

Picts and Vikings at Westness

Anthropological investigations
of the skeletal material from
the cemetery at Westness,
Rousay, Orkney Islands

Berit J. Sellevold

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Abstract

A small graveyard at Westness on Rousay in the Orkney Islands, dating to between the seventh and 11th centuries, was archaeologically excavated between 1968 and 1984 by Sigrid Kaland of the University of Bergen. Several generations of Picts had used the cemetery, and subsequently the Viking settlers also buried their dead there. Work on the archaeological report is in progress. This preliminary report presents the results of the anthropological examinations and analyses of the surviving skeletal material.

The skeletal material comprises the remains of 29 individuals. The people at Westness lived to a ripe age, and some of the women became quite old. Women in general had a higher average age at death than men. There were few children among the buried individuals. The skeletal remains show that there was a close biological relationship between many of the buried individuals: Three individuals had been born with only 11 pairs of ribs, and six individuals had extreme overbites. The general health seems to have been fairly good, but two individuals may have had tuberculosis. One of these was a young adult pregnant female with the tiny bones of an unborn child in the fifth to sixth foetal month still in place in the pelvic region of the woman's skeleton.

The surviving skeletal remains showed that there were differences in the physical appearances of the Picts and the Vikings at Westness. Two boat graves from the Viking Age contained the remains of two middle-aged men. These men were considerably taller than the other men in the cemetery. One of the men was underbite, in contrast to the many individuals in the graveyard with overbites. This man had probably died a violent death, and had perhaps been killed by arrows, since four arrow points were found in association with his bones.

Key words: Westness, Rousay, Orkney - physical anthropology - skeletons - Picts - Vikings - dental conditions - pathology

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Referat

I perioden 1968-1984 gjennomførte arkeolog Sigrid Kaland, Universitetet i Bergen, arkeologiske utgravninger av en liten gravplass på Westness på Rousay på Orknøyene. Gravplassen ble datert til mellom syvende og 11. århundre, og inneholdt levningene av mange generasjoners beboere på gården Westness. Både pictere og vikinger ble begravd på denne gravplassen. Den arkeologiske rapporten er under utarbeidelse. Denne foreløpige rapporten presenterer resultatene av de antropologiske undersøkelser og analysene av det bevarte skjelettmaterialet fra gravplassen.

Skjelettmaterialet omfatter levningene av 29 individer. Westness-folkene levde til de ble godt voksne, og noen av kvinnene ble til og med svært gamle. Kvinnene ble i gjennomsnitt eldre enn mennene. Det var få barn blant de gravlagte. Skjelettrestene viste at det var nært biologisk slektskap mellom flere av de gravlagte. Tre individer var født med bare 11 par ribben, og seks individer hadde et karakteristisk og ekstremt overbitt. Den generelle helsetilstand synes å ha vært ganske god, men to individer kan ha hatt tuberkulose. En av disse var en ung voksen gravid kvinne. Det ufødte barnet var i femte til sjette fostermåned, og de små fosterknoklene ble funnet på plass i kvinnens bekken.

De bevarte skjelettrestene fremviste forskjeller i fysisk fremtoning mellom picterne og vikingene på Westness. To vikingtids båtgraver inneholdt levningene av to middelaldrende menn. Disse var betraktelig høyere enn de andre mennene på gravplassen. En av mennene hadde underbitt, i motsetning til de mange individene på gravplassen med overbitt. Denne mannen hadde sannsynligvis lidd en voldelig død og var antagelig drept av pilskudd, for det ble funnet fire pilesvisser i nær tilknytning til mannens skjelett.

Emneord: Westness, Rousay, Orknøyene - fysisk antropologi - skjeletter - pictere - vikinger - tannforhold - patologi

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Preface

The Orkneyinga Saga does not mention the Picts. The story about the early Norse settlers in the archipelago seems to take place in a previously uninhabited land.¹ In his book, *History of Orkney*, Thomson points to the difficulties inherent in gaining knowledge about the Pictish population of Orkney because of the scarcity of evidence available (Thomson 1987). There are very few written sources and many of these are difficult to interpret. In addition to this written material there are place-names and linguistic studies, "and the analysis of the biological characteristics of the present population."²

The present study deals with a category of source material which is not mentioned by Thomson, namely the skeletal remains of the Picts themselves. In the cemetery at Westness on Rousay, Picts had laid their dead to rest for centuries, and, when the Norse Vikings settled at Westness, the new settlers buried their dead in the same cemetery. This study reports the results of the anthropological investigations of the skeletal remains of these Picts and Vikings, and presents the basic data from the investigations. The analysis of the skeletal material is still in progress. The results will be incorporated in the forthcoming archaeological report.³

In the present report, some of the results of the skeletal investigations of the Westness material have been compared with available data for Viking Age Norway and Denmark, but no attempts have been made to compare the Westness skeletal data with data from the present Orkney population.

The investigation of the skeletal remains was carried out over a period of time during the late 1980's and early 1990's. During the early phase of the Westness project, I had a research grant from the Norwegian Council for Research in the Humanities to study the skeletal remains from the Iron Age in Norway (Berit J. Sellevold and Jenny-Rita Næss, "Iron Age people of Norway", NAVF 1984-1989). The Westness material included Viking finds, and the skeletal examinations of this material was therefore incorporated in the Norwegian Iron Age project. In 1994, I joined NIKU – the Norwegian Institute of Cultural Heritage Research, and I brought the Westness data base with me. Intermittently I have worked on the analyses of the data since then. NIKU has provided the funds for the data analyses, and for the production and printing of the present scientific report (NIKU Project # 22603), for which I am very grateful.

On several occasions during the 1970's I had heard about the exciting finds that Sigrid Kaland had made at Westness, with very well preserved and complete skeletons. Many of us wondered about who was going to be allowed to study the anthropological material. I would like to thank Sigrid warmly for entrusting me with this task. It has been very interesting and rewarding to collaborate with her. For a while we thought that the whole cemetery was from the Viking Age, like the first graves that were investigated. But when the ¹⁴C-datings came, it turned out that the cemetery contained graves dating back to Pictish times. This made the material even more interesting.

The skeletal remains were returned to Scotland in November 1997, and are now stored at the National Museums of Scotland in Edinburgh.

Oslo in August 1999
Berit J. Sellevold

Forord

I Orknøyingenes saga nevnes ikke pikterne med et ord. Historien om de første norske innvandrerne i øyriket synes å finne sted i et tidligere ubebodd land.⁴ I boken *History of Orkney* peker Thomson på vanskelighetene forbundet med å få kunnskap om den piktiske befolkningen på Orknøyene fordi det finnes så få kilder (Thomson 1987). Det er svært lite skriftlig kildemateriale, og blant det som eksisterer kan det være store problemer med tolkningen. I tillegg til de få skriftlige kildene finnes stedsnavn- og lingvistiske studier, og det finnes analyser av den nålevende befolkningen.⁵

Denne rapporten omhandler et kildemateriale som Thomson ikke nevner, nemlig skjelettrestene av pikterne selv. Pikterne gravla sine døde på gravplassen på Westness gjennom flere århundrer, og da vikingene bosatte seg på Westness gravla nybyggerne sine døde på den samme gravplassen. Denne studien gir resultatene av de antropologiske undersøkelsene av levningene av disse pikterne og vikingene, og presenterer de grunnleggende data fra undersøkelsene. Analysene av skjelettmaterialet foregår fremdeles. Resultatene vil bli inkorporert i den kommende arkeologiske rapporten.⁶

I den herværende rapporten blir noen av resultatene fra undersøkelsen av skjelettrestene sammenlignet med tilgjengelige data for norske og danske skjelettmaterialer fra vikingtid, men det er ikke gjort forsøk på å sammenligne skjelettrestene fra Westness med den nålevende befolkningen på Orknøyene.

Undersøkelsene av skjelettlevningene ble gjort over en lengre periode sist på 1980-tallet og begynnelsen av 1990-tallet. I den første fasen av Westness-prosjektet hadde jeg forskningsmidler fra Norges Allmennvitenskapelige Forskningsråd til et prosjekt som omhandlet skjelettresten fra jernalderen i Norge (Berit J. Sellevold og Jenny-Rita Næss, "Jernalderens mennesker i Norge", NAVF 1984-1989). Westness-materialet omfattet funn fra vikingtid, og undersøkelsene av dette materialet ble inkorporert i det norske jernalderprosjektet. Innenfor NAVF-prosjektet ble det imidlertid ikke tid til å analysere data eller til å skrive ned resultatene av undersøkelsene. I 1994 ble jeg ansatt i det nyopprettede NIKU – Norsk institutt for kulturminneforskning, og jeg tok med meg databasen for Westness-materialet. Med avbrekk har jeg så arbeidet videre med midler fra NIKU til å gjennomføre analysene. NIKU har også bevilget midler til produksjon og trykking av denne fagrapporten (NIKU Prosjekt nr. 22603), hvilket jeg er svært takknemlig for.

I løpet av 1970-tallet hadde jeg flere ganger hørt om det spennende materialet Sigrid Kaland hadde gravd ut på Westness, med meget velbevarte og komplette skjeletter. Det knyttet seg en viss spenning til hvem som skulle få lov til å studere det antropologiske materialet. Jeg vil her varmt få takke Sigrid som betrodde meg denne oppgaven. Det har vært meget givende og svært interessant å samarbeide med henne. Vi trodde en stund at hele gravplassen var fra vikingtid likesom de første gravene som ble funnet. Men da ¹⁴C-dateringene kom, viste det seg at gravplassen inneholdt graver som var datert helt tilbake i piktisk tid. Dette gjorde materialet ytterligere interessant.

Skjelettmaterialet ble returnert til Skottland i november 1997, og oppbevares nå i the National Museums of Scotland i Edinburgh.

Oslo i august 1999
Berit J. Sellevold

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Handwritten report by dr. Alastair Whyte, July-August 1964: «Report on Bones from Viking Grave found at Westness, Orkney.» (3 pp. + cover page)			
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1 Introduction

The Orkney archipelago consists of a great number of islands. Rousay is one of the larger ones, located on the west side in the middle part of the archipelago. The largest farm on Rousay, the Westness farm, lies on the southwest coast of the island. Archaeological investigations at Westness were carried out intermittently between 1968 and 1984. The archaeologist Sigrid Kaland of the University of Bergen was in charge of the excavations, which uncovered a Viking farm with a boat-house – a *noust* (Norwegian: *naust*) – and a cemetery, close to the shore.

The present report deals with the skeletal remains from this cemetery. Radiocarbon dates show that the cemetery was in use between the seventh and the 11th century. For most of this time span, the cemetery was used by the local Pictish population, but towards the end of its functioning period, Vikings were also buried there (Kaland 1987).

The cemetery comprised between 30 and 40 graves, and most of these contained skeletal remains. The graves were not visible on the surface, but the excavation showed that, at the time of use, most of the graves had grave markers in the form of a headstone. The graves were of different types. Some were completely or partly lined with stone slabs and some had slabs covering the body. Some were only shallow trenches.

The Picts had no grave-goods, and the dead were deposited supine, that is, extended on the back, in narrow, full-length, shallow graves.

“The graves of the Vikings were of different types, rectangular without grave-goods, oval-shaped, or boat graves with grave-goods. The oval-shaped graves were lined with slabs on edge, and could also have some covering slabs. Behind the head the lining stone was higher, “a stemstone” pointing towards the sea. The Viking men or women buried in such graves had different grave-goods – weapons: sword, axe, spear or arrows, shieldboss, - jewellery, - tools: sickle, adze, or weaving implements. The grave-goods showed whether they were warriors and/or farmers, or farmer’s wives.”⁷

The first Viking grave at Westness was accidentally discovered in 1963 by Ronald Stevenson of the Westness farm. The grave contained the remains of a young woman with a newborn child (see below, **Appendix B: Reports on earlier finds**). Nothing is known about the grave itself. The woman had been buried with a lot of grave-gifts, including two tortoise-shaped brooches, a gilt silver ringed pin with gold filigree and amber inlays, beads, weaving batten, bronze straps, bronze bowl, and two wool combs.⁸

The excavations revealed that the Vikings had respected the graves of the native population, since none of the Pictish graves had been disturbed. The Pictish graves must therefore have been visible on the surface at the time of the Viking burials.

Fig. 1 shows the Orkney archipelago with Rousay and the excavation area at Westness. The map of Westness shows the archaeologically investigated features: The farm, the cemetery, and the noust. **Fig. 2** shows the cemetery with the graves identified. This figure is based on Kaland’s working sketch of the cemetery.

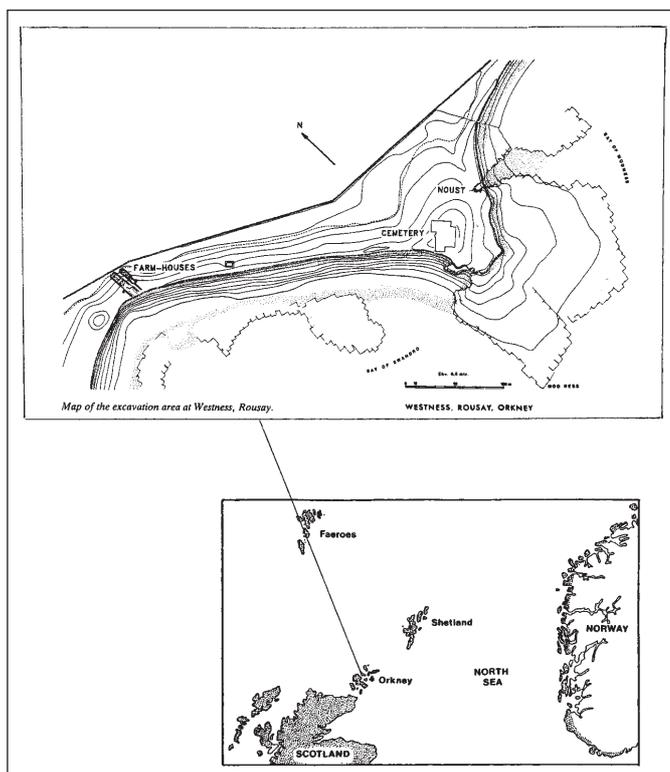
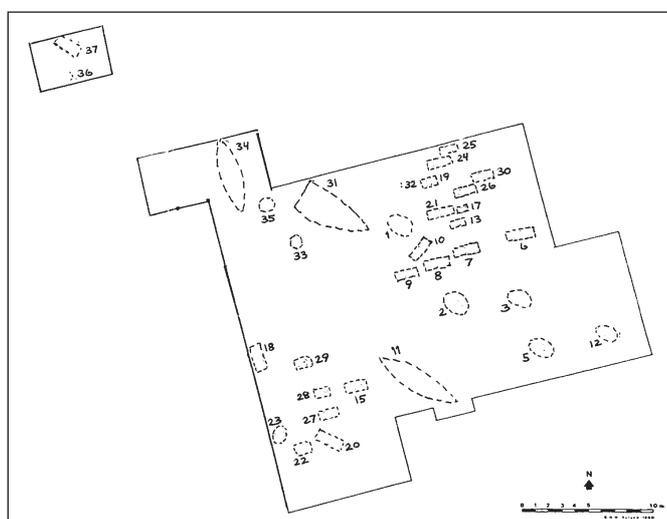


Fig. 1: Map showing the location of Westness. (Adapted from Kaland 1987).

Fig. 2: Survey map of the cemetery, identifying the graves. (Based on Kaland’s working sketch of the cemetery.)



2 The skeletal investigations: Analyses and results

The cemetery was in use for more than five centuries, which means that the skeletal material comprises individuals from many generations. The results of the investigations of the material will not tell us about the people living at Westness at any given time, but will represent a cross-section of the population of Westness throughout these centuries. The radiocarbon analyses do not provide absolute dates for each individual, but place the finds within a time span of between 35 years (Grave 28) and 250 years (Grave 26). The average time span on the datings is c. 120 years. The dates have been calibrated and corrected for the marine component of the diet of the individuals (see **Table 1**, below). Because the Westness material comprises few individuals, the whole material has been treated as a unit in the present analyses, but attempts have been made to consider the different datings of the skeletons when interpreting the results, comparing the Pictish and Viking remains with each other.

The skeletal investigations have consisted in macroscopic examinations of the remains: Identification of the individuals, age-

and sex determinations, measurements of defined parameters, and registration of nonmetric traits, that is, variations in minor skeletal features which are held to be genetically and/or environmentally determined, or determined by a combination of these factors. Pathological and anomalous conditions in the bones and the dentitions have also been registered.

2.1 Number of individuals

Skeletal remains of 29 individuals have been identified in the material which has been available for the present investigations. However, more human remains from the Westness cemetery have survived. Appendix B, below, describes the skeletal remains of three individuals which were discovered before the Norwegian investigations began. There are thus surviving remains of 32 individuals from Westness.

The present report deals with the 29 individuals from the Norwegian investigations. Table 1 below lists the graves, the sex and age of the individuals, and the results of the radiocarbon datings and the $\delta^{13}\text{C}$ -analyses, as well as the percentage of the marine element in the individual diet.

Table 1: Identification of the skeletal material

Grave no.	Sex	Age	Age group	Lab.ref	^{14}C cal.	^{14}C cal./marine corr.	$\delta^{13}\text{C}$ (‰)	Marine diet (%)
2a	Indet.	35-55 yrs	Mat					
2b	M	20-30 yrs	Ad					
5	F	35-45 yrs	Mat	T-6532	775-890 AD	875-980 AD	-21.1	13
6	F	50-70 yrs	Mat/Sen	T-6813	650-780 AD	655-785 AD	-22.7	-
7	F	50-70 yrs	Mat/Sen					
8	F	60-80 yrs	Sen					
9	M	35-45 yrs	Mat	T-7464	720-880 AD	895-995 AD	-19.3	30
10	F	20-25 yrs	Ad	T-6527	630-685 AD	665-790 AD	-20.7	17
11	M	45-55 yrs	Mat	T-6814	670-790 AD	820-980 AD	-19.1	32
12	M	35-45 yrs	Mat	T-6815	680-880 AD	880-1015 AD	-18.7	36
13	Indet.	7-8 mths	Inf I	T-7465	600-650 AD	670-770 AD	-19.1	32
14	M	20-60 yrs	Grown					
15	M	45-55 yrs	Mat					
17	Indet.	6 mths	Inf I	T-7467	800-950 AD	965-1020 AD	-19.7	27
18	F	20-35 yrs	Ad	T-6816	770-950 AD	780-965 AD	-22.7	-
19	Indet.	7-8 mths	Inf I	T-7469	650-770 AD	665-810 AD	-21.3	11
20	M	35-45 yrs	Mat	T-6528	605-665 AD	660-780 AD	-20.1	23
21	M	40-50 yrs	Mat	T-7468	620-660 AD	780-875 AD	-17.1	51
24	F	30-35 yrs	Ad	T-7466	630-660 AD	675-780 AD	-19.5	28
25	Indet.	7-8 yrs	Inf II	T-6529	435-600 AD	610-675 AD	-19.0	33
26	M	16-17 yrs	Juv	T-6817	610-810 AD	770-1020 AD	-17.3	49
28a	F	25-30 yrs	Ad	T-7471	550-620 AD	650-685 AD	-19.2	31
28b	Indet.	5.- 6. foet.mth	Foetus/Inf 0	«	«	«		
30	F	60-70 yrs	Sen					
32	F	50-70 yrs	Mat/Sen	T-7470	600-660 AD	635-685 AD	-21.6	9
34	M	50-60 yrs	Mat					
36	F	45-55 yrs	Mat	T-6530	1030-1170 AD	1065-1230 AD	-21.2	12
Noust	M	35-55 yrs	Mat					
Dispersed	F	20-35 yrs	Ad					

2.2 Age and sex

The graves of men, women and children are intermingled in the cemetery. There are no areas reserved for either sex or for specific age groups. **Fig. 3** shows the distribution of the sexes in the cemetery. The graves with dotted outlines did not yield skeletal remains for the present investigation.

Table 2 gives the sex- and age distribution in the material. There is an almost equal representation of the sexes: 11 males and 12 females. The remains of five children and one adult could not be sex determined.

Six individuals were subadult. The youngest of these was an unborn child (fifth to sixth foetal month), whose skeletal remains were found in the abdominal/pelvic region of the skeleton of a young adult female. Three infants were less than one year old. One child was seven to eight years. One young male was about 16-17 years. He is considered to be biologically subadult since his skeleton was not fully matured even though he may have had the social status of an adult.

Fig.3: Distribution of the sexes in the cemetery

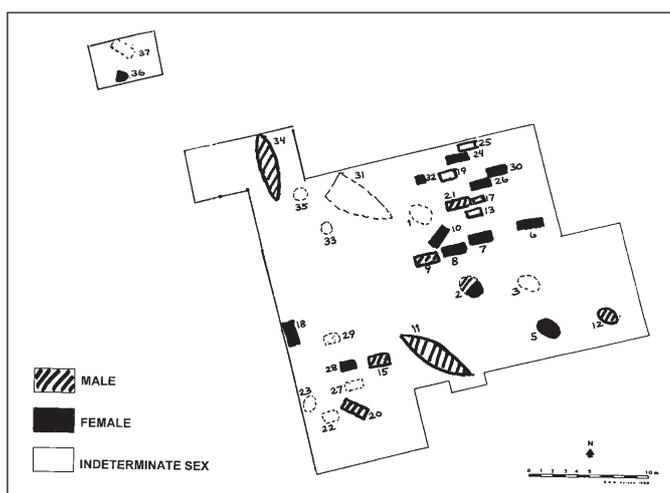


Table 2: Age- and sex distribution in the skeletal material

Age group	Males		Females		Indet.		Total	
	n	%	n	%	n	%	n	%
Foetus/Infans 0					1	16.7	1	3.4
Infans I					3	50.0	3	10.3
Infans II					1	16.7	1	3.4
Juvenis	1	9.1					1	3.4
Adultus	1	9.1	5	41.7			6	20.7
Maturus	8	72.7	2	16.7	1	16.7	11	37.9
Maturus/Senilis			3	25.0			3	10.3
Senilis			2	16.7			2	6.9
Grown	1	9.1					1	3.4
Sum	11	100.0	12	100.1	6	100.1	29	99.7

2.2.1 Average ages at death

The average age at death for males was c. 41 years, for females c. 45 years. There is an uneven distribution of the sexes in the three adult age groups: *young adult*, *middle-aged*, and *old*. No males survived beyond middle age (age group *Maturus*, i.e., 35-55 years), while five of the females attained old age (age groups *Maturus/Senilis* and *Senilis*, i.e., older than c. 55-60 years). This constitutes more than 40% of all females.

2.2.2 Subadult/ adult ratio

The six subadults in the material constitute 20.5% of all individuals. This is a ratio of 26 subadults per 100 adults. This ratio might seem to indicate a very low childhood mortality at Westness, but, since this is a multigenerational cemetery, we do not know whether this ratio reflects the situation among the living at any given time.

2.2.3 Sex ratio

The sex of 23 skeletons could be determined. There were 11 males and 12 females, which means a sex ratio of 92 males per 100 females. As with the subadult/ adult ratio, we do not know whether this figure is meaningful. The number of burials is small, and the cemetery was in use over five centuries.

2.3 Measurements and indices

Whenever possible, a set of dimensions on the skull and the major long bones were measured, according to criteria given by Martin and Knussmann (1988).⁹ The measurements are used to describe the size of bones. In addition, a small number of indices have been calculated, which describe the shape of given features.

2.3.1 Cranial measurements and indices

35 measurements on the skull were recorded, and seven indices were calculated. The skulls were not particularly well preserved. One or more cranial measurements could be taken on 14 of the 29 individuals. The skull was entirely missing in five skeletons, and was too fragmented for measuring in 10 skeletons. **Table A-1 in Appendix A: Comprehensive tables**, below, gives the individual cranial measurements and indices, as well as the average values, the ranges of variation, the standard deviations and the minimum and maximum values for the measurements.

Only two male skulls were well enough preserved to yield a number of measurement. One of these skulls was large, the other very small. The small skull was from Grave 26, and belonged to the adolescent boy of 16-17 years. At this age, the human skull is considered to have reached practically its fully developed size. This boy's skull, however, was in fact smaller than any of the female skulls in the material for most of the measurements. It does not appear to be pathologically small, however. The skulls of the males in the two boat graves were not well enough preserved to yield measurements which are useful for cranial descriptions. Six of the female skulls were fairly well preserved, and yielded a number of measurements, while two female skulls only yielded a few measurements.

Table 3: Intra- and intermembral indices

Index	Males						Females					
	n	Right mean	s.d.	n	Left mean	s.d.	n	Right mean	s.d.	n	Left mean	s.d.
Radio-humeral	3	76.2	0.72	2	76.4	1.77	4	74.8	2.37	7	76.6	3.53
Tibio-femoral	5	79.3	0.83	4	79.4	1.42	6	81.3	1.77	6	81.4	1.49
Intermembral	3	71.2	2.40	1	66.5		3	69.1	1.31	5	68.4	1.19

The average breadth-length index was 75.3 for the two male skulls, and 75.9 for the six female skulls. These values are in the interval for *mesocrany*, that is, skulls of medium breadth relative to the length. The two male skulls have almost the same indices, but the average index for the six females covers a range of values between 71.1, *dolichocrany*, that is, a skull which is narrow relative to the length, and 83.7, *brachycrany*, that is, a broad and short skull. However, only one skull was in the brachycranial category (the skull of the female in Grave 30), while three were long and narrow and two were of medium length and breadth.

In cranial shape the Westness skulls resemble the skulls of the Norwegian and Danish Iron Age populations. Most of the Scandinavian Iron Age skulls are long and narrow, with a sizable proportion in the medium range, especially among the Viking Age skulls, and very few short and round ones (Sellevold, Hansen et al. 1984; Sellevold 1992).

2.3.2 Postcranial measurements and indices

The postcranial bones were mostly rather well preserved, and a great number of measurements could be taken. The individual measurements for the major long bones are given in Appendix A: **Table A-2** (upper arm bone: *humerus*), **Table A-3** (radius: *radius*), **Table A-4** (elbow bone: *ulna*), **Table A-5** (thigh bone: *femur*), and **Table A-6** (shin bone: *tibia*).

2.3.3 Limb proportions

The limb proportions have been analyzed by calculating the *intramembral indices*, which are the ratios between the lengths of major long bones of, respectively, the upper and lower extremities, and the *intermembral indices*, which are the ratios between the total lengths of the upper and lower limbs.

Table 3 gives the means and standard deviations of the intra- and intermembral indices, with the sexes and two sides reported separately. The values for each individual for each of the three calculated indices are given in **Tables A-7** (*radio-humeral indices*), **A-8** (*tibio-femoral indices*), and **A-9** (*intermembral indices*) in Appendix A.

2.3.3.1 Intramembral indices

For the upper limb, the *radio-humeral index* (*brachial index*) was calculated, based on the maximum length of the radius (M1) and the maximum length of the upper arm bone (*humerus*) (M1). The radio-humeral index values for both sides in both sexes are in the middle range, which means that the lower arm bone is of medium length relative to the upper arm bone.¹⁰

Table 4 shows that the corresponding values for Danish Viking Age skeletons are quite similar to those in the Westness materi-

Table 4: Intra- and intermembral indices in several skeletal groups

	Males						Females					
	n	Right mean	s.d.	n	Left mean	s.d.	n	Right mean	s.d.	n	Left mean	s.d.
Radio-humeral index												
Westness	3	76.2	0.72	2	76.4	1.77	4	74.8	2.37	7	76.6	3.53
Danish Vikings	4	75.6	2.25	3	76.6	3.01	4	76.6	1.79	1	77.9	1.95
Anglo-Saxon	62	74.6		48	75.4		31	73.5		26	74.2	
Tibio-femoral index												
Westness	5	79.3	0.83	4	79.4	1.42	6	81.3	1.77	6	81.4	1.49
Danish Vikings	8	80.5	1.79	9	80.3	1.95	11	80.3	1.27	7	81.5	2.89
Intermembral index												
Westness	3	71.2	2.40	1	66.5		3	69.1	1.31	5	68.4	1.19
Danish Vikings	3	69.3		2	68.9		3	71.1		1	72.0	

al. The Westness skeletons also have almost the same upper arm proportions as does a group of Anglo-Saxon skeletons.¹¹

For the lower limb, the *tibio-femoral index* (*crural index*) has been calculated. In the present study, the ratios between the measurements of the length of the tibia (M1) (that is, the distance between the lowest point of the medial malleolus and the lateral condyle), and the maximum length of the femur (M1) have been used for the calculations.¹² The tibio-femoral index values show that the shin bone (*tibia*) is about 4/5ths of the length of the thigh bone (*femur*) in both sides for both sexes. Again, Table 4 shows that the values for the Danish Viking Age and Westness skeletons are quite similar.

2.3.3.2 Intermembral indices

The ratio between the lengths of the upper and lower limbs, the *intermembral index*, has been calculated based on the sum of the lengths of the radius (M1) and the upper arm bone (*humerus*) (M1) and the sum of the lengths of the shin bone (*tibia*) (M1) and the thigh bone (*femur*) (M1).

The mean values of the intermembral index for both sides in both sexes are between 66.5 and 71.2, which means that the upper extremities are between 2/3 and 3/4 of the length of the lower extremities.

Table 4 shows that the values for the Danish Viking Age and Westness skeletons are very similar with regard to this index. In the Danish Iron Age skeletal material, there were no demonstrable differences between the Early Roman period groups and those from the Viking Age. The present study therefore indicates that the Westness skeletons resemble the Iron Age skeletons of Denmark (0 – 1050 AD) with regard to limb proportions.

