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BARGE'S ANTHROPOLOGICA
Nr. 3
Leiden
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Published by:
Barge's Anthropologica
Leiden University
P.O. Box: 9602
2300 RC, The Netherlands

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SUMMARY

During 1985-1988 the larger part of a former Roman cemetery, dating from 50-225 AD was excavated near the village of Valkenburg in the western part of The Netherlands. Of the recovered human remains, the skeletons of the 47 inhumed adults and children were taken to the department of Anatomy of Leiden University for laboratory analysis. In a separate study, the remains of tens of inhumed babies and hundreds of cremations from the same burial place were analyzed in the Institute of Pre- and Protohistory of the University of Amsterdam (Smits, 1987; in preparation). Lack of uniformity in orientation and positioning of the uncoffined dead suggested a hasty and/or negligent interment. But no evidence was found that the dead were victims of an epidemic disease or acts of violence. Sex and age distribution of the deceased indicated that it was not a community of families. Were they socially related to the much larger group of cremations from the same cemetery? It seems more probable that this was a socially separate group of people, for instance native labourers. The paleopathology found in the individual skeletons strongly supports the latter point of view. Adequate growth conditions had resulted in tallness of the adults. The average stature of the males was calculated to be ca. 176 cm. This also seems to indicate that the deceased originated from the native Romano-Dutch population. The tough physical lifestyle of the adults was for instance expressed by multiple cases of fractured lumbar vertebras, and by the early onset of degenerative joint diseases. Like in other contemporary Romano-British communities, the latter had affected at least 50% of the adults. Evidence of (occupationally?) overstrained upper extremities was found in high frequency, e.g., fractures and degenerated joints of the bones of the shoulder girdle, and coraco-clavicular facetting. Remarkable in this context was the absence of fractures, and the low frequency of degenerative joint disease in the lower extremities. From the distribution pattern of these pathological changes it is our impression, that these individuals were non-agriculturalists, straining their upper body half by for example carrying heavy loads at the local granaries and landing stages along the Rhine. Despite the tallness of the adult males, local growth conditions seemed to have fluctuated. Indications of seasonally related outbreaks of scurvy were found, as well as enamel hypoplasia due to health insults, and cribra orbitalia from chronic anemia. The equal prevalence of cribra orbitalia among the sexes seemed to reflect that life conditions for both sexes were similar during growth. But at the same time, the age distribution of enamel hypoplasia indicated an increasing frequency of health insults with age for girls. Skeletal evidence of frequent squatting was found. A frequency of caries in 6.5% of the inspected teeth is considered to be rather low if compared to contemporary data. Is there a relationship between the coarseness of an unrefined unromanized diet and dental caries supportable? The serious molar attrition from such an abrasive diet, probably due to ground cereal grains from the granaries, explained the mainly interproximal position of carious lesions. Another interesting and frequent finding was the chipping off and serious attrition of incisors. The teeth appear to have been used as tools.

KEYWORDS: Roman Period, human skeletons, inhumations, paleo-pathology.

INTRODUCTION

In the 1940s a Roman "castellum" (fortress) was excavated in the village of Valkenburg in The Netherlands (van Giffen, 1955). Valkenburg (in the province Zuid Holland) is situated along the southern bank of the Rhine river, a few kilometers east of where the stream enters the North Sea. Its "castellum" is considered to be one of a series of strongholds situated along the "limes" (northern boarder) of the Roman Empire. From a 12th century copy of a 3rd century Roman map, the so-called "Peutinger map", we know that Valkenburg in Roman times was known as "Praetorium Agrippinae". Later in the 1970s, the remains of the "vicus", the native settlement near the castellum, were discovered about one kilometer to the south (Sarfatij, 1975). Excavations were carried out in between the two sites, from 1985 to 1988, to explore the dimensions of the vicus of this most northern situated frontier-post of the Roman Empire (van Dierendonck et al., 1993). A considerable quantity of Roman military- and native archeological structures was discovered. There had been a connecting road along the southern bank of the Rhine, a mini-castellum, "horrea's" (granaries), landing stages, native farms and a cemetery (Bult and Hallewas, 1986, 1987, 1990). The cemetery had been situated westward along the twice constructed Roman road. It consisted mainly of burials of at least 250 cremated individuals and tens of inhumed babies. In contrast to the common Roman burial practice of cremating, 47 inhumations were also found. Only one of these was a common grave containing two adults and a child. It is this latter collection of unburned human remains which is the subject of our study. In order to assess the demographic origin and the health status of this group of people, their sex, age at death, stature and pathological changes were analyzed.

MATERIAL and METHODS

The excavation was hampered by the sticky clay of the river Rhine in which the bodies had originally been buried. This difficulty is expressed by the considerable postmortem loss of teeth, 21% of those present at death. The inhumation graves were found scattered all over the cemetery, and showed no particular orientation. Only one common grave containing a male, a female and a child was found. Coffins had not been used. People had been "interred" in almost any outlying body position, even prone. In some cases the grave had been "too small". No gravegoods were found. After cleaning, washing and reconstruction of the often fragmented skeletons, the degree of preservation and the completeness of the skeletons were recorded. Preservation of the bone tissue varied from poor to good.

Assessment of sex and age was performed according to the recommendations of the "Workshop for European Anthropologists (1980). Sex determination concerned adults only. Because of the incompleteness of many bones, only non-metrical morphological sex characteristics of the pelvis and cranium were used.

Methods for diagnosing skeletal age at death differed for various phases of ageing. For age diagnoses in children, dental development was the most important indicator. Here the diagrams of Ubelaker (1978) were used. From the age of twelve years on, epiphyseal fusion was taken into account, as this is considered to be the main age indicator for that period of life. For adults the so-called Complex Method of Acsády and Nemeskéri (1970) was applied. In this method, age characteristics are read from the: (1) degree of obliteration of the endocranial sutures; (2) changes of face of the pubic symphysis; (3) spongiosa changes in the proximal femur, and (4) spongiosa changes in the proximal humerus. If less than three age indicators were available, additional seriation with respect to molar attrition was conducted (see below). When only small segments of the cranial sutures were preserved, the diagram of Vallois (1937) based on closure of ectocranial sutures was used. If necessary, the final estimated age at death interval of individuals was derived by means of seriation with respect to molar attrition scores from individuals with an adequate number of skeletal age indicators. All final age and sex diagnoses were settled in co-operation with L. Smits, who analyzed the inhumed babies and the cremations from the same cemetery (Smits, 1987; in preparation).

Prior to stature calculation, the maximum length of long bones was measured with a sliding calliper according to the instructions of Trotter and Gleser (1952, 1958). In addition, the physiological length of the femur was measured to calculate stature after Manouvrier (1892). Both methods were applied to compare this population with contemporary samples.

The shape of the proximal part of the shaft of the femur and tibia was expressed as shaft-shape indices (Brothwell, 1981).

Paleopathological diagnoses were established using the criteria stipulated in Steinbock (1976), Ortner and Putschar (1985) and Robbins et al. (1984). For the roentgenological analysis of healed fractures and dental eruption patterns, X-rays were made with the aid of an Enraf-Nonius (type Elinos 90/40; 90 kV; 0.3 mAmp; focus-film distance 130 cm.). Tracing Harris's lines in tibias was impossible because of the vast deposits of soil in the marrow cavities.

Dental analysis was performed by visual inspection. The number of non-erupted and erupted teeth was scored. Absent teeth were classified as either antemortem or postmortem loss. In the case of alveolar bone resorption, it was assumed that originally 32 teeth had erupted. Molar attrition, sites of abscesses, alveolar resorption, calculus formation, carious lesions, fistulas, and periodontal disease were recorded according to the standards in Brothwell (1981). Incisor attrition was recorded after Molnar (1971). The age of enamel hypoplasia formation was determined with the aid of diagrams on the mineralization of teeth during development (Ubelaker, 1978).

In a separate catalogue all details of these analyses are presented per individual, including age and sex diagnosis, state of preservation, completeness, length of long bones, pathology, anomalies, and dental analyses. With respect to age and sex determination, the analyzed bones are mentioned between brackets. Dental attrition display conforms to the following outline:

Incisors (I)	maxillary :		**C I2 I1 I1 I2 C**	
/ Canine (C):	mandibular:	right:	**C I2 I1 I1 I2 C**	:left
Molars (M) :	maxillary :		**M3 M2 M1 M1 M2 M3**	
	mandibular:	right:	**M3 M2 M1 M1 M2 M3**	:left

RESULTS

Sex and age determination

Sex determination produced the diagnosis of twenty males and four females (Table 1). Sex could not be assessed for ten incomplete adult skeletons.

Age determination identified thirteen subadults between 5 and 20 years of age. For demographical analysis, the 24 adults were attributed to five 10 year intervals (Fig. 1): 7 males (35% of the males) and 2 females (50% of the females) died between 20 and 30 years of age; 1 male (5%) and 1 female (25%) between 30 and 40 years; 6 males (30%) between 40 and 50 years; 3 males (15%) and 1 female (25%) between 50 and 60 years; and 3 males between 60 and 70 years of age (15%). Three of the four women had died between 20 and 40 years of age, while only one had died at an older age, i.e., in the 50-60 years interval.

In one, three, four and eight adults, respectively 4, 3, 2 and 1 age indicator(s) of the Complex Method of Acsádi & Nemeskéri (WEA, 1980) was (were) used. Additionally, seriation of molar attrition and the degree of closure of the external sutures clarified the attribution to the age at death intervals (Table 1).

Stature

The lengths of various long bones in only twelve individuals could be measured to estimate their stature with the aid of the formulas of Trotter and Gleser (1952, 1958) and of the tables of Manouvrier (1892). The results are shown in Table 2. The recommended correction for the decline in height after the 30st year in Trotter and Gleser's formulas was only performed for the calculation of the individual statures, but not for the averages (mean). The mean standing height for these ten men and two women was respectively 175.9 cm and 159.3 cm after Trotter and Gleser (1952, 1958). The results of the method of Manouvrier produce cadaver lengths. In order to obtain living statures 2 cm have to be subtracted (Manouvrier, 1892). The mean cadaver length was 172.4 cm for the ten men, and 158.5 cm for the two women. The mean maximal femur lenth was 50.4 cm (N=3) for males and 42.0 cm (N=2) for females.

Shaft indices of femur and tibia

In addition, the shaft shape of the subtrochanteric part of the femur shaft and of the tibia shaft was examined (Table 3). The mean femoral-shaft, or so-called meric index was 76.5. This index reflected the considerable antero-posterior flattening of the femur shaft, i.e., platymeria. Eighty-five percent of the men and all women obviously displayed this feature. Six of the men were even hyperplatymeric!.

The mean tibia-shaft, also known as the cnemic index was 73.7. This value, within the eurycnemic range, expressed a fairly common slight transversal flattening of the tibia shaft. This phenomenon was seen in 67% of the men and in all four women. A distinct transverse flattening of the tibia shaft, known as hyperplatycnemia, was seen in one man only.

Paleopathology:

Traumas

Signs of traumas were found in 16 of the 47 complete and incomplete skeletons examined! Surprisingly, a very low frequency of traumas of the lower extremities was seen.

Eleven individuals (23%) showed healed malaligned fractures: nine males, one female, and one child with a skeletal age of 9 years (Table 4). Three males were found with multiple fractures. Most frequent, in terms of affected bone and number of affected individuals, were fractures of vertebras, metacarpal bones and ribs. Less frequent were fractures of clavicles and scapulas. Only one solitary fracture of the pelvis was found. Most remarkable were the fractured vertebras of three males, all with a skeletal age between 20 and 30 years. Two of these individuals showed compression fractures of two lower lumbar vertebras (Fig. 2). In the third individual, a complicated spondylolysis of the fifth lumbar vertebra was found, i.e., a complete bilateral separation between the superior and inferior articular processes with healed fractured ends (spondylolysis), in addition to a recent fracture of the left lamina of the same vertebral arch (Fig. 3). One man displayed a fracture of the posterior rim of his acetabulum. Most fractures had healed well. Only one male showed non-healed rib fractures at the time of his death. A male, with a skeletal age between 22 and 24 years old was found to have a pseudo-arthrosis of a fractured acromial part of the scapula in addition to the above mentioned spondylolytic lumbar vertebra. One female, aged 23, had developed a pseudo-arthrosis at the site of a fractured costal process of her first lumbar vertebra.

Besides fractures, other mechanical traumas were seen in five individuals, 11% of the total sample of 47 skeletons. In two individuals the cranium was involved. One male was found to have a healed blunt trauma of the vault (Fig. 4), in addition to two fractured metacarpal bones. Another male was discovered with a more or less oval perforation in the right parietal bone which was possibly antemortem inflicted (30x40 mm). The lesion was located close to the articulation of the coronal and sagittal sutures. The diameter of the aperture at the inner surface of the vault was larger than at the outer surface. The rather smooth margins showed no signs of healing. No fracture lines radiating from the opening or tool marks were visible. Roentgenologically, no bone repair was seen. Additionally, atrophy of the lateral proximal side of a second metatarsal was seen in the right foot of an adult of unknown sex.

Vertebral and peripheral osteoarthritis (vOA and pOA)

At least 12 (50%) of the 24 sexed adults were found to have this degenerative disorder, i.e., nine males and three females. Vertebral osteoarthritis (vOA) of facet joints was spotted in eight of the twelve examined males, and three of the four females examined (Table 5). Peripheral (extra spinal) osteoarthritic changes (pOA) were found in five males and two females (Table 6).

