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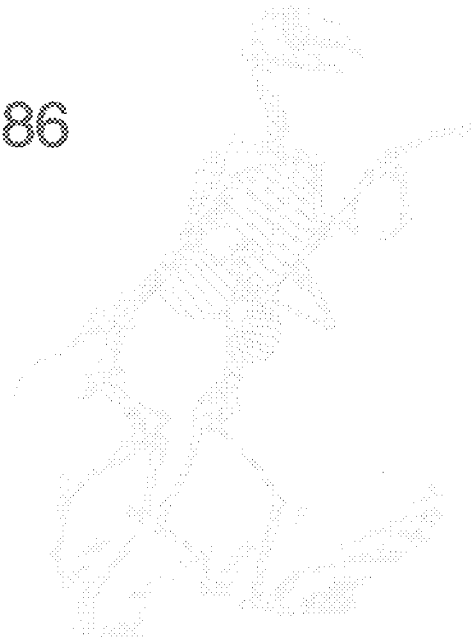

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Familiar Relationship Reconstruction in the Burials "Circles" of the Alfedena Necropolis (Iron Age: L'Aquila, Italy) using the Mobility and Topographic Distribution of Non-malignant Osseous Neoplasm

LUIGI CAPASSO

OSSA

The author presents the result of a topographic study on an exostotic disease which tends to run in family lines. The paleopathological analysis confirms the hypothesis that inhumations in the Alfedena necropolis occur in relation to kinship among deaths.

Keywords: Exostosis - Iron Age - Italy

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Introduction

The necropolis of Alfedena (L'Aquila, Italy) dates to the Iron Age. The graves are grouped in "circles", and formerly Mariani (1901) supposed that these groupings were related to a relationship among the deaths buried in the same "circle".

Unfortunately, the anthropological material excavated by Mariani and other earlier archaeologists have uncertain topographical references.

In recent times new archaeological excavations have been performed. Between 1974 and 1979 the "Soprintendenza Archeologica d'Abruzzo" excavated 132 graves in an not earlier explored area of the necropolis. These graves are grouped in 4 "circles" (Bedini & Coll., 1975).

The first circle includes graves 1-55 and dates between the second half of the VIth century and the first half of the Vth century B. C.

The second circle, including graves 56-94, dates to the first half of the Vth century B. C.

The third circle, including graves 94-120, dates to the same time.

The fourth circle is not grouped in an orderly structure and the assemblage of graves is not evidently circular. It includes graves 121-132 and dates between the end of the VIth century and the beginning of the Vth century B. C.

Graves located in the central area of each circle (except the fourth) are probably more ancient than those located in the periferic area of each circle.

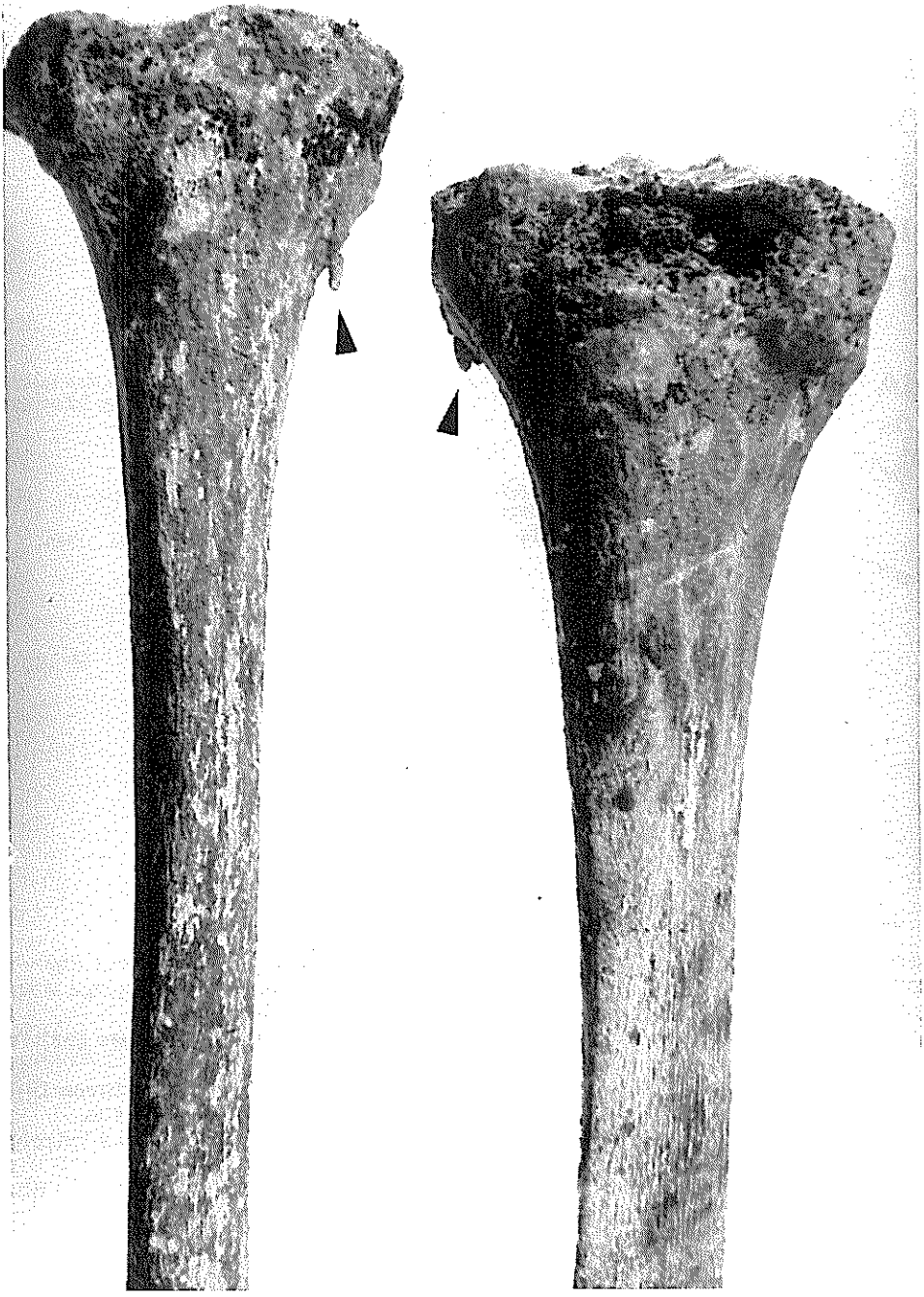

Fig. 1. Two tibias from burial No. 97 and from burial No. 119 of Alfedena necropolis. Arrows shows osteocartilagineous solitary exostoses.

Archeologists studied the relations and the differences between the circles and between the graves located in the various area of the same circle, on the basis of the cultural materials (funeral outfit). This study shows that the graves grouped in circular structures are based on clan's relations among the deaths of the same circle (Parise Badoni & Coll., 1980).

Unfortunately, the archaeological screening shows exclusively the clan's relations but doesn't show the familiary relation. This information has a biological character andneeds a biological screening.

To demonstrate the familiar character of grave grouping, Coppa & Coll. (1980a and b and 1982) studied the metrical and non-metrical characters of skulls and teeth. They suggests exclusively biological micro-differences among the various circles.

Nemeskéri & Coll. (1982) suggests the existence of significative statistical biological differences between circles and within circles using metrical and non-metrical characters of cranium, post-cranium and teeth.

The paleopathological survey of the skeletal materials from Alfedena permits the use of hereditary diseases for the study of relationship among the graves of each circle.

Osteocartilagineous solitary exostoses are osseous benign neoplasm; today the represent about 45% of all osseous benign neoplasm and 12% of all osseous tumors (Dahlin, 1967).

Today, femur and tibia are the more frequent loci of the tumors (about 50% of all cases). Male is favourite sex (Geschicketer & Copelan, 1949).

The nature of the osteocartilaginous solitary exostoses is still discussed. Disontogenetic origin is accepted for the multiple osteocartilagnous exostoses.

Solitary exostoses are related to the activity of bone growth and a disontogenetic origin is probably involved. Clinically, they are conveyed with familiarity.

Material

Materials studied consist in skeletal remains from 132 graves of the Alfedena necropolis. Ninety of them contain at least one tibia. Altogether 161 tibias have been studied.

All material belonging to the Institute of Anthropology of the University of Rome.

Observations

Osteocartilagineous solitary exostoses are present only in three tibias (see fig. 1). All tibias are left and belonging to three different individuals:

1 - Burial No. 97: male, $39,33 \pm 3$ years.
2 - Burial No. 119: male, $27,50 \pm 2,5$ years
3 - Burial No. 122: female, $61,00 \pm 2,5$ years.

Sex and age determination has been calculated by Nemeskéri & Coll. (1982). All exostoses are found on the metaphysis of the tibia, below the tibial plate. Exostoses are extended cranio-caudally; the length varying between 8 and 12 mm. The topographic distribution of exostoses in burials show that they are concentrated in the 3th and 4th "circles". The frequence of osteocartilaginous solitary exostoses in these "circles" is 12,5% about. Obviously, this frequence is 0,0% in other "circles".

Conclusion

Three cases of osteocartilaginous solitary exostoses of the tiba, a "familiary" disease, have been found in the skeletal material coming from the Alfedena necropolis (Italy, Iron Age). The cases are concentrated in a little area of the necropolis; this suggest that inhumations occurs in relation to kinship among deaths.

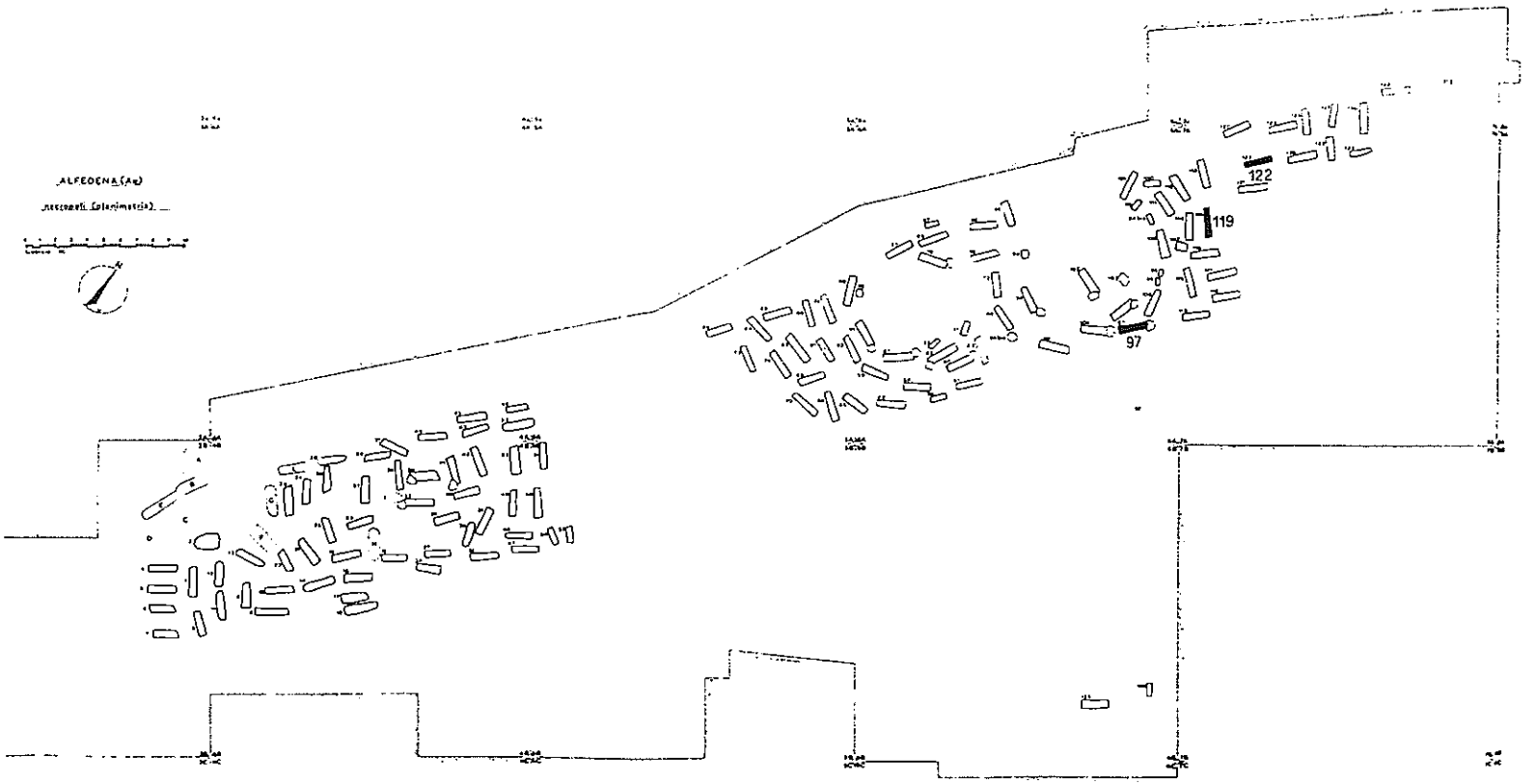

Fig. 2. Plant of the region recently excavated by the Soprintendenza Archeologica d' Abruzzo in the Alfedena necropolis. Plant show the grouping of graves. Graves in black belonging to subjects with osteocartilaginous solitary exostoses of tibia (after Parise & Coll., re-dis.).

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Dental Pathology of the Skeletal Remains of Pontecagnano, Salerno Italy: VII–IV centuries B.C.

GINO FORNACIARI, MARIA GIULIA BROGI and ESTER BALDUCCI

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The work deals with the analysis of dental pathology revealed in the skeletal remains of the necropolis of Pontecagnano (Salerno). The material was divided into two groups (VII-VI and V-IV century B.C.) corresponding respectively to the Etruscan and Oscan periods. In the overall sample the males generally, in contrast to the females, presented a dental pathology more frequent and serious. The lengthy life span of the males could explain this phenomenon. If in fact one considers the dental pathology index that takes into consideration the age at death, both sexes seem to be affected with equal incidence. In general, the mandibular teeth are more affected by these dental pathologies and in particular by caries. Therefore it is likely that the major residues of food occurred at the mandibular teeth: in fact the prevalent type of caries is the interproximal one. As a comparison between the two groups studied, the more ancient group presents a greater dental wear and a greater degree of periodontal disease than the more recent group. The explanation could perhaps consist in a change of eating habits of the two groups. Enamel hypoplasia occurs more frequently in the individuals of the VII-VI cent. B.C. than in those of the V-IV cent. B.C. The phenomenon could be explained by the existence, in the more ancient period of greater stress during the growing period. Regarding congenital anomalies, a high incidence of agenesis of the third molar was found.

Keywords: Dental Pathology - Classical Age - Southern Italy - Etruscans - Lucans.

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Introduction

The skeletal material, the dentition of which is the subject of this research, was discovered in the necropolis of Pontecagnano (Salerno) (Fig. 1) which was in use for a long period: from the Iron Age to the III century B.C. For historical information and details of the excavations refer to Prof. Edoardo Pardini's systematic anthropological study on the skeletal remains of Pontecagnano (Pardini et al., 1982). The present study takes into consideration the individuals of the VII-IV centuries B.C., which are sub-divided into two groups. The reasons for such a choice are to be sought in the historical vicissitudes which seem to have characterized the necropolis: the first sample takes in the end of the

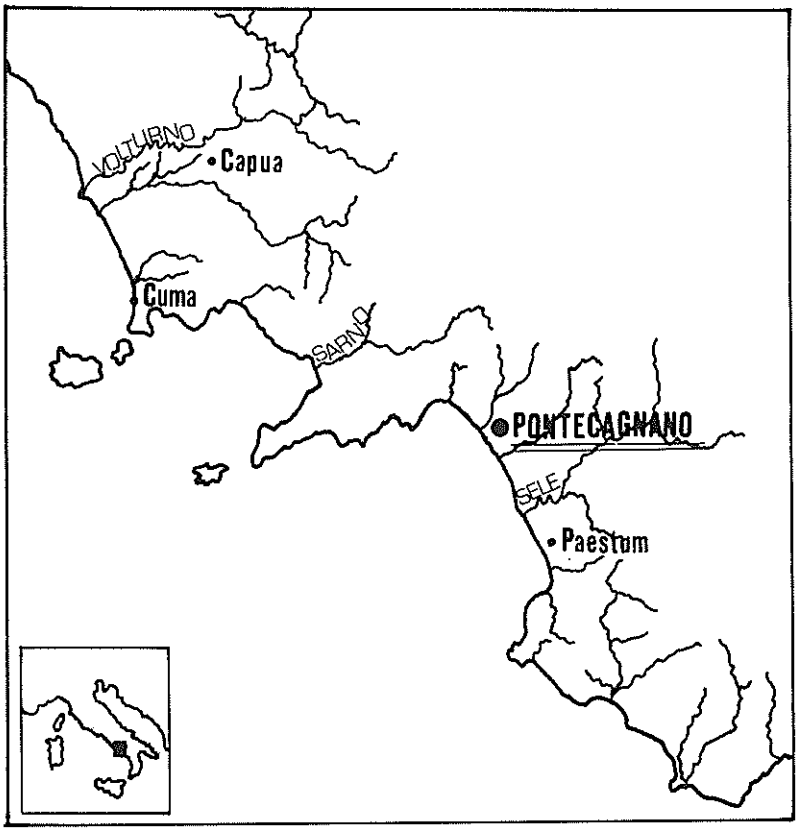


Fig. 1. Position of Pontecagnano in respect to some important towns in Campania.

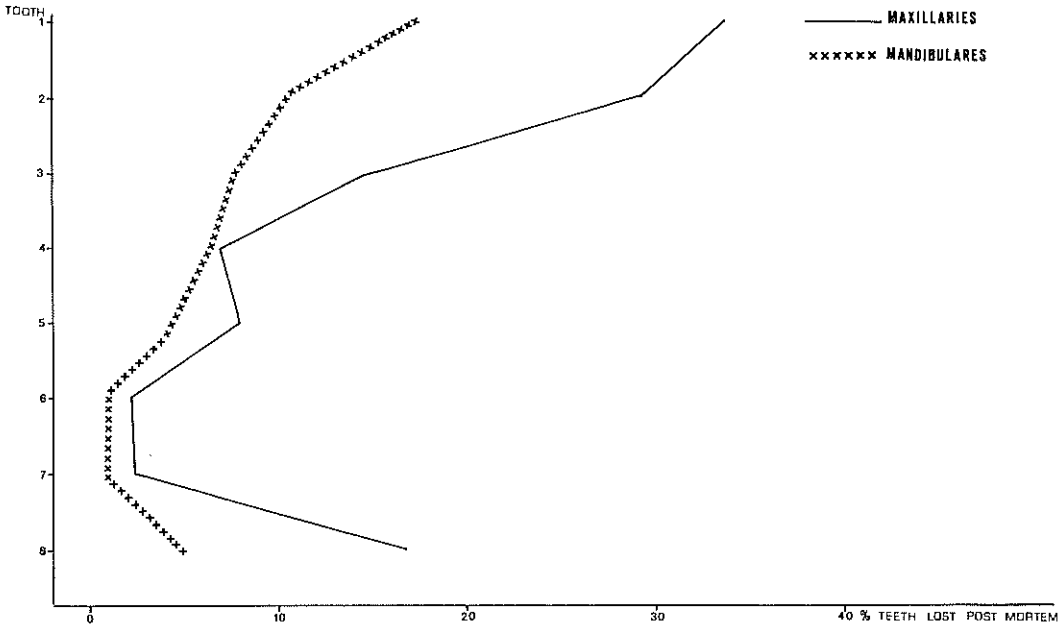
Greek domination and the Etruscan period, while the other regards the end of the Etruscan domination and the whole of the Oscan period. Further sub-divisions were impossible because a substantial number of the tombs cannot be precisely dated; even the V-VI century group was considered as a single sample, notwithstanding the probable change in population (the Oscans took the place of the Etruscans). This is justified by the fact that, on the evidence of previous anthropological studies (Pardini et al., 1982) the Oscan element would not seem to have had a massive influence on the population of Pontecagnano.

Sex and age at death were determined according to the diagnosis of Mallegni et al. (1984) for the VII-VI century remains, while for the V-IV century group we referred to those of Pardini et al. (1982). 35 individuals of the VII-VI century group (21 males and 14 females) and 102 individuals of the V-IV century group (53 males, 44 females and 5 youths) were taken into account.

Material, methods and statistical treatment

The dental pathologies evidenced on the maxillary and mandibular teeth of 137 individuals were taken into consideration: 74 males, 58 females and 5 youths aged between 12 and 15. Deciduous dentition was not, therefore, taken into account. Our study involved only 2831 teeth instead of the approximately 4000 teeth which one would have expected if all the dental arches had been entire and with a complete dentition. Not all the individuals present both maxilla and mandible, so some of the dental arches are incomplete and we have to remove from our calculations not only intra vitam and post mortem tooth loss but also the agenesiac teeth and those which never erupted (and are hence still retained in the alveoli). For further information on this subject see the study by Mallegni et al. (1984).

The dental pathologies were observed individual by individual, tooth by tooth, and the data were then set in tables, following the methodology recently adopted for other skeletal finds: Punic (Mallegni et al., 1981) and Roman (Mallegni et al., 1982). The terminology



Graph 1. Post mortem loss of each type of tooth in the overall sample.

adopted conforms with the usual international anthropological conventions: the maxilla and mandible of a single individual, when both present, appear in the upper and lower quadrants of their respective tables, in order to give an immediate view of the overall pathological picture. The description of diseases and malformations follows the usual international dental terminology (Brothwell, 1963; Benagiano, 1972; Ortner, 1981). In observing dental wear we adopted Martin and Saller's method for the posterior teeth and Dalitz's method for the anterior teeth (from canine to canine); the methods are, in fact, equivalent in their respective fields.

The degree of periodontal disease has been indicated in accordance with Dalitz's methodology (1962).

Enamel hypoplasia was examined macroscopically with the aid of a magnifier, in accordance with Brothwell (1981). The statistical elaboration of qualitative and quantitative information follows the pattern set by previous studies on Etruscan (Mallegni et al., 1980) and Punic (Mallegni et al., 1981) skeletal remains and that of a recent study on Romano-British material (McWhirr et al., 1982). The comparison between percentages was made with the calculation of χ^2.

For comparisons between samples of different populations the dental lesion index was used, corrected for age in accordance with Bisel's methodology (1980).

Post mortem loss of teeth

Post mortem tooth loss regards 323 teeth, that is, 10% of the total dentition: it is more marked in the maxilla (205 teeth out of a total of 1435, amounting to 14.3%) than in the mandible (118 teeth out of a total of 1783, amounting to 6.6%) (Graph 1)

The position and morphology of the roots may, at least in part, explain this difference which has also been observed in other groups of skeletal remains of the Hellenistic and Roman periods, such as the Etruscans of Tarquinia (Mallegni et al., 1980) and the Romans of Vada (Mallegni et al., 1982). The explanation is to be sought in the large number of post mortem loss in the maxillaries caused by their well known fragility. This

TABLE 1. "Post mortem" loss of each type of tooth in the total sample

	MAXILLARIES		MANDIBULARS	
	P. E.	p. m. C%	P. E.	p. m. C%
I1	186	33.8	225	17.3
I2	191	29.3	228	10.5
C	195	14.8	233	7.7
P1	203	6.9	236	6.3
P2	189	7.9	227	4.4
M1	184	2.2	236	0.8
M2	168	2.4	229	0.9
M3	119	16.8	169	4.7

P. E. = Position of eruption
p. m. C% = Percentage of post-mortem loss.

phenomenon would seem to be typical of primary burial-places, while in the ossuaries and secondary burials the situation is inverted and it is the mandible which shows a higher number of loss, given that at the moment of removal, this latter is not treated with the same respect as the skull. An example worth noting are the recent observations on a Punic sample from Carthago dating from the III-II century B. C. (Mallegni et al., 1981).

In both the maxilla and mandible it is the simple, single rooted anterior teeth which show the highest percentage of loss (Table 1, Graph 1). M3, P1 and P2 follow in that order.

M1 and M2 show the lowest number of post mortem loss; in this case the explanation is probably to be sought in the number and morphology of the latter' s roots which are both more numerous and more complex.

Dental wear

From the individual analytical tables (available on request) one can note the presence of an increased degree of dental wear from the beginning of the third decade of life onwards. Here we are dealing with a very advanced state of wear common to many ancient peoples: such an extreme degree is rarely reached by modern Europeans, even at senility. The worst affected teeth are the molars and premolars, in other words, those which were prevalently involved in astication.

In both the VII-VI century group and the V-IV century group one can observe a sharp difference in terms of wear between the males and females: it is, in fact, the males who show a major degree of wear. This phenomenon, which is also significant from a statistical point of view (Table 2), can be easily explained if one takes into account the average age at death (in the VII-VI century group: males = 32.6, females = 27.7; in the V-IV century group: males = 32, females = 27); it is thus the males, who died at a more advanced age, who present a more advanced degree of wear. In other words, the degree of dental wear is directly correlated to age.

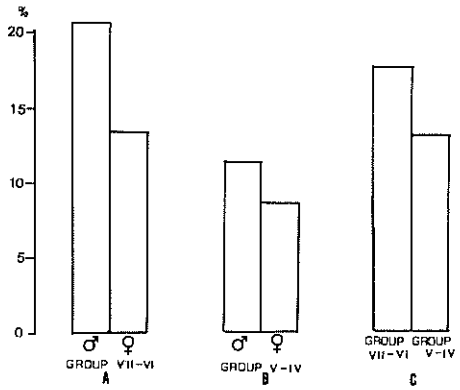
Examining, instead, the degree of dental wear taking both sexes together but separating the two groups, it is the more ancient group (VII-VI century B. C.), which presents a more advanced degree of dental wear than that of the more recent group (V-IV century B. C.); this difference is also significant from a statistical point of view (Table 3, Graph 2).

TABLE 2. Percentages of the maximum levels of wear (Martin's grades 3-4) for the separate sexes.

	Males	Females	χ^2	P%
VII-VI Cent. Group	20.6	13.4	*4.2	5.0
V-IV Cent. Group	11.4	8.8	2.1	15.0
Total	14.0	10.0	**9.5	1.0

TABLE 3. Percentages of the maximum levels of wear (Martin's grades 3-4) taking both sexes together.

	VII-VI group	V-IV group	χ^2	P%
% max. level of wear	17.6	13.1	**7.33	1.0



Graph 2. A comparison between the percentages of the teeth with the maximum levels of wear (Martin's grades 3-4) taking the sexes separately (A e B) and taking both sexes together (C).

The difference encountered cannot be explained by the simple difference in the average age at death of the individuals of the two groups. In fact the average age at decease amongs the females of the VII-VI century group is 27,7 years as against 27 years in the V-IV century group; the average age at death amongst the males of the more ancient group is 32.6 as against the 32 of the males of the more recent group. For this reason the only likely explanation for this phenomenon would be a difference between the alimentary habits of the two groups. Amongst the cases of abnormal wear one should draw attention to three individuals of the V-IV century group (PC 1224 = a male aged between 35-40; PC 1259 = a female aged 30 and PC 1768 = a male aged between 35-40) and a single individual of the VII-VI century group (PC 1004 = a male aged 40) who demonstrate a particularly increased degree of wear in the case of the anterior teeth while the posterior teeth present only a modest degree of wear. A possible explanation is that these individuals used their anterior teeth for some working acitivity which is unknown to us (Dérobert, 1974).

Periodontal disease

As one can observe from the individual tables, there is a considerable degree of periodontal disease present in our population sample. The teeth worst affected are the molars, the premolars, and sometimes even the anterior teeth.

In the V-IV century group there is a sharp difference in the instance of periodontal disease between the maxilla and the mandible in both males and females, a difference which is also significant from the statistical point of view; such a difference, even if less marked, also exists in both sexes of the VII-VI century group B. C.

TABLE 4. Percentages of the maximum levels of periodontal disease (Dalitz's grades 3-4) in the two dental arches.

	Maxilla	Mandible	χ^2	P%
VII-VI cent. group				
Males	37.6	44.7	1.5	20.0
Females	39.0	44.3	0.5	50.0
V-IV cent. group				
Males	33.4	42.5	** 6.9	1.0
Females	20.1	35.8	*** 18.7	0.1

This phenomenon is difficult to explain, but it could be due to the stagnation of food residues at the level of the mandibular teeth and to the consequent inflammatory processes at the level of the gums; it would thus follow, as we shall see, the same pattern as dental caries and dental abscesses.

In the V-IV century B. C. group one can observe a sharp difference in periodontal disease between males and females which is statistically significant; such a difference is not evidenced by the VII-VI century B. C. group.

TABLE 5. Percentages of the maximum levels of periodontal disease (Dalitz's grades 3-4) for both dental arches.

	Males	Females	χ^2	P%
VII-VI cent. group	41.7	42.2	0.002	95.0
V-IV cent. group	38.8	29.2	*** 15.1	0.1

If, however, we examine the degree of periodontal disease taking both groups togetherå it is always the males who demonstrate the greater incidences, with a difference which is statistically significant:

	Males	Females	χ^2	P%
% Periodontal disease	39.7	32.8	*** 10.4	0.1

Finally, if we take both sexes together, the VII-VI century B.C. group displays a higher degree of periodontal disease than the more recent group, and also in this case the difference is statistically significant!

	VII-VI cent. group	V-IV cent. group	χ^2	P%
% periodontal disease	41.9	34.7	**9.7	1.0

From this evidence it is clear that the course of disease well enough mirrors that of dental wear and consequently, that a strict correlation exists between periodontal disease and wear.

In other words, the more the wear, the more the masticatory activity involves the alveolar ridges, provoking their resorption.

These results concur with those obtained by Holmer et al. (1956) and Mellquist et al. (1948) from examples of Swedish peoples of the Late Middle Ages.

Caries

It was observed that of the 2660 teeth involved in the study, 228 were affected by caries, representing 8.6% of the total of the remaining teeth, with no significant difference between the two groups:

	VII-VI cent. group	V-IV cent. group	χ^2	P%
% of carious teeth	8.6	8.5	0.001	90.0

In both groups the males seem to be slightly worse affected than the females; this difference, which is not very significant statistically, might also be explained in this case by the higher average age at death of the males.

	Males	Females	χ^2	P%
% of carious teeth	9.27	7.50	2.42	10.0

In the case of both sexes, the mandibles present a larger number of decayed teeth; in the case of the females however the difference appears more marked.

TABLE 6. Percentages of caries for separate arches in the overall sample.

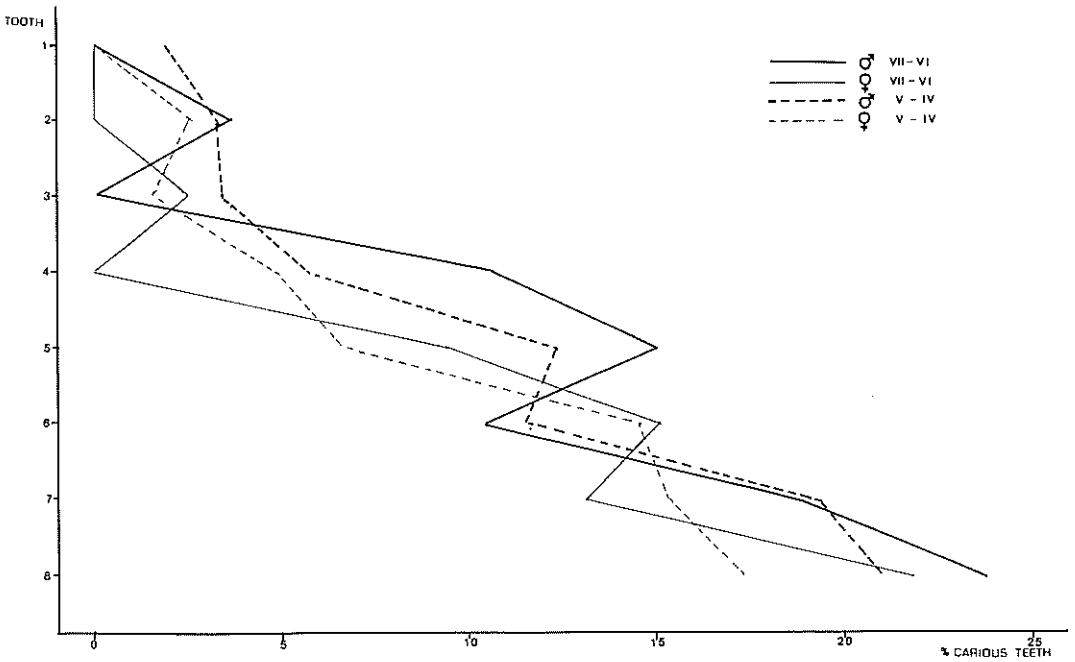
	Maxilla	Mandible	χ^2	P%
Males	6.84	11.27	** 7.74	1.0
Females	3.70	10.49	**18.27	0.1

This phenomenon is even more evident if one examines the percentages of caries in each individual tooth (Tables 7, 8, 9 and Graphs 3, 4, 5).

TABLE 7. Percentages of caries in the individual teeth taking both dental arches together in the groups of the VII-VI Centuries B. C. and the V-IV Centuries B. C.

	VII-VIth Century Group				V-IVth Century Group			
	Males		Females		Males		Females	
	T.E.	%C	T.E.	%C	T.E.	%C	T.E.	%C
II	47	0.0	35	0.0	106	1.9	93	0.0
I2	55	3.6	38	0.0	125	3.2	114	2.6
C	62	0.0	40	2.5	147	3.4	123	1.6
PI	65	10.7	42	0.0	158	5.7	125	4.8
P2	53	15.0	43	9.3	146	12.3	121	6.6
MI	48	10.4	40	15.0	148	11.5	124	14.5
M2	53	18.8	38	13.1	135	19.2	124	15.3
M3	38	23.7	23	21.7	76	21.0	75	17.3

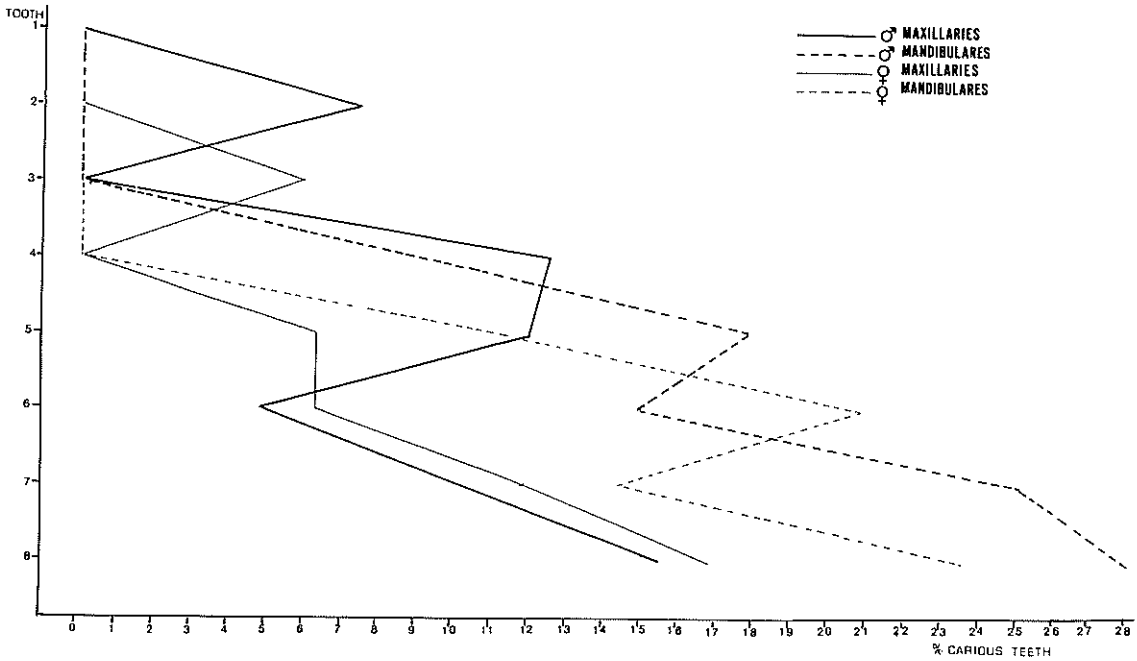
T. E. = Teeth examined
%C = Percentage of carious teeth.



Graph 3. Percentages of caries in individual teeth taking both arches together.

TABLE 8. Percentage of caries in individual teeth in each dental arch for the VII-VI cent. group.

	MAXILLARIES		MAXILLARIES		MANDIBULARS		MANDIBULARS	
	Males		Females		Males		Females	
	T.E.	%C	T.E.	%C	T.E.	%C	T.E.	%C
II	25	C.0	I6	0.0	22	0.0	I9	C.0
I2	27	7.4	I6	0.0	28	0.0	22	C.0
C'	28	0.0	I7	5.9	34	0.C	23	C.0
PI	32	I2.5	I6	0.0	33	9.0	26	C.0
P2	25	I2.0	I6	6.2	28	I7.8	27	II.I
MI	2I	4.7	I6	6.2	27	I4.8	24	2C.8
M2	20	IC.0	I7	II.7	33	25.0	2I	I4.9
M3	I3	I5.4	6	I6.6	25	28.C	I7	23.5

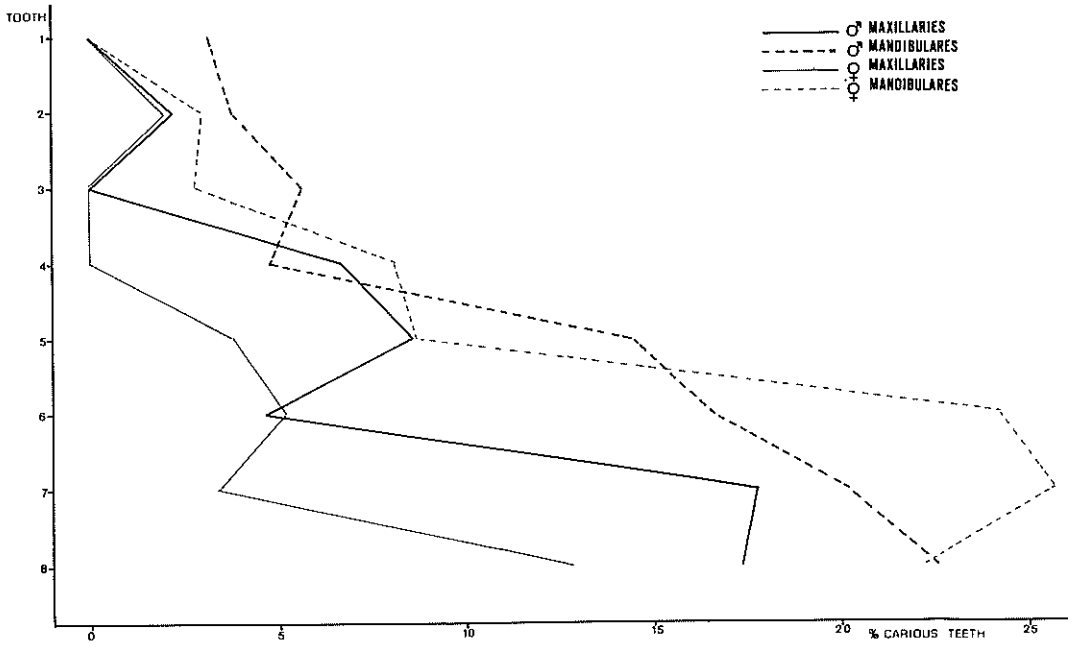


Graph 4. VII-VI century B. C. group. Percentages of caries in individual teeth taking the dental arches separately.

TABLE 9. Percentages of caries in individual teeth in each dental arch for the V-IV cent. group.

	MAXILLARIES		MAXILLARIES		MANDIBULARS		MANDIBULARS	
	Males		Females		Males		Females	
	T.E.	%C	T.E.	%C	T.E.	%C	T.E.	%C
I1	43	0.0	33	0.0	63	3.2	60	0.0
I2	46	2.2	48	2.0	79	3.8	66	3.0
C'	60	0.0	53	0.0	87	5.7	70	2.8
I1	75	6.7	51	0.0	83	4.8	74	8.1
I2	70	8.6	52	3.8	76	14.5	69	7.7
M1	64	4.7	58	5.2	84	16.6	66	24.2
M2	56	17.8	58	3.4	79	20.2	66	25.7
M3	23	17.4	39	12.8	53	22.6	36	22.2

%C = Percentage of carious teeth.
T. E. = Teeth examined



Graph 5. V-IV centry B. C. group. Percentages of caries in individual teeth taking the dental arches separately.

One can see from Tables 7, 8 and 9 and Graphs 3, 4 and 5, that the teeth worst affected by caries are the mandibulars, respectively: M_1, M_2 and M_3, followed by P_2 and, at a distance, P_1 and C, : the incisors show a negligible percentage of caries. This phenomenon, which may be explained by the major presence of food residues between the teeth of the lower jaw, is more clearly evidenced by the more numerous sample pertaining to the V-IV century B. C. That notwithstanding, the differences between the two groups would not seem to be significant, as one can observe from Table 7 and Graph 3 which show a synthesis of the data for both arches. One can also see that, of all the teeth, the M3 are the worst hit by caries, followed by the M2 and the M1.

As far as regards the individuals affected by caries, no significant difference emerges either between the two groups (VII-VI century B. C. = 51.4%, V-IV century B.C. = 56.7%; $\chi^2 = 0.11$, P% = 70.0) or between the sexes (males = 51.3%; females = 60.3%; $\chi^2 = 0.73$, P% = 45.0).

On examining the individuals affected by caries, subdivided into age groups, it was possible to ascertain that the females were worse hit, in percentage terms, at an earlier age, than the males (see Table 10).

TABLE 10. Percentages of individuals affected by caries in the different age groups.

Males

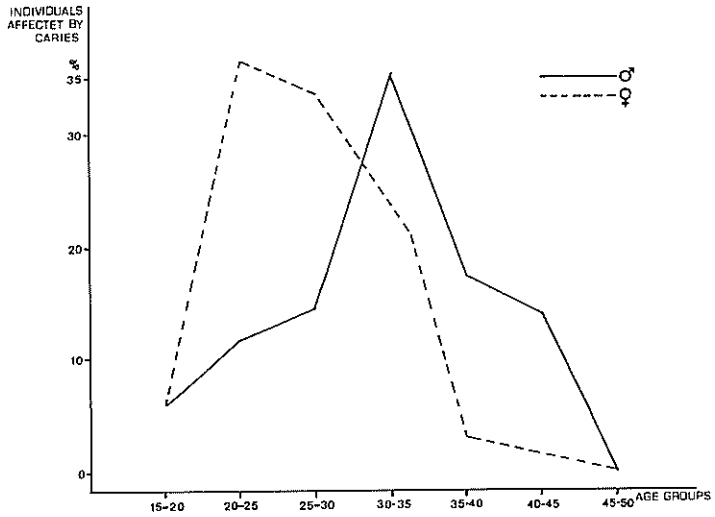
	15-20	20-25	25-30	30-35	35-40	40-45	45-50	Total
n	3	13	16	21	9	6	0	68
C	2	4	5	12	6	5	0	34
%	66.6	30.7	31.2	57.1	66.6	83.3	0.0	50.0

Females

	15-20	20-25	25-30	30-35	35-40	40-45	45-50	Total
n	6	23	14	10	1	0	1	55
C	2	12	11	7	1	0	0	33
%	33.3	52.2	78.6	70.0	100.0	0.0	0.0	60.0

Males + Females

	15-20	20-25	25-30	30-35	35-40	40-45	45-50	Total
n	9	36	30	31	10	6	1	123
C	4	16	16	19	7	5	0	67
%	44.4	44.4	53.3	61.3	70.0	83.3	0.0	54.5



Graph 6. Percentage distribution of the individuals affected by caries, sub-divided into age groups.

The females were stricken by caries at a high percentage between the age of 30 and 25, while the males presented the highest incidences between the age of 30 and 45. It would thus appear a plausible hypothesis that different decay factors affected the different sexes. In other words, the female caries present at an early age would have been significantly affected by the frequency of pregnancy and breast-feeding which favour its development.

The males, for the opposite reason, were afflicted by caries only at a more advanced age. One must also take into account the precocious female mortality. In fact, the mean age at death for the females was 27.2 years, while that of the males was 32.2 years. The influence of the mortality differential on the overall percentage of caries, is thus evident: had the females precociously affected by decay symptoms, in fact, survived, the situation would obviously have been inverted.

This phenomenon is even more evident if one shows on a graph of the percentage of individuals affected and subdivided into age groups (Graph 6).

Taking into consideration the various types of caries, often multiple in a single tooth, it was noted that in both groups there was a marked prevalence of penetrating caries in the mandibular teeth.

TABLE 11. Percentage of penetrating and non-penetrating caries.

	VII-VI group		V-IV group		VII-VI;V-IV group	
Caries	Max.	Mand.	Max.	Mand.	Max.	Mand.
Total	21	48	43	127	64	175
C.P.	16	43	32	104	48	147
%	76.2	89.5	74.4	81.9	75.8	84.0
C.N.P.	5	5	11	23	16	28
%	23.8	10.4	25.6	18.1	25.0	16.0

As regards caries location we notice a prevalence of interproximal caries (mesial more than distal) at the level of the maxilla without differences between the groups (Table 12). Destructive caries follows the same pattern of distribution.

TABLE 12. Percentage and location of interproximal caries.

	VII-VI group		V-IV group		VII-VI;V-IV gr.	
Caries	Max.	Mand.	Max.	Mand.	Max.	Mand.
Total	21	48	43	127	64	175
C.I.	11	16	18	32	29	48
%	52.4	33.3	41.7	25.2	45.3	27.4

The prevalence of interproximal caries over other types of caries is obvious because fragments of food tend to accumulate between one tooth and the other, but we cannot say why this type of caries and destructive caries affect the maxillaries more than the mandibulars.

TABLE 13. Location of caries.

	VII-VI group		V-IV group		VII-VI;V-IV group	
Caries	Max.	Mand.	Max.	Mand.	Max.	Mand.
Total	21	48	43	127	64	175
m	6	6	7	16	13	22
d	5	10	11	16	16	26
v	0	7	1	19	1	26
l	0	0	1	2	1	2
o	2	4	3	17	5	21
cl	2	13	5	30	7	43
r	1	2	1	2	2	4
dt	5	6	14	25	19	31

m = mesial; d = distal; v = vestibular; l = lingual; o = occlusal; cl = at the neck; r = at the root; dt = destructive.

For a comparison with other population samples we collected data relative to six groups, from the Neolithic to the Early Middle Ages (Table 14).

Both arches were analysed together and we calculated the incidence of caries in each tooth. Graph 7 gives a better reading of the comparisons between the populations. We can observe that the curve of Middle Minoans is similar to that of Pontecagnano.

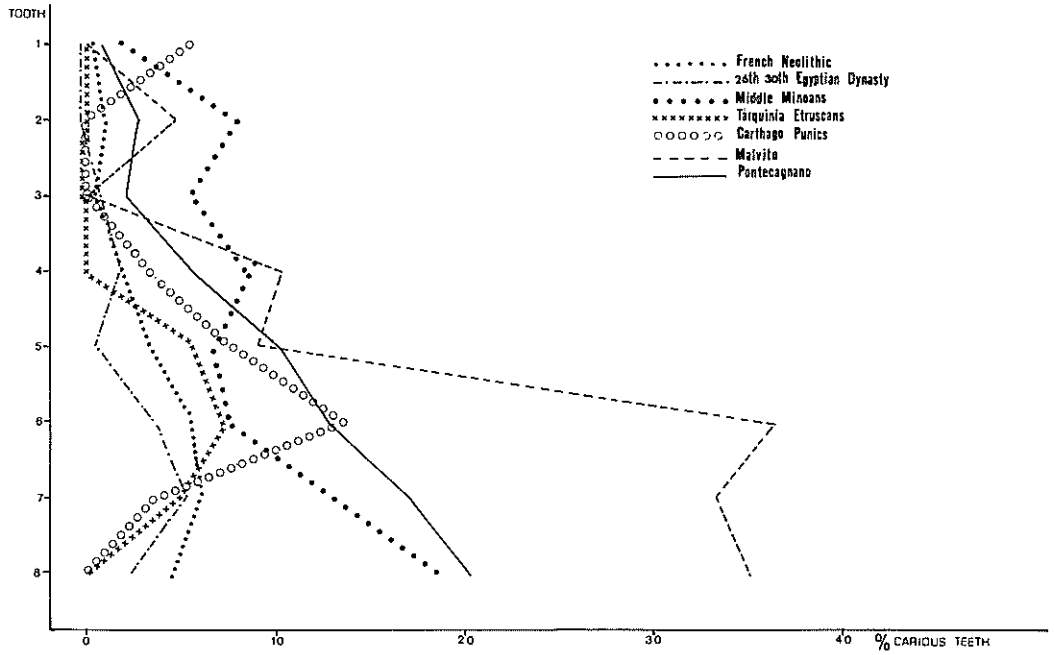
The only differences are a greater incidence of caries in the anterior teeth and less incidence in the molars. The Pontecagnano curve, except for M2 and M3, is also similar to that of the Carthago Punics, and, but only for the anterior teeth, to that of the early Middle Ages population of Malvito.

TABLE 14. Percentage of incidence of caries for single teeth in some ancient population samples.

	FRENCH[o] NEOLITHICS		EGYPTIAN[o] DYNASTY 26th-30th		MIDDLE[o] MINOANS		ETRUSCANS[oo] TARQUINIA III B.C.		PUNICS[ooo] CARTHAGO III-II B.C.		EARLY[oooo] MIDDLE AGES PACIURI VII-VIII A.D.		PONTECAGNANO VII-IV B.C.	
	T.E.	%C	T.E.	%C	T.E.	%C	T.E.	%C	T.E.	%C	T.E.	%C	T.E.	%C
II	992	C.3	I20	0.0	II2	I.8	29	C.0	I8	5.5	20	0.0	28I	0.7
I2	I067	I.0	I30	C.0	II3	8.0	37	0.0	22	0.0	2I	4.7	332	2.7
C_1'	I395	0.4	I53	0.7	2C3	5.4	39	0.C	32	C.0	28	C.0	372	2.1
PI	I63C	I.8	226	I.8	I89	8.5	39	0.0	32	3.I	29	IC.3	390	5.6
P2	I479	3.2	229	C.4	I94	6.7	36	5.5	27	7.4	33	9.0	363	IC.2
MI	I96I	5.5	327	3.4	268	7.5	4I	7.3	22	I3.6	22	36.4	360	I2.8
M2	I9I4	6.0	339	5.3	280	I2.9	39	5.2	28	3.6	2I	33.3	350	I7.I
M3	279	4.7	2I8	2.3	I46	I8.5	3I	0.0	23	0.0	20	35.0	2I2	20.3

T.E. = Teeth examined.
%P = Percentage of carious teeth.

o = From Brothwell, D.R. 1963
oo = From Mallegni F. et al. 1980
ooo = From Mallegni F. et al. 1981
oooo = From Menicagli E. 1981



Graph 7. Percentage incidence of caries for single teeth in some ancient population samples.

Most probably the curves reflect differences in diet of the sample populations. Some of them (French Neolithics, Egyptians) show a low incidence of caries, while other populations (Middle Minoans, Carthago Punics, Pontecagnano) are worse affected by this disease. The diet of the Neolithics and the Egyptians was probably meagre and lacking in sugary substances (which often cause caries). On the other hand, the Pontecagnano population had a richer and more varied diet, as did most populations of the Classic Age.

Abscesses and granulomas

Only the abscesses and granulomas visible to the naked eye were taken into account; so their calculation is certainly defective. 47 alveoli out of 3218 were afflicted, for a percentage of 1.46.

The V-IV group shows a greater incidence (statistically significant) of abscesses and granulomas than the VII-VI group:

	VII-VI group	V-IV group	χ^2	P%
% absc. gran.	0.78	1.72	* 3.38	4.5

In both groups the males seem to be hit slightly worse than the females; this difference, which one can observe but which is not significant in the overall sample, becomes significant when the two groups are separated, and especially in the VII-VI century B. C. group.

This phenomenon may be due to the more advanced age at death of the males. The mandibles have a larger number of abscesses and granulomas in both sexes; this difference is evident in the males but is significant in the case of the females.

The difference observed is similar to that relative to caries in general and penetrating caries in particular; so the two pathologies seem to be strictly connected.

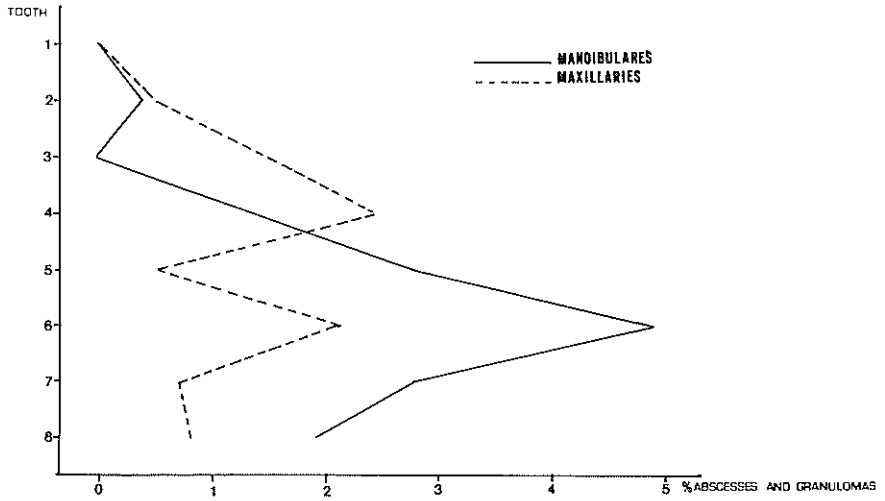
The teeth worst affected by abscesses and granulomas are M_1, followed by M_2, P^1, M^1 (Graph 8).

TABLE 15. Percentages of abscesses and granulomas for each sex, for both the overall sample and in separate groups.

	Males	Females	χ^2	P%
VII-VI group	1.34	0.00	3.5	4.7
V-IV group	2.09	1.25	1.9	23.0
Total	1.90	0.89	0.001	90.0

TABLE 16. Percentages of abscesses and granulomas in separate arches for the total sample.

	Max.	Mand.	χ^2	P%
Males	1.77	2.23	0.25	65.0
Females	0.30	1.38	* 3.58	4.7



Graph 8. Percentages of abscesses and granulomas in each tooth of both arches.

As regards the individuals affected by abscesses and granulomas, no significant differences were observed, either between the groups (VII-VI gr. = 20%; V-IV gr. = 21.6%; χ^2 = 0.0013; P% = 90.0) or between the sexes (males = 24.3%; females = 17.2%; χ^2 = 0.6; P% = 55.0). The possible correlation between dental wear and the arising of abscesses and granulomas was calculated. A high level of wear (Dalitz's grades 3 and 4) with perforation of the pulp chamber may be the cause of abscesses and granulomas resulting in teeth loss. Contrary to what R. L. Costa (1980) discovered in Eskimo populations (from Point Hope), our sample either examined as one group or divided into two separate groups (VII-VI century B. C. group and V-IV century B. C. group), does not show such a correlation. On the other hand, caries, abscesses and granulomas seem to be strictly correlated to intra vitam losses (Table 17). The results of the two studies were expected since the populations examined were culturally different. In the prehistorical populations of Point Hope, a primitive culture with a diet lacking in sugary substances, and used to preserve food in several ways (drying, freezing etc.), dental wear was the greatest cause of tooth loss. In the Pontecagnano sample, of probably urbanized culture, with a diet richer in sugary substances and refined food, caries was mostly responsible for tooth loss.

TABLE 17. Abscesses and granulomas and degree of dental wear.

		Presence of abscesses or granulomas					
		Degree of dental wear				Destructive caries	Intra vitam losses
Ponte-cagnano:	P.E.	0=1	1=2	2-3	3-4		
Males:	1803 a)	0	3*	1	2*	12	16
	b)	0.0	4.0	1.3	2.7	16.2	21.6
Females:	1419 a)	0	0	0	0	10	3
	b)	0.0	0.0	0.0	0.0	17.2	5.2

P. E. = Position of eruption.
a) = Total number of lesions in the group.
b) = Number of lesion in each individual.
* = Affected by destructive caries.

Intra vitam tooth loss

209 teeth out of 3218 were lost intra vitam (6.5%); no significant difference between the groups was observed:

	VII-VI group	V-IV group	χ^2	P%
% loss i.v.	7.35	6.16	1.31	25.0

In both groups the males are slightly worse affected than the females; this difference, statistically not very significant, may be due to the mean age at death of the males.

TABLE 18. Percentage of loss intra vitam for each sex separately.

	Males	Females	χ^2	P%
VII-VI group	6.84	5.32	2.04	15.0
V-IV group	7.85	6.64	0.30	50.0

The mandibles show more loss intra vitam; this difference, statistically not significant in the male sex, is very significant in the female sex.

TABLE 19. Percentages of loss intra vitam for separate arches in the overall sample.

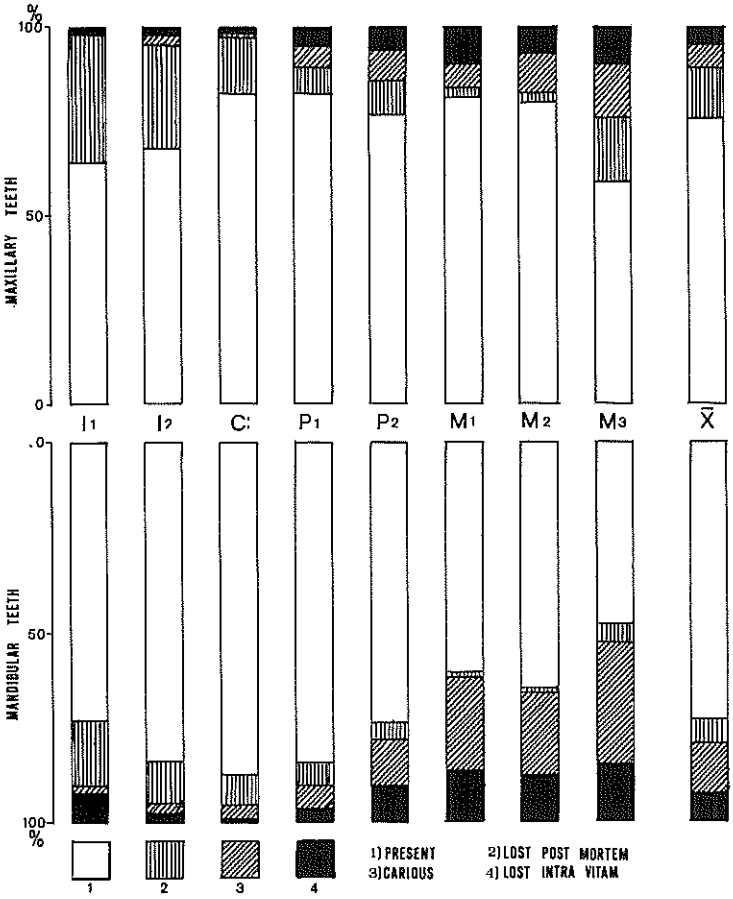
	Max.	Mand.	χ^2	P%
Males	6.90	7.27	0.02	90.0
Females	3.56	7.30	9.42	I.0

It is difficult to explain this phenomenon; perhaps the loss intra vitam followed the course of caries which, as already observed, more hit the lower than the upper jaw.

The difference between males and females could be explained with the precocious age at death of the women ; that is, caries, which precociously hit the females' mandibles, probably caused loss of mandibular teeth. Percentages of loss intra vitam relative to each tooth are shown in graph 9, this graph also gives a synthesis of the dental situation of Pontecagnano skeletons.

Dental lesion index

The dental lesion index was calculated through the percentage ratio of the number of damaged teeth (lost intra vitam, carious and/or affected by abscesses), out of the total number of examined alveoli. The average based on these indices involves some variations due to age at death, since the number of pathologies usually increases with age. So, in this research, all the individuals over 18 were analysed in such a way as to produce a "normal" curve in order to make the comparisons. We followed Bisel's formula (1980) which gives a linear curve with the equation: $Y = 0.48399514 + (0.58206327)X$. In this equation, if X is substituted with the difference of age of the analysed individual compared with the standard age of 40.875, we get an Y value to add or subtract from the lesion index of the same individual.



Graph 9. Dental situation of Pontecagnano skeletal remains.

So we got the average ($\bar{x}$) and the sigma (σ) of the dental lesion index of the two analysed groups, for sex separately and together, and for other eight samples of ancient populations (Table 20).

We observed that the sigma (σ) has very high values; this demonstrates the presence of great individual variations. This phenomenon was expected since the population samples are of various historical ages and thus they had different individual alimentations. It is interesting to observe that the female sex usually shows worse dental pathology than the males, probably due to the many childbirths and the consequent breast feeding in ancient societies. The several populations can be gathered into three main groups:

a) A group with low dental lesion index (Greeks from Akanthos, Etruscans from Tarquinia and Byzantines).

b) A more numerous group with intermediate dental lesion index (Punics from Carthago, Iron Age Athenians and Pontecagnano).

c) A group with high dental lesion index (Hellenistic Age Athenians, Early Middle Ages people from Paciuri).

The differences observed reflect the different alimentary habits of the various populations.

Enamel hypoplasia

132 individuals were analysed and 38 of them (28.8%) showed signs of enamel hypoplasia in the anterior teeth.

We did not observe statistically significant differences between the sexes although the males are on the average worse affected than the females:

TABLE 20. Dental lesion index in some ancient population samples.

Site	Age	Dental lesion index (n) $\bar{x} \pm \sigma$		Dental lesion index rectified with age (n) $\bar{x} \pm \sigma$		
		Male	Female	Male	Female	Male+Female
1)Pontecagnano	VII-VI B.C.	(21) 13,9±15,3	(12) 13,1±14,6	(21) 18,3±13,9	(12) 21,3±15,0	(33) 19,4±14,3
2)Pontecagnano	V-IV B.C.	(53) 14,7±19,0	(44) 14,5±15,9	(47) 19,5±18,9	(41) 25,7±15,0	(88) 21,2±17,3
3)Athens	Mycenaean	(11) 12,7±22,3	(11) 35,3±28,6	(11) 16,1±22,0	(11) 36,4±24,7	(22) 26,2±23,3
4)Athens	XII-VIII B.C.	(8) 21,5±24,5	(7) 13,2±24,6	(8) 21,0±20,0	(7) 17,5±18,3	(15) 19,4±19,2
5)Akanthos	V-IV B.C.	(10) 4,4 ±3,9	(7) 8,0± 7,1	(10) 6,9± 7,9	(7) 6,7± 6,2	(17) 6,8± 7,2
6)Athens	IV-I B.C.	(6) 20,4±22,7	(12) 35,4±30,0	(6) 13,9±23,7	(12) 30,8±31,3	(18) 25,2±28,8
7)Tarquinia Etruscans	III B.C.	(7) 11,1±13,7	(5) 12,5±27,9	(7) 10,5±14,5	(5) 9,6±11,8	(12) 10,1±17,9
8)Carthago Punics	III-II B.C.	(9) 21,3±17,1	(9) 17,2±10,6	(9) 16,9±14,7	(9) 14,9±10,6	(18) 15,9±12,6
9)Early Middle Ages Paciuri	VII-VIII A.D.	(8) 38,1±23,6	(7) 25,1±34,0	(8) 35,3±19,7	(7) 27,9±27,9	(15) 31,8±23,5
10)Costantinople	Byzantine	(23) 16,8±22,8	(8) 7,8± 7,8	(23) 12,7± 6,2	(8) 7,8± 7,3	(31) 11,4± 6,5

3,4,5,6,10 from Bisel, S.L.C. 1980

7 from Mallegni,F. et Al. 1980

8 " Mallegni,F. et Al. 1981

9 " Menicagli,E. 1981

	Males	Females	χ^2	P%
% hypoplasia	33.8	22.4	1.53	20.0

The VII-VI century B.C. group, considered as a whole, shows a higher number of cases of hypoplasia; the difference in this case is significant from statistical point of view:

	VII-VI group	V-IV group	χ^2	P%
% hypoplasia	45.7	22.6	5.58	5.0

As for the hypoplastic lines, 8 individuals out of 38 (21.0%) show one line, 13 (34.2%) show two lines, 11 (28.9%) show three lines and 6 (15.9%) show four lines. As one can see in Table 21, there are not significant differences between the sexes, either in the entire sample or in separate groups.

TABLE 21. Number of enamel hypoplastic lines for each separate sex and in separate groups.

	VII-VI group		V-IV group		
	Males	Females	Males	Females	total
Lines	10	6	15	7	38
1	2	-	4	2	8
%	20.0	0.0	26.6	28.6	21.0
2	3	3	4	3	13
%	30.0	50.0	26.6	42.8	34.2
3	3	2	4	2	11
%	30.0	33.3	26.6	28.6	28.9
4	2	1	3	-	6
%	20.0	16.7	20.0	0.0	15.9

Enamel hypoplasia can be the sign of stress, either due to malnutrition or to disease, which affects an individual during the teething period (El-Najjar et al., 1978; Brothwell, 1981). So one can suppose that the individuals of the more ancient group, during their infancy, were more exposed to diseases and malnutrition.

Dental anomalies

As regards dental anomalies we chose Roccia's classification (1953) and divided them into the following groups:

a) Eruption anomalies: we have this kind of anomaly when permanent dentition appears too early or too late. For example, there is an individual (PC 1315 = female aged 30) in which we can observe a permanence of first mandibular milk-molars and the agensis of the corresponding P_1; with a radiographic examination we noticed, under the milk-molars, a large cystic cavity.

We discovered also a case of persistence of the left maxillary milk-canine (PC 1184 = male aged 45). In another individual (PC 2707a = female aged 25-30) a third mandibular molar shows a forward inclination.

b) Dental retention: a case of complete retention of the left C, was observed (PC 446 = male aged 30); this anomaly is probably due to the persistence of the milk-canine (later lost) which prevented the eruption of the permanent tooth.

Nowadays retention is frequent enough in the maxillary canine, but it is very rare in the mandibular canine.

c) Anomalies in teeth sites: observed anomalies are shown in individual tables: among them we point out a case of crowding of the lower incisor-canine group (PC 337 = male aged 25) and a case of vestibular misposition of the upper left second incisor (PC 1661 = female aged 25-30).

d) Number anomalies: the agenesis of the third molar was observed in 68 cases out of the total of 364 individuals examined. The frequency was quite high: that is, equal to 18.1%; nowadays Europoid populations show percentages of about 9% to 15% (Gabriele, 1980). The VII-VI century B. C. group shows a percentage of agenesis of 6.7%, while the V-IV century B. C. group has a higher percentage, equal to 21.6%. We do not know the causes of this phenomenon, probably due to genetic and microevolutive factors in both groups.

e) Shape anomalies: An individual (PC 1485 = male aged 25) with a third upper molar showing a supernumerary cusp on the vestibular side (protostyloid) was observed. A third left mandibular molar of another individual (PC 2412 = male aged 35-40) shows an evident enamel pearl.

f) Volume anomalies: several conoid reductions of the maxillary lateral incisors were observed (PC 1669 = female aged 35; PC 2881 = female aged 20). Coming to a conclusion one can say that the dental anomalies of Pontecagnano skeletal remains are usually the same as those of modern populations. One can only point out the small number of wrong positions and dysgnathia, which are quite frequent nowadays.

On the other hand the relatively most frequent anomaly is the agenesis of the third molar which reaches a higher percentage than that of modern Europeans. This phenomenon can be due to genetic factors of microevolutive kind.

Conclusions

In the entire Pontecagnano sample the males show more frequent and serious dental lesions (caries, abscesses and granulomas, loss intra vitam, wear, periodontal disease) than the females. This phenomenon is easily explained with the higher average age at death of the males. In fact, if one considers the dental lesion index, which takes into account the age at death, one observes that both sexes are hit with equal incidence.

Mandibular teeth are usually worse affected by pathologies (especially by caries) than maxillary teeth. This may be due to the remaining of fragments of food at the level of the lower arch; in fact the prevalent type of caries is the interproximal one. In the comparison between the groups, the more ancient one (VII-VI century B. C.) shows a greater dental wear and a higher degree of periodontal disease than the more recent one (V-IV century B. C.). A change in the diet during the two different periods may explain this difference. Enamel hypoplasia occurs more frequently in the individuals of the VII-VI century B. C. compared to those of the V-IV century B. C. This phenomenon may be caused by greater stress (either malnutrition or diseases) affecting children during the growing period. As for congenital anomalies we should point out a high incidence of agenesis of the third molar.

