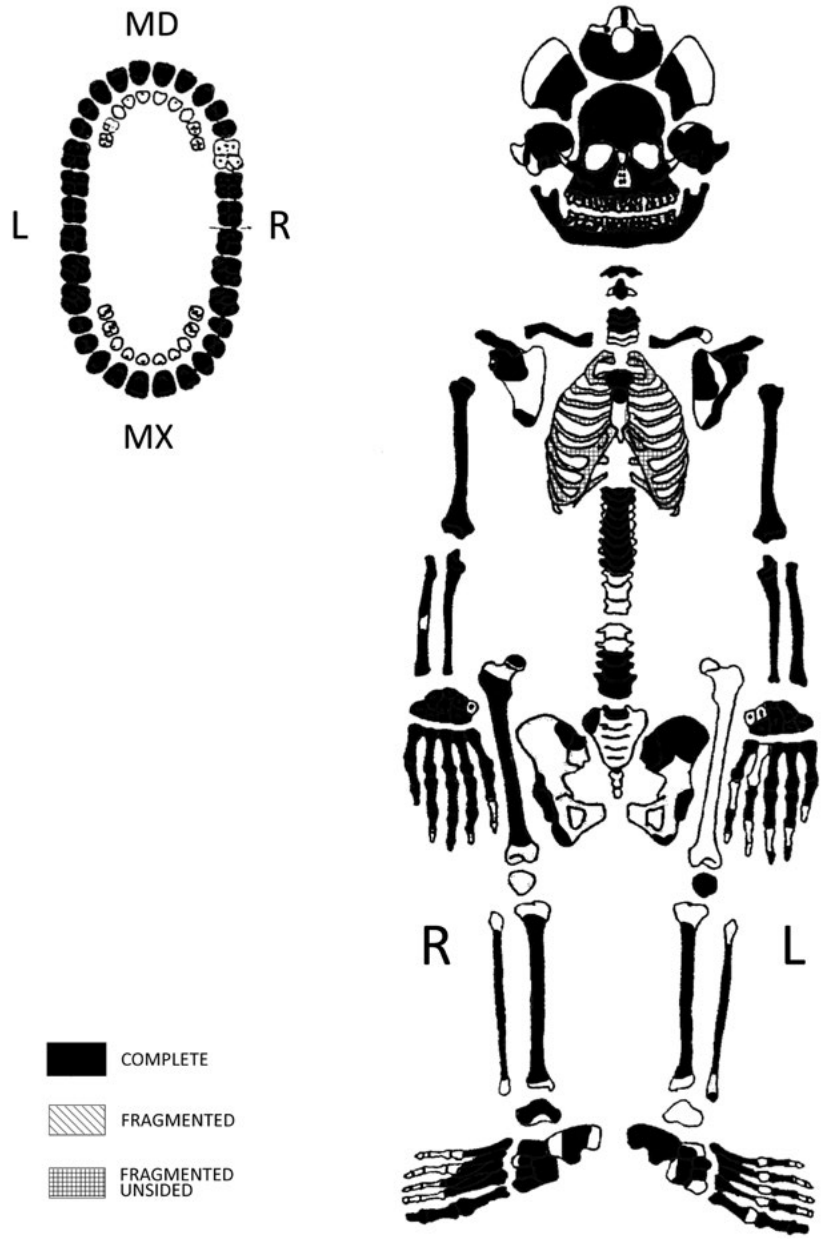


Figure 68

Sex: female
Sex was determined through the analysis of fourteen morphological features of the skull and four of the pelvis, with a total sexual index of -1.43.

Age: 18-26 years
Age was determined on the basis of dental wear and the sternal rib end modifications.

Stature: 151.0 cm

Dental pathologies
Both maxilla and mandible are well preserved; the maxilla preserves all sixteen teeth in situ and the mandible fourteen teeth in situ and one is lost during life.
Enamel hypoplasia occurred between 2 and 4 years.
No caries are present on mandibular teeth; the crown of the mandibular left first molar was completely destroyed by a grade 4 caries.
The first left and the second right maxillary premolars are rotated.
There is no calculus, and a grade 1 alveolar resorption affects the maxilla and the mandible.

Anatomical variants
In the skull the complete metopic suture, the complete infraorbital suture on both sides, two distinct infraorbital foramen on the left side, the bilateral zygomatic foramina and the parietal foramina are present.
In the post-cranial skeleton, there are the complete accessory transverse foramina on C5 and C6, both bilateral suprascapular foramen and the double accessory facet on both calcanei.

Ergonomy
The individual shows a medium development of muscular insertions, except for the deltoid and conoid ligament of the clavicles and the interosseous tubercle of the left radius, which shows a strong development.

Pathologies
Diffuse grade 1 periositis was observed on both femurs and tibiae.

SU 2282

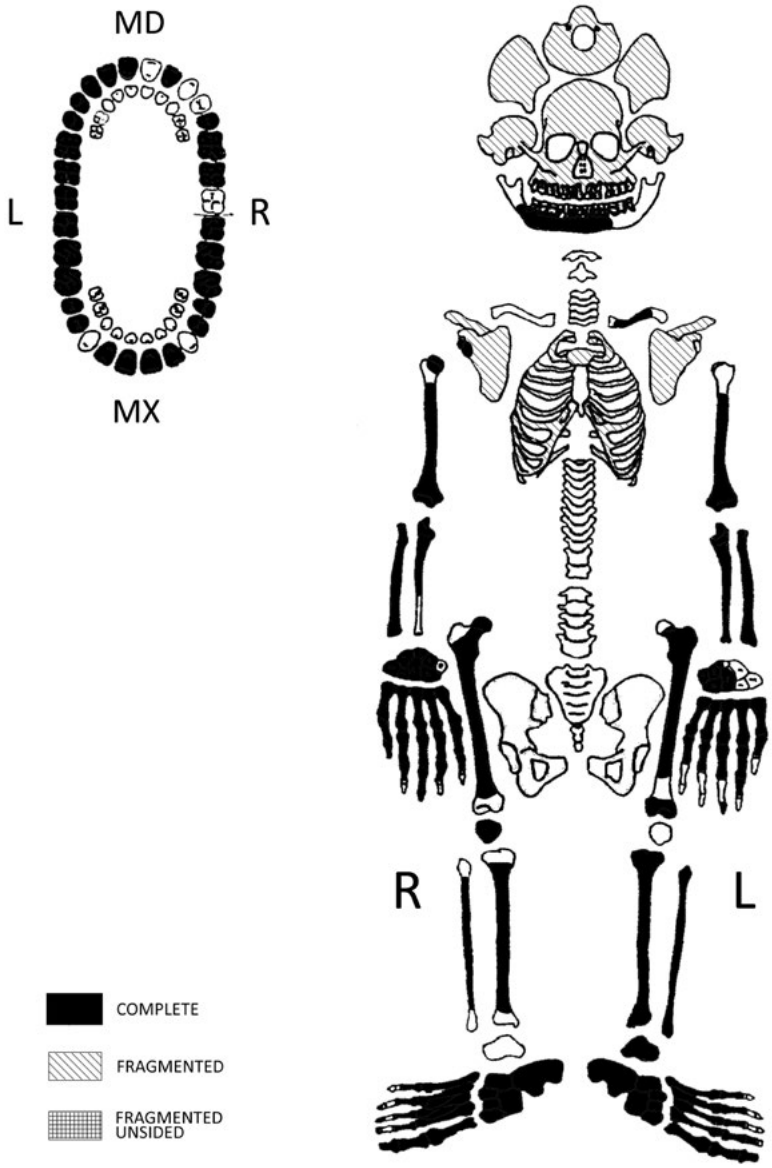


Figure 69

Sex: undeterminable

Age: 15-20 years
Age at death was determined on the basis of dental wear and stage of fusion between diaphyses and epiphyses.

Stature: 161.7 cm

Dental pathologies
The maxillary teeth are preserved and isolated, except for the left first incisor and third molar, which are missing. The mandibular teeth are preserved and isolated, except for the canines, which are missing.
Strong calculus affects both the maxillary and the mandibular teeth.
Enamel hypoplasia occurred between 2.5 and 3 years, with two episodes.
The three right maxillary molars have caries: on the first molar there is one mesial caries of grade 3 at the cemento-enamel junction; on the second molar one distal caries of grade 1 at the cemento-enamel junction; on the third molar one occlusive caries of grade 1.

Anatomical variants
In the skull the parietal foramen is present; in the postcranial skeleton the double anterior facet on both calcanei is observed.

Ergonomy
The individual shows a low-medium development of the preserved muscular insertions, except for the gluteus maximus of the left femurs, which shows a strong development.

Pathologies
The presence of cribra cranii on the parietal bones is observed. Diffuse grade 1 periosteal reaction is visible on tibiae, fibulae and femurs.
The second and third phalanges of the fifth finger of the right foot are fused.

SU 2283

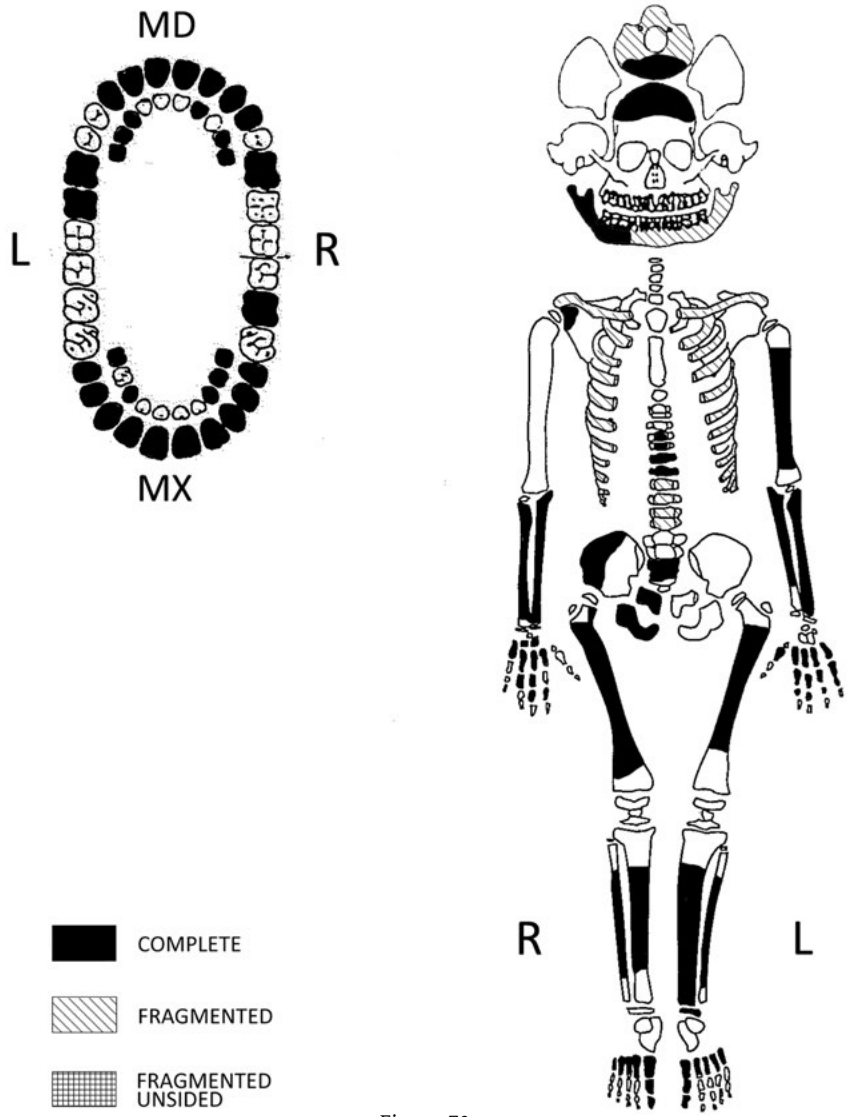


Figure 70

Sex: undeterminable

Age: 8-9 years
Age at death was determined on the basis of dental eruption, development of the permanent teeth, stage of fusion between diaphysis and epiphysis, and long bone length (ulna).

Dental pathologies
Some deciduous maxillary teeth are present isolated: the canines, left second molar, right first and second molar; the permanent maxillary teeth are preserved and isolated, except for the left first and second molar and the right first molar, which were lost post-mortem. Some deciduous mandibular teeth are preserved in situ: the molars, right second incisor and left canine; permanent mandibular teeth are in situ, except for the left canine and right second molar, which were lost post-mortem. The right canine and first premolar, and the left second molar are in form of germ.
Mild calculus affects both the maxilla and the mandible. Enamel hypoplasia occurred between 2.5 and 4.5 years, with four episodes.

Anatomical variants
In the skull the parietal foramen is present on both sides.

Pathologies
Diffuse grade 1 periosteal reaction affects both tibiae.

SU 2284

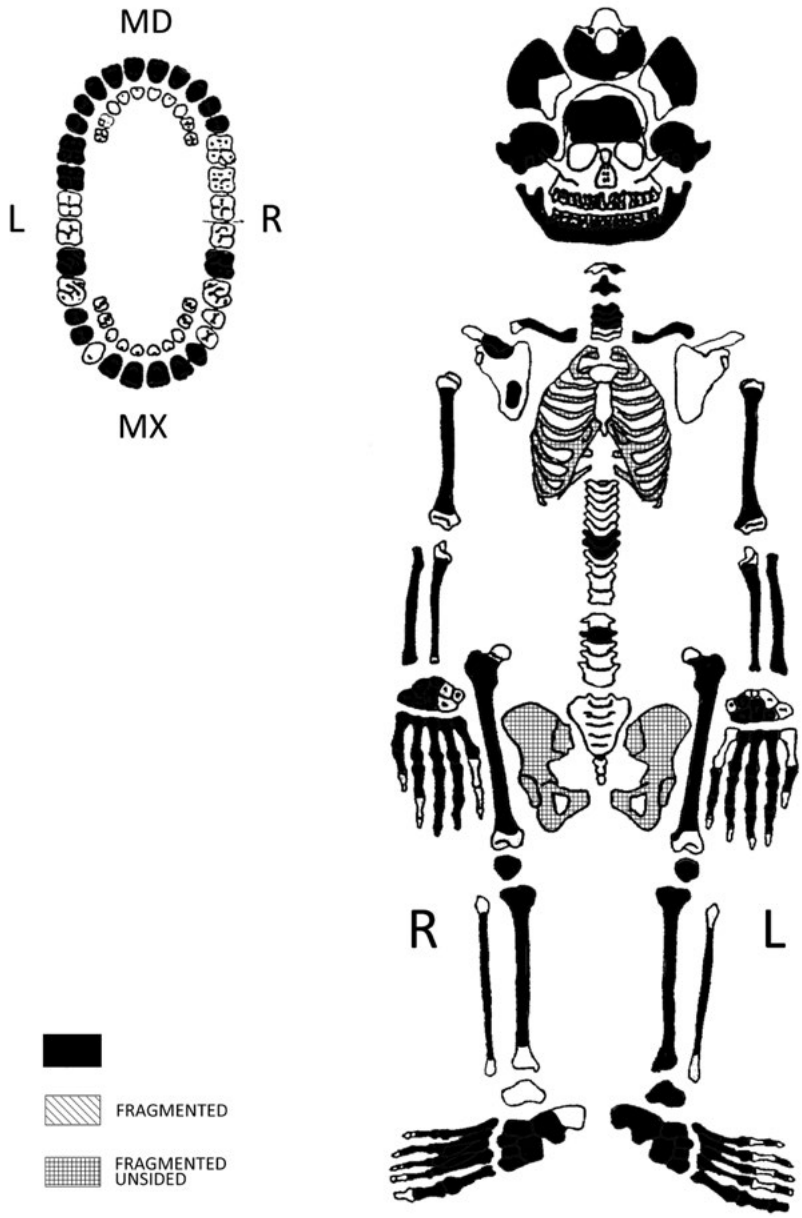


Figure 71

Sex: male
Sex was determined through the observation of nine morphological features of the skull, which provided a sexual index of 0.89.

Age: 35-45 years
Age at death was determined on the basis of dental wear and sternal rib end modifications.

Stature: 160.1 cm

Dental pathologies
The maxillary teeth are preserved isolated, except for the left first molar, which was lost during life, the second molars, which are in situ, and the left canine, right premolars and first molar, which are missing. The mandibular teeth are preserved and in situ, except for the right first molar, which was lost during life and the right second molar, which was lost post-mortem; the left second molar is preserved as root. There is agenesis of all the third molars.
Alveolar resorption of grade 1 affects the maxilla and the mandible.
Mild calculus affects the maxillary and the mandibular teeth; strong calculus is present on anterior mandibular teeth.
There is a mesial caries of grade 2 on the second maxillary molar at the cemento-enamel juction. The crown of the second left mandibular molar was completely destroyed by a grade 4 caries; an apical abscess is also present.
Enamel hypoplasia occurred between 3 and 6 years, with four episodes.

Anatomical variants
In the skull the zygomatic foramina, one on the right and multiple on the left, the parietal foramen, and some lambdoid ossicles on the right are present.

Ergonomy
The individual shows a medium development of muscular insertions, except for the gluteus maximus of the femurs and the patellar ligament of the patellae, which present a very strong development, the biceps brachii of the right radius, which shows a grade 2 entesopathy, and of the left radius, which shows a grade 1 enthesopathy.

Pathologies
Grade 1 osteoarthritis is present on the facet for acromion of the left clavicle, sternal facet of the right clavicle, distal joint surface of both radii, proximal ulnae, left upper sacral articular process, and distal joint of the left femur; osteoarthritis of grade 2 affects the vertebral bodies, the facet for acromion of the right clavicle.
Diffuse grade 1 periosteal reaction is visible on femurs, tibiae and fibulae.
There is a fusion of two cervical vertebrae.

SU 2285

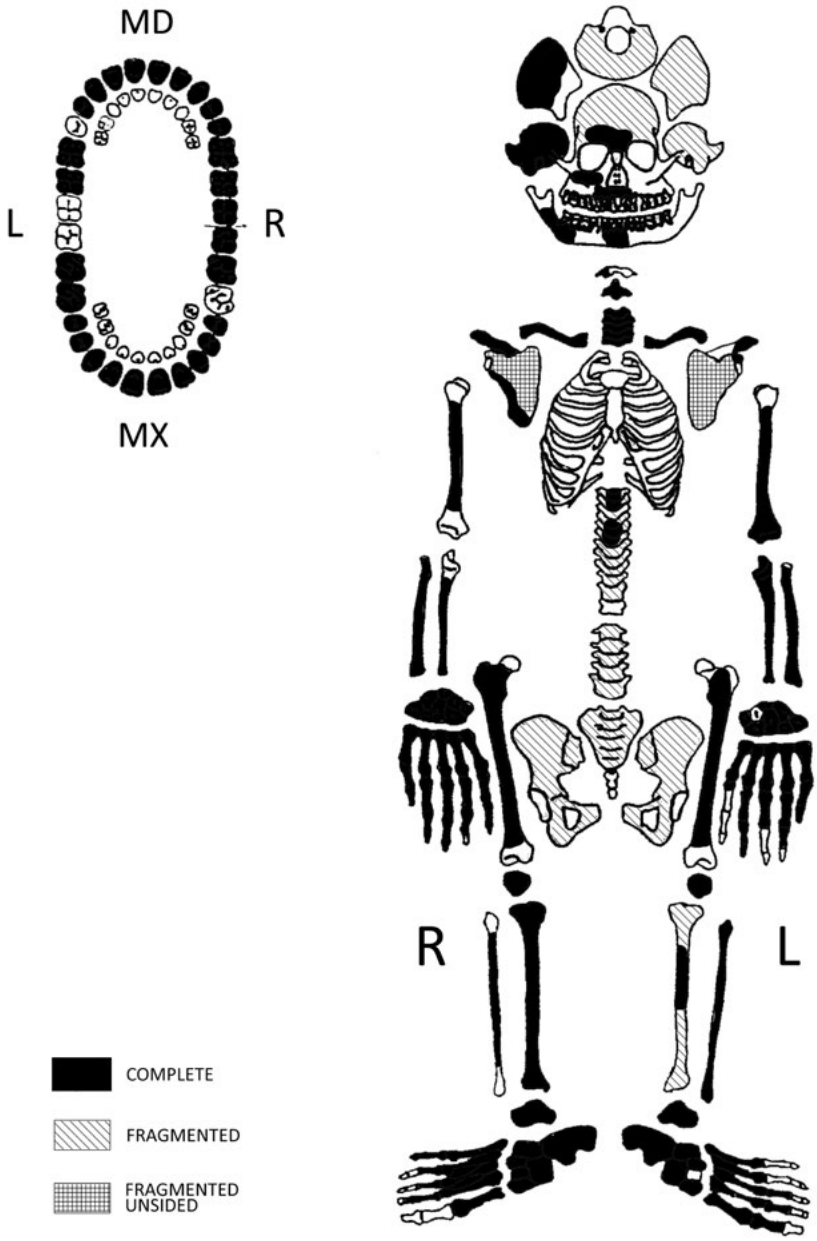


Figure 72

Sex: female
Sex was determined through the observation of ten morphological features of the skull, which provided a sexual index of -0.8.

Age: 20-30 years
Age at death was determined on the basis of dental wear, degree of fusion between diaphyses and epiphyses, and sternal rib end modifications.

Stature: 158.4 cm

Dental pathologies
The maxillary teeth are preserved and in situ, except for the left premolars and first and second molar, which are isolated, right first molar and left third molar, which were lost post-mortem. Mandibular teeth are preserved in situ, except for the premolars, left first molar, which are isolated, and left third molar, which was lost post-mortem.
One grade 4 caries affects the maxillary left first molar, and one grade 1 distal caries affects the mandibular left first molar.
Enamel hypoplasia occurred between 1.5 and 4.5 years, with 7 episodes.
Alveolar resorption of grade 1 affects the mandible. Mild calculus is visible on maxillary teeth, strong on the mandibular ones.

Anatomical variants
In the post-cranial skeleton the transverse accessory foramen on the right of C3, on both sides of C6, the septal aperture on the left humerus and the double anterior facet on both calcanei are present.

Ergonomy
The individual shows a medium-strong development of the muscular insertion, except for the right deltoid and the conoid ligament of the left clavicle, the pectoralis major and the latissimus dorsi/teres major of the left humerus, the interosseous tubercle of the left radius, the gluteus maximus of the femurs and the vastus medialis of the right femur, which have a strong development, and the trapezoid ligament of the right clavicle, which has a very strong development.

Pathologies
Schmorl's nodes affects three thoracic vertebrae. Diffuse grade 1 periosteal reaction is visible on the tibiae. A healed fracture of the right clavicle and scapula are present. The second and third phalanges of the fifth finger of the left foot are fused. Both tibiae and the distal epiphysis of the left femur are affected by osteomyelitis.

SU 2286

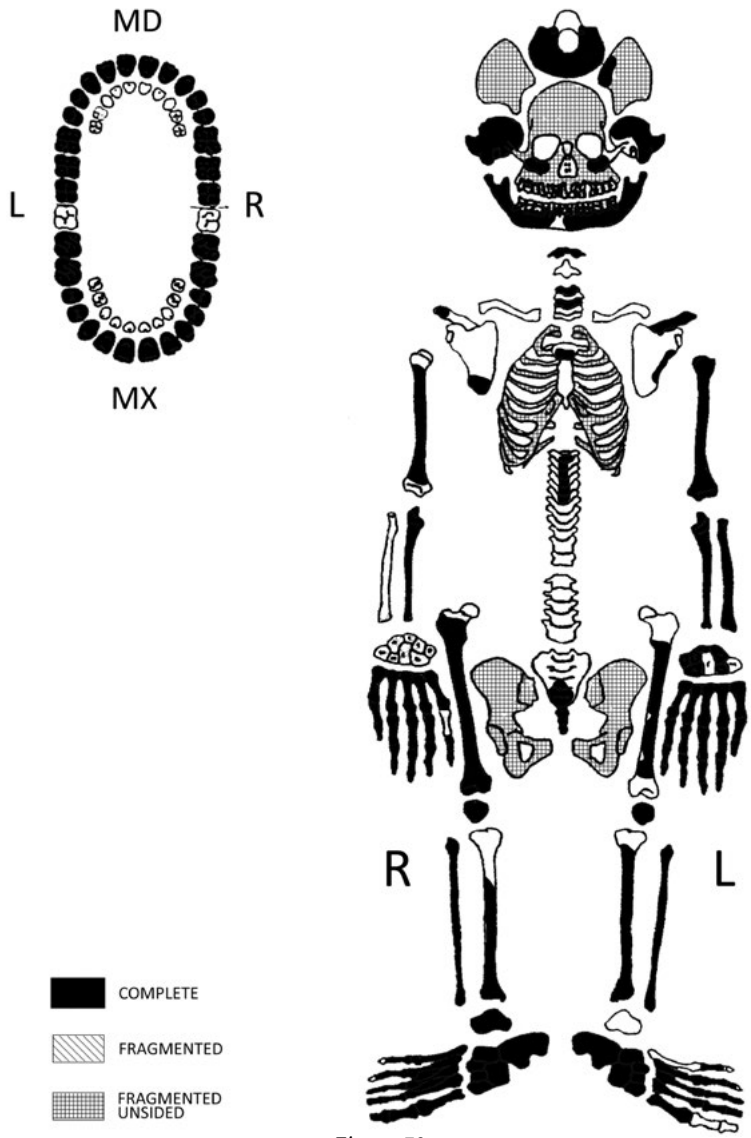


Figure 73

Sex: male
Sex was determined through the analysis of eight morphological features of the skull, which provided a sexual index of 0.06.

Age: 20-25 years
Age at death was determined on the basis of dental wear, fusion between diaphyses and epiphyses, and sternal rib end modifications.

Stature: 154.8 cm

Dental pathologies
The maxillary teeth are preserved and isolated, except for the left second incisor, which is in situ.
The mandibular teeth are preserved in situ, except for the right incisors, canine and first premolar, which are isolated. The third molars are in form of germ.
Alveolar resorption of grade 1 affects the mandible.
Mild calculus affects the maxillary and the mandibular teeth. One distal caries of grade 1 is present on the maxillary left second premolar, and one mesial caries of grade 3 is present on the maxillary right first molar.
Enamel hypoplasia occurred at 3.5 years, with one episode. Extramasticatory wear affects the canines and the maxillary and mandibular incisors. The rotation of the mandibular left first premolar is observed.

Anatomical variants
In the skull the bilateral zygomatic foramina are present; in the post-cranial skeleton there are the double facet of the atlas, a small septal aperture in the left humerus, and the accessory facet on the head of the first left metatarsal.

Ergonomy
The individual shows a low development of the muscular insertions, except for the deltoid of the right clavicle and the conoid ligament of both clavicles, which have a strong development.

Pathologies
Diffuse grade 1 periosteal reaction affects both femurs and tibiae.
The fibulae, and the radii and ulnae to a lesser extent, have a slight curvature, probably due to healed rickets.

Trench 8

SU 2289

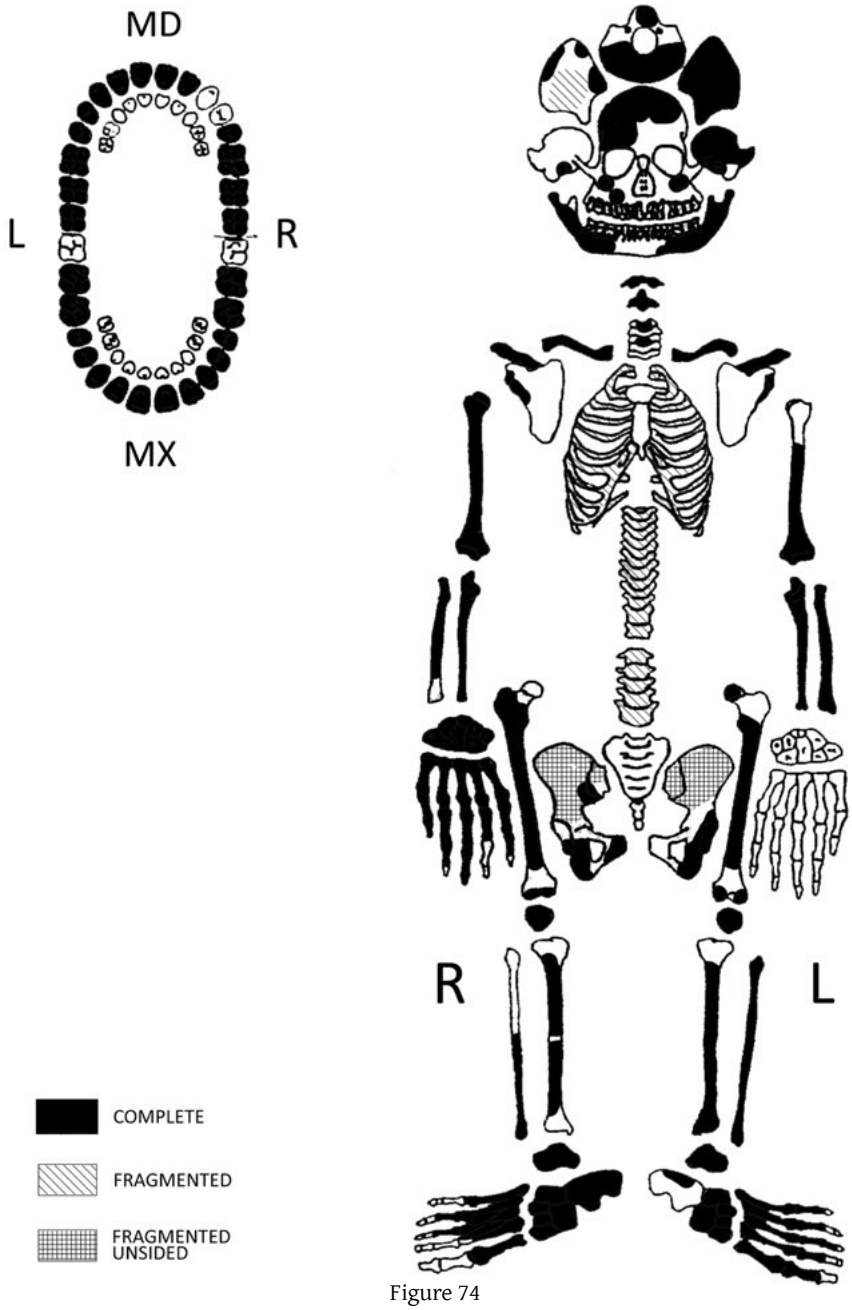


Figure 74

Sex: female
Sex was determined through the analysis of nine morphological features of the skull and three of the pelvis, which provided a total sexual index of -0.8.

Age: 35-45 years
Age at death was determined on the basis of dental wear, morphology of the pubic symphysis, and sternal rib end modifications.

Stature: 159.6 cm

Dental pathologies
The maxillary teeth are preserved and isolated, except for the right second incisor, canine, premolars and molars, which are in situ.
The mandibular teeth are preserved isolated, except for the left molars and right second and third molar, which are in situ, and the right canine and first premolar, which were lost post-mortem.
Alveolar resorption of grade 1 affects both the maxilla and the mandible.
Mild calculus is present on the mandibular teeth.
An occlusal caries of grade 1 is present on the maxillary left first molar; in the mandible there are several caries: one occlusal caries of grade 1 on the left second molar and on the right second molar, one buccal caries of grade 1 on the right first molar and on the left third molar, and one buccal caries of grade 2 on the right third molar.
Enamel hypoplasia occurred between 2 and 4.5 years, with six episodes.

Anatomical variants
In the skull the zygomatic foramen on the right, the parietal foramen and the mastoid extrasutural foramen bilaterally were present. In the postcranial skeleton the accessory facet on the distal epiphysis of the left tibia is observed.

Ergonomy
The individual shows a low development of muscular insertions, except for the conoid and trapezoid ligament of the clavicles, which have medium and strong development respectively.

Pathologies
Cribra cranii of grade 1 affects the occipital bone. Diffuse grade 1 periosteal reaction is present on the left femur and the right fibula.
Localised grade 3 periosteal reaction is present on distal third of the right femur, the diaphysis of both tibiae (on the left is of grade 4) and the right fibula. Possible healed trauma affects the diaphysis of the left tibia.
Grade 1 osteoarthrosis is present on the acromial facet of the right scapula, the proximal articular surface of the right radius and the distal joint of the right first metatarsal.

SU 2290

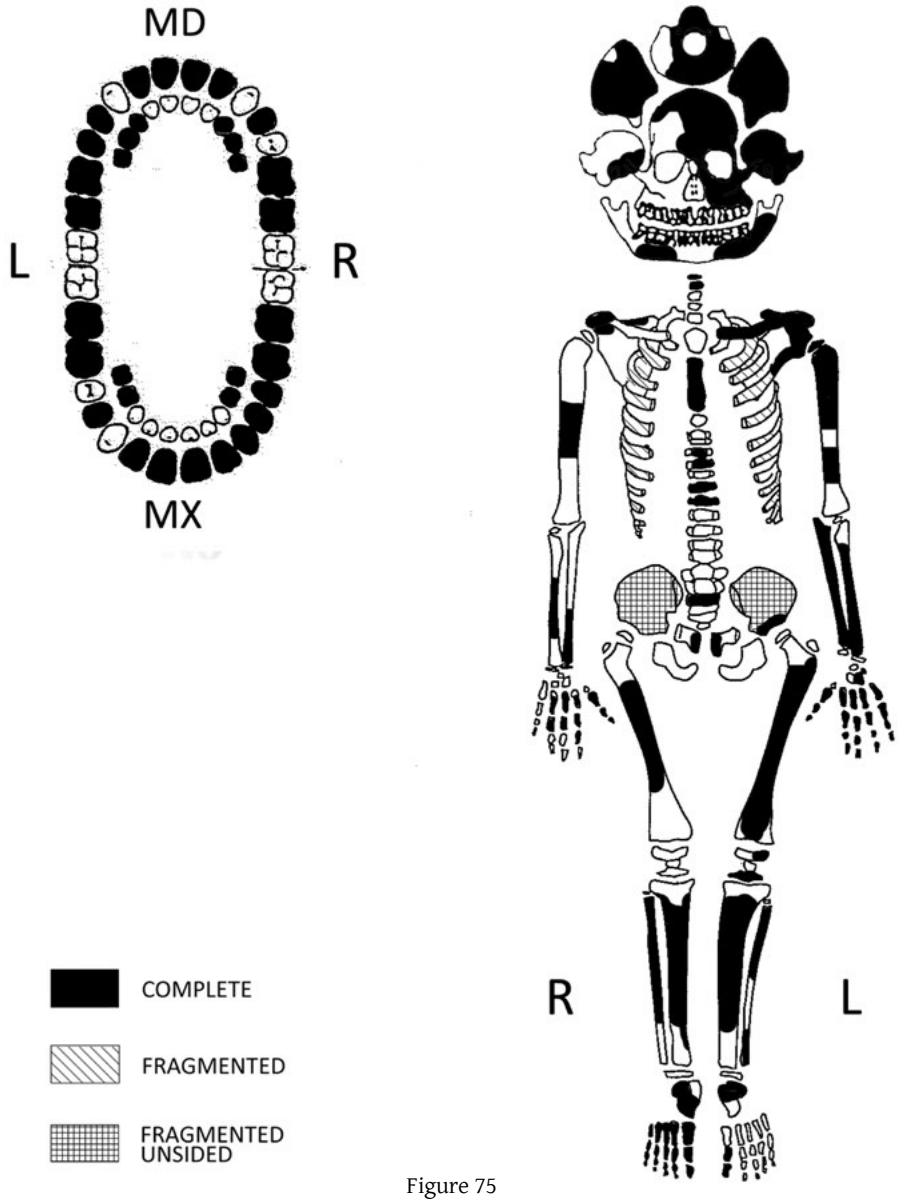


Figure 75

Sex: undeterminable

Age: 9 years
Age at death was determined on the basis of dental eruption, long bone length, and degree of fusion between diaphyses and epiphyses.

Dental pathologies
The permanent maxillary teeth are preserved and isolated, except for the left first molar, which is in situ, and the left canine and first molar, which are missing. The premolars and second molars are in form of germs. The deciduous molars are still present and

isolated, except for the left second molar, which is in situ.
The permanent mandibular teeth are preserved and isolated, except for the canines and right second premolar, which are missing. The premolars and second molars are in form of germ. The deciduous molars and canines are preserved and all isolated, except for the second right molar, which is in situ.
Enamel hypoplasia occurred between 1.5 year and 3.5 years, with five episodes.
Some caries are present on the deciduous teeth: one mesial of grade 3 on the mandibular left first molar, one distal grade 3 on the mandibular right canine, one mesial grade 3 on the right first molar, one mesial grade 3 on the maxillary left first molar, and one mesial grade 1 on the maxillary right first molar.

Anatomical variants
In the skull the complete infraorbital suture, the zygomatic foramen, two infraorbital foramina, the mastoid extrasutural foramen, all on the left side, and some lambdoid ossicles on the right are observed.

Pathologies
Cribra cranii of grade 1 are visible on the frontal bone and cribra orbitalia of grade 1 on the left orbital roof. Diffuse grade 1 periosteal reaction is present on the left femur.

SU 2291

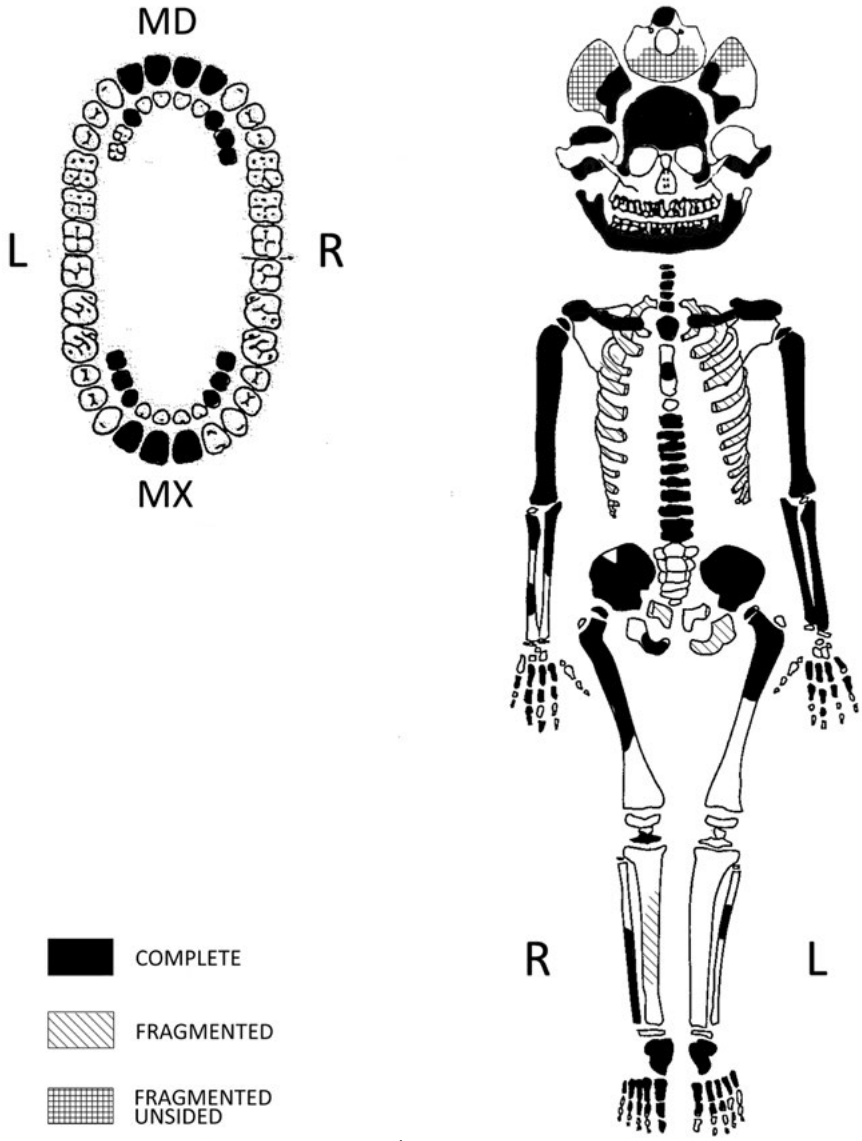


Figure 76

Sex: undeterminable

Age: 9-10 years
Age at death was determined on the basis of dental eruption, long bone length, and degree of fusion between diaphyses and epiphyses.

Dental pathologies
The permanent maxillary teeth are present isolated, except for the second incisors and right canine, which are missing; the canine and premolars are in form of germs. The deciduous maxillary molars are preserved isolated.

The permanent mandibular teeth are preserved in situ, except for the left second premolar, and right premolars, which are missing; the canines, left first premolar and first molars are in form of germs. The deciduous mandibular molars and canines are in situ.
A grade 1 caries is present on the occlusal surface of the deciduous mandibular right first molar. Enamel hypoplasia occurred between 1 and 4 years, with seven episodes.
Mild calculus affects the maxillary and mandibular teeth.

Anatomical variants
In the skull the complete supraorbital foramen on the left and the zygomatic foramina bilaterally are observed. In the post-cranial skeleton the partial accessory transverse foramen on the left of C5 and complete on the left of C6 are present.

Pathologies
Cribra cranii of grade 1 affects the frontal bone and cribra orbitalia of grade 1 both orbital roofs. Diffuse grade 1 periosteal reaction is present on the left femur. Several anomalies of the column were observed: the posterior arch defect of the atlas, the fusion of C2 and C3, thoracic and lumbar supernumerary vertebrae, and the posterior arch defect of S2; there is also bifurcation of one rib. All these feature suggest a diagnosis of Klippel-Feil syndrome. The superior vertebral plate of L5 presents an area of osteolysis, which could suggest a possible case of brucellosis.

SU 2292

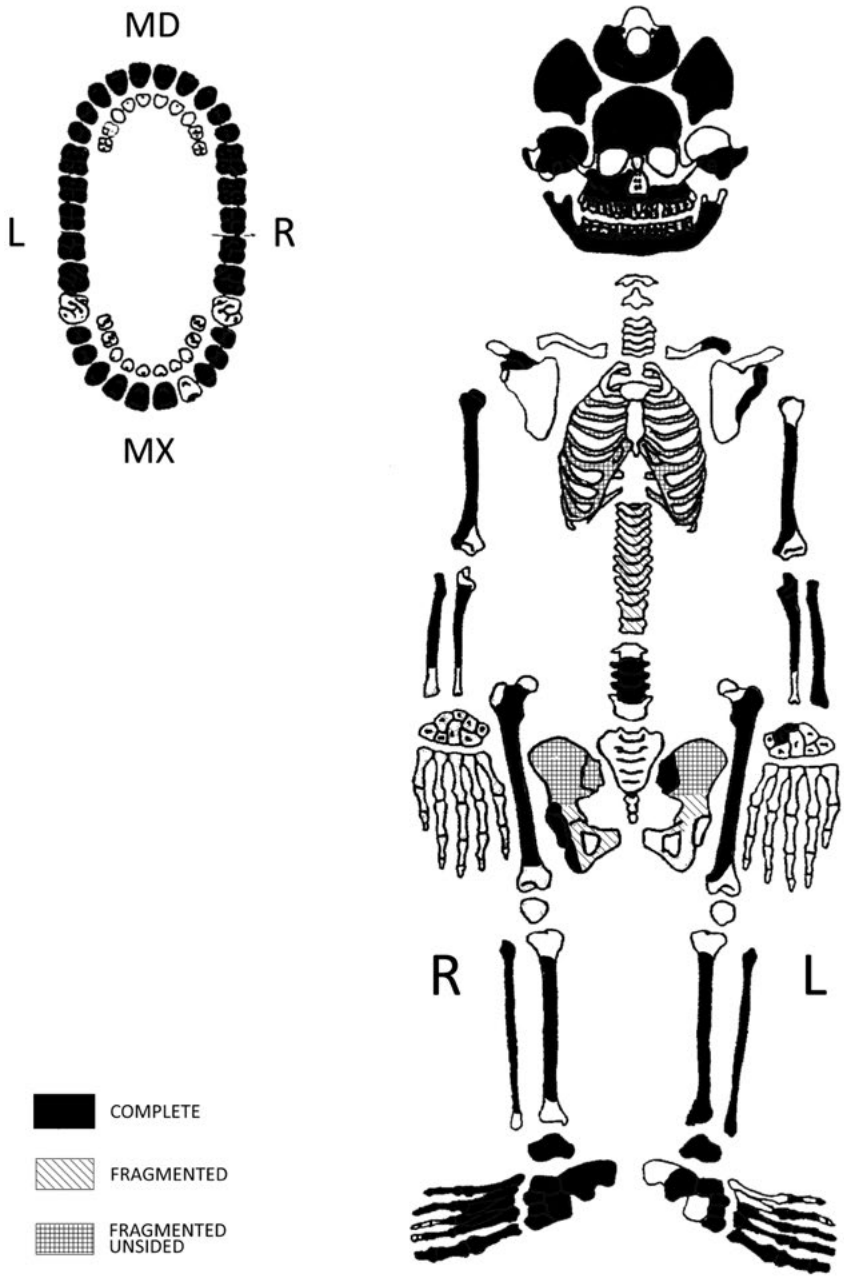


Figure 77

Sex: female
Sex was determined through the analysis of thirteen morphological features of the skull and two of the pelvis, which provided a total sexual index of -0.8.

Age: 25-30 years
Age at death was determined on the basis of dental wear, degree of fusion between diaphyses and epiphyses, and sternal rib end modifications.

Stature: 157.8 cm

Dental pathologies
The maxilla and the mandible preserve all teeth in situ, except for the maxillary right second incisor, which was lost post-mortem, both maxillary first molars, which were lost during life, and the right mandibular first molar, which is isolated.
Alveolar resorption of grade 1 affects the maxilla, especially in correspondence of the first molars. Strong calculus is present on the mandibular anterior teeth.
In the maxillary teeth several caries were observed: one distal caries of grade 3 on the left second premolar, one occlusal caries of grade 1 on the left second and the third molars, one distal caries of grade 2 on the right canine and one mesial caries of grade 3 on the third molar. In the mandibular teeth, an occlusal caries of grade 1 is present on the left first premolar, on the left second molar and on the right third molar, one caries of grade 4 on the left third molar, three occlusal caries of grade 1 on the right first molar.
Enamel hypoplasia occurred between 1.5 and 4.4 years, with six episodes.

Anatomical variants
In the skull there are the complete supraorbital foramen on the right, a zygomatic foramen on both sides, the left parietal foramen, the apical bone, the lambdoid ossicles on the left and the mastoid extrasutural foramen on the left. In the postcranial skeleton the anterior double facet on both calcanei is observed.

Ergonomy
The individual shows a low development of all muscular insertions, except for the brachioradialis of the left humerus, the biceps brachii of the left radius and the gluteus maximus of the left femur, which have a strong development.

Pathologies
Osteoarthritis of grade 1 affects three lumbar vertebrae; two out of three lumbar vertebrae are affected by Schmorl's nodes. Diffuse grade 1 periosteal reaction is visible on femurs and tibiae.

SU 2293

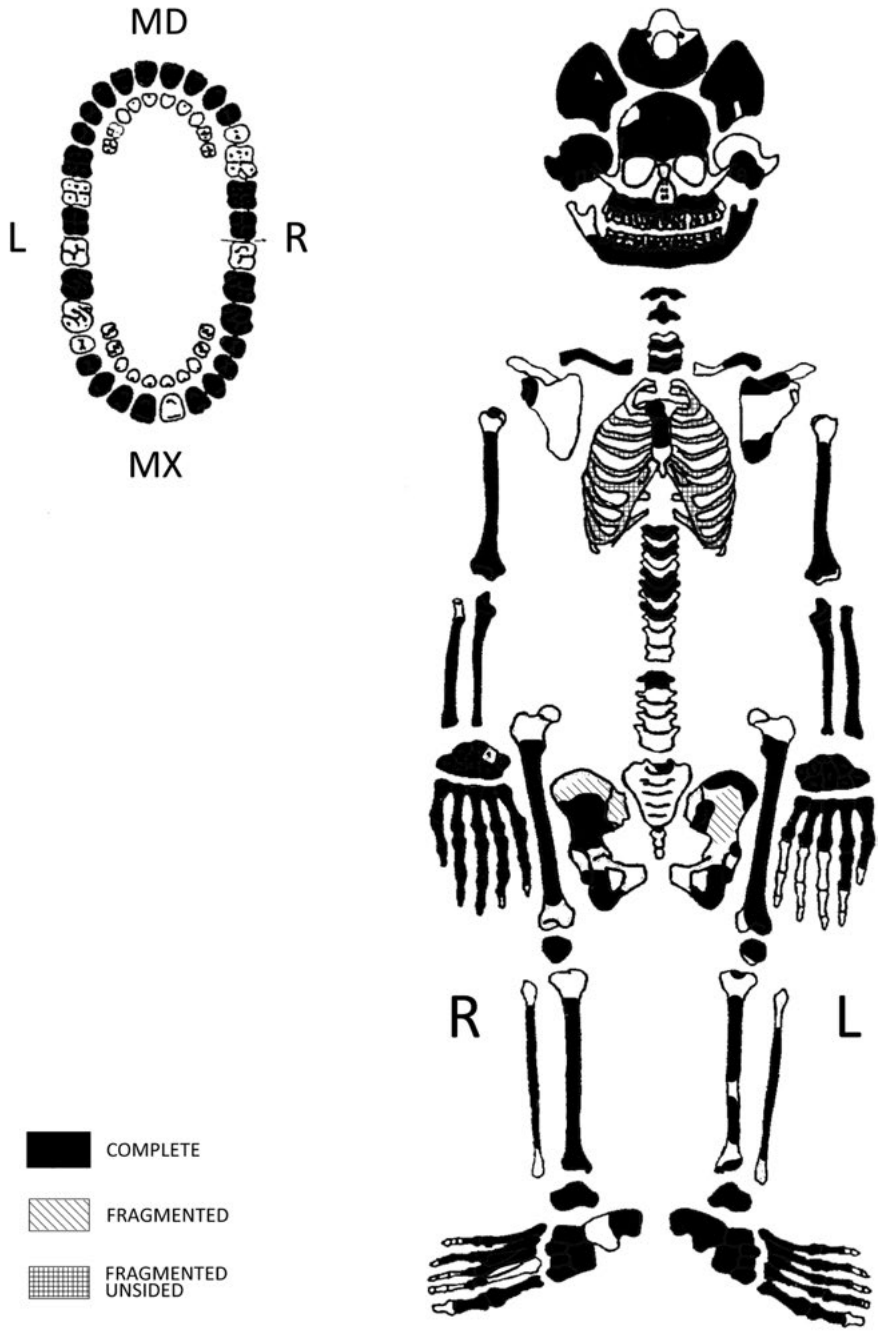


Figure 78

Sex: female
Sex was determined through the analysis of thirteen morphological features of the skull and three of the pelvis, which provided a total sexual index of -0.1.

Age: 40-45 years
Age at death was determined on the basis of dental wear, morphology of the auricular surface of the ilium, and sternal rib end modifications.

Stature: 154.4 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the first right incisor, which was lost post-mortem, and the second right premolar and first right molar, which were lost during life; there is agenesis of the third molars.
The mandibular teeth are preserves in situ, except for the right second premolar and first molar, and the left second molar, which were lost during life; the left first molar and the right first molar are preserved as root.
Alveolar resorption of grade 2 affects both the maxilla and the mandible.
Several caries were observed in the maxillary teeth: one distal caries of grade 1 on the left canine at the cemento-enamel junction, one occlusal caries of grade 1 and one mesial caries of grade 1 at the cemento-enamel junction on the left first premolar, one occlusal caries of grade 1 on the left second molar, one medial caries of grade 1 on the right first molar. On the mandibular teeth there

are: one grade 4 caries on the left first molar and one on the right second molar, and one medial caries of grade 3 on the left third molar at the cemento-enamel junction. Enamel hypoplasia occurred between 2 and 4 years, with six episodes.

Anatomical variants
In the skull the zygomatic foramen and the parietal foramen on the right, and two zygomatic foramina on the right are present. In the post-cranial skeleton there are the vastus notch of the right patella, the accessory facet on the distal epiphyses of the right tibia and the anterior double facets of both calcanei.

Ergonomy
The individual shows a low/medium development of several muscular insertions, except for the trapezoid ligament of the left clavicle, the latissimus dorsi/teres major and left deltoid and the brachioradialis of the humeri, the supinator of the right ulna and the soleus of the right tibia, which show a strong development. The deltoid and conoid ligament of both clavicles, the trapezoid ligament of the right clavicle, the gluteus maximus of both femurs, the patellar ligament of both tibiae and the Achilles tendon of the right calcaneus show a very strong development. An osteophytic enthesopathy of grade 1 is observable at the level of the Achilles' tendon of the left calcaneus.

Pathologies
Diffuse grade 1 periosteal reaction affects both femurs, tibiae and fibulae. Osteoarthritis of grade 1 affects the bodies of the thoracic and lumbar vertebrae. Schmorl's nodes are present on two out of nine observable thoracic vertebrae.

SU 2294

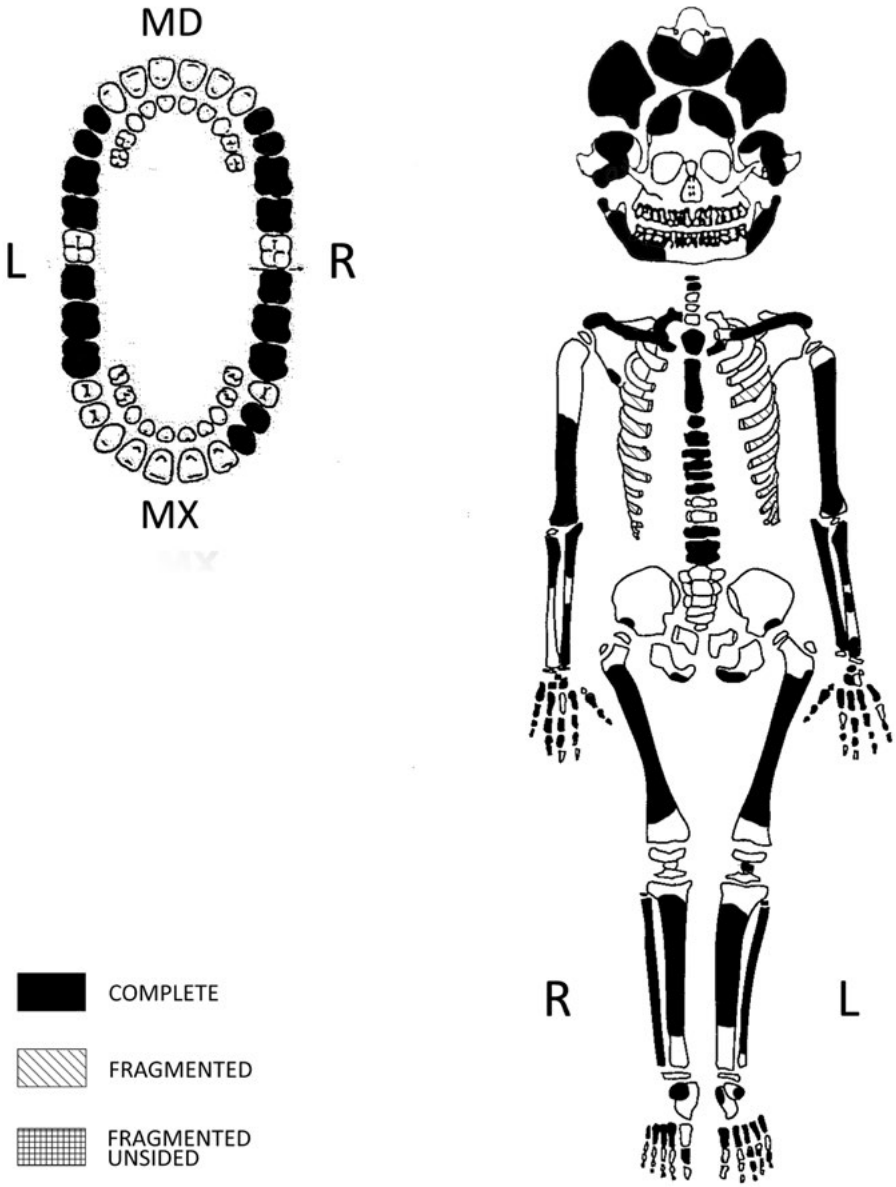


Figure 79

Sex: undeterminable

Age: 15-17 years
Age at death was determined on the basis of dental eruption and degree of fusion between diaphyses and epiphyses.

Dental pathologies
The maxillary teeth are preserved and isolated, except for the incisors, left canine, premolars, and right second premolar, which were lost post-mortem. The third molars are preserved as germ. The mandibular teeth are preserved isolated, except for the right molars, which are in situ, and the incisors and canines, which were lost post-mortem.
Only the right maxillary canine permitted to observe enamel hypoplasia, which occurred between 4 and 5 years, with two episodes.

Anatomical variants
None observed.

Pathologies
Enlarged vascular foramina are visible on the bodies of the thoracic vertebrae.

SU 2295

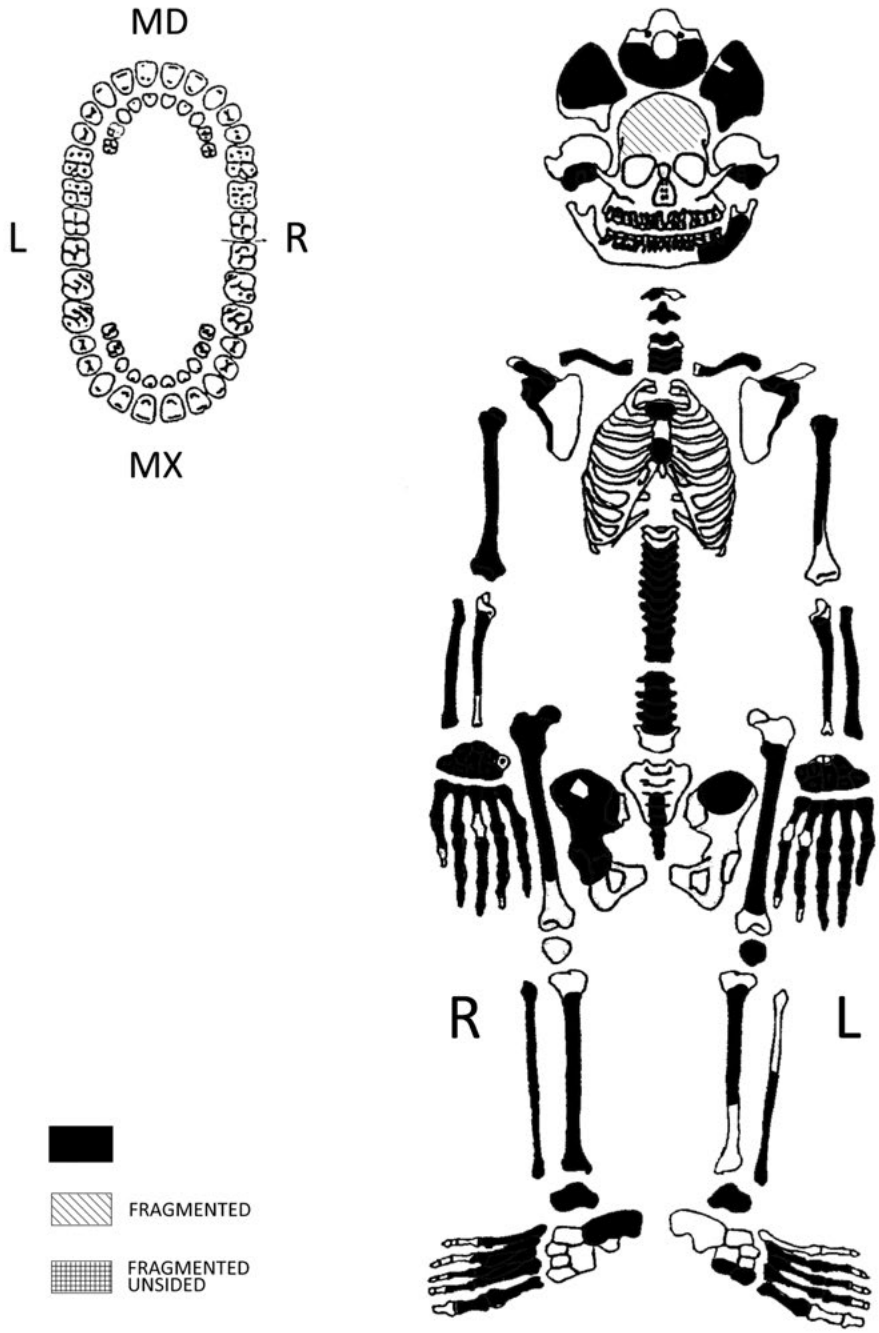


Figure 80

Sex: female
Sex was determined through the analysis of seven morphological features of the skull and seven of the pelvis, which provided a total sexual index of -1.

Age: 40-50 years
Age at death was determined on the basis of morphology of the auricular surface of the ilium and sternal rib end modifications.

Stature: 143.0 cm

Dental pathologies
The maxilla is entirely missing, whereas only the left angle of the mandible is preserved. No teeth are preserved. This fragment shows that the three molars were lost during life.

Anatomical variants
In the skull the left parietal foramen and the right mastoid extrasutural foramen are present. In the postcranial skeleton the complete transverse accessory foramen on the right side of C7 and the supraglenoid facet on both scapula are observed.

Ergonomy
The individual shows a low/medium development of muscular insertions, except for the deltoid and costoclavicular ligament of the right clavicles, the conoid and trapezoid ligament of both clavicles and the Achilles' tendons of the right calcaneus, which show a strong development. The interosseous tubercle of the radius shows a very strong development on the right and an enthesopathy of grade 1 on the left.

Pathologies
Osteoarthritis of grade 1 affects all the vertebrae (of grade 2 on C7), the clavicular notches of the sternum, the head of both humeri, and the facet for the calcaneus of the left talus. Diffuse grade 1 periosteal reaction is visible on the femurs and the left tibia.

SU 2296

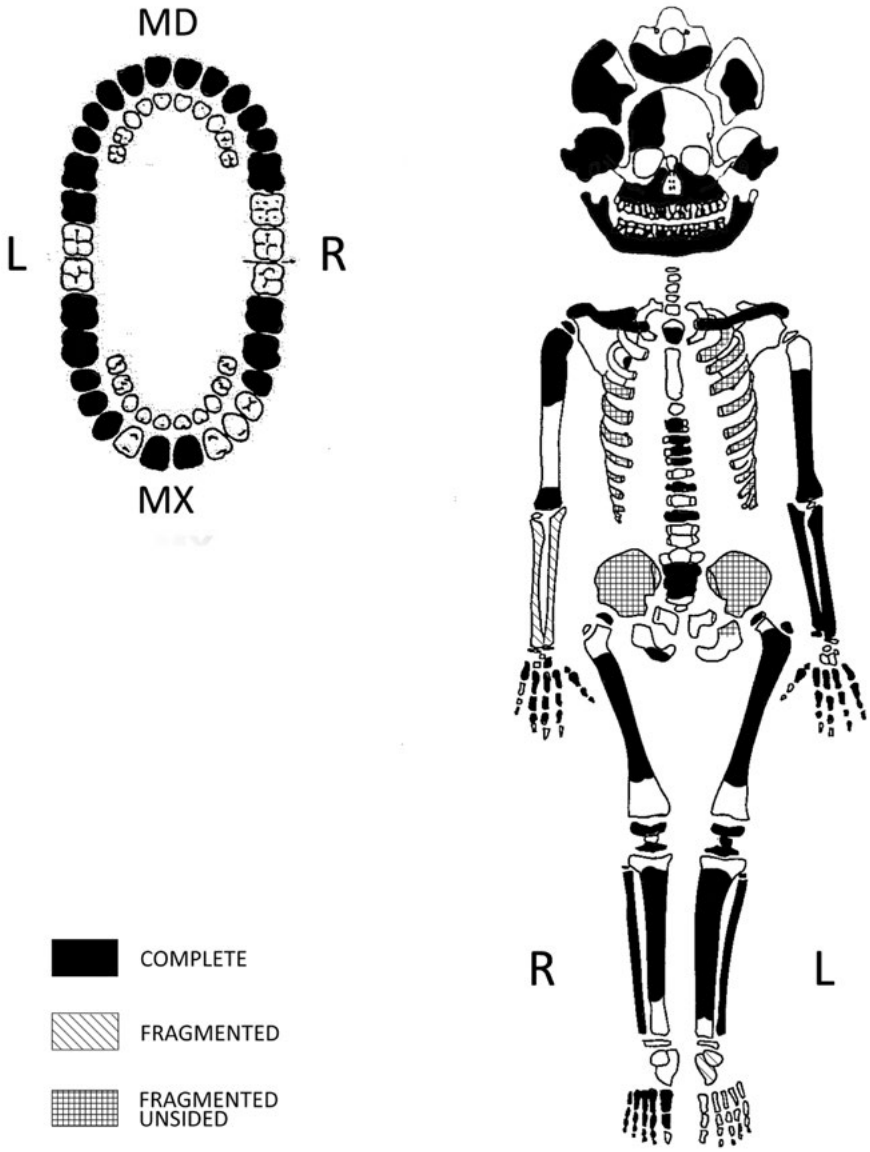


Figure 81

Sex: undeterminable

Age: 14-15 years
Age at death was determined on the basis of the sternal rib end modifications, dental eruption, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
All maxillary and mandibular teeth are in situ, except for the maxillary second incisors and right canine, which were lost post-mortem. All third molars are in form of germ.
An occlusal caries of grade 1 is present on the mandibular left second molar.
Enamel hypoplasia occurred between 2 and 4.5 years, with six episodes.

Anatomical variants
In the skull two infraorbital foramina and a zygomatic foramen on the left side are present; in the postcranial skeleton a small septal aperture on the left humerus is observed.

Pathologies
Diffuse grade 1 periosteal reaction is observed on the femurs. Osteolythic lesions are visible on the ventral side of the sacrum.

SU 2297

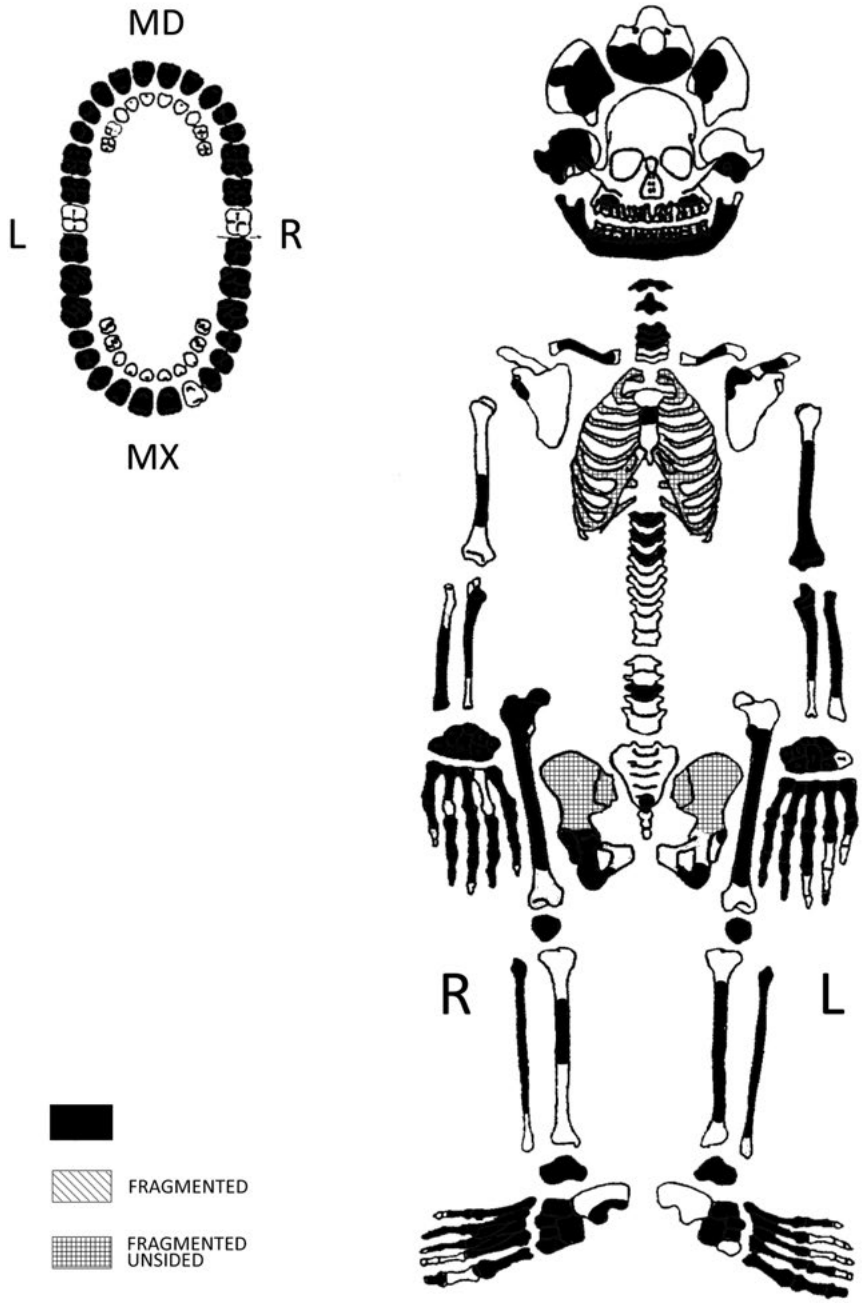


Figure 82

Sex: female
Sex was determined through the analysis of nine morphological features of the skull, which provided a sexual index of -0.2.

Age: 18-22 years
Age at death was determined on the basis of dental wear, morphology of the pubic symphysis, and sternal rib end modifications.

Stature: not determinable

Dental pathologies
The maxillary teeth are preserved isolated, except for the left premolars and right and left first and second molars, which are in situ, and the right second incisor, which is missing. The mandible preserves all teeth in situ, except for the third left molar, which was lost post-mortem. There is agenesis of the third right molar.
Alveolar resorption of grade 1 affects both the maxilla and the mandible.
Mild calculus is present on the maxillary and the mandibular teeth.
An occlusal caries of grade 1 is present on the mandibular second left molar.
Enamel hypoplasia occurred between 3 years and a half and 6 years, with five episodes.

Anatomical variants
In the skull the right parietal foramen and in the postcranial skeleton the Poirier's facet on the right femur are present.

Ergonomy
The individual shows a low development of muscular insertions.

Pathologies
Diffuse grade 1 periosteal reaction is observed on the left femur. A probable muscular trauma in form of enthesopathy is visible on the diaphysis of the left femur.