The onset of cervical osteoarthritis was seen in one man of 37-46 years and in one woman of 25-34 years. Eburnation of the first cervical joint was apparent in an old male in the age at death interval of 60-70 years, and in a female of 50-60 years. The old male also showed thoracic facet eburnation and bilateral ankylosis of the facets of Th11 and Th12.

Beginning and advanced changes from vertebral osteoarthritis at thoracic and lumbar levels, with pitting and osteophytes of the facet joints, were found in three young males and one young female, all in the age interval of 20-30 years.

Peripheral (extra spinal) osteoarthritis was frequently found. For example, pOA was located unilaterally in the temporomandibular joints of two males with estimated ages of 50-60 and 60-70 years. One male, of 40-50 years, had osteoarthritic changes of his right sterno-clavicular and acromio-clavicular joint. In addition to osteophytes along the left glenoid fossa in a female of 50-60 years, non-physiological pitting of the symphyseal face of her pubic bones and of both knee joints were recorded. The right hand of a male of 37-46 years, who had two healed metacarpal fractures, showed secondary eburnation of the scaphoid and radius. The presence of osteoarthritis of the first metacarpophalangeal joint was found unilaterally in a female aged only 23, bilaterally in a male of 42 years, and in the right hand of an old male with an estimated age of 60-70 years.

The latter case of the old male is worth mentioning in more detail. Widespread and severe osteoarthritis affected many of his other joints, such as severe vertebral osteoarthritis with eburnation of cervical and thoracic facets, ankylosis of two sets of thoracic facets (Th11-12), peripheral osteoarthritis of one temporomandibular joint and of several costo-vertebral joints (at three low thoracic levels), ankylosis of the right first costo-manubrial joint and ossification of the right ilio-lumbar ligament

(Fig. 5). Besides eburnation of the left humeral head and osteoarthritis in both of his elbow joints, his hands showed the aforementioned osteoathritis of the right first metacarpo-phalangeal joint, as well as osteoarthritis (Heberden nodes) and eburnation of distal interphalangeal joints. In addition to pitting in his left acetabulum, the left femur condyle and patella showed eburnation of their lateral articular surfaces, while his right knee also showed pitting.

Vertebral osteophytosis (VO)

Schmorl's nodes were seen at thoracic and lumbar levels in four males younger than 30 years old (Table 7). Osteophytosis of the vertebral bodies and/or Schmorl's nodes were spotted in nine males and in only one female. Osteophytes on vertebral bodies had already been noted at thoracic and/or lumbar levels in two males and one female in the age interval of 20-30 years. Four males, 40-60 years of age, were also affected at thoracic and lumbar levels. The old male discussed above, with an estimated age at death of 60-70 years who was severely affected by osteoarthritis also showed severe vertebral osteophytosis at all spinal levels: "kissing" and "parrot beak" formed osteophytes on some vertebras at cervical and thoracic levels, and fused osteophytes developed at the left side between L1 and L2.

Other pathological changes:

Deficiency diseases

Cribra orbitalia was seen in 45% of the 31 inspectable skulls, i.e., seven men, two women and five children! Seven of the seventeen men (41%), two of the four women (50%), and five of the ten children (50%) were affected. Often this phenomenon is found together with porotic hyperostosis of the vault. But the latter was not seen.

The lower extremities of 28 individuals were available for analysis of non-inflammatory periosteal changes. Tibias of four males, one female, one adult of unknown sex, and one child showed periosteal bone apposition, mainly on the medial plane (Table 8). The bone seemed to be thickened and somewhat striated. Sagittal and transverse sections revealed that the bone tissue was deposited on an intact periosteal cortical surface. The symmetry of the affection was noticeable. In one of the males, with a skeletal age of 65-74 years, the bone apposition around the shaft of the right tibia was more porous and extensive than on the left. In this individual the linea aspera of the right femur was affected to a lesser degree as well. In another male, of 22-24 years old, the same bone changes were found along the distal shaft of the left femur. The female, aged 21-23 years, had periosteal reactions on the distal part of her right fibula. The child displayed periosteal bone reaction with a browny discoloration around the nutricial foramen of the right fibula as well as on the right tibia just opposite of the affected area on the fibula.

Tumors

An osteoma, a button-formed bony elevation, on the outer table of the skull was seen in two individuals. In another individual the osteoma was originally situated in the left frontal sinus, but had perforated the outer table of the frontal bone (Fig. 6). An old male of 63-72 years of age, who already suffered from severe osteoarthritis, showed an extensive erosion without any bone reaction on the outer aspect of the frontal process of the left maxillary bone.

Osteochondritis dissecans

One of the young males, aged 22-24, with aforementioned non-inflammatory appositions on the left femur and both tibias also showed changes of the articular surfaces of his left knee and both ankle joints. The distal articular surface of his femur and the mating surface of the patella showed a ridged appearance. On the medial part of the distal articular surface of both tibias a round punched-out defect without any bony reaction was seen (diameter: ca. 1 cm).

Occupational and posture changes

In three individuals antero-posterior flattening of the sternal half of their clavicles was found. Ventral aspects showed horizontal ridges, while the thickness of the cortex itself seemed to be unchanged (Fig. 7). This symmetrical change was slightly present in a subadult with an age of 13-19 years, and was fully developed in two adult males. Another deformity of the clavicle was seen in a young male who displayed coraco-clavicular articular faceting on the right side(Fig. 8).

Furthermore, squatting facets at the distal articulation of the tibia were present in one female and three males (11%).

Enthesopathies

Six males and one female, aged 20-60 years, showed ossifications of tendon and ligament insertions (Table 9). One male had ossifications along the middle of the interosseus membrane attachment of the ulna. Upon X-ray, no discontinuities of this ulna and associated radius were traceable.

Anomalies

A metopic suture was seen in four individuals (14%). In one female an incomplete metopic suture was found. Extra sutural bones along the lambdoid suture, known as Wormian bones, were present in 12 of the 30 examinable skulls (40%). In addition to the former, one male also showed an extra sutural element at Bregma, whilst another male had extra elements in the sagittal suture. A bathocephalic skull-shape was seen in eight males and one female of the 29 examinable skulls (31%). A concurrence of over 50% of bathocephaly and Wormian bones was found. A double mental foramen was traced in three of the 29 mandibulas.

A congenital defective closure of the vertebral arch, known as spina bifida occulta, was seen in three individuals. In addition to an incomplete spina bifida occulta of the sacrum (only the arch of S1 was available), one male had a spondylolysis of L5. Two other males (13%) showed a defect in the closure of the posterior vertebral arch of the atlas. In one child, one female and two males, a foramen olecrani of the humerus was spotted (11%). Anomalies discovered in the proximal part of the femur included third trochanters (26%), hypotrochanteric fossas (21%) and a hypotrochanteric crests (18%). The occurrence of these three non-metrical traits coincided in five of the nine individuals examined.

Dental pathology

The dental remains of 30 individuals were examined: 17 males, 4 females, 1 individual of unknown sex and 8 subadults. The total number of developed teeth was 945 (Table 10). All non-developed elements, cases of hypodontia, concerned third molars. Another developmental disorder of the third molar, microdontia, was seen in the lower jaw of one individual. A non-erupted, impacted canine was found in the upper jaw of one male. A supernumerary tooth between C and P1 was detected in two individuals. The overall number of inspected elements was 696, which was 73.7% of the developed teeth. The postmortem loss was 20.9% of the teeth present at death, mostly from the upper jaw. The antemortem tooth-loss was 3.6%, with molars (M) having the highest incidence of loss: maxillary M1=8%, M2=7% and M3=4%; mandibular M1=15%, M2=13% and M3=0%.

The overall rate of caries was 6.5% of the observed teeth (Table 11). Only 5 out of 30 individuals showed no sign of dental decay, and two of them were adults. The ratio of mandibular versus maxillary affected elements was 1:1.1. Carious lesions were mostly found in 2nd premolars and in all molars, with percentages ranging from 7 to 17% of the observed teeth. The mandibular M1 and M3 were most seriously affected. Occlusal caries was only recorded in two cases, both with an opposing tooth in the opposite jaw. Here, caries lesions were located in the natural fissures of the crown. In over 82.2% of the carious teeth the initial disease process was localized interproximally in the neck. In 13.3% of all carious teeth, the dental decay had made such progress that the initial site of development could not be traced. In most cases the extent of caries development was considerable. In advanced cases, the pulp cavity was visible. Abscesses and/or fistulas were apparent in 16 dentitions. The first molar was most involved. Fistula openings into the maxillary sinus surrounded by reactive bone formation (which is suspect of a complicating sinusitis) was seen in two cases.

Mainly in combination with carious teeth, 12 of the 25 examinable individuals showed changes from periodontal disease on the maxilla or mandibula. Subperiosteal spreading of the disease was obvious in an individual who showed bony reaction on the left buccal side of the lower jaw in combination with a carious molar and periodontal disease (Fig. 9). In general, pathological retraction of alveolar bone was considerable. Antemortem loss of molars was responsible for a physiologically advanced alveolar atrophy in some individuals.

Depositions of calculus could be traced in 22 individuals. Noticeably, in 12 cases the deposits were on the mandibular incisors only. The degree varied from slight (5 cases), medium (3 cases) to considerable (1 case). Other localizations were present in various degrees. Occlusal tartar was not seen. There seemed to be no predominance for calculus with respect to sex or age.

Molar attrition was considerable. Dentine was already exposed on the permanent first molars of children by the time they had reached their 12th year. The attrition progressed with age to such an extent that the occlusal surface was worn off flat by the time they reached adulthood (Table 12). Matching functional age of the teeth (wear status) to skeletal age of individuals was only possible in 13 cases. Only the intact dentitions of males with an adequate determination of skeletal age at death were taken into consideration. Therefore, age intervals over 55 years were not included in Table 12. The incisors and canines also showed a remarkable degree of attrition. For example, a male of 52 years old had excessive wear on the upper medial incisors with the development of a secondary dentine patch on the lingual side. An example of atypical attrition of anterior teeth was illustrated by the lingual abrasia of the incisors of a woman of 50-60 years. A male of approximately 26 years old showed attrition of the left mandibular canine which was far more advanced than that of the surrounding teeth.

The anterior teeth of twelve individuals also showed destruction of their cutting edges as if the enamel had been chipped off (Fig.

10). Enamel hypoplasia was seen on the teeth of 13 of the 30 inspected individuals. Five children (63% of all children), five males (29% of all males) and three females (75%) were affected. Five individuals showed multiple lesions corresponding to different ages of development. Table 13 shows the age of formation of the enamel defects. Fifty percent of the enamel defects was formed at the age of approx. 3 years. Several individuals showed a change in the color of their teeth. This discoloration varied from darkblue (4 individuals) to red-brown (5 individuals). In one individual the entire crown of separated teeth was affected.

DISCUSSION

Demography

The phenomenon of a cemetery from the Roman Period being composed of a minority of inhumed individuals buried amongst a vast majority of individuals who were cremated according to Roman tradition, has been discussed before by Wahl and Kokabi (1988). They noted that this situation was found to be the case in many burial places of large and small Roman settlements. Explanations for this phenomenon have been proposed, but a "satisfying" one has never been found (Wahl and Kokabi, 1988). Some interesting results may elucidate this phenomenon with the case of Valkenburg.

Lack of uniformity in body orientation and posture of the inhumed skeletons indicated that we were dealing with impromptu interments receiving little or no care. Such a finding is a remarkable contrast to the contemporary Roman burials found at Poundbury (Woodward, 1993; Molleson, 1993). There, the dead were placed in coffins with care and sophistication. Could our inhumed individuals have been victims of an epidemic or a siege? If so, then one would expect many common graves. But, except for one common grave for three, these were not found. Additionally, the distribution of the burials over the cemetery indicated interments at different times over a long period. Consequently, we can reject such an origin for the inhumed bodies.

Because of the unbalanced sex ratio, the male-female ratio was 5:1, it is very unlikely that our group of 47 inhumed individuals can be viewed on as representing a group of families. If this is in fact the case, then the inhumed deceased should be demographically a part of the much larger cemetery community, but buried in a deviant way. Such an explanation, based on similarity in stature of cremated and inhumed individuals, was given before in a study of a contemporary cemetery at Stettfeld in Germany by Wahl and Kokabi (1988). Instead, it seems more plausible to assume that we are dealing with a socially separate group of people, for instance native labourers. The demography and paleopathology of this group strongly supports the latter point of view.

The more or less U-shaped age at death distribution of Figure 1 resembles a typical cemetery profile of ancient populations (Waldron, 1994). But this diagram also shows an unusually large proportion of deceased adolescents and young adult males. Risks for this group seem to have been relatively very high, and/or they represent a substantial extra or "immigrated" group of native men in the community. A logical option seems to be that these were male labourers recruited for work related to the castellum, the granaries, the farms, the landing stages along the river, etc.. Of the four women, three had died between 20 and 40 years of age, and only one had reached an old age (50-60 years). This could reflect the risks women endured during their fertile period from complications due to pregnancy and delivery. But here we have to realize that our sample may be too small for such interpretations.