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Osteoid-osteoma from Middle-Ages Cemetary in Poland[1)]

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OSSA

A case of osteoid-osteoma in an adult male from medieval Szczecin is presented.

Keywords: Paleopathology - Neoplasm in human tibia from the Middle Age.

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During the renovation of the castle in Szczecin skeletons of four individuals were found. They were under the floor of the St. Otton church built in this place in 1346. The skeletons were in a bad state of preservation; they come from the XIV-XV century (Rogosz 1974).

One of these skeletons number 1/74 is of great interest. It is represented only by a few bones: a fragment of mandible, the right femoral bone, all bones of the shanks, two metatarsal and six phalangear bones. The build of the bones and their pattern suggests that they belonged to a man. The abrasion of the teeth shows that the man was 30-40 years old ad death (Fig. 1). He was rather tall, -175 cm.

The bones of his left leg are more slender than those of the right. This may be caused by the tumor visible on the shaft of the left tibia. This lesion is localized in the upper part /1/3/ of the anterior margin. Its approximate dimensions are: length -62 mm, breadth -26 mm and height -5 mm. The tumor is spindle-shaped. Its surface is smooth, some evident longitudinal furrows being present only on the perifery (Fig. 2). The central part of this tumor prodtrudes somewhat and is surrounded by a flat furrow (Fig. 3).

The radiological picture shows in the 1/3 of the superior part of the shaft, on its anterior margin, a spindle-shaped thickening of sclerotic structure as the bone reaction to the pahtological process. This lesion is clearly separated from the normal bone tissue. In the upper part of the vicinity of the tumor the cortex is partially porous and its contour is indistinct. In the centre of the tumor a radiolucent area with an evident margin is present. This radiological picture is characteristic for osteoid-osteoma. It is necessary to distinguish this change from some sclerotic processes. In our case the nidus of the osteoid-osteoma is so very evident that it excludes other causes of this tumor (Fig. 4).

The histological examination shows distinct changes in the bone tissue structure. From the central part of this tumor a segment of 2 mm thickness was taken. It was decalcified

1) This study was supported by the Anthropological Committe of the Polish Academy of Sciences.

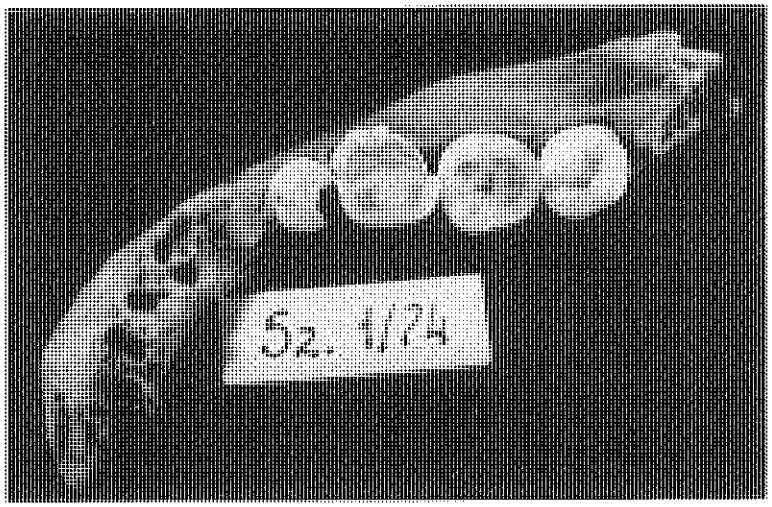

Fig. 1. A fragment of the preserved mandible.

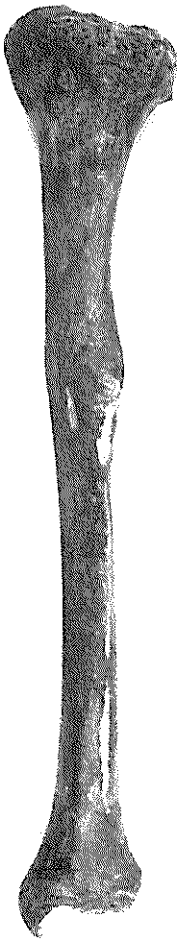

Fig. 2. Left tibial bone with evident swelling on its anterior margin.

Fig. 3. The smooth surface, on its perifery longitudinal furrows, and in the center a flat furrow surrounding the "nidus" is visible.

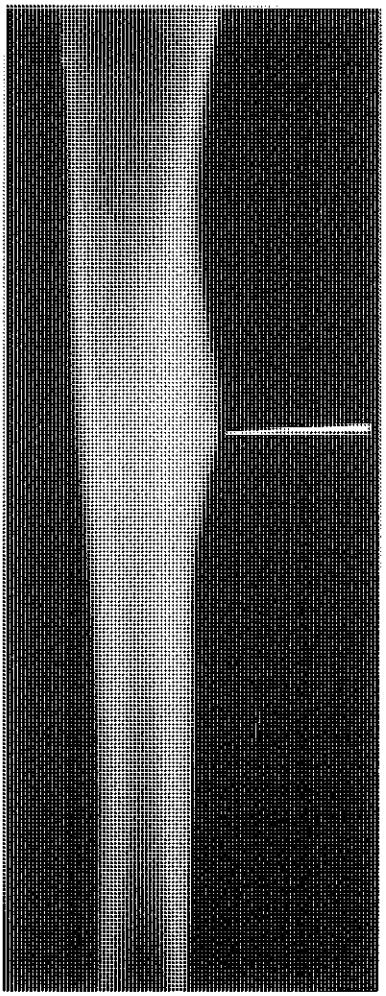

Fig. 4. X-ray of the tumor; the arrow shows the "nidus" of the osteoid-osteoma.

by electrolysis in a 3% nitric acid at 6 V D. C. 1 A current for 3 h. The decalcified bone was rinsed in 70% etanol. The rinsing was arrested when the alcohol was neutral. Then the slides were dehydrated with increasing concentrations of etanol. Transluminated with xylene they were embedded in paraffin. The 8μ-thick slides were stained according the Schmorls' method.

At the top of the tumor wide spaces surrounded with irregulary composed bone lamellas are visible (Fig. 5). Slightly deeper near these wide spaces transversely cut osteons are present (Fig. 6). Proceeding towards the marrow space beside the transversely cut osteons there are also longitudinal cut ones (Fig. 7). Such a composition of the osteons

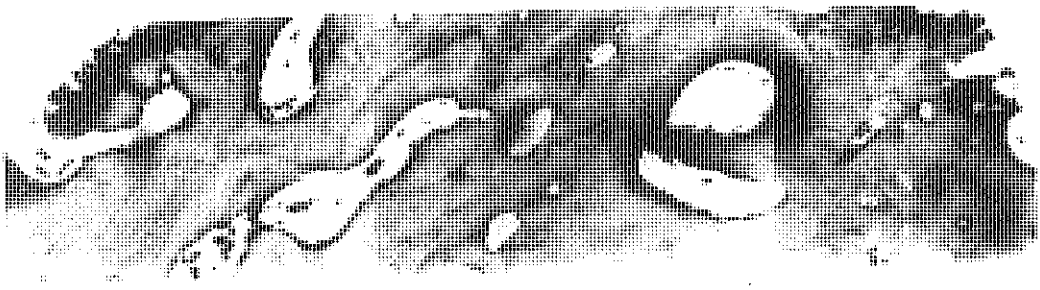

Fig. 5. Histological picture of the top part of the tumor (magnified 40 X).

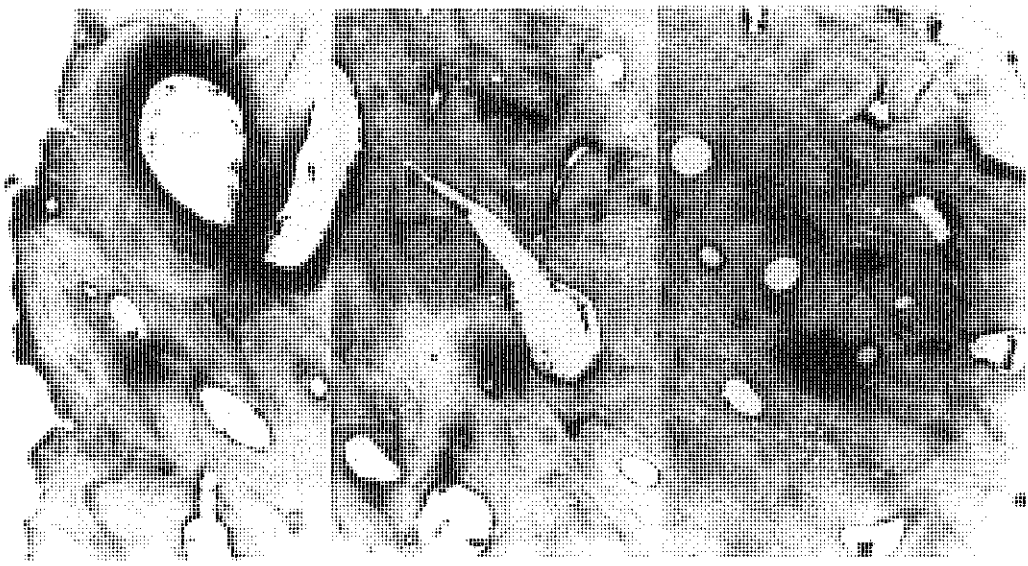

Fig. 6. Histological picture below the top part of the tumor (magnified 50X).

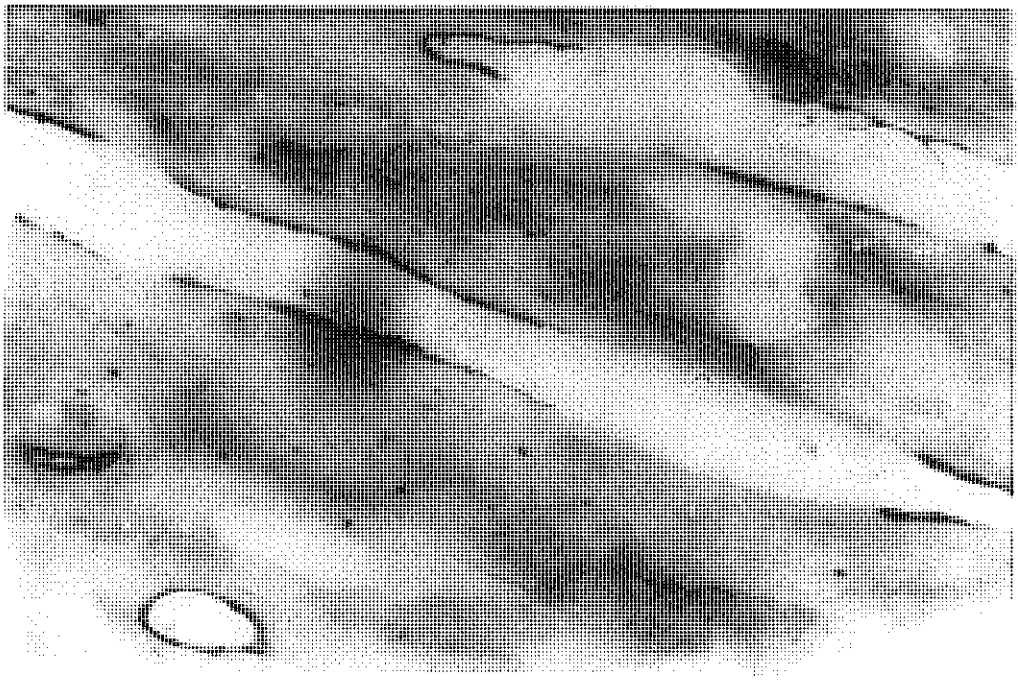

Fig. 7. Longitudinal cut osteons (magnified 100X).

seems to be chaotic. Also there are some widened Haversian canals here. On the same level, but outside the tumor the osteon system is characteristic for a normal compact bone tissue (Fig. 8).

Two types of osteoid-osteoma are known: intracortical and intraspongiosal. The etiology of this tumor has not yet been explained. The dimensions of osteoid-osteoma are small and do not exceed 1 cm in medium. It can be localised in every bone, but up to now no case of this tumor has been found in the skull. The long bones of the legs are its favourable place.

Intracortical osteoid-osteoma is localised in the internal surface of the bone cortex. The thickening of the cortex is present not only in the direct vicinity of the tumor but also some centimeters along the bone shaft. For osteoid-osteoma there is a characteristic centre named "nidus". Its structure is osseous or cancellous. Such nidus is surrounded

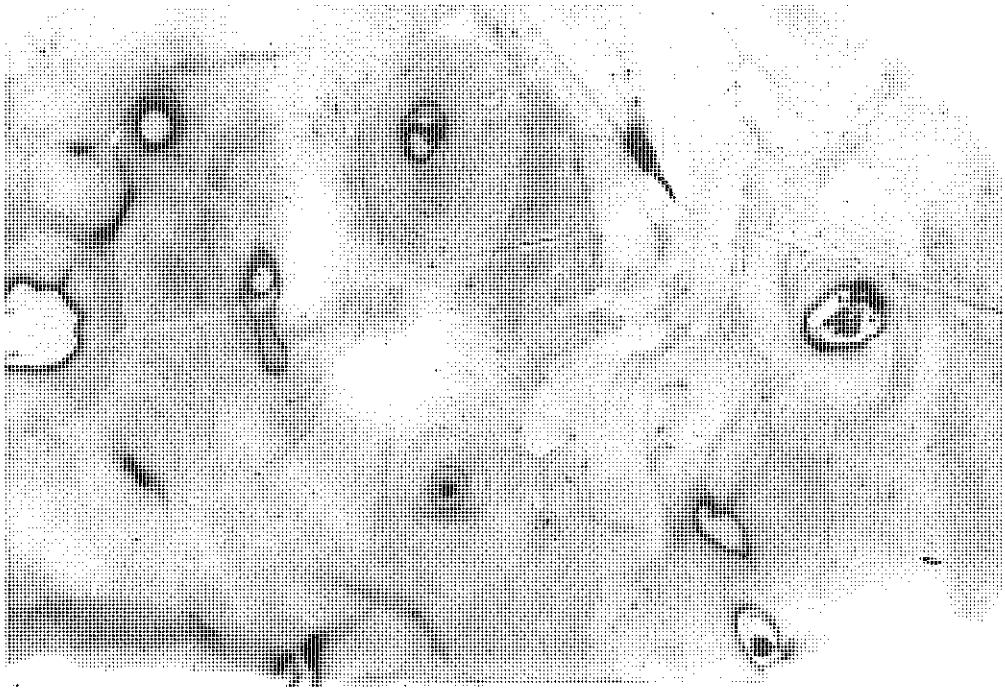

Fig. 8. The normal compact tissue of the bone (magnified 100X).

by a layer of changed tissue, a perifocal reaction. Osteoid-osteoma is a relatively small, but very painful tumor. Mainly it attacks men. It appears in childhood and adolescence and in an unchanging from of the nidus may last many years (Jaffe, 1966).

Today osteoid-osteoma is often observed (Jaffe, 1966). In the skeletons from archaeological excavations this case of tumor is very rare (Gladykowska-Rzeczycka,1982; Wells, 1965; Ortner, Putschar, 1981; Sandison, 1966; Steinbock, 1976). In 1961 Brothwell presented a case from Sedgeford dating from the Anglo-Saxon period. As he wrote on the shaft of the left tibia of a man there was about 100 mm long swelling with smooth surface. On the surface of the accidently broken bone in the place of this tumor, some dense tissue surrounded with porous tissue was visible. The author was not sure whether this tumor was caused by osteoid-osteoma. The porosity suggested that the observed change may be the effect of a low-grade abscess (Brothwell, 1961). No radiological picture was made so no diagnosis was certain. In 1965 Wells described a standard case of osteoid-osteoma. It comes from an Anglo-Saxon (VII c.) cemetery from Caister-on-Sea. On the medial surface of the shaft of a male left femur a characteristic swelling was present. The radiological examination shows a nidus of this tumor in the centre of the fusiform swelling. The second unquestionable case was described in 1971 by Vyhnanek. His case comes from a preslavic cemetery dating from VII-IX century. The tumor was located on the right tibia of an adult man. The anterior margin of this bone, in its middle part was changed by a fusiform, smooth swelling about 8 mm long. The radiological picture shows an evident nidus in the centre of the fusiform thickness of the cortex.

All these three unquestionable cases: from England (Wells, 1965), Tchechoslovakia (Vyhnanek, 1971) and from Poland now described present the intracortical type of osteoid-osteoma. The lack of the intraspongiosal type may be caused by its small size and by the fact that the spongy substance is most often badly preserved.

The great rarity of this tumor suggests that at the time VII - IX century it was a sporadic illness. Its great frequency today is perhaps connected with the

drawbacks of the development of civilisation. More accurate ecological, medical and paleopathological research is necessary before the problem can be solved.

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Age-related Bone Loss in a Prehistoric Koniag Eskimo Population

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OSSA

This study describes patterns of macro- and microscopic changes in cortical bone with age in a prehistoric Eskimo population. Femoral cortical bone cores from 90 adult Koniag Eskimo skeletons were analyzed by photon absorptiometry and quantitative histomorphometry. Cortical thickness and bone mineral index decreased with age in both males and females. Both old males and females showed a greater area of cortical bone undergoing osteon remodeling ($p. < .02$) than younger individuals, with an increase in haversian canal area ($p. < .01$). The decrease in bone mineral index with age may have been due to a loss of cortical thickness and an increase in intracortical porosity (haversian canal area).

Keywords: Bone Loss - Koniag Eskimo Skeletons (500 B.C. - 1700 A.D.).

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Introduction

A reduction in bone mass is part of the natural ageing process in all people (Garn, 1975). This phenomenon may occur either as a generalized loss in bone density (Wall, Chatterji, Jeffrey, 1979) or as a thinning of the cortices of long bones as endosteal resorption exceeds periosteal formation (Garn, 1970). With increasing age, there is also a decrease in bone mineral content (Thompson, 1980) accompanied by an increase in the numbers (Curry, 1964) and size(Thompson, 1979) of haversian canals, and the number of osteons (Kerley, 1965; Singh & Grunberg, 1970). The cortical thickness of male bones also exceeds that of female bones (Garn, 1970; Thompson, 1978).

The age of onset and the rate at which this bone loss occurs differs between men and women, and between populations. The cortical bone of women in modern white populations begins to decrease from the forearm at age 40, while the rate of cortical bone loss is slower in men beginning at or after age 50 (Mazess & Cameron, 1975). A greater and earlier net loss of cortical bone has been observed in present day Canadian and North Alaskan Eskimos than in modern U.S. whites (Mazess & Mather, 1974), or in prehistoric Aleuts (Laughlin, Harper & Thompson, 1979). Present day Eskimo women and men begin to lose radial cortical bone in their thirties and forties, respectively (Mazess & Mather, 1975). These differences have been attributed in part to the thinner long bone cortices of Eskimos compared to other populations (Pawson, 1974), and to different

patterns of osteon remodeling (Erickson, 1980). The cortical bone of Eskimo femurs has also been shown to contain more osteons per unit area than U.S. whites (Thompson & Gunness-Hey, 1981.

Recently, photon absorptiometry and quantitative histomorphometry have been applied to the study of bone loss patterns in prehistoric populations (Martin & Armelagos, 1979; Perzigian, 1973; Thompson & Gunness-Hey, 1981). The objective of this study was to describe patterns of macro- and microscopic changes in cortical bone with age in a prehistoric skeletal population of Koniag Eskimos using photon absorptiometry and quantitative histomorphometry. The specific problem addressed was the question of whether generalized cortical bone loss trends have significantly changed over time or remained similar between modern and prehistoric populations.

Materials

Ninety left femora were selected from adult Koniag Eskimo skeletons from a collection at the Smithsonian Institution, Washington, D.C. Criteria for selection were the presence of a fifth lumbar vertebra, a femur and/or a radius, and skeletal completeness necessary for morphological age and sex determination. The Koniag Eskimo skeletons (500 B.C. to 1700 A.D.) (Clark, 1979) were recovered from a single site on Kodiak Island, Alaska, and represent a pre-European contact period. Sex was determined from pelvic and cranial morphological differences (Phenice, 1969). The age of death of each skeleton was determined primarily by an assessment of documented morphological changes with age in the pubic symphysis (Gilber & McKern, 1973; McKern & Stewart, 1957). This analysis was then correlated with other skeletal age developments, such as fusion of the basilar suture and epiphyseal union in the ilium, ischium, clavicle, shoulder and knee (Krogman, 1962).

Methods

Bone Core Analysis

A bone core 0.4 centimeters in diameter was removed from the anterior femoral midshaft using a high speed Dremel drill. Preparation and analysis of the core followed the procedure described by Thompson (1979) and is summarized below. The following variables were measured. Cortical thickness (mm) of the bone core was the measurement of the minimum thickness of cortical bone measured from the periosteal to the endosteal surface. After removal of the trabecular bone by hand filing, the cortical bone density (g/cm^3) of the cortical bone core was determined using the formula: mass (weight of the bone core)/unit volume of a cylinder. The bone mineral index (g/cm^2) was calculated as the ratio of bone mineral (g/cm) to bone width (cm) and was determined by photon absorptiometry using a Norland-Cameron Bone Mineral Analyzer. Precision of the machine was 1.63% for bone mineral and 1.39% for bone width.

Histological Analysis

A section, 90-100 microns thick, was cut from each bone core with a Buehler Isomet saw. The area and numbers of secondary osteons and haversian canals were measured using a point counting technique (Chalkley, Cornfield, & Park, 1949) (Fig. 1). A square test grid with 121 points was used. All measurements were carried out at a 100X magnification using a phase-contrast microscope. Secondary osteons and haversian canals from four adjacent fields along the periosteal border of one section were quantitated for each bone core. This corresponded to a total number of 484 test points which gave an error of 6.5%. The following variables were measured.

1. Secondary osteon lamellae area (SOL) (mm^2) calculated as:

$$A_{A,\ SOL} = P_{SOL}/P_T$$

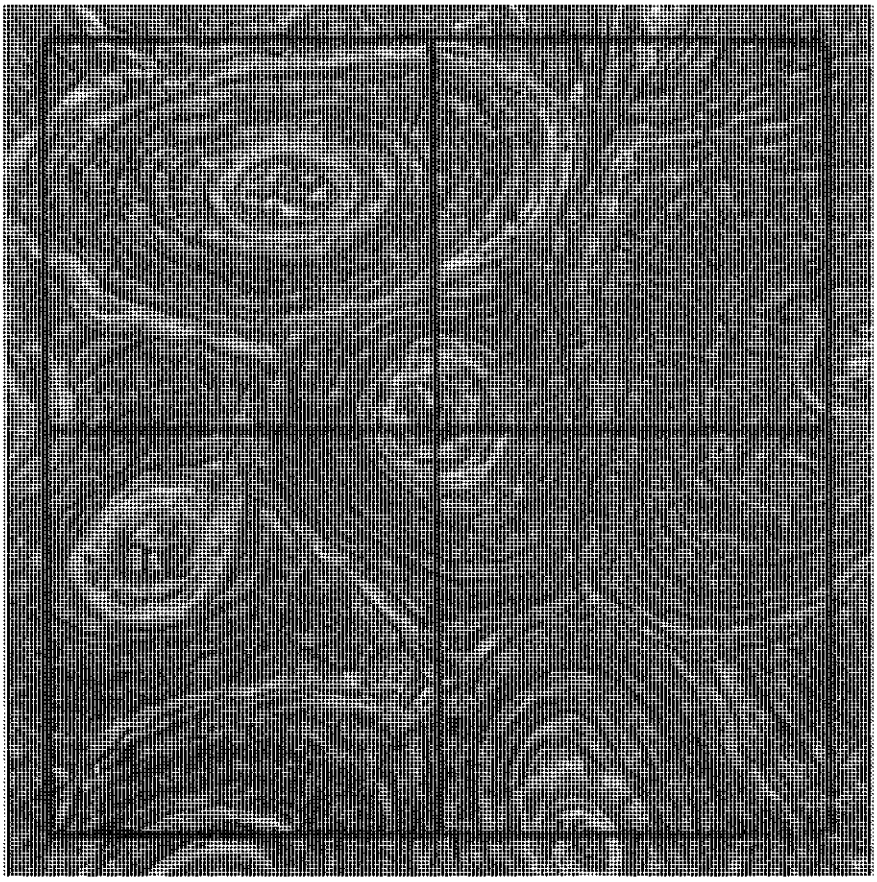

Fig. 1. A microphotograph of a femoral bone core section from a 44 year old Koniag Eskimo female showing secondary osteon lamella (SOL) and a haversian canal (HC). Magnification X280.

Secondary osteon lamellae area = points on SOL = 6 / total points = 25 = 0.24

Haversian canal area = points on HC = 1 / total points = 25 = 0.04

Secondary osteon number = 4

Haversian canal number = 4

where P_{SOL} = points on secondary osteons defined by a cement line and concentric lamellae surrounding an haversian canal, and secondary osteon fragments in which a section of the haversian canal was visible. Fragments without haversian canals and primary osteons were excluded.

P_T = total test points.

2. Haversian canal area (HCA) (mm^2) calculated as:

$$A_{A,\,HCA} = P_{HC}/P_T$$

where P_{HC} = points on haversian canals, primary osteons and Volkmanns canals.

P_T = total test points.

3. Total area (TA)(mm^2) calculated as:
$$A_{A,T} = A_{A,SOL} + A_{A,HCA}$$
4. Secondary osteon number (N_{SO}).
5. Haversian canal number (N_{HC}).
6. Mean secondary osteon lamellae area (MSOL):
$$A_{A,MSOL} = A_{A,SOL}/N_{SO}$$
7. Mean haversian canal area (MHCA):
$$A_{A,MHCA} = A_{A,HCA}/N_{HC}$$

Data analysis

The variables were analyzed using a factorial analysis of variance adjusted for unequal cell sizes with 2 levels: age (young vs. old) and sex (male vs. female). Significant interaction differences for cortical thickness and cortical bone density were determined by the least significant interval (lsi) comparison (Snedecor & Cochran, 1967). This comparison was a Student's t-test using a pooled error variance derived from the analysis of variance. The main age effect for the remainder of the variables was evaluated from the analysis of variance. When a significant age effect was observed, the results were pooled for males and females and then compared between age groups.

Results

A greater amount of cortical bone was seen in Koniag Eskimo males than in females. The cortical thickness of young males, 5.476 mm, was significantly different from that of young females, 4.406 mm (lsi =0.236, $P < .01$) (Table 1). This difference was maintained across age groups. Old male and female cortical thickness', 4.851 mm and 4.353 mm, respectively, were also significantly different (lsi=0.212, $P < .05$). Both males and females showed a loss of cortical bone with age. Cortical bone mass decreased from young to old individuals by 11.4% in males and 1.2% in females. This loss of cortical bone mass with age, however, was significant for the males only (lsi=0.238, $P < .01$). Bone cores from younger females were also more dense, 1.923 g/cm^3, than the cores of older females, 1.850 g/cm^3 (lsi=0.021, $P < .05$). A decrease in the bone mineral index with age was similar for both males and females ($F=7.17$, $P < .01$).

Intracortical porosity became more apparent with increasing age in Koniag Eskimos (Table 2). The area of total osteon remodeling of cortical bone was greater in older individuals than in younger individuals ($F=5.25$, $P < .02$). This was seen mainly as an increase in haversian canal area ($F=19.85$, $P < .01$) rather than in secondary osteon lamellae area ($F=2.75$, NS). Accompanying the increases in area were increases in the numbers of secondary osteons ($F=12.60$, $P < .01$) and haversian canals ($F=7.98$, $P < .01$). While each haversian canal became larger with age ($F=3.20$, NS) the mean secondary osteon lamellar area decreased ($F=6.27$, $P < .05$).

Discussion

A prehistoric Koniag Eskimo population showed patterns of cortical bone loss similar to those in modern populations (Arnold et al., 1966; Garn, 1970; Mazess & Mather, 1975). Trotter and Hixon (1974) and Sabatier et al. (1982) showed that females in modern populations contain less bone than males at skeletal maturity which supports the finding that female Koniag Eskimos described in this study had smaller and thinner femoral cortices than male Koniag Eskimos. A reduction in bone mass shown to occur as a decrease

TABLE 1. Cortical thickness (mm), cortical bone density (g/cm^3), and bone mineral index (g/cm^2) for Koniag Eskimos

	Young (20-39 years)		Old (40+ years)	
	Male N=25	Female N=25	Male N=26	Female N=14
Cortical thickness (mm)	5.476 (0.884)	4.406 (0.710)	4.851 (0.008)	4.353 (0.579)
Cortical bone density (g/cm^3)	1.897 (0.058)	1.923 (0.030)	1.891 (0.070)	1.850 (0.097)
Bone mineral index (g/cm^2)	0.389 (0.027)	0.386 (0.022)	0.381 (0.033)	0.359 (0.040)

Data expressed as mean ± SEM

TABLE 2. Summary of histological analysis of Koniag Eskimo femora.

	Young (20-39 years)		Old (40+ years)	
	Male N=22 ($\bar{x}$ age=27 yrs)	Female N=25 ($\bar{x}$ age=27 yrs)	Male N=23 ($\bar{x}$ age=51 yrs)	Female N=13 ($\bar{x}$ age=51 yrs)
Secondary osteon lamellae area (mm^2)	0.373 (0.184)	0.390 (0.134)	0.396 (0.089)	0.465 0.045)
Haversian canal area (mm^2)	0.054 (0.015)	0.047 (0.012)	0.073 (0.029)	0.069 (0.022)
Total area (mm^2)	0.428 (0.188)	0.437 (0.138)	0.469 (0.080)	0.533 (0.051)
Secondary osteon number (#/mm^2)	12.06 (6.55)	11.08 (4.43)	14.78 (2.89)	15.76 (3.05)
Haversian canal number (#/mm^2)	16.84 (4.81)	14.67 (3.24)	18.10 (2.49)	17.98 (3.27)
Mean secondary osteon lamellae area (mm^2)	0.0331 (0.014)	0.0364 (0.012)	0.0272 (0.006)	0.0304 (0.005)
Mean haversian canal area (mm^2)	0.0035 (0.001)	0.0032 (0.001)	0.0041 (0.002)	0.0037 (0.001)

in cortical thickness (Garn, 1970) and density (Wall et al., 1979) with age in living populations was also found in Koniag Eskimos. While male Koniag Eskimo femurs showed a significant decrease in cortical thickness with age, density decreased with age for the Koniag Eskimo females only. For each Koniag Eskimo age group, however, male and female density values were not significantly different, and were in agreement with the finding of Wall et al. (1979) that femoral cortical bone density was similar between living males and females. While Mazess and Cameron (1975) found bone loss, measured as bone mineral content, to be quite different between the sexes in U.S. whites, Koniag Eskimo male and female bone mineral index values were not significantly different. Nielson et al. (1980) have shown that a decrease in cortical thickness and bone mineral index were correlated with a decrease in bone ash concentration and indicative of a loss of bone mass in living populations. Cortical bone loss in the Koniag Eskimo was also manifest as a significant reduction in the bone mineral index with increasing age group for both males and females.

Histologically, secondary osteon remodeling units with larger haversian canals have been shown to increase with age in human bone (Thompson, 1980). Density and intrinsic strength of femoral cortical bone also decreased after the fourth decade (Wall et al., 1979) which gave rise to a more porous and fragile bone. Koniag Eskimo cortical bone appeared to undergo similar age changes. The decrease in the bone mineral index may have been due to an increase in intra-cortical porosity with age. Indeed, as the secondary osteons became more numerous with age, the haversian canal area increased, and the Koniag Eskimo bone became more porous.

Studies of bone loss in modern Eskimo populations have shown that both male and female Eskimos undergo a 5% loss per decade greater than the bone loss seen in U.S. whites (Mazess & Mather, 1974; 1975). Results from this study of Koniag Eskimos represented a cross-sectional analysis of bone loss trends of a population frozen in time, and did not indicate rates of loss for individuals. This study did, however, demonstrate that cortical bone loss trends were similar between modern and prehistoric skeleton populations, and occurred as a result of a decrease in cortical thickness and bone mineral index with a corresponding increase in intracortical porosity, shown as an increase in number and size of haversian canals.

Acknowledgments

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Bilateral Ankylosis of Temporomandibular Joint from the 9th Century

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OSSA

In the old Slavonic burial ground in Rajhradice (9th century A. D.) the skull of a person of about 18 years of age with a bilateral ankylosis of the temporomandibular joint was found. The lower jaw is quite immobile and expressively deformed. It appears to be a condition after a very old injury, the trauma healed but resulting ankylosis heavily influenced the subsequent development of the mandible.

Keywords: Ankylosis - Temporomandibular Joint - 9th Century A. D.

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It is not a rare phenomenon that pathological changes which we can find now only very exceptionally were found in the anthropological material from the primeval and medieval burial grounds. Doubtless the finding in the old Slavonic burial ground in Rajhradice also belongs among these uniques.

This burial ground dated to the time of the Great Moravian Empire (9th century A. D.) was uncovered from the greater part in years 1952 and 1953 but the last 27 graves were uncovered there by the investigation of C. Stana in the year 1975. In the grave number 331 there was a greatly damaged skeleton of a person died in the age between 18 and 20 years. It was buried in the great depth of 160 cm in a fir coffin in stretched position with hands along the body, outside the pelvis. The only archeological finding was an iron knife. The post-cranial skeleton is saved in fragments, the skull has a damaged upper face and it is slightly post-mortally deformed, but its saving is so much good that it has enabled judging of the unusual finding - the bilateral ankylosis of the temporomandibular joint.

The skull has quite open sutures, nor the basisphenoid synchondrosis grows together. The sloping forehead with slightly formed frontal tuberosities and relatively dull upper margins of the orbits are characteristic for a male skull, for a change a flat glabella of the 1st grade, flat superciliary arches, a shallow root of the nose, frail facial bones and small mastoid processes would witness for female sex. But the diagnosis of sex is in this case immensely difficult because the shape of the skull is expressively modificated by the already mentioned pathological change. Let's add that according to the rather narrow and asymetric greater sciatic notch (the absence of the sulcus praeauri-

Fig. 1. Rajhradice, the skull with the temporomandibular ankylosis, norma frontalis, verticalis and basalis.

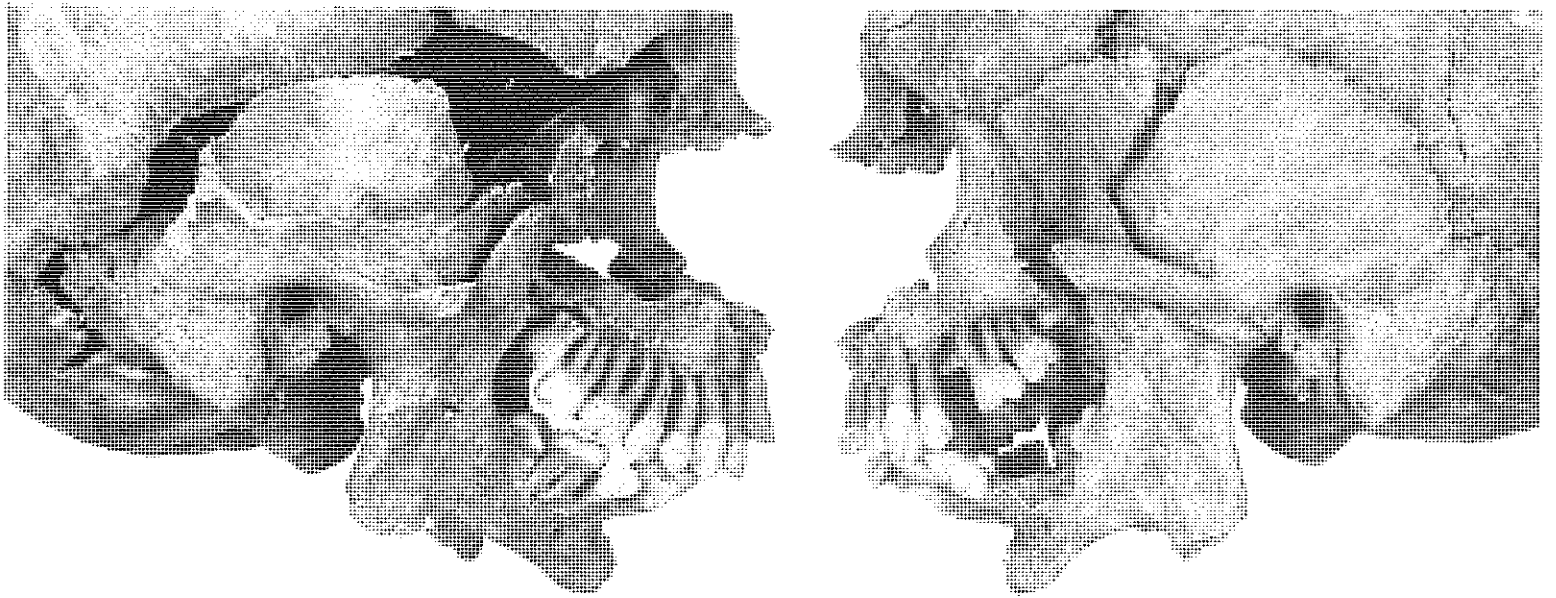

Fig. 2. At the view from both sides the complete ankylosis of temporomandibular joints is perceptible.

cularis is not the relevant argument in this case with regard to the deceased' s condition of health) we are inclined to that the remainders are those of a male, but with regard to the damaging of the finding this determination is very uncertain. According to the determination of age of the deceased we can first state that the permanent set of teeth is erupted with the exception of the third molars which have been erupting, in the lower jaw they are still hidden in the bone. On the fragments of the post-cranial skeleton we can observe that the head of humerus is still not obliterated and the epiphyseal line is visible in the head of the femur.

The lower jaw is in both temporomandibular joints firmly grown together to the temporal bone. The condylar process compared with the coronoid process is expressively shortened on both sides, the original of the head is extended and absolutely perfectly grown together with the temporal bone so that only a shallow groove is left on the back side. The coronoid process is on both sides roughly about 25 mm longer than the condylar process, it is loose, it did not grow together with the temporal bone, but its shape is substantially changed in comparison with the normal: in the lower half it is thickned and runs out in a blunt stump. Both gonia are extended and unscrewed to sides (the ends are broken off in both sides). The body of the lower jaw is most deformed: it is very low, in the place where there should be the mental protuberance there is a deep incision to which the flat mental tubercles vault aside. Viewed from below the lower shape reminds of the wide open letter W where the middle point forms the only impressive mental spine (in both sides there is not the least suggestion of the digastric fossa) and the lower points form the both mental tubercles. From the front on both sides we can see the large mental foramen, namely in the level of the second premolars. From the side we can see that the lower and upper halves of the body of the mandible contain nearly the right angle, the alveolar part is bent in the section between the first premolars in such a way that it is directed at the regular orientation of the skull, nearly horizontally forward.

From the measurements which are shown in the added Table it follows that the skull was brachycranic euryprosopic, but the value of the facial index is comprehensibly strongly influenced by the changes on the mandible which was described and which can be seen in added pictures.

Dental Status:

17, 16, 15, 14, 13, 12; 18 not erupted, 11 missing, central caries in 17, 16 and 14;
21, 22, 23, 24, 26, 27; 21 with broken half of the crown and open pulp cavity, alveolus of 25 is vacant, central caries in 26 and 27; 28 not erupted;
The broken crown of 21 appears to be due to the trauma probably in the period of the lesion of the both articular processes of the mandible.
In 38 the germ is present, the roots are in state of development, 37 in lingual inclination; 34, 33, 32 and 31 in protrusive position, vacant alveolus of 36 and 35;
41 and 42 in protrusive position, 43 in distal rotation, 44 in vestibular inclination, 45 in distal rotation and vestibular inclination, 46 and 47 in a significant lingual inclination. 48 cavity after originated germ, central caries in 46.
The mandible has a characteristic shape, according to bilateral ankylosis originated in childhood. There is a significant presence of tooth crowding.

The fixed connection of the mandible with the temporal bone is called the ankylosis temporomandibularis (Krueger, G., 1984). This connection can be partial or total, one-sided or double-sided. Most frequently it occurs in childhood (Künzel, W., 1984), its causes being inflammations of the mandibular joints following infectious diseases such as gonorrhoea or typhus, further the purulent inflammation of the otitis media, by the osteomyelitis of the mandible, by sepsis and after injuries of the entire region in question (Urban, F., 1972). Nevertheless it is sometimes impossible to find out the cause of ankylosis. As for the injuries it is most frequently the trauma during forceps childbirth ("congenital ankylosis") or later on, especially in adolescency, the ankylosis of TM joint after a

Fig. 3. The set of teeth in the upper and lower jaws of the skull from Rajhradice.

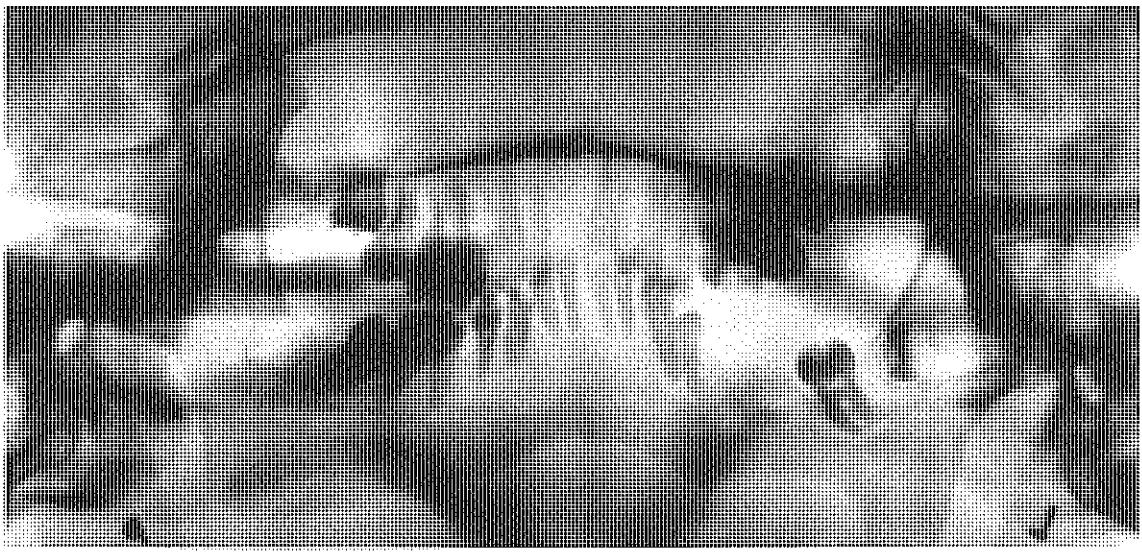

Fig. 4. The panoramatic posterio-anterior radiograph of the set of teeth in the skull with the bilateral ankylosis of the temporomandibular joints.

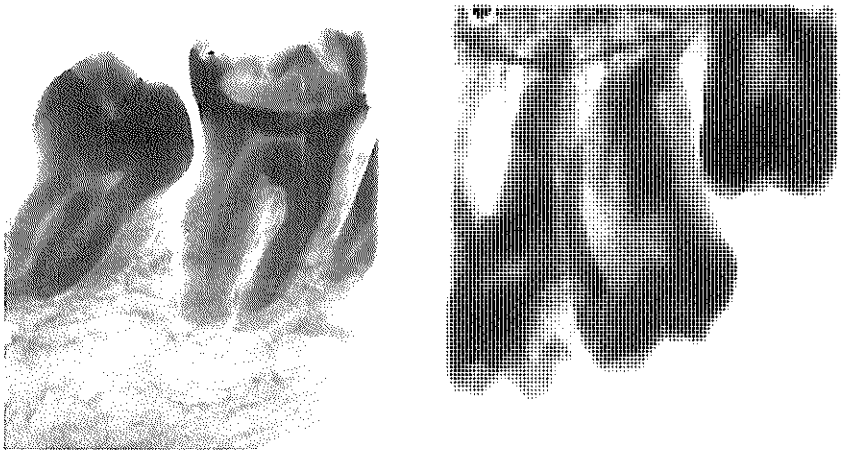

Fig. 5. The radiographs of a) 26, 27 and 28, b) 46 and 47; central caries in 26, 27 and 46 are clearly visible.

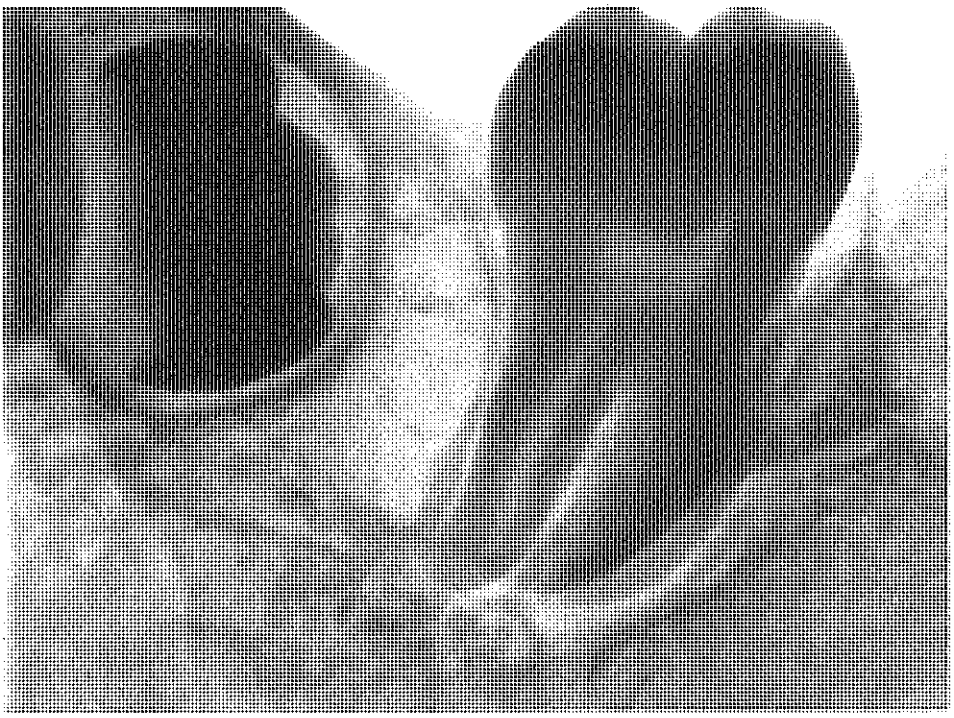

Fig. 6. The germ of the left third lower molar (38) in the radiograph.

fracture of the structure in the region of the joint. In both cases we can find a contusion of the periarticular tissue or a fracture of the condylar process of the mandible with the injury of the external auditory canal, mainly its frontal wall.

Clinically, the ankylosis manifests by the reduced mobility of the mandible. With the partial ankylosis the movement of the mandible is possible only in vertical direction while with the total ankylosis it is feasible rather in horizontal or oblique direction, and this only within a small range. If the growing cartilage zone of the condylar process is damaged before finishing its growth, then, naturally the growth of the mandible on the damaged side is deteriorated (Murray, C., 1973). The injured side compared with the healthy one is shortened and the ramus and body of the mandible contain the right angle, with a so called "spur" on the lower edge (Hořejš, J., 1985). The chin is deviated to the pathologcial side or, in case of bilateral damage, it is small and undeveloped. The profile of the patient according to the conspicuously protruding jaw bone (maxilla) and the nose is typical for this abnormity and on account of its shape it is called the bird profile or the shrew-mouse profile (Kufner, J. 1981). As a result of the limited function of the chewing apparatus there is a bad hygiene of the mouth leading to increased teeth decay and even to the enhanced production of caries. Speaking is altered too, missing sonority. Beside the mentioned changes on the TM joint leading to restriction of mobility or even to immobility it may cause also the so called extraarticular or a false form of the ankylosis. The osseous bridge connects the mandible with the temporal bone going across or above the TM joint, overarching it. Sometimes we can also find concretion of the coronoid process at the zygomatic bone. It is called Jacob' s disease (Urban, F., 1972) possibly resulting from a fracture of the zygomatico-maxillary complex and the muscular

prominence of the mandible. Of course. there is a possibility of combination of both the mentioned concretions.

On an X-ray picture we can find out only the disappearance of the joint chink caused by the overrarching of fibrous bands which later on gain the features of a bone tissue and in fact are really calcified. In the first case we call it a fibrous ankylosis, in the second one an osseous ankylosis. The other type of fixed connection of the jaw-bones with intact TM joints is called syngnathia (Dvorak, J., 1964). The mentioned bridge can after a few years completely wipe off the original shape of the head of the mandible. If the illness or injury occurred in childhood, we can see a striking asymmetry of the mandible. In the case of unilateral damage the middle of the mandible is deviated to the pathological side, the body and the ramus of the mandible are shortened, the teeth are crowded and there is also a retention of the molars because of the lack of space. There is a striking change in the region of the mandibular angle described above and slightly sinking chin resulting from the limited growth of the injured side. In the case of bilateral ankylosis in the time of growing the change in profile in lateral projection of the skull is very conspicuous. Insufficient nutrition in childhood and adolescence has an influence on the retardation of the general development of the patient.

Complete ankylosis is a rare condition in skulls dating from ancient times (Brothwell, D. & Sandison, A. T., 1967). Our skull from Rajhradice demonstrates a finding of a bilateral ankylosis - in fact the right osseous ankylosis of a young person - at about 18 years of age, originating probably in the trauma of both TM joints in the time following the exchange of dentition. Of course, there is a slight possibility of infectious origin, but this type is mostly unilateral. All the features mentioned above are present, which means a bird' s profile with bilateral shortening of the body and the ramus of the mandible as well as the sharply protruding of the mandible, the so called spurs. Very striking is a relatively small skull which is not in accordance with a rather well developed second dentition, meaning the eruption of the first and the second molars.

The skull with the bilateral ankylosis of temporomandibular joint from Rajhradice is a quite rare finding. The pathological changes which are probably the result of the old injury conduce to the absolute immobility of the lower jaw. The handicapped person could not open the mouth, bite, even receive normal food, he could be fed only with liquid or highly mashed food. Nevertheless the person survived for some years, evidently thrown upon a care of his surrounding. The setting to the fir coffin can be considered as rather exceptional, it was given only to persons of higher standing. The discovery from Rajhradice seems to be very interesting not only from the pathological point of view but also because it bears witness about the society which succeeded in keeping alive a gravely handicapped person and finally it gave him the burial which can be indicated as above-average in conditions of its time.

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Cranial Measurements and Indices /Numbers after Martin-Saller/

Maximum skull length /1/	181
Nasion-basion length /5/	103
Maximum skull breadth /8/	145
Anterior forehead breadth /9/	104
Posterior forehead breadth /10/	123
Biauricular breadth /11/	119
Asterion breadth /12/	112
Basi-bregmatic height /17/	133
Auricular-bregma height /20/	111
Horizontal circumference /23/	523
Transverse arc /24/	316
Median sagittal arc /25/	355
Nasion-bregma arc /26/	122
Bregma-lambda arc /27/	125
Lambda-opisthion arc /28/	108
Nasion-bregma length /29/	108
Bregma-lambda length /30/	108
Lambda-opisthion length /31/	92
Upper facial breadth /43/	106
Inner orbital facial breadth /43:1/	97
Bizygomatic breadth /45/	122 ?
Nasion-gnathion height /47/	101
Angle breadth /66/	105
Length-breadth index /I 1/	80,1
Length-height index /I 2/	73,5
Breadth-height index /I 3/	91,7
Transv. frontopariet. index /I 13/	71,7
Facial index /I 38/	82,8
Frontomandibular index	101,0

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Cremation of a Diseased Rich Man from Latène-Period Carriage Grave near Husby, Kr. Flensburg, North Germany

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OSSA

The cremation of a mature male 2400 years ago is presented in detail showing different anomalies and pathological changes.

Morphological features: Strong skeleton with pronounced muscular attachments and bulging arcus superciliares, low maxillary height and strong mandible. Stature above average (Martin-Saller). The following aberrations were found: a groove on the left lateral orbital ridge, exostosis of ear, a ridge - like enlargement with perforations in one of the long bones.

Apart from general pathological features (viz. alveolar closure, spondylarthrosis, spondylosis deformans, arthrosis) the following was observed:

1) Hour-glass-like mass of benign osteoblastoma in the right mastoid process.+)(For comparison a left mastoid process of a middle adult male with a row of defined round masses of compact bone was used).
2) Ossification of the anterior ligament in the lower section of the spinal column with presumably partial ankylosis.
3) Sclerosed lamella on the inner cavity of a long bone presumably encircling a pathological process.

On that account it is assumed that the male was in need of care at times, and his grave goods are luxorious as well as of practical use (perhaps for life in another world).Ten bear claws from a burned bear's fur used for warmth, and a carriage provided for mobility are further findings. These objects might have been lever snaffles for the two horses drawing the carriage.

Although the cremation contains only parts of the skeleton, the heat has conservated the superficial structures in great detail.

Judging by several pathological changes in this skeleton make us believe there has also been organic diseases.

Keywords: Male Cremation - Latène Period - Benign Osteoblastoma - Diseased Spine - Sclerotic layer in Long Bone - Bear Claws - Antler Objects.

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+) With diagnoses by B. Remagen, Institute of Pathology, Knochentumor-Register, University of Basel, Switzerland.

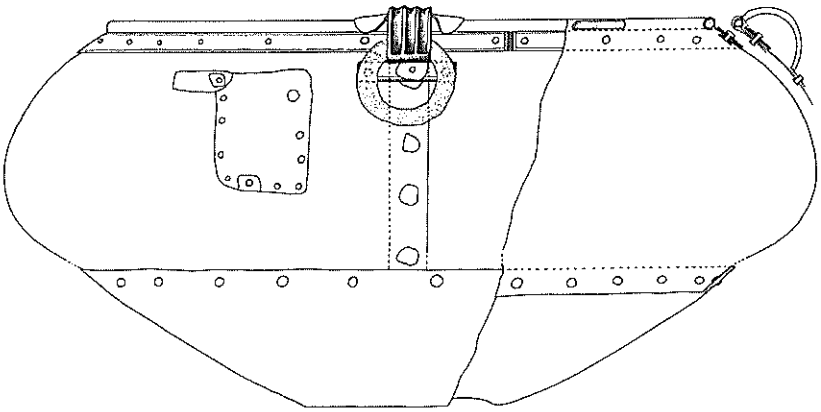


Fig. 1. Drawing of the cauldron with a few of the seven repairs. The cauldron originates from the Southeast Alpine Region (after Raddatz, 1967).

Introduction

1200 cremations have been excavated from an urnfield near Husby. A grave with unusual contents was found in the northern and oldest part of the cemetery (Raddatz, 1967): A bronze cauldron, now used as an urn, was found standing inside a chamber made of stone slabs. The vessel had been repaired at least seven times and soot on the outer surface tells us that it had been used for cooking. Partly folded felloes and iron parts of a small four-wheeled carriage without any bronze-ornaments, which had obviously been burned at the same time, were placed around it.

Two bridoons were found in the cremation but no skeletal remnants of horses could be found in the burial.

Apart from the iron remnants of the carriage and melted bronze particles the cremation contains the following grave-goods: Ten bear-claws and parts of 3 or 4 decorated objects made of antlers. Date: The burial is dated in section A of the Latène Period, appr. 500-380 B.C.

An investigation of the skeletal material with regard to age and sex is reported in the conviction that this is an unusual cremation.

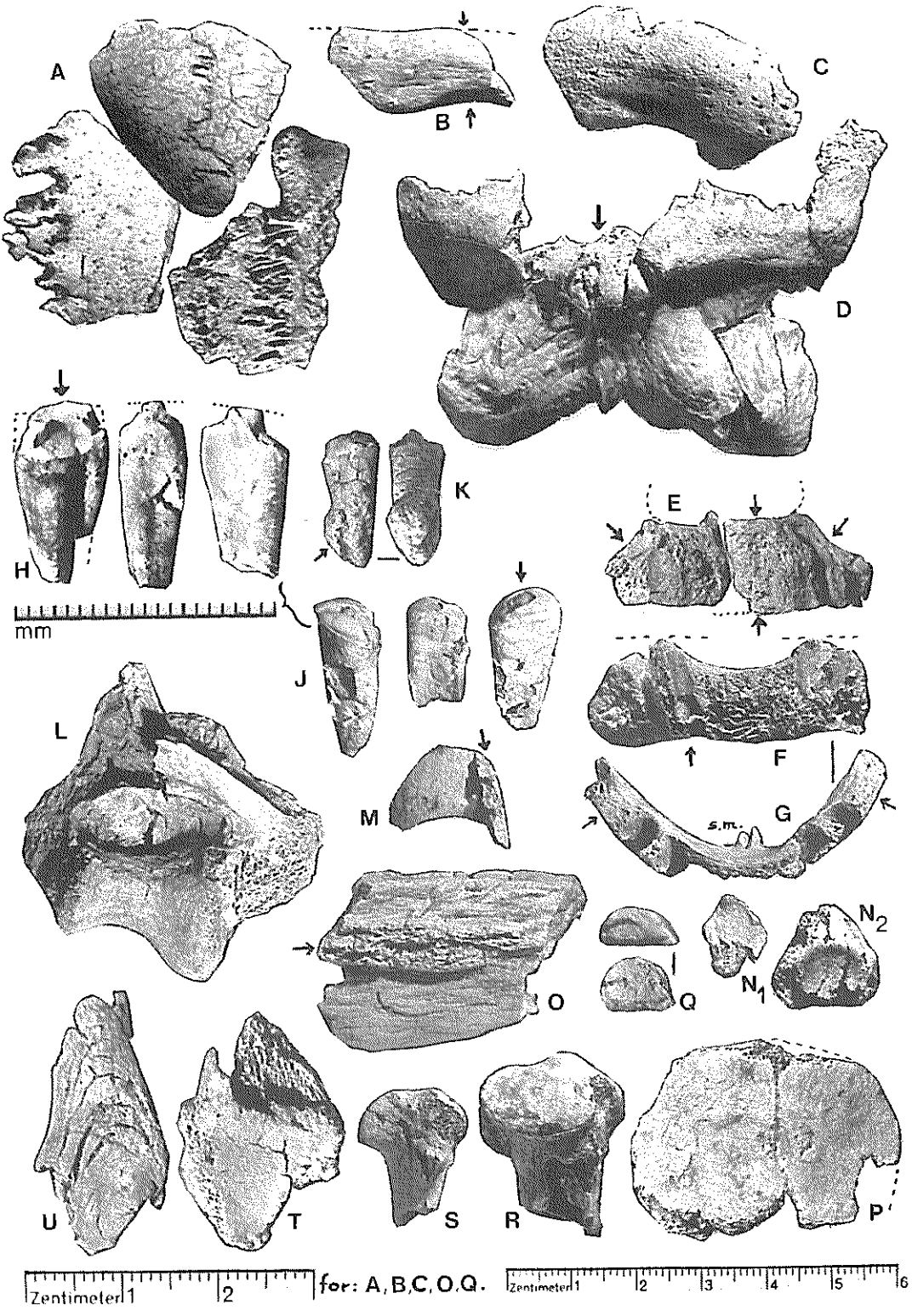
Material: The cremation weighs 1415 g. 125 g derive from the skull (8,6%).

The degree of cremation is imperfect, its colour very variable from white to middle and dark grey. Grey predominates on parts from the right side of the body, a dark blue grey burning of the shaft of one (?) femur. Additional green discoloration from the cauldron.

Size of fragments: Skeletal remnants are in general severely broken, with only a few larger parts. Fragments of skull usually about 2 cm^2. Occipital region and mandible were reconstructed by glueing, making 18-20 cm^2. Remnants of long bones usually 1.5 - 3 cm, at most 11 cm long (crista anterior tibiae, glued).

Preserved parts of the skeleton:

Skull (Fig. 2 A-K and Fig. 3-4): Remnants of skull vault, partly with sutures, some in fusion. Middle region of occipital bone with the protuberance broken off. From temporal bone, fragments of zygomatic arches with smooth surfaces, root of left external auditory meatus, right petrous part and right mastoid process and remnant of lower part of second mastoid process with normal pneumatic structure. From frontal bone, middle region with crista frontalis and parts of sinus frontales, right arcus superciliaris, remnants with supraorbital margins and temporal ridges (Linea temporalis). From malar bone, left processus fronto-sphenoidalis. From maxilla anterior part with low palatum durum and floor of nasal cavity, outer surface is broken away. Remnants of alveoli P2 left - P2 right present. From mandible, two larger portions were reconstructed, only alveoli of M1 right side is lacking. As the parts of the mandible show M3-alveoli and the anterior crest of the ramus, the shape of the lateral aspect of the mandible was reconstructed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Caption, Fig. 2 A-T:

Relevant skeletal remnants for ageing and sexing the cremation:
A. Three fragments of skull vault, sutures already closed in two.
B. Remnant of zygomatic arch with smooth surface (not roughened by muscular attachments).
C. Strong arcus superciliaris from right side.
D. Middle region of occipital bone, the protuberance is broken off (arrow).
E. Maxilla, anterior aspect, surface damaged. Oblique arrows pointing to maxillary sinusses, vertical arrows indicate maxillary height (M/S).
F. Mandibula, anterior aspect, surface damaged. Arrow points to osteolythic cavity at tip of alveolus of right canina.
G. Mandible, same fragment, superior aspect with spina mentalis (s. m.) and alveolar closure of alveolii P2 l. and r. (arrows).
H. Three teeth with worn and laterally damaged crowns.
J. Three front teeth with crowns worn off to the dentine (arrow).
K. Tooth with bulging cementum near tip of the root, two aspects. Crown is completely broken off.
L. Part of left distal humerus without foramen supratorchleare.
M. Remnant of humeral diaphysis with pronounced lateral muscle attachment.
N. Carpals: N1: Os pisiforme. N2: Os lunatum.
O. Part of femoral diaphysis with linea aspera, laterally pronounced roughening (arrow).
P. Damaged broad patella.
Q. Os sesamoidea, superior and lateral aspect.
R. Capitulum of I. metatarsus, left side.
S. Capitulum metatarsus, lateral view.
T. Damaged distal end of fibula, its breadth is recognizable by comparison with U, distal fibula from a female cremation.

by superimposition of both sketches as shown in a drawing in Fig. 4. Parts, mostly roots, of appr. 17 teeth.

Remnants of spinal parts of several vertebrae, of ribs and hip only very small remnants preserved. From extremities, mainly fragments of diaphyses and small remnants of joints, relevant parts being: Distal humerus left and right, proximal radius left and right. From carpals, os lunatum . and os pisiforme. Part of one patella. Tibia and fibula distalis, fragment of Os naviculare pedis, metatarsal left and right. One os sesamoidea and parts of two phalanges are present (Fig. 2 L-U and Fig. 5).

Some measures (shrinkage by the firing must be taken into consideration): Thickness of skull vault 2.2 - 3.5 mm, supraorbital margin 2.5 mm, breadth of zygomatic arches 8.2 - 8.5 mm. Height of maxilla (measure 48 of Martin/Saller) appr. 14-15 mm. Height of corpus mandibulae at region of M3 right side: appr. 21 mm. Reconstructed breadth of ramus appr. 32-34 mm, largest breadth appr. 45-46 mm. Distance from angulus mandibulae to crown of articular process is appr. 69-70 mm. Thickness of crown of articular processes 5.5 - 7 mm. Height of anterior arch of atlas without tip of anterior tubercle 10.5 mm. Extremities: Diameter of trochlea humeri appr. 27 - 28 mm, humeral vault thickness appr. 2.7 mm, diameter of capitulum radii left 22, right (deformed) 20-21 x 22.5 mm. Circumference of diaphyses of radius/ulna 34 - 36 mm. (For comparison, this measurement in female cremations is 29 - 31 mm). Vault thickness in femur appr. 4 mm. Breadth of patella: preserved 41.5 mm (completed appr. 42 - 42.5 mm. For comparison, this measurement in female cremations is 30 - 35 mm). Vault thickness of tibia 2.9 - 5 mm. Preserved breadth of distal extremity of fibula 27 mm (completed appr. 28? mm). Breadth of articular surface of first metatarsal measures 19.8 mm, total breadth of the capitulum 21 mm (for comparison, these measurements in females are 17.5 and 20 mm). Largest proximal breadth of second phalangy of first toe 21.2 mm.

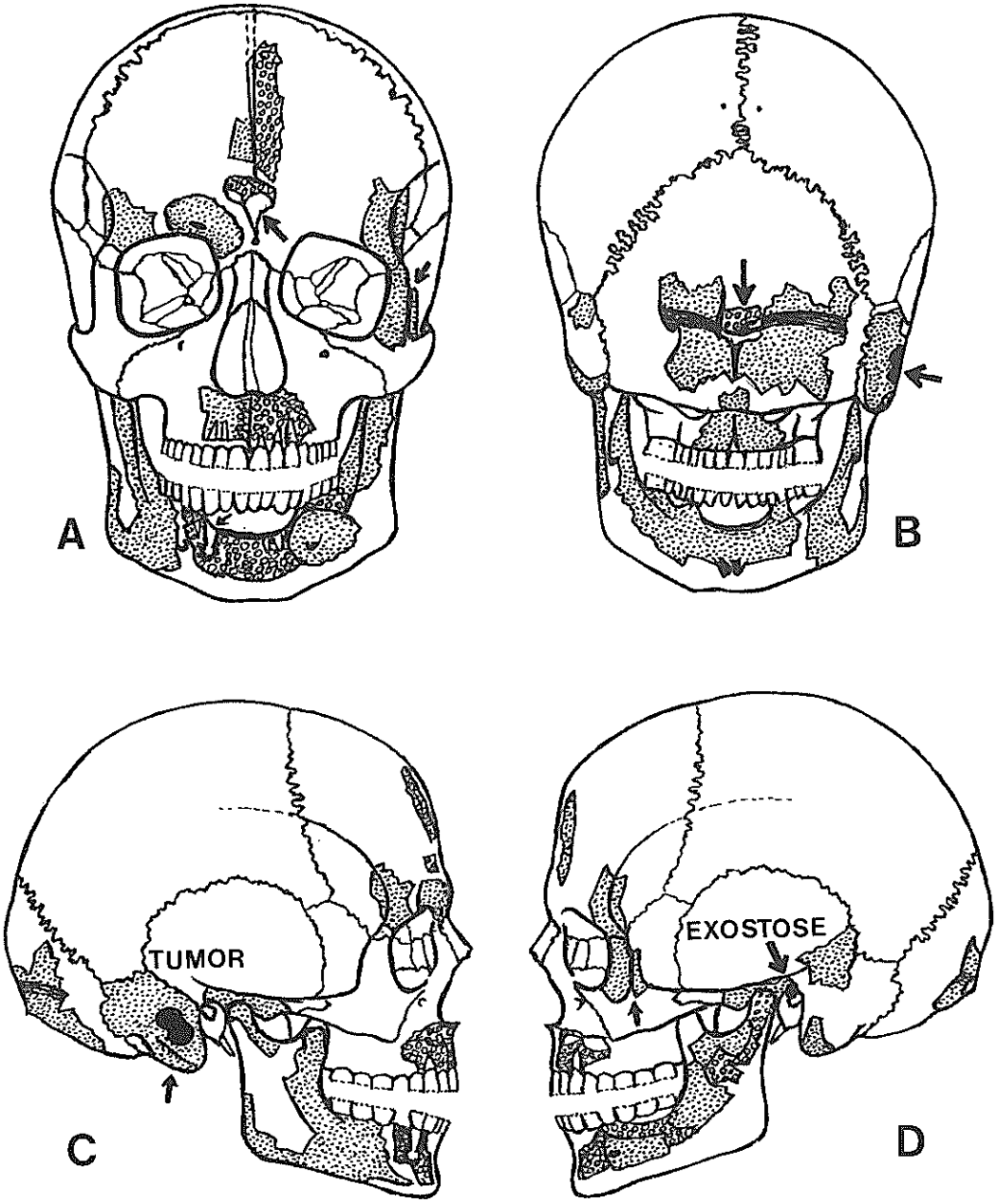


Fig. 3. Definable fragments of skull. A. Frontal aspect. The large arrow points to preserved frontal sinusses, the middle arrow to the groove in the left lateral orbital crest, the smallest arrow points to the right alveolus with osteolytic enlargement of mandible. B. Occipital aspect. The vertical arrow points to the region of the broken off Protuberantia occ. externa. The right arrow shows the tumor in the right mastoid process. C. Right lateral aspect with localized tumor (arrow). D. Left lateral aspect with groove of the lateral orbital crest (small arrow) and ear exostosis (strong arrow). Dotted lines shall indicate wear of teeth.