2.4 Statures

The 12th century source, *Historia Norvegiae*, describes the Picts as "a diminutive race, little more than pygmy in stature," according to Thomson (1987).¹³ It was therefore with considerable interest that the stature calculations for the skeletal remains were carried out. Would the results corroborate the ancient myth?

Stature could be calculated for 15 individuals: seven males and eight females. Whenever possible, the maximum length measurements of the thigh bones (*femora*) were used in the calculations.¹⁴ If the thigh bones were missing, the calculations were based on the maximum length measurement of one of the other major long bone categories: the shin bone (*tibia*),¹⁵ or the upper arm bone (*humerus*).¹⁶ It turned out that all except two calculations could be based on femoral measurements. The two exceptions were the females in Graves 5 and 8, where the femora were missing and the humerus measurements were used. The calculations are done using the regression equations of Trotter and Gleser (1952 and 1958). The individual calculated statures are given in **Table 5**.

Table 5: Statures

Grave	Sex	Age	Age group	Stature	Calc.basis
5	F	35-45	Mat	151.8	Humerus
6	F	50-70	Mat/Sen	153.8	Femur
28a	F	25-30	Ad	161.0	Femur
24	F	30-35	Ad	161.6	Femur
10	F	20-25	Ad	162.5	Femur
30	F	60-70	Sen	162.8	Femur
7	F	50-70	Mat/Sen	164.5	Femur
8	F	60-80	Sen	164.8	Humerus
n				8	
mean				160.4	
s.d.				4.86	
min				151.8	
max				164.8	
26	M	16-17	Juv	171.1	Femur
14	M	20-60	Grown	171.1	Femur
20	M	35-45	Mat	171.6	Femur
Noust	M	35-55	Mat	171.1	Femur
21	M	40-50	Mat	171.7	Femur
11	M	45-55	Mat	180.6	Femur
34	M	50-60	Mat	180.1	Femur
n				7	
average				173.9	
s.d.				4.42	
min				171.1	
max				180.6	

The average stature for the seven males is 173.9 cm, while the average for the eight females is 160.4 cm. The difference between the average statures of males and females is thus 13.5 cm. The difference between the shortest and tallest male is 9.5 cm, while the difference between the shortest and the tallest female is 13 cm.

Of especial interest is the observation that the two tallest males were buried in the boat graves, Grave 11 and Grave 34. These two are almost 10 cm taller than the other males. **Fig. 4** is a diagram which shows the statures of the 15 individuals.

Five of the males and six of the females are remarkably alike in stature: the males are all around 171–172 cm, and the females around 160–165 cm. The exceptions are two tall males (Graves 11 and 34, the boat graves), who were around 180 cm, and two short females (Graves 5 and 6), who were around 152–154 cm.

In **Section 3, Discussions**, below, the calculated statures for the Westness skeletons are compared with those of Norwegian and Danish Viking skeletons.

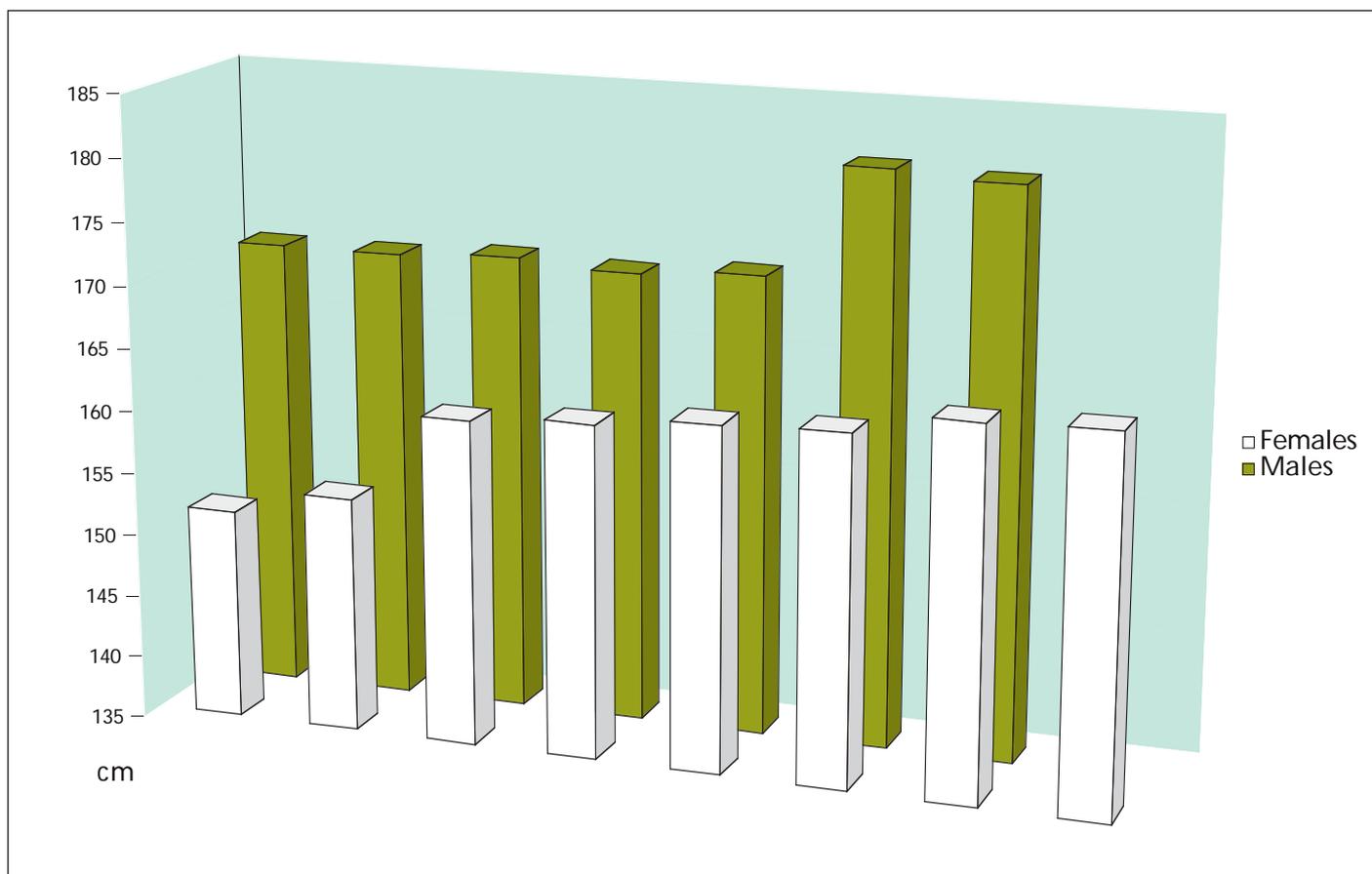


Fig.4: Individual statures in cm

2.5 Nonmetric traits

Nonmetric traits are small, nonmeasurable morphological variations which are found throughout the skeleton, and which are especially frequent in the skull (Sellevoid 1977; Sellevoid, Hansen et al. 1984); (Hauser and De Stefano 1989). The traits are mostly recorded as being either present or absent, but for some traits, the degrees of expression are also registered. The variations involve, *i.a.*, the sutures of the skull, and various holes (*foramina*) and canals which transmit blood vessels and nerves, etc.

Table 6 gives the frequencies of occurrence of 32 traits on the skull and postcranial bones. Seven traits are situated in the midline of the skull, while 25 traits occur bilaterally in the skull and postcranial skeleton. The data were registered separately for males, females and individuals of indeterminate sex. The age groups were pooled, but, since most individuals of indeterminate sex in this material are subadult, while most males and all females are grown, there is, in fact, also a crude sorting by age. **Table A-10** in Appendix A gives the data for each individual.

The percentage frequencies are based on a very small number of observations, and no significant conclusions may be drawn as to whether or not there are within-population (intrapopulation) differences.

The Westness data have been compared with data from suitable skeletal groups, see **Table 7** below. Some of the data for the comparisons are found in an article by Berry (1974), who reports on several populations around the North Sea, including a group of skulls from the Orkneys: 25 crania from "a disused graveyard dating from 900 A.D., but used into mediaeval times,"¹⁷ and a material from the Viking settlement of Vesterbygden (the Western settlement) in Greenland. Table 7 also includes data from a skeletal group from the Viking settlement of Østerbygden (the Eastern settlement) in Greenland (Sellevoid 1977),¹⁸ and from Iron Age Denmark (Sellevoid, Hansen et al. 1984).¹⁹ Unfortunately, there are no published data on the occurrence of nonmetric traits in Norwegian Viking populations.

Table 7 lists the percentage frequencies of occurrence of 18 nonmetric variants of the skull. Except for the Danish Iron Age material, the numbers of observations are small, and the results are therefore not conclusive.

Table 6: Nonmetric traits: Frequencies of occurrence

Trait	Side	Males		Females		Indeterminate		Total	
		n	%	n	%	n	%	n	%
Metopic suture		4	0.0	8	0.0	1	0.0	13	0.0
Coronal ossicles		3	66.7	5	20.0			8	37.5
Ossicle at bregma		3	0.0	5	0.0			8	0.0
Sagittal ossicles		1	0.0	6	16.7			7	14.3
Ossicle at lambda		3	0.0	9	11.1	2	0.0	14	7.1
Inca bone		3	0.0	10	0.0	2	0.0	15	0.0
Parietal foramen	R	4	50.0	8	62.5	2	0.0	14	50.0
	L	4	75.0	8	37.5	1	0.0	13	46.2
Lambdoid ossicles	R	3	33.3	6	33.3	2	50.0	11	36.4
	L	3	33.3	6	16.7	1	100.0	10	30.0
Ossicle at asterion	R	3	0.0	5	0.0	1	0.0	9	0.0
	L	3	0.0	8	12.5			11	9.1
Parietal notch bone	R	3	0.0	6	0.0	1	0.0	10	0.0
	L	3	0.0	8	12.5			11	9.1
Fronto-temporal articulation	R	1	0.0	3	33.3			4	25.0
	L	1	0.0	4	25.0			5	20.0
Epipteris bone	R	2	0.0	3	33.3			5	20.0
	L	2	0.0	4	0.0			6	0.0
Accessory infraorbital foramen	R	2	0.0	5	40.0			7	28.6
	L	3	0.0	4	25.0			7	14.3
Supraorbital foramen	R	4	100.0	7	71.4			11	81.8
	L	4	50.0	8	37.5	1	100.0	13	46.2
Zygomatico-facial foramen	R	3	100.0	8	62.5			11	72.7
	L	4	75.0	6	83.3	2	50.0	12	75.0
Foramen ovale incomplete	R	3	0.0	9	11.1	1	0.0	13	7.7
	L	4	0.0	8	25.0	2	0.0	14	14.3
Divided hypoglossal canal	R	3	66.7	7	0.0	2	0.0	12	16.7
	L	3	33.3	8	12.5	2	0.0	13	15.4
Condylar facet double	R	2	0.0	7	0.0	1	0.0	10	0.0
	L	2	0.0	8	0.0	1	0.0	11	0.0
Tympanic dehiscence	R	4	25.0	8	0.0	1	0.0	13	7.7
	L	5	20.0	8	0.0	1	0.0	14	7.1
Superior sagittal sinus	R	3	33.3	10	80.0	2	100.0	15	73.3
	L	3	66.7	10	20.0	2	0.0	15	26.7
Maxillary torus	R	3	33.3	7	0.0	1	0.0	11	9.1
	L	4	0.0	8	0.0	1	0.0	13	0.0
Palatine torus		3	0.0	7	0.0	1	0.0	11	0.0
Mandibular torus	R	7	14.3	8	25.0	2	0.0	17	17.6
	L	7	14.3	9	22.2	2	0.0	18	16.7
Mylohyoid bridge	R	7	14.3	8	12.5	1	0.0	16	12.5
	L	5	0.0	8	0.0	2	0.0	15	0.0
Accessory mental foramen	R	6	16.7	8	12.5	2	0.0	16	12.5
	L	6	33.3	9	0.0	2	0.0	17	11.8
Frontal grooves	R	3	33.3	6	33.3			9	33.3
	L	3	33.3	7	14.3	1	0.0	11	18.2
Perforated olecranon fossa	R	6	16.7	8	12.5	2	0.0	16	12.5
	L	5	0.0	8	25.0	2	0.0	15	13.3
Preauricular sulcus	R	3	0.0	9	100.0	1	0.0	13	69.2
	L	5	20.0	7	100.0	1	0.0	13	61.5
Supraacetabular sulcus	R	3	0.0	7	42.9	1	0.0	11	27.3
	L	5	0.0	7	57.1	1	0.0	13	30.8
Parturition scars	R	2	0.0	6	16.7			8	12.5
	L	3	0.0	6	16.7			9	11.1
Atlas bridging	R	4	0.0	8	50.0	1	0.0	13	30.8
	L	4	0.0	8	50.0	1	0.0	13	30.8
Tibial squatting facet	R	4	75.0	7	71.4			11	72.7
	L	6	66.7	6	83.3			12	75.0

Table 7: Cranial nonmetric traits in several skeletal groups

Nonmetric trait	Sellevoid 1999 Westness		Berry 1974 Orkney		Berry 1974 Greenland, Western settlement		Sellevoid 1977 Greenland, Eastern settlement		Sellevoid 1984 Iron Age Denmark	
	n	%	n	%	n	%	n	%	n	%
Metopic suture	13	0	25	3.2	51	3.9	13	0	276	5.4
Coronal ossicles	8	37.5	25	0	51	0.8	4	0	137	18.2
Ossicle at bregma	8	0	25	0	51	0	9	0	219	0.5
Ossicle at lambda	14	7.1	25	0	51	8.0	23	4.3	214	13.1
Parietal foramen	27	48.1	25	58.8	51	59.8	33	54.5	418	46.9
Lambdoid ossicles	21	33.3	25	41.9	51	41.0	34	52.9		
Ossicle at asterion	20	5.0	25	1.9	51	3.2	32	9.4	320	4.4
Parietal notch bone	21	4.8	25	5.9	51	6.3	30	0	334	15.0
Fronto-temporal articulation	9	22.2	25	0	51	3.6	16	12.5	244	4.1
Epipteric bone	11	9.1	25	5.9	51	16.9	15	0	210	14.8
Accessory infraorbital foramen	14	21.4	25	10.5	51	11.4	7	0	163	4.9
Supraorbital foramen	24	62.5	25	21.1	51	23.1	18	22.2	448	30.4
Foramen ovale incomplete	27	11.1	25	0	51	3.3	38	5.3	304	2.3
Divided hypoglossal canal	25	16.0	25	15.0	51	16.8	54	29.6	294	17.7
Condylar facet double	21	0	25	0	51	2.4	49	6.1	223	1.3
Tympanic dehiscence	27	7.4	25	8.7	51	3.3	47	2.1	203	14.3
Maxillary torus	24	4.2	25	12.0	51	13.1	32	12.5	407	1.0
Palatine torus	11	0	25	44.0	51	47.8	16	50.0		

The frequencies of occurrence of traits are approximately of the same order of magnitude in the compared groups. The exceptions are:

- *Coronal ossicles*: present in 37.5% of the Westness individuals, and in 18.2% of the Eastern settlement individuals, but virtually absent in the other three groups, including Berry's Orkney material;
- *Ossicle at lambda*: twice as frequent in the Danish Iron Age material as in the Westness material, and totally absent in Berry's Orkney material;
- *Parietal notch bone*: three times as frequent in the Westness material as in the Danish Iron Age material, and totally absent in the Eastern settlement material;
- *Fronto-temporal articulation*: most frequent in the Westness material, with almost twice the occurrence frequency of the Eastern settlement material;
- *Accessory infraorbital foramen*: twice as frequent in the Westness material as in Berry's two groups;
- *Supraorbital foramen*: very frequent in the Westness material: twice as frequent as in the Danish Iron Age material, and three times as frequent as in the other groups;
- *Maxillary torus*: rare in the Westness group and the Danish Iron Age group, but frequent in the other groups;
- *Palatine torus*: completely absent in the Westness group, while very frequent in Berry's Orkney and Western settlement material and in the material from the Eastern settlement.

In the overall pattern of frequencies of occurrence of nonmetric traits, however, the compared groups do not differ significantly from each other.

2.6 Pathological and anomalous conditions

There are several pathological and anomalous conditions, both in bones and teeth of the skeletons from the Westness cemetery. Some of the pathological conditions are commonly observed in ancient skeletal material, such as osteoarthritis (degenerative joint disease), or dental caries. Other conditions are of the rarely observed kind. The pathological and anomalous conditions are discussed below.

Pathological conditions in the teeth and jaws are discussed in **Section 2.7, Dental conditions**.

The pathological changes and anomalous conditions for each individual are described in detail in **Section 8: Catalogue of the material**.

2.6.1 Traumatic conditions

Traumatic conditions in the Westness material include bone fractures, and fractured dental crowns.

One of the more noticeable injuries is seen in the top skeleton of Grave 2, a badly healed fracture of the left clavicle with pathological changes in the surrounding bones. This find was studied by Øivind Larsen (1972), who determined the bones to be of a middle-aged male (however, see the entry on Grave 2 in the Catalogue below). Larsen suggested that the injury may have been the result of torture. The changes to the bones are consistent with the man's arms having been tied behind his back at

the wrists, after which he was strung up by the wrist ties. This treatment caused a fracture of his left clavicle. The man lived for some time after the traumatic event, and developed secondary osteoarthritis in the joints of the involved bones.

Three individuals had fractured ribs: an elderly female (Grave 6) and two middle-aged males (Grave 21 and the noust grave). In two of these cases there were multiple fractures, and several ribs as well as other skeletal parts were involved. The female in Grave 6 had fractured 10 ribs, the right radius near the wrist, and the second lumbar vertebra. The male in Grave 21 had fractured the right clavicle, six ribs and the fifth lumbar vertebra. The male in the noust grave had a fractured first right rib.

Vertebral compressions are caused by fractures. Several individuals had compressed vertebrae, mostly in the lower back: the middle-aged male in Grave 9 had a compressed vertebral body on the 12th thoracic vertebra; the middle-aged male in Grave 15 had the same condition in the 11th and 12th thoracic vertebrae, while the old female in Grave 30 had compressed vertebral bodies of the eighth and ninth thoracic vertebrae. One elderly female (Grave 32) had pathological changes in the cervical vertebrae bodies which may have been caused by fractures, resulting in a curved cervical spine, with the head leaning towards the left shoulder.

2.6.2 Osteoarthritis (degenerative joint disease)

Pathological changes in the joints, called degenerative joint disease or osteoarthritis, are the most commonly observed pathologies in ancient bones.

"...the prevalence ... increases markedly with age; in modern populations it tends to be more common in females than in males. ... (Osteoarthritis) is probably the product of a normal remodelling or repair process and is the natural reaction of a synovial joint to joint failure. ... (The) age, systemic and genetic predisposition of the individual are also important factors in the development of the disease." ²⁰

Several individuals in the material from Westness were affected by degenerative joint disease, both in small joints, mainly in the spine, and in large joints, such as the hip joints. Examples of the latter are the elderly male in Grave 34 and the middle-aged male in the noust grave. In some cases, the condition was probably the result of normal wear and tear, while in other cases, the pathological changes were secondary to an injury or another pathological condition, such as in the left shoulder joint of the top skeleton of Grave 2, a middle-aged male, discussed above, and in the young adult female in Grave 24. Descriptions of the changes in each individual are given in Section 8 below, Catalogue of the skeletal material.

2.6.3 Congenital anomalies

There were a number of congenital anomalies in the Westness skeletons. Brief discussions of some of these conditions are presented in the following.

Three individuals had only 11 pairs of ribs: a young adult female (Grave 10), a small child of 7-8 months (Grave 13), and a young

adolescent male of 16-17 years (Grave 26). This is a congenital, hereditary anomaly. There are also other anomalies in these three skeletons: the adult female and the young male had lumbarized 12th thoracic vertebrae. The little child had fused vertebrae in the lower thoracic spine, from the fifth through the 12th thoracic vertebrae. The female and the male both had pronounced overbites, while the dental occlusion of the little child could not be determined. The child had strong enamel hypoplasias on all four deciduous upper and lower central incisors, in the form of dark brown/black stains located centrally on the incisive edges, corresponding to the fifth foetal month in dental development (see below, Section 2.7, Dental Conditions). In spite of their relatively young ages, both the female and the male had ossified hyoid bones, which is an anomaly.

These three individuals were buried fairly close together in the northern part of the cemetery. The ¹⁴C dates of the female and the child are close in time. The female in Grave 10 is dated to 665-790 AD, and the child in Grave 13 to 670-770 AD (see Table 1). They may very well have been mother and child. It seems probable that the young male in Grave 26 was closely related to these two. The date of this individual, however, was 770-1020 AD, thus from a slightly later date than the female and the child.

Normally, there are five sacral vertebrae, but some individuals are born with six. Two individuals at Westness had six sacral vertebrae: the old female in Grave 7, and the young adult pregnant female in Grave 28.

Other congenital vertebral conditions include sacralized fifth lumbar vertebrae. This condition was found in two cases. The two old females in Graves 6 and 7. The female in Grave 7 therefore had six sacral vertebrae in addition to a sacralized fifth lumbar vertebra, as mentioned above. There was pseudarthrosis between the fourth and fifth lumbar vertebrae of this female. This condition was also found in the grown male in Grave 14, where there was pseudarthrosis between the fifth lumbar vertebra and the sacrum.

In the skeleton of the middle-aged male in one of the boat graves, Grave 11, there was fusion between the first cervical vertebra (atlas) and the base of the skull. This could either be the result of an injury, or a congenital anomaly, known as atlas occipitalization or atlanto-occipital fusion, which occurs in around 1% of the general population.²¹ The left first rib of this individual was deformed into a large, bony "blade".

The male in Grave 11 and the old female in Grave 30 both had *hallux valgus* on both feet, which means that the big toe points markedly inwards towards the second toe.

Congenital anomalies in the dentition are discussed below in Section 2.7, Dental conditions.

2.6.4 Tuberculosis

Several pathological changes were observed in the thoracic region of two individuals:

The old female in Grave 7 had osteoarthritic changes in the joints between sternum and the first ribs on both sides, in the joint between manubrium and the corpus of the sternum and in both sterno-clavicular joints. The right clavicular bone is c. 1 cm shorter than the left. There are osteoarthritic changes in all costosternal joints. The 10th thoracic vertebra has a 19 mm deep cyst or abscess into the vertebral body on the left side. The cyst continues on the 10th left rib deep into the enlarged costal part of the rib. The trabeculae surrounding the cyst have become sclerotic. At the time of excavation of this skeleton, the archaeologist found fragments of thin bony plates and bagged these as "bony matter from within the rib cage". These fragments are probably 'plaques of pleural calcification'.²²

The young pregnant female in Grave 28 also had numerous changes in the thoracic region of the skeleton: Both acromial processes of the scapulae are loose, with pseudarthrosis to the scapulae. All parts of the sternum, including the processus xiphoides, are fused. There are sharp osteophytes around the sterno-costal joints, both on the sternum and on the ribs. Thin, bony plate fragments – calcified pleura – were found in the rib cage. In addition, an irregularly shaped bony lump was found among the left ribs. Another irregularly shaped bony lump was found among the foetal bones in the pelvic region.

These two females may have suffered from tuberculosis. Osteological evidence has established that tuberculosis was well-established in Europe already during the Neolithic.²³ Arcini (1999) points out that tuberculosis has a low infectivity, and that long and close contact between people, as for example in a room or in a house, is necessary for the disease to spread.²⁴ In a large material from early medieval Lund in Southern Sweden, only one case of tuberculosis was found.²⁵

The presence of pleural calcifications provides important evidence of tuberculosis.²⁶ Møller-Christensen reports two cases of calcified pleura in two middle-aged males in the medieval Æbelholt monastery cemetery.²⁷ In an article by Weiss and Møller-Christensen (1971) there is a description of the skeleton of a leper from a medieval graveyard at Næstved in Denmark, at the site of a leprosarium (Skt. Jørgen's Spital). The skeleton was of a middle-aged male. Three sets of plate-like pleural calcifications were found in the thoracic cavity near the eighth, ninth and 10th ribs. The individual also had partial destruction and fusion of the second through the fourth thoracic vertebrae and bony proliferation in the costal joints of the ribs. The Westness individuals did not have similar destructive lesions in the spine, but the old female in Grave 7 had a large cyst or abscess in the 10th thoracic vertebra and corresponding rib. The trabeculae surrounding the abscess had become sclerotic. A diagnosis of tuberculosis in these two individuals might be verified by analyzing extracted DNA,²⁸ but such a test, unfortunately, is outside the scope of the present study.

Grave 28 has been ¹⁴C-dated to 650-685 AD (calibrated, and corrected for marine component, T-7471), while Grave 7 has not been dated. Grave 7, however, was located in a group of four graves lying in a line, the eastern grave of which, Grave 6, was dated to 655-785 AD (T-6813) while the western grave, Grave 9, was dated to 895-995 AD (T-7464) (see Table 1, above). Grave 7 had the same type of construction as the other graves in this group, and must therefore be considered to be contemporary with these graves.

If these two females in fact did suffer from tuberculosis, the cases would be among the earliest found in Great Britain. (Stirland and Waldron 1990) describe three cases from two cemeteries of the Roman period, found at Dorchester and Ashton, probably dating to between the second and fourth centuries, and point out that "few unmistakable cases have been diagnosed in contexts earlier than the Medieval period in (Great Britain)". They suggest that, as more skeletal material is investigated, the likelihood of finding other "good examples of tuberculosis" will increase.²⁹

Larsen (1973) reports a case of tuberculosis in the skeleton of a middle-aged male from the island Gisløy in Øksnes parish, Nordland county, Norway.³⁰ The find is dated to the Merovingian period, that is, to between 600 and 800 AD, thus slightly earlier than the Westness graves, but roughly speaking from the same period. According to Larsen, the Norwegian skeleton had unmistakable tuberculous changes in the right shoulder joint, the right hip joint, and in the fourth and fifth lumbar vertebrae. However, there were no plaques of pleural calcification. From Denmark there are very few certain cases before the Middle Ages, but one case of fused and deformed vertebrae from the early Roman cemetery at Simonsborg (0–200 AD) has been diagnosed as tuberculosis.³¹

2.6.5 The pregnant woman

The pregnant woman in Grave 28, who probably suffered from tuberculosis, had anomalous changes in the pelvic bones. There are six sacral vertebrae (discussed above, Section 2.6.3). The first sacral vertebra is partly lumbarized. The left spina ischiadica is noticeably enlarged, jutting into the pelvic opening. There are osteophytes around the sacroiliac joints, with very deep preauricular sulci. The pelvis is rather high and relatively narrow. Giving birth to a fully developed child would have been difficult and possibly very dangerous, both for the mother and the child. But the woman probably died before the parturition process had started, possibly of causes not related to the pregnancy. The foetus, which was in the fifth–sixth foetal month, was still in place in the pelvic region at the time of death.

2.6.6 Legg-Calvé-Perthes' disease

The 7-8 year old child in Grave 25 had osteochondrosis of the femoral head, that is, Legg-Calvé-Perthes' disease. The disease is usually unilateral, and in this child the right hip was affected. Aufderheide and Rodriguez-Martin (1998) classify it as a circulatory disorder, which mostly affects children between three and 10 years of age. "The condition represents obstruction to the blood supply of the growing femoral head with resultant avascular necrosis."³² In this child, the shaft of the right thigh bone

(*femur*) was 1.5 cm shorter than the left. The neck of the thigh bone had an angle of less than 90° with the shaft. The femoral head was deformed, and the acetabulum was flattened.

According to Aufderheide and Rodríguez-Martín (1998), the disease is "... an autolimiting condition with a strong tendency to spontaneous resolution."³³ It depends on when the condition developed, and the severity and other factors. If the child had survived, it would most probably have developed degenerative joint disease, which is the most common complication arising from this disease.

2.6.7 Depressions on cranial bones

On the skulls of two individuals there were depressions on the cranial bones which may be trepanation scars. Trepanation is a surgical operation in which a part of the skull bone is removed. Trepanation scars have been registered in archaeological finds of skulls from the Stone Age to the present in many parts of the world.³⁴ Sometimes the patient died during the operation, but surprisingly often the patient survived, and the hole in the skull healed. In Danish prehistoric skeletons, a remarkable 79% of the individuals with trepanation scars had survived the operation.³⁵ We do not always know the reasons for the trepanation. At times the operation seems to have been performed as a therapeutic measure related to cranial fractures (Jørgensen 1988), but the reasons may equally well be sought in ritual magic and religious practices (Jennbert 1991).

On the skull of the middle-aged female in Grave 5 there was a depression on the frontal bone, located c. 2 cm to the left of bregma, close to the coronal suture. The depression is roughly circular, measuring c. 1.2 x 1.0 cm, and is c. 1.5 mm deep. The cranial bone is smooth and slightly thickened on the internal surface. The depression is roughened in the middle, and there is a groove around the perimeter. The depression resembles a completely healed trepanation.³⁶

The middle-aged male in Grave 21 also had depressions on the skull. On the left parietal bone, close to bregma, there are three small, circular depressions with diameters of 2 to 3 mm. There is no change on the internal surface of the bone. (Jørgensen 1988) reports a case from pre-Inka Peru of an adult male with three unhealed trepanation holes close together in the left temporal region of the skull. He describes the holes as "typical drill-holes, measuring 4 mm in diameter and with traces of a rather coarse drill," and interprets these as an attempt to treat a cranial fracture in this area.³⁷ The depressions on the Westness skull may be such healed trepanation holes.