Trench 9

SU 2298

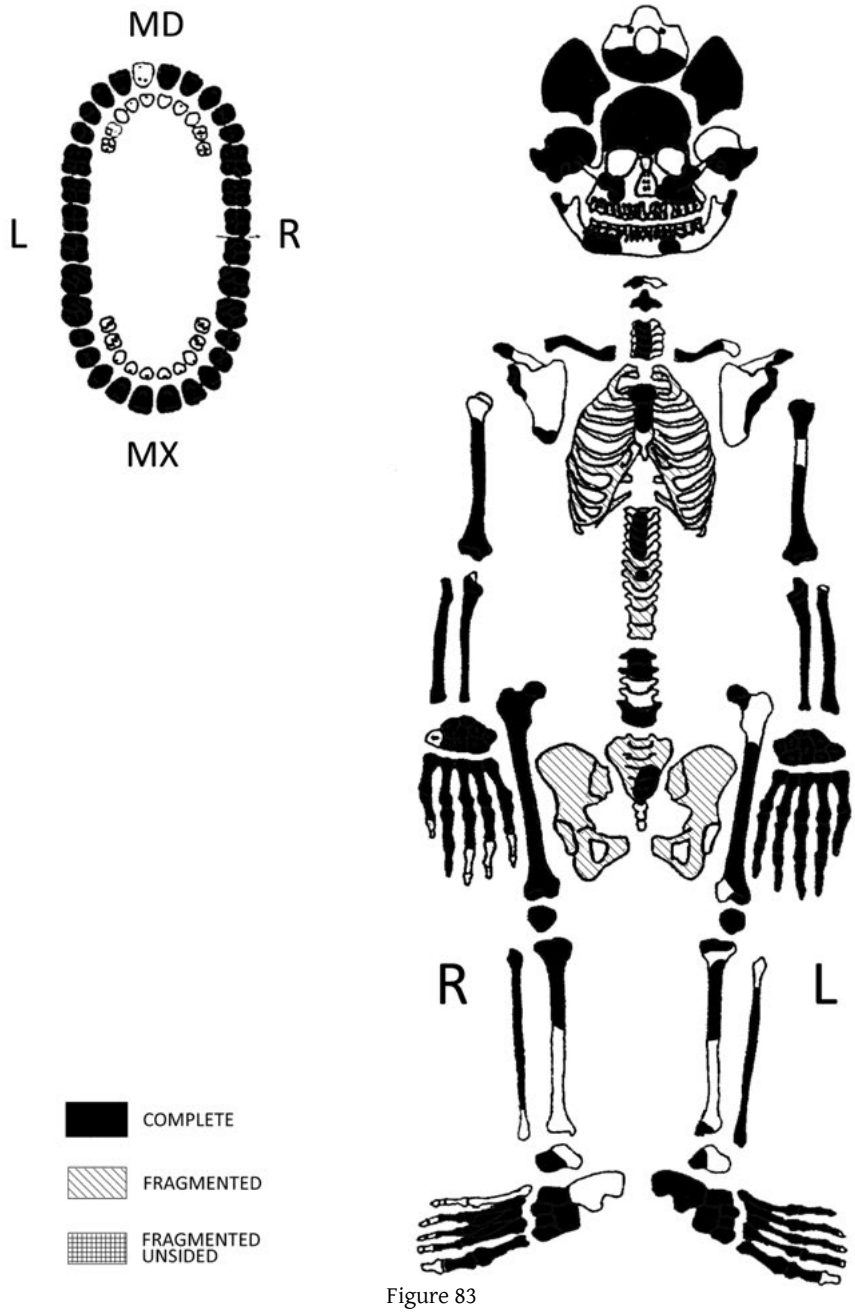


Figure 83

Sex: female
Sex was determined through the analysis of thirteen morphological features of the skull, which provided a sexual index of -0.7.

Age: 20-24 years
Age at death was determined on the basis of dental wear, morphology of the pubic symphysis, sternal rib end modifications, and vertebral stage of fusion.

Stature: 153.7 cm

Dental pathologies
The maxillary teeth are all preserved and in situ, except for the right incisors and molars, which are isolated. The mandibular teeth are all preserved and in situ, except for the left first incisor and molars, which are isolated, and the second incisor, which was lost post-mortem.
A grade 1 occlusal caries affects the mandibular left second molar.
Enamel hypoplasia occurred between 2.5 and 5 years, with five episodes.
The maxillary canines are rotated.
Alveolar resorption of grade 1 affects the maxilla.

Anatomical variants
In the postcranial skeleton the transverse accessory foramen complete on the right of C6 and the septal aperture of both humeri are present.

Ergonomy
The individual shows a low-medium development of the muscular insertions.

Pathologies
Diffuse grade 1 periosteal reaction is present on femurs, tibiae and fibulae. Mild osteophytosis affects the margin of the acoustic meatus on both sides. Schmorl's nodes are present on two cervical, two thoracic and one lumbar vertebrae. The second and third phalanges of the fifth finger of the left foot are fused.

SU 2299

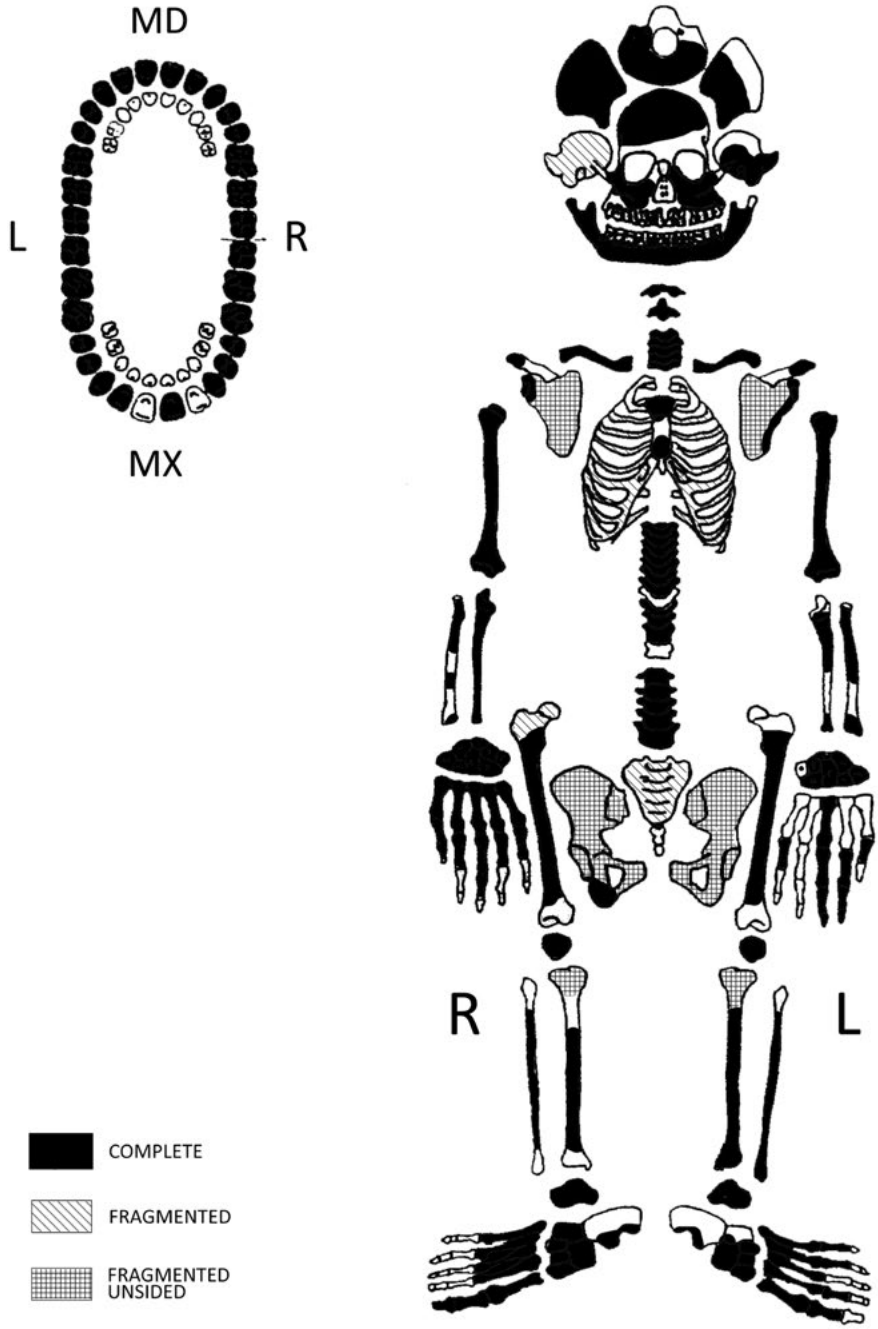


Figure 84

Sex: undeterminable

Stature: 164.3

Age: 15-18 years
Age at death was determined on the basis of dental eruption, stage of fusion between diaphyses and epiphyses, sternal rib end modifications, and vertebral stage of fusion.

Dental pathologies
The maxillary teeth are preserved isolated, except for the left premolars and right first molar, which are in situ, and the left first incisor and right second incisor, which were lost post-mortem.

The mandibular teeth are all present and in situ, except for the second molars, which are isolated.
Alveolar resorption of grade 1 affects both maxilla and mandible.
In the maxillary teeth, one grade 3 buccal caries affects the left first molar, one grade 3 distal caries the left and right second molar, and one grade 2 buccal caries affects the right first molar; in the mandibular teeth one grade 3 distal caries is visible on the left first molar.
Mild calculus is present on the maxillary and the mandibular teeth.
Enamel hypoplasia occurred between 1.5 and 4.5 years, with five episodes.

Anatomical variants
In the skull the infraorbitary suture on both sides, a zygomatic foramen on the right and multiple foramina on the left, and the extrasutural mastoid foramen on the left are present. In the postcranial skeleton the double facet on the atlas on both sides, the transverse accessory foramen complete on the right of C5, partial on the right of C6 and C7, are visible.

Pathologies
Diffuse grade 1 periosteal reaction is present on the femurs and localised on the superior third of the diaphysis. Mild osteophytosis of the external acoustic meatus is present on the left. Schmorl's nodes affect five thoracic and one lumbar vertebrae.

SU 2300

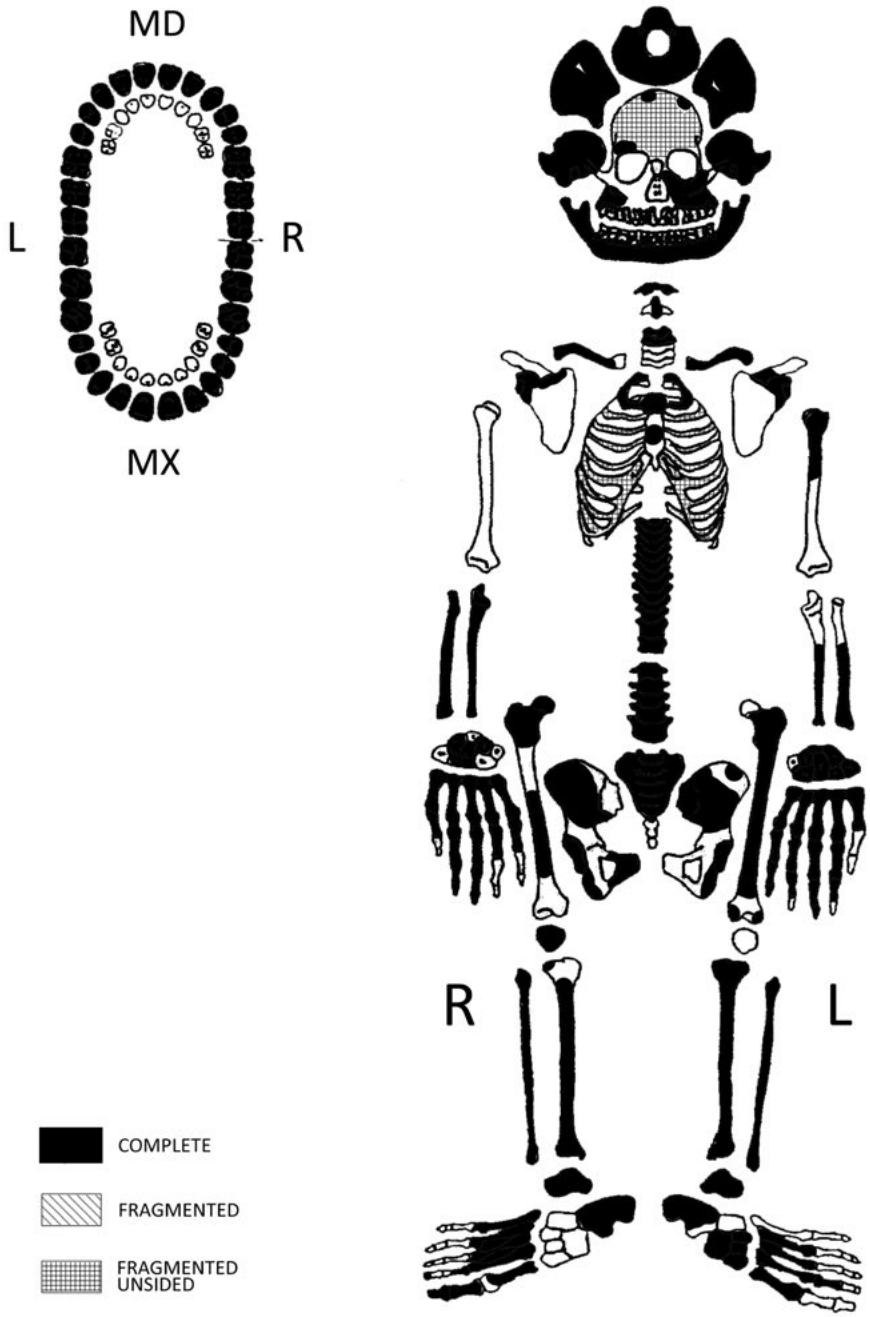


Figure 85

Sex: male
Sex was determined through the analysis of ten morphological features of the skull and three of the pelvis, which provided a total sexual index of 0.5.

Age: 25-30 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, morphology of the pubic symphysis, and auricular surface of the ilium.

Stature: 147.6 cm

Dental pathologies
The maxilla preserves all teeth in situ, except for the right canine, first and second incisor and right left first incisor, which are isolated. The mandible preserves all teeth in situ. The third left mandibular molar is in eruption.
Mild calculus affects the maxillary teeth and strong the mandibular teeth.
There are an occlusal caries of grade 1 on the mandibular second left molar and on the maxillary and mandibular right third molar. Enamel hypoplasia occurred between 1.5 and 4 years, with four episodes.
There are malpositions on the mandibular teeth: the first and second left incisors are affected by crowding, the third left molar and right canine are rotated.

Anatomical variants
In the skull a zygomatic foramen on the left, multiple zygomatic foramina on the right and the mastoid extrasutural foramen on the left are present. In the postcranial skeleton the accessory facets on the distal epiphyses of both tibiae and the anterior double facet on both calcanei are present.

Ergonomy
The individual shows a general low development of muscular insertions, except for the pectoralis major of the left clavicle and the brachioradialis of the right humerus, which show a strong development.

Pathologies
There is a thickening of the left parietal bone, but there are no cribra cranii.
Diffuse grade 1 periosteal reaction is visible on both femurs and tibiae. A Schmorl's node is present on one out of five lumbar vertebrae.

SU 2301

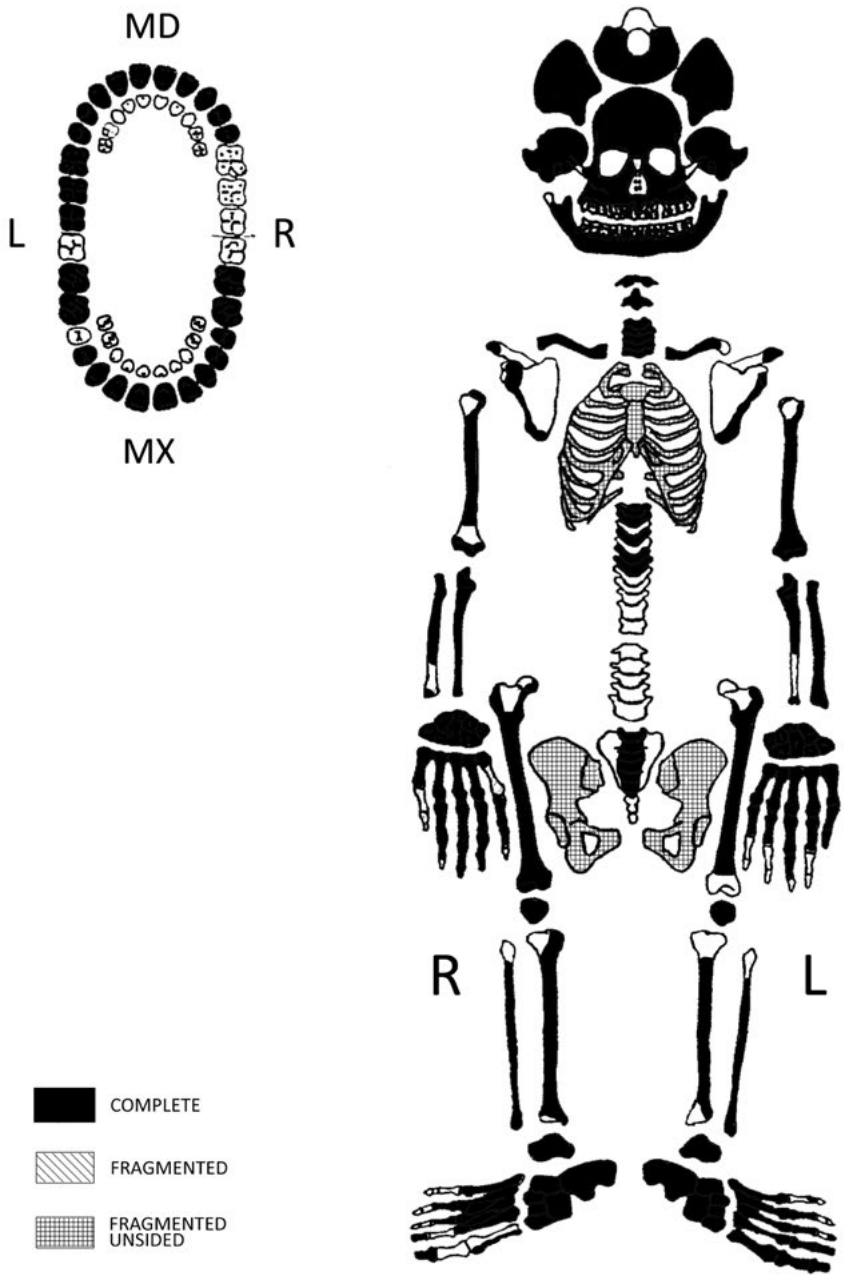


Figure 86

Sex: male
Sex was determined through the analysis of nineteen morphological features of the skull and one of the pelvis, which provided a total sexual index of 0.8.

Age: 40-50 years
Age at death was determined on the basis of sternal rib end modifications. Dental wear provided an age of about 35-40 years, but is probably distorted by the lack of mandibular molars.

Stature: 165.4 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the right second premolar, which was lost during life, and the left second premolar, which was lost post-mortem. The mandibular teeth are preserved in situ, except the left molars, which were lost during life. The right molars are preserved as root.
Alveolar resorption of grade 2 affects both the maxilla and the mandible.
Mild calculus is present on the maxillary and mandibular teeth.
Enamel hypoplasia occurred between 3.5 and 4 years, with two episodes.
In the maxilla there is the presence of only one mesial caries of grade 1 at the cemento-enamel junction on the first left premolar. In the mandibular teeth, the three left molars, of which only the root remains, have caries of grade 4; on the right side there is one mesial caries of grade 2 at the cemento-enamel junction on the second

premolar; on the same side, at the level of the three molars, lost intra vitam, there is a large abscessual cavity. The mandibular right second premolar is 90° rotated. A marked extramasticatory wear is observed on the anterior teeth, especially the maxillary.

Anatomical variants
In the skull the complete infraorbital suture bilaterally, a zygomatic foramen on the right and two in the left are present. In the post-cranial skeleton there are the Allen fossa of the right femur, the double anterior facet of both calcanei and the accessory facet on the neck of the right talus.

Ergonomy
The individual shows a general medium development of muscular insertions, except for the triceps brachii of the right scapula, the brachioradialis of the left humerus, the brachialis of the right ulna, the supinator of the left ulna, the gluteus maximus of the femurs, and the Achilles' tendon of the calcanei, which show a strong development.

Pathologies
A right elbow fracture, affecting the distal epiphysis of the humerus and the proximal epiphysis of radius and ulna, was observed. Localised grade 2 periosteal reaction affects the lower third of the diaphysis, medial side, of the right tibia and half of the diaphysis of the right fibula. The facet for the cuboid of the left calcaneus present a bony spur, which is probably due to a microtrauma. Osteoarthritis of grade 1 affects the joints of the clavicles, the distal articular surface of the humeri, both the articular surfaces of the radii and the proximal joint of the ulnae; osteoarthritis of grade 2 affects the distal articular surface of the right humerus, and the proximal articular surface of the right radius and ulna.

SU 2307

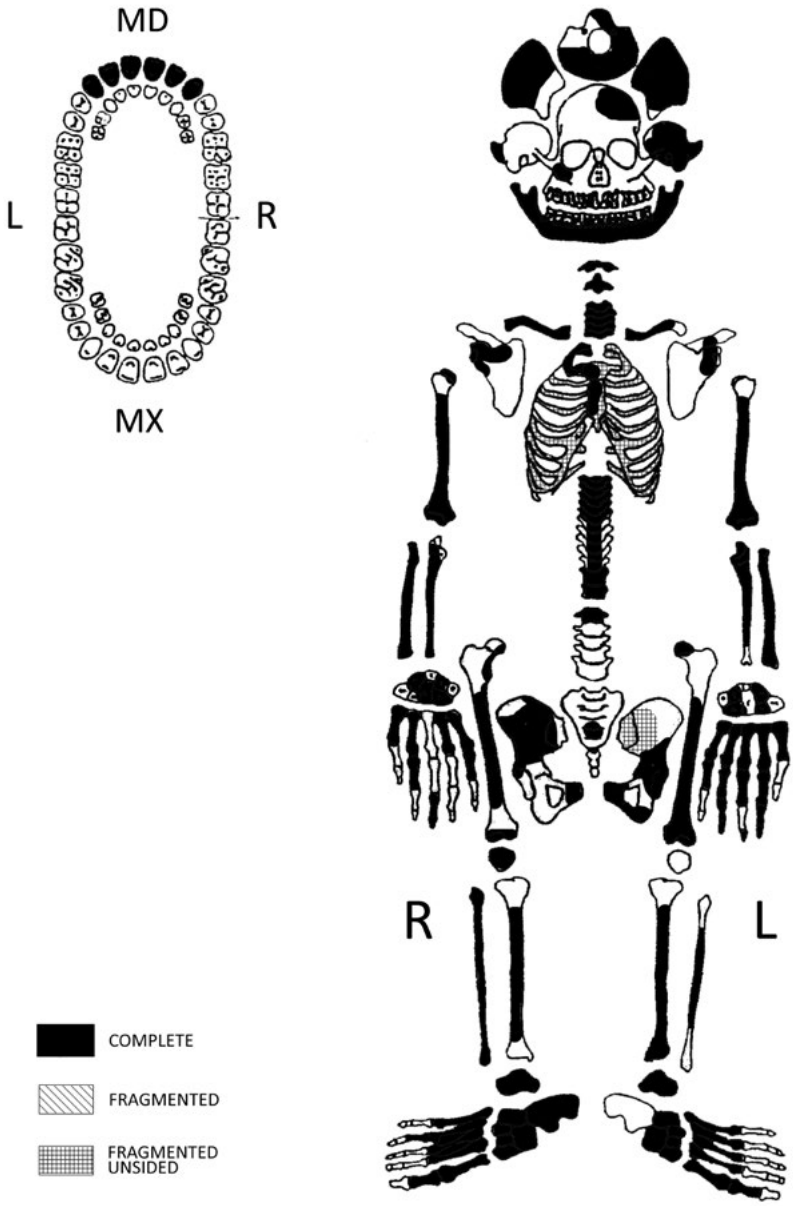


Figure 87

Sex: female
Sex was determined through the analysis of ten morphological features of the skull and two of the pelvis, which provided a total sexual index of -0.7.

Age: 40-45 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, and morphology of the pubic symphysis.

Stature: 149.0 cm

Dental pathologies
No maxillary teeth are preserved. The mandibular teeth are preserved in situ, except for the right first premolar, second premolars and molars, which were lost during life, and the left first premolar, which was lost post-mortem.
The mandibular right canine is rotated.
Alveolar resorption of grade 1 affects the mandible.
Mild calculus is present on the mandibular teeth.
Enamel hypoplasia occurred between 2 years and 4.5 years, with five episodes.
Several caries were observed, all at the cemento-enamel junction: one mesial caries of grade 1 is present on the left first incisor, one distal caries of grade 1 on the right first incisor, one distal caries of grade 3 on the right second incisor, and one mesial grade 2 caries on the right canine.

Anatomical variants
In the skull the left parietal foramen and zygomatic foramina on the right are present. In the post-cranial skeleton the supraglenoid facet of the right scapula, the accessory facet on the distal epiphysis of the left tibia and the double anterior facet of the right calcaneus are visible.

Ergonomy
The individual shows a general medium development of muscular insertions, except for the deltoid, the conoid ligament, the right trapezoid ligament of the clavicles, the triceps brachii of the right scapula, the interosseous tubercle of the right radius, the left brachialis and the supinator of the ulnae, the right ileopsoas and the gluteus maximus of the femurs, which show a strong development. The interosseous tubercle of the left radius shows a very strong development.

Pathologies
An oblong healed blunt force trauma of 2 cm is visible on the left frontal bone. A Schmorl's node affect T12. Osteoarthritis of grade 1 affects the sternal end of both clavicles, the acromial end of the right clavicle, the acromial facet and the glenoid cavity of the right scapula, the clavicular incisure of the sternum, the distal joint of the right humerus, both joints of the right radius, the proximal joint of both ulnae, the acetabular cavity of the left coxal bone, the distal joint of the left femur, the posterior facet of the right patella and the distal joint of both first metatarsals.

SU 2308

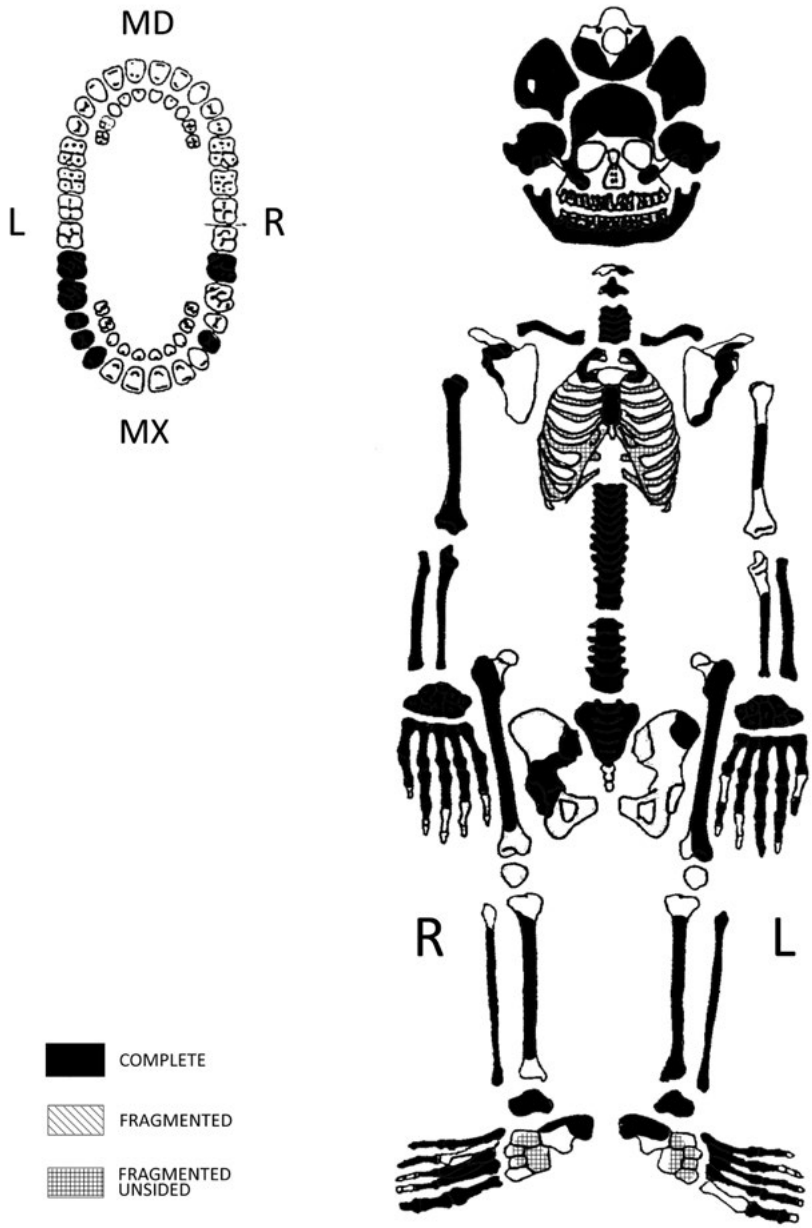


Figure 88

Sex: female
Sex was determined through the analysis of ten morphological features of the skull and six of the pelvis, which provided a total sexual index of -0.8.

Age: 30-40 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, and morphology of the auricular surface of the ilium.

Stature: 164.9 cm

Dental pathologies
The maxillary teeth are preserved and isolated, except for the incisors, right canine, second premolar, first and third molar, left third molar, which were lost after death.
The mandible is completely edentulous.
Enamel hypoplasia was detected only on the left canine, and occurred between 2.5 and 5 years.
There are one mesial grade 3 caries at the cemento-enamel junction on the left first molar and one mesial grade 2 caries at the cemento-enamel junction on the right second molar.
Strong calculus affected the maxillary teeth.

Anatomical variants
In the skull multiple zygomatic foramina on the right and one zygomatic foramen on the left, and the extrasutural mastoid foramen of the right temporal bone are present. In the post-cranial skeleton the right complete accessory transverse foramen on C5 and bilaterally on C6, the sacralization of L5 on the left side, the accessory facet on the distal epiphysis of the left

tibia and the double anterior facet on the left calcaneus are present.

Ergonomy
The individual shows a low-medium development of the muscular attachments, except for the triceps brachii of the left scapula, which showed a strong development.

Pathologies
On both orbital roofs cribra orbitalia of grade 1 are detected.
Diffuse grade 1 periosteal reaction is present on femurs, tibiae and fibulae; localised grade 4 periosteal reaction is visible on the proximal metaphysis of the left tibia, which shows thickening of probable traumatic origin (bone callus).
Thoracic and lumbar vertebrae are affected by grade 1 osteoarthritis; a Schmorl's node is visible on T6.

SU 2309

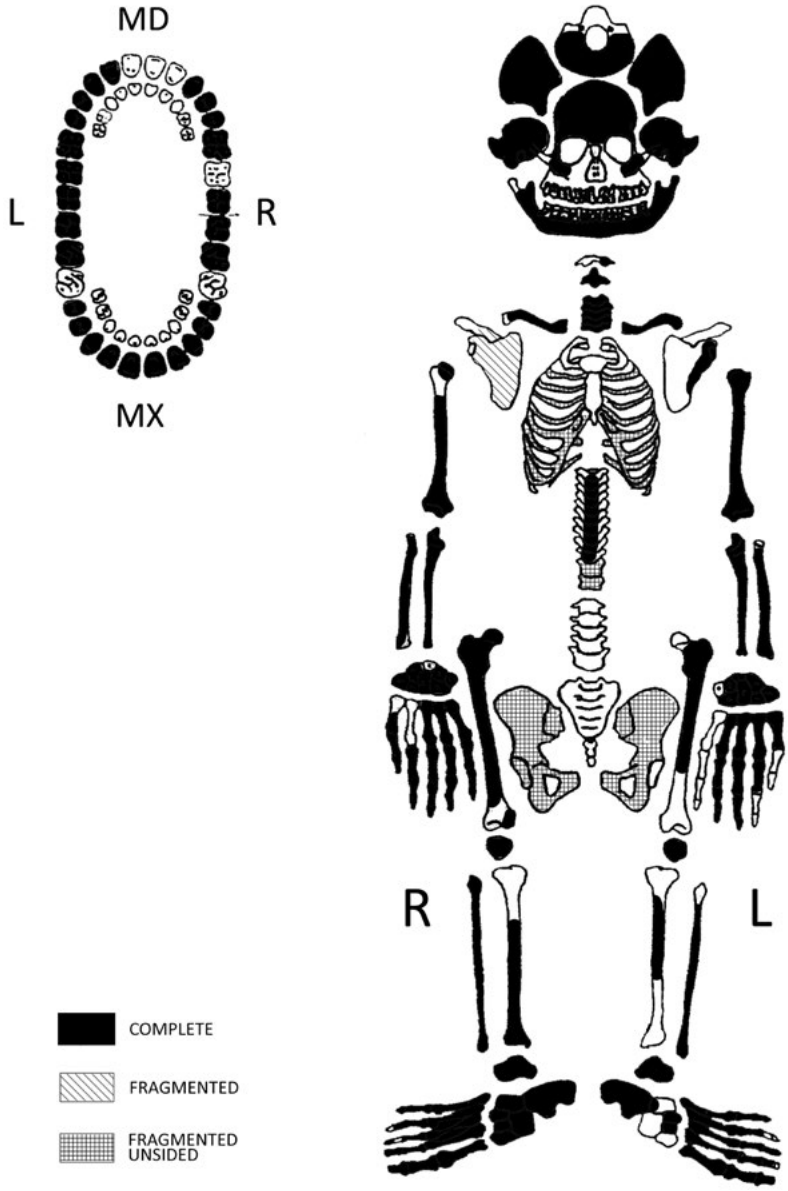


Figure 89

Sex: male
Sex was determined through the analysis of eleven morphological features of the skull and one of the pelvis, which provided a total sexual index of 1.5.

Age: 30-40 years
Age at death was determined on the basis of dental wear, morphology of the auricular surface of the ilium, sternal rib end modifications, and vertebral stage of fusion.

Stature: 168.3 cm

Dental pathologies
All maxillary teeth are present and in situ, except for the first molars, which were lost during life. All the

mandibular teeth are preserved and in situ, except for the first incisors and second right incisor, which were lost post-mortem, and the right second molar, which was lost during life.
Several caries are present. In the maxillary teeth, one grade 3 mesial caries is present on the right second premolar, second molar, left third molar; one grade 3 distal caries is on the left canine and second molar; one grade 4 caries affects the left first premolar. In the mandibular teeth, one grade 1 distal caries is on the right second premolar at the cemento-enamel junction, one grade 3 mesial and one grade 1 distal both at the cemento-enamel junction on the right first molar, and one grade 1 occlusal on the right third molar.
Enamel hypoplasia occurred between 3 and 4 years, with two episodes.
Alveolar resorption of grade 2 affects the maxilla and the mandible.
Mild calculus affects the maxillary teeth and strong calculus the mandibular teeth.

Anatomical variants
In the skull the parietal foramina on both sides, some lambdoid ossicles on the left, and the extrasutural mastoid foramen on both sides are present. In the postcranial skeleton the throclear extension on both talii is visible.

Ergonomy
The individual shows a low-medium development of the muscular insertions, except for the biceps brachii of the radii, which shows a strong development, and the costo-clavicolar ligament and the pectoralis major of the clavicles, which show a very strong development.

Pathologies
Cribra orbitalia are present on the left orbit, cribra cranii on the parietal, frontal and occipital bones. Diffuse grade 1 periosteal reaction is visible on the femurs; Schmorl's nodes affect three thoracic and two lumbar vertebrae. C2 and C3 are fused through the body and posterior arch.

SU 2310

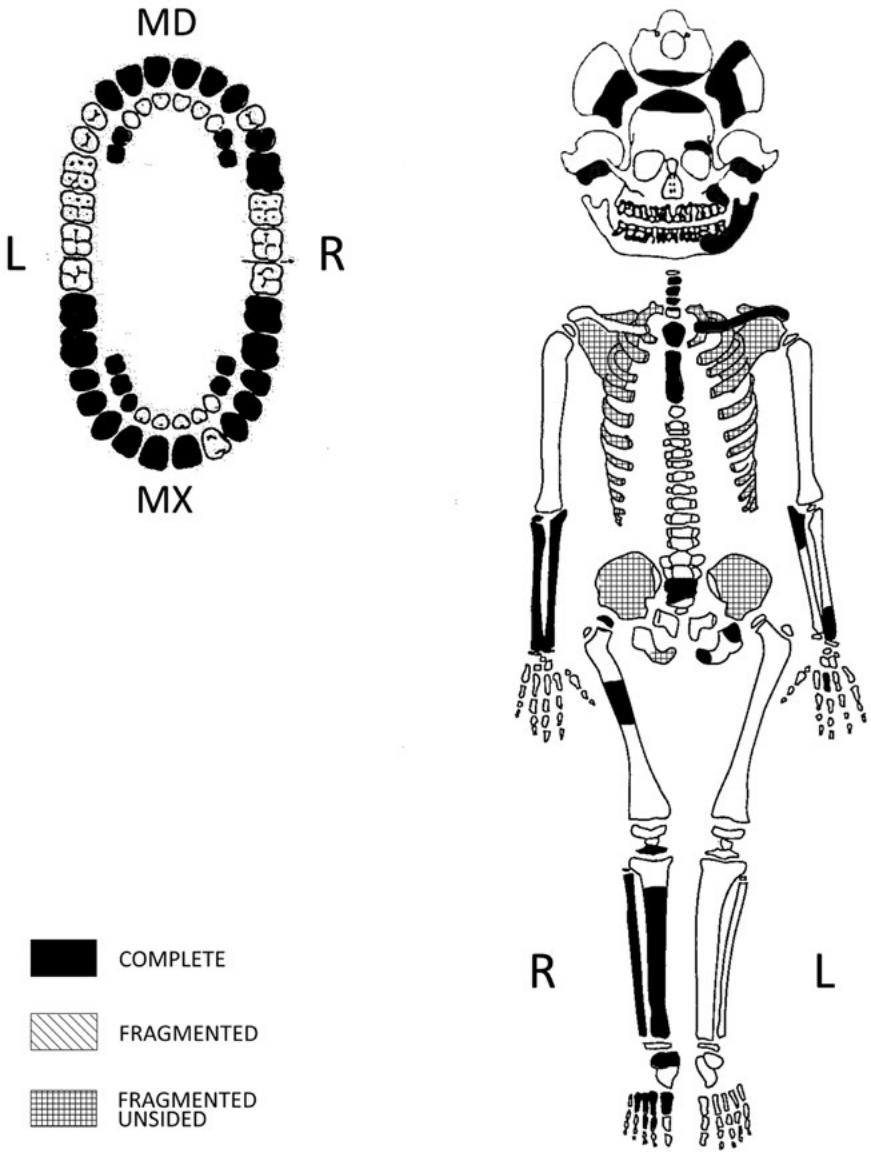


Figure 90

Sex: undeterminable

Age: 8-9 years
Age at death was determined on the basis of long bone length and stage of dental eruption.

Dental pathologies
The maxillary teeth are preserved and isolated, except for the left incisors, canine, and premolars, which are in situ; the second incisor, canines, premolars and first molars are in form of germ. Deciduous maxillary left canine and molars are in situ, right molars are isolated. Mandibular teeth are preserved and isolated, except for the left canine and first molar, which are in situ; the right canine and second premolar are in form of germ; deciduous left molars are in situ, right molars are isolated.
Enamel hypoplasia occurred between 1.5 and 4 years, with five episodes.

Anatomical variants
In the skull the parietal foramen on the left, two sagittal ossicles, three lambdoid ossicles on the right and three on the left are observed. In the post-cranial skeleton a partial accessory transverse foramen on the left of C6 is present.

Pathologies
Cribra orbitalia of grade 1 are present on the left orbital roof.

SU 2311

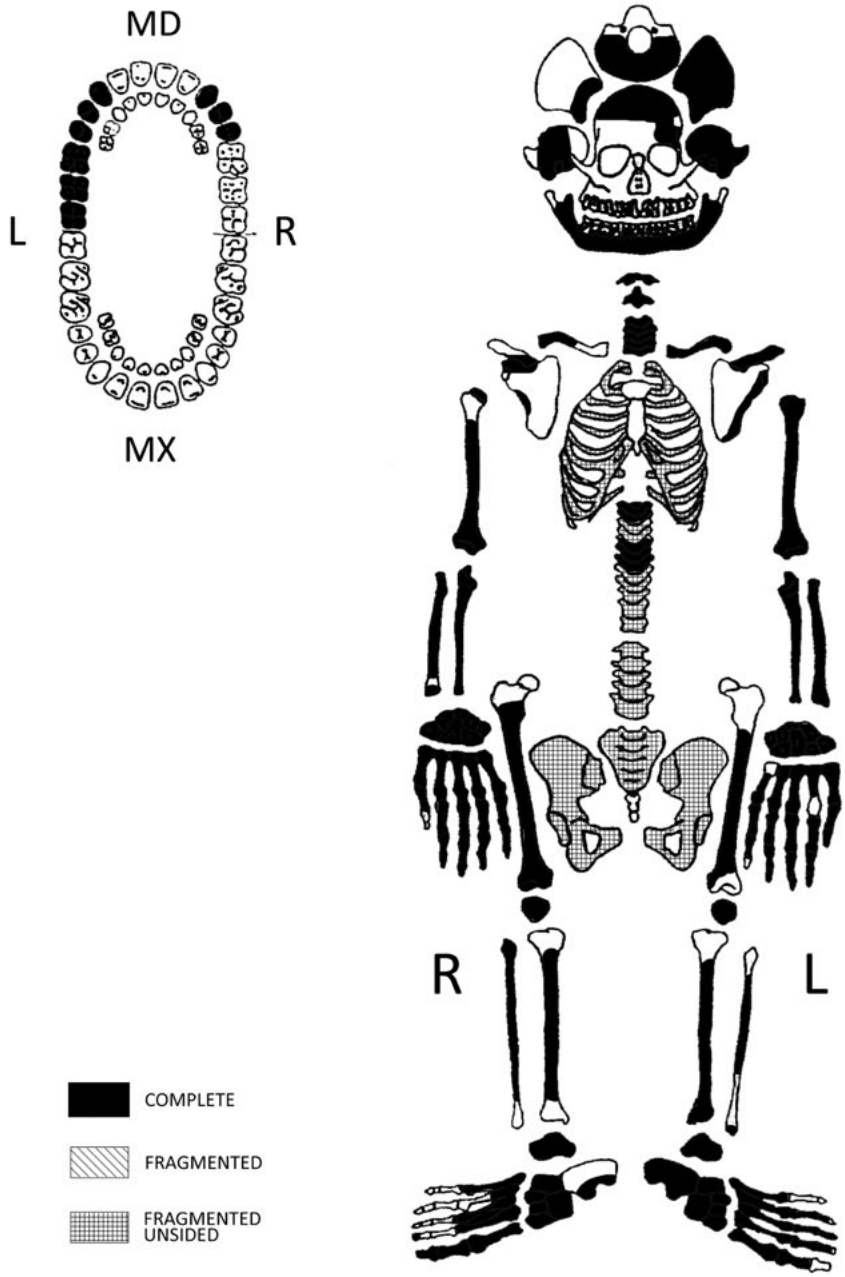


Figure 91

Sex: male
Sex was determined through the analysis of seventeen morphological features of the skull and one of the pelvis, which provided a total sexual index of 0.7.

Age: 30-40 years
Age at death was determined on the basis of sternal rib end modifications and dental wear.

Stature: 163.1 cm

Dental pathologies
The maxillary teeth were lost during life, except for the left molars, which were lost post-mortem. The mandibular teeth are preserved in situ, except for the incisors and right molars, which were lost during life.
Alveolar resorption of grade 3 affects the mandible.
Enamel hypoplasia occurred between 2.5 and 4 years, with three episodes.
The presence of an apical abscess at the level of the maxillary right first premolar is observed. In the mandibular teeth, some caries have been identified: one grade 3 mesial caries at the cemento-enamel junction on the left second premolar; one grade 1 occlusal caries on the left third molar and one of grade 2 mesial at the cemento-enamel junction on the right first premolar. There is also the rotation of the mandibular left third molar.
Strong calculus affects the mandibular teeth.

Anatomical variants
In the skull the parietal foramina on both sides are present. In the post-cranial skeleton the accessory transverse foramen in C6, the bipartite acromion of the left scapula, the vastus notch of both patellae, the accessory facet on the distal epiphysis of the left tibia, the double anterior facet of both calcanei and the accessory facet on the neck of the talii are present.

Ergonomy
The individual shows a general strong development of muscular insertions, except for the pectoralis major of the right humerus, the brachioradialis of both humeri and the biceps brachii in the right radius, the gluteus maximus of both femurs and the Achilles' tendon of the left calcaneus, which show a very strong development. An osteophytic entesopathy of grade 2 is present at the biceps brachii of the left radius.

Pathologies
Diffuse grade 1 periosteal reaction affects the right tibia and grade 2 affects the left tibia. A healed rib fracture and crushed vertebral bodies from C5 to C7 have also been identified.
Osteoarthritis of grade 1 is present on both sternal and acromial joints of the right clavicle, on the joint surfaces of both humerii, radii and ulnae, on the articular surface for cuboid of the right talus and on the distal articular surface of the first metatarsals. Osteoarthritis of grade 2 is present on the acromial facet of the left clavicle and on the distal joint of the right ulna. The preserved vertebrae show a marginal lipping that varies from grade 1 to grade 2.

SU 2312

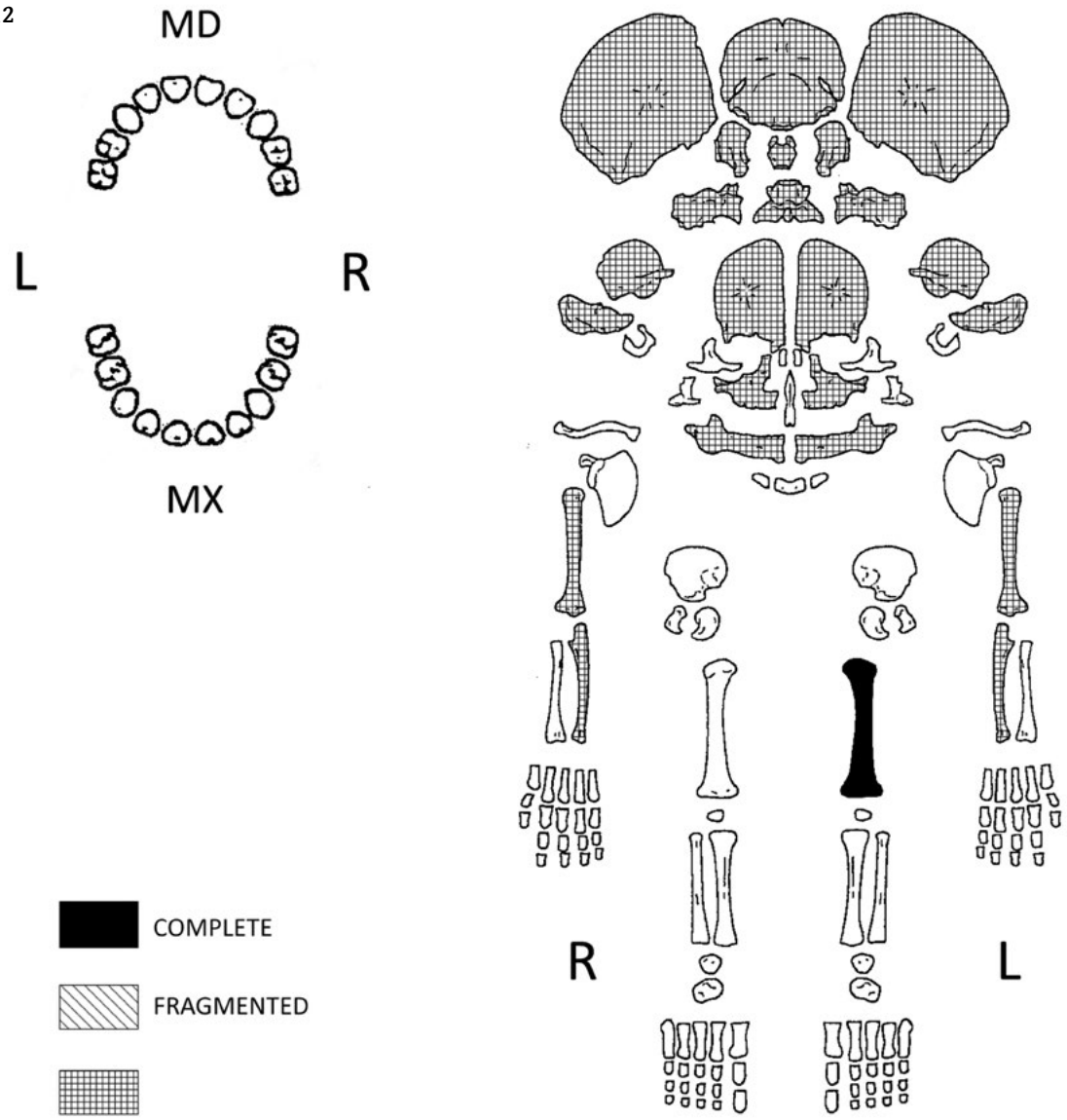


Figure 92

Sex: undeterminable

Age: 9-12 months
Age at death was determined on the basis of length of the left femur.

Trench 10

SU 2513

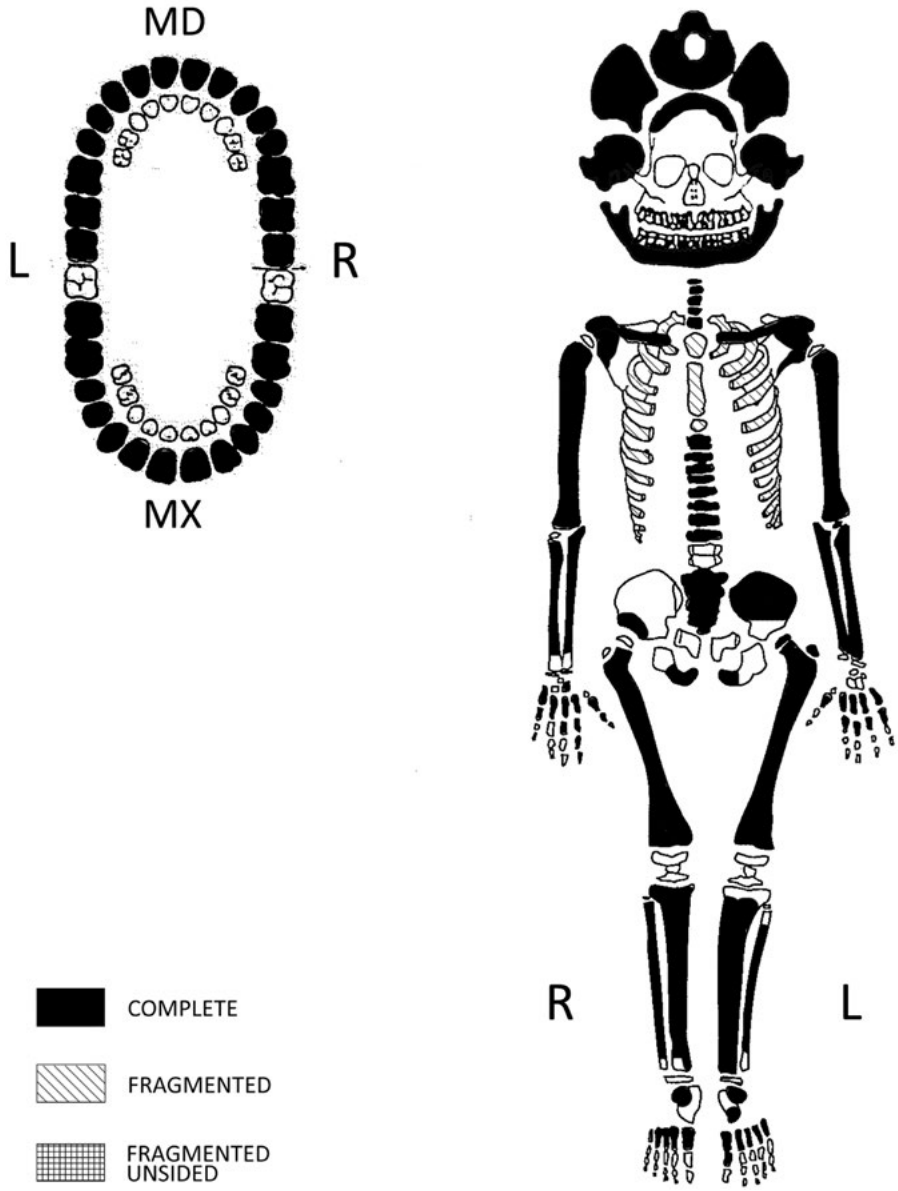


Figure 93

Sex: undeterminable

Age: 12-13 years
Age at death was determined on the basis of dental eruption, development of permanent teeth, and degree of fusion between diaphyses and epiphyses.

Dental pathologies
The maxillary teeth are preserved and isolated, except for the right second and third molar, which are in situ. The mandibular teeth are all preserved in situ. The mandibular molars are in form of germ.
Mild calculus is present on both the maxillary and the mandibular teeth.
Enamel hypoplasia occurred between 2 and 5 years, with six episodes.

Anatomical variants
In the skull the zygomatic foramina on the left, the right sagittal ossicles, the apical bone and the lambdoid ossicles bilaterally are present; in the post-cranial skeleton the complete transverse accessory foramen on the left side of C5, partial on both sides of C6 and partial on the left of C7are observed.

Pathologies
Diffuse grade 1 periosteal reaction is present on femurs, tibiae and fibulae.

SU 2514

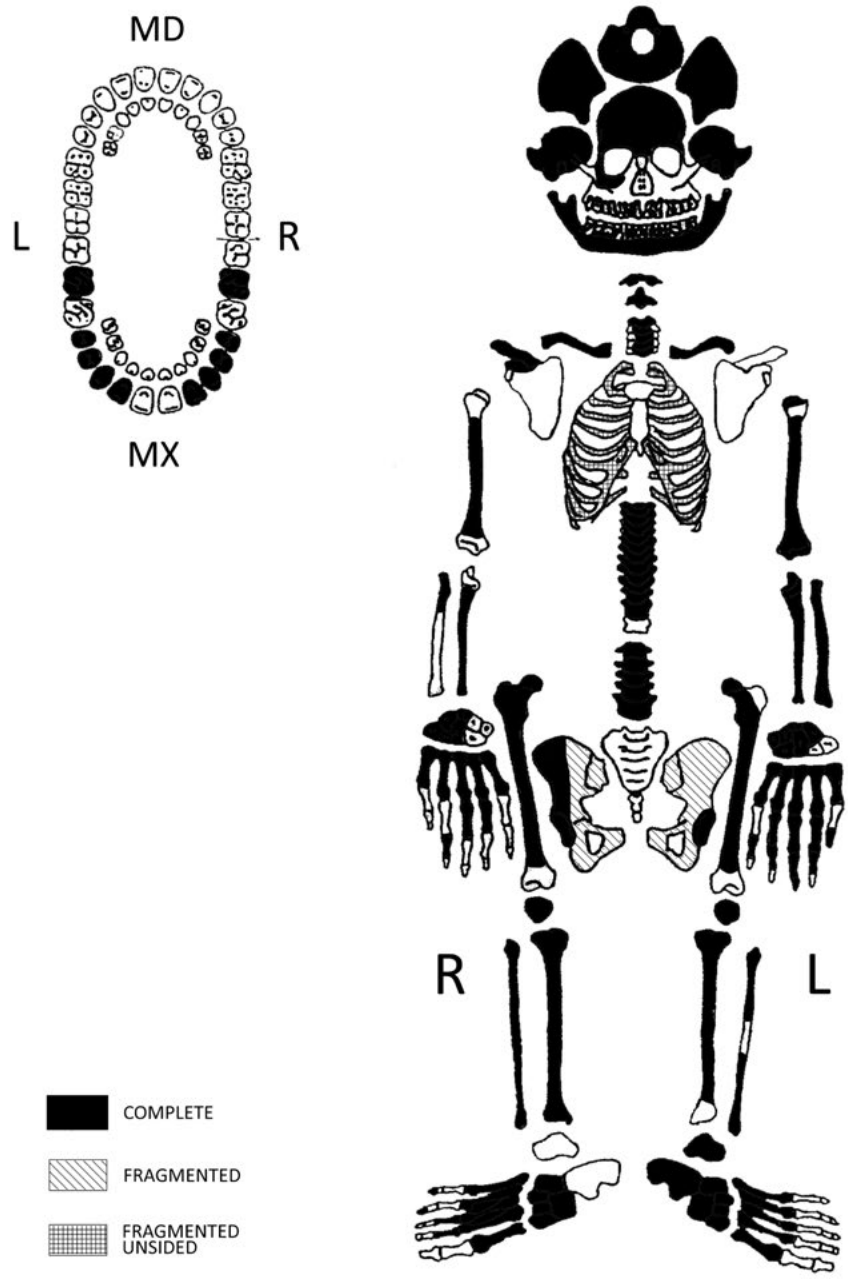


Figure 94

Sex: female
Sex was determined through the analysis of thirteen morphological features of the skull, which provided a sexual index of -1.3.

Age: 30-35 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, and morphology of the pubic symphysis.

Stature: 162.8 cm

Dental pathologies
The maxillary teeth are preserved and isolated, except for the first incisors and left first molar, which were lost during life, and the right first molar, which is missing. The mandible is completely edentulous, probably due to a juvenile periodontal disease.
Three caries in the left side of the maxilla were identified: one mesial of grade 1 on the second incisor at cemento-enamel junction, one mesial caries of grade 1 on the first premolar and one grade 4 caries on the second molar. On the right side, the second molar has one mesial caries of grade 2.
Alveolar resorption of grade 3 affects the maxilla.
Strong calculus is present on the maxillary teeth.
Enamel hypoplasia occurred at 3.5 years, with one episode.

Anatomical variants
In the skull the zygomatic foramina on both lateralities, the parietal forearm and lambdoid ossicles both on the

left side are present.
In the post-cranial skeleton there is the septal aperture in the left humerus, the acetabular crease on the left acetabulum and the exostosis of the right femoral trochanteric fossa.

Ergonomy
The individual shows a general low development of muscular insertions, except for the biceps brachii of both radii, which show an osteolytic enthesopathy of grade 2.

Pathologies
The individual was affected by bilateral congenital subluxation of the hip.
Schmorl's nodes are present on two out of five cervical, ten out of eleven thoracic and three out of five lumbar vertebrae.
Diffuse grade 1 periosteal reaction is visible on both femurs, left tibia and both fibulae. Osteoarthritis of grade 1 affects the proximal joint surface of left humerus, left ulna and right radius, the first right metacarpal and the distal joint of the first right metatarsal.

SU 2515

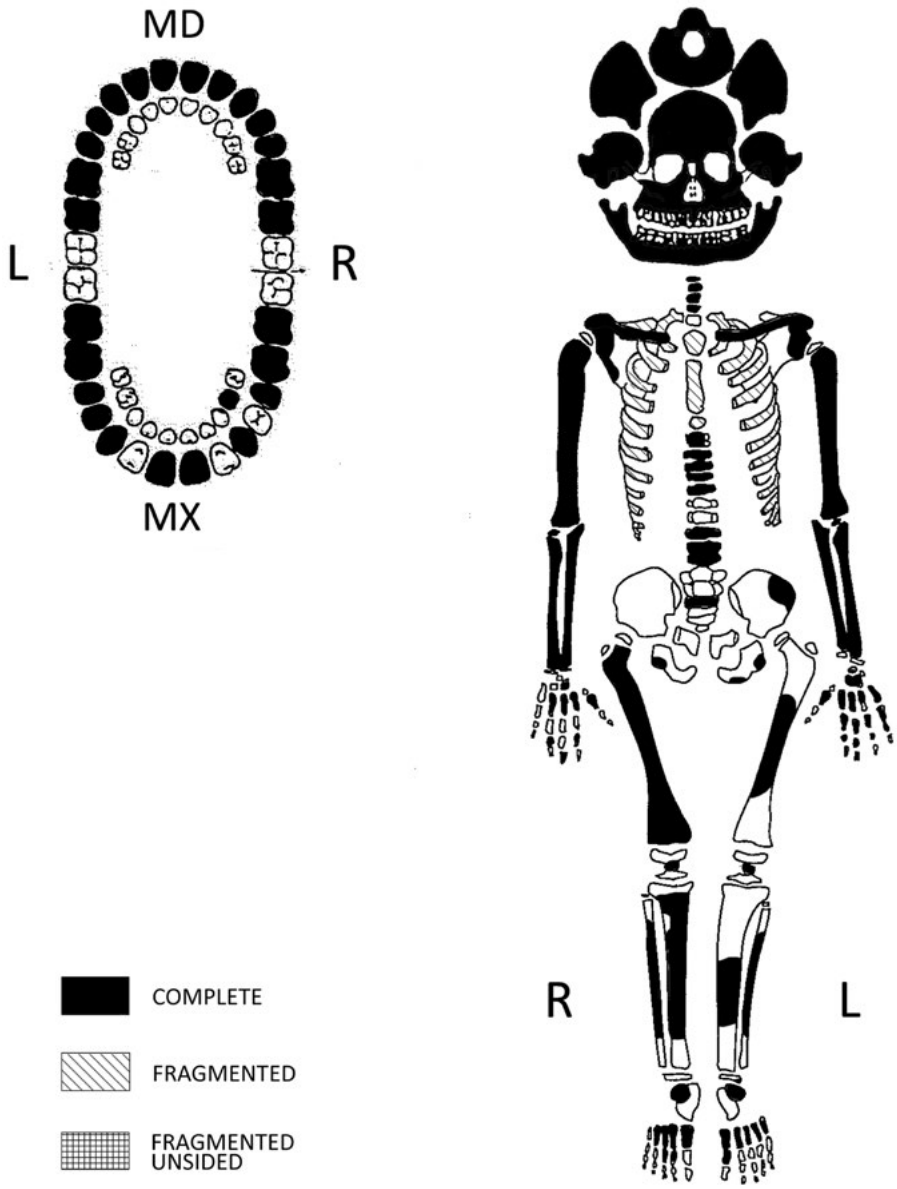


Figure 95

Sex: undeterminable

Age: 10-11 years
Age at death was determined on the basis of dental eruption, development of permanent teeth, and stage of fusion between diaphyses and epiphyses.

Dental pathologies
The maxillary teeth are preserved in situ, except for the second incisors and the right first premolar, which were lost post-mortem, and the right first incisor, which is isolated; the canines and second molars are in eruption. The deciduous maxillary right first molar

is present in situ. The maxillary teeth are preserved in situ; the second molars are in form of germ.
Mild calculus is present only on the mandibular teeth.
Enamel hypoplasia occurred between 1 and 5 years, with seven episodes.

Anatomical variants
In the skull the complete metopic suture, the left zygomatic foramina, the epipteric bone, the bilateral coronal ossicles, the apical bone, the lambdoid ossicles and the extrasutural mastoid foramen on the left are present; in the post-cranial skeleton there is the right accessory facet of the atlas.

Pathologies
Diffuse grade 1 periosteal reaction is present on the tibiae and fibulae. A healed fracture is observable on the frontal bone over the right orbit (blunt force trauma).

SU 2516

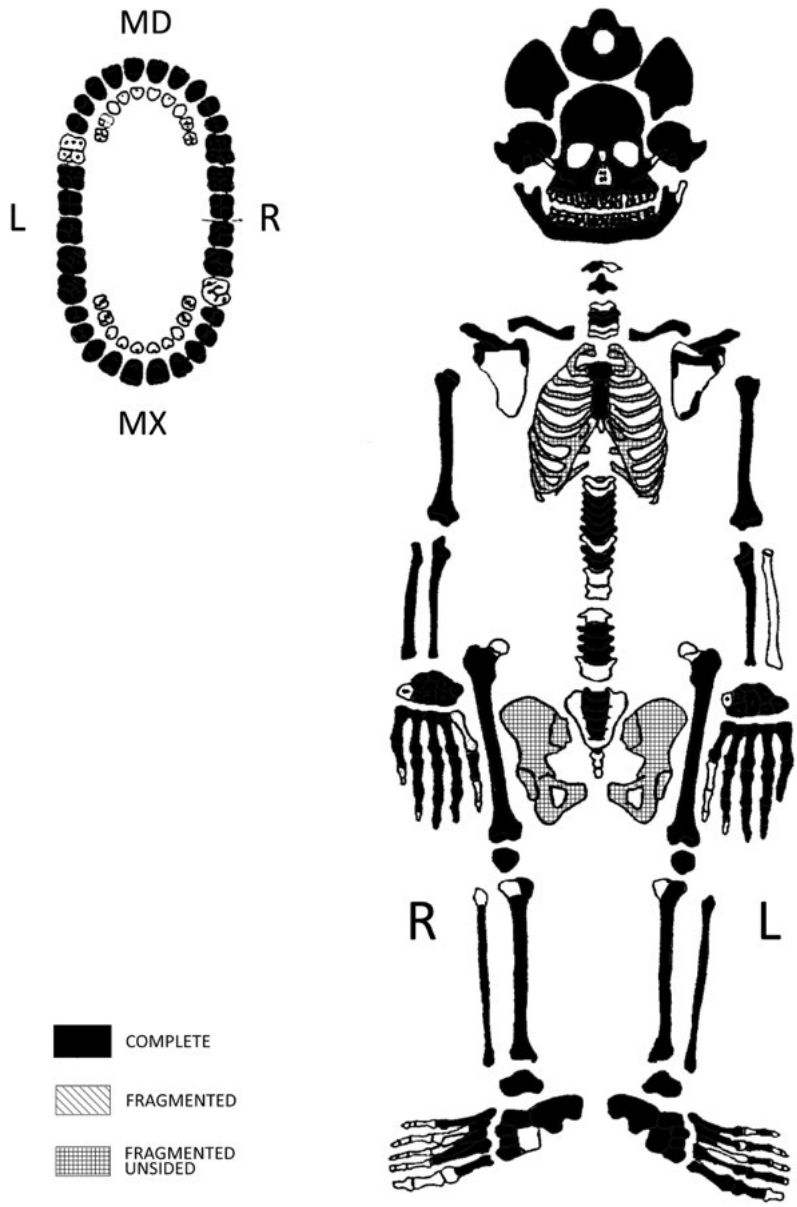


Figure 96

Sex: female
Sex was determined through the analysis of fourteen morphological features of the skull, which provided a sexual index of -1.

Age: 20-30 years
Age at death was assessed through dental wear, morphology of the pubic symphysis and sternal rib end modifications.

Stature: 147.3 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the right first molar, which was lost during life. The mandibular teeth are preserved in situ, except for the left first molar, which was lost during life.
Two caries are visible on the right side of the maxilla: one mesial of grade 2 on the first premolar at the

cemento-enamel junction and one grade 4 affecting the second molar.
Strong calculus is present on both the maxillary and the mandibular teeth.
Alveolar resorption of grade 1 affects the maxilla and the mandible.
It has not been possible to measure adequately the enamel hypoplasia due to the presence of strong calculus; the unique episode occurred at 3.5 years.

Anatomical variants
In the skull the partial metopic suture, the supraorbital foramen on the left, the complete bilateral infraorbital suture, two infraorbital foramen on the right, the parietal foramen on the left and the lambdoid ossicles on the right are present. In the post-cranial skeleton the vastus notch of the right patella and the accessory facet on the neck of the left talus are observed.

Ergonomy
The individual shows a low/medium development of the muscular insertions, except for the gluteus maximus of the right femur and the Achilles' tendon of the left calcaneus, which show a strong development, and the Achilles' tendon of the right calcaneus, which shows a very strong development.

Pathologies
Osteochondritis dissecans is observed on the proximal articular surface of the first phalanx of the first finger of the left foot. There is diffuse grade 1 periosteal reaction on femurs, tibiae and fibulae.

SU 2517

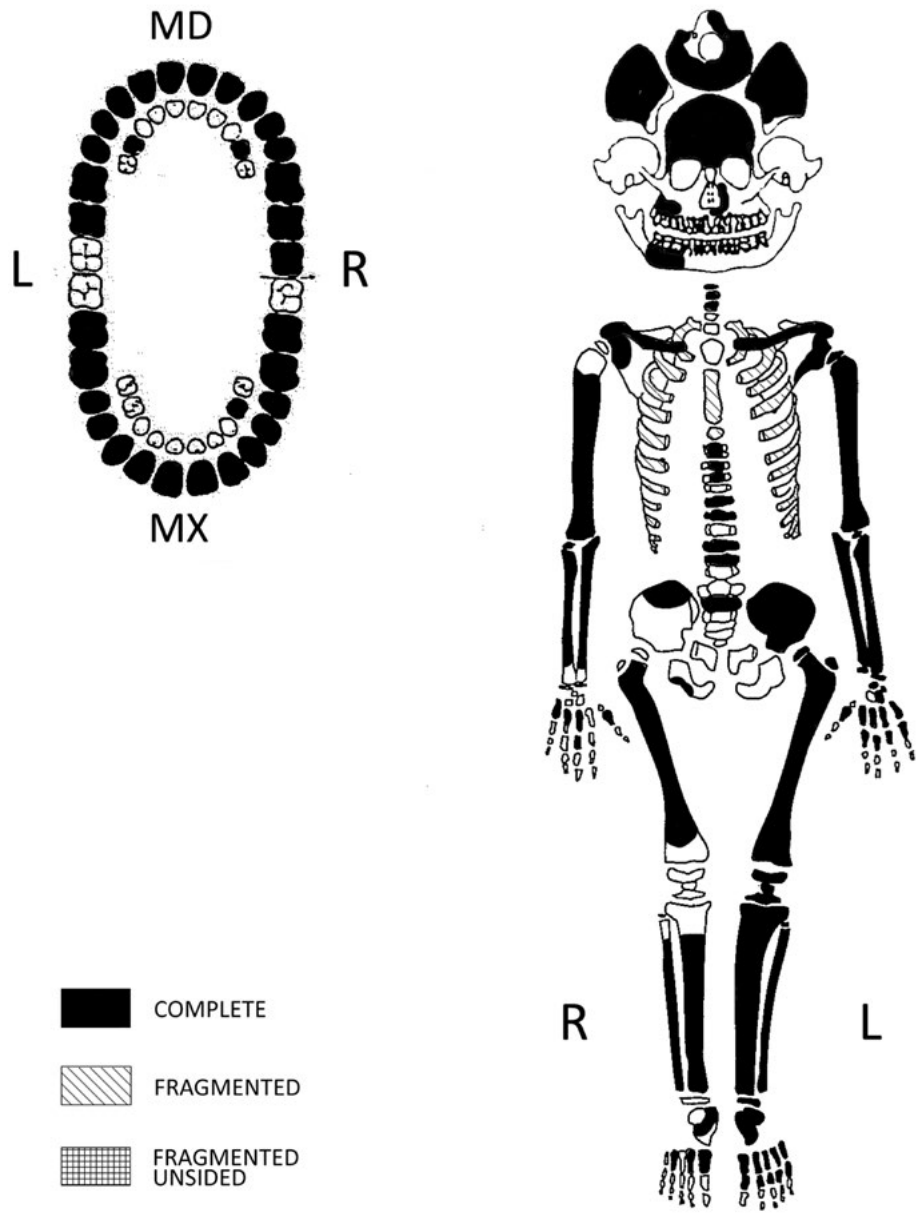


Figure 97

Sex: undeterminable

Age: 11-12 years
Age at death was determined on the basis of dental eruption, development of permanent teeth, and degree of fusion between diaphyses and epiphyses.

Dental pathologies
The maxillary teeth are present and isolated, except for the left molars, right premolars and molars, which are in situ. The deciduous right first molar is in situ. The mandibular teeth are preserved in situ, except for the incisors, which are isolated. The deciduous first molars are in situ.

Mild calculus affects the maxillary and the mandibular teeth.
Enamel hypoplasia occurred between 1 and 4.5 years, with six episodes.

Anatomical variants
In the skull the zygomatic foramina on the left, the lambdoid ossicles on the right, and the posterior condylar canal bilaterally are present.
In the post-cranial skeleton there is an accessory transverse foramen on the left side of C5.

Pathologies
Cribra orbitalia of grade 1 are observed on the right orbital roof.