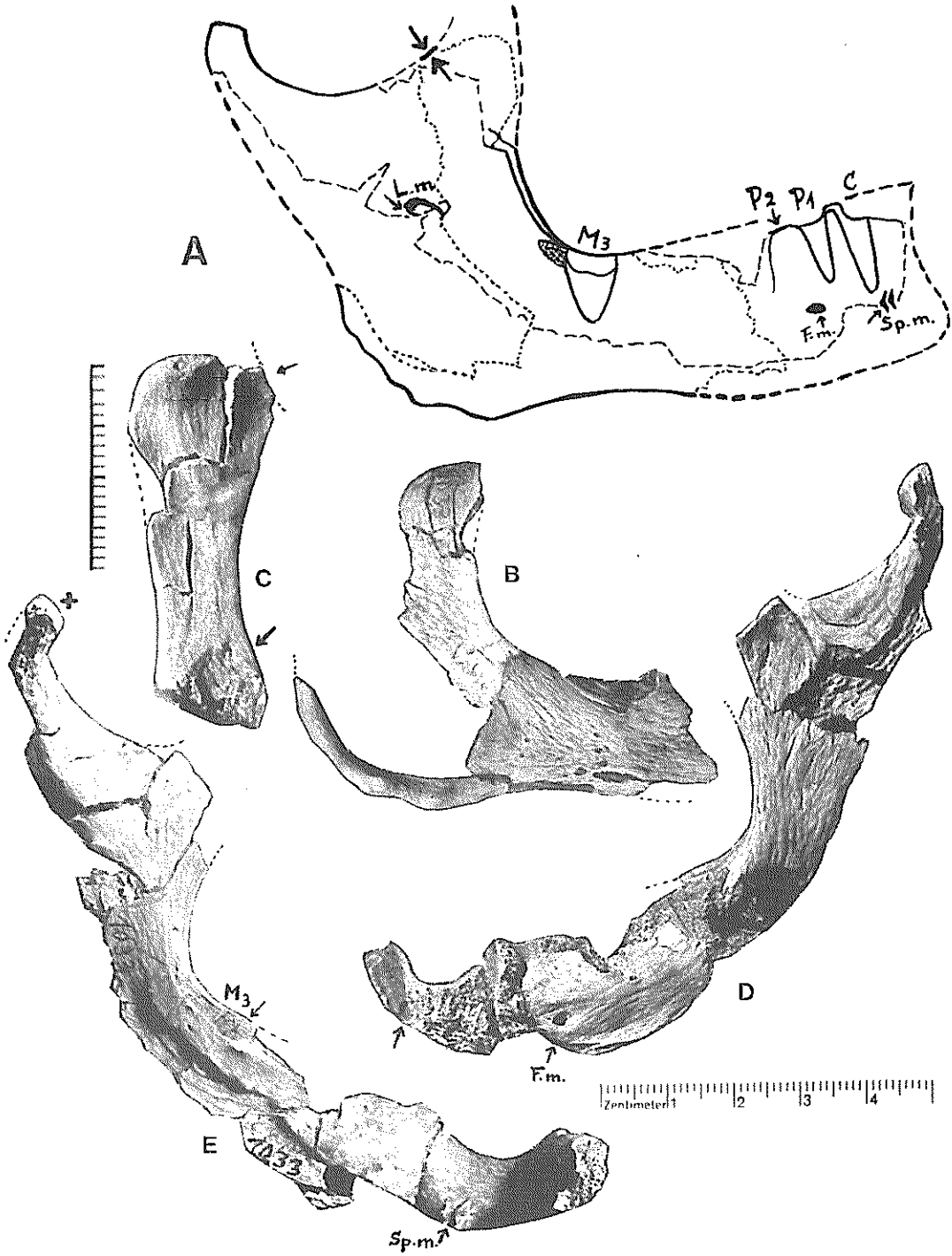


Fig. 4. Parts of mandible and its reconstruction. A. Outline drawing of mandible by superimposition of left and right part. B. Part of right mandible with angle. The coronoid process is slightly bent by the heat. (This part consists of four fragments glued together.) C. Coronoid process, enlarged, showing its original breadth by a small preserved segment of margin towards incisura mandibulae (small arrow). The larger arrow pointing to roughened region posterior to third molar. D. Part of left mandible, outer surface with foramen mentale (F. m.) and the osteolytic cavity in alveolus of right canine (arrow). E. Same part, inner surface, showing alveolus of third molar (M3), mylohyoid line, and spina mentalis (sp. m.). See also the flattened articular surface (x).

Results of analysis

Sex: Obviously male, judging by strongly developed occipital muscular attachments and strongly arched rough superciliary arch. Breadth of smooth zygomatic arch and reconstructed mandibular ramus show convincingly male features, as it seen too in skeletal extremities from measurements of distal humerus, patella, distal fibula and I. metatarsal capitulum. Muscular attachment areas are strong, especially the linea aspera femoris, showing strong lateral roughening indicative of male (Fig. 2 O).

Age: Mature. Synostosis of sutures of the skull is well developed. Dental crowns are severely worn, in incisors already down to secondary dentin (Fig. 2 J), but the pulp is still enclosed. Dental loss has started (Fig. 2 G). Criteria point more definitely to mature then to adult age. (Further criteria for age, see pathology.)

Body height: Appr. 166 - 170 cm, according to diameter of reconstructed capitulum radii: appr. 22 mm. This is according to Martin's classification system (1957) as of above-average stature.

Epigenetic traits:

1) Exostosis of ear: In the upper part of the left external meatus there is, running along inside, a roll-like exostosis of 8.6 mm in length and 1.5 mm in diameter ending in a knot of 1.8 mm at the inner end (Fig. 5 D).

2) Longitudinal groove in left external orbital ridge. This I have seen in no other cremation so far. Remagen gives the following information on this: "Part of the left zygomatic arch, fronto-sphenoidal process: distinct grooving of the facies temporalis in conjunction with the lateral structure of the temporal muscle. According to my opinion this is at best a variation with distinct ridge formation of the groove which holds the anterior surface of the temporal muscle. This by comparison with several skulls of different age." (Fig. 5 E)

3) The curved edge of a fragment of the diaphysis of a larger long bone 5.2 cm long and outer layer 2.2 mm thick shows a ridge-like thickening of the compact tissue 3.2 mm in height and rom 3 - 5.5 mm enlarged in breadth in the longitudinal direction of the bone.

There are three foraminae of different shapes and sizes on the base of maximal height running almost obliquely to the ridge (Fig. 9 C-E). A flat depressed area in the compacta, especially in relation to the large middle foramen, is observable and the x-ray shows thinning of the compacta (Fig. 9 A-C). The outer crests of the perforating foramen are rounded on both sides, which is best seen next to the curving diaphysis. The preserved fragments of compact layer suggest that at least one blood vessel extended further on its surface. W. Remagen explains: "This ridge-formation is seen as a variation of norm of entrance of vasa nutritia; I do not think that this is due to a pathological change."

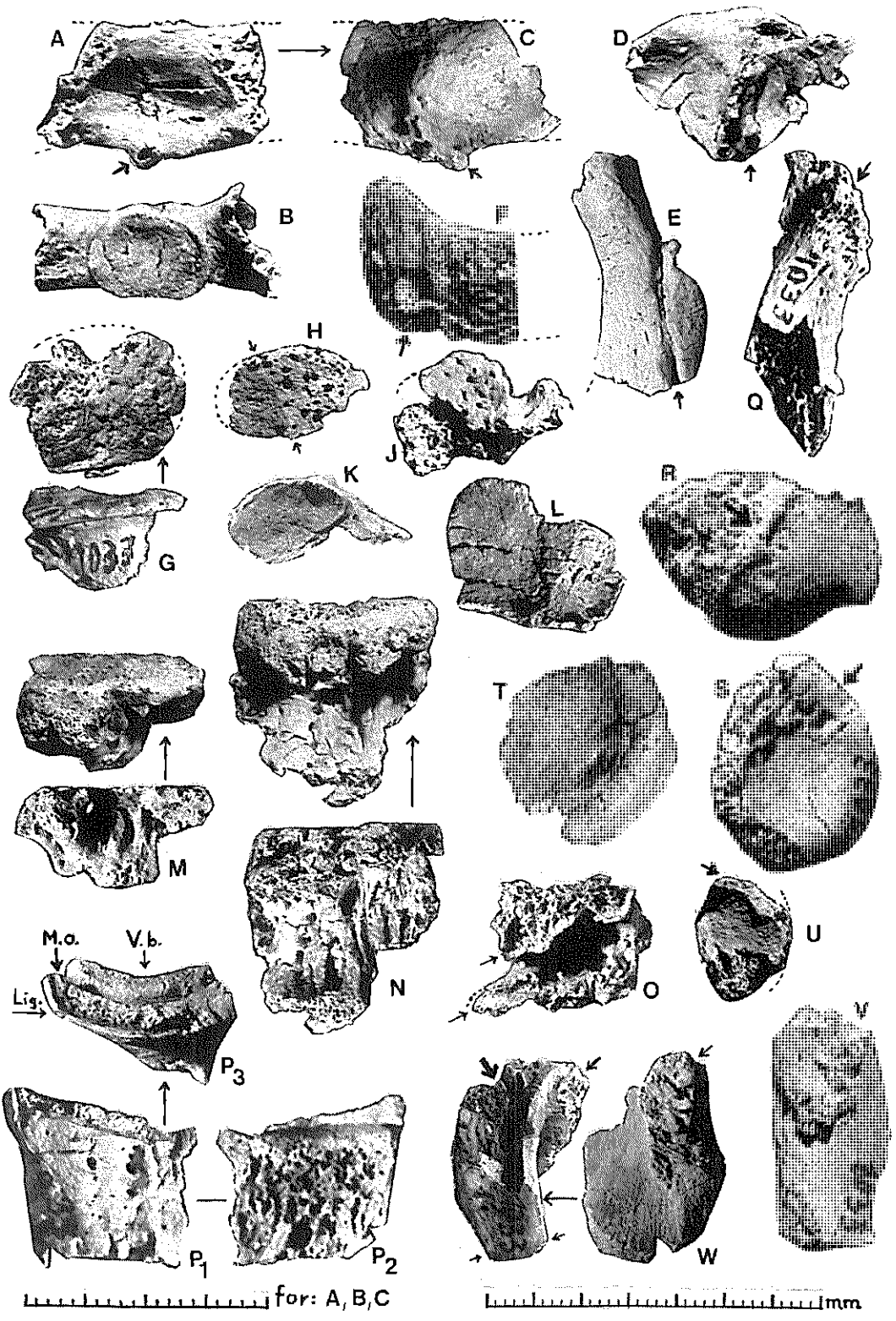
Pathology

1) Jaws

a) Dental loss: The damaged maxilla shows two areas of suggested remnants of alveoli spongy bone substance: in area of P1 left and P2 right. This looks like closure of alveoli following dental loss. In the better preserved mandible there is closure of alveoli following tooth loss of P2 left and right. In the opinion of the dentist H.-J. Harms this dental loss took place 2 - 3 years prior to death. (Fig. 2 E and G).

b) Osteolytic cavity: Near the area of the end of the dental root in the alveolus of the right canine there is a cavity of 4 mm in diameter caused by an osteolytic process (Fig. 2 F, arrow).

According to information from H.-J. Harms it cannot be confirmed whether this developed by apical process. (The tooth showing cementosis is not from this alveolus.)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mm

Caption, Fig. 5:

Anomalies and pathology. A. Fovea dentis of atlas, horizontally heavily worn, almost polished (in the middle region cracks caused by the fire), also tip of the anterior tubercle is opened (arrow). B. For comparison an also cremated fovea dentis with normal surface (apart from cracks caused by the heat). C. Anterior aspect of A), showing tuberculum anterior with its slightly damaged lower part and tip. D. Remnant of left temporal bone with part of fossa for mandibular condyle (left) and ear-exostosis (arrow). E. Frontal process of left malar bone with vertical groove (arrow). F. Photo cutting of anterior mandible with osteolytic cavity (arrow) at tip of left alveoli of canine. G. Articular process of vertebra, lateral aspect, see the enlarged articular plate. Above: the articular plate deformed by spondylarthrosis (left part damaged). H. Another articular process affected by spondylarthrosis and slightly bent: (arrow) left part roughened, with few small pores, at right numerous, larger pores. J. Remnant of another articular process with same destruction. K. For comparison: Articular process with normal surface from another cremation. L. Normally structured articular surface of man Husby 1033. M, N, O, P. Remnants of vertebral bodies with ossified ligamentum. M, N. Two fragments obviously from lower part of the spine with cordlike structures of the ligamentum. The vertebral margins are turned outward, to be seen at the slightly turned aspects above, also showing severly deformed vertebral plates including the vertebral margin. O. Vault fragment of another vertebra, upper and lower margin extremely turned outward, arrows point to its extent. P. Suitable broken remnant of vertebra from upper part of the spine with smooth surface of the ligamentum. P1. Behind the fractured border at the upper part of this remnant marginal osteophytes of spondylosis deformans present. P2. Fragment P1 from behind showing open spongy tissue of the vertebra, remnant of vertebral plate and marginal osteophytes preserved appr. 2 1/2 mm in height. P3. Same fragment from above showing original margin of vertebral body (V.b.), the surrounding marginal osteophytes (M.o.), and the whitish layer of the ligamentum anterior (Lig.), (arrow). Q. Vertebral process with arthrotic osteophytes (arrow). R. Capitulum of distal humerus with arthrotically deformed surface (arrow). S. Damaged articular surface of radius with depressions from hardened carilage. T. Part of the other capitulum radii without any defects. U. Os pisiforme with partly broken off arthrotic marginal osteophyte (arrow). V. Remnant of long bone with arthrotically roughened surface. W. Remnant of diaphysis of femur with severly deformed and roughened trochanter minor (arrow). At left the remnant turned showing the extent (small arrow) of this deformed part. The thick arrow points to the black, incompletely cremated inside of this bone fragment. See at the lower and the thickness of the shaft vault (smallest arrows).

2) Teeth

a) There is a thickening caused by cementosis near the tip of the root of a frontal tooth. According to H.-J. Harms, this develops in people nowadays only after age 30 (Fig. 2 H).
b) Attrition is already severe at the crowns of teeth, which are also severely damaged by fire. The incisors already show dentine, but the pulpa is not yeat opened. The rounded portions of molars are entirely worn by attrition.

By reason of severe heat damage to the dental crowns, no caries finding is possible.

3) Tumor

An hour-glass shaped tumor of the right mastoid process is of special interest. Its diagnosis by W. Remagen, Basel:

"The irregularly shaped portion of the mastoid shows on inspection by use of a magnifying glass typical osteo-structure of the mastoid with central canal for blood-vessel and concentric layers of lamella, on the outher surface a continuous general lamella with several pervading canals for blood vessels. Enclosed is an almost hour-glass-shaped tumor of 19 x 9 mm diameter, which is separated from surrounding bone by a free gap

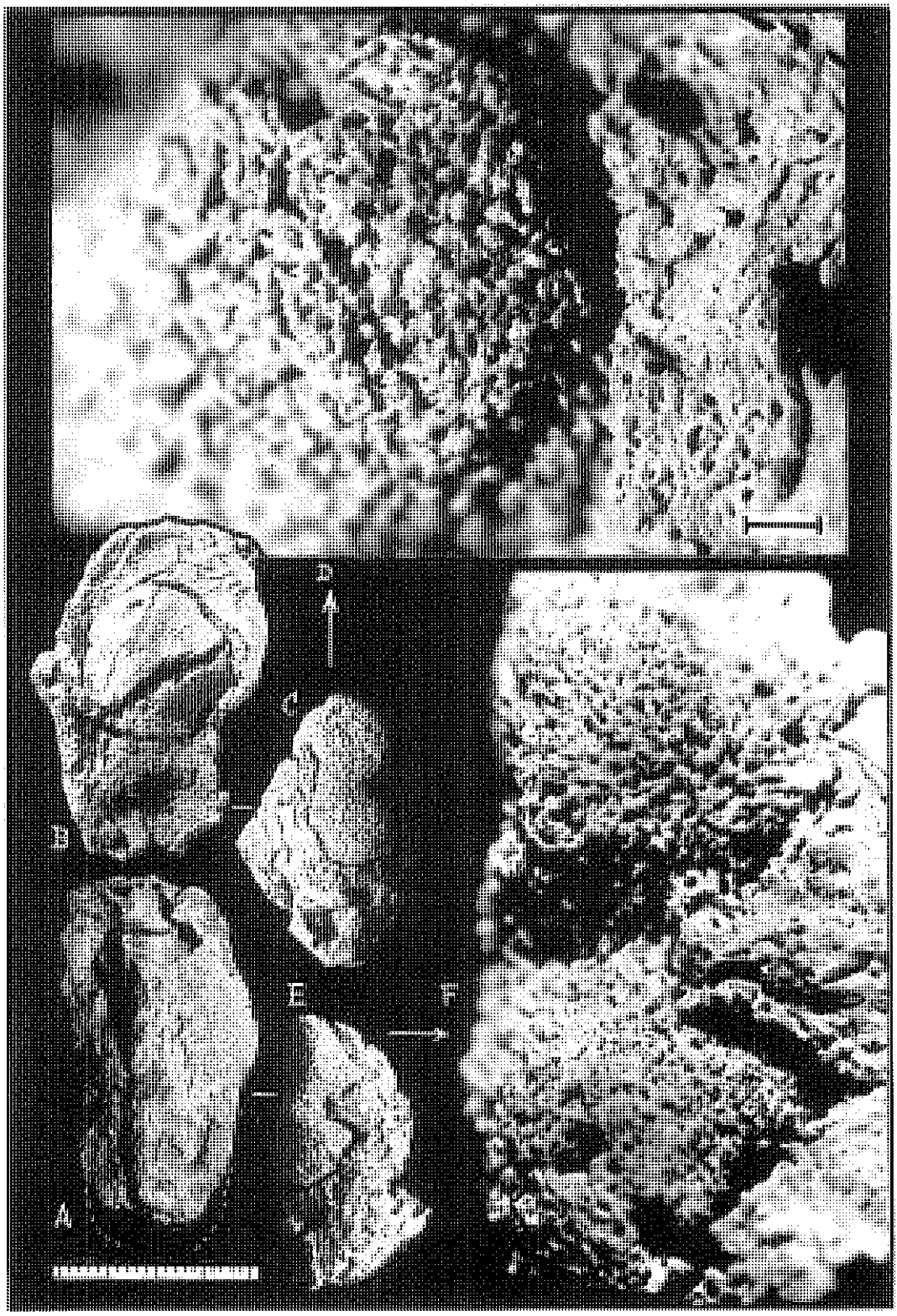

Fig. 6.

Caption, Fig. 6:

A. External surface of right mastoid process, with drawing of tip. B, C, The opened mastoid process, for B) text by W. Remagen: "Inner surface with cavitation, into which the exposed tumor of the other fragment fits. Here the inner surface again shows a fine three-dimensional trellis of bone structures. In all probability this is the inner layer of reactive bone by which the osteom similar to the related osteoid-osteom is encapsuled". C. Hour-glass-shaped tumor in distinct compact bone substance of mastoid process. (For comparison see Fig. 7 D2). D. "Microscopic view of upper tumor part, right showing crevice to surrounding bony structure. Measure equals 1 mm". E. Lateral aspect, here as well the bordering crevice in conjunction with surrounding mastoid. F. Microscopic view of the tumor: Text by W. Remagen: "It is composed of three-dimensional trellises of minute, irregular, obviously non-directed bone structures, which are fully mineralized. The marrow cavities are extraordinarily tight". (Photo D and F by H.R. Ziysset, Patholog. Inst., Basel).

on average 1/2 mm wide. The lesion consists of three-dimensional trellis of minute irregularly shaped, obviously not normally structured bone tissue which is fully mineralized. The marrow cavities are extremely narrow, but only the upper surface can be judgeg as the tumor is not opened up (Fig. 6).

X-ray pictures of both joined portions of the mastoid as well as on photos of the tumor carrying portion show a sharp border between the hour-glass-shaped tumor and the surrounding bone. The free edge of it shows distinct delineation of bone structure, which in depth is covered. An inner cavity or otherwise abnormal structure is not recognizable (Fig. 7).

On account of the bony structure and the sharp border against normal bone there is a high probability (95%) of osteoblastom. Benigne osteoblastom is non-lethal, deriving osteoblasts, known to occur in this localisation. We have a similar finding for this localisation measuring more than 8 cm in diameter.

The external portion of the mastoid with the surface is available for investigation. On the inner side there is a cavity into which the tumor from the other portion fits. Here the inner surface also shows fine three-dimensional trellises of bony structure.

In all probability this is the inner layer of reactive bone by which the osteoblastom is surrounded, similar to that seen in the related tumor osteoid-osteom (Fig. 6 B).

For differential diagnosis consideration is given to osteomyelitis of the sclerotisizing type, an osteom and an osteosarcoma. Osteomyelitis is with almost absolute certainty to be excluded, because in this case a central excavation with the inflammatory focus would be seen. This is not the case. Nor is it an osteom, because here the structure of bone formation with its fine network, small densely packed structure, is distinctly different from the case of a spongy osteom, which shows an almost normal trabecular structure, and from a compact osteom, in which bone structure is almost comparable to that which is seen here in the surrounding mastoid bone. An osteosarcoma is in all probability to be excluded, because the lesion is distinctly defined by the fine gap formation (described above) separating it from autochthonous bone. By contrast, the malignant tumor osteosarcoma grows by infiltration and destruction of surrounding tissue, be it bony or soft.

Like all primary bone tumors, the osteoblastom essentially a tumor of juvenile age, the lowest point of incidence to be seen at transition from first to second decennium. As the upper point of incidence otherwise comes in the sixth decennium, definite ageing of the afflicted person is not possible.

The tumor must have existed for years, this being the only possible explanation for the full mineralisation of bone structure. The tumor certainly did not give rise to handicaps or caused pain."

A possibly similar case is seen in the flat left mastoid process 22 mm broad from a cremation of a middle adult man from grave 1984 of the Roman Period of "Brautberg"

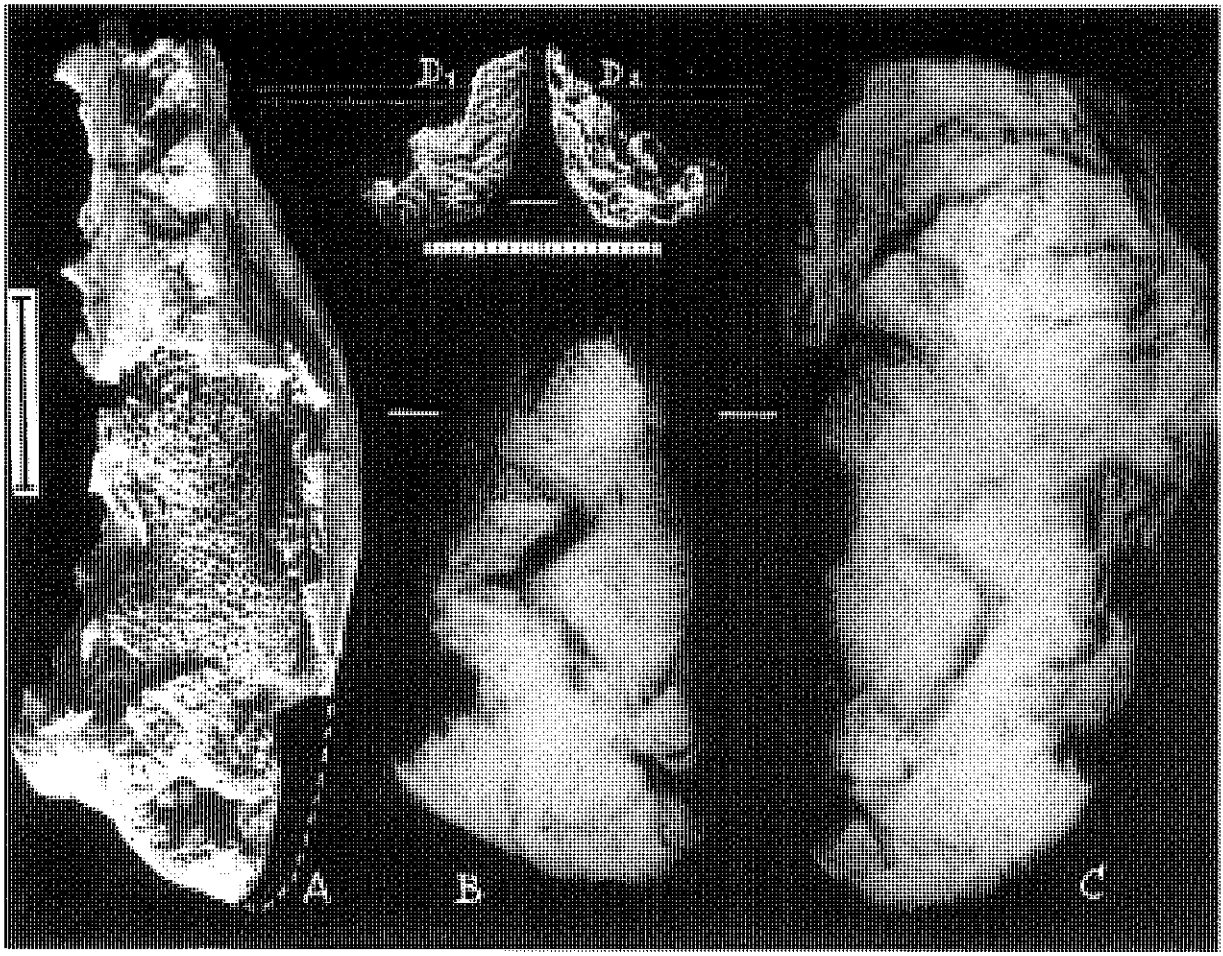

Fig. 7.

Caption, Fig. 7:

Tumor. A. "Mastoid process, lateral aspect seen from posterior: on account of damage to the external surface the tumor is visible. Measure equals 10 mm." B. "X-ray of tumor-bearing mastoid portion, lateral aspect." C. "X-ray of whole mastoid process. Both X-ray pictures show crevice between tumor and surrounding compact bony substance". (Photos A, B, C by H.R. Ziysset, Pathol. Inst. Basel). D. Fragment of the lower section of the second mastoid process. D1. The rough outer surface. D2. The inside with normal pneumatisation.

urnfield near Bordesholm, Kreis Rendsburg, North Germany: The first thing I noticed in the area of broken down external bony layer was the exposed open, unorganized bone structure. X-ray showed, additionally, a row of appr. four tightly joined and rounded bony concentrations parallel to the posterior edge of the mastoid process. (No other peculiarities were found in remnants from this skeleton). A medical diagnosis has not yet been obtained.

4) Vertebral column

a) Spondylarthrosis. All that remains of the atlanto-epistroepheal joint is the fovea dentis, which is already reduced to a horizontal depression with accompanying exostosis entirely worn down, and the lower tip of the anterior tubercle also shows degenerative change (Fig. 5 A).

Some small articular surfaces of other vertebrae are preserved. These are porous and worn (osteoporotic changes) but show no signs of ankylosis (Fig. 5 G, H, J).

b) Spondylosis deformans. There is evidence of degenerative change in vertebral discs including first signs in the upper thoracic section of the spinal column, a milder form, also more severe exostoses, spongial deformations of discal surfaces, and changes in borders of vertebral plates of the lower sections of the vertebral column (Fig. 5, examples given in M, N). Marginal osteophytes also developed in the preserved processus spinalis (Fig. 9 Q).

c) Ossification of the anterior ligament. The ventral surfaces of some vertebrae are dense and smooth and of white colour in contrast to greyish bony parts. Some vertebrae surfaces appear to be covered by vertical cordlike structures.

A favourable broken fragment shows that this is a distinct layer, the ossified anterior ligament (Fig. 5, P1-P3). The lateral aspect seen through a lens shows marginal osteophytes in between the edge of the vertebral body and the ossified ligament, giving evidence of earlier spondylosis deformans. Obviously there has already been at least a partial immobilisation of the spinal column. No suggestion can be made as to the possibility of advancing ankylosis, i.e. of the pelvic region of the spinal column, as the preserved skeletal remains are too scanty and broken.

5) Extremities

a) Arthrotic changes. There are signs of arthrotic changes in diverse skeletal sections including osteophytic formations.

The distal end of the humerus right elbow joint already shows formation of a protrusion of the lateral aspect of the capitulum (Fig. 5 R).

There is also a partially deformed joint surface of capitulum radii, but on account of smallness of the fragment it remains uncertain whether this is of the right or left side.

The left distal humerus end is normal, also the preserved joint surface of the second proximal end of radius.

The edge of the joint surface of os pisiforme also shows arthrotic exostosis (Fig. 5 U), and there is arthrotic roughening of the trochlear end of a middle phalange.

Remnant of long bone with partly roughened surface (Fig. 6 V), and remnant of femur(?) with degenerative roughened trochanter minor (Fig. 5 W).

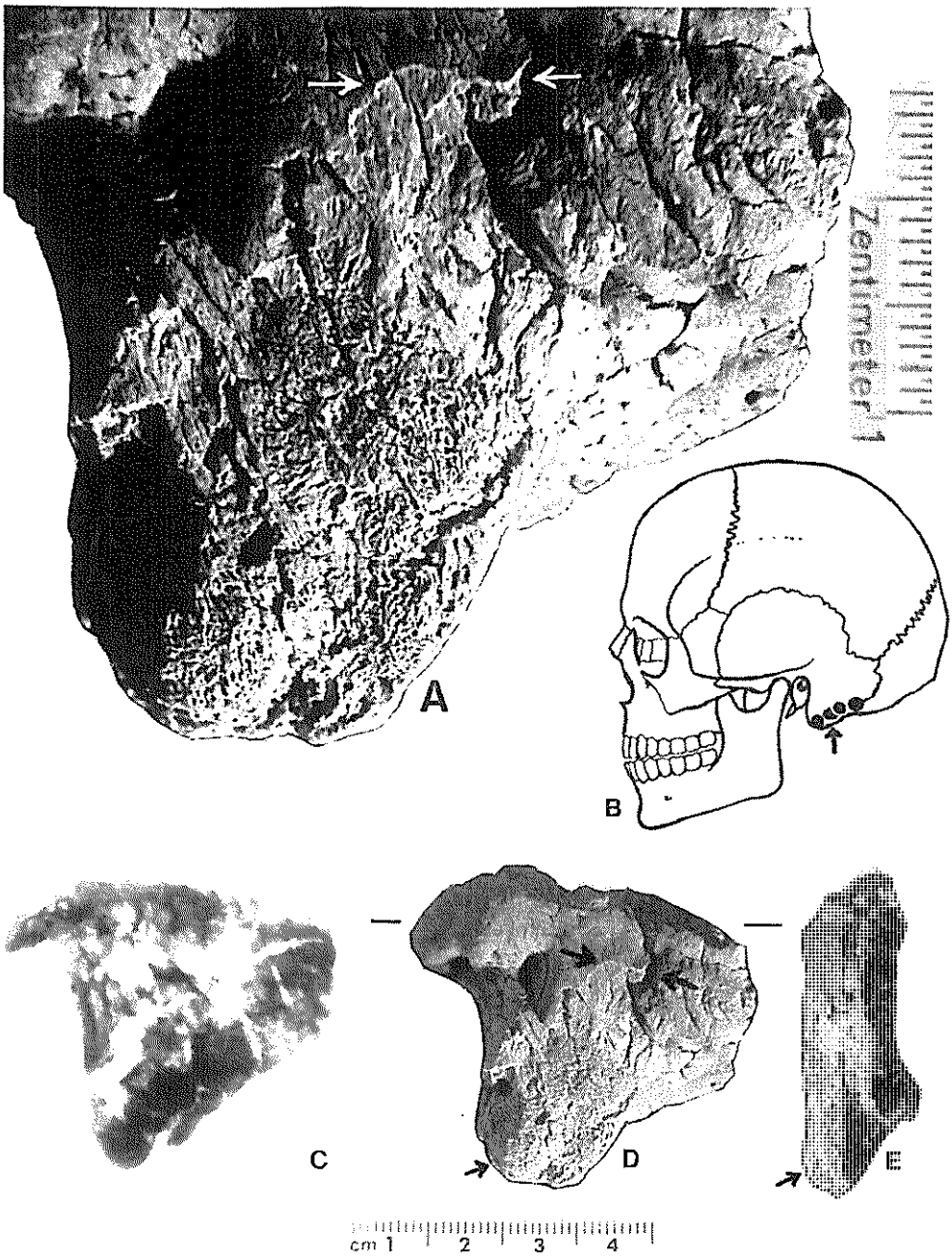

Fig. 8.

Caption, Fig. 8:

A. Left mastoid process from another cremation for comparison (Brautberg near Bordesholm, urn 1984) with broken off external layer (line of separation see arrows). The upper portion normal, further down fine structured undirected bone structures visible. B. Localisation of bony concentrations near the posterior edge of the mastoid process. C. The x-ray shows a row of four round bony concentrations (X-ray by R. Kamradek and W. Gosch). D. Whole fragment mastoid process 22 mm broad. The oblique arrow points to the lowest bony concentration, the two upper arrows to the line of separation. E. Lateral view from posterior, the oblique arrow points to the lower globular knot.

b) Fragment of two pieces of a larger long bone with secondary sclerotic deposit on the inner wall. Its diagnosis by W. Remagen, Basel:

"The two small pieces of long bones show on inner surfaces a definite smooth and dense structure with some smaller porous openings (Fig. 9, G and H). These changes are non-specific; they represent sclerotisiation of the inner wall, which is peculiar to osteomyelitis. A benign tumor is also sometimes separated from surrounding bone by such lamella. The fine pores are then to be seen as vessel canals." Additional information: "When changes in long bones are caused by osteomyelitis it is obviously possible that the individual, at times or permanently, was a case for care. A chronic suppurating osteomyelitis of certain duration can be lethal, in which case usually secondary disease is the cause of death, e.g. a general amyloidosis or a generalised septicaemia."

Bear Claws

The cremation material contained 10 bear claws which, according to definition by Prof. E. Schmid, Basel, belong to three paws of presumably one bear. It is suggested that the cremated person was in possession of a bear's fur, which was left with the phalanges as is the custom still today (Fig. 10) (Schmid, 1941).

Objects made of antlers

There are larger portions of two ornamented objects made of antlers of which one piece shows distinct marks of wear damaging the engraved ornaments. Some particles point to possibly third and fourth objects. The two larger pieces are broken in identical sections (incidental?). (Fig. 11) The decorated objects made of dear's antlers severely worn in parts, were presumably used as lever snaffles for the two horses drawing this carriage.

Charcoal

Analysis of remnants of charcoal by H. Gottwald, Hamburg showed that Alnus sp. (elder) was possibly used for cremation. This is relatively unusual, because in general oak wood was used. (It remains obscure whether perhaps these small and few remnants ev. derive from the carriage also burned, no remnants of which could be found in the burial, neither in larger portions nor at the iron parts of the vehicle.)

A. Czarnetzki analysed the unburned skeletal remnants of two carriage graves from Lower Rhine Region of the Early Latène Period (1979).

Burial 4 contained remnants of a strong male skeleton of mature age (lambdoidal suture at inner vault partly fused. Metopic suture present).

Pathology: Apart from common age changes (obvious slight attrition of teeth without any caries, loss of 1st right lower molar by an inflammatory process, and general age resorption of one third of the roots of the alveolar borders of maxilla and mandibula, in the spine only slightly developed spondylosis deformans of the lumber vertebrae and

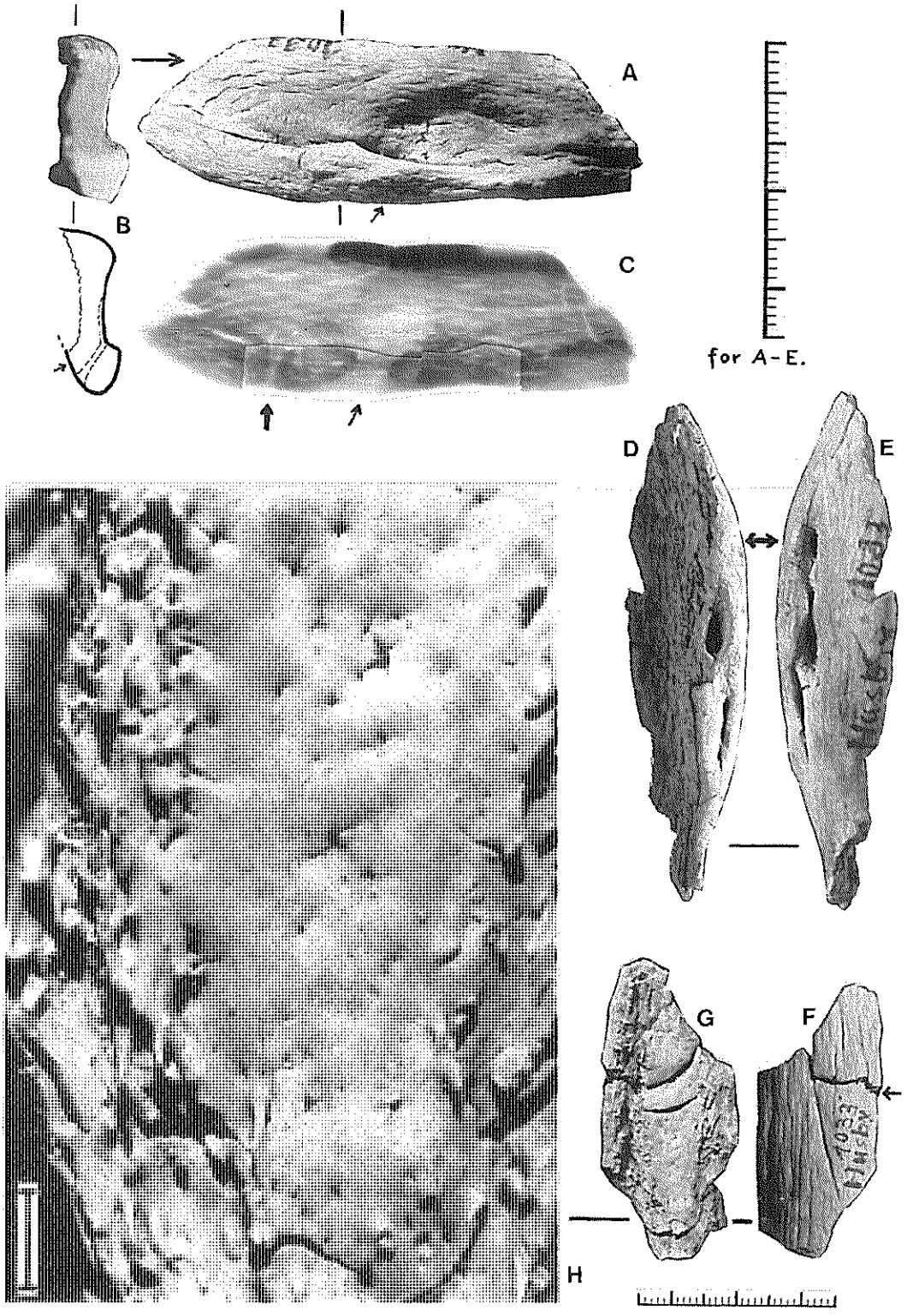

Fig. 9.

Caption, Fig. 9:

A-E: Fragment of long bone with ridge-like thickening which is penetrated by three foraminae, in different aspects: A. Outer vault with ridge at the lower border and flat depressed area. B. Same fragment, lateral view showing the extent of the ridge. C. X-ray from: a) The depressed area is directed to the largest foramina (small, oblique arrow, same as in A). The thick arrow points to the smallest foramina with conical shape. The third, crevice-shaped foramina is not seen on the x-ray. D. Inner side of the fragment with spongy tissue at left, but also compact bone at the lower side of the ridge! (see arrow in B). Here are the three foraminas seen: uppermost the pin-head small opening of the conical foramen (thick arrow), in the middle the largest near the depression and underneath the crevice-shaped foramen. The foraminae from external aspect of the long bone fragment. Thick arrow points to the larger opening of the conical foramen. F. External aspect of another fragment of a long bone, in two pieces, arrow points to line of separation. Compacta of normal structure. G. Internal aspect of same fragment with sclerotic layer. H. Microscopic photo from lower part shows the dense structure of the layer with some small pores. Measure equals 2 mm. (Photo by H.R. Ziysset, Basel)

slight osteoporosis in thoracal and lumbar vertebrae), A. Czarnetzki found three skeletal abnormalities which were so severe as to demand a carriage for the transport for the patient (but we do not know the probable organic diseases):
1) Among the few remnants of ribs there is one fragment of a left rib, appr. 15-17 mm broad, with healed transverse fracture, its caudal half showing a bony swelling, surrounding a cavity, according to A. Czarnetzki probably a cyst or caused by a tumor in connection with the healing process. An exact diagnosis seems to be impossible.
2) Of os sacrum the first segment is lumbalisized.
3) The last segement of os sacrum shows hiatus sacralis.

Burial 5 contained a very few skull-remnants, surprisingly of a child, age latest infans II (by very slight attrition of first molar).

Acknowledgments

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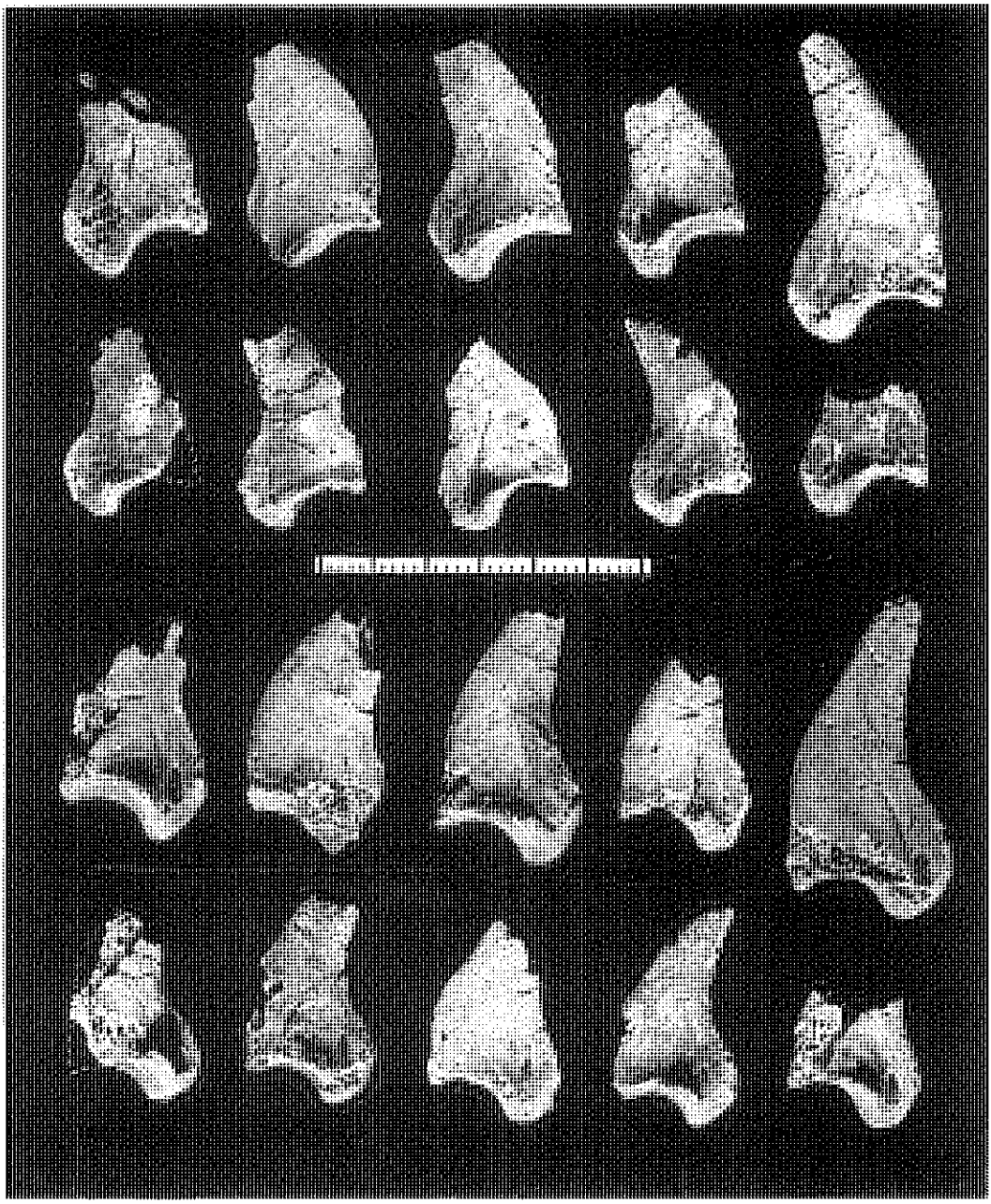

Fig. 10. Ten bear claws, in two aspects, some heavily fragmented. From all of them the claw-bone has been broken away by the heat of the cremation fire.

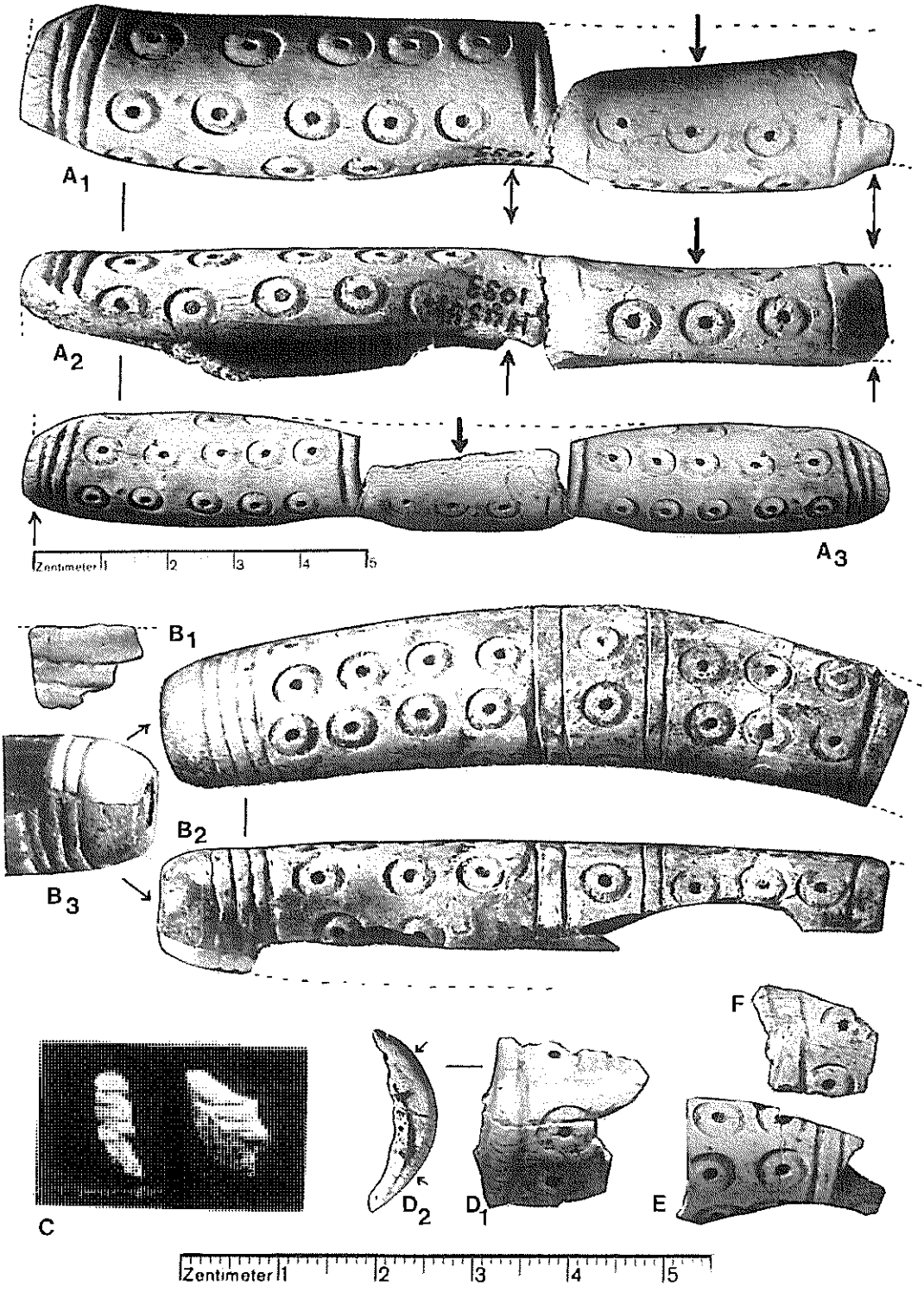

Fig. 11.

Caption, Fig. 11:

Ornamented objects made of dear-antlers, of unknown utility. A. Right-broken gadget with distinct traces of wearing, partly damaged ornamentation, with two depressions (thin arrows) and a more shallow worn portion in the middle of the fragment (thick arrows). As this part between the depressions shows distinct ornamentation it may possibly be the middle portion of a longer object. For attempted reconstruction see A3. B. Another object without signs of wear. Frontal aspect. Broken right side. B2. Lateral view. B3. The reconstructed part in slightly oblique view shows the well-shaped end. Four grooves were here punched around the object with a chisel, but the double grooves in the middle portion were made by scratching. C. Two very small fragments of a further object with very fine scratched parallel grooves. D. Fragment of a further object. D1. Ornamented side. D2. The fragment turned, showing the left end with smooth part in different breadth (arrows) and broken part. E. Further fragment with partly worn ornaments (belonging to the object shown in D?). F. Fragment showing circular, non-parallel grooves (not running together).

Peripheral Polyarthritis in two Neolithic Skeletons[1)]

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OSSA

Some rheumatic disorders, e.g. degenerative disease and ankylosing pelvospondylitis result in permanent skeletal changes which easily can be recognized when ancient skeletal materials are investigated. Today's most common chronical inflammatory disorder is rheumatoid arthritis (RA). This disease is mainly non-proliferating and cartilage erosive. Therefore the premises for leaving permanent skeletal changes are worse, and in addition one of its characteristics is affection of small joints in which changes are easily overseen. Some authors have claimed that RA is a modern disease not appearing until the beginning of the 19th century - alleging that the disease could not be traced in older literature, in art or in paleopathological investigations. The crucial point, of course, is the latter. Recently there are a few reports published describing articular changes well compatible with in vivo presence of RA. The aim of the present paper is to make a further contribution to this field. Two skeletons from a neolithic grave-yard in the isle of Gotland in Sweden are described. In both there are severe and multiple articular changes indicating that the individuals in vivo have suffered from a chronical peripheral arthritis. Based on today's disease panorama and clinical pictures rheumatoid arthritis must be the most probable diagnosis.

Keywords: Peripheral Polyarthritis - Neolithic - Isle of Gotland - Sweden.

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Introduction

Rheumatoid arthritis (RA) is one of our most common disabling diseases today. It is a world wide disorder and epidemiologic studies usually result in prevalence figures between 1-3%. However, several authorities have claimed that RA is a modern disease not appearing until the beginning of the 19th Century (Snorrason, 1952; Boyle & Buchanan, 1971; Buchanan & Murdoch, 1979). The reason for this late appearance might be a newly introduced enviromental factor. Since the etiology of RA still is unknown, this is an important question. Supporters of the view of recent onset have claimed that evidence for the existence of RA during ancient times can be found neither in old literature nor in paintings and - most important - convincing paleopathological finds of RA

1) This paper is a contribution to the First Seminar of Nordic Physical Anthropology at the University of Lund, January 28, 1984.

are lacking. The crucial point is whether there is paleopathological evidence or not. Recently some data have been presented, indicating that peripheral arthritis existed during Roman and medieval times in the British islands (Roger, 1981; Thould and Thould, 1983). The following presentation reviews the results of an examination of skeletons found during an excavation of a neolithic burial place in the isle of Gotland in Sweden.

The skeletons

During the middle neolithic period of the stoneage about 2500-1900 B.C., the so called Pitted Ware Culture appeared in Scandinavia. At Fridtorp, south of Visby, a stoneage site from this period measuring about 20 000 m^2 has been known since the beginning of this century. An area of approximately 350 m^2 was periodically investigated within the years 1976-78. A detailed monography describing the archaeological findings and observations has been published (RAGU, 1982). In the area eleven graves were found and excavated - all belonging to the Pitted Ware Culture. The eleven skeletons were very well preserved. All the skeletons belong to adult individuals, 5 were men and 6 women. In two of the skeletons (in grave 4 and 15) multiple and remarkable peripheral articular changes were found together with severe spondylosis of their spines. In the other nine skeletons there were no peripheral joint changes and only slight to moderate spondylosis in four of them. In other words, there were no unusual changes in the majority of the skeletons.

For the anthropological determination craniometric calculations have been done according to Martin and Saller and estimation of body height according to Trotter and Gleser. Anthropological data are given in Table 1. Columnar changes have been classified in two cathergories, severe and mild to moderate (Fig. 1). Peripheral changes also have been classified in severe and mild to moderate (Table 2). Presence of bony and fibrous ankyloses were registered. Fibrous means that the bones involved actually could be separated with mild force. There was no bony overbridging although the actual bones at the primary investigation gave a sensation of tight joining (talo-calcaneal joints in individual 4).

A detailed description of the skeletons in grave 4 and 15 is given below.

Grave 4. The skeleton is almost complete but very weathered and partly crushed by pressure. The frontal bone, the mandible and some of the long extremity bones have been reconstructed for measuring. The craniometric values and anthropological indices which can be derived from the measuring mentioned above are given in Table 3.

Sex, estimated age and height are given in Table 1.

Columna: according to the proposed criteria there were severe changes in all three sections. All the vertebrae gave an osteoporotic impression. Nowhere there was bony bridging and there were no noticeable changes in the sacro-iliacal joints.

Peripheral joints: there were multiple peripheral changes in large as well as small joints and of varying severity. Details are given in figure 2 and representative photos of severe changes are shown in figures 3 and 4.

Grave 15. An almost complete skeleton. Not much weathered, but partly crushed by pressure. The skull was completely crushed, but has been partly reconstructed so that some of the anthropological measurements could be taken. Anthropological data corresponding to those given for individual 4 are given in tables 1 and 3.

Columna: the vertebrae were of normal density while the other findings were similar to those in individual 4.

Peripheral joints: severe changes were only present in two large joints. Details are given in figure 2. On the distal two thirds of the tibia periostitic changes were noted.

TABLE 1. Anthropological data.

ANTHROPOLOGICAL DATA

Grave no.	Sex	Estimated age at death (year)	Estimated height (cm)	Articular changes Peripheral joints	Columnar
4	♂	> 60	163	Yes	C + T + L
15	♂	35-40	169	Yes	C + T + L
16A	♀	25-30	158	No	L
25	♀	45-50	152	No	L
26	♀	35-40	169	No	C
27	♂	45-50	162	No	L
16B.28	♂	25-30 45-50	164 Not possible	No	No
17.22.24	♀	> 20 25-30 35-40	158 155 163	No	No

C = cervical, T = thoracic, L = lumbar

TABLE 2. Peripheral changes.

SEVERE

REBUILDING AND/OR PRESENCE OF OSTEOPHYTES

EBURNATION

PRESENCE OF PARAARTICULAR SINUS

MILD-MODERATE

SEVERE NOT FULFILLED

COLUMNAR CHANGES

SEVERE	MILD-MODERATE
OSTEOPHYTES	SEVERE NOT FULLFILLED
ALL VERTEBRAL BODIES INVOLVED IN A SECTION	
COMPRESSION	

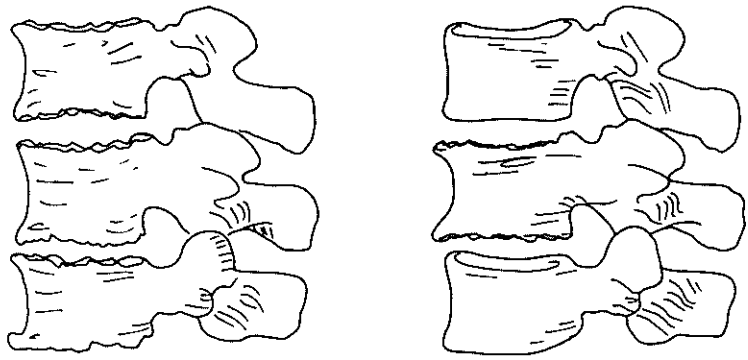

Fig. 1.

Discussion

Arthrotic lesions usually are mono- or oligoarticular and characterized by profilerative changes which easily can be recognized in paleopathological materials (Steinbock, 1976).

Septic arthritis affects one joint as a rule and usually heals with bony ankylosis (Steinbock, 1976). Some types of aseptic arthritis, spondylarthropathies of which pelvospondylitis (Mb Bechterew) is the most well-defined, induce bony bridging due to ossification of the long columnar ligaments and ankylosis of the sacro-iliac joints. Perihperal afflictions are usually pauciarticular and may result in bony ankylosis, all lesions easily recognized in paleopathological material. Several undisputable cases dating back to ancient times have been described (Ruffer and Rietti, 1911-12). Crystal arthritis, e.g. gout, has been reported from investigations of skeletal materials. The few cases reported probably reflect that urated deposits have been overlooked (Karsh and McCarthy, 1960).

Today's most common chronical aseptic polyarthritis is rheumatoid arthritis (RA). The peripheral changes dominate and often the small joints of the hands and feet are most severly stricken. Early in disease the bone becomes osteopenic and later the characteristic erosive (atrophic) changes develop. Usually the disease does not start until middle age or later. Authorities of paleopathology usually give these reasons when stating that no convincing case of RA has been described (Bourke, 1967; Steinbock, 1976). However,

TABLE 3:1. Craniometric values (mm) for the skeletons in grave 4 and 15.
The numbers (Nr) and indices (Ind) are in accordance with Martin & Saller (1958).
Due to the crushed skeleton it was only possible to measure a few Nr and Ind.)

Nr		Grave 4	Grave 15	
1	Max length		184	
8	Max breadth		144	
9	Min forehead breadth	104	100	
10	Bicoronal "		120	
65	Bicondylar "	134		
66	Bigonial "	121	101	
Ind				
1	Breadth-length	-	78.3	Mesocranial
12	Transv. frontal	-	83.3	Sphero-parallelometopic
13	Transv. fronto-parietal	-	69.4	Eurymetopic
164	Mandibular	90.5		
	Angulus mandibulae	dx 126° sin 126°	dx 123°	

TABLE 3:2. Measurements (mm) for calculation of length in accordance with Trotter & Gleser (1958). (Estimates italicized.)

	HUMERUS			RADIUS			ULNA			FEMUR			TIBIA			FIBULA		
	Dx	Sin	$\bar{M}$	Dx	Sin	$\bar{M}$	Dx	Sin	$\bar{M}$	Dx	Sin	$\bar{M}$	Dx	Sin	$\bar{M}$	Dx	Sin	$\bar{M}$
Grave 4	-	286	286	229	-	229	245	-	245	420	-	420	346	-	346	-	-	-
Grave 15	320	307	314	247	242	245	267	261	264	435	442	439	374	373	374	-	-	-

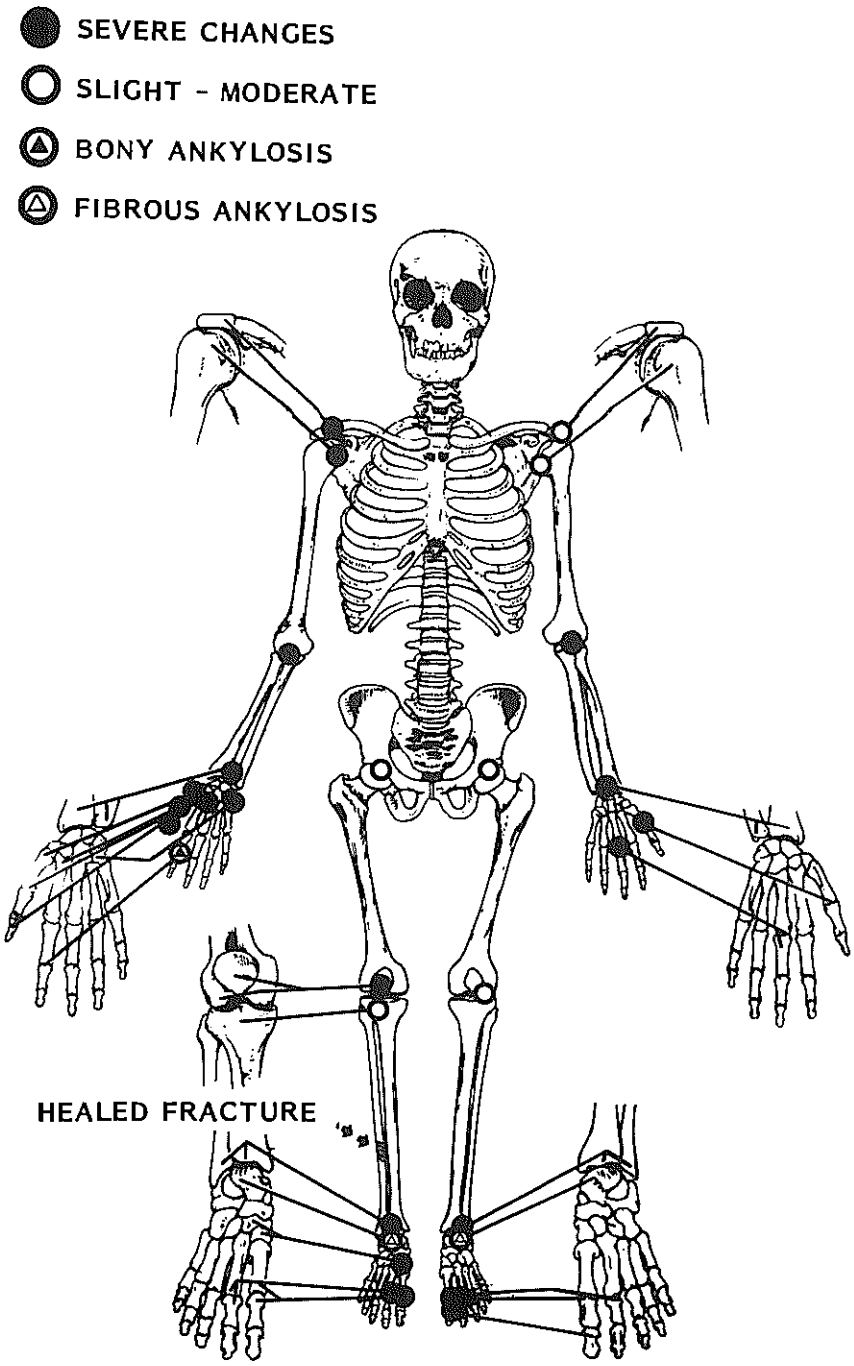

Fig. 2:1. Schematic presentation of the peripheral articular changes present in the skeleton in grave 4.

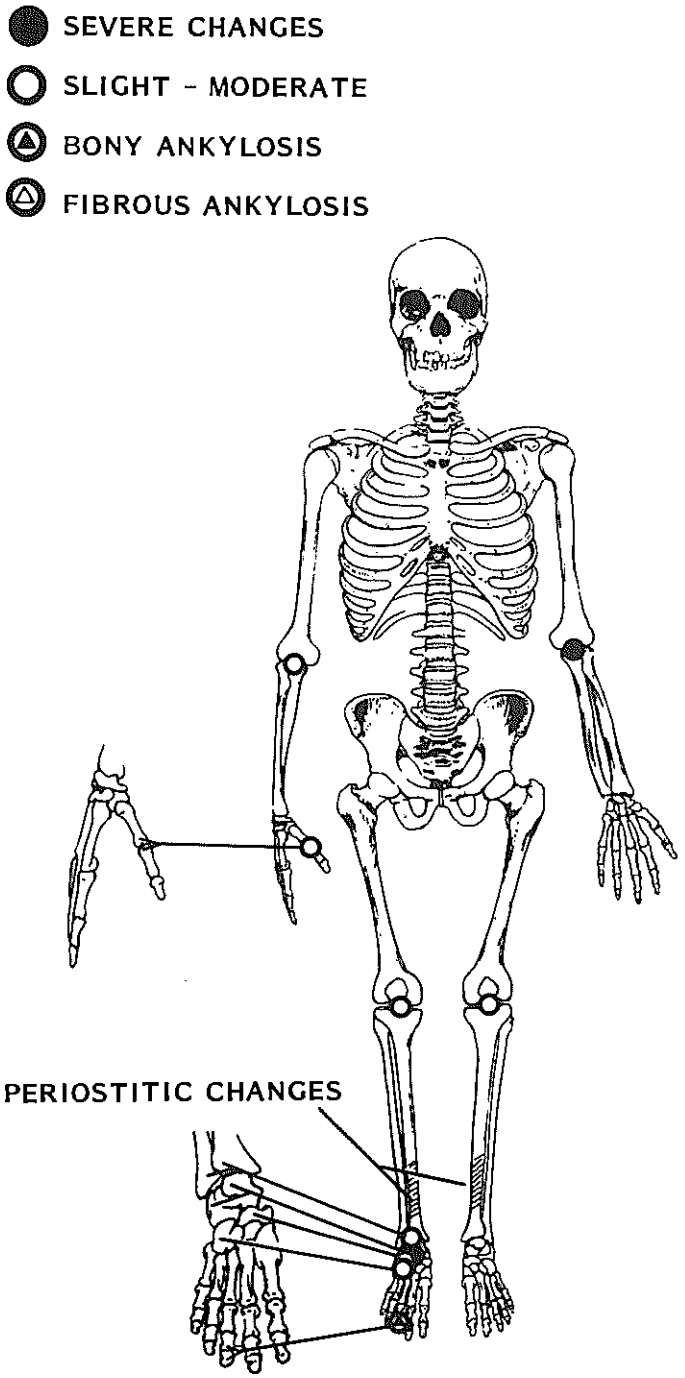

Fig. 2:2. Schematic presentation of the peripheral articular changes present in the skeleton in grave 15.

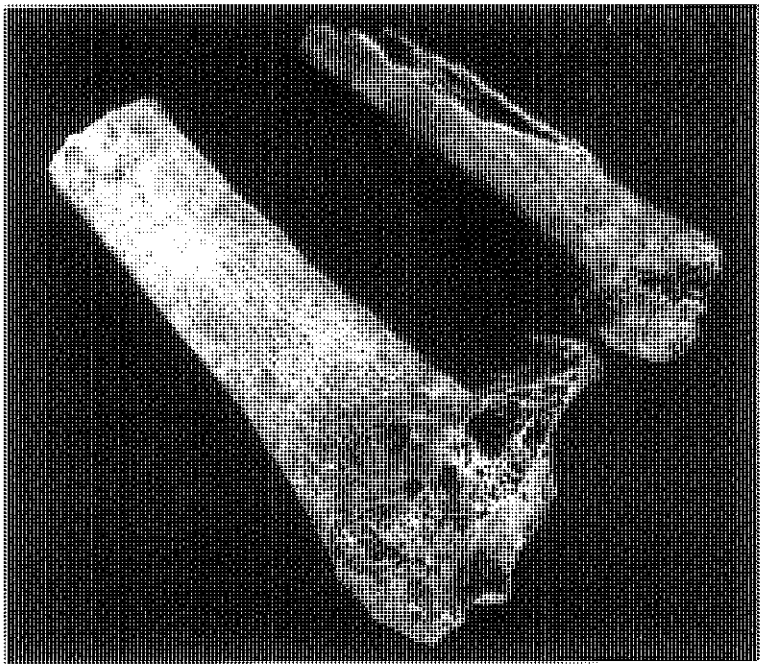

Fig. 3. The distal part of the right radius and ulna, skeleton nr 4. Note the marked proliferation and rebuilding. The paraarticular sinuses in radius is well compatible with osteolysis due to synovial infiltration - a very characteristic sign in rheumatoid arthritis.

sometimes fibrous or bony ankylosis develops in some peripheral joints, stigma which is practically always absent in arthrosis. Furthermore, the end stage of RA, the burnt out lesion, is usually arthrotic, sometimes showing extensive proliferation and rebuilding. Therefore it might be assumed that in an individual affected by RA for several years lesions would probably develop which can be paleopathologically recognized. In other words, severe "arthrotic" lesions in several peripheral joints, large as well as small, are highly suggestive of RA, especially if joints like elbows and wrists are bilaterally involved. These joints are practically never affected by primary osteoarthrosis. Presence of peripheral fibrous or bony ankylosis should be taken as a further support.