Stature (living standing height)

For many years, different sets of regression equations have been developed from various human reference groups to estimate living stature from the lengths of long bones. Intrinsically, this indicates the limited use of calculation formulas applied to archaeological skeleton collections. Nevertheless, an attempt was made to compare the Valkenburg statures with those of other samples from the same period. The results, originally calculated after Trotter and Gleser (1952, 1958) and Manouvrier (1892), are listed in Table 14.

Borgognini-Tarli et al. (1977) had compared their results from Collelongo in Italy with other Italian samples from the same period from Barumini, Potenzia and Bagnacavallo (1st century BC - 3rd century AD). Molleson (1993) recorded the stature of adult skeletons from the Roman cemetery at Poundbury Camp near Dorchester in England, while Wells (1982) studied the Romano-British cemeteries at Cirencester. Wahl and Kokabi (1988) analyzed the Roman cemetery at Stettfeld in Germany; their sample represented a so-called native "gallo-, kelto-römische" population. In evaluating all of the results which were obtained using the "formulas of preference" from Trotter and Gleser (1952, 1958), one must take into consideration that since all available long bone lengths were used in Poundbury, Stettfeld and Valkenburg, these will lead to more variable estimates than in the study of Cirencester where only femoral and tibial lengths were used. In Table 14 the similarity in stature from Cirencester to the inhumed and cremated individuals of Stettfeld is striking. But the males from Valkenburg seem to be about 4-7 cm taller than those from the aforementioned groups. The difference for females is less obvious. Comparing the results from the tables after Manouvrier (1892), the males from Valkenburg are approximately 6-10 cm taller than those from the Italian samples, and approx. 4.5 cm taller than those from the German sample. Unfortunately, small sample sizes hinder interpretations of these analyses. Still, the data seem to confirm relative differences in standing height among European populations, as they still exist today (Falkner and Tanner, 1978). Thus, with respect to stature, we may conclude that the inhumed of the Valkenburg cemetery most probably were the deceased of the local native Romano-Dutch population.

When stature is viewed in diachronical perspective, it can be used as an indicator of the general health status of a population. In general, growth shifts in stature during the centuries are attributed to changes in socio-economic and hygienic conditions of populations (e.g. Maat, 1984). It seems acceptable to assume that the inhumed men at Valkenburg will not show major genetic differences with the present inhabitants of the Low Countries during the past few centuries. If so, then one may conclude with respect to an adult stature of 167.5 cm in 1865 AD (Oppers, 1966) and recently of 180.3 cm in 1980 (C.B.S., 1980), that the stature of males at Valkenburg of 175.9 cm points to reasonable health conditions during growth.

Shaft indices of femur and tibia

Platymeria, antero-posterior flattening of the proximal femur shaft, was seen in 85% of all males and in 100% of females. At the same time almost all tibias were eurycnemic ("normal"). Generally such long bone shapes are seen as a response during growth to the typical physical stress stemming from the habit of squatting (Brothwell, 1981; Martin and Saller, 1958), hard agricultural labour (Wells, 1964), or nutritional deficiencies (Brothwell, 1981). Additional evidence (Finnegan, 1978; Brothwell, 1981) suggestive of frequent squatting was detected in several non-metrical skeletal traits such as: a third femoral trochanter (26%), a crista- (18%) and fossa hypotrochanterica (21%), and so called tibial squatting facets (11%). The latter frequency was also found in the contemporary Poundbury burials (10%; Molleson, 1993).

Pathology:

In interpreting the observed pathology, discussed in the following sections, one should keep in mind the varying degree of preservation of the skeletal material. This was for instance illustrated by the considerable postmortem loss of teeth (ca. 21%).

Traumas

Examples of the many healed fractures were seen in 11 individuals (23%), i.e., nine males (45%), one female (25%), and one child (8%). The same overall rate was recorded in the Romano-British sample from Cirencester (21%; Wells, 1982). Here 55 males (27%), 6 females (7%), and 0 children (0%) were injured. A similar pattern of sex distribution, but considerably lower overall rate of 9%, was reported in the study from Poundbury (Thould and Thould, 1983; Molleson, 1993). Notwithstanding the more or less similar frequency of osteoarthritis of these three samples (which indicated equal strenuous life conditions) fewer physical hazards must have been responsible for the lower fracture rate at Poundbury. The coexistence in our collection of fractured vertebras, metacarpal bones, ribs, bones of the shoulder girdle and a fracture of the acetabulum may be interpreted as quite indicative of a hard physical lifestyle of our inhumed group. The fact that less females showed broken bones does not mean that it was only the men who suffered from these (labour?) conditions. In our collection only four females could be examined at all.

Most remarkable was the unusual absence of fractures of the lower extremities at Valkenburg. As is usually the case, the contrary was reported for the Romano-British samples. At Cirencester (Wells, 1982), the tibia was the bone most often fractured. There, the overall impression was that of "a violent group which led vigorous, energetic lives and sustained many accidents". At Poundbury (Thould and Thould, 1983; Molleson, 1993), the fibula was the main affected bone from a sample, which said to be consisting of "skilled farmers and artisans who led a physically hard life." The latter was also concluded by Wells (1964) who explained the high rate of fractured leg bones among Anglo-Saxons as a result of their livelihood as agriculturists. With respect to the quoted conclusions, the fracture pattern of Valkenburg is more indicative of non-agricultural activities. They strained especially their upper body half e.g. by carrying heavy loads. At the site such labour activities must have been widespread, since large granaries and several landing stages along the tributaries of the river Rhine were exposed during the excavations at Valkenburg (Bult and Hallewas, 1990).

Also at Valkenburg, a number of fractures were found in vertebras, i.e., a lumbar spondylolysis in a male and lumbar compression fractures in two other males. All were aged 20-30 years. Although spondylolysis (interarticular separation of the vertebral arch) is still often described as a congenital anomaly (Ubelaker, 1978), it is nowadays generally accepted to be a fracture from chronic stress (Merbs, 1989). But, an acute trauma can be the cause as well. Both causes were most probably involved in the one male who had a recent internal fracture of a healed bilaterally separated arch. The presence of his spina bifida occulta of the sacrum is considered to be unrelated to the cause of his spondylolysis.

A 42 year old male with healed rib fractures, also showed a posterior fracture on the rim of his right acetabulum. The slight bone reaction of the latter was indicative of a recent fracture caused by a powerful force directed along the femoral shaft during (semi-) flexion of the hip joint (Adams, 1987).

In addition to fractures, other signs of trauma were seen in five individuals (11%). Evidence of trauma affecting the cranium was found in an old male with a healed blunt trauma of the left parietal and frontal bone in addition to two fractured metacarpals and severe osteoarthritis of his whole skeleton. With respect to the one case of "cranial perforation," the difference in diameter between the outer and inner table of the oval opening may be the result of a blow to the head at the time of death. But, it remains difficult to imagine that a real trauma had happened since no radiating fracture lines typical for a fracture of living bone tissue, nor toolmarks could be detected. Most likely we are dealing with a postmortem injury.

The upper extremities of two males showed unusual bone changes. One male had bone proliferation on the middle of the diaphysis of the right ulna. A perforating trauma leading to reactive bone formation is thought to be the cause, since a fracture of the forearm would have led to malalignment. The other male displayed a bony elevation on the olecranon of the right ulna. This was most probably the result of a post-traumatic ossification of the triceps insertion. A fracture of the olecranon is very unlikely, because the trochlea was intact. The atrophy of the proximal shaft of the second metatarsal bone of another adult could stem from a fractured neighboring metatarsal which was missing.

Osteoarthritis (vOA and pOA)

Degenerative (osteoarthritic) changes in the synovial joints, have been recorded as osteophytosis, pitting and eburnation. The latter being the final stage of the process. Osteoarthritis itself is an idiopathic systemic disorder which affects synovial joints in general if one is prone to this condition from birth (Maat et al., 1995). Furthermore, it is generally acknowledged that joint wear and tear by mechanical strain is an additional etiological component in the development of this disease. All of our cases of arthritis at synovial joints were diagnosed as true osteoarthritis (Cockburn et al., 1979; Rogers et al., 1985). No rheumatoid, nor suppurative arthritides were found. The prevalence at Valkenburg if compared to contemporary groups from Cirencester (Wells, 1982) and from Poundbury (Thould and Thould, 1983), was 50, 45 and 66 % respectively. These are interpreted as being more or less similar. In Valkenburg, like in Cirencester and Poundbury, it is tempting to explain the onset of vertebral osteoarthritis at young ages as a result of joint degeneration from a tough physical lifestyle.

Noticeably, osteoarthritis was the frequent condition of the upper extremities in all communities from the Roman Period. The observed changes on the first metacarpophalangeal joint in three individuals supports this hypothesis; that peripheral osteoarthritis (pOA) of hand and wrist joints may result from the repetitive and heavy strain of "professional" use (Jurmain, 1977). The same relationship holds with respect to the osteoarthritic changes visible at the acromio-clavicular, sterno-clavicular, shoulder, and elbow joints of several individuals. Even the osteoarthritic changes of several costo-vertebral joints in two males could be interpreted as markers of occupational stress (Kennedy, 1989). The eburnation of the scaphoid bone and of the radius of the right arm of a 37-46 year old male is most likely due to secondary peripheral osteoarthritis after fracturing of two right metacarpal bones. Additional proof for the habit of squatting, previously discussed, was possibly found as eburnation of the left lateral femoral condyle and opposing patella, and as pitting of the right knee joint in an old male (Steinbock, 1976). Ortner and Putschar (1985) however, ascribed the involvement of the patella as part of the usual pattern of osteoarthritis of the knee.

Vertebral osteophytosis (VO)

The changes at the non-synovial articulations, mainly at the discs between successive vertebral corpora, have been recorded as vertebral osteophytosis (VO) with Schmorl's nodes and osteophytes (Steinbock, 1976; Ortner and Putschar, 1985). Recent data have revealed that nowadays vertebral osteophytosis starts around the thirtieth year of life (Ortner and Putschar, 1985). In communities from the Roman Period (Wells, 1982; Thould and Thould, 1983), as in our study, the disease already started at aroud the age of 20. This is at least 10 years earlier, and must be viewed as another indicator of hard physical life conditions at Valkenburg. The anatomical site of affliction is similar in ancient and recent cases. An alternative explanation for the observed non-physiological pitting of the symphyses of the pubic bones of an old female could be a parturition scar (Putschar, 1976).

One male, aged 60-70 years, was discussed previously in more detail because of his severe osteoarthritic changes, i.e., the eburnation of several vertebral and peripheral synovial joints in addition to his severe non-synovial changes, i.e., "parrot-beak" formed osteophytes at several spinal levels, unilaterally fused osteophytes at lumbar levels, together with an unilateral ossification of the ilio-lumbar ligament. Both the osteoarthritis and the vertebral osteophytosis must have seriously limited his mobility. However, the diverse morphology and distribution of the pathology can only be explained in part by degenerative changes. The possibility of a concomitant presence of DISH (Diffuse Idiopathic Skeletal Hyperostosis) has to be considered as well. This rather common idiopathic disorder comes with age, and is marked by the progressive ossification of connective tissue structures such as ligaments, joint capsules, muscle insertions and cartilage (Maat et al., 1995). This particular case is discussed in a separate paper (Lonnée and Maat, 1995).

Other pathological changes:

Deficiency diseases

According to Stuart-Macadam (1985) in a study on the Romano-British Poundbury Camp, the presence of cribra orbitalia (pitting of the anterior part of the orbital roof) is considered to be the result of chronic anemia during childhood. As in that study, the occurrence within our population was equally distributed among males, females and children. In Valkenburg, cribra orbitalia was found in 45% of the examinable skulls. The related porotic hyperostosis of the vault was not seen. It is not known to what extent its absence reflects less severity of the anaemia. The high overall incidence could be the result of a chronic dietary iron deficiency. Other explanations, such as widespread chronic infections (parasites!) or hereditary hemoglobinopathies, seem less likely. For comparison, in contemporary Poundbury the frequency was also rather high (ca. 30%; Molleson, 1993).

Periosteal bone appositions were seen on the long bones of the lower extremities of seven adults and one child. Only one male with porotic bony appositions on one of his tibias may have been victim of a periosteal (super-) infection. The absence of lytic changes and fistulas in the other individuals excluded such a diagnosis. Since the underlying periosteal surface was intact, the lesions are interpreted as ossifications of subperiosteal haematomas. In the literature various explanations for these non-specific changes have been given, e.g., tight worn shoe-wear, professional traumas (Wells, 1964), and horseback riding (Wahl and Kokabi, 1988). But the anatomical location of the appositions did not correspond with such causes. Systemic disorders which can lead to bone appositions are few (Robbins et al., 1984; Steinbock, 1976; Ortner and Putschar, 1985). Because of the absence of any conditions for hypervitaminosis A and fluorosis, the possibility of scurvy is the only remaining explanation. Scurvy develops from a lack of dietary vitamin C. It leads to bone fragility and to haematomas after minor traumas (Ortner and Putschar, 1985). In Valkenburg, the symmetry of the tibial lesions in at least three of the seven individuals, and the additional changes of the femoral bone in two males, and of the knee joint in one male, correspond to the features of healed scurvy as described by Maat (1982). Since only features of healed scurvy were detected, we suppose that most people recovered from this deficiency disease during this period. Since vitamin C is only found in fresh fruit and vegetables, it could very well be that shortages at the end of the winter period almost yearly led to sublethal suffering of the local community. A similar situation was still common in The Low Countries in later ages (Maat, 1982). The prevalence of acute scurvy is unknown, since a number of bleedings are resorbed without leaving traces.