2.6.8 Nonspecific infections

Four individuals exhibited bony reactions to nonspecific infections. The middle-aged female in Grave 4 had periostitic changes notably on the shaft of the left leg bone (*fibula*), but there were also traces on the shaft of the right leg bone and on both shin bones (*tibiae*). The same conditions were found on the upper part of the shaft of the left tibia in the middle-aged male in Grave 20, on the lower part of the shaft of the left tibia of the young adult female in Grave 24, and on the lower part of the shaft of the right elbow bone of the middle-aged male in the

noust grave. The reasons for these pathological changes are not known.

2.6.9 Other observations

The grown male in Grave 14 had a deformed left elbow bone (*ulna*): it was bowed, almost S-shaped. The left radius appeared normal, as did the ulna and radius of the right arm. The upper arm bones are missing. The long bones of the lower extremities of this individual are rather robust and have strongly marked muscle attachment areas. The cause of the deformed left ulna is not known, but might possibly be related to a specific physical activity.

2.7 Dental conditions

A great number of dental features have been recorded. For the present study, the FDI (*Fédération Dentaire Internationale*) two-digit system of tooth labelling has been used.³⁸ Teeth and dental conditions were recorded with regard to status, size (mesiodistal and buccolingual diameters, that is, crown length and breadth), attrition,³⁹ position, dental calculus, caries, enamel hypoplasia, occlusion and nonmetric traits (shovel shape, Carabelli's cusp and cement-enamel junction). Some pathological conditions involving the jaw bones were also recorded, such as, for example, traces of periodontitis, presence of cysts etc.

2.7.1 Dental status

Twenty-three of the 29 individuals had surviving teeth. The number of teeth per individual varied from only one surviving tooth to all 32 teeth present.⁴⁰ **Table 8** shows the number of teeth in the material.

There were 505 teeth in all, including tooth germs and roots without crowns.⁴¹ Among 445 permanent teeth, only six teeth were found loose, while the rest, 439 teeth, were present in their sockets. There were 60 deciduous teeth, all of which were present in their sockets. In three individuals, Grave 10 (young adult female), Grave 24 (young adult female), and Grave 26 (adolescent male), there were absent/missing wisdom teeth. These may either be congenitally missing (agenesis), or they may still be in the jaws (retained, impacted, not erupted).⁴²

2.7.2 Dental measurements

Whenever possible, the mesiodistal (crown length) and buccolingual (crown breadth) diameters of the teeth were measured with a vernier caliper, using the method recommended by Goose (1963). The values have been recorded in tenths of millimeters: the value 71 means a measurement of 7.1 mm. The individual measurements are given in **Tables A-11** (*mesiodistal and buccolingual diameters, maxillary teeth*) and **A-12** (*mesiodistal and buccolingual diameters, mandibular teeth*) in Appendix A. These tables also give the average measurements and standard deviations for each tooth type.

The tables report the data according to sex. The number of observations is rather low; not all individuals had surviving teeth, and in many individuals the teeth were so worn that the chosen dimensions could not be measured. In some cases,

Table 8: Number of teeth in the material

Grave	Sex	Age	Age group	Permanent teeth				Deciduous teeth				Total no. of teeth
				In socket		Loose		In socket		Loose		
				Max	Mand	Max	Mand	Max	Mand	Max	Mand	
2a	Indet.	35-55 yrs	Maturus									0
2b	Male	20-30 yrs	Adultus				15					15
5	Female	35-45 yrs	Maturus	15	16							31
6	Female	50-70 yrs	Maturus/Senilis	2	2	3						7
7	Female	50-70 yrs	Maturus/Senilis	16	15							31
8	Female	60-80 yrs	Senilis	12	12							24
9	Male	35-45 yrs	Maturus			1	1					2
10	Female	20-25 yrs	Adultus	16	15							31
11	Male	45-55 yrs	Maturus	16	16							32
12	Male	35-45 yrs	Maturus	5	9	1						15
13	Indet.	7-8 mths	Infans I	2	2			9	10			23
14	Male	20-60 yrs	Grown									0
15	Male	45-55 yrs	Maturus									0
17	Indet.	6 mths	Infans I	1	6			9	9			25
18	Female	20-35 yrs	Adultus	1								1
19	Indet.	7-8 mths	Infans I		8			10	10			28
20	Male	35-45 yrs	Maturus	14	16							30
21	Male	40-50 yrs	Maturus	15	16							31
24	Female	30-35 yrs	Adultus	14	16							30
25	Indet.	7-8 yrs	Infans II	3	10				3			16
26	Male	16-17 yrs	Juvenis	15	15							30
28a	Female	25-30 yrs	Adultus	15	16							31
28b	Indet.	5-6 foet.mth	Foetus/Infans 0									0
30	Female	60-70 yrs	Senilis	14	5							19
32	Female	50-70 yrs	Maturus/Senilis	13	3							16
34	Male	50-60 yrs	Maturus	8	13							21
36	Female	45-55 yrs	Maturus	7	9							16
Noust	Male	35-55 yrs	Maturus									0
Dispersed	Female	20-35 yrs	Adultus									0
Total no. of teeth, including nonerupted teeth				204	235	5	1	28	32	0	0	
Sum				439		6		60		0		
Total number of teeth						445		60				505

heavy dental calculus made it impossible to measure especially the buccolingual diameter.

The tables show that, although there may be overlapping values between males and females for single, individual measurements, the average measurements for male teeth are always larger than for female teeth. This result is in accordance with the common observation that, in all human population groups, males generally have larger teeth than females.

2.7.3 Occlusion

Among the more remarkable aspects of the skeletal material from the Westness cemetery are the dental occlusions. Seventeen individuals had surviving jaw bones or jaw bone fragments, and among these, the dental occlusion could be examined in 11 individuals: four males and seven females. The different types of

occlusion have been registered on a scale from 0 to 7, and the numbers of occurrences in each category are shown in **Table 9**.

Table 9 shows that the most frequent type of occlusion is *horizontal overbite*. Five of the 11 individuals examined had horizontal overbite. In addition, one individual had a vertical overbite. Four individuals had edge-to-edge bites, while only one individual was underbite.

Fig. 5 is a plan of the cemetery which shows the location of the graves of the individuals with the different types of occlusion.

Six individuals had marked overbite. All six were buried very close to each other, in the northern part of the cemetery. Three of the four individuals with edge-to-edge bites were buried in the southern part of the cemetery, while one was buried among the

Table 9: Dental occlusion

Type of occlusion	n	%	Comments
0 Edge-to-edge bite	4	36.4	2 males, 2 females
1 Horizontal underbite	0		
2 Vertical underbite	1	9.1	1 male
3 Horizontal overbite	5	45.5	1 male, 4 females
4 Vertical overbite	1	9.1	1 female
5 Horizontal and vertical underbite	0		
6 Horizontal and vertical overbite	0		
7 Open bite	0		
Sum	11	100.1	

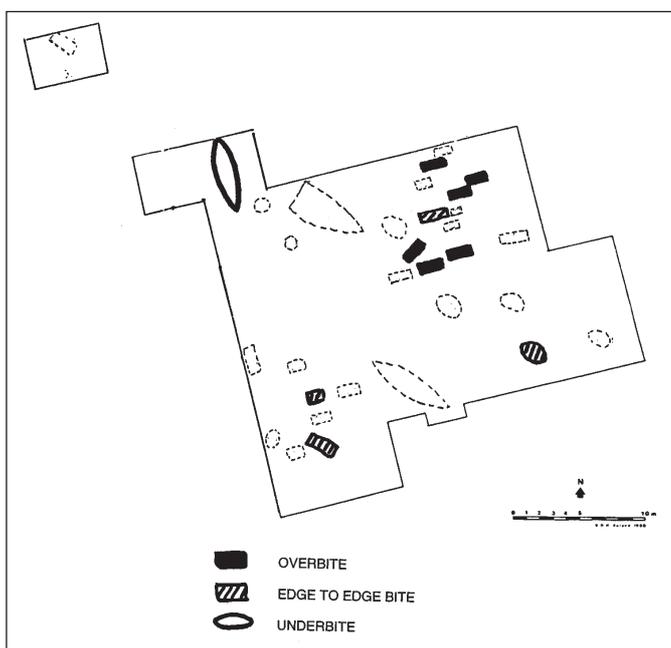


Fig.5: Distribution of the types of occlusion

individuals with overbite in the northern part. The only person with underbite was the male in the northernmost of the boat graves, Grave 34, a Viking grave.

Among the six individuals with marked overbite, there were five females and one male. In all six dentitions, the upper incisors stuck far out in front of the lower incisors, with overjets between six and 10 mm. In all six dentitions, the molars were in approximately normal occlusion, which means that it is the incisor occlusion which creates the characteristic overbite. The very marked overbite of the adolescent male in Grave 26 is shown in **Figs. 6a** and **6b**.

There seems to be a strong hereditary factor with regard to dental occlusion. Lundstrom (1948), cited by Simon Hillson (1996), found that certain traits, such as overjet, was strongly hereditary, and claimed a heritability of 75% for this trait, while other traits had lower heritabilities. Based on this study, it was as-

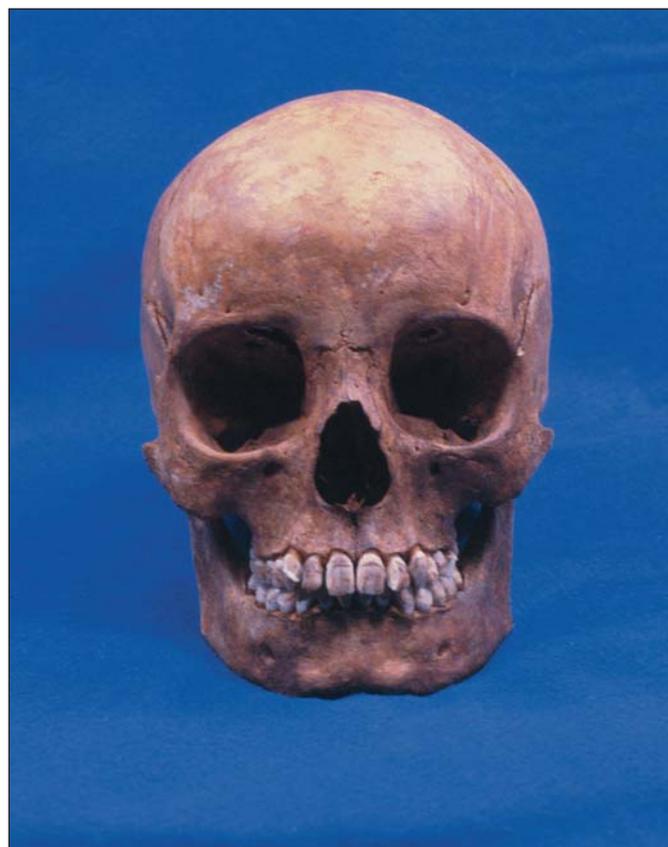


Fig. 6a: Overbite. Adolescent male, Grave 26. Front view.

Fig. 6b: The right side of the skull in Grave 26.
Photos: B. J. Sellevold



sumed that occlusion was strongly influenced by genetic factors. Other researchers, however, believe that the heritability factor must be lower, on the average of c. 15%, and that environment may be more important than genes. Among of the most important environmentally determined factors are, of course, diet and chewing activity. Hillson (1996) points out that

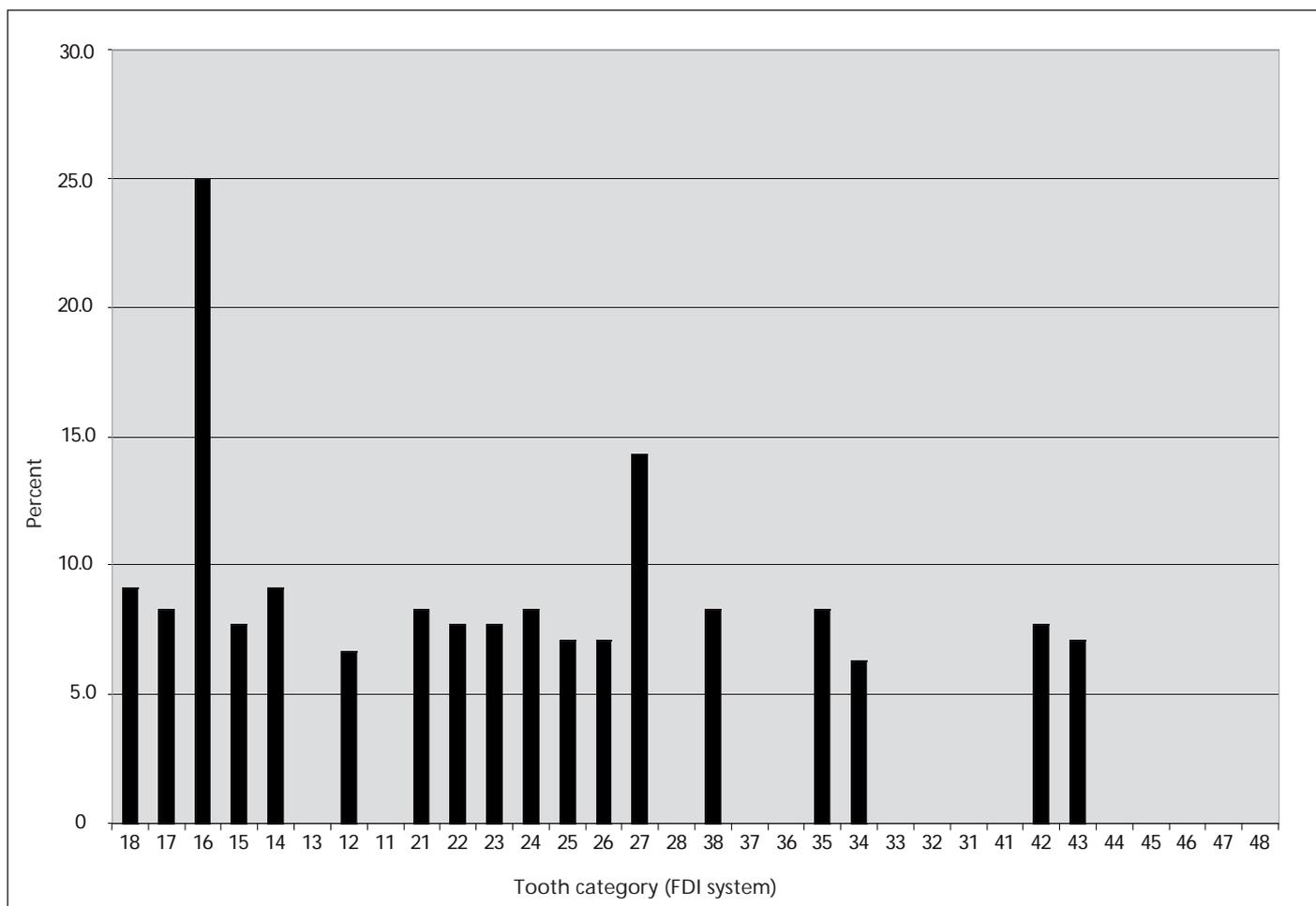


Fig. 7: Caries frequencies, permanent teeth

"there is no doubt that dental attrition modifies the occlusion. ... Attrition cannot, however, be the only factor involved and the dynamic maintenance of jaw morphology must also be important, as it constantly remodels under the influence of stresses acting through the pull of muscles and the meeting of teeth against resistance." 43

The individuals with overbite constitute 54.5% of the individuals whose occlusion could be recorded. They are clearly distinguished from the rest of the group. If we accept Lundstrom's finding, that overjet is a (strongly) hereditary trait, we may postulate that the six individuals with extreme overjets were closely related to each other. They have all been dated to the Pictish period, and are thus of the indigenous population at Westness. They had been buried within a relatively short time span, very close to each other in the cemetery. It is noteworthy that the only individual with a completely different type of dental occlusion, namely underbite, was buried in a Viking grave (the boat grave, Grave 34).

2.7.4 Caries

Nineteen individuals had intact jaw bones or jaw bone fragments with one or more permanent teeth present. Among these, eight individuals had caries in one or several teeth. This means that 42.1% of the individuals had caries.

505 teeth were inspected: 445 permanent and 60 deciduous teeth. 21 permanent teeth (4.7%) had caries, while no caries was found in the surviving deciduous teeth.

Seven of the individuals with caries were grown; one young adult female, two middle-aged males and a middle-aged female, and three old females. Only one of the children had caries, in one permanent tooth. One individual, the 60-80 year old female in Grave 8, had caries in nine teeth. The 50-70 year old female in Grave 32 had caries in three teeth, while the other six individuals had caries in one to two teeth.

Fig. 7 shows the caries frequency for each tooth category. It is clearly seen that the tooth category most frequently exhibiting caries is the upper first molar on the right side (tooth16). It also seems to be a pattern that the teeth in the upper jaw (that is, from tooth 18 to tooth 28) are more frequently attacked by caries than the teeth in the lower jaw (from tooth 38 to tooth 48). However, it must be kept in mind that the number of observations is small: the number of teeth present in each tooth category varies between nine and 16. For example, only nine individuals had a surviving wisdom tooth on the right side of the lower jaw (tooth 48), while 16 individuals had a surviving first premolar on the left side of the lower jaw (tooth 34).

The distribution of individuals in the cemetery with and without caries did not show a definite pattern. The male in the large boat grave, Grave 11, who had all 32 teeth present in the jaws, had only one carious tooth. In contrast, the old female in Grave 8 (the middle of the three rectangular graves just north of the boat grave) had nine carious teeth among the 14 teeth present in the jaw bones.

Detailed studies of dental caries have been carried out on British archaeological material, and a consistent pattern of dental caries was found from the Neolithic to medieval times; the molars were the most commonly affected teeth, while the canines and incisors were the least affected (Hillson 1996). In the Westness material, the highest frequencies are found for the right upper first molar (tooth 16) and the left upper second molar (tooth 27), which is consistent with the mentioned pattern. Among the canine teeth, there is no caries in any of the right upper and left lower canines (tooth 13 and 33), while the left upper and right lower canines (tooth 23 and 43) are affected. Among the eight incisors, there are carious lesions in the right and left lateral and left central incisors of the upper jaw (tooth 12, 21 and 22) and in the right lateral incisor of the lower jaw (tooth 42). The frequencies of occurrence are low, less than 10%, in all these cases.

2.7.5 Enamel fractures

The occurrence of small enamel fractures around the periphery of the occlusal/incisal surfaces and of larger crown fractures not involving the pulpa have been registered. According to Alexandersen (1986), small enamel fractures, also called peripheral enamel chipping, indicates biting of hard food, or the use of the teeth as a tool, for example to hold onto objects. Chipping of the front teeth often reflects this situation, while chipping of the molars and premolars most probably is caused by hard particles in the food.

Table 10 below shows the frequencies of occurrence of the conditions. The diagram in **Fig. 8** below illustrates the frequencies of occurrence of peripheral enamel chipping per tooth category in the permanent dentition.

In all, 352 permanent teeth were inspected. Table 10 shows that the number of observations per tooth category is relatively low; the most frequently occurring teeth in this analysis are the teeth 12, 23, 25 and 26, of which there were 13 each.

Ninety-seven of the inspected teeth had enamel chipping. This constitutes 27.6%, or almost one third of all teeth, which seems to be a high frequency of occurrence. Unfortunately, I have not been able to find comparable data for these observations.

The diagram in Fig. 8 shows that the teeth in the upper right half of the dentition are most frequently involved, from the upper right six year molar (tooth 16) to the upper left canine (tooth 23). And, correspondingly, the lower right half of the dentition also has fairly high frequencies of occurrence, i.e., from the lower left small incisor (tooth 32) to the lower right second molar (tooth 47). The Westness people seem to have used the right side of the jaws more vigorously for chewing than the left.

Table 10: Enamel defects in the permanent dentition

Tooth identification number	Periferal enamel chipping		Dental crown fracture	
	N	Occurrences %	Occurrences %	
18	10	2 20.0	0	0
17	11	3 27.3	0	0
16	12	5 41.7	1	8.3
15	12	5 41.7	1	8.3
14	10	4 40.0	0	0
13	12	6 50.0	0	0
12	13	5 38.5	0	0
11	11	5 45.5	0	0
21	12	7 58.3	0	0
22	12	4 33.3	0	0
23	13	5 38.5	0	0
24	11	0 0	1	9.1
25	13	2 15.4	0	0
26	13	4 30.8	1	7.7
27	12	1 8.3	0	0
28	8	1 12.5	0	0
38	11	3 27.3	0	0
37	10	3 30.0	0	0
36	11	2 18.2	0	0
35	10	2 20.0	0	0
34	11	2 18.2	2	18.2
33	12	1 8.3	1	8.3
32	10	4 40.0	0	0
31	9	3 33.3	0	0
41	9	3 33.3	0	0
42	11	3 27.3	0	0
43	11	3 27.3	0	0
44	10	1 10.0	2	20.0
45	10	2 20.0	0	0
46	12	3 25.0	1	8.3
47	11	3 27.3	0	0
48	9	0 0	0	0
Sum	352	97 27.6	10	2.8

The central and lateral incisor of the upper jaw are the most frequently involved teeth. The tooth type with the highest frequency of occurrence is the upper left central incisor (tooth 21). Almost 60% of this tooth type had enamel chipping.

Ten teeth exhibited larger fractures, involving the enamel and the dentine. This constitutes 2.8% of all teeth inspected. The number of observations is small. Table 10 shows that there are single occurrences throughout the dentition, except for the lower left first premolar (tooth 34) and the lower right first premolar (tooth 44) of which there are two cases each of larger fractures of the dental crown. The crown fractures thus do not seem to "favor" a particular side of the dentition nor a particular tooth category.

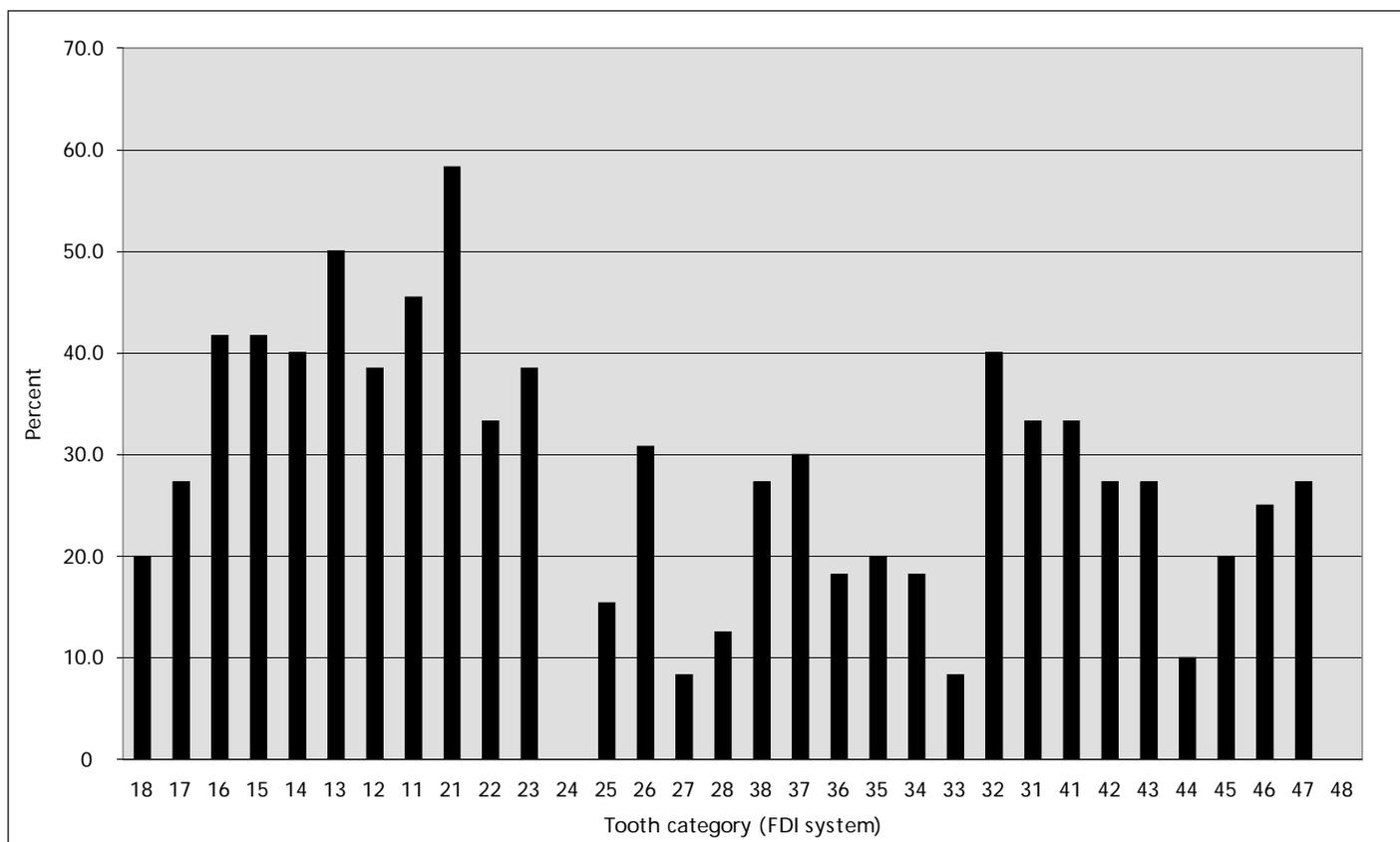


Fig. 8: Periferal enamel chipping

2.7.6 Periodontal pathologies

"Periodontitis is a global problem, estimated by the World Health Organization to affect 75% of adults to some degree."⁴⁴ The condition is also very frequently observed in archaeological skeletal material, thus also in the Westness skeletons, although it does not occur in as high a frequency as in present-day populations.

Several elements of the disease may be singled out, and in the present study, four such elements have been registered, on a five-point scale, from no change through very slight changes to extreme changes. **Table 11** below shows the frequencies of occurrences of the following stages of development:

- 0 = no pathological changes visible macroscopically;
- 1 = periapical porosities (enlarged socket and septal destruction);
- 2 = periapical porosities with bone perforation;
- 3 = furcature involvement (noticeably developed); and
- 4 = total periodontitis (enlarged socket, septal and facial-lingual lamellae destroyed, porosities).

The numbers of observations are small, and no firm conclusions may be drawn from the data. Periapical porosities seem to be distributed throughout the dentition. Bone perforation was rarely observed, but was mostly found in the molar regions, as was the case with furcature involvement. The occurrence of total periodontitis was found most frequently in the molar regions, but also occurred elsewhere.

"In large clinical studies, there is a clear relationship between periodontitis and age" (Hillson 1996).⁴⁵ This is also the case in the Westness skeletal material. The middle-aged and old individuals are most severely affected. The most extreme cases are seen in the skeletons of the two old females in Grave 8 and Grave 30. According to Hillson, periodontal disease is "... multifactorial in origin and involves inheritance, environment, diet and hygiene together."⁴⁶

Table 11: Periodontal pathological conditions in the permanent dentition

Tooth identification number	N	Periapical porosities		Bone perforation		Furcature involvement		Total periodontitis	
		Occurrences	%	Occurrences	%	Occurrences	%	Occurrences	%
18	11	2	18.2	0	0	1	9.1	3	27.3
17	12	4	33.3	0	0	0	0	2	16.7
16	12	3	25.0	1	8.3	1	8.3	0	0
15	12	3	25.0	0	0	0	0	1	8.3
14	12	3	25.0	0	0	0	0	2	16.7
13	12	2	16.7	0	0	0	0	1	8.3
12	12	2	16.7	0	0	0	0	2	16.7
11	11	1	9.1	0	0	0	0	0	0
21	10	1	10.0	0	0	0	0	0	0
22	14	0	0.0	0	0	0	0	1	7.1
23	12	1	8.3	0	0	0	0	0	0
24	13	3	23	1	7.7	0	0	0	0
25	13	2	15.4	1	7.7	0	0	0	0
26	14	0	0.0	0	0	2	14.3	1	7.1
27	14	2	14.3	0	0	2	14.3	2	14.3
28	12	0	0.0	1	8.3	2	16.7	5	41.7
38	14	3	21.4	0	0	0	0	4	28.6
37	13	3	23.1	0	0	0	0	2	15.4
36	14	2	14.2	1	7.1	1	7.1	0	0
35	15	4	26.7	1	6.7	0	0	1	6.7
34	16	3	18.8	0	0	0	0	0	0
33	16	1	6.3	0	0	0	0	1	6.3
32	13	2	15.4	1	7.7	0	0	0	0
31	13	2	15.4	0	0	0	0	0	0
41	13	2	15.4	0	0	0	0	0	0
42	13	2	15.4	1	7.7	0	0	0	0
43	14	1	7.1	0	0	0	0	1	7.1
44	13	2	15.4	0	0	0	0	1	7.7
45	14	3	21.4	0	0	0	0	0	0
46	15	3	20.0	0	0	1	6.7	1	6.7
47	13	3	23.1	0	0	1	7.7	0	0
48	11	2	18.2	0	0	1	9.1	1	9.1
Sum	416	67	16.1	8	1.9	12	2.9	32	7.7

3 Discussions

3.1 Statures

Table 12 shows the calculated average statures for the Westness skeletons and the corresponding values for the Norwegian and Danish Viking skeletal material.⁴⁷

Table 12: Statures in Viking Age Norway and Denmark, and at Westness, Rousay, Orkney

Skeletal material	n	mean	s.d.	min	max
Males					
Westness	7	173.9	4.42	171.1	180.6
Norway, Viking Age	14	175.5	3.59	169.7	180.8
Denmark, Viking Age	23	172.6	6.34	162.9	184.8
Females					
Westness	8	160.4	4.86	151.8	164.8
Norway, Viking Age	6	158.8	6.31	148.6	164.4
Denmark, Viking Age	20	158.1	5.07	149.3	166.6

The average stature of the Westness males lies between those of the Norwegian and Danish Vikings. On the average, the Westness males are 1.3 cm taller than the Danish Viking males, and 1.6 cm shorter than the Norwegian Viking males. The range of variation among males is greatest in the Danish material, with a difference between the shortest and the tallest male of 21.9 cm, while the difference between the tallest and shortest male at Westness is 9.5 cm. Among the Norwegian males, the difference is 11.1 cm.