Both skeletons described above show severe and multiple peripheral articular changes - in our opinion the end stage of a chronic arthritis. There are also severe columnar changes of the degenerative type but no bony bridging. Based on today's disease panorama and clinical pictures rheumatoid arthritis is the most probable diagnosis. Our findings are in accordance with a few recently published reports by groups in which anthropologists, osteologists and physicians have cooperated. Thus peripheral articular changes suggestive of RA have been found in skeletal material dating back to Roman and Saxon time (Rogers et al., 1981; Thould and Thould, 1983). There is also a similar report from Denmark (Bennike, 1985).

We would like to conclude by quoting Wood: "We think the idea that RA is a recent disease is armchair speculation". Today there are several paleopathological reports describing articular changes in ancient skeletal material compatible with *in vivo* presence of RA. An osteological investigation of skeletal remains from different epochs with the purpose of studying and differentiating the prevalence of arthrosis and arthritis is highly desirable.

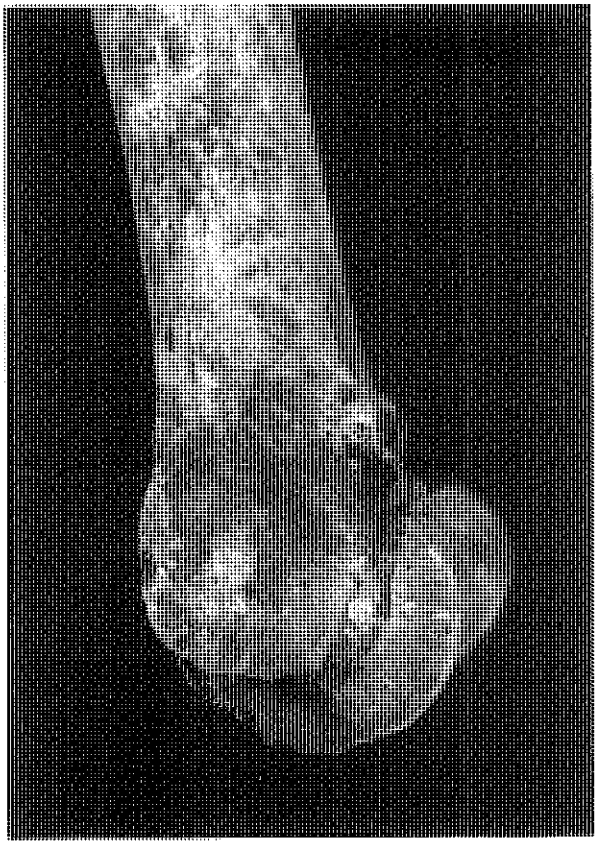

Fig. 4a. The distal part of the left humerus, skeleton nr. 15. Huge proliferation is seen. The articular surface shows eburnation.

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Fig. 4b. To the right is the left radial head, skeleton nr 15. A huge rim proliferation is seen. As comparison the normal radial head from the right elbow is shown.

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All photographs and pictures of this paper produced by Jan Strömblad, Lund.

Causes of Variability of Non-metric Traits in Inbred Strains of Mice

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Non-metric traits of the skeleton of artificially produced mono- and dizygotic mice of an inbred strain were investigated. MZ and DZ each exhibited a higher concordance in about half of the characters studied. Therefore causes of variability could not alone be made responsible for endogen mechanism like "plasticity". Without further investigation the findings of this study could only be attributed to random causes.

Keywords: Non-metric Traits - Inbred Mice.

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Metric and non-metric traits of the human skeleton were used to measure biological distances among past populations. Besides some studies in man (Torgersen 1951; Selby et al. 1955; Suzuki & Sakai 1960), most attributes of non-metric traits were investigated using inbred strains of small mammals. Because of the occurrence of analogous variants in man, comparable genetical conditions were assumed (Berry & Berry 1967).

Series of genetical studies on the skeletons of inbred strains of mice (Grüneberg 1950; 1951; 1952) showed that these "quasi-continuous" traits are based on a multiple factor inheritance. This produces a continuous variaton of liability and the expression of traits is formed by imposing physiological thresholds between present or non-present. The position of continuous variation to physiologicalthreshold possesses the same susceptibility to environmental influences as comparable metric traits. Genetical causes and environmental influences such as maternal effects could be made responsible only for a small part of the total variance of liability in isogenic inbred strains of mice (Searle 1954a, b; Deol & Truselove 1957; Grüneberg 1963). The remaining components were explained as "intangible non-genetic factors" (Searle 1954a) or as "chance variation" (Grüneberg 1963).

In the meantime the influence of environment on an inbred strain is so far standardized that the positions of variances of many traits to each other and their mean value are fixed. The residual spread of variance was traced back to "intangible variance" (Falconer 1960) or "phenotypic plasticity (Bradshaw 1965). Gärtner & Baunack (1981) demonstrated this kind of non-genetic influences by comparing monozygotic twins (MZ), derived artifically from ova separated at the 8-cell stage, with similary treated dizygotic twins (DZ). The greater degree of similarity of body weights and ages of maturation observed in MZ is attributed to endogene mechanism, which generated differences in plasticity before the third cell division. These differences caused greater variation of the investigated

traits within pairs of DZ and Gärtner (1982) made them responsible for the residual variance of many quantitative traits in inbred strains.

Endongenous mechanisms should equally influence expression and pattern of incidences of non-metric traits, because differences in plasticity ought to effect the relation of the underlying continuous variation of liability to the threshold and this threshold itself. Following this interpretation the investigated MZ and DZ of Gärtner & Baunack (1981) are used to obtain an indication of the effect of plasticity as "intangible non-genetic factor" on non-metric traits of the skeleton.

Materials and methods

The twins descended from an inbred strain of mice (AKR/N Han) derived from brother-sister mating over more than 150 generations. Continuously verified by the usual tests there were no indications of residual heterozygosity. MZ and DZ were prepared by Gärtner & Baunack (1981) under the same conditions but without mechanical separation of DZ. The success of transfer experiments was about 10 in 200 (MZ) and about 13 in 50 (DZ).

Five pairs of MZ and DZ were investigated. Out of specific literature 41 traits were chosen. 7 were discarded due to ambiguity in their scoring criteria, 10 variants occurred too rarely ($p<10\%$) and 9 traits were totally absent in the investigated population. 10 bi- and 5 unilateral variants were scored as absent, present or double in their character state. (Table 1).

Results

In analysis only the general presence or absence of a uni- or bilateral trait was chosen. The twins were compared by using a pairwise rate of concordance (Allen et al. 1967). This rate proportion R represents the relation of concordant twins to all investigated twins of MZ resp. DZ. (Table 1).

MZ produced a higher rate in 7 variants, mainly based on post-cranial traits, while DZ showed a higher similarity in 8 traits especially at the skull. It was not possible to judge the observed results in a statistical sense, because of the small sample size. Therefore the results have been estimated and discussed less statistically, but according to the qualitative value of the material.

Discussion

The sum of the non-metric traits studied in artificially produced monozygotic twins did not show a higher similarity than in equally treated dizygotic twins. The demonstrated influence of endogene mechanisms (plasticity) on body weights and ages of maturation (Gärtner & Baunack 1981) could not be found in the appearence of non-metric traits. Although body size and incidence of traits should be correlated (Searle 1954b; Deol & Truslove 1957; Grüneberg 1963) a higher similarity was produced now only by MZ in 7 variants but by DZ in 8. Although only 5 pairs of MZ and DZ were examined the nature of the material should give insight into the earliest development of the characters studied.

Genetic and environmental effects as components of variance were not due to the findings. Only a low overall effect of these factors could be found (Searle 1954a; Self & Leamy 1977). Evidence of age dependence existed only for non-adult individuals (Self & Leamy 1977). Moreover the adult twins were raised in an identical environment (Gärtner & Baunack 1981).

The observed results could only be explained by causes, which in their consequences had little if any effect on the findings of Gärtner & Baunack (1981). Indications of morphological and functional polarisation of 8-cell embryos (Johnson & Ziomek 1981; Pratt et al. 1982; Reeve 1983) possibly allowed no exact separation in identical halves. The

TABLE 1. Variants and pairwise rate of concordance (R).

	Variants	MZ	DZ
1.	Maxillary foramen I absent	0.6	0.8
2.	Maxillary foramen II absent	0.8	1.0
3.	Processus pterygoideus absent	0.2	0.6
4.	Foramen sphenoidale medium present	0.6	0.8
5.	Basisphenoid-presphenoid-fusion present	0.8	0.6
6.	Fused Frontals present	0.4	1.0
7.	Parted Frontals present	0.8	1.0
8.	Foramen mentale double	0.8	0.4
9.	Preorbital foramen double	0.8	0.5
10.	Foramen pterygoideum double	0.6	1.0
11.	Foramen hypoglossi double	0.8	0.25
12.	Processus spinosus of Th. II absent	1.0	0.4
13.	Fossa olecrani perforata present	1.0	0.8
14.	Accessory scapular foramen present	0.33	0.6
15.	Foramen acetabuli perforans present	0.67	0.6

percentage of losses in the production of the twins pointed to a selection, which operated not homogeneously on the morphological heterogeneous variants. Other causes such as asymmetry of cytoplasm, unequal distribution of cell organells, different positions of cells within the blastomere, disarrangements in the control of gene activities etc. could have effected the ovum after the first cell division. Immense quantities of factors are produced by the concerted action of proteins and substrate competition between cells. Each of these factors ought to influence just polygene generated small variants. Therefore the different appearance of non-metric traits within MZ and DZ could not be attributed only to differences in plasticity. Furthermore, as long as there is no detailed knowledge about the ontogenese of non-metric traits, whether the variants acted homogeneously or not, whether Pauwels' (1965) theory of histogenese could be used or not and how far the represented indications are valid, intangible non-genetic factors as components of variance will produce a 'chance variation'.

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Schädel-Hirn-Traumata im Alten Ägypten und ihre Therapie nach dem "Wundenbuch" des Papyrus E. Smith (ca. 1500 v.Chr)*

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OSSA

Ancient Egyptian written sources, i.e. cases of the surgical papyrus Edwin Smith are compared with approximately corresponding macroscopically and roentgenologically demonstrated injuries of the head in Egyptian mummies of different historical periods. Mostly it was difficult and occasionally impossible to reach a reliable interpretation of the findings, especially concerning brain involvement. Therefore this report should be regarded as a trial presenting at least a realistic imagination of the mechanisms and the morphology of the traumatisation occurring in antiquity and confronting the physicians as well as the medical staff of the Nile country. An important aspect in this connection however, is that the anthropological material provides no indication pointing to therapeutical actions, probably due to the procedure during the embalming process. Furthermore the hieroglyphic casuistry lacks a more detailed information about additional symptomes connected with skull and brain damage. There is no doubt that such diagnostical signs must have been familiar to the Egyptian physician. It is quite unclear why they are not mentioned in the Smith papyrus, which is often classified as a "texthook".

Keywords: Egyptian Mummies - Skull and Brain Injuries - Papyrus Edwin Smith - Therapy.

An ägyptischen Mumien werden exemplarisch Schädel-Hirn-Traumata (SHT) vorgestellt und der Versuch unternommen, annähernd korrespondierende Textstellen des chirurgischen Papyrus Edwin Smith (ca.1500 v. Chr.) beizufügen. Der Versuchscharakter liegt in der Eigenart der Casus einerseits sowie im beschränkten Aussagewert anthropologischer Fundobjekte anderseits begründet. Letzte lassen vorrangig die traumatische Schädigung ossärer Strukturen erkennen und liefern oft keine verlässlichen Kriterien für Art und Ausmass der cerebralen Mitbeteiligung. Ein Vergleich der hier diskutierten Fälle mit Fallbeispielen des sogenannten Wundenbuches ist deshalb nur approximativ möglich, illustriert jedoch Mechanismen und Morphologie der Verwundungen, mit denen die altägyptische Medizin konfrontiert worden sein muss.

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Einleitung

Die Bedeutung von Schädel-Hirn-Traumata (SHT) für die moderne Medizin lässt sich einer 1968 publizierten Studie entnehmen, die für das Gebiet der Bundesrepublik Deutschland und West-Berlin von jährlich ca. 200 000 Kopfverletzungen mit stationärer oder ambulanter Behandlung ausgeht (Tönnis et al. 1968). In dieser Zahl dürften bis zu 30 000 Fälle erheblichen Schweregrades enthalten sein, wobei der überwiegende Teil durch Unfälle im Strassenverkehr verursacht ist.

Im osteologischen Fundmaterial Altägyptens stellen Schädel-Hirn-Verletzungen grösstenteils Kriegsverwundungen dar. Dass ihr Stellenwert auch für die ägyptische Medizin beachtlich gewesen sein muss, geht aus dem zahlenmässig hohen Anteil entsprechender Falldarstellungen bzw. Therapievorschlägen im einzigen uns bisher bekannten chirurgischen Papyrus, dem Papyrus E. Smith, hervor. Diese 4,7 m lange und durchschnittlich 32 cm breite Papyrusrolle stammt aus der Mitte des 16. vorchristlichen Jahrhunderts. Paläographische und linguistische Untersuchungen deuten darauf hin, dass es sich um eine modifizierte Abschrift handelt, deren Original ins Alte Reich (ca. 2700-2100 v. Chr.) datiert.

Wenn auch an dieser Stelle die Problematik der Trennung von magischen und empirisch-rationalen Elementen innerhalb der frühen ägyptischen Medizin nicht diskutiert werden kann, so ist doch die einzigartige Präsentation chirurgischer Praxis in diesem Werk bewundernd hervorzuheben. Intuition im Sinne von Kombinationsfähigkeit, handwerkliches Können und Empirie sind gleichermassen harmonisch integriert und verleihen den noch erhaltenen insgesamt 48 Casus eine für damalige Verhältnisse ungewohnte Systematik.

Ob der Text des Papyrus, wie sein Herausgeber und Übersetzer J. H. Breasted (1930) (2) annahm, tatsächlich auf Imhotep, Vezir des Pharao Djoser (um 2600 v. Chr.) zurückgeht, bleibt einstweilen Spekulation. Manches - etwa die Art der Verletzungen als kombinierte Knochen-Weichteilläsionen- lässt es möglich erscheinen, dass sein Besitzer als Wundarzt die Heere des Pharao begleitet hat.

Im folgenden werden exemplarisch SHT an ägyptischen Mumien vorgestellt und der Versuch unternommen, annähernd korrespondierende Textstellen des Papyrus E. Smith in der ausgezeichnet kommentierten Übersetzung nach Westendorf (3) beizufügen. Dass es sich dabei nur um einen Versuch handeln kann, liegt in der Eigenart der niedergelegten Casus einerseits sowie im beschränkten Aussagewert der anthropologischen Fundobjekte andererseits. Letzte lassen vorrangig die traumatische Schädigung knöcherner Strukturen erkennen und liefern oft keine verlässlichen Kriterien für Art und Ausmass der cerebralen Mitbeteiligung. Ein Vergleich der hier diskutierten Fälle mit Fallbeispielen des sogenannten Wundenbuches ist deshalb nur ansatzweise möglich, illustriert aber Mechanismen und Morphologie der Verwundungen, mit denen altägyptische Ärzte konfrontiert wurden.

Material und Methode

Die Untersuchungsobjekte entstammen der ägyptischen Mumiensammlung des Instituts für Anthropologie und Humangenetik der Universität Tübingen und der Sammlung des Anatomischen Instituts der Universität Kairo/Ägypten (ehemals Sammlung Batrawi). Lokale Provenienz und historische Zeitstellung sind nicht hinreichend berichtet, doch finden sich Indizien, dass es sich um Funde aus Unterägypten handelt. Mumifizierungstechnische Eigenheiten ermöglichen deren chronologische Einordnung in den Zeitraum ca. 1500-300 v. Chr.

Neben der zunächst makroskopischen Begutachtung der Objekte wurden Röntgenfilmaufnahmen mit feinzeichnenden Folien und Raster angefertigt. Die Spannungswerte variierten - insbesondere in Abhängigkeit von intracraniell eingebrachten Einbalsamierungssubstanzen - zwischen 40 und 50 kV.

Abb. 1.

Zur Bestimmung des individuellen Sterbealters wurde die Obliteration der Schädelnähte sowie Zahnstatus und Abrasionsgrad herangezogen, die Feststellung des Geschlechts orientierte sich an etwaigen, noch vorhandenen primären und/oder sekundären Geschlechtsmerkmalen. Zudem fanden folgende geschlechtsdeterminierende Merkmale am Schädel Berücksichtigung: Arcus superciliares, Protuberantia frontales, Margo supraorbitales, Processus mastoideus, Robustizität des Jochbogens, Relieferung des Planum nuchale sowie die Beschaffenheit des Unterkiefers.

Kasuistik

Fall I, Inv. No. 1629 (Abb. 1)

Makroskopischer Befund

Im Bereich des mittleren Drittels einer gedachten Verbindungslinie zwischen rechtsseitigem Porus acusticus externus und Lambda (Schnittpunkt der Sutura sagittalis mit der Sutura lambdoidea) stellt sich ein kombinierter Weichteil-Knochendefekt dar. Seine Form erscheint annähernd rhomboidal mit abgerundeten Eckpunkten (Grundseite ca. 6 cm, Schmalseite ca. 3.5 cm bei einer Höhe von ca. 4 cm), wobei eine die beiden Schrägseiten verbindende Muskulatur-Hautbrücke verblieben ist. Die Frakturkanten imponieren makroskopisch durch ihren hohen Steilheitsgrad bei grösstem Durchmesser der Läsion in der Tabula interna. Reparationszeichen sind weder im Weichteil - noch im Knochenbereich erkennbar.

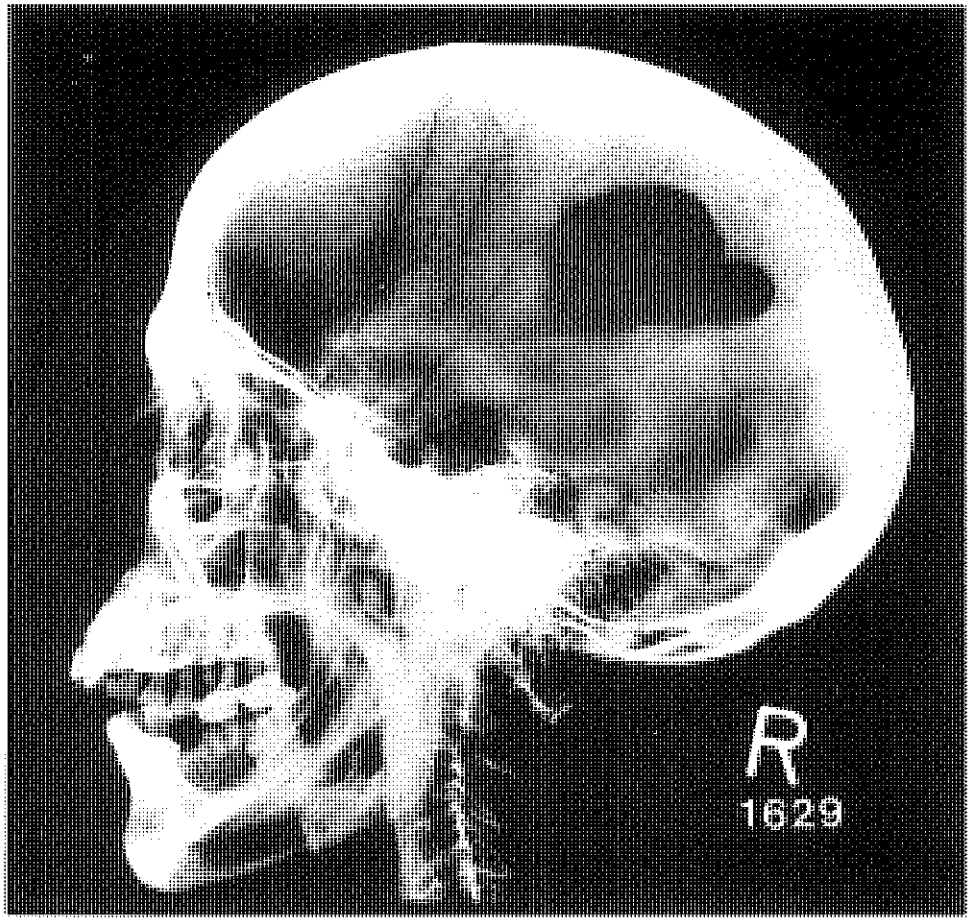

Abb. 2.

Die Frage einer möglichen intravitalen oder längere Zeit post mortem erfolgten Verursachung des Defektes muss unter Beachtung der hinlänglich bekannten Diskussion um diese Frage aus folgendem Grund zugunsten der ersten beantwortet werden: Im Umfeld der o. g. Gewebebrücke finden sich bei Betrachtung mittels Stereolupe gelapptförmige, glattrandige Weichteilreste, die darauf hindeuten, dass die Verletzung noch im Stadium der vitalen Retraktionsfähigkeit der Haut entstanden sein muss. Weichteilläsionen, die nach dem artifiziell durchgeführten Dehydrations- und Schrumpfungsprozess, etwa durch Grabräuber beigebracht wurden, zeigen erfahrungsgemäss durch die Art ihrer Randkonturierung meist deutlich die postmortale Herkunft an. Der Einwand, dass die Verletzung eventuell im Rahmen der Einbalsamierung entstanden sein könnte, erscheint gerechtfertigt, doch im vorliegenden Fall nicht sehr wahrscheinlich, da der Kopf insgesamt eine äusserst umsichtige Behandlung durch die Mumifizierungspriester erfahren hat. Dies zeigt sich unter anderem durch eine kunstvolle Modellierung der Augenpartie, des Mundes sowie durch die linksnasale Gehirnentnahme, welche bei einer Beschädigung des Kopfes aus Nachlässigkeit, wie sie zuweilen während der Römischen Periode Ägyptens vorgekommen ist, nicht mit der gegebenen Sorgfalt ausgeführt worden wäre.

Röntgenbefund

Das laterale Schädel-Röntgenbild (Abb. 2) des ca. 40jährigen Mannes zeigt einen steigbügelförmigen, den obigen Massen entsprechenden ossären Defekt mit scharf abgrenz-

Abb. 3.

Abb. 4.

baren Randkonturen. Eine grössere Splitterung der Tabula interna ist nicht anzunehmen. Die gewöhnlich bei längerem Überleben des Traumas feststellbaren Knochenresorptionszonen fehlen. Als Zusatzbefund findet sich neben einer apikalen Abszesshöhle rechts mandibulär die mehrfache Frakturierung der Siebbeinplatte. Sie ist ursächlich auf die schon bei Herodot (Lib. II, 86) beschriebene transnasale Eviszeration des Cerebrums mit Hilfe eines Metallhakens zurückzuführen.

Kasuistik

Fall II, Inv. No. 1668 (Abb. 3 und 4)

Makroskopischer Befund

Ventral des Kreuzungspunktes (Bregma) von Sutura sagittalis und Sutura coronalis im Os frontale gelegener, ca. 4 x 2 cm grosser Lochdefekt traumatischer Genese. Die Defektränder erscheinen scharf begrenzt und fallen zur Tabula interna umgekehrt trichterförmig ab. Anzeichen reparativer Knochenreaktionen sind markoskopisch nicht wahrnehmbar. Die Fraktur ist mit einem Holzstück abgedeckt. Mumifizierungstechnisch erwähnenswert ist die transnasale Gehirnentnahme. Die knöcherne Absplitterung am Kinn dürfte postmortal entstanden sein.

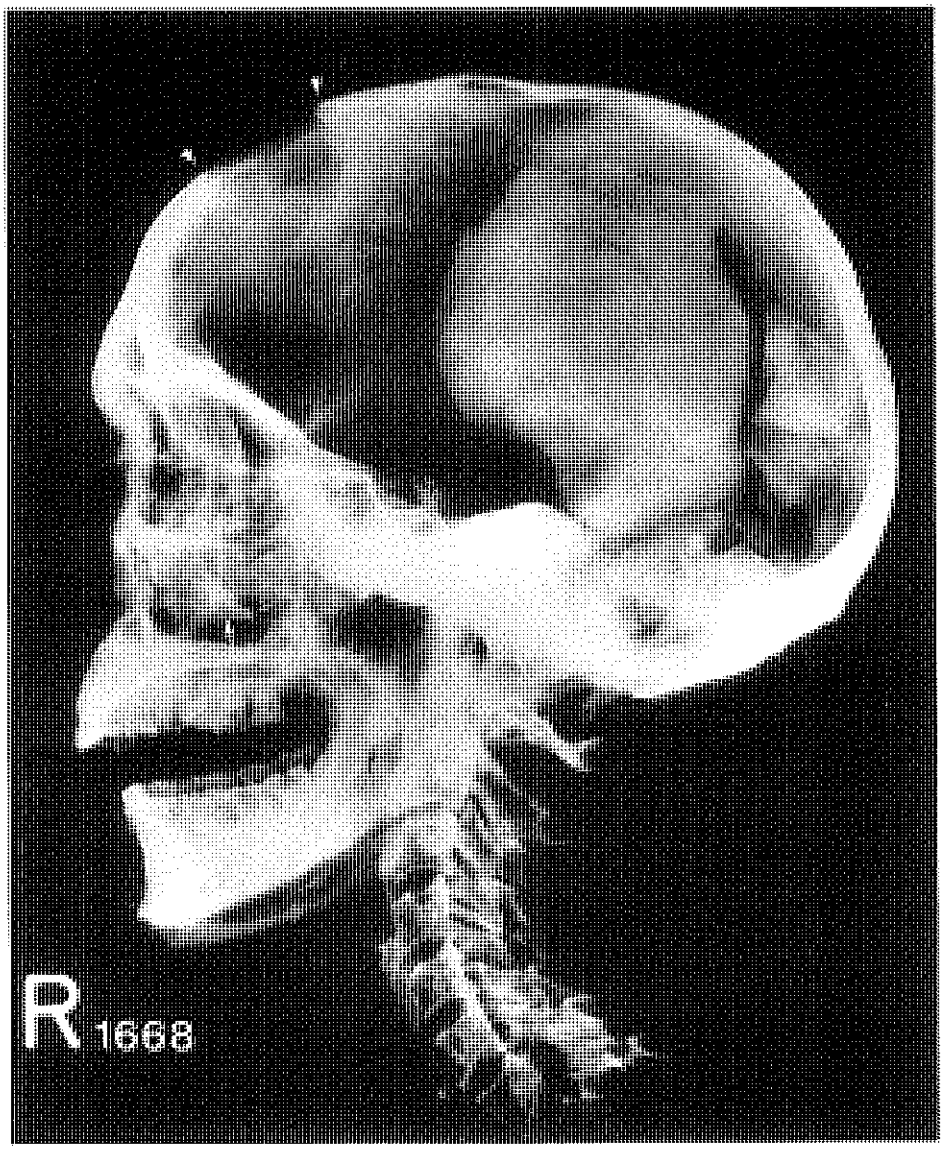

Abb. 5.

Röntgenbefund

Schädel eines adulten, ca. 40 jährigen Mannes (Abb. 5) mit ausgeprägter Glabellaregion, mässiggradiger Prognathie und postmortal induzierter Hyperlordose der HWS. Das Gehirn wurde entfernt und an dessen Stelle bitumenartige Substanzen eingebracht. Sie projizieren sich als strahlendichte Masse temporo-occipital. Die im Frontale lokalisierte Impressionsfraktur imponiert im lateralen Röntgenbild als ca. 2 cm grosse Konturunterbrechung der Schädelcircumferenz, zeigt scharfe Berandung im Bereich der Tabula externa und fällt flachwinklig zur Tabula interna ab. Ossäre Reparationszeichen fehlen. Als Nebenbefund erweisen sich post mortem prävertebral in Höhe HWK 2 sowie in die Kieferhöhle verlagerte Zahnreste.

Papyrus E. Smith +

Fall 6 (2,17-3,1)

Informationen über eine Klaff-Wunde an seinem Kopf, die bis zum Knochen reicht, zersplittert ist sein Schädel, aufgebrochen ist das Gehirn seines Schädels.
Wenn du einen Mann untersuchst mit einer Klaff-Wunde an seinem Kopf, die bis zum Knochen reicht, zersplittert ist sein Schädel, aufgebrochen ist das Gehirn seines Schädels; dann sollst du seine Wunde abtasten, und findest du jenen Splitterbruch, der an seinem Schädel ist wie diejenigen Schrumpeln, die an gegossenem Metall entstehen; es ist etwas darin (d.h. im aufgebrochenen Schädel), das zittert (und) flattert unter deinen Fingern wie die schwache Stelle der Schädeldecke eines Kindes, die noch nicht festgeworden ist. Es entsteht jenes Zittern (und) Flattern unter deinen Fingern, sobald das Gehirn seines Schädels aufgebrochen ist. Er gibt Blut aus seinen Nasenlöchern; er leidet an Versteifung in seinem Nacken.

Dann musst du dazu sagen: einer mit einer Klaff-Wunde an seinem Kopf, die bis zum Knochen reicht, zersplittert ist sein Schädel, aufgebrochen das Gehirn seines Schädels; er leidet an Versteifung in seinem Nacken. Eine Krankheit die man nicht behandeln kann. Dann sollst du jene seine Wunde mit Öl/Fett beträufeln(?); du sollst ihn nicht verbinden; du sollst nicht zwei Binden auf sie legen, bis du weisst, dass er zu etwas (Endgültigem) gelangt ist. Was anbetrifft: zersplittert ist sein Schädel, aufgebrochen das Gehirn seines Schädels.

Das ist : ein grosser Splitterbruch, der offen ist zum Innern seines Schädels, (nämlich) der Haut, die sein Gehirn umschliesst; und so ist est (d.h. das Gehirn) aufgebrochen (und) quillt aus dem Innern seines Kopfes.
Was anbetrifft: diejenigen Schrumpeln, die an gegossenem Metall entstehen. Das ist: das Metall, das der Metallarbeiter giesst, bevor es mit einem Stein zu dem (gewünschten) Gegenstand breitgeschlagen (d.h. verarbeitet) wird. Seine Oberfläche ist uneben wie Blasen. Das bedeutet, dass man sagt: es ist wie die Schrumpeln von Eiter.

Kommentar

Die Beschreibung des Falles 6 (2,17-3,1) wie auch der meisten der im Rahmen dieser Arbeit zitierten Texte aus dem "Wundenbuch" des Papyrus E. Smith folgt einem festgelegten Schema. Dieses besteht aus einer Überschrift ("Informationen über eine Klaff-Wunde..."), gefolgt von Untersuchungsgang, Diagnosestellung und Therapieanweisung. Meist sind noch glossenartige Anmerkungen beigefügt, (Was anbetrifft..."), welche ebenfalls schematischen Aufbau zeigen und als Erklärungshilfen für bestimmte Textstellen dienen. Im Gegensatz zur Abschrift sind diese im Originaltext von zweiter Hand verfasst worden.

Die Untersuchung beschränkt sich in Fall 6 auf die Palpation der Wunde, deren Reinigung möglicherweise schon vorausgegangen ist. Anschliessend folgt die Diagnosestellung, die eine Identifizierung und Benennung der Erkrankung ("Dann musst du dazu sagen...") sowie als zentraler Bestandteil das sogenannte Verdikt ("Eine Krankheit, die

+ Anmerkung zu den Textbeispielen: (...) = zum besseren Verständnis des Textes eingebaute, im ursprüngligen Text nicht vorkommende Wörter, = Auslassungen des Schreibers, = Textlücken.

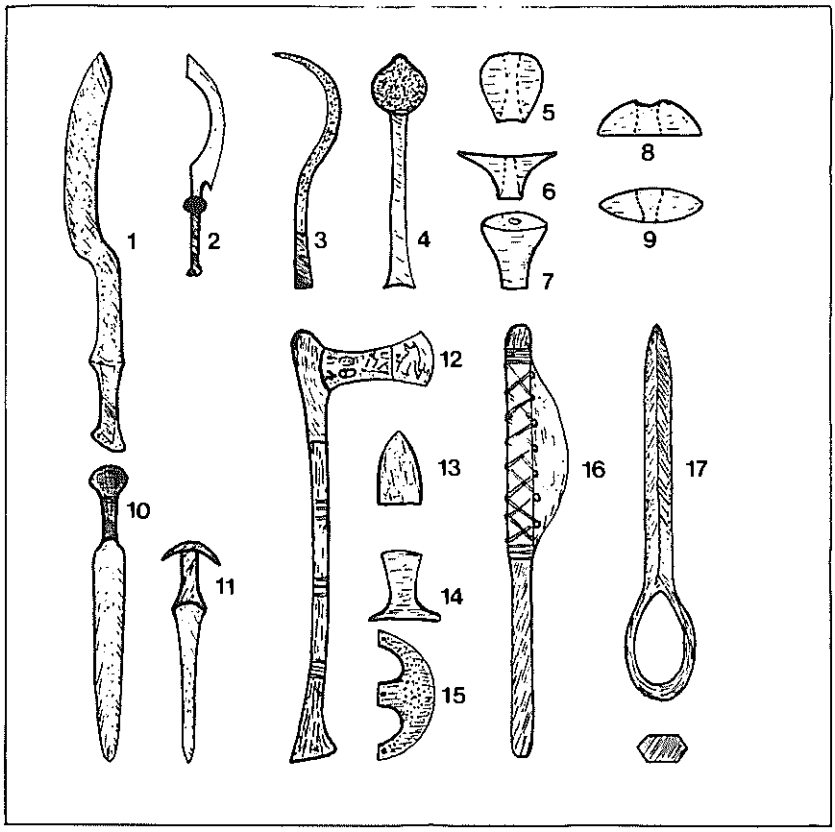

Abb. 6. Altägyptische Waffen: 1-3 Sichelschwerter, 4-9 Steinknaufkeulen, 10-11 Dolche, 12-17 Streitäxte/Streitaxtklingen (modifiziert n. Wolf, 1926).

man nicht behandeln kann") enthält. Diesem möchten wir - oft gedeutet als infauste Prognose - nur relative Bedeutung bezüglich des Krankheitsausgangs beimessen, da wider Erwarten doch eine, wenn auch eingeschränkte Behandlung ("Dann sollst du seine Wunde mit Öl/Fett beträufeln") erfolgt. Ausserdem lässt die Anweisung "... nicht verbinden ... bis ..." die Annahme zu, dass ein vitaler Ausgang des Geschehens, mit welchen physischen und psychischen Folgen auch immer, nicht von vorneherein auszuschliessen sei.

Die in Glosse 2 erwähnten "Schrumpeln" meinen wohl tatsächlich abgetrocknetes Wundsekret. Eine treffendere Erklärung dieses Phänomens konnte auch von uns nach Beobachtung von frisch Schädel-Hirntraumatisierten nicht gefunden werden. Der verwendete Vergleich von im Wundbereich auftretenden Sekretablagerungen mit der Oberfläche von gegossenem Metall kann, unter Beachtung der im Altertum angewandten Techniken der Metallverarbeitung, wobei nach Abschluss des Rennprozesses das Werkstück zunächst als Rohluppe mit oberflächlichen Unebenheiten und Granulationen durch anhaftende Schlacke und sonstige Verunreinigungen vorliegt, als gelungen bezeichnet werden.

Für die dem Text zugeordeneten Individuen Inv. No. 1629 und 1668 gelten zunächst die oben gemachten Ausführungen bezüglich der eingeschränkten Nachweisbarkeit cerebraler Substanzschädigung. Die Beurteilung der Defektrandzonen, die eine grobe Splitterung der Tab. interna wie auch Frakturen und Fissuren im Defektumfeld vermissen lässt, erlaubt den Schluss, dass die Traumatisierung mit hoher, hebelartiger Schlagenergie erfolgt sein dürfte. In Abhängigkeit der verwendeten Waffe - am ehesten ist an ein Beil oder eine Keule zu denken - (Abb. 6, 4-9) muss es dann zu Verletzungsfolgen unterschiedlichster

Schweregrade gekommen sein. Diese könnten sich in einer Verblutung nach aussen, einer Atemlähmung durch fortschreitenden Hirndruck infolge Raumforderung, progredienter Ödembildung oder einer inneren Massenblutung manifestiert haben. Aber auch eine direkte Verletzung des Stammhirns wäre denkbar. Sicher ist, dass der Tod der beiden Krieger mit oder bald nach Beibringung der Hiebe eingetreten ist; vitale Umbaureaktionen im Bereich des Knochens oder der Weichteile, wie sie bei längerer Überlebenszeit nachweisbar wären, fehlen. Auch Behandlungsspuren lassen sich nicht (mehr) feststellen. Die Abdeckung der Fraktur an Mumie 1668 (Abb. 3) dürfte vermutlich im Zuge des Mumifizierungsverfahrens vorgenommen worden sein, obgleich nicht auszuschliessen ist, dass sie das Überbleibsel eines letzten Endes misslungenen Therapieversuchs darstellt. Die schlüssige Interpretation dieses Befundes macht jedoch insofern Schwierigkeiten, als es sich in unserem Untersuchungsmaterial um einen Einzelfall handelt und auch generell zu wenig verlässliche Daten über derartige Erscheinungen existieren.

Kasuistik

Fall III, Inv. No. 1651 (Abb. 7-9)

Makroskopischer Befund

Calvarium eines Ägypters mit insgesamt 3 Hiebverletzungen im Bereich der linken Schädelhälfte. Retroauriculär findet sich ein rundlicher, ca. 3 cm im Durchmesser betragender Tangentialdefekt mit Abscherung der Kopfweichteile einschliesslich der Galia aponeurotica. Bei diesem Hieb ist es auch zur Abtrennung nahezu des gesamten äusseren Ohres gekommen (Abb. 7, 8 und 9). Weiter zeigen sich parieto-occipital zwei keilförmig von parietal nach occipital verlaufende, etwa 10 cm lange Einhiebe mit glattrandiger Penetration der Schädelkalotte. Quer zu diesen und ca. 0.5 cm oberhalb ihres Schnittpunktes imponiert eine beidseitige knöcherne Einkerbung. Reparationszeichen an Knochen oder Weichteilen lassen sich nicht diagnostizieren.

Röntgenbefund

Die beiden parieto-occipitalen Hiebspuren (Abb. 10 und 11) am Schädel des frühadulten, ca. 20jährigen Mannes erwiesen sich auch röntgenologisch als das Schädeldach penetrierende Verletzungen mit scharfer Randbegrenzung ohne grobe Splitterung der Tabula interna. Im Zuge einer der beiden Schläge, mit hoher Wahrscheinlichkeit des mehr occipital gelegenen (Abb. 10, 1) dürfte es zu einer Verkeilung der Klinge gekommen sein, bei deren Aushebelung, vermutlich unter Rotation der Waffe, der untere keilförmige Anteil des Knochens herausgebrochen wurde. Ferner müssen durch den Aushebelungsvorgang die stumpfwinklig abknickende Frakturlinie am cranialen Ende des weiter medial erkennbaren Hiebes (Abb. 10, 1), die Aufspreizung der mehr parietal gelegenen Fraktur nach ventral (Abb. 10, 2) sowie die auf der Schädelbasisaufnahme erkennbaren und von dem basal lokalisierten Spitzenbereich der Fraktur auslaufenden occipitalen Biegungsbrüche entstanden sein (Abb. 12).

Abb. 7.

Abb. 8.

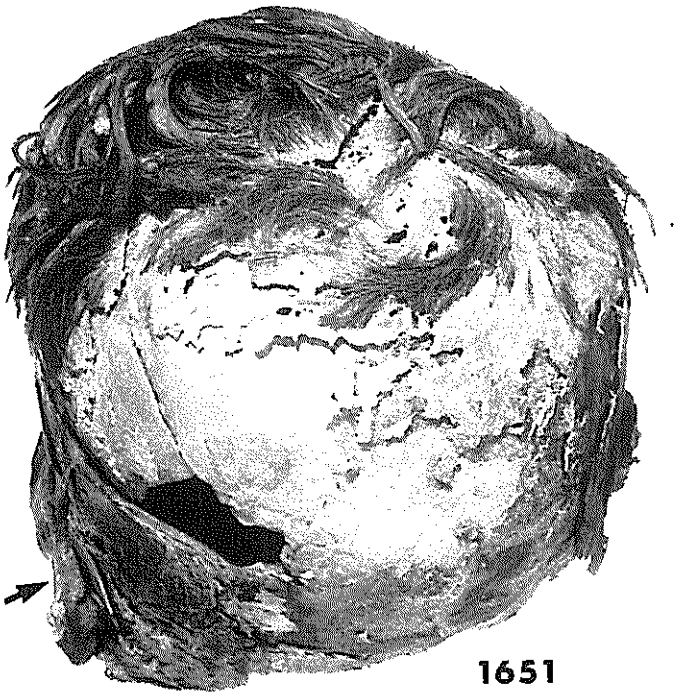

Abb. 9

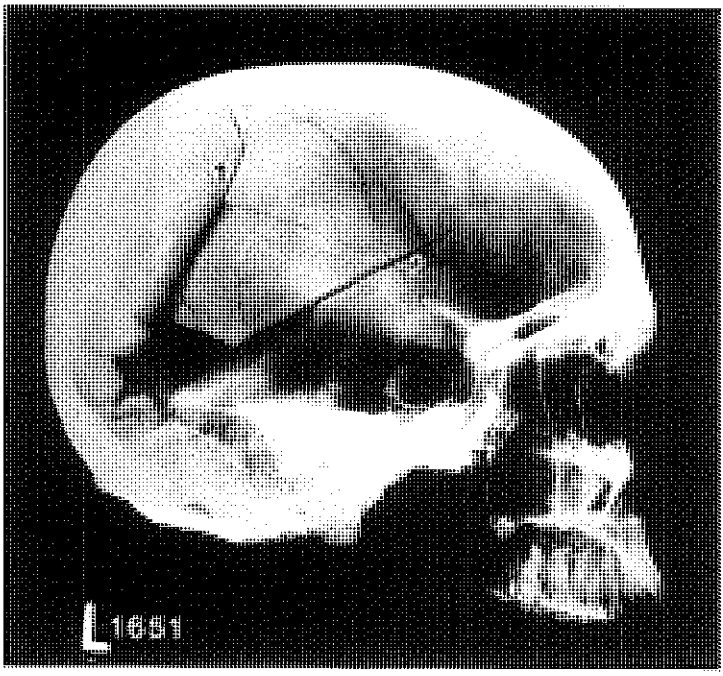

Abb. 10.

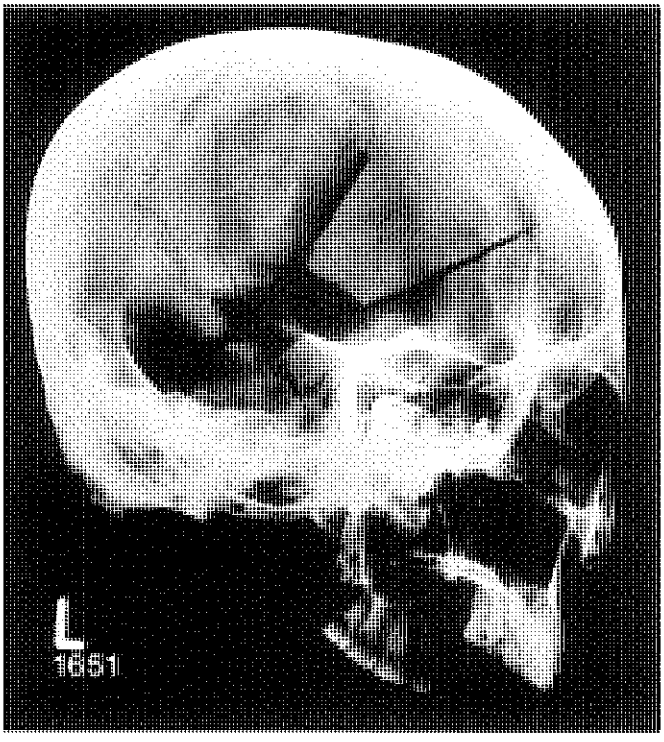

Abb. 11.

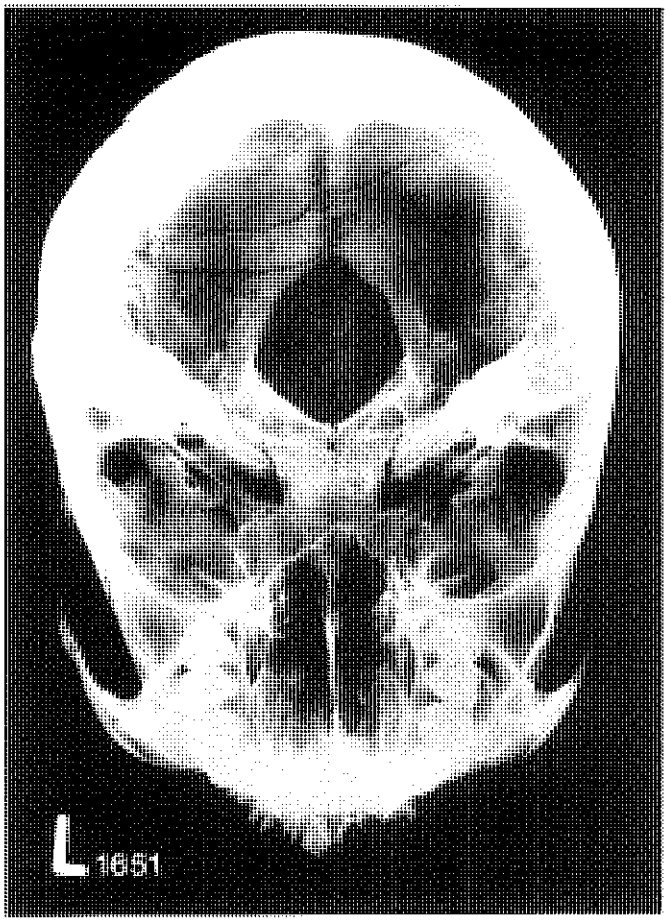

Abb. 12.

Kasuistik

Fall IV, Inv. No. 1643 (Abb. 13-20)

Makroskopischer Befund

Kopf eines erwachsenen Mannes mit Mehrfachtraumatisierung (Abb. 13 und 14). Die rechte Profilaufnahme (Abb. 13) zeigt einen ca. 6 cm langen, klaffenden Hautdefekt im Bereich der Wange, in dessen Tiefe eine Abtrennung des rechten Processus condylaris des aufsteigenden Unterkieferastes (Abb. 18, Pfeil) zu diagnostizieren ist. Zusätzlich wurde durch die Eindringtiefe der Waffe eine Kontinuitätsunterbrechung der gleichseitigen A. carotis externa bewirkt. Die Abbildungen 19 und 20 beweisen eine weitere komplizierte Hiebverwundung linksseitig, die zu einer grossflächigen Durchtrennung des Processus mastoideus sowie zu einer Aufspaltung der Fossa cranii posterior links dorsolateral des Foramen magnum geführt hat. Hiebverletzungen, die sich z. T. kreuzen und Kalottendefekte hervorgerufen haben sind auf den Abbildungen 15 und 17 (Überschneidung der Hiebe 2 und 3) zu erkennen. Eine vollständige Penetration des Schädeldaches liegt offensichtlich nicht vor. Links parietal, ca. 5 cm oberhalb des Ohres und parallel zum Verlauf

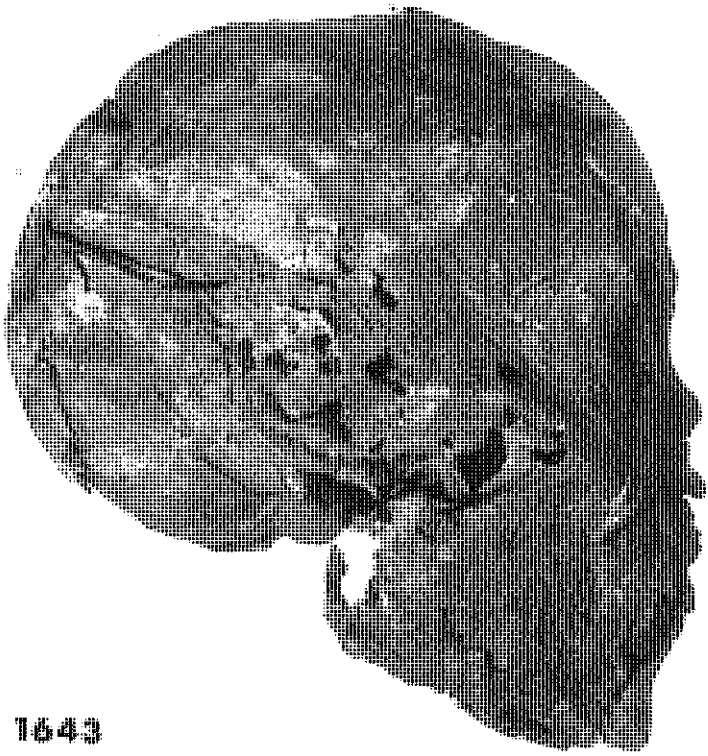

Abb. 13.

Abb. 14.

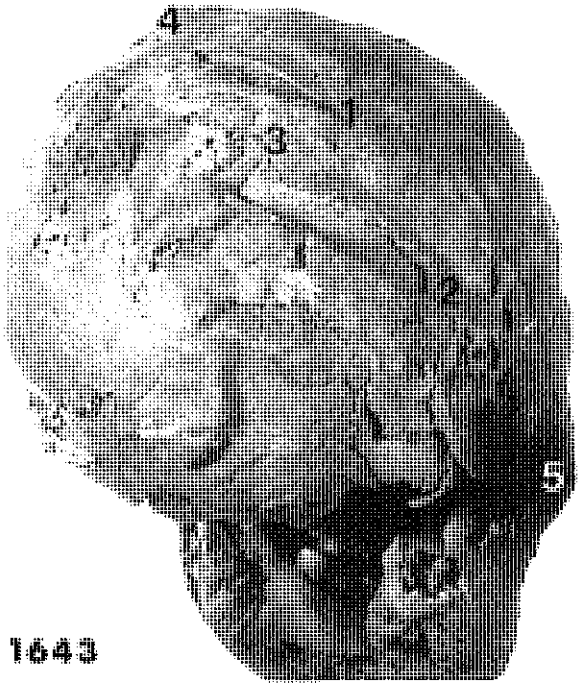

Abb. 15.

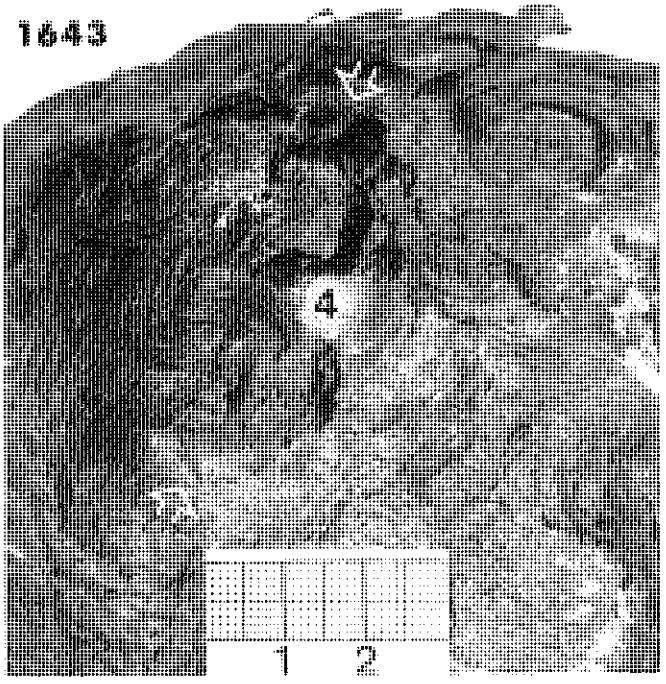

Abb. 16.

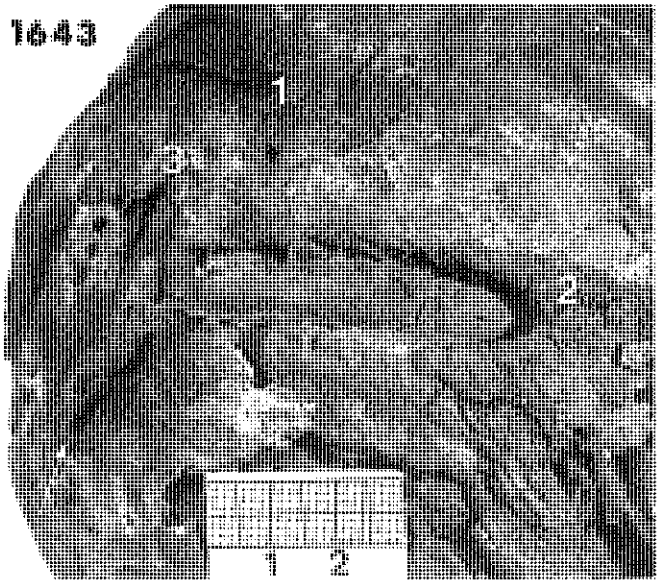

Abb. 17.

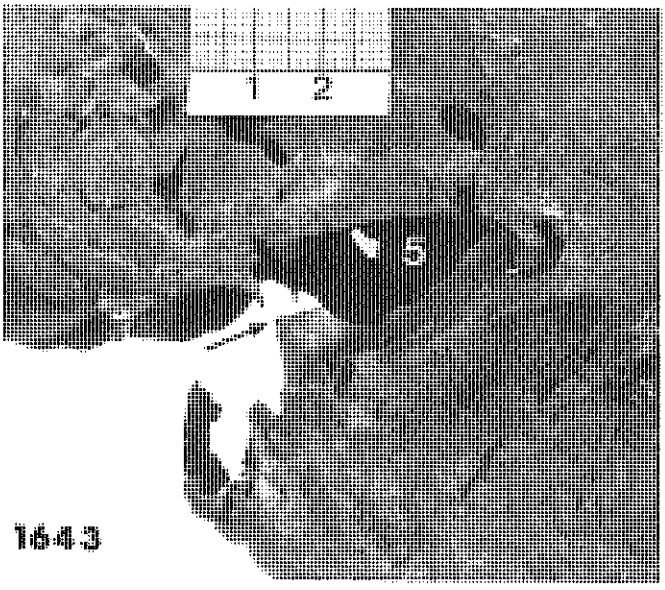

Abb. 18.

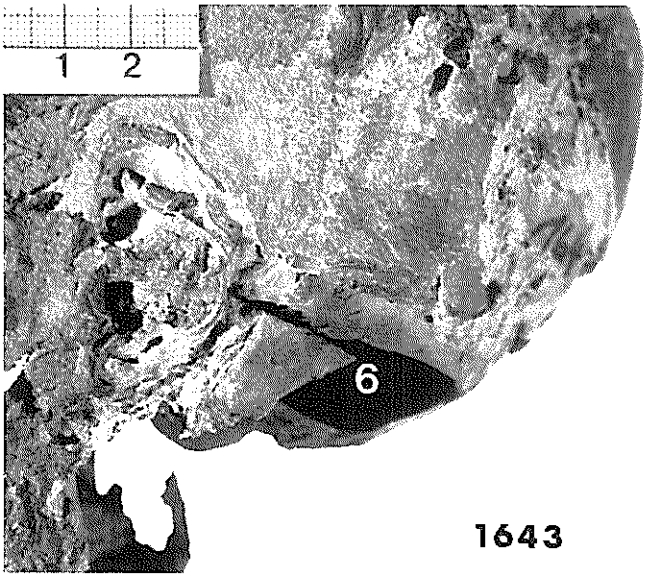

Abb. 19.

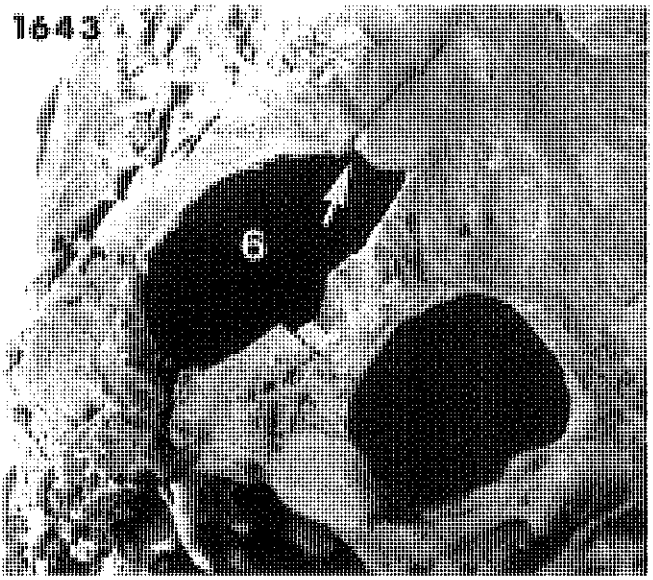

Abb. 20.

der Sutura coronalis findet sich ein klaffender Weichteildefekt ohne Hinweis auf ossäre Beteilungung (Abb. 16, 4) der genannten Verwendungen zeigt Spuren, die auf einen intravitalen posttraumatischen Umbau von Weichteil - oder Knochenstruktur schliessen lassen.

Röntgenbefund

Die in a.p., linksseitlicher sowie 90° Grad gekippter Projektion angefertigten Schädelaufnahmen (Abb. 21-23) bestätigen

1) eine querverlaufende klaffende Fraktur, die ihren Ursprung von Wunde 1 (Abb. 17) nimmt und als Biegungsfraktur in eine temporo-occipitale, s-förmig geschwungene, von Hieb 2 ausgehende Fraktur re. einstrahlt (Abb. 15, 17 und Abb. 22, Pfeil).

2) eine von Wunde 3 (Abb. 17) ausgehende schräg von re. parieto-occipital nach li. occipito-basal (Abb. 20, 21, 23 Pfeile) verlaufende Berstungsfraktur, die caudal in einen annähernd elliptischen Defekt einmündet. Dieser entspricht Wunde 6 (Abb. 19 und 20) und weist radiäre Frakturausläufer bis ins benachbarte Foramen occipitale magnum auf (Abb. 20 und 23).

3) einen ovalären Aufhellungsbezirk re. occipito-basal (Abb. 23) unklarer Genese.

4) eine Abtrennung des Processus condylaris des re. aufsteigenden Unterkieferastes (Abb. 18, Abb. 21 und 23) in Zusammenhang mit Weichteilverletzung 5 (Abb. 18).

Papyrus E. Smith

Fall 4 (2,2 -11)

Informationen über eine Klaff-Wunde an seinem Kopf, die bis zum Knochen reicht, gespalten ist sein Schädel.
Wenn du einen Mann untersuchst mit einer Klaff-Wunde an seinem Kopf, die bis zum Knochen reicht, gespalten ist sein Schädel; dann sollst du seine Wunde abtasten, und findest du etwas daran, das uneben ist unter deinen Fingern; es schaudert ihn sehr; die Anschwellung, die auf ihm (d.h. dem Spalt) ist, steigt hoch; er gibt Blut aus seinen Nasenlöchern (und) aus seinen Ohren; er leidet an Versteifung in seinem Nacken; nicht kann er auf seine Schultern und seine Brust blicken:
Dann musst du dazu sagen: einer mit einer Klaff-Wunde an seinem Kopf, die bis zum Knochen reicht; gespalten ist sein Schädel; er gibt Blut aus seinen Nasenlöchern (und) aus seinen Ohren; er leidet an Versteifung in seinem Nacken. Eine Krankheit, mit der ich kämpfen werde.
Wenn du also jenen Mann findest, indem sein Schädel gespalten ist, dann sollst du ihn nicht verbinden, (sondern) zur Erde legen auf sein Ruhebett, bis die Zeit seines Leidens vorübergegangen ist. Seine Behandlung besteht im Stillsitzen, indem ihm zwei Stützen von Ziegeln gemacht sind, bis du weisst, dass er zu etwas (Endgültigem) gelangt ist. Dann sollst du Öl/Fett an seinen Kopf geben, sein Nacken und seine Schultern sollen damit erweicht werden. Ebenso mögest du an jedem Manne handeln, den du findest, indem sein Schädel gespalten ist.
Was anbetrifft: gespalten ist sein Schädel.
Das bedeutet: es hat sich eine Scherbe seines Schädels von der (anderen) Scherbe getrennt, indem Stücke im Fleisch seines Kopfes geblieben sind, sie sind nicht zu Boden gefallen.
Was anbetrifft: die Anschwellung, die auf ihm ist, steigt hoch.
Das bedeutet: gross ist die Schwellung, die auf diesem Spalt ist, indem sie nach oben erhoben ist.

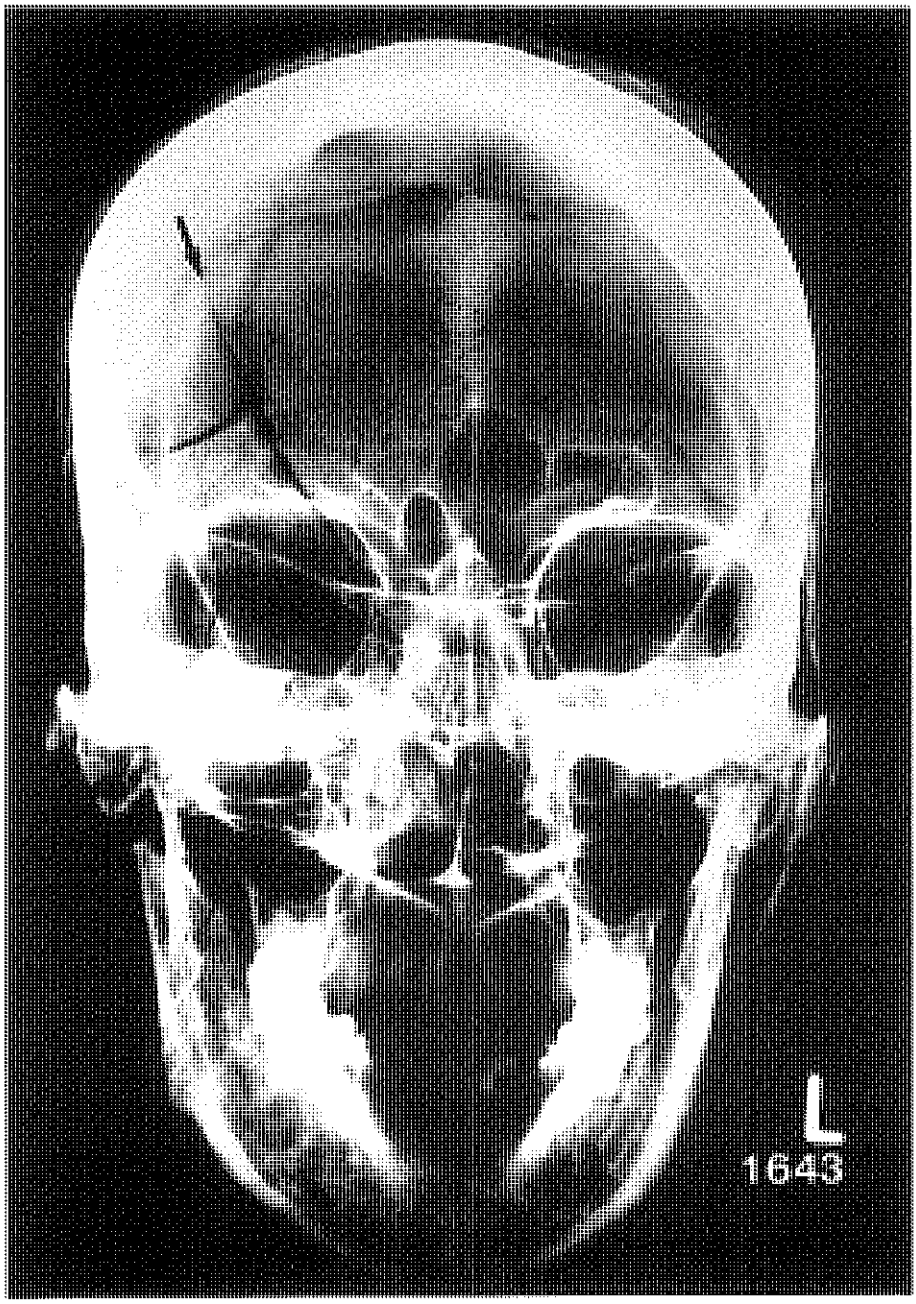

Abb. 21.

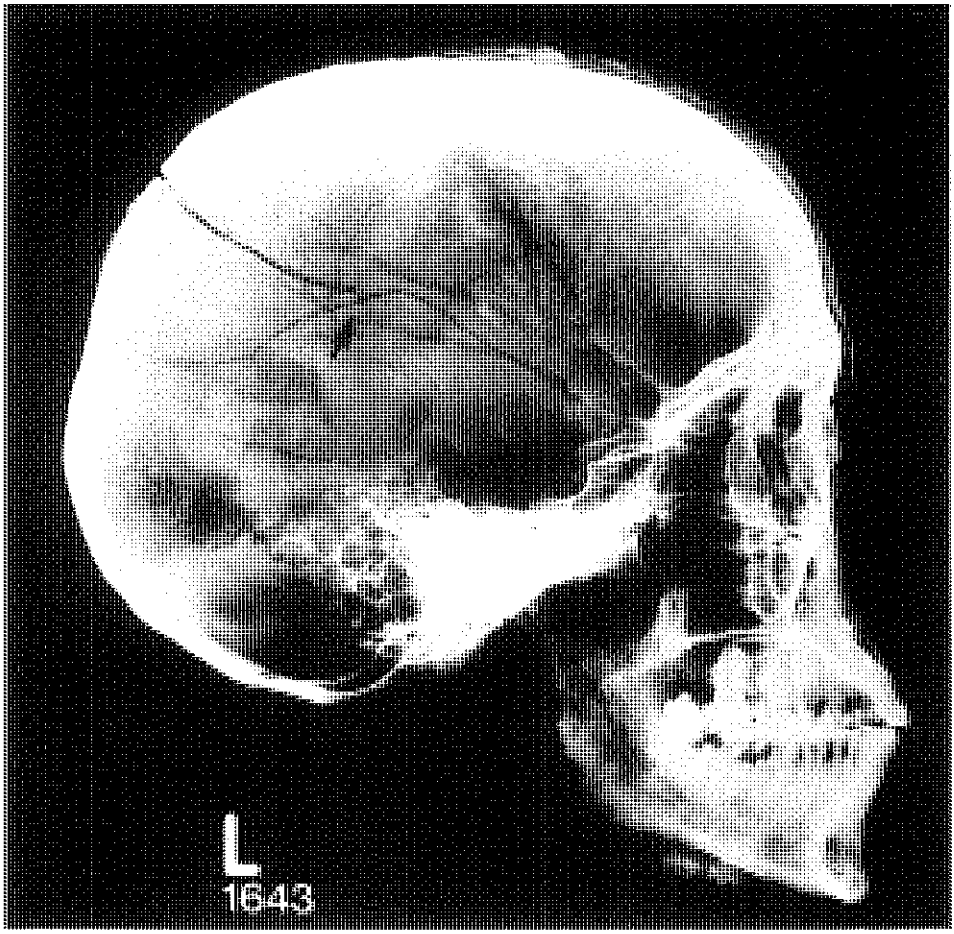

Abb. 22.

Was anbetrifft: du weisst, dass er zu etwas (Endgültigem) gelangt ist.
Das bedeutet, dass man sagt: du weisst, dass er sterben oder dass er leben wird, denn er ist ein (Patient mit dem Verdikt:) "eine Krankheit, mit der ich kämpfen werde".

Kommentar

Im Gegensatz zu Fall 6 des Papyrus E. Smith handelt es sich im Fall 4 (2, 2 - 11) um ein SHT, welches aufgrund des Verdikts ("Eine Krankheit, mit der ich kämpfen werde") offensichtlich prognostisch günstiger beurteilt wird. Die angedeutete Symptomatik dagegen lässt eher das Gegenteil vermuten! Die Blutung aus Ohren und Nase weist auf eine Mitbeteiligung der Schädelbasis hin, die Nackensteife kann als Zeichen einer akuten Durchwanderungsmeningitis interpretiert werden. Nicht erwähnt wird die Bewusstseinslage des Patienten, der "Meningismus" spricht jedoch gegen das Vorliegen zumindest einer tiefen Bewusstlosigkeit. Schliesslich legt der zweimalige Hinweis auf eine "aufsteigende" Anschwellung den Verdacht nahe, dass eine ödematöse Hirnschwellung mit Hirnprolaps, eine durch die Fraktur sich selbst drainierende intracranielle Blutung oder auch nur ein Kephalhämatom vorliegen könnte. Die Beobachtung, dass es den Patienten "schaudert" kann als fiebrige Begleiterscheinung, hingegen auch als cerebraler posttraumatischer Krampanfall gedeutet werden.