Tumors

In contrast to three males who had osteomas on the vault and mandible, one male had an osteoma in an unusual location (in his left frontal sinus). During life this benign button-formed tumor could have easily caused chronic sinusitis. Another male had an erosion of the frontal process of his left maxillary bone, which was most probably due to a slowly proliferating malignant tumor.

The absence of bony reaction, and the presence of intact trabeculae surrounding the defect suggest that an inflammation or a postmortem lesion is less likely as a cause. The site of affection and the age of the male (63-72 years) greatly supported a diagnosis of a skin malignancy called ulcus rodens (basalioma).

Osteochondritis dissecans

The "punched out" lesions on the distal articular surface of both tibias in a male with features of healed scurvy, must have resulted from osteochondritis dissecans. This disorder, which seems to have some genetic predisposition, causes spots of ischemic necrosis on articular surfaces. From trauma the local subchondral bone becomes detached, and may become a loose body within the joint cavity. Young males are in particular more frequently affected (Zimmerman and Kelley, 1982). Wells (1974) ascribed the high percentage of tibia plateau involvement among Romano-British groups to the strenuous life conditions of agriculturalists. Indeed, tough physical activities could have contributed to the development of these cartilage lesions.

Occupational changes (see also above, the paragraph on "Shaft indices of femur and tibia")

The bilateral antero-posterior flattening of the clavicles found in three individuals was described before as an anatomical variety (Martin and Saller, 1958). However, when the ridged aspect of the cortex and the lesser degree of deformation in the younger individual are considered, a change due to external pressure seems more plausible, including occupational deformation caused by the bearing of a yoke or armour. Another occupational change of the clavicula, recently discussed by Merbs (1990), was the observed unilateral coraco-clavicular articular faceting in a male. It is attributed to habitual shoulder elevation.

Enthesopathies

Solitary ossifications of muscle insertions, fascias, ligaments and tendons are not an unusual response to muscular hyperactivity, e.g. due to occupational stress (Dutour, 1986; Kennedy, 1989; Ortner and Putschar, 1985; Rogers and Waldron, 1989). Examples were found in four males and one female.

In Valkenburg, as in the large sample studied by MacLaughlin (1990), manubrio-costal fusion was only seen in individuals over 65 years of age.

Anomalies

The distribution of anomalies and non-metrical skeletal traits within a community has previously been used to confirm hypothetical genetic relationships between different populations (Berry, 1974; Finnegan, 1978). Our small sample makes such a statistical approach impossible. Moreover, it is not known to what extent our high percentages of metopism (Brothwell, 1981) and spina bifida of the atlas (Moore, 1982) can corroborate local interbreeding. Table 15 is presented to compare samples from Cirencester (Wells, 1982), Stettfeld (Wahl and Kokabi, 1988) and Poundbury (Molleson, 1993) which are contemporary to the Valkenburg inhumed.

Dental pathology

In this section, results of dental analysis of Valkenburg will be compared to samples from the same period from Cirencester and Poundbury (Wells, 1982; Molleson, 1993). In our study, only two adults (13%) showed an intact dentition at time of death. Congenital absence of the third molar, hypodontia, was seen in 33% of the individuals at Valkenburg. Such a frequency seems somewhat too high. It could indicate group isolation (Brothwell et al., 1963; Brothwell, 1981). Because of the vulnerability of diseased teeth to postmortem loss, and because of the inclusion of subadults in dental scoring, the actual percentages of postmortem and antemortem tooth loss, and of carious elements will be only slightly different for adults (Table 16).

The overall rate of caries at Valkenburg and Cirencester corresponded reasonably well with that of the Romano-British Period (9.3%; Moore and Corbett, 1973). That rate stayed low until the Medieval Period. In this context however, the Valkenburg percentage (6.5%) seems to be on the low side when compared to contemporary Poundbury (15.8%; Molleson, 1993). Maybe this was the result of a less refined, less romanized diet containing fewer easy fermentable carbohydrates.

Molar attrition was similar to that found in Poundbury (Molleson, 1993). Because of the so-called caries-attrition competition, the site of most carious lesions was in agreement with the high attrition rate of both groups (Maat and Van der Velde, 1987). As in our case, Wells (1982) and Molleson (1993) noticed that caries predominantly attacked the neck of the molars (Table 16). This is due to the cleansing effect of relatively course foodstuffs, such as ground cereal grains, which hinders the development of occlusal caries even when the vulnerable dentine becomes exposed. Locally, coarse cereals must have been readily available, as multiple granaries were excavated at the site (Bult and Hallewas, 1990).

Like in Cirencester, periodontal disease was not frequently observed. It was mainly found in combination with carious teeth. Depositions of calculus, or mineralized dental plaque, were moderate. Why this tartar formation was exclusively positioned on the mandibular incisors is not known. Was it due to unknown mastication habits? Indicative for the latter was the atypical wear of the enamel of many of the incisors (Molnar, 1971 , 1972), and the observed "pressure chipping" of the cutting edges of the teeth. The occurrence of this phenomenon was discussed previously in relation to meat eating populations (Turner et al., 1969).

Enamel hypoplasia, detected in 43.3% of the examined individuals, is considered to be the result of health insults during dental development (Goodman et al., 1980). Multiple enamel lesions, reflecting repetitive periods of these health insults, were detected in 38% of the affected individuals. The fact that dental hypoplasia was seen 2.5 times more frequently in females, and that they also had possessed 3 times as many multiple lesions, corroborated the previously observed indications of less favorable growth conditions for females. The peak of development of enamel hypoplasia at around the age of 3 years, and the observed concurrence of over 50% of enamel hypoplasia and cribra orbitalia, indicated that children were more vulnerable during this early phase of childhood development. The period is marked as the end of the weaning period, and its occurrence might be attributed to the susceptibility to infectious diseases (Stuart-Macadam, 1989). The mentioned discoloration of teeth was most likely the effect of postmortem chemical reactions.

ACKNOWLEDGEMENTS

We wish to thank the team at the "Rijksdienst voor het Oudheidkundig Bodemonderzoek" (ROB) for their careful excavation and cleaning of the human skeletons. We would also like to acknowledge the Department of Anatomy at Leiden University. We especially want to thank W.J. Mulder for his advises and help in sectioning long bones, J.H. Lens for the photography, Dr. C.W. Spoor for the X-rays and F. L'Engle Williams for correcting the English manuscript.

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CATALOGUE:

Burial no.: I001, Find no.: 051.0182/051.0167/035.0054 Age: 42 yrs (internal suture 3, femur 3, symphysis 2). Sex: male (pelvis 0, skull 10 features). Preservation /completeness: robust skeleton. from the skull only occipital and part of parietal bone preserved. from upper extremities left proximal part absent. cervical vertebrae absent, other fragmented. Length: R ulna 27.7 cm. Pathology: bilateral osteophytosis first metacarpal bones. healed rib fractures L (Th8, 9 of 10) + osteophytosis costal articular process. osteophytosis of several foveas of the transversal process (2x). posterior fracture of the right acetabular rim with little bone reaction visible. slight osteophytosis of the femoral head. Anomalies: bathocephaly.

Burial no.: I005, Find no.: 051.0102 Age: 19-23 yrs (dental eruption, epiphysis elbow and wrist). Sex: male (pelvis 0, skull 9 features). Preservation/completeness: fragmented skeleton, covered with redbrown precipitation. Pathology: cribra orbitalia. bone apposition on shin R tibia. Anomalies: hypotrochanteric fossa and third trochanter. Teeth: eruption: max. M3-M3, mand. M3-M3. antemort.loss: 1 max.M1R .postmort.loss: 1 max. I1R. caries: 4 max. M2-,M3R, mand.M1-,M2L interproximally.
Attrition (oblique max. lingually, mand. buccally):
molars: 1 2+. 3-2 1
1 2 3 3-2+1
Other: atrophia max. M1R. abscess formation mand. M1L., slight calculus formation mand. ling., considerable max. bucc. C-P1. signs of periodontitis max. R Mand. Periosteal bone on mandible P1-M3. enamel hypoplasia: 9 months ± 3 months.

Burial no.: I008, Find no.: 051.0109 Age: 26-35 yrs (dental seriation). Sex: indeterminable (pelvis 0, skull 0 features). Preservation/ completeness: only parts of the mandible with some teeth preserved. Teeth: eruption: mand. M3-M3. antemort.loss: 0. postmort. loss: 6 mand.RI1,-I2, LI1,-I2,-C,-P1., (max. 16). caries: 1 mand. M3R.
Attrition:
molars: . . . .
2 2 3+ 3+2 2
Other: enamel hypoplasia 3 yrs ± 12 months.

Burial no.: I009, Find no.: 051.0116 Age: 23-40 yrs (internal suture). Sex: indeterminable (pelvis 0, skull 0 features). Preservation /completeness: only occipital part of parietal bone preserved.

Burial no.: I010, Find no.: 043.0260 Age: 52 yrs (internal suture 3, femur 3, symphysis 3). Sex: male (pelvis 6, skull 8 features). Preservation/completeness: fragmented spinal skeleton and ends of long bones. Length: R ulna 27.2/ R radius 24.1. Pathology: healed fractured R metacarpal bone 4. bilateral exostoses calcaneus. Anomalies: bathocephaly, cribra orbitalia (gracile skull bones), double mental foramen L. Teeth: eruption: max. M3-M3, mand. M3-M3. antemort.loss: 6 max.M2R, M1L, mand.M-1,-P2R+L. postmort.loss: 2 mand.I1R,-CL. caries: 7 advanced max. RM1, LP1,-P2,-M2, mand.RP1,-M2. interproximal mand.M3.
Attrition (oblique max.lingually, mand. lingually):
molars: 3-. . . . 3- incis./can.: 4 5 5 5 4 3
3-. . . 2+3- 3 4 4 4 3 .
Other: atrophia max.M1-,M2L and mand. M1R. fistulation mand. M3L. abscess

formation mand.P2L and max.P1,-M2L and M1R. enamel hypoplasia: 3 yrs ± 12 months.

Burial no.: I015, Find no.: 043.0256/043.0257 Age: 22-24 yrs (femur 1, clavicular epiphysis). Sex: male (pelvis 9, skull 14 features). Preservation /completeness: skeleton nearly intact, robust. Length: L humerus 34.3/ L radius 26.1/ R ulna 28.4. Pathology: pseudo-arthrosis of fractured acromion of left scapula with healed smooth fracture ends. spondylolyses L5; bilateral separation between superior and inferior facets with healed fracture ends, in addition to a fresh fracture of the left lamina of the vertebral arcus. spina bifida occulta: only S1 closed. Anomalies: hypotrochanteric crista and fossa, third trochanter, and squatting facet R tibia (L not examinable). Teeth: eruption: max. M3-M3, mand. M2-M3 (M3 R not developed). antemort.loss: 0. postmort.loss: 1 mand.RI2. caries: 0.
Attrition (oblique max. lingually, mand. buccally):
molars: 1 2 2+ 3-2 1 incis./can.:3 3 4 4 2 3
. 2 3- 3-2 1 3 . 4 4 4 2
Other: much calculus formation max. molars buccally, considerable amount of calculus mand. generalized lingually. "chipping" of max.: I1L, I1-,P2R, mand.P1R.

Burial no.: I019A, Find no.: 001.155A Age: 22-24 yrs (internal suture / symphysis /clavicular epiphyses). Sex: male (pelvis 10, skull 14 features). Preservation/completeness: well preserved, robust almost complete skeleton. Length: ulna L 29.9 / femur L 52.3 (phys.:51.6). Pathology: Cribra orbitalia R (L-side not examinable). Coraco-clavicular articular faceting R-side. Schmorl's nodes on cranial side of vertebral bodies Th6-12, also on caudal side of Th11-12. Pitting of superior articular process L2. L1 not examinable. Vertebral osteophytosis L4 (L) and L5 (R). Supracondylar periosteal bone apposition on both flexor- and extensor sides of L femur. The articular facets of the L femur condyles and L patella show irregularities without bone reaction. Distal ends of both tibias show periosteal bone reaction, predominantly on the medial side of the shaft. The articular sides of both malleoli show a defect (ca. 1 cm.), no fistulas, no bone reaction. Both fibulae show periosteal reaction at the distal end. R calcaneus with slight exostosis on insertion side of achilles tendon. Anomalies: bathocephaly, sutura metopica, Wormian bones, double mental foramen L in mandible, bilateral squatting facets. Teeth: eruption: max. M3-M3, mand. M2-M2. antemort.loss: 0. postmort.loss: 0. caries: 2 mand.M1 bilateral/interproximal.
Attrition (horizontal plane):
molars: 1 2 3- 3-2 1 incis./can.:2 2 3 3 2 2
. 2 3 3 2 . 2 2 3 3 2 2
Other: Signs of periodontitis mandibular M1 bilaterally, slight calculus formation mandibular incisors lingually.