SU 2518

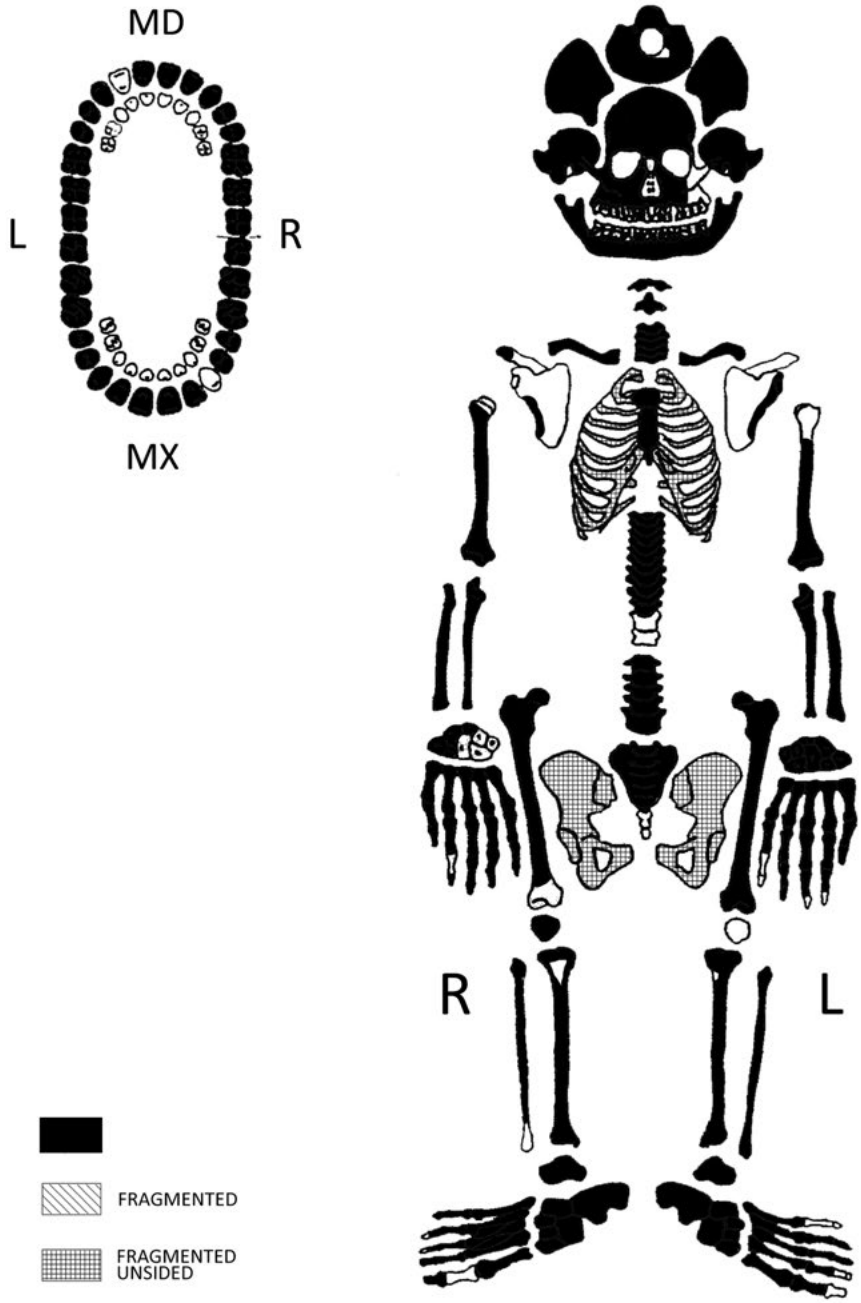


Figure 98

Sex: male
Sex was determined through the analysis of fourteen morphological features of the skull, which provided a sexual index of 0.6.

Age: 35-45 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, and morphology of the pubic symphysis.

Stature: 154.5 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the right second incisor, which was lost during life. The mandibular teeth are preserved in situ, except for the left second incisor, which was lost during life.
There is only one mesial caries of grade 1 on the maxillary right first molar at the cemento-enamel junction.
Alveolar resorption of grade 1 affects both maxilla and mandible.
Strong calculus is present on the maxillary and mandibular teeth.
Enamel hypoplasia occurred between 2 and 4 years, with three episodes.

Anatomical variants
In the skull the left complete supraorbital foramen, multiple zygomatic foramen on the right and one on the left, the right parietal foramen, the right mastoid extrasutural foramen, the condylar canal on the right, and the precondylar tubercle are present. In the postcranial skeleton the following are observed: the double facet of the atlas on the left, the complete right transverse accessory foramen of C6, the vastus notch of the patellae, the accessory facet of the distal epiphysis of the tibiae, and the double anterior facet of both calcanei.

Ergonomy
The individual shows a general low development of the muscular insertions.

Pathologies
Osteochondritis dissecans is observed on the triquetral and capitate bone. A healed fracture is observable on the head and capitulum of the right radius.
Grade 1 osteoarthritis affects the proximal articular surface of the left ulna, the articular surface for cuboid of both calcanei, the calcaneal surface of both talii, and the bodies of the lumbar vertebrae; grade 2 osteoarthritis affects the proximal articular surface of the right ulna.
Diffuse grade 1 periosteal reaction is observed on femurs, fibulae and right tibia; localized grade 2 periosteal reaction is visible on the left tibia.

SU 2519

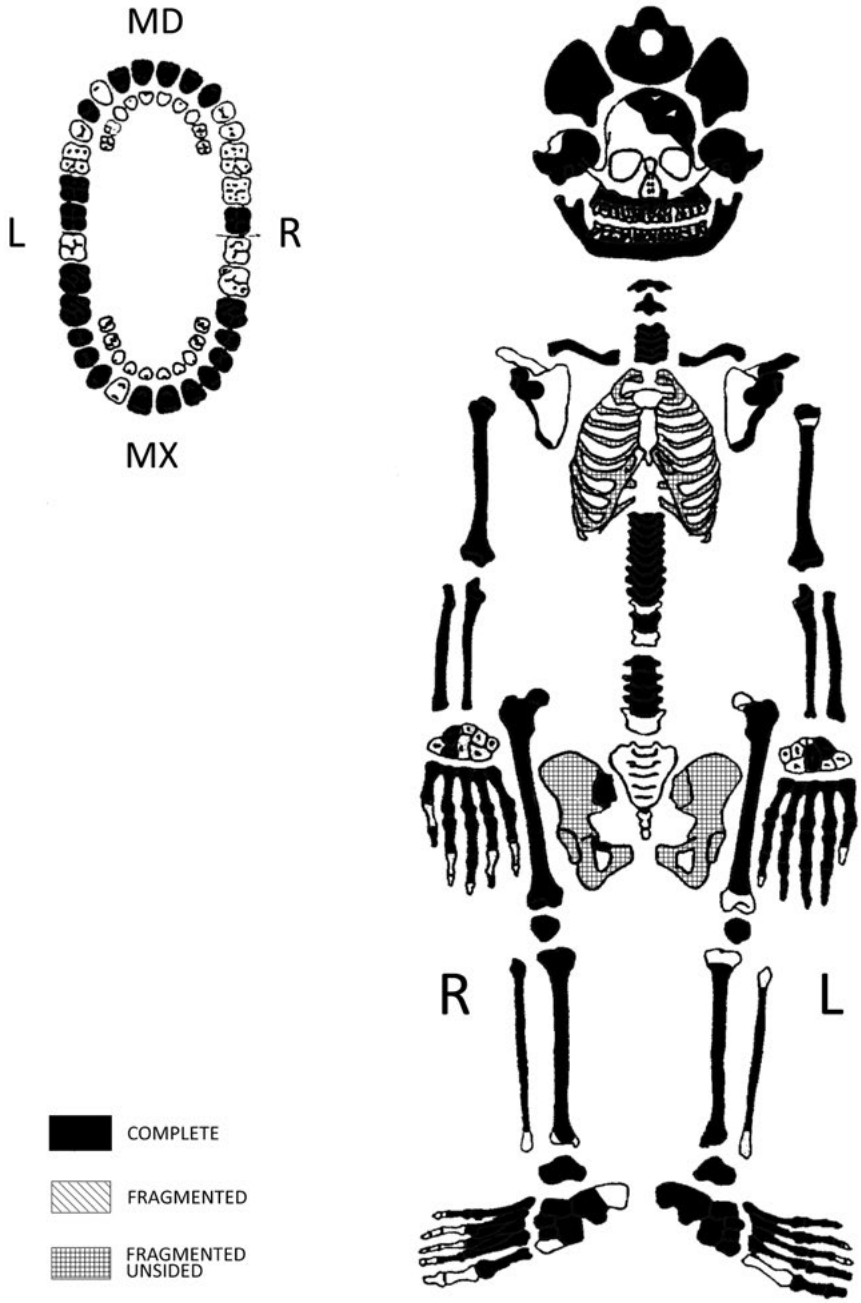


Figure 99

Sex: female
Sex was determined through the analysis of eleven morphological features of the skull, which provided a sexual index of -1.7.

Age: 35-45 years
Age at death was determined on the basis of dental wear, morphology of the pubic symphysis, and sternal rib end modifications.

Stature: 150.3 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the left third molar and right second molar, which were lost during life, and the left second incisor, which was lost post-mortem. The mandibular teeth are preserved in situ, except for the left canine, second premolars and first molars, and the right second molar, which were lost during life, and the right first premolar, which was lost post-mortem. The left first premolar is preserved as root.
Alveolar resorption of grade 2 affects both the maxilla and the mandible.
Strong calculus is present on the maxillary and the mandibular teeth.
There are two caries in the maxillary teeth both mesial of grade 2 at the cemento-enamel junction: one on the left canine and one on the left first premolar.
On the left side of the mandible there are two caries of grade 1 on the second molar at the cemento-enamel junction: one mesial and one buccal. Two other caries

of grade 3 were observed on the third molar at the cemento-enamel junction: one lingual and one buccal. On the right side of the mandible there are: one mesial caries of grade 1 on the second incisive and one distal of grade 3 on the third molar at the the cemento-enamel junction.
Enamel hypoplasia occurred between 1.5 and 4 years, with six episodes.

Anatomical variants
In the skull the bilateral parietal foramen and some lambdoid ossicles on the right are observed. In the post-cranial skeleton there are the complete transverse accessory foramen on C6, the circumflex sulcus on the right scapula, the scapular foramen on the left and the double anterior facet on the left calcaneus.

Ergonomy
The individual shows a general low development of the muscular insertions.

Pathologies
Diffuse grade 1 periosteal reaction is observed on the femurs, tibiae and fibulae. Osteoarthritis of grade 1 affects the sternal articular facet of the clavicles, the glenoid cavity of the right scapula, the proximal articular joint of ulnae, the articular facet of the right patella and the vertebral bodies of the thoracic and lumbar vertebrae.

SU 2520

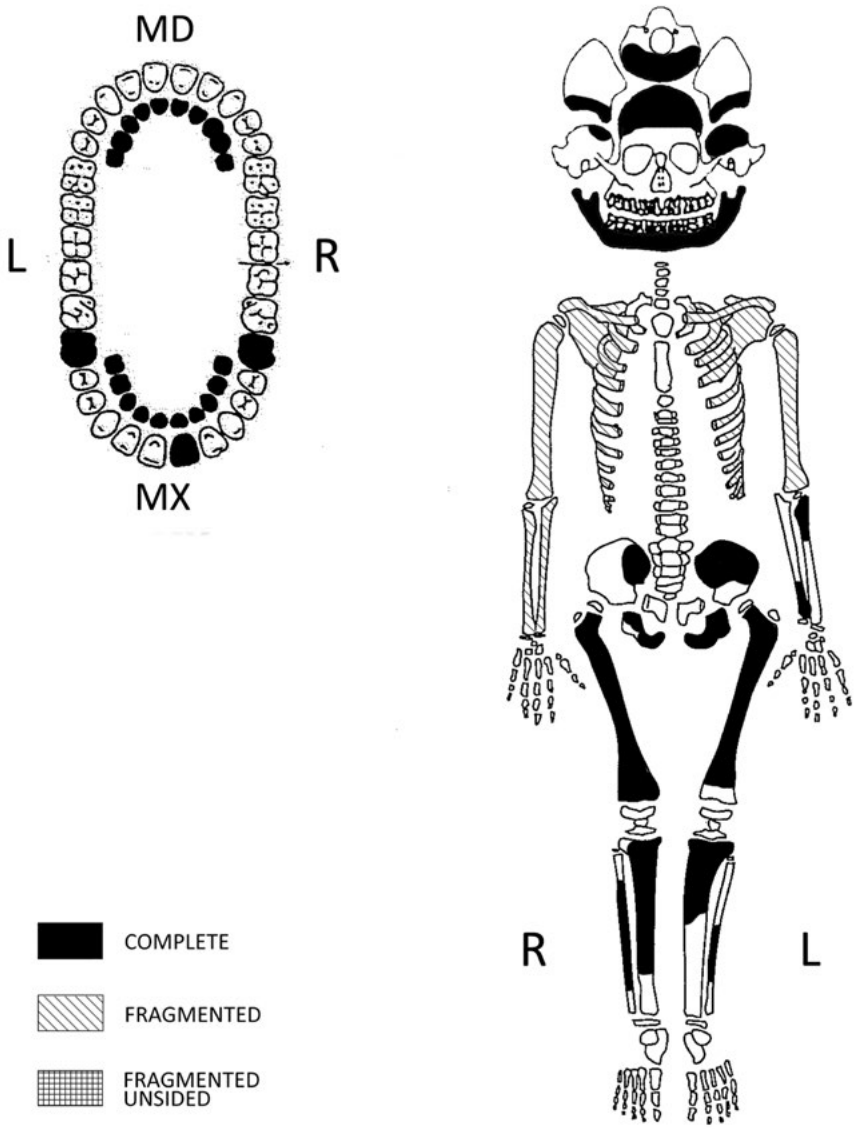


Figure 100

Sex: undeterminable

Age: 1-2 years
Age at death was determined on the basis of dental eruption, development of permanent teeth, long bone length (femur), and stage of fusion between diaphyses and epiphyses.

Dental pathologies
The deciduous maxillary teeth are preserved and isolated; the permanent right first incisor and third

molars are in form of isolated germ. The mandibular teeth are preserved isolated, except for the first molars, which are in situ. All the deciduous second molars are in eruption.

Anatomical variants
In the skull the apical bone and the left parietal foramen are present.

SU 2521

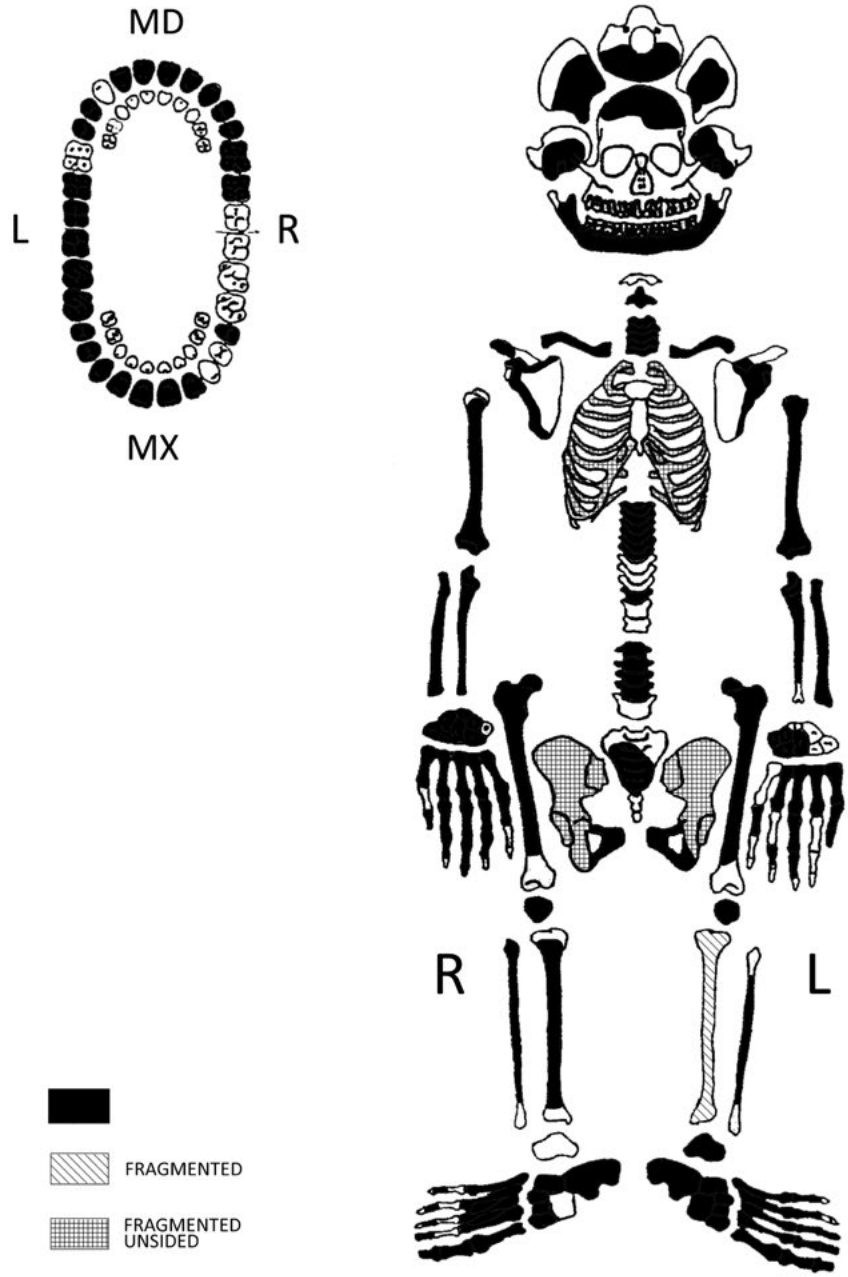


Figure 101

Sex: male (?)
Sex was determined through the analysis of seven morphological features of the skull, which provided a sexual index of 0.1.

Age: 25-30 years
Age at death was determined on the basis of dental wear, morphology of the pubic symphysis, sternal rib end modifications, and degree of fusion between diaphyses and epiphyses.

Stature: 157.2 cm

Dental pathologies
The maxillary teeth are preserved and isolated, except for the left molars, which are in situ, and the right molars, which were lost post-mortem. The mandibular teeth are preserved in situ, except for the left canine and first molar, which were lost post-mortem.
Alveolar resorption of grade 1 affects both the maxilla and the mandible.

Mild calculus is present on both the maxillary and the mandibular teeth.
Enamel hypoplasia occurred between 1.5 year and 3.5 years, with five episodes.

Anatomical variants
In the skull the right parietal foramen is present; in the postcranial skeleton the partial transverse accessory foramen on C6, the septal aperture on both humeri and the Poirier facet on both femurs are present.

Ergonomy
The individual shows a low development of muscular insertions, except for the deltoid of the left clavicle, which shows a strong development.

Pathologies
Diffuse grade 1 periosteal reaction is visible on femurs, tibiae and fibulae. A possible healed fracture affects the left fibula.

SU 2522

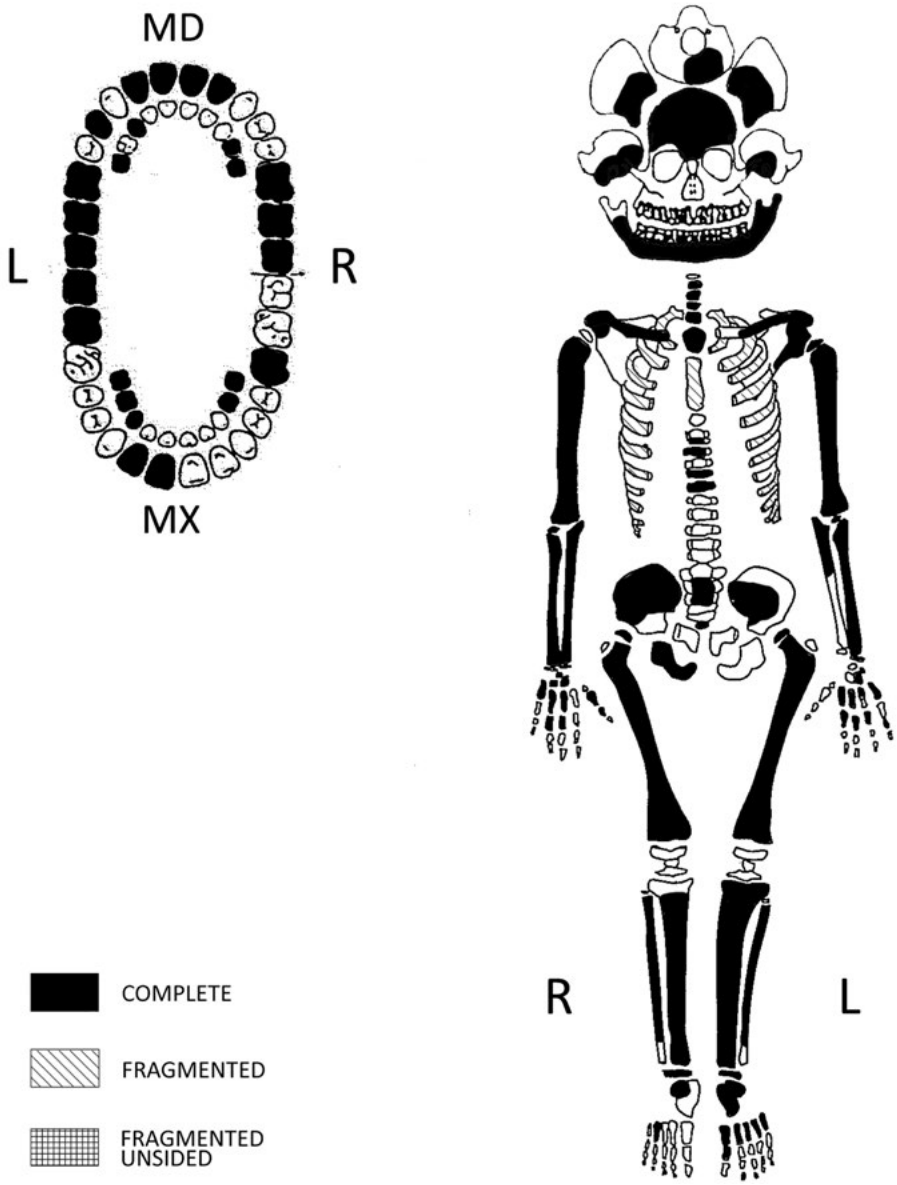


Figure 102

Sex: undeterminable

Age: 9-10 years
Age at death was determined on the basis of dental eruption, grade of development of permanent teeth, and stage of fusion between diaphyses and epiphyses.

Dental pathologies
The permanent preserved maxillary teeth are the left incisors, first molar and germ of the second molar, which are in situ, and the right first molar, which is isolated. The deciduous maxillary right molars are isolated, the left canine and molars are in situ.
The permanent mandibular teeth preserved are the incisors, first molars, germs of second and third molars,

which are in situ; deciduous mandibular right molars, left canine and second molar are in situ.
Mild calculus affects the maxillary teeth, strong the mandibular teeth.
There are four caries, all on deciduous teeth: one mesial of grade 2 on the maxillary right first molar, one mesial of grade 2 on the mandibular right canine at the cemento-enamel junction; two of grade 2 on the mandibular right first molar: one occlusal of grade 2 and one mesial at the cemento-enamel junction.

Enamel hypoplasia occurred between 2 and 4.5 years, with five episodes.

Anatomical variants
In the skull the complete metopic suture, the left parietal foramen and the lambdoid ossicles bilaterally are present. In the post-cranial skeleton there is the complete transverse accessory foramen on both sides of C5 and C6.

SU 2523

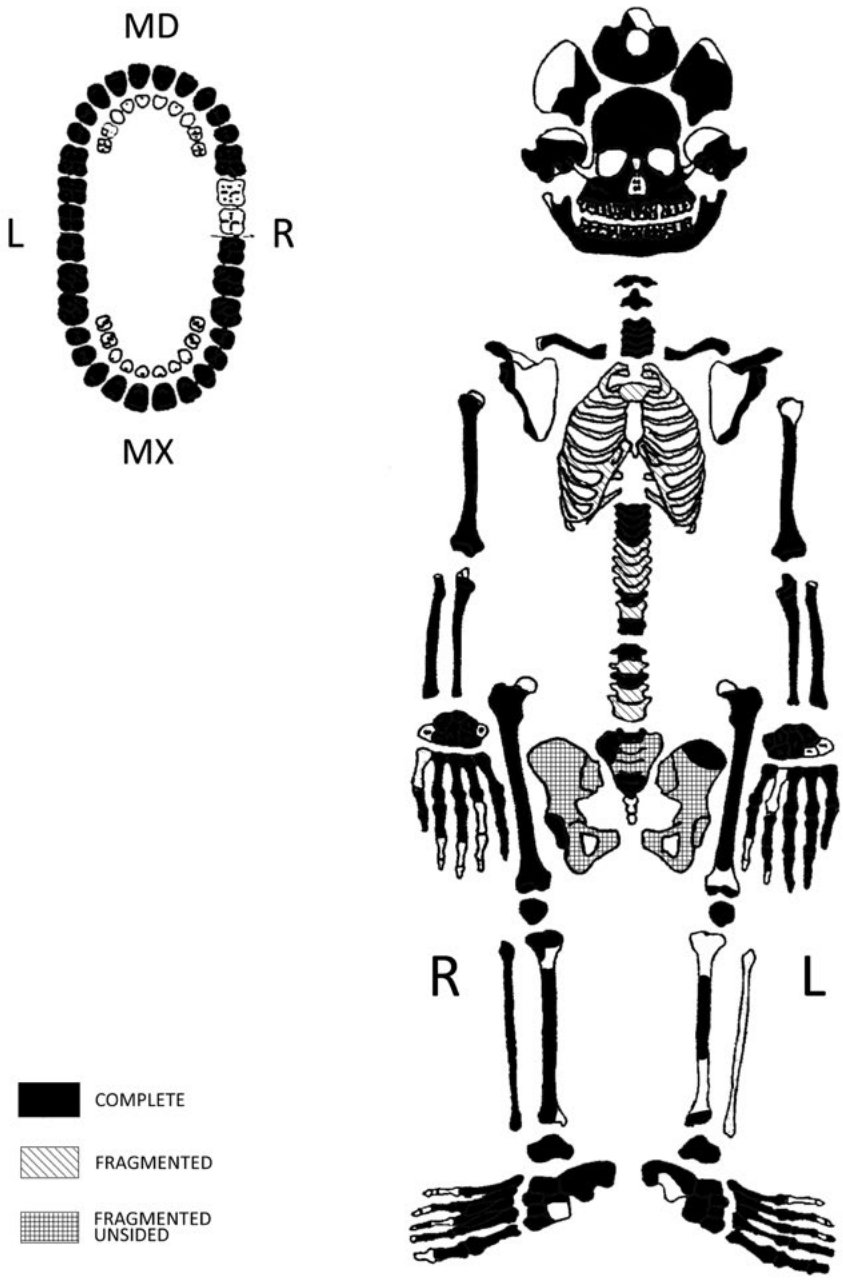


Figure 103

Sex: female
Sex was determined through the analysis of nineteen morphological features of the skull, which provided a sexual index -0.8.

Age: 20-30 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, and degree of fusion of the vertebrae.

Stature: 152.7 cm

Dental pathologies
Al maxillary teeth are preserved and in situ. All mandibular teeth are preserved and in situ, except for the right second molar, which was lost during life; there seems to be agenesis of the left third molar.
Enamel hypoplasia occurred between 2.5 and 5 years, with five episodes.
Alveolar resorption of grade 1 affects maxilla and mandible.
Mild calculus is visible on the maxillary and the mandibular teeth.

Anatomical variants
In the skull multiple zygomatic foramina on both sides, the parietal foramen on the left, the extrasutural mastoid foramen on the left, and the condylar canal on both sides are present.
In the postcranial skeleton the double facets of the atlas, the transverse accessory foramen complete on both sides of C5 and C6, partial on the right of C7, the unfused acromion on the left scapula, the squatting facet on the right tibia, and the throclear extension on both talii are visible.

Ergonomy
The individual shows a low-medium development of muscular insertions, except for the deltoid, the conoid and the trapezoid ligament of the left clavicle, which show a strong development, and the deltoid and the trapezoid ligament of the right clavicle, which show a very strong development.

Pathologies
Cribra cranii are present on the parietal bones, mild osteophytosis of the margin of the acoustic meatus on the right is visible. Diffuse grade 1 periosteal reaction affects femurs and tibiae; osteoarthritis of grade 1 affects the distal articular surface of the femurs.

SU 2524

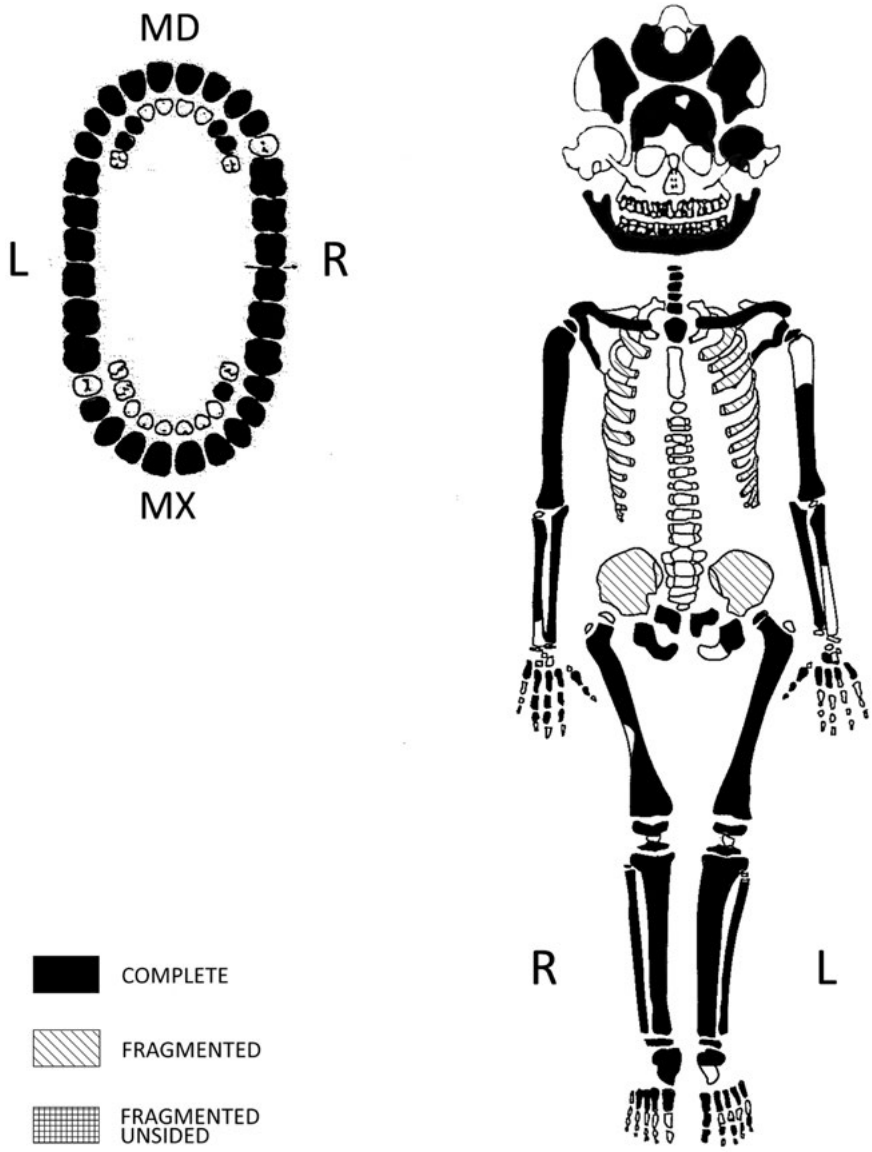


Figure 104

Sex: undeterminable

Age: 10-12 years
Age at death was determined on the basis of dental eruption, grade of development of permanent teeth, and fusion between diaphyses and epiphyses.

Dental pathologies
The maxillary teeth are preserved isolated; the left canine and the third molars are in form of germ; the deciduous right first molar is preserved isolated.
The mandibular teeth are preserved in situ; the canines and third molars are in form of germ; the deciduous canines and first molars are in situ.
Mild calculus is present on both the maxillary and the mandibular teeth.
Enamel hypoplasia occurred between 1.5 year and 4 years, with five episodes.

Anatomical variants
In the skull the parietal foramen on the left is present.

Pathologies
A possible healed fracture affects the diaphysis of the left clavicle.

SU 2525

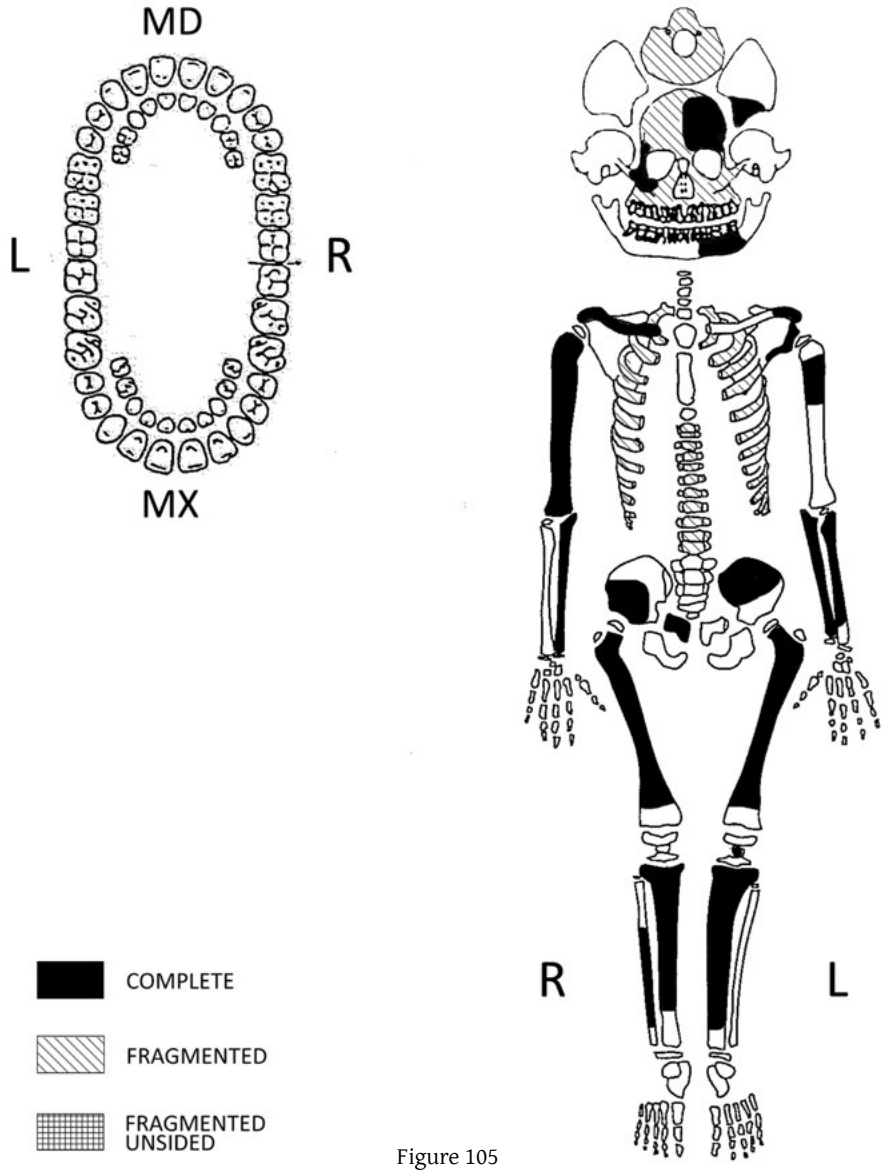


Figure 105

Sex: undeterminable

Age: 6-12 months
Age at death was determined on the basis of dental eruption and long bone length.

Dental pathologies
No teeth are preserved.

Pathologies
A thickening of the skull bones and diffuse cribra cranii are observed.

SU 2526

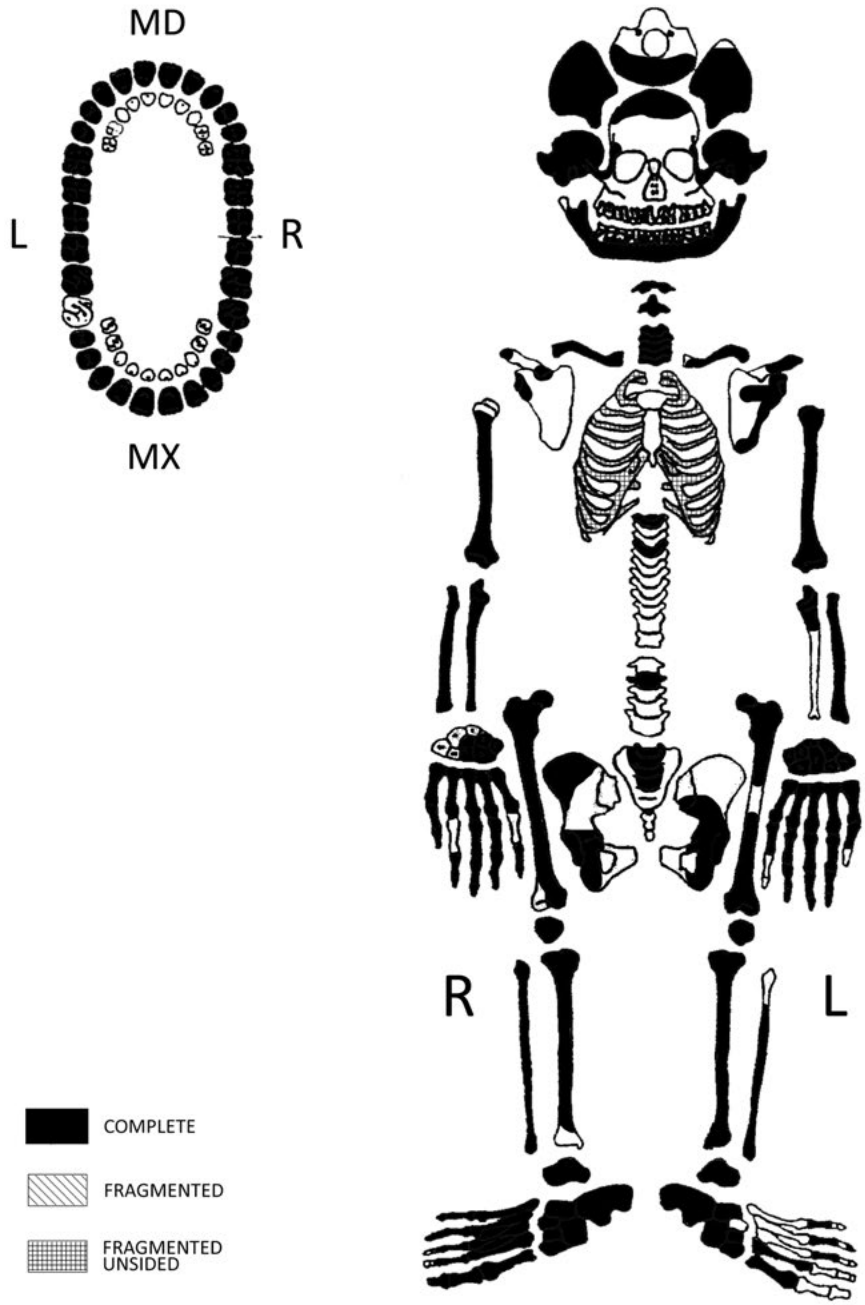


Figure 106

Sex: male
Sex was determined through the analysis of eleven morphological features of the skull and 6 of the pelvis, which provided a total sexual index of 0.8.

Age: 25-35 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, and degree of fusion between diaphyses and epiphyses.

Stature: 170.3 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the left first molar, which was lost during life; the right first molar is preserved as root. The mandibular teeth are all preserved in situ.
Alveolar resorption of grade 2 affects the maxilla, and grade 1 affects the mandible; calculus is strong on both the maxilla and mandible, in particular on the left mandibular molars.
On the maxillary teeth 2 caries were detected: one grade 4 on the right first molar and one distal caries of grade 3 on the left second molar. In correspondence of the left first molar there is an apical abscess. On the mandibular teeth there is one buccal caries of grade 3 on the right second molar and one buccal caries of grade 2 on the left second molar.
Enamel hypoplasia occurred between 2 and 3.5 years, with 2 episodes.

Anatomical variants
In the skull the complete metopic suture, the zygomatic foramina on the right, the parietal foramen bilaterally, the apical bone and the lambdoid ossicles bilaterally are present. In the postcranial skeleton the complete transverse accessory foramen on C5 on the left and on C6 bilaterally and the double anterior facet on both calcanei are present.

Ergonomy
The individual shows low/medium development of the muscular insertions, except for the conoid ligament of both clavicles, and the triceps brachii of the left scapula, which have a very strong development.

Pathologies
Osteochondritis dissecans affects the proximal epiphysis of the first right metatarsal. Diffuse grade 1 periosteal reaction is present on the femurs. The second and third phalanges of the fifth finger of the right foot are fused.

SU 2527

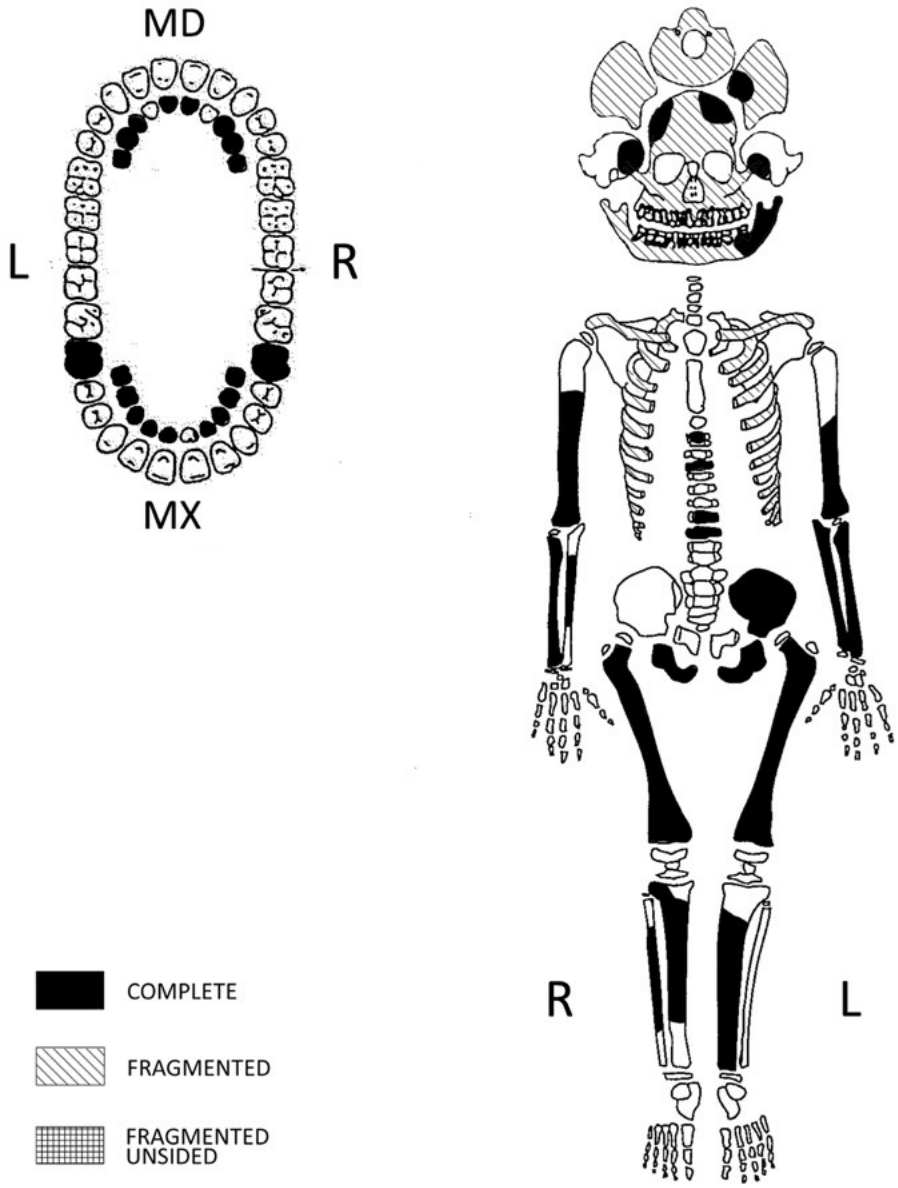


Figure 107

Sex: undeterminable

Age: 2-3 years
Age at death was determined on the basis of dental eruption, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
The deciduous maxillary teeth are preserved isolated, except for the right first incisor, which is missing; the germs of the permanent first molars are isolated. The deciduous mandibular teeth are preserved isolated, except for the second incisors, which are missing.

Anatomical variants
In the skull there is the parietal foramen bilaterally.

Pathologies
Localised grade 2 periosteal reaction is visible on the right fibula.

SU 2528

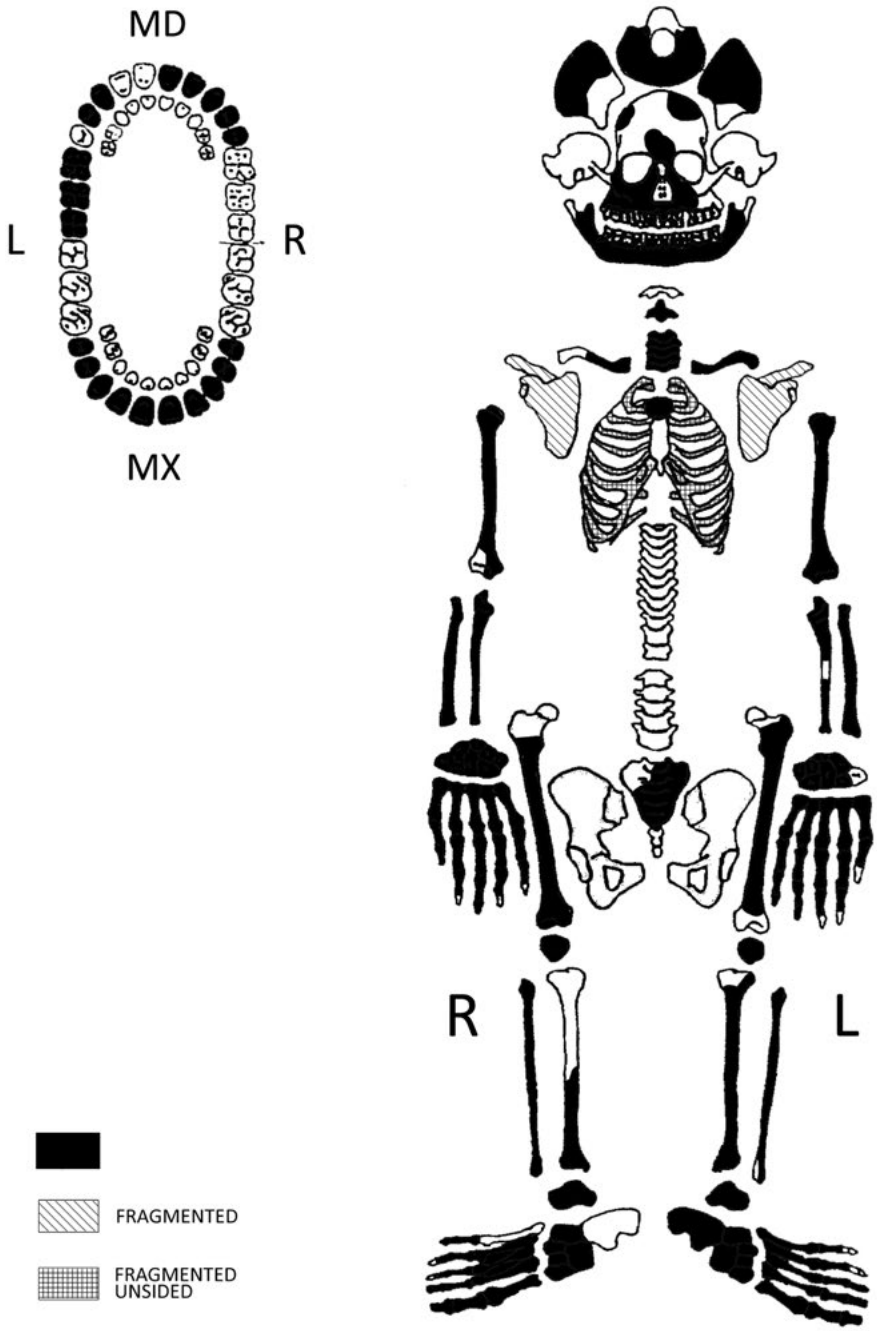


Figure 108

Sex: female
Sex was determined through the analysis of twelve morphological features of the skull and seven of the pelvis, which provided a total sexual index of -1.

Age: 35-45 years
Age at death was determined on the basis of dental wear and sternal rib end modifications.

Stature: 151.1 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the left molars and right second molar, which were lost post-mortem, and the right first molar, which was lost during life. There is agenesis of the third molars.
The mandibular teeth are preserved in situ, except for the left incisors, second premolar and right first and second molar, which were lost during life, and the right third molar, which was lost post-mortem.

Alveolar resorption of grade 1 affects the maxilla and of grade 2 the mandible.
Strong calculus is present on both the maxillary and the mandibular teeth.
There is a buccal caries of grade 2 on the root of the mandibular right canine.
Enamel hypoplasia occurred between 2 years and 5 years, with six episodes.

Anatomical variants
In the skull the bilateral parietal foramen and a zygomatic foramina on the left were observed. In the postcranial skeleton there are the complete accessory transverse foramen of C4 and C5 bilaterally and on the right on C6, the accessory facet on the epiphysis of the left tibia, the double anterior facet on the left calcaneus and the accessory facet on the neck of the right calcaneus.

Ergonomy
The individual shows a medium development of the muscular insertions, except for the conoid ligament of the clavicles, the deltoid of the right clavicle and the gluteus maximum on both femurs which show a strong development.

Pathologies
The frontal bone presents an osteoma. Grade 1 osteoarthritis affects the distal articular surface of the left femur and the articular facet of the left patella. Diffuse grade 1 periosteal reaction is present on the femurs, tibiae and fibulae. Osteolythic lesions are present on the head of the metacarpals, suggesting a possible inflammatory disease, such as rheumatoid arthritis in an initial stage. A healed fracture of the coccyx is visible.

SU 2529

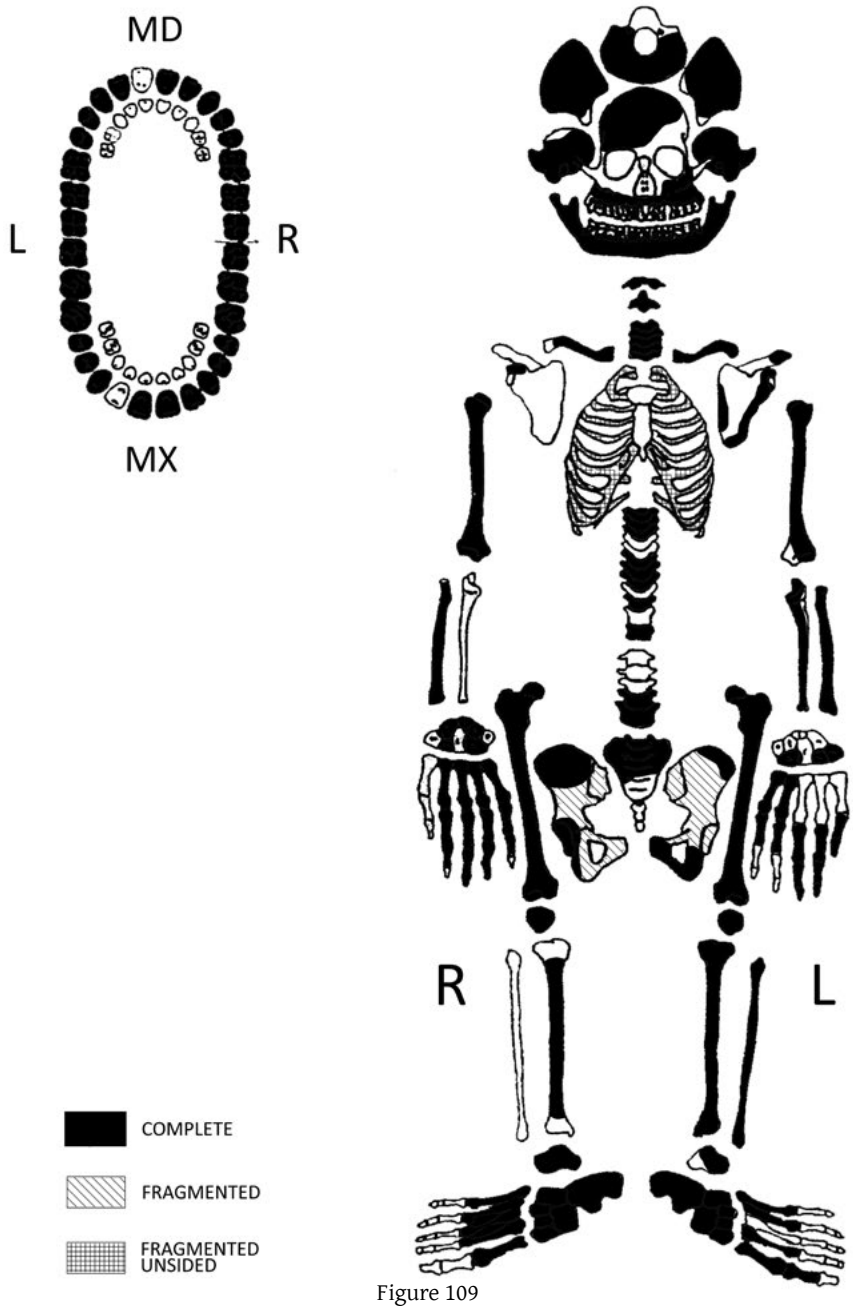


Figure 109

Sex: female
Sex was determined through the analysis of twelve morphological features of the skull and two of the pelvis, which provided a total sexual index of -0.6.

Age: 18-22 years
Age at death was assessed on the basis of dental eruption, degree of fusion between diaphyses and epiphyses, dental wear, sternal rib end modifications and morphology of the pubic symphysis.

Stature: 146.7 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the left first incisor, which was lost post-mortem; the right first incisor is preserved as root. The mandibular teeth are preserved in situ, except for the left second incisor, which was lost post-mortem.
Alveolar resorption of grade 2 affects the maxilla and of grade 1 the mandible.
Strong calculus is present on both the maxillary and the mandibular teeth.

Enamel hypoplasia occurred between 3 and 4.5 years, with four episodes.

Anatomical variants
In the skull a zygomatic bone on the left, some lambdoid ossicles, the mastoid extrasutural foramen, and the condylar canal on the right are present. In the postcranial skeleton there are the septal aperture on the left humerus, the Allen's fossa and the exostosis of the fovea on the right femur, and the double anterior facet on the left calcaneus.

Ergonomy
The individual shows a low development of the muscular insertions.

Pathologies
Diffuse grade 1 periosteal reaction is present on femurs and tibiae. A second and third phalanges of the right foot are fused. Evidence of blunt force trauma is visible on the right side of the frontal bone.

SU 2557

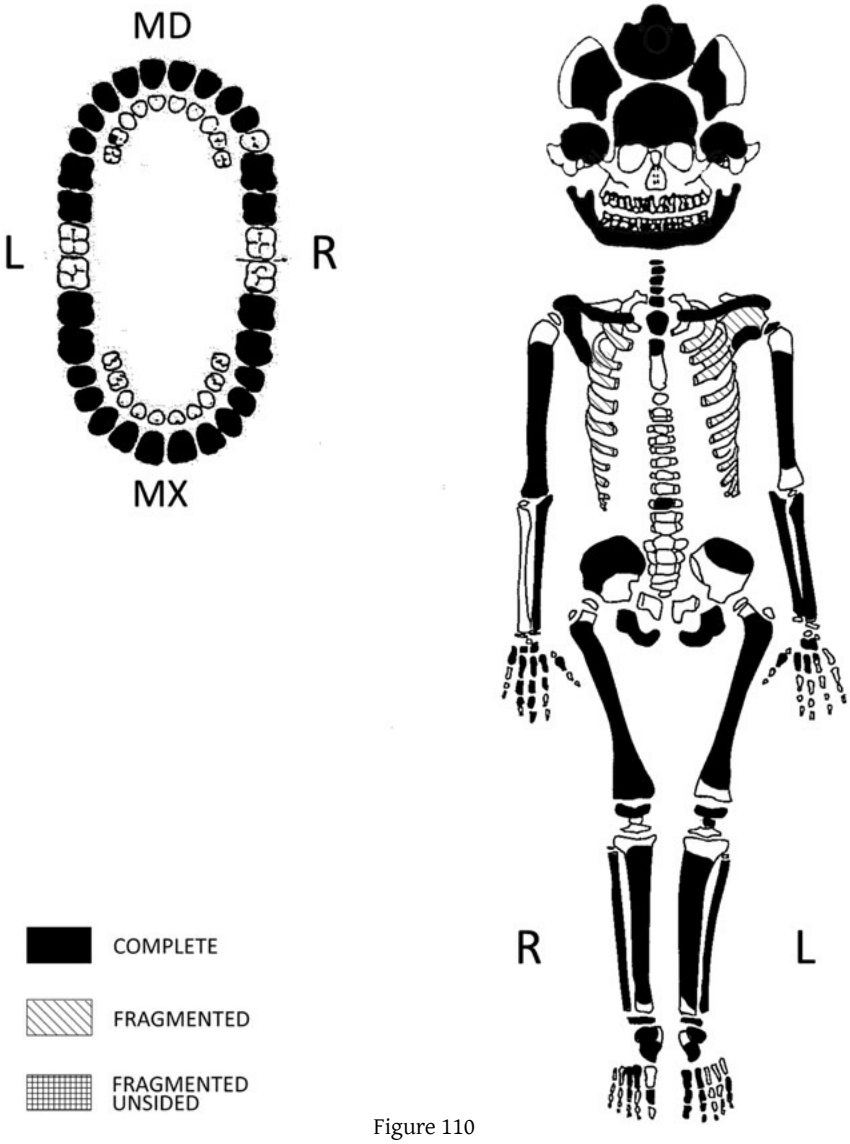


Figure 110

Sex: undeterminable

Age: 10-12 years
Age at death was determined on the basis of dental eruption, development of permanent teeth, sternal rib end modifications, and degree of fusion between diaphyses and epiphyses.

Dental pathologies
The maxillary teeth are preserved in situ, except for the second molars, which are isolated. The mandibular teeth are preserved in situ; the premolars and second molars are in eruption; the deciduous left first molar is in situ.
Mild calculus is present on the mandibular teeth.
Enamel hypoplasia occurred between 2 and 4.5 years, with five episodes.

Anatomical variants
In the skull several zygomatic foramina and the parietal foramen on both sides are present. In the postcranial skeleton there is a small septal aperture on the right humerus.

Pathologies
Cribra orbitalia of grade 1 are visible on both orbital roofs and diffuse grade 1 periosteal reaction is present on both tibiae.
The bodies of several thoracic and lumbar vertebrae present enlarged vascular foramina.

SU 2558

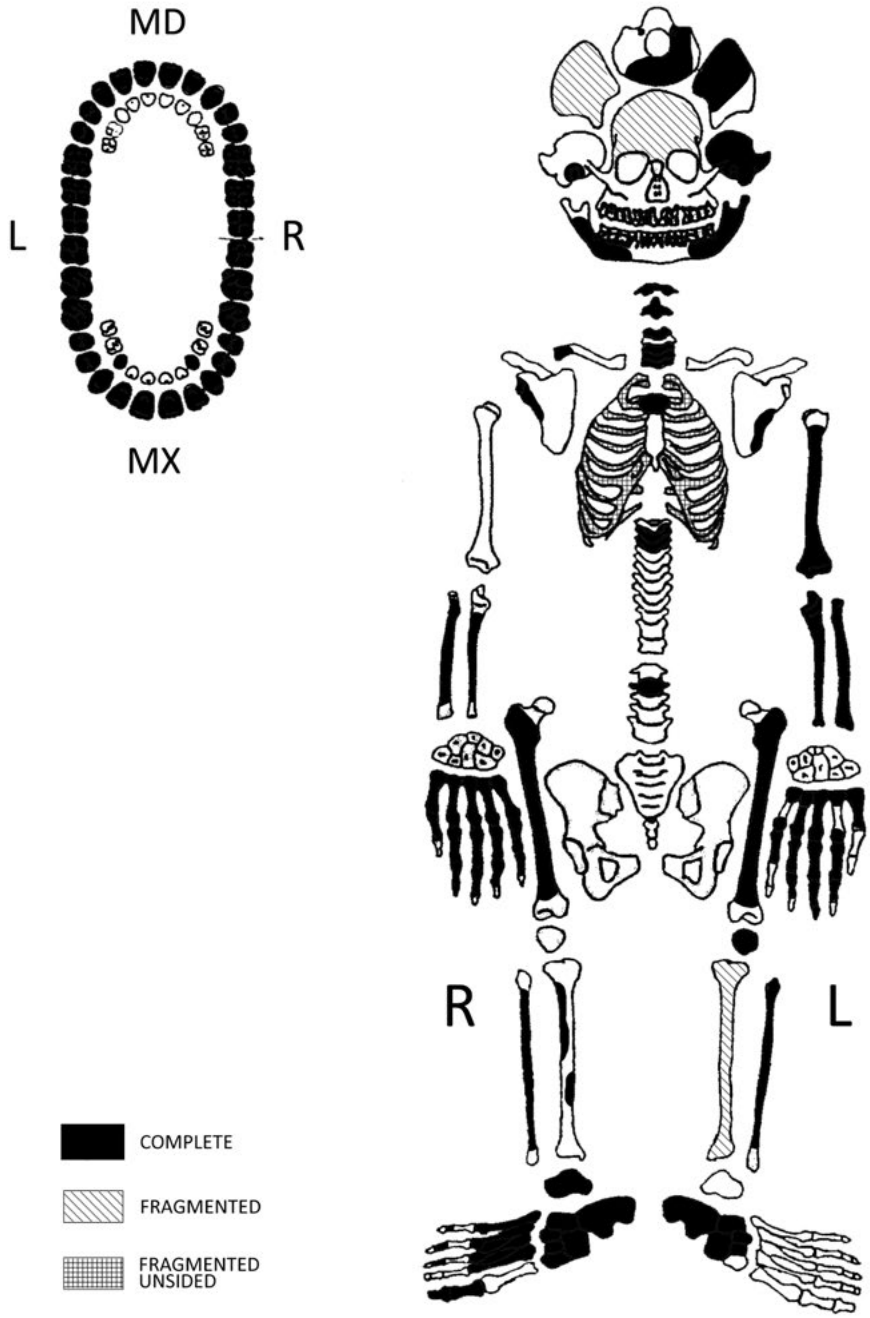


Figure 111

Sex: undeterminable

Age: 12-14 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, dental eruption, development of permanent teeth, long bone length, and degree of fusion between diaphyses and epiphyses.

Dental pathologies
The maxillary teeth are preserved in situ, except for the incisors, canines and left first premolar, which are isolated; the third molars are in eruption; the deciduous canines are preserved isolated. The mandibular teeth are preserved isolated, except for the right canine, premolars and molars, which are in situ; the third molars are in form of germ.
Enamel hypoplasia occurred between 1.5 year and 4.5 years, with six episodes.
There are caries of grade 3 on both deciduous maxillary canines.

Anatomical variants
In the skull the condylar canal on the left is present.

SU 2559

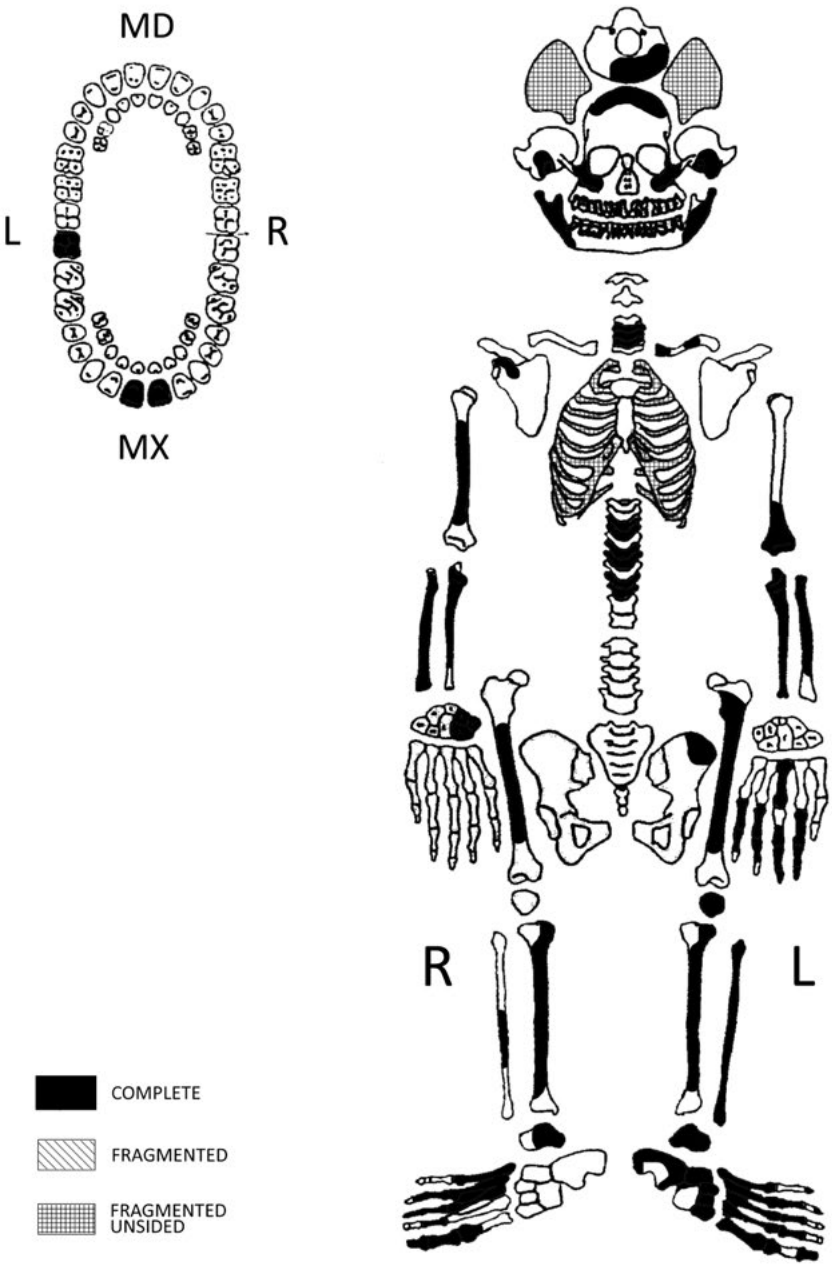


Figure 112

Sex: undeterminable

Age: 35-45 years
Age at death was determined on the basis of dental wear and sternal rib end modifications.

Stature: 152.8 cm

Dental pathologies
Only 3 maxillary teeth are preserved isolated, the first incisor and the left third molar. The mandibular

second and third molars were lost during life; there is an isolated root not identifiable; the other teeth are not preserved.
Some caries on these teeth were detected: one mesial caries of grade 3 on the left first incisor; three caries at the cemento-enamel junction on the right first incisor: one buccal, one distal and one mesial of grade 1.
Enamel hypoplasia occurred between 3 and 4.5 years of age, with three episodes.

Anatomical variants
In the skull the parietal foramen on the right side is present.

Ergonomy
The individual shows a medium development of the observable muscular insertions, except for the brachioradialis of both humeri, the pronator teres and the interosseous tubercle of both radii, and the gluteus maximus on the femurs, which show a strong development.

Pathologies
Diffuse grade 1 periosteal reaction is visible on the femurs, tibiae and left fibula. A healed fracture is in correspondence of the proximal third of the left fibula and of the fourth metatarsal of the left foot.
Osteoarthritis of grade 1 affects the sternal facet of the left clavicle, the distal articular surface of the left humerus, the proximal articular surface of both radii, the proximal articular surface of the right ulna, the articular surface of the left patella, and the articular facet for the talus of the left calcaneus.

SU 2560

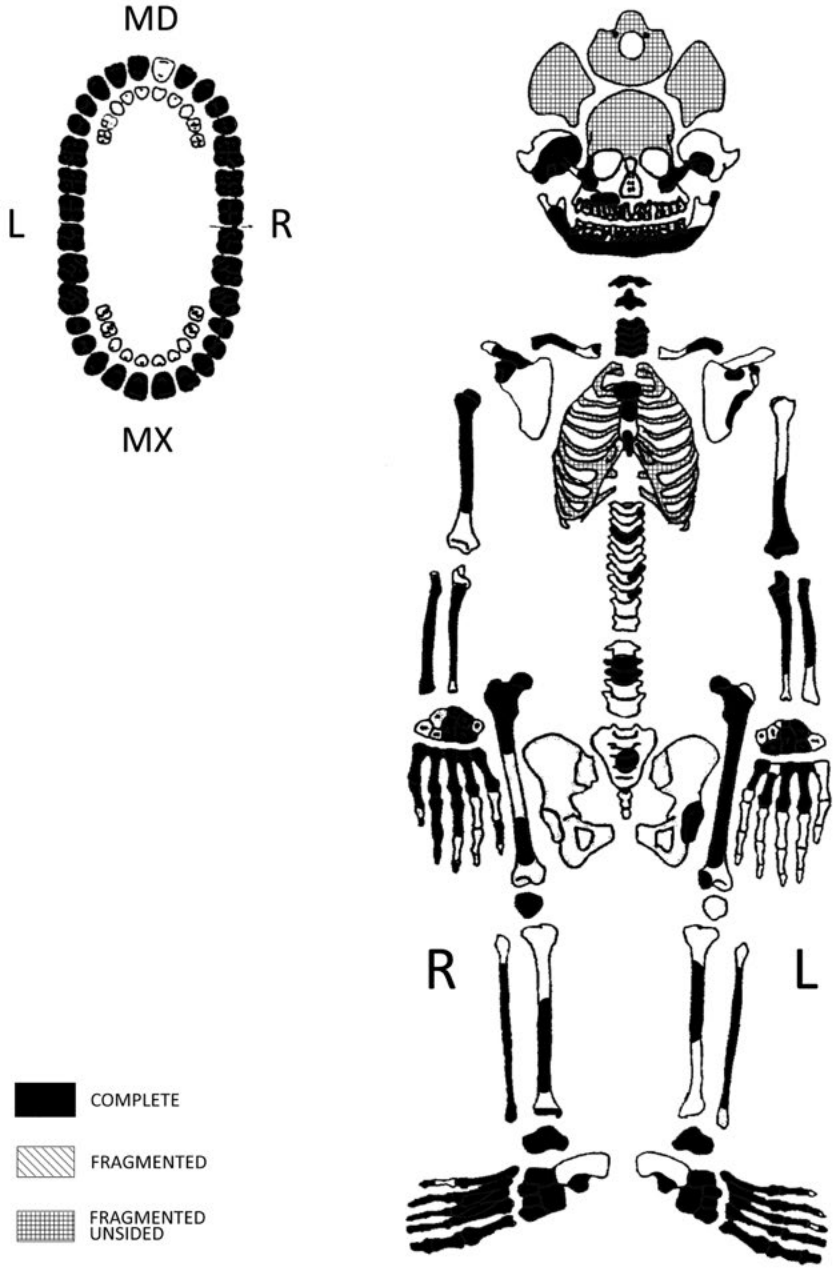


Figure 113

Sex: undeterminable

Age: 16-20 years
Age at death was determined on the basis of dental wear, development of permanent teeth, degree of fusion between diaphyses and epiphyses, and sternal rib end modifications.

Stature: 161.6 cm

Dental pathologies
The maxillary teeth are preserved and isolated, except for the right second incisor, canine, premolars, first and second molar. The mandibular teeth are preserved in situ, except for the left molars, which are isolated, and the right first incisor, which was lost during life.

Mild calculus is present on mandibular teeth.
Enamel hypoplasia occurred between 2.5 and 4.5 years, with three episodes.