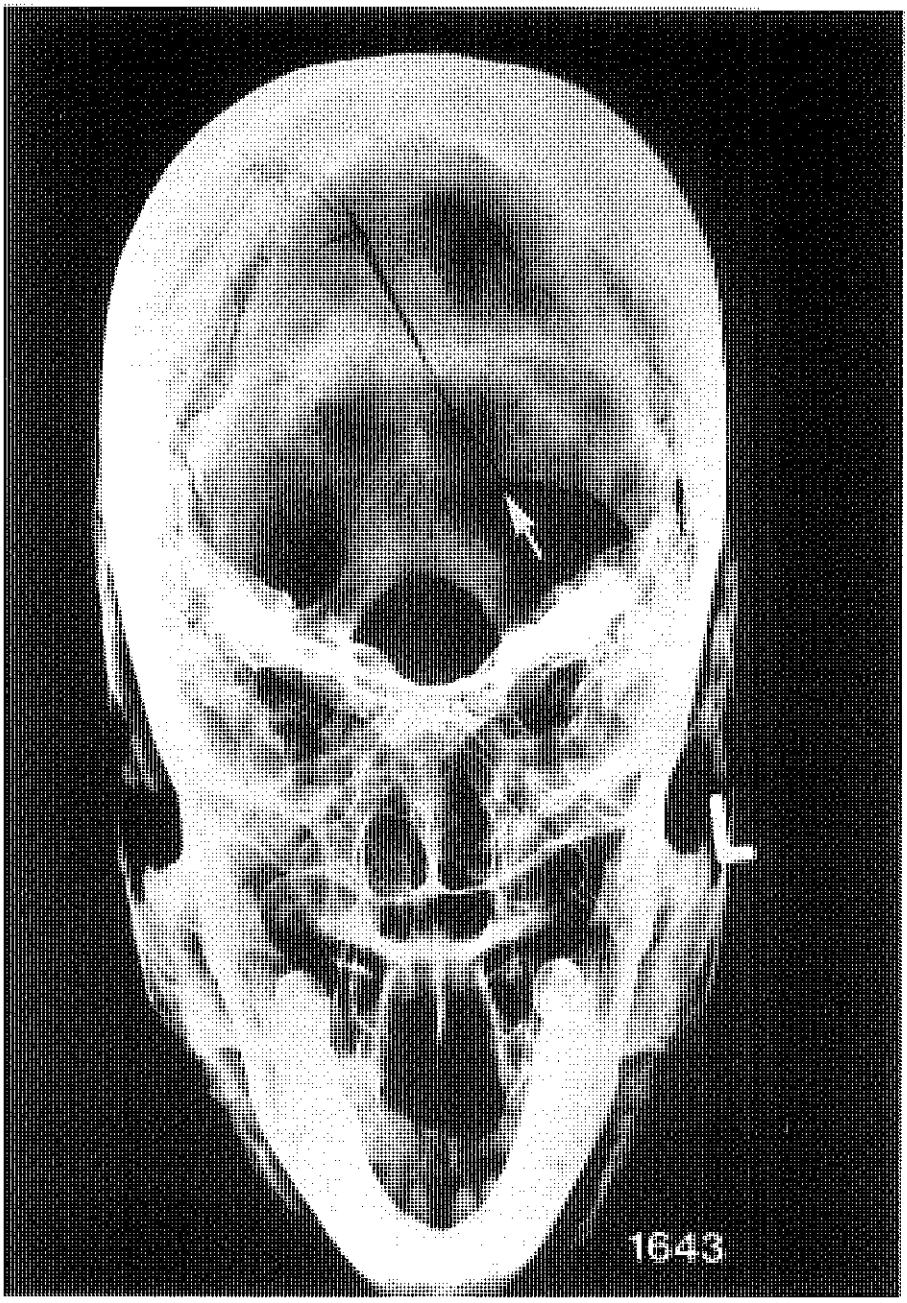

Abb. 23.

Nach Anweisung des Arztes wird auf das Anlegen von Wundverbänden zunächst verzichtet und dies damit begründet, dass der Patient bzw. dessen Erkrankung zu "etwas" (Endgültigem) gelangen muss. Erst danach erscheinen therapeutische Massnahmen indiziert. Zwischenzeitlich erfolgt eine Verlaufsbeobachtung, die dem behandelnden Arzt konkrete Hinweise auf Progredienz oder Besserung der Symptomatik vermitteln soll. Leider fehlen über Art und Beschaffenheit der Prognostika nähere Angaben. Die Befunde selbst stehen, wie oben erwähnt, in gewissem Widerspruch zum beigegebenen Verdikt. Eine Erklärung hierfür wäre, dass durch die "nicht zu Boden gefallenen Scherben" des Schädels, d.h. die in der Kopfschwarte verbliebenen Knochenfragmente, prima vista der Eindruck eines weniger komplizierten behandlungswürdigen SHT entstanden ist.

Ähnliches könnte sich im Fall der Mumie Inv. No. 1651 zugetragen haben: Ausgehend davon, dass der parieto-occipitale Aussprengungskeil zunächst nicht "zu Boden gefallen" sein braucht, sondern an den Kopfweichteilen verblieben ist, könnte die lokale Erscheinung der Wunde einen minder besorgniserregenden Eindruck hinterlassen haben, so dass - postuliert man kurzfristiges Überleben dieser Hiebe - der Verletzungssymptomatik nur sekundäre Aufmerksamkeit beigemessen wurde. Da die Schnittkanten sowie die Schnittflächen im Bereich der Defekte scharf und glatt berandet sind und keine wesentliche Knochensplitterung aufweisen, scheint hohe Bewegungsenergie angewendet worden zu sein, bei der es nicht zwangsläufig zu einer Verletzung von Dura und Gehirnanteilen gekommen sein muss. Als obligatorische Folge eines Translationstraumas sind dagegen sofort auftretende, unterschiedlich lang andauernde Ströungen mehrerer oder aller cerebraler Funktionssysteme zu erwarten. Spätestens beim Versuch die eingekeilte Waffe - hier kommen Sichelschwerter in Frage (Abb. 6, 1-3) - zu lösen, muss eine Eröffnung der Hirnhäute und Destruktion von Gehirngewebe erfolgt sein, die den Tod des Mannes nach sich zogen. Dieser kann durch akuten Blutverlust - wahrscheinlich aus dem Sinus - mit Verblutung nach extracranial oder bei fehlender Abflussmöglichkeit sekundär durch Hirnstammeinklemmung hervorgerufen worden sein.

Bei Individuum Inv. No. 1643 führten vier Hiebverletzungen parieto-occipital rechts und parietal links, deren Aufeinanderfolge nicht ausreichend differenziert werden kann, zunächst zur Durchtrennung der Kopfweichteile und zur mehrfachen Aufspaltung des Schädeldaches. Die Waffe, vermutlich ein Sichelschwert oder ein Dolch, (Abb. 6, 10-11) ist hierbei nur jeweils wenige Millimeter tief bis etwa auf das Niveau der Diploe eingedrungen. Dabei kam es, insbesondere von den Wunden 1 und 2 ausgehend, zu Berstungsfrakturen am gesamten Schädel sowie zu länglichen elliptiformen, den Weichteilläsionen in Form und Grösse annähernd entsprechenden Absprengungen der hirnseitigen Kalotte. Es ist denkbar, dass diese Verletzungen nicht unmittelbar tödlich verliefen, im günstigen Fall bei entsprechender ärtzlicher Behandlung und familiärer Fürsorge überlebt werden konnten und von daher das Verdikt "Eine Krankheit, mit der ich kämpfen werde" rechtfertigen könnten. Allerdings hätte jeder einzelne der beiden zusätzlichen Hiebe kaum überlebt werden können: Der von rechts lateral und caudal geführte Angriff betraf die Wangenpartie, spaltete zum Teil das rechte Jochbein im Bereich der Sutura temporozygomatica und bewirkte eine glatte Abtrennung des Processus condylaris des gleichseitigen Unterkieferastes. Dabei drang die Klinge so tief ein, dass die rechte Carotis externa durchtrennt worden sein muss, die Interna dagegen unversehrt geblieben sein dürfte. Zusätzlich erfolgte ein nahezu horizontaler Einhieb in die hintere Schädelgrube mit elliptiformer knöcherner Aussprengung und fast vollständiger Durchtrennung des linken Processus mastoideus, womit eine Substanzschädigung cerebellärer Strukturen verbunden war. Der Tod des Individuums Inv. No. 1643 ist, abgesehen von den Komplikationen in Zusammenhang mit den gehirngeweblichen Verletzungen (Hirnstamm-Syndrome), am ehesten durch akuten Blutverlust eingetreten.

Papyrus E. Smith

Fall 23 (8, 18-22)

Informationen über eine Wunde an seinem Ohr.
Wenn du einen Mann untersuchst mit einer Wunde an seinem Ohr, die einschneidet bis zur Öffnung seines Fleisches, während etwas von der Unterseite seines Ohres verblieben ist am Fleisch, dann sollst du ihm mit einem Faden die Hinterseite der Hautschicht(?) seines Ohres zusammenfassen. Dann musst du dazu sagen: einer mit einer Wunde an seinem Ohr, die einschneidet bis zur Öffnung seines Fleisches. Eine Krankheit, die ich behandeln werde.
Wenn du jene Wunde findest, indem ihre Naht verschoben ist, (aber noch) verblieben ist an den Lippen seiner Wunde, dann sollst du ihm Polster von Stoff machen und die Hinterseite seines Ohres damit ausstopfen. Behandle du ihn danach mit Öl/Fett, Honig, Fasern jeden Tag, bis es ihm besser geht.

Kommentar

Das Verdikt: "Eine Krankheit, die ich behandeln werde", gilt als Hinweis darauf, dass z.B. unkomplizierte Weichteil-Knorpelverletzungen für die altägyptischen Ärzte therapeutisch angehbar waren. Die an Individuum Inv. No. 1651 im Zusammenhang mit dem Tangentialtrauma erfolgte teilweise Abtrennung der linken Ohrmuschel oberhalb des Porus acusticus externus hätte, wäre sie die einzige Verwundung des Patienten gewesen, nach obiger Behandlungsanweisung versorgt und überlebt werden können. Aus mumifizierungstechnischen Gründen angelegte Hautnähte beweisen, dass in Ägypten zufriedenstellende Nahttechniken bekannt waren. Allerdings ist nirgends überliefert, welches Nahtmaterial am Lebenden Verwendung gefunden hat, ja es gibt noch nicht einmal archäologische Befunde, die eine derartige chirurgische Behandlung am Patienten bestätigen könnten. Das Hauptproblem der im Fall 23 behandelten Verletzung dürfte therapeutisch die Blutstillung gewesen sein. Leider fehlen jegliche Hinweise, die Rückschlüsse auf diesbezügliche medikamentöse Therapeutika erlauben würden. Demgegenüber wird mitgeteilt, wie die Wunde unmittelbar vor dem Auflegen der Verbände versorgt wurde: mit Öl/Fett, speziell mit Honig. Dass hiermit eine weitere Komplikation von offenen Verletzungen minimiert werden sollte, wissen wir erst seit kurzem: Honig besitzt antibakterielle Potenz und hat somit einer Infektion der Wunde vorgebeugt. Für die ägyptische Medizin ist dies ein bedeutender Erfahrungswert gewesen, wie eventuell auch die Tatsache, dass die hypertonen Eigenschaften von Bienenhonig eine für den Heilungsprozess notwendige Drainage der Wundsekretion begünstigen konnten.

Kasuistik

Fall V, Inv. No. 1543 (Abb. 24 und 25)

Makroskopischer Befund

Münzgrosser ovaler Lochdefekt im rechten Tuber frontale mit Teiladhäsion der nach intracraniell eingestülpten Kopfschwarte. Im Bereich beider Arcus superciliares sowie in Höhe des linken Jochbeines Trockenrisse und Abschertraumen vornehmlich postmortaler Genese. Unterhalb der Nasenwurzel halbkreisförmige Lochbildung. Die rechsseitige Profilaufnahme zeigt einen erbsengrossen Weichteildefekt mit scharfer Randbegrenzung in Höhe des Processus zygomaticus. Die strahlenförmig von hier auslaufenden Trockenrisse der Weichteile korrespondieren teilweise mit darunterliegenden Frakturen.

Abb. 24

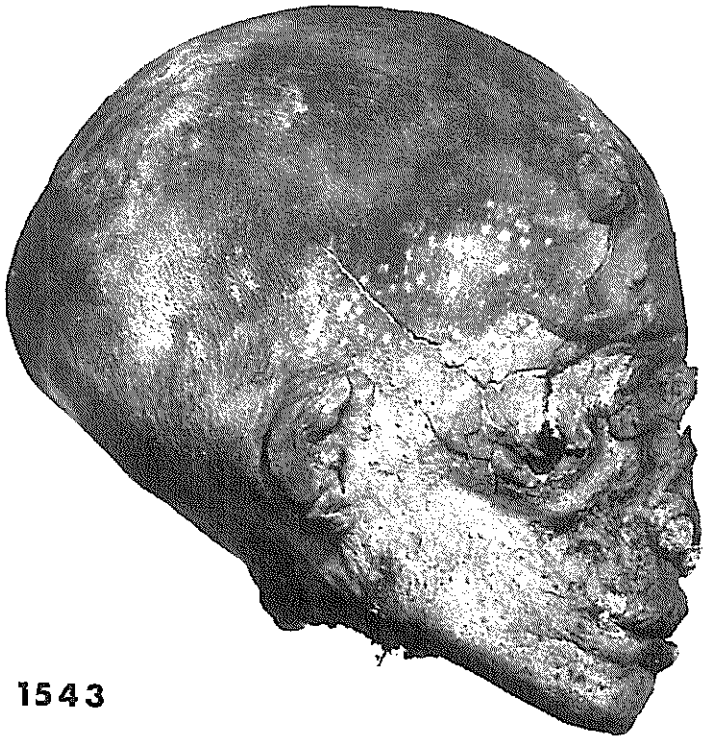

Abb. 25.

Röntgenbefund

Die a.p.-Aufnahme (Abb. 26) des Schädels eines frühadulten Mannes lässt im linken Frontale eine annähernd ovale und scharf begrenzte Aufhellungsfigur erkennen, von der aus sich eine Fraktur in Richtung des oberen Orbitarandes projiziert. Medialseits scheint es zu einer Aussplitterung der Tabula gekommen zu sein. Daneben finden sich Frakturen des lateralen oberen Orbitarandwinkels sowie eines Teils der rechten Orbitahöhle. Scharf abgrenzbarer knöcherner Defekt im Bereich der Nase mit Einstrahlung in den linken medialen Orbitarand, Konturauslöschung des mittleren Drittels des linken lateralen Orbitarandes (Abb. 27).

In rechtsseitlicher Projektion sich deutlich darstellender Lochdefekt frontal mit klaffender Frakturlinie nach caudal und lateral zur Ala major auslaufend. Zusätzliche Frakturzonen im Ober- und Mittelgesichtsbereich, der Frontobasis, in Projektion auf das rechte Sphenoidale sowie von der rechten Sutura parietotemporalis nach parietal und cranial ausstrahlend. Die im Occipitale lokalisierte flächige Verdichtungsstruktur entspricht den über die Nasenhöhle eingefüllten Mumifizierungssubstanzen.

Kasuistik

Fall VI, Inv.No. 1628 (Abb. 28)

Makroskopischer Befund

Im linken Frontale paramedian gelegene ovaläre, die Schädelkalotte perforierende Fraktur. Randkonturen scharf begrenzt und steil zur Tabula interna abfallend. Keine Zeichen der vitalen Knochenreaktion. Die den Defekt umgebenden Weichteile zeigen postmortale Rissbildung. Die Destruktion von knöcherner Nase und Nasenknorpel dürfte post mortem erfolgt sein.

Röntgenbefund

Auf der p.a.-Aufnahme (Abb. 29) ist im linken Frontale eine ca. walnussgrosse Aufhellung zu erkennen, die in ihrem cranialen Anteil scharf abgegrenzt erscheint, deren unterer Rand hingegen eine leichte Unschärfezeichnung aufweist. Diese ist mit einer Splitterung der Tabula interna sowie der im Zuge der Traumatisierung erfolgten Eröffnung der linksseitigen Anteile des Sinus frontalis zu erklären. Medial- und lateralseits des Lochdefektes verlaufen Berstungslinien, wobei die medial gelegene in Richtung des rechten Überaugenwulstes zuläuft. Die Linksseitenaufnahme (Abb. 30) verdeutlicht den in die rechte Orbita einstrahlenden Berstungsriss sowie weitere im Bereich der linken Schläfenregion, parietoocipital rechts und eine Sprengung der Sutura frontozygomatica. Anhand der fortgeschrittenen Nahtobliteration und des Gebissstatus lässt sich das Individualalter des Mannes auf etwa 50 Jahren beziffern.

Papyrus E. Smith

Fall 9 (4,19 - 5,5)

> Informationen über eine Wunde an seiner Stirn, zersplittert ist die Scherbe (bzw. Schale) seines Schädels.
> Wenn du einen Mann untersuchst mit einer Wunde an seiner Stirn, zersplittert ist die Scherbe (bzw. Schale) seines Kopfes:
> Dann sollst du ihm machen: ein Ei des Strausses, zerrieben in Öl/Fett; (es) werde an die Öffnung seiner Wunde gegeben. Danch sollst du ihm machen: ein Ei des Strausses, zerrieben (und) zu einem Streupuder gemacht. Das ist die Trocknung (bzw. ein Trockenmittel) einer Wunde.
> Dann sollst du ihm eine Binde vom Besteck des Arztes darauf (d.h. auf die Wunde) geben. Dann sollst du sie (d.h. die Wunde) am dritten Tag entblössen

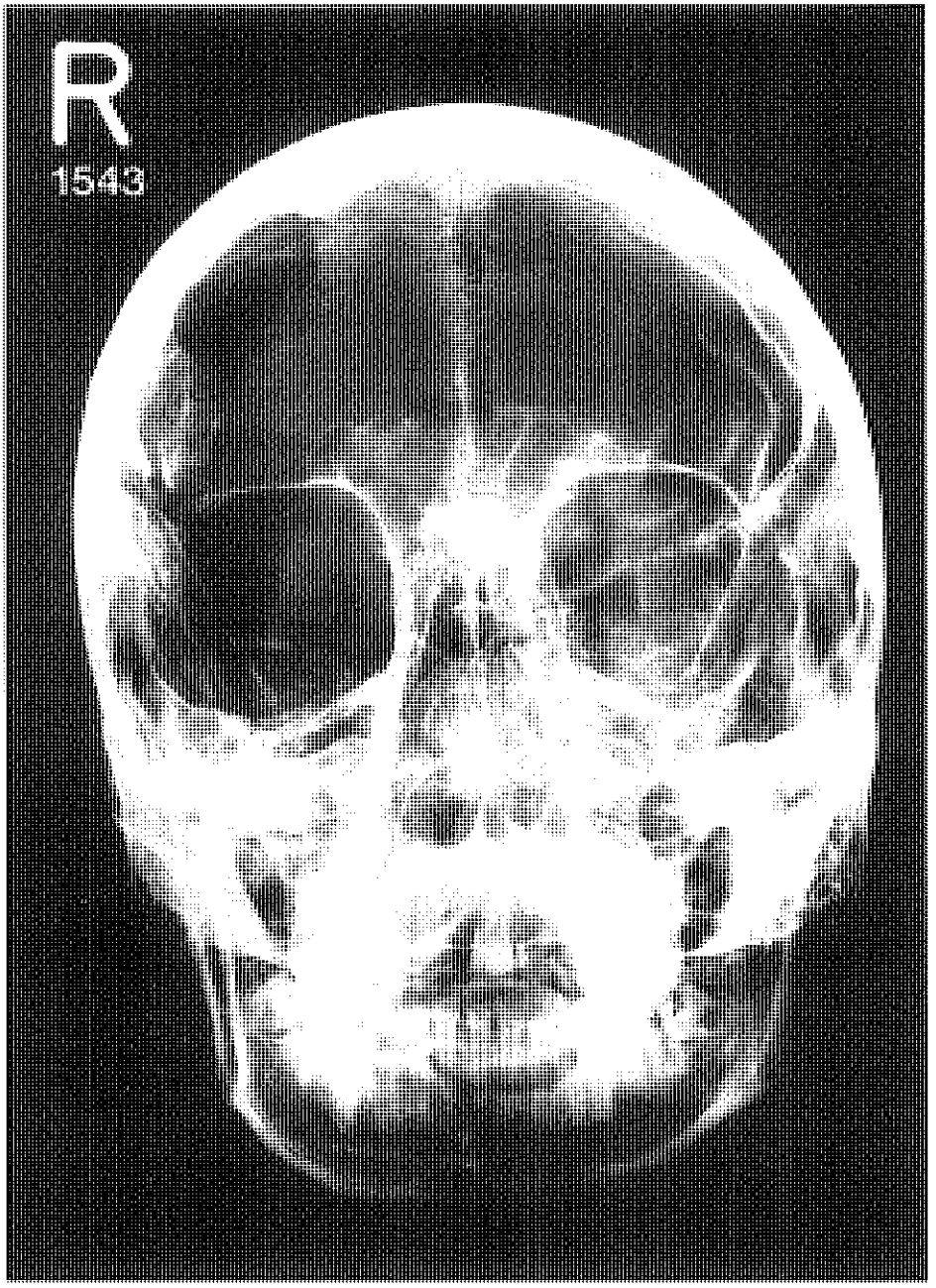

Abb. 26.

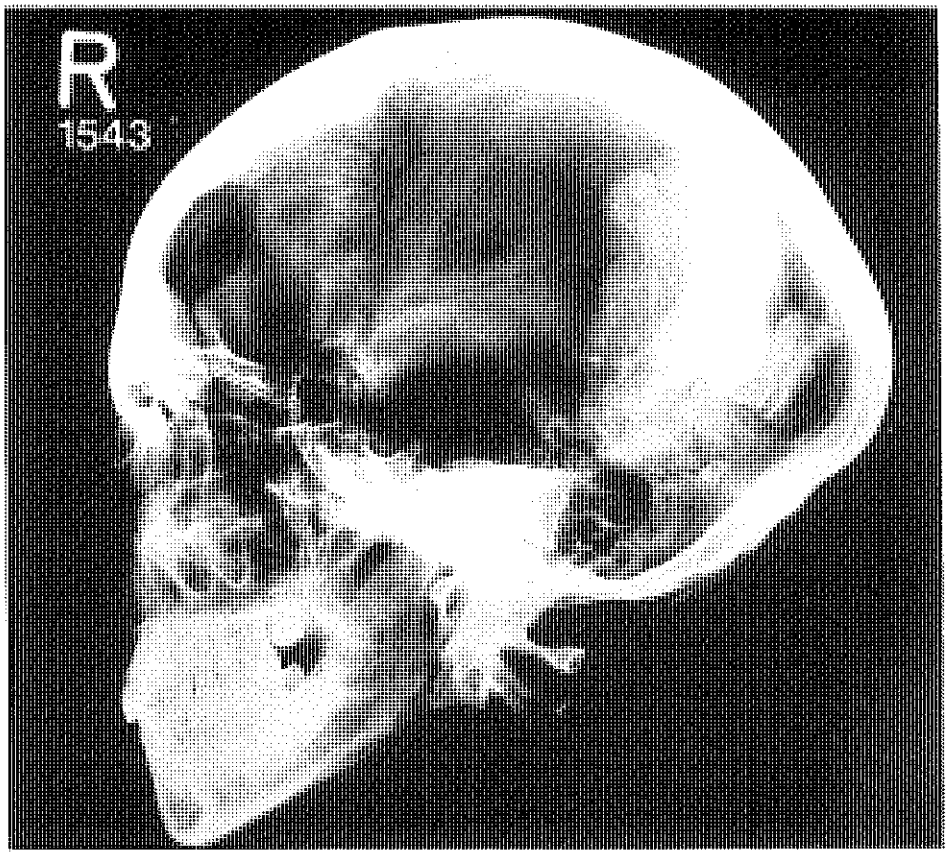

Abb. 27.

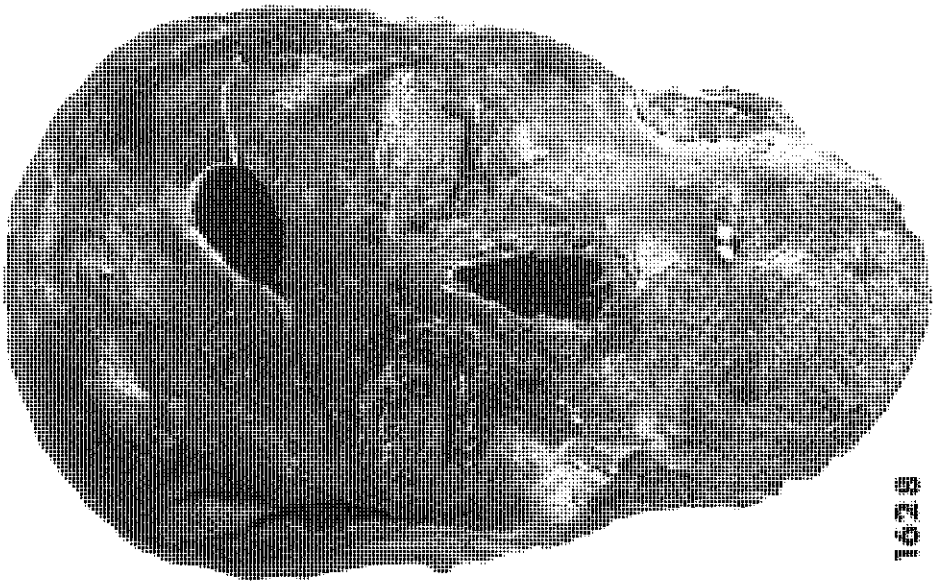

Abb. 28.

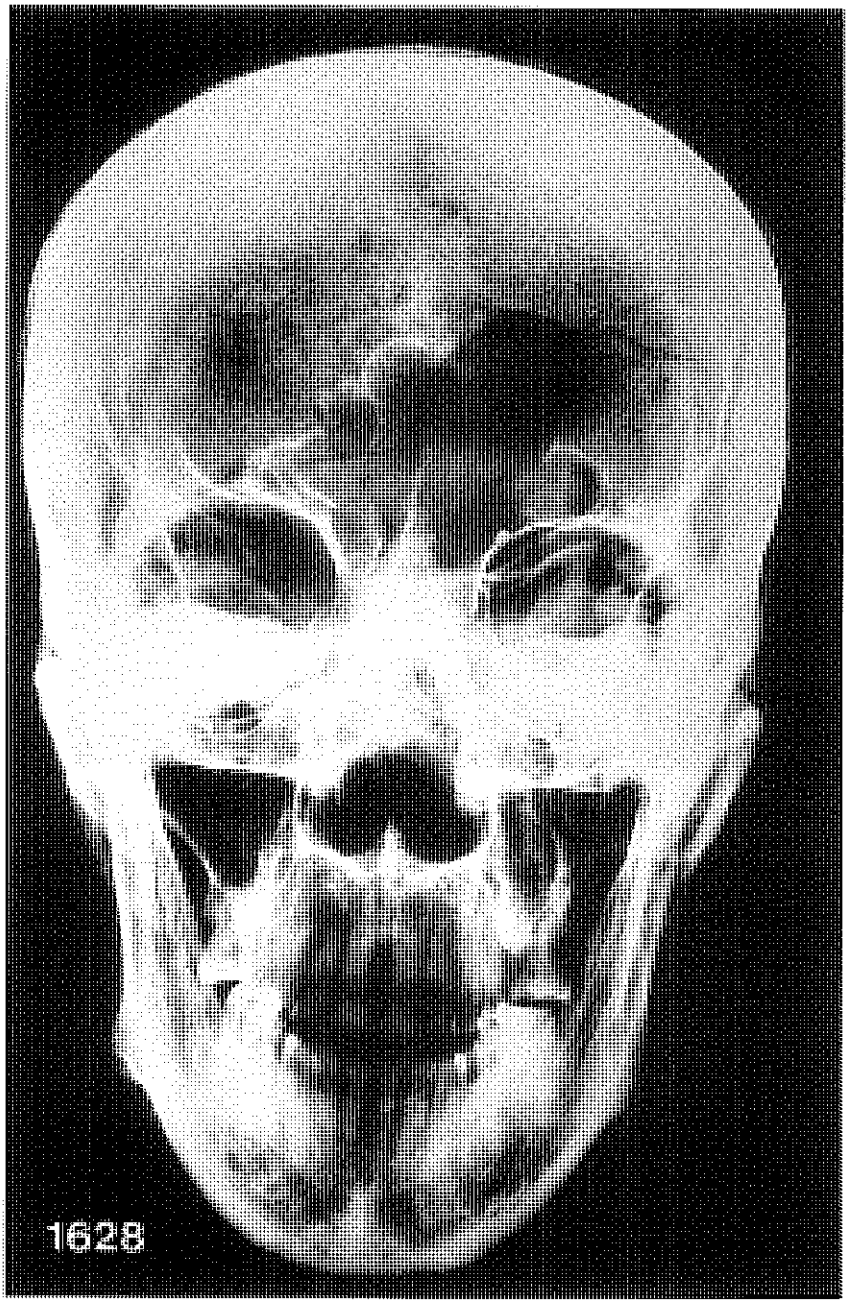

Abb. 29.

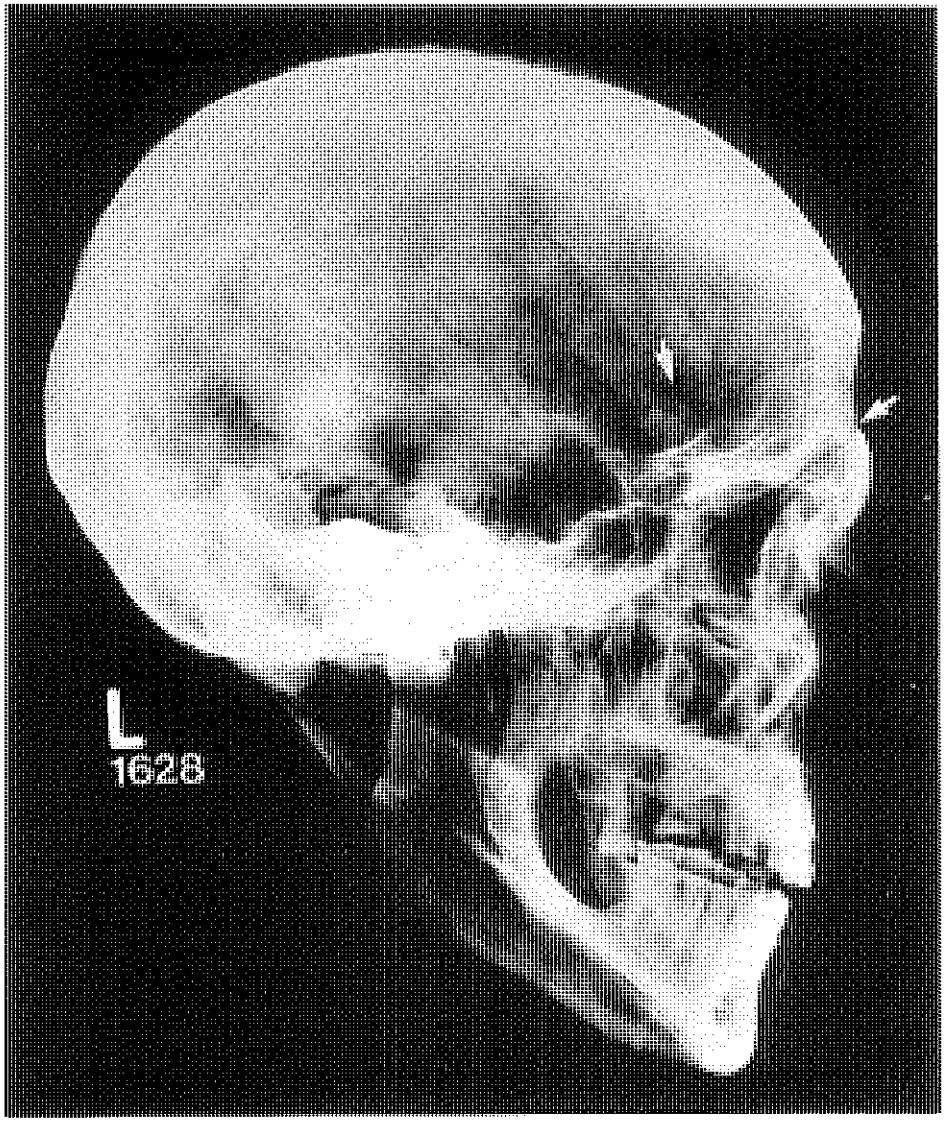

Abb. 30.

und finden (= feststellen), dass er (d.h. der Streupuder) die Scherbe (bzw. Schale) zusammengefügt hat, indem die Beschaffenheit wie ein Ei des Strausses ist.
Was als Zauber über diesem Heilmittel gesagt wird: Vertrieben werde der Feind, der in der Wunde ist; zum Zittern gebracht werde das Böse, das im Blute ist, dem Feind des Horus. Ein Schutz ist der Zauberspruch der "Nützlichen". Nicht soll diese Schläfe in Gefahr kommen, nicht soll das Gefäss darin (d.h. die Ader?) Schaden nehmen(?). Ich bin im Schutz der "Nützlichen", gerettet wird (erneut) der Sohn des Osiris.
Danach sollst du ihm Kühlung verschaffen: Früchte der Feige, Öl/Fett, Honig; (es) werde gekocht, werde abgekühlt, werde ihm gegeben.
Was anbetrifft: eine Binde vom Besteck des Arztes.
Das ist: eine Binde, die diesem Verbinder (d.h. dem Arzt) zur Verfügung steht, die er auf dieses Heilmittel legt, das auf dieser Wunde ist, die an seiner Stirn ist.

Papyrus E. Smith

Fall 17 (7,1 - 7)

Informationen über einen Splitterbruch in seiner Wange.
Wenn du einen Mann untersuchst mit einem Splitterbruch in seiner Wange, dann sollst du deine Hand auf seine Wange legen in der Umgebung jenes Splitterbruches; er verschiebt sich unter deinen Fingern; und ausserdem gibt er (d.h. der Mann) Blut aus seinem Nasenloch (und) aus seinem Ohr, (und zwar) auf der Seite von ihm mit jener Schlagverletzung, und ausserdem gibt er auch noch Blut aus seinem Munde; es ist schwierig, dass er seinen Mund öffnet infolgedessen.
Dann musst du dazu sagen: einer mit einem Splitterbruch in seiner Wange; er gibt Blut aus seinem Nasenloch (und) aus seinem Ohr (und) aus seinem Munde; er ist bewusstlos. Eine Krankheit, die man nicht behandeln kann.
Dann sollst du ihn verbinden mit frischem Fleisch am ersten Tage. Seine Lagerung ist Stillsitzen, bis seine Anschwellung ausgezogen ist. Behandle du ihn danach mit Öl/Fett, Honig, Fasern jeden Tag, bis es ihm besser geht.

Kommentar

Die Analyse des Falles 9 (4,15 - 5,5) hinsichtlich seines schematischen und inhaltlichen Aufbaus ergibt, dass - im Gegensatz zu den oben zitierten Textbeispielen - die für eine zufriedenstellende Interpretation unablässige Beschreibung der mit der Stirnverletzung einhergehenden Symptomatik fehlt; auch Diagnosestellung und Verdikt sind ausgelassen, wenn auch letztes durch die Tatsache einer Behandlungsanweisung erahnt werden kann. Entgegen der sachlichen Darstellung vorausgehender Fälle (vielleicht ausgenommen eine Textstelle in Fall 8, in welcher eine Halbseitenlähmung durch "den Hauch eines Gottes" verursacht wird) weist die vorgeschlagene Behandlung Eigentümlichkeiten auf, indem sie auf sogenannte Sympathiemittel (Straussenei-Puder bei Verletzung der Kalotte) und Zauberformeln zurückgereift. Es ist deshalb anzunehmen, dass ein derartiges Konglomerat aus vorwiegend magischen Elementen und aus therapeutisch zunächst vernünftiger Handlung (Applikation von Heilmitteln und Verbänden) einer jüngeren Stufe altägyptischer Heilkunde entstammt, die sich neben sprachlichen und stilistischen Kennzeichen vor allem durch die progrediente Abkehr von empirisch-rationalen Inhalten und einer regressiven Hinwendung zur magisch-mythischen Medizin, wie sie in der Spätzeit aufkommt, auszeichnet. Es bedarf keiner besonderen Kenntnis chirurgischer Praxis, um zu erkennen, dass die reale Umsetzung des dargelegten Behandlungsschemas - selbst unter Beachtung psycho-

logisch bedingter Nebeneffekte von Therapiezauber - keinen konstruktiven Beitrag zur Rehabilitation Schädel-Hirn-Traumatisierter im allgemeinen sowie beim Schweregrad der Verletzungen der Individuen Inv. No. 1543 und 1628 im besonderen zu leisten imstande war (sofern letzte ihren ausgedehnten Wunden nicht schon unmittelbar bei oder nach der Traumatisierung erlegen sind). Jedenfalls kann eine längere Überlebenszeit aufgrund fehlender vitaler Reaktion des Gewebes ausgeschlossen werden. Vermutlich hat die aus der Randstruktur der Defekte ableitbare Eindringtiefe der Waffen (Abb. 6, 12-17) zu einer erheblichen Destruktion von Hirnhäuten und Cerebrum im Bereich des Lobus frontalis geführt und unstillbare Blutungen, insbesondere die Doppeltraumatisierung (Kalottendefekt und Schläfenwunde) des Mannes Inv. No. 1543 betreffend, verursacht. Sollten diese Hiebverletzungen kurzfristig überlebt worden sein - in der paläopathologischen Literatur Ägyptens findet sich ein entsprechendes Beispiel (5), allerdings ohne die in den vorliegenden Fällen vorhandenen Berstungsfrakturen - so war damit zumindest insbesondere bei frontobasalen SHT eine günstige Infektionsbasis geschaffen, die früher oder später über aufsteigende entzündliche Komplikationen (Meningitis) den Tod des Mannes bedeutet hätten. Der im Papyrus Smith beschriebene Fall 17 (7, 1 -7) könnte zu der Verwundung des seitlichen Gesichtes und der Schläfenregion bei Inv. No. 1543 passen. Auffällig ist hier die Kombination von negativem Verdikt und nachfolgender Behandlungsanweisung. Westendorf glaubt, dass der im Therapiesatz erscheinende Terminus "Anschwellung" auf einer fehlerhaften Übertragung eines an anderer Stelle (Fall 16, 17-21) genannten Wortes beruht, da er keine Entsprechung im vorausgehenden Text hat. Nach unserer Auffassung ist jedoch nicht auszuschliessen, dass in Inspektion und Diagnose des Falles 17 die Nennung des Symptomes einer "Anschwellung" entweder bewusst ausgelassen (da im vorhergehenden Fall bereits erwähnt) oder was wahrscheinlicher ist, vergessen wurde. Ausserdem scheint ein negatives Verdikt, wie Fall 6 (2, 17 - 3, 1) (vgl. S. 119) belegt, eine Behandlung nicht unbedingt auszuschliessen. Es ist zu fragen, ob diese immer als Therapie im Sinne einer partiellen Wiederherstellung bzw. einer Restitutio ad integrum aufzufassen ist oder vielleicht auch einer ethischen Grundhaltung entsprochen haben könnte, die den altägyptischen Heilkundigen zur Hilfestellung und Schmerzlinderung auch in prognostisch aussichtslosen Fällen verpflichtet hat.

Papyrus E. Smith

Fall 13 (6, 3 - 7)

> Informationen über einen Splitterbruch in seiner Nase.
> Wenn du einen Mann untersuchst mit einem Splitterbruch in seiner Nase, dann sollst du deine Hand auf seine Nase legen in der Umgebung dieses Splitterbruches, er (d. h. der Bruch) verschiebt sich unter deinen Fingern; und ausserdem gibt er (d. h. der Patient) Blut aus seinem Nasenloch (und) aus seinem Ohr, (und zwar) auf der Seite von ihm mit jenem Splitterbruch, und auch aus seinem Munde; es ist schwierig, dass er seinen Mund öffnet infolgedessen; er ist bewusstlos.
> Dann musst du dazu sagen: einer mit einem Splitterbruch in seiner Nase. Eine Krankheit, die man nicht behandeln kann.

Kommentar

Die Entstehung der im Fall 13, (6, 3 - 7) erörterten Nasenbeinfraktur lässt sich gewöhnlich auf stumpfe Gewalteinwirkung zurückführen. In Anbetracht der vielfältigen Symptomatik mit Creptitatio, Epistaxis, Blutung aus dem homolateralen Gehörgang (ohne Differenzierung in Richtung einer möglichen Liquorrhoe) sowie aus dem Munde ist an eine kompliziert Fraktur zu denken: Mit grosser Wahrscheinlichkeit liegt zusätzlich ein fronto- und/oder latero-basales Trauma - etwa ein Bruch der Pars petrosa - zugrunde, das äusserlich zunächst nicht in Erscheinung tritt. Schliesslich muss der Hinweis auf

die Bewusstlosigkeit des Patienten neben der vermuteten Schädelbasisfraktur differentialdiagnostisch auch eventuell eingetretene endocranielle Komplikationen in Erwägung ziehen. Therapeutisch beschränkt sich der altägyptische Arzt auf die Nennung des Verdiktes: "Eine Krankheit, die man nicht behandeln kann" und vermeidet es, irgendeine Behandlungsweisung nach bekanntem Schema zu erteilen. Selbst der Hinweis, abzuwarten, bis der Kranke zu "etwas" (Endgültigem) (s. Fall 6) gelangt ist, scheint hier seine Berechtigung verloren zu haben. Trotzdem gehen wir davon aus, dass eine notdürftige Versorgung des Verletzten nicht zu umgehen war und diese vielleicht durch medizinische Hilfskräfte besorgt wurde. Leider ist davon nichts berichtet, wie wir auch nicht sicher wissen, ob - nachdem die "Schulmedizin" den Patienten aufgegeben hatte - nicht doch noch Behandlungsversuche durch in ihrer Therapie vorwiegend magisch ausgerichtetes ärztliches Personal unternommen wurden.

Geht man bei Mumie Inv. No. 1543 davon aus, dass die im Bereich des Nasenskeletts erkennbaren Frakturen durch intravitale Traumatisierung zustande gekommen sind, liesse sich Fall 13 (6,3 - 7) des Wunderbuches ohne Bedenken anwenden. Wir meinen jedoch, dass die äusserlich sichtbare Frakturierung unterhalb der Nasenwurzel mit dem erwähnten Abschertrauma in Zusammenhang zu bringen ist, d.h. nur eine postmortale Verursachung in Frage kommt. Die tiefer lokalisierten, zusätzlich röntgenologisch diagnostizierbaren knöchernen Defekte, die einen Teil der vorderen Schädelgrube mit einbeziehen sind mit Sicherheit ebenfalls postmortalen Ursprungs und mit der transnasalen Eviszeration des Gehirns durch die Balsamierungspriester zu erklären.

Kasuistik

Fall VII, Inv. No. 232 c (Abb. 31 a-c)

Makroskopischer Befund

Robuster Schädel eines maturen Mannes mit annähernd ovalem Perforationsdefekt im Os frontale paramedian links. Nahezu vollständige, ventralseits überlappende Abdeckelung, teils durch die imprimierte Knochenplatte, teils durch Kallusbildung auf dem Niveau der Tabula interna. Dorsal (parallel zur obliterierten Sutura coronalis) und ventralseits an drei Stellen unvollständiger Verschluss bzw. Überbauung des Defektes. Die Innenseite der Kalotte wird durch die imprimierten Knochenfragmente um ca. 8 mm flächig und uneben überragt. Glattwandige, zum Schädelinnern kraterartig abfallende Randzone mit unterschiedlichem Steilheitsgrad. Extern ist der Randbereich der Fraktur ebenfalls geglättet und zeigt lateral eine zungenförmige, oberflächliche Ausbuchtung. Abb. 232 c c) lässt zudem eine schräg nach ventral und lateral in Richtung des linken Foramen frontale verlaufende oberflächliche und verheilte Frakturlinie mit inkompletter defektrandständiger Splitterung erkennen. Orbitadach nicht frakturiert. Charakteristische geringgradige Arrodierung der Defektumgebung insbesondere medial und dorsal als Hinweis auf eine entzündliche Begleitreaktion.

Röntgenbefund

In p. a.-Projektion halbkreisförmige Aufhellungsfigur im Frontale links paramedian mit deutlicher medialer und ventraler Randbegrenzung sowie mit breitem, die Mediansagittale überschreitendem unterschiedlich strahlentransparentem und wie abgerundet erscheindem Verdichtungssaum, der als Indiz für eine vitale Reaktion des Knochens gewertet werden muss. Bis auf Perforationen entsprechenden Aufhellungen ventralseits und dorsal ist die Fraktur auf einem unterhalb der Tabula externa gelegenden Niveau lamellös knöchern überbrückt. Die auf dem Defektgrund in sagittaler Verlaufsrichtung sichtbare feine, z.T. gelappte Aufhellungslinie lässt sich auf eine Splitterung des imprimierten Knochens im Zuge des Verletzungsereignisses zurückführen. Zusätzlich projiziert sich auf den linken Anteil des Sinus frontalis eine fissurähnliche, in ihrem mittleren Drittel nahezu ausgelöschte Aufhellungslinie, die von Defektrand bis in die Überaugenregion einstrahlt. Dort

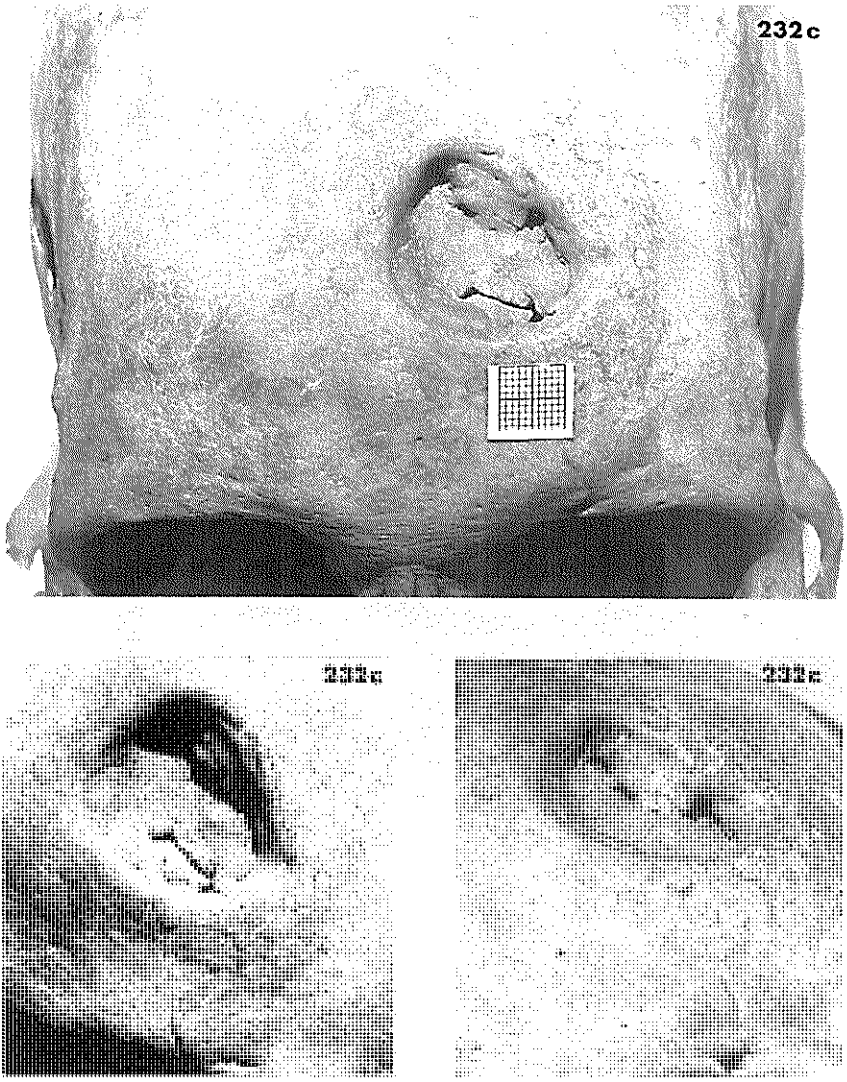

Abb. 31.

scheint sie in eine gut abgrenzbare breitere Aufhellung überzugehen. Eine Frakturierung des cranialen Orbitarandes ist nicht zu diagnostizieren.

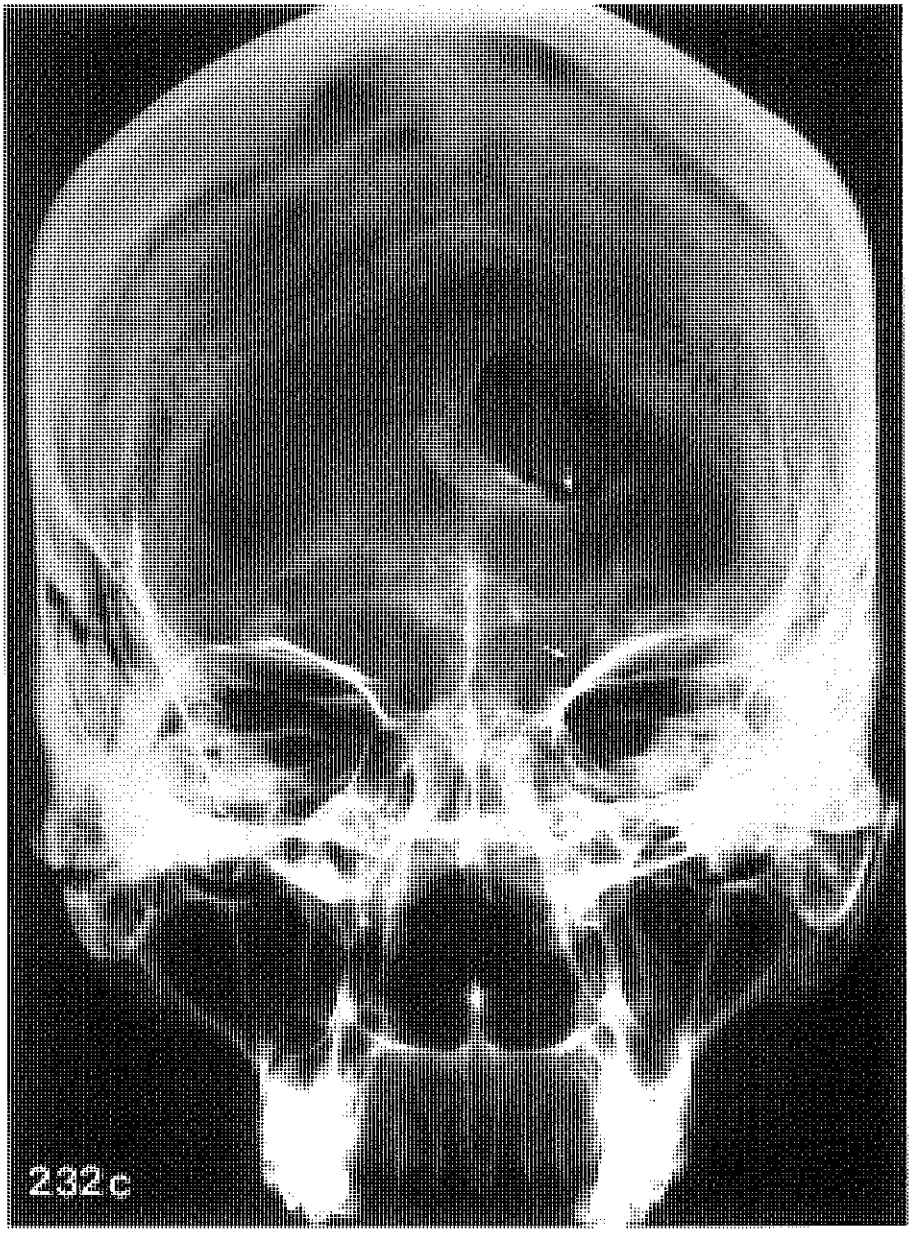

Abb. 32.

Papyrus E. Smith

Fall 3 (1, 18 - 2, 2)

⌊Informationen über⌋ eine Klaff-Wunde ⌊an seinem Kopf⌋ die bis zum Knochen reicht, durchlöchert ist sein ⌊Schädel⌋.
⌊Wenn du einen Mann untersuchst mit einer Klaff-Wunde an⌋ seinem ⌊Kopf⌋, die bis zum Knochen reicht, durchlöchert ist sein Schädel; dann sollst du seine Wunde abtasten, ⌊und findest du ihn, indem er nicht auf seine Schultern und⌋ seine Brust ⌊blicken kann⌋, er leidet an Versteifung in seinem Nacken:
Dann musst du dazu sagen: einer mit einer ⌊Klaff-⌋⌊Wunde ⌊an seinem Kopf, die bis zum Knochen reicht, durchlöchert ist⌋ sein Schädel, er leidet an Versteifung in seinem Nacken. Eine Krankheit, die ich behandeln werde.
Wenn ⌊du also jenen Mann findest, indem sein Schädel durchlöchert ist, dann sollst du nicht⌋ frisches ⌊Fleisch auflegen⌋ am ersten Tag auf seine Wunde; du sollst ihn nicht verbinden, (sondern) zur Erde legen ⌊auf sein Ruhebett, bis die Zeit seines Leidens vorübergegangen ist⌋; behandle du ihn danach mit Öl/Fett, Honig, Fasern jeden Tag, bis es ihm besser geht.
⌊Was anbetrifft: durchlöchert ist sein Schädel.⌋
⌊Das bedeutet: ...⌋ ist sein Schädel. Der Bruch ist klein, weil er (der Mann? der Kopf?) versehen ist mit einem Bruch wie die Durchlöcherung eines Topfes ⌊...⌋
Was anbetrifft: nicht kann er auf seine Schultern und ⌊seine⌋ Brust blicken.
⌊Das bedeutet: nicht ist es ihm angenehm, dass er⌋ auf seine Schultern ⌊blickt⌋; nicht ist es ihm angenehm, dass er auf seine Brust blickt.
Was anbetrifft: er leidet an Versteifung in seinem Nacken.
Das bedeutet: ein Steifsein infolge seines besagten Leidens; dieses ist abgewandert in seinen Nacken, und so schmerzt sein Nacken infolgedessen.
Was anbetrifft: (er) werde gelegt zur Erde auf sein Ruhebett.
Das bedeutet: ihn zu legen auf sein gewohntes Lager, ohne ihm ein Heilmittel zu machen.

Papyrus E. Smith

Fall 5 (2, 11 - 17)

Informationen über eine Klaff-Wunde an seinem Kopf, zersplittert ist sein Schädel.
Wenn du einen Mann untersuchst mit einer Klaff-Wunde an seinem Kopf, die bis zum Knochen reicht, zersplittert ist sein Schädel; dann sollst du seine Wunde abtasten, und findest du jenen Splitterbruch, der an seinem Schädel ist, tief (und) eingesunken unter deinen Fingern; die Anschwellung, die auf ihm ist, steigt hoch; er gibt Blut aus seinen Nasenlöchern (und) aus seinen Ohren; er leidet an Versteifung in seinem Nacken; nicht kann er auf seine Schultern und seine Brust blicken.
Dann musst du dazu sagen: einer mit einer Klaff-Wunde an seinem Kopf, die bis zum Knochen reicht; zersplittert ist sein Schädel; er leidet an Versteifung in seinem Nacken.
Eine Krankheit, die man nicht behandeln kann.
Du sollst ihn nicht verbinden, (sondern) zur Erde legen auf sein Ruhebett, bis die Zeit seines Leidens vorübergegangen ist.
Was anbetrifft: zersplittert ist sein Schädel.
Das bedeutet: zersplittert ist sein Schädel, indem die Knochen-(splitter) infolge jenes Splitterbruches entstanden sind, eingesunken sind zum Innern seines Schädels. Es hat das Buch "Über die Wunden" da⌊zu⌋gesagt: Das

ist ein Zersplittern seines Schädels in viele Stücke, die eingesunken sind zum Innern seines Schädels.

Kommentar

Die Fälle 3 (1,18 - 2,2) und 5 (2,11 - 17) des Papyrus E. Smith behandeln offensichtlich SHT, die nach aktueller Lehrmeinung als mittelschwer bis schwer klassifiziert werden können. Indizien hierfür sind die Erwähnung von Klaff-Wunden, also Kopfschwartendurchtrennung zusammen mit knöchernen Läsionen (Durchlöcherung des Schädelknochens/Splitterbruch), meningitischen Zeichen (Nackensteife/Unfähigkeit auf Brust und Schulter zu blicken), im Fall 5 zusätzlich die Blutung aus Nase und Ohren sowie die Nennung einer "Anschwellung", welche wohl als Kephalhämatom, schlimmstenfalls als prolapsus cerebri gedeutet werden könnte. Vermutlich sind die beiden letztgenannten Aspekte für die aus den Verdikten hervorgehende grundsätzliche Unterscheidung der beiden Fälle massgeblich. Allein die Gegensätze "behandelbar" und "nicht behandelbar" sind gebraucht, während die dritte Möglichkeit, das Verdikt "Eine Krankheit, mit der ich kämpfen werde", nicht in Betracht gezogen wird. Auffallend ist bei alledem, dass die Beschreibung der Symptomatik angesichts des zu vermutenden Schweregrades der Verwundungen doch etwas ärmlich ausfällt, denn in beiden Fällen hat es der ägyptische Arzt mit komplizierten, offenen Impressionsfrakturen zu tun, die zu einer umschriebenen kortikalen, wahrscheinlich auch tiefer gelegenen cerebralen Substanzschädigung und zu fokalen Funktionsstörungen geführt haben dürften. Einschränkend ist allerdings zu sagen, dass die klinische Symptomatik, die posttraumatische Entwicklung und der Ausgang des Geschehens wesentlich von der strukturellen Hirnläsion, d. h. dem Ort der gewebLichen Destruktion abhängig ist, wobei dieser im Text nicht näher bezeichnet wird, und gelegentlich auch komplizierte Impressionsfrakturen ohne Bewusstseinsstörung und korrespondierende cerebrale Anfälle einhergehen. Nichtsdestoweniger würde die Interpretation der Casus dadurch erleichert werden, wenn Informationen über eventuell abgelaufene Bewusstseinsstörungen, vegegative (Übelkeit, Erbrechen, Kreislaufkomplikationen) und otorhinologische (Anosmie, Rhino-liquorrhoe) Störungen, über Schwindel, fokale Krampfereignisse oder Störungen des Sehens, der Augenmotorik, der Pupillen, des Atemzentrums, der Motorik (z. B. Grimmasieren) mitgeteilt würden. Die Aufzählung dieser und anderer Zeichen demonstriert, wie "unvollständig" aus Gegenwartssicht die Präsentation und wie schwierig die Beurteilung der Fälle 3 und 5, aber auch der meisten anderen Fallbeispiele des "Wundenbuches" ist und in welch hohem Masse die Ausdeutung der Spekulation überlassen werden muss.

Individuum 232 c zeigt einen nahezu kompletten Verschluss des Knochendefektes im Frontale auf dem Niveau der Tabula interna und eine geglättete Randzone, die für ein längeres Überleben des Impressionstraumas beweisend sind. Nach heutiger neurochirurgischer Erkenntnis ist eine Impressionsfraktur dann behandlungsbedürftig, wenn Anteile der Kalotte um mehr als Schädeldachdicke gegen das Schädelinnere verlagert wurden. Im vorliegenden Fall beträgt diese Verlagerung ca. 80% der Kalottenstärke (ca. 1 cm, gemessen in der Traumazone). Keine Angaben lassen sich allerdings über wichtige zusätzliche Kriterien machen, etwa die Frage, ob eine offene oder eine unkomplizierte Fraktur mit Durazerreissung und Rindenkontusion durch imprimierte Knochenfragmente bei fehlender externer Weichteilverletzung vorgelegen hat. Vermutlich ist es nicht zu intrakraniellen Komplikationen (Hämatombildung, Hirnödem) gekommen, die zu einem protrahierten Verlauf geführt hätten und nicht beherrschbar gewesen wären. Sicher belegbar anhand der ossären Abdeckelung ist jedoch eine Splitterung des imprimierten Knochenareals. Eine nennenswerte infektionsbedingte Verzögerung der Wundheilung dürfte nicht stattgefunden haben, da bis auf eine medial und dorsal lokalisierte oberflächliche Arrodierung des Knochens keinerlei entzündliche Zeichen im Sinne einer Ostitis vorliegen. Eventuell ist durch gewebliche Irritation von aus dem Niveau der Interna teils scharfkantig herausragenden Knochensplittern zu posttraumatischen cerebralen Krampfanfällen gekommen. Als verursachende Waffe könnte eine Steinknaufkeule (Abb. 6, 5-9) benutzt worden sein. Die oben

erwähnte flache Ausbuchtung lateral, im Bereich der Randzone des Defektes weist auf eine gestielte Waffe hin und lässt es möglich erscheinen, dass der Hieb von links seitlich unten vorgenommen wurde.

Bei der verheilten, vom Defekt zum Orbitarand links reichenden Fraktur handelt es sich nicht um ein separates, zweites Trauma, sondern höchstwahrscheinlich um einen in Zusammenhang mit der Impressionsfraktur stehenden Berstungsbruch, bei dem es zu einer Eröffnung des Sinus frontalis gekommen sein dürfte. Auffälligkeiten, die für eine posttraumatische entzündliche Komplikation sprächen, lassen sich weder makroskopisch noch röntgenologisch verifizieren.

Schluss

Als einzigartes medizinhistorisches Dokument stellt das "Wundenbuch" des Papyrus E. Smith gegenwärtig die bedeutendste Quelle unseres Wissens über die Chirurgie Altägyptens dar und erst mit dem Corpus Hippocraticum der Griechen finden wir Vergleichbares, wenn auch auf einer fortentwickelten Ebene: der in der ägyptischen Medizin vorherrschende Praxisbezug wird hier um systematische Theorienbildung und -erprobung, gemeinhin als Wissenschaft bezeichnet, erweitert. Bemerkenswert ist, dass die Heilkunde der Spätzeit den Kriterien einer partiell empirisch ausgerichteten Diagnostik und Therapie nicht mehr standhält, sondern - auf eine archaische Stufe zurückgreifend - sukzessive von magischen Tendenzen überlagert wird. Entsprechende Texte bestätigen eine Mischung von objektiven Tatbeständen und Magie mit späterhin dominierender magischer Komponente, die schliesslich auch chirurgisches Terrain in Ansätzen erfasst. Dass hier der vergleichbar geringste Anteil "irrationaler" Elemente eingeflossen ist unterstreicht die Sonderstellung der Chirurgie innerhalb der medizinischen Disziplinen. Demgegenüber hat die Innere Medizin, als deren wichtigster Repräsentant der Papyrus Ebers gilt, zu keiner Zeit der altägyptischen Geschichte dieses hohe Mass an Sachlichkeit erlangen können. Einer der Gründe hierfür dürfte auf dem charakteristischen, vielen alten Kulturen eigenen Kausalitätsdenken, die Pathogenese von Krankheiten betreffend, beruhen, deren Auftreten meist als von aussen, d.h. durch extracorporal agierende okkulte Mächte verursacht angesehen wurde und die auf dem Gebiet der Traumatolgie in ihrer Ätiologie viel eher einsichtbar und beherrschbar waren, als auf irgendeinem anderen Sektor der Medizin. Neben den bereits weiter oben angedeuteten interpretativen Einschränkungen bzgl. der Parallelisierung von Text-Fallbeispielen und anthropologischem Fundobjekt, die nicht selten auf spekulative Konstruktionen zurückgreifen muss, existiert eine weitere, zum jetzigen Zeitpunkt nicht ausräumbare Unstimmigkeit, die an dieser Stelle angesprochen werden soll: die Diskrepanz zwischen den inhaltlichen Ausführungen des Papyrus und realer Therapie bzw. aktuellen Spuren medizinischer Behandlung am Untersuchungsobjekt. Bis heute ist der Nachweis einer solchen contemporär unternommenen Therapie nicht zufriedenstellend gelungen. Die bisher publizierten mutmasslichen Indizien - seien es solche aus dem Bereich der Knochenchirurgie oder Zahnheilkunde - werden oft aus unterschiedlichen Gründen - angezweifelt und können somit nicht zu einer endgültigen Klärung des Problems beitragen. Die verschiedentlich auch in Fachkreisen geäusserte Meinung, dass das in den medizinischen Papyri niedergelegte Wissen lediglich theoretische Funktion besessen und nie das Stadium der praktischen Umsetzung erreicht habe, entbehrt u.E. allein schon aufgrund der spezifischen Struktur des altägyptischen Medizinsystems jeglicher sinnvollen Grundlage, ganz ungeachtet der uns überlieferten zeigenössischen Berichte (Herodot Lib. II, 84 und Homer: Odyssee), die davon künden, dass es Spezialisierungen innerhalb der Ärzteschaft gab und ägyptische Ärzte an ausländischen Höfen lange Zeit wegen ihres Könnens begehrt und geschätzt waren (6, 7). Den eigentlichen Grund für die erschwerte Nachweisbarkeit von Behandlungsrelikten möchten wir dem Faktum zuschreiben, dass gerade diejenigen Bevölkerungsschichten, die sich eine ärztliche Versorgung leisten konnten, nach ihrem Tode mumifiziert wurden und die in diesem Zusammenhang angewandten diversen Techniken zu einer Auslöschung bzw. Vernichtung etwaiger Spuren in Form von Salben, Verbänden, Schienen etc. geführt

haben. Allerdings liefert dieses Argument keine Erklärung z. B. für das Fehlen übernähter und sich im Stadium der Heilung befindlichen Wunden (die auch nur entdeckt werden können, wenn dem Untersucher unbandagierte, ausgewickelte Mumien zur Verfügung stehen). Dies ist in den von uns überblickten, bisher untersuchten Serien eher die Ausnahme gewesen. Gerade in jüngster Zeit werden jedoch systematische Nachforschungen angestellt, deren Resultate, soweit heute bereits überschaubar, die bestehende Fundlücke schliessen helfen (9).

Abschliessend sei eine kritische Bemerkung angefügt: Beim Studium der schädelchirurgischen Fallbeispiele des Papyrus E. Smith fällt auf, dass sich diese durch eine relative Symptomarmut auszeichnen, d. h. dass - abgesehen von den Fällen 7 (3, 2 - 4, 4) und 8 (4, 5 - 18) - ausser den diagnostischen Hinweisen auf Bewusstlosigkeit, Blutung aus Ohren und Nase sowie meningitische Infektion, kaum ergänzende Symptome, wie sie häufig bei SHT vorkommen und zu denen besonders bei Hirnstammläsionen Störungen der Motorik, des Vegetativums und der Atemfunktion gehören, beschrieben werden. Es lässt sich schwerlich vorstellen, dass der konsultierte Wundarzt diesen, z. T. eindrucksvollen Leitbildern keine Aufmerksamkeit geschenkt bzw. diese nicht wahrgenommen haben soll, zumal die beiden oben genannten Casus einen deutlichen Beleg für die ausgeprägte Fähigkeit des altägyptischen Mediziners zu exakter Beobachtung darstellen. Auch dann, wenn man postuliert, dass tatsächlich einige der SHT, insbesondere diejenigen Fälle minderen Schweregrades ohne klassiche Befunde abgelaufen sind, ist es dennoch unwahrscheinlich, dass fast ausschliesslich solche in das Wundenbuch aufgenommen worden sein sollen. Wurde vielleicht die prognostische Relevanz derartiger Zeichen nicht erkannt? Oder waren diese "obligatorisch", so dass sie keiner gesonderten Notierung bedurften? Letztes ist eher anzunehmen, da es auch auf dem Gebiet der Therapie Parallelen zu geben scheint. So ist es undenkbar, dass die therapeutische Palette chirurgischer Massnahmen SHT betreffend, sich in der Applikation von Verbänden, Sympathiemitteln und der Anwendung der Nahttechnik erschöpfte. Vielmehr glauben wir, dass man sich daneben spezieller Verfahren bedient haben muss, zu denen als Primärversorgung die sogenannte Wundtoilette, d. h. die Säuberung der Wunde von Knochenfragmenten, aber möglicherweise auch die Glättung der Wundränder gehört hat. Angesichts derartiger Auffälligkeiten ist die Frage nach der wirklichen Funktion des Papyrus E. Smith erlaubt. Handelt es sich dabei tatsächlich um einen herkömmlichen Lehrtext?

Wir meinen nicht, jedenfalls nicht im Sinne eines erschöpfenden und ausreichenden Lehrbuches! Nach unserer Auffassung könnten die Fallbeispiele eher den Zweck eines "Memory" erfüllt haben, welches in Verbindung mit dem ärztlichen Basiswissen ein schnelles, stichwortartiges Zurechtfinden im Notfall ermöglichte oder auch dem Berufsneuling als abrisshaft komprimierte Orientierungshilfe gedient haben mag. Eine Überprüfung dieser Hypothese mittels systematischer Datensammlung und Vergleichsstudien an weiteren medizinischen Schriften steht noch aus.