However, it should be taken into consideration that the two males in the Viking boat graves at Westness were 10 cm taller than the other males in the cemetery. If we excluded these two from the calculations, the average stature for the other five males is 171.3 cm, with a standard deviation of only 0.27. This is a lower average stature than in Viking Age Denmark and Norway. However, even though they are slightly shorter than the Danish Viking males, these individuals are far from being "pygmies", as suggested in the 12th century *Historia Norvegiae* (Thomson 1987). The statures of the Pictish men are well within the range of male statures in Northwestern Europe.

The average stature of the Westness females is higher than the values for both Norway and Denmark, exceeding the Norwegian females by 1.6 cm and the Danish females by 2.3 cm. The range of variation among females is greatest in the Danish material, with a difference between the shortest and the tallest female of 17.3 cm, while the corresponding difference among the Norwegian females is 15.8 cm. The smallest range of variation is found among the Westness females, with a difference of 13.0 cm between the tallest and shortest individual.

3.2 Assessment of sex based on teeth

Sex determining a child's skeleton is very difficult, if not impossible, since the secondary sex characteristics are not expressed in the bones until after puberty. However, many researchers have tried to sex determine children on the basis of the size of the teeth. Some claim to have achieved a correct sex determination in 60% to 90% of children's skeletons examined. There is a thorough discussion of this method in Hillson (1996). However, he cautions against intra- and interobserver errors with regard to measurements, since the actual size differences between sexes in individual teeth are very small (c. 0.4 to 0.5 mm), and recommends establishing a baseline group for each test case, based on sex determinations of pelvic bones.

In the skeletal material from Westness, males and females have been sex determined based on both pelvic and cranial traits, and the baseline group is therefore well established. There are six individuals of indeterminate sex in the material. Only one of these had surviving measurable, permanent teeth, namely the 7-8 year old child in Grave 25.

Using dental measurements, we may therefore try to determine the sex of this child (Tables A-11 and A-12, Appendix A). Three permanent maxillary teeth and six permanent mandibular teeth survived. These teeth yielded 18 measurements (mesiodistal and buccolingual diameters). Comparing these measurements with the corresponding measurements for male and female teeth in the material, it is found that 11 measurements are most like the female values, one is like the male values and four could be either male or female. The measurements of the child's teeth thus indicate *female*. The basis for a determination, however, is insecure, since the numbers of teeth are small. The result is therefore tentative. But it is perhaps interesting that, during the examination of the skeletal parts, it was noted that the *incisurae ischiadica major* of the child's pelvis seemed broad and open. This is a feminine trait in the fully developed skeleton, and might therefore support a sex determination of female for this child.⁴⁸ The child in Grave 25 may have been a little girl. Unfortunately, there are no burial elements which can corroborate this finding.

4 Summary

The present publication is a preliminary report on the anthropological investigations of the skeletal material from Westness on Rousay, Orkney, excavated by Sigrid Kaland, the University of Bergen, Norway, between 1968 and 1984. The cemetery contained both Pictish and Viking graves, and the radiocarbon dates span the period between the seventh and the 11th century. The report presents the analyses and the results of the investigations. It includes a catalogue of the material and the raw data from the investigations.

The anthropological investigations of the material have consisted in macroscopic examinations of the skeletal remains, determining the number of individuals in the material, and the age and sex of the skeletons. The bones have been measured according to Martin and Knussmann (1988), and the teeth were measured according to Goose (1963). Nonmetric traits and pathological and anomalous conditions in the bones and teeth were recorded. The basic data for each individual are reported in comprehensive tables in Appendix A of this report.

There were 29 individuals in the material available for the present investigation, 23 adults and six subadults. Another three individuals were found prior to Kaland's excavations. These have not been available for the present analyses, but are described in Appendix B of this report.

Among the 23 grown individuals, there were 10 males, 12 females and one individual of indeterminate sex. Among the six subadult individuals, one skeleton was of an adolescent boy, while five were of children of indeterminate sex: an unborn child in the fifth to sixth foetal month, three infants and one seven to eight year old.

On the average, women lived longer than men. The average age at death for grown males was c. 41 years, and for grown females c. 45 years. The spread in the age groups differed between the sexes; among the females there were young adult and very old individuals, while among the males there were mostly middle-aged individuals.

The average cranial index among the individuals was in the lower end of the *mesocrane* range, which means that the skulls were of medium breadth relative to the length, tending towards being long and narrow. Only one skull was short and round (*brachycrane*). The cranial shapes of the few investigated Westness skeletons resemble those of the Norwegian and Danish Vikings.

Stature could be calculated for 15 individuals; seven males and eight females. The average stature for males was 173.9 cm, and for females 160.4 cm. Five of the seven males were remarkably alike in stature, around c. 171–172 cm, while two of the males were noticeably taller; 10 cm taller than the others. These two were buried in the Viking boat graves. Among the females, six were of similar stature, between 160–165 cm, while two females were shorter than the rest, at 152–154 cm. The short males at Westness are shorter than the Norwegian and Danish Viking

males, while the two tall males, at c. 180 cm, were as tall as the tallest in the Norwegian material, and only slightly shorter than the tallest male in the Danish material. The six tall Westness females are taller than the average Viking Age females of Denmark and Norway, while the two short females are shorter than the averages for the Norwegian and Danish Viking materials. There were no abnormally short or abnormally tall individuals in the Westness material. Stature is closely related to diet and living conditions, and as much as 10% of the stature may be determined by these factors. The two tall Viking men and the two short women may have had slightly different living conditions than the other individuals during the years of growth and development.

The frequencies of occurrence of a set of nonmetric traits on the skull and postcranial skeleton were analyzed and compared with data from a skeletal material from a medieval churchyard in the Orkneys, from the Viking Norse of the Eastern and Western settlements in Greenland, and Iron Age Danish skeletons. The overall frequencies of occurrence for the nonmetric traits did not differ significantly between the Westness material and the other skeletal groups, although there were some differences for a few of the traits.

Pathological and anomalous conditions in the Westness skeletons were analyzed. There were healed fractures of various bones; ribs, vertebrae and radius. One of the individuals had broken the left collar bone, and the fracture had healed badly. There were traces of degenerative joint disease and spondylosis, especially in the older individuals. Some individuals had traces of nonspecific infections. One child had a deformed right femur, a condition known as Legg-Calvé-Perthes' disease. Two cases of possible tuberculosis were registered, with presence of a vertebral-costal abscess in one individual, and plaques of calcified pleura in both. One of these two was young woman who had died while pregnant. The bones of the foetus were found in the slightly deformed pelvic region of this female's skeleton.

Several individuals had congenital, hereditary anomalies. Some of these occurred in more than one individual, confirming the expected situation, that the cemetery contained members of the same family. The presence in the graveyard of three individuals with only 11 pairs of ribs, and six individuals with extreme overbites is noteworthy.

Two individuals had small depressions in the skull bones, but the etiology of these anomalies are not known.

Dental occlusion could be inspected in 11 individuals, and among these, more than half – six individuals — were markedly overbite. Four individuals had edge-to-edge occlusion, and one individual, a Viking male, was underbite.

There were 505 surviving teeth. Of these, 445 were permanent teeth, and 60 deciduous. There was a low frequency of caries. Among the 445 inspected permanent teeth, 21 (4.7%) had caries, while there was no caries in the deciduous teeth. The 21 carious teeth were distributed among eight individuals, but nine of them were found in one individual, a 60-80 year old female.

5 Conclusions

The cemetery at Westness lay adjacent to a farm, which it served throughout many centuries. Several generations have been buried in the graveyard. The earliest graves are from the beginning of the seventh century, at which time the Picts inhabited the Orkney islands. The latest graves are from the 11th century, and contain the remains of the Viking settlers.

Differences in physical appearance between the Picts and the Vikings are detectable in the skeletal material. There are congenital anomalies which show a close biological relationship between several of the individuals.

The skeletal remains yield information about the lives and deaths of the people at Westness. In the investigated part of the cemetery there were about equal numbers of men and women, but there were relatively few children, which may indicate that most people survived childhood. Especially the women attained high ages, some of them living into old age. The men died earlier, in middle age. The skeletal remains are robust and well developed and give evidence of fairly good living conditions. The skeletons of the older individuals had markedly developed traces of degenerative joint disease, which is a very common finding in archaeological skeletal material. Some skeletons had traces of nonspecific infections, and two individuals may have had tuberculosis. There were some healed bone fractures. Dental conditions were fairly good. There was little caries, and periodontal disease was present but not very frequent.

The causes of death could not be determined for any of the individuals, although the man in the boat grave, Grave 34, probably suffered a violent death, as indicated by the four arrow points found in close association with the skeleton. The arrows had not left any marks on the bones, but one or more of the arrows probably killed him.

6 Sammendrag

Den foreliggende publikasjon er en foreløpig rapport om de antropologiske undersøkelsene av skjelettet materialet fra Westness på Rousay på Orknøyene, utgravd av arkeolog Sigrid Kaland, Universitetet i Bergen, mellom 1968 og 1984. Gravplassen omfattet både piktiske graver og vikingtidsgraver. Radiologiske dateringer omfatter tidsrommet mellom det syvende og det 11te århundre. Rapporten presenterer analysene av skjelettet materialet og resultatene av disse, samt omfatter en katalog over materialet, basisdata fra undersøkelsene, og diskusjoner av flere av forholdene som ble registrert under undersøkelsene.

De antropologiske analysene av materialet har bestått i makroskopiske undersøkelser av skjelettrestene. Antall individer og individenes kjønn og alder er bestemt. Knoklene er målt i henhold til Martin and Knussmann (1988). Tennene ble registrert i henhold til FDI-systemet, og ble målt etter retningslinjer gitt i Goose (1963). Nonmetriske trekk og patologiske og anomale forandringer på knokler og tenner er registrert. Basisdata for hvert individ finnes i samletabellene i Appendix A.

Rapporten dreier seg om undersøkelsene av skjelettrestene av 29 individer. Ytterligere tre individer ble funnet før Kaland's utgravninger fant sted. Disse tre er ikke tatt med i analysene her, men de er beskrevet i Appendix B nedenfor.

Blant de 29 individene var det 23 voksne og seks barn og ungdommer. Blant de voksne var det 10 menn, 12 kvinner og ett individ som ikke kunne kjønnsbestemmes. Skjelettrestene av de ikke utvokste individene stammet fra fem barn som ikke kunne kjønnsbestemmes; et ufødt barn i femte til sjette fostermåned, tre spedbarn og ett barn i syv-åtte års alderen, samt fra en ung gutt i 15-16 års alderen.

Gjennomsnittlig levde kvinnene lenger enn mennene. Den gjennomsnittlige dødsalder for voksne menn var ca 41 år, og for voksne kvinner ca 45 år. Men spredningen av individene i de voksne aldersgruppene var forskjellig for de to kjønn: Blant kvinnene fantes både unge voksne og meget gamle individer, mens det blant mennene i hovedsak var middelaldrende individer.

De gjennomsnittlige kranieindeksene for begge kjønn var i den lavere ende av intervallet for mellomskaller (*mesokran*) dvs. at gjennomsnittene tenderer mot langskallethet (*dolichokran*). Bare en skalle var kort og rund (*brachykran*). De få kraniene som var velbevarte nok til å bestemmes, lignet i form på skallene til norske og danske vikingtidsskjeletter.

Kroppshøyden kunne beregnes for syv menn og åtte kvinner. Gjennomsnittlig kroppshøyde for menn var 173.9 cm, og for kvinner 160.4 cm. Fem av de syv mennene var bemerkelsesverdige like i kroppshøyde, rundt ca 171–172 cm, mens to av mennene var betraktelig høyere, hele 10 cm høyere enn de andre. De to høye mennene ble funnet i de to båtgravene fra vikingtid. Blant kvinnene var seks individer mellom 160 og 165 cm høye, mens to var betydelig kortere, ca 152–154 cm. De korte mennene på Westness er lavere enn norske og danske vikingtidsmenn, mens de to høye mennene fra Westness med sine 180 cm er like høye

som den høyeste vikingtidsmann i det norske materialet, og bare ubetydelig kortere enn den høyeste mann i det tilsvarende danske materialet. De seks kvinnene over 160 cm i Westness-materialet er høyere enn gjennomsnittet for vikingtidens kvinner både i Danmark og Norge, mens de to korte kvinnene er kortere enn gjennomsnittene i det norske og danske vikingtidsmaterialet. Det var ingen unormalt korte eller unormalt høye individer i Westness-materialet. Kroppshøyde henger nøye sammen med ernæringens mengde og sammensetning, samt levekårene under oppveksten. Opptil ca 10% av kroppshøyden bestemmes av disse faktorene, mens resten bestemmes av arvelige forhold. De to høye vikingtidsmennene og de to korte kvinnene kan ha hatt noe forskjellige levekår under oppveksten enn de andre på gravplassen.

Forekomstfrekvensene i et sett nonmetriske trekk i kraniet og de postkranielle knoklene ble analysert og sammenlignet med data fra skjelettmaterialer fra en middelalderkirkegård på Orknøyene, fra nordbo-bygdene Vesterbygden og Østerbygden på Grønland, og fra jernalderens Danmark. Samlet sett var ikke forekomstfrekvensen signifikant forskjellig mellom Westness og de andre gruppene, selv om det ble funnet forskjeller for enkelte av trekkene.

Patologiske og anomale forandringer på Westness-skjelettene ble registrert og analysert. Det fantes opphelede bruddskader på flere ribben, hvirvler og et spoleben. Ett av individene hadde et dårlig helet brudd på høyre kraveben. Det fantes spor etter slitasjegikt, dvs. osteoartrose og spondylose, særlig blant de eldre individene. Noen individer hadde spor etter infeksjoner. Et barn hadde et deformert høyre lårben som skyldtes Legg-Calvé-Perthes' sykdom. To tilfeller av mulig tuberkulose ble registrert. I det ene tilfellet var det en stor abscess/cyste i en brysthvirvel med tilhørende ribben, og blant skjelettrestene fra begge ble det funnet forbenet lungehinnevev (pleura). Den ene av disse to var en ung voksen kvinne som var gravid da hun døde. Knoklene av et fem-seks måneder gammelt foster ble funnet mellom de noe deformerte hoftebenene på kvinneskjelettet.

Flere individer hadde medfødte, arvelig betingede anomalier. Noen av de samme anomaliene ble funnet hos flere individer, hvilket bekrefter formodningen om at gravplassen ble brukt av medlemmer av samme familie. For eksempel fantes det tre individer med bare 11 par ribben (det normale er 12), og seks individer med ekstremt overbitt.

På to individer fantes små groper på kraniet, men årsaken til dannelsen av disse gropene er ikke kjent.

Tannbittet kunne registreres hos 11 individer, og blant disse hadde seks et ekstremt overbitt i det fortennene i overkjeven stakk frem ca 1 cm foran fortennene i underkjeven. Fire individer hadde kant-i-kant bitt, og én mann, fra en av vikingtidsbåtgravene, var underbitt.

Blant 505 registrerte tenner var det 445 permanente tenner, og 60 melketenner. Karies forekom ikke særlig hyppig. Blant de 445 permanente tennene var 21 (4.7%) angrepet av karies, mens det ikke fantes karies i melketennene. De 21 karierte tennene var fordelt blant åtte individer, men hele ni av disse tennene fantes hos ett individ, en gammel kvinne.

7 Konklusjoner

Gravplassen på Westness lå nær en gård, og fungerte som gravplass for folkene på denne gården gjennom flere århundrer. Flere generasjoner er gravlagt på den lille gravplassen. De eldste gravene er fra begynnelsen av det syvende århundre da pikterne bodde på Orknøyene. De yngste gravene er fra det 11te århundre og rommer levningene av vikingtidens innvandrere.

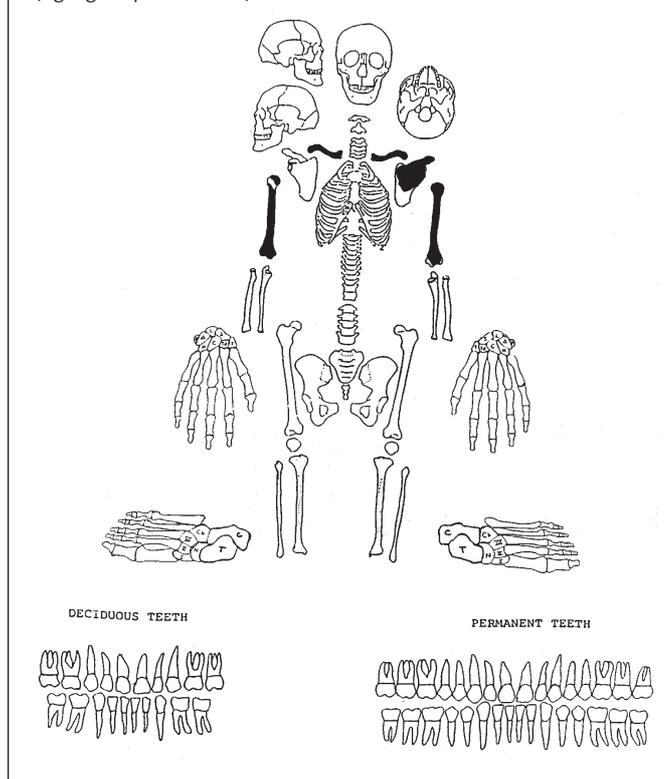
Skjelettmaterialet fremviser forskjeller i den fysiske fremtoningen av henholdsvis piktere og vikinger, og i skjelettrestene finnes medfødte anomalier som viser at det var et nært biologisk slektskap mellom flere av individene.

Skjelettrestene gir informasjon om liv og død blant folkene på Westness. I det undersøkte delen av gravplassen var det omtrent like mange menn som kvinner, men det var relativt få barn, hvilket kunne bety at folk flest overlevde barndommen. Særlig kvinnene levde til de ble ganske gamle, og noen oppnådde en betydelig alder. Mennene døde tidligere, som middelaldrende. Knoklene er robuste og velutviklede og viser at levekårene var ganske gode. Skjelettene av de eldre individene hadde spor etter osteoartrose, slik det er veldig vanlig å finne i skjeletter fra arkeologiske utgravninger. Noen skjeletter hadde spor etter forskjellige infeksjoner, og to individer kan ha hatt tuberkulose. Det ble også funnet en del opphelede bruddskader i skjelettene. Tannforholdene var relativt gode. Det var ikke mye karies, og parodontose fantes, men var ikke utbredt eller alvorlig.

Dødsårsaken kunne ikke entydig bestemmes for noen av individene, men det er sannsynlig at mannen i Grav 34, en vikingtids båtgrav, fikk en voldelig død, fordi fire pilespisser ble funnet i nær tilknytning til mannens skjelett. Pilespissene hadde ikke satt merker på knoklene, men en eller flere av dem har sannsynligvis drept ham.

8 Catalogue of the skeletal material from the Norwegian investigations

GRAVE 2 (1): Indeterminate sex, 35-55 years
(age group *Maturus*)



GRAVE 2 (1): Indeterminate sex, 35-55 years (age group *Maturus*)

This is the upper skeleton of Grave 2.

Surviving material

Incomplete skeleton. The surviving material available for investigation consists of both upper arm bones (*humeri*), both collar bones (*claviculae*) and the left shoulder blade (*scapula*).

Condition

The bones are damaged, but several measurements could be taken.

Sex

Indeterminate sex. There are no clear sex determining criteria.⁴⁹

Age

The age has been estimated to be between 35 and 55 years, that is, middle-aged (age group *Maturus*), based on the appearance of the epiphyses and the condition of the joint surfaces.

Pathologies and anomalies

The left collar bone is severely deformed, perhaps a healed fracture. There is osteophyte formation, pitting and eburnation on the acromial end of the bone. The muscle attachment areas on the upper half of the upper arm bones are strongly developed, especially on the right side.

Stature

The only bone available for stature calculation is the right upper arm bone. If the remains are of a male, the stature is calculated to 164.8 cm (+/- 4.57). If the bones are of a female, the stature is 161.3 cm (+/- 4.45) or 158.8 cm, depending on value of the constant, see (Trotter and Gleser 1952; Trotter and Gleser 1958). The individual was thus either a fairly short male, or a fairly tall female.

Cranial indices

No cranial indices could be calculated.

Other information

According to Larsen (Larsen 1972), there was more surviving material when he investigated this skeleton than what has been available for the present investigation. The following is a translation from his article (which is in German) on the shoulder injury:

One of the graves contained two skeletons, one lying above the other in a jumbled heap of bones. The skeleton in the bone heap was incomplete. For example, all vertebrae and almost all bones from hands and feet were missing. The other parts were severely postmortally damaged. However, it is possible to determine, with a certain degree of confidence, that the remains are of a c. 60-year old male, approximately 164 cm tall.

Larsen discusses the injury, which he interprets as the result of torture, suggesting that the man's arms were tied behind his back, and that he was strung up by the wrist ties. Larsen describes the left collar bone as follows:

The left collar bone is somewhat shortened and has a deformed acromial end. According to radiographs, there was probably an old fracture. In the place of the insertion of the coracoclavicular ligament there is a c. 2 cm long exostosis, which must be interpreted as an ossified ligament. Judging from the state of osteoarthritis of the joints throughout in the preserved bones, the severe deformations of the lateral end of the collar bone must have been caused by a sudden traumatic stress, for example luxation, with resulting rupture of the ligament.

Larsen concludes that, even if the person was not subjected to torture, the pathological changes to the collar bone are consistent with a traumatic injury in the manner described above.

SUMMARY

The upper skeleton in Grave 2 was incomplete, and the bones were damaged postmortally. The remains are of an individual of indeterminate sex, possibly a male. If the individual was male, he was rather short, approximately 164.5 cm. The left collar bone was severely deformed, probably as a result of a traumatic injury caused by an accident. There were traces of osteoarthritis in the joints, and there were strongly developed muscle attachment areas on both upper arms, indicating hard physical stress on the arm muscles.

GRAVE 2 (2): Male, 20-30 years (age group *Adultus*)

This is the lower skeleton of Grave 2.

Surviving material

Incomplete skeleton. Only the mandible is preserved.

Condition

The mandible is relatively well preserved, as are the extant teeth: almost all measurements could be taken.

Sex

The size and shape of the bone indicates male: the mandible has a square "chin", and steeply rising rami. The sex has been determined as male.

Age

The age has been estimated to be between 20 and 30 years, that is, in the age group *Adultus*. The age estimation is based on dental features (attrition, degree of retraction of alveolar bone, translucency of roots).

Pathologies and anomalies

The first molar on the right side of the lower jaw (tooth 46) has an *intra vitam* enamel fracture. There is a certain amount of calculus, especially on the lingual side of the front teeth. There is no caries.

Stature

Cannot be estimated.

Cranial indices

Cannot be calculated.

SUMMARY

The mandible is of a young adult male, probably between 20 and 30 years of age at death. Dental attrition is moderate, and there is no caries. The lower right first molar has an enamel fracture, which occurred while the man was living.

GRAVE 5: Female, 35-45 years (age group *Maturus*)

Surviving material

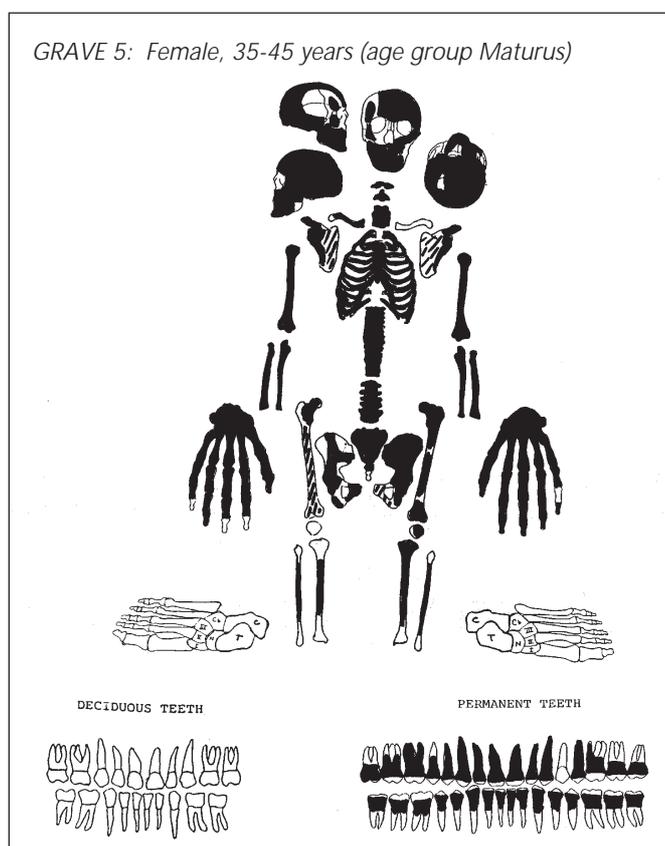
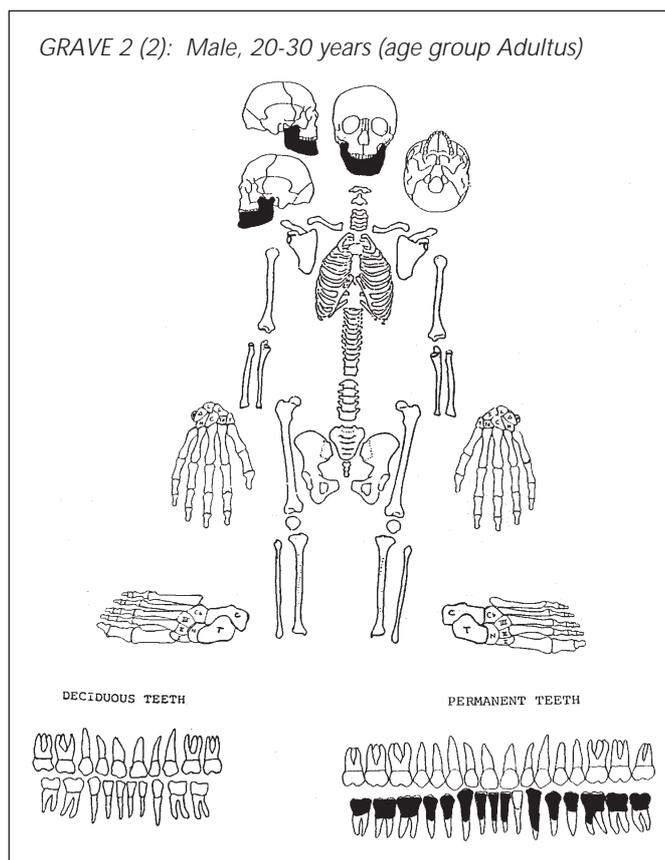
Complete skeleton except that the bones from both feet are missing. Fragments of 12 ribs (85 grams) have been used for ¹⁴C-analysis.

Condition

The skull is damaged, but a few measurements could be taken. The bones from both arms are intact, while the thigh bones and leg bones are damaged/fragmented.

Sex

Based on pelvic, cranial and postcranial traits, the sex has been determined as female.



Age

Based on dental conditions, the appearance of cranial sutures and the pubic symphysis, the age has been determined as *Maturus*, between 35 and 45 years.

Pathologies and anomalies

There is a depression on the frontal bone (resembling a pseudo-trepanation), approximately circular, c. 1.2 x 1 cm, located c. 2 cm to the left of bregma, close to the coronal suture, c. 1.5 mm deep. The bone is slightly thickened on the internal surface, but smooth. There is almost a groove around the perimeter, and the bone is roughened in the middle of the depression. There are very slight osteoarthritic changes (osteophytes) on the small joints of a few vertebrae, and in the sacroiliac and sternocostal joints. The left fibula is pathologically thickened with marked signs of periostitis with a rather porous surface. There are slighter signs of periostitis on both tibiae and the right fibula. There is moderate dental attrition, and quite heavy calculus, especially on the lingual side of the front teeth in both jaws. There is caries in the first and second right upper molars, and traces of enamel hypoplasias in several teeth. There are slight pathological changes in the jaw bones in and around the alveoles of the carious teeth. Edge-to-edge dental occlusion.

Stature

Stature has been calculated to c. 152 cm, based on the maximum length measures of both upper arm bones (Trotter and Gleser 1952; Trotter and Gleser 1958). It was not possible to measure the lengths of the femora.

Cranial indices

The breadth-length index of the skull is 77.8, which means that the skull is *mesocranial* in shape, or of medium breadth relative to the length.

SUMMARY

Grave 5 contained the remains of a middle-aged female, c. 35-45 years of age at death. She was of fairly short stature, c. 152 cm tall, with a *mesocranial* skull. There were rather severe pathological changes in the left shin bone, with formation of new bone (bone apposition) on the shaft, perhaps the sequela of periostitis. There was caries in two teeth. Edge-to-edge occlusion.

GRAVE 6: Female, 50-70 years (age group *Maturus/Senilis*)

Surviving material

Complete skeleton, although parts of the skull, the left pelvic bone, and small hand- and footbones are missing. The fragmented left femur was used for ¹⁴C-analysis (c. 220 grams).