Anatomical variants
In the skull the lambdoid ossicles bilaterally are present; in the postcranial skeleton the double facet of the atlas on the right, the complete transverse accessory foramen on C6 on the left side, and the exostosis of the trochanteric fossa on the left femur are present.

Ergonomy
The individual shows a low development of the muscular insertions.

Pathologies
The right ulna is bended.

SU 2760

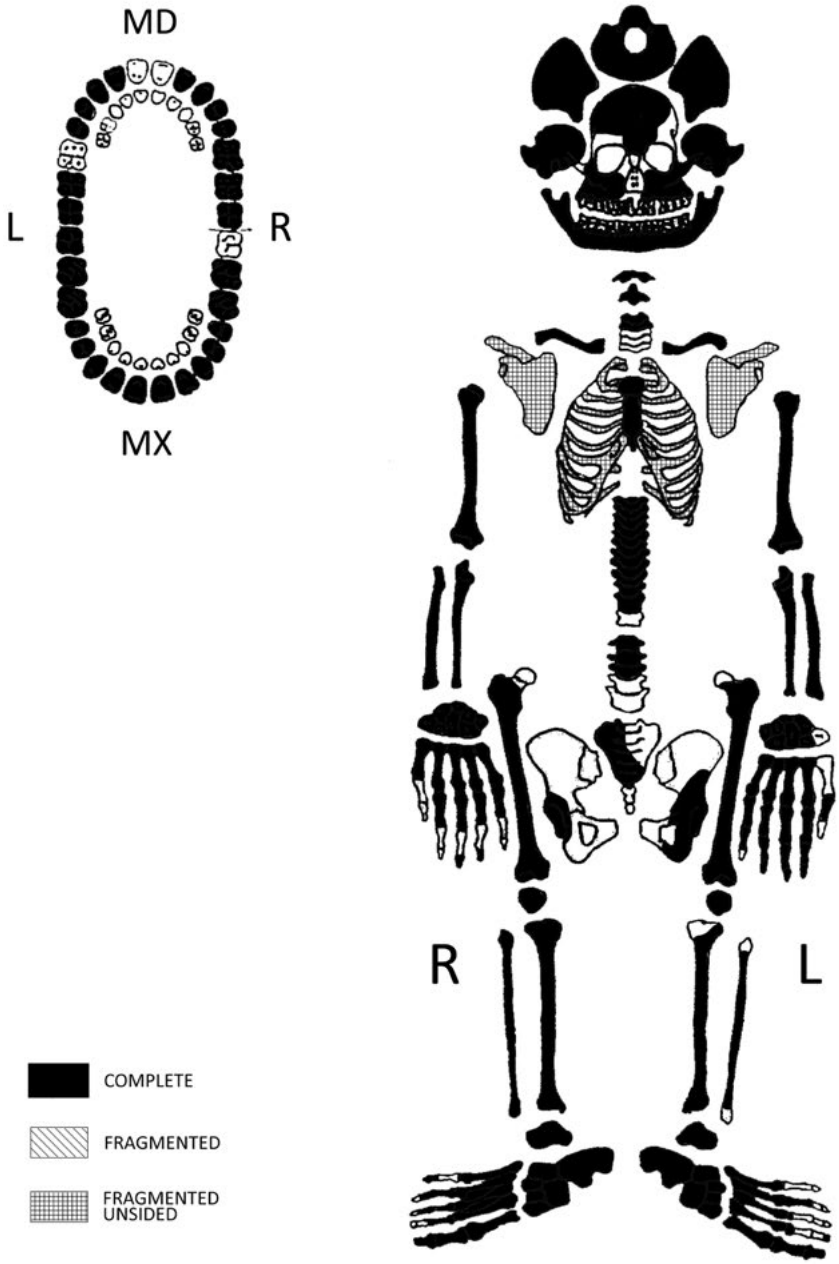


Figure 114

Sex: female
Sex was determined through the observation of three morphological features of the skull, which provided a sexual index of -1.3.

Age: 45-55 years
Age at death was determined on the basis of dental wear and sternal rib end modifications.

Stature: 155.1 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the incisors, which are isolated; the left canine is retained in the bone horizontally. The mandibular teeth are preserved in situ, except for the left first molar, which was lost during life, and the central incisors, which were lost post-mortem.
One grade 1 distal caries was observed on the maxillary left third molar at the cemento-enamel junction; there is one buccal caries of grade 2 on the mandibular right third molar at the cemento-enamel junction.
Alveolar resorption of grade 1 affects both the maxilla and the mandible.
Strong calculus is present on the maxillary and the mandibular teeth.
Enamel hypoplasia occurred between 2 and 4 years, with four episodes.

Anatomical variants
In the skull the complete metopic suture, bilateral zygomatic foramina, lambdoid ossicles on the left and the parietal notch bone on both sides are present.
In the post-cranial skeleton there is the complete transverse accessory foramen on C5 on the right, the vastus notch on both patellae, the accessory facet on the distal epiphysis on the left tibia, the double anterior facet on both calcanei and the accessory facet on the neck of both talii.

Ergonomy
The individual shows a low/medium development of the muscular insertions, except for the deltoid of the clavicles and the biceps brachii of the right radius, which show a strong development.

Pathologies
Grade 1 osteoarthritis affects the joints of the clavicles, the distal articular joints of the humeri, the articular joint for the talus of the right calcaneus and the thoracic vertebrae. Diffuse grade 1 periosteal reaction is present on femurs, tibiae and fibulae.

SU 2761

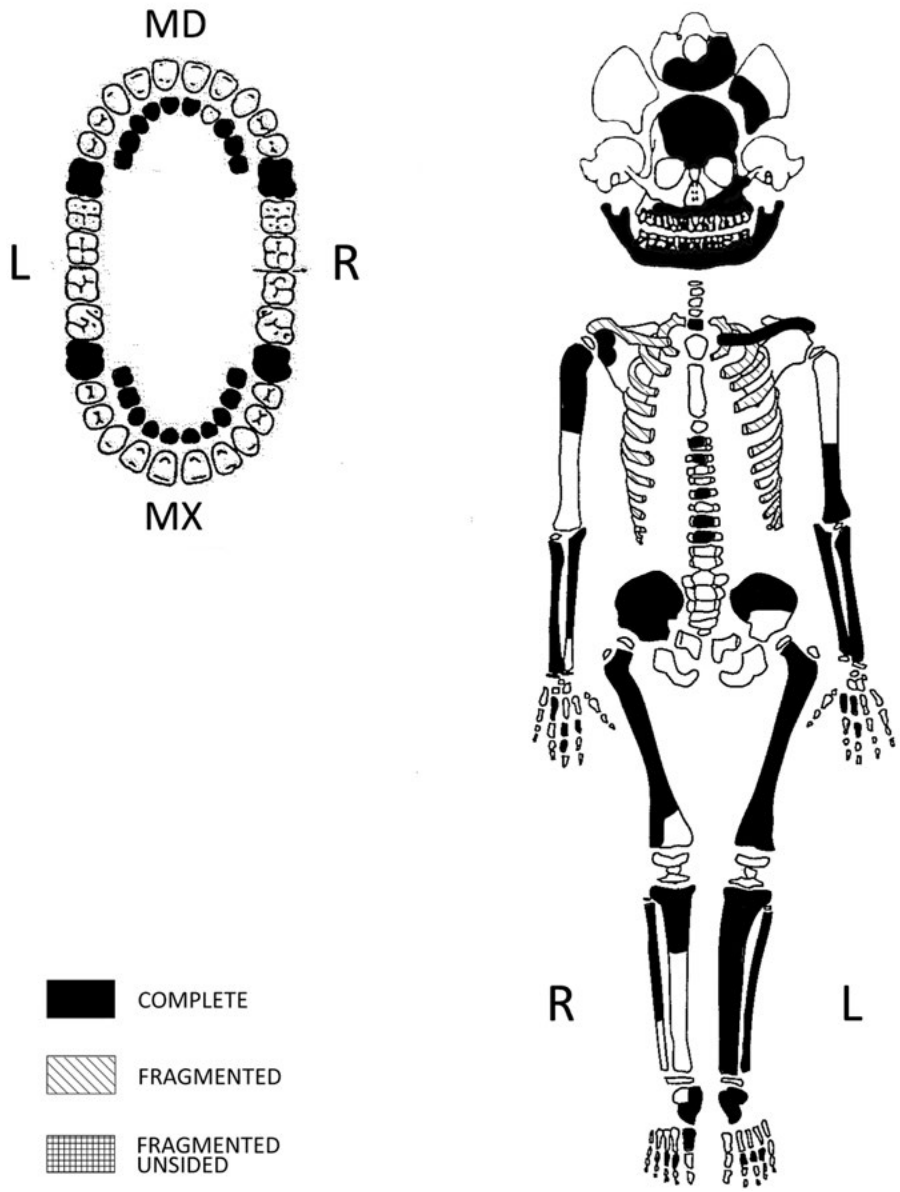


Figure 115

Sex: undeterminable

Age: 1.5-3 years
Age at death was determined on the basis of dental eruption, fusion between diaphyses and epiphyses and long bone length.

Dental pathologies
The deciduous maxillary teeth are preserved in situ. The deciduous mandibular teeth are preserved in situ, except for the right second incisor, which was lost post-mortem. The permanent first molars are in form of germ.

Anatomical variants
In the skull bilateral zygomatic foramina and lambdoid ossicles on the left were observed.

Pathologies
No pathologies were observed.

SU 2762

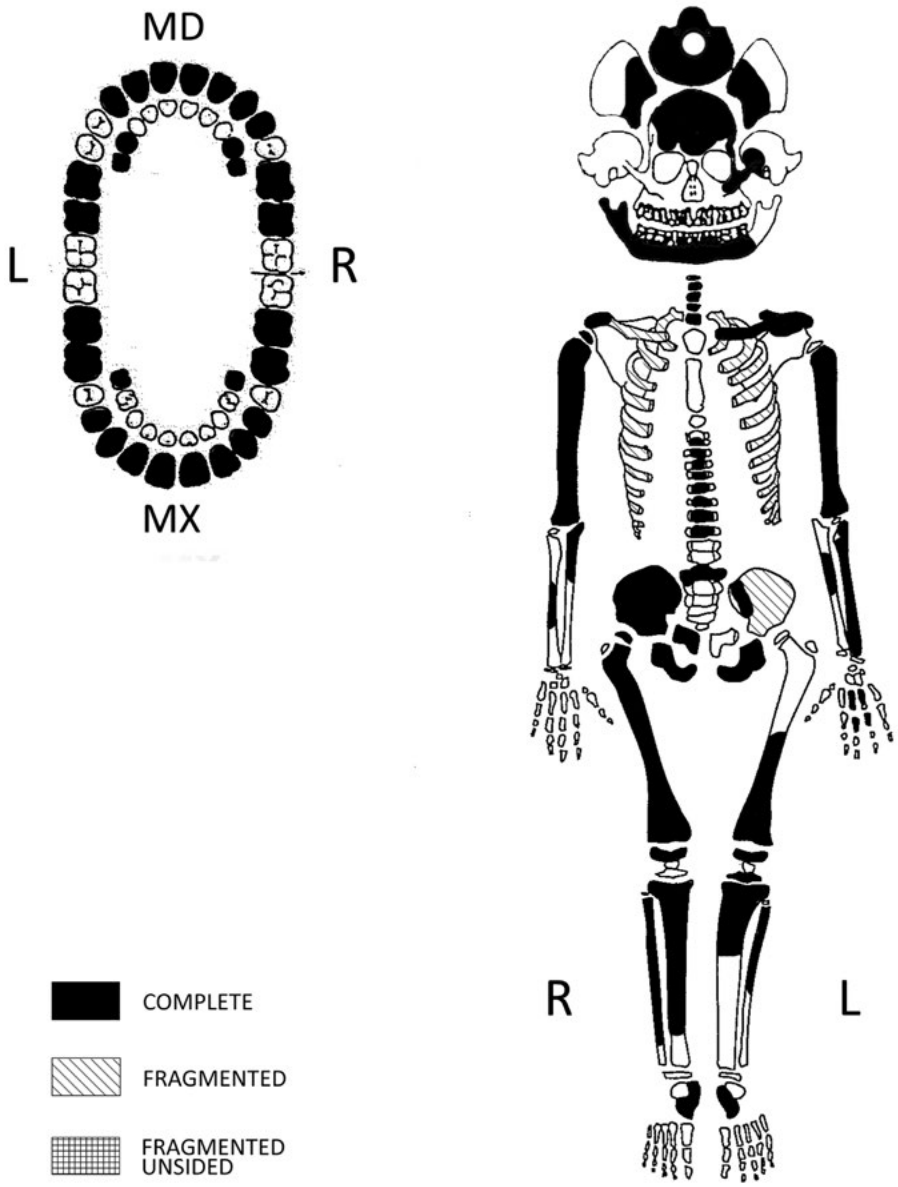


Figure 116

Sex: undeterminable

Age: 9 years
Age at death was determined on the basis of dental eruption, degree of development of permanent teeth, long bone length, and degree of fusion between epiphyses and diaphyses.

Dental pathologies
The maxillary teeth are preserved isolated, except for the second premolars, which are missing; the deciduous second molars are isolated. The mandibular teeth are preserved in situ, except for the left premolars and the right second premolar, which are missing; the canines and second molars are in eruption; the deciduous molars are in situ.
Two caries were observed on deciduous mandibular teeth, both mesial at the cemento-enamel junction: one caries of grade 2 on the left first molar, and one caries of grade 1 on the right first molar.
Mild calculus is present only on the mandibular teeth.
Enamel hypoplasia occurred between 2 and 5 years, with five episodes.

Anatomical variants
In the postcranial skeleton the transverse accessory foramen on the right side of C6 is present.

Pathologies
Cribra cranii of grade 1 are observed on the left parietal bone and cribra orbitalia of grade 2 are visible on both orbital roofs. Diffuse grade 1 periosteal reaction is present on the right femur and tibia.
The coronal suture is obliterated, resulting in craniosynostosis; in the internal plate digitated impressions are clearly detectable.

SU 2763

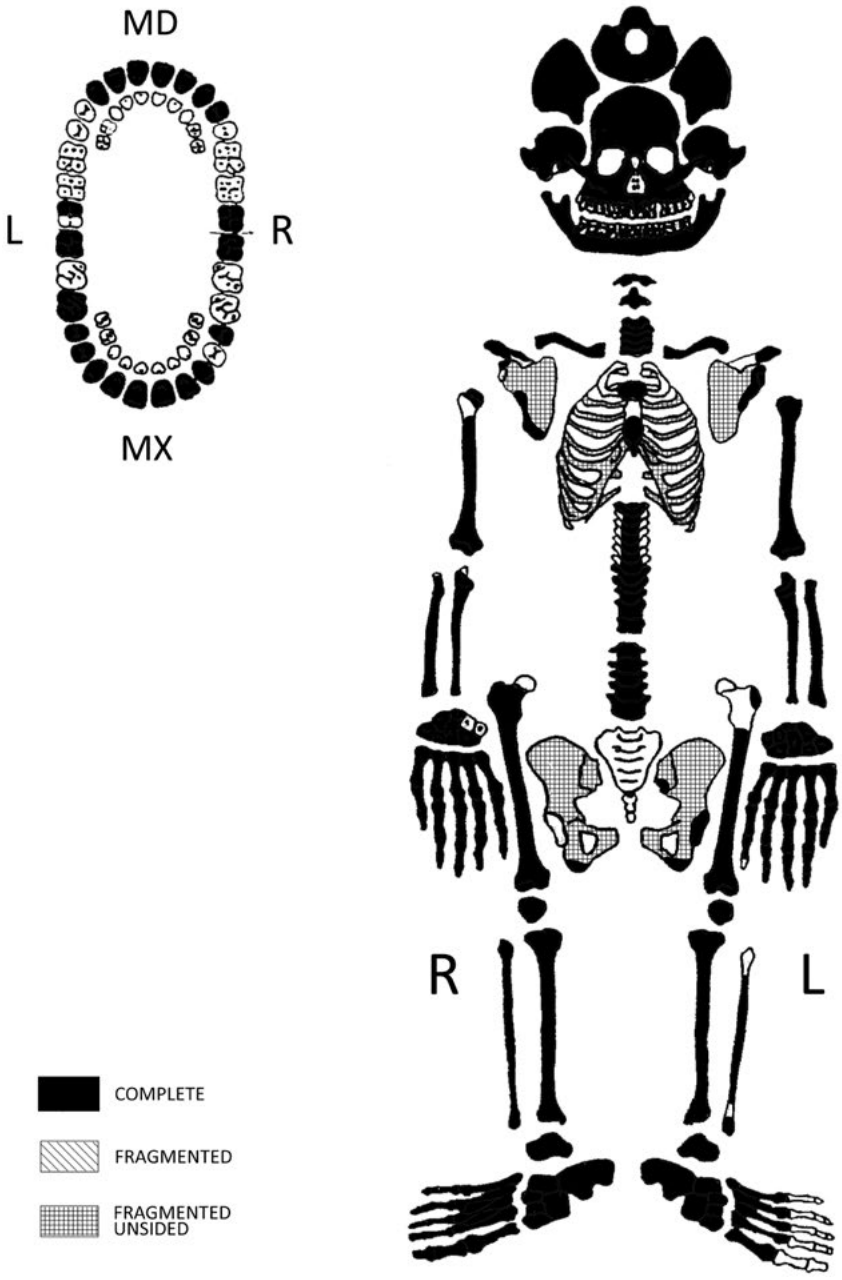


Figure 117

Sex: female
Sex was determined through the analysis of fourteen morphological features of the skull, which provided a sexual index of -1.3.

Age: 40-50 years
Age at death was determined on the basis of dental wear, morphology of the pubic symphysis, and sternal rib end modifications.

Stature: 165.1 cm

Dental pathologies
All maxillary teeth are present and in situ, except for the left second molar, right first premolar, first and second molar, which were lost during life. All mandibular teeth are present and in situ, except for the left premolars, first and second molar, right second premolar, and first and second molar, which were lost during life.
Several caries were observed. In the maxillary teeth one grade 2 mesial caries affects the left first incisors at cemento-enamel junction, one grade 4 caries affects the left second incisor and canine, one grade 1 distal the left first molar. In the mandibular teeth one grade 3 mesial is present on the right canine and one grade 1 lingual on the right third molar.
Enamel hypoplasia occurred between 2 and 5 years, with four episodes.
Alveolar resorption of grade 2 affects maxilla and mandible.
Mild calculus affects the maxillary teeth, strong the mandibular ones.

Anatomical variants
In the skull the complete supraorbital foramen on the right, multiple infraorbital foramina on the left, a zygomatic foramen on the right, the parietal notch bone on both sides, and the condylar canal on both sides are present. In the postcranial skeleton the transverse accessory foramina partial on both side of C4, on the left of C5 and on the right of C6, the unfused acromion of both scapulae, and the anterior double facet on the left calcaneus are present.

Ergonomy
The individual shows a low-medium development of muscular insertions, except for the deltoid of the clavicle, which has a strong development on the right and very strong on the left, the pectoralis major of the left clavicle and the gluteus maximus of both femurs, which have a strong development.

Pathologies
Cribra orbitalia are present on the left orbit. Diffuse grade 1 periosteal reaction is visible on femurs and tibiae. A healed blunt force trauma, measuring 4 x 1.5 cm, is present on the right parietal bone. Osteoarthritis of grade 1 affects the majority of the articular surfaces, the vertebral bodies and facets; grade 2 osteoarthritis affects the left superior articular process of the sacrum. There is the lumbarization of S1.

SU 2764

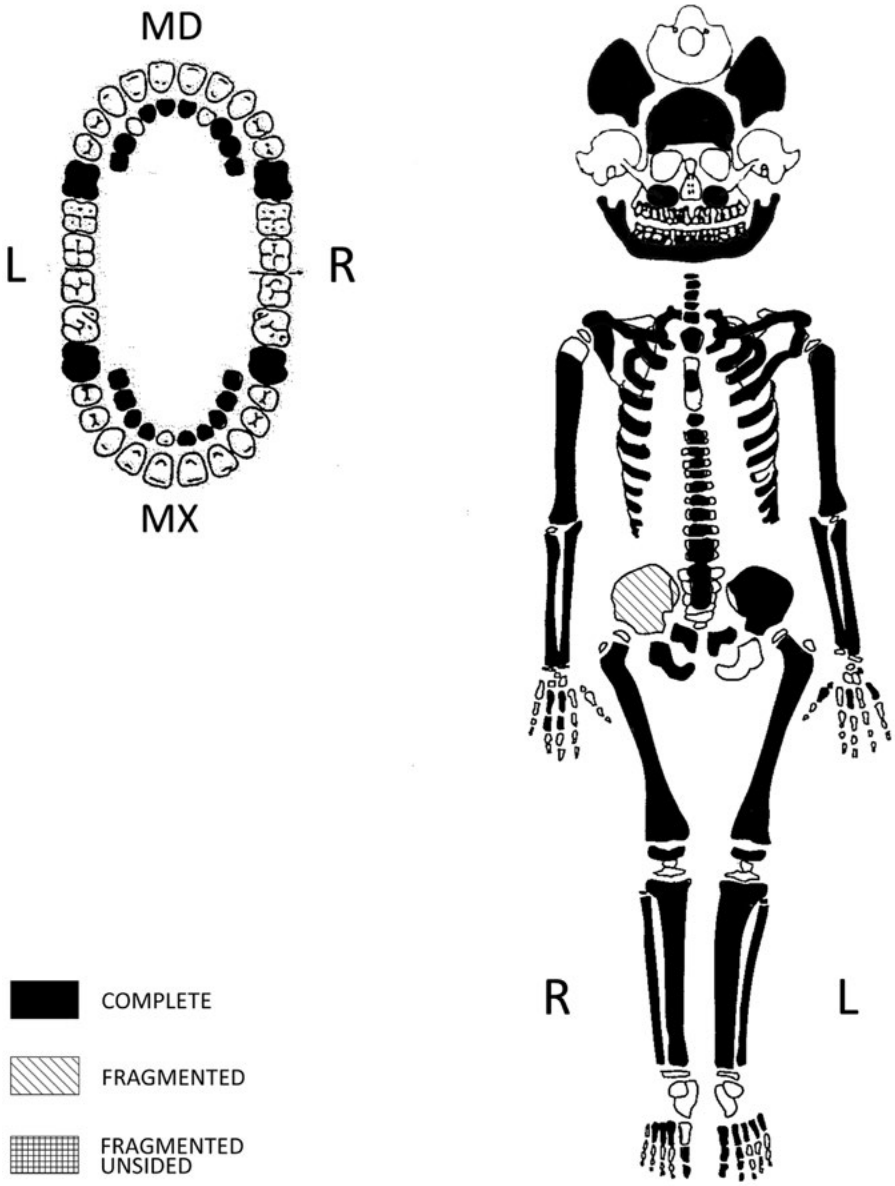


Figure 118

Sex: undeterminable

Age: 5-7 years
Age at death was determined on the basis of dental eruption, development of permanent teeth, degree of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
The deciduous teeth are all present and in situ, except for the maxillary left second incisor, canine and molars, which are isolated, the maxillary left first incisor and mandibular left canine and right second incisor, which were lost post-mortem. The permanent maxillary and mandibular first molars are in situ; the maxillary left first incisor, canine and premolars, mandibular second molars are in form of germs.
Enamel hypoplasia occurred at 4 years, with one episode.

Anatomical variants
In the skull the complete metopic suture, multiple zygomatic foramina on the left, the parietal foramen on the right, the lambdoid ossicles on the right, the asterionic bone on both sides, and the extrasutural mastoid foramen on both sides are present.

Pathologies
Cribra orbitalia are visible on the right orbit.

SU 2765

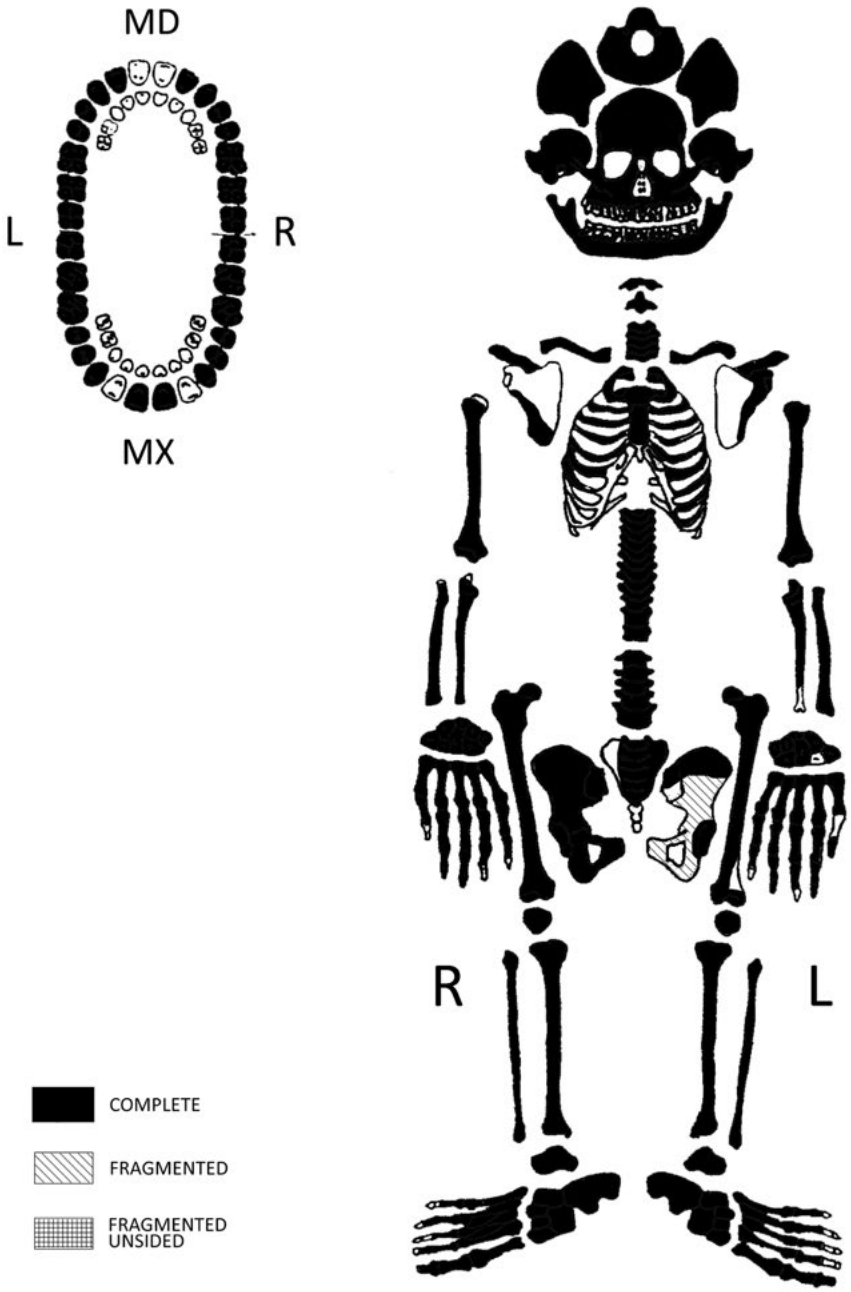


Figure 119

Sex: female
Sex was determined through the analysis of twelve morphological features of the skull and eight of the pelvis, which provided a total sexual index of -1.

Age: 35-45 years
Age at death was determined on the basis of dental wear, morphology of the auricular surface of the ilium, and sternal rib end modifications.

Stature: 156.2 cm

Dental pathologies
All maxillary teeth are preserved and in situ, except for the second incisors, which were lost during life. All the mandibular teeth are present and in situ, except for the first incisors, which were lost during life.
In the maxillary teeth one grade 3 mesial caries at cemento-enamel junction affects both the left and right third molar; in the mandible one grade 3 mesial at the root of the left first molar and one grade 2 mesial caries at the cemento-enamel junction on the left second molar are present.
Enamel hypoplasia occurred between 2.5 and 4 years, with four episodes.
Alveolar resorption of grade 2 affects the maxilla and the mandible.
Strong calculus is present on the anterior mandibular teeth.

Anatomical variants
In the skull the complete metopic suture, the complete supraorbital foramen on the left, the complete infraorbital suture on both sides, two infraorbital foramina on the left, multiple zygomatic foramina on both sides, the parietal foramen on the right, the extrasutural mastoid foramen on both sides, and the precondylar tubercle are present.
In the postcranial skeleton the transverse accessory foramen partial on both sides of C5 and C6, the unfused acromion on the scapulae, the septal aperture on both humeri, and the throclear extension on both talii are visible.

Ergonomy
The individual shows a medium development of muscular insertions, except for the conoid ligament and the triceps brachii of the right clavicle, the pectoralis major of both clavicles, and the brachioradialis of the right humerus, which show a strong development, and the patellar ligament of the right patella, which shows a very strong development.

Pathologies
Osteoarthritis of grade 1 affects the acromial facet of the clavicles, the head of the humeri, the proximal articular surface of the ulnae, the distal articular surface of the right ulna, the proximal and distal articular surface of the femurs, the distal articular surface of the fibulae, the calcanear articular surface of the talii, and the bodies and facets of the vertebrae. Diffuse grade 1 periosteal reaction is visible on femurs and tibiae. Schmorl's nodes affects the thoracic and lumbar vertebrae. A healed fracture affects the diaphysis of the right clavicle. Lytic lesions are present on the antero-superior margin of L2 and L3, suggesting possible brucellosis.

SU 2792

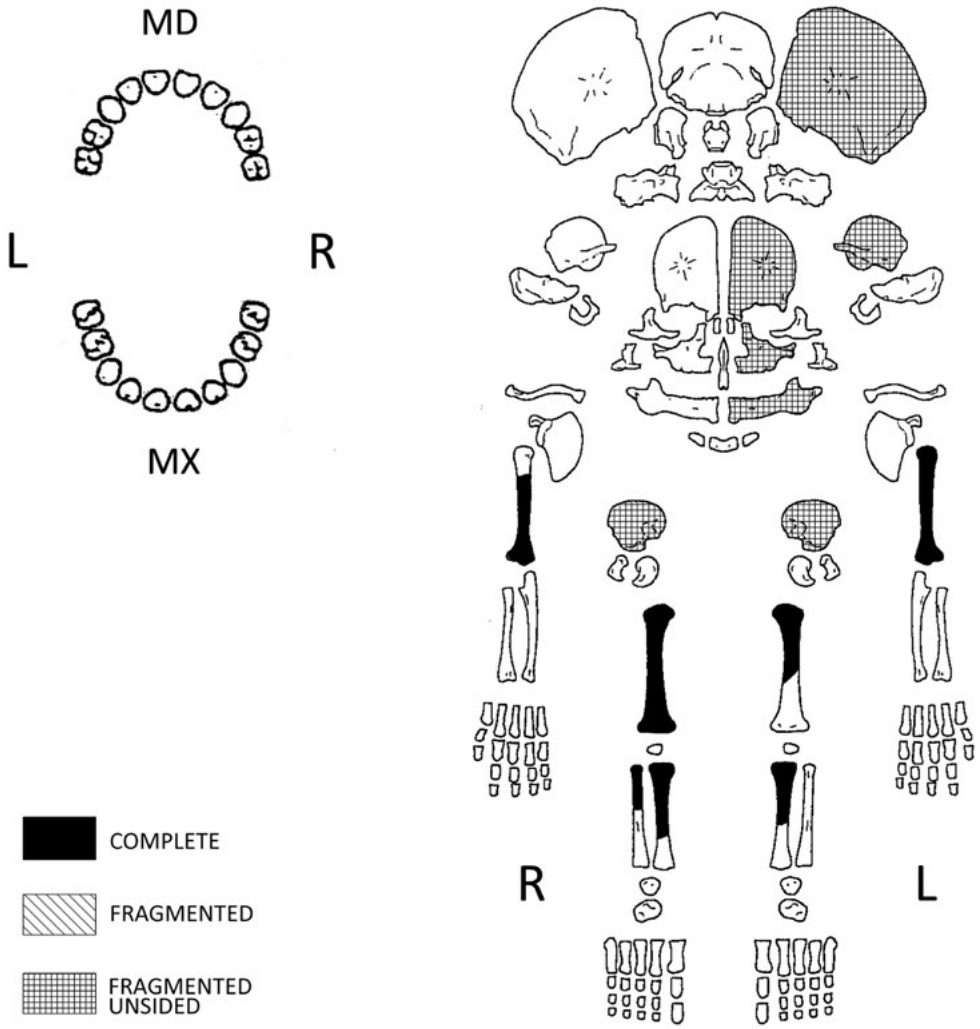


Figure 120

Sex: undeterminable

Age: newborn
Age at death was determined on the basis of long bone length.

SU 2793

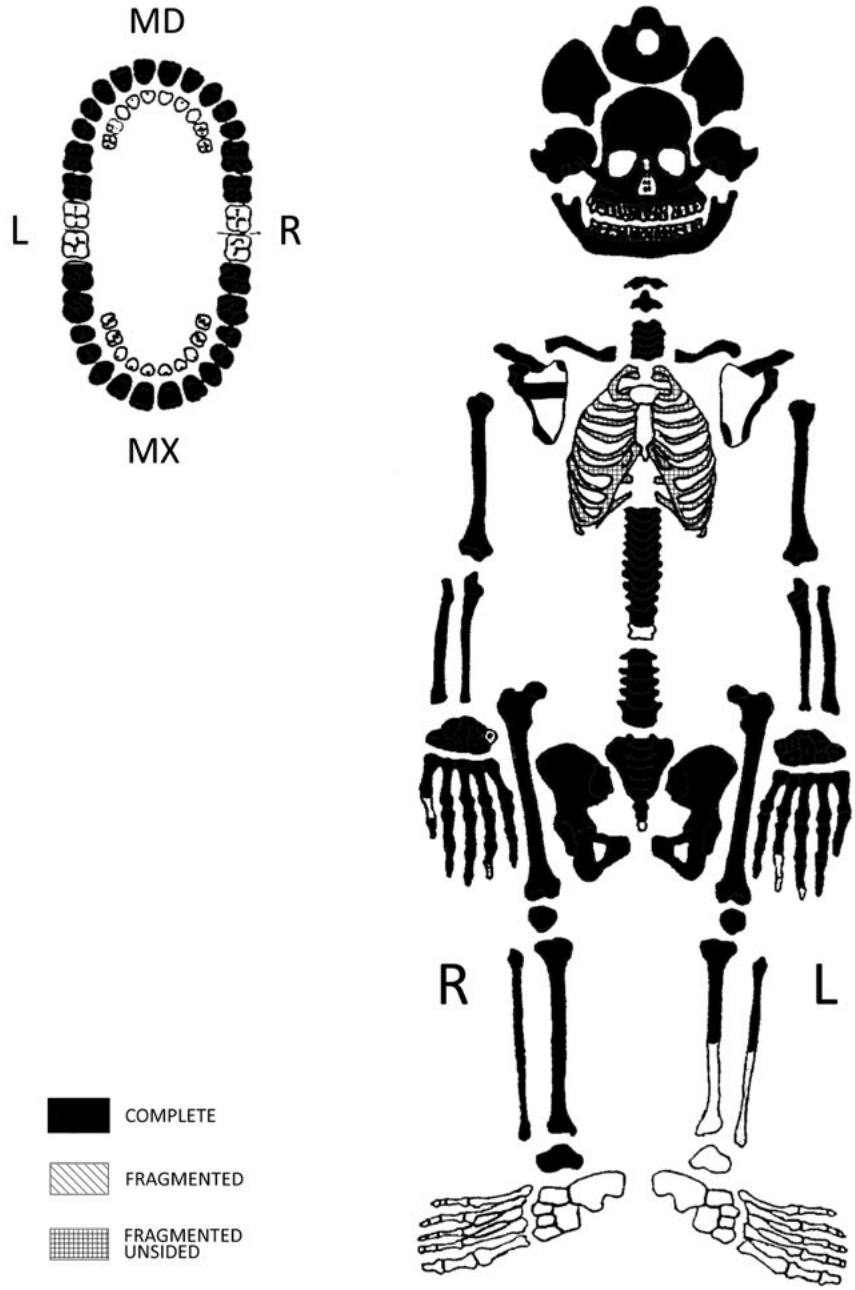


Figure 121

Sex: female
Sex was determined through the analysis of fourteen morphological features of the skull and eight of the pelvis, which provided a total sexual index of -0.4.

Age: 40-50 years
Age at death was determined on the basis of dental wear, morphology of the pubic symphysis, and sternal rib end modifications.

Stature: 153.7 cm

Dental pathologies
The maxillary and the mandibular teeth are all in situ. There is an agenesia of the third molars.
Mild calculus is present on both the maxillary and the mandibular teeth.
Alveolar resorption of grade 3 affects the maxilla at the level of the first premolars and the anterior teeth. On the mandible the resorption is of grade 2.
There are three caries on the left maxilla: one mesial of grade 2 on the second incisor at the cemento-enamel junction; one distal of grade 2 on the canine, and one mesial of grade 1 on the first molar. On the mandible, only one buccal caries of grade 2 affects the left first premolar at cemento-enamel junction.
Enamel hypoplasia occurred between 2 and 4.5 years, with six episodes.

Anatomical variants
In the skull the complete metopic suture, the bilateral infraorbital suture, the zygomatic foramina (one on the left, multiple on the right), the parietal foramina, some lambdoid ossicles, the condylar canal, the coronal ossicles on the right, and the asterionic bone are present.
On the post-cranial skeleton, only the accessory facet on the neck of the right talus is observed.

Ergonomy
The individual shows a low/medium development of the muscular insertions.

Pathologies
There is a diffuse grade 1 periosteal reaction on the femurs, tibiae and fibulae.
Grade 1 osteoarthritis affects the margins of a few thoracic vertebrae, the distal joints of the femurs, the distal joint of the right humerus and the proximal joint of the right ulna.
There is porosity of the vertebral plates of the cervical vertebrae, indicating inflammation in the disk.

SU 2794

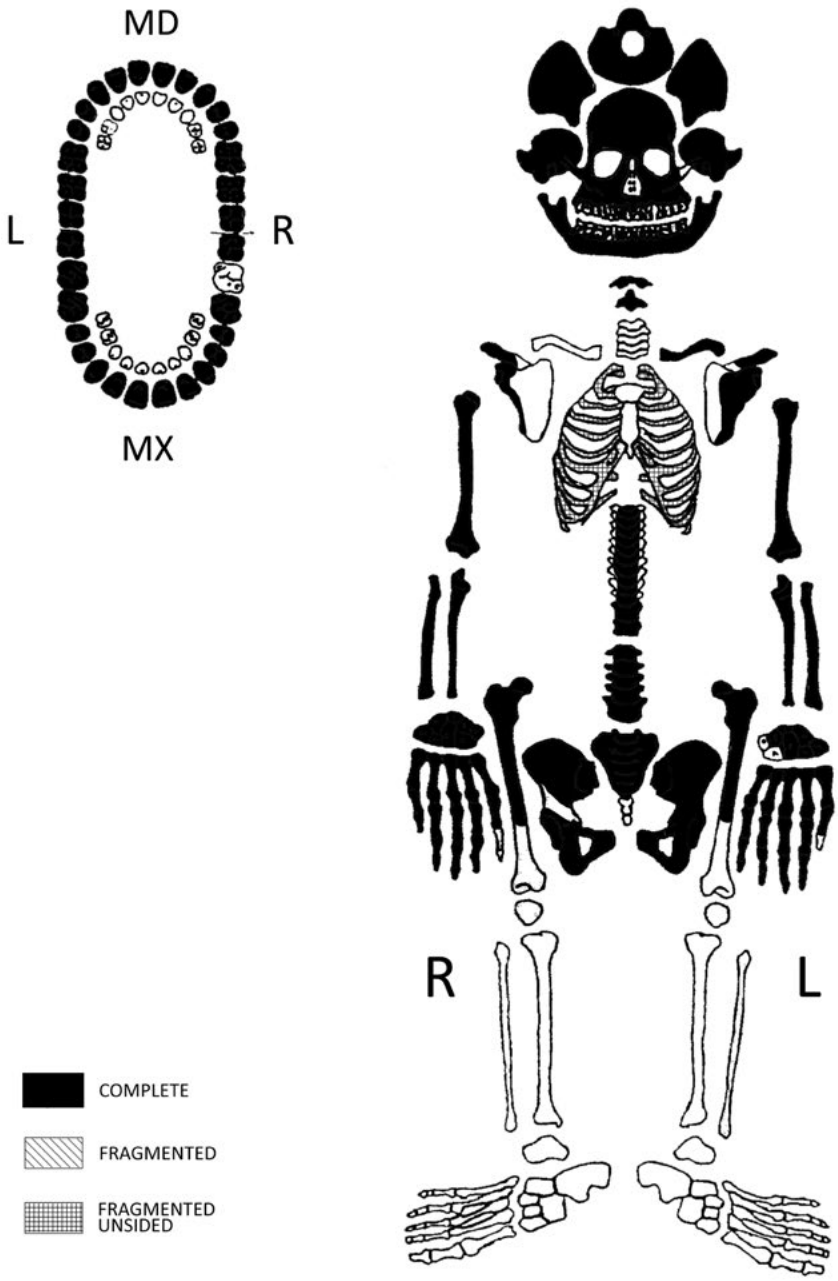


Figure 122

Sex: female
Sex was determined through the analysis of fourteen morphological features of the skull and nine of the pelvis which provided a total sexual index of -0.9.

Age: 30-40 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, morphology of the pubic symphysis and of the auricular surface of the ilium.

Stature: 146.0 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the right first and third molars, which were lost during life; the second premolars are preserved as root. The mandibular teeth are all preserved in situ.
Strong calculus is present on the maxillary and the mandibular teeth.
Alveolar resorption of grade 1 affects the maxilla, and grade 2 affects the mandible.
In the maxillary teeth there are one grade 4 caries on the left second premolar and two caries on the right side: one distal of grade 1 on the first incisor, one of grade 4 on the second premolar.
The maxillary right second premolar and the two mandibular canines are rotated.
Enamel hypoplasia is occurred at 3.5 years, with one episode.

Anatomical variants
In the skull zygomatic foramina (one on the left, multiple on the right), the coronal ossicles on the left, and the parietal notch bone on the right are present.
In the post-cranial skeleton the accessory transverse foramen on the left side of C6 is present.

Ergonomy
The individual shows a low development of the muscular insertions, except for the gluteus maximus of the femurs, which has a very strong on the right and strong development on the left.

Pathologies
Grade 1 osteoarthrosis affects the proximal articular surface of the ulnae. There is the sacralisation of the coccyx.

Trench 11

SU 2550

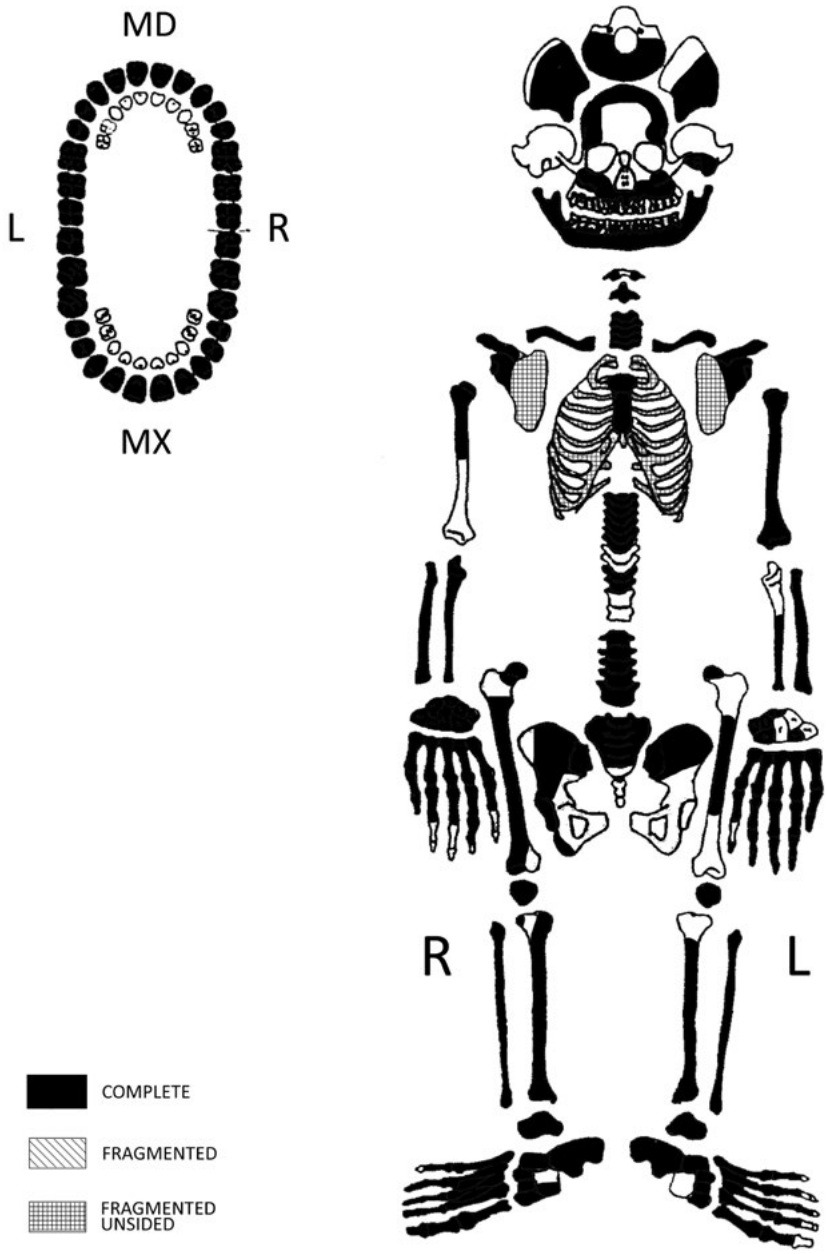


Figure 123

Sex: female
Sex was determined through the analysis of twelve morphological features of the skull and seven of the pelvis, which provided a total sexual index of -1.5.

Age: 18-22 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, morphology of the pubic symphysis, and degree of fusion between diaphyses and epiphyses.

Stature: 153.5 cm

Dental pathologies
All the maxillary teeth are in situ, except for the right maxillary molars that are isolated. All mandibular teeth are in situ.
Microdontia of the third left maxillary molar is observed.
Mild enamel hypoplasia occurred between 1.5 and 4.5 years, with eight episodes.

Anatomical variants
In the skull the complete metopic suture, two complete supraorbital foramina bilaterally, the parietal foramen on the suture bilaterally, the sagittal ossicles, the lambdoid ossicles bilaterally and the extrasutural mastoid foramen on the right are present.
In the postcranial skeleton the unfused acromial epiphysis on both scapulae, the complete accessory transverse foramen on the right in C5 and C7 and on the left in C6, the septal aperture in the right humerus, the accessory facet on the distal epiphysis of the tibiae and the double anterior facet on the calcanei are present.

Ergonomy
The individual shows a low-medium development of the muscular attachments, except for the trapezoid ligament of the right clavicle, which has a strong development.

Pathologies
Mild osteophytosis of the margin of the left acoustic meatus and Schmorl's nodes on seven thoracic vertebrae are observed. A muscular trauma is visible on the auricular surface of the right ilium, probably related to the delivery.

SU 2551

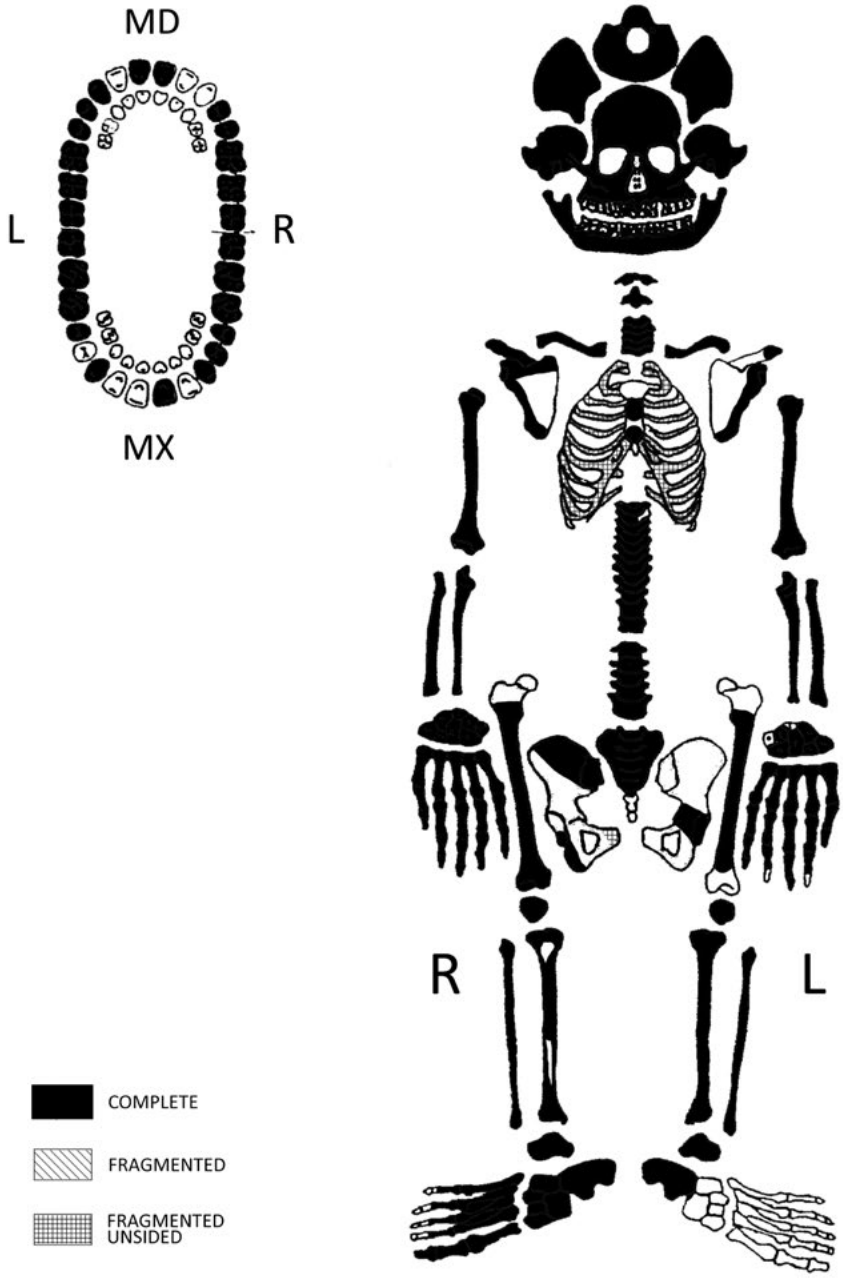


Figure 124

Sex: female
Sex was determined through the analysis of fourteen morphological features of the skull and seven of the pelvis, which provided a total sexual index of -1.4.

Age: 25-35 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, and morphology of the pubic symphysis.

Stature: 155.6 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the left incisors and canine, which were lost post-mortem; there is agenesis of the second right incisor.
The mandibular teeth are preserved in situ, except for the right canine and the second incisors, which were lost post-mortem.

Mild calculus affects the maxillary and the mandibular teeth, strong on the mandibular left canine and maxillary right canine.
Enamel hypoplasia occurred between 1 and 4 years, with six episodes.
A grade 3 caries affects the mesial side of the maxillary right second molar.

Anatomical variants
In the skull the complete supraorbital foramen on the right, the zygomatic foramina on the left maxilla, the parietal foramina, and the condylar canal bilaterally are present. In the post-cranial skeleton the accessory transverse foramen on the left in C5 and the accessory facets on the distal epiphysis of the tibiae are present.

Ergonomy
The individual shows a low muscular development, except for the deltoid of the right clavicle, which has a strong development.

Pathologies
Ossification of the yellow ligaments are present on the thoracic vertebrae. Schmorl's nodes affect two thoracic and three lumbar vertebrae.

SU 2552

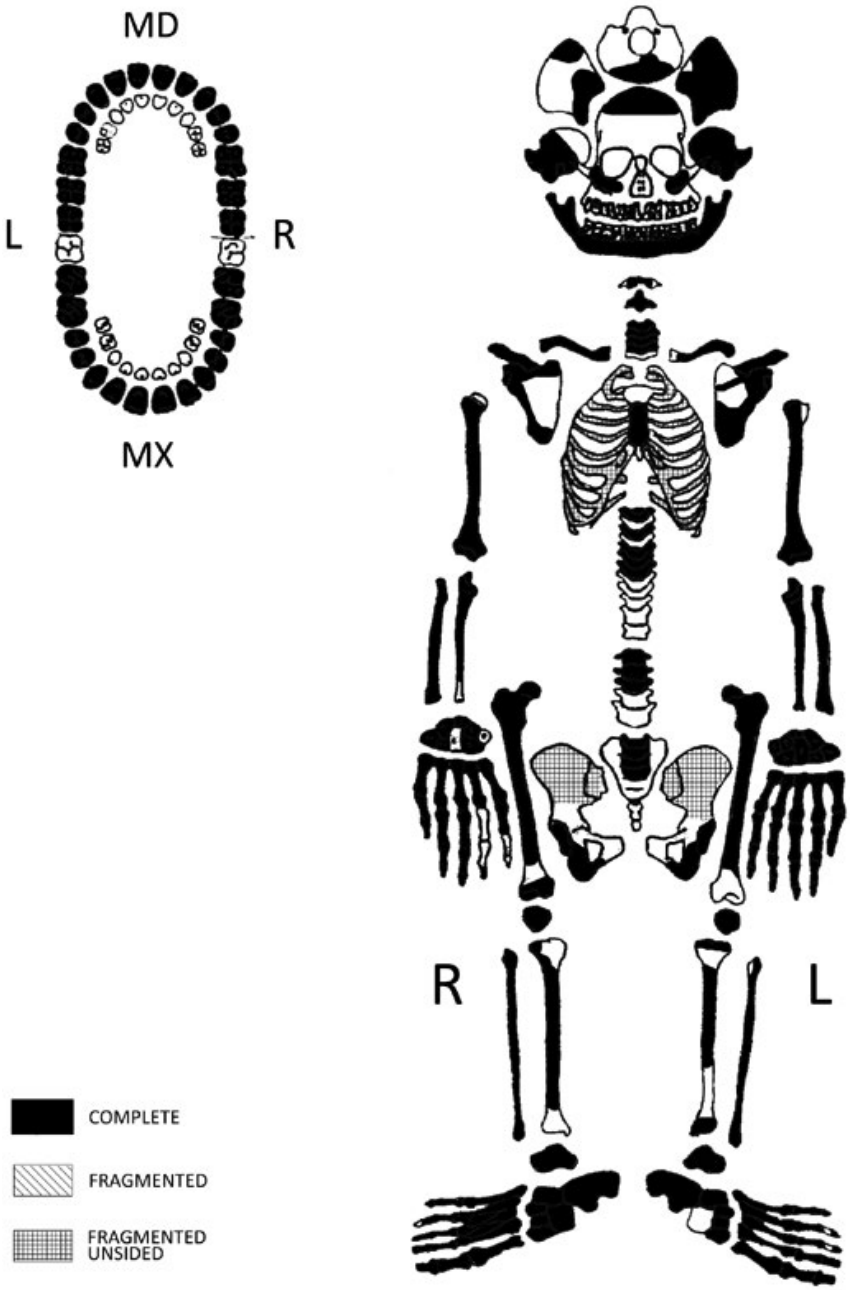


Figure 125

Sex: female
Sex was determined through the analysis of nine morphological features of the skull and three of the pelvis, which provided a total sexual index of -0.9.

Age: 13-15 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, and stage of fusion between diaphyses and epiphyses.

Dental pathologies
The maxillary teeth are preserved in situ, except for the right second molar, left incisors, canine and first premolar, which are isolated. The mandibular teeth are preserved in situ, except for the first incisors, which are isolated. The mandibular third molar are in form of germ, whereas the maxillary third molars are absent.
There is a grade 1 caries on the occlusal surface of the maxillary right second molar.
Enamel hypoplasia occurred between 1.5 and 5 years, with eight episodes.
Mild calculus affects the maxillary and the mandibular teeth.

Anatomical variants
In the skull the complete metopic suture, the complete infraorbital suture on the left, the zygomatic foramen bilaterally, the lambdoid ossicles on the left, and the extrasutural mastoid foramen bilaterally are present.
In the post-cranial skeleton the accessory facet of the distal epiphysis of the tibiae is present.

Pathologies
Cribra cranii is observable on both parietal bones and cribra femoralia on both femoral necks. Enlarged vascular foramina are visible on the vertebral bodies.

SU 2553

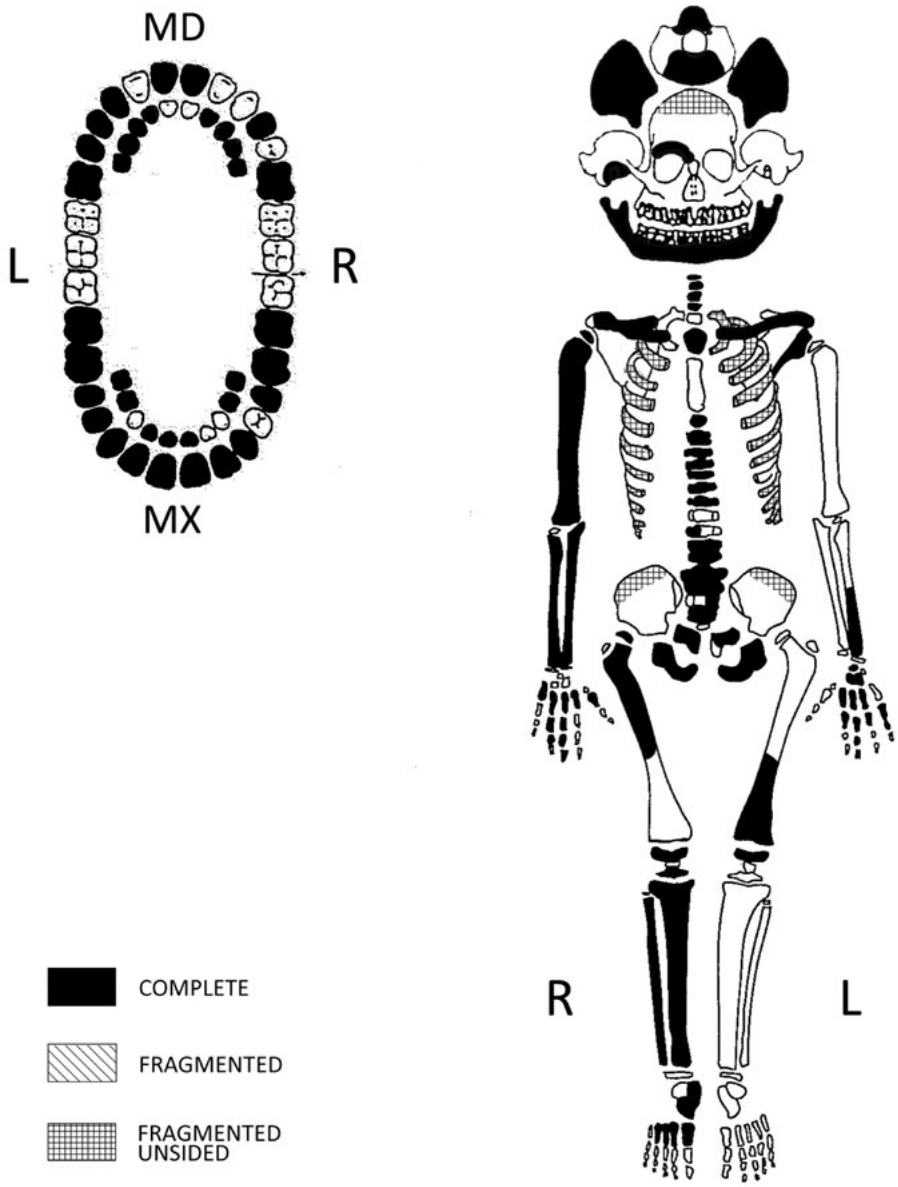


Figure 126

Sex: undeterminable

Age: 6-7 years
Age at death was determined on the basis of dental wear and stage of fusion between diaphyses and epiphyses.

Dental pathologies
The maxillary permanent teeth are preserved and isolated and in form of germ, except for the first molars, which are erupted; the maxillary deciduous teeth are preserved isolated, except for the canines, which are missing.
The permanent mandibular teeth are preserved in situ; the teeth are in form of germ, except for the first molars, which are erupted. The deciduous mandibular teeth are preserved in situ, except for the central incisors, which are missing.
Mild enamel hypoplasia occurred between 1.5 and 4 years, with five episodes.

Anatomical variants
In the skull the parietal foramen is present on the suture and some lambdoid ossicles on the right are present.

Pathologies
Enlarged vascular foramina are visible on the vertebral bodies and cribra femoralia on the neck of the right femur. The second and third phalanges of the fifth finger of the right foot are fused.

SU 2554

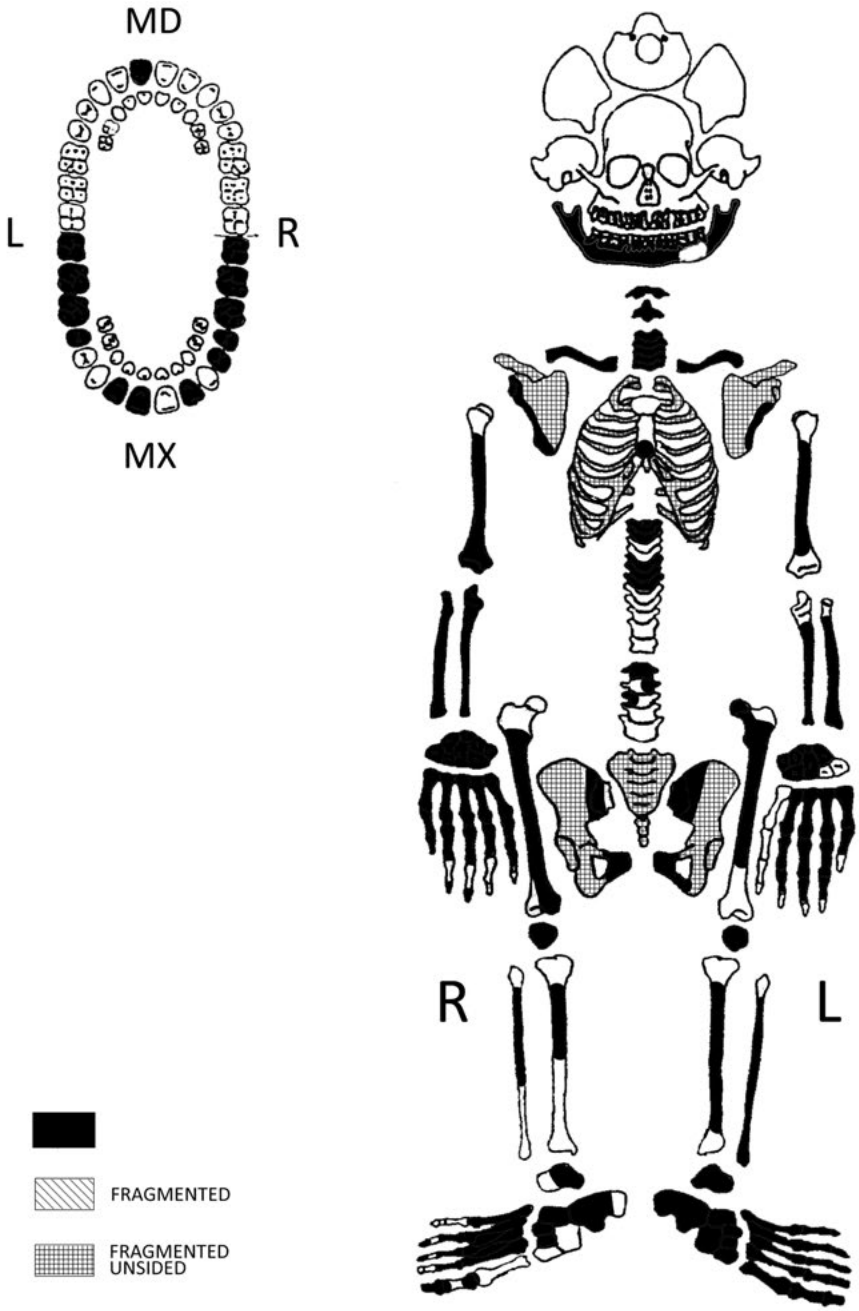


Figure 127

Sex: female
Sex was determined through the analysis of three morphological features of the pelvis, which provided a sexual index of -1.

Age: 30-35 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, and morphology of the auricular surface of ilium.

Stature: 150.5 cm

Dental pathologies
The unique maxillary tooth preserved is the left first incisor.
The teeth of the mandible are preserved in situ, except for the left second premolar and molars, which are isolated, and the right first incisor and canine, which were lost post-mortem.
Caries were observed in the mandibular teeth: one grade 1 caries distal on the left first molar, one grade 3 caries buccal on the left third molar and one grade 4 caries on the right first molar. One molar was not identifiable due to a grade 4 caries that destroyed the entire crown.
Alveolar resorption of grade 1 affects the mandible.
Enamel hypoplasia occurred between 1 and 3.5 years, with six episodes.

Anatomical variants
None observed.

Ergonomy
The individual shows a medium development of the muscular insertion, except for the conoid ligament of the clavicles, which shows a strong development.

Pathologies
There is the ossification of the yellow ligaments in the unique lumbar vertebra preserved.

SU 2555

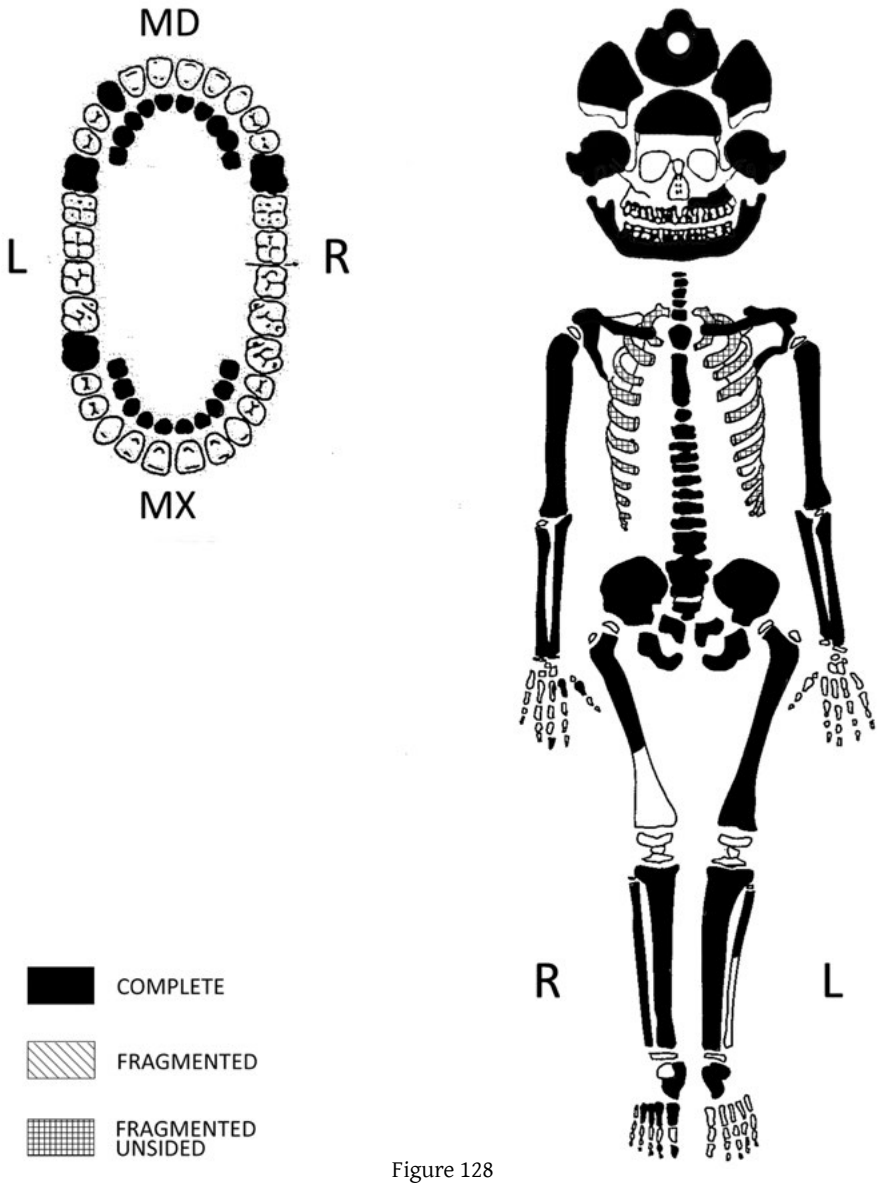


Figure 128

Sex: undeterminable

Age: 2-3 years
Age at death was determined on the basis of stage of dental eruption, stage of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
The deciduous maxillary teeth are preserved in situ, except for the teeth of the right side, which are isolated. The deciduous mandibular teeth are preserved in situ, except for left canine, and the first molars, which are isolated. The germ of the permanent maxillary left first molar, mandibular left canine and first molar and right first molar are preserved in situ.

Anatomical variants
In the skull the lambdoid ossicles on the left are present.

Pathologies
Diffuse grade 1 periosteal reaction is observed on the right tibia and fibula. Enlarged vascular foramina affect some vertebral bodies, in particular of the thoracic and sacral segments.

SU 2857

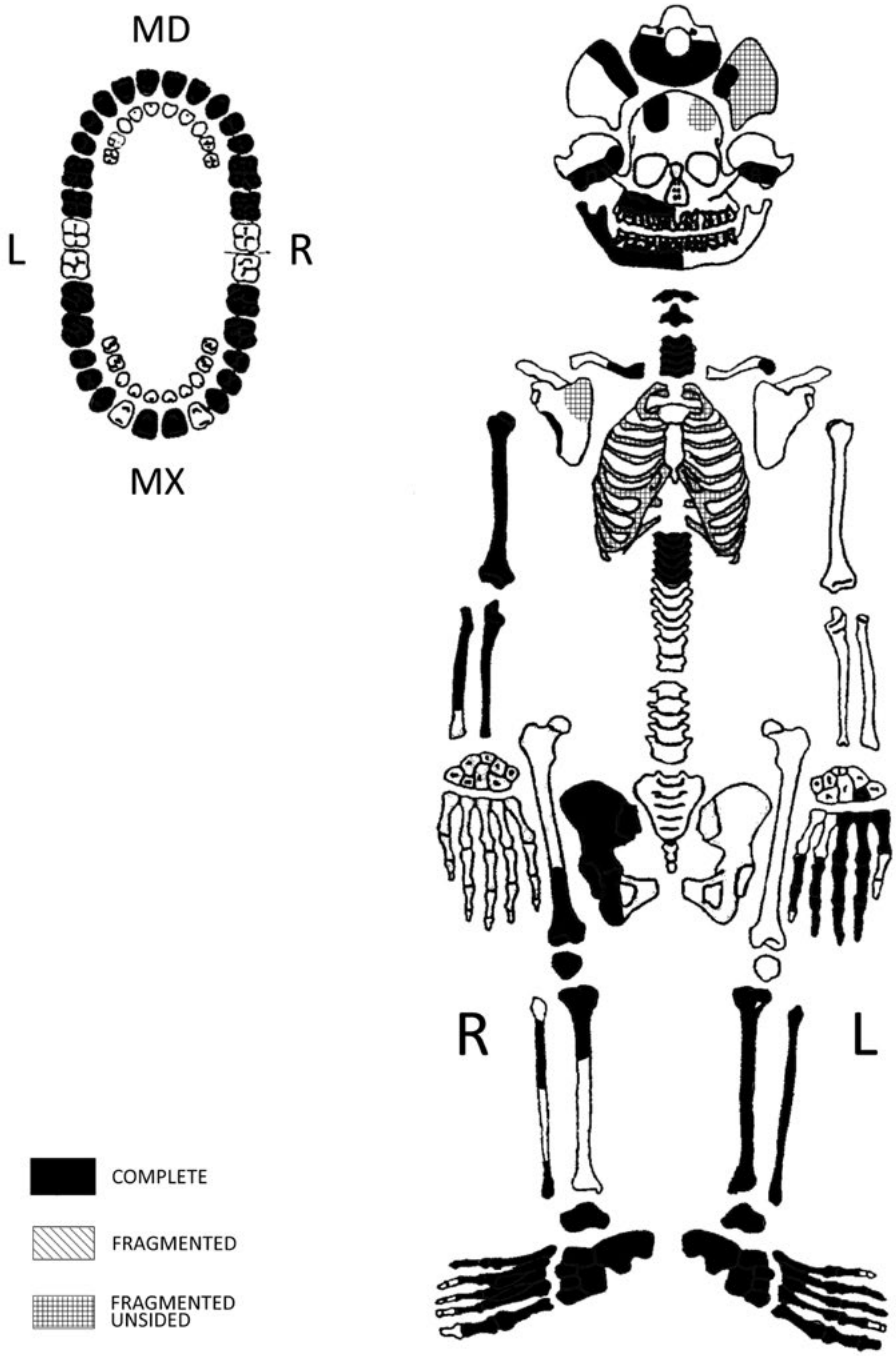


Figure 129

Sex: female
Sex was determined through the analysis of eight morphological features of the skull and seven of the pelvis, which provided a total sexual index of -1.