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Radiography of an Egyptian "Cat Mummy". An Example of the Decadence of the Animal Worship in the Late Dynasties?*

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The radiological investigation of an ancient Egyptian "cat mummy" (Ptolemaic Period) reveals an up to now singular finding: The contents of the parcel could be identified as consisting of a head of an Egyptian sand cat, Felis silvestris libyca, and an imitation of the body compounded of a fractured human tibia and fibula. A fibular fragment seems to be pointed and pierced into the Foramen occipitale magnum. It is tried to integrate the finding in the context of the Late Period animal worship.

Keywords: "Cat mummy" - Composition of Animal and human bones - Ptolemaic Period - Ancient Egyptian animal worship.

Berichte wird über einen bisher singulären Befund an einer ägyptischen Tiermumie aus ptolemaischer Zeit. Bei der konventionellen Röntgenuntersuchung erwies sich ihr Inhalt als Kopf einer Katze (Felis silvestris lybica), während der Körper ein Imitat aus menschlicher Tibia und Fibula darstellte. Es wird versucht, den Befund in den Kontext des spätzeitlichen ägyptischen Tierkultes einzuordnen.

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Introduction

In the frame of the ancient Egyptian animal worship - notably during the last centuries B. C. - numerous mummies were made, among them a great number of cat mummies. Only relatively few of them have reached worldwide museum collections abroad. Their scientific examination which in the meantime has almost been concluded permits a classification in regard to their macroscopic and radiological appearance (Table 1).

In the course of recently undertaken investigations of Egyptian mummies the occasion arose to examine a not yet x-rayed object resembling to be a cat mummy. The object under investigation, a ca 32 cm bandaged mummy without a casket (Ill. NFM 10), is part of the Egyptian mummy collection of Niagara Falls Museum, Niagara Falls, Ontario, Canada (Fig. 1). According to the style of bandaging, the painting of the head

*) Dedicated to H. Winkler, Tübingen.

TABLE 1. Macroscopic appearance and radiological findings in the investigation of animal mummies resembling to be cats

Macroscopic appearance	Radiological finding
Mummy parcel (M.p.) in a coffin of cat-shape	
M.p. in a coffin in shape of a chapel with the relief of a cat	- Empty parcel - Mummy (dummy) with different filling material (gras, sand, earth, straw, etc.) - Skeleton of a cat - Skeletal fragments of a cat - Skeleton of another animal - Skeletal fragments of another animal
M.p. in a coffin of conventional shape (case) with a cat-statue on the cover	
M.p. mostly of longitudinal shape with coloring of the facial features indicating a cat	
M.p. of cylindrical shape with coloring and modelling of attributes resembling a cat	
M.p. mostly longitudinal in size of a cat but without indications to the mummified object	
M.p. indicating a cat or a dog because of modelling f.ex. head and tail	
+)	

with black ink and the typically sewed green thread weave, the object can be chronologically classified as belonging to the late phase of pharonic history, most probably to the Ptolemaic period.

Radiological examination

The ap (Fig. 2a+b) and lateral (Fig. 2c+d) x-rays reveal the contents of the mummy package to be that of an animal skull, exhibiting above all signs of occipital decay and a fractured lower jaw. The surrounding bandages are represented by darker, shadowed strips running lengthwise and crosswise. Soft tissue remains are still partially recognizable (Fig. 2a+d, arrows). The zoological classification of the animal is that of a cat (Felis silvestris lybica). In place of the missing postcranial skeleton, four bone fragments can be observed, one of which (Fig. 2c, fragment IV) appears to enter the foramen occipitale magnum, thereby demonstrating the link between head and rump. Comparative investigations as to the zoological classification of the fragments conclude that they are most probably those of a human skeleton. It can be assumed that fragment I (Fig. 2c) represents the proximal 2/3 of a human left tibia (ca 22 cm in length) and that fragments II and IV (16 cm and 6 cm in length, respectively) represent the corresponding segments of a human fibula. Although the proximal epiphysis appears to be missing, the corresponding sections of the tibia cannot be definitely assessed in this direction. It is possible that the proximal section of the epiphysis is missing here also. This could best be explained if the fragments had originally belonged to a young individual who had not yet reached the stage where these areas were permanently occluded. In our opinion, however, the total appearance of the fragments, especially the pronounced features of the corticalis

+) A further "animal mummy" from its outer appearance resembling to be a cat is stored in the Nrapstek Museum Prague (Inv. No. P. 24 95). In the opinion of Strouhal (1979) it seems to be a recent fake, due to the roentgenological contents consisting of a human humerus.

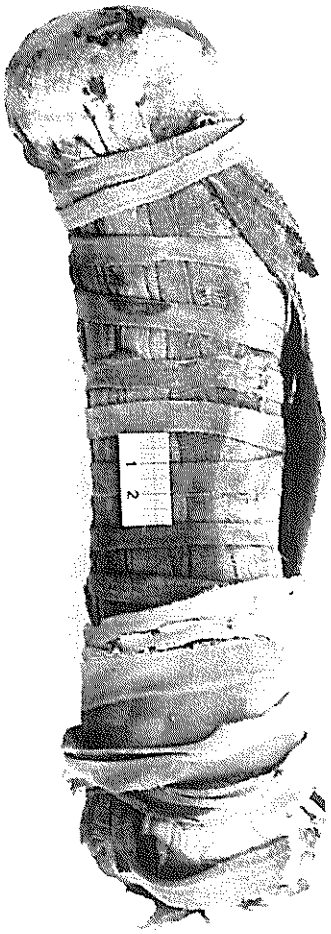

Fig. 1.
Animal mummy NFM 10 of longitudinal shape. Painted head. External appearance resembling to be a cat.

as well as the trabecular structure, would strongly favor those of an adult person. An epiphyseolysis, however, cannot be ruled out in early adult years. A definite assertation concerning the relationship of fragment III (Fig. 2c) to the fragments already mentioned, based on the available radiograms, is not possible. But it is most likely that fragment I (tibia) and fragment III belong together, whereby the latter could represent the distal portion.

Discussion

The cult of animals, as characteristic of the Egyptian religion in the last pre-Christian centuries, aroused scepsis and interest among Greek writers, amazement and ridicule among Roman commentators. Christian writers pointed to the cult as an example of the atavistic and excessive tendencies of paganism. In fact, the enthronement, care and welfare, as well as the Osirian burial were not, as in earlier times, limited to a single holy animal. For example, at approximately the time of the 18th Dynasty (1570-1293 B. C.)[1]

1) Chronology according to Baer, K., Oriental Institute of Chicago (cited according to Burleigh, 1980)

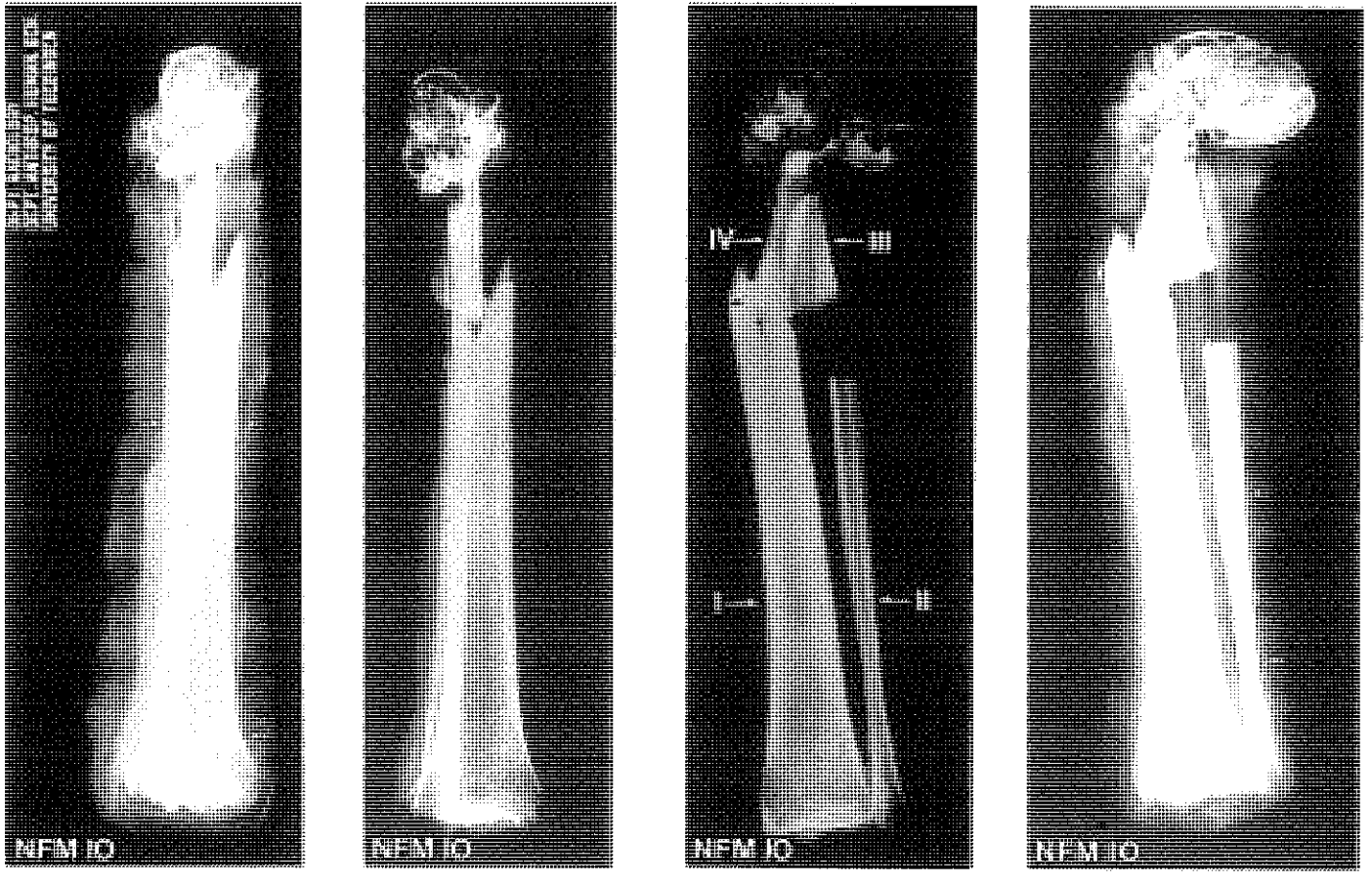

Fig. 2a-d. a) Radiograph showing the arrangement of bandages (a p projection). Fragment I (cf. Fig.c) must have been covered by skin when it was bandaged (slight layer of soft tissue on the bone indicated by arrows)
b) a p -projection demonstrating the structure of the proximal part of the tibia
c) Right lateral projection indicating the different fragments of bone (I-IV). Black arrows: possible joining of fragments done by the mummification priests
d) Right lateral projection to demonstrate bandages and soft tissue. Arrows: soft tissue remains

a certain Prince Thutmosis, the oldest son of Amenophis III, presented a limestone casket for a cat ("To the Osiris Ta-miat, the Justified"); the erection of the Serapeum in Memphis for the Apis animals was another example of this cult's practices. Later, however, all specimens of a specific holy animal were included in the cult. It was at this time that Herodotus could report that on the death of a cat, members of a household would have their eyebrows cut off (Herodotus, Lib. II, 68). It was also ordained during this time that whoever purposely killed a holy animal forfeited his life:[1] "And whoever intentionally kills on of these animals is put to death, unless it be a cat or an ibis that he kills; but if he kills one of these, whether intentionally or unintentionally, he is certainly put to death, for the common people gather in crowds and deal with the perpetrator most cruelly, sometimes doing this without waiting for a trial" (Diodours of Sicily, Lib. I, 83, 6-8).

Countless animal mummies of many different species- bulls, crocodiles, monkeys, dogs, cats, snakes, birds, ichneumons, etc. - date from this period of the animal cult's flowering, to which mummy NFM 10 also belongs. Its uniqueness is due to the combined presence of animal and human bones in a demonstrably genuine sample, which, in view of its decorative work, is doubtlessly recognizable as an animal mummy. As far as we know, such a combination has not yet been observed in Egyptian animal mummies even though there are cases (see Table I) where different types of filler material were employed to provide the adequate number of animal "sacrifices" when the required animals were not available. It is beyond doubt that the human bones employed served not only the function of filler material but also provided an imitation of a cat's body. This is easily recognizable in bone fragment No. IV (Fig. 2c) which was introduced into the foramen occipitale magnum. It even seems that fragment IV was especially modified, i.e. tapered, for this purpose, (Fig. 3, empty arrows). The question as to why only the head of the cat was mummified can only be speculated on. Possibly the rest of the body was separated from the trunk due to carnivores or other causes. A possible indication for such causes can be seen in the decayed occipital region, which eventually was affected by exterior intervention. Finally, the case of mummy NFM 10 raised the question of whether the human bones were recognized by the embalming priests as such and consciously used by them.

In this context it should be assumed that those responsible for preparing animal mummies were not identical to the priest class who were concerned with human mummies. Although the latter occassionally had the possibility to examine macerated or partially macerated skeleton parts and were presumably able to differentiate and topographically order larger bone fragments, those responsible for the animal cult did not possess such knowledge. It can therefore be assumed that human extremity bones were collected without knowledge of their origin and, in order to fit the rear cranial opening, correspondingly fractured. They were probably not recognized as human remains and regarded as belonging to an animal. Such findings, of course, do not represent anything exceptional when one assumes that the Egyptian soil and desert sand has been seeded since pre-historic times with thousands of corpses which were uncovered and scattered by wind erosion or dragged away by animals. Any trip to the interior of the country will easily confirm this process even today. We would go as far as to doubt that the complex ancient Egyptian

1) Studies by Armitage & Clutton-Block show that obvious exceptions were made to the priest class: the time of death of the examined cats with "2 peaks between 1 and 4 months and 9 and 12 months" point to death by violent means. This view is supported by the observation that some of the animals display extreme dislocation of the upper spine, a fact which would be compatible with animal sacrifice. "It may be surmised that cats were specially bred and reared until they were nearly full-grown. They were then killed, perhaps by strangling, and were made into mummies to be sold to the populace as votive offerings that were placed in sacred repositories" (p. 188).

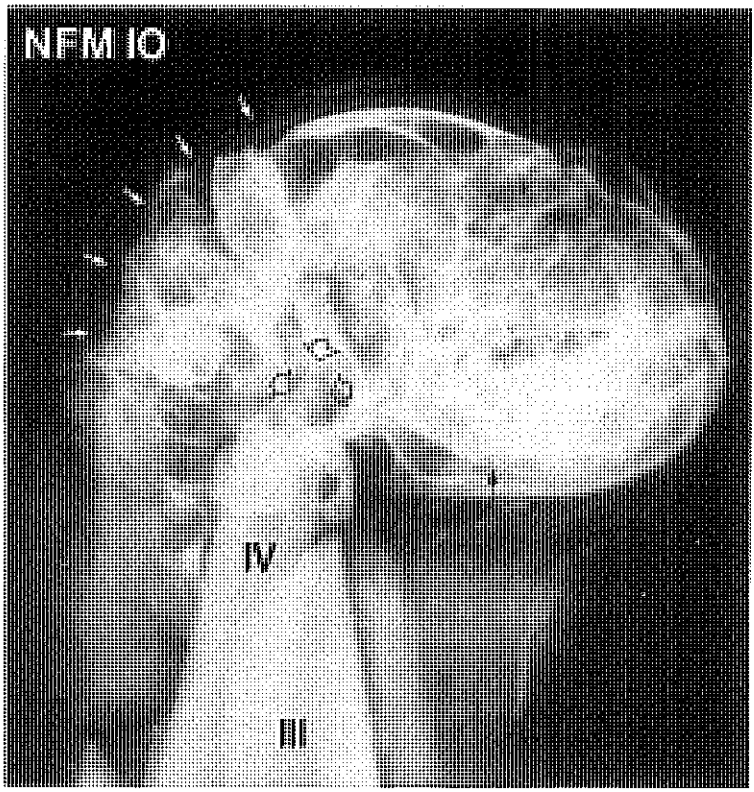

Fig. 3. Detail of the head of Felis silvestris lybica showing the fractured occipital (white arrows) and mandibular region (black arrow), the fragment III and IV. The empty arrows indicate that fragment IV is pierced in the skull most probably via the Foramen occipitale magnum.

view of the afterlife, which required corporal intactness in order to pass into the afterlife, had an inhibiting effect on the use of human remains. Radiological examination of mummies of the outgoing Egyptian dynasties too often point to factors which would demonstrate a crude and unprofessional treatment of the corpses, such as during evisceration or "fitting" a body too large into a too small casket.

Conclusion

The preparation of an animal mummy in use of bones of animal and human origin represents a unique finding in animal mummy research to date. Similar curious cases are found separately in the technical literature. In contrast to the case at hand, these cases concern mummies of anthropomorphic appearance, such as packages of infant mummies, in which radiological examination reveals animal skeletons as well as parts of human skeletons to be present (Fig. 4) (see Diener 1969/1973/1980). A subsequent explanation of the reasons and motives for such procedures, especially when one considers the rarity of such objects, cannot be given easily. The x-ray findings of mummy NFM 10, however, help at least for the moment to broaden the above Table 1 and is probably a further contribution to complete the modern scientific image of the latest dynasties' animal cult with its manifold and often excessive characteristics.

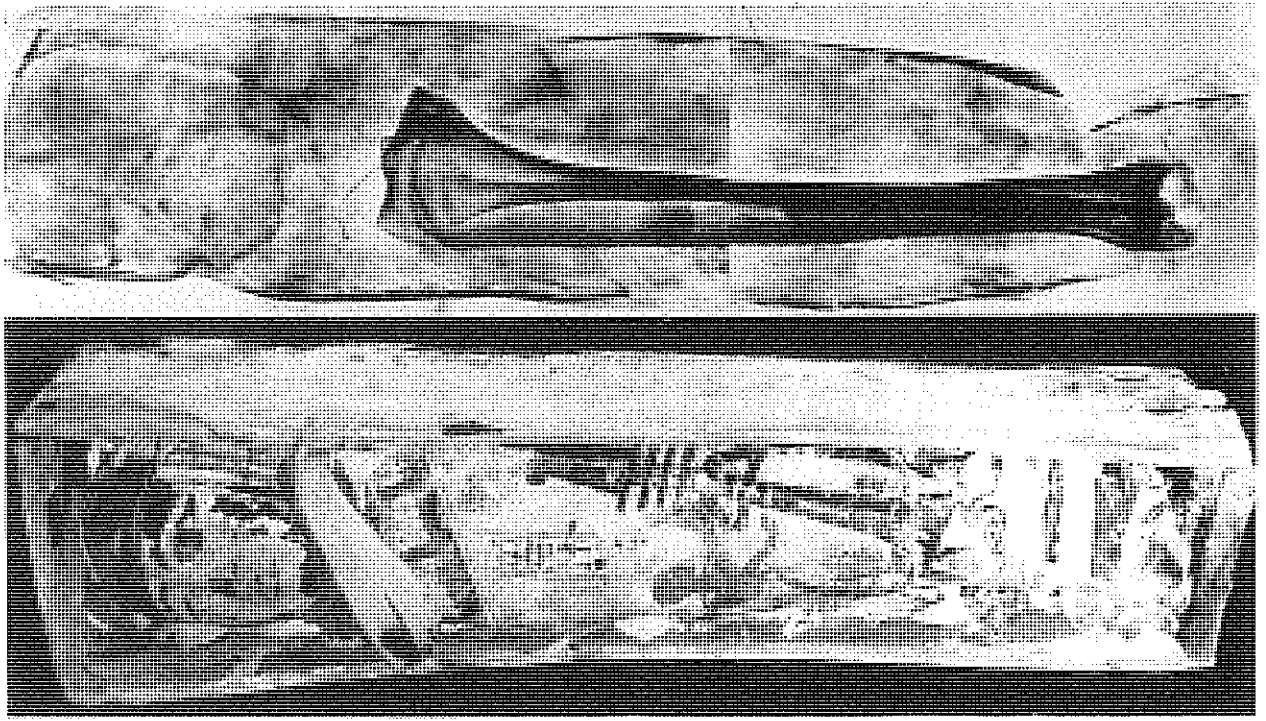

Fig. 4. "Child mummy" of probable 21st Dynasty date, containing the lower leg bones of an adult human individual (Mus. Mediterranean and Near Eastern Antiquities: inv. NME 12). (By courtesy of Dr. L. Diener, Stockholm)

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A Review of British Trepanations with Reports on two New Cases

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OSSA

Two hitherto undescribed specimens of trepanation in Britain are described. A medieval specimen exhibits two incomplete scraped lesions of the left parietal bone in which bone remodelling had occurred. A sixth century AD specimen exhibits a complete scraped trepanation of the left parietal bone in which there is also a linear injury. Bone remodelling of both lesions had occurred and it is suggested that the trepanation may have been performed as a sequel to the linear injury.

Recorded trepanations in Britain are reviewed. Four Neolithic, five Bronze Age, one Iron Age, three Romano-British, ten post-Roman and three undated examples are described. One postmortem trepanation is identified, and one multiple antemortem trepanation is noted. With advancing time there seems to be developing a preference of operative method from grooving to scraping. Use of a surgical burr is uncommon. Drilling and sawing methods of operation are unknown in Britain. Magico-ritual and therapeutic indications for trepanations in antiquity are considered.

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Introduction

Trepanation is the purposeful surgical procedure by which a full-thickness fragment of cranium is removed. It is the oldest surgical operation known. Specimens exhibiting the lesion of trepanation are known from the Neolithic era and have been recognised from all subsequent periods. Quite possibly the operation was performed more commonly in the Neolithic than at any other period, and findings in the chambered tombs of the Seine-Oise-Marne region suggest that the procedure gained particular favour there at that time. Trepanation was geographically widespread with examples from prehistoric and historic periods in Europe, Asia, the Middle East, South America, Africa and Oceania. Seemingly the operation was carried out contemporaneously in areas and societies widely separated geographically and between which there is no evidence of contact or exchange of ideas and ritual. This independent development of a philosophy concerning cranial surgery, a bizarre, dangerous and therapeutically sterile practice in distant antiquity, is an enigma. What prompted early man to perform and to accept a surgical procedure which must surely have demonstrated a high operative mortality, is beyond our modern sensibility.

In osteoarchaeological contexts, five methods of trepanation are recognised. A method of sawing removed a roughly quadrilateral fragment of cranium and, from purely geometric considerations, was rarely, if ever, compatible with survival. A system of drill perforation with interconnection carried similar high mortality rates. Neither of these methods is recognised in British material. A grooving method is recognised in which a circular groove delineating a roundel was cut through the cranium by a progressive, and probably unidirectional, scraping of the surface of the cranium. In many cases this saucer-shaped lesion has a small endocranial perforation but a large area of outer table loss. Because of the greater operative control at the moment of inner table perforation, this method confers greater operative survival than the other methods employed in early

societies. It is perhaps significant, therefore, that this scraping method was the method of choice in Britain. The use of a surgical burr was an uncommon practice in the early periods but gained favour in post-medieval and modern times. Whatever method of cranial perforation was employed, the initial operative procedures of scalp incision and reflection, and extra-cranial soft tissue incision, must have been conducted. It is not possible to determine whether trepanation was carried out on the conscious or unconscious patient. It is not possible to determine whether some primitive method of anaesthesia was employed. Indeed, in those examples of presumed operative death, it is rarely possible to determine whether the operation was carried out as an antemortem or as a postmortem practice.

A review of British trepanations

Neolithic Period

1. Fussell's Lodge, Wiltshire (Ashbee, 1966)

During excavations at Fussell's Lodge long barrow two fragmentary skulls were found which were thought to have been trepanned. One skull came from a group of bone labelled 'B', the other from group 'E'. These deposits were two of four discrete collections of inhumed bone (some of this bone had suffered incidental burning), which formed a wedge shape within the barrow. Group 'B' contained skulls and long bones and group 'E' represented the bone which was found randomly distributed throughout the surrounding cairn. Neither group of bones had associated artefacts. The bones from group 'B' were thought to represent the remains of 5 males, 1 possible male, 3 females and 2 probable females; there are also the remains of 11 children. A breakdown of the sex distribution for group 'E' bones is not possible because of the very fragmentary nature of the material. Despite this it is thought that both the trepanned skulls are from male skeletons.

The lesions of these skulls are as follows:

a) Skull 11 (group 'B') has a depression in the right parietal which is only visible on the external surface of the skull. Due to the fragmentary condition of the bone, it is not known whether the trepanation originally perforated the cranium. The lesion has a maximum diameter of 20 mm and has smooth edges. This latter suggests bone remodelling associated with healing.

b) The second skull is more fragmentary than the first and only a third of the site of the lesion remains. In addition, the bone is blackened and charred. Despite these difficulties it was possible to see that this trepanation was very similar to the other one, having a maximum diameter of 20 mm and showing signs of healing. As with the first skull, there is uncertainty as to whether the skull would originally have been perforated.

2. Bisley, Gloucestershire (Parry, 1921)

A trepanned skull was found from a long barrow at Bisley, Gloucestershire. The provenance of the skull suggests that it was not in primary association with the barrow. The report of the trepanation (Parry, 1921) did not make any mention of the presence of any associated material.

The trepanation is on the right frontal bone and exposes part of the frontal sinus. It takes the form of a circular groove which does not perforate the cranium. The groove delimits an elliptical area of bone whose dimensions are 31 mm x 28 mm. The furrow itself varies in width from 3.5 mm to 4.75 mm. On the endocranial surface, corresponding to the lesion site, is an area of bone from which the inner table has been lost. This last, in conjunction with a portion of the groove which is deeper, suggests that the surgeon, having gouged the furrow to a certain depth, intended to lever the remaining bone out rather than risk damaging the dura mater by gouging the whole way through. The characteristics of this trepanation suggest that it is incomplete, the individual having died from the operation before it could be finished.

3. Maiden Castle, Dorset (Wheeler, 1943)

Whilst excavating at Maiden Castle, Wheeler found the burial of a badly mutilated and trepanned male of 25-35 years of age. The burial was situated at the eastern end and on the central line of a neolithic earthwork. Adjacent to the burial was a ritual pit containing pottery, shells and animal bones which, it is thought, was associated with the burial.

The lesions of the mutilation are extensive and are as follows:
a) The frontal bone exhibits linear wounds with some loss of very small fragments.
b) The base of the skull has a cut along a transverse line extending from the level of the foramen magnum. The line is then continued across the mastoid to the right of the squamous temporal bone. Much of this bone is missing.
c) On the left parietal bone several cuts have been made with the possible intention of removing a roundel of bone. The method by which this was attempted has no known British parallel. It is thought that a flint tool was placed on the outer surface of the skull and struck on its butt end. Most of the bone was removed in this fashion but the final portion seems to have broken off.
d) On the occipital bone there are signs of cutting but no bone has been removed. In addition to the head wounds there are extensive injuries to the postcranial skeleton.

In the discussion of these injuries the author (Morant, 1943) postulated a sequence of events:
(i) Trepanation of the left parietal bone with the intention of removing the brain.
(ii) Damage to the rest of the skull when it was found that the trepanation was insufficient to complete the objective.

Bronze Age

1. Amesbury G71, Wiltshire (Christie, 1967)

When the three-phase round barrow of Amesbury G71 was excavated a skeleton of a man 20-30 years old at death was discovered in the upper fill of an outer ditch. The skull from this skeleton appears to have been trepanned. A C14 date, extracted from associated material, gave a date of 1640BC.

The trepanation is situated at the back of the skull to the right of the sagittal suture, and it involved cutting through both parietal bones and the occipital bone. The trepanation is an irregularly shaped orifice which shows some evidence of attempts having been made to square off the hole. Remodelling of bone at the edges of the lesion indicates that healing had occurred.

There were two other skeletons found in the ditch. One was that of an adolescent, the other of a child. All three burials were contracted burials, and the trepanned skeleton and that of the child were orientated with their heads to the east. The head of the adolescent skeleton faced south-west. The trepanned skeleton differed from the other two in three respects:
a) The skeleton lay on its right side whilst the other two lay on their left sides.
b) The skull had been covered with flints.
c) The soil around the skull was flecked with charcoal.

2. Amesbury 51, Wiltshire (Ashbee, 1975-6)

A second barrow (51) from Amesbury was excavated by Ashbee and was found to contain a possible trepanned skull. The excavation showed that the barrow had a central cave and a wooden mortuary chamber. The bones were found in the centre of the barrow and belonged to an adult male of about 20-30 years at death. A long-necked beaker, a bronze awl, an antler strip, a flint scraper, a roe deer antler point, a horn core and an oak object were found with the skeleton. An oak board covered the burial.

Although incomplete, the fragments of the skull are sufficient to show the position and the extent of the trepanation. The pieces of the surrounding bone come from the

temporal, frontal, parietal and occipital bones. The roundel is roughly circular and has well cut margins, as have the fragments. It is probable that the roundel was removed by the gradual deepening of a groove. The roundel has a maximum diameter of 115 mm (Brothwell, Powers & Denston, 1975-6).

The trepanation is similar to the one from Crichel Down. Both are larger than the other trepanations being discussed and this may have been the reason for their apparent failure; if indeed they were intended to succeed.

3. Crichel Down, Dorset (Piggott, 1940)

In 1938 a collection of barrows at Crichel Down was investigated (Piggott, 1940). One barrow contained the inhumed remains of a trepanned individual. The skeleton was in a shallow grave and lay on its side with the head bent slightly forward. The legs were drawn up so that the heels nearly touched the pelvis. The left arm was extended and the right arm flexed so that the hand was resting on the shoulder. A beaker of B1 variety was associated with the burial and lay at the foot of the grave, on its side, with the base touching the right tibia of the skeleton. The trepanation had been carried out by the grooving method and is situated in the left parietal bone. Some cracking of the inner table has occurred but it is thought that this was a deliberate act to protect the dura mater from injury when the groove was finally perforated. There is no evidence of healing around the wound and the individual may have died as a result of the operation.

4. Traigh Bhan, Islay, Argyllshire (Ritchie & Stevenson, 1982)

In 1980 three cists, dated to the second half of the second millenium BC, were excavated at Traigh Bhan. In the first of the cists were the remains of two individuals. The primary internment is that of a woman 30-35 years old and the second a male of 17-25 years of age. The female skeleton was covered by a slab and lay at the south-west end of the cist. The male skeleton lay parallel to the female. A food vessel was associated with the female burial and five fragments of flints were associated with the burials as a whole. The skull of the male skeleton had been trepanned.

Although this skull is in several pieces, it is possible to determine that there are two holes anterior to the bregma. One situated to the right of the midline measures 19 x 90 mm. The other is situated to the left of the midline and measures 20 x 10 mm. It is thought that the hole on the left was made some time before that on the right. There is also evidence for alveolar bone resorption and a dental abscess.

5. Eynsham, Oxfordshire (Leeds, 1938)

At the beaker cemetery site of Foxley Farm, Eynsham eighteen graves were discovered. All but one one of the formally excavated graves were orientated north-south. Nine skeletons lay on their left side, two on their right and one supine. The graves were rectangular and each skeleton was surrounded by grey-black ash.

One grave contained the remains of a male skeleton of about 50 years at death, whose skull had been trepanned. The skeleton lay on its left side with both knees flexed. There were no associated grave goods. However, there was a collection of cremated female bone behind the skeleton and in contact with the pelvis. The report by Leeds did not provide details of the trepanation.

Iron Age

1. Hunsbury, Northamptonshire (Parry, 1921)

According to the report on this trepanation, the operation was, without doubt, post-mortem. The skull has three perpendicular holes drilled into the calvarium. The holes are arranged in a rough triangle, one perforating the sagittal suture and the other two slightly anterior to the first on either side of the sagittal suture. The characteristics of the holes

suggests that they have been bored with a metal tool.

The skull was found by Pitt-Rivers (Pitt-Rivers, 1892) in or around the Iron Age camp of Hunsbury. It was mentioned in the published report as a trepanation.

Romano-British

1. Whitchurch, Shropshire (Jones & Webster, 1968)

Beneath the floor of building III at the Roman site of Whitchurch, a skeleton of a 20-30 year old man was discovered. The interest generated by this intramural burial was increased when it was discovered that the skull of the skeleton had been trephined (i. e. trepanation with a specially designed tool known as a trephine). As such, it is one of only two examples so far found in Britain.

The hole produced by the trephine has perpendicular sides and a diameter of a little over 27 mm. As there is no evidence of healing it is possible that the individual died as a result of the trephination.

One final important aspect of this skeleton is the absence of pathology with the exception of advanced caries in a right mandibular third molar.

2. Cirencester, Gloustershire (McWhirr, Viner & Wells, 1982)

Inhumation 305 from the Romano-British cemetery at Cirencester contained a very interesting trepanned skull. The skeleton is that of a man 45-55 years old at death. The burial was on a north-south line and was in a supine position. The grave had a scatter of six nails but no other grave goods.

This trepanation is associated with an extensive linear wound which had cut and depressed a large area of bone measuring 56 x 46 x 37 mm. There is marked remodelling of the edges of the lesion which indicates that healing has taken place. It is thought that it may be the result of a sword cut.

The trepanation on this skull is on the right frontal bone and extends from the midline about 32 mm anterior to the coronal suture. The wound is elliptical and its long axis lies in the coronal plane. The trepanation measures 42 x 21 mm and has smoothly bevelled edges posteriorly, laterally and medially. Anteriorly there is a small ridge of bone.

The final reason for interest in this particular skull is that it is one of the few decapitated skulls in the cemetery.

3. York, Yorkshire (Brothwell, 1974)

A trephined skull of the Roman period was discovered from a cemetery excavated in the 19th century in advance of building a railway station.

The trephination is situated in the left mastoid region near the parietal notch. There is no evidence of healing or infection on the bone surrounding the cut. There is, however, a small area of pitting on the surface of the unexcised roundel. It is possible that this pitting is the result of infection and it is this that has provided the motivation for the operation. As the skull has received some post-mortem damage this may, of course, be the result of erosion.

Post-Roman

1. Swaffham, Norfolk (Wells, 1974)

Inhumation 'A' from the Paddocks cemetery, Swaffham contained the remains of two individuals, one male and one female. The male was 30-40 years of age at death and had been trepanned. The orientation, associations and condition of the burial are not known as the burial was discovered accidentally.

The hole in the skull is elliptical with its long axis on the obleionic region of the parietal bone. The floor of the groove has been perforated and extends across the sagittal suture

to involve the right parietal bone. The edges of the lesion are bevelled and smooth and the margins are remodelled. The dimensions of the lesion are as follows:

anteroposterior	42.8 mm
transverse	22.5 mm
orifice	16.4 x 10.7 mm
angle of the bevel (sides)	50°
angle of the bevel (ends)	30°

In addition to these features, the healing of the trepanation has left a small ridge of new bone growth approximately 1 mm in height on the margin. The area of trepanation shows no evidence of infection.

2. Swaffham, Norfolk (Wells, 1974)

Inhumation 7 from the same cemetery contained a male skeleton aged 40-55 years which had been trepanned. The individual was buried in an extended position and on a west-east orientation. The associated artefacts included a large iron spearhead found to the right of the skull and a small iron knife found at the wrist. The spear dates the burial to no earlier than the 6th century AD.

The opening in the skull is elliptical with the long axis close to the sagittal plane. The hole is 20 mm to the right of the sagittal suture and 18 mm anterior to the lamboid suture. The dimensions are as follows:

anteroposterior	41.2 mm
transverse	21.5 mm
orifice	12.3 x 8.4 mm
angle of the bevel (sides)	45°
angle of the bevel (ends)	30°

As with the other trepanations from this cemetery, there is a low ridge of bone on the medial margin of the lesion and there is no evidence of infection.

3. Eriswell, Suffolk (Wells, 1974)

Excavations at the sixth century AD cemetery of Eriswell discovered the burial of a skeleton with a trepanned skull. It is reported to be the grave of a male of 30-35 years of age.

The opening in the skull is elliptical with the long axis in the mid sagittal plane. The dimensions are:

anteroposterior	22.5 mm
transverse	13.2 x 9.8 mm
angle of bevel (sides)	45°
angle of bevel (ends)	30°

The trepanation has healed without infection taking place. As with the two previous trepanations, there is new bone growth around the margin of the lesion.

There is also thought to be a second trepanation from this site from inhumation 22 (Wells, unpublished).

4. Grimston 'B', Norfolk (Wells, 1974)

During excavations at this cemetery site the remains of a man aged 30-40 years were found and included what was thought to have been a trepanned skull.

The trepanation is elliptical and located in the anterior third of the right parietal bone. The long axis of the lesion is close to the sagittal plane, lying about 32.2 mm to the right of the sagittal suture and 5 mm posterior to the coronal suture. The dimensions of the lesion are as follows:

anteroposterior	41.4 mm
transverse	20.8 mm
orifice	9.5 x 4.1 mm
angle of bevel (sides)	45°
angle of bevel (ends)	27°

There is no evidence of infection and healing has occurred.

There is a second depression in this skull which is also thought to be trepanation. It is situated on the left side of the frontal bone and is elliptical in shape. It crosses the coronal suture. There is no original opening at the base of the depression however, and the bone is well healed. The incomplete nature of the trepanation suggests that it was not the cause of death. The dimensions are:

anteroposterior	39 mm
transverse	22.8 mm

5. Watton, Hertfordshire (Wells, 1974)

The trepanned skull found at Watton was uncovered by a mechanical digger and therefore has no provenance or valid associations.

The skull is that of a male of 25-35 years old. The opening in the skull is elliptical and is situated on the left side of the frontal bone. The long axis of the trepanation is in the sagittal plane and the edges of the lesion lie approximately 9 mm from the midline of the skull. The dimensions of the lesion are as follows:

anteroposterior	37.8 mm
transverse	21.7 mm
orifice	14.8 x 6.1 mm
angle of the bevel (sides)	40°
angle of the bevel (ends)	25°

There is no evidence of infection and the margins of the lesion are smoothly bevelled.

Wells, who reported the last five skulls, was of the opinion that, because of the similarities between the lesions, these trepanations should be considered contemporary. Indeed, he went further and suggested that one could postulate that all the trepanations had been done by the same tool and the same trepanner. Certainly all the lesions do have common characteristics.

6. Lyminge, Kent (Warhurst, 1955)

The cemetery of Lyminge is a row cemetery of extended inhumations with a majority orientation of west-east. Grave 34 was the burial of a 40-60 year old man buried in a supine position without grave goods. As such, his burial followed the trends of the cemetery. This individual had, however, been trepanned.

The trepanation is situated in the left parietal bone, 120 mm from the sagittal suture and with a diameter of 40 mm.

7. Snells Corner, Horndean, Hampshire (Cave, 1955-7)

The Anglo-Saxon cemetery at Snells Corner contained 33 inhumations. The orientation of the burials were south by sout-west and north-north-east. One of these inhumations, inhumation 22, exhibited evidence of having been trepanned.

The burial of the trepanned man was orientated south-south-west and the body was positioned as follows: the arms were by the side, the left hand was beneath the right femur, the left leg was straight and the right leg was bent to the right. There was a collection of associated material with the burial which included an iron knife found between the elbow and the spine, a smaller knife found near to the point of the first knife, a plain bronze buckle and two human teeth. The teeth were not thought to belong to the skeleton.

The cranial lesion, which is thought to be a trepanation is situated in the centre of the frontal bone. It is almost circular and has smooth edges. There is a second lesion in this skull located at the posterior aspect of the skull. It is a linear cut 88 mm in length and is not thought to be a trepanation.

8. Sleaford (graves 5 and 12), Lincolnshire (Ashbee, 1975-6)

There is no reference to trepanations in the original report of this excavation. However, it is thought that the two graves (5 and 12) do contain possible trepanations (Brothwell et al., in Ashbee, 1975-6). In the original report the bones are described as relics which suggests that they are fragmentary. Despite this, measurements have been obtained for the lesions. The trepanation from grave 12 is 71 mm by 41 mm and is situated in the right parietal. The trepanation is well healed. The skull from grave 5 has an elliptical hole in the fronto-parietal region close to the bregma. It has a maximum diameter of 65 mm and is also healed.

Undated specimens

There are four undated trepanations, two of which were discovered in rivers and two from contexts which prevent a date being postulated for them.

1. The River Skulls (Parry, 1921)

The first of these two skulls comes from the River Wear, the other from the Thames near to Hammersmith Bridge. There was no associated material so it is therefore impossible to know from which period these skulls might have come.

2. The Edinburgh Skull (Parry, 1921)

This skull was rediscovered by Parry in the Edinburgh Museum. It was believed to be prehistoric but there was no definite knowledge of the skull's provenance or date. The skull was of added interest because it appeared to be that of a negroid type.

3. The Rothwell Skull (Parry, 1921)

This skull was discovered in the crypt of the church at Rothwell, Northamptonshire. As it was one of thousands of bones found in the crypt it was impossible to determine from what date it might have come.

New specimens

1. An Anglo-Saxon trepanation from Willoughby-on-the Wolds

Excavation at Willoughby-on-the-Wolds, close to the Fosse Way and south-east of Nottingham, uncovered a total of 105 burials from the sixth century AD. During recent examination of the skeletal material from the site, an example of trepanation was isolated. This specimen comes from a triple burial (62/63/64) on the site. It was unfortunately not possible to distinguish the separate skeletons due to confusion of the bone assemblage. The bones were accompanied by a collection of bronze grave goods and glass and clay beads.

The only part of the skeleton on which it is possible to comment is the cranium. The majority of the left parietal and occipital bones survive, whilst the anterior part of the right parietal bone is missing. Approximately half of the left and less of the right temporal bones are present.

The partially reconstructed cranium has suffered from post-mortem damage either in the ground or during excavation. However, the bone itself is in a good state of preservation. Morphologically the remains appear to be female. Accurate age estimation was

not possible due to the incomplete nature of the remains. However, the degree of union of the cranial sutures suggests that the individual was a mature/elderly adult.

It was not possible to take any cranial measurements due to the incompleteness of the skeleton. The pitting of the parietal and occipital bones indicates the presence of porotic hyperostosis, a condition associated with chronic anaemia.

In the mid-anterior area of the left parietal bone are two lesions. The first is a linear injury (Fig. 1a) 52 mm long and 7 mm wide, running parallel with the sagittal suture. Medial to the injury is an oval depression in the skull (Fig. 1b). This lesion is 32 mm long and 17 mm wide with its long axis parallel to the wound. In the centre of the depression is a small hole 3 mm x 4 mm which extends through the three layers of the skull. The opening on the endocranial surface is the same size (Fig. 2).

Both lesions have smooth remodelled edges which indicate healing. There is superficial inflammatory change anterior to the depression at the posterior end of the wound.

It is suggested that the two lesions represent an initial injury, probably by a blunt object, with subsequent trepanation using the scraping method. It is possible that the trepanation was performed in response to the injury but this cannot be proven. Healing is evident and suggests that the individual survived both events and lived for a considerable length of time.

2. A partial trepanation of the medieval period from Ilkley, West Yorkshire

In 1982/83 excavation was carried out at the base of the tower within the church of All Saints at Ilkley, Yorkshire. The work was carried out preparatory to the resiting of three pre-Norman Conquest crosses within the interior of the Church. Approximately ten late medieval inhumations were discovered in the area of the excavation. No significant abnormality was found in these fragmentary and incomplete remains, with the exception of the present case.

A single skeleton was found lying immediately beneath and east of reused Roman stones which lay at the junction of the end of the tower and the nave. These stones probably came from the headquarters building of the Roman fortress of Olicana, which previously occupied the site. The burial orientation was east-west with the skull lying to the west. Most of the postcranial skeleton lay beneath the floor of the nave and was beyond the limits of the excavation. Dating of this skeleton from archaeological features was not possible, but it was probably from earlier in the medieval period than the outer burials. It may date from an early phase, possibly pre-Norman Conquest, in the history of the Church.

The skeletal remains

The specimen consists of a skull and upper four cervical vertebrae. The cranial base and the facial skeleton are fragmentary and incomplete. The right mandibular condyle is fragmentary. There has been some postmortem cranial deformation with opening of the left lamboid suture.

Morphologically the remains are considered to be those of a female. Age estimation from molar attrition assessment is not possible because of the antemortem absence of these teeth. The posterior segment of the sagittal suture and the lateral segments of the coronal suture are ossified. It is likely therefore that the individual was a mature/elderly adult at death. Estimation of stature is not possible.

Although the cranium has a somewhat globular shape with some frontal bossing, and has a small palate relative to the remainder of the cranium, no significant pathological lesions other than that to be described are evident. The endocranial surface of the calvarium appears normal, with some areas of postmortem surface erosion.

In the anterosuperior quadrant of the left parietal bone there are two lesions (Fig. 3). There is a superficial depression of the extracranial surface. It is approximately 20 mm

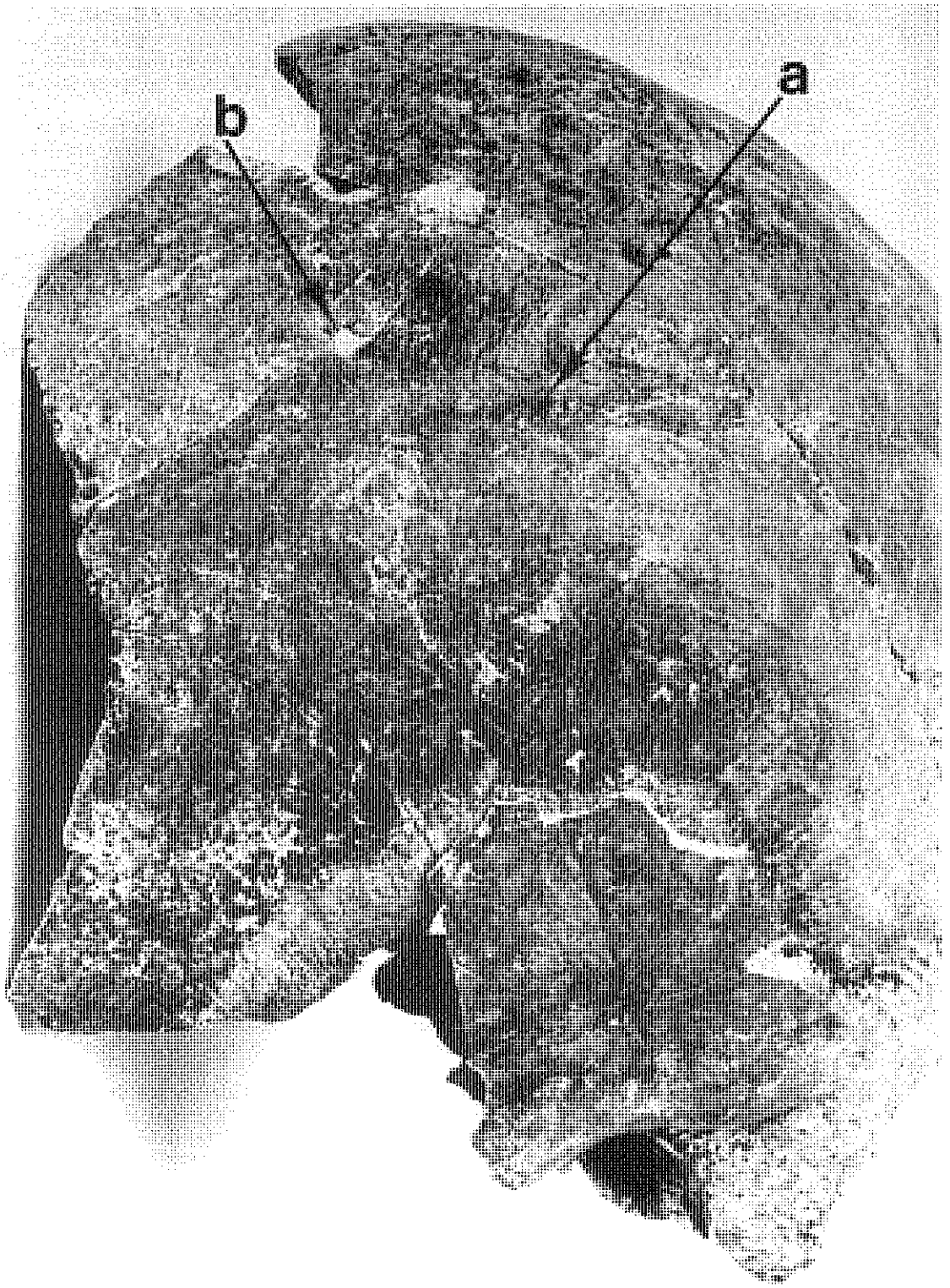

Fig. 1. Willoughby-on-the-Wolds. Cranium. Left lateral view. External surface.
a. Linear injury of left parietal bone; b. Trepanation.

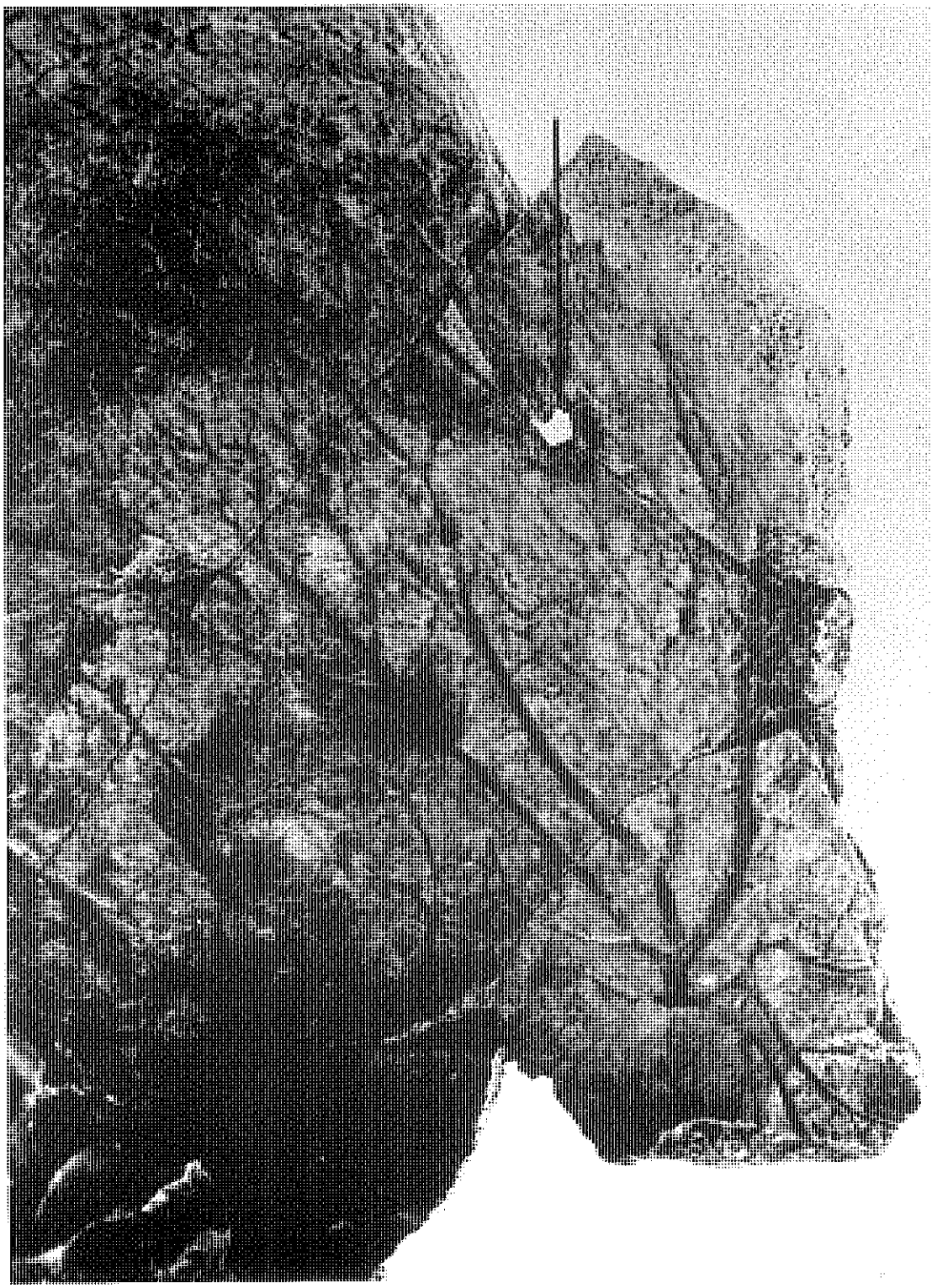

Fig. 2. Willoughby-on-the-Wolds. Cranium. Endocranial surface. Arrowed: orifice of trepanation.

Fig. 3. Ilkley. Cranium. Oblique left posterolateral view. Arrowed: trepanation.

in width and 15 mm in length, with the long axis in the left bregma-asterion plane (Fig. 4a). The lesion does not extend through the outer table of the skull. Continuous with and anteromedial to this lesion there is a further depression 40 mm long and 35 mm wide with the long axis in the transverse plane (Fig. 4b). This lesion extends into but not through the diploe. The edges of the two lesions are smooth due to bone remodelling. The diploic base of the larger lesion is reorganised with little of the original diploic tissue being evident. Although the extracranial surface surrounding the lesions is lighter in colour than the rest of the calvarium, there is no evidence of inflammatory disease of the bone. Both lesions are saucer-shaped. It is suggested that these two lesions are the results of attempted trepanation. That the lesions represent incomplete trepanation and not partially healed complete trepanation is attested by the intact endocranial surface at the site. The lesions were not produced by the use of a surgical burr but were affected by a scraping method probably delivered in an anteroposterior direction. The smooth remodelled edges of the lesions suggest healing and therefore survival of the individual. Because in one lesion there was removal of the complete outer table with exposure of the diploe, it is considered that these lesions are not the result of anatomical parietal bone thinning.

The technique of operation in this case is fairly clear. The reason for the operation is unknown. Survival from such an open operation with the potentiality for infection is perhaps remarkable, but by no means unique in trepanation in Britain. There was likely to have been effective antibacterial wound care given to the scalp, albeit in ignorance of the nature of infective disease.

Discussion

Ever since the recognition of trepanation in prehistory, two main reasons have been adduced for its practice; it is generally thought to have had either religious or medical significance. In addition, it has been observed, in contemporary primitive societies, to have been a matter of fashion and an aid to longevity (Crump, 1901). However, these motives have been drawn from evidence of locations other than Britain. Although ethnographic evidence is valuable in offering guidelines to prehistoric behaviour stringent codes must be applied to the kind of data that is collected and used. In the case of trepanation, it is the belief of the authors that these codes have not been met. In most cases the evidence was collected in isolation and significant data is absent. As a result, ethnographic data is only referred to when it can offer ideas as to the type of condition treated by trepanation.

Here, the proposal is that the two motives outlined above should not be considered discrete but rather as complementary. In order to validate this hypothesis the evidence set out in the preceding pages will be considered as it fulfills the criteria for religious or medical significance.

Trepanation as a religious phenomenon

In considering trepanation as a purely religious phenomenon it is vital to remember that, as is so often the case, the archaeologist is being asked to explain the intangible with the tangible. It is virtually impossible to recreate the religious feelings of prehistoric man, but this is what must be done if the social context into which the operation fits is to be determined.

These drawbacks have not, however, prevented the formulation of theories emphasising the religious nature of the operation. Certainly there is some evidence that the trepanation might have been performed as part of a religious ritual. Indeed, from the discoveries in South America and parts of Europe, particularly France, the evidence suggests that it is justifiable to do this.

The criterion by which a trepanation may be regarded as having some ritual significance is that there is an indication in the archaeological or skeletal record of differen-

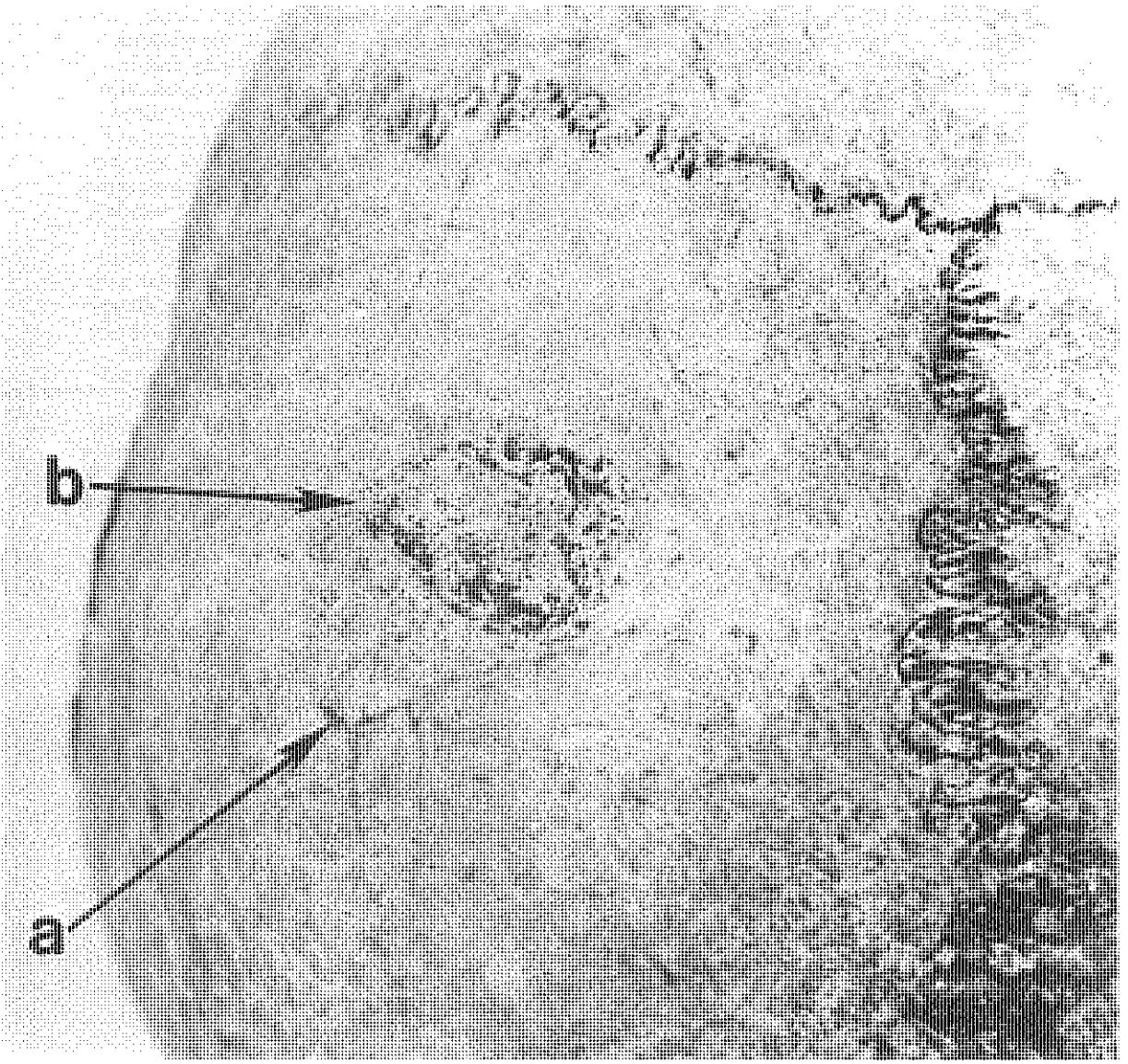

Fig. 4. Ilkley. Cranium. Superior view. External surface.
a. Partial trepanation in bregma-asterion plane
b. Partial trepanation in transverse plane.

tial treatment of the individual trepanned. From the British skulls there are only four which might conceivably be said to do this. They are the Hunsbury, Whitchurch, Amesbury G71 and Maiden Castle skulls.

The skull from Hunsbury, Northamptonshire (Parry, 1921) exhibits three unhealed, and probably postmortem holes arranged in a manner which suggests that they were cut to facilitate suspension of the skull. It is likely that this represents a ritual act.

The Whitchurch skull is from an intramural burial which was not normal for the period or context. As such it probably represents ritual behaviour. This kind of burial can inspire suggestions that this was a foundation rite. As the skeletal record implies that the cause of death was the trepanation, then the only question left is whether the ritual, if there was one, is connected with the trepanation.

The Amesbury G71 skull was found to have been buried with flints covering it with the surrounding soil flecked with charcoal. The association with fire and the covering of the head is highly suggestive of ritual. Once again, the problem of whether the ritual, if it existed, was connected with the trepanation, remains; though the fact that it is the skull which is the focus of ritual attention may reasonably be said to argue in favour of the trepanation as a motive for the behaviour.

The final skull, from Maiden Castle, is very interesting and perhaps the most convincing evidence of ritual behaviour connected with trepanning. In addition to the trepanation, the skeleton had suffered extensive mutilation and it has been suggested that the injuries to the skull represent an attempt to remove the brain (Wheeler, 1943). Such practice has parallels in many other peoples, for instance, the New Guinea Highlanders and the ancient Irish. In the ancient Irish literature there is reference to the practice of removing the brains and mixing them with lime to form hard balls. These, it was said, were held by the victor who had made them, while disputing (Hurlston Jackson, 1971). It would seem that the activity may be a result of a wish to have some evidence of victory or to acquire some highly regarded attribute of the vanquished person.

Alternatively, the brains may have represented a food source; though the eating of brain is also thought to have had ritual significance. For all of these examples it would be difficult to suggest anything but a ritual purpose.

Trepanation as curative surgery

There is evidence, from ethnographic sources, that trepanation was also performed for curative purposes. From their observations of primitive societies elsewhere (Horsley, 1888) and Crump (1901) suggest that trepanation was used to alleviate fractures of the skull, epilepsy, headaches, cerebral symptoms, certain forms of madness, and neuralgia. In fact, trepanation appears to have been a fairly wide-ranging cure.

In order to say that a skull was trepanned for curative purposes there must be some evidence of the condition for which treatment was undertaken. Of the British skulls considered earlier, only six may possibly meet this requirement. These are the Cirencester Whitchurch, Snells Corner, Traigh Bhan, York and Willoughby-on-the-Wolds skulls.

The Cirencester skull had a large linear wound in the right parietal and this was accompanied by a trepanation. It is possible that the trepanation was carried out to relieve intracranial pressure resulting from the depressed fracture.

The second skull has already been discussed in the section on trepanation as a religious phenomenon. This is the skull from Whitchurch, Shropshire. The report on this skeleton noted that it was a healthy specimen with the exception of advanced caries in the right mandibular third molar. In the opinion of the authors this may have caused sufficient pain to drive the individual to drastic remedies, namely trepanation. There is doubt, however, for if the man was able to find a trepanner in Britain then how much more likely would he be able to find an experienced tooth puller. This statement implies a recognition of the source of the pain and it is possible that the tooth would give rise to referred pain.

The skull from Snells Corner has two lesions in the calvarium. One is a trepanation and the other is a linear cut that has healed. It is unclear whether the two lesions are connected.

The fourth skull in this category was found at Traigh Bhan, Argyllshire. The young man in question had severe periodontal disease which had led to the resorption of much alveolar bone. Whether this condition would have been sufficiently painful to warrant trepanation is unclear but, as the rest of the skeleton was apparently healthy, it is a possibility. The skull exhibits two trepanations both of which have healed. The one on the left is thought to have preceded that on the right by some time. If the operation was therapeutic it is possible that the first trepanation failed to relieve the condition and so a second was attempted.

Six skulls out of twenty-eight is a small sample. However, lack of evidence does not rule out the possibility of the other trepanations being therapeutic. If the ethnographical evidence is referred to it will be noticed that many of the diseases mentioned do not exhibit skeletal manifestations.

The fact that neither the medical nor the religious interpretations, when taken as discrete reasons for the operation, appear to have compelling supportive evidence in the British cases, suggests that the real interpretation is far more complex. It would seem that the evidence requires a more cautious explanation, one which combines ideas of primitive assumptions about the body and its diseases; the incidence of different forms of diseases; the distribution of special roles in the communities concerned, especially the roles concerned with religion and surgery; and the significance attached to the head in ideas about the nature of personal identity.

Whatever the method; whatever the motive; whatever the era; and whatever the society, trepanation must surely rank as one of the most bizarre and enigmatic practices of earlier man.

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Quantitative Study of the Animal Bones from Archaeological Sites: Methodological Approach

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OSSA

This article is an attempt at the evaluation of cognitive value of animal bone remains, discovered in archaeological examination.

A hypothesis was made that the manifested differentiation of a chronological and cultural one of human groups is reflected in the differentiation of archaeozoological data. The authors used data from the literature of about twentythree settlement sites. They also took into consideration four basic species of animals: cattle, sheep and goat, pigs and game, together with horses. For the analysis of data the author used a multi-feature method of distance of Grewal as modified by Sjøvold, and the method of main components.

It was observed that the cultural and chronological differentiation of the investigated groups does not correlate with the differentiation of the structure of their meat consumption.

Keywords: Animal Bones - Quantitative Study - Intercultural Comparisons.

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Introduction

The animal bone remains become more and more interesting in the complex archaeological investigations of local communities. They are a valuable source for the research of production and consumption of animal protein in prehistory and in historical periods.

Using information coming from analysis of bone remains one should first consider the question to what a degree the proportions of the participation of particular species of animal reflect the structure of a historical herd as they are described by archaeology. It concerns mainly the structure of consumption of animal protein. Many research workers were interested in this problem, however, it seems that it did not receive until now a satisfactory solution, (e.g. Paaver & Kulikauskas 1965, Chaplin 1971, Milisauskas 1977, Kruk 1980, Kruk & Makowicz-Poliszot 1981).

The reconstruction of the structure of a prehistoric herd or of the structure of consumption of meat is most frequently made in order to determine the qualitative and quantitative characterization of economic phenomena. Very often in archaeological analyses the differences or similarities described in the reconstructed structure of meat consumption are used for the verification or falsification of archaeological hypotheses, which are framed on the basis of analysis of various cultural phenomena. Comparative research

(inter-regional, inter-cultural and the like) of archaeozoological data are now conducted with the use of simple statistical methods. The results obtained in the form of percentage results are most often used in the description of economic phenomena.

The aim of this article is to assess cognitive value of archaeozoological data in the investigations of prehistoric groups. In particular we want to assess whether the chronological and cultural differentiation of the investigaed groups is reflected in the differentiation of archaeozoological data. According to the research practice adopted until now we should assume that groups coming from various cultures and chronological periods come from various socio-economic systems. Thus one should expect that groups belonging to a similar socio-economic system are characterised by the similar structure of breading economy.

In this article, using the multi-feature statistical methods, we make an analysis of differentiation of human groups from the periods of Neolithic, Bronze and Iron Age on account of the reconstructed (on the basis of archaeozoological data) information about the structure of meat consumption. In addition we want to emphasize that the present article is a contribution to the discussion on the improvement of methods.

Material

Archaeozoological expertises concerning the bone remains contain three basic categories of data: 1) a number of bones of particular species of animals, 2) minimum number of animals, 3) quantities or proportions of consumed meat of particular species calculated by means of the so called weight method.

In the investigations we used merely the second category of data: i.e. minimum number of animals. It characterizes the consumption of four main species, i.e. horned-cattle. small horned animals - sheep and goat, pig, game (together with horse). Just these data most frequently occur in various archaeological works (e.g. Paaver, Kulikauskas, 1965; Milisauskas, 1977).

The material used in the analysis was taken from the literature of the subject. It imposed strict criteria of its selection. The compilation of particular sites selected for this work, their dating, distribution, authors of the study are contained in Table 1.

For the evaluation of similarities and differences of the investigated groups the author used the method of biological distance of Grewal as modified by Sjovold (1973), determined according to the following formula:

$$\bar{X} = \frac{\sum\left[(\Theta_1 - \Theta_2)^2 - \left(\frac{1}{N_1} + \frac{1}{N_2}\right)\right]}{r}$$

$$var\,\bar{X} = \frac{\sum\left[2\left(\frac{1}{N_1} + \frac{1}{N_2}\right)^2\right]}{r^2}$$

where:

Θ - angular transformation $\Theta = arc\ sin\ 1 - 2p$

Θ_1 - angular transformation of the frequency of features in the first group (on site 1)

Θ_2 - angular transformation of the frequency of features in the second group (on site 2)

N_1 - the number of group one

N_2 - the number of group two

r - the number of investigated features (species of animals) the significance of biological distances calculated in this way will be determined at the level of 0,05.