Burial no.: I019B, Find no.: 001.155B Age: 23 yrs (internal suture / symphysis /humerus). Sex: female (pelvis 9, skull 15 features). Preservation/completeness: well preserved, gracile, nearly complete skeleton. Length: humerus L 31.4/ ulna L 25.3/ femur L 44.1 (phys. 43.5). Pathology: first metacarpal bone L with osteophytosis distally. Vertebral osteophytosis of the upper sides of Th12 and L1. Separate costal process L1 R; pseudo-arthrosis formation between dorsal side of costal process and corpus. Pitting of the articular facets of L2, L3. Periosteal bone reaction on distal part of shin of L tibia. Anomalies: Wormian bones, crista hypotrochanterica, third trochanter, squatting facets. Teeth: eruption: max. M3-M3, mand. M2-M2. antemort.loss: 1 M1R-mand. postmort.loss: 0. caries: 1 I1L-max. interproximally.

Attrition (oblique plane):
molars: 1 2 3- 3-2 1 inc./can.: 2 3 5 5 3 2
. 2+. 3 2+. 3 4 4 4 3 3
Other: considerable atrophia mandibular M1 R, signs of periodontitis mandibular M2, slight calculus formation mandible lingually, enamel hypoplasia: 9 yrs ± 24 months.

Burial no.: I022, Find no.: 001.0038 Age: 13-19 yrs (humero-ulnar epiphysis). Preservation/completeness: fairly well preserved, fragmented. Pathology: Antero-posterior flattening of the sternal part of the L clavicle, R clavicle absent. Teeth: eruption: max. M2-M2, mand. M2-M2 (M3 developed mand.). antemort.loss: 0. postmort.loss: 0. caries: 1 M1 max. R interproximally.
Attrition (oblique plane):
molars: . 2 . 2+2+. incis./can.: 1 2 3 3 2 1
. 2 3- 3-2 . 2 3 3 3 3 2
Other: slight calculus formation mand. incisors lingually, red-brown discoloration teeth, enamel hypoplasia: 18 ± 6 months / 3 yrs ± 12 months.

Burial no.: I023, Find no.: 001.0170 Age: 8 yrs ± 24 months (teeth). Preservation/completeness: lower extremities fragmented. Anomalies: fragile skull with cribra orbitalia. Teeth: eruption: according to age (M3-M3 developed). antemort.loss: 0. postmort.loss: 0. caries: 0.
Other: considerable calculus formation mandibular incisors lingually, red-brown discoloration molars, enamel hypoplasia: 3 yrs ± 12 months.

Burial no.: I025, Find no.: 006.0257/064.0080 Age: 15-20 yrs (proximal femoral epiphysis). Preservation/completeness: skull absent, only distal L humerus, and proximal parts of L ulna/radius and of both femoral bones preserved. Anomalies: robust femoral bones with crista hypotrochanterica, fossa hypotrochanterica and third trochanter.

Burial no.: I030, Find no.: 006.0223 Age: 30-60 yrs (humerus 2). Sex: male (pelvis 6, skull 2 features). Preservation/completeness: only mandible, no other skull bones present. postcranial skeleton fragmented, lower extremities absent. Length: ulna L 28.3/ hum. R 35.0/ radius R 26.0. Pathology: considerable bony outgrowth on the olecranon of the R ulna at the site of attachment of the triceps tendon, trochlear incisure intact, no limitation of the extension of the humero-ulnar joint. Vertebrae fragmented, some thoracic articular facets R with pitting Lumbar vertebral osteophytosis. Teeth: eruption: max. absent, mand.M2R,-M3L. antemort.loss: 1 mand. M2R. postmort.loss: 1 mand.M2L. caries: 1 mand.M3L interproximally.
Attrition (oblique mand. buccally):
molars: . . . . incis./can.: . . . .
. . 5 3+. . 4 5 6 6 5 3
Other: considerable formation of calculus mand. inc. lingually. atrophia M2R-mand..

Burial no.: I033, Find no.: 006.0246 Age: >22 yrs (epiphysis tarsus) Sex: indeterminable (pelvis 0, skull 0 features). Preservation/ completeness: only R tarsal bones and R fibula preserved.

Burial no.: I038, Find no.: 006.0255 Age: >23 yrs (proximal epiphysis tibia). Sex: indeterminable (pelvis 0, skull 0 features). Preservation/completeness: robust R tibia, other bones absent. Pathology: subperiosteal bone apposition on shin R tibia.

Burial no.: I039, Find no.: 006.0313 Age: 9 yrs ± 24 months (dental eruption). Preservation/completeness: skull nearly complete, long bones and hands and feet fragmented. Pathology: greater convexity of acromial end of R clavicle suspect for 'Greenstick'-fracture. Anomalies: Wormian bones. Teeth: eruption: conform age. antemort.loss: 0. postmort.loss: 0. caries: 1 carious deciduous molar. Other: dark-blue discoloration.

Burial no.: I040, Find no.: 006.0219 Age: 65-74 yrs (external suture). Sex: male (pelvis 0, skull 2 features). Preservation/completeness: of the skull only the vault preserved, postcranial skeleton covered with redbrown precipitation. pathology: R ulna with bone formation at the line of the interosseous membrane in the middle of the diafysis, no connection with radius. No discontinuities of both bones visible. Subperiosteal bone apposition on linea aspera of the R femur. L tibia with periosteal bone apposition medial side. R tibia and fibula covered with porous bone apposition, no fistulas visible. Anomalies: bathocephaly. Teeth: eruption: 18 teeth preserved with fragmented part of mand.: 5P, 7I, 4M, 2C. antemort.loss: 0. postmort.loss: 14. caries: 0.
Attrition (oblique max. lingually, mand. buccally):

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molars:      . . 4+ 4 . .      incis./can.:5 5 6  . . .
             . . 4+ 2+. .                  5 6 6  6 6 5
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Other: considerable calculus formation.

Burial no.: I042, Find no.: 006.0248 Age: 12 yrs ± 30 months (dental eruption). Preservation/completeness: postcranial skeleton fragmented, and covered with redbrown precipitation. Pathology: cribra orbitalia, fragile skull bones. Anomalies: supratrochlear foramen R. Teeth: eruption: max. M3-M3, mand. M3-M3; M3 not erupted. antemort.loss: 0. postmort.loss: 1 C-max. L. caries: 0
Attrition (oblique):

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molars:      . 2 3- 2+2 .incisors:   oblique plane of attrition
             . 2 3- 3-2 .
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Other: redbrown discoloration premolars/molars,"chipping" of I1L- max..

Burial no.: I048, Find no.: 006.0305 Age: >23 yrs (proximal epiphysis tibia). Sex: indeterminable (pelvis 0, skull 0 features). Preservation /completeness: robust L tibia, other bones absent.

Burial no.: I050, Find no.: 006.0181 Age: 37-46 yrs (internal suture/ symphysis). Sex: male (pelvis 7, skull 15 features). Preservation /completeness: skull well preserved, spinal skeleton fragmented, L lower extremities absent. Length: ulna L 28.2 / femur R 48.7 (phys. length: 48.1). Pathology: eburnation of articular surface of the R radius and R scaphoid. healed fractures of the R 3rd and R 5th metacarpal bone, and of two ribs (L dorsal). acromial end of L scapula absent, bony reaction suspect for fracture. pitting of C7-Th1 and Th1-6. pitting, vertebral osteophytosis of Th10-12 R, L1-L5 L. Anomalies: bathocephaly, atlas with persistent posterior medial cleft. Teeth: eruption: max. M3-M3, mand. M3-M3. antemort.loss: 0. postmort.loss: 0. caries: 2 Cmand.R + supernumerary element.
Attrition (oblique max. lingually, mand buccally):

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molars       2 3 5  5+3 2      incis./can.:4 5 5  5 5 4
             2 3+4  4+3+2                  4 5 5  5 5 4
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Other: Extra element R mand., between C and P1 and pushing aside P1 buccally, and with advanced caries of C and fistulation. Abscess formation R C mand. antemortal destruction of the enamel of max. R P1 and L I1, P2 and M2. atypical attrition between R I1 and I2 max., signs of periodontitis incisors max.. considerable calculus formation: max. incisors buccally, mand. incisors buccally / lingually.

Burial no.: I052, Find no.: 006.0237 Age: 19-28 yrs (internal suture, femur 1). Sex: male (pelvis 10, skull 15 features). Preservation/ completeness: nearly complete. Length: femur R 50.0 (phys. 49.4)/ femur L 50.5 (phys. 49.8)/ tibia R 38.2. Pathology: cribra orbitalia. pitting of 1 R superior vertebral articular facet, other not examinable. Vertebral bodies with Schmorl's nodes at the superior and inferior sides. Compression fractures L4, L5. Osteophytosis articular facet of L5. Anomalies: bregmatic bone and Wormian bones, squatting facet R, L-side not examinable. Teeth: eruption: max. M3-M3, mand. M3-M3. antemort.loss: 0. postmort.loss: 0. caries: 0.
Attrition (oblique max. lingually, mand. bucc.):

molars:	2 2 3- 3-2 2	incis./can.:	3 3 4 4 3 3
	2 2 3- 3-2 2		3 4 4 4 4 3

Other: diastema mand. C-P1R, tremata max. I1-I1. "chipping" of buccal side medial max. inc. and mand. I1 R. supernumerary element R max. between C and P1, not pushing aside any element. considerable calculus formation lingual/buccal max., much calculus mand. molars ling. apical abscess I2L-max. with fistulation C. Signs of periodontitis mand. molars and CR.

Burial no.: I053, Find no.: 006.0118 Age: 15-21 yrs (dental eruption). Preservation/completeness: skull fragmented, mandible and postcranial skeleton absent. Pathology: cribra orbitalia. Anomalies: sutura metopica, Wormian Bones. Teeth: eruption: max. M3-M3 not fully erupted, mandibula not examinable. antemort.loss: 0. postmort.loss: 16 mandibular, 2 maxillary (2x I1).
Other: considerable calculus formation maxilla R lingually / buccally, enamel hypoplasia 4 yrs ± 12 months.

Burial no.: I054, Find no.: 006.0259 Age: >23 yrs (distal epiphysis femur). Sex: indeterminable (pelvis 0, skull 0 features). Preservation/completeness: robust L femur.

Burial no.: I056, Find no.: 006.0177 Age: 11 yrs ± 30 months (dental eruption). Preservation/completeness: only postcranial L-side preserved, fragmented. Anomalies: cribra orbitalia. Teeth: eruption: according to age, M3 maxillary not developed. antemort.loss: 0. postmort.loss: 0. caries: 0.
Other: plane of attrition incisors oblique, "chipping" of the maxillary incisors.

Burial no.: I062, Find no.: 006.0334 Age: 30-60 yrs (internal suture). Sex: male (pelvis 0, skull 15 features). Preservation/completeness: skeleton fragmented, lower extremities absent. Pathology: pitting and osteophytosis of acromion of R acromio-clavicular joint. osteophytosis sternal articular facet of R clavicle, acromial end not examinable. exostoses R olecranon and L tuberositas radii. thoracic vertebrae with vertebral osteophytosis and Schmorl nodes, and two articular facets with osteophytosis and pitting. lumbar vertebrae with osteophytosis and pitting of articular facets. Anomalies: Wormian bones, supratrochlear foramen L. Teeth: eruption: max. M3-M3, mand. M3-M2 (M3 L not developed). antemort.loss: 3 max.RM2, LP2,-M2. (broken crowns max.P1-, -P2R, -M1L, mand.RP2, -LC,-P1). postmort.loss: 1 mand. RI1. caries: 3 max.RM1, mand.LP2,-M1: interproximally.
Attrition (horizontal):

molars:	2+. 5 . . .	incis./can.:	5 6 6 5 5 4
	2+3 4+ . . .		5 5 5 5 5 .

Other: atrophia max.RM2, fistula max.RM1. signs of periodontitis mandible LM2. generalized darkblue discoloration. enamel hypoplasia: 3 yrs ± 12 months.

Burial no.: I064, Find no.: 006.0192 Age: 22-24 yrs (dental seriation). Sex: male (pelvis 2, skull 4 features). Preservation/completeness: fragmented, of the skull bones only mandible present. Most vertebra and articular surfaces of the long bones not examinable. Pathology: two compression fractures of the three present lumbar vertebrae, also Schmorl's nodes. Teeth: eruption: maxilla ? mandibular M3-M3 present. antemort.loss: 0. postmort.loss: 14. maxillary, except M3, I2. caries: 0.
Attrition (oblique plane lingually):
molars: 2 . . . . . incis./can.: . . . . . .
2 2+3- 3 3-2 1 2 3 3 1 2
Other: considerable calculus formation lingually/buccally, especially L molars. signs of periodontitis, red-brown discoloration incisors, canine and premolars. "chipping" of the maxillary incisors.

Burial no.: I065, Find no.: 070.0008 Age: 30-60 yrs (internal suture). Sex: male (pelvis 0, skull 7 features). Preservation/completeness: skull without maxilla and mandible. postcranial skeleton absent. Pathology: massive skull bones. cribra orbitalia. oval perforation of the vault at bregma. postmortem lesion (diameter 3.2 cm.).