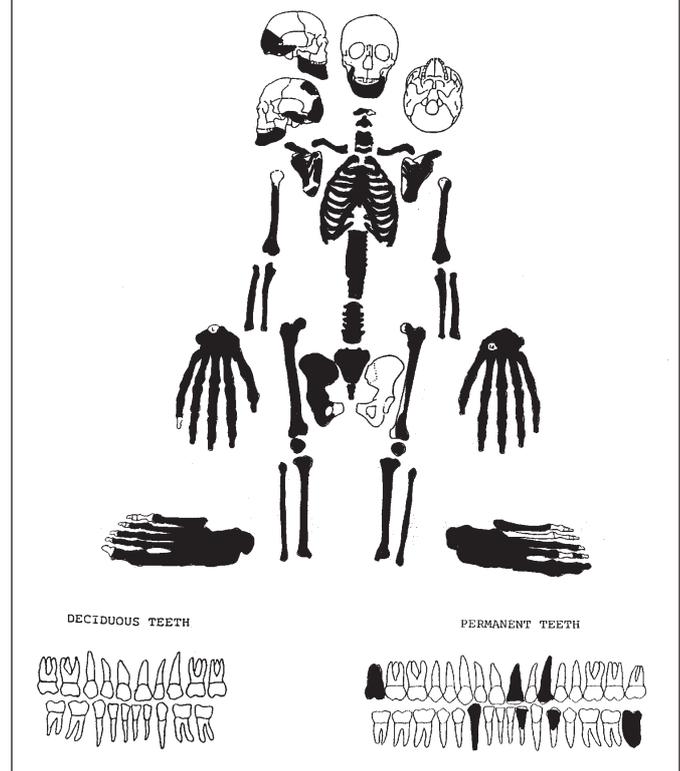
Condition

The skull is fragmented, while the postcranial skeleton is fairly well preserved.

Sex

The sex has been determined as female, based on traits of the pelvis, the skull and the major long bones. The skeleton is gracile.

GRAVE 6: Female, 50-70 years (age group *Maturus/Senilis*)



Age

Age at death has been estimated to between c. 50-70 years (age group *Maturus/Senilis*), based on the dental conditions, sutural closure and appearance of the large joints.

Pathologies and anomalies

There are marked to severe osteoarthritic changes in almost all vertebrae and in most of the smaller and larger joints, in many cases with eburnated areas. The second lumbar vertebra is wedge-shaped, possibly as a result of a fracture. Ten ribs have healed fractures. The distal end of the right radius has a healed fracture. There are anomalous changes in the mandible, and extensive *intra vitam* tooth loss.

Stature

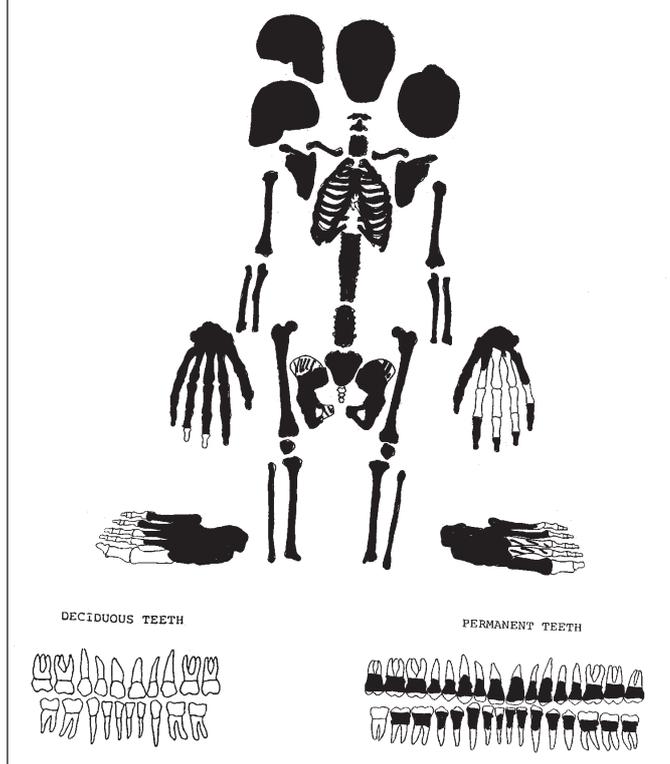
Stature has been calculated to 153.8 cm, based on the maximum length measure of the femora. If other major long bones could have been used in the calculations, the calculated stature might be slightly higher.

Cranial indices

No cranial measurement could be taken, hence no indices could be calculated.

SUMMARY

The individual in Grave 6 was an elderly female, 50-70 years of age at death, with marked to severe traces of osteoarthritis and many healed fractures; a lumbar vertebra, several ribs, and the right radius were afflicted. There had been extensive *intra vitam* tooth loss.

GRAVE 7: Female, 50-70 years (age group *Maturus/Senilis*)

GRAVE 7: Female, 50-70 years (age group *Maturus/Senilis*)

Surviving material

Complete skeleton. Only a few hand- and foot bones are missing.

Condition

The skeleton is very well preserved, and most of the relevant measurements could be taken.

Sex

The sex has been determined as female, based on traits of the pelvis, the skull and the postcranial bones. The skeleton is gracile.

Age

The age has been estimated to be c. 50–70 years at the time of death (age group *Maturus/Senilis*), based on age related changes in the pubic symphysis, the dentition, the cranial sutures, and the appearance of the major joints.

Pathologies and anomalies

The coronal and sagittal sutures are completely obliterated. Osteoarthritic changes throughout the skeleton, especially severe in the lumbar vertebrae. Sacralization of the fifth lumbar vertebra. There were plaques of pleural calcification, bagged and marked as "bony matter from within the rib cage". The left clavicle is 1 cm longer than the right, and both bones have marked muscle attachment areas. Osteoarthritic changes in both sternoclavicular joints. Osteoarthritic changes and marked

muscle attachment areas in both hands. Heavy dental attrition. No caries. Anomalous dental occlusion, with 6 mm horizontal overbite. The central incisors of the lower jaw are crowded, while there is a diastema between the upper central incisors.

Stature

The stature is calculated to 164.5 cm, based on the maximum length measurements of both thigh bones.

Cranial indices

The breadth-length index of the skull is 75.8, which means that the skull is *mesocranial*, that is, of medium breadth relative to the length. Both eye sockets have height-breadth index values of 82.9, *mesoconch*, which means they are rectangular in shape. The nasal aperture is of medium width relative to height, but tending towards being narrow, with an index of 47.1, *mesorhine*.

SUMMARY

The individual was an elderly female, c. 50-70 years of age, with very marked traces of osteoarthritis throughout the skeleton. Pathological changes and the presence of calcified pleura may indicate tuberculosis. The woman had a very marked horizontal overbite of 6 mm.

GRAVE 8: Female, 60-80 years (age group *Senilis*)

Surviving material

Incomplete skeleton: both thigh bones and both shin bones are missing.

Condition

The extant bones are relatively well preserved.

Sex

The sex has been determined as female, based on pelvic, cranial and postcranial traits.

Age

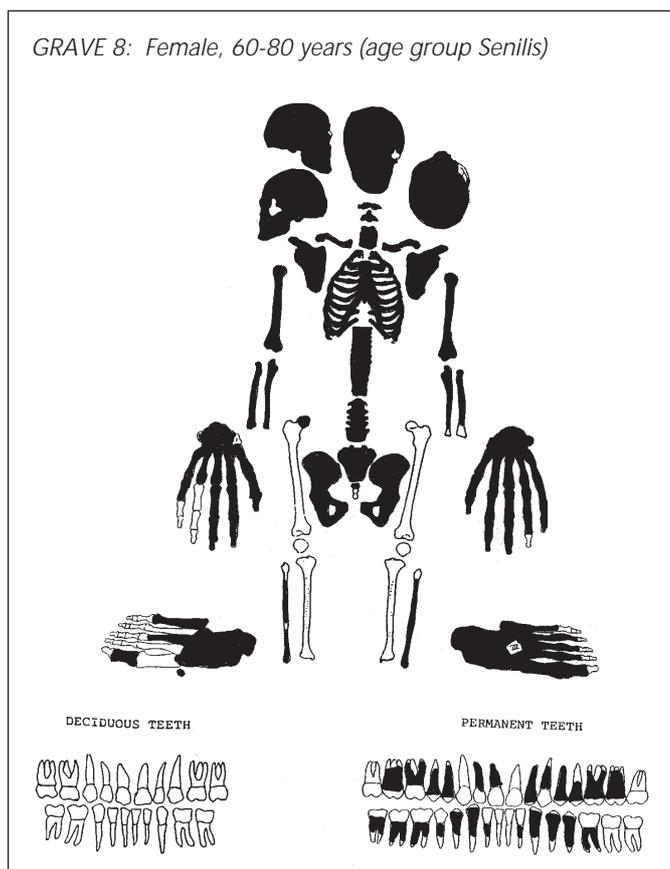
The age at death has been estimated to between 60 and 80 years, the age group *Maturus/Senilis*. The age estimation is based on the appearance of the pubic symphysis, cranial sutures, dental attrition and the appearance of the large joints.

Pathologies and anomalies

Severe osteoarthritis in practically all vertebrae, as well as other anomalies. Sacralization of the fifth lumbar vertebra. In addition there are six sacral vertebrae. There is a pseudarthrosis between the neural arches of the fourth and fifth lumbar vertebrae. Severe osteoarthritic changes in both hands. Extreme dental attrition, and extensive caries. Pathological changes in the jaw bones.

Stature

The stature has been calculated to 164.8 cm, based on the maximum length of the upper arm bones.



Cranial indices

The cranial breadth-length index is 71.1, which means that the skull is long and narrow, *dolichocranial*. Only the right eye socket could be measured, and the index for that is 86.4, that is, an almost square aperture, *hypsiconch*. The nasal aperture index is 45.3, which means a narrow nasal opening, *leptorrhine*.

SUMMARY

The individual in Grave 8 was an elderly female, between 60 and 80 years at the time of death. She had a long and narrow skull, with almost square eye sockets, and a narrow nasal aperture. She had been severely afflicted with osteoarthritis, and had extreme dental attrition and caries in many teeth, as well as pathological changes in the jaw bones (alveolar processes).

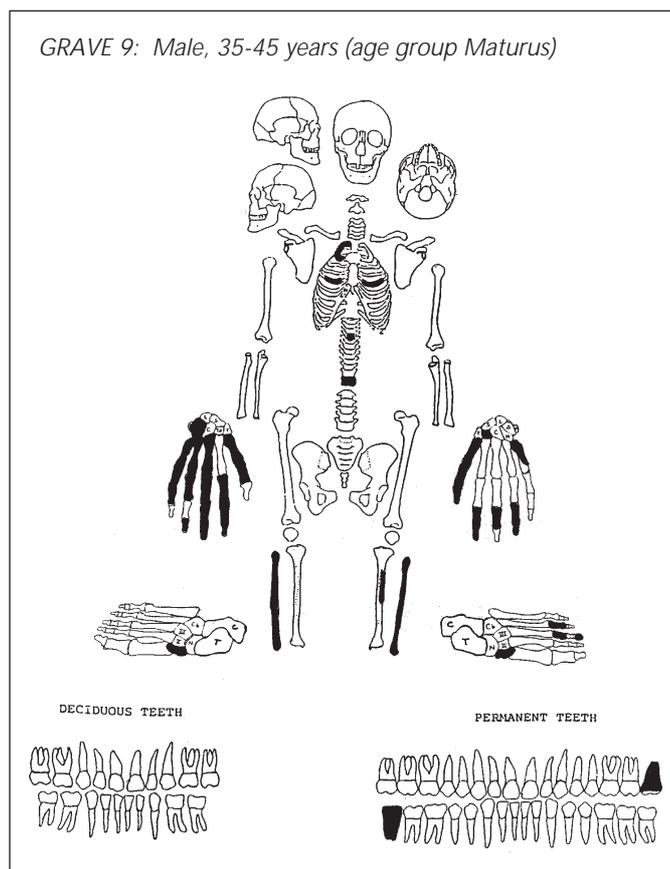
**GRAVE 9:
Male, 35-45 years (age group *Maturus*)**

Surviving material

Only a few bones and fragments have survived of this skeleton. No skull fragments are extant, but two teeth were recovered. Fragments of the left femur, c. 65 grams, were used for ¹⁴C-analysis.

Condition

The extant bones are fairly well preserved.



Sex

The sex has been determined as male, based on postcranial bone morphology.

Age

The age at death has been estimated to between 35 and 45 years, the age group *Maturus*, based on dental conditions, and age related changes in the extant bones.

Pathologies and anomalies

There is a bony spur on the right fibula, c. 10 mm long, located c. 4 cm below the knee joint. The body of the 12th thoracic vertebra is compressed, and there are marked osteophytes around the edges on the upper surface of the vertebral body. There is calculus on both surviving loose teeth.

Stature

Cannot be calculated.

Cranial indices

Cannot be calculated.

SUMMARY

The individual in Grave 9 was a middle-aged male, 35-45 years of age at death. Only a few bones and fragments and two loose teeth have survived from his skeleton. He had a compressed vertebra in the lower thoracic spine, and a bony spur on the right leg bone below the knee joint.

GRAVE 10: Female, 20-25 years (age group *Adultus*)

GRAVE 10: Female, 20-25 years (age group *Adultus*)

Surviving material

Complete skeleton. Only some of the smaller finger and toe bones are missing. C. 70 grams of rib fragments have been used for ^{14}C -analysis.

Condition

Relatively well preserved.

Sex

The sex has been determined as female, based on pelvic, cranial and postcranial traits.

Age

The age at death has been estimated to between 20 and 25 years, the age group *Adultus*, based on the degree of closure of the sphenobasilar synchondrosis, the appearance of the pubic symphysis and on dental conditions.

Pathologies and anomalies

The woman had only 11 pairs of ribs (the normal is 12), and the 12th thoracic vertebra is lumbarized. There are slight osteoarthritic changes in the vertebrae, and there are osteophytes around the pubic symphysis. The woman had a 7 mm overbite. Dental attrition is slight to moderate. There was no caries, nor any pathological changes in the jaw bones.

Stature

Stature has been calculated to 162.5 cm, based on the maximum lengths of the femora.

Cranial indices

The cranial breadth-length index is 72.8, which is *dolichocranial*, i.e., a long and narrow skull, of medium height (72.3, *orthocranial*), with a fairly low and broad upper face (84.6, *euryprosop*), and a medium high face seen as a whole (51.5, *mesene*). The eye sockets are asymmetrical, the right being almost square (90.9, *hypsiconch*) and the left rectangular (80.9, *mesoconch*). The nasal aperture is medium broad (47.2, *mesorrhine*).

SUMMARY

The individual in Grave 10 was a young adult female, c. 20-25 years of age at death. She was c. 163 cm tall, had a long and narrow skull with a face of medium height and breadth, rectangular to square eye openings and a medium broad nasal aperture. She was markedly overbite.

GRAVE 11: Male, 45-55 years (age group *Maturus*)

Surviving material

The whole skeleton is represented, but some bones are missing, such as all bones from the left hand, the left pelvic bone, the sacrum and several thoracic vertebrae. C. 90 grams of various bone fragments have been used for ^{14}C -analysis.

Condition

The surviving bones are damaged or fragmented, and only a few measurements could be taken.

Sex

The sex has been determined as male, based on traits in the skull, pelvis and postcranial bones.

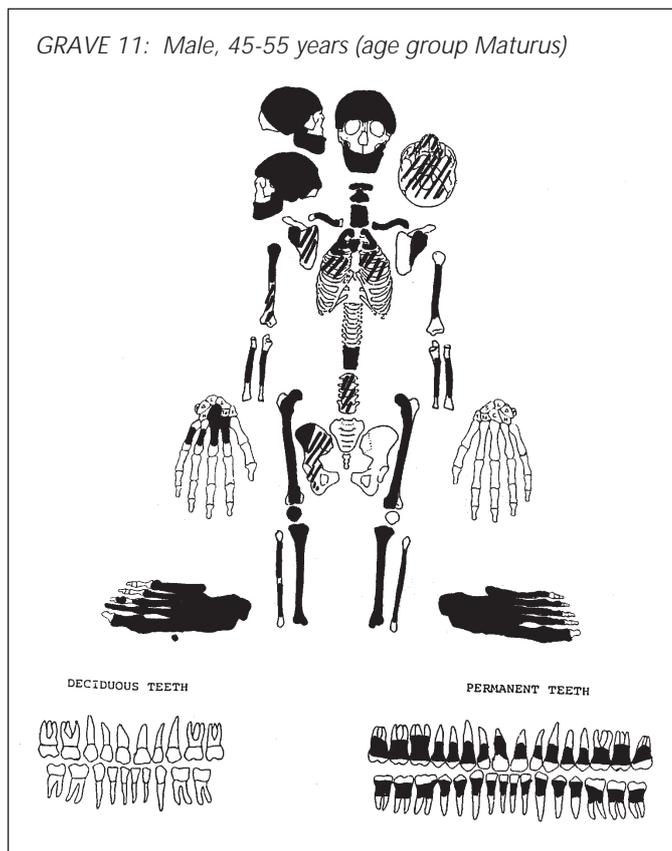
Age

The age at death has been estimated to be between 45 and 55 years, age group *Maturus*. The cranial sutures are obliterated, and the dental attrition is heavy.

Pathologies and anomalies

There are rusty spots on many of the bones, and on the left elbow and left lower leg there are small fragments of rusted metal stuck on the bones. The first cervical vertebra is ankylosed to the basis of the skull. There are severe osteoarthritic changes in the other cervical vertebrae. The left first rib is deformed. On both feet there is hallux valgus. There is heavy dental attrition. In the left second premolar of the lower jaw there is caries. The crown of the left first premolar of the lower jaw was fractured *intra vitam*. Several tooth crowns have chipped enamel. There is mechanical abrasion on the upper central and lateral incisors, and some pathological changes in the jaw bones.

GRAVE 11: Male, 45-55 years (age group *Maturus*)



Stature

Stature has been calculated to 180.6 cm, based on the maximum length of the right femur.

Cranial indices

None of the cranial indices could be calculated.

Other information

The man was buried in a boat.

SUMMARY

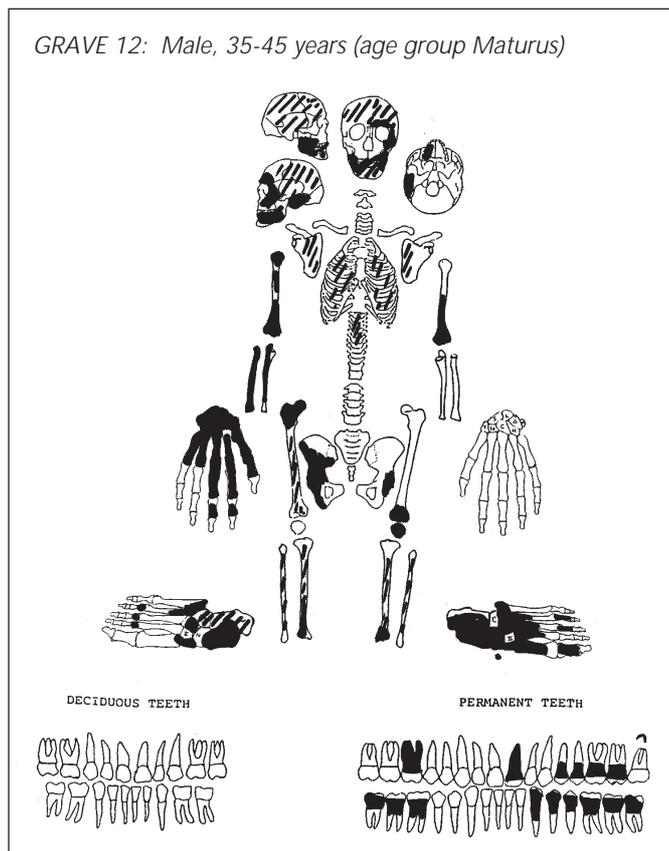
The boat grave, Grave 11, contained the remains of a tall, middle-aged male, c. 45-55 years and c. 181 cm tall. He had severe osteoarthritic changes in the cervical vertebrae, and the first cervical vertebra was ankylosed to the basis of the skull. The first left rib was deformed. His teeth were heavily worn, and there were pathological changes in the jaw bones. There were signs of mechanical abrasion on the upper front teeth, some enamel chipping and a fractured dental crown. Iron objects in the grave had left rusty stains on many of the bones.

**GRAVE 12:
Male, 35-45 years (age group *Maturus*)**

Surviving material

There are surviving bone fragments from most of the skeleton, but the lower left arm and hand are missing, as are most of the vertebrae and the clavicular bones. C. 90 grams of bone fragments have been used for ¹⁴C-analysis.

GRAVE 12: Male, 35-45 years (age group *Maturus*)



Condition

The skull is completely fragmented, and only a few measurements could be taken on some of the postcranial bones, which are also mostly fragmented.

Sex

The sex has been determined as male, based on traits of the pelvis, the skull and the postcranial bones, which are very large and robust.

Age

Age at death has been estimated to c. 35 to 45 years, the age group *Maturus*: The cranial sutures are closed and there is beginning obliteration, and the teeth are heavily worn.

Pathologies and anomalies

There are no pathological changes on the surviving bone fragments. There is some dental calculus, but no caries and no pathological changes in the jaw bones.

Stature

Stature could not be calculated.

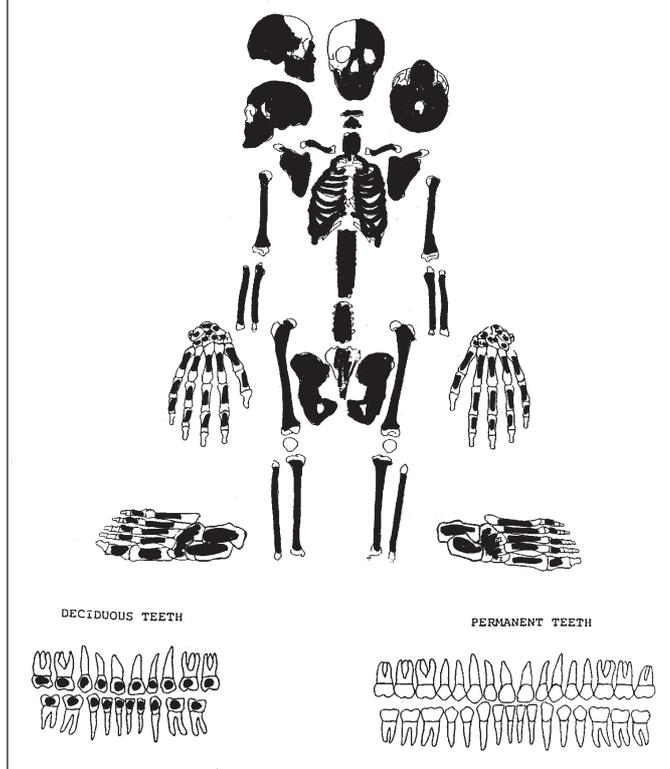
Cranial indices

Cranial indices could not be calculated.

SUMMARY

The individual in Grave 12 was a middle-aged male, between c. 35 and 45 years, with large bones and a robust skeleton. There were no pathological changes in the bone fragments.

GRAVE 13: Indeterminate sex, 7-8 months (age group *Infans I*)



GRAVE 13:
Indeterminate sex, 7-8 months (age group *Infans I*)

Surviving material

Complete skeleton. C. 25 grams of bones have been used for ¹⁴C-analysis (the left hip bone, thigh bone, shin bone and leg bone).

Condition

The skull is relatively well preserved, and the postcranial bones are intact.

Sex

Cannot be determined.

Age

The age at death has been determined to between seven and eight months, age group *Infans I*, based on dental development and the size of the postcranial bones.

Pathologies and anomalies

The infant has only 11 pairs of ribs. Eight of the neural arches of the thoracic vertebrae are ankylosed. There are very severe enamel hypoplasias on four unerupted teeth, that is, on the upper and lower central and lateral incisors: dark brown to black spots at the incisal edges. The location of the enamel hypoplasias correspond to disturbances in dental development around the fifth foetal month.

Stature

Cannot be calculated.

Cranial indices

Cannot be calculated.

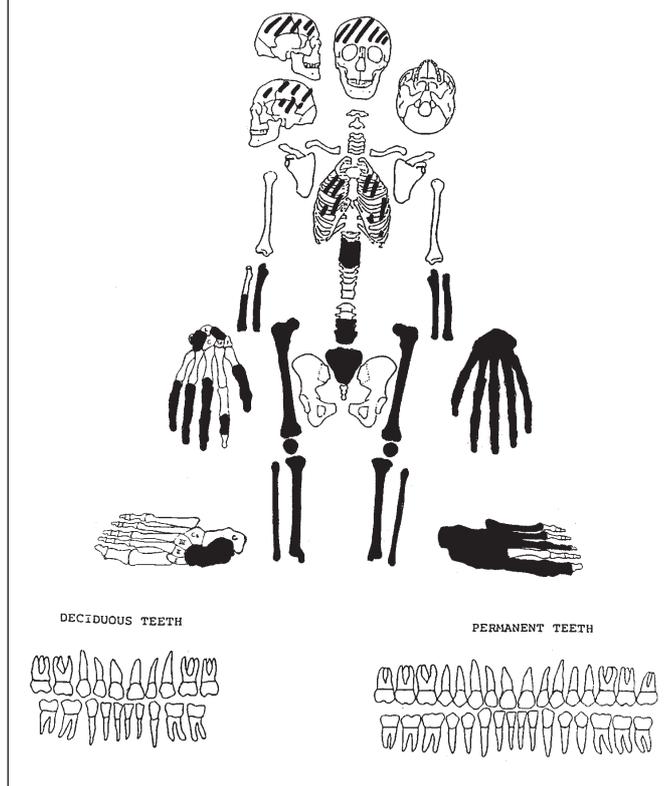
Other information

All bones from the right side of the body were systematically bagged and marked as "left side", and *vice versa*. If this is not just a mistake, it means that the child was buried face down.

SUMMARY

Grave 13 contained the skeletal remains of a seven-eight month old infant. There were pathological changes in the spine (several vertebrae were ankylosed) and in all four incisors. The child only had 11 pairs of ribs. See the notes for Grave 10, young adult female, who also had only 11 pairs of ribs. Perhaps these two are mother and child? The ¹⁴C-dates of the skeletons correspond.

GRAVE 14: Male, 20-60 years (age group *Grown*)



GRAVE 14:
Male, 20-60 years (age group *Grown*)

Surviving material

Incomplete skeleton. Most of the upper part of the skeleton is missing. There are only a few cranial fragments.

Condition

The extant bones are mostly intact.

Sex

The sex has been determined as male, based on traits in the pelvis and postcranial bones. The bones are very robust, although not particularly large.

Age

The male was grown, but it is not possible to allocate the skeleton to an age group.

Pathologies and anomalies

The bones are very thick and robust, with heavily marked muscle attachment areas. There is pseudarthrosis between the fifth lumbar and the first sacral vertebrae. The left elbow bone (*ulna*) is bowed, almost S-shaped.

Stature

Stature has been calculated to 171.1 cm, based on the maximum length measures of the femora.

Cranial indices

Cannot be calculated.

SUMMARY

The individual in Grave 14 was a grown male, over 20 years of age, heavily built, not particularly tall, c. 171 cm.

GRAVE 15:

Male, 45-55 years (age group Maturus)

Surviving material

Incomplete skeleton. Only a few bones and fragments have survived, mainly vertebrae, the left radius, some ribs and finger bones.

Condition

The bones are fragmented and badly preserved.

Sex

The postcranial bones and fragments are large and robust and the sex has been determined as probably male.

Age

The age at death has been estimated to between 45 and 55 years, that is, a middle-aged to old individual.

Pathologies and anomalies

There are marked osteoarthritic changes in the lower part of the spine, with spondylosis, Schmorl's depressions, strongly developed osteophytes and other anomalies in the vertebrae. The 11th and 12th thoracic vertebral bodies are compressed.

Stature

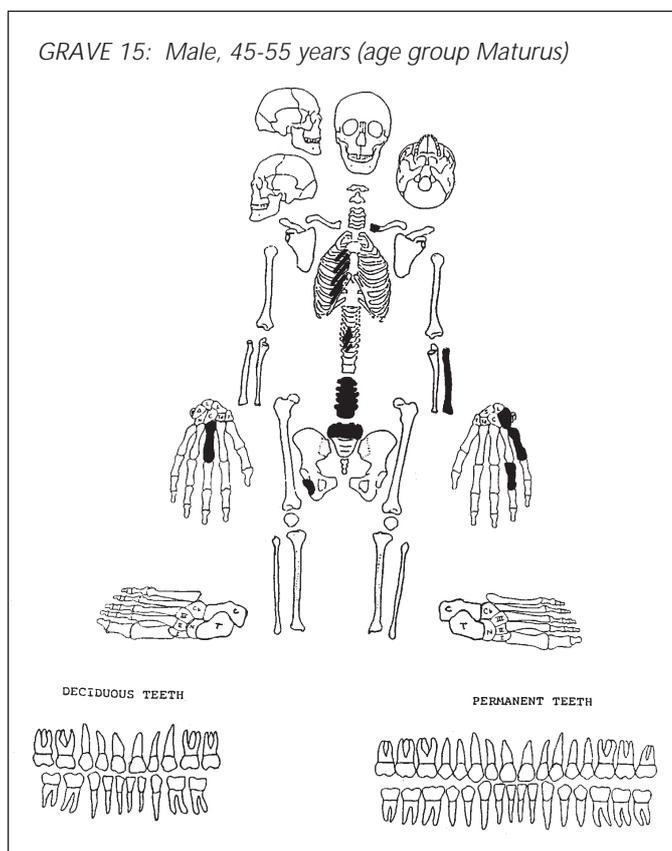
Cannot be calculated.