Age: 18-22 years
Age at death was determined on the basis of dental wear and stage of dental eruption, sternal rib end modifications, stage of fusion between diaphyses and epiphyses, and morphology of auricular surface of the ilium.

Stature: 148.5 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the teeth of the left side, which are isolated, and the second incisors, which were lost post-mortem. The mandibular teeth are preserved in situ, except for the teeth of the left side, which are isolated. The third molars are absent.
Mild calculus is present on the mandibular incisors.
Enamel hypoplasia occurred between 1.5 and 4.5 years, with eight episodes.

Anatomical variants
In the skull the left parietal foramen, the coronal ossicles on the right, the sagittal ossicles, the apical bone, and the lambdoid ossicles on the left are present. In the post-cranial skeleton the accessory transverse foramen on C5 and C6, partial on the left and complete on the right, the septal aperture on the right humerus, the accessory facets of the distal epiphysis of the tibiae, and the double anterior facet on the left calcaneus are present.

Ergonomy
The individual shows a low development of the muscular insertions.

Pathologies
Three healed cranial trauma are visible on the right parietal bone, near the sagittal suture.

SU 2858

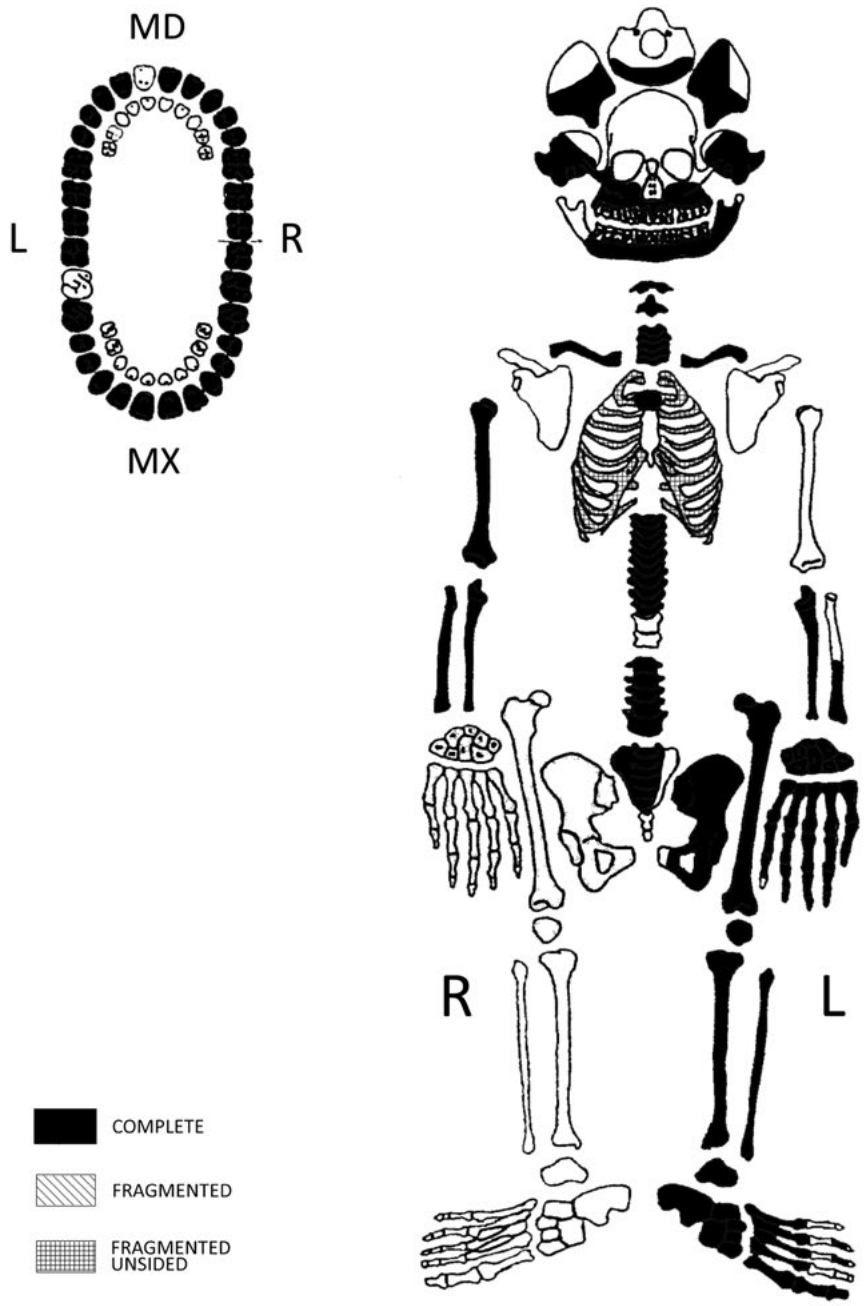


Figure 130

Sex: male
Sex was determined through the analysis of fourteen morphological features of the skull and eight of the pelvis, which provided a total sexual index of 1.2.

Age: 30-40 years
Age at death was determined on the basis of dental wear and morphology of the auricular surface of the ilium.

Stature: 159.8 cm

Dental pathologies
The maxillary teeth are preserved in situ. There seems to be agenesis of the second left molar. The mandibular teeth are preserved in situ, except for the right third molar, which is isolated, and the first right incisor, which was lost post-mortem.
Alveolar resorption of grade 1 affects the maxilla, while grade 2 affects the mandible.
Enamel hypoplasia occurred between 2 and 4 years, with four episodes.
Strong calculus is present on the maxillary and the mandibular teeth, in particular on the right side. An unusual dental wear affects the maxillary left premolars and first molar, possibly related to the strong calculus on the opposite side.
The following caries were observed: one distal grade 3 caries on the left first molar, one mesial grade 3 caries on the right second molar and one occlusal grade 3 caries on the right third molar.

Anatomical variants
In the skull the partial metopic suture, the zygomatic foramen bilaterally, the parietal foramen on the right, the parietal notch bone bilaterally, and the precondylar tubercle are present. In the post-cranial skeleton the suprascapular foramen in both scapulae is present.

Ergonomy
The individual shows a low-medium development of the muscular insertions, except for the conoid ligament and the trapezoid ligament of the clavicles, and the brachialis of the ulnae, which have a strong development, and the gluteus maximus of the right femur, which shows a very strong development.

Pathologies
Cribra orbitalia are visible on both orbital roofs; Schmorl's nodes affect two thoracic and two lumbar vertebrae. There is ossification of the yellow ligaments.

SU 2859

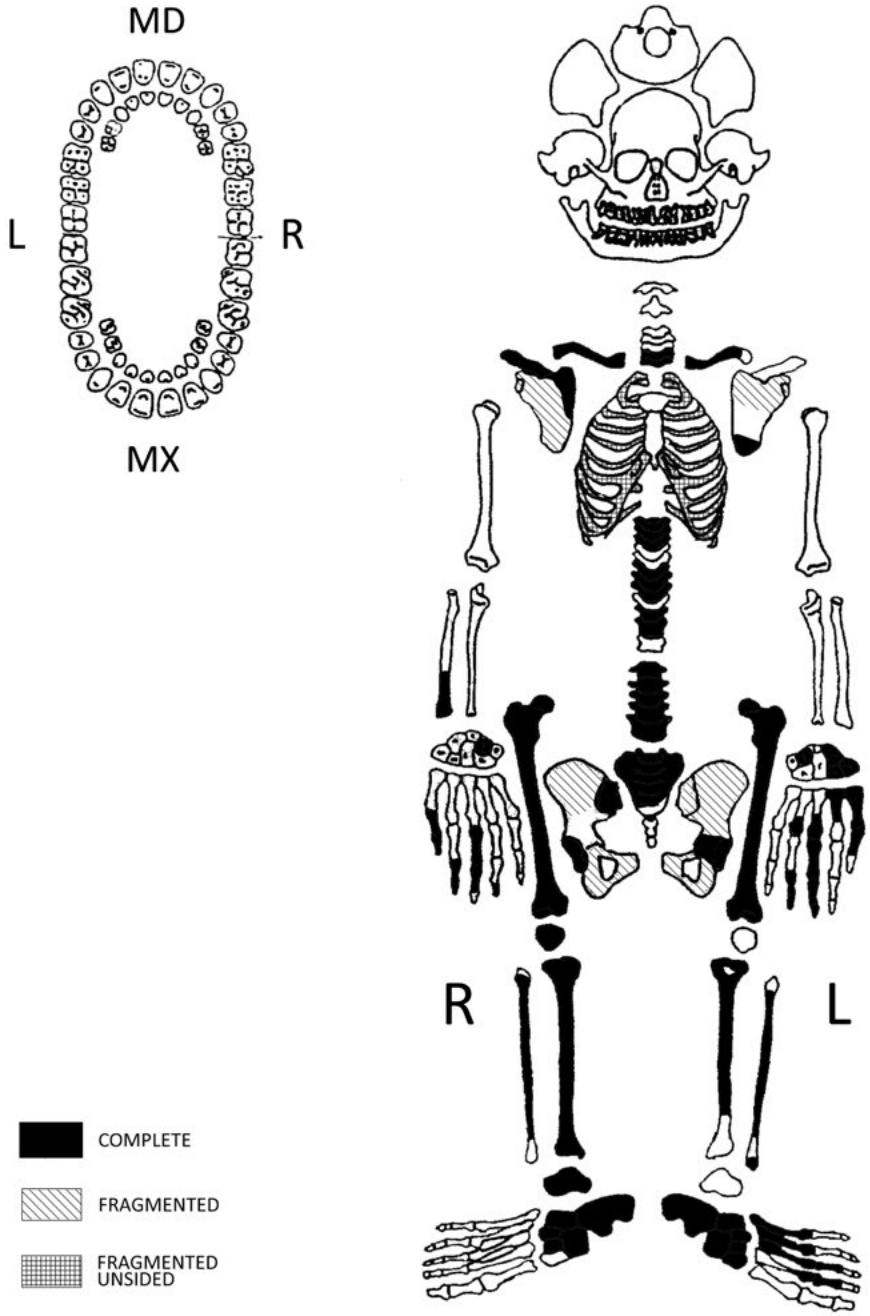


Figure 131

Sex: male
Sex was determined through the analysis of one morphological feature of the pelvis and through the measures of the femoral condyles, head of the femur, talus and calcaneus.

Age: 40-50 years
Age at death was determined on the basis of the sternal rib end modifications and stage of fusion of the vertebrae.

Stature: 173.0 cm

Dental pathologies
No teeth are preserved.

Anatomical variants
In the post-cranial skeleton the accessory transverse foramen of C6 (complete), the Poirier's facet on both femurs, the exostosis of the fovea of the right femur, the accessory facet of the distal epiphysis of the right tibia, and the accessory facet on the neck of right talus are present.

Ergonomy
The individual shows a low development of the muscular insertions, except for the costo-clavicular ligament, the trapezoid ligament and the conoid ligament of the right clavicle, the deltoid of the left clavicle, the gluteus maximus of the left femur and the soleus of the left tibia, which have a strong development; the gluteus maximus of the right femur has a very strong development.

Pathologies
Localised grade 1 periosteal reaction affects the proximal third of the diaphyses of the fibulae. Osteoarthritis of grade 1 is present on the thoracic and lumbar vertebrae, the sternal end of the clavicles, the acromial end of the left clavicle, the left clavicular notch of the sternum, and the right acetabular cavity; grade 2 osteoarthritis affects the acromial end of the right clavicle, the sternal facets, the auricular surface of the sacrum and the superior margin of the first sacral vertebra.

SU 2860

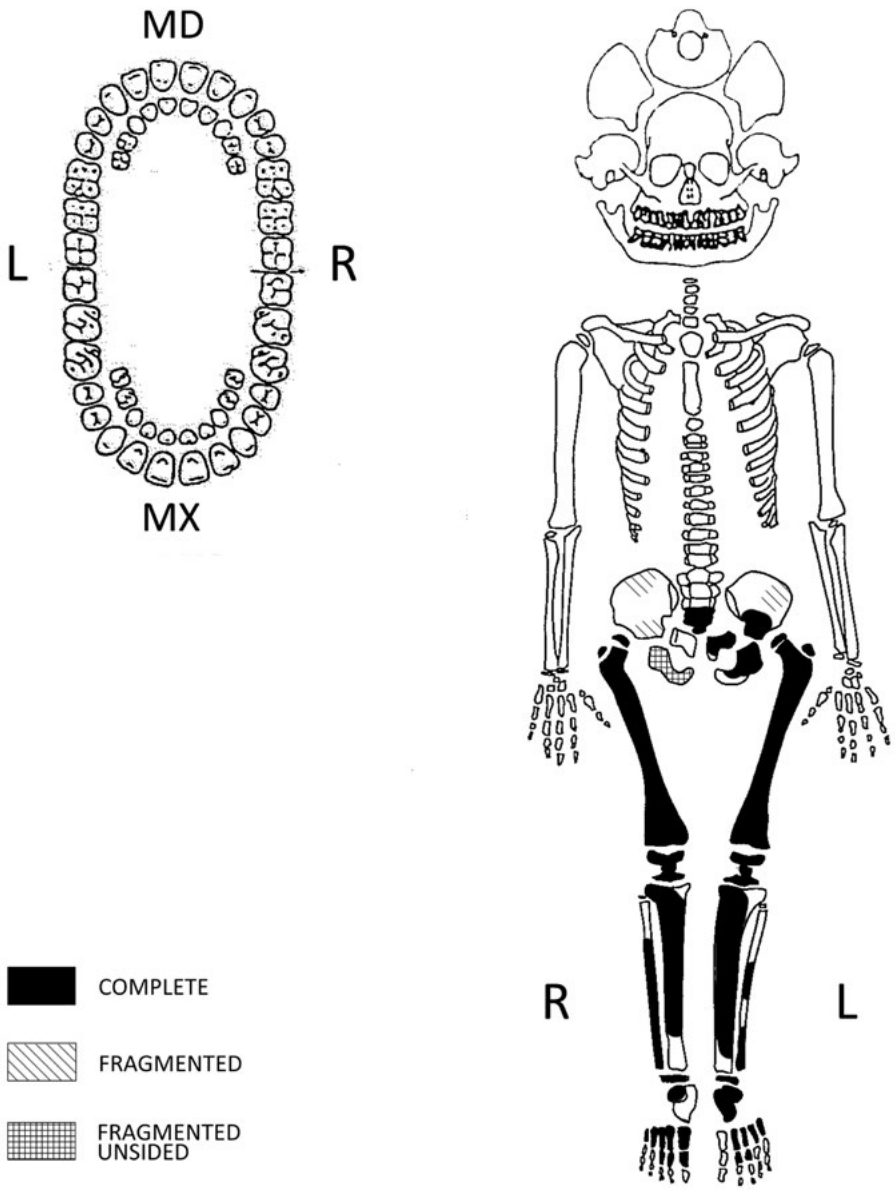


Figure 132

Sex: undeterminable

Age: 14-15 years
Age at death was determined on the basis of stage of fusion between diaphyses and epiphyses and long bone length.

Dental pathologies
No teeth are preserved.

Anatomical variants
None found.

Pathologies
Cribra femoralia are visible on the neck of both femurs.

SU 2861

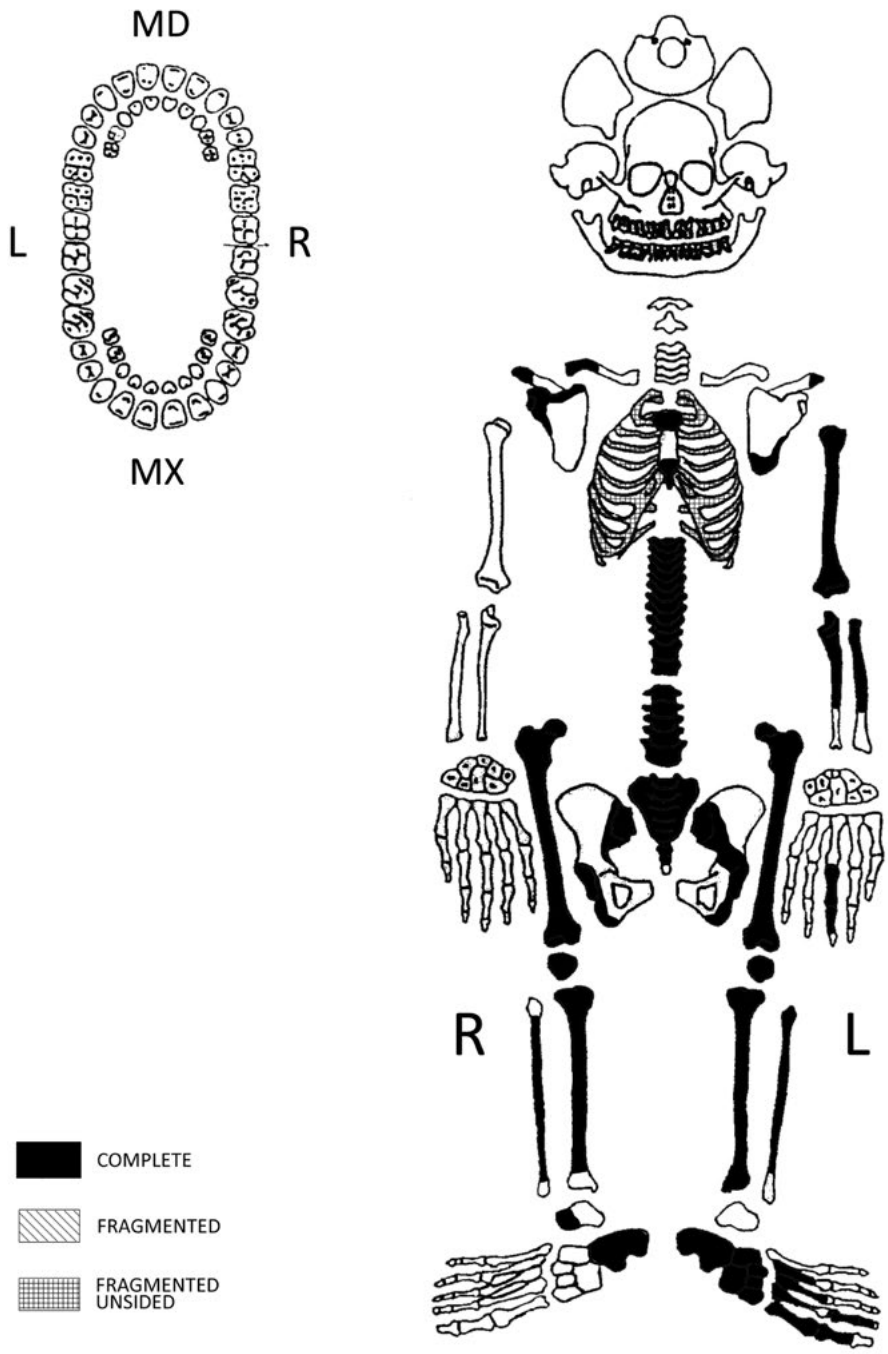


Figure 133

Sex: female
Sex was determined through the analysis of six morphological features of the pelvis, which provided a sexual index of -1.

Age: 35-40 years
Age at death was determined on the basis of the sternal rib end modifications, epiphyseal ring of the vertebrae, and morphology of the auricular surface of the ilium.

Stature: 156.4 cm

Dental pathologies
No teeth are preserved.

Anatomical variants
In the post-cranial skeleton the supraglenoid facet of the right scapula, the unfused acromial epiphysis of the right scapula, the exostosis of the throcanteric fossa of the femurs, the double anterior facet of the left calcaneus, and the third throcanter on the left femur are present.

Ergonomy
The individual shows a medium-strong development of the muscular insertions: in particular the trapezoid ligament of the right clavicle, the pectoralis major and the latissimus dorsi/teres major of the left humerus, the pronator teres of the left radius, the triceps brachii and the brachialis of the left ulna, the gluteus maximus of both femurs, the quadriceps tendon of the left tibia and of the right patella show a strong development; the deltoid and the conoid ligament of the right clavicle, the brachioradialis of the left humerus and the interosseous tubercle of the left radius show a very strong development.

Pathologies
Grade 1 osteoarthritis affects the clavicular notch and the facets for the attachment of the ribs of the sternum, the glenoid cavity of the right scapula, the acetabular cavity of both coxal bones, the auricular surface and the superior articular process of the sacrum, the articular facet of the patellae, the proximal joint of the tibiae, and the articular facet for the cuboid of the right talus; grade 2 osteoarthritis affects the proximal joint of the right femur and the distal articular surface of the femurs; grade 3 osteoarthritis affects the proximal articular surface of the left femur. Ossification of the yellow ligaments is visible on the thoracic and lumbar vertebrae; Schmorl's nodes are present on 7 thoracic and 5 lumbar vertebrae.
Diffuse grade 1 periosteal reaction is visible on the femurs, and localised grade 1 periosteal reaction affects the proximal epiphyses of the tibiae.

SU 2862

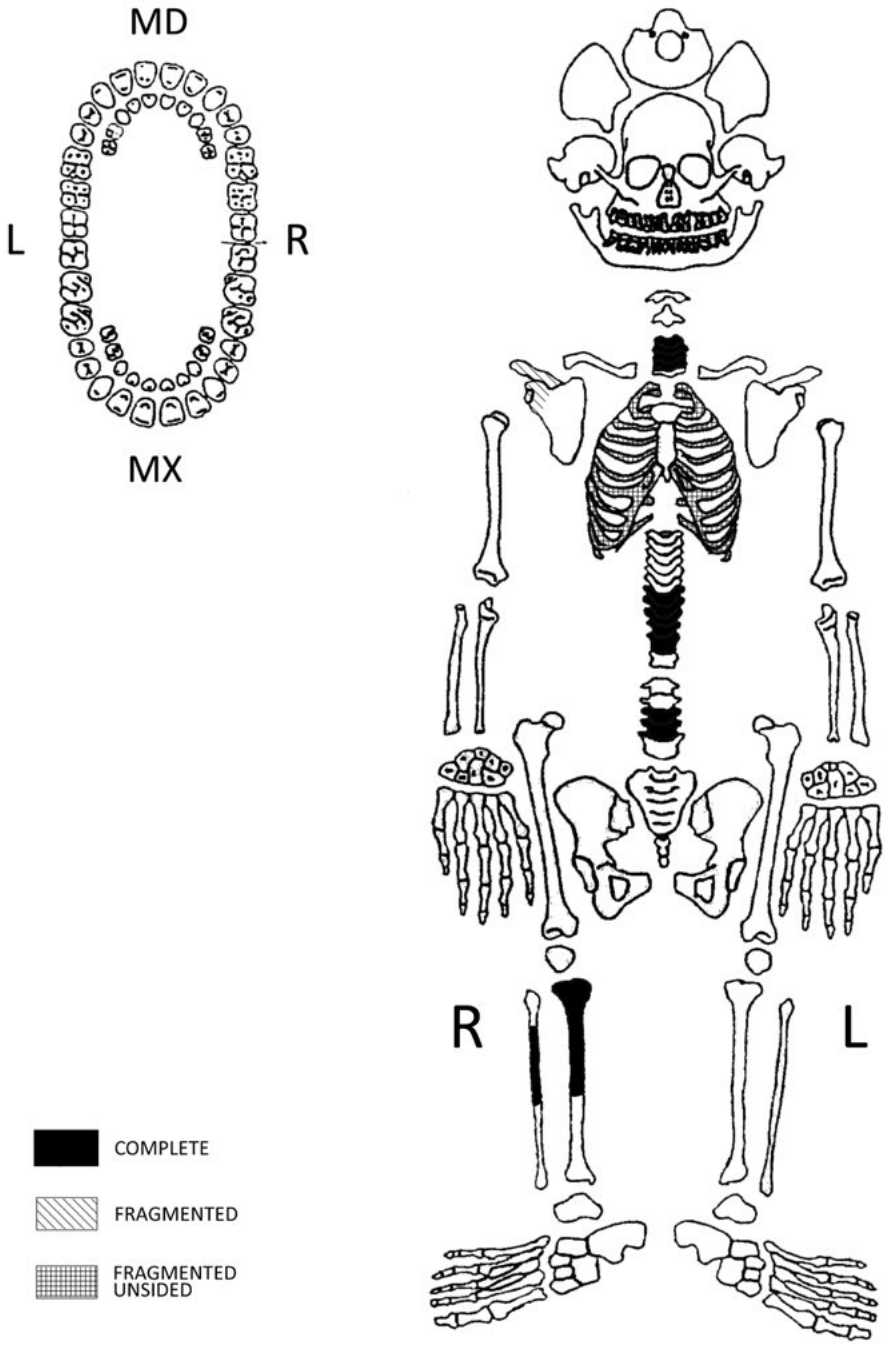


Figure 134

Sex: undeterminable

Age: more than 30 years
Age at death was determined only on the basis of the epiphyseal ring of the vertebrae.

Stature: undeterminable

Dental pathologies
No teeth are preserved.

Anatomical variants
None found.

Ergonomy
Only the quadriceps tendon of the right tibia was observable, with a medium development.

Pathologies
A Schmorl's node is present on a thoracic vertebra and on a lumbar vertebra; ossification of the yellow ligaments is present; grade 1 osteoarthritis affects the preserved cervical and thoracic vertebrae.

SU 2863

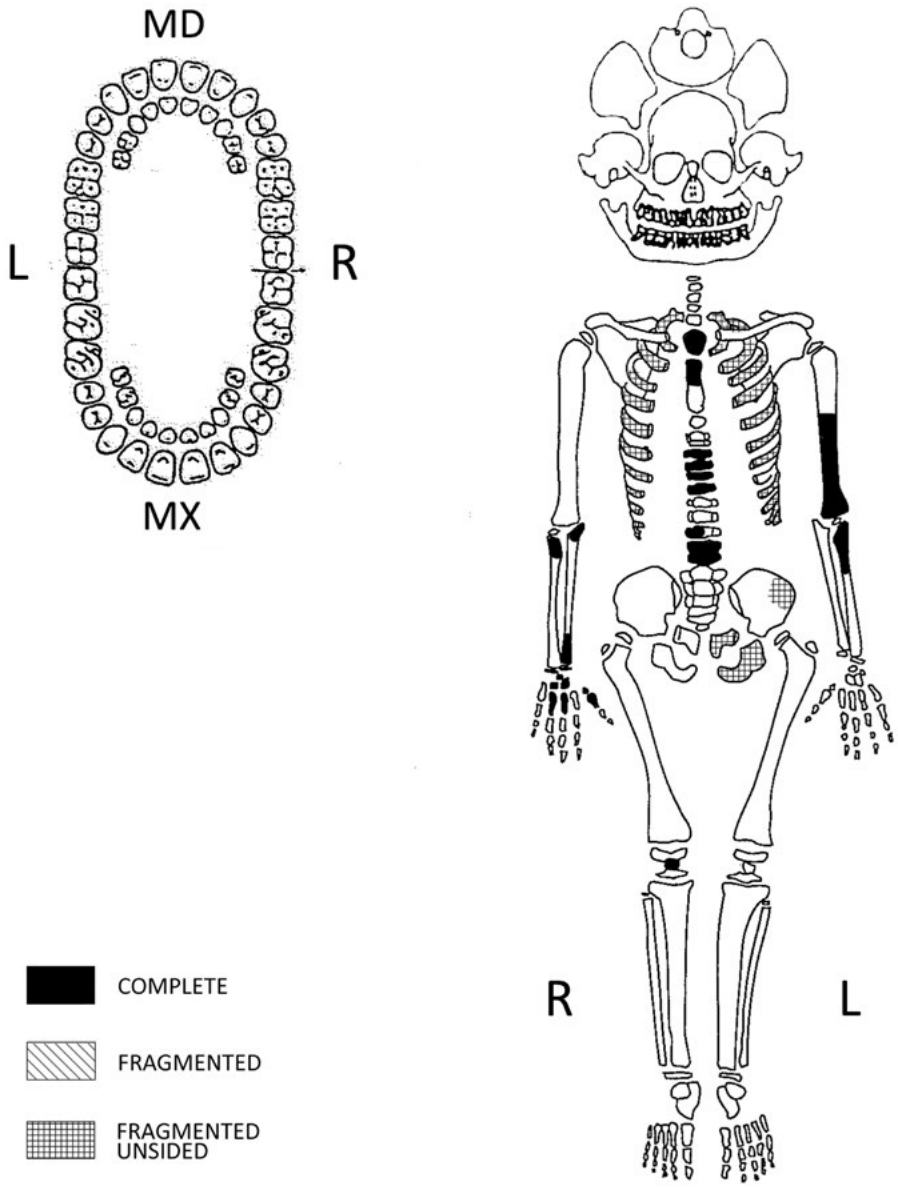


Figure 135

Sex: undeterminable

Age: 13-15 years
Age at death was determined on the basis of the stage of fusion between diaphyses and epiphyses, sternal rib end modifications, and epiphyseal ring of the vertebrae.

Dental pathologies
No teeth are preserved.

Anatomical variants
None found.

SU 2864

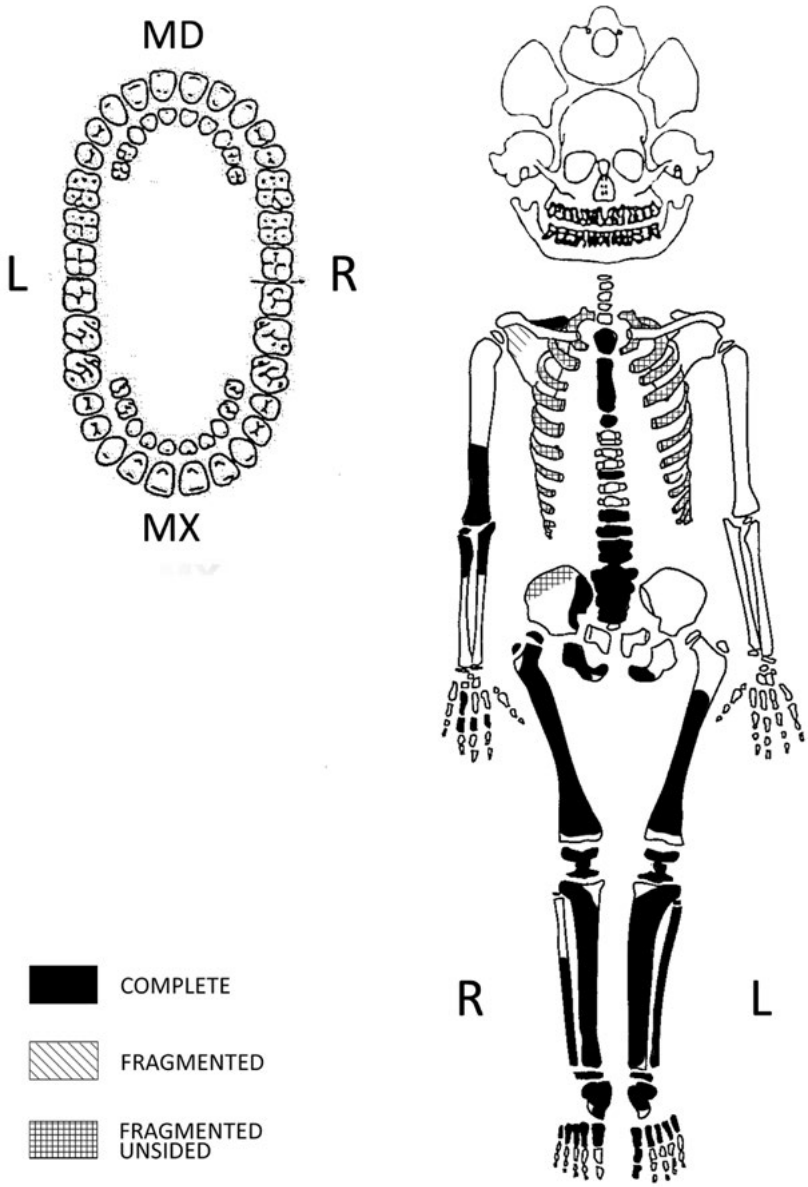


Figure 136

Sex: undeterminable

Age: 12-14 years
Age at death was determined on the basis of stage of fusion between diaphyses and epiphyses and long bone length.

Dental pathologies
No teeth are preserved.

Anatomical variants
None found.

Pathologies
Cribra femoralia are present on the neck of the right femur and localised grade 1 periosteal reaction is visible on the right tibia and fibula, probably a consequence of a trauma.

Trench 12

SU 2386

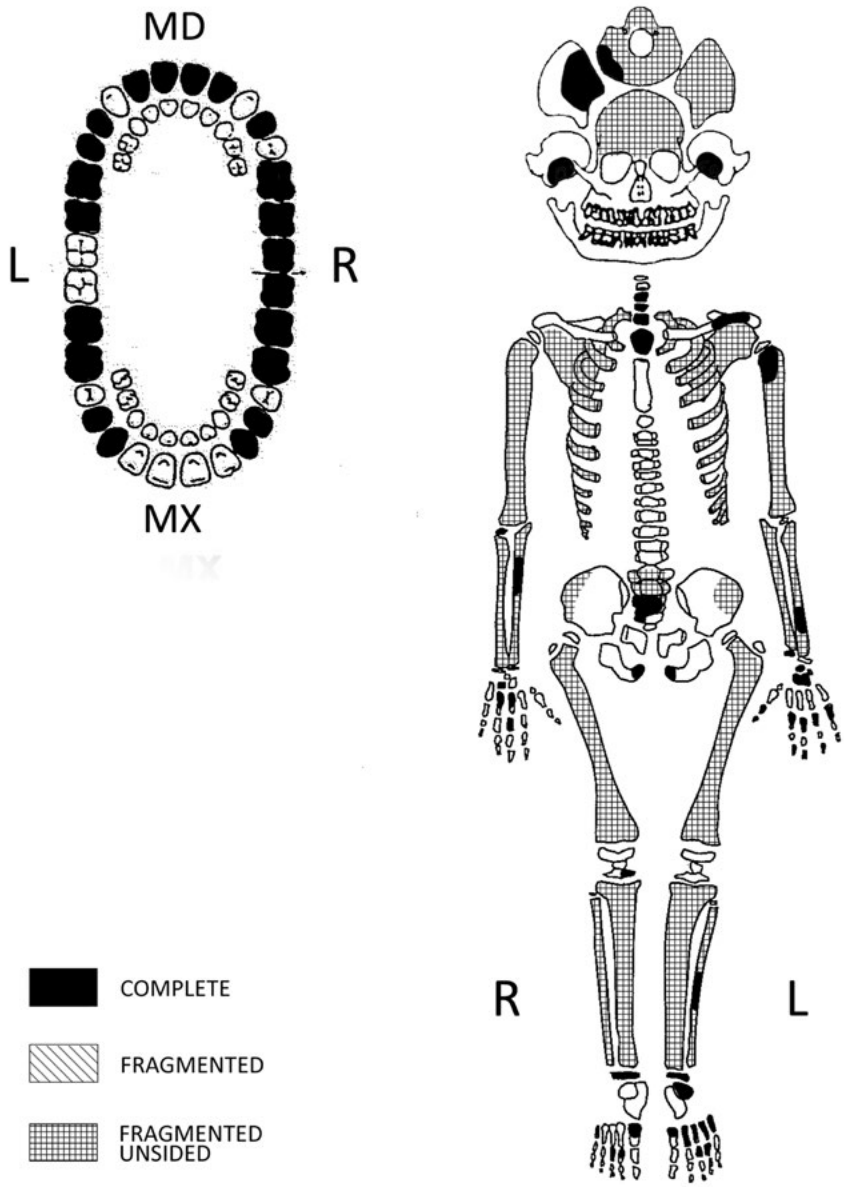


Figure 137

Sex: undeterminable

Age: 13-15 years
Age at death was determined on the basis of dental wear, stage of dental eruption, stage of fusion between diaphyses and epiphyses, and stage of fusion of the vertebrae.

Dental pathologies
The maxillary teeth are preserved isolated, except for the incisors, second premolars, and left third molar, which are missing. The mandibular teeth are preserved isolated, except for the canines and left third molar, which are missing.
A mesial grade 3 caries is present on the mandibular left first molar.
Enamel hypoplasia occurred between 1.5 and 4 years, with six episodes.
Mild calculus affects the maxillary and the mandibular incisors.

Anatomical variants
In the skull the lambdoid ossicles are present on the right.

Pathologies
None observed.

SU 2396

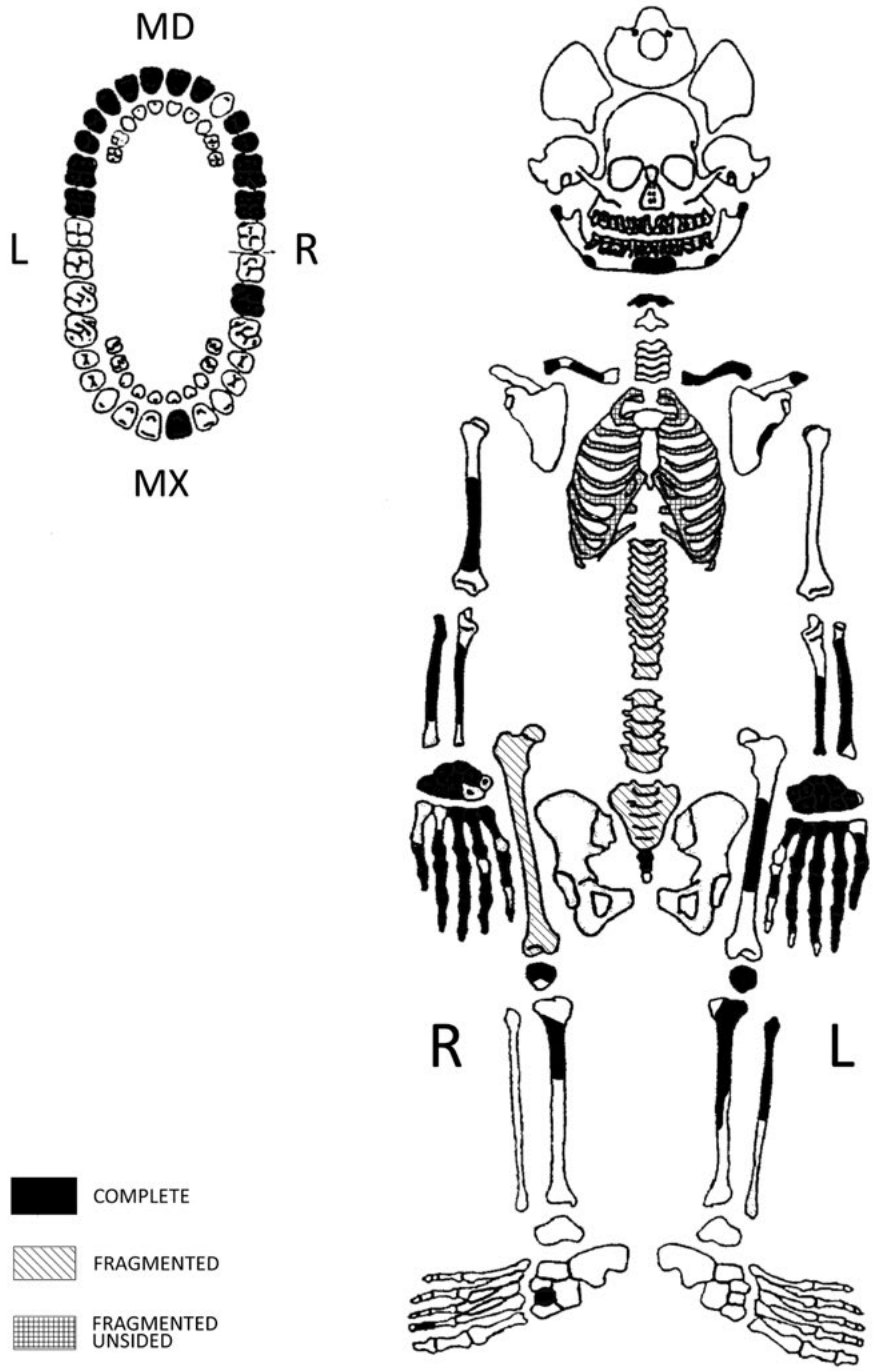


Figure 138

Sex: male
Sex was determined through the analysis of two morphological features of the skull, which provided a sexual index of 1.3.

Age: 25-30 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, and stage of fusion of the vertebrae.

Stature: undeterminable

Dental pathologies
Only the maxillary right second molar and first incisor are preserved isolated. The mandibular teeth are preserved isolated, except for the third molars and right canine, which are missing.
A grade 1 occlusal caries is present on the maxillary right second molar. In the mandibular teeth, several grade 1 caries are present: one occlusal on the left first molar, one mesial on the right first premolar, and one occlusal on the right second molar.

Enamel hypoplasia occurred between 1.5 and 4.5 years, with six episodes.
Mild calculus affects the mandibular teeth.

Anatomical variants
None observed.

Ergonomy
The individuals shows a low-medium development of the muscular attachments.

Pathologies
Diffuse grade 1 periosteal reaction is present on femurs and tibiae. The second and third phalanges of the third finger of the right hands are fused.

SU 2412

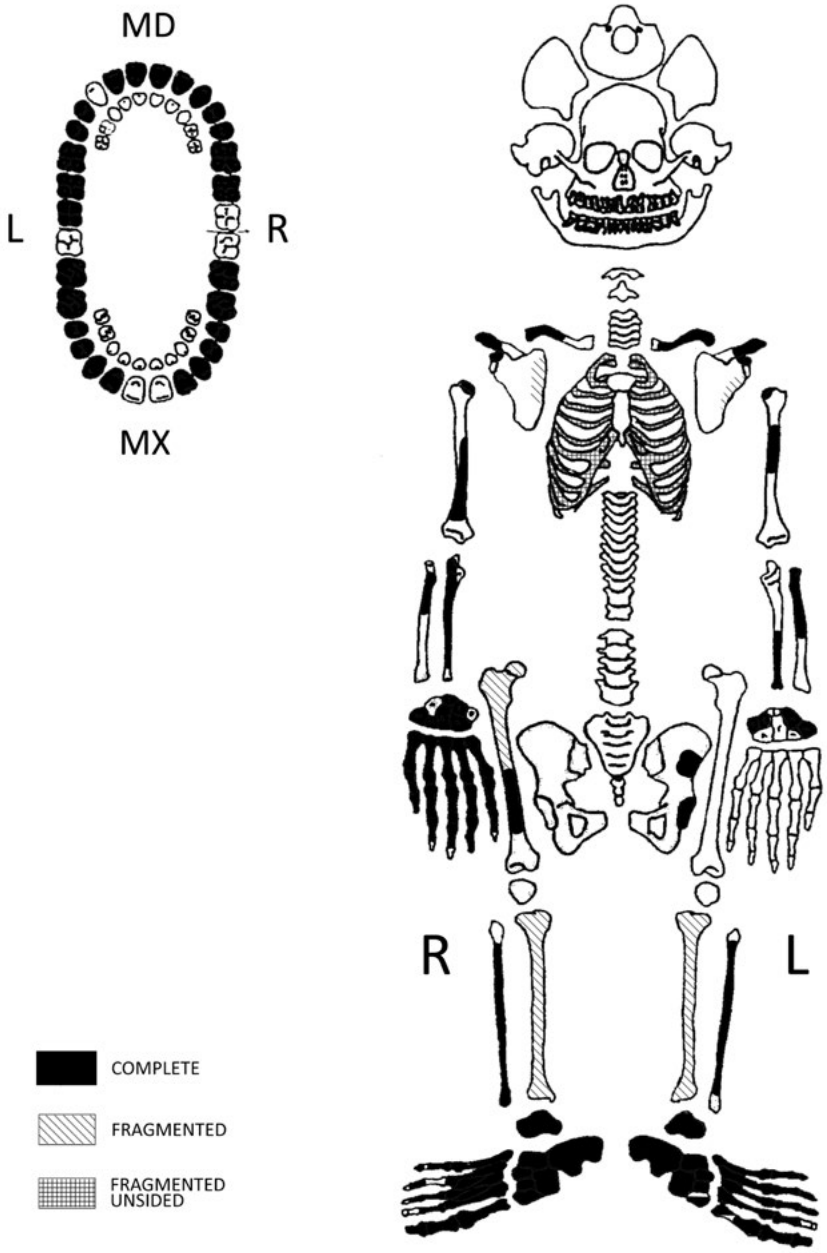


Figure 139

Sex: female
Sex was determined through the analysis of the dimension of the preserved bones.

Age: 18-24 years
Age at death was determined on the basis of dental wear and eruption, sternal rib end modifications, stage of fusion of the diaphyses and epiphyses and vertebrae.

Stature: undeterminable

Dental pathologies
The maxillary teeth are preserved and isolated, except for the left canine and second premolar, which are in situ, and the central incisors and left third molar, which are missing. The mandibular teeth are preserved and isolated, except for the two right premolars, right

canine, left second premolar and first and second molars, which are preserved in situ.
Alveolar resorption of grade 1 affects the mandible.
Some caries were found: in the maxillary teeth, one grade 3 caries mesial on the left second incisor, one caries of grade 1 distal on the left second incisor, one grade 3 caries mesial on the right second incisor, one grade 1 caries lingual on the second right incisor; in the mandibular teeth, one grade 2 caries mesial on the left first incisor, one grade 1 caries mesial on the left first premolar, one grade 3 caries mesial, one grade 4 buccal, one grade 3 distal, and one grade 1 occlusal on the left first molar, one grade 2 caries mesial on the right first incisor, one grade 3 caries distal and one grade 1 mesial on the right canine, and one grade 4 caries mesial on the right first molar.
Enamel hypoplasia occurred between 1.5 and 5 years, with eight episodes.
The maxillary right second premolar and the mandibular left second premolar are rotated.

Anatomical variants
None observed.

Ergonomy
The individual shows a low muscular development, except for the conoid ligament of the clavicles, which shows a strong development, and the trapezoid ligament of the right clavicle, which shows a very strong development.

Pathologies
Schmorl's nodes affect two lumbar vertebrae.

SU 2413

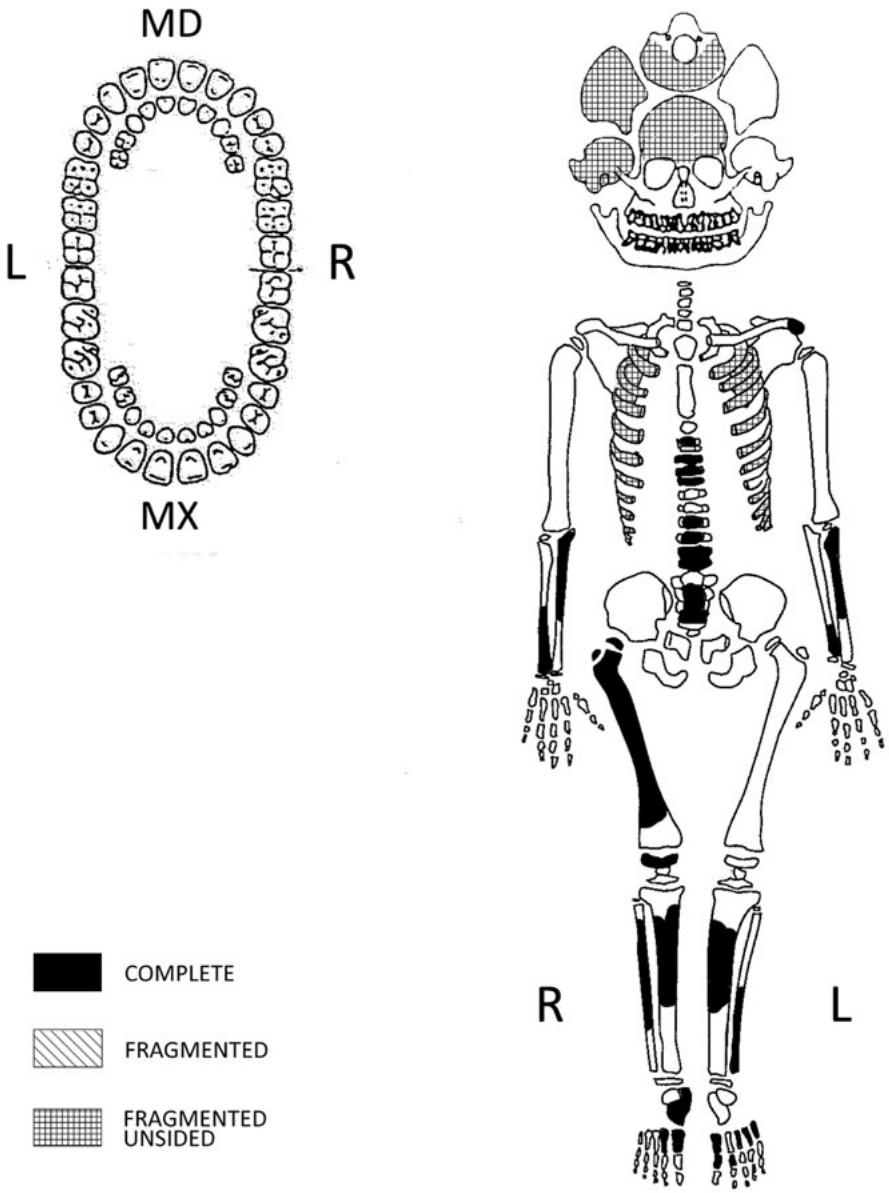


Figure 140

Sex: undeterminable

Age: 4 years
Age at death was determined only on the basis of the grade of fusion between vertebral arch and body.

Dental pathologies
All teeth were lost post-mortem, except for the deciduous maxillary right second incisor.

Anatomical variants
None observed.

Pathologies
Diffuse grade 1 periosteal reaction is present on the tibiae and the left fibula. Enlarged vascular foramina are observable on the anterior portion of the vertebral bodies.

SU 2414

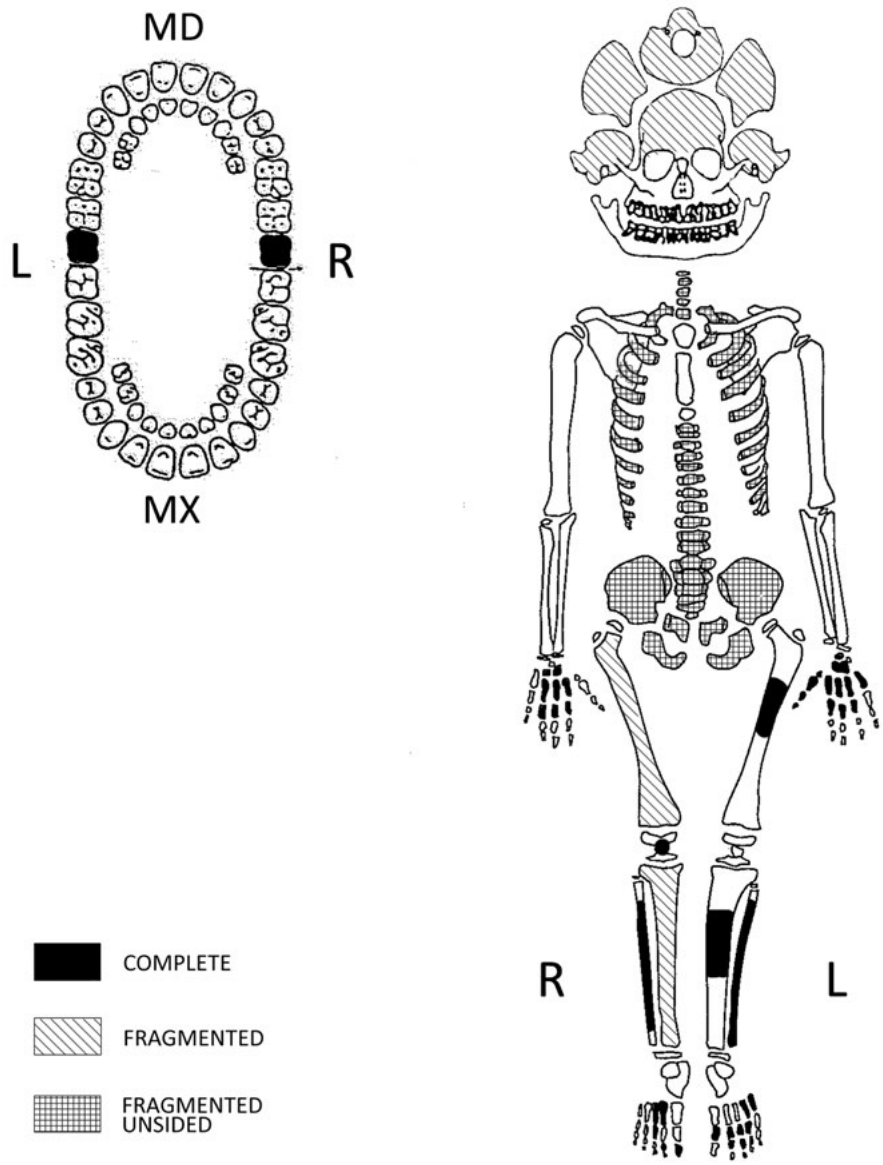


Figure 141

Sex: undeterminable

Age: 15-20 years
Age at death was determined on the basis of dental eruption and stage of fusion between diaphyses and epiphyses.

Dental pathologies
Only the mandibular second molars, which are in eruption, are present.

Anatomical variants
None observable.

Pathologies
None observable.

SU 2415

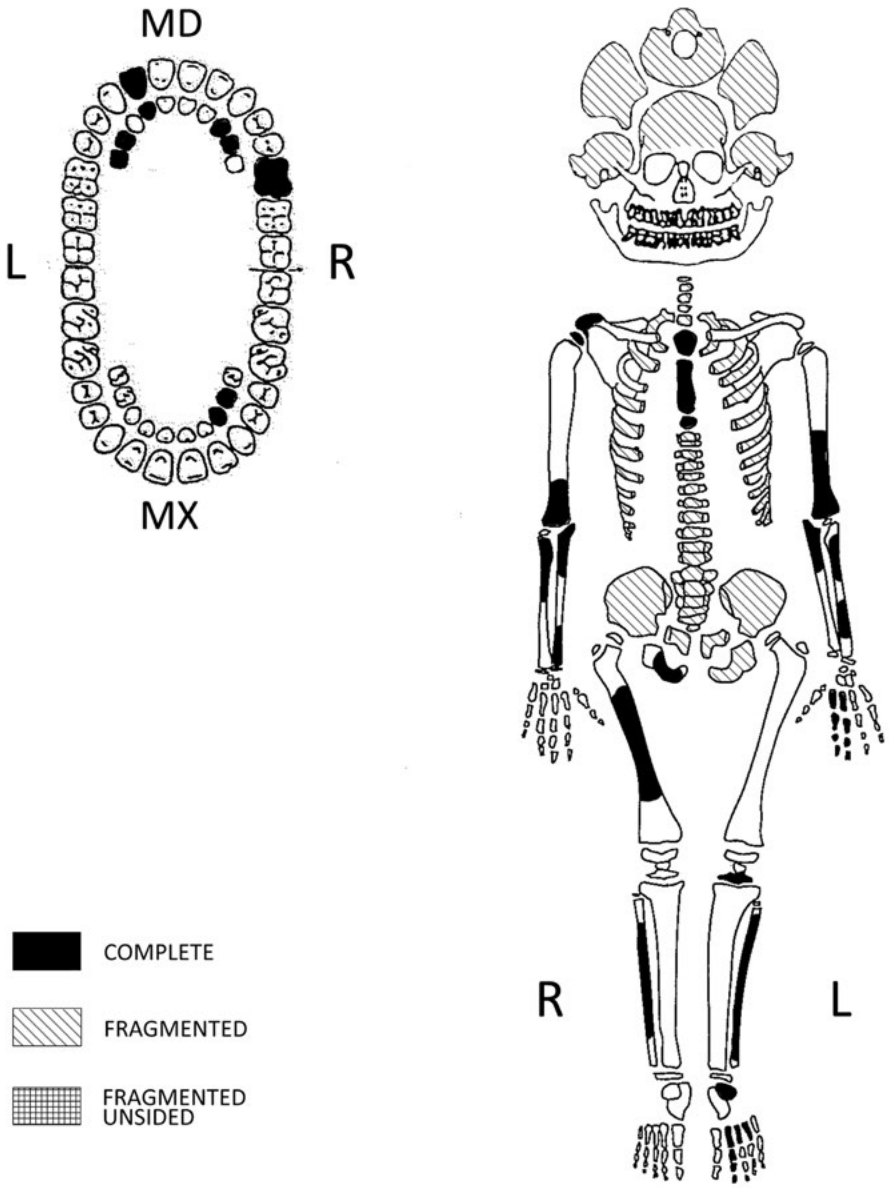


Figure 142

Sex: undeterminable

Age: 7-9 years
Age at death was determined on the basis of fusion between diaphyses and epiphyses and on dental eruption.

Dental pathologies
The deciduous maxillary teeth are missing, except for the right canine and first molar, which are preserved isolated. The deciduous mandibular teeth are preserved isolated, except for the central incisors, left canine, right second incisor and second molar, which are missing.
The germ of the permanent mandibular right first molar and left second incisor are preserved in situ.

Anatomical variants
None observable.

Ergonomy
Not observable.

Pathologies
None pathologies observed.

SU 2416

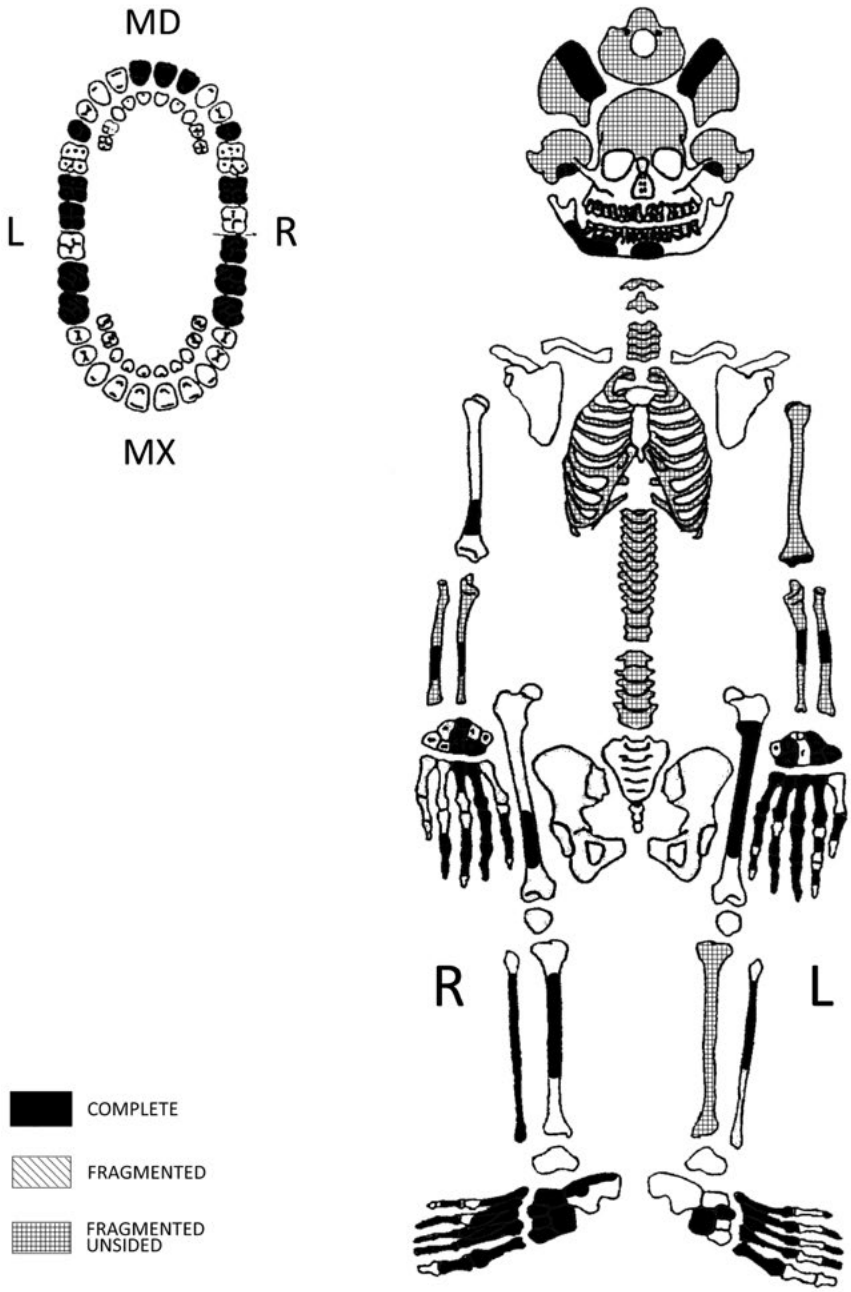


Figure 143

Sex: undeterminable

Age: 30-35 years
Age at death was determined on the basis of dental wear, cranial suture stage of obliteration, and stage of fusion of the vertebrae.

Stature: undeterminable

Dental pathologies
The maxillary teeth are missing, except for the first and second molars, and right third molar, which are preserved and isolated. The mandibular teeth are missing, except for the right second and third molar, which are in situ, the central incisors, second premolars, right second incisor and left first molar, which are preserved and isolated, and left second molar, which was lost during life.
Alveolar resorption of degree 2 affects the mandible.
Several caries of grade 3 at the cemento-enamel junction were observed: one buccal caries on the mandibular left second molar, one distal caries on the mandibular right second premolar, one buccal caries on the mandibular right second molar, and one mesial caries on the maxillary right second molar; one grade 3 distal caries was observed on the maxillary left second molar, one grade 4 caries destroyed the crown of the maxillary left first molar, one grade 3 lingual caries is present on the maxillary right third molar.
Mild dental calculus affects the maxillary teeth, strong the mandibular teeth.

Anatomical variants
None observed.

Ergonomy
The individual shows a low-medium muscular development.

Pathologies
Osteoarthrosis of grade 1 affects the proximal joint of the right femur. A proliferative lesion is visible on the distal epiphysis of the left humerus.

SU 2417

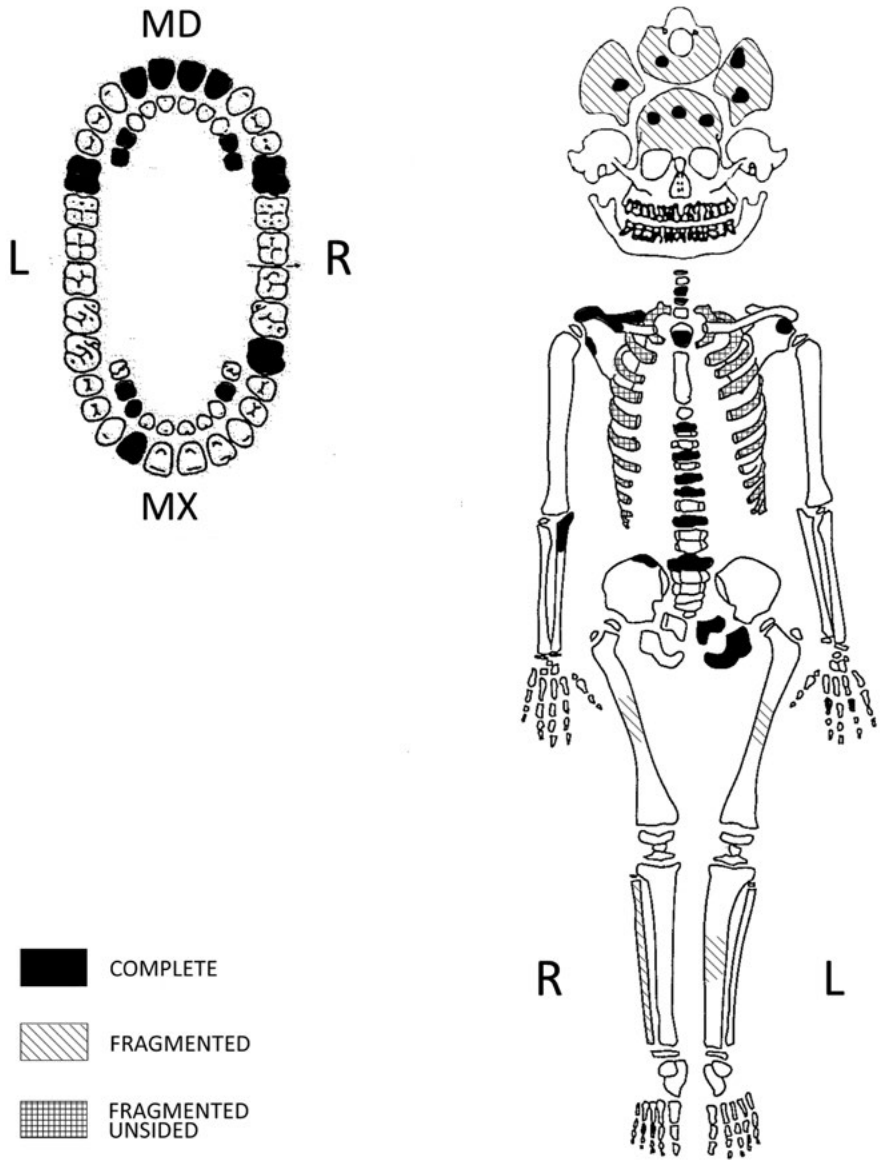


Figure 144

Sex: undeterminable

Age: 2-4 years
Age at death was determined on the basis of stage of dental eruption and stage of fusion between vertebral bodies and arches.

Dental pathologies
The deciduous maxillary molars are preserved and isolated; the other teeth are missing. The deciduous mandibular first molars and right canine are preserved isolated; the other teeth are missing.
The permanent maxillary incisors, first maxillary molars, mandibular left first molar, and right second incisor are preserved isolated as germs.

Anatomical variants
None observable.

Pathologies
None observable.

SU 2418

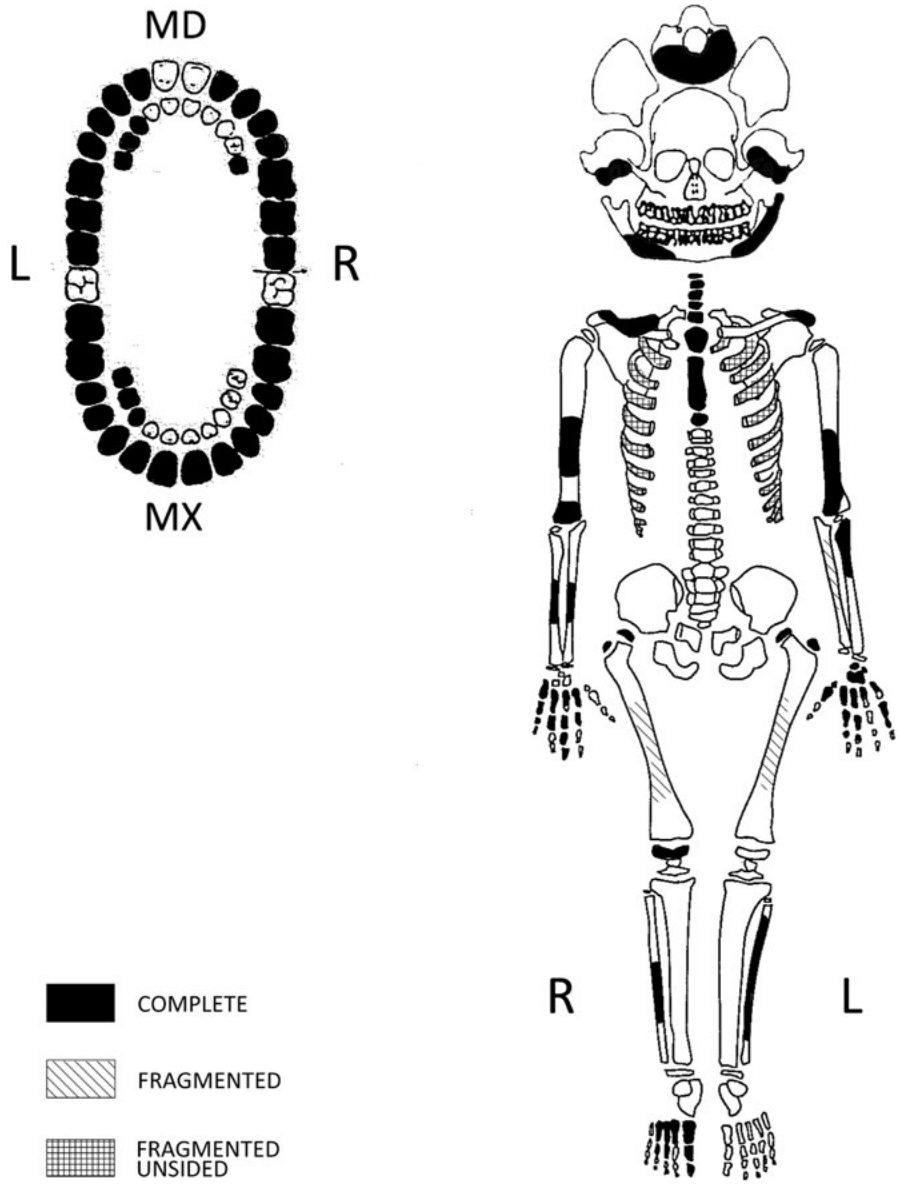


Figure 145

Sex: undeterminable

Age: 8-9 years
Age at death was determined on the basis of dental eruption and stage of development of permanent teeth.

Dental pathologies
The permanent maxillary teeth are preserved and isolated; the second premolars and second molars are in form of germ; the deciduous left canine and molars are preserved and isolated. The permanent mandibular teeth are preserved and isolated, except for the germ of the second and third molar, which are in situ; the central incisors, which were lost post-mortem; the premolars, second and third molars are in form of germ; the deciduous right canines and molars and left second incisor are preserved and isolated.
Enamel hypoplasia occurred between 2 and 4 years, with five episodes.
A grade 3 interproximal caries affects the deciduous mandibular left canine; a grade 1 occlusal caries affects the permanent mandibular right first molar.

Anatomical variants
In the postcranial skeleton the complete accessory transverse foramen is present on the right side of C3.

Pathologies
Localized grade 1 periosteal reaction is visible on the diaphysis of the right fibula.