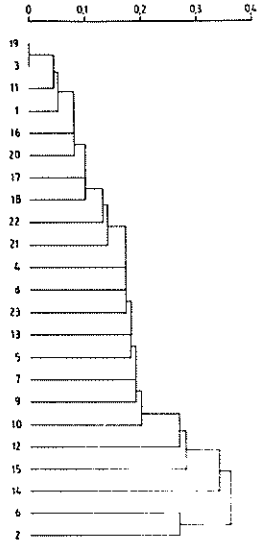

Fig. 1. Dendrogramme arranging the differentiation of groups from table 3.

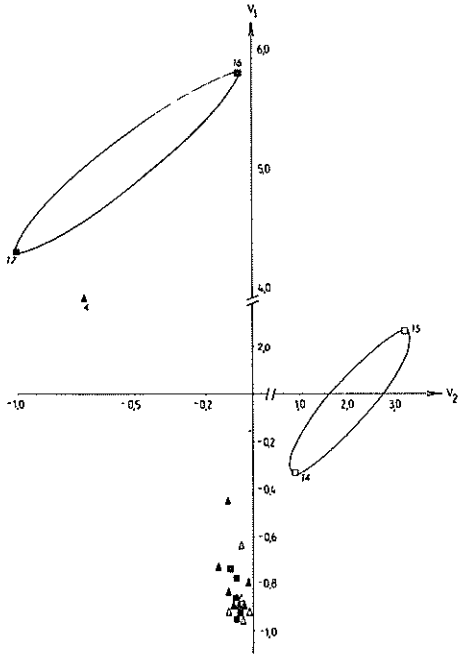

Fig. 2. Distribution of groups described by the first and the second principal component.

In the second stage of analysis the author calculated the principal component, resolving in this way the observed variables to the new (not correlated) variables (Caliński, Czajka, Kaczmarek, 1975). The obtained results were also presented in a graphic form. The matrix of biological distances was set in order by means of a dendrogramme (Fig. 1), and the mutual position of groups defined by the first and the second component was presented in Figs.3 and 4.

Results

The minimum number of individuals and their relative frequency in the herd for the analyzed groups are shown in Table 2. In this table values of the first and second principal component are also presented. The data on the frequency of occurrence of particular species of animals in the herd (on the structure of breeding) served for the determination of distances between the investigated groups. The matrix of distances illustrating the intragroup differentiation of breeding structures is shown in Table 3. The data from Table 3 were ordered with application of the method of dendrite (Fig. 2). The differentiation of the investigated groups with respect to the structure of breeding of animals (structure of consumption) is very small. Arranging the differentiation of groups with the dendrogramme we did not obtain subgroups consisting of the series, similar as far as the cultural system or chronological period are concerned. Dendrogramme is not divided into clans but is not a homogeneous set of series which are combined into pairs or triads.

In the second stage of research an analysis of main components was applied. Table 4 presents the coefficients of correlation between the investigated variables and four principal components and the range of mutual variability which is exhausted by particular components. It appears that to the greatest degree are correlated with each other the

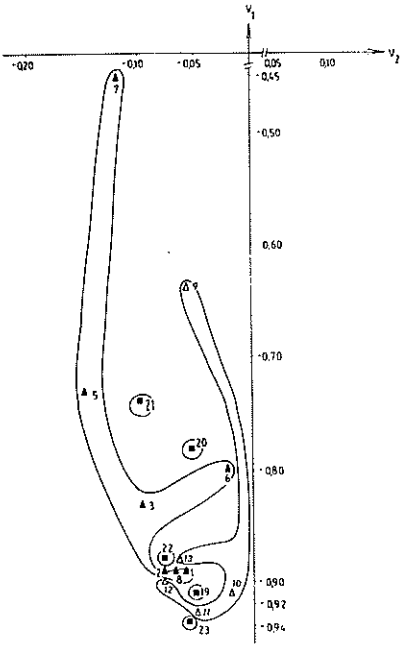

Fig. 3. Distribution of groups described by the first and the second principal component (analysis of concentration of groups from Fig. 2).

frequencies of occurrence of cattle, pigs, and small horned animals. Where as the frequency of occurrence of other animals in the structure of consumption is correlated lower with the other variables. In Table 5 are presented coefficients of correlation between original variables and the principal components. It can be seen from these data that the first component describes the structure of consumption on the basis of data on the frequency of occurrence of cattle, pigs and small horned animals. The second component describes differentiation of the structures of consumption with respect to the participation of other animals in these structures.

In Fig. 3 is shown the distribution of groups described by the first and the second component. Most of the series create a group in relation to which a different position is occupied by the group of funnel beakers. Their different position is conditioned in particular by the second main component since these are groups which are distinguished by the prevalent share of game in the structure of consumption (lowland zone), or by the very small share of the game in the structure of consumption (loess zone). The concentration of groups from Fig. 1 was presented separately in Fig. 4. Groups belonging to the same archaeological cultures were combined into three sets. To the first one were included series from the Central Europe dated to the period of Early Neolithic. To the second group belong the series of early band pottery culture and the Lengyel culture, and to the third subgroup belong the series from the iron age.

Fig. 4 illustrates that neither the first nor the second main component make it possible to separate subgroups consisting of the series coming from the same archaeological cultures or chronological periods. The series from the Early Neolithic included within the early band pottery cultures and series coming from the iron age are situated very close to each other. The cultural and chronological differentiation of the investigated groups does not correlate therefore, with the differentiation of their structures of animal consumption.

Discussion

The analysis consisting in the evaluation of the distance between groups, determined with respect to the differences in the structure of animal consumption, and the analysis of the main component did not lead to the division of groups according to cultural differentiation. On the basis of the hitherto conducted research work one might expect that groups which differ as far as their cultural and chronological attachment is concerned are characterized by the peculiar structure of animal consumption (breeding economy). It appeared on the basis of comparative investigations of the structure of consumption of 23 Central European series from the Neolithic and the iron age that the data on the frequency of occurrence of particular species of animals are very little differentiated for these groups. Only groups belonging to the funnel beaker culture are characterized by the peculiar share of game in the structure of consumption. The other groups do not differ actually in relation to each other as far as the frequency of occurrence of particular species of animals.

The obtained results may be interpreted in two ways. First, we should assume that in the investigated groups occurred similar socio-economic structures, regardless of their cultural and chronological attachment. Their cultural differentiation was manifested in a number of archaeological artefacts, and the structure of breeding of animals (and thus the structure of animal consumption) was similar because of the ecological conditions of the occupied areas (the oecumene of the Central European Lowland).

This interpretation does not agree with the analyses which were described in various archaeological publications. In these publications a number of differences in the breeding economy between the prehistorical groups described (e.g. Ostoja-Zagórski, 1974, 1982; Makiewicz, 1980; Pyrgała, 1973; Kubasiewicz, 1963). Interpretations contained in these publications are not confirmed in the results of analyses which we obtained and which used the multi-feature methods.

Second, the obtained results may also be interpreted in such a way that the data obtained for the investigated groups becuase of the way of their reconstruction do not present reliable information on economy, animal breeding or the structure of animal consumption.

The data which we analysed inform only about a minimum number of animals of different species, observed in archaeological investigations, on the basis of identification of animal bones, discovered in certain archaeological sites.

In archaeological publications it is assumed that the data of this type reflect the structure of meat consumption and in this connection it is assumed that they may constitute the basis of quantitative and qualitative evaluation of the prehistorical herd (e.g. Kruk, Makowicz-Poliszot, 1981).

We think, on the basis of the obtained results, that the assumption applied, when the archaeological data are used, that investigations of bone remains inform directly about the structure of meat consumption, or the structure of the herd should be rejected and the problem of interpretation of results of archaeozoological expertises requires further analysis.

Results

The investigations which we conducted prompt us to draw the following conclusions:

1. The differentiation of breeding economy, described in various archaeological publications, of human groups from the period of the Neolithic or the Iron Age does not find its confirmation when archaeozoological data are analysed by means of multi-feature statistical methods.

2. Evaluation of distances between groups performed on the basis of reconstruction of minimum number of animals discovered in the given archaeological sites and analysis of these data by means of the method of principal components points to the fact that the share of cattle, pigs, and small horned animals in the structure of consumption of various groups from the Neolithic and the Bronze Age was almost identical.

3. Cultural or chronological differentiation of the investigated groups does not show any relation with the structures of animal consumption reconstructed for these groups.

4. The quantitative research of economic phenomena, based on the data on the structure of animal consumption must be preceded in future by the working out of the more precise methods of transformation of archaeozoological data into variables which describe economic phenomena. Only after the principles of the reconstruction of phenomena concerning breeding economy (animal consumption) from archaeological data have been worked out will it be worthwhile to make attempts at intercultural or intergroup comparisons. At the present stage of archaeozoological research such attempts do not bring positive results.

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Footnotes

In this article - like in some archaeological publications - we use interchangeably the concepts of the structure of the herd and the structure of meat consumption. However, we wish to emphasize that we think that the reconstruction of the structure of the herd should be performed by means of other rules of transformation of archaeometric data into historical variables than in the case of reconstruction of the structure of meat consumption. The above problem may be left out of account in this publication, because the subject of comparative investigations is a minimum number of animals.

TABLE 1. List of analized of the materials

N°	Station	Chronology	Authors of the data
1	Müddersheim W. Germany	Linear Band Pottery Culture	Stampfli 1965
2	Bylany Czechoslovakia		Clason 1967
3	Jeleni Louka Czechoslovakia		Kratochvil 1972
4	Győr Papai Hungary		Bökönyi 1959
5	Pomaz-Zdravlyok Hungary		Bökönyi 1959
6	Floreshti USSR		Pasek and Chernysh 1963
7	Noviye Ruseshti USSR		David and Markevich 1967
8	Traian Romania		Necrasov and Haimovici 1962
9	Samborzec Poland		Wiślański 1973
10	Strzelce Poland		Wiślański 1973
11	Radziejów Poland		Wiślański 1973
12	Pleszów - phase I Poland	Lengyel-Polgar	Wiślański 1973
13	Pleszów - phase II Poland		Wiślański 1973
14	Szlachcin Poland		Wiślański 1973
15	Ustowo Poland		Wiślański 1973
16	Ćmielów Poland		Wiślański 1973
17	Gródek Nadbużny Poland		Wiślański 1973
18	Zesławice - phase I Poland		Wiślański 1973
19	Aukštadvaris USSR	Iron Age	Paaver and Kulikauskas 1965
20	Aukštadvaris - settle USSR ment		Paaver and Kulikauskas 1965
21	Nemenčiné USSR		Paaver and Kulikauskas 1965
22	Migonys - settlement USSR		Paaver and Kulikauskas 1965
23	Bačkininkéliai - settle USSR ment		Paaver and Kulikauskas 1965

TABLE 2. Percentage of animals based on the minimum number of individuals and values of the principal components
N - minimal number of individuals.

	Station	Cattle		Pig		Sheep goat		Other wild animals		V_1	V_2
		N	%	N	%	N	%	N	%		
1	Müddersheim	7	43,8	3	18,7	4	25,0	2	12,5	- 0,89592	- 0,065471
2	Bylany	7	38,9	8	44,4	3	16,7	-	-	- 0,89170	- 0,079288
3	Jeleni Louka	8	33,3	4	16,7	11	45,8	1	4,2	- 0,84681	- 0,102210
4	Győr Papai	354	68,3	64	12,4	100	19,3	-	-	0,40389	- 0,715800
5	Pomaz-Zdravlyok	30	47,6	16	25,4	17	27,0	-	-	- 0,73925	- 0,153380
6	Floreshti	20	41,7	12	25,0	6	12,5	10	20,8	- 0,80803	- 0,023002
7	Noviye Ruseshti	56	38,6	36	24,8	36	24,8	17	11,8	- 0,45112	- 0,121060
8	Traian	9	50,0	5	27,8	3	16,6	1	5,6	- 0,89644	- 0,071491
9	Samborzec	36	36,4	24	24,2	13	13,1	26	26,3	- 0,64557	0,059094
10	Strzelce	3	25,0	-	-	1	8,4	8	66,6	- 0,91228	- 0,002611
11	Radziejów	2	40,0	1	20,0	1	20,0	1	20,0	- 0,93296	- 0,057269
12	Pleszów - I	2	22,2	2	22,2	5	55,6	-	-	- 0,90552	- 0,081431
13	Pleszów - II	21	65,6	8	25,0	1	3,1	2	6,3	- 0,88104	- 0,064828
14	Szlachcin	57	27,3	14	6,7	11	5,3	127	60,7	- 0,33690	0,849490
15	Ustowo	383	31,0	268	21,7	76	6,2	507	41,1	2,65550	3,250200
16	Ćmielów	1626	59,8	570	20,9	284	10,4	241	8,9	5,83290	- 0,604160
17	Gródek Nadbużny	1265	60,4	453	21,6	252	12,0	126	6,0	4,37050	- 1,092900
18	Zesławice	446	56,0	218	27,5	98	12,3	33	4,2	1,15620	- 0,574320
19	Aukštadvaris	2	25,0	2	25,0	2	25,0	2	25,0	- 0,91937	- 0,053824
20	Aukštadvaris	15	33,3	10	22,2	12	26,7	8	17,8	- 0,78712	- 0,058414
21	Nemenčinė	23	37,7	21	34,4	13	21,3	4	6,6	- 0,74465	- 0,103640
22	Migonys	4	28,6	3	21,5	6	42,8	1	7,1	- 0,88939	- 0,079296
23	Bačkininkėliai	3	50,0	2	33,3	-	-	1	16,7	- 0,93498	- 0,054371

TABLE 3. Matrix of biological distances.

	1	2	3	4	5	6	7	8
2	0,3671							
3	-0,1919	0,2285						
4	0,4145	1,2608	0,0846					
5	0,1657	0,8435	-0,0340	0,5682				
6	0,2047	-0,0114	0,0933	1,1107	0,6025			
7	0,0324	0,2245	-0,0924	0,7307	0,2960	0,0855		
8	0,1043	0,6998	-0,1165	0,3965	-0,0003	0,5118	0,2456	
9	0,1337	0,7885	-0,0994	0,3460	0,0040	0,5922	0,2994	0,0029
10	0,1406	0,8905	-0,0896	0,2925	0,0128	0,6565	0,3200	0,0158
11	-0,0079	0,5004	-0,2467	0,1134	0,0925	0,3663	0,1417	0,0052
12	0,2732	1,3450	0,0322	0,1005	0,1519	1,0088	0,5233	0,1527
13	0,2077	0,8257	-0,0900	-0,0806	0,3684	0,7193	0,4455	0,2142
14	0,4150	1,1848	0,1072	0,2860	0,1354	1,0313	0,6849	0,1264
15	0,3075	1,2132	0,0160	0,0346	0,1859	0,9934	0,5857	0,1399
16	-0,0237	0,4381	-0,2064	0,3683	0,0895	0,2593	0,0536	0,0448
17	0,0419	0,6228	-0,1869	0,1394	0,1644	0,4511	0,1933	0,0796
18	0,0476	0,7687	-0,1842	0,1577	-0,0014	0,5474	0,2248	-0,0274
19	-0,0962	0,3054	-0,2883	0,1410	0,2138	0,1619	-0,0157	0,0935
20	0,0094	0,4767	-0,2096	0,1607	0,2222	0,3370	0,1307	0,1129
21	0,0761	0,8322	-0,1470	0,1176	0,1345	0,5895	0,2512	0,0803
22	0,1157	0,7245	-0,1567	-0,0877	0,3314	0,5933	0,3236	0,1795
23	0,0038	0,5691	-0,1166	0,7087	-0,1045	0,2870	0,0261	-0,0155

TABLE 3. cont.

	9	10	11	12	13	14	15	16
10	0,0065							
11	0,0078	0,0138						
12	0,1172	0,0510	0,1051					
13	0,1906	0,1757	−0,0192	0,1484				
14	0,0915	0,1010	0,1415	0,1709	0,2138			
15	0,1003	0,0679	0,0607	−0,0072	0,0566	0,0639		
16	0,0669	0,0719	−0,0381	0,1951	0,1738	0,3114	0,2257	
17	0,0805	0,0710	−0,0611	0,1132	0,0347	0,2357	0,1083	0,0144
18	−0,0355	−0,0482	−0,0768	−0,0115	0,0552	0,0740	0,0023	−0,0092
19	0,1150	0,1074	−0,1158	0,1691	0,0020	0,3811	0,1904	−0,0853
20	0,1233	0,1203	−0,0655	0,1870	0,0342	0,3183	0,1741	−0,0002
21	0,0719	0,0400	−0,0306	0,0093	0,0591	0,2185	0,0591	0,0354
22	0,1641	0,1423	−0,0632	0,1059	−0,1016	0,2492	0,0552	0,0940
23	0,0164	0,0150	0,0805	0,1571	0,4578	0,3161	0,3009	−0,0386

	17	18	19	20	21	22
18	−0,0255					
19	−0,0800	−0,0188				
20	−0,0173	0,0091	−0,1295			
21	−0,0022	−0,0474	−0,0398	0,0170		
22	−0,0222	0,0145	−0,0928	−0,0345	−0,0023	
23	0,1255	−0,0084	0,0701	0,1502	0,0889	0,3609

TABLE 4. Correlation matrix and coefficients of correlation between original variables (x) and principal components (v).

Variable	x_2	x_3	x_4	V_1	V_2	V_3	V_4
x_1 – cattle	0,9769	0,9913	0,5197	0,9738	0,9937	0,9656	0,6945
x_2 – pig	–	0,9659	0,6509	-0,2182	-0,0516	-0,2441	0,7192
x_3 – sheep goat		–	0,4966	0,0012	-0,0948	0,0812	0,0211
x_4 – wild animals			–	0,0641	-0,0300	-0,0371	0,0047
			%	83,76	15,68	0,40	0,16

TABLE 5. Coefficients for principal components.

	x_1 cattle	x_2 pig	x_3 sheep goat	x_4 wild animals
W_1	0,5320	0,5429	0,5275	0,3794
W_2	- 0,2756	- 0,0651	- 0,3083	0,9082
W_3	0,0092	- 0,7488	0,6414	0,1668
W_4	0,8006	- 0,3746	- 0,4640	0,0585

Anthropological Studies on the Dental Remains from some Irish Archaeological Sites

CATRYN POWER

OSSA

This study is concerned with the anatomy and pathology of skeletal material from three Irish Archaeological sites. The prevalence of tooth decay, periodontal disease, and various other pathological conditions and abnormalities are indicated and discussed.

Keywords: Dental Wear - Caries - Periodontal Disease - Hypoplasia - Bony Defects - Enamel Variations.

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Introduction

Three medieval/post medieval populations from Ireland (Fig. 1) were examined to determine their state of dental health:
1. 45 individuals (12th/13th centuries) from Wood Quay, Dublin City.
2. 25 individuals (16th century) from Tintern, County Wexford (Fig. 2).
3. 36 individuals (17th/18th centuries) from Kilrush, County Limerick (Fig. 3).

A total of 1228 teeth, representing the dentitions of 106 individuals, were examined from the above sites.

Wood Quay

Wood Quay is one of the medieval urban sites of Dublin and it was excavated from 1972-81 under the directorship of Mr P. F. Wallace, the National Museum of Ireland. These excavations revealed that a major redevelopment of the port, including land reclamation and dock building, was undertaken in the beginning of the 13th century (Wallace, 1981). The human remains examined belong to the pre-reclamation phase of the late 12th and early 13th centuries. They came from an area immediately outside the town wall (built ca 1100 A. D.) on the southern bank of the River Liffey. This area was readily accessible from the Winetavern Street gate. These skeletons were carelessly placed in shallow trenches dug into a naturally laid deposit of estuarine mud. Little effort would have been required to dig these graves. A 'mass grave' consisted of nine individuals who were interred with the minimum of care into a pit, 2 m long and 0.80 m wide.

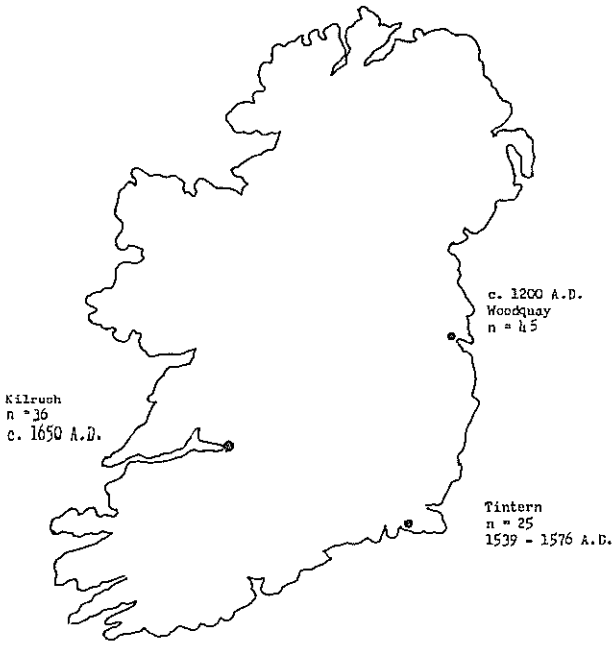

Fig. 1. A map of Ireland showing the sites at which the remains examined were excavated. The number of subjects (n) studied from each site is indicated, and the appropriate date ascribed to each site.

Tintern

Tintern Minor, County Wexford was a Cistercian Abbey founded ca 1200 A.D. and it was a daughter house of Citeaux in France. The Abbey of Tintern Minor was suppressed in 1536 A.D. Sir Anthony Colclough was granted the abbey and its lands in 1576 A.D. The Colclough family converted part of the Abbey into a private residence. In the early 1960's it became a National Monument. Excavations to find the original monastic floor levels in the nave of the church began in 1982, under the directorship of Dr. Anne Lynch. The skeletal remains of 50 individuals were uncovered; 25 of these had dental remains. Most of the burials came from the nave, but some were uncovered in the South Transept. These burials were found at a higher level than the original monastic floor. It is unlikely that burials continued to be interred after the Colclough family took up residence (ca 1576) and the Colclough floor level was above the interments. The 1983 excavations in the chancel showed that an early 17th century drain cut through the burials. Therefore the burials belong to the period ca 1539-1576 A.D. (Lynch, personal communication).

Kilrush

Kilrush Church, County Limerick is known to date to 1201 A.D. and is probably older (Harbison, 1979). The founder is unknown. A rescue excavation took place at Kilrush Church in 1980, prior to the construction of dwelling houses in the vicinity of the church. Only a small proportion around Kilrush Church was excavated (Power, 1984). Fifty-one burials were recovered and 36 of these had dental remains. No complete skull was found.

Fig. 2. The Abbey of Tintern Mimor, County Wexford, Ireland.

Fig. 3. The site of Kilrush Church, County Limerick, Ireland.

The majority of these burials were of children. These skeletons may be the remains of a special type of graveyard called a *cillin* where young children (usually infants) were buried together. Therefore this assemblage might not constitute a representative sample of the population. The burials were damaged due to incidental factors: a) being near the ground surface, b) the use of heavy machinery in close proximity to the burials during the construction of the houses. This accounts for the fragmentary nature of the skeletal material and the postmortem loss of many teeth. There was very little alveolar bone remaining for the Kilrush subjects, hence very few full alveolar bone measurements could be made. An accurate estimate of the incidence of pathologies requiring jaws (e.g. alveolar abscesses and bone defects) could not be adequately determined from these remains.

Methods

All the teeth were examined, identified and charted. An estimate of the approximate age of each subject was obtained from the degree of development of the dentitions in the younger subjects and from a comparison of the rate of wear on the molar teeth in older subjects. Tables were made detailing the incidence of various pathologies. Diagrams were drawn to show the extent of calculus deposition and alveolar bone loss on 68 selected individuals.

Radiographs were used in estimating the age of the younger subjects; to elucidate root and pulp chamber morphology in all the teeth, and to demonstrate the presence or extent of various pathological conditions.

A quantitative study of tooth size was undertaken for each of the three populations. This should be of use when future comparative studies present similar data.

The extent of periodontal disease was quantified from the degree of alveolar bone loss which occurred during life. Care was taken not to confuse postmortem damage with this type of bone loss. A loss of 3 mm is generally accepted as indicating the initial stages of periodontal disease. The distance from the alveolar margin of the bone vertically to the cervical margin of the tooth was measured at three points along both the buccal and lingual aspects, in accordance with common clinical practice.

Thirty teeth from among those which best showed typical interproximal and occlusal wear patterns were selected and examined using a Jeol JSM-35 Scanning Electron Microscope at x10-x900 magnifications to clarify the wear patterns. Longitudinal ground sections were cut from a total of 16 teeth and examined and photographed at magnifications of x20-x400 using a Reichert-Jung Polyvar photomicroscope. These sections gave detailed information on hypoplasia and postmortem damage. Any teeth showing unusual morphology or pathology were photographed.

Observations

Age

The following table illustrates the frequency of individuals and their age at death in the Wood Quay, Tintern and Kilrush populations.

TABLE 1.

Site	Age in years				
	0-10	11-20	21-30	31-40	40+
Kilrush	72%	8%	14%	6%	-
Wood Quay	22%	29%	36%	11%	2%
Tintern	28%	-	16%	44%	12%

Of the Wood Quay population 25% are under the age of 10 years and 12% are between the age of 11 and 20 years; 38% of the population belong to the 21-30 years age group. A high proportion (44%) of the Tintern population are in the 31-40 age group. Children form a large proportion (28%) of this population: they are aged under 9 years. Sixteen per cent of the population are in the 21-30 year age group and 12% are at least 40 years. The majority (64%) of the Kilrush population are children under the age of 4 years; children aged between 5 and 10 form 72% of the population. In Kilrush 14% are adults who died between the age of 21 and 30 years and 6% between 31-40 years.

Dental Wear

Attrition

A grading system was developed to indicate the degree of occlusal and incisal wear:

	Molars	Anterior teeth
0=	no attrition	no attrition
1= mild attrition	confined to the enamel	enamel wear on incisal (cusp) tip only
2= moderate attrition	one or more islands of dentine exposed	dentine only exposed incisally or occlusally
3= severe attrition	severe dentine exposure with or without pulp exposure, someshowing secondary dentine or pulp cavities	

The following table shows the various degrees of attrition in the Wood Quay, Tintern and Kilrush populations with erupted teeth.

TABLE 2. Degrees of Attrition

	0	1	2	3
		Wood Quay		
adult	-	-	-	54%
children	-	11%	7%	28%
Total	-	11%	7%	82%
		Tintern		
adult	-	-	8%	71%
children	-	13%	8%	-
Total	-	13%	16%	71%
		Kilrush		
adult	-	4%	17%	21%
children	33%	21%	4%	-
Total	33%	25%	21%	21%

Attrition is present on all the individuals with teeth and this includes the child population from Wood Quay and Tintern (Power, 1984). Attrition was absent from 33% of the Kilrush population (with erupted teeth); these were children. Attrition resulted in severe exposure of the dentine with or without pulp exposure in 82% of the Wood Quay population with teeth including two children. In the Tintern population this occurred on 71% of the adults with teeth and on 21% on those from Kilrush.

Scanning Electron Microscopy showed microscratches of occlusal attrition (ibid) (Fig. 4).

Fig. 4. The microscratches of occlusal attrition on a tooth from Wood Quay, Dublin City, Ireland.

Abrasion

Interproximal abrasion grooves were found on two subjects from Wood Quay and on four subjects from Tintern. Scanning Electron Microscopy revealed very clear abrasion grooves, most of these were confined to the crown. At magnifications of x240-x540 the floor of each interproximal abrasion groove contained a large number of parallel scratch marks (Fig. 5).

Calculus

Calculus may be present as a mild, moderate or severe deposition (Power, 1984). Calculus was present on 83% of the Wood Quay population, 13% were deposits on deciduous teeth. Mild deposits were present on 45% of the population; of these 9% were deposits on deciduous teeth. Severe deposits were found on 13% of these people; of these 2% were on deciduous teeth. Seventy-five per cent of the Tintern population displayed calculus deposits;

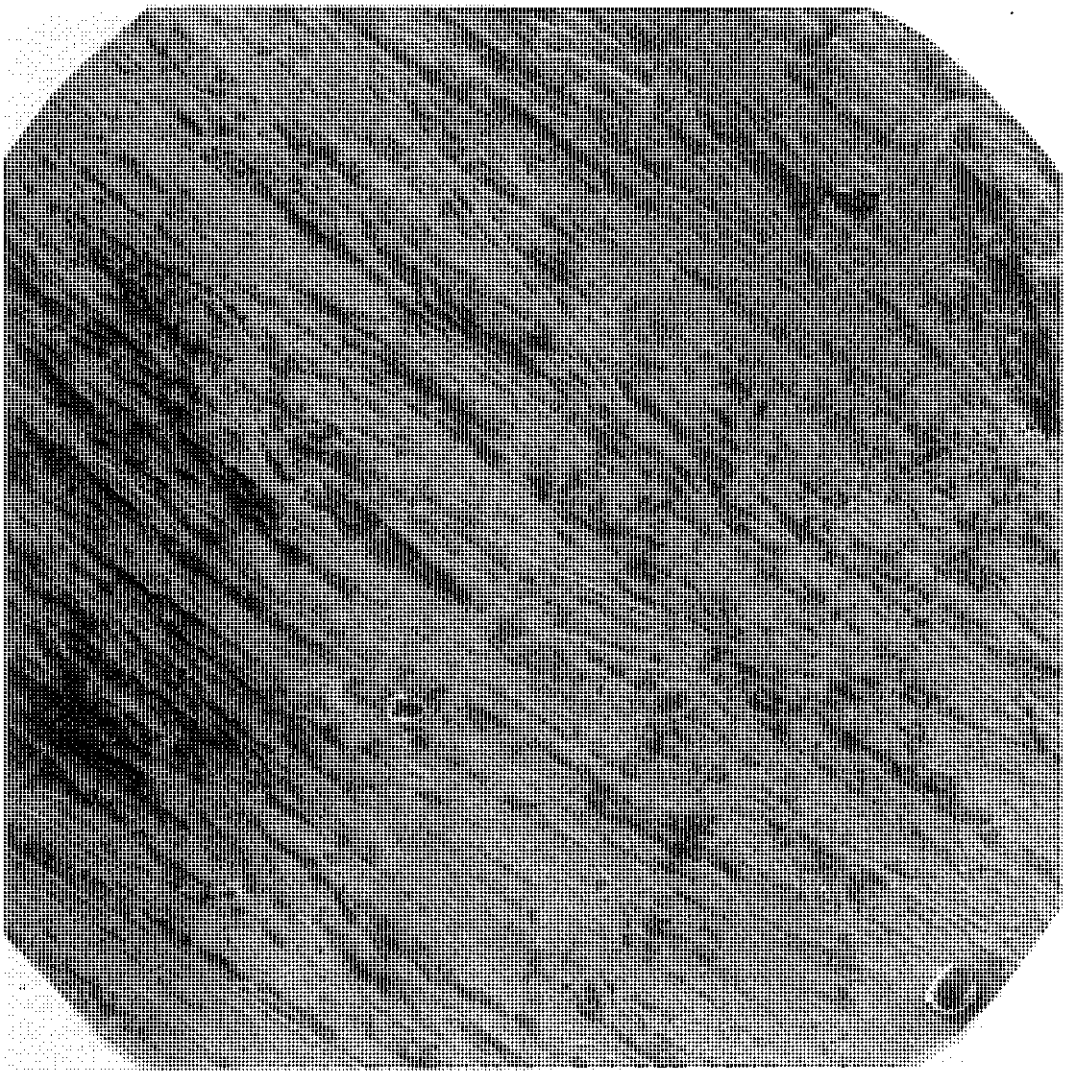

Fig. 5. Parallel scratchmarks in the floor of an interproximal abrasion groove on the mesial surface of a tooth from Tintern (Scanning electrom micrograph, X540).

8% were on deciduous teeth. Mild deposits occurred on 21% of the population; 4% of these were on deciduous teeth. Severe deposits were present on 29% of the population, all of these were adults. Mild calculus deposits were present on 27% of the Kilrush population; of these 9% were on deciduous teeth. There was no apparent relationship between age and the degree of calculus in these populations (Power, 1984).

Dental Abscess

The following table shows the frequency of abscess cavities in the Wood Quay and Tintern populations:

TABLE 3.

	Total number of abscess cavities	Number of individuals with abscess cavities according to age			
		20-29	30-39	40+	Total
Wood Quay	7	4	-	1	5
Tintern	23	3	4	2	9

There were seven periapical abscess cavities in 11% of the Wood Quay population. Sometimes more than one tooth was affected by a single abscess cavity in an individual subject and in one person up to three teeth were affected (Power, 1984). There were 23 periapical abscess cavities in 38% of the Tintern people; most of these had drained onto the buccal surface of the alveolar bone (Fig. 6). Nine per cent of the Wood Quay individuals with dental caries had periapical abscess cavities. Forty-two per cent of the Tintern population had periapical abscess cavities and caries. In the Wood Quay and Tintern populations the number of abscess cavities appears to increase with age; they occurred most frequently in the 20-29 age group. They increased in the 40+ age group of Tintern and occurred in one individual from Wood Quay. Abscess cavities were absent in the Wood Quay 30-39 age group.

Dental Caries

The overall caries rate of the subjects from Wood Quay was 50%; 11% was under 16 years and included one child under 10 years. The rate for Tintern was 58% and consisted of individuals over the age of 20 years. Of the Kilrush population 21% had dental caries, 3% of these were under 16 years and included one child under 10 years. In the permanent dentition caries occurs chiefly on the molar teeth. In these populations the number of teeth involved and the number of cavities increased with age (Power, 1984). In the Tintern subjects the cavities occurred principally on the root near the cervical margin and in the Wood Quay and Kilrush subjects they occurred chiefly on or near the cervical margin (The initial caries occurs in this type of material in the dentine - the root, under the border of enamel - cement junction. Caries today - initially - in the occlusal or approximal surface /editor's comment/).

Periodontal Disease

Periodontal disease was present in 43% of the Wood Quay population; of this 15% had chronic periodontitis. Alveolar bone recession was considerable in some of these individuals. At least 40 teeth were lost from these individuals during their lifetime and the majority of these teeth were probably lost due to periodontal disease (Power, 1984). Some may have been lost as a result of trauma, but infection often supervenes in such cases. Evidence for chronic periodontitis was present in 71% of the Tintern population. There was considerable bone loss. At least 123 teeth were lost from 67% of these individuals with periodontitis during their lifetime. Some of these and perhaps also at Wood Quay and Kilrush, may have been deliberately extracted, but it is not possible to determine this from the evidence available. Periodontal disease was present in 12% of the Kilrush population. Alveolar bone loss was present, although it was not as severe as in the other populations; however, the paucity of alveolar bone from this site could not possibly give an accurate estimate of the incidence of periodontal disease. Seven teeth were lost from three individuals from Kilrush and these may have been due to periodontitis.

It is well documented that the prevalence and severity of periodontitis increases with age (Sherp, 1964). Age might afford sufficiently prolonged exposure of the periodontitium to pathogenic factors in bacterial deposits. In the Wood Quay population the incidence of periodontitis increases with age. The number of teeth lost increased from two in the 20-29 age group to 11 in the 40+ age group. In the younger age groups the molars were the teeth most frequently lost but with increasing age the premolars and anterior teeth were the

Fig. 6.
A lower right first permanent molar from Tintern has lost its crown, possibly due to caries or a trauma. The distal root is associated with a sinus. On the apex of the distal root you find an apical periodontitis destruction due to an infection.

teeth most frequently affected. In the Tintern population the number of teeth lost increased slightly in the 30-39 and 40+ age groups and in some cases, even included the anterior teeth.

Osteomyelitis was evident in a 30 year old female from Tintern. Pus had drained through sinuses from the periodontal pockets to the bone surface, on the buccal aspects of the permanent lower right molars. The infection, resulting in osteomyelitis, probably spread from the periodontally infected ligaments.

Hypoplasia

Hypoplasia occurred on 28% of the Wood Quay population, on 13% of those from Tintern and on 42% of those from Kilrush. Hypoplasia occurred in all except one of the Wood Quay individuals before the age of 5 years. One subject, a 25 year old male, from Tintern had two distinct and clearly demarcated bands of hypoplasia, which occurred between the age of 4-6 years and again between 10-12 years. Hypoplasia occurred during the age of 3-4.5 years on the other two Tintern subjects with hypoplasia. Hypoplasia commenced in all from Kilrush before the age of 5 years. Four children had hypoplasia for a short period (less than one year) up to the time of death. Hypoplasia recurred in two of the Kilrush individuals at the age of 11-16 years; these two individuals survived until the age of 20-30 years.

Hypercementosis

The deposits of hypercementosis on the teeth examined were slight in comparison to the severe deposits found in modern clinical practise. Hypercementosis occurred in 14% of those from Wood Quay, in 60% of those from Tintern and in 19% of individuals from Kilrush. In the Wood Quay and Kilrush subjects it occurred primarily in the 20-29 age group and in those from Tintern it occurred most frequently in the 30-39 age group; it was also present in the 20-29 and 40+ age groups.

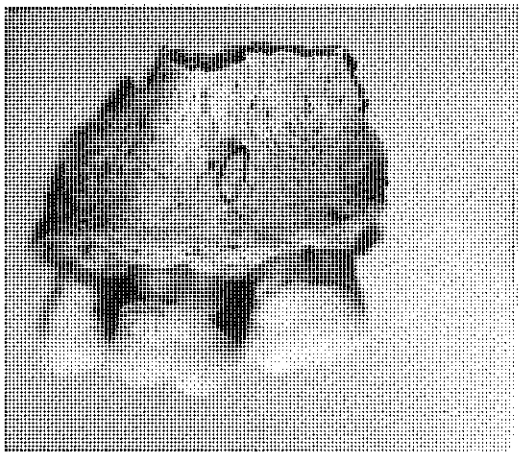

Fig. 7.
A fenestration defect over the disto-buccal root of an upper right first permanent molar from Kilrush Church.

Pulpstones

Pulpstones occurred in a single tooth from each of three individuals from Wood Quay and in three individuals from Kilrush. The pulpstones were found on molar teeth of individuals between the age of 18-30 years.

Root Translucency

Root translucency was detected on 13 individuals from Tintern. All of these individuals were aged at least 25-40 years.

Fenestrations

Fenestrations were present in three of the subjects from Wood Quay, in one from Kilrush (Fig. 7) and in two from Tintern. In all subjects they occurred primarily in the maxillae and were located buccally.

Dehiscences

Dehiscences occurred in one individual from Wood Quay and one from Kilrush. They were located buccally. In the individual from Kilrush fenestrations were present in a similar tooth position to two of these dehiscences.

Enamel Variations

Two enamel pearls were present on one tooth from Wood Quay. One individual from Kilrush had interradicular extensions of enamel on four teeth (Fig. 8); an enamel pearl is associated with one of these enamel extensions (Fig. 9). Interradicular extensions of enamel were present on two teeth from an individual from Tintern. The interradicular extensions of enamel in these individuals occurred more frequently on the mandibular teeth.

Tori

Four tori mandibularis were found on three individuals from Wood Quay.

Fig. 8. This shows interradicular extensions of enamel on the crowns of the lower right first and second permanent molars from an individual from Kilrush Church.

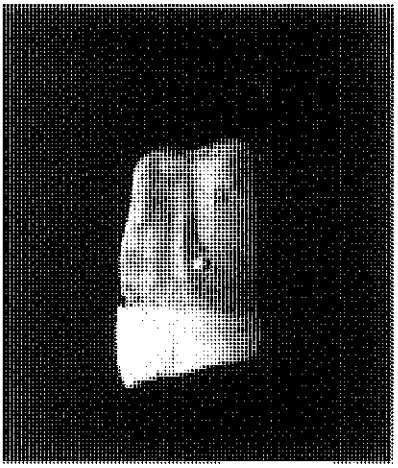

Fig. 9. An enamel pearl is present on the mesial surface of the root of an upper right second permanent molar from Kilrush.

Cysts

Two cysts were present in the remains: one on a male subject from Wood Quay, and the second on a female from Tintern. The cyst in the Wood Quay individual was probably caused by an unerupted maxillary canine. The female from Tintern was in her late 30's and had a periodontal apical cyst.

Discussion

Age

The majority (64%) of the Kilrush population were children under the age of 4 years; children between 5 and 14 years formed 14% of the population. In Kilrush 14% were adults who died between the age of 20-29 years and 6% between 30-39 years. In Kilrush the infant mortality rate was high. It must be remembered that only a small proportion around Kilrush Church was excavated and this assemblage might not constitute a representative sample of the population.

The age distribution in the Wood Quay and Tintern populations suggests a high mortality of children. Of the Wood Quay population 25% were under the age of 11 years and 28% of the Tintern population were aged under 9 years. Child mortality in pre-20th century times has always been high. Prolonged or sporadic famine can lead to death in a population and young children are most at risk. Child deaths were caused by infection, congenital abnormalities or malnutrition. The average age of death in the Wood Quay population was 24 years. These skeletons appear to have been hastily buried (Power, 1984). Disease may account for the early age of death of these people which may have necessitated a hasty burial. The burials were at the furthest point accessible from the Winetavern Gate, as far away from the townspeople as possible. Disease may account for one "mass grave". Samuel Pepys (Rhys, 1912) described the fear of contacting the Great Plague of London in 1655, "a coffin with a dead body, dead of the plague" was left in the

open for several days before someone buried it, "This disease making us more cruel to one another than we are to dogs". Pepys described the mounds of graves where the plague victims were buried; many were hurriedly placed in mass graves.

The average age of death for males at Tintern was 31 years and that for females was 33 years. This contrasts with the findings from other medieval groups where the average life span of females is less than that of the males (Manchester, 1983). This earlier death of the females was usually caused by the hazards of childbirth or because most societies were male dominated, the women were undernourished and overworked (Wells, 1975).

Dental Wear

Attrition

The severe attrition in the Wood Quay and Tintern populations suggests that the food was of coarse physical consistency. This is supported by the available historical and archaeological evidence. Cereal growing was extensive from the 10th century onwards and corn formed the staple diet (Lucas, 1960). Oats was the most commonly grown cereal. Corn was used to make coarse bread. Corn ground by millstones was probably responsible for the inclusion of sand or grit in much of the food consumed.

In Ireland stone used for millstones depended on local rock formations and varied from granite to sandstone. Rotary quern stones from Wood Quay were coarse-grained igneous rocks (Wallace, pers. comm.). The paucity of quern stones led Wallace to believe that the corn was ground in mills outside urban medieval Dublin. Two mills were in use near the monastery at Tintern at the time of the dissolution of the monasteries in the 16th century (Hore, 1901). Grain was also presumably available at Kilrush. The diet of the Kilrush people was less abrasive and may have consisted of potatoes which had been introduced by the 17th century into Ireland and quickly became part of the staple diet.

Abrasion

Interproximal abrasion grooves were associated with periodontal disease on the Tintern population. Some teeth are all that remain from the two Wood Quay subjects with abrasion grooves and their periodontal status could not be evaluated. The causative agent passed beneath the contact area, in the space once occupied by gingiva. This process was obviously facilitated by gingival recession. Such grooves can be caused by gritty particles in the food or drinking water or by tooth picks. However, similar grooves have been found by the author on a 19th century individual from Cork city. One of the teeth from this person showed an unusual pattern of scratches, suggestive of the insertion and withdrawal of a toothpick.

Calculus

The large amount of calculus reflect poor standards of oral hygiene in the Wood Quay and Tintern populations. Better standards of oral hygiene may have been practised by the Kilrush individuals or they may have been genetically inclined to deposit less calculus. Calculus was probably formed by the consumption of an oatmeal porridge (stirabout). This was the diet on which many Irish survived in medieval times (Lucas, 1960). *Bánbíd* or "white foods" consisting of cheese, milk and curds, also played a major part in the Irish diet up to the 17th century and later (ibid.). The porridge and *bánbíd* probably provided the fermentable diet condusive to plague and calculus formation. In the populations examined, the degree of calculus formation must also have been influenced by each individual's personal eating habits and oral hygiene.

Dental Abscess

The considerable occlusal wear and/or dental caries probably account for the majority of abscess cavities in the Wood Quay and Tintern populations.

Dental Caries

The prevalence of dental caries suggests poor standards of oral hygiene. The rate of caries in the Wood Quay and Tintern populations is comparable to that of present-day society, where 50-90% of all teeth are affected by dental decay. The rate for Kilrush is considerably less. As in modern times the deciduous teeth showed decay, and with an increase in age, the incidence of caries increased. A significant differance however is that in the Wood Quay, Tintern and Kilrush populations the majority of cavities occurred on or near the cervical margin, mainly on the interstitial surfaces. This feature has also been noted from other medieval populations (Moore & Corbett, 1973). With the attritional breakdown of the dental contact points, there was subsequent impaction of food. Presumably the standards of oral hygiene were low, with plaque and food debris trapped in stagnation areas around the necks of the teeth long enough for acids from the carbohydrates to form.

Periodontal Disease

Periodontal disease in the Wood Quay and Tintern populations was undoubtedly caused by a combination of factors -

1. Micro-organisms in the mouth.
2. Individual resistance to infection. It is known that some individuals and races are particularly susceptible to periodontal disease (Day & Shourie, 1947).
3. Poor oral hygiene. Numerous surveys have shown that there is a strong correlation between periodontal disease and oral hygiene (Burnett & Scherp, 1966).
4. A diet, high in carbohydrates, e.g. cereals.

The increase of the prevalence and severity of periodontitis with age might account for the greater incidence of the disease in the Tintern population, where the age at death was higher than that at Wood Quay.

In Kilrush the mild frequency of periodontal disease was probably related to the small amounts of alveolar bone remaining. However, where periodontal disease was present it was mild; this may suggest:

1. Better resistance to infection.
2. A generally favourable diet which was rough and low in carbohydrates.
3. Higher standards of oral hygiene. In the 17/18th centuries and earlier, it was known that cloths and sponges were adequate for teeth-cleansing and that salt water or salt was a good antiseptic when rubbed into the gums (Woodforde, 1968).

Hypoplasia

In the Wood Quay subjects the ages affected by hypoplasia may be associated with weaning, the period when the child begins to adapt to solid foods. In modern society the age of weaning is 1-2 years, considerably less than the natural period of 2-4 years (Raphael, 1977). The practise of early weaning, sometimes from the day of birth exposes the baby to infection. In Wood Quay, weaning may have taken place at the later age of 4 years. There was very little attrition on the teeth of two 5 year olds who had hypoplasia for ca. one year before death; these children may have been weaned at ca. 4 years. Those with hypoplasia in the 16-18 months age group may reflect a period of illness. On the other hand, in the advent of the birth of another child, it may have been that older children between 9-18 months had to be weaned, resulting in hypoplastic defects on the older child i.e. 6-18 months.

In the Kilrush population the most likely causes of hypoplasias were nutritional disturbances, possibly associated with the weaning diet. Hypoplasia commenced in all subjects before the age of 5 years. The inadequate weaning diet may in turn have been the result of more widespread nutritional deficiencies caused by seasonal malnutrition, or lack of certain vitamins, especially Vitamin D, or lack of phosphorus e.g. in dairy products.

If by some mechanism, such as warfare or bad weather, the population lost their livestock or crops, then they would have lost the source of their staple foods. In the case of *bánbíd* or "white foods" they would then lack their usual source of Vitamin D. Hypoplasia in the Tintern individuals may be associated with weaning at the age of ca 3.5-4 years or episodes of illness.

Hypoplasia was present up to a short time before/at death in one child from Wood Quay and four children from Kilrush; it is possible that these children died from factors associated with the causes of these defects.

Hypercementosis

Where hypercementosis is localized to one tooth, it is possible that the tooth or surrounding periodontium was subjected to a low-grade infection. Hypercementosis is considered as compensation for the destroyed fibrous attachment to the tooth, in teeth subject to low-grade periapical infection. The majority of individuals with hypercementosis from the populations examined also suffered from dental decay or periodontal disease. There infection was present in most individuals with hypercementosis localized to one tooth. In generalized hypercementosis the teeth are generally not infected (Stones, 1966), and it has been suggested that deposits may have been caused by stresses from occlusal attrition (Sicher, 1953). However, in view of the gross occlusal attrition which was widespread in the populations under study, there was relatively little overall cement deposition. Indeed, considering the greater deposits of cement on modern teeth which have little or no attrition, it would seem that contrary to Sicher's hypothesis the greater the rate of occlusal attrition the smaller the quantity of cement deposition.

Pulpstones

Pulpstones in the teeth from Wood Quay and Kilrush are associated with the older age groups, i.e. 18-30 years. They are associated with considerable occlusal wear in two individuals and with slight occlusal wear in one individual. They do not occur on the teeth from Tintern.

Root Translucency

Root translucency is associated with ageing and is present in the older age groups in Tintern i.e. 25-40 years. It does not occur on the teeth from Wood Quay.

Cysts

The periodontal apical cyst in the individual from Tintern probably resulted from chronic low-grade infection. Seventeen teeth belonging to this individual were lost during life, probably due to periodontitis. In modern clinical practise, such cysts typically occur in the fourth decade of life; the Tintern individual was in her late 30's. The cyst in the Wood Quay individual could have been caused by an unerupted maxillary canine during development.

Fenestrations

All fenestrations were located bucally and are associated with prominent roots. The fenestrations in the individuals from Wood Quay and Tintern were associated with the greater occlusal wear grade (3).

Dehiscences

All dehiscences were located buccally and were associated with prominent roots and severe occlusal wear.

Tori

There is a frequency of 7% of the Wood Quay population with tori mandibularis.

Enamel Variations

Enamel variations occurred on three individuals, one from each site examined. Individuals with enamel extensions may be more susceptible to food particles lodging on the gum of the base thereof, whereby increasing the risk of developing dental caries. The individuals from Kilrush and Tintern had caries on the root near the enamel extension.

Summary and Conclusions

The age distribution in these three populations suggests a high mortality of children. Disease might account for the death of the Wood Quay people whose average age was considerably below that of other Medieval groups. The greater age-at-death of the Tintern females in comparison to the males, contrasts with that from other Medieval Populations.

With the rapid rate of occlusal and interproximal contact area wear seen on the specimens from the sites examined, there is no doubt that these peoples subsisted on a tough, abrasive diet. The considerable occlusal wear and/or dental caries probably accounts for the majority of the abscess cavities.

The prevalence of dental caries suggests poor standards of oral hygiene. Their resistance to infection was similar to that of modern Ireland resulting in a high incidence of periodontal disease in the Wood Quay and Tintern populations. Poor standards of oral hygiene are also reflected by the high incidence of calculus suggesting a diet combining soft foods and meat. Better standards of oral hygiene may have been practised by the Kilrush individuals.

Nutritional disturbances occurring in early childhood were indicated by hypoplastic defects. These were probably associated with weaning or seasonal malnutrition or vitamin deficiencies. Some seem to reflect periods of illness and in the Wood Quay and Kilrush populations, hypoplasia was probably associated with factors which ultimately led to death in some children.

In these populations, hypercementosis was associated with decay or periodontal disease and occurred primarily in the older age groups as does root translucency in the Tintern subjects. Pulpstones in the Wood Quay and Kilrush subjects were associated with considerable occlusal wear.

Fenestrations and dehiscences occurred with prominent roots and severe occlusal wear. Cysts were present in two subjects and enamel variations in three subjects. Tori were present in three individuals from Wood Quay.

In the absence of detailed dental studies from other Irish medieval sites it is not feasible to draw general conclusions on medieval populations in Ireland on these results.

Acknowledgements

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Alveolar Osteitis and Other Oral Diseases in Smilodon Californicus

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OSSA

Of the approximately 2000 skeletal remains of Smilodon Californicus about five percent show oral diseases of several types. Of these pathologies those related to trauma are heavily represented. These include trauma to bone tissue, tooth and, in life, the gingiva and other soft tissues. The likely source of most of this traumatic destruction to oral tissue stemmed from the aggressive employment of the sabres in intraspecific and likely interspecific combat and predation.

Keywords: Paleopathology - Smilodon Californicus.

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Introduction

The materials for this study consist of mascerated bone tissue removed from the asphalt matrix at Rancho La Brea, California and stored at the George C. Page Museum. The bones were collected over a period of decades and in all cases were cleaned and, where necessary, repaired. There were 350 individuals represented in this sample population.

Oral inflammatory lesions almost always represent pathogens introduced at the point of trauma but trauma may not necessarily be the initiating factor. Any mammal may be a natural carrier of a pathogen and an infection could be established through hematogenously borne bacteria. But in contemporary clinical practice where cortical inflammations occur in an otherwise healthy body, there usually has been some kind of trauma to the area of direct invasion from a nearby source of entry.

The course of alveolar cortical inflammation is highly variable. An inflammatory process may manifest itself as the slightest trace periosteal lytic bone (Fig. 1) or proceed through a continuous gradation of increased tissue damage and may result in large amounts of tissue, both cortical and medullary, undergoing simultaneous osteogenesis, suppuration and necrosis (Fig. 2 a and 2 b). The variables which determine the process are complex and, in part, unknown but they must encompass host/agent relationships, immunity, virulency and the strain of pathogen involved. For purposes of definition light inflammatory lesions will be refered to periosteitis. Where there is more reactive bone and greater destruction to the cortical tissue the lesion will be called osteitis. Osteomyelitis will refer to medullary involvement and expansion of structure.

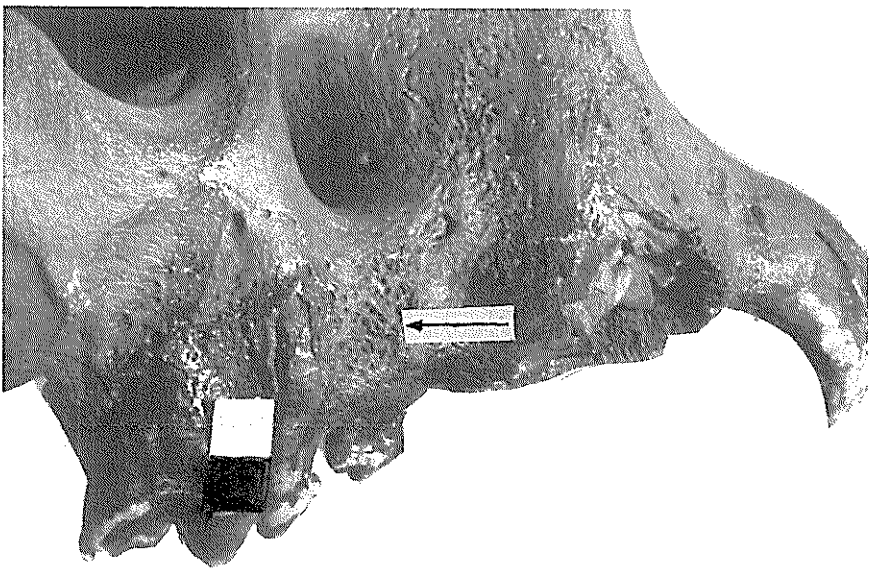

Fig. 1. LACMHC 2001-419. Right Maxilla exhibiting light, lacy osteoclastic bone with resorptive pitting (arrow) extending from incisor region to carnassials. Such marginal periosteitis likely resulted from chronic gingivitis, a consequence of abrasion or trauma. Bar = 2 cm.

Methods

Much of the skeletal material under discussion had previously been examined by Merriam and Stock (1932) who provided the definitive study of the normal anatomy of Smilodon and by Moodie (1929) who confined his observations to pathology. While Moodie's conclusions do not differ from mine his scope was much more limited. Examination of the skeletal material was done at both the gross visual level and with radiographs.

In all instances of alveolar osteitis the lesions are obvious. Normal color and texture of the cortical bone was altered. The lesions are invariably darker and coarser than normal cortical bone. In the most exacerbated instances, those covered with involucrum bone, the surface texture is often extremely rough and marked with one or more cloacae or foramina excavated by suppuration. This porous bone will be elevated above the surrounding normal cortical tissue and often irregularly shaped with areas of more intense osteogenic activity along side areas of bone resorption.

Findings of inflammatory lesions

With little exception lesions of alveolar osteitis in the mandible are located near the carnassial teeth. They can be found on both the buccal and lingual surfaces. The buccal surface alone, however, is affected more often by a margin of seven to one. The one exception to carnassial focus of infection is LACMHC (Los Angeles County Museum, Hancock Collection) 2002-R-618 where the lesion is on the lingual surface of the diastema between the lateral incisor and P1. In two examples the lesions are slightly mesial or slightly distal to the carnassials. But for the most part the lesions are directly inferior to P4 or M1. In 28 examples the focus of infection is between these two teeth in the mandible.

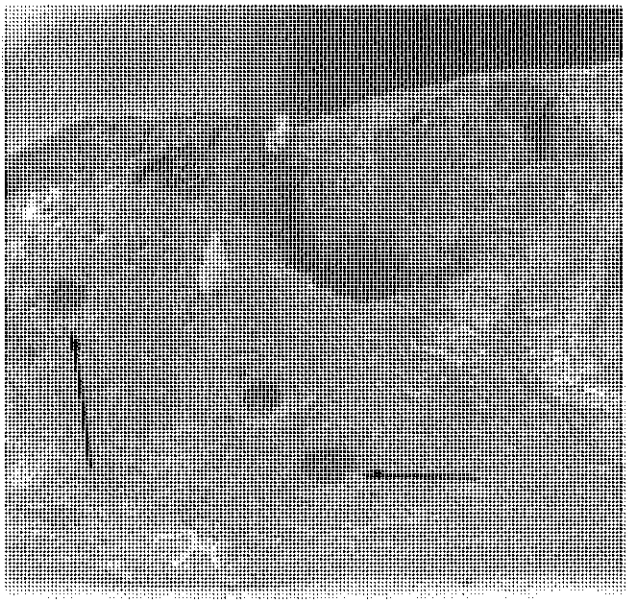

Fig. 2a. LACMHC 2002-L-415. Localized osteomyelitis of mandible immediately inferior to P4, M1. Holes (arrows) are cloacae excavated by pus. M1 was lost before death.

Fig. 2b. Same as above with buccal surface removed. Large channel at bottom is continuous with the vascular supply and mandibular nerve. Socket of anterior root of M1 is discolored reflecting necrosis (arrow). Bar = 3 cm.

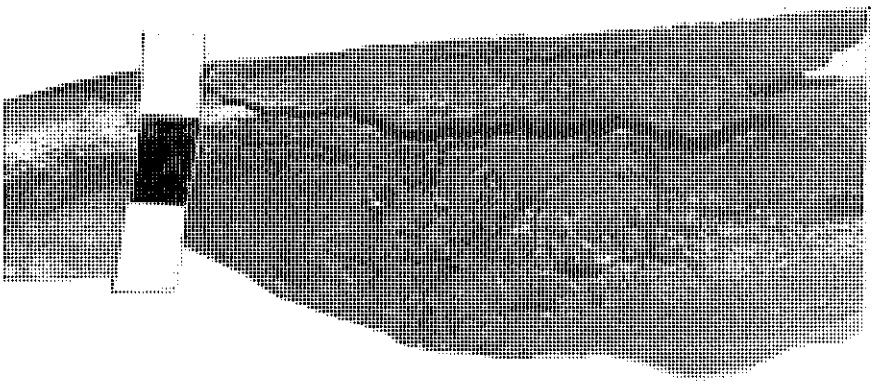

Fig. 3. LACMHC 2002-L-423. Inferior view of mandible showing both osteomyelitic expansion and heavy involucrum formation. Normal bone is on the left. Bar = 3 cm.

In cases of extreme medullary involvement (advanced alveolar osteomyelitis) expansion of the bone may be quite marked. Measured between P4 and M1 the mediolateral thickness of normal bone is about 23 mm. Those mandibles with advanced alveolar osteomyelitis and heavy involucrum the diameter can be as much as 35 mm (Fig. 3). However, the mean increase is 6 mm.

Where the splanchnocranium is involved the lesions take the form of light, lacy resorptive bone with irregular pitting. In this sample from Rancho La Brea there is no thick involucrum or freshly deposited bone nor is there any osteomyelitic expansion. Further, the lesion is usually not stained darker than the surrounding cortical tissue. While the lesions tend to center around the carnassial teeth, they tend to spread in a diffuse pattern extending into the buccal plate. With one exception, the lesions are less severe in the cranium than the mandibles in terms of cortical destruction. The exception, LACMHC 2001-190, represents an avulsion of the left sabre from the buccal plate with subsequent callus repair tissue (Fig. 4). Other examples of sabre avulsion have been noted (Shermis, in press).

Marginal periosteitis and alveolar necrosis are found in both the maxilla and mandibles. This is characterized by resorption of the alveolar bone immediately below the gingival attachment usually on the buccal surface. This uneven and pitted bone tissue is found most commonly around the carnassial teeth. On three examples this marginal periosteitis extends to the adjacent osseous tissue.

On the right side of mandible LACMHC 2001-551 (Fig. 5) there is the antemortem loss of P4 with such severe erosion of the alveolar bone that only the apical portion of the root sockets can be seen in the necrotic alveolar bone.

Neoplasias

There are unambiguous examples of neoplasias on the buccal surfaces of mandibles LACMHC 2002-L-575 and 2002-L-696. The former is a small cortical osteoma measuring 6 mm by 6 mm on the inferior border of the masseteric crest. The latter is located near the mesial root of P4 and measures 14 mm in width and 19 mm in height. This is of the "button" osteoma type. Both are benign.

An additional growth is enigmatic. The lesion is located on the right side of mandible LACMHC 2002-R-577 on the mesial portion of the premolar diastema and measures 4 mm AP by 10 mm ML and 3 mm in height. Given the vulnerability of the diastema because of

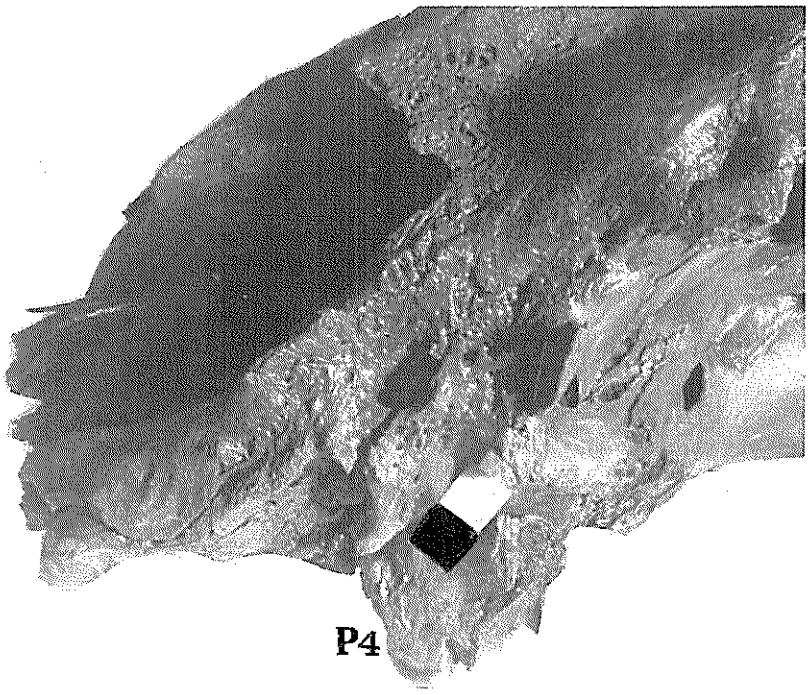

Fig. 4. LACMHC 2001-190. Left maxilla showing healing callus and osteolytic bone with some inflammation (arrow) as a result of the avulsion of the sabre. Bar = 2 cm.

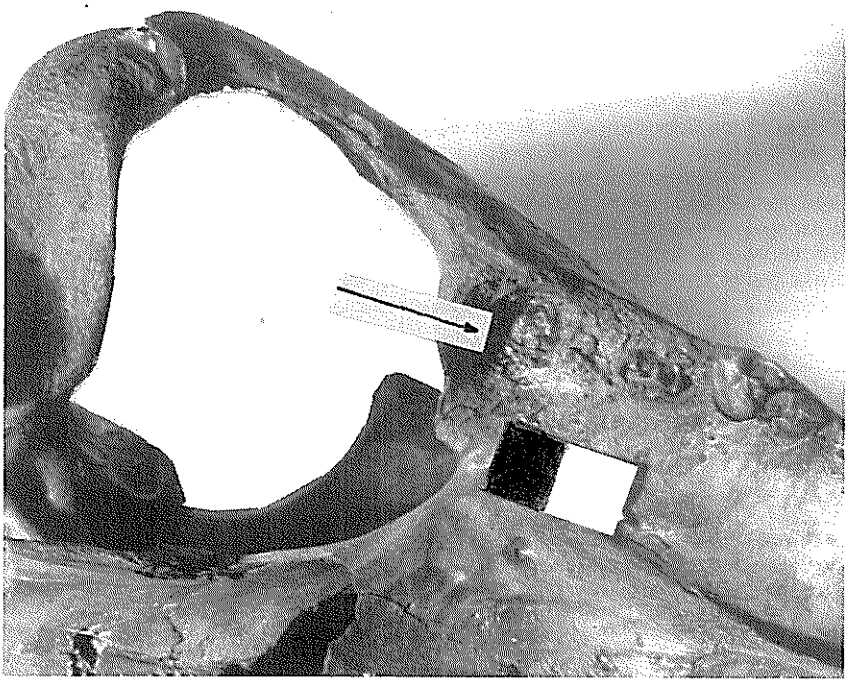

Fig. 5. LACMHC 2001-155. Total obliteration of tooth in right maxilla (arrow). This destruction is likely consequent to chronic alveolar inflammation. Bar = 2 cm.

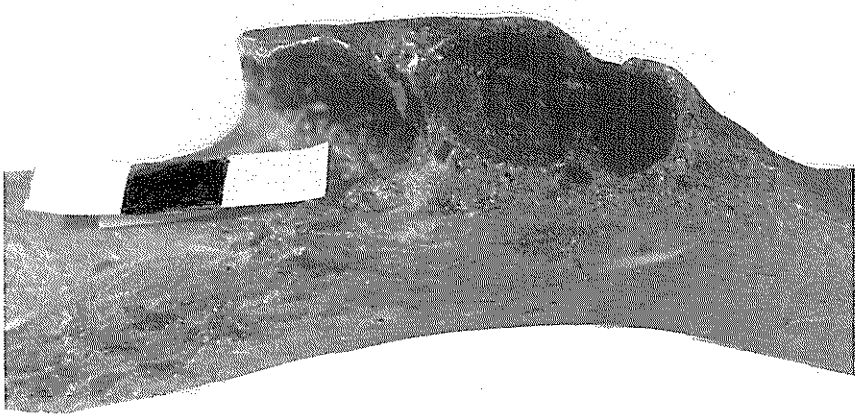

Fig. 6. LACMHC 2002-566. Fracture and subsequent malalignment of the mandibular body. Arrow points to original buccal surface. Bar = 3 cm.

its broad gingival surface and the ambiguous appearance of the lesion, it is possible that this exostotic growth is in response to trauma and represents a variant of myositis ossificans traumatica.

Trauma

There are three traumatic fractures of the mandible, two of them representing well consolidated healed unions and the third a pseudoarthrosis. A healed fracture (LACMHC 2002-4-119) is on the right ascending ramus with obvious distortion of the structure. Although well knitted, the fracture resulted in malocclusion and severe attrition of M1. LACMHC 2002-L-566, a mandible, is fractured through the horizontal ramus distal to P4 with the consequent loss of M1 and the likely subsequent loss of P4. The slight build-up of reactive bone suggests that the fracture was accompanied by a low-grade inflammation. In the healing process of this bone, the original bone is relocated 14 mm laterally to the healed surface (Fig. 6). Given either sexually dimorphic differences, disuse atrophy, normal size changes through time (Shaw, personal communication) or traumatic dysplasia, this mandible is noticeably smaller than the norm.

LACMHC 2002-R-668 exhibits a pseudoarthrosis located through the diastemic interval of the right side of the mandible (Fig. 7). The usual signs of non-union are seen: expanded, highly irregular joint surfaces which, in life, were lined with fibrocartilage attesting to excess movement of the mandible while in the healing process. This non-union fracture shows neither atrophy, malocclusion nor osteoarthritis of the head.

Osteoarthritis

One example of osteoarthritis is seen in this sample. The right medial surface of mandible LACMHC 2002-L-225 exhibits the pitting consequent to subchondral cystification. There is no eburnation present.

Surpressed eruption

There is a single example of suppressed eruption. P4 on mandible LACMHC 2002-466 is entirely contained in the horizontal ramus. Inasmuch as the lingual cortical surface is eroded, the tooth is entirely visible and well below the gingival crest.

Other pathology

On mandible LACMHC 2002-R-71 there is a smooth margined hole mesial to P4 on the right side. It is approximately round and about 9 mm in diameter. Its etiology is unclear.