Cranial indices

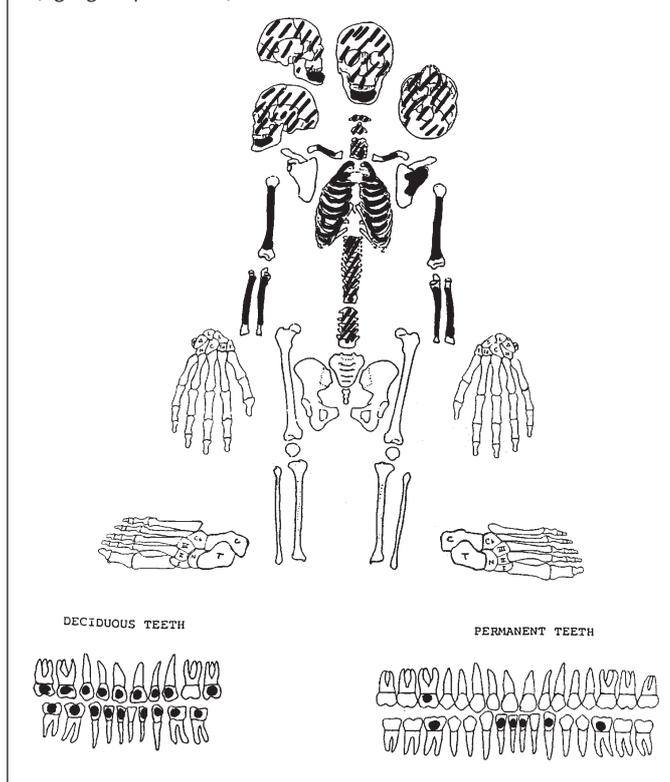
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SUMMARY

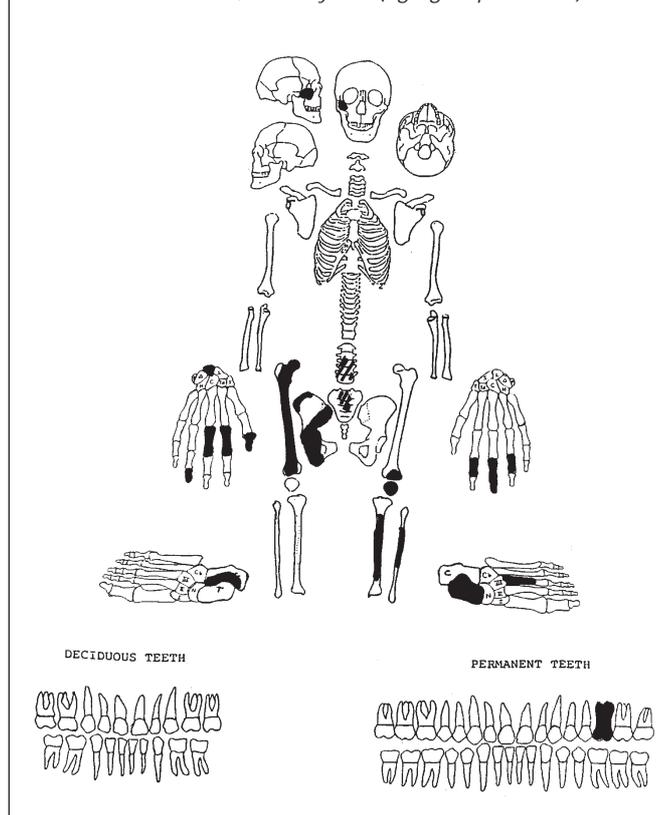
The individual in Grave 15 was a middle-aged male, who had suffered from severe osteoarthritis and fractures of the two lowest thoracic vertebrae. He was probably rather large and robust.



GRAVE 17: Indeterminate sex, 6 months
(age group *Infans I*)



GRAVE 18: Female, 20-35 years (age group *Adultus*)



GRAVE 17:
Indeterminate sex, six months (age group *Infans I*)

Surviving material

Incomplete skeleton. Only fragments of the upper skeleton had survived. C. 28 grams of fragments were used for ¹⁴C-analysis.

Condition

Badly preserved and fragmented bones.

Sex

Cannot be determined.

Age

Age at death has been estimated to c. six months, age group *Infans I*, based on dental development.

Pathologies and anomalies

None observed.

Stature

Cannot be calculated.

Cranial indices

Cannot be calculated.

SUMMARY

The individual in Grave 17 was a six-month old infant of indeterminate sex.

GRAVE 18:
Female, 20-35 years (age group *Adultus*)

Surviving material

Incomplete skeleton. Only a few fragments and bones from the lower part of the body, and a few cranial fragments and one loose tooth have survived. C. 70 grams of bone fragments have been used for ¹⁴C-analysis.

Condition

Very badly preserved, fragmented.

Sex

Sex has been determined as probably female, based on traits in the pelvic bones and other postcranial bones.

Age

Age at death has been estimated to between 20 to 35 years, the age group *Adultus*.

Pathologies and anomalies

There are no pathological changes or anomalies in the surviving bones and fragments.

Stature

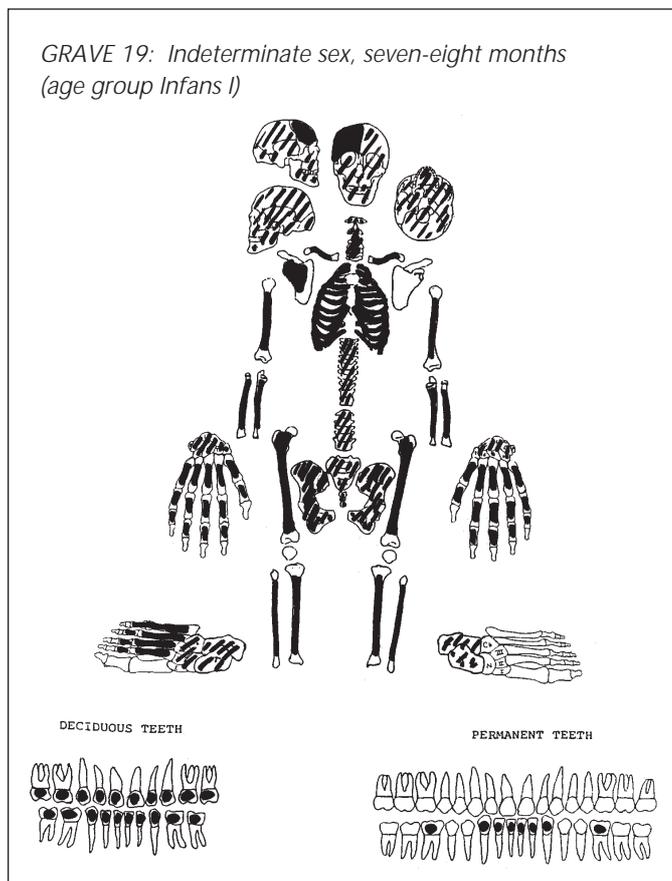
Cannot be calculated.

Cranial indices

Cannot be calculated.

SUMMARY

The individual in Grave 18 was a young adult female, between 20 and 35 years of age.



GRAVE 19:
Indeterminate sex, seven-eight months (age group *Infans I*)

Surviving material

Complete skeleton. Only a few smaller bones are missing. C. 23 grams of rib fragments have been used for ¹⁴C-analysis.

Condition

The bones are fragmented and badly preserved.

Sex

Cannot be determined.

Age

Age at death has been estimated to between seven and eight months, the age group *Infans I*, based on dental development.

Pathologies and anomalies

There are slight traces of *cribra orbitalia* in the roof of the surviving right eye socket.

Stature

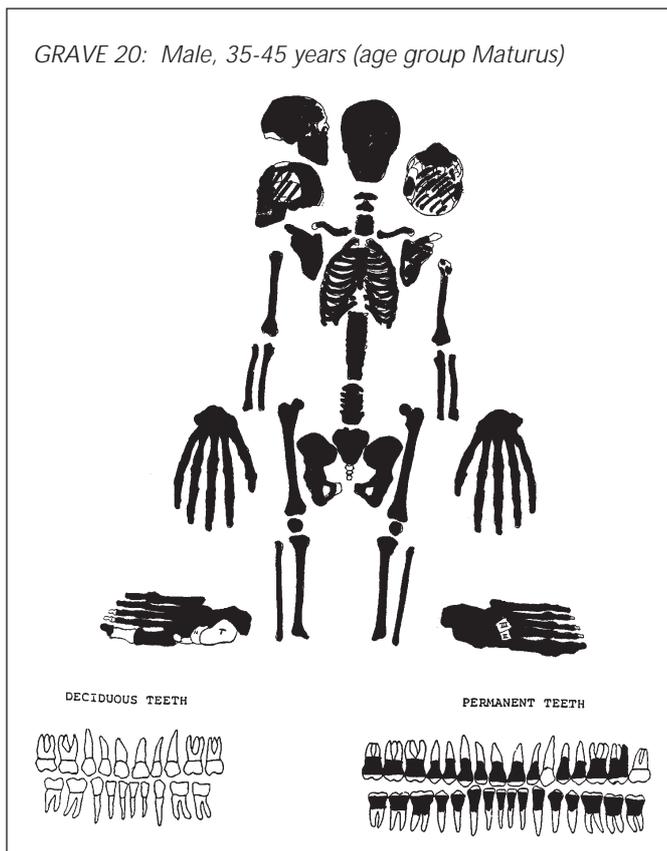
Cannot be calculated.

Cranial indices

Cannot be calculated.

SUMMARY

The individual in Grave 19 was a seven-eight month old infant of indeterminate sex, who had probably suffered from slight iron deficiency anemia.



GRAVE 20:
Male, 35-45 years (age group *Maturus*)

Surviving material

Complete skeleton. Only a few minor bones are missing. C. 100 grams of rib fragments have been used for ¹⁴C-analysis.

Condition

The skull is damaged, but the postcranial bones are intact.

Sex

Sex has been determined as male, based on cranial, pelvic and postcranial traits.

Age

Age at death has been estimated to between 35 and 45 years, age group *Maturus*. The cranial sutures have begun to obliterate, and the appearance of the pubic symphysis accords with the age group *Maturus*. There is fairly heavy dental attrition.

Pathologies and anomalies

There are osteoarthritic changes in the lower spine and in the hip joints. The left shin bone (*tibia*) has anomalous changes below the knee joint, with bone apposition and a rather marked muscle attachment area. The distal and medial phalanges of both right and left little toes are synostosed. There are cyst-like depressions on the medial cuneiform bone of the right foot, and the right elbow bone (*ulna*) has a large foramen nutricium in the middle of the shaft, while there is no such foramen on the left ulna. The upper left canine tooth and wisdom tooth were lost *intra vitam*. In the wisdom tooth area there is a severe pathological reaction. There is caries in the right upper first molar, and the crown was fractured. There is extensive but not heavy dental calculus throughout. There is anomalous attrition (abrasion) on the upper front teeth and on the two lower canines, and there is extensive enamel chipping. The occlusion was edge-to-edge.

Stature

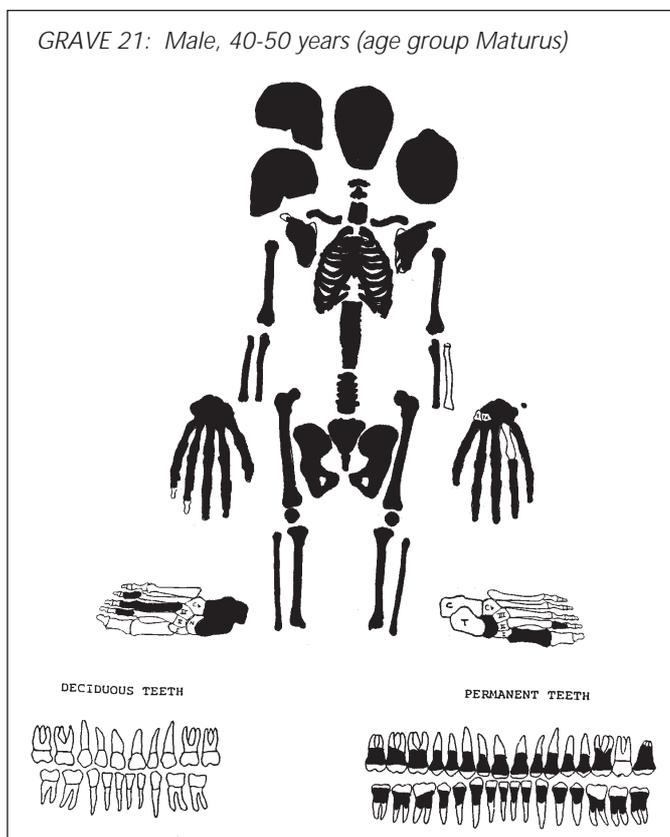
Stature has been calculated to 171.6 cm, based on the maximum lengths of the femora.

Cranial indices

Only indices for the left eye socket and the nasal aperture could be calculated. The eye socket is low and rectangular (*chamaeconch*), with an index of 73.9. The nasal aperture is very narrow, *leptorrhine*, with an index of 43.4.

SUMMARY

The individual in Grave 20 was a robustly built middle-aged male, between 35 and 45 years, with osteoarthritis in the lower spine, and minor anomalies in some of the bones. There are pathological changes in the teeth and jaw bones.



GRAVE 21: Male, 40-50 years (age group *Maturus*)

Surviving material

Complete skeleton. Only a few minor bones are missing. 57 grams of fragments from the left leg bone (*fibula*) have been used for ^{14}C -analysis.

Condition

The surviving bones are intact.

Sex

Sex has been determined as male, based on pelvic, cranial and post-cranial criteria. The bones are not particularly robust, but there are marked muscle attachment areas, especially on the occipital bone.

Age

Age at death has been estimated to between 40 and 50 years, age group *Maturus*, based on changes in the pubic symphysis and the cranial sutures, which have begun to obliterate.

Pathologies and anomalies

There are extensive osteoarthritic changes in the spine, and the development is very severe in the lumbar and thoracic vertebrae. The body of the fifth lumbar vertebra is compressed, there is extreme osteophyte formation to the extent that there is pseudoarthrosis between the vertebral osteophyte and sacrum; there is extreme osteophyte development on the ninth and 10th thoracic vertebrae. The small joints of the first and second cervical vertebrae have eburnated areas and marked osteophytes. The right clavicle, three right and three left ribs have healed fractures.

Stature

Stature has been calculated to 171.7 cm, based on the maximum lengths of the femora.

Cranial indices

The skull is *mesocranial*, that is, of medium breadth relative to the length, with an index of 75.5. It is rather flat, *chamaecranial*, index 68.9. The facial index is *mesoprosop*, that is, of medium breadth relative to the height, index 85.5, while the upper face has an index of 50.7, *mesene*, thus also of medium breadth relative to height. Both eye sockets are rectangular with indices of respectively 81.0 for the right and 78.6 for the left socket, *mesoconch*. The nasal aperture is narrow to medium, index 47.1, *mesorrhine*.

SUMMARY

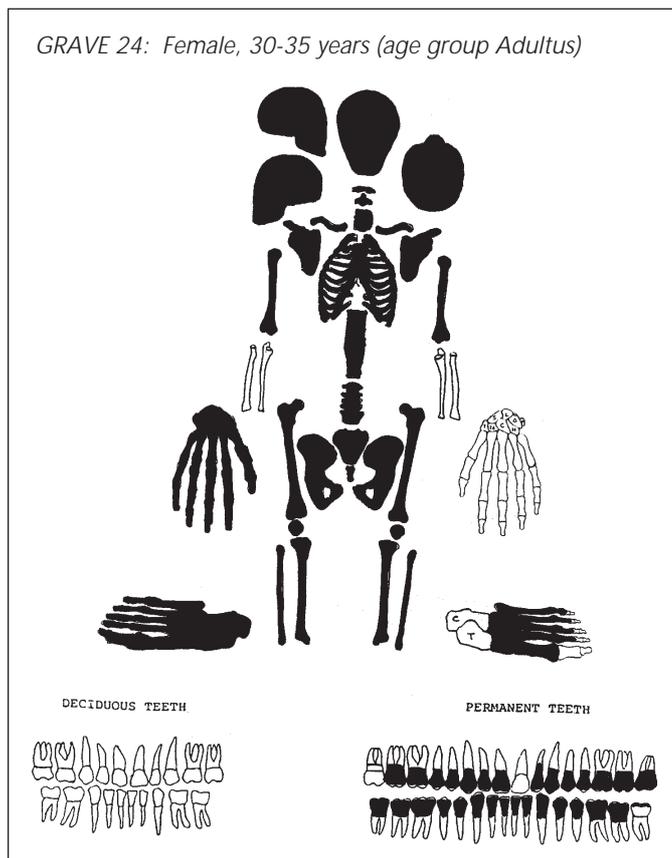
The individual in Grave 21 was a middle-aged male, between 40 and 50 years at the time of death. He was c. 172 cm tall, and had suffered from very severe osteoarthritis, especially in the spine.

GRAVE 24: Female, 30-35 years (age group *Adultus*)

Surviving material

Incomplete skeleton. The lower left arm bones and hand bones, the lower right arm bones and some minor bones are missing.

GRAVE 24: Female, 30-35 years (age group *Adultus*)



115 grams of fragments from the left ribs have been used for ¹⁴C-analysis.

Condition

The extant bones, including the skull, are intact.

Sex

Sex has been determined as female, based on traits of the pelvis, cranium and postcranial bones.

Age

Age at death has been estimated to between 30 and 35 years, age group *Adultus*. The cranial sutures are partly obliterated, but the appearance of the pubic symphysis and other age related changes, including dental conditions, point to a young adult age rather than to a middle-aged individual.

Pathologies and anomalies

Slight osteoarthritic changes in the vertebrae and the hip joints. The left tibia is longer and thicker than the right: on the lower half of the left tibial shaft there is bone apposition. In the left ankle joint, both on the tibia and the fibula, there are periostitic changes and a large, deep cyst dorsally just above the joint. (The left calcaneus and talus bones are missing.) The left caput femoris and acetabulum are smaller than the right. The upper right wisdom tooth is congenitally missing (or unerupted). The lower left wisdom tooth is not erupted. Dental attrition is moderate, but there is heavy calculus formation. The woman was markedly overbite, with a 9 mm horizontal overjet. There is no caries, but slight enamel hypoplasias.

Stature

Stature has been calculated to 161.6 cm, based on the maximum lengths of the femora.

Cranial indices

The cranial breadth-length index is 74.2, *dolichocranial*, a long and narrow skull, which is rather flat, *chamaecranial*, index 67.6. The facial index is 93.7, that is *leptoprosop*, very high and narrow. The upper face is *mesene*, that is, of medium breadth and height. Both eye sockets are almost square, with indices for the right respectively the left of 90.2 and 90.5. The nasal aperture is of medium breadth relative to the height, index 49.1, *mesorrhine*.

SUMMARY

The individual in Grave 24 was a young adult female, with a long, narrow and rather flat skull, a high and narrow face, square eye openings and a medium broad nasal aperture. She was c. 162 cm tall. There were pathological changes in the lower left leg, and moderate osteoarthritis in the spine. She was markedly overbite.

GRAVE 25: Indeterminate sex, seven-eight years (age group *Infans II*)



**GRAVE 25:
Indeterminate sex, seven-eight years
(age group *Infans II*)**

Surviving material

Complete skeleton. Only a few bones are missing. 69 grams of fragments from the right and left ribs have been used for ¹⁴C-analysis.

Condition

The skull is fragmented, but the postcranial bones are relatively well preserved.

Sex

Cannot be determined.

Age

Age at death has been estimated to between seven and eight years, age group *Infans II*, based on dental development and the size of the bones.

Pathologies and anomalies

The right femur is pathologically deformed: the angle between the neck of the femur and the shaft is less than 90 degrees. The acetabulum is flat and rather deformed, as is the loose caput femoris. The acetabulum on the left side appears normal.

Stature

Cannot be calculated.

Cranial indices

Cannot be calculated.

SUMMARY

The individual in Grave 25 was a seven to eight year old child of indeterminate sex. There are pathological changes in the right hip which must have affected mobility.

GRAVE 26: Male, 16-17 years (age group Juvenis)

Surviving material

Complete skeleton. Only a few minor bones are missing. Fragments of the left elbow bone (*ulna*) and radius have been used for ¹⁴C-analysis, c. 70 grams.

Condition

Both skull and postcranial bones are intact.

Sex

The sex has been determined as male, based on pelvic, cranial and postcranial criteria.

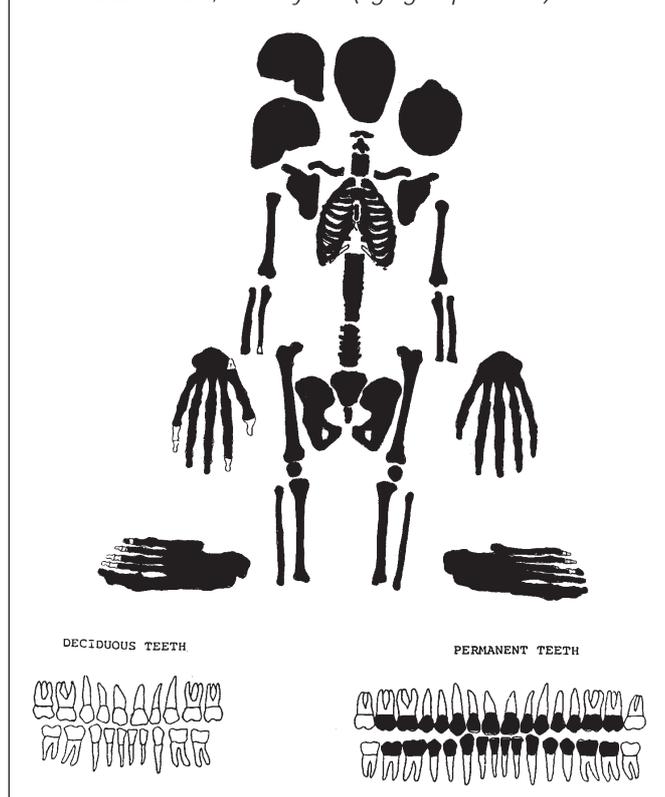
Age

Age at death has been estimated to between 16 and 17 years, based on dental conditions, state of ossification and other age related changes.

Pathologies and anomalies

There are only 11 pairs of ribs (cfr. Graves 10 and 13), and the 12th thoracic vertebra is lumbarized. The hyoid bone is ossified. The wisdom teeth are not erupted. There is some dental calculus. There is very marked overbite.

GRAVE 26: Male, 16-17 years (age group Juvenis)

**Stature**

Stature has been calculated to 171.1 cm, based on the maximum lengths of the femora.

Cranial indices

The cranial breadth-length index is 75.1, which means that the skull is *mesocranial*, of medium breadth relative to length. It is also of medium height relative to length, with an index of 73.4, *orthocranial*. The facial skeleton is low and broad, *hypereuryprosop*, with an index of 79.3. The upper face is also low and broad, with an index of 47.1, *eurylene*. The right eye socket is rather square (index 85.7, *hypsiconch*), while the left is more rectangular (index 83.7, *mesoconch*). The nasal aperture is of medium breadth relative to height, index 48.9, *mesorrhine*.

SUMMARY

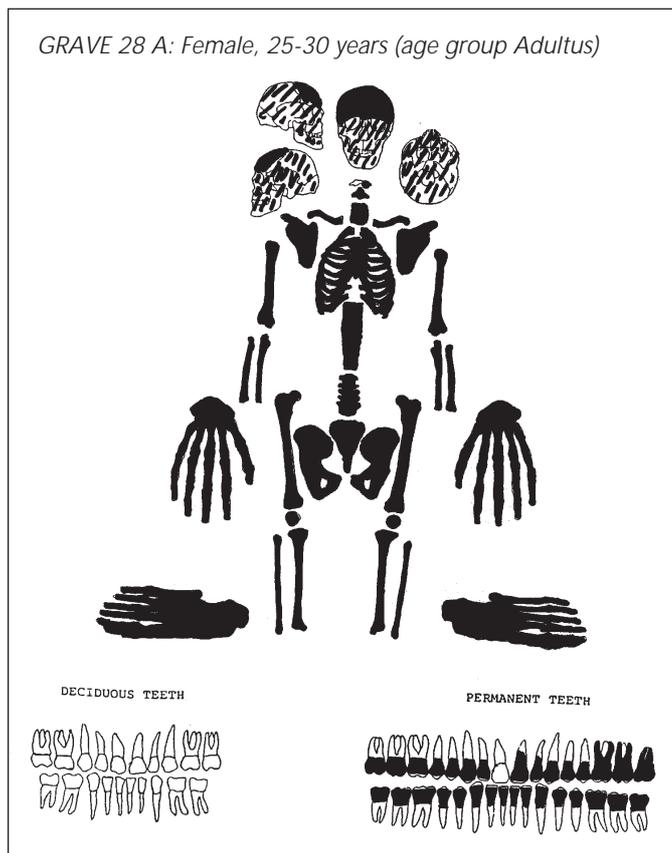
The individual in Grave 26 was an adolescent male of c. 16-17 years, c. 171 cm tall. Like the individuals in Graves 10 and 13, he only had 11 pairs of ribs. And like many of the others in this cemetery, he had a very marked overbite. His skull was of medium breadth and length, fairly low, with a medium broad and high facial skeleton, rectangular to square eye sockets and a medium broad nasal aperture.

GRAVE 28 A: Female, 25-30 years (age group Adultus)

Surviving material

Complete skeleton. Both fibulae were used for ¹⁴C-analysis.

GRAVE 28 A: Female, 25-30 years (age group Adultus)



Condition

The skull is fragmented, but the postcranial bones are intact.

Sex

Sex has been determined as female, based on pelvic, cranial and postcranial criteria. Skeletal remains of a foetus (described as "28 B") were found in the pelvic region.

Age

Age at death has been estimated to between 25 and 30 years, based on the appearance of the pubic symphysis, the cranial sutures and dental conditions.

Pathologies and anomalies

Calcified pleura was found in the chest region. There are sharp edges with osteophytes around the costal joints. All parts of the sternum are ankylosed, including the processus xiphoideus. The costosternal joints are deep with very sharp edges. There are six sacral vertebrae. Slight osteoarthritis in some vertebrae. Loose acromial processes and pathological changes in both shoulder joints. The pelvis is rather high and narrow which might have meant a difficult delivery of the foetus. The left spina ischiadica is enlarged and juts into the pelvic opening. A bony lump was found with the foetal bones: perhaps a renal calculus or a calcified lymphoma. The preauricular sulci are strongly marked, and there are very sharp edges, almost like osteophytes around the perimeter on both the right and the left facies auricularis. There is caries in the right upper second premolar and first molar, and heavy calculus on the lingual side of the lower front teeth. The occlusion is edge-to-edge. There are pathological changes in the jaw bones of the upper and lower left molar regions.

Stature

Stature has been calculated to 161.0 cm, based on the maximum lengths of the femora.

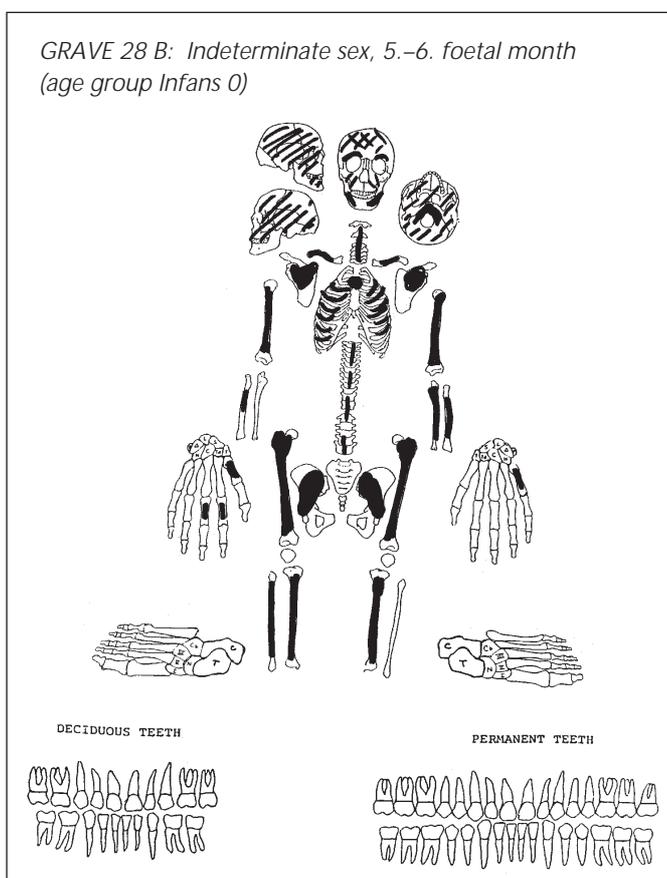
Cranial indices

No cranial indices could be calculated.

SUMMARY

The young woman in Grave 28 died while pregnant. She was between 25 and 30 years old, and c. 161 cm. tall. There were many pathological changes; she may have had tuberculosis. There was calcified pleura in the chest region, and signs of skeletal stress throughout the rib cage. Her pelvis was high and narrow, and she might have encountered severe difficulties during parturition.

GRAVE 28 B: Indeterminate sex, 5.-6. foetal month (age group Infans 0)



GRAVE 28 B:
Indeterminate sex, fifth-sixth foetal month (age group Infans 0)

Surviving material

Complete skeleton.

Condition

The skull is fragmented, the postcranial bones are damaged.

Sex

Cannot be determined.

Age

Age at death has been estimated to the end of the fifth foetal month, based on the length of the femoral shaft, which is 42 mm.

Pathologies and anomalies

None observed.

Stature

Not applicable.

Cranial indices

Not applicable.

SUMMARY

In the pelvic region of the young adult woman in Grave 28 were the remains of a foetus in the fifth to sixth foetal month.