Burial no.: I066, Find no.: 006.0263 Age: 25-34 yrs (external suture). Sex: female (pelvis 4, skull 12 features). preservation/ completeness: skull nearly complete, long bones fragmented, as were the hands and feet. Pathology: osteoma temporal bone R. pitting of the articular facets C3, C4. vertebral osteophytosis of T11, L4. Anomalies: partial metopic suture (from coronal suture halfway). Atlas with persistent posterior median cleft. Teeth: eruption: max. M3-M3 (C R not erupted), mand. M3-M3. antemort.loss: 0. postmort.loss: 1 mand. RI1. caries: 3 max.LM2, M3-interprox.-mand. RM3-occl.
Attrition (oblique max. lingually, mand. buccally):
molars: 2 2+4 4 . 2 incis./can.: . 4 5 5 5 4
2 3 4 4+3-2 3 5 . 5 5 4
Other: non-erupted C, R in maxilla, visible in palatum. "chipping" of the medial incisors occl. max., and of longitudinal axis buccal P2L-max.+ mand. Considerable formation of calculus molars ling. L mand., fistula max.LM3., signs of periodontitis mand. ling.+bucc., max. bucc. L. enamel hypoplasia: 18 ± 6 months / 9 yrs ± 24 months.

Burial no.: I068, Find no.: 006.0337/ 059.0030(below) Age: 18-21 yrs (dental eruption/ spheno-occipital synchondrosis). Sex: male (pelvis, 0 skull 6 features). Preservation/completeness: fragmented skull with loose teeth. only right upper extremity present. Teeth:eruption: max. M3-M3, mand. M3-M3. antemort. loss: 0. postmort.loss: 1 mand. RI1. caries: 0.
Attrition (oblique max. lingually, mand. buccally):
molars: 1 2 3- 3-2 1 incis./can.: 2 2 3 3 2 2
2 2 3- 3-2+2 2 3 3 3 . 2
Other: slight calculus formation, enamel hypoplasia: 3 yrs ± 12 months

Burial no.: I068, Find no.: 059.0030 Age: >21 yrs (femoral epiphysis). Sex: indeterminable (pelvis 0, skull 0 features). Preservation/ completeness: only R pelvis with R lower extremity and left foot preserved. Pathology: second metatarsal bone of the right foot with atrophia distally and laterally of the proximal end.

Burial no.: I069, Find no.: 006.0167 Age: 55-64 yrs (external suture). Sex: male (pelvis 0, skull 8 features). Preservation/completeness: lower extremities incomplete, skull intact, robust skeleton. Length: ulna L 24.9 / radius L 22.6. Pathology: cribra orbitalia, massive skull bones. exostoses on both olecrani, as on both patellar bones. Schmorl's nodes thoracic/lumbar. Vertebral osteophytosis two thoracic vertebrae. Teeth: eruption: max. M3-M3, Mand. M2-M2. antemort. loss: 4 max.M1R,-P1R,-M1L, mand.M2L. postmort. loss: 1 max. M3R. caries: 3 max.P2L, mand.P2L,-M1L.interproximally.
Attrition (oblique max. lingually, mand. buccally):
molars: . 2 . . 1 1 incis./can.: 3 5 5 5 5 4
. 2 3- . . . 3 4 4 4 . 4
Other: considerable atrophia maxillary L/R M1, mandibular L M1 M2, slight calculus formation mand. incisors buccally, abscess formation max. R P2, mand. L M1. dark-blue discoloration teeth, signs of periodontitis incisors.

Burial no.: I072, Find no.: 059.0242 Age: 26.50 yrs (internal suture 1, symphysis 2, femur and humerus 1). Sex: male (pelvis 10, skull 15 features). Preservation/completeness: well preserved, robust skeleton. Length: humerus L 32.3, R 32.5/ ulna R 27.7/ rad. R 25.3. Pathology: cribra orbitalia. antero-posterior flattening of the sternal part of the clavicles with grooving of the sternal cortex. Pitting of the right art. facets of T11. Anomalies: bathocephaly, Wormian bones, hypotrochanteric fossa, third trochanter, and double mental foramen R. Teeth: eruption: max. M3-M3, mand. M3-M3. antemort.loss: 0. postmort.loss: 0. caries: 1 mand.RI1 ling.
Attrition (oblique max. ling. concave, mand. ling. convex):
molars: 1 2 3- 3-2 1 incis./can.: 3 2 4 4 2 2
2 2+3 3 2 2 3 3 4 4 4 6
Other: L mand. C is located buccally, and severely worn off, without severe attrition of other elements. considerable calculus formation of all teeth, especially mand. inc. lingual. fistulation L I2 mand. "chipping" of the max.I1L I1R,CR, mand.I1R,-I2R. enamel hypoplasia: 3 yrs ± 12 months/12 yrs ± 30 months.

Burial no.: I076, Find no.: 059.0031 Age: 50-59 yrs (external suture). Sex: male (pelvis 3, skull 15 features). Preservation / completeness: gracile skeleton fairly well preserved, spinal skeleton fragmented. Pathology: osteophytosis and pitting of the right temporomandibular joint. sinusitis max. R. mandibular osteomas: P1 R, and L lingual. healed fracture of left clavicle with deformation: lateral part fixed below and medially of the sternal part. vertebral osteophytosis (2x) and osteophytosis and pitting of art. facets of two loose vertebral arches of cervical vertebrae. Anomalies: fossa and crista hypotrochanterica, third trochanter. Teeth: eruption: max. M3-M3, mand. M3-M3. antemort.loss: 0. postmort.loss: 0. caries: 0.
Attrition (oblique max. ling., mand. bucc.):
molars: 2 2+4+ 3+2+2 incis./can.: 4 3 4 3 3 3
2+3-3+ 3+3-2+ 4 4 4 4 4 3
Other: microdontia M3 max. R. much calculus on molars; mand. lingual and max. buccal, signs of periodontitis. fistulation M1 R (buccal) and M2R (sinus). "chipping" of the max.I1L,-I1R,-CR, mand.I1R,-CR.

Burial no.: I086, Find no.: 014.0189/014.0213 Age: 63-72 yrs (internal suture, symphysis). Sex: male (pelvis 8, skull 15 features). Preservation/completeness: skull and postcranial skeleton in reasonable state of preservation. L foot, fibula and tibia absent. Length: radius R 23.8. Pathology: robust skull with signs of healed blunt trauma L frontal and parietal bones. frontal process of L maxillary bone with erosion (3x8 mm.) without bone reaction visible. pitting R temporomandibular joint (mandibular fossa), condylar process not examinable. antero-posterior flattening of the sternal part of both clavicles, with groove formation of the ventral cortex. eburnation head L humerus and osteophytosis of L humerus-condyle. bilateral osteophytosis olecranon. osteophytosis L radial

caput. osteophytosis R I metacarpophalangeal joint (MCP). osteophytosis and eburnation of three medial and two distal phalangeal bones (DIP). Fracture L metacarpal bones 3,4 (other not examinable) and osteoarthritis distal phalanges (2x). eburnation atlanto-dental joint. C5: eburnation L art.fac. inf, C6-C7: R vertebral "kissing osteophytes", Th3-4: R eburnation/ pitting/ osteophytosis, Th5-6: bilateral eburnation + pitting, Th.7: osteophytosis R fovea costalis, Th9-10: R vertebral osteophytosis ("kissing osteophytes") + bilateral eburnation/pitting, Th10-11: eburnation/pitting, Th11-12: ankylosis art. fac., Th11: bilateral osteophytosis fov. cost., Th12-L1: bilateral vertebral osteophytosis, L1-2:spondylo-ankylosing/pitting. L3: R vertebral osteophytosis cran./caud., L4: R vertebral osteophytosis cran., L5:vertebral osteophytosis cran.R/ caud.L, S1: L vertebral osteophytosis. ossification of the first R costo-manubrial joint. ossification R ilio-lumbar joint, auricular surface no pathology. pitting L acetabulum. eburnation lateral facets of distal L femur and of L patellar bone. exostosis R patellar bone. Teeth: eruption: max. M3-M3, mand. M3-M3. antemort.loss: 4 max.LM2, mand.RM1,-M2, LM1. postmort.loss: 3 max.RM1,-P2, mand.LI1. caries: 4 max. RM2,-C,-I2,-P2 interprox..
Attrition (horizontal):
molars: . 5+. . . . incis./can.: 7 8 8 . . .
5 . . . 5++5++ 7 7 7 . 7 7
Other: fistula max.RP1, abscess mand.RM3, LM1. atrophia located at the site of antemortal lost elements.

Burial no.: I087, Find no.: 059.0280 Age: 40-80 yrs (external suture). Sex: female (pelvis 0, skull 7 features). Preservation/ completeness: skull without maxilla, mandible without alveolar bone and with several teeth. postcranial skeleton gracile and fragmented. Pathology: massive skull bones. cribra orbitalia. exostosis R tuberositas radii. osteophytosis L glenoidal fossa. eburnation atlanto-dental joint. pitting and osteophytosis of L articular facets of C2 and C3,4,5. eburnation and severe pitting of lower cervical articular facets. non-physiological pitting of fragmented symphyseal faces of the pubic bones. pitting of medial articular surface of both patellar bones and pitting of the left femur condyle (right absent). Teeth: eruption: indeterminable. present elements: 1 molar: attrition 3+, 3 premolars, 2 canine, 4 incisors. antemort.loss: 0. postmort.loss: 22. caries: 3 P1,P2,C interproximal
Attrition:
inc./can.: . . . . . .
4 6 5 5 5 4
Other: atypical attrition of the incisors; plane of attrition oblique lingual orientated with grooving in longitudinal axis. considerable amount of calculus on the buccal and lingual sides of the premolars.

Burial no.: I090, Find no.: 014.0192 Age: >19 yrs (epiphysis humerus / ulna). Sex: indeterminable (pelvis 0, skull 0 features). Preservation/completeness: only R humeral diafysis, and proximal 3/4 of R radius, ulna present.

Burial no.: I095, Find no.: 059.0283 Age: 12 yrs ± 30 months (dental eruption). Preservation/completeness: well preserved, nearly complete skeleton. Pathology: cribra orbitalia. periosteal reaction and brown discoloration, around nutricial foramen of the left fibula and its neighboring side of the tibia. Teeth: eruption: conform age. antemort.loss: 0. postmort.loss: 0. caries: 0.
Attrition (oblique max. lingual., mand. bucc.):
molars: . 2 3- 3-2 .
. 2 3- 3-2 .
Other: "chipping" of I1L,I1R,I2R buccal. enamel hypoplasia: 3 yrs ± 12 months/6 yrs± 24 months.

Burial no.: I105, Find no.: 071.0074 Age: 6 yrs ± 24 months (dental eruption). Preservation/completeness: fragmented. Anomalies: Wormian bones. Teeth: conform age.

Burial no.: I112, Find no.: 014.0248 Age: 30-60 yrs (internal suture). Sex: male (pelvis 2, skull 6 features). Preservation/completeness: badly preserved, parts of the vault with redbrown precipitation. Pathology: exostoses bilaterally at the olecranon of the ulnae. spinal skeleton not examinable. periosteal bone appositions on both tibias, mainly on the shin. Anomalies: bathocephaly, Wormian bones, supratrochlear for. R. Teeth: eruption: max. absent, mand. M3-M3. antemort.loss: 5 mand.RM1,-M2.-P1, LM1,-M2. postmort.loss: 16 max., 10 mand. RI1,-I2,-C,-P2,-M3, LI1,-I2,-P1,-P2,-M3. caries: 0.
Other: atrophia mandibular molars.

Burial no.: I113, Find no.: 071.0026 Age: 15 yrs ± 36 months (dental eruption, epiphyses). Preservation/completeness: badly preserved. right upper extremity absent, axial skeleton fragmented. Teeth: eruption: only available part of mandible shows P1 M1 M2 and not fully developed M3.

Burial no.: I126, Find no.: 071.0078 Age: 15 yrs 45± 36 months (dental eruption). Preservation/completeness: badly preserved, skeleton covered with redbrown precipitation. Pathology: bone reaction in R maxillary sinus, suspect of sinusitis. Anomalies: Wormian bones. Teeth: eruption: conform age. antemort.loss: 0. postmort.loss: 0. caries: 2 max.M1R, mand.M1R interproximally.
Attrition (oblique max. ling., mand. bucc.):
molars: . 2 . 2+2 . incis./can.: 2 2 3 3 2 2
. 2 . 2+2 . 2 3 3 3 3 2
Other: "chipping" of the max. I1L. atrophia molars mand.R. abscess formation max.M1R lingual, and signs of periodontitis max. molars.

Burial no.: I129, Find no.: 071.0071/025.0175 Age: 35-44 yrs (external suture). Sex: male (pelvis 2, skull 10 features). Preservation/completeness: fairly well preserved robust skeleton with fragmented joints and spinal skeleton. Pathology: osteoma in left frontal sinus, perforating the outer table of the frontal bone. several fresh ventral rib fractures with little bone reaction. Anomalies: bathocephaly, metopic suture, Wormian bones. extra elements in saggital suture, crista and fossa hypotrochanterica, third trochanter. Teeth: eruption: max. M3-M3, mand. M3-M3. antemort. loss: 2 mand.M1,-M2R. postmort.loss: 12 max. 4xM,2xP,2xC,4xI, 3 mand.RC,-P1,-P2. caries: 0 mand.
Attrition:
molars: . . . . . . incis./can.: . . . . . .
2+. . 3 5++5 . 6 6 6 . .
Other: "chipping" of mand. I2L. slight calculus formation, extreme atypical attrition molars L. signs of periodontitis molars.