SU 2419

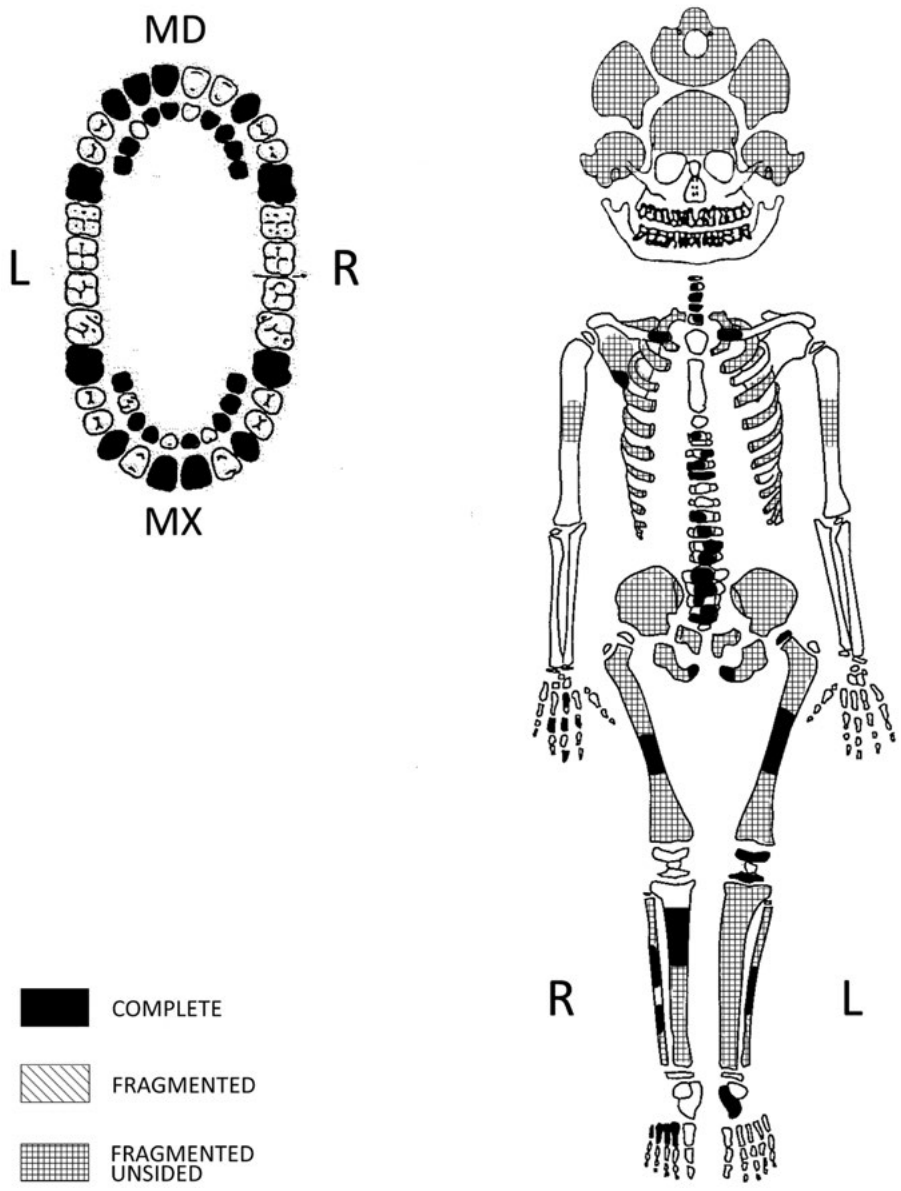


Figure 146

Sex: undeterminable

Age: 3-4 years
Age at death was determined on the basis of stage of dental eruption and stage of fusion between diaphyses and epiphyses.

Dental pathologies
The deciduous maxillary teeth are preserved and isolated, except for the left first incisor and first molar and right second incisor, which are missing; the permanent incisors, canines, and germ of the first molars are preserved and isolated. The deciduous mandibular teeth are preserved and isolated, except for the left canine and right first incisor, which are missing. The permanent canines, germ of first molars and left incisors are preserved and isolated.

Anatomical variants
Not observable.

Pathologies
None observable.

SU 2420

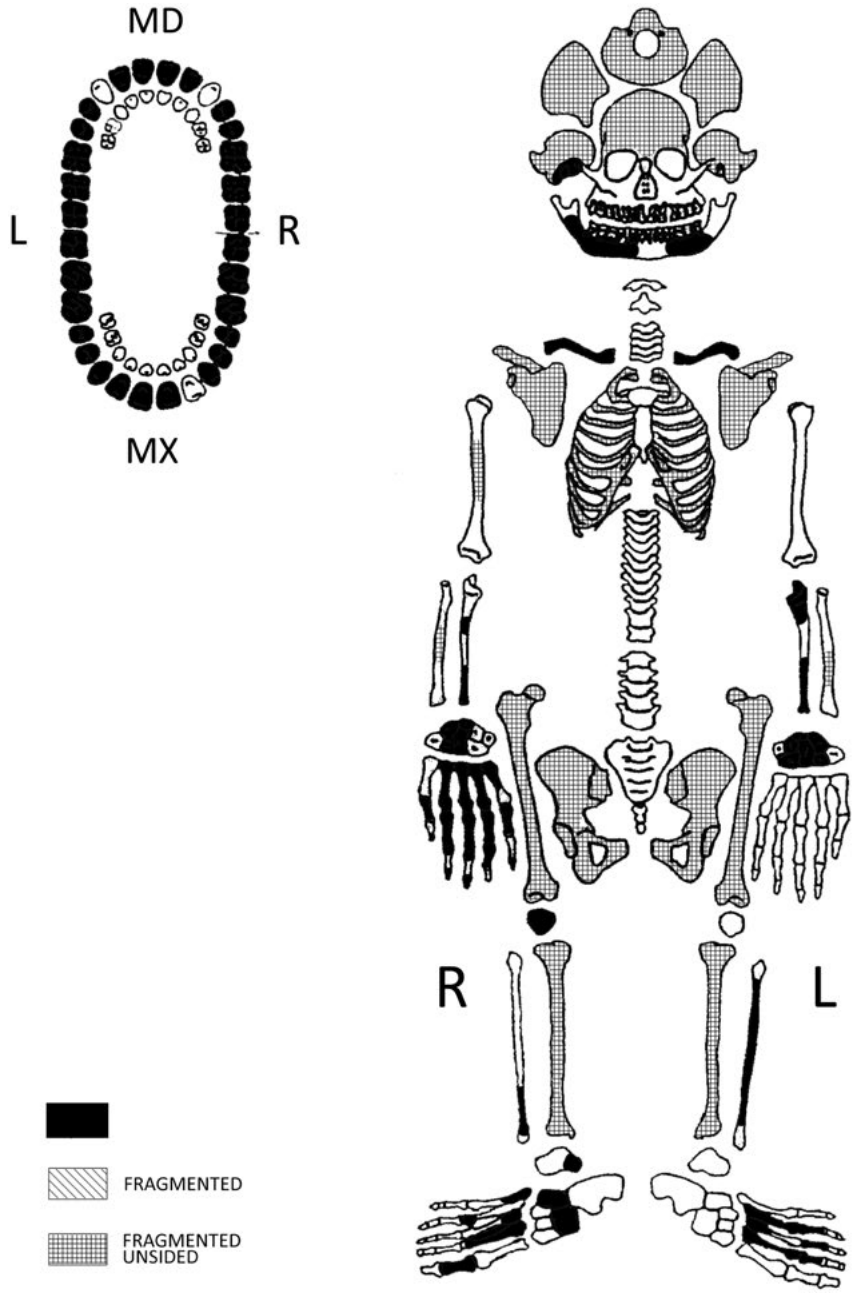


Figure 147

Sex: undeterminable

Age: 20-25 years
Age at death was determined on the basis of dental wear, stage of dental eruption, stage of fusion between diaphyses and epiphyses, sternal rib end modifications, and stage of fusion of the vertebrae.

Stature: undeterminable

Dental pathologies
The maxillary teeth are preserved isolated, except for the second premolars and right first molar, which are missing.
The mandibular teeth are preserved and isolated, except for the second and third molars, which are in situ, and the right second incisor, which is missing.
Enamel hypoplasia occurred between 1.5 and 4.5 years, with six episodes.
Mild calculus affects the mandibular teeth.

Anatomical variants
None found.

Ergonomy
The individual shows a strong and very strong development of the observable muscular attachments, except for the deltoid of both clavicles, the conoid ligament of the left clavicle and the biceps brachii of the left radius, which have a medium development.

Pathologies
None observed.

SU 2421

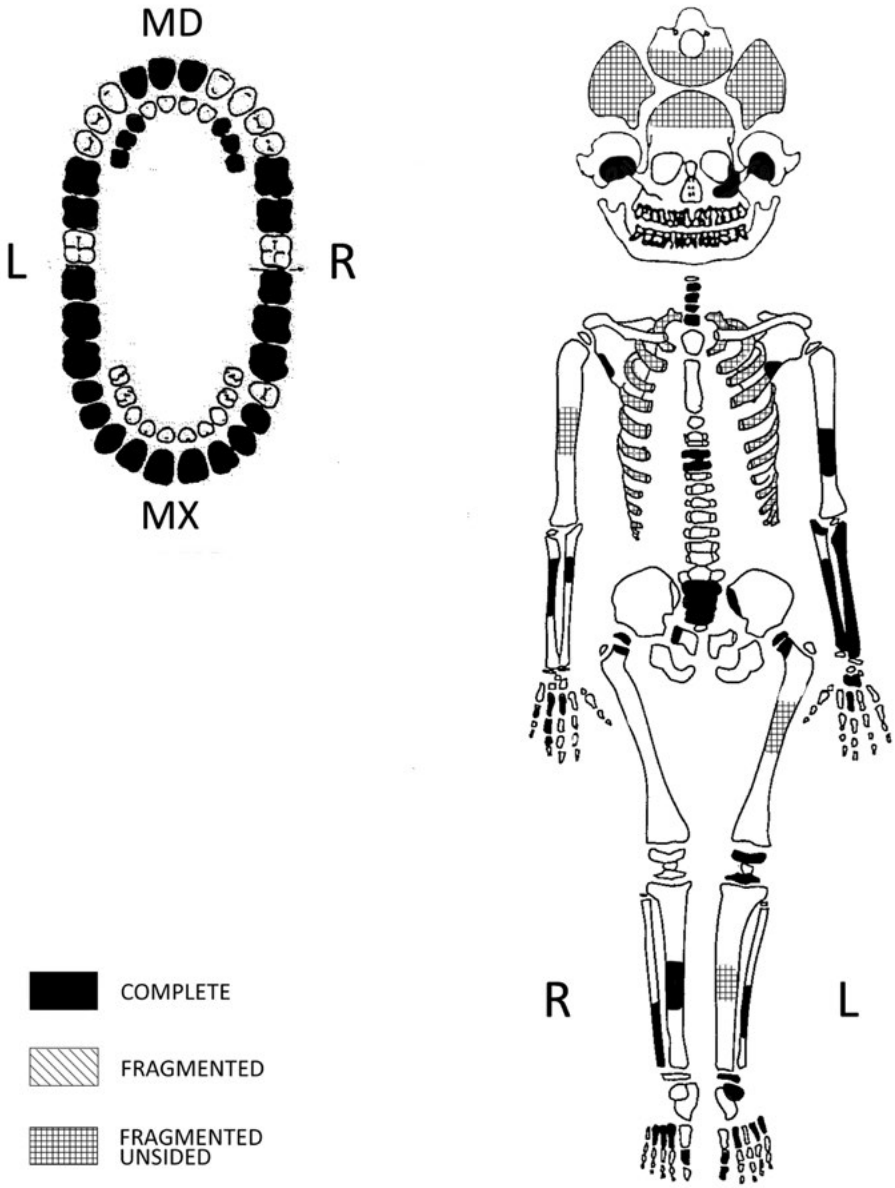


Figure 148

Sex: undeterminable

Age: 9-10 years
Age at death was determined on the basis of stage of dental eruption, stage of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
The permanent maxillary teeth are preserved and isolated, except for the right second premolar, which is missing; the deciduous canines and molars are preserved and isolated. The permanent mandibular teeth are preserved and isolated, except for the right second incisor, canines, and premolars, which are missing; the deciduous canines and molars are preserved and isolated.

A grade 3 mesial caries is present on the deciduous mandibular left first molar, a grade 4 mesial caries on the mandibular right first molar.
Enamel hypoplasia occurred between 1 and 4 years, with five episodes.
Mild calculus affects the mandibular teeth.

Anatomical variants
In the skull there is a supernumerary ossicle, but not identifiable.

Ergonomy
Not observable.

Pathologies
Localised grade 1 periosteal reaction affects the diaphysis of the right tibia.

SU 2422

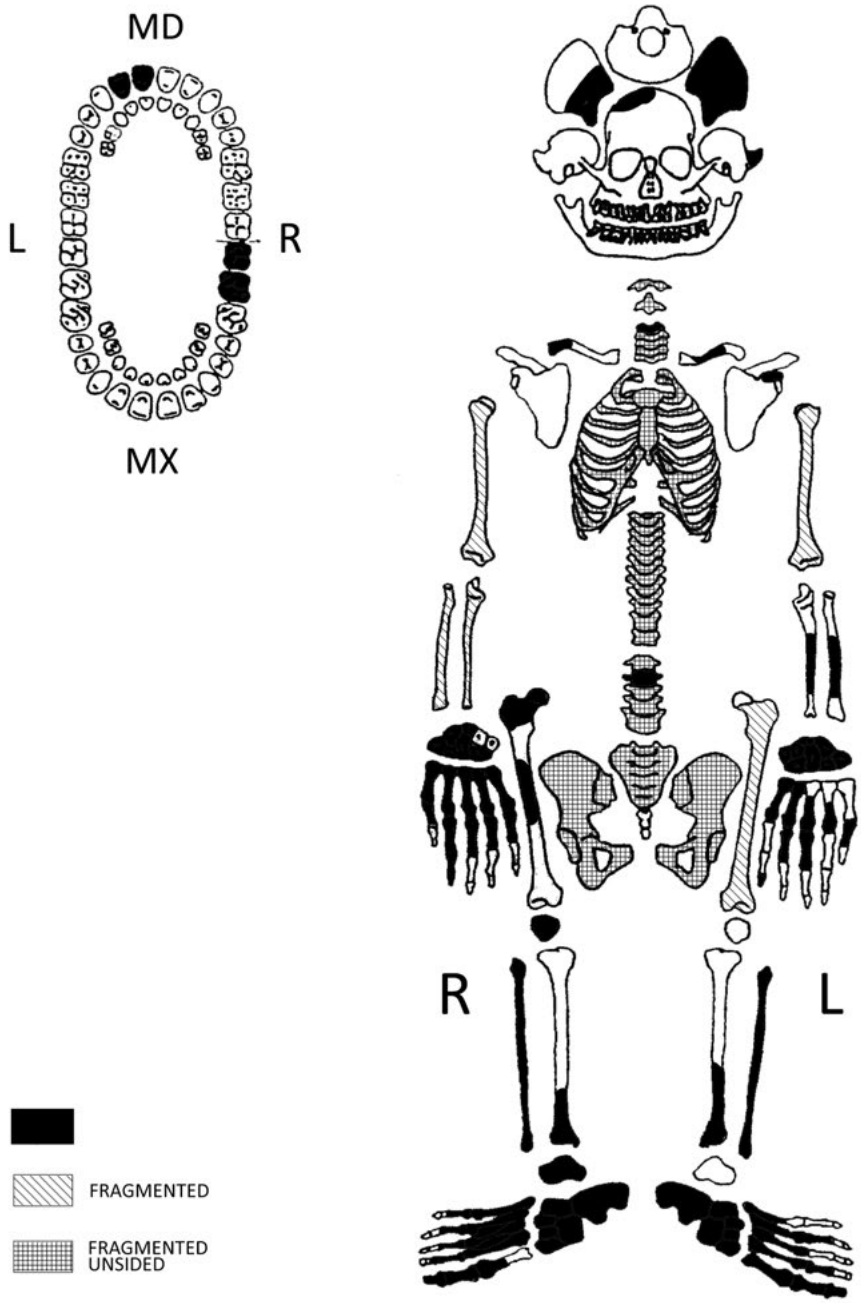


Figure 149

Sex: male (?)
Sex was determined through the measures of preserved bones.

Age: 35-40 years
Age at death was determined on the basis of sternal rib end modification.

Stature: 157.3 cm

Dental pathologies
Only the maxillary right second and third molars and the two mandibular left incisors were present, all isolated.

On the two mandibular incisors hypoplastic lines are detected, but they are not measurable due to the presence of strong calculus.
Three caries have been identified in the two maxillary right molars: one distal of grade 1 at the cemento-enamel junction and one mesial of grade 2 on the second molar; a buccal caries at the cemento-enamel junction of grade 3 on the third molar.

Anatomical variants
In the postcranial skeleton the vastus notch and the accessory facet on the neck of the talus, both on the right side, are present.

Ergonomy
The individual shows a strong development of the few observable muscular insertions.

Pathologies
A fracture of the proximal epiphysis of the right femur, with the involvement of the corresponding acetabular cavity, can be observed. Diffuse grade 1 periosteal reaction affects the tibiae.

SU 2423

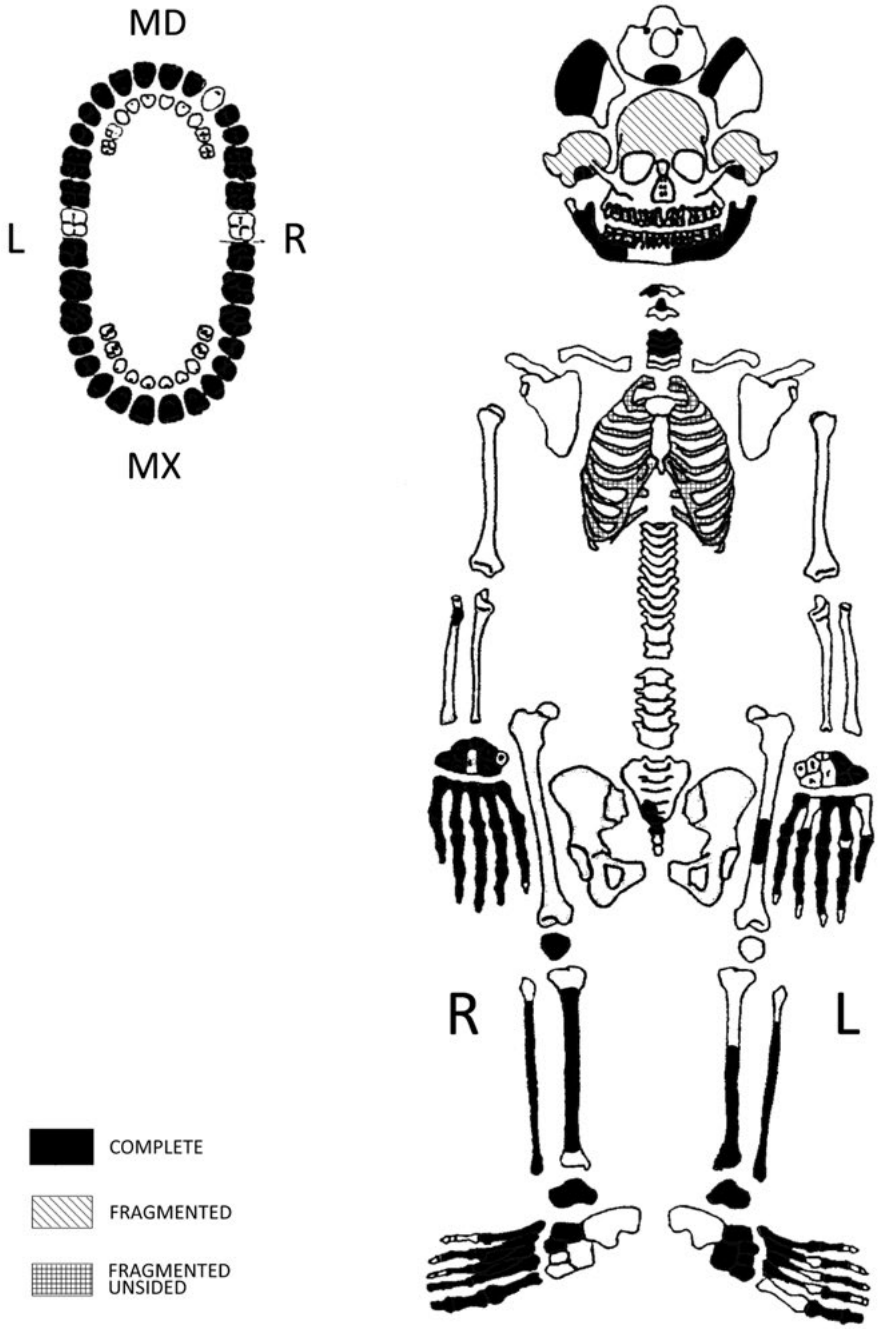


Figure 150

Sex: undeterminable

Age: 20-30 years
Age at death was determined on the basis of dental wear, stage of fusion between diaphyses and epiphyses, and stage of fusion of the vertebrae.

Stature: undeterminable

Dental pathologies
The maxillary teeth are preserved isolated, except for the right premolars, which are in situ. The mandibular teeth are preserved and isolated, except for the left second molar, right premolars and first and second molars, which are preserved in situ.
Enamel hypoplasia occurred between 1.5 and 5 years, with seven episodes.

A grade 3 distal caries is present on the mandibular left first premolar.
Mild calculus affects the mandibular anterior teeth.

Anatomical variants
In the skull a zygomatic foramen and zygomatic foramina on the right are present.

Ergonomy
The individual shows a low-medium development of the muscular attachments.

Pathologies
Diffuse grade 1 periosteal reaction is present on the left tibia.

SU 2424

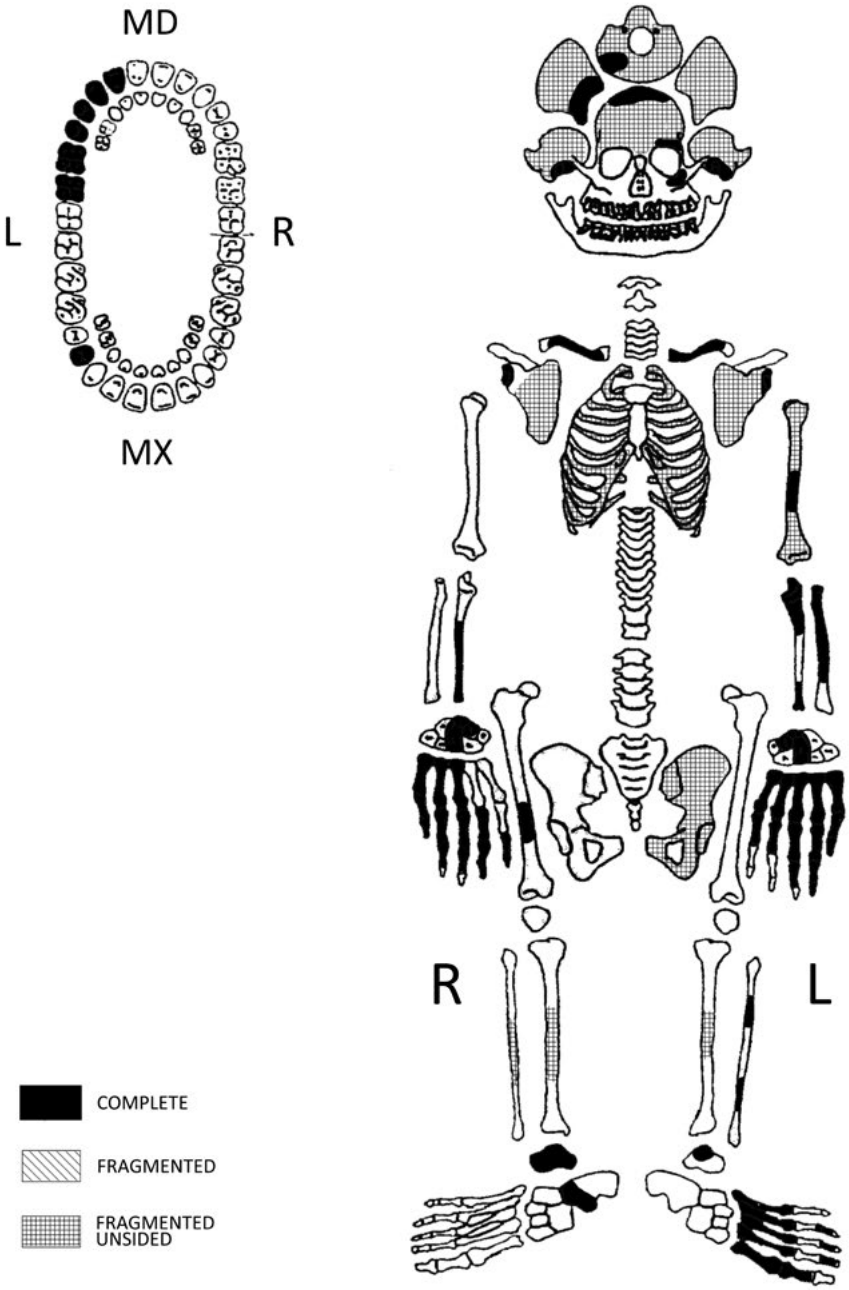


Figure 151

Sex: undeterminable

Age: 25-35 years
Age at death was determined on the basis of dental eruption.

Stature: undeterminable

Dental pathologies
Only the maxillary left first premolar is preserved and isolated. The mandibular left second incisor, canine, premolars and first and second molars are preserved and isolated. The other teeth are missing.
Enamel hypoplasia occurred between 3 and 6 years, with three episodes.

A grade 3 distal caries is present on the mandibular first left molar.

Anatomical variants
Not observable.

Ergonomy
Not observable.

Pathologies
None found.

SU 2425

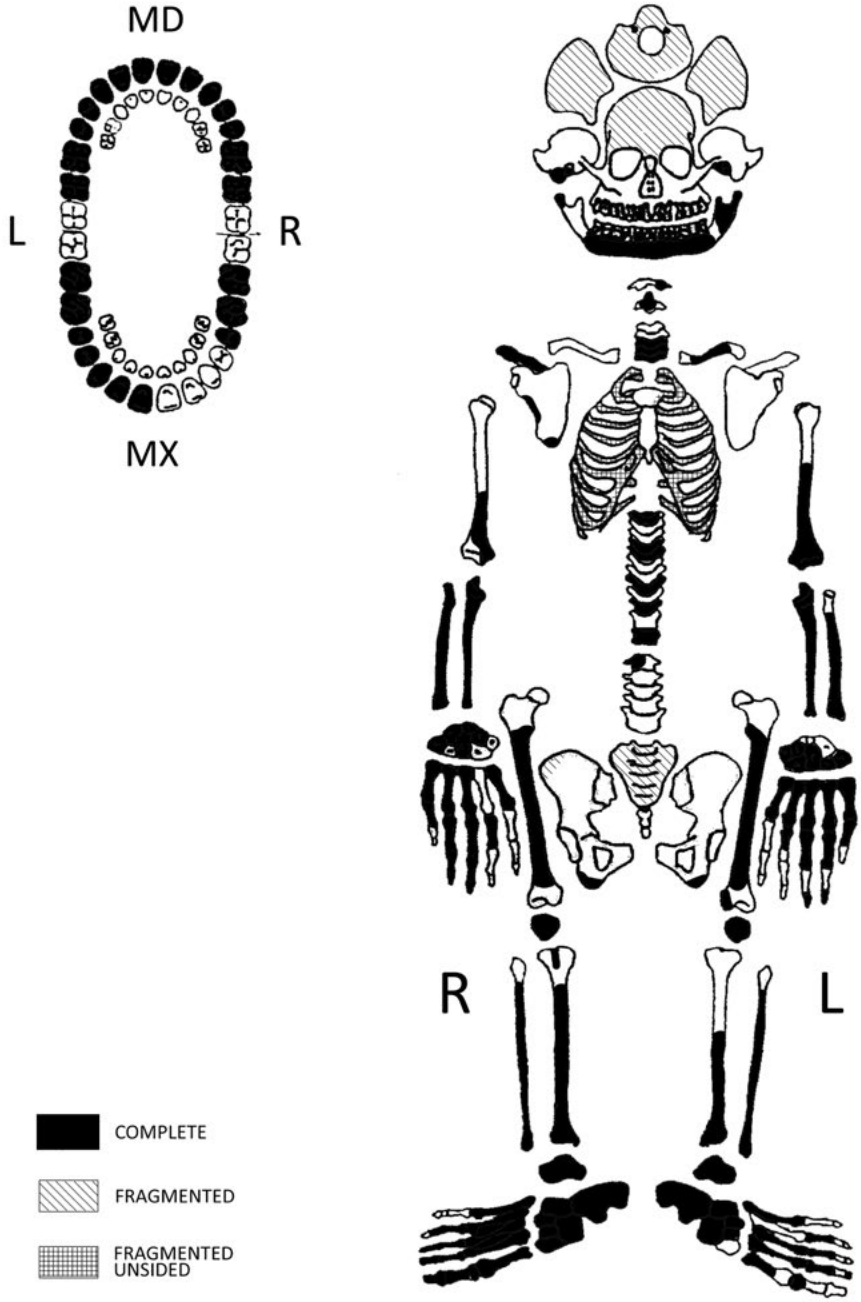


Figure 152

Sex: male
Sex was determined through the analysis of five morphological features of the skull, which provided a sexual index of 1.2.

Age: 25-35 years
Age at death was determined on the basis of dental wear, sternal rib end modifications, and stage of fusion of the vertebrae.

Stature: undeterminable

Dental pathologies
The maxillary teeth are preserved isolated, except for the right incisors, canine, and first premolar, which are missing. The mandibular teeth are all preserved in situ. The third molars are absent.
Alveolar resorption of grade 1 is present in the mandible.

Enamel hypoplasia occurred between 2.5 and 4 years, with three episodes.
Mild calculus affects the mandibular teeth.

Anatomical variants
In the post-cranial skeleton the accessory facet of the distal epiphysis of the right tibia is present.

Ergonomy
The muscular attachments of the individual show a low-medium development, except for the quadriceps tendon of the right tibia which shows a very strong development.

Pathologies
Diffuse periosteal reaction of grade 1 is present on femurs and tibiae, localised on the first and third diaphysis of the left fibula. The yellow ligaments are ossified and Schmorl's nodes affects the thoracic vertebrae. Osteoarthritis of grade 1 affects the cervical and thoracic vertebrae.

SU 2426

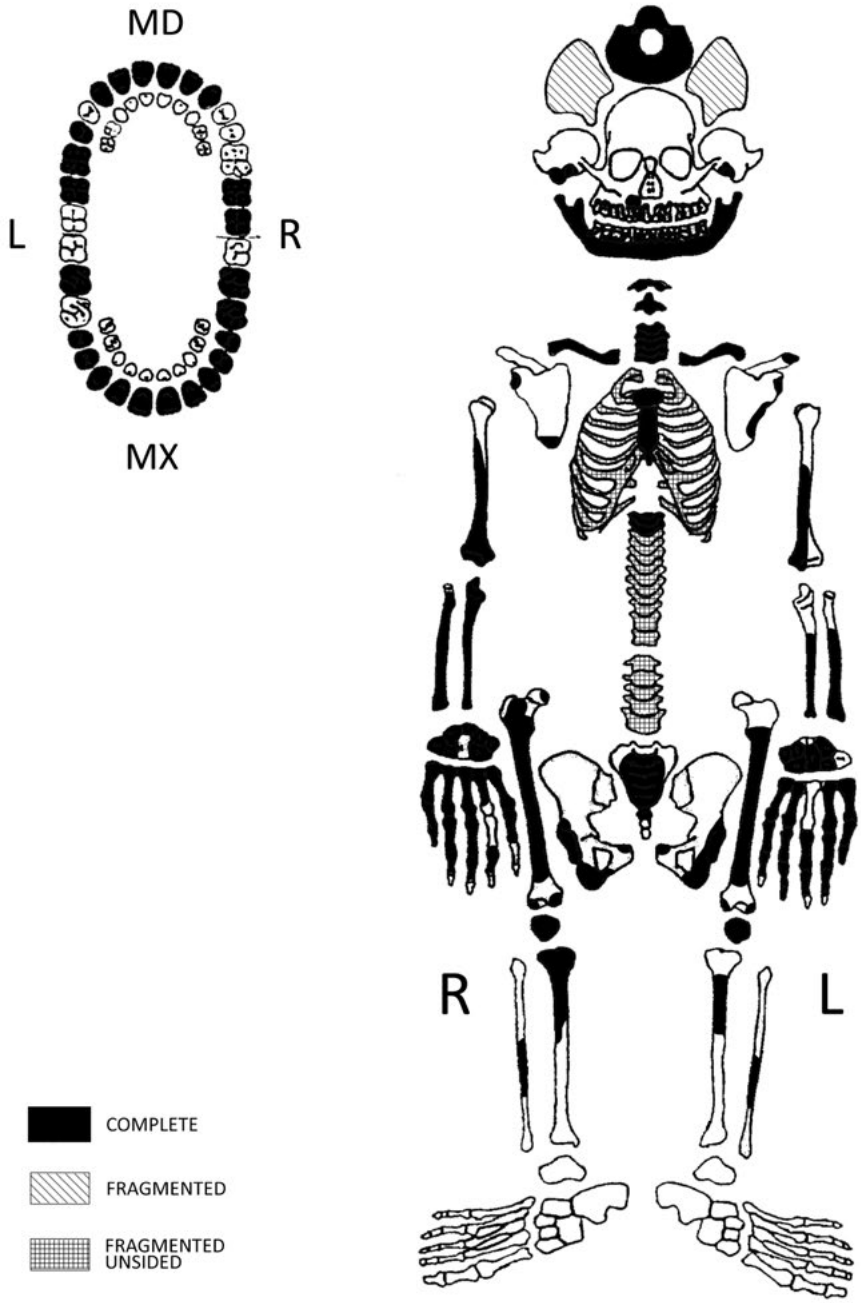


Figure 153

Sex: male
Sex was determined through the analysis of six morphological features of the skull, with a sexual index of 1.1.

Age: 40-50 years
The age at death was determined by dental wear, morphology of the pubic symphysis, sternal rib end modifications, and stage of fusion of the vertebrae.

Stature: not determinable

Dental pathologies
The maxillary teeth are missing, except for the left canine and premolars, which are preserved in situ. The mandibular teeth are missing, except for the left second premolar, first and second molar, right second and third molars, which are preserved in situ; the left third molar and right first molar were lost during life.
Alveolar resorption of grade 1 affects the maxilla, and grade 2 affects the mandible.
Enamel hypoplasia occurred between 1.5 and 4 years, with six episodes.
One grade 3 mesial caries is present on the maxillary right second molar; in the mandible, one grade 4 caries destroyed the crown of first molar, one grade 2 occlusal caries is present on the second left molar, and one grade 2 distal caries is present on the right second molar.
Mild calculus affects the maxillary teeth, strong calculus is present on the anterior teeth of the mandible.

Anatomical variants
In the post-cranial skeleton the unfused acromial epiphysis of the left scapula is observed.

Ergonomy
The individual shows a low-medium development of the muscular attachments, except for the costo-clavicular ligament of the left clavicle, the brachioradialis of the right humerus, and the gluteus maximus of the right femur, which have a strong development. A possible muscular trauma is visible in correspondence of the costo-clavicular ligament of the right scapula.

Pathologies
Osteoarthritis of grade 1 is present on the acromial facet of the right clavicle, the proximal and distal joint surfaces of the left ulna, the acetabular cavities, the distal joint of the left femur, the articular facet of the patellae, and the lumbar vertebrae. Diffuse grade 1 periosteal reaction is present on the femur, localised on the proximal epiphysis of the left fibula.

Trench 13

SU 5112

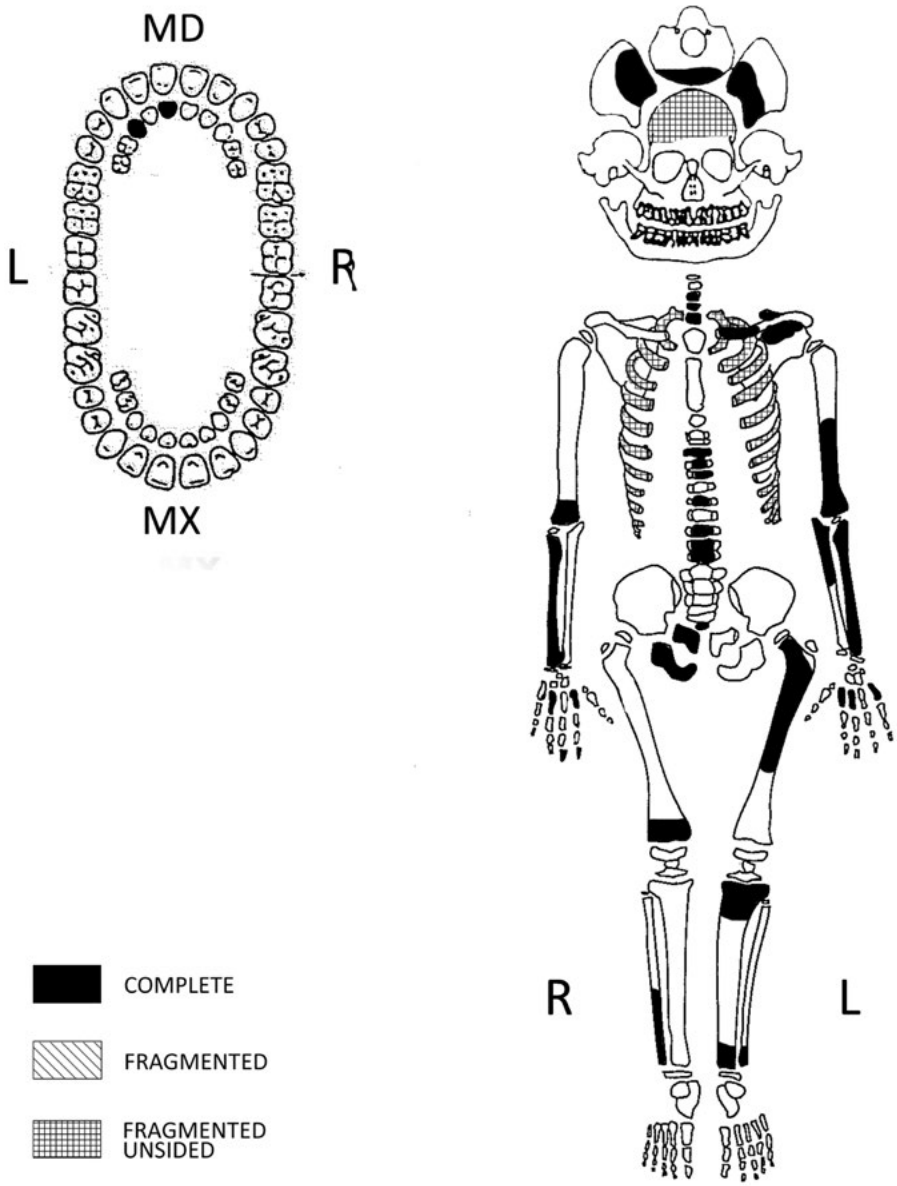


Figure 154

Sex: undeterminable

Age: 18-24 months
Age at death was determined on the basis of degree of fusion between diaphyses and epiphyses and long bone length.

Dental pathologies
The two preserved teeth are isolated, the deciduous mandibular left canine and first incisor.

Anatomical variants
None observed.

Pathologies
Localised grade 1 periosteal reaction is visible on the left femur.

SU 5113

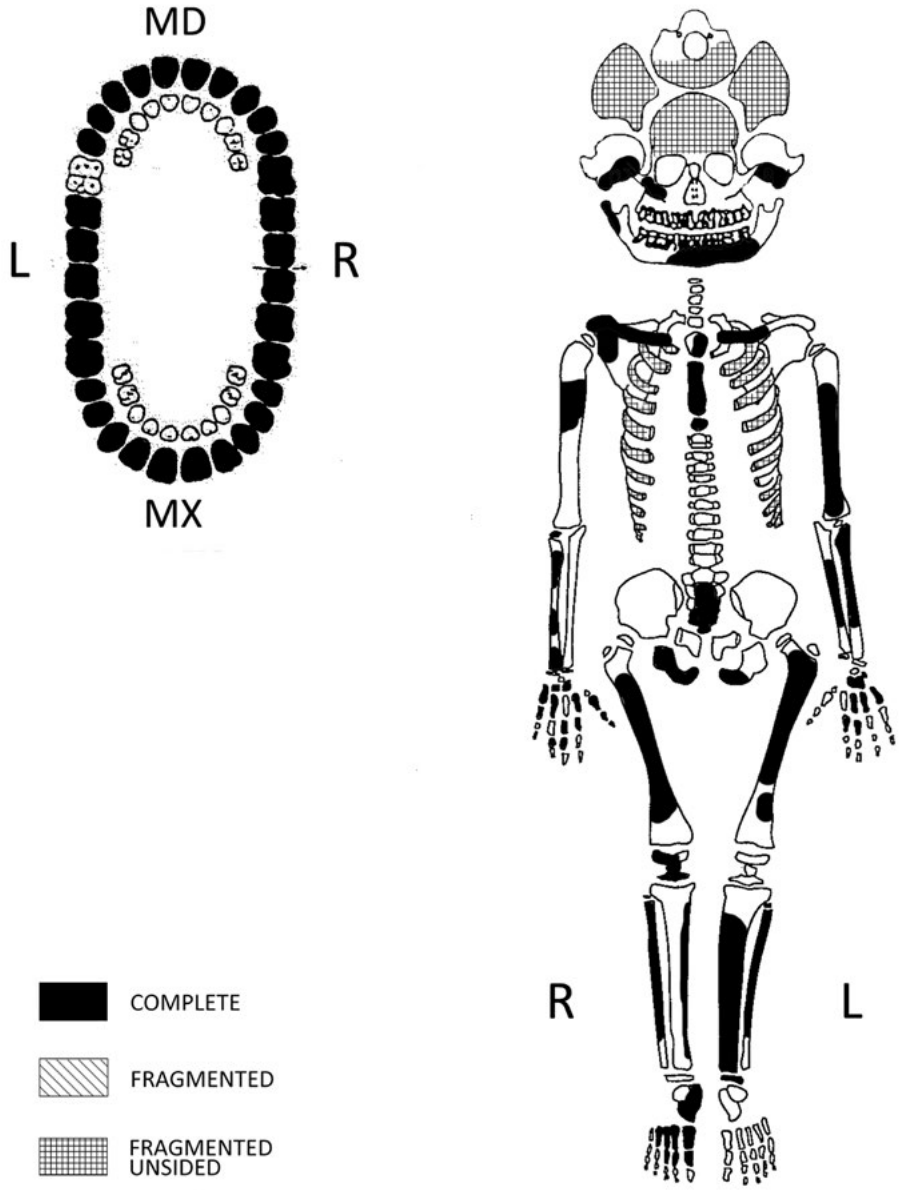


Figure 155

Sex: undeterminable

Age: 14-16 years
Age at death was determined on the basis of degree of fusion of the vertebral bodies, sternal rib end modifications, stage of fusion between diaphyses and epiphyses, long bone length, and dental eruption.

Dental pathologies
All mandibular teeth are preserved isolated. The mandibular teeth are preserved in situ, except the right molars and left second and third molar, which are preserved isolated, and the left first molar, which was lost post-mortem.
Enamel hypoplasia occurred between 1.5 and 5 years, with eight episodes.
Several grade 1 caries are detected in the maxilla: three occlusal on the left first molar, two occlusal and one on lingual on the left second molar, four occlusal on the right first molar, two occlusal on the right second molar; in the mandible, two occlusal caries on the second molars bilaterally, and three occlusal on the right first molar.

Anatomical variants
None observed.

Pathologies
Diffuse grade 1 periosteal reaction is present on both femurs, whereas localised grade 1 periosteal reaction is visible on the central diaphysis of the left fibula.
A healed fracture affects the diaphysis of the left clavicle.

SU 5114

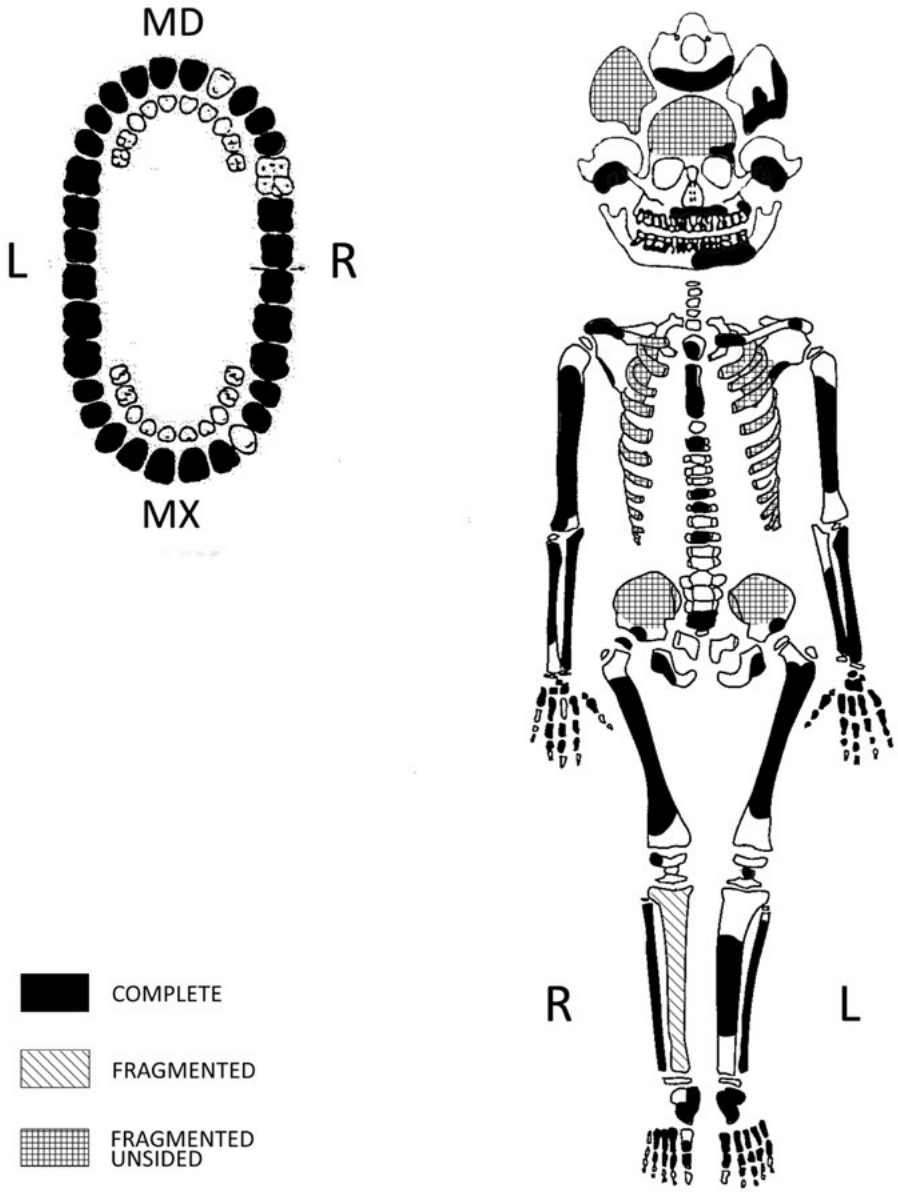


Figure 156

Sex: undeterminable

Age: 14-15 years
Age at death was determined on the basis of degree of fusion between diaphyses and epiphyses, dental eruption, degree of development of permanent teeth, and sternal rib end modifications.

Dental pathologies
The maxillary teeth are preserved in situ, except for the right canine and the left third molar, which were lost post-mortem, and the left premolars and right first molar, which are preserved and isolated. The mandibular teeth of the right side are preserved in situ, except for the right first incisor, canine, premolars, second and third molar, which are preserved and isolated, and the right second incisor and first molar, which are lost post-mortem.
A grade 1 buccal caries is present on the mandibular left first and second molar.
Enamel hypoplasia occurred between 2.5 and 4 years, with three episodes.
Strong calculus affects the mandibular central incisors.

Anatomical variants
In the skull the zygomatic foramina on the left is present.

Ergonomy
The individual shows a low development of the muscular insertions, except for the trapezoid ligament of the right clavicle, which shows a strong development.

Pathologies
Diffuse grade 1 periosteal reaction is observable on the femurs and the left tibia.

SU 5115

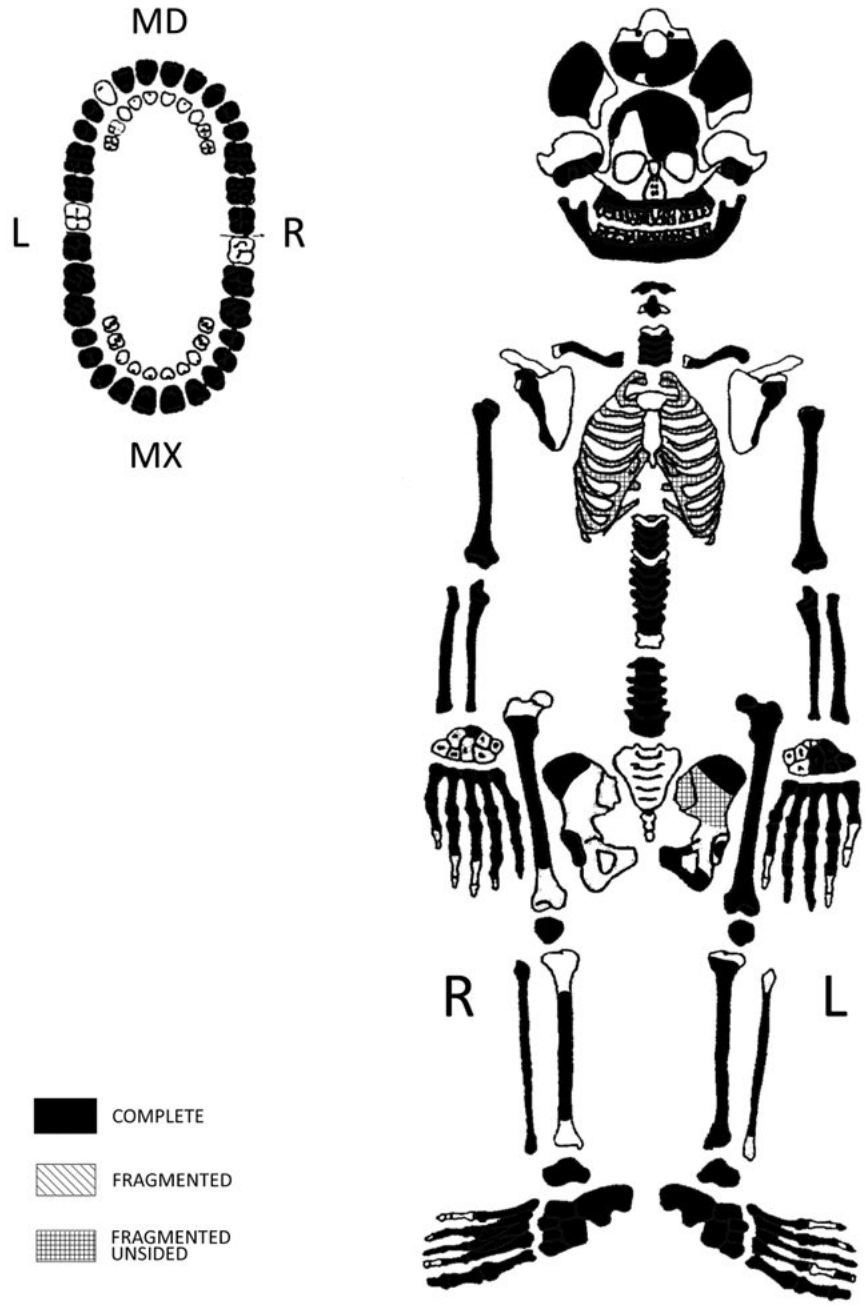


Figure 157

Sex: male
Sex was determined through the analysis of thirteen morphological features of the skull and three of the pelvis, which provided a total sexual index of 0.8.

Age: 20-30 years
Age at death was determined on the basis of dental wear, morphology of pubic symphysis, and sternal rib end modifications.

Stature: 161.9 cm

Dental pathologies
All the maxillary teeth are preserved in situ, except for the left first premolar and third molar, which were lost post-mortem. The mandibular teeth are preserved in situ, except for the right first and second premolars, which are preserved isolated, and the right third molar, which was lost post-mortem.
An occlusal grade 3 caries affects the maxillary left third molar.
Enamel hypoplasia occurred between 2 and 4 years, with six episodes.
Mild calculus affects both the maxillary and the mandibular teeth.

Anatomical variants
In the skull the complete left supraorbitary foramen, a right and left zygomatic foramen, and some lambdoid ossicles are present. In the post-cranial skeleton, the

anterior calcaneal accessory facets are present on both sides.

Ergonomy
The individual shows a medium developmentof the muscular insertions, except for the vastus medialis of the right femur, which presents a very strong development. An enthesopathy is present in correspondence of the deltoid of the right clavicle.

Pathologies
Cribra orbitalia of grade 1 are visible on the left orbit; cribra cranii of grade 1 are present on the parietals, occipital and frontal bones; diffuse grade 1 periosteal reaction affects both femurs and tibiae.
Osteochondritis dissecans is visible on the medial epicondyle of the right humerus.

SU 5116

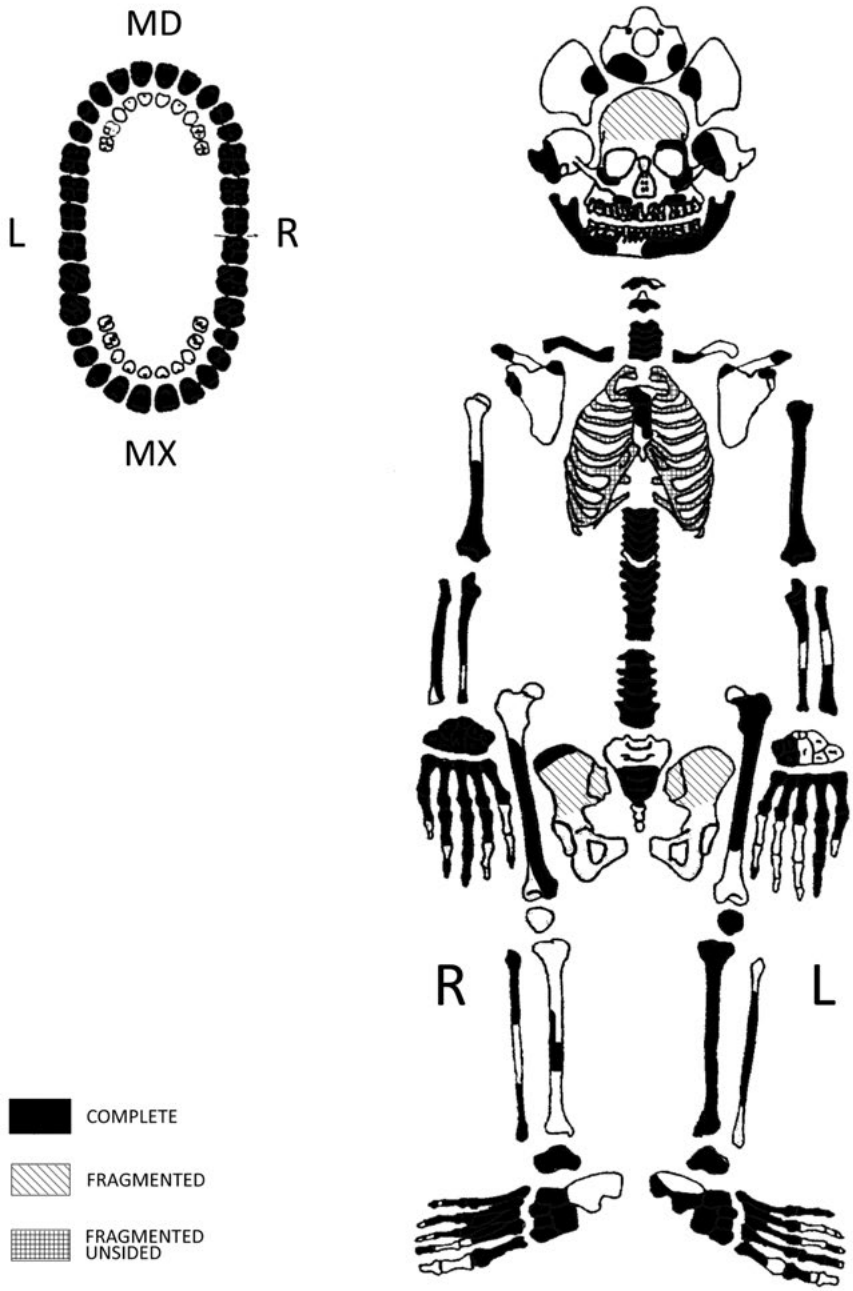


Figure 158

Sex: male
Sex was determined through the analysis of four morphological features of the skull and of two of the pelvis, which provided a total sexual index of 0.4.

Age: 40-50 years
Age at death was determined on the basis of dental wear, sternal rib end modifications and vertebral stage of fusion.

Stature: 166.5 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the incisors, right canine and left first premolar, which are preserved and isolated, and the left second premolar, which was lost during life. The mandibular teeth are preserved in situ, except for the central incisors, right second incisor, canine and first premolar, which are preserved and isolated.
Alveolar resorption of grade 1 affects the maxilla and the mandible.
Enamel hypoplasia occurred between 1.5 and 4.5 years, with six episodes.
There are several caries of grade 1: one mesial on the maxillary left first molar at the cemento-enamel junction, one occlusal on the maxillary on each of the following: left third molar, right second and third molar; two other grade 1 caries are found on the mandibular left second molar. One buccal grade 3 caries is present on the maxillary left third molar at the cemento-enamel junction, one grade 4 is present on the mandibular left third molar; on the mandibular right second molar there are one occlusal grade 1 caries and one buccal grade 3 caries.

Anatomical variants
In the post-cranial skeleton the accessory transverse foramen on the left of C4, the supracondilar process on the humeri, the vastus notch on the right patella and the left patella emarginata are present.

Ergonomy
The individual shows low/medium development of the muscular insertions, except for the brachialis of both ulnae and the supinator of the right ulna, which show a strong development.

Pathologies
Osteoarthritis of grade 1 is present at the level of the distal joint of the right first metatarsal; the yellow ligaments of the lumbar vertebrae are ossified; Schmorl's nodes affect one thoracic and four lumbar vertebrae. The right trapezoid is fused with the second metacarpal; the second and third phalanges of the fifth finger of the right and left foot are fused.

SU 5117

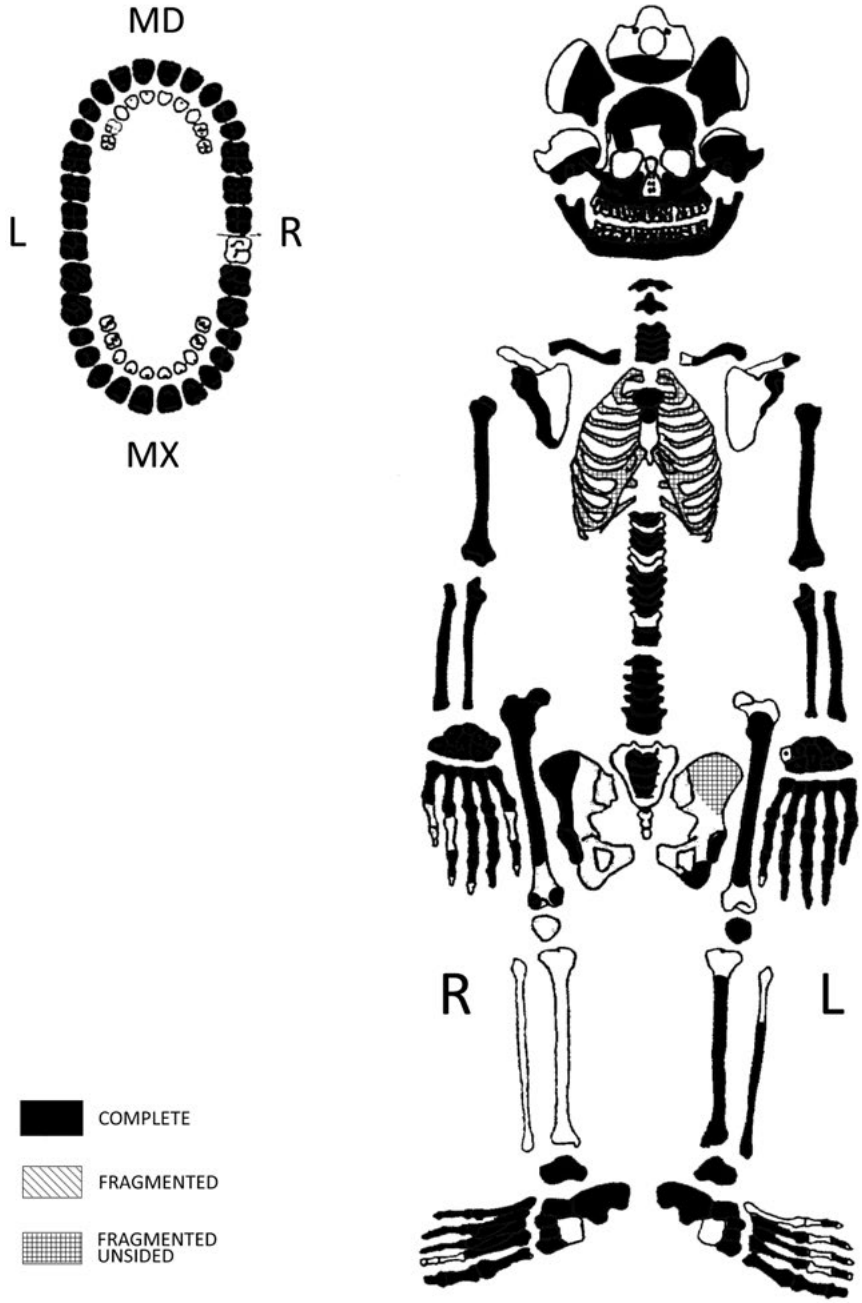


Figure 159

Sex: male
Sex was determined through the analysis of twelve morphological features of the skull and one of the pelvis, which provided a total sexual index of 0.7.

Age: 25-30 years
Age at death was determined on the basis of dental wear and sternal rib end modifications.

Stature: 165.5 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the right third molar, which was lost post-mortem. The mandibular teeth are all preserved in situ.

One grade 3 distal caries is visible on the maxillary left first premolar. Alveolar resorption of grade 2 affects the maxilla, and grade 1 affects the mandible.
Extramasticatory wear of the mandibular and maxillary incisors is recorded.
Mild calculus affects both the maxillary and the mandibular teeth.
Enamel hypoplasia occurred between 1.5 and 4 years, with seven episodes. The rotation of the maxillary left canine and first premolar and of the maxillary right canine is observed.

Anatomical variants
In the skull the parietal foramina on both sides and some lambdoid ossicles on both sides are present. In

the post-cranial skeleton the complete transverse accessory foramen on both sides of C6 and the Poirier facet on the right femur are present.

Ergonomy
The individual shows a medium-strong development of the muscular insertions, except for the deltoid and of the costo-clavicular ligament of the right clavicle, the pectoralis major and brachioradialis of the right humerus, the triceps brachii and brachialis of both ulnae, the iliopsoas of the right femur and the Achilles' tendon of the right calcaneus, which show a strong development.

Pathologies
Cribra orbitalia of grade 1 affects both orbits and cribra cranii of grade 1 are visible on the parietal and frontal bones. Ossification of the yellow ligament was observed in three thoracic and one lumbar vertebra. A Schmorl's node is present on the only preserved lumbar vertebra.

SU 5118

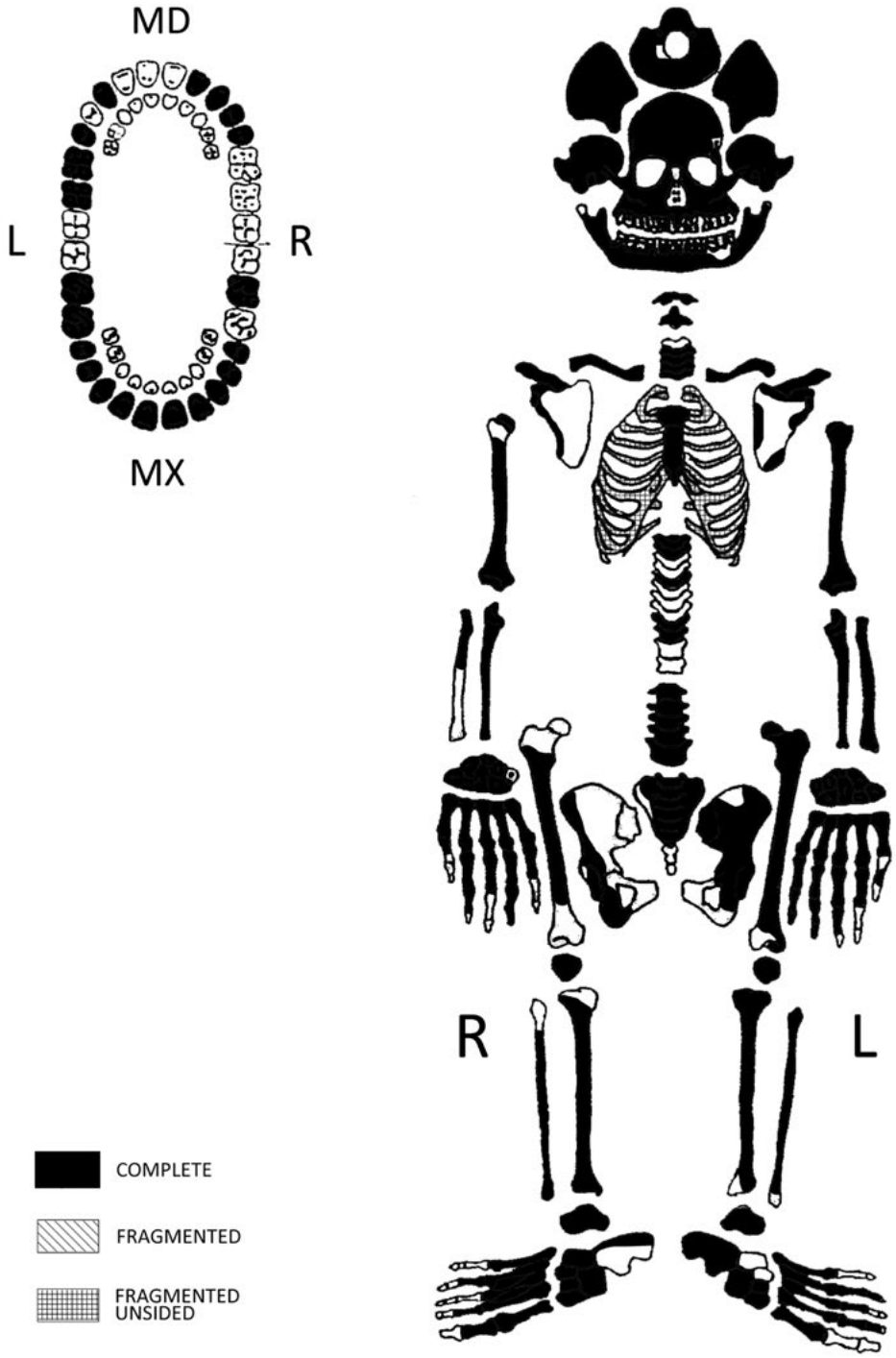


Figure 160

Sex: female
Sex was determined through the analysis of nineteen morphological features of the skull and nine of the pelvis. There is a discrepancy between the skull features that suggested male sex, with a sexual index of 0.9, and those of the pelvis suggesting a female sex, with an index of -0.2.

Age: 40-50 years
There is a discrepancy in the results of two different methods: the analysis of the sternal rib end modifications suggested a range between 50 and 60 years, while the morphology of the auricular surface of ilium an age of about 35-39 years. Dental wear, on the other hand, is not detectable due to the high quantity of calculus present.

Stature: 158.2 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the right first molar, which was lost during life. There is agenesis of the two third molars. The mandibular teeth are preserved in situ, except for the right molars and the left first premolar, which were lost during life, and the left second premolar, which is preserved and isolated; the right incisor is preserved as root.
On the maxillary right second molar there are four occlusal caries, all of grade 2.
The mandibular left canine and the right first and second premolars are rotated.
Alveolar resorption grade 2 affects the maxilla and the mandible.
Very strong calculus is observed, particularly in the left laterality, which completely covers the crown of the maxillary canine, first and second premolars, first and second molar and mandibular canine, second premolar, first and second molar.
Very marked enamel hypoplasia occurred between 2 and 4 years, with four episodes.

Anatomical variants
In the skull, the complete supraorbital foramen and the extrasutural mastoid foramen bilaterally are present. In the post-cranial bones the xifoid perforation, an accessory transverse foramen on the left of C5, bilateral in C6, and the exostosis of the trochanteric fossa of the left femur are observed.

Ergonomy
The individual shows a strong/very strong muscular development; in particular there are osteophytic enthesopathies of grade 2 at the level of the deltoid of the right humerus and of the Achilles' tendon of both calcanei; a grade 2 osteolythic enthesopathy at the level of the costo-clavicular ligament of the right clavicle and a grade 1 osteophytic enthesopathy of the triceps brachii of the left ulna.

Pathologies
Osteoarthrosis of grade 1 affects the articular surfaces of the upper limbs and lower limbs, except for the ankles and feet. Osteoarthrosis of grade 2 affects the acromion facet of the right clavicle and the acromial joint facet of the corresponding scapula, the distal joint of the left humerus, the proximal joint of the right ulna and the superior margin of L4.
There are cribra cranii of grade 1 in the parietal bones.
Diffuse grade 1 periosteal reaction is present on both femurs and on the left tibia; localized grade 2 periosteal reaction is present on the posterior portion of the upper diaphysis of the left femur, on the external side of the both proximal tibiae, on the upper third of the right fibula, and on different areas of the diaphysis of the left fibula.
There are Schmorl's nodes on three out of six thoracic vertebrae and on three out of five lumbar vertebrae.
In addition, the presence of a rib fracture and the fusion of the first metacarpal with the first phalanx of the right hand are observed.