GRAVE 30: Female, 60-70 years (age group Senilis)

Surviving material

Complete skeleton. Only a few bones are missing: the right fibula, the left clavicle and most of the left ribs.

Condition

All extant bones are intact.

Sex

The sex has been determined as female, based on pelvic, cranial and postcranial criteria.

Age

Age at death has been estimated to between 60 and 70 years, age group *Senilis*. The appearance of the pubic symphysis corresponds to an old age group. The cranial sutures are obliterated, and there is heavy dental attrition and extensive *intra vitam* tooth loss.

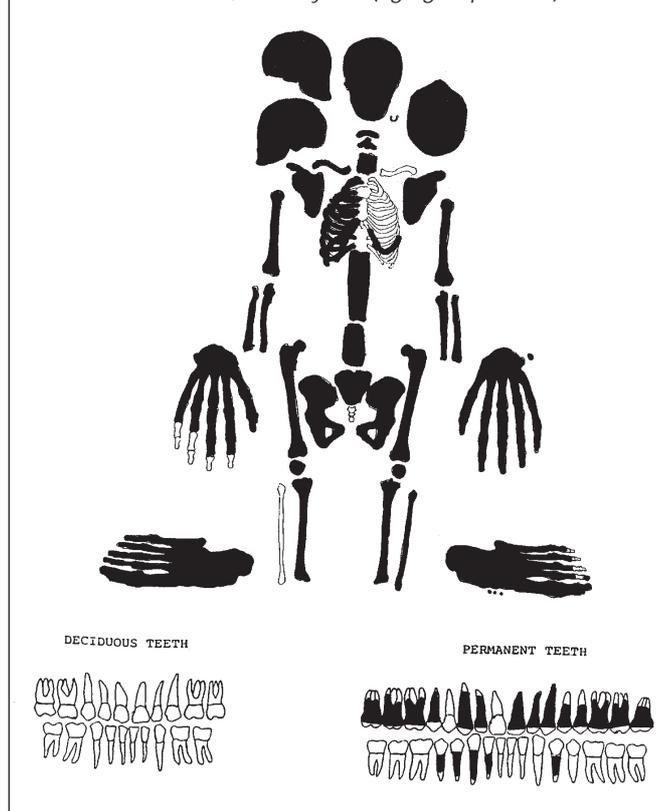
Pathologies and anomalies

The woman has a very marked horizontal overbite, with a horizontal overjet of 10 mm. There is very heavy dental attrition, and extensive pathological changes in the jaw bones. She had very severe osteoarthritis of the thoracic spine, with ankylosis of vertebrae nos. 7, 8 and 9, and compressed vertebral bodies, so that she had a markedly forward curvature of the spine. She could not have straightened up. There are also pathological changes in the lumbar vertebrae and in most of the large joints: the shoulder, elbow, hip, knee and sacroiliac joints. There is hallux valgus on both feet.

Stature

Stature has been calculated to 162.8 cm, based on the maximum lengths of the femora.

GRAVE 30: Female, 60-70 years (age group Senilis)

**Cranial indices**

The skull is short, broad, and high. The breadth-length index is *brachycranial*, 83.7, and the breadth-height index is 77.0, *hypsicranial*. The facial skeleton is low and broad, index 82.2, *euryprosop*, while the upper face is of medium height and breadth, index 52.6, *mesene*. The right eye socket is rather square (index 88.4, *hypsiconch*), while the left is of medium height and breadth, that is, more rectangular (index 76.6, *mesoconch*). The nasal aperture is of medium height and breadth (index 48.1, *mesorrhine*).

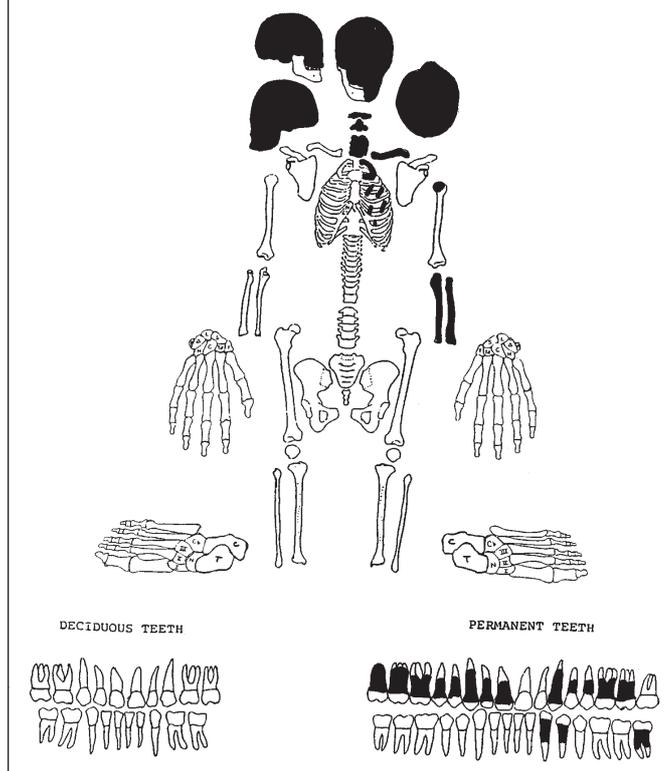
Other information

This is not a particularly large skeleton, yet the skull is relatively large. Relatively small hands and feet. The muscle attachment areas are not markedly developed except in some places in the right hand.

SUMMARY

The individual in Grave 30 was an old female between 60 and 70 years of age, and c. 163 cm tall, with a short, round and broad skull and a low and broad face. The eye sockets are asymmetrical, the left being rectangular while the right is square. The nasal aperture is medium. Her back was bent forward because of pathological changes in the spine: Three of the lower thoracic vertebrae were ankylosed and the vertebral bodies were fractured and compressed. She could not have straightened up. She had a very marked overbite, with the upper front teeth jutting out 10 mm over the lower teeth. There was no caries.

GRAVE 32: Female, 50-70 years
(age group *Maturus/Senilis*)



GRAVE 32:
Female, 50-70 years (age group *Maturus/Senilis*)

Surviving material

Incomplete skeleton. Only fragments of skull, cervical vertebrae, left shoulder and left lower arm are preserved. Twenty-eight grams of fragments of left ribs and caput humerus have been used for ¹⁴C-analysis.

Condition

The bones are fragmented.

Sex

The sex has been determined as probably female.

Age

Age at death has been estimated to between 50 and 70 years, age group *Maturus/Senilis*. There is heavy dental attrition and extensive *intra vitam* tooth loss. The cranial sutures are obliterated.

Pathologies and anomalies

There are severe osteoarthritic changes in the cervical vertebra, and the neck is bent towards the left shoulder: she could not have straightened up. There is also osteoarthritis in the left shoulder joint. Heavy dental attrition, caries in three teeth, and extensive pathological changes in the alveolar processes. The crown of the lower left canine was fractured.

Stature

Cannot be calculated.

Cranial indices

The right eye socket is high and square, index 87.5, *hypsiconch*. Other indices cannot be calculated.

SUMMARY

The individual in Grave 32 was probably a female, c. 50 to 70 years of age at death. She had severe osteoarthritis in the neck and could not carry her head straight. There was also osteoarthritis in the left shoulder.

GRAVE 34: Male, 50-60 years
(age group *Maturus/Senilis*)



GRAVE 34:
Male, 50-60 years (age group *Maturus/Senilis*)

Surviving material

The entire skeleton is represented in the material from this grave, but the skull except for the mandible is missing, as is the left pelvic bone. Two hundred grams of fragments from the left ribs and shoulder blade, the right ribs, and the left tibia have been used for ¹⁴C-analysis.

Condition

The condition of the extant bones vary from relatively well preserved to fragmented.

Sex

The sex has been determined as male, based on the shape of the jaw and the postcranial morphology.

Age

Age at death has been estimated to between 50 and 60 years, age group *Maturus/Senilis*.

Pathologies and anomalies

The distal end of the fifth metacarpal bone on the right hand is deformed, perhaps the result of an injury. There are osteoarthritic changes in the right hip joint. On the left tibia, the foramen nutricium is enlarged, and nearby there are marked muscle attachment areas. The mental foramina are also enlarged. The man had a vertical underbite, and there is very heavy attrition, especially on the upper front teeth: The four incisors and the left canine, with buccal wear facets. There is enamel chipping and many dental anomalies and abrasions.

Stature

Stature has been calculated to 180.1 cm, based on the maximum length of the left femur.

Cranial indices

Cannot be calculated.

Other information

This man had been buried in a boat. During the archaeological excavation, four arrow points were found in the grave: One was found close to the cervical vertebrae, one was in the left rib cage, one by the left lower arm and one by the right knee joint. The arrows had left no traces on the bones and must have been lodged in the soft tissue. There were red miscolourations on several skeletal parts, e.g., on the thoracic vertebrae. The miscolourations are most probably caused by conditions of the soil. The vertebrae have been preserved in the matrix, and it should be possible to analyze the soil to determine the factors causing the miscolouring. The thoracic vertebrae have not been examined for osteoarthritic changes, since they are in the matrix. However, there are osteophytes on the costovertebral joints of the ribs, which may indicate corresponding changes in the vertebrae.

SUMMARY

The individual in the boat grave, Grave 34, was a middle-aged male, aged c. 50-60 years, with a calculated stature of c. 180 cm. He had a marked underbite. He was probably killed by arrows. Arrow points were found in the grave but they had left no marks on the bones. There were miscolourations of several bones, and the dental roots were also miscoloured.

GRAVE 36: Female, 45-55 years (age group *Maturus*)

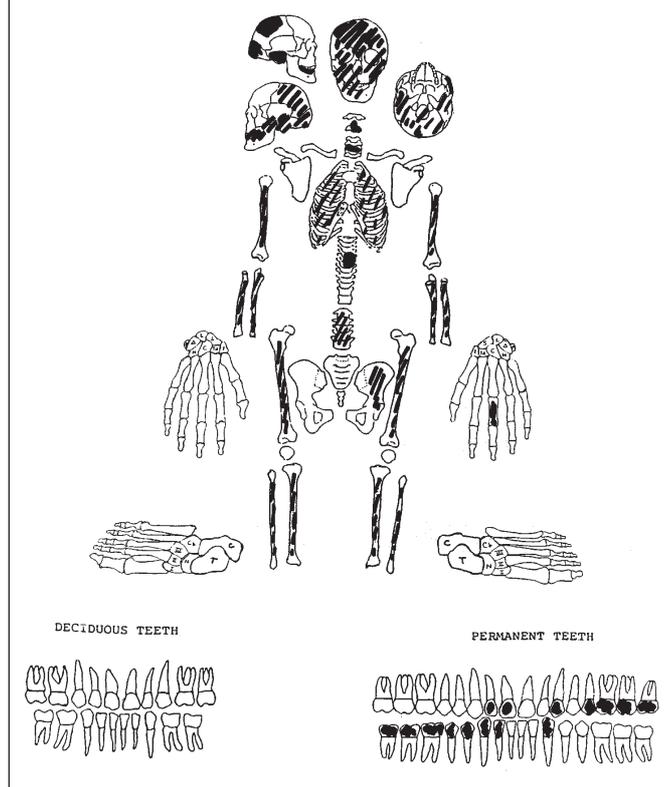
Surviving material

The entire skeleton is represented, but many bones, especially minor ones, are missing. A small amount of bone fragments has been used for ¹⁴C-analysis.

Condition

Both skull and postcranial bones are fragmented.

GRAVE 36: Female, 45-55 years (age group *Maturus*)



Sex

The sex has been determined as female, based on pelvic, cranial and postcranial criteria.

Age

Age at death has been estimated to between 45 and 55 years, age group *Maturus*.

Pathologies and anomalies

There are no pathological changes on the surviving fragments. The teeth are rather small and not heavily worn.

Stature

Cannot be calculated.

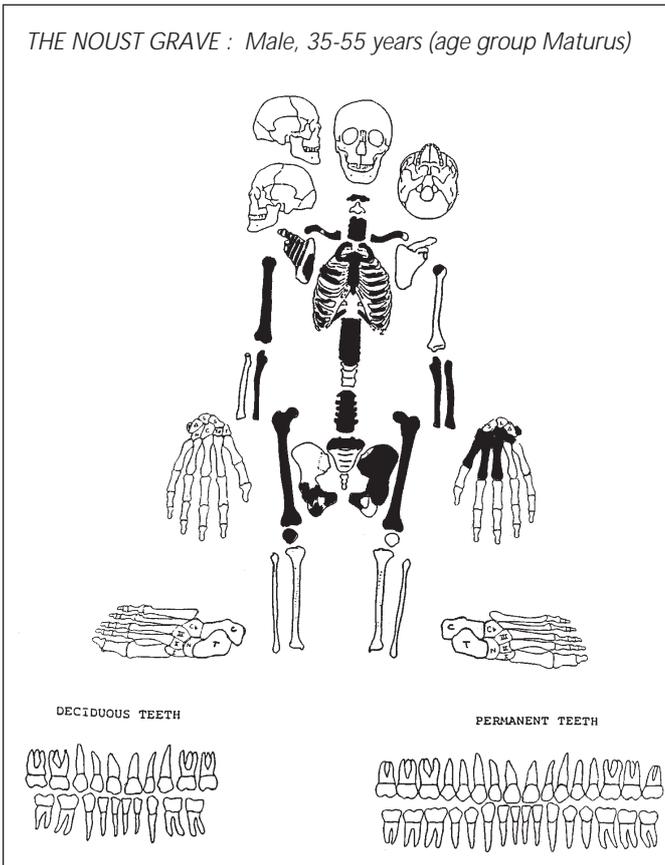
Cranial indices

Cannot be calculated.

SUMMARY

The individual in Grave 36 was a middle-aged female between 45 and 55 years.

THE NOUST GRAVE : Male, 35-55 years (age group Maturus)



THE NOUST GRAVE:
Male, 35-55 years (age group Maturus)

Surviving material

Incomplete skeleton. The skull is missing as well as most bones from the upper part of the skeleton and all bones below the knees.

Condition

The postcranial bones are relatively well preserved.

Sex

Sex has been determined as male, based on pelvic and postcranial criteria.

Age

Age at death has been estimated to between 35 and 55 years, age group *Maturus*.

Pathologies and anomalies

There is a healed fracture of the first right rib. There are severe osteoarthritic changes in the right hip joint, and very marked muscle attachment areas on the back of the right femoral shaft. There are vessel impressions on the femoral diaphysis. There are also osteoarthritic changes in the vertebrae. There is periostitis on the lower half of the shaft of the right elbow bone (*ulna*).

Stature

Stature has been calculated to 171.1 cm, based on the maximum lengths of the femora.

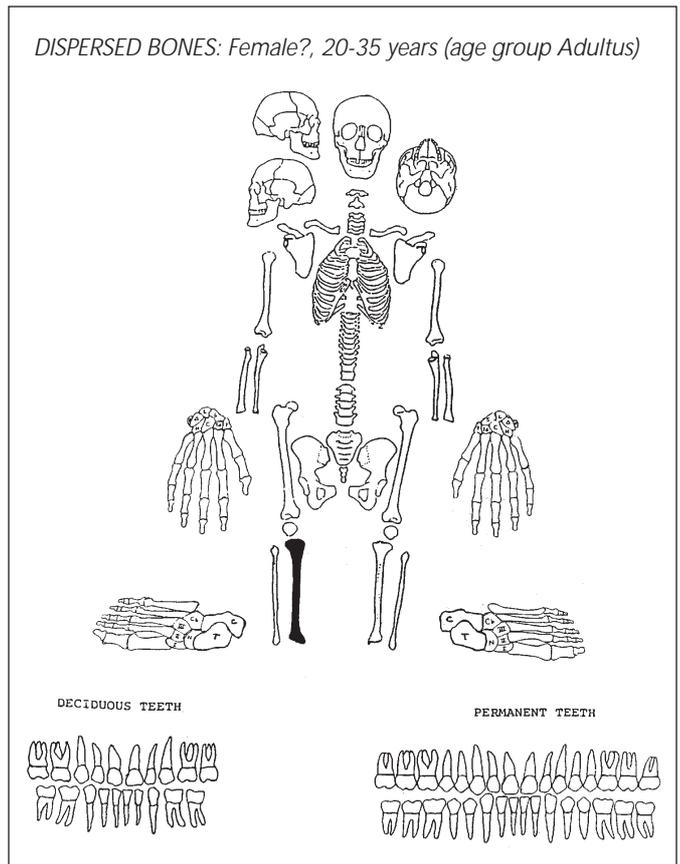
Cranial indices

Cannot be calculated.

SUMMARY

The individual buried in the noust was a middle-aged male, between 35 and 55 years of age at death, c. 171 cm tall. He had a fractured first rib on the right side, osteoarthritic changes in most of the vertebrae and in the right hip joint. There are periostitic changes on the lower half of the right elbow bone (*ulna*).

DISPERSED BONES: Female?, 20-35 years (age group Adultus)



DISPERSED BONES:
Female?, 20-35 years (age group Adultus)

Surviving material

One well preserved right tibia was found without association to a grave. It could not be matched with any of the skeletons in the graves.

The bone derives from a young adult individual of indeterminate sex, possibly a female since the bone is rather gracile and short. There are no macroscopically visible pathological changes in the bone.

Table A-2. Humerus: measurements and indices

Grave	Sex	Age	Age group	RADIUS															
				M 1 R	M 1 L	M 7 R	M 7 L	M 5 R	M 5 L	M 6 R	M 6 L	M 4 R	M 4 L	M 7/1 R	M 7/1 L	M 6/5 R	M 6/5 L		
2a	?	35-55	Mat	300		63	64	24			17			62		21		70,8	
5	F	35-45	Mat	276	275	57	55	21	20	16	16	56	56	20,7	20	76,2	80		
6	F	50-70	Mat/Sen		283	55	56		20		19	58	58		19,8		95		
7	F	50-70	Mat/Sen	316	314	58	58	23	23	17	17	57	57	18,4	18,5	73,9	73,9		
8	F	60-80	Sen	314	307	67	67	27	25	18	18	62	62	21,3	21,8	66,7	72		
10	F	20-25	Ad	320	317	61	59	20	20	20	19	61	62	19,1	18,6	100	96		
24	F	30-35	Ad	320	316	55	53	20	20	15	15	56	56	17,2	16,8	75	75		
28a	F	25-30	Ad	306	299	61	60	25	23	17	16	57	56	19,9	20,1	68	69,6		
30	F	60-70	Sen	317	314	65	65	26	25	20	19	58	58	20,5	20,7	76,9	76		
n				7	8	8	8	7	8	7	8	8	8	7	8	7	8		
mean				309,9	303,1	59,9	59,1	23,1	22,0	17,6	17,4	58,1	58,1	19,6	19,5	76,7	79,7		
s.d.				15,67	16,14	4,45	4,82	2,91	2,27	1,90	1,60	2,23	2,53	1,44	1,54	11,03	10,22		
min				276	275	55	53	20	20	15	15	56	56	17,2	16,8	66,7	69,6		
max				320	317	67	67	27	25	20	19	62	62	21,3	21,8	100	96		

12	M	35-45	Mat			75						66	66						
20	M	35-45	Mat	342		71	67	25		21		63	64	20,8			84		
21	M	40-50	Mat	331	328	68	65	24	23	19	18	66	66	20,5	19,8	79,2	78,3		
26	M	16-17	Juv	318	308	55	54	19	20	16	16	57	57	17,3	17,5	84,2	80		
34	M	50-60	Mat		366		70		26		20	69	69		19,1		76,9		
Nouust	M	35-55	Mat	340		70		27		21		66		20,6		77,8			
n				4	3	5	4	4	3	4	3	6	5	4	3	4	3		
mean				332,8	334,0	67,8	64,0	23,8	23,0	19,3	18,0	64,5	64,4	19,8	18,8	81,3	78,4		
s.d.				10,94	29,46	7,60	6,98	3,40	3,00	2,36	2,00	4,14	4,51	1,67	1,18	3,28	1,55		
min				318	308	55	54	19	20	16	16	57	57	17,3	17,5	77,8	76,9		
max				342	366	75	70	27	26	21	20	69	69	20,8	19,8	84,2	80		

Table A-3. Radius: measurements and indices

Grave	Sex	Age	Age group	RADIUS					
				M 1 R	M 1 L	M 3 R	M 3 L	M3/1 R	M3/1 L
5	F	35-45	Mat	211	202	36	36	17,1	17,8
6	F	50-70	Mat/Sen	224	229	33	31	14,7	13,5
7	F	50-70	Mat/Sen	230	230	37	37	16,1	16,1
8	F	60-80	Sen		250	40	41		16,4
10	F	20-25	Ad	233	232	41	38	17,6	16,4
28a	F	25-30	Ad		229	39	38		16,6
30	F	60-70	Sen	245	243	43	41	17,6	16,9
32	F	50-70	Mat/Sen		236		35		14,8
n				5	8	7	8	5	8
mean				228,6	231,4	38,4	37,1	16,6	16,1
s.d.				12,46	14,04	3,36	3,27	1,24	1,33
min				211	202	33	31	14,7	13,5
max				245	250	43	41	17,6	17,8

12	M	35-45	Mat	271		49		18,1	
14	M	20-60	Grown		257		42		16,3
15	M	45-55	Mat		242		45		18,6
20	M	35-45	Mat	259	257	44	45	17,0	17,5
21	M	40-50	Mat	251		45		17,9	
26	M	16-17	Juv	245	239	37	35	15,1	14,6
34	M	50-60	Mat		275		48		17,5
Nouust	M	35-55	Mat		254		45		17,7
n				4	6	4	6	4	6
mean				256,5	254,0	43,8	43,3	17,0	17,0
s.d.				11,24	12,87	4,99	4,50	1,37	1,40
min				245	239	37	35	15,1	14,6
max				271	275	49	48	18,1	18,6

Table A-4. Ulna: measurements and indices

Grave	Sex	Age	Age group	ULNA					
				M 1 R	M 1 L	M 3 R	M 3 L	M3/1 R	M3/1 L
5	F	35-45	Mat	228	219	33	33	14,5	15,1
6	F	50-70	Mat/Sen	248	245	31	31	12,5	12,7
7	F	50-70	Mat/Sen	252	250	31	31	12,3	12,4
8	F	60-80	Sen		265	36	38		14,3
28a	F	25-30	Ad		246	34	32		13,0
30	F	60-70	Sen	264	263	35	35	13,3	13,3
32	F	50-70	Mat/Sen		256		32		12,5
n				4	7	6	7	4	7
mean				248,0	249,1	33,3	33,1	13,2	13,3
s.d.				14,97	15,42	2,07	2,54	1,00	1,01
min				228	219	31	31	12,3	12,4
max				264	265	36	38	14,5	15,1

12	M	35-45	Mat			43			
14	M	20-60	Grown		279		35		12,5
20	M	35-45	Mat	279	277	40	38	14,3	13,7
21	M	40-50	Mat	273	271	36	36	13,2	13,3
26	M	16-17	Juv		259	32	30		11,6
34	M	50-60	Mat			41	40		
Noust	M	35-55	Mat	278	276	43	43	15,5	15,6
n				3	5	6	6	3	5
mean				276,7	272,4	39,2	37,0	14,3	13,3
s.d.				3,21	8,05	4,36	4,47	1,15	1,50
min				273	259	32	30	13,2	11,6
max				279	279	43	43	15,5	15,6

Table A-5. Femur: measurements and indices

Grave	Sex	Age	Age group	M 1 R	M 1 L	M 2 R	M 2 L	M 8 R	M 8 L	M 9 R	M 9 L	M 10 R
5	F	35-45	Mat								22	
6	F	50-70	Mat/Sen	404	403	402	400	78	79	26	28	24
7	F	50-70	Mat/Sen	448	446	445	443	82	82	33	32	24
8	F	60-80	Sen									
10	F	20-25	Ad	438	440	436	436	90	90	31	30	26
24	F	30-35	Ad	435	435	431	432	81	81	33	33	22
28a	F	25-30	Ad	432	433	428	428	85	86	34	34	26
30	F	60-70	Sen	437	443	431	437	87	87	32	30	30
18	F?	20-35	Ad							29		23
n				6	6	6	6	6	6	7	7	7
mean				432,3	433,3	428,8	429,3	83,8	84,2	31,1	29,9	25,0
s.d.				14,90	15,63	14,44	15,23	4,36	4,17	2,79	4,02	2,65
min				404	403	402	400	78	79	26	22	22
max				448	446	445	443	90	90	34	34	30

11	M	45-55	Mat	496		491		100		34		28
12	M	35-45	Mat									
14	M	20-60	Grown	456	454	455	453	89	90	35	33	27
20	M	35-45	Mat	455	459	450	454	95	93	33	33	31
21	M	40-50	Mat	456	459	454	456	93	95	34	31	29
26	M	16-17	Juv	454	456	448	450	77	78	30	30	23
34	M	50-60	Mat		494		490		95		35	
Noust	M	35-55	Mat	455	455	450	453	95	95	34	33	30
n				6	6	6	6	6	6	6	6	6
mean				462,0	462,8	458,0	459,3	91,5	91,0	33,3	32,5	28,0
s.d.				16,67	15,41	16,38	15,15	7,94	6,66	1,75	1,76	2,83
min				454	454	448	450	77	78	30	30	23
max				496	494	491	490	100	95	35	35	31

Table A-5 (cont.)