Burial no.: I135, Find no.: 073.0058 Age: > 20 yrs (proximal femoral epiphysis). Sex: indeterminable (pelvis 0, skull 0 features). Preservation/completeness: proximal half of L robust femur preserved. Anomalies: third trochanter.

Burial no.: I137, Find no.: 025.0182 Age: <13-16 yrs (acetabular epiphyses).

Preservation/ completeness: only parts of an ulna, carpal bones and parts of the spinal skeleton preserved. Belonging to 025-156 (096)?

Burial no.: I139, Find no.: 073.0047 Age: > 19 yrs (proximal ulnar epiphysis). Sex: indeterminable (pelvis 0, skull 0 features). Preservation/completeness: only parts of L ulna, L radius, L femur and L patellar bone preserved.

Burial no.: I140, Find no.: 025.0156 Age: <13-16 yrs (acetabular epiphyses). Preservation/completeness: only fragmented parts of R humerus, pelvis, both femoral bones, one patellar bone, and part of the spinal skeleton present.

Burial no.: I141, Find no.: 055.0160 Age: 21-23 yrs (epiphysis iliac crest, clavicle, femur 1). Sex: female (pelvis 7, skull 15 features). Preservation/completeness: well preserved, gracile skeleton, spinal skeleton fragmented. Length: femur R 39.8 (phys.39.1)/ tibia R 33.8. Pathology: cribra orbitalia, subperiosteal bone reaction lateral part of R fibula. Anomalies: bathocephaly, Wormian bones, supratrochlear foramen R, third trochanter. Teeth: eruption: max. M3-M3, mand. M2-M2. antemort. loss: 2 max.M1R, mand.M1L. postmort.loss: 2 max.M3R,-M3L. caries: 6 max.P2R,-M1L,-M2L, mand.P2,-M1.-M2 interproximally.

Attrition (oblique max. ling., mand. bucc.):
molars: . 2 . 2 2+. incis./can.: 4 4 4 4 4 4
. 2 2+ . 2+. 3 . 4 3 3 3

Other: fistulation mand.P2R, max.M2L. abscess formation max.M1R,-M1L,-M2L, mand.M1R. signs of sinusitis max. L. signs of periodontitis max. molars L and mand. R. slight calculus formation mand. inc. buccal. dark-blue discoloration premolars/molars. enamel hypoplasia: 3 yrs ± 12 months / 12 yrs ± 30 months.

Burial no.: I142, Find no.: 029.0115 Age: 23-40 yrs (internal suture). Sex: male (pelvis 0, skull 10 features). Preservation/completeness: only vault preserved. Pathology: oval perforation in the right parietal bone, in the corner formed by the coronal and saggital suture (30x44 mm.). smooth edges, intact diplöe, no toolmarks or signs of bone reaction visible. diameter of the internal aperture larger than the outer.

Table 1. SEX AND AGE AT DEATH DETERMINATION.

Bur. Nr.	Skeletal age (years)[1]	Interval (years)
105	6 ± 24 months	5-10
023	8 ± 24 months	5-10
039	9 ± 24 months	5-10
056	11 ± 30 months	10-20
042	12 ± 30 months	10-20
095	12 ± 30 months	10-20
140	<13-16	10-20
137	<13-16	10-20
113	15 ± 36 months	10-20
126	15 ± 36 months	10-20
022	13-19	10-20
025	15-20	10-20
053	15-21	10-20
033[2]	>22	
046[2]	>23	
038[2]	>23	
054[2]	>23	
090[2]	>19	
009[2]	23-40	
008[2]	26-35	
37[2]	>21	
135[2]	>20	
139[2]	>19	

Bur. Nr.	Sex[1]	PF[3]	SF[4]	Skeletal age (yr)	Interval (years)
19A	male	10	14	22-24	20-30
064	male	2	4	22-24	20-30
068	male	0	6	18-21	20-30
015	male	9	14	22-24	20-30
005	male	0	9	19-23	20-30
052	male	10	15	19-28	20-30
072	male	10	15	26.50	20-30
142	male	0	10	23-40	30-40
050	male	7	15	37-46	40-50
030	male	6	2	30-60	40-50
062	male	0	15	30-60	40-50
001	male	10	0	42	40-50
129	male	2	10	35-44	40-50
112	male	2	6	30-60	40-50
010	male	6	8	52	40-60
076	male	3	15	50-59	50-60
065	male	0	7	30-60	50-60
069	male	0	8	55-64	60-70
086	male	8	15	63-72	60-70
040	male	0	2	65-74	60-70
141	female	7	15	21-23	20-30
19B	female	9	15	23	20-30
066	female	4	12	25-34	30-40
087	female	0	7	40-80	50-60

ad.1: after WEA (1980).
ad.2: adults of unknown sex.
ad.3: number of examined sex features of the pelvis.
ad.4: number of examined sex features of the skull.

Table 2. STATURE ASSESSMENTS (cm).

Males:			Females:		
Bur. Nr.	Trotter and Gleser (1958)[1]	Manouvrier (1892)[2]	Bur. Nr.	Trotter and Gleser (1952)[1]	Manouvrier (1892)[2]
019	186.9 (fe)	185.7 (fe)	19B	163.0 (fe)	161.9 (fe+hu+ul)
069	165.1 (ra)	163.0 (ul+ra)	141	155.5 (fe+ti)	154.1 (fe+ti)
050	178.5 (fe)	174.9 (fe+ul)			
052	177.3 (fe+ti)	174.4 (fe+ti)			
030	178.1 (hu+ra)	175.7 (hu+ra+ul)			
086	167.5 (ra)	165.4 (ra)			
015	178.1 (hu+ra)	176.1 (hu+ra+ul)			
010	169.4 (ra)	169.1 (ul+ra)			
001	179.0 (ul)	175.4 (ul)			
072	173.2 (hu+ra)	169.8 (hu+ra+ul)			
Mean[3]	175.9	172.4		159.3	158.5

( ): longbone (femur/tibia/humerus/radius/ulna)
1 : living stature
2 : cadaver length
3 : without correction for age

Table 3. SHAFT-INDICES OF THE FEMUR AND TIBIA OF 12 MALES AND 2 FEMALES.

MERIC INDEX (femur)

Means:					Distribution:		
Sex	Left(L)	Right(R)	L+R	Range	Hyperpl.	Platym.	Eumeric
Male	73.1(6)	78.1(7)	75.1(13)	50.0-100.0	46.2%(6)	38.5%(5)	15.4%(2)
Female	81.2(2)	76.6(2)	78.9 (4)	75.8- 81.8	0.0 %(0)	100.%(4)	0.0 %(0)

CNEMIC INDEX (tibia)

Means:					Distribution:			
Sex	Left(L)	Right(R)	L+R	Range	Hyperc.	Platyc.	Mesocn.	Eurycn.
male	73.4(7)	72.2(8)	72.8(15)	52.4-85.7	6.7%(1)	0.0%(0)	26.7%(4)	66.6%(10)
female	74.9(2)	77.1(2)	76.0 (4)	72.4-77.4	0.0%(0)	0.0%(0)	0.0 %(0)	100 % (4)

Hypermeric = <74.9   Platymeric = 75-84.9   Eurymeric = >85   Eurycnemic= >70
Hypercnemic= <54.9   Platycnemic= 55-62.9   Mesocnemic= 63-69.9   ( )= sample size

Table 4. FRACTURES OF 47 INDIVIDUALS.

Bone:	Number of individuals affected	Number of fractures
vertebra	4	7
clavicle	2[1]	2
costa	3	5
acromion	2	2
acetabulum	1	1
metacarpal	3	5

1: included is one child

Table 5. DISTRIBUTION OF CHANGES FROM VERTEBRAL OSTEOARTHRITIS (vOA) IN 11 ADULTS.

Change:	Facets	Number of individuals affected
Pitting:	cervical	4
	thoracic	6
	lumbar	2
Osteophytes:	cervical	2
	thoracic	1
	lumbar	1
Eburnation:	cervical	2
	thoracic	1
	lumbar	0

Table 6. DISTRIBUTION OF PERIPHERAL OSTEOARTHRITIS OF 7 ADULTS

Joint:	Number of joints affected	Number of individuals affected
temporomandibular	2	2
costo-vertebral	3	3
acromio-clavicular	1	1
sterno-clavicular	1	1
humero-scapular	1	1
elbow	2	1
wrist	1	1
metacarpo-phalangeal I	4	3
distal interphalangeal	3	1
pubic symphysis	1	1
hip	2	2
knee	4	2

Table 7. DISTRIBUTION OF CHANGES FROM VERTEBRAL OSTEOPHYTOSIS (VO) IN 10 ADULTS.

Change:	Body	Number of individuals affected
Osteophytes:	cervical	1
	thoracic	3
	lumbar	4
Schmorl's nodes:	cervical	0
	thoracic	3
	lumbar	2

Table 8. DISTRIBUTION OF NON-INFLAMATORY PERIOSTEAL APPOSITIONS ON THE LONG BONES OF 7 ADULTS.

Bone:	Number of bones recorded	Number of individuals affected
femur	2	2
tibia	9	6
fibula	2	2

Table 9. ENTHESOPATHIES.

Change:	Number of bones recorded	Number of individuals affected
olecranon spur	5	3
radial tuberosity	2	2
patellar tuft	2	
calcanear spur	3	2

Table 10. TOTAL COUNT OF TEETH.

Tooth:	Teeth developed	Not developed	Teeth not-erupted	Teeth erupted erupted	Ante-mortem loss	Post-mortem loss	Teeth observed
maxilla:							
I^1	60	-	-	60	-	18	42
I^2	60	-	-	60	-	14	46
C	60	-	1	59	-	16	43
P^1	60	-	2	58	1	12	45
P^2	60	-	-	60	1	15	44
M^1	60	-	-	60	5	12	43
M^2	60	-	-	60	4	13	43
M^3	54	6	6	48	2	19	27
mandibula:							
I^1	60	-	-	60	-	13	47
I^2	60	-	2	58	-	11	47
C	60	-	2	58	-	9	49
P^1	60	-	-	60	1	9	50
P^2	60	-	-	60	2	10	48
M^1	60	-	-	60	9	5	46
M^2	60	-	-	60	8	7	45
M^3	49	11	10	39	-	10	29
Supernum.:	2			2			2
Totals:	945	17	23	922	33	193	696

Table 11. CARIOUS TEETH.

Tooth:	Overall		Occlusal	Inter-proximal	Advanced	Absces/ fistula	Antemortem loss
	N	%#	N	N	N	N	N
maxilla:							
I^1	1	2	-	1	-	-	-
I^2	1	2	-	1	-	-	-
C	1	2	-	1	-	-	-
P^1	2	4	-	1	1	2	1
P^2	3	7	-	2	1	1	1
M^1	5	12	-	4	1	3	5
M^2	6	14	-	5	1	2	4
M^3	2	7	-	2	-	1	2
mandibula:							
I^1	1	2	-	1	-	-	-
I^2	0	0	-	-	-	1	-
C	1	2	-	1	-	1	-
P^1	2	4	-	1	1	-	1
P^2	5	10	-	5	-	1	2
M^1	7	15	-	7	-	3	9
M^2	3	7	-	2	1	-	8
M^3	5	17	2	3	-	1	-
Totals:	45	6.5%	2	37	6	16	33

ad #: percentage of the teeth inspected (N/number= 696).

Table 12. AVERAGE MOLAR ATTRITION (after Brothwell, 1981)

	Age interval (years)				
Molar:	12-17 (N=4)	17-25 (N=4)	25-35 (N=3)	35-45 (N=1)	45-55 (N=1)
M1:	2+/3-	2+/3	3-/3	4+/5+	3+/4+
M2:	2	2 /2+	2 /2+	3 /3+	2 /3-
M3:		1	1 /2	2	2 /2+

N= number of individuals

Table 13. DATING OF THE AGE OF FORMATION OF ENAMEL HYPOPLASIA (according to the diagrams of Ubelaker, 1978)

Age of formation:	9mon	18mon	3yrs	4yrs	6yrs	9yrs	12yrs
Number of individuals affected:	1	2	9	1	1	2	2

mon= months
yrs= years

Table 14. COMPARISON OF STATURES (cm).

Site:	Males (N), calculated according to: T&G('58)*	M(1892)⁰	Females (N), calculated according to: T&G('52)*	M(1892)⁰
Collelongo[1]	-	162.5(14)	-	154.0(10)
Barumini[1]	-	162.6 (4)	-	-
Potenzia[1]	-	164.2(36)	-	156.6(27)
Bagnacavallo[1]	-	166.4(29)	-	154.7(18)
Poundbury[2]	166.2(328)	-	160.9(357)	-
Cirencester[3]	169.1(107)	-	157.9 (44)	-
Stettfeld[4]:				
- inhumed	171.7 (15)	-	157.3 (4)	-
- cremated	171.0 (37)	168.0(37)	161.8 (39)	159.5(39)
Valkenburg (inhum.)	175.9 (10)	172.4(10)	159.3 (2)	158.5 (2)

*: living stature.
0: cadaver length.
N: number of individuals.
T7G: Trotter and Gleser
M: Manouvrier

1: Borgognini-Tarli and La Gioia (1977)
2: Molleson (1993)
3: Wells (1982)
4: Wahl and Kokabi (1988)

Table 15. DISTRIBUTION OF ANOMALIES.