SU 5119

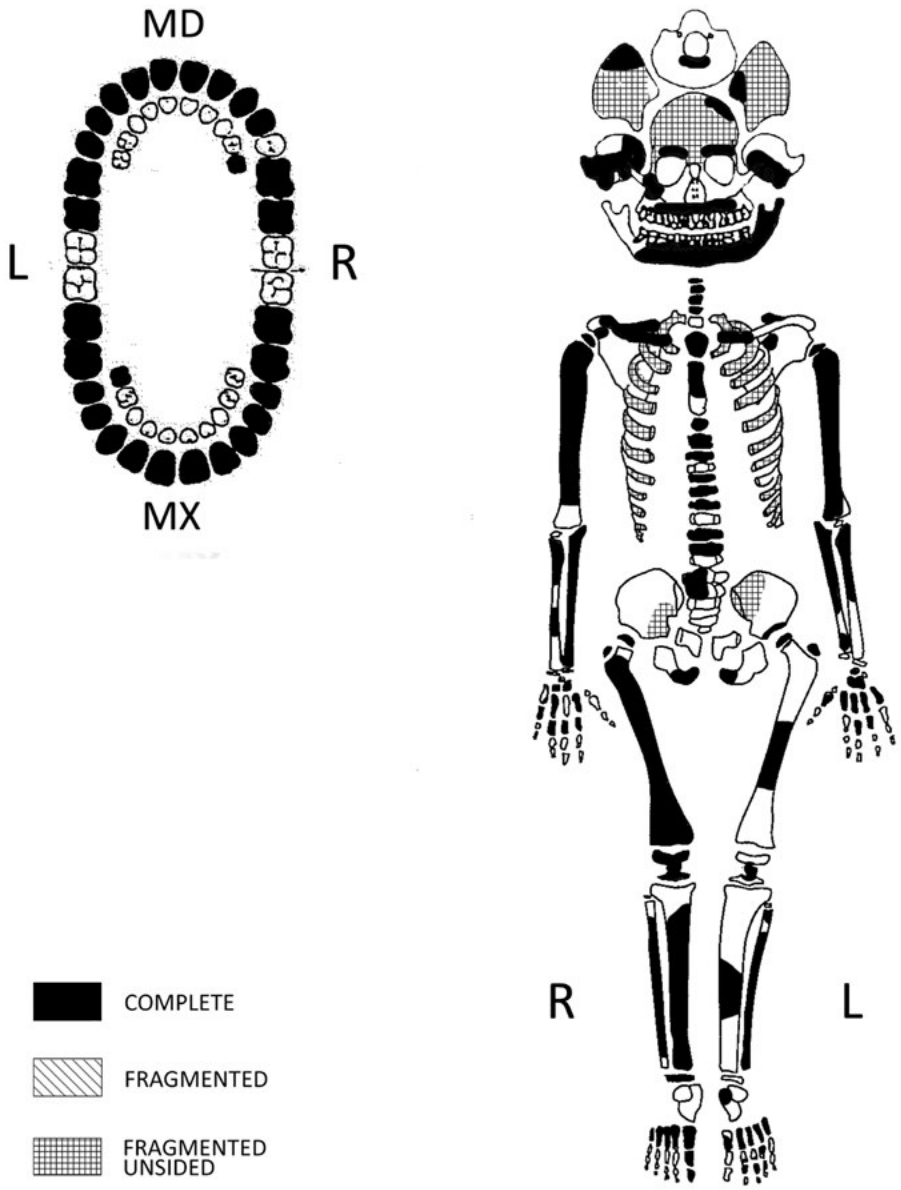


Figure 161

Sex: undeterminable

Age: 9-11 years
Age at death was determined on the basis of dental eruption and the degree of fusion of epiphyses and diaphyses.

Dental pathologies
The maxillary teeth are preserved in situ, except for the right second molar, left first and second molar, which are preserved and isolated, and the maxillary second incisor and right canine, which were lost post-mortem; the deciduous maxillary left second molar is preserved isolated. The mandibular teeth are preserved in situ, except for the germ of mandibular right third molar, which is preserved and isolated, and the right second premolar, which was lost post-mortem; the deciduous right second molar is preserved in situ.

One grade 1 occlusal caries is present on the maxillary left first molar and on the mandibular left first premolar. Enamel hypoplasia occurred between 2 and 5 years of age, with four episodes.

Anatomical variants
In the skull the zygomatic foramen is present on the right.

Ergonomy
Not observable.

Pathologies
A healed fracture of the head of the right humerus is present. Diffuse grade 1 periosteal reaction affects the right femur and the tibiae.

SU 5120

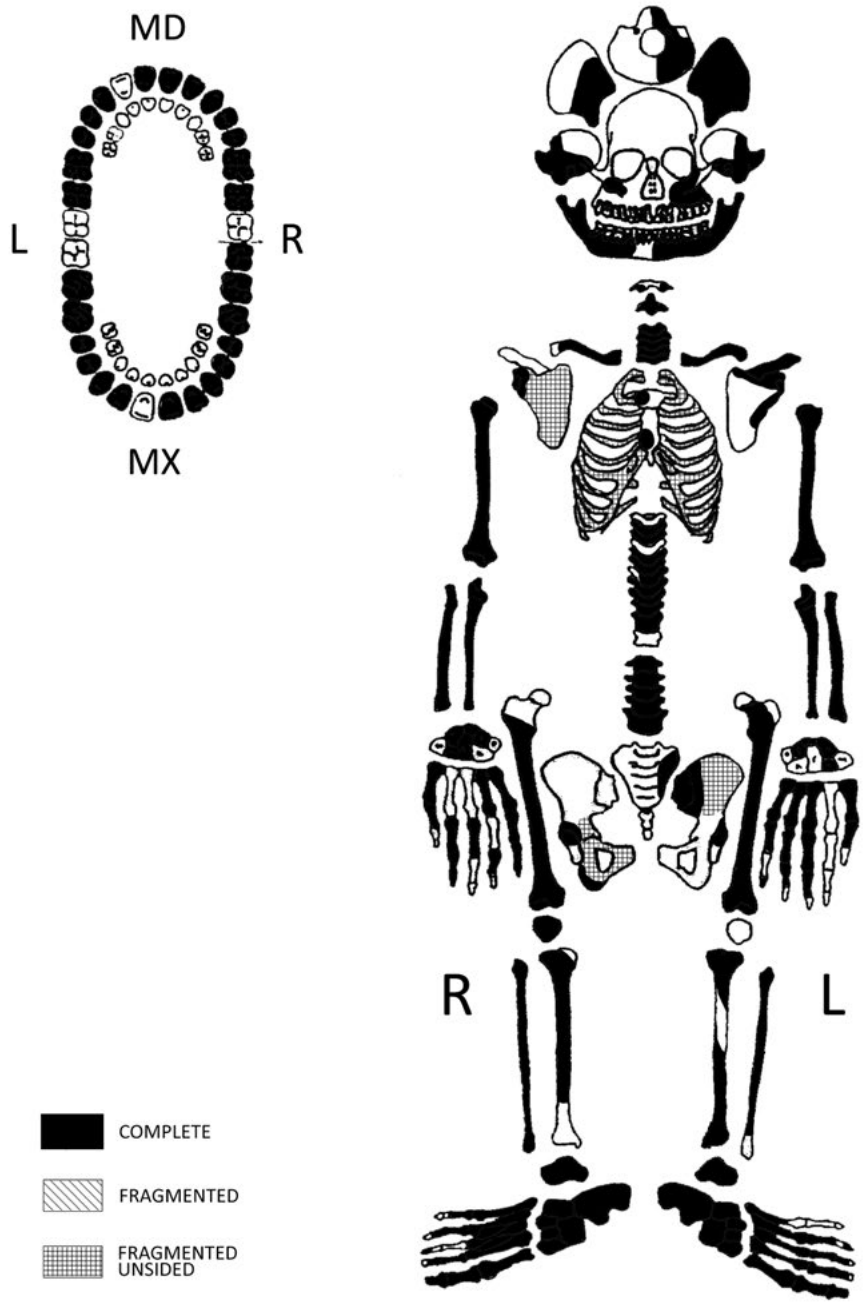


Figure 162

Sex: female
Sex was determined through the analysis of seven morphological features of the skull and three of the pelvis, which provided a total sexual index of -0.7.

Age: 30-40 years
Age at death was determined on the basis of dental wear and sternal rib end modifications.

Stature: 151.4 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the right second incisor, canine, first premolar, third molar, and left incisors, which are preserved and isolated, and the right first incisor, which was lost post-mortem. The mandibular teeth are preserved in situ, except for the right second incisor, canine, first premolar and left incisors, which are preserved and isolated, and the right first incisor, which was lost post-mortem. There is agenesis of the mandibular third molars and maxillary left third molar.
Enamel hypoplasia occurred between 2 and 5 years, with five episodes.
Alveolar resorption of grade 2 affects the maxilla and grade 3 affects the mandible.
In the left maxillary teeth there are grade 3 caries at the cemento-enamel junction: one distal on the second incisor, one mesial on the canine, and one distal on the left first molar; also one occlusal grade 1 caries is

present on the first premolar. On the right maxilla one occlusal grade 1 caries is visible on the second molar, two occlusal grade 1 on the second molar, one grade 4 on the third molar. In the left mandible there is one distal grade 3 caries at the cemento-enamel junction on the first premolar, one occlusal grade 1 on the first molar, one grade 4 on the second molar; on the right mandible there are one distal grade 2 caries at the cemento-enamel junction on the canine, one occlusal grade 1 on the first molar, and three caries on the second molar: two occlusal of grade 2 and one distal grade 3 at the cemento-enamel junction.
Strong calculus affects both the maxillary and the mandibular teeth, in particular on the two left mandibular incisors, which are almost entirely covered. The maxillary second left molar and right third molar present microdontia.

Anatomical variants
In the skull the zygomatic foramina on the left and the parietal foramina on both sides are present; in the post-cranial skeleton the complete transverse accessory foramen on the left of C6, the supraglenoid facet on the left scapula, the accessory facets on the distal epiphysis of the left tibia, and the anterior double facet on the left calcaneus are present.

Ergonomy
The individual shows a low-medium development of the muscular insertions.

Pathologies
Osteoarthrosis of grade 1 affects the proximal articular surface of the humeri and the glenoid cavity of the scapulae. Diffuse grade 1 periosteal reaction is present on the left femur. Schmorl's nodes affect three thoracic and three lumbar vertebrae.

SU 5121

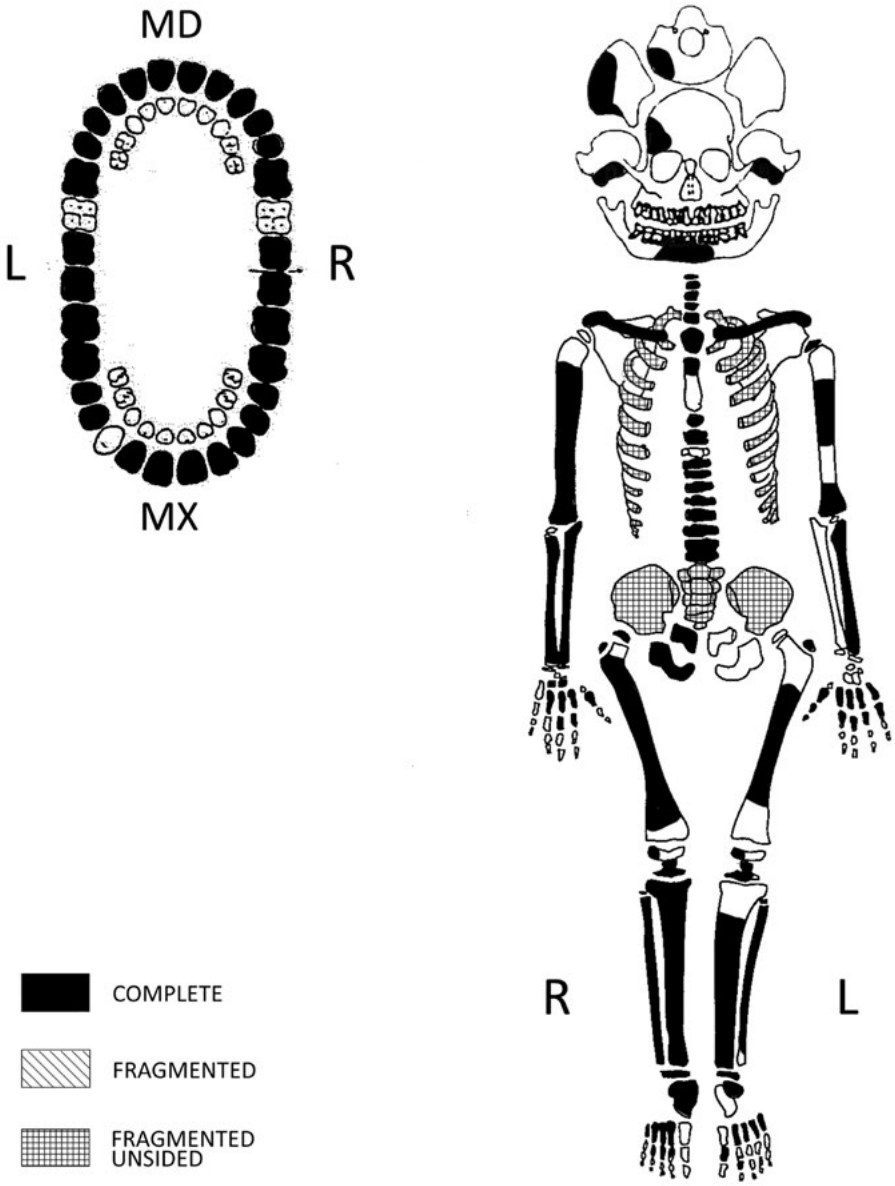


Figure 163

Sex: undeterminable

Age: 12-15 years
Age at death was determined on the basis of dental eruption and dental wear, degree of fusion between diaphyses and epiphyses, long bone length, and stage of fusion of the vertebrae.

Dental pathologies
The maxillary teeth are preserved and isolated, except for the first left incisor, first and second left premolars, and germ of the third molars, which are preserved in situ, and the second incisor and left canine, which were lost post-mortem.
The mandibular teeth are preserved isolated, except for the incisors, right canine, and germ of the right third molar, which are preserved in situ, and the second molars, which were lost post-mortem.
Alveolar resorption of grade 1 affects both the maxilla and the mandible.
Enamel hypoplasia occurred between 1.5 and 4.5 years, with six episodes.

Anatomical variants
In the skull some lambdoid ossicles on the left are visible; in the post-cranial skeleton the transverse accessory foramen on the left of C5 and on the right of C6 are present.

Pathologies
None observed.

SU 5123 (+ 5123 bis)

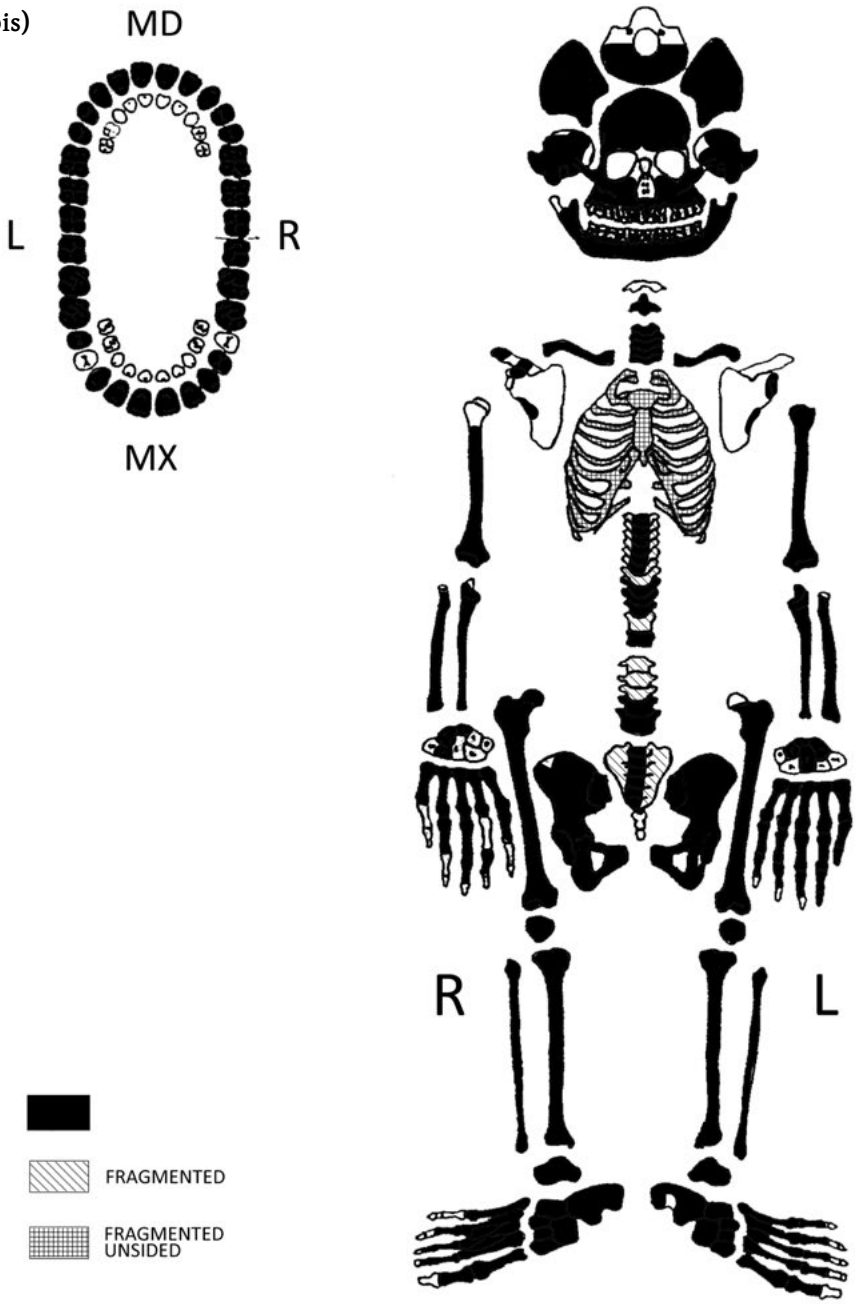


Figure 164

Sex: female
Sex was determined through the analysis of nine morphological features of the skull and fourteen of the pelvis, which provided a total sexual index of -1.1.

Age: 20-22 years
Age at death was determined on the basis of dental wear, morphology of the pubic symphysis and auricular surface of the ilium, degree of development of permanent teeth, and sternal rib end modifications.

Stature: 153.35 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the second premolars, which were lost post-mortem. The mandibular teeth are all preserved in situ.
Enamel hypoplasia occurred between 1.5 and 5 years, with eight episodes.
Alveolar resorption of grade 1 affects the maxilla and the mandible.
Mild calculus is present on the maxillary and the mandibular teeth.

Anatomical variants
In the skull the lambdoid ossicles on the left and the extrasutural mastoid foramen on the left are present. In the postcranial skeleton the transverse accessory foramen partial on the right of C5 and on both sides of C6, the unfused acromion in the right scapula, the septal aperture in both humeri, the acetabular crease in the right acetabulum, and the throclear extension in both talii are present.

Ergonomy
The individual shows a low-medium development of muscular insertions, except for the pectoralis major of both clavicles, which has a strong development.

Pathologies
Cribra orbitalia of grade 1 are present on the left side; mild osteophytosis affects the margin of the external acoustic meatus. Localised grade 4 periosteal reaction affects the proximal third of the diaphysis of tibiae and fibulae. Osteoarthritis of grade 1 is present on the head of both femurs. A microtrauma is visible on the posterior portion of the distal third of the right femur; a musculo-tendineous trauma is visible in correspondence of the soleus of the left tibia.
The woman was pregnant; the foetus (SU 5123 bis) is estimated around 14-16 weeks.

SU 5124

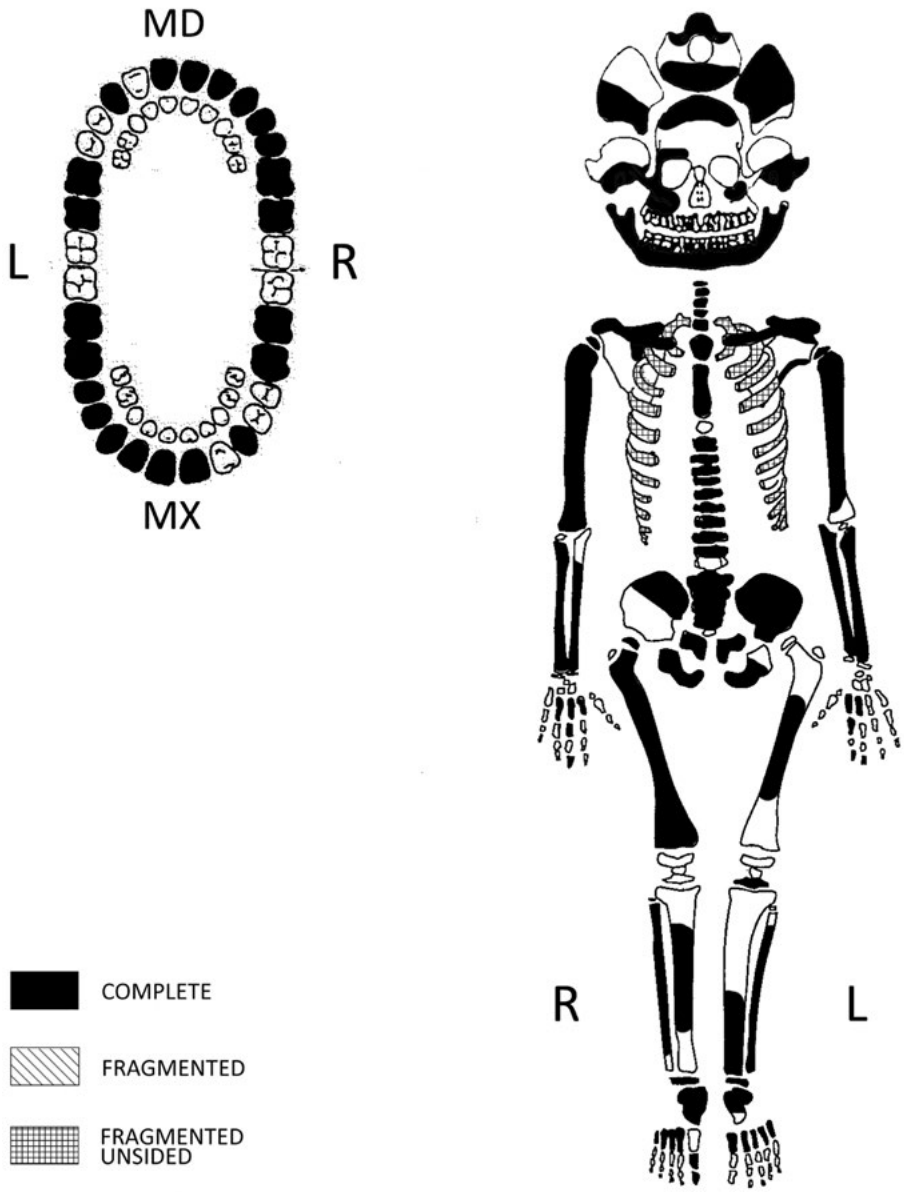


Figure 165

Sex: undeterminable

Age: 5-6 years
Age at death was determined on the basis of dental eruption, degree of fusion between diaphyses and epiphyses, long bone length, and development of permanent teeth.

Dental pathologies
The maxillary teeth are present isolated, except for the first right molar, which is preserved in situ; the permanent teeth are in form of germ, except for the first molars. The deciduous canines and molars are preserved and isolated. The mandibular teeth are preserved in situ, except for the germs of the first incisors, and left second incisor, which are isolated; the mandibular teeth are preserved as germ, except for the first molars. The deciduous right canine and molars are preserved in situ; the deciduous right incisors are preserved isolated.
Enamel hypoplasia occurred between 1.5 and 4 years, with five episodes.

Anatomical variants
In the skull the parietal foramen on the left and the posterior condylar canal on both sides are present. In the post-cranial skeleton there is the accessory transverse foramen on the right of C3, on both sides of C6.

Pathologies
Cribra orbitalia of grade 1 are present on the right orbit.

SU 5125

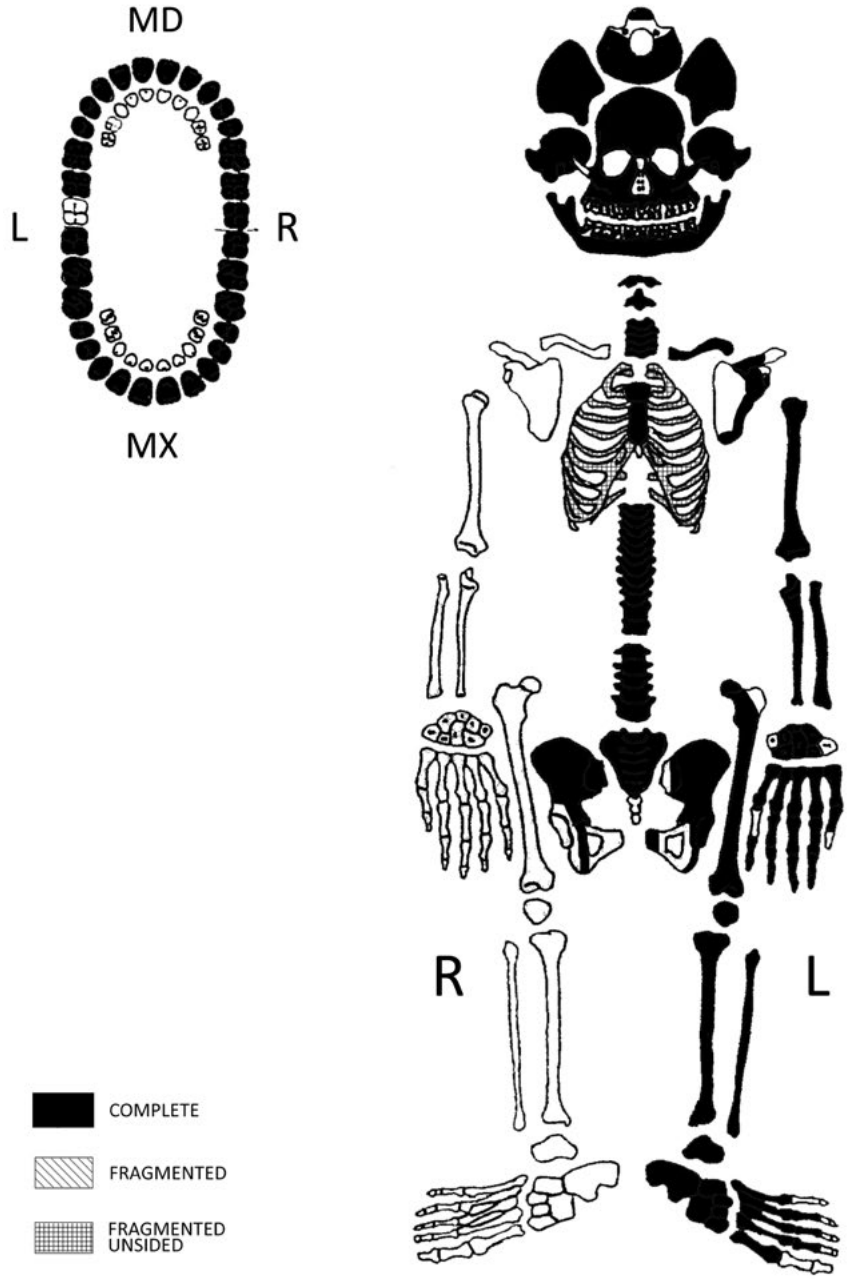


Figure 166

Sex: male
Sex was determined through the analysis of twenty morphological features of the skull and of ten of the pelvis, which provided a total sexual index of 0.7.

Age: 40-50 years
Age at death was determined on the basis of pubic symphysis morphology, sternal rib end modifications and dental wear. However, it should be noted that the latter suggested a different interval (35-40 years).

Stature: 166.1 cm

Dental pathologies
The maxillary teeth are all preserved in situ; the third left molar is in eruption. The mandibular teeth are preserved in situ. There is agenesis of the left third molar.
Alveolar resorption of grade 1 affects the maxilla and the mandible.
Mild calculus is present on the maxillary and the mandibular teeth.
Enamel hypoplasia occurred between 2 and 4 years, with four episodes.
Crowding is present in the mandibular anterior teeth.

Anatomical variants
In the skull the complete infraorbital suture, the parietal foramen and the lambdoid ossicles bilaterally are present. In the post-cranial skeleton, the complete accessory foramen on the right in C5 and in both lateralities in C6, the accessory facet in the distal epiphysis of the left tibia and the double accessory facet in the left calcaneus are present.

Ergonomy
The individual shows a strong muscular development, especially at the level of the shoulder, elbow and hip.

Pathologies
The presence of cribra orbitalia on the left orbit and cribra cranii on both parietals is observed. Diffuse grade 1 periosteal reaction affects the left femur and tibia. Schmorl's nodes are present on seven thoracic vertebrae out of twelve and on 3 lumbar vertebrae out of 5. There is grade 1 osteoarthritis at the level of the two joint of the left clavicle and of the proximal joint of the left ulna.
There are two depressed areas in the skull: one located at the center of the frontal bone, about 1 cm in diameter, the other at the center of the left parietal, about 1.5 cm in diameter; these are probably blunt force traumas. There is also the occipitalization of the atlas and a possible avulsion fracture of the base of the 5th left metatarsal. Finally, the presence of vascular enlarged foramina on some thoracic and lumbar vertebral bodies is visible.

SU 5126

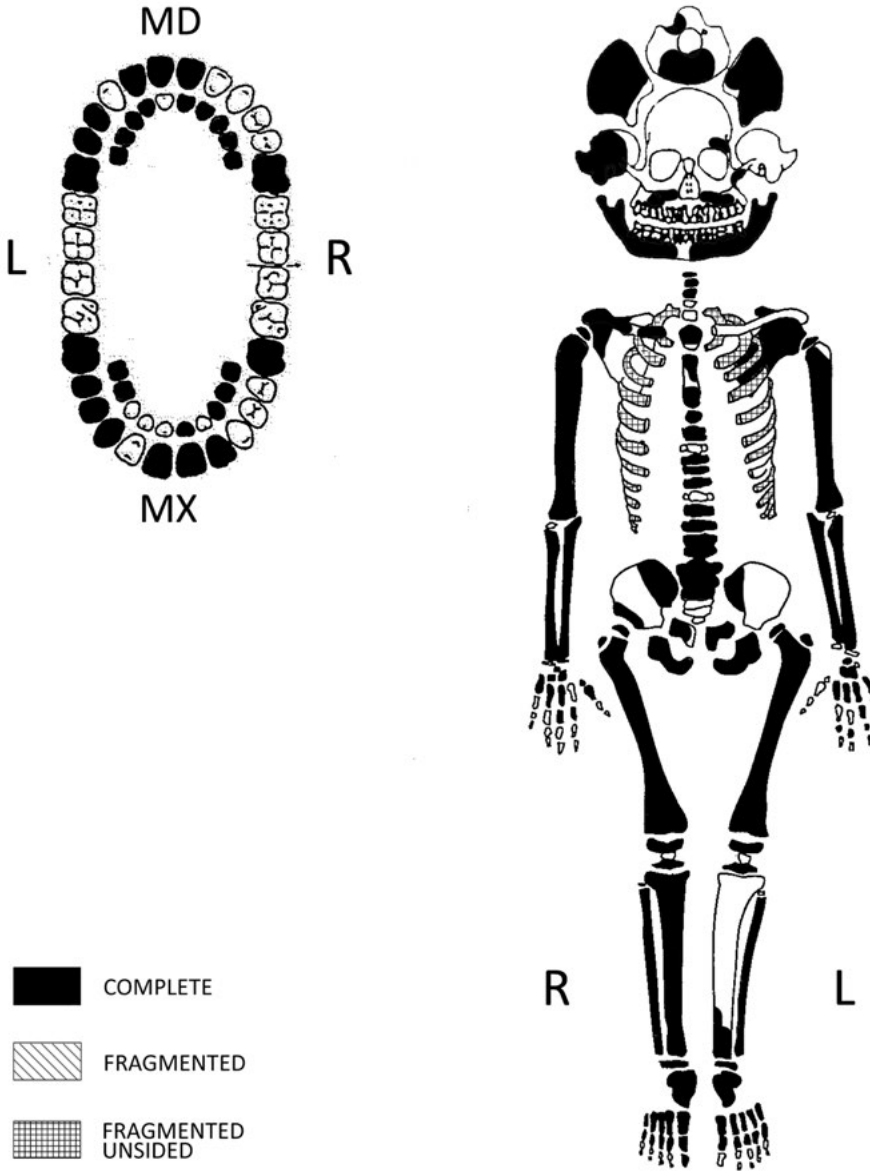


Figure 167

Sex: undeterminable

Age: 6-8 years
Age at death was determined on the basis of dental eruption, degree of fusion between diaphyses and epiphyses, long bone length, and development of permanent teeth.

Dental pathologies
The deciduous maxillary teeth are preserved isolated, except for the right second molar, which is preserved in situ, and the left incisors and canine, which are missing. The permanent first incisors and left canine are preserved isolated; the permanent right incisors and left premolars are in eruption; the first molars

and the germ of the second molars are preserved in situ. The deciduous mandibular teeth are preserved isolated, except for the left second incisor, canine and molars, which are preserved in situ; the left first incisor and right first molar are missing. The permanent mandibular first incisors, and germs of the right premolars are preserved isolated, and the first molars and germ of the second molars are preserved in situ.
Enamel hypoplasia occurred between 1.5 and 4 years, with six episodes.

Anatomical variants
In the skull the extrasutural mastoid foramen on the right, and in the post-cranial skeleton the septal aperture in the humeri are present.

Pathologies
Lithic lesions are visible on the anterior portion of the bodies of the thoracic and lumbar vertebrae.

SU 5127

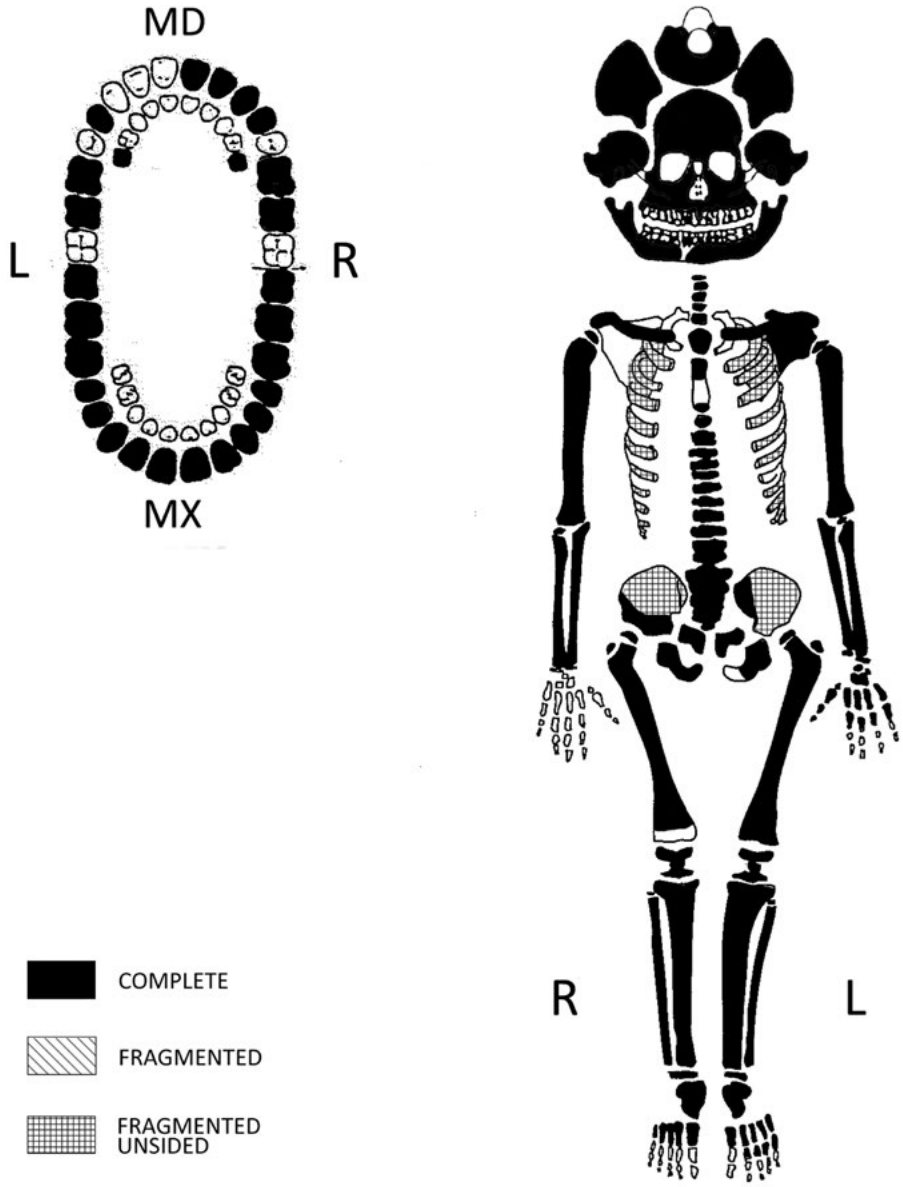


Figure 168

Sex: undeterminable

Age: 10-12 years
Age at death was determined on the basis of degree of fusion between diaphyses and epiphyses, dental eruption, degree of development of permanent teeth, and long bone length.

Dental pathologies
The maxillary teeth are preserved in situ, except for the left third molar, which was lost post-mortem; the canines, left second premolar and second molars are in eruption. The mandibular teeth are preserved in situ, except for the left incisors and canine, which were lost post-mortem; the right canine, first premolar and

second molars are in eruption; the deciduous second molars are preserved in situ.
A grade 1 occlusal caries is visible on the mandibular right first molar.
Enamel hypoplasia occurred between 2 and 5 years, with four episodes.

Anatomical variants
In the skull the complete infraorbitary suture bilaterally, the zygomatic foramina on the right maxilla, the bilateral parietal foramina, the lambdoid ossicles on the left, and the extrasutural mastoid foramen on the left are present. In the post-cranial skeleton the complete accessory transverse foramen is visible on the right in C5 and C6.

Pathologies
Cribra orbitalia of grade 1 are present on both orbital roofs; diffuse grade 1 periosteal reaction is observable on the right femur. Enlarged vascular foramina are visible on the anterior portion of the vertebral bodies; cribra femoralia affects the neck of both femurs.

SU 5128

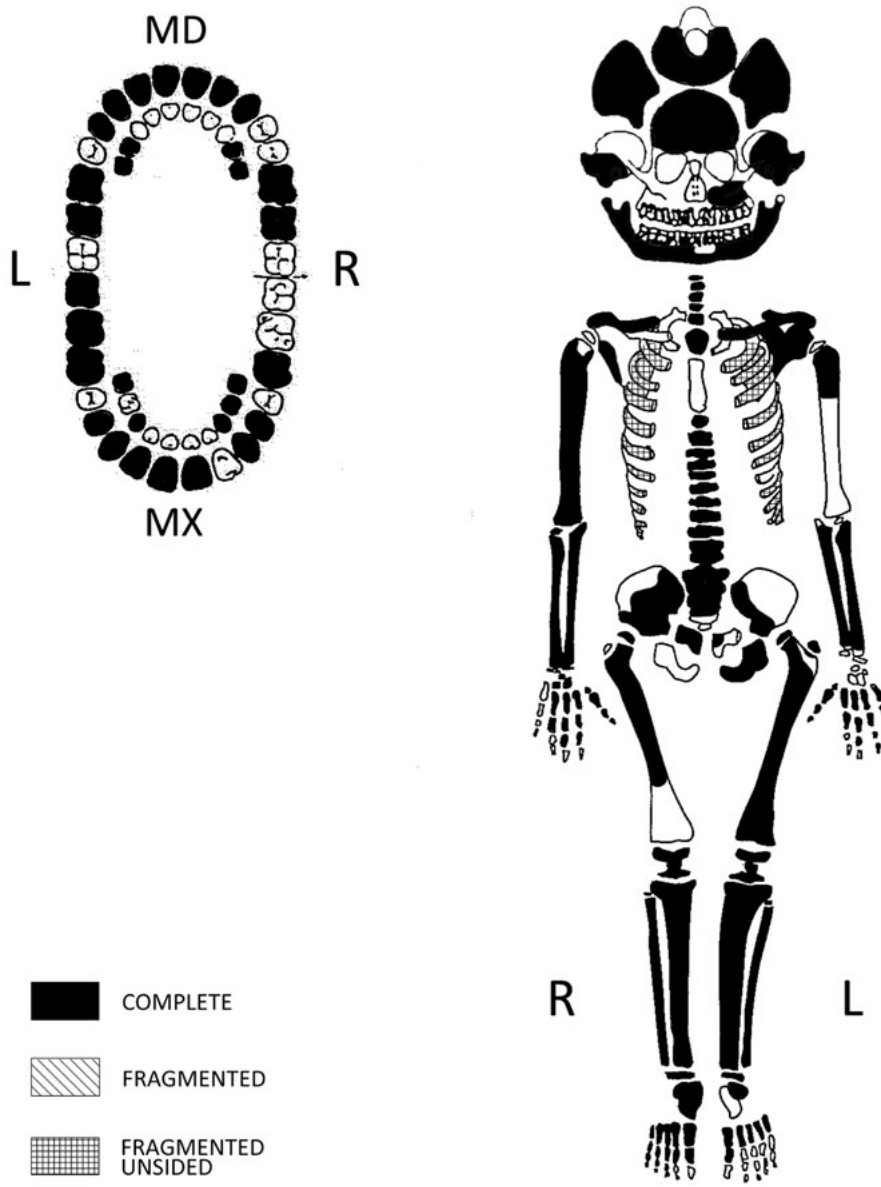


Figure 169

Sex: undeterminable

Age: 9-11 years
Age at death was determined on the basis of degree of fusion between diaphyses and epiphyses, dental eruption, degree of development of permanent teeth, and long bone length.

Dental pathologies
The maxillary teeth are preserved in situ, except for the right incisor, and first and second molars, which are preserved isolated; the right second incisor was lost post-mortem; the canines and right second premolar are in eruption. Deciduous canines and third molars are preserved, the left in situ, the right isolated. The

mandibular teeth are preserved isolated, except for the first molars, which are preserved in situ; the left premolars and the second molars are in eruption. Deciduous mandibular molars are preserved in situ.
Enamel hypoplasia occurred between 1.5 and 5 years, with six episodes.
Five caries are recorded on the deciduous teeth: one grade 3 distal caries on the maxillary left canine, one grade 2 distal caries on the maxillary right canine, one grade 2 occlusal caries and one grade 3 mesial caries on the maxillary right second molar, and one grade 1 occlusal caries on the mandibular right second molar.

Anatomical variants
In the skull the complete metopic suture, the zygomatic foramina, the parietal foramina bilaterally, the apical bone, the lambdoid ossicles bilaterally, the asterionic bone on the left, and the double occipital condylar facet on the left are present.
In the postcranial skeleton the partial accessory transverse foramen on the right of C5 and the anterior double facet on the right calcaneus are visible.

Pathologies
Cribra orbitalia of grade 1 are present on both orbital roofs. Enlarged vascular foramina are present on the bodies of the thoracic, lumbar and sacral segment. Cribra femoralia are observable on both femoral necks.

Trench 14

SU 2496

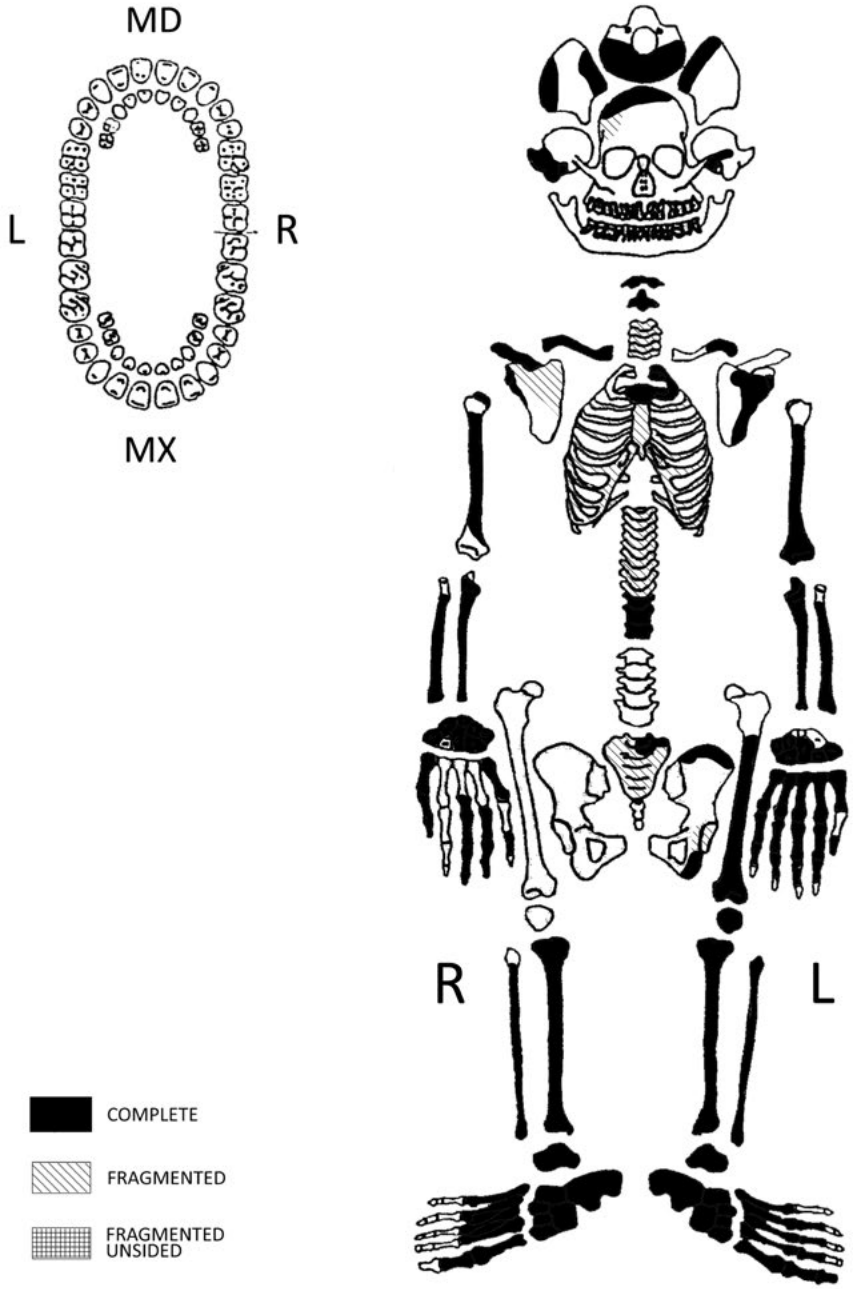


Figure 170

Sex: male (?)
Sex was determined through the analysis of three morphological features of the skull and two of the pelvis, which provided a total sexual index of 0, and through the measures of preserved bones.

Age: 25-35 years
Age at death was determined on the basis of cranial sutures, stage of fusion of the vertebrae, and sternal rib end modifications.

Stature: 163.7 cm

Dental pathologies
No teeth are preserved.

Ergonomy
The individual shows a general low development of the muscular insertions, except for the trapezoid ligament and the pectoralis major of the right clavicle, the conoid ligament of the left clavicle, and the brachialis of both ulnae, which show a strong development, and the trapezoid ligament of the left ulna and the triceps brachii of the left radius, which show a very strong development.

Anatomical variants
In the skull the sagittal ossicles and the lambdoid ossicles on both sides are present; in the post-cranial skeleton the double facet of the atlas, the transverse accessory foramen on C4, complete on the left, partial

on the right, and on C5, complete on the left, and the suprascapular foramen of the scapulae are observed.

Pathologies
Vascular impressions are visible on the endocranial surface. A healed fracture is visible on the distal third of the right tibia and fibula, with shortening of the bones and infective process demonstrated by the presence of a cloaca on both bones. A healed fracture affects the third proximal portion of the left ulna. Schmorl's nodes are present on four lumbar vertebrae. Osteochondritis dissecans is visible on the distal epiphysis of the right radius and ulna.

SU 2909

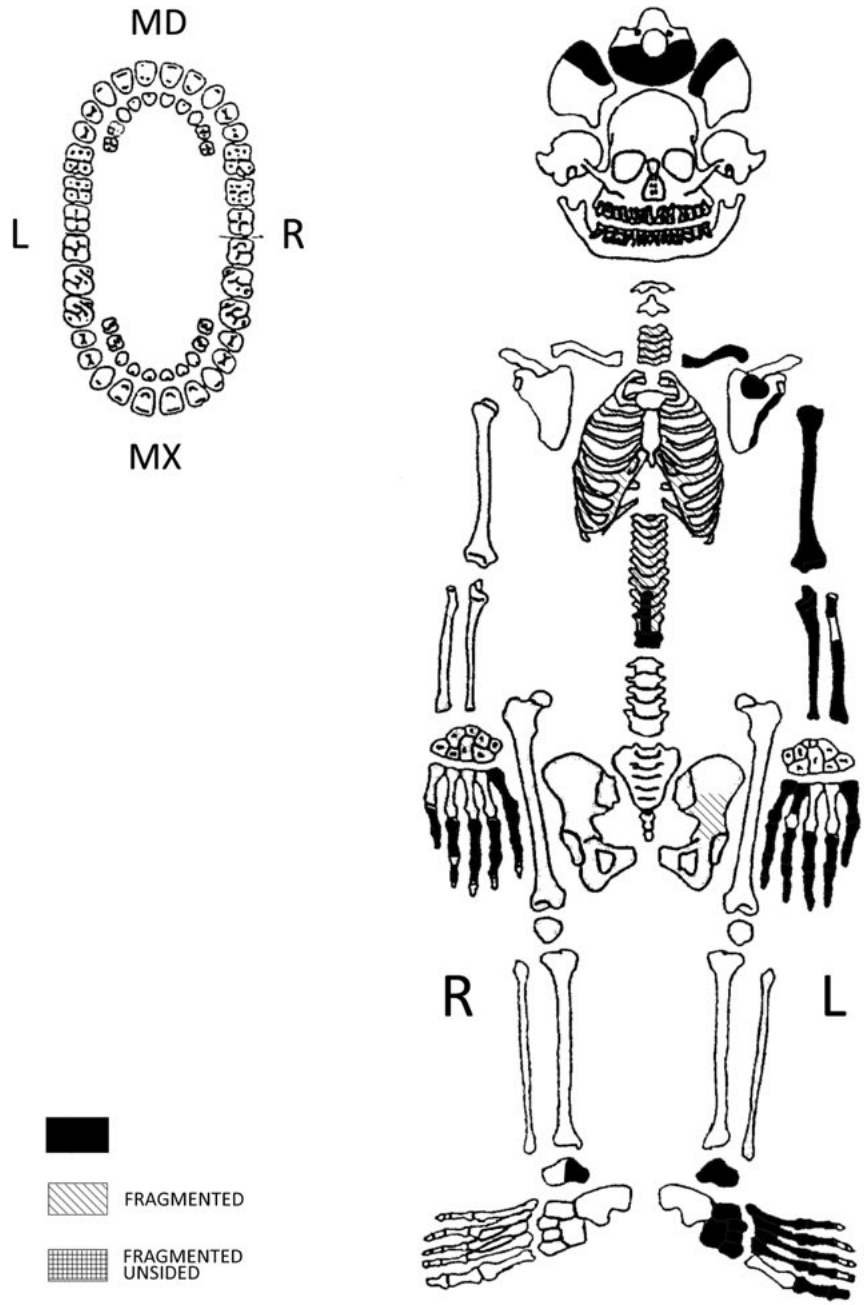


Figure 171

Sex: male
Sex was determined through the analysis of two morphological features of the skull, which provided a sexual index of 0.9.

Age: 28-35 years
Age at death was determined on the basis of cranial sutures and stage of fusion of the vertebrae.

Stature: 164.8 cm

Dental pathologies
No teeth are preserved.

Ergonomy
The individual shows a general low-medium development of the muscular insertions, except for the

pectoralis major of the left humerus, which presents an enthesopathy.

Anatomical variants
In the skull the lambdoid ossicles on the left are present. In the postcranial skeleton the septal aperture in the left humerus is observed.

Pathologies
A Schmorl's node is visible on a thoracic vertebra. Grade 1 osteoarthritis affects the cervical and thoracic vertebrae.

SU 2926

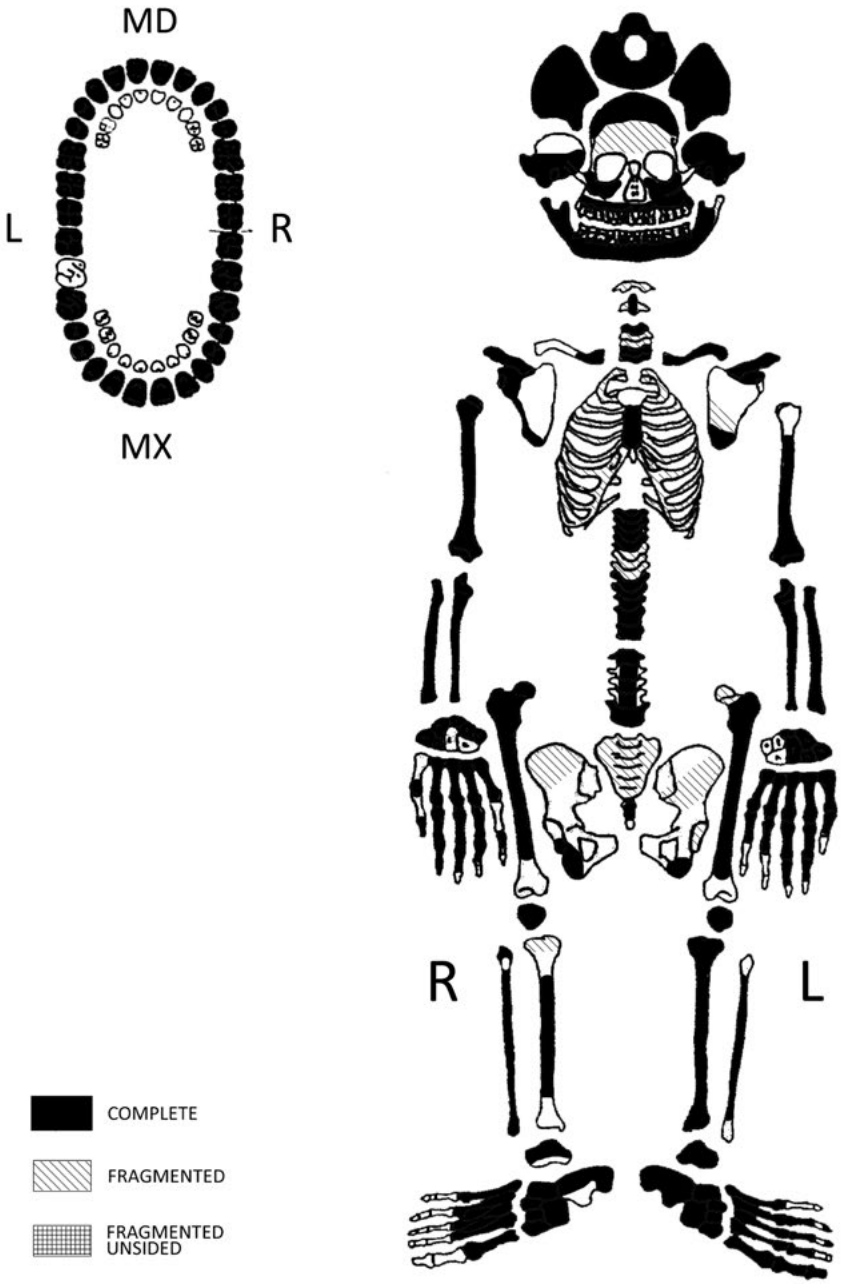


Figure 172

Sex: female
Sex was determined through the observation of ten morphological features of the skull and one of the pelvis, which provided a total sexual index of -1.1.

Age: 17-23
Age at death was determined on the basis of dental wear, stage of fusion of the vertebrae, and sternal rib end modifications.

Stature: 156.5 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the first incisors, and right second incisor, which are isolated, the left second premolar, which was lost during life, and the left second molar, which was lost post-mortem. The mandibular teeth are all preserved in situ.

Several caries of grade 1 are present: one distal at the cemento-enamel junction on the maxillary left first molar, one occlusal on the maxillary right second molar, one distal on the mandibular left first molar, one mesial on the left second molar, and one distal on the right first molar, one mesial on the right second and third molar.
Enamel hypoplasia occurred between 2.5 and 3.5 years, with three episodes.
Mild calculus affects the maxillary and the mandibular teeth.
Alveolar resorption of grade 2 affects the maxilla and the mandible. The mandibular right canine is rotated.

Ergonomy
The individual shows a general low-medium development of the muscular insertions.

Anatomical variants
In the skull the complete metopic suture, the sagittal ossicles, and the lambdoid ossicles on both sides are present; in the postcranial skeleton the septal aperture on the left humerus and the squatting facet on the left tibia are visible.

Pathologies
Diffuse grade 1 periosteal reaction affects the right fibula. A microtrauma is visible on the metaphyseal portion of the right fibula.

SU 2946

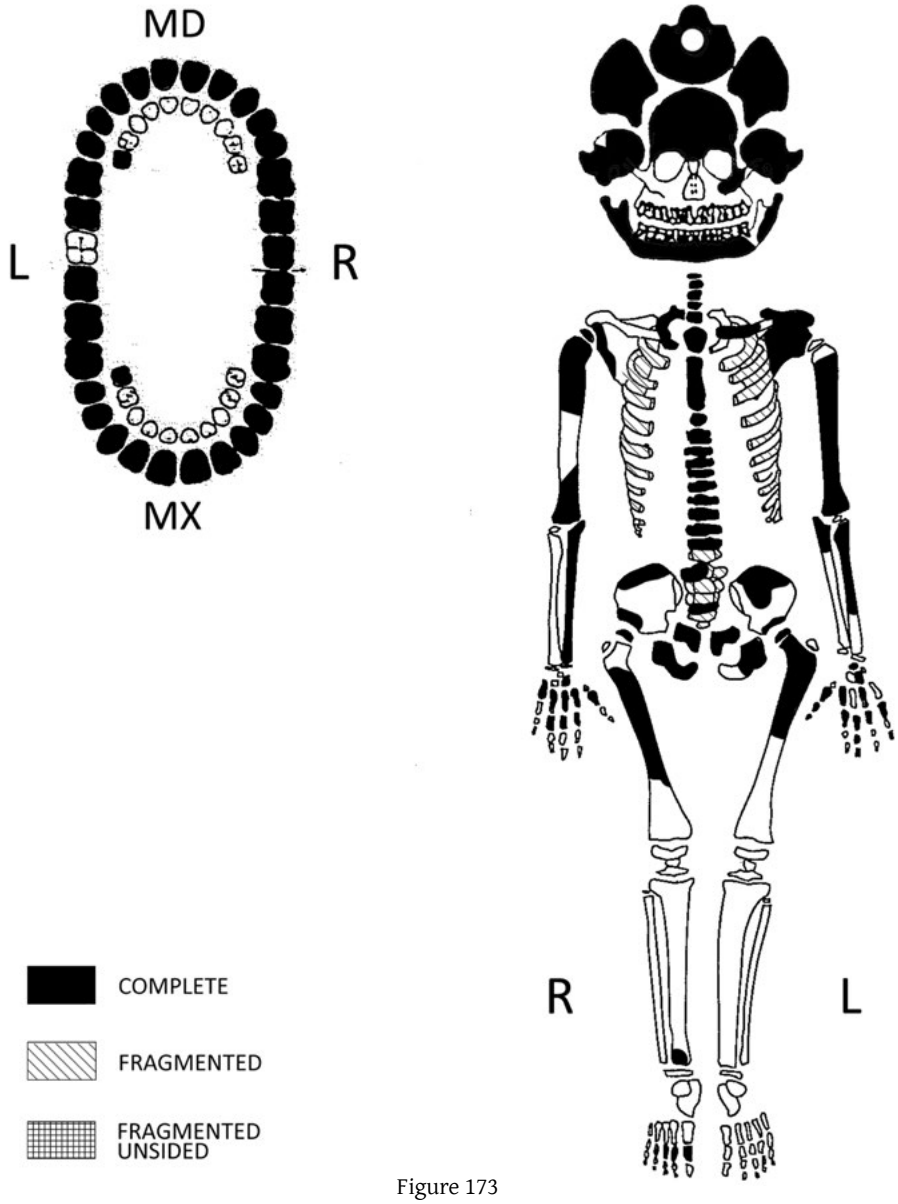


Figure 173

Sex: undeterminable

Age: 10-11 years
Age at death was determined on the basis of stage of dental eruption, development of permanent teeth, fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
Permanent maxillary teeth are all preserved isolated; the canines, premolars and second molars are in eruption; deciduous maxillary left second molar is present isolated.
Permanent mandibular teeth are all preserved and in situ; the canines, premolars and second molars are in eruption. Deciduous mandibular left second molar is present in situ.
A grade 1 distal caries is visible on the deciduous maxillary left second molar.
Enamel hypoplasia occurred between 2 and 4.5 years, with five episodes.

Anatomical variants
In the skull the metopic suture, the complete supraorbital foramen on the right, a zygomatic foramen on the left, the sagittal ossicles, the parietal notch bone on the left, the extrasutural mastoid foramen on the right, and the condylar canal on the left are present. In the post-cranial skeleton a partial accessory transverse foramen on the right of C3, and complete on the left of C6 and C7 are present.

Pathologies
Lytic lesions affects the anterior portion of the vertebral bodies.

SU 2959

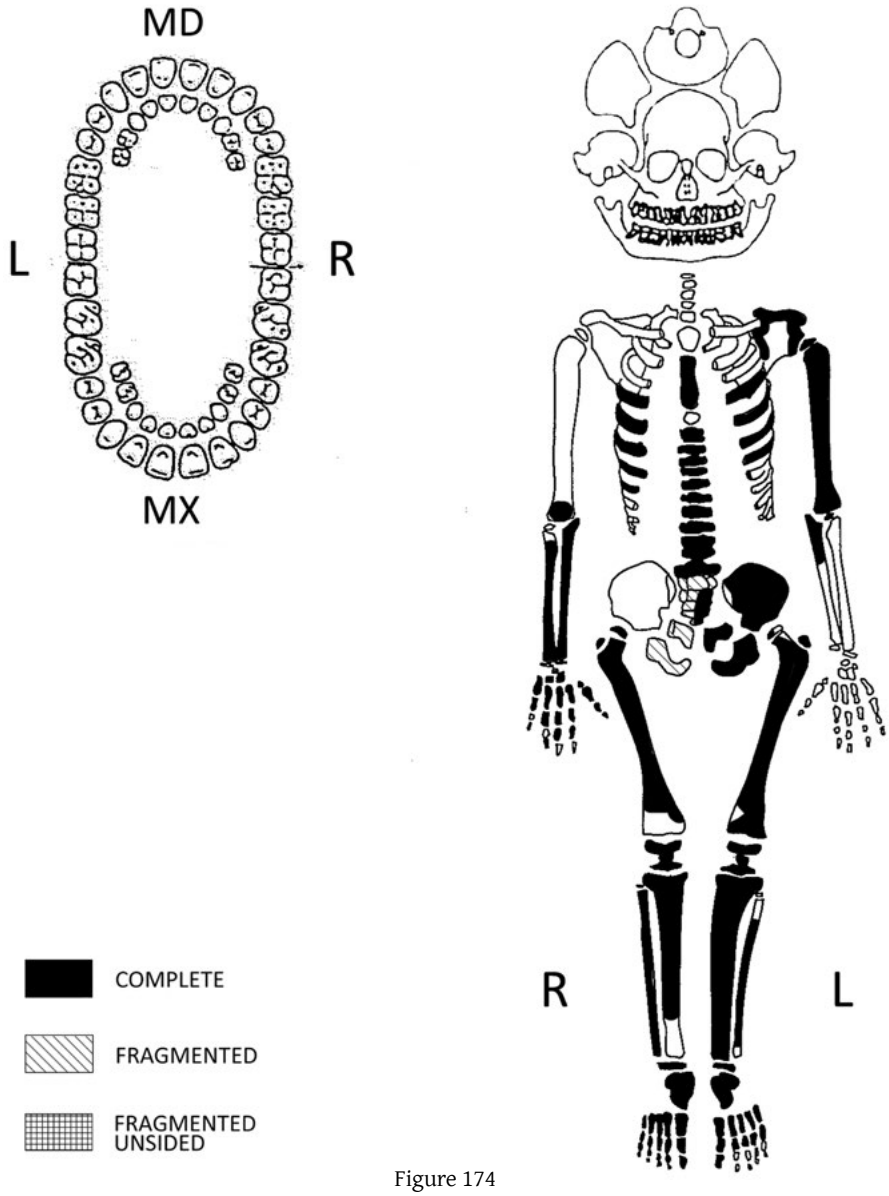


Figure 174

Sex: undeterminable

Age: 14-16 years
Age at death was determined on the basis of fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
No teeth are preserved.

Anatomical variants
In the post-cranial skeleton the squatting facet of both tibiae is present.

Pathologies
A healed fracture of the distal metaphyseal portion of the left femur is visible. Localised grade 1 periosteal reaction affects the distal third of the left fibula, of grade 3 the distal third of the left tibia.

SU 5089

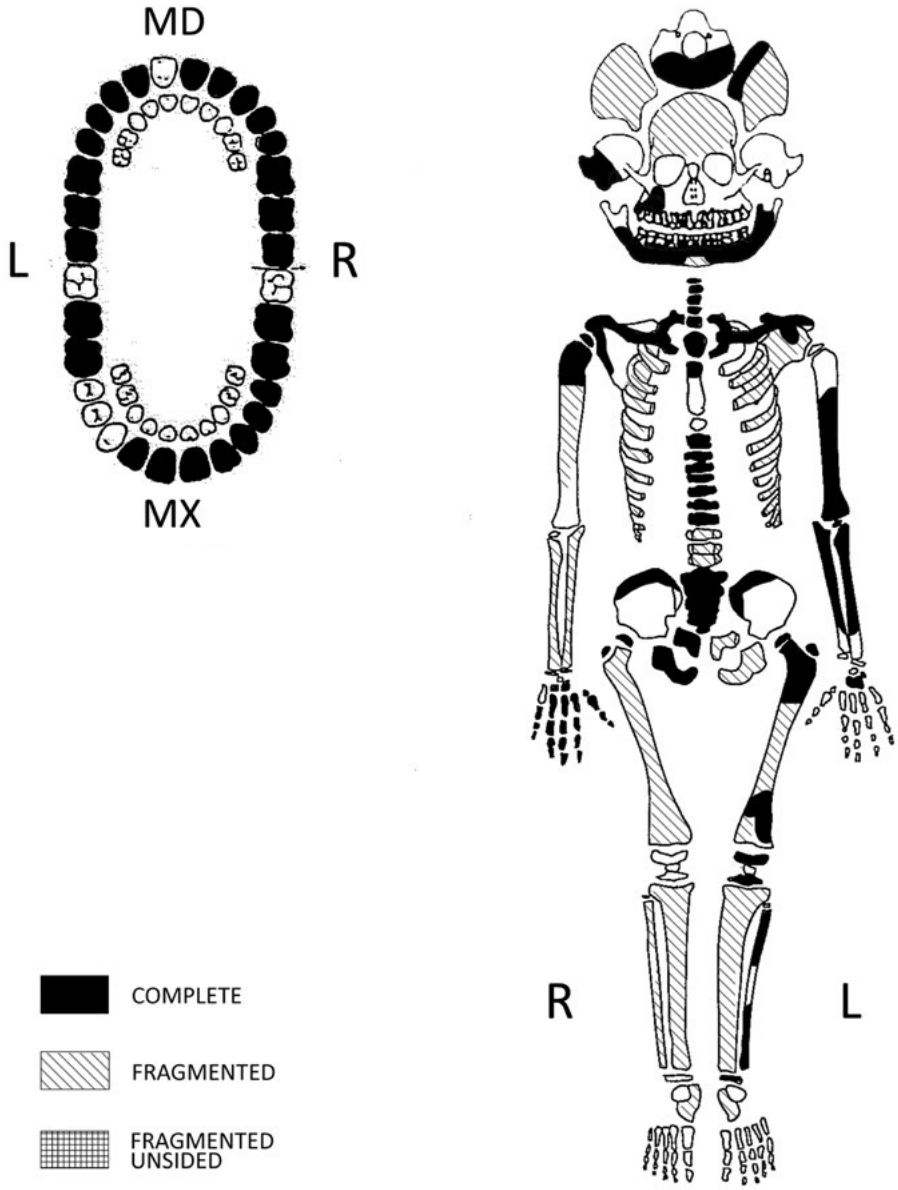


Figure 175

Sex: undeterminable

Age: 11-15 years
Age at death was determined on the basis of stage of dental eruption, development of permanent teeth, fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
The maxillary teeth are preserved isolated, except for the left canine and premolars, which are missing. Mandibular teeth are preserved and isolated, except for the right canine, premolars, first and second molars, which are in situ, and the left first incisor and right second incisor, which are missing. The mandibular third molars are in eruption.
A grade 3 mesial caries affects the mandibular right first molar.
Enamel hypoplasia occurred between 3 and 6 years, with five episodes.
Alveolar resorption of grade 1 affects the mandible.
Mild calculus affects the left side of the maxillary and mandibular teeth, strong on the right side.

Anatomical variants
In the skull the lambdoid ossicles on both sides and the double occipital condylar facet on the left are present. In the post-cranial skeleton the double facet of the

atlas, the transverse accessory foramen on the left of C5, on the right of C6, and the double anterior facet on the left calcaneus are present.

Pathologies
None observed.

SU 5108

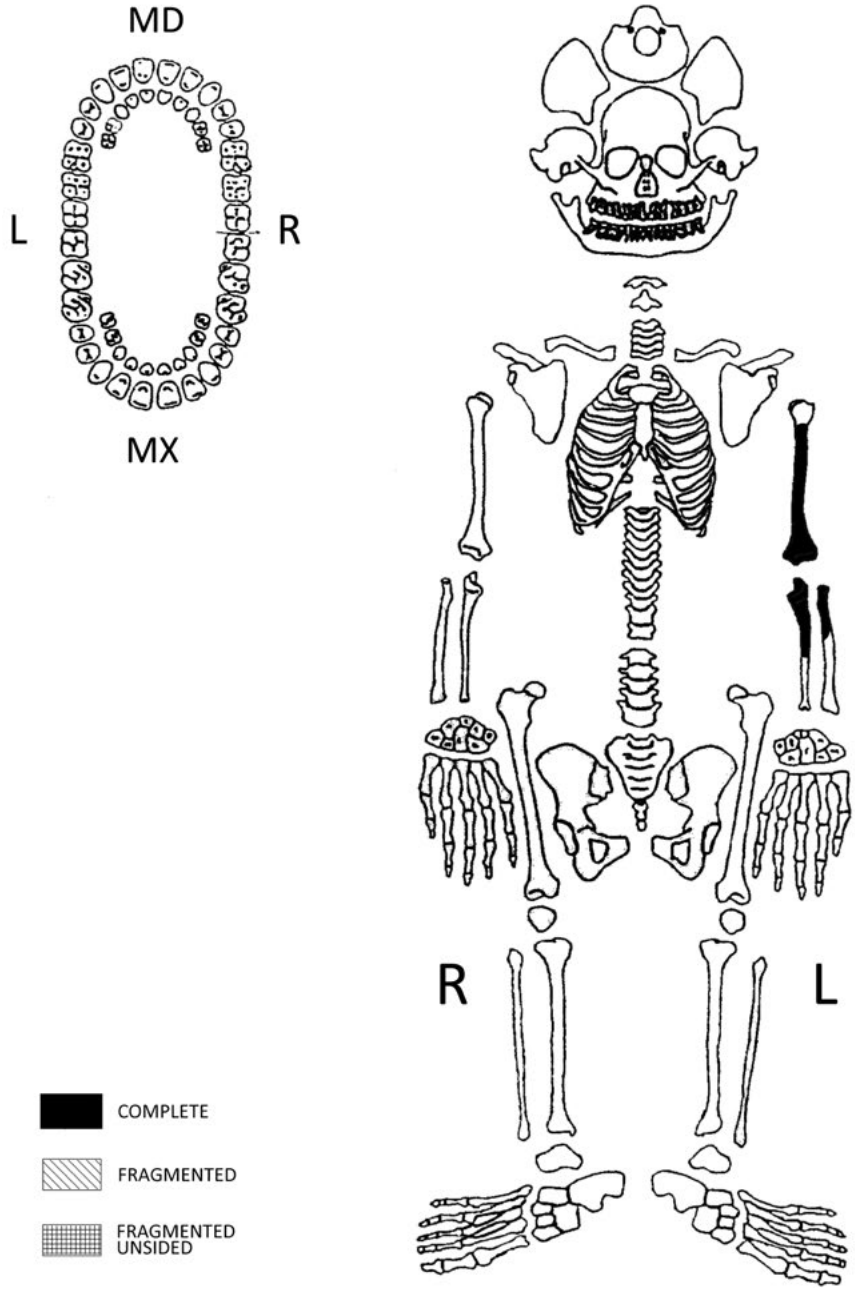


Figure 176

Sex: male (?)
Sex was determined through the measures of the capitulum of the radius.