M 10 L	M 21 R	M 21 L	M 19 R	M 19 L	M 20 R	M 20 L	M 29 R	M 29 L	M 8/2 R	M 8/2 L	M 10/9 R	M 10/9 L
30				41		154		130				136,4
25	74	73	40	40	129		130	138	19,4	19,8	92,3	89,3
25	78	78	45	45	145		130	130	18,4	18,5	72,7	78,1
				44								
26	80	80	44	44	138	139	131	137	20,6	20,6	83,9	86,7
25	75	75	45	43	143	137	130	140	18,8	18,8	66,7	75,8
28	75	76	45	45	142	142	130	132	19,9	20,1	76,5	82,4
29	77	76	43	43			130	132	20,2	19,9	93,8	96,7
				39		122		120				79,3
7	6	6	8	7	6	4	7	7	6	6	7	7
26,9	76,5	76,3	43,1	43,0	136,5	143,0	128,7	134,1	19,6	19,6	80,7	92,2
2,12	2,26	2,42	2,36	1,91	9,09	7,62	3,86	4,10	0,84	0,80	9,97	20,72
25	74	73	39	40	122	137	120	130	18,4	18,5	66,7	75,8
30	80	80	45	45	145	154	131	140	20,6	20,6	93,8	136,4

			49				130	140	20,4		82,4	
			53									
25	80	78	47	46	148	145	140	140	19,6	19,9	77,1	75,8
31	85	84	50	51	162		130	130	21,1	20,5	93,9	93,9
29	85	83	48	48	153	153	130	130	20,5	20,8	85,3	93,5
22	74	75	45	44	142	140	130	130	17,2	17,3	76,7	73,3
29				53		169		141		19,4		82,9
30	86		51	51	164	163		140	21,1	21,0	88,2	90,9
6	5	4	7	6	5	5	5	7	6	6	6	6
27,7	82,0	80,0	49,0	48,8	153,8	154,0	132,0	135,9	20,0	19,8	83,9	85,1
3,44	5,05	4,24	2,65	3,43	9,28	12,08	4,47	5,49	1,47	1,37	6,64	9,08
22	74	75	45	44	142	140	130	130	17,2	17,3	76,7	73,3
31	86	84	53	53	164	169	140	141	21,1	21	93,9	93,9

Table A-6. Tibia: measurements and indices

Grave	Sex	Age	Age group	M1 R	M1 L	M10b R	M10b L	M8a R	M8a L	M9a R	M9a L	M10b/1 R	M10b/1 L	M9a/8a R	M9a/8a L
Dispersed	?	20-35	Ad	340		70		35		24		20,6		68,6	
5	F	35-45	Mat				70		30		23		19,2	19,3	69,7
6	F	50-70	Mat/Sen	328	326	63	63	33	32	23	22		19,8	19,8	72,7
7	F	50-70	Mat/Sen	359	354	71	70	33	32	24	23		19,4	19,1	63,6
10	F	20-25	Ad	360	361	70	69	33	32	21	21		19,1	21,5	67,7
24	F	30-35	Ad	341	349	65	75	31	33	21	22		19,6	19,9	67,6
28a	F	25-30	Ad	357	356	70	71	34	34	23	23		20,1	19,7	71,4
30	F	60-70	Sen	363	370	73	73	35	34	25	24		23	23	71,9
18	F?	20-35	Ad		6	6	7	6	8	6	8		19,5	19,9	68,8
n				351,3	352,7	68,7	70,2	33,2	32,7	22,8	22,6		0,38	0,85	3,24
mean				13,81	14,88	3,83	3,76	1,33	1,30	1,60	0,92		19,1	19,1	63,6
s.d.				328	326	63	63	31	30	21	21		20,1	21,5	72,7
min				363	370	73	75	35	34	25	24		21,5	21,5	76,7
max															
11	M	45-55	Mat	396	397	76	77	40	40	26	27		19,2	19,4	65,0
14	M	20-60	Grown	355	351	76	75	36	35	25	25		21,4	21,4	69,4
20	M	35-45	Mat	361	367	78	77	40	39	26	26		21,6	21,0	65,0
21	M	40-50	Mat	363	366	78	78	40	39	27	27		21,5	21,3	67,5
26	M	16-17	Juv	363	367	66	65	32	33	23	23		18,2	17,7	71,9
34	M	50-60	Mat		5	5	5	6	6	6	6		20,4	20,2	67,6
n				367,6	369,6	74,8	74,4	37,3	37,3	25,2	25,2		1,58	1,59	2,69
mean				16,21	16,76	5,02	5,37	3,27	2,73	1,47	1,83		17,7	17,7	65
s.d.				355	351	66	65	32	33	23	23		21,6	21,4	71,9
min				396	397	78	78	40	40	27	27		21,6	21,4	66,7
max															

Table A-7. Radio-humeral indices

Radius M1x100/Humerus M1			
Grave	Sex	R	L
5	F	76,4	73,5
6	F		80,9
7	F	72,8	73,2
8	F		81,4
10	F	72,8	73,2
28a	F		76,6
30	F	77,3	77,4
n		4	7
mean		74,8	76,6
s.d.		2,37	3,53
min		72,8	73,2
max		77,3	81,4

20	M	75,7	
21	M	75,8	
26	M	77,0	77,6
34	M		75,1
n		3	2
mean		76,2	76,4
s.d.		0,72	1,77
min		75,7	75,1
max		77,0	77,6

Table A-8. Tibio-femoral indices

Tibia M1 x 100 / Femur M1			
Grave	Sex	R	L
6	F	81,2	80,9
7	F	80,1	79,4
10	F	82,2	82,0
24	F	78,4	80,2
28a	F	82,6	82,2
30	F	83,1	83,5
n		6	6
mean		81,3	81,4
s.d.		1,77	1,49
min		78,4	79,4
max		83,1	83,5

11	M	79,8	
14	M	77,9	77,3
20	M	79,3	80,0
21	M	79,6	79,7
26	M	80,0	80,5
n		5	4
mean		79,3	79,4
s.d.		0,83	1,42
min		77,9	77,3
max		80,0	80,5

Table A-9. Intermembral indices

Radius M1+Humerus M1/Tibia M1+Femur M1 x 100			
Grave	Sex	R	L
6	F		70,2
7	F	67,7	68,0
10	F	69,3	68,5
28a	F		66,9
30	F	70,3	68,5
n		3	5
mean		69,1	68,4
s.d.		1,31	1,19
min		67,7	66,9
max		70,3	70,2

20	M	73,7	
21	M	71,1	
26	M	68,9	66,5
n		3	1
mean		71,2	66,5
s.d.		2,40	
min		68,9	
max		73,7	

Table A-10. Nonmetric traits, sorted by sex and age

Grave	Sex	Age	Age group	Sut. metop.	Oss. sut. coron.	Oss. bregma	Oss. sut. sag.	Oss. lambda	Os Incae	For. parietale R	For. parietale L	Oss. sut. lambda. R	Oss. sut. lambda. L	Oss. asterion R	Oss. asterion L	Oss. incis. par. R	Oss. incis. par. L	Art. front-temp R	Art. front-temp L	Oss. pterion R	Oss. pterion L	Mult. for. inf. orb.R	Mult. for. inf. orb. L	For. sup. orb. R	For. sup. orb. L	For. zyg. fac. R	For. zyg. fac. L	
2a	?	35-55	Mat																									
13	?	7-8 md	Inf I					0	0	0	0	1	1												1		1	
25	?	7-8 år	Inf II	0				0	0	0	0	0	0			0												0
Number of observations				1	0	0	0	2	2	2	1	2	1	1	0	1	0	0	0	0	0	0	0	0	0	1	0	2
Trait occurrence				0				0	0	0	0	1	1	0		0									1		1	
10	F	20-25	Ad	0	0	0	0	0	0	0	0	0		0	0			1	1	0	0	0	1	1	0	1	1	
Dispersed	F	20-35	Ad																									0
18	F	20-35	Ad																									0
28a	F	25-30	Ad	0	1	0	1	0	0	1	0				0	0	0								0	0	1	1
24	F	30-35	Ad	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	F	35-45	Mat	0	0	0	0	1	0	1	1	1	1	0	0		1		0						0	1	1	
36	F	45-55	Mat						0																			
6	F	50-70	Mat/Sen					0	0				0		0													
7	F	50-70	Mat/Sen	0				0	0	1	1					0						1	0	1	0	1	1	
32	F	50-70	Mat/Sen	0	0	0	0	0	0	1	1	1	0	0	0	0	0								1	1		
30	F	60-70	Sen	0			0	0	0	1	0	0	0	0	0	0	0	0	0	0		0	0	0	1	1	1	1
8	F	60-80	Sen	0				0	0	0	0	0	0	0	1	0	0				1	0	1	1	8	0		
Number of observations				8	5	5	6	9	10	8	8	6	6	5	8	6	8	3	4	3	4	5	4	7	8	8	6	
Trait occurrence				0	1	0	1	1	0	5	3	2	1	0	1	0	1	1	1	1	1	0	2	1	5	3	5	5
26	M	16-17	Juv	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
2b	M	20-30	Ad																									
12	M	35-45	Mat																						1			1
20	M	35-45	Mat	0	1	0		0	0	1	1	0	0	0	0	0	0							0	0	1	0	
Noust	M	35-55	Mat																									
21	M	40-50	Mat	0	0	0		0	0	0	0	1	1	0	0	0	0			0	0	0	0	1	0	1	1	
11	M	45-55	Mat	0						0	1													1	1			
34	M	50-60	Mat																									
Number of observations				4	3	3	1	3	3	4	4	3	3	3	3	3	3	3	1	1	2	2	2	3	4	4	3	4
Trait occurrence				0	2	0	0	0	0	2	3	1	1	0	0	0	0	0	0	0	0	0	0	0	4	2	3	3

Table A-10 (cont.)

For. ovale inc. R	For. ovale inc. L	Div. can. hypogl. R	Div. can. hypogl. L	Cond. occ. double R	Cond. occ. double L	Hüisches for. R	Hüisches for. L	Sin. sag. sup. R	Sin. sag. sup. L	Torus max R	Torus max L	Torus palatinus	Torus mand. R	Torus mand. L	Arc. mylohy. R	Arc. mylohy. L	Mult. ment. for. R	Mult. ment. for. L	Sulc. N/A sup. orb. R	Sulc. N/A sup. orb. L	Perf. hum. R	Perf. hum. L	Sulc. preauric. R	Sulc. preauric. L	Sulc. sup. acetab. R	Sulc. sup. acetab. L	Imp. ligg. pub. R	Imp. ligg. pub. L	Can. atlant. R	Can. atlant. L	Tib. squatt. R	Tib. squatt. L	
0	0	0	0					1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	2	2	2	1	1	1	1	2	2	1	1	1	2	2	1	2	2	2	2	0	1	2	2	1	1	1	1	0	0	1	1	0	0
0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	3	3	0	2	0	0	0	0	0	2	2
																							2									0	
0	0	0	0	0	0	0	0	0	1		0	0	0	0	0	0	1	0	0	0	0	0	5	4	0	0	0	0	0	1	0	3	3
0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	1	0	0	1	1	1	1	0	
1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2		0	2		0	0				
								1	0																								
0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	4		0							1	1
0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	1	1	0	0	3	3	2	2		1	1	1	0	1	
0	1		0		0		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	1	0	0	0	0	8	1	1	1
0	0	0	8	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	3	3	0	0	0	0	8			
0	0	0	0	0	0	0	0	1	0	0	0	0	3	3	0	0	0	0	1	0	0	5	5	3	3	0	0	0	0	8			
9	8	7	8	7	8	8	8	10	10	7	8	7	8	9	8	8	8	9	6	7	8	8	9	7	7	7	6	6	8	8	7	6	
1	2	0	1	0	0	0	0	8	2	0	0	0	2	2	1	0	1	0	2	1	1	2	9	7	3	4	1	1	4	4	5	5	
0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	4	4	1	0	0	0	0	0	0	0	0	0	0	3	3
													0	0	0	0	1	1															
0	0	1	1			0	0	1	0	2	0	0	3	3	0	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	
																						0	0	0	0	0							
0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	1	1
	0					0	0						0	0	0	0	0	0	0													2	0
													0	0	0	0	0	0			0	0									0	0	2
3	4	3	3	2	2	4	5	3	3	3	4	3	7	7	7	5	6	6	3	3	6	5	3	5	3	5	2	3	4	4	4	6	
0	0	2	1	0	0	1	1	1	2	1	0	0	1	1	1	0	1	2	1	1	1	0	1	0	0	0	0	0	0	3	4	4	

Table A-11. Dental measurements: maxillary mesiodistal and buccolingual diameters

Mesiodistal diameter - maxilla																	
Permanent teeth																	
Grave	Sex	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
25	?							58			61						97
5	F						71	67	83	80	62	69				97	
6	F	79										69					
7	F	90			65			71									
10	F	92	99	115	69	73	85	75	87	86	73	84	72	69	113	100	92
18	F														95		
24	F		86	107	67	64	73	73	88		68	73	63	65	107	90	69
28A	F	89	90		59	64	73	63		86	65	71	68	62	90	92	88
n		4	3	2	4	3	4	5	3	3	4	5	3	3	5	3	3
mean		87,5	91,7	111,0	65,0	67,0	75,5	69,8	86,0	84,0	67,0	73,2	67,7	65,3	100,4	94,0	83,0
s.d.		5,80	6,66	5,66	4,32	5,20	6,40	4,82	2,65	3,46	4,69	6,26	4,51	3,51	9,37	5,29	12,29
min		79	86	107	59	64	71	63	83	80	62	69	63	62	90	90	69
max		92	99	115	69	73	85	75	88	86	73	84	72	69	113	100	92
12	M									92			71	63	102	98	
20	M					71	80				67		74				
26	M		97	118	70	73						75		72			
n		0	1	1	1	2	1	0	0	1	1	1	2	2	1	1	0
mean			97,0	118,0	70,0	72,0	80,0			92,0	67,0	75,0	72,5	67,5	102,0	98,0	
s.d.						1,41							2,12	6,36			
min			97	118	70	71	80			92	67	75	71	63	102	98	
max			97	118	70	73	80			92	67	75	74	72	102	98	
Deciduous teeth																	
Grave	Sex				55	54	53	52	51	61	62	63	64	65			
17	?				85	72	73	54	63	66	51	70		82			
19	?				89	74	71	53	70	70	53	72	72	84			
n					2	2	2	2	2	2	2	2	1	2			
mean					87,0	73,0	72,0	53,5	66,5	68,0	52,0	71,0	72,0	83,0			
s.d.					2,83	1,41	1,41	0,71	4,95	2,83	1,41	1,41		1,41			
min					85	72	71	53	63	66	51	70	72	82			
max					89	74	73	54	70	70	53	72	72	84			
Buccolingual diameter - maxilla																	
Permanent teeth																	
Grave	Sex	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
25	?							63				63					110
5	F						70					72				107	
6	F	113										79					
7	F	108			92			68									
10	F	105	117	120	98	97	94	72	79	77	69	89	97	97	118	112	108
18	F														103		
24	F		101	104	90	87	76	63	66		63	77	89	93			85
28A	F	95	111		95	92	79	65		70	62	80	96	95	109	112	97
n		4	3	2	4	3	4	4	2	2	3	5	3	3	4	2	3
mean		105,3	109,7	112,0	93,8	92,0	79,8	67,0	72,5	73,5	64,7	79,4	94,0	95,0	109,3	112,0	96,7
s.d.		7,59	8,08	11,31	3,50	5,00	10,21	3,92	9,19	4,95	3,79	6,19	4,36	2,00	6,34	0,00	11,50
min		95	101	104	90	87	70	63	66	70	62	72	89	93	103	112	85
max		113	117	120	98	97	94	72	79	77	69	89	97	97	118	112	108
12	M									80			86	88	109	109	
20	M					94	77				68		95				
26	M		120	119										100			
n		0	1	1	0	1	1	0	0	1	1	0	2	2	1	1	0
mean			120,0	119,0		94,0	77,0			80,0	68,0		90,5	94,0	109,0	109,0	
s.d.													6,36	8,49			
min			120	119		94	77			80	68		86	88	109	109	
max			120	119		94	77			80	68		95	100	109	109	
Deciduous teeth																	
Grave	Sex				55	54	53	52	51	61	62	63	64	65			
17	?				91	83	56	50	53	53	47	56		90			
19	?				98	92	63	46	51	51	47	63	92	96			
n					2	2	2	2	2	2	2	2	1	2			
mean					94,5	87,5	59,5	48	52	52	47	59,5	92	93			
s.d.					4,95	6,36	4,95	2,83	1,41	1,41	0,00	4,95		4,24			
min					91	83	56	46	51	51	47	56	92	90			
max					98	92	63	50	53	53	47	63	92	96			

Table A-12. Dental measurements: mandibular mesiodistal and buccolingual diameters

Mesiodistal diameter - mandibula																	
Permanent teeth																	
Grave	Sex	38	37	36	35	34	33	32	31	41	42	43	44	45	46	47	48
25	?			114		92	71	52			55				107		
5	F	102	97	102	62	62	66	56	51	46	55			61	110	98	105
6	F	97										63					
10	F	114	100	107	72	69	73	61	50	51	61	72	69	70	111	104	
24	F		100	109	69	66	67	60	56	57	62	63	70	64	100	102	95
28A	F	107	98	108	70	64	65	61	54	54	64	63	63	63	103	99	116
n		4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4
mean		105,0	98,8	106,5	68,3	65,3	67,8	59,5	52,8	52,0	60,5	65,3	67,3	64,5	106,0	100,8	105,3
s.d.		7,26	1,50	3,11	4,35	2,99	3,59	2,38	2,75	4,69	3,87	4,50	3,79	3,87	5,35	2,75	10,50
min		97	97	102	62	62	65	56	50	46	55	63	63	61	100	98	95
max		114	100	109	72	69	73	61	56	57	64	72	70	70	111	104	116
2b	M	115	112	112	70	75	75		57	56	61	76	74	74	117	115	111
12	M	117	126	122	74	74	75								126	122	110
20	M				71								76				
26	M		109	117	77	73	73					69	72	70	117	107	
n		2	3	3	3	4	3	0	1	1	1	2	3	2	3	3	2
mean		116,0	115,7	117,0	73,7	73,3	74,3		57,0	56,0	61,0	72,5	74,0	72,0	120,0	114,7	110,5
s.d.		1,41	9,07	5,00	3,51	1,71	1,15					4,95	2,00	2,83	5,20	7,51	0,71
min		115	109	112	70	71	73	0	57	56	61	69	72	70	117	107	110
max		117	126	122	77	75	75	0	57	56	61	76	76	74	126	122	111
Deciduous teeth																	
Grave	Sex				75	74	73	72	71	81	82	83	84	85			
17	?				119	80	56	45		42	47	56	81				
19	?				100	81	62	50	42	44	51	62	89				
25	?				99								78	102			
n					3	2	2	2	1	2	2	2	3	1			
mean					106,0	80,5	59,0	47,5	42,0	43,0	49,0	59,0	82,7	102,0			
s.d.					11,27	0,71	4,24	3,54		1,41	2,83	4,24	5,69				
min					99	80	56	45	42	42	47	56	78	102			
max					119	81	62	50	42	44	51	62	89	102			
Buccolingual diameter - mandibula																	
Permanent teeth																	
Grave	Sex	38	37	36	35	34	33	32	31	41	42	43	44	45	46	47	48
25	?			105		79	71	55			55				106		
5	F	88	103	101	71	68	69							75	100	96	90
6	F	90										72					
10	F	108	98	110	84	76	78	74	64	64	75	79	79	85	105	103	
24	F													78	107	102	96
28A	F	99	97	106	83	73	74	66	67	60	60	77	75	85	101	95	92
n		4	3	3	3	3	3	2	2	2	2	3	2	4	4	4	3
mean		96,3	99,3	105,7	79,3	72,3	73,7	70,0	65,5	62,0	67,5	76,0	77,0	80,8	103,3	99,0	92,7
s.d.		9,18	3,21	4,51	7,23	4,04	4,51	5,66	2,12	2,83	10,61	3,61	2,83	5,06	3,30	4,08	3,06
min		88	97	101	71	68	69	66	64	60	60	72	75	75	100	95	90
max		108	103	110	84	76	78	74	67	64	75	79	79	85	107	103	96
2 (2)	M	107	103	111	85	86	83		61	64	68		89	91	115	108	100
12	M	107	106	109	86	81									111	111	103
20	M				83								83				
26	M		100		87	84	78					81	81	84	110	101	
n		2	3	2	3	4	2	0	1	1	1	1	3	2	3	3	2
mean		107,0	103,0	110,0	86,0	83,5	80,5		61,0	64,0	68,0	81,0	84,3	87,5	112,0	106,7	101,5
s.d.		0,00	3,00	1,41	1,00	2,08	3,54						4,16	4,95	2,65	5,13	2,12
min		107	100	109	85	81	78		61	64	68	81	81	84	110	101	100
max		107	106	111	87	86	83		61	64	68	81	89	91	115	111	103
Deciduous teeth																	
Grave	Sex				75	74	73	72	71	81	82	83	84	85			
17	?				80	63	49	43		39	42	50	63				
19	?				84	69	60	46	40	40	46	59	69				
25	?				92								97	93			
n					3	2	2	2	1	2	2	2	3	1			
mean					85,3	66,0	54,5	44,5	40,0	39,5	44,0	54,5	76,3	93,0			
s.d.					6,11	4,24	7,78	2,12		0,71	2,83	6,36	18,15				
min					80	63	49	43	40	39	42	50	63	93			
max					92	69	60	46	40	40	46	59	97	93			

10 Appendix B: Reports on earlier finds

In 1963, prior to the Norwegian investigations, farm labourers found graves at Westness. These were studied on two occasions, in 1964 and 1965, and two brief skeletal reports were made of the finds. These reports have kindly been made available by dr. Caroline Paterson. In the cover letter to the copies of the reports she writes:

"You may be rather surprised at the mention of "graves" as opposed to "grave", since this material is usually called Grave 1. However, there are as you will discover, parts of two adult female skeletons (A & B) and a full-term foetus. From correspondence at the time it appears two burials were discovered in separate locations, when two cows were buried, c. 10 feet apart. I therefore do not imagine the women were buried together, but that they come from these different discoveries. I also imagine that Grave 1 refers to the female burial which was accompanied by rich grave goods, and hope to confirm this after further work." 50

The following are transcriptions of the reports.

"Report on Bones from Viking Grave found at Westness, Orkney." Handwritten report by dr. Alastair Whyte, July-August 1964 (3 pp. + cover page).

"A. Adult bones

Bones listed in green (*) are presumably of a second person.⁵¹

1. Skull. Part of – facial bones and anterior part of vault on L. side, 2 teeth missing, right central and right lateral incisors.
1. Skull. Part of – posterior half of vault & base with a large part of the occipital bone, foramen magnum almost complete.
1. Mandible – complete except (for 2 teeth) for left central incisor and left first premolar lost post mortem.
5. Vertebra – lumbar. * 5. lumbar vertebrae
7. " thoracic * 2. thoracic vertebrae - small
- * 1. " " - larger
1. Sacrum
2. Hip bones
 - 1 complete female * 1. hip bone incomplete (female)
 - 1 incomplete female.
2. femur (larger) * 2. femur (smaller)
2. tibia. * 2. tibial fragments (one in two parts)
2. fibula. * 1. fibular fragment.
2. patella.
1. coracoid process.
2. clavicle, R. & L..
2. humerus. R. & L. * 1 humerus upper part L.

2. humerus. R. & L. * 1 " lower part R.
2. ulna.
 - 1 complete except for olecranon
 - 1 in two parts
2. radius 1 complete & 1 in two parts
- 2.. first ribs R. & L.
- 36 rib fragments * 3 rib fragments
- 5 carpal bones.
- 28 metacarpals & phalanges.
4. metatarsals.
- 1 cuneiform.

Various fragments.

1. manubrium sterni
1. body of sternum
2. calcaneus * 2 calcaneus
1. temporal bone (mostly petrous)
- * 1 occipital condyle

The suture between sphenoid & occipital is not ... available, but the sagittal & coronal sutures are, indicating that the age of the person is less than 30 years. The mandibular angle is about a right angle.

The two hip bones of the one person, as judged by the great sciatic notch & the distance between symphysis pubis & anterior border of acetabulum compared with the diameter of the acetabulum, indicate that the sex is female.

The other, 3rd hip bone, incomplete, indicates that the sex is female, relying on the sciatic notch alone.

B. The foetal bones accompanying the find.

11. foetal limb bones
 - 2. femur
 - 2. tibia
 - 2. fibula
 - 2. radius
 - 2. ulna
 - 1 long bone?
2. fragments – foetal long bones.
5. foetal ribs – complete
- 6 " " - fragments
15. fragments of foetal bones – mostly skull.
1. hip bone – foetal."

**"Skeletal remains from Westness, Rousay, Orkney
(Viking Grave)."**

**Typewritten report by R. D. Lockhart, 1965
(1 1/2 pp.).**

"One Skull

The greater part of the right parietal area and the right temporal region, and the inferior part of the left parietal area are missing. In the upper jaw the central incisor and lateral incisor are missing, in the lower jaw, also the left central incisor and the left premolar. These teeth have been lost in the excavation, otherwise, the dentition would have been perfect and in excellent condition.

The bones which have been marked with the letter A.

The pelvis, that is, both hip bones and sacrum are complete except for the right ischium. This pelvis is markedly female in character. There is a good left humerus, a broken right one, and right and left fore-arm bones are good, and both clavicles. There are numerous hand and foot bones. There is the manubrium and body of the sternum, numerous ribs and an intact left first rib, 14 vertebrae (*sic*); only the coracoid process of one scapula; there is also part of the right hip bone of another skeleton, also female in type, marked A, but it probably belongs to the set of bones marked B. There are two femora with the lower and upper ends defective but with heads present, 2 patellae marked A, 2 defective tibiae (*sic*).

Bones marked B

There are two femora with the heads and part of the necks missing, 2 tibiae (*sic*) practically complete, 2 fibulae the right one defective, parts of 2 ribs, and one right humerus with the head missing; this has been marked A2 but it looks as if it belongs to the above bones marked B.

Foetal Skeletal Remains.

The following bones are from a full-time human foetus (or infant at birth): - temporal and sphenoid fragments of the skull, parts of the vault of the skull, both femora, tibiae (*sic*) and fibulae, one humerus complete, one radius and 2 ulnae complete.

Note: There are also 6 vertebrae imperfect which bear no marks but look as if they belong to the remains marked B."

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Notes

- 1 Holtsmark (1970).
- 2 Thomson (1987), p. 2.
- 3 Kaland, work in progress.
- 4 Holtsmark (1970).
- 5 Thomson (1987), p. 2.
- 6 Kaland, under utarbeidelse.
- 7 Kaland (1987), p. 26.
- 8 Kaland (1987), p. 23f.
- 9 In the tables, the measurements are identified with the letter "M", which refers to the definition of the measurements given in Volume I of Martin and Knussmann (1988).

- 10 Martin and Knussmann (1988), p. 229, give the following definitions of the upper limb proportion: brachykeric (short lower arm) < 74.9; mesokeric (medium long lower arm) 75.0 – 79.9; dolichokeric (long lower arm) > 80.0. There are no corresponding definitions with regard to the lower limb indices and the intermembral indices.
- 11 Data for the Danish Vikings are from Tables 7-57a and 7-57b, p. 201 in Sellevold, Hansen et al. (1984). No standard deviations were calculated for the intermembral index for this material. The data for the Anglo-Saxons are from Krogman (1978), Table 64, which is based on Table XV in Münter (1936). No standard deviations were reported for the means in Krogman's table. There are no data for the tibio-femoral index or the intermembral index for the Anglo-Saxon skeletons.
- 12 Martin and Knussmann (1988), Vol. I/1, p. 229, recommend using the M1b measurement of the tibia and the M2 measurement of the femur for this index. However, in order to be able to compare the Westness values with the values for the Danish Viking Age material, the M1 measurements for both bones have been chosen for the calculations in the present study, since they were used in the study of the Danish skeletons (Sellevold, Hansen et al. 1984, p. 199ff).
- 13 Thomson (1987), p. 1.
- 14 This value has a standard deviation of 3.94 for males and 3.72 for females.
- 15 The standard deviation for stature values based on the maximum length of the tibia is 4.00 for males and 3.66 for females.
- 16 The standard deviation for stature calculations based on the maximum length of the humerus is 4.57 for males and 4.45 for females.
- 17 Berry (1974), p. 347. Unfortunately, Berry does not give any information as to the particular graveyard from which her Orkney material derived.
- 18 This material consists of the skeletal remains of the Viking Norse settlers at Qagsiarsuk, the former Brattahlid, which was the Eastern settlement of the Vikings in Greenland who had emigrated from Iceland. The skeletal remains are from Tjodhilde's churchyard at Brattahlid, the first church in Greenland, dated to c. 1000 AD. It was excavated in the 1960's (Krogman 1967), (Jørgensen n.d.). The data on the nonmetric traits are from Sellevold (1977). See also Sellevold (1980).
- 19 The data for cranial nonmetric traits in the Danish Iron Age skeletal groups include data on the Danish Vikings. These did not differ from the other skeletal groups of the Danish Iron Age, thus a pooled data set from the whole Danish Iron Age is used in the present comparisons. The presentation of the data from all groups in Table 7 have been adjusted in order to be comparable with Berry's data, i.e., the sexes and sides have been pooled.
- 20 Rogers and Waldron (1995), p. 32-33.
- 21 Aufderheide and Rodríguez-Martín (1998), p. 59.
- 22 Brothwell (1981), p. 132.
- 23 Aufderheide and Rodríguez-Martín (1998), p. 126.
- 24 Arcini (1999), p. 114.
- 25 Arcini (1999), p. 121.
- 26 Steinbock (1976). See also Aufderheide and Rodríguez-Martín (1998), p. 124, who point out that the presence of tuberculous pleuritis is an extremely common part of active pulmonary tuberculosis.
- 27 Møller-Christensen (1982), p.177.
- 28 See, for example, Aufderheide and Rodríguez-Martín (1998), p. 127 and p. 133.
- 29 Stirland and Waldron (1990), p. 221.
- 30 Larsen (1973 and 1986).
- 31 Sellevold (1979), Bennike (1985).
- 32 Aufderheide and Rodríguez-Martín (1998), p. 84.
- 33 Aufderheide and Rodríguez-Martín (1998), p. 84.
- 34 Bennike (1985), Jennbert (1991), and many others.
- 35 Bennike (1985), p. 97.
- 36 See for example, an illustration in Jennbert (1991), p. 366, where there is a similar but not completely healed trepanation: there is still a hole in the middle of the depression.
- 37 Jørgensen (1988), p. 3.
- 38 Hillson (1996) describes both the FDI method and other methods that may be used to record the dentition.
- 39 Occlusal attrition was recorded using the system described in Smith (1984).
- 40 The recording of teeth have been done macroscopically, hence teeth embedded in the jaw bones are not included in the present study. Radiographic examinations of the jaws are outside the scope of the present study.
- 41 The crowns may have been worn away so that only the roots are present, or the crowns may have broken off and become lost post mortem.
- 42 Whether there is agenesia of a tooth, or whether it is impacted in the jaw bone can be determined by radiographic examination.
- 43 Hillson (1996), p. 116.
- 44 Aufderheide and Rodríguez-Martín (1998), p. 401.
- 45 Hillson (1996), p. 266.
- 46 Hillson (1996), p. 269.
- 47 The statures for the Norwegian and Danish skeletons are all calculated on the basis of femoral maximum lengths (M 1). The data are from Sellevold, Hansen et al. (1984); Sellevold (1992).
- 48 However, this child suffered from a circulatory disease (Legg-Calvé-Perthes) which had resulted in a deformed right thigh bone and acetabulum. Conceivably, this condition might contribute to the broader incisurae ischiadica major.
- 49 This individual was sex determined 'male' by Larsen (1972), who had more skeletal material on which to base his determination than was available for study during the present investigation. I found that the maximum length of the surviving humerus is substantially shorter than the minimum lengths of the humeri of the securely determined males in the Westness material, and I have therefore chosen to label the skeleton as 'indeterminate sex'.
- 50 Quoted from a letter to the author from Caroline Paterson, National Museums of Scotland, dated September fourth 1997.
- 51 In the present transcriptions, an asterisk (*) indicates where dr. Whyte had used a green pen to distinguish between the individuals.

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- 1996-13 Om Lydvalloftet på Voss.
- 1996-20 Om kulturminner og E18 gjennom Oslo.
- 1997-6 Om kvistnagler fra Tønsberg.
- 1997-7 Om kristusfigur fra Otterøy kirke.
- 1997-13 Om konservering i Nore stavkirke.
- 1997-19 Om ødeleggelse av kulturminner i Skien kommune.
- 1997-22 Om historiske vandringer i Trondheim.
- 1998-2 Om konservering og restaurering av 1700-talls maleri i Vevelstad kirke.
- 1998-4 Om skader på kulturlag i middelalderbyer.
- 1998-12 Om utgravningene i Erkebispegården.
- 1998-15 Om ødeleggelse av kulturminner i Trondheim.
- 1998-16 Om Fuglefrisen i Olavsklosteret i Oslo.
- 1998-17 Om konservering og restaurering av altertavlen i Førde kirke.
- 1998-20 Om to båtvrak fra 1600-tallet funnet på Sørenga i Oslo.
- 1998-22 Om arkeologiske utgravninger av Vestfrontplassen i Trondheim.
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- 1999-2 Om utgravninger på Tønsberg torv.
- 1999-3 Om status for kongeørn i Norge.
- 1999-4 Om verdifull og sårbar natur ved Sundvollen i Hole kommune.
- 1999-5 Om laksen og forsuringen på Sørlandet og Sørvestlandet.
- 1999-6 Om konserveringen av 19 bemalte veggplanker i Ål stavkirke.
- 1999-7 Om fjellreven som er på randen av utryddelse.
- 1999-8 Om kosthold og erverv i Erkebispegården i Trondheim.