Anomaly:	Valkenburg %	N	Cirencester %	N	Stettfeld %	N
metopism	14	(29)	8.2	(194)	23	(22)
Wormian bones:						
bregmatic	3	(29)	1.3	(150)	0	(22)
sagittal	3	(30)	7.6	(131)	5	(21)
lambdoid	40	(30)	62.3	(239)	67	(21)
bathocephaly	31	(29)	-[1]		142	(21)[2]
double mental foramen	10	(30)	4.4	(316)	15	(20)
spina bifida occulta:						
- sacrum	6	(17)	5[3]		0[3]	
- atlas	13	(16)	0[3]		1[3]	
supratrochlear foramen	11	(36)	4.5	(264)	35	(17)

ad N: number of examinable individuals
ad 1: not mentioned
ad 2: calculated by the authors
ad 3: the No. of affected individuals

Table 16. DENTAL STATUS OF THE TWO SAMPLES FROM THE ROMAN PERIOD

	Valkenburg(%)	Cirencester(%)
postmortem loss[1]	20.9	22.5
antemortem loss[1]	3.6	8.5
caries incidence[1]	6.5	4.7
- occlusal[2]	5.1	21.1
- neck[2]	94.9	78.9

ad 1: percentage of inspected teeth
ad 2: percentage of inspected carious teeth

LEGENDS:

Fig. 1: Age at death distribution.

Fig. 2: Lateral view of compression-fractures of the 4th and 5th lumbar vertebrae of a male, aged 20-30 years. The more severely deformed 5th lumbar vertebra shows besides flattening in the saggital plane, an increase in the diameter of the corpus and protrusion of the spongiosa at its inferior surface (arrow).

Fig. 3: Dorsal view of a flattened spondylolytic 5th lumbar vertebra of a male, aged 20-30 years, with bilateral interarticular separation of the vertebral arch (bilateral arrows). Note the smoothly healed fractured ends. Also visible is a recent fracture of the left lamina of the vertebral arch showing little bone reaction and pitting of the fracture ends (middle arrow).

Fig. 4: View on the left side of the vault of a male, aged 60-70 years. The frontal bone is directed to the right. On the left frontal and parietal bone are impressions of a healed blunt trauma (arrows).

Fig. 5: Cranial view on the right iliac crest of a male of 60-70 years with an ossified ilio-lumbar ligament (arrow).

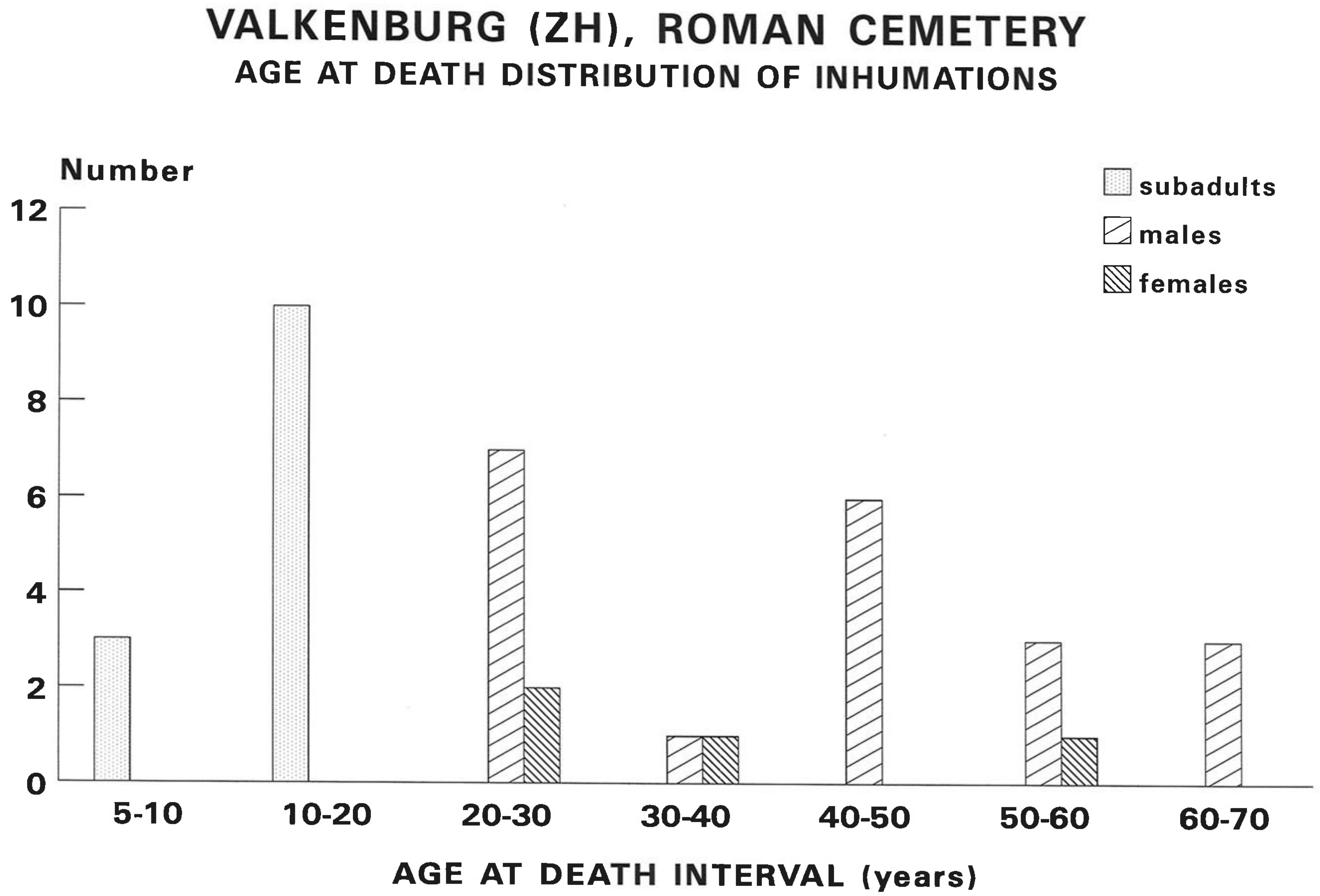
Fig. 6: Viewed from below, the left frontal sinus is filled with expanding bone which occupies nearly the entire cavity and has perforated the outer table of the left frontal bone (arrow).

Fig. 7: The clavicles of two adults showing antero-posterior flattening of the sternal part, and horizontal grooving of the ventral cortex.

Fig. 8: Unilateral coraco-clavicular articular faceting at the right side of a young male.

Fig. 9: The left side of the upper and lower jaw of a male, aged 21-30 years. Besides enamel hypoplasia, tartar formation and microdontia of the upper third molar, an abscess at the first mandibular molar is seen with periosteal bone reaction on the buccal side (arrows).

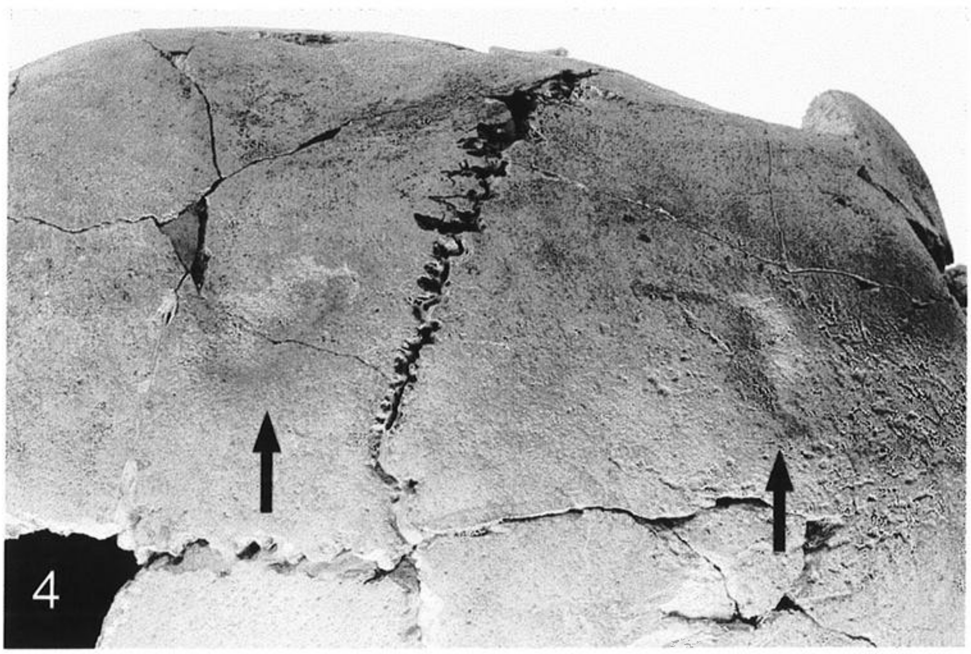
Fig.10: View on the right half of the maxilla of a male, aged 40-50 years, with pressure chipping (arrows) of the left medial incisor, of the right lateral incisor, canine and first premolar. Note calculus formation and signs of periodontal disease. The atypical attrition of the right incisors is obvious.



Ages after WEA, 1980
Lonnée and Maat, 1995
Fig. 1

2

3



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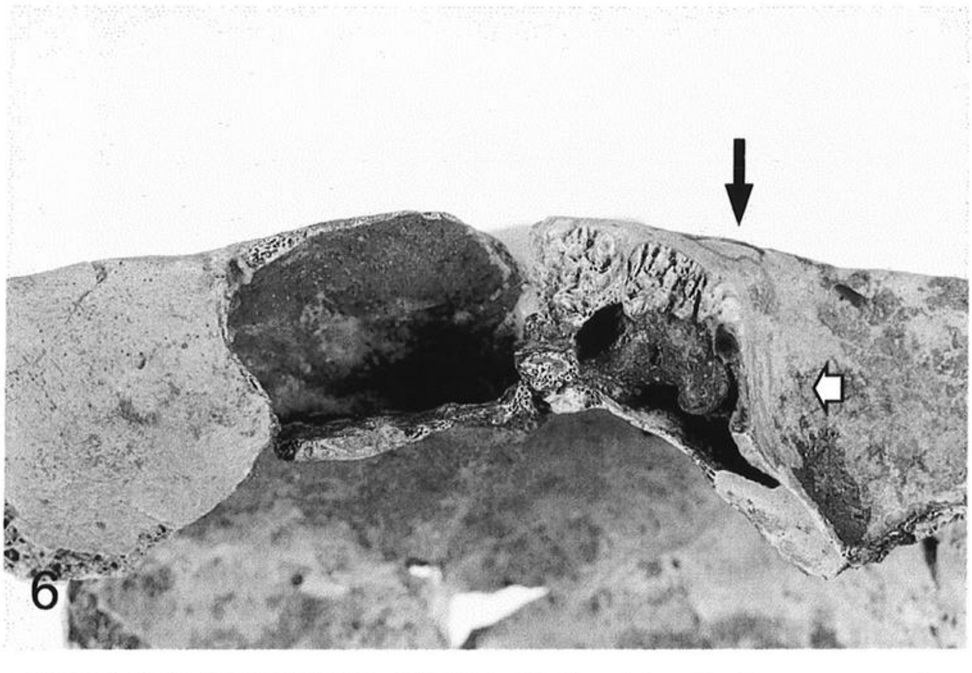
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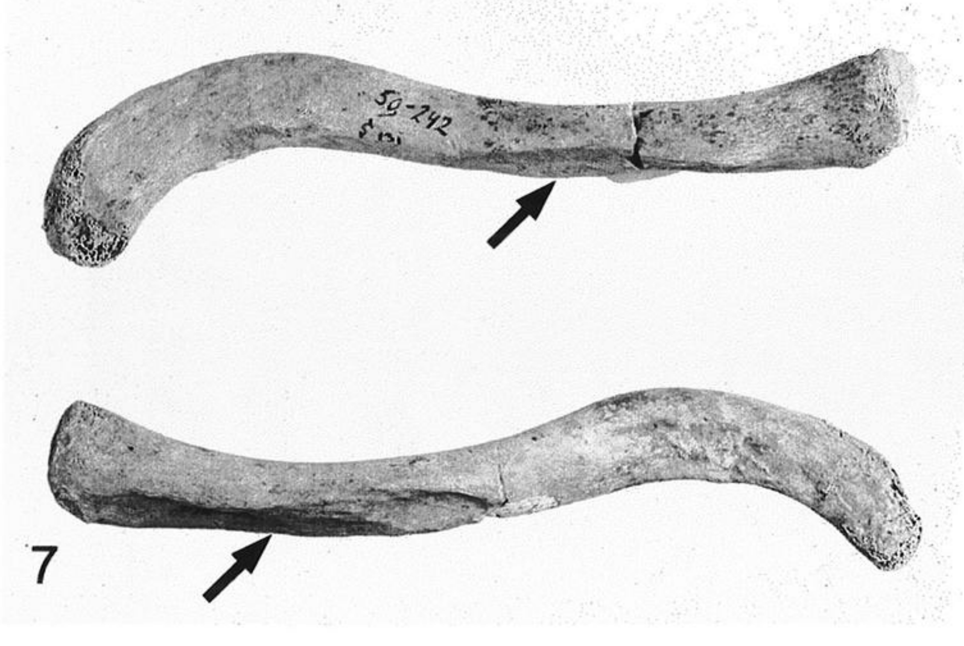

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