Age: 25-30 years
Age at death was determined on the basis of skeletal morphology.

Stature: undeterminable

Dental pathologies
No teeth are preserved.

Ergonomy
The left upper limb, the unique preserved, shows a low-medium development of the muscular insertions.

Anatomical variants
None observed.

Pathologies
None observed.

Trench 16

SU 2978

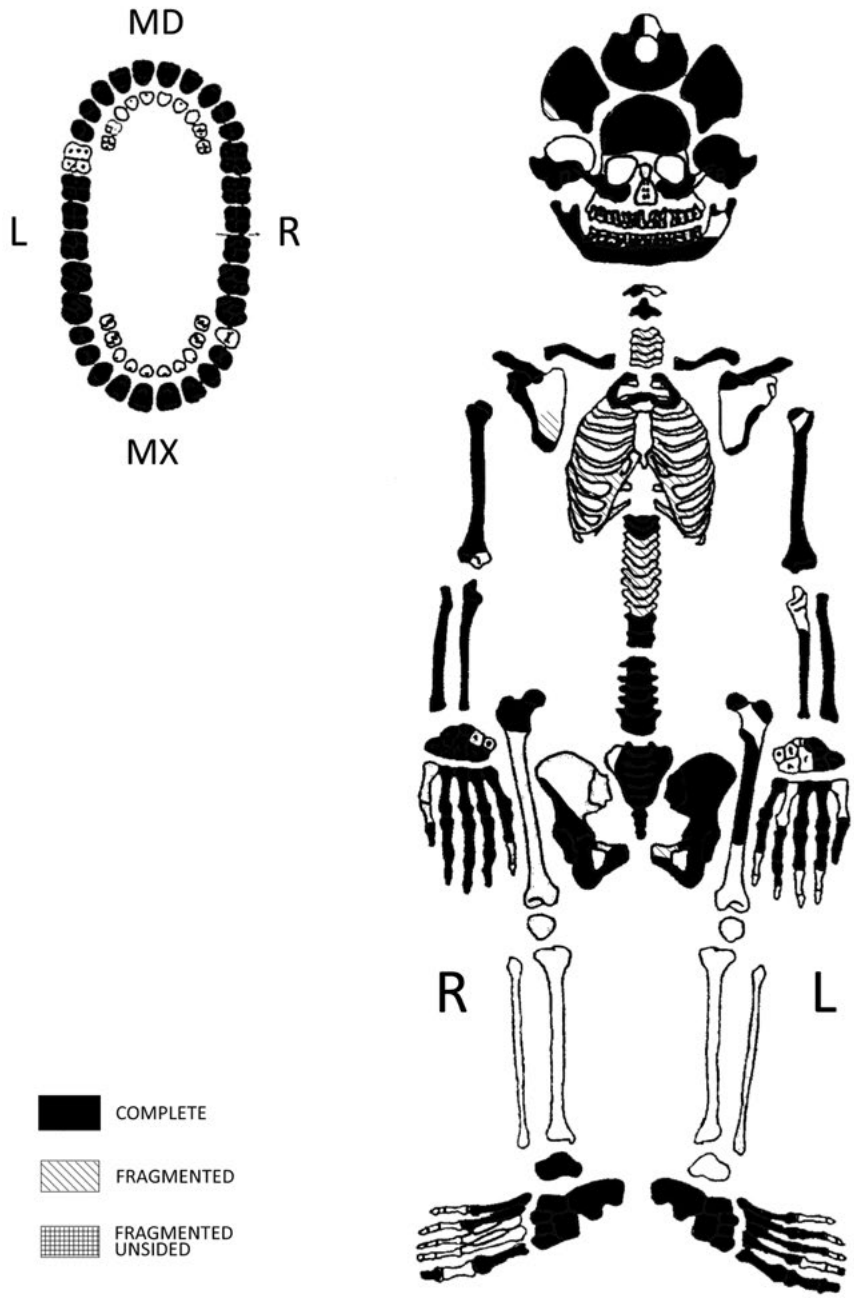


Figure 177

Sex: male
Sex was determined through the analysis of nineteen morphological features of the skull and fourteen of the pelvis, which provided a total sexual index of 1.3.

Age: 50-60 years
Age at death was determined on the basis of dental wear, morphology of the auricular surface of the ilium, morphology of the pubic symphysis, sternal rib end modifications, and vertebral stage of fusion.

Stature: 163.8 cm

Dental pathologies
The maxillary teeth are preserved in situ, except for the right second premolar, which was lost during life. The mandibular teeth are preserved in situ, except for the left first molar, which was lost during life.
Several caries were observed: one grade 3 buccal affecting the root of the maxillary right first molar, one grade 3 buccal on the right third molar, and one grade 1 distal on the mandibular left second premolar.
Enamel hypoplasia occurred between 2 and 5 years, with six episodes.
Alveolar resorption of grade 3 affects the maxilla and the mandible.

Ergonomy
The individual shows a medium-strong development of the muscular insertions, except for the costo-clavicular ligament of the left clavicle, the conoid ligament of the right clavicle, and the trapezoid ligament of both

clavicles, which show a very strong development. The costo-clavicular ligament of the right clavicle, the triceps brachii of the right clavicle, and Achilles' tendon of the calcaneus are affected by enthesopathies.

Anatomical variants

In the skull the zygomatic foramen on both sides, the lambdoid ossicles on both sides and the precondylar tubercle are present. In the postcranial skeleton the double facet on the left of the atlas, the circumflex sulcus and the supraglenoid articular facet of the right scapula, the exostosis of the fovea on both femurs, the anterior double facet of both calcanei, and the throclear extension of the right talus are present.

Pathologies

Grade 1 osteoarthritis affects the sternal facets of the clavicles, the acromial facet of the scapulae, the glenoid cavity of the right clavicle, the proximal articular surface of the right ulna, the acetabular cavity of the left coxal bone, the superior articular process of the sacrum, the superior margin of the first vertebra of the sacrum, and the proximal articular facet of the femurs. Grade 2 osteoarthritis affects the acromial facet of the clavicles, the acetabular cavity of the right coxal bone, and the bodies and facets of the cervical, thoracic and lumbar vertebrae.

Ostochondritis dissecans is visible on the right acetabular cavity. Healed fracture of two ribs are visible. Schmorl's nodes affects two thoracic and three lumbar vertebrae.

SU 2979

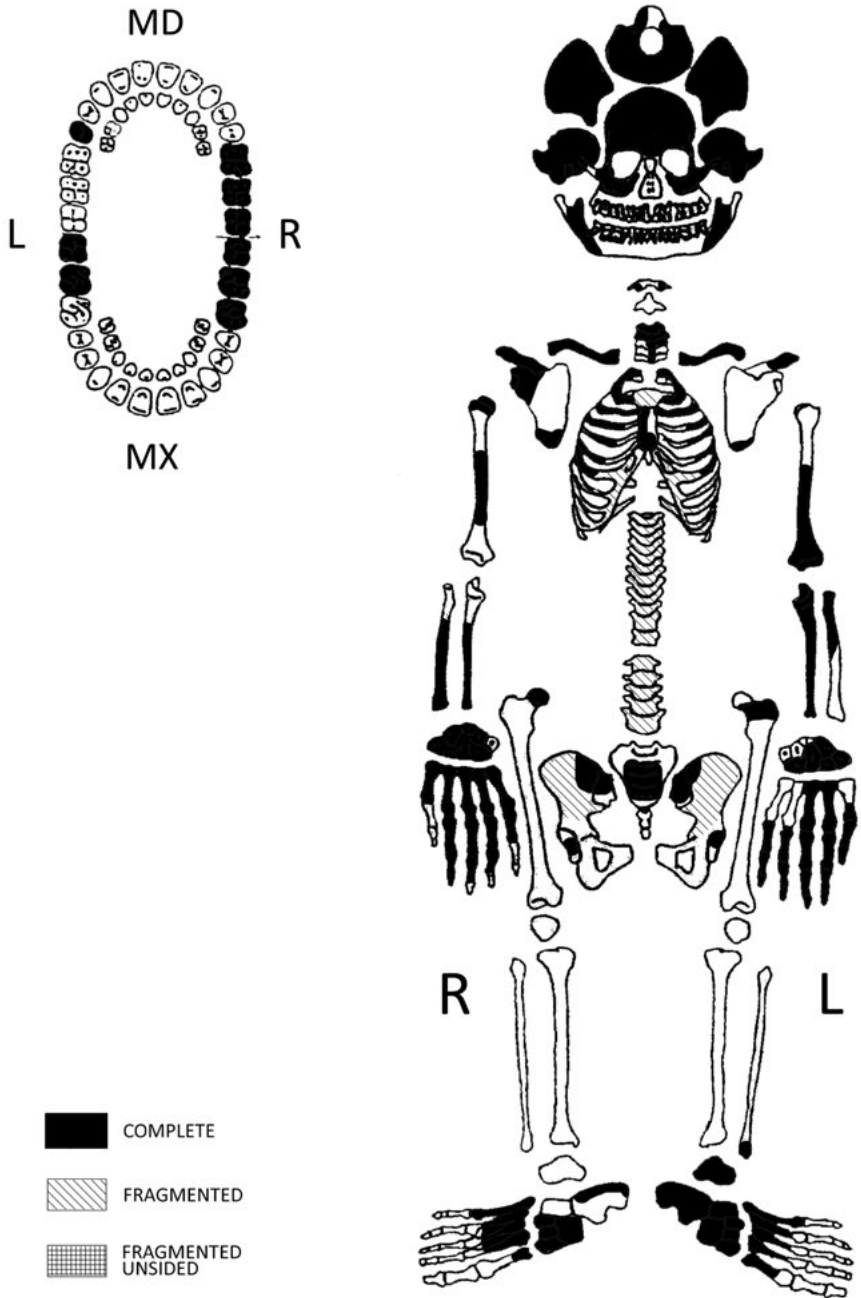


Figure 178

Sex: female
Sex was determined through the analysis of nine morphological features of the skull and one of the pelvis, which provided a total sexual index of -1.

Age: 16-21 years
Age at death was determined on the basis of dental wear, stage of dental eruption, fusion between diaphyses and epiphyses, long bone length, and vertebral stage of fusion.

Stature: 148.2 cm

Dental pathologies
All preserved teeth are isolated and include: the maxillary right molars, left second premolar, the mandibular right molars, and left second and third molars. The third molars are in eruption.

A grade 1 distal caries affects the maxillary right first molar.

Anatomical variants
In the skull the complete supraorbital foramen, a zygomatic foramen on the left, several zygomatic foramina on the right, the coronal ossicles on the left, the lambdoid ossicles on both sides, the asterionic bone on both sides, the extrasutural mastoid foramen on both sides, and the precondylar canal are present. In the postcranial skeleton the partial transverse accessory foramen on both sides of C6, the double anterior facet on both calcanei and the throclear extension on the left talus are present.

Pathologies
None observed.

SU 5074

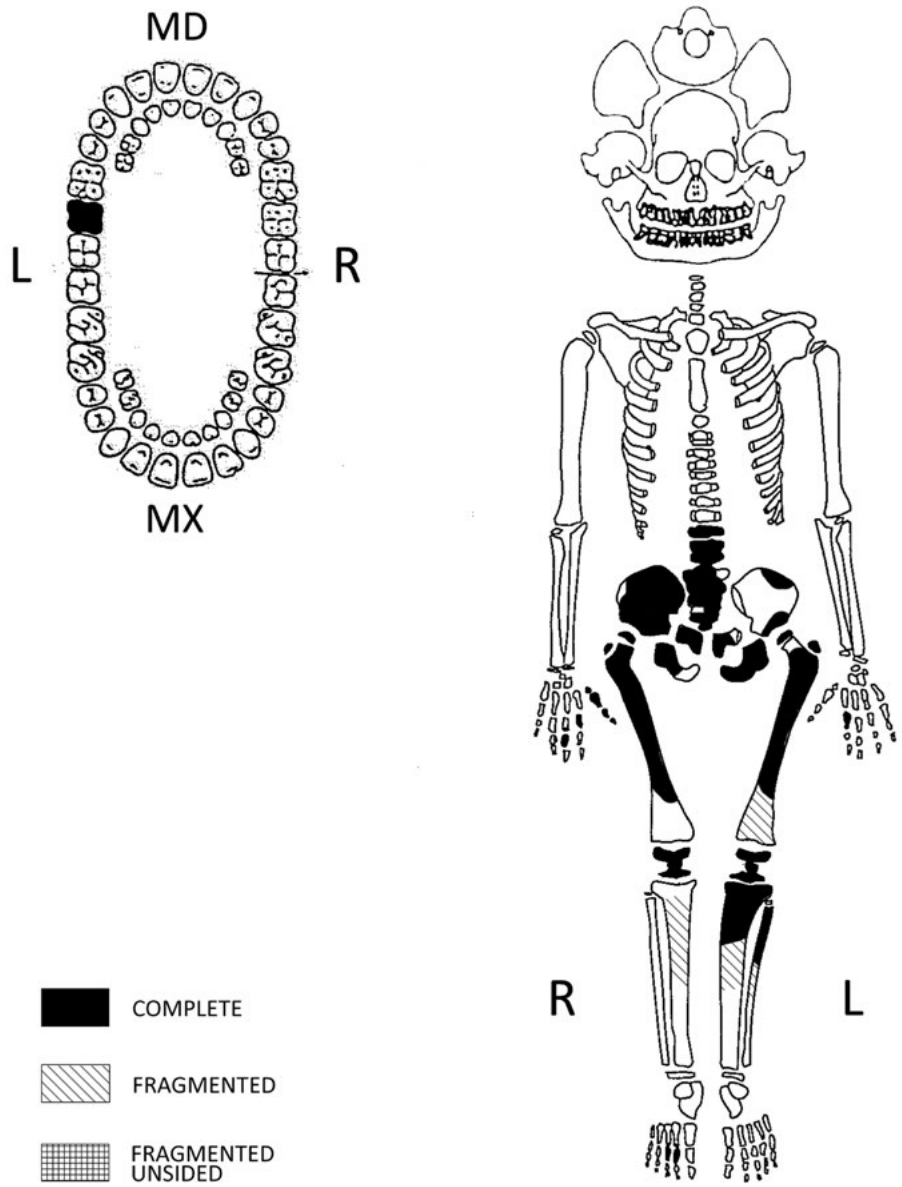


Figure 179

Sex: undeterminable

Age: 7-9 years
Age at death was determined on the basis of stage of dental eruption, development of permanent teeth, fusion between diaphyses and epiphyses, and long bone length.

Dental pathologies
The unique preserved tooth is the permanent mandibular left second molar, which is isolated.

Anatomical variants
None observed.

Pathologies
None observed.

SU 5075

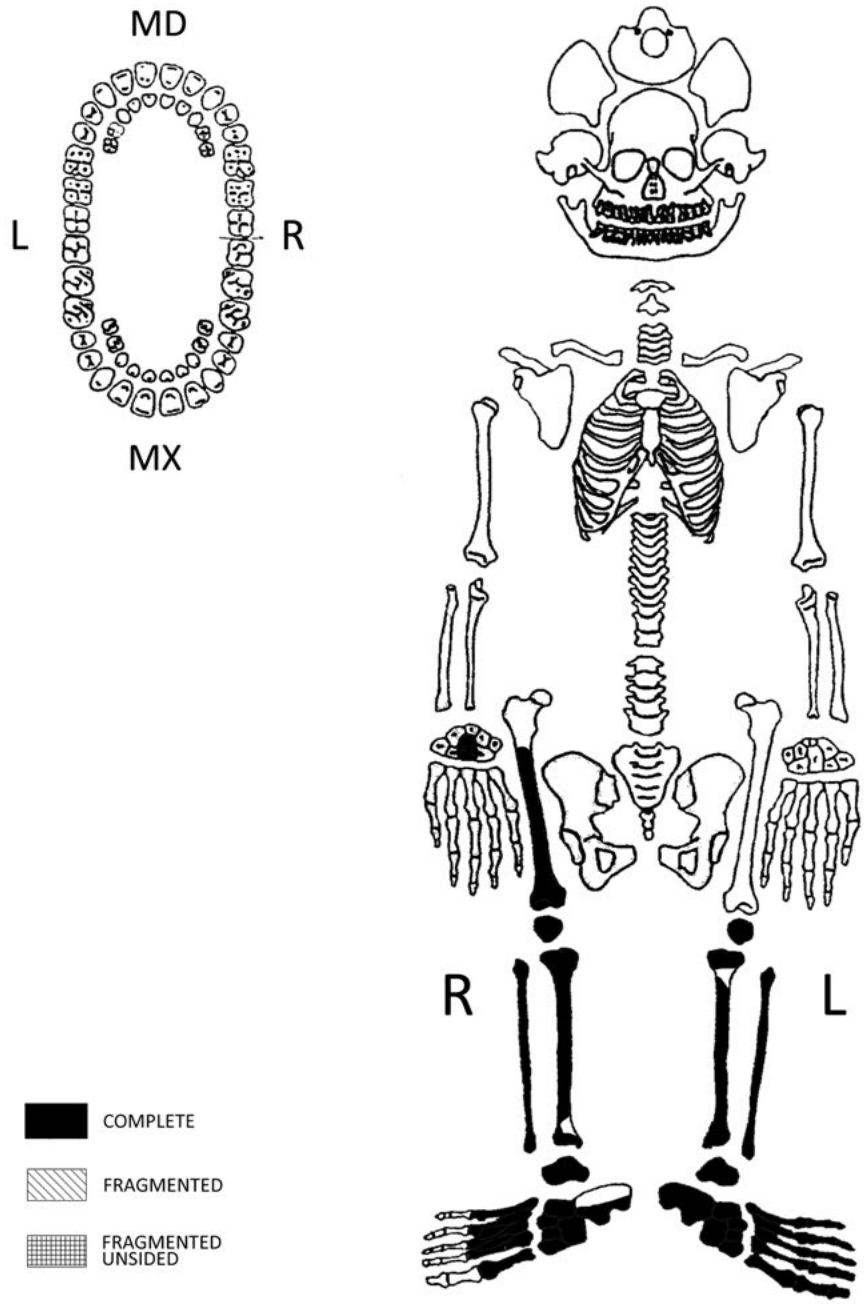


Figure 180

Sex: male (?)
Sex was determined through the measures of the patella and feet bones.

Age: 25-30 years
Age at death was determined on the basis of skeletal morphology.

Stature: 156.0 cm

Dental pathologies
No teeth are preserved.

Ergonomy
The lower limbs, the unique preserved, show a low-medium development of the muscular insertions.

Anatomical variants
In the postcranial skeleton the vastus notch of both patellae, the squatting facets of both tibiae, the double anterior facet of both calcanei, the throclear extension of both talii, and the accessory facet of the head of the first metatarsals are present.

Pathologies
A possible healed fracture of the left tibia, which presents a thickening at half diaphysis, with narrowing of the medullar cavity, is present.

References

Acsadi, G., Nemeskéri, J. 1970. *History of Human Life Span and Mortality*. Budapest: Akadémiai Kiadó.

Afrianty, I., Nasien, D., Kadir, M.R.A., and H. Haron 2013. Determination of gender from pelvic bones and patella in forensic anthropology: a comparison of classification techniques. First International Conference on Artificial Intelligence, Modelling & Simulation; 1-5.

Al-Motabagani, M.A., and M. Surendra 2006. Total occipitalization of the atlas. *Anatomical Science International* 81: 173-180.

Al-Oumaoui, I., Jiménez-Brobeil, S., and P. Du Souich 2004. Markers of activity patterns in some populations of the Iberian peninsula. *International Journal of Osteoarchaeology* 14: 343-359.

Andrades Valtuena, A., Mittnik, A., Key, F.M., Haak, W., Allmae, R., Belinskij, A., Daubaras, M., Feldman, M., Jankauskas, R., Jankovic, I., Massy, K., Novak, M., Pfrengle, S., Reinhold, S., Slaus, M., Spyrou, M.A., Szecsenyi-Nagy, A., Torv, M., Hansen, S., Bos, K.I., Stockhammer, P.W., Herbig, A., and J. Krause 2017. The stone age plague and its persistence in Eurasia. *Current Biology* 27, P3683-3691.

Angel, J.L. 1966. Porotic hyperostosis, anemias, malarias, and marshes in the prehistoric Eastern Mediterranean. *Science* 153: 760-763.

Angelerio, Q.T. 1598. *Epidemìologia sive tractatus de peste, ad Regni Sardiniae Proregem*. Madrid: ex Typographia Regia.

Aufderheide, A.C., and C. Rodriguez-Martin 1998. *The Cambridge Encyclopedia of Human Paleopathology*. Cambridge: Cambridge University Press.

Baker, B.J. 1999. Early manifestations of tuberculosis in the skeleton, in G. Pálfi, O. Dutour, I. Deák, and I. Hutás (eds) *Tuberculosis. Past and Present*: 301-330. Budapest/Szeged: Golden Book Publishers Ltd. and Tuberculosis Foundation.

Beers, C., and A. Mousavi 2013. Mercury speciation and safety evaluation of cinnabar-containing traditional medicines: a mini-review. *Toxicological & Environmental Chemistry* 95: 2.

Berrizbeitia, E.L. 1989. Sex determination with the head of the radius. *Journal of Forensic Sciences* 34: 1206-1213.

Berry, A.C., and R.J. Berry 1967. Epigenetic variation in the human cranium. *Journal of Anatomy* 101: 361-379.

Bertino, F. 1989. *Notizie e ipotesi su un borgo sardo-ligure del Basso Medioevo: l'Alghero dei Doria*, Vol. I. Alghero: Edizioni del Sole.

Bertino, F. 1994. *Alegerium, Sa Lighera, L'Alguer. Ipotesi sull' origine di Alghero e del suo nome,* in A. Mattone and P. Sanna (a cura di) *Alghero, la Catalogna, il Mediterraneo*: 38-48. Sassari: Gallizzi.

Bhadada, S.K., Sridhar, S., Steenackers, E., Dhiman, V., Mortier, G., Bhansali, A., and W. Van Hul 2014. Camurati-Engelmann disease (progressive diaphyseal dysplasia): reports of an Indian kindred. *Calcified Tissue International* 94: 240-7.

Bianucci, R., Rahalison, L., Ferroglio, E., Rabino Massa, E., and M. Signoli 2007. Détection de l'antigène F1 de la peste à l'aide d'un Test de Diagnostic Rapide. *Comptes Rendus Biologies* 330: 747-754.

Bianucci, R., Benedictow, O., Fornaciari, G., and V. Giuffra 2013. Quinto Tiberio Angelerio and new measures for controlling plague in 16th century Alghero, Sardinia. *Emerging Infectious Diseases* 19: 1478-1483.

Bianucci, R., Tzortzis, S., Fornaciari, G., and M. Signoli 2010. Nuovi approcci storici e paleobiologici alle sepolture di massa della peste nella Francia di Età Moderna (secoli XVI-XVIII). *Medicina nei secoli: arte e scienza* 22: 273-296.

Biraben, J.N. 1975. *Les hommes et la peste en France et dans le pays européens et méditerranéens*. Parigi-La Haye: Mouton Éditions.

Bizot, B., Castex, D., Raynaud, P., and M. Signoli 2005. *La saison d'une peste (avril-* 190 *septembre 1590): le cimetière des Fédons à Lambesc*. Paris: CNRS Éditions.

Bizot, B., Reynaud, P., and P.-H. Rigaud 2007. Le cimitière de l'infirmerie des Fédons (Lambesc, Bouches du Rhône) avril-septembre 1590, in M. Signoli, D. Chevé, P. Adalian, G. Boetsch, and O. Dutour (eds) *Peste: entre Épidémies et Socíétés*: 67-70. Firenze: Firenze University Press.

Blick, S. 2019. Bringing pilgrimage home: the production, iconography, and domestic use of Late-Medieval devotional objects by ordinary people. *Religions* 10: 392.

Bodur, H., Erbay, A., Colpan, A., and E. Akinci 2004. Brucellar spondylitis. *Rheumatology International* 24: 221-6.

Bos, K.I., Schuenemann, V.J., Golding, G.B., Burbano, H.A., Waglechner, N., Coombes, B.K., McPhee, J.B., DeWitte, S.N., Meyer, M., Scmedes, S., Wood, J., Earn, D.J.D., Herring, D.A., Bauer, P., Poinar, H.N., and J. Krause 2011. A draft genome of Yersinia pestis from victims of the Black Death. *Nature* 478: 506510.

Boyadjiev, S.A. 2007. Genetic analysis of non-syndromic craniosynostosis. *Orthodontics & Craniofacial Research* 10: 129-37.

Bramanti, B., Zedda, N., Rinaldo, N., and E. Gualdi-Russo 2018. A critical review of anthropological studies on skeletons from European plague pits of different epochs. *Scientific Reports* 8: 17655.

Bramanti, B., Dean, K.R., Walløe, L., and N. Chr Stenseth 2019. The Third Plague Pandemic in Europe. *Proceedings of the Royal Society – Biological Sciences* 286: 20182429.

Brasili, P., Zaccagni, L., E. Gualdi-Russo 1999. Scoring of nonmetric cranial traits: a population study. *Journal of Anatomy* 195: 551-562.

Brickley, M., and R. Ives 2008. *The bioarchaeology of metabolic bone disease*, Oxford: Elsevier Academic Press.

Brooks, S., and J.M. Suchey 1990. Skeletal age determination based on the os pubis: a comparison of the Acsádi-Nemeskéri and Suchey-Brooks methods. *Human Evolution* 5: 227-238.

Brothwell, D.R. 1959. Teeth in earlier human populations. *Proceedings of the Nutrition Society* 18: 59-65.

Brothwell, D.R. 1981. *Digging up Bones*. Oxford: Oxford University Press.

Brown, R. 1994. Alghero prima dei catalani, in A. Mattone and P. Sanna (a cura di) *Alghero, la Catalogna, il Mediterraneo*: 50-58. Sassari: Gallizzi.

Budruni, T. 1981. *Breve storia di Alghero*. Alghero: Edizioni Culturali.

Budruni, A. 2010. *Storia di Alghero. Il Cinquecento e il Seicento*. Alghero: Edizioni del Sole.

Budruni, T. 1986. Pestilenze e ripopolamento ad Alghero nell'età spagnola (1582-1652). Crisi e vitalità di una cultura urbana. *Quaderni sardi di storia* 5: 109-141.

Budruni, T. 1989. *Breve storia di Alghero, dal 1478 al 1720*, vol II. Alghero: Edizioni del Sole.

Buikstra, J. 2019. *Ortner's identification of pathological conditions in human skeletal remains*. London: Academic Press.

Buikstra, J.E., and D.H. Ubelaker (eds) 1994. Standards for data collection from human skeletal remains. Fayetteville: Arkansas Archeological Survey Research Series.

Burns, KR. 1999. *Forensic Anthropology Training Manual*. Saddle River NJ: Prentice–Hall.

Butler, T. 2014. Plague history: Yersin's discovery of the causative bacterium in 1894 enabled, in the subsequent century, scientific progress in understanding the disease and the development of treatments and vaccines. *Clinical Microbiology and Infection* 20: 202-9.

Capasso, L., Kennedy, A.R., and C.A. Wilczack 1999. *Atlas of occupational markers on human remains*. Teramo: Edigrafital.

Castex, D., and S. Kacki 2016. Demographic patterns distinctive of epidemic cemeteries in archaeological samples. *Microbiology Spectrum*: 4.

Castex, D. 2008. Identification and interpretation of historical cemeteries linked to epidemics, in Raoult, D., and M. Drancourt (eds) *Paleomicrobiology past Human Infections*: 23-48. Berlin: Springer.

Casula, F.C. 1998. *La Storia di Sardegna*. Sassari: Carlo Delfino Editore.

Chae, S.Y., Sim, H.B., Kim, M.J., Jang, Y.H., Lee, S.-J., Kim, D.W., and W.J. Lee 2015. Button osteoma: a review of ten cases. *Annals of Dermatology* 27: 394-397.

Chelli Bouaziz, M., Ladeb, M.F., Chakroun, M., and S. Chaabane 2008. Spinal brucellosis: a review. *Skeletal Radiology* 37: 785-90.

Claiborne, M.S. 1911. *Hierinymus fracastor's syphylis from the original latin: a translation in prose of this immortal poem*. Saint Louis, MI: The Philmar Company.

Cooper, A., Tong, R., Neil, R., Owens, D., and A. Tomkinson 2010. External auditory canal exostoses in white water kayakers. *British Journal of Sports Medicina* 44: 144-7.

Coppa, A., De Stefano, G.F., and M. Rubini (a cura di) 1996. *Per la conoscenza del patrimonio biologico umano. Scheletro e denti. Atlante dei caratteri discontinui*. Roma: Soprintendenza Archeologica per il Lazio.

Corbett, E., and W.J. Moore 1976. Distribution of dental caries in ancient British populations IV: the 19th century. *Caries Research* 10: 401-414.

Corruccini, R.S. 1991. Anthropological aspects of orofacial and occlusal variations and anomalies, in M.A. Kelley and C.S. Larsen (eds) *Advances in dental anthropology*: 295-323. New York: Wiley-Liss.

Corruccini, R.S., Handler, J.S., and K.B. Jacobi 1985. Chronological distribution of enamel hipoplasia and weaning in a Caribbean slave population. *Human Biology* 57: 699-711.

Currarino, G., Rollins, N., and J.T. Diehl 1994. Congenital defects of the posterior arch of the atlas: a report of seven cases including an affected mother and son. *American Journal of Neuroradiology* 15: 249-254.

Curtis, D.R., and J. Roosen 2017. The sex-selective impact of the Black Death and recurring plagues in the Southern Netherlands, 1349-1450. *American Journal of Physical Anthropology* 164: 246-259.

Cvrcek, J., Veleminski, P., Dupej, J., Vostry, L., and J. Bruzek 2018. Kinship and morphological similarity in the skeletal remains of individuals with known genealogical data (Bohemia, 19th to 20th centuries): a new methodological approach. *American Journal of Physical Anthropology* 167: 541-556.

D'Anastasio, R., Zipfel, B., Moggi-Cecchi, J., Stanyon, R., and L. Capasso 2009. Possible brucellosis in an early hominin skeleton from Sterkfontein, South Africa. *PLoS ONE* 4: 1-5.

Dabrowski, P., Kulus, M., Grzelak, J., Radzikowska, M., Oziemblowski, M., Domagala, Z., and M.T. Krajcarz 2020. Assessing weaning stress – Relations between enamel hypoplasia, δ^{18} and δ^{13}C values in human teeth obtained from early modern cemeteries in Wroclaw, Poland. *Annals of Anatomy* 232: 151546.

Danforth, M.E., Wrobel, G.D., Armstrong, C.W., and D. Swanson 2009. Juvenile age estimation using diaphyseal long bone lengths among ancient Maya populations. *Latin American Antiquity* 20: 3-13.

Denko, C.W., and C.J. Malemud 2006. Body Mass Index and Blood Glucose: Correlations with Serum Insulin,

Growth Hormone, and Insulin-Like Growth Factor-1 Levels in Patients with Diffuse Idiopathic Skeletal Hyperostosis (DISH). *Rheumatology International* 26: 292-297.

Dettwyler, K.A. 1995. A time to wean: The hominid blueprint for the natural age of weaning in modern human populations, in Stuart-Macadam, P., and K.A. Dettwyler (eds), *Breastfeeding: Biocultural perspectives*: 39-73. New York: Aldine De Gruyter.

DeWitte, S.N. 2009. The effect of sex on risk of mortality during the Black Death in London, A.D. 1349-1350. *American Journal of Physical Anthropology* 139: 222-234.

DeWitte, S.N. 2010a. Age patterns of mortality during the Black Death in London, AD 1349-1350. *Journal of Archaeological Science* 37: 3394-3400.

DeWitte, S.N. 2010b. Sex differentials in frailty in Medieval England. *American Journal of Physical Anthropology* 143: 285-297.

DeWitte, S.N. 2014. Differential survival among individuals with active and healed periosteal new bone formation. *International Journal of Paleopathology* 7: 38-44.

DeWitte, S.N., and J. Bekvalac 2011. The association between periodontal disease and periosteal lesions in the St. Mary Graces cemetery, London, England A.D. 1350-1538. *American Journal of Physical Anthropology* 146: 609-618.

DeWitte, S.N., and J.W. Wood 2008. Selectivity of black death mortality with respect to preexisting health. *Proceedings of the National Academy of Sciences USA* 105: 1436-1441.

Dittmann, K., and G. Grupe 2000. Biochemical and palaeopathological investigations on weaning and infant mortality in the early Middle Ages. *Anthropologischer Anzeiger* 58: 345-355.

Duday, H., and M. Guillon 2006. Understanding the circumstances of decomposition when the body is skeletonized. In Schmitt, A., Cunha, E., and J. Pinheiro (eds). *Forensic Anthropology and Medicine: Complementary Sciences from Recovery to Cause of Death*: 117-157. New Jersey: Humana Press: 117-157.

Duday, H. 2009. *The archaeology of the dead: lectures in archaeothanatology*. Oxford: Oxbow.

Duday, H., Le Mort, F., Pearce, J., and A.M. Tillier 2014. Archaeothanatology and funeral archaeology. Application to the study of primary burials. *Anthropologie (Brno)* 52: 235-246.

Duday, H. 2006. *Lezioni di archeotanatologia. Archeologia funeraria e antropologia sul campo*. Roma: Ministero dei Beni Culturali.

Esses, S.I. 1995. *Textbook of Spinal Disorders*. Philadelphia: JB Lippincott.

Facchini, F., Rastelli, E., and P. Brasili 2004. Cribra orbitalia and cribra cranii in Roman skeletal remains from the Ravenna area and Rimini (I-IV century AD). *International Journal of Osteoarchaeology* 14: 126-136.

Fara, G.F. 1835. *De rebus sardois*. Torino: ediz. Torino.

Fazekas, I.G., and F. Kósa 1978. *Forensic fetal osteology*. Budapest: Akadémiai Kiadó.

Feldman, M., Harbeck, M., Keller, M., Spyrou, M.A., Rott, A., Trautmann, B., Scholz, H.C., Paffgen, B., Peters, J., McCormick, M., Bos, K., Herbig, A., and J. Krause 2016. A high-coverage Yersinia pestis genome from a sixth-century justinianic plague victim. *Molecular Biology and Evolution* 33: 2911-2923.

Ferembach, D., Schwidetzky, I., and M. Stloukal 1977-1979. Raccomandazioni per la determinazione dell'età e del sesso sullo scheletro. *Rivista di Antropologia* 60: 5-51.

Ferretto, A. 1903. Branca Doria e la sua famiglia. *Atti della società Ligure di Storia patria* 31.

Filippou, G., Filippucci, E., Mandl, P., and A. Abhishek 2020. A critical review of the available evidence on the diagnosis and clinical features of CPPD: do we really need imaging? *Clinical Rheumatology*.

Finnegan, M. 1978. Non-metric variation of the infra-cranial skeleton. *American Journal of Physical Anthropology* 125: 23-37.

Flohr, S., Jasch, I., Langer, A., Riesenberg, M., Hahn, J., Wisotzki, A., Kierdorf, H., Kierdorf, U., and J. Wahl 2018. Secondary hypertrophic osteoarthropathy in a male from the Early Medieval settlement of Lauchheim, Germany. *International Journal of Paleopathology* 20: 72-79.

Floris, G., Floris, R., Fonzo, O., and E. Sanna 2012. Variazioni staturali in Sardegna dal Neolitico al XX secolo, in *Atti della XLIV riunione scientifica: la preistoria e la protostoria della Sardegna*: 1-4. Firenze: Istituto Italiano di Preistoria e Protostoria.

Gambaro, L., Rigeade, C., De Piero, M., Ardagna, Y., Gobbo, V., Buchet, L., Fozzati, L., Drusini, A., and M. Signoli 2001. La fouille de l'ile du Lazzaretto Vecchio de Venise: premieres donnees, in Signoli, M., Cheve, D., Adalian, P., Boetsch, G. and O. Dutour (eds), *La peste: entre épidémies et sociétés*: 97-103. Firenze: Firenze University Press.

Geyik, M.F., Gür, A., Nas, K., Çevik, R., Saraç, J., Dikici, B., and C. Ayaz 2002. Musculoskeletal involvement of brucellosis in different age groups: a study of 195 cases. *Swiss Medical Weekly* 132: 98-105.

Giuffra, V., and G. Fornaciari 2013. Breastfeeding and weaning in Renaissance Italy: the Medici children. *Breastfeeding Medicine* 8: 257-262.

Giuffra, V., Bianucci, R., Milanese, M., and G. Fornaciari 2013. A probable case of non-syndromic brachycephaly from 16th century Sardinia (Italy). *International Journal of Paleopathology* 3: 134-137.

Giuffra, V., Bianucci, R., Milanese, M., Tognotti, E., Montella, A., Caramella, D., Fornaciari, G., and P. Bandiera 2016a. Sclerosing bone dysplasia from 16th century Sardinia (Italy): a possible case of Camurati-Engelmann disease. *International Journal of Osteoarchaeology* 23: 830-841.

Giuffra, V., Milanese, M., and P. Bandiera 2017a. Congenital anomalies in a Sardinian population

of 16th century (Italy). *Medicina Historica* 1: 173-178.

Giuffra, V., Milanese, M., and S. Minozzi 2020. Dental health an adults and subadults from the 16-th century plague cemetery of Alghero (Sardinia, Italy). *Archives of Oral Biology* 120: 104928.

Giuffra, V., Montella, A., Milanese, M., Tognotti, E., and P. Bandiera 2017b. Atlas occipitalization associated with other anomalies in a 16th century skeleton from Sardinia (Italy). *Folia Morphologica* 76: 123-127.

Giuffra, V., Montella, A., Tognotti, E., Milanese, M., and P. Bandiera 2016b. Posterior arch defect of the atlas associated to absence of costal element of foramen transversarium from 16th century Sardinia (Italy). *Spine* 41: 182-184.

Glasgow, M.M. 1976. Brucellosis of the spine. *British Journal Surgery* 63: 283-288.

Goodman, A.H., Allen, L.H., Hernandez, G.P., Amador, A., Arriola, L.V., Chávez, A., Pelto, G.H., Chavez, A., and G.H. Pelto 1987. Prevalence and age at development of enamel hypoplasias in Mexican children. *American Journal of Physical Anthropology* 72: 7-19.

Goodman, A.H., and J.C. Rose 1990. Assessment of systemic physiological perturbations from dental enamel hypoplasias and associated histological structures. *Yearbook of Physical Anthropology* 33: 59-110.

Graham, M.D. 1979. Osteomas and exostoses of the external auditory canal. *Annales of Ontology, Rhinology and Laringology* 88: 566-572.

Grainger, I., Hawkins, D., Cowal, L., and R. Mikulski (eds) 2008. The black death cemetery, East Smithfield, London. London: Museum of London.

Grauer, A.L. 1993. Patterns of anemia and infection from medieval York, England. *American Journal of Physical Anthropology* 91: 203-213.

Griene, T.R., Kuba, C.L., and J.D. Irish 2005. Quantifying calculus: A suggested new approach for recording an important indicator of diet and dental health. *HOMO* 56: 119-132.

Guenkel, S., Schlaepfer, S., Gordic, S., Wanner, G.A., Simmen, H.P., and C.M. Werner 2013. Incidence and variants of posterior arch defects of the atlas vertebra. *Radiology Research and Practice*: 957280.

Guidetti, M. 1989. *Storia dei sardi e della Sardegna*, vol. III. L'età moderna. Dagli Aragonesi alla fine del dominio Spagnolo. Milano: Jaca Book.

Haas, L. 1998. *The Renaissance man and his children. Childbirth and early childhood in Florence, 1300-1600*. London: MacMillan.

Hall, R.L. 1982. *Sexual dimorphism in Homo sapiens. A question of size*. New York: Praeger.

Hammer, O., Harper, D.A.T., and P.D. Ryan 2001. PAST: Paleontological statistics software package for education and data analysis. *Palaeontologia Electronica* 4: 1-9.

Hardwich, J.L. 1960. The incidence and distribution of caries throughout the ages in relation to the Englishman's diet. *British Dental Journal* 108: 9-17.

Harris, E.F. 2007. Mineralization of the mandibular third molar: A study of American blacks and whites. *American Journal of Physical Anthropology* 132: 98-109.

Hillson, S. 2000. Dental pathology, in Katzenberg, M.A. and S.R. Saunders (eds), *Biological anthropology of the human skeleton*: 249-286. New York: Wiley-Liss.

Hillson, S. 2005. *Teeth*. Cambridge: Cambridge University Press.

Hillson, S.W. 1996. *Dental Anthropology*. Cambridge: Cambridge University Press.

Horikawa, F.K., Freitas R.R., Maciel, F.A., and A.J. Gonçalves 2012. Peripheral osteoma of the maxillofacial region: a study of 10 cases. *Brazilian Journal of Otorhinolaryngology* 78: 38-43.

Hussain, A., and F.A. Khan 2016. History of dentistry. *Archives of Medicine and Health Sciences* 2: 106-110.

Hutchinson, J. 1858. Report on the effects of infantile syphilis in marring the development of the teeth. *Transactions of the Pathological Society of London* 9: 449-455.

Hutchinson, J. 1878. *Illustrations of clinical surgery consisting of plates, photographs, woodcuts, diagrams etc: illustration surgical diseases, symptoms and accidents, also operative and other methods of treatment, with descriptive letterpress*. London: J. & A. Churchill.

Hutchinson, J. 1887. *Syphilis*. London: Cassell & Company Limited.

Hutchinson, J. 1909. *Syphilis*. London: Cassell & Company Limited.

Ingrassia, G.F. 1576. *Informatione del pestifero, et contagioso morbo: il quale affligge et have afflitto questa Città di Palermo, e molte altre Città e Terre di questo Regno di Sicilia, nell'Anno 1575 et 1576.* Parte I, cap. XVI, Palermo: Plumelia edizioni.

Ioannou, S., Henneberg, M., Henneberg, R.J., and T. Anson 2015. Diagnosis of mercurial teeth in a possible case of congenital syphilis and tuberculosis in a 19th century child skeleton. *Journal of Anthropology*, 103842, 1-11.

Iscan, Y.M., and M. Steyn 2013. *The Human skeleton in Forensic Medicine* (3rd ed.). Springfield, IL: Charles C. Thomas.

Iscan, Y.M., and S.R. Loth 1985. Age estimation from the rib by phase analysis: white females. *Journal of Forensic Science* 30: 853-864.

Iscan, Y.M., Loth, S.R., and R.K. Wright 1984. Age estimation from the rib by phase analysis: white males. *Journal of Forensic Science* 29: 1094-1104.

Jadhav, A., and J. Ghanekar 2013. Camurati-Engelmann disease. *Indian Journal of Clinical Practice* 24: 171-174.

Janssens, K., Vanhoenacker, F., Bonduelle, M., Verbruggen, L., Van Maldergem, L., Ralston, S., Guañabens, N., Migone, N., Wientroub, S., Divizia, M.T., Bergmann, C., Bennett, C., Simsek, S., Melançon, S., Cundy, T., and W. Van Hul 2006. Camurati-Engelmann disease: review of the clinical,

radiological, and molecular data of 24 families and implications for diagnosis and treatment. *Journal of Medical Genetics* 43: 1-11.

Janssens, K., Gershoni-Baruch, R., Van Hul, E., Brik, R., Guañabens, N., Migone, N., Verbruggen, L.A., Ralston, S.H., Bonduelle, M., Van Maldergem, L., Vanhoenacker, F., and W. Van Hul 2000. Localisation of the gene causing diaphyseal dysplasia Camurati–Engelmann to chromosome 19q13. *Journal of Medical Genetics* 37: 245-249.

Jatautis, S., Mitokaitė, I., and R. Jankauskas 2011. Analysis of cribra orbitalia in the earliest inhabitants of medieval Vilnius. *Anthropological review* 74: 57-68.

Jiménez-Brobeil, S.A., Al Oumaoui, I., and Ph. du Souich 2010. Some types of vertebral pathologies in the Argar Culture (Bronze Age, SE Spain). *International Journal of Osteoarchaeology* 20: 36-46.

Jurmain, R., Alves Cardoso, F., Henderson, C.Y., and S. Villotte 2012. Bioarchaeology's holy grail: the reconstruction of activity, in Grauer, A.L. (ed.). *A companion to paleopathology*: 531-552. New-York: Wiley-Blackell.

Jurmain, R. 2005. Stories from the skeleton: behavioral reconstruction in human osteology. London: Taylor and Francis.

Kacki, S. 2016. *Influence de l'état sanitaire des populations anciennes sur la mortalité en temps de peste. Contribution à la paléoépidémiologie.* PhD Thesis, Univ. of Bordeaux.

Kerr, N.W., Bruce, M.F., and J.F. Cross 1988. Caries experience in the permanent dentition of late mediaeval Scots (1300-1600 A.D.). *Archives of Oral Biology* 33: 143-148.

Kim, D.Y., and K.S. Oh 2015. A rare case of peripheral osteoma of the zygoma. *Archives of Plastic Surgery* 42: 103-105.

Klimo, P. Jr, Blumenthal, D.T., and W.T. Couldwell 2003. Congenital partial aplasia of the posterior arch of the atlas causing myelopathy: case report and review of the literature. *Spine* 28: E224-E228.

Krogman, W.M. and Iscan, M.Y. 1986. The human skeleton in forensic medicine. Springfield, lllinois: Charles C. Thomas Pub.

Kwon, J.K., Kim, M.S., and G.J. Lee 2009. The incidence and clinical implications of congenital defects of atlantal arch. *Journal of Korean Neurosurgical Society* 46: 522-7.

Lajeunie, E., Merrer, M.L., Bonaiti-Pellie, C., Marchac, D., and D. Renier 1995. Genetic study of nonsyndromic coronal craniosynostosis. *American Journal Medical Genetics* 55: 500-504.

Larsen, C.S. 1997 and 2015. *Bioarchaeology: interpreting behavior from the human skeleton*. Cambridge: Cambridge University Press.

Loddo Canepa, F. 1974. *La Sardegna dal 1478 al 1793*, vol. I. Sassari: Gallizzi.

Lovejoy, C.O., Meindl, R.S., Mensforth, R.P., and T.J. Barton 1985a. Multifactorial age determination of skeletal age at death: a method and blind tests of its accuracy. *American Journal of Physical Anthropology* 68: 1-14.

Lovejoy, C.O. 1985b. Dental wear in Libbean population: its functional pattern and role in the determination of adult skeletal age at the death. *American Journal of Physical Anthropology* 68: 47-56.

Lovejoy, C.O., Meindl, R.S., Pryzbeck, T.R., and R.P. Mensforth 1985c. Chronological metamorphosis of the auricolar surface of the ilium: a new method for the determination of adult skeletal age at death. *American Journal of Physical Anthropology* 68: 15-28.

Lovell, N.C. 1997. Trauma analysis in paleopathology. *Yearbook of Physical Anthropology* 40: 139-170.

Lukacs, J.R. 2011. Sex differences in dental caries experience: Clinical evidence, complex etiology. *Clinical Oral Investigations* 15: 649-656.

Lukacs, J.R., and L.L. Largaespada 2006. Explaining sex differences in dental caries prevalence: saliva, hormones, and 'life-history' etiologies. *American Journal of Human Biology* 18: 540-55.

Lukacs, J.R., and L.M. Thompson 2008. Dental caries prevalence by sex in prehistory: magnitude and meaning, in Irish, J.D., and G.C. Nelson (eds), *Technique and application in dental anthropology*: 136-177. Cambridge: Cambridge University Press.

Maat, G.J. 2001. Diet and age-at-death determinations from molar attrition. A review related to the Low Countries. *The Journal of Forensic Odontostomatology* 19: 18-21.

MacGregor, A.J., and A.J. Silman 1998. Rheumatoid arthritis: classification and epidemiology, in J.H. Klippel and P.A. Dieppe (eds), Rheumatology: 1-6. Philadelphia: Mosby.

Maczel, M., Ardagna, Y., Aycard, Ph., Berato, J., Zink, A., Nerlich, A.G., Panuel, M., Dutour, O., and G. Palfy 2001. Traces of skeletal infections in a French Medieval osteoarchaeological sample (La Celle, Var, France), in La Verghetta, M. and L. Capasso (eds), *Proceedings of the XIIIth European Meeting of the Paleopathology Association, Chieti, 18-23 Settembre 2000*: 167-177. Teramo: Edigrafital SpA.

Mader, R., Verlaan, J.J., Eshed, I., Jacome, B-A., Sarzi Puttini, P., Atzeni, F., Buskila, D., Reinshtein, E., Novofastovsli, I., Fawaz, A., Kurt, de V., and X. Baraliakos 2017. Diffuse idiopathic skeletal hyperostosis (DISH): where we are now and where to go next. *RMD Open* 3: e000472.

Manconi, F. 1994. *Castigo de Dios. La grande peste barocca nella Sardegna di Filippo IV*. Roma: Donzelli Editore.

Margerison, B.J., and C.J. Knusel 2002. Paleodemographic comparison of a catastrophic and an attritional death assemblage. *American Journal of Physical Anthropology* 119: 134-143.

Mariotti, V., Facchini, F., and M.G. Belcastro 2004. Enthesopathies, Proposal of a Standardized Scoring Method and Applications. *Collegium Antropologicum* 28, pp. 145-159.

Mariotti, V., Facchini, F., and M.G. Belcastro 2007. Enthesopathies. Proposal of Standardized Scoring Method and Applications. *Collegium Antropologicum* 28: 291-313.

Mariotti, V., Zuppello, M., Pedrosi, M.E., Bettuzzi, M., Brancaccio, R., Peccenini, E., Morigi, M.P., and M.G. Belcastro 2015. Skeletal evidence of tuberculosis in a Modern identified human skeletal collection (Certosa cemetery, Bologna, Italy). *American Journal of Physical Anthropology* 157: 389-401.

Marques, C., Matos, V., and N. Meinzer 2019. Proliferative periosteal reactions: assessment of trends in Europe over the past two millennia, in R.H. Steckel, C.S. Larsen, C.A. Roberts and J. Baten (eds), *The Backbone of Europe: Health, Diet, Work and Violence over Two Millennia*: 137-174. Cambridge: Cambridge University Press.

Martin, R., and K. Saller 1957-62. *Lehrbuch der Anthropologie*. Stuttgart: G. Fischer.

Maxia, C., and A. Fenu 1963. Sull'antropologia dei protosardi e dei sardi moderni. Sinossi iconografica. Nota IV. I crani e i femori della cripta della Chiesa di S. Michele in Bono (fine XVI- metà XIX secolo). *Rendiconti del Seminario della Facoltà di Scienze dell'Università di Cagliari* XXXIII: 125-212.

Mays, S.A. 2007. Lysis at the anterior vertebral body margin: evidence for brucellar spondylitis? *International Journal of Osteoarchaeology* 17: 107-118.

Mays, S. 2018. How should we diagnose disease in palaeopathology? Some epistemological considerations. *International Journal of Paleopathology* 20: 12-19.

Meloni, G. 1994. Alghero tra Genova, Arborea, Milano, Catalogna. Nuovi documenti, in *Atti del Convegno su Alghero, la Catalogna, il Mediterraneo, Alghero, 30 Ottobre-2 Novembre 1985*: 59-74. Sassari: Edizioni Gallizzi.

Milanese, M. (a cura di) 2010. *Lo scavo del cimitero di San Michele ad Alghero (fine XIII-inizi XVII secolo), campagna di scavo giugno 2008-settembre 2009*. Pisa: Felici Editore.

Milanese, M. 2013. *Alghero. Archeologia di una città medievale*, Sassari: Carlo Delfino Editore.

Minozzi, S., and A. Canci 2015. *Archeologia dei resti umani. Dallo scavo al laboratorio*. Roma: Carocci.

Mitchell, P.D., and R.C. Redfern 2011. Brief communication: developmental dysplasia of the hip in medieval London. *American Journal of Physical Anthropology* 144: 479-84.

Mittler, D.M., and D.P. Van Gerven 1994. Developmental, Diachronic, and Demographic Analysis of cribra orbitalia in the Medieval Christian populations of Kulubnarti. *American Journal of Physical Anthropology* 93: 287-297.

Molnar, P. 2011. Extramasticatory dental wear reflecting habitual behavior and health in past populations. *Clinical Oral Investigations* 15: 681-9.

Moon, H. 1877. On irregular and defective tooth development. *Transations of the Odontological Society of Great Britain* 9: 223-243.

Moore, W.J., and E. Corbett 1973. The distribution of dental caries in ancient British populations II, Iron Age, Romano-British and Mediaeval Periods. *Caries Research* 7: 139-153.

Moore, W.J., and M.E. Corbett 1975. Distribution of dental caries in ancient British populations: III. The 17th century. *Caries Research* 9: 163-175.

Mudaliar, R.P., Shetty, S., Nanjundaiah, K., Kumar, J.P, and K.C. Jyothi 2013. An osteological study of occipitocervical synostosis: its embryological and clinical significance. *Journal of Clinical Diagnostic Research* 7: 1835-7.

Mutolo, M.J., Jenny, L.L., Buszek, A.R., Fenton, T.W., David, R., and D.R. Foran 2012. Osteological and Molecular Identification of Brucellosis in Ancient Butrint, Albania, Michigan State University. *American Journal of Physical Anthropology* 147: 254-263.

Norn, S., Permin, H., Kruse, E., and P.R. Kruse 2008. Mercury – a major agent in the history of medicine and alchemy. *Danish Medicinhistorisk Arbog* 36: 21-40.

Nughes, A. 1994. La diocesi di Alghero nel XVI secolo, in Mattone, A. (a cura di) *Alghero, la Catalogna, il Mediterraneo*: 361-368. Sassari: P. Sanna.

Nughes, A. 1980. *La riforma tridentina nella diocesi di Alghero sotto l'episcopato di Andreu Baccallar*. Roma: Tesi di Laurea.

O'Shea, J.G. 1990. 'Two minutes with venus, two years with mercury' -mercury as an antisyphilitic chemotherapeutic agent. *Journal of the Royal Society of Medicine* 83: 392-395.

Okumura, M.M., Boyadjian, C.H.C., and S. Egger 2007. Auditory exostoses as an aquatic activity marker: A comparison of coastal and inland skeletal remains from tropical and subtropical regions of Brazil. *American Journal of Physical Anthropology* 132: 558-567.

Olivier, G., and H. Pineau 1960. Nouvelle determination de la taille foetale d'apres les longneurs diaphysaires des os longs. *Annales des Medicine Légale* 40: 141-144.

Orava, S., and K. Virtanen 1982. Osteochondroses in athletes. *British Journal of Sports Medicine* 16: 161-168.

Ortner, D.J. 2003. *Identification of pathological condition in human skeletal remains*. New York: Smithsonian Institution Press.

Ortner, D.J. 2012. Differential diagnosis and issues in disease classification, in Grauer, A.L. (ed.) *A Companion to Paleopathology*: 250-267. Chichester, UK: Wiley-Blackwell.

Osborn, M.L. 1979. The rent breasts: a brief history of wet-nursing. *Midwife, Health Visitor & Community Nurse* 15: 302-306.

Palfi, G., Bereczki, Z., Ortner, D.J., and O. Dutour 2012. Juvenile cases of skeletal tuberculosis from the terry anatomical collection (Smithsonian Institution, Washington, DC, USA). *Acta Biologica Szegediensis* 56: 1-12.

Pany, D., and M. Teschler-Nicola 2007. Klippel-Feil syndrome in an Early Hungarian Period juvenile skeleton from Austria. *International Journal of Osteoarchaeology* 17: 403-415.

Pedersen, D.D., Milner, G.R., Kolmos, H.J., and J.L. Boldsen 2019. The association between skeletal lesions and tuberculosis diagnosis using a probabilistic approach. *International Journal of Paleopathology* 27: 88-100.

Pourbagher, A., Pourbagher, M.A., Savas, L., Turunc, T., Demiroglu, Y.Z., Erol, I., and D. Yalcintas 2006. Epidemiologic, clinical, and imaging findings in brucellosis patients with osteoarticular involvement. *American Journal of Roentgenology* 187: 873-80.

Ragsdale, B.D., Campbell, R.A., and C.L. Kirkpatrick 2018. Neoplasm or not? General principles of morphologic analysis of dry bone specimens. *International Journal of Paleopathology* 21: 27-40.

Raoult, D., Mouffok, N., Bitam, I., Piarroux, R., and M. Drancourt 2013. Plague: history and contemporary analysis. *Journal of Infection* 66: 18-26.

Rasmussen, S., Allentoft, M.E., Nielsen, K., Orlando, L., Sikora, M., Sjogren, K.G., Pedersen, A.G., Schbert, M., Van Dam, A., Outzel Kale, C.M., Nielsen, H.B., Brunak, S., Avetisyan, P., Epimakhov, A., Khalyapin, M.V., Gnuni, A., Kriiska, A., Lasak, I., Metspalu, M., Moiseyev, V., Gromov, A., Pokutta, D., Saag, L., Varul, L., Yepiskoposyan, L., Sicheritz-Ponten, T., Foley, R.A., Lahr, M.M, Nielsen, R., Kristiansen, K., and E. Willerslev 2015. Early divergent strains of Yersinia pestis in Eurasia 5,000 years ago. *Cell* 163: 571-582.

Resnick, D., and G. Niwayama 1995. Osteomyelitis, septic arthritis and soft tissue infection: mechanism and situations, in D. Resnick (ed.) *Diagnosis of bone and joint disorders*: 2325-2418. Philadelphia: Saunders.

Roberts, C.A., and J.E. Buikstra 2003. *The bioarchaeology of tuberculosis. A global view on a reemerging disease*. Gainesville: University Press of Florida.

Robin, J.B. 2008. *A paleopathological assessment of osteoarthritis in the lower appendicular joints of individuals from the Kellis 2 cemetery in the Dakhleh Oasis, Egypt*. PhD thesis, Southern Illinois University.

Robledo, B., Trancho, G.J., and D.R. Brothwell 1995. Cribra orbitalia: health indicator in the late roman population of Cannington (Sommerset, Great Britain). *Journal of Paleopathology* 7: 185-193.

Rogers, J., and T. Waldron 2001. DISH and the monastic way of life. *International Journal of Osteoarchaeology* 11: 357-365.

Saini, V., Singh, R., Bandopadhyay, M., Tripathi, S.K., and S.N. Shamal 2009. Occipitalization of the atlas: its occurrence and embryological basis. *International Journal of Anatomical Variations* 2: 65-68.

Salvadei, L., Ricci, F., and G. Manzi 2001. Porotic hyperostosis as a marker of health and nutritional conditions during childhood: Studies at the transition between imperial Rome and the Early Middle Ages. *American Journal of Human Biology* 13: 709-17.

Samartzis, D., Herman, J., Lubicky, J.P., and F.H. Shen 2006. Classification of congenitally fused cervical patterns in Klippel-Feil patients: epidemiology and role in the development of cervical spine-related symptoms. *Spine* 31: E798-E804.

Sauer, N.J. 1998. The timing of injuries and manner of death: distinguishing among antemortem, perimortem and postmortem trauma, in K. Reichs (ed.), *Forensic osteology: advances in the identification of human remains*: 321-332. Springfield: Charles C. Thomas.

Saunders, S.R., De Vito, C., and M.A. Katzenberg 1997. Dental caries in nineteenth century Upper Canada. *American Journal of Physical Anthropology* 104: 71-87.

Schaefer, M., Black, S., and L. Scheuer 2009. *Juvenile osteology: A laboratory and field manual*. London: Academic Press.

Schenk, R.C., and J.M. Goodnight 1996. Osteochondritis dissecans. *Journal of Bone and Joint Surgery. American volume* 78: 439-456.

Schour, L., and M. Massler 1941. The development of the human dentition. *The Journal of the American Dental Association* 28: 1153.

Schrader, S.A. 2015. Elucidating inequality in Nubia: an examination of entheseal changes at Kerma (Sudan). *American Journal of Physical Anthropology* 156: 192-202.

Schuenemann, V.J., Bos, K., DeWitte, S., Schmedes, S., Jamieson, J., Mittnik, A., Forrest, S., Coombes, B.K., Wood, J.W., Earn, D.J.D., White, W., Krause, J., and H.N. Poinar 2011. Target enrichment of ancient pathogens yielding the pPCP1 plasmid of Yersinia pestis from victims of the Black Death. *Proceedings of the National Academy of Sciences USA* 108: E746-E752.

Sechi Copello, B. 1984. *Storia di Alghero e del suo territorio*. Alghero: Edizioni Bastiò.

Seifert, L., Wiechmann, I., Harbeck, M., Thomas, A., Grupe, G., Projahn, M., Scholz, H.C., and J.M. Riehm 2016. Genotyping Yersinia pestis in historical plague: evidence for long-term persistence of Y. pestis in Europe from the 14th to the 17th century. *PLoS One* 11: e0145194.

Sellen, D.W. 2001. Comparison of infant feeding patterns reported for nonindustrial populations with current recommendations. *The Journal of Nutrition* 131: 2707-2715.

Senoglu, M., Safavi-Abbasi, S., Theodore, N., Bambakidis, N.C., Crawford, N.R., and V.K. Sonntag 2007. The frequency and clinical significance of congenital defects of the posterior and anterior arch of the atlas. *Journal of Neurosurgery Spine* 7: 399-402.

Serri, G. 1980. Due censimenti inediti dei 'fuochi sardi': 1583, 1627. *Archivio sardo del movimento operaio, contadino e autonomistico* 11-13: 351-390.

Shiau, H.J., and M.A. Reynolds 2010. Sex differences in destructive periodontal disease: exploring the

biologic basis. *Journal of Periodontology* 81: 1505-17.

Signoli, M., Chausserie-Lapree, J., and O. Dutour 1995. Etude anthropologique d'un charnier de la peste de 1720-1721 a Martigues. *Prehistoire et Anthropologie Mediterraneennes* 4: 173-189.

Signoli, M., Chevé, D., Adalian, P., Boetsch, G., and O. Dutour 2007. *Peste: entre épidémie set Sociétés*. Firenze: Firenze University Press.

Silva, A.M. 1995. Sex assessment using the calcaneus and talus. *Antropologia Portuguesa* 13: 107-119.

Sjøvold, T. 1990. Estimation of stature from long bones utilizing the line of organic correlation. *Human Evolution* 5: 431-447.

Slaus, M., Bedic, Z., Sikanjic, P.R., Vodanovic, M., and A.D. Kunic 2011. Dental health at the transition from the Late Antique to the Early Medieval period on Croatia's Eastern Adriatic Coast. *International Journal of Osteoarchaeology* 21: 577-590.

Smith, B.H. 1984. Patterns of molar wear in Hunter-gatherers and agriculturalists. *American Journal of Physical Anthropology* 63: 39-56.

Smith-Guzman, N.E. 2015. The skeletal manifestation of malaria: an epidemiological approach using documented skeletal collections. *American Journal of Physical Anthropology* 158: 624-635.

Spjut, H.J., Dorfman, H.D., Fechner, RE., and L. Ackerman 1970. *Tumors of bone and cartilage*. Washington D.C.: Armed Forces Institute of Pathology.

Spyrou, M.A., Keller, M., Tukhbatova, R.I., Scheib, C.L., Nelson, E.A., Andrades Valtueña, A., Neumann, G.U., Walker, D., Alterauge, A., Carty, N., Cessford, C., Fetz, H., Gourvennec, M., Hartle, R., Henderson, M., von Heyking, K., Inskip, S.A., Kacki, S., Key, F.M., Knox, E.L., Later, C., Maheshwari-Aplin, P., Peters, J., Robb, J.E., Schreiber, J., Kivisild, T., Castex, D., Lösch, S., Harbeck, M., Herbig, A., Bos, K.I., and J. Krause 2019. Phylogeography of the second plague pandemic revealed through analysis of historical Yersinia pestis genomes. *Nature Communications* 10: 4470.

Spyrou, M.A., Keller, M., Tukhbatova, R.I., Scheib, C.L., Nelson, E.A., Andrades Valtueña, A., Neumann, G.U., Walker, D., Alterauge, A., Carty, N., Cessford, C., Fetz, H., Gourvennec, M., Hartle, R., Henderson, M., von Heyking, K., Inskip, S.A., Kacki, S., Key, F.M., Knox, E.L., Later, C., Maheshwari-Aplin, P., Peters, J., Robb, J.E., Schreiber, J., Kivisild, T., Castex, D., Lösch, S., Harbeck, M., Herbig, A., Bos, K.I., and J. Krause 2016. Historical Y. pestis genomes reveal the European Black Death as the source of ancient and modern plague pandemics. *Cell Host Microbe* 19: 874-881.

Standen, V.G., Arriaza, B.T., and C.M. Santoro 1997. External auditory exostosis in prehistoric Chilean populations: a test of the cold water hypothesis. *American Journal of Physical Anthropology* 103: 119-129.

Steckel, R.H., Larsen, C.S., Sciulli, P.W., and P.L. Walker 2005. *The global history of health project data collection codebook*. Cleveland, OH: Global History of Health Project.

Stenseth, N.C., Atshabar, B.B., Begon, M., Belmain, S.R., Bertherat, E., Carniel, E., Gage, K.L., Leirs, H., and L. Rahalison 2008. Plague: past, present, and future. *PLoS Medicine* 15: e3.

Stermer Beyer-Olsen, E.M., and S. Risnes 1994. Radiographic analysis of dental development used in age determination of infant and juvenile skulls from a medieval archaeological site in Norway. *International Journal of Osteoarchaeology* 4: 299-303.

Stirland, A.J., and T. Waldron 1997. Evidence for activity related markers in the vertebrae of the crew of the Mary Rose. *Journal of Archaeological Science* 24: 329-335.

Stloukal, M., and H. Hanakova 1978. Die länge der Längsknochen altslawischer Bevölkerungen – Unter besonderer Berücksichtigung von Wachstumsfragen. *Homo* 29: 53-69.

Stothers, D.M., and J.F. Metress 1975. A system fort the description and analysis of pathological changes in prehistoric skeletons. *Ossa* 2: 3-9.

Stuart-Macadam, P. 1998 Iron deficiency anemia: exploring the difference, in A.L. Grauer and P. Stuart-Macadam (eds), *Sex and Gender in Paleopathological Perspective*: 45-63. Cambridge: Cambridge University.

Sutton, D. 1993. *Textbook of radiology and medical Imaging* Vol. 1. Edinburgh: Churchill Livingstone.

Tesi, C., Giuffra, V., Fornaciari, G., Larentis, O., and M. Motto 2019. A case of erosive polyarthropathy from Medieval northern Italy (12th-13th centuries). *International Journal of Paleopathology* 25: 20-29.

Toda y Güell E. *L'Alguer. Un popolo catalano d'Italia*. Traduzione, introduzione e note a cura di Rafael Caria. Edizioni Gallizi, 1888.

Tognotti, E. 2008. *Per una storia della malaria in Italia. Il caso della Sardegna*. Milano: Franco Angeli.

Tzortzis, S., and M. Signoli 2009. Les tranchées des Capucins de Ferrières (Martigues, Bouches-du-Rhône, France). Un charnier de l'epidémie de peste de 1720 à 1722 en Provence. *Comptes Rendus Palevol* 8, 749-760.

Ubelaker, D.H. 1989. *Human skeletal remains: excavation, analysis, interpretation*, Washington, Taraxacum.

Ventades, N.G., Laza, I.M., Hervella, M., and C. de-la-Rua 2018. A recording form for differential diagnosis of arthropathies. *International Journal of Paleopathology* 20: 45-49.

Verlaan, J.J, Oner, F.C., and G.J.R. Maat 2007. Diffuse Idiopathic Skeletal Hyperostosis in Ancient Clergymen. *European Spine Journal* 16: 1129-1135.

Villotte, S., Knusel, C.J. 2013. Understanding entheseal changes: definition and life course changes. *International Journal of Osteoarchaeology* 23: 135-146.

Villotte, S., Stefanovic, S., and C.J. Knusel 2014. External auditory exostoses and aquatic activities during the Mesolithic and the Neolithic in Europe: results from a large prehistoric sample. *Anthropologie* 52: 73-89.

Vodanovic, M., Brkic, H., Slaus, M., and Z. Demo 2005. The frequency and distribution of caries in the Mediaeval population of Bijelo Brdo in Croatia (10th-11th century). *Archives of Oral Biology* 50: 669-680.

Wagner, D.M., Klunk, J., Harbeck, M., Devault, A., Waglechner, N., Sahl, J.W., Enk, J., Birdsell, D.N., Kuch, M., Lumibao, C., Poinar, D., Pearson, T., Fourment, M., Golding, B., Riehm, J.M., Earn, D.J., Dewitte, S., Rouillard, J.M., Grupe, G., Wiechmann, I., Bliska, J.B., Keim, P.S., Scholz, H.C., Holmes, E.C., and H. Poinar 2014. Yersinia pestis and the plague of Justinian 541-543 AD: a genomic analysis. *Lancet Infectious Diseases* 14: 319-26.

Waldron, T. 2008. *Paleopathology*. Cambridge: Cambridge University Press.

Walker, P.L., Bathurst, R.R., Richman, R., Gjerdrum, T., and V.A. Andrushko 2009. The causes of porotic hyperostosis and cribra orbitalia: a reappraisal of the iron-deficiency-anemia hypothesis. *American Journal of Physical Anthropology* 139: 109-25.

Wapler, U., Crubezy, E., and M. Schultz 2004. Is cribra orbitalia synonymous with anemia? Analysis and interpretation of cranial pathology in Sudan. *American Journal of Physical Anthropology* 123: 333-339.

Weatherill, T. 1833. Extraordinary ravages of syphilis and mercury on the human countenance. *Lancet* 20: 357-359.

Weiss, E., and R. Jurmain 2007. Osteoarthritis revisited: A contemporary review of aetiology. *International Journal of Osteoarchaeology* 17: 437-450.

Wells, C. 1974. Osteochondritis dissecans in ancient British skeletal material. *Medical History* 8: 365-9.

Weston, D.A. 2012. Nonspecific infection in paleopathology: interpreting periosteal reactions, in A.L. Grauer (ed.), *A companion to paleopathology*: 492-512. Chichester, UK: Blackwell.

Wood, J.W., Milner, G.R., Harpending, H.C., and K.M. Weiss 1992. The osteological paradox: Problems of inferring prehistoric health from skeletal samples. *Current Anthropology* 33: 343-370.

Yang, R. 2017. Plague: Recognition, Treatment, and Prevention. *Journal of Clinical Microbiology* 56: e01519-17.

Yaussy, S.L., DeWitte, S.N., and R. Redfern 2016. Frailty and famine: patterns of mortality and physiological stress among victims of famine in medieval London. *American Journal of Physical Anthropology* 160: 272-283.

The Plague Cemetery of Alghero (Sardinia, Italy, 1582-1583) presents a bioarchaeological analysis of the individuals exhumed from the cemetery of Alghero, which is associated with the plague outbreak that ravaged the city in 1582-1583. This cemetery revealed a particular burial typology, consisting of long and narrow trenches, each containing multiple inhumations, which attests to a catastrophic event, such as an epidemic with high mortality in a short period of time. Given the rarity of human remains from epidemic contexts buried in trenches, the skeletal sample from Alghero represents valuable material. In fact, no other Italian plague cemeteries have been examined through a detailed bioarchaeological analysis, and the study thus serves as a model for future research.

The author examines a series of parameters, starting from the demographic profile of the sample –181 individuals from 15 trenches – and taphonomic analysis, and then analysing stature, dental pathologies, stress indicators, degenerative joint disease, entheseal changes and other pathologies. The study is intended to illuminate a cross section of 16th century Sardinian society in a coastal city through a holistic view, which interweaves the documentary evidence for plague, funerary responses and the health status of the population. The main objective is therefore to shed light on a population which lived during a period of plague, revealing lifestyles, activity patterns and illnesses and providing a significant contribution to the bioarchaeology, palaeopathology, and archaeology of the Italian territory.

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ISBN 978-1-80327-076-0