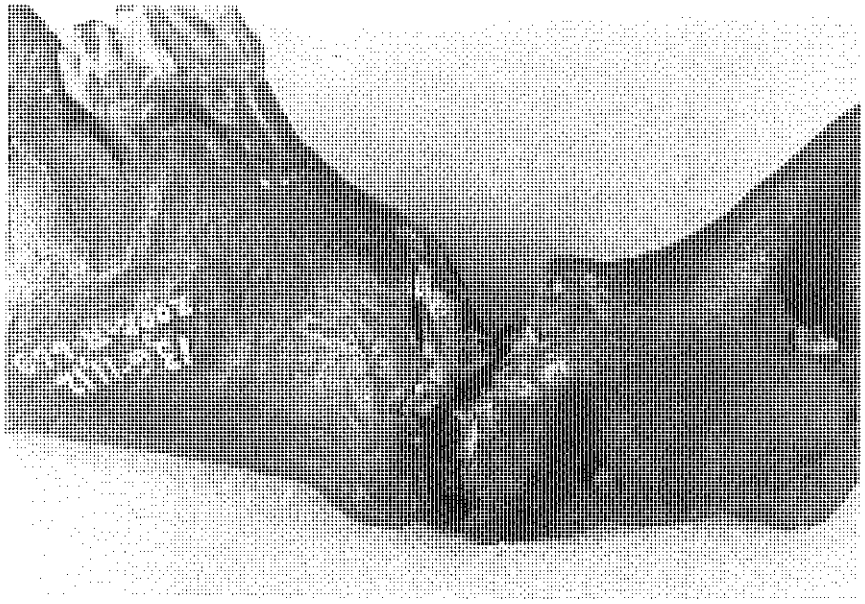

Fig. 7. LACMHC 2002-R-668. Pseudoarthrosis through right diastema. Continued use of mandible prevented bone from forming full union.

It could be the remnants of a cystic fibroma or a source of focal infection, the hole having been excavated by the highly osteolytic pus. The adjacent alveolar tissue as well as the tooth are normal.

Discussion

As was observed, about five percent of the splanchnocrania of *Smilodon* exhibit some kind of pathology, primarily inflammatory and of a chronic nature. However, all four of Fagan's (personal communication) basic categories are represented. These are developmental and congential defects, maxillo-facial trauma, periodontal disease and trauma to the teeth. In terms of sheer numbers, the most common oral disorder is periodontal disease of an inflammatory nature. While there are several sources of causality for periodontitis, it is likely that gingivitis is the initiating factor is this felid. Most of the instances of marginal periodontitis, the inflammation of the cortical alveolar tissue immediately adjacent to the neck and root of the tooth, are to be found in the maxilla and largely confined to the area around the posterior teeth. If the cause of periodontitis in *Smilodon* is analogous to that observed in dogs, the inflammatory process begins in the connective tissue at the gingival margin (Page & Schroeder, 1982). Very little of the irregular bone suggestive of chronic necrotic destruction of the alveolar tissue is seen in the maxilla. With few exceptions osteomyelitic expansion is absent in the sampled maxillae.

In searching for a cause for the gingivitis, I believe a clue can be seen in other trauma-induced pathologies. The sabre fractures and the traumatic dental avulsions attest to the rigorous use to which this felid gave its teeth. Further evidence is observed in intraspecific combat (Shermis, in press) where numerous perforations of the scapula are observed along with fractures and perforations of the ribs and one example of frontonasal perforation. With this extent of sabre utilization it is probable that the soft tissue received some trauma. Further, it is entirely likely that the dental apparatus received

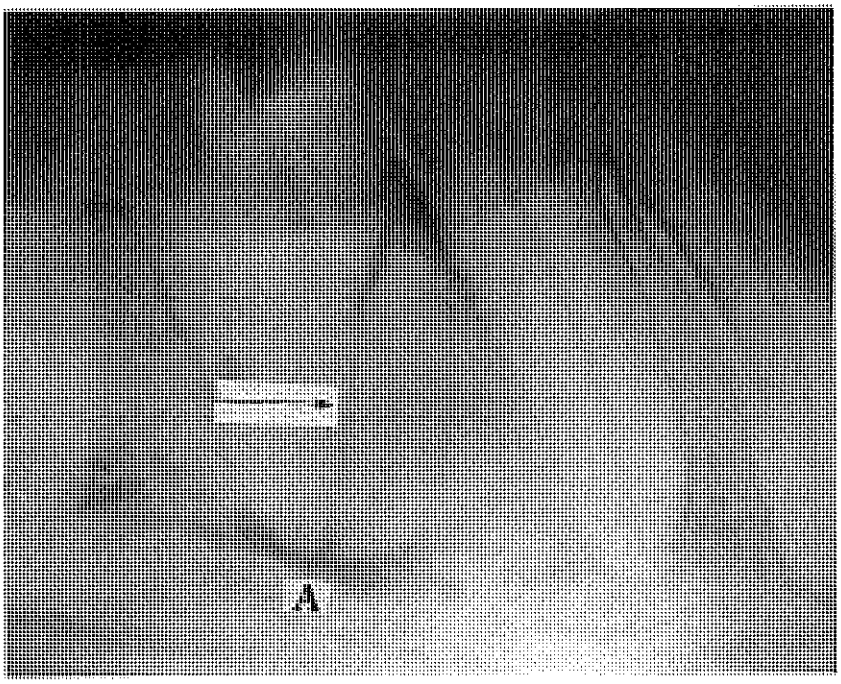

Fig. 8. LACMHC 2002-L-116. Radiograph of mandible showing fracture through root (arrow) which terminates in apical abscess "A". Resulting inflammation produced osteomyelitis.

vigorous use in interspecific combat and predation as well. In short, it would appear that Smilodon generated gingivitis from traumatic abrasion of the gingiva resulting in marginal periodontitis. Inasmuch as this felid inflicted severe puncture wounds with the maxillary sabres, it would seem reasonable that the maxilla would be the recipient of the gingival trauma with its inflammatory consequences.

Mandibular oral disease, in part, mirrors the maxilla in that we find some incidence of marginal periosteitis around the molar teeth. It is here, however, that the more exacerbated forms of alveolar osteitis with osteomyelitis are seen. Radiography reveals the cause in every instance.

At the apex of the cheek teeth in those mandibles where inflammatory lesions are found, two constant features are observed. These are either periapical abscesses or fractures through the pulp or root of the tooth. In Figure 8 a fracture can be seen descending from the mesial root of M1 of mandible LACMHC 2002-R-116 (arrow). This fracture can be seen terminating in a radiolucent pocket of suppuration near the apex of the root. This class 6 fracture, i.e. a fracture of the root, with or without loss of crown structure (Shafer, 1974; Fagan, personal communication) represents the likely introduction of pyogens into the medullary cavity of the mandible. Owing to the enormous pressures which must have been generated during mastication this is not an improbable consequence. The other mechanism is the periapical abscess. In a radiograph these can be recognized as radiolucent areas around the apex of the root.

The precise route by which the periapical abscess comes about may be obscured by the deterioration of the crown of the tooth as a result of the natural process of weathering and abrasion in the asphalt matrix. In a class 3 fracture (Shafer, 1974) i.e. extensive fracture of the crown involving considerable dentin but not the pulp, pyogens transcend the length of the tooth and is a common source of dental and alveolar inflammation.

Fig. 9. LACMHC 2002-R-115. Moderat reactive bone on left body of the mandible below the cheek teeth. Naturally stained area represents extent of inflammatory process. Bar = 3 cm.

However, it may occur idiopathically (Schluger et al., 1977) to the consternation of contemporary clinicians. Should the abscess continue to exacerbate and the medullary portion of the bone become involved, osteomyelitis with its destruction of hard and soft tissue is the usual consequence. As part of the reparative process, coarse involucrum bone will be deposited upon the cortical surface of the bone (Fig. 9) generally causing overall expansion of the structure's external dimensions.

LACMHC 2001-115 (Fig. 5) represents an instance of exacerbated periodontitis, one in which there was chronic and heavy production of pus. Given the powerful osteolytic action of some of the components of suppuration, the alveolar bone surrounding the neck of P4 and a large portion of the root, sloughed off leaving an excavation in the alveolar process.

In a general way the several mandibular fractures reflect the combativeness and ferocity of *Smilodon* and are typical of the substantial amount of trauma observed in this species. Schaller (1972) observed a lion with a traumatic fracture of the mandible and speculated that it was caused by a kick of a zebra. These fractures could surely have the same origin, though the range of causality might be broader in this species.

Conclusion

The most common oral disease seen in *Smilodon* is directly related to trauma to either bone, tooth or gingiva. I believe that the exaggerated mode of stabbing employed in offense and defense, predation and intraspecific combat predisposed this felid to considerable hard and soft tissue damage. In the pathology collection at the George C. Page Museum the bones of this felid are heavily represented and of this number trauma is the main cause of pathology.

Acknowledgements

The suggestions of Christopher A. Shaw are acknowledged with profound thanks. My special gratitude extends to David A. Fagan for his expertise in exotic animal oral disease and his willingness to share this information.

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A Method for Assessing the Clinical Severity of Periodontal Bone Loss in Human Dry Skulls

HAIM TAL

OSSA

The degree of root exposure from periodontal bone resorption is a major criterion for the detection and evaluation of periodontal disease in man. This communication presents an index on bone loss to be used when dried skulls are analyzed for epidemiological purposes by clinical criteria. The distance between the cemento-enamel junction (CEJ) and the alveolar bone crest (ABC) is measured in relation to all surfaces of every available tooth. Individual surface measurements are graded and scored in relation to the severity of bone loss. A bone Loss Index (BLI) score is assigned to each tooth according to the combination of the surfaee scores related to it. The criteria for BLI scores in this system are clinical, and being subjective, they may be modified by each investigator if necessary.

Keywords: Periodontal Bone Loss - Periodontal Indices.

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Introduction

The need for an objective method to assess the periodontal condition in patients has long been recognized, thereby encouraging the development of epidemiological indices (for review, see Carranza, 1984). These indices partially solved the difficulties associated with the estimation of the periodontal status of groups of individuals by resolvning degrees of pathology into reproducible numerical values. However, there are numerous shortcomings (Braga, 1980); the two main criticisms against the more commonly used indices being that they are based on the assumption that: (i) gingivitis is an early form of periodontitis and the gingiva and periodontal attachment apparatus were considered as a single entity; and (ii) predetermined areas in the mouth represent the disease status of the whole mouth (Russel, 1956; Ramfjord, 1959).

A system for evaluating the periodontal status of humans by clinical criteria has been suggested and used by Geiger, et al. (1971), in which they converted measured loss of periodontal attachment at each surface of every tooth present into Tissue Destruction Index (TDI) scores. These scores were subjective as they referred to criteria of clinical severity.

+ Supported in part by a grant from the South African Medical Research Council.

It is well recognized that skeletal material provides an opportunity to assess periodontal destruction very accurately by biometrical means. Yet, little work has been carried out on human skeletons. Furthermore, most research conducted on periodontal bone loss in human skulls consisted of qualitative rather than biometrical means.

Most of the biometrical periodontal studies on dry skulls have dealt primarily with the distance between the cemento-enamel junction (CEJ) and the alveolar bone crest (ABC) at selected points relative to the teeth (Barker, 1975a). An "objective" method for evaluating the periodontal state of human skulls has been described by Davies, et al. (1969). They devised a Tooth Cervical Index (TCI) which showed a significant correlation to the periodontal state as estimated by using "clinical criteria" (Russel' s index, 1956).

The purpose of this article is to suggest a Bone Loss Index (BLI) which may facilitate evaluation of the severity of periodontal bone loss in dry skulls by clinical criteria. As such criteria may differ between groups of clinicians, the index permits easy modifications to the subjective clinical criteria accepted by different investigators.

Methodology

Periodontal bone loss is measured as the distance between the CEJ and the ABC along the buccal, lingual, mesial and distal midvertical lines of each surface of each unirooted tooth. In multirooted teeth, measurements are acquired relative to the buccal and lingual surfaces of each of the mesial and distal roots in mandibles, and the mesio and disto buccal, and the palatal roots in the maxilla (Fig. 1). On each side (buccal or lingual) of these multirooted teeth, the greater measurement between the two (mesial and distal) is selected to represent the condition of that surface. Thus, 6 measurements are performed around the mandibular molars and 5 around the maxillary. Measurements may be conducted with a caliper to the nearest 0.1 mm (Davies & Picton, 1969; Gahan, Tal & Lemmer, 1982) or with a fine calibrated periodontal probe to the nearest millimeter (Tal, 1985a).

Individual surface measurements are then grouped, graded and scored (Table 1). Since the four surfaces of each tooth may show bone loss in any combination of the above grades, all possible combinations of the scores are listed (Table 2). For buccal or lingual surfaces of multirooted teeth where mesial and distal roots are treated separately, the greater of the two grades is considered.

Table 2 has presently been reviewed by a group of experienced clinicians who were requested to arrange all the possible combinations of the surface scores in categories of severity. The severity of bone loss of each tooth is thus judged in relation to the severity of bone loss on each surface.

Four degrees of severity have been established in terms of tooth support scores: 1 = nil; 2 = slight destruction; 3 = moderate destruction; and 4 = extensive or severe destruction. These numbers will be hereafter referred to as Bone Loss Index (BLI) scores. A BLI score is assigned to each tooth; this may simply be conducted by using a personal or regular computer. The method permits calculations of the distribution and frequencies of different BLI scores according to homologous teeth, dentitions, and groups of specimens. Analysis between and within age groups, variance and regression analysis are simple and may again be produced by commonly available computer programs.

Discussion

The degree of root exposure from periodontal bone resorption has long been a major criterion for the detection and evaluation of periodontal disease in man. Although

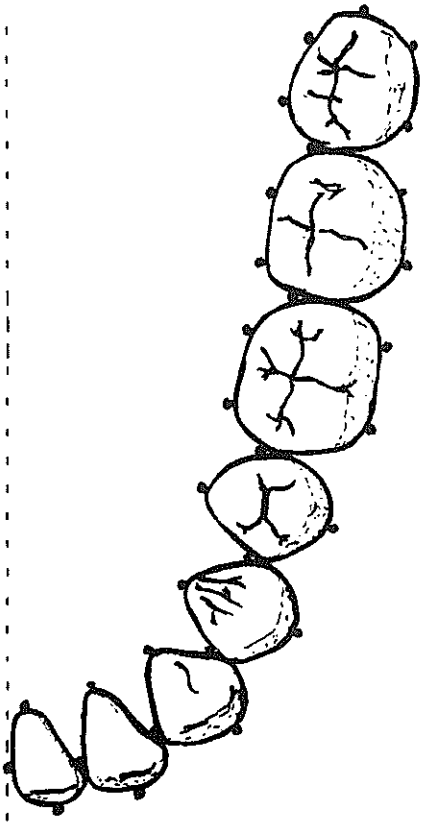

Fig. 1. Diagrammatic illustration showing the sites of measurements in the mandible.

TABLE 1. Surface measurement scores

CEJ-to-ABC Distance	Surface Score
0-2 mm	1
3-4 mm	2
5-7 mm	3
8 + mm	4

TABLE 2. Distribution of combination of all possible scores for 4 surfaces of teeth and the assigned Bone Loss Index (BLI) scores

Combination of surface scores				BLI scores	
1	1	1	1	Nil	= 1
2	1	1	1		
2	2	1	1	Slight	= 2
2	2	2	1		
2	2	2	2		
3	1	1	1		
3	2	1	1	Moderate	= 3
3	2	2	1		
3	2	2	2		
3	3	1	1		
3	3	2	1		
3	3	2	2		
3	3	3	1		
3	3	3	2		
3	3	3	3		
4	1	1	1		
4	2	1	1		
4	2	2	1		
4	2	2	2		
4	3	1	1		
4	3	2	1		
4	3	2	2	Extensive	= 4
4	3	3	1		
4	3	3	2		
4	3	3	3		
4	4	1	1		
4	4	2	1		
4	4	2	2		
4	4	3	1		
4	4	3	2		
4	4	3	3		
4	4	4	1		
4	4	4	2		
4	4	4	3		
4	4	4	4		

radiographic methods are less accurate than direct observations and measurements (DeWaal, Lemmer & Tal, 1982; Shapiro, 1982), more data on periodontal bone loss have in fact been obtained from radiographic studies than from any other method used (Sheppard, 1936; Marshall-Day & Shourie, 1949; Schei, et al., 1959; Markkanen, et al., 1982).

Detection of early periodontitis and differentiation between normal and slightly pathological is difficult in skulls. Barker (1975a) considered a CEJ-to-ABC distance of less than 3 mm as being normal. Baer and Morris (1975) regarded 1.86 mm as the normal average distance and Gahan, Tal and Lemmer (1982) reported a mean distance of 1.40 mm (± 0.45) to be the normal cervical dental height in South African juveniles, free of signs of periodontitis. The present method considers 2 mm as a normal distance (nil destruction) and 3 mm as slight destruction, based upon the available literature, and since its criteria was based to suit primarily the skeletal material of blacks in South Africa (Tal & Tau, 1983).

In relation to the TCH index described by Davies, et al. (1969), Barker (1975b) drew attention to the fact that in the Aboriginal skulls which he examined, the lingual distance between the CEJ and the ABC was often greater than the buccal, a fact which is disregarded by the TCH system. Similar trends were also found on the mandibular incisors of South African blacks (Tal, 1985a, 1985b). An additional shortcoming of the TCH index is that when used for large samples of skulls, it tends to obscure the pattern of distribution, severity and frequency of periodontal destruction according to sites, as it reduces these factors to an average score. This has recently been pointed out as a disadvantage of many statistical methods of analysis of data from clinical periodontal trials (Haffajee, Socransky & Lindhe, 1983).

The advantages of the BLI scores system are:

1. Each tooth is assigned a severity score.
2. The morphology and degree of bone loss around each tooth, rather than mean bone loss is considered.
3. The method may easily be modified for different populations.
4. Analysis is simple with the use of the most popular computer programs.
5. The system allows analysis of the severity of periodontal breakdown by clinical (non parametric) criteria.
6. With the use of a mathematical matrices, analysis of the severity of periodontal breakdown may be carried out according to the location in the skulls, age groups, and their combinations.

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The Clinical Severity of Periodontal Bone Loss in Dry Mandibles of South African Blacks

HAIM TAL

OSSA

Periodontal bone loss associated with periodontitis results in increase in the distance between the cemento-enamel junction (CEJ) and the alveolar bone crest (ABC). This study evaluated the clinical severity of periodontal bone destruction in 100 mandibles of South African Blacks who were never exposed to preventive or restorative dental treatment. Specimens were equally distributed over the third to the seventh decade of adult life. Measured CEJ-ABC (CA) distances along the mesial, distal, buccal and lingual surfaces of 983 teeth were converted into severity surface ratings. Based upon these surface ratings, a Bone Loss Index (BLI) score was assigned to each tooth. Analysis of the frequencies of BLI scores showed that (1) the severity of periodontal bone loss increased with age; (2) BLI 1 and 2 (slight or no periodontal destruction) predominated in the third decade of life, while BLI 3 and 4 (moderate and severe destruction) were predominant by the fifth decade of life and later; and (3) periodontal destruction was more severe ($p < 0.05$) and occurred earlier in life around the incisors and canines.

Keywords: Periodontitis - Alveolar Bone Loss.

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Introduction

The degree of root exposure from periodontal bone resorption has long been a major criterion for the detection and evaluation of periodontal disease. In some studies, bone loss was evaluated by radiographs (Sheppard, 1936; Marshall-Day & Shouri, 1949; Schei et al., 1959; Boyle et al., 1973; Markkanen et al., 1982); in others by measuring the probing depth or loss of attachement around retained teeth (Ross & Thompson, 1971; Lindhe & Nyman, 1975; Knowles et al., 1979). Bone loss was also studied by direct measurements on dry skulls by some investigators (Picton, 1957; Davies et a., 1969; Davies & Picton, 1969). Most authors have used the cemento-enamel junction (CEJ) as a reference marker and considered a distance of 3 mm between the CEJ and the alveolar bone crest (ABC) as being normal.

A method of analyzing the severity of periodontal breakdown in human dry skulls by clinical criteria has recently been described (Tal, in press). Unlike clinical indices (Goldman, 1949; Braga, 1980) or anthropometrical ones (Davies & Picton, 1969), the analysis by clinical criteria was carried out be measuring bone loss around all the teeth present and by assigning a Bone Loss Index (BLI) score to each tooth.

A recent biometric study or periodontal bone loss of South African blacks suggested that bone loss was more severe around the anterior teeth, and that it occurred more rapidly between the third decade of life and the fifth. Later this pathologic process slowed down (Tal, 1985).

The purpose of this study was to evaluate the clinical severity of periodontal bone loss in dry mandibles of a multitribal group of Bantu-speaking South African blacks.

Material and methods

One hundred mandibles of South African blacks were selected from the most recent addition of skulls in the Raymond A. Dart collection of human skeletons (Anatomical Museum, University of Witwatersrand, Johannesburg; for further details on this collection see Tal & Tau, 1983).

Mandibles selected fulfilled the following criteria:

(1) Known tribe, sex, and stated age.
(2) Stated age should not differ by more than ten years from the estimated age, using a calibrated attrition scale.
(3) Mandibles should not show obvious post-mortem damage to the alveolar crest.

Twenty mandibles were selected for each of the five decades of life, from the third to the seventh.

Because the more recent additions to the collection were more fully documented in respect to tribe, sex and stated age, and were in a better preserved condition, the research material was accumulated by working backwards seriatim from the most recent specimen. The distribution of the selected specimens by age, sex and tribe is shown in Table 1.

The distance between the CEJ and ABC (CA distance) was measured along the buccal, lingual, mesial, and distal mid-vertical lines of each surface of each tooth. In view of the possibility that alveolar bone destruction may occur separately around each root of multi-rooted teeth, these tooth measurements were made along the buccal and lingual mid-vertical lines of both roots, and the greater was recorded.

Measurements were conducted to the nearest millimeter with a fine periodontal probe with millimeter markings from 1 to 10 mm checked for accuracy. Measurements were made under standard conditions of good illumination.

Individual surface measurements were converted to severity scores and a BLI score was assigned to each tooth by a method described previously (Tal, in press). Data was recorded on special charts desgined for the ease of computation and analyzed by the varians technique. Probability values equal or smaller than 5% were considered significant.

Results

There were 1,106 teeth present in the 100 mandibles. Two hundred forty-five teeth (17.5%) were lost ante-mortem and 49 (3.5%) post-mortem. On these teethå 5,012 surfaces were observed: 1,764 on molars and 3,248 on bicuspids, canines and incisors. One hundred twenty-three teeth had at least one measurement missing owing to tooth fracture, caries or dehiscence, reducing the number of teeth that could be scored by BLI to 983.

As shown in Figures 1 and 2, the percentage frequency of BLI score 1 decreased significantly from the third decade of life (10.6%) to the fourth (0.9%) but it did not change significantly later (0.0-0.6%) The reduction of BLI score 2 from the third decade of life to the fourth was also marked and significant (from 53.1% to 30%; $p<0.01$). But from the fourth decade of life to the fifth, this reduction was slight and statistically not significant (from 30% to 38% p = NS). In the sixth decade, the frequency of BLI score 2 was 29.6% and in the seventh, it was 17%.

The frequency of BLI score 3 was inconsistant, ranging between 13% in the third decade of life to above 20% in the sixth. The frequency of BLI score 4 showed a moderate increase from the third decade of life to the fourth and from the fourth to the fifth (22.7%, 50.9%, 61.5%; $p<0.05$). During the sixth decade of life, the frequency decreased to 49.7% followed by an increase to 68.9% in the seventh decade.

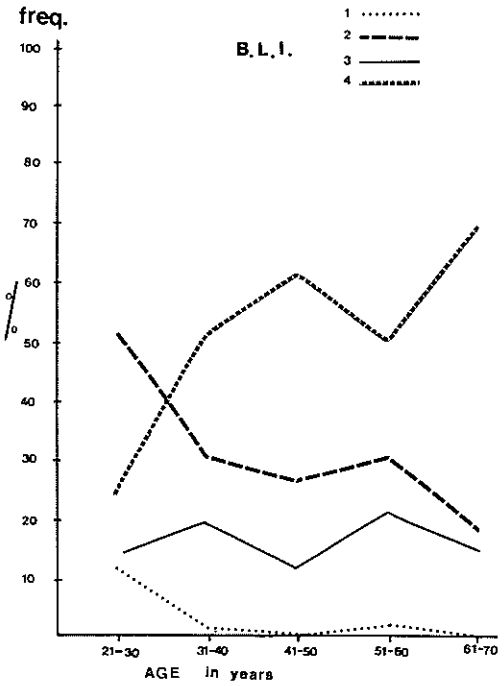


Fig. 1. Frequencies of BLI scores according to age.

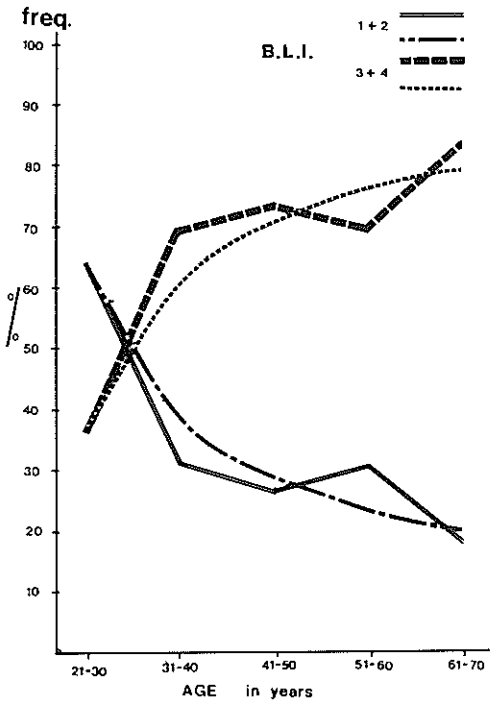


Fig. 2. Frequencies of BLI scores 1 and 2, and 3 and 4 according to age.

When scores 1 and 2 were totaled, and taken to represent teeth having little or no destruction, there was a general trend for index scores 1 and 2 to be predominant (63.7%) in the third decade of life. In the fourth, fifth and seventh decades, BLI scores 3 and 4 predominated (69.1%, 73.2%, 69.8%, 82.9%), representing moderate and severe destruction during this period of life (Fig. 3).

Bone loss was not uniform. Generally, bicuspids were more commonly scored by BLI scores 1 and 2. The incisors were most severly affected, followed by the canines (Fig. 2). The severity of bone loss was symmetrical; there was no significant difference between the left and right sides ($p < 0.5$).

Discussion

Detection of early periodontal disease and differentiation between normal and slightly pathological is difficult on skulls. According to Barker (1975), exposure of roots of less than 3 mm is not indicative of pathological recession of bone. Baer and Morris (1977) considered 1.86 mm as the normal average CEJ-to-ABC distance in skulls, free of signs of periodontitis; Gahan et al. (1982), reported a mean distance of 1.40 mm (0.45) in mandibles of South African juveniles free of signs of periodontitis. For the present study, distances smaller than 2.5 mm (recorded as 2 mm) were considered normal.

Twenty-five (2.54%) showed no bone loss on any of the surfaces (BLI = 1). Of these, 22 were from the 21-30 year-old group. These data suggest that mild periodontitis was common even prior to the third decade of life. Although bone loss before this period was not studied in the present investigation, Gahan et al. (1982), who investigated the normal dental cervical height in juvenile South African blacks, had to exclude 3 skulls from the 23 which were available to them owing to the presence of obvious periodontal bone destruction.

BLI scores 1 and 2 (representing no bone loss or slight bone loss) were most frequently assigned to the bicuspids, while BLI score 4 (representing severe bone loss) was assigned predominantly to the incisors followed by the canines (Fig. 3). It is a well known observation that calculus is frequently found on the lingual surfaces of the lower incisors, and as this is a contributing factor to periodontitis, it may account, in part, for the relatively severe bone loss around these teeth. The buccal position of the canines in the dental arch may have been the cause for a relatively increased distance between the CEJ and the ABC observed in the present sample (Tal, 1985).

Purely on biometric grounds (mean bone loss), the canines would have represented a biometric midway between the incisors and the bicuspids (Tal, 1985). However, since the BLI method is influenced more by individual measurements, than are the means, the position of the canines were shifted from this biometric midway towards the incisors. The overall greater buccal measurements on canines is a further criticism of the assumption of Davies et al. (1969) that buccal and mesial measurements can be regarded as representing bone loss right around the teeth.

The correlation between the increase in severity and age is obvious. Although periodontitis is claimed to be a cyclic rather than linearly progressing process (Schluger et al., 1977), the progressive increase of BLI scores 3 and 4 with age was expected, since the present study is a cross sectional rather than a longitudinal one. However, even longitudinal clinical surveys (Hirschfeld & Wasserman, 1978; Loe et al., 1979) being based upon mean measurements from a group of subjects, likewise failed to reveal the cyclical nature of the disease.

It should be explained, however, that each group of specimens included mandibles of people who suffered little or no periodontal breakdown, on the one hand, while others exhibited moderate or severe bone loss. Hence, deviations from these calculated rates are to be expected in individual specimens. Previous authors (Hirschfeld & Wasserman, 1978; Lindhe et al., 1983) observed in their investigated populations that small groups of individuals accounted for most of the teeth lost due to periodontitis. Furthermore, it

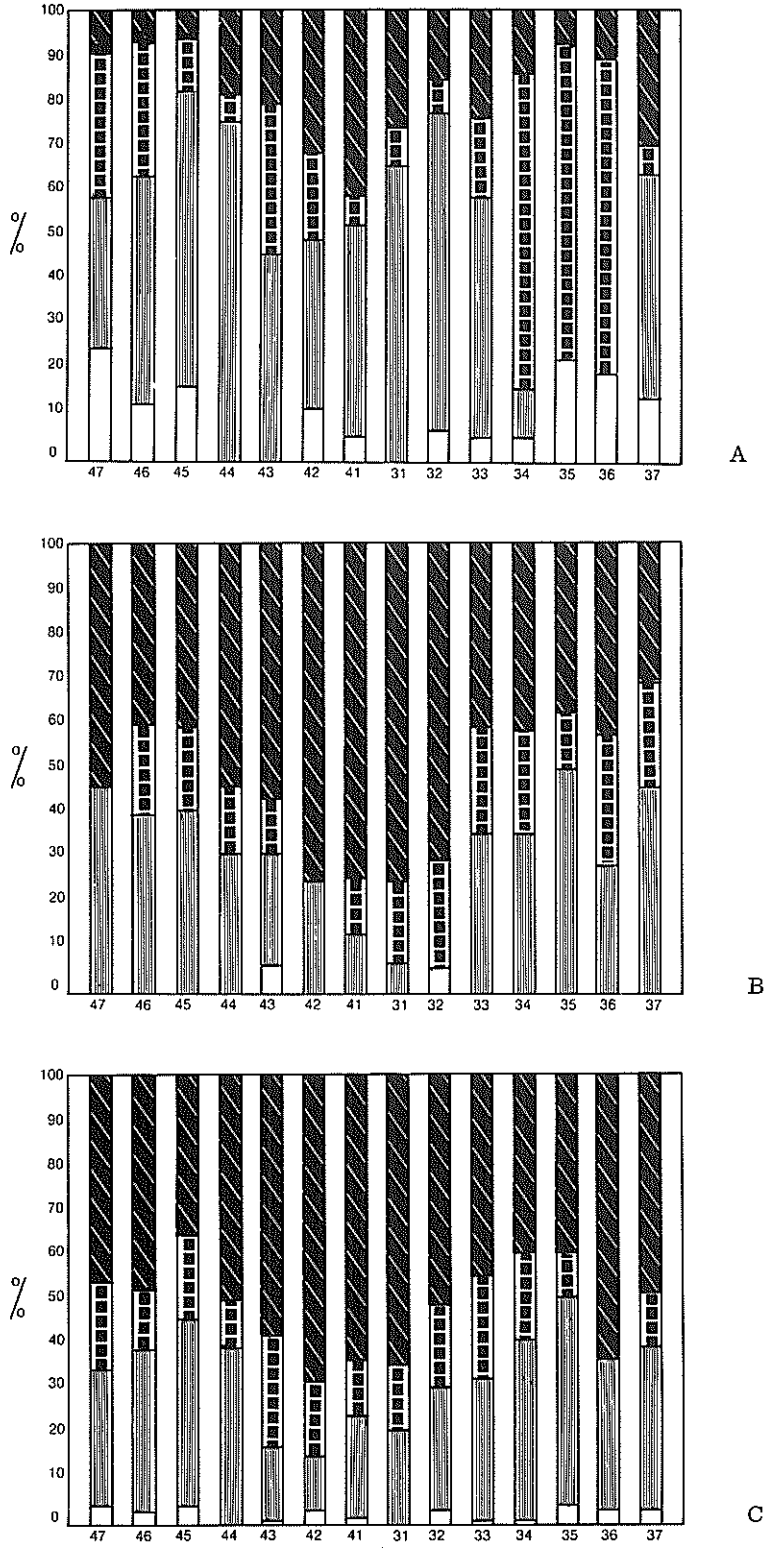
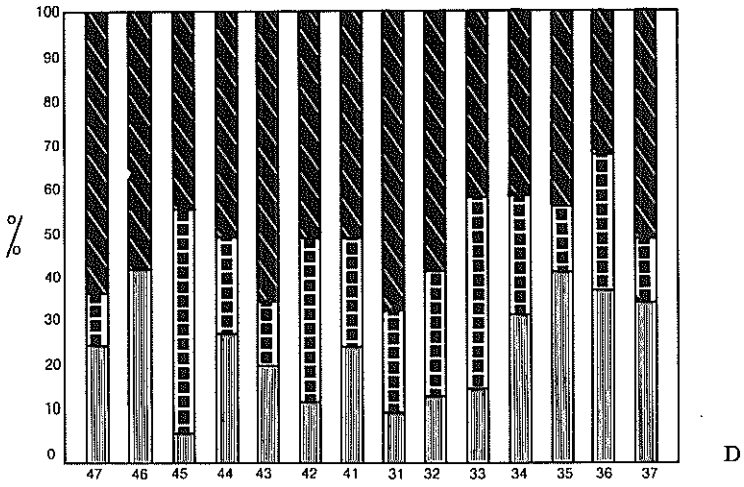


Fig. 3. Adjusted frequencies of BLI scores according to teeth.
A. Age 21-30 years; B. Age 31-40 years; C. Age 41-50 years.



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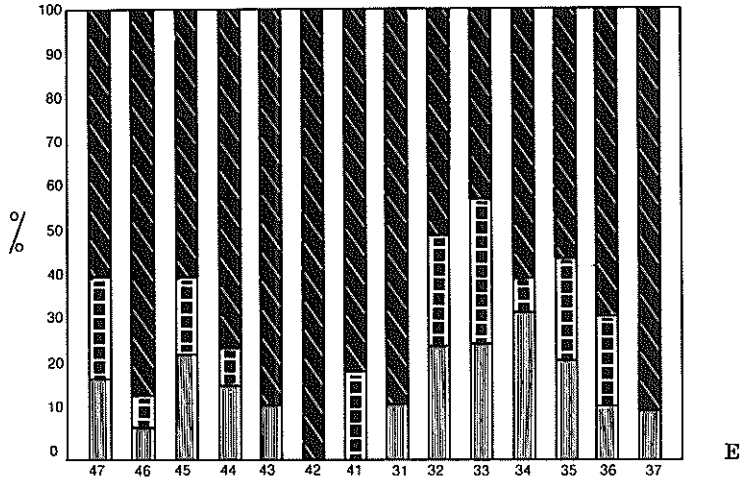

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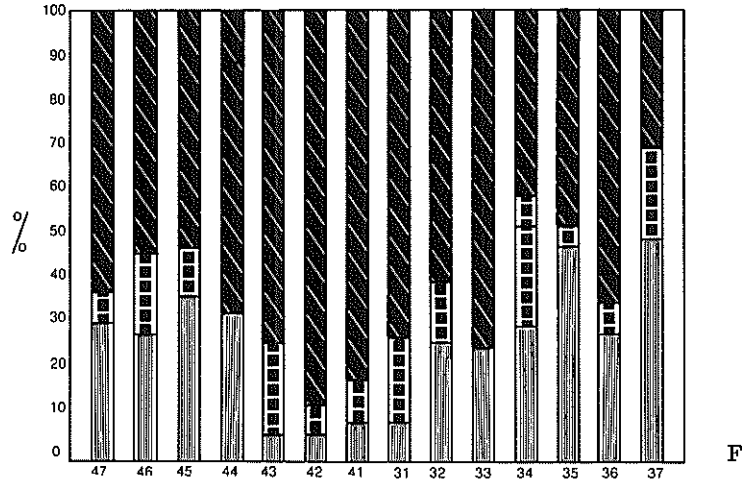

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Fig. 3. cont. D. Age 51-60 years; E. Age 60-70 years; F. All age groups taken together.

has been suggested that active periodontal breakdown occurs in episodes of relatively short duration rather than being chronic and continuous (Haffajee et al., 1983; Listgarten et al., 1984). Calculated averages of bone loss with time should therefore be accepted with caution.

During the sixth decade of life, there were some unexpected deviations from the expected trends. This may possible be explained by the fact that more teeth were missing from older specimens. One may assume that in the aged, those teeth which were missing had been more severly affected by bone loss than those which were retained (Tal & Tau, 1984). It must be pointed out, however, that for this particular sample of specimens, similar deviations during the sixth decade of life were also recorded in relation to furcal depth (Tal, 1982a; Tal, 1982b; Tal & Lemmer, 1982). It is thus possible that purely by chance several non-representative skulls found their way into the randomly selected group of 20 specimens from the sixth decade.

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TABLE 1. Distribution of specimens by age, sex and tribe.

Age Group	Sex		Tribe											
	Male	Female	Malawi	Pedi	Pondo	Shangan	Sotho	Swazi	Tonga	Tswana	Venda	Xhosa	Zulu	Total
21-30	8	12				2	7	1		2		2	6	20
31-40	11	9	1			3	2		1	3		2	8	20
41-50	19	1	1			1	4	1			1	5	7	20
51-60	16	4		2		1	6	1		1		4	5	20
61-70	16	4		2	1	2	5			3		5	2	20
Total	70	30	2	4	1	9	24	3	1	9	1	18	28	100

Dental Morphology and Oral Health of the A.D. 1764 Medvedev Russian Party, Nikolski, Alaska

CHRISTY G. TURNER II, WILLIAM S. LAUGHLIN and ALBERT B. HARPER

OSSA

Teeth and oral pathology of Russians killed by Aleuts in 1764 on Umnak I., Aleutian Is., Alaska, are described and compared with teeth of other Europeans and prehistoric Aleuts. European teeth are so similar to those of the Russian party that the former can safely be used to estimate post-contact admixture amounts in living Aleuts, Eskimos and Indians.

Keywords: Dental Anthropology - Aleuts - Russian-America - Alaska - Oral Pathology.

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The dentition. Of the more than 200 articles and books which focus on or significantly contribute to the anthropology of the Aleutian Islands, at least one third deal with the physical anthropology of past and/or living Aleuts. Conspicuously missing from every one of these works is information on the biology of the Russian occupants in the Aleutians. As has been commented on frequently since the 1820's when I. Veniaminov made many valuable observations, the early Russians interbred with the Aleutian natives causing a change in their genetic make-up or gene pool. Until now, no direct information has existed on the biology and genetics of Alaskan Russians, and all attempts to quantify the amount and kinds of genetic, physiological, and anatomical changes that may have resulted from interbreeding have had to assume what might have been the Russian biological characteristics. The determination of the amount of admixture in living Aleuts and other Alaskan natives is important because to date our concept of what these people are like is based on living population samples. Our ideas about present and prehistoric relationships could be in error if admixture is great and different in various communities.

The discovery and excavation of the Medvedev skeletons at the Chaluka site, Nikolski, Umnak Island, Alaska, in 1970 by A. Harper, S. Laughlin, W. S. Laughlin, and others now gives a magnificantly informative glimpse of the skeletal and dental biology of the early Russians. Because of the care given by the archeological team nearly all the teeth were found, and because the teeth are relatively free of disease and not severely worn, this small series of ten individuals provides as much usable information as other skeletal samples many times larger.

After completing our examinations and study of the Medvedev dentition, we have decided to include for the purpose of increasing the sample size, a Russian skeleton excavated from the same site by W. S. Laughlin in 1961. This skeleton (S-4) has all its dental features within the narrow range of the Medvedev crania that lack any suggestion of Mon-

goloid mixture. One of the Medvedev party, skeleton no. 7, does possess dental features suggestive of a European-Mongoloid hybrid. It is possible that no. 7 had been a Kamchadal or other Siberian creole.

Table 1 shows the ranked scale observations of the Russian tooth crown morphology. Trait definitions are given in the cited references and counting procedures are those used by Turner (Turner and Scott, 1977).

For most, the Russian crown characteristics are within the ranges known for European and American whites, and outside those of American Indians, Aleut-Eskimos, and Asian Mongoloids. Also, the Medvedev teeth are small, a feature of European teeth, although measurements were not taken for this paper.

Table 2 provides information on the Russian tooth roots. As with their crown anatomy, the frequencies of root variants are like those known for Europeans, and not like Asian or Asian-derived populations.

Table 3 gives observations on mandibular and palatine tori and lower jaw shape. Although strictly comparable European data are unavailable, our impression is that both tori and jaw form are more like those of Europeans rather than Mongoloids, especially Alaskan Aleuts and Eskimos.

Table 4 details the oral health condition of the Russians. Periodontal disease, as best as can be evaluated from osseous remains, is not as severe as that seen in prehistoric Aleut and Eskimo jaws. We have no information on the frequency or intensity of this multi-factorial disease in 18th century Europe or Siberia. Tooth chipping is mild to moderate excepting in skeleton no. 8 who possessed seven chipped teeth - an extent comparable to high Arctic Eskimos of Canada and Greenland and in Okhotsk crania (on loan to W. S. Laughlin). Were it not for the presence of dental caries and a European-like dentition, skeleton no. 8 might also have been considered as a Siberian aboriginal because of the occlusal surface damage thought due to severe dietary practices.

Alveolar abscessing is somewhat less than what is known for prehistoric Aleuts, but dental caries, even though absolutely infrequent in the Medvedev crania, are significantly more numerous than in prehistoric Aleuts. Crown caries have never been found in any well documented prehistoric Aleut teeth. The locations of the Medvedev caries are, as expected, in the groove and fossa-rich molar teeth. Root translucency and degree of cement development are appropriate for these young to middle-aged male skeletons. No root caries were seen, a condition generally limited to older individuals.

Table 5 shows tooth wear and antemortem loss. In contrast to prehistoric Aleuts the Russian teeth are worn less and show fewer missing teeth for a young to middle-aged adult sample. We assume this reflects a relatively soft and clean choice of food-stuffs. As with most human populations, the first molars are among the most commonly lost teeth during life.

Table 6 shows frequencies of crown and root variants in Russians, Aleuts, and Europeans. As can easily be noted, the Medvedev teeth are more like those of Europeans than Aleuts. The main exceptions are lower first premolar lingual cusp number, and lower first molar root number. Skeleton no. 7 is the only skull with a three-rooted lower first molar (a condition very characteristic of Mongoloids) as well as other features which lead us to suspect he was a creole.

These observations and dental comparisons suggest three main interpretations. First, the dentition of the Medvedev party reveals a European pattern. This supports the archeological and other physical anthropological evidence that these skeletons were Russians and not hybrid Aleuts later buried at Chaluka. Second, the preservation of the teeth is excellent. Undoubtedly, the teeth are chronologically rather recent. This fact correlates with the associated historic gravegoods, stratigraphic information, and other evidence of chronology. Third, and most important, the Medvedev teeth show that the Russian occupants of Alaska had dental characteristics of better studied European dental series. Therefore, future studies of Native Alaskan population genetics can safely

assume European gene frequencies were carried to Alaska, at least as far as those which determine dental morphology are concerned .

Dental summary. The dental characteristics of eleven Russian skeletons are presented. The teeth are essentially identical to those of Europeans. The possibility exists that one of the Medvedev party was a Russian-Mongoloid creole. The oral health of the Russians was generally better than prehistoric Aleuts, although the Russians introduced dental caries. In future studies of Aleut dental microevolution, European dental trait frequencies can be safely used to assess admixture and post-contact genetic changes in the Aleut population.

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TABLE 1. Russian dental crown morphology (individual count).

Trait and expression	Tooth and frequency				No.	Procedure and notes
Winging	I11				7	Enoki and Dahlberg, '58
Bilateral	14.3					
Unilateral	0.0					
Straight	71.4					
Bilateral counterwinging	14.3					
Unilateral counterwinging	0.0					
Shoveling	I1	I2	C	I1	8	Scott, '73. This
0 (none)	12.5	12.5	33.3	I2	8	scale approximates
1	25.0	50.0	55.5	C	9	that of Hrdlicka
2 (trace)	37.5	25.0	11.1			('20) as: 0=none;
3	25.0	12.5	0.0			1-2=trace; 3-4=
4 (semi-shovel)	0.0	0.0	0.0			semi-; 5-6=shovel.
Double-shovel (labial)	I1	I2	C	I1	8	Modified from
Smooth labial surface	75.0	100.0	100.0	I2	8	Dahlberg, '51.
Mesial border ridged	25.0	0.0	0.0			
Tuberculum dentale	I1	I2	C	I1	8	Modified after
No expression (smooth)	12.5	71.4	10.0	I2	8	Scott, '73.
0.5 (trace of ridging)	0.0	0.0	30.0	C	10	
1	37.5	14.3	20.0			
2	37.5	14.3	10.0			
3 (moderate ridging)	0.0	0.0	0.0			
4	12.5	0.0	10.0			
5 (strong ridging)	0.0	0.0	10.0			
6 (free or nearly free cusp)	0.0	0.0	10.0			
Incisor interruption grooves	I1	I2		I1	8	Turner, '67
Mesial lingual border	0.0	0.0		I2	8	
Distal lingual border	0.0	12.5				
Mesial & distal borders	0.0	12.5				
None	100.0	75.0				
Canine mesial ridge			C	C	9	Modified after
0 (none)			100.0			Morris, '75
1 (trace)			0.0			
Canine distal accessory ridge		C	C	C	4	Scott, '73
0 (none)		25.0	25.0	C	4	
1 (trace)		0.0	25.0			
2 (weak)		25.0	25.0			
3 (moderate)		50.0	25.0			
4 (strong)		0.0	0.0			
Premolar cusp number	P1	P2		P1	9	Turner, '67
two cusps	100.0	100.0		P2	9	
three cusps	0.0	0.0				

TABLE 1, cont.

Trait and expression	Tooth and frequency			No.		Procedure and notes
Premolar accessory cusps	P1	P2		P1	9	Turner, n.d.
Mesial border	0.0	0.0		P2	9	
Distal border	0.0	0.0				
None	100.0	100.0				
Cusp 5 (distal)	M1	M2	M3	M1	4	Turner and Warner
0 (none)	100.0	100.0	85.7	M2	5	n.d. Scale under
1-4 (trace to strong)	0.0	0.0	0.0	M3	7	development
5 (heavy)	0.0	0.0	14.3			
Carabelli's trait	M1	M2	M3	M1	8	Dahlberg, '63
0 (no expression)	0.0	100.0	87.5	M2	9	
1 (line or furrow)	50.0	0.0	12.5	M3	8	
2 (pit)	0.0	0.0	0.0			
3 (double line)	25.0	0.0	0.0			
4 (Y-form)	0.0	0.0	0.0			
5 (no contact with groove)	25.0	0.0	0.0			
6 (small contact with gr.)	0.0	0.0	0.0			
7 (high cone)	0.0	0.0	0.0			
Hypocone (cusp 4)	M1	M2	M3	M1	8	Larson, Scott and
0 (no expression)	0.0	11.1	22.2	M2	9	Turner (Scott,'73).
1 (weak ridges)	0.0	0.0	11.1	M3	9	This scale approxi-
2 (small cuspule)	0.0	0.0	11.1			mates that of Dahl-
3	0.0	0.0	44.4			berg ('51) as: 0-1=
3.5	0.0	44.4	11.1			3; 2=3+; 3-3.5=4-;
4 (large cusp)	87.5	44.4	0.0			4-5=4 pattern.
5 (very large cusp)	12.5	0.0	0.0			
Parastyle	M1	M2	M3	M1	8	Turner and Warner,n.
0 (no expression)	100.0	100.0	100.0	M2	9	Modified after
				M3	8	Katich,'75.
Lower incisor shoveling	I1 2				7	Scott,'73. Grade 3
0 (no expression)	28.6					approximates Hrd-
1	42.9					licka's "trace" grad
2	28.6					for upper incisors.
3 (trace)	0.0					
Premolar lingual cusps	P1	P2		P1	10	Scott,'73. This
A (no lingual cusp)	30.0	0.0		P2	10	scale also counts
0	40.0	50.0				lingual cusps: A=0;
1	10.0	0.0				0=1; 1-7=2; 8-9=3
2	10.0	10.0				lingual cusps.
3	0.0	30.0				
4-5	0.0	0.0				
6	10.0	10.0				
7-9	0.0	0.0				
Molar groove pattern	M1	M2	M3	M1	6	Gregory,'16; Hellman
Y (cusps 2 and 3 contact)	83.3	30.0	14.3	M2	10	'28; Jorgense,'55.
+ (1,2,3,4 contact)	16.7	0.0	14.3	M3	7	
X (1 and 4 contact)	0.0	70.0	71.4			
Molar cusp number	M1	M2	M3	M1	8	Modified after Gre-
7 (C1-7 present)	0.0	0.0	0.0	M2	10	gory,'16; see Turner
6 (C1-6 present)	12.5	0.0	0.0	M3	7	'67.
5 (C1-5 present)	87.5	50.0	71.4			
4 (C1-4 present)	0.0	50.0	28.6			

TABLE 1, cont.

Trait and expression	Tooth and frequency			No.	Procedure and notes
Deflecting wrinkle	$M\overline{1}$	$M\overline{2}$	$M\overline{3}$	$M\overline{1}$ 0	Seybert and Turner,
0 (no expression)	-	100.0	100.0	$M\overline{2}$ 9	n.d. Scale under
1-3 (various expression)	-	0.0	0.0	$M\overline{3}$ 7	development.
Triconid crest	$M\overline{1}$	$M\overline{2}$	$M\overline{3}$	$M\overline{1}$ 2	Hanihara,'61
0 (C1-2 ridge absent)	100.0	100.0	100.0	$M\overline{2}$ 9	
1 (C1-2 ridge present)	0.0	0.0	0.0	$M\overline{3}$ 7	
Protostylid	$M\overline{1}$	$M\overline{2}$	$M\overline{3}$	$M\overline{1}$ 8	Dahlberg,'63
0 (no expression)	75.0	80.0	71.4	$M\overline{2}$ 10	
1 (pit in buccal groove)	25.0	20.0	28.6	$M\overline{3}$ 7	
2-6 (various expressions)	0.0	0.0	0.0		
Cusp 5 (hypconulid)	$M\overline{1}$	$M\overline{2}$	$M\overline{3}$	$M\overline{1}$ 7	Turner and Warner,
0 (no expression)	0.0	50.0	28.6	$M\overline{2}$ 10	n.d. Scale under
1 (faint cuspule)	0.0	0.0	0.0	$M\overline{3}$ 7	development.
2 (trace cusp)	0.0	40.0	0.0		
3 (moderate cusp)	85.7	10.0	14.3		
4 (large cusp)	14.3	0.0	42.8		
5 (very large cusp)	0.0	0.0	14.3		
Cusp 6 ("entoconulid")	$M\overline{1}$	$M\overline{2}$	$M\overline{3}$	$M\overline{1}$ 8	Turner,'70
0 (C6 absent)	87.5	100.0	100.0	$M\overline{2}$ 10	
1 (C5 >> C6)	12.5	0.0	0.0	$M\overline{3}$ 7	
2-5 (various expression)	0.0	0.0	0.0		
Cusp 7 ("metaconulid")	$M\overline{1}$	$M\overline{2}$	$M\overline{3}$	$M\overline{1}$ 9	Turner,'70
0 (C7 absent)	100.0	100.0	100.0	$M\overline{2}$ 10	
1-4 (various expression)	0.0	0.0	0.0	$M\overline{3}$ 7	
Third molar occurrence	$M\underline{3}$	$M\overline{3}$	$M\overline{3}$	$M\overline{3}$ 10	Any opening in alve
L and R absent	0.0	30.0		$M\underline{3}$ 9	lar bone showing M3
L or R absent	0.0	0.0			considere present,
L and R present	100.0	70.0			even if M not func-
One or more M3 absent			33.3	LR$M\overline{3}$ 9	tionally sitioned.
Peg-form	$I\overline{2}$	$M\overline{3}$		$I\overline{2}$ 8	M-D diame er < 7.0
Present	0.0	0.0		$M\overline{3}$ 9	
Absent	100.0	100.0			
Odontome (any site)	$P\overline{12}$			$P\underline{1}$ 9	Alexandersen,'70
Present	0.0			$P\underline{2}$ 9	
Absent	100.0			$P\overline{1}$ 10	
				$P\overline{2}$ 10	

TABLE 2. Russian dental root morphology

Russian dental root morphology							
Trait and tooth	Expression & frequency				No.		Procedure and notes
Enamel extensions	0	1	2	3	P1	9	Pedersen,'49. 0=no
P1	100.0	0.0	0.0	0.0	P2	9	extension; 1=slight
P2	100.0	0.0	0.0	0.0	M1	8	2=medium; 3=marked.
M1	62.5	37.5	0.0	0.0	M2	9	
M2	44.4	0.0	11.1	44.4	M3	8	
M3	50.0	25.0	12.5	12.5			
P1	100.0	0.0	0.0	0.0	P1	10	
P2	100.0	0.0	0.0	0.0	P2	10	
M1	44.4	44.4	11.1	0.0	M1	9	
M2	40.0	20.0	30.0	10.0	M2	10	
M3	57.1	28.6	0.0	14.3	M3	7	
Root number	1	2	3		I1	9	Turner,'67
I1	100.0	0.0	0.0		I2	7	
I2	100.0	0.0	0.0		C	7	
C	100.0	0.0	0.0		P1	9	
P1	44.4	55.5	0.0		P2	4	
P2	100.0	0.0	0.0		M1	7	
M1	0.0	0.0	100.0		M2	8	
M2	12.5	12.5	75.0		M3	8	
M3	37.5	25.0	37.5				
I1	100.0	0.0	0.0		I1	9	
I2	100.0	0.0	0.0		I2	8	
C	100.0	0.0	0.0		C	9	
P1	100.0	0.0	0.0		P1	8	
P2	100.0	0.0	0.0		P2	9	
M1	0.0	88.8	11.1		M1	9	
M2	10.0	90.0	0.0		M2	10	
M3	14.3	85.7	0.0		M3	7	

TABLE 3. Russian mandible form and tori (individual count)

Trait	Frequency		No.	Procedure and notes
Torus	Maxilla	Mandible	Max. 9	Turner & Scott,'73
Absent	0.0	40.0	Mand.10	
Trace	55.6	60.0		
Medium	33.3	0.0		
Large	11.1	0.0		
Very large	0.0	0.0		
Rocker jaw		Mandible	Mand.10	Turner n.d. scale
0 (absent)		90.0		under development
1 (threshhold)		10.0		
2 (rocker)		0.0		

TABLE 4. Russian dental pahtology (individual count)

Trait and expression	Location and frequency				No.	Notes and procedure
Periodontal disease	Alveolar bone				10	None=alveolar border same or c. 2 mm. short of enamel border; slight=2-4 mm. short + ragged edge; medium=>4-5 mm recession; severe=half or more root exposed.
None	20.0					
Pocket	10.0					
General (slight)	50.0					
General (medium)	20.0					
Severe	0.0					
Tooth chipping	Any site				10	Turner & Cadien,'69
0 teeth	10.0					
1	50.0					
2	20.0					
3	10.0					
4-6	0.0					
7	10.0					
Alveolar abscess number	Maxilla	Mandible	Both jaws			Any infective site no related to tooth sock wall.
0	77.8	77.8	62.5	Max.9		
1	11.1	22.2	25.0	Man.9		
2-4	0.0	0.0	0.0	Max. &		
5	11.1	0.0	0.0	man.8		
6	0.0	0.0	12.5			
Carious teeth	Maxilla	Mandible	Both jaws			Any decay site on enamel.
0	88.9	66.7	62.5	Max.9		
1	11.1	0.0	0.0	Man.9		
2	0.0	22.2	12.5	Max. &		
3	0.0	11.1	25.0	man.8		
Caries location	Carious			Teeth		
$I\frac{1}{}$	0.0			10		
$I\frac{2}{}$	0.0			13		
$C\frac{}{}$	0.0			15		
$P\frac{1}{}$	0.0			15		
$P\frac{2}{}$	0.0			17		
$M\frac{1}{}$	0.0			15		
$M\frac{2}{}$	6.3			16		
$M\frac{3}{}$	0.0			17		
$\frac{I1}{}$	0.0			11		
$\frac{I2}{}$	0.0			14		
$\frac{C}{}$	0.0			14		
$\frac{P1}{}$	0.0			17		
$\frac{P2}{}$	0.0			17		
$\frac{M1}{}$	6.3			16		
$\frac{M2}{}$	16.7			18		
$\frac{M3}{}$	21.4			14		

TABLE 5. Russian antemortem tooth loss and wear

Tooth	Wear* 0	0.5	1	2	3	4	Antemortem loss 5	No. (teeth)
Upper								
I1	0.0	0.0	90.0	10.0	0.0	0.0	0.0	10
I2	0.0	30.8	69.2	0.0	0.0	0.0	0.0	13
C	0.0	25.0	75.0	0.0	0.0	0.0	0.0	16
P1	0.0	33.3	53.3	13.3	0.0	0.0	0.0	15
P2	0.0	23.5	58.8	17.7	0.0	0.0	0.0	17
M1	0.0	0.0	11.1	55.5	16.7	0.0	16.7	18
M2	0.0	23.5	58.8	11.8	0.0	0.0	5.9	17
M3	0.0	82.3	5.9	11.8	0.0	0.0	0.0	17
% ave.	0.0	28.4	49.6	16.3	2.4	0.0	3.2	123
Lower								
I1	0.0	0.0	83.3	8.3	0.0	0.0	8.3	12
I2	0.0	0.0	85.7	14.3	0.0	0.0	0.0	14
C	0.0	14.3	85.7	0.0	0.0	0.0	0.0	14
P1	0.0	41.2	58.8	0.0	0.0	0.0	0.0	17
P2	0.0	35.3	64.7	0.0	0.0	0.0	0.0	17
M1	0.0	0.0	29.4	47.1	11.8	5.9	5.9	17
M2	0.0	27.8	38.9	33.3	0.0	0.0	0.0	18
M3	0.0	57.1	42.9	0.0	0.0	0.0	0.0	14
% ave.	0.0	22.8	59.3	13.8	1.6	0.8	1.6	123

* 0 no wear; 0.5 wear but not to dentine; 1 dentine visible; 2 cusps gone; 3 pulp exposed; 4 root stumps functional; 5 tooth gone.

TABLE 6. Dental trait frequencies in Europeans, Umnak Russians and Aleuts[+]

Trait	European	Russian	Aleut
Winging $\underline{I1}\underline{1}$	3.0	14.3	29.6
Shoveling $I\underline{1}$**	.017-.365	.292	.736-.866
Double-shovel $I\underline{1}$**	.100	.125	.052
Carabelli trait $M\underline{1}$**	.450-.543	.357	.054
Hypocone $M\underline{2}$**	.363-.447	.666	.270
Single-lingual cusp $P\overline{1}$	47.8	70.0	97.1
Y groove pattern $M\overline{2}$	4.0-20.7	30.0	0.0-13.9
Four-cusped $M\overline{2}$	86.8-100.0	50.0	8.2
Protostylid $M\overline{1}$**	.029-.122	.031	.036
One-rooted $P\underline{1}$	30.0-56.0	44.0	87.0
Three-rooted $M\overline{1}$	0.0-3.0	11.1	43.7
One-rooted $M\overline{2}$	2.8-4.3	10.0	47.5

*Sources are varied for Europeans and cited in Turner (n.d.) Aleut frequencies from Moorrees ('57) and Turner ('67).
**Denotes adjusted frequencies using weighting coefficients (Turner,'75).

Book Reviews:

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IREGREN, E.: The Ethnic Grouping of Populations. The Vivallen cemetery as an example of a methodological study in physical anthropology. Archaeology and Environment, Umeå 1985, pp. 211–219.

In very few instances is there reason to review a single paper. Papers in journals or in edited books are generally checked by at least one editor, or by one or more referees, with respect to content and scientific value. That a paper in this way may be subject to revision before publication is a guarantee to the readers that the paper is of some quality, and that formal or scientific errors have been erased. Occasionally, however, there may be a slip in the editorial process, and papers that do not conform with the least scientific standard may happen to be published.

At least, a scientific paper is expected to provide information arranged according to the following sequence: introduction, material, methods, results, discussion and conclusion. A brief summary may be given at the end of the paper, or an abstract above its introduction, providing the main results or a condensed version of the paper. Above all, the heading should cover the content of the paper, no more, no less. Though the results, discussion and conclusion depend on the author of the paper only, throughout the paper at least references to authors cited or to given events should be correctly made. If not, readers who are not familiar with the line of research may accept incorrect quotations or erroneous statements as facts, whereas those familiar with the literature and research development may be professionally annoyed with respect to wrong information being published. Naturally, one or another misquotation or misinterpretation may appear in print without any serious implication, but when series of mistakes are made, showing that the author has but a faint idea about the literature and the field of research involved, it is quite another matter. In such a case, a review has to be made (for instance, Bellwood 1985), in order to prevent serious damage to the conception of the research on the subject. This is unfortunately the situation with Iregren's paper, which contains a large number of direct errors concerning the references quoted, apart from contradictions and more or less misleading statements.

The material studied derives from a mediaeval, possibly Saamish cemetry. The heading of the paper indicates that results concerning the cementery should be given. This impression is strenghtened when reading the abstract, in which it is stated:

> In order to establish the ethnic origin of the Vivallen population and its relationship to Saami and Nordic populations, individuals from it are studied by skull measurements, dental examination and with regard to minor morphological traits in skull and teeth.

However, no results whatsoever are found in the text, nor of comparisons with other populations which were also mentioned,or of any of the anticipated results. Considering the usual parts of a scientific paper, this one therefore at most contains just the introduction, material and methods.

The Introduction of the paper starts with the statements:

> In their attempts to clarify the ethnic grouping of populations, the historians of civilization expect assistance from physical anthropology. Anthropology is regarded as an exact science, since researchers take measurements and make statistical calculations.

The first statement may perhaps be confirmed on some rare occasions, although Zachrisson (1985), who is involved in the same project, actually claims that it is the first time "that an archaeological cum osteological research project on the Swedish side has been chiefly concerned to arrive at an ethnic determination of a material." The second statement above is a contradiction. Statistical calculations are made because anthropology is not an exact science. In the following paragraph, it is stated that

> Recent investigations also show that changes constantly take place within populations ,

a fact that has been known for a long time, one may for instance recall Darwin (1859).

In a section called Research background, Iregren briefly relates osteological studies of the 19th century, and states:

> The term population, however, did not exist, neither were ecology and environment included in the physical anthropologists' terminology of that time. This meant often that a very small body of material was drawn upon for hypotheses and published results.

Alas, in many sciences there is an initial lack of material, a situation which in some cases, for instance with respect to paleaeontology including the study of fossil man, persists permanently. The 19th century physical anthropologists actually made their hypotheses and published their results based on the material and methods at hand, just as today. Lack of particular words in the terminology that may eventually be introduced can never prevent scientists from drawing conclusions from the material they have got. The concept "population" was certainly known, but geographically interpreted, just as today in connection with vital statistics from different countries. Even in this meaning (that is, the French, English, German, Finn, American population, etc.) the term population is even used among present day physical anthropologists.

Iregren continues in the following paragraph:

> We can still see today collections which were once built up according to these principles. At the University of Stockholm, Osteological Research Laboratory, the so-called Retzius collection is preserved, consisting of crania collected in different parts of the globe chiefly during the years 1840-1900. In this collection scarcely any larger series is included.

According to what principles? The 19th century anatomists collected whatever they could get hold of, and it was certainly not an aim to have as few individuals

as possible from a given area. A large number of skulls were brought back to Sweden by Swedish explorers, for instance Nordensköld, who for practical reasons could not return unlimited number of skulls, but in any case brought back several specimens from each place visited. In this way, the collection provides a fair display of worldwide variation of skull morphology. As for the scarceness of larger series, Iregren mentiones (p.215) the fire in 1892 which, amongst others, destroyed the collection of 19th century Swedish and Saami skeletons. The paragraph continues:

> Likewise, at the Anatomical Institute at the University of Oslo c.5000 crania are preserved in glass cabinets. The other parts of the skeletons are often preserved as well, but the skull was isolated from the other skeletal elements and stored separately.

What does "likewise" imply? And does it matter that skulls and postcranial remains are stored separately, as long as they are accessable, properly marked, and possible to match.

In the next paragraph it is stated:

> Frenchmen (Rollet 1889, Manouvrier 1892, 1892), Englishmen (Pearson 1899), Germans (Breitinger 1937), Finns (Telkkä 1950) and others worked on the problems concerning stature. As a rule, they used dissection material, which influenced the results. ... Moreover, the number of individuals investigated was of neccessity small.

She does not tell that both Rollet, Manouvrier and Pearson dealt with the same (French) material, or that Breitinger based his study on 2700 living subjects, a number that is far from small in this connection.

The following paragraph relates Trotter & Gleser's (1952, 1958) studies, stating that

> they revolutionized the calculating methods when they investigated the bodies of nearly 6000 American citizens of different races,... .

Actually, they used the same calculating methods which were introduced by Pearson (1899), roughly half a century before. It was their material (both living stature of the subjects as well as their long bone lengths known) that was remarkable, a fact that Iregren eventually mentions.

The next paragraph starts with the statement:

> For around fifteen years anthropologists have been studying the genetic constitution of populations by investigating minor morhological skull variants. The method was put forward by Berry & Berry (1967), who had previously worked on rodent populations.

In the first place, this had already been done about ten years in advance by Laughlin & Jørgensen (1956) by approximately the same method, and by Brothwell (1958). In the second place, just one of the Berrys had previously been working with rodents, which had been studied from several points of view, of which some had to do with skeletal morphology. In the same paragraph, it is further stated:

> The term population is normally defined as a group of individuals who have a greater exchange of genes with each other than with outside groups.

Is that really so! It may be interesting to know how children exchange genes with their parents, not to mention how later generations exchanges genes with past generations. Iregren here contradicts her own statement from the Introduction, where it was claimed that changes constantly take place within populations. This means that several generations have to belong to the same population, otherwise changes cannot take place. But Iregren's idea about how the term population is normally defined excludes even children from the same population as their parents since, with respect to humans, parent and child very exceptionally mate with each

other and, so far, producing offspring is the only way to exchange genes.

In the subsequent paragraph the nature of non-metrical traits is described, and how they should be classified:

> ..., the traits shall be classified only as being present or not. There should thus be no sliding scale reflecting the development of the trait, which could cause problems in the assessment and subsequent calculations. This is what lies behind the term "discontinuous" in the often used expression "discontinuous traits" or "discrete traits". However, not even Berry & Berry (1967) followed this principle to the letter, since they made use, for example, of traits such as torus formations in the palate and lower jaw, which can develop in varying degrees.

Those familiar with the nature of non-metrical traits all know that a graded development may exist, for instance that a trait may be absent, or present in one of a number of distinct expressions. Methods for treating such a graded expression have been developed (Bhattacharyya 1946; Sjøvold 1977, Section 1.12.). The "often used" term "discontinuous traits" is hardly used since the traits are considered as results of some kind of threshold imposed on an underlying continuous genetic-environmental variable. The most usual terms are threshold characters, quasi-continuous, non-metrical, epigenetic and even discrete traits. Concening Berry & Berry (1967), the lower jaw was not studied at all, and a bony torus was scored strictly as present or absent only. Then there is the statement:

> Another and greater problem regarding methods is that the heredity of the majority of traits has not as yet been investigated. There are probably differences in heredity between the sexes.

Actually this has recently been studied by Sjøvold (1984). That paper is found in Iregren's reference list, but it has not been quoted in the text.

Iregren's next statement reveals a great lack of knowledge about the research on non-metrical traits, which makes it necessary to quote the whole paragraph:

> It is also clear (Jaeger 1967) that certain minor traits are correlated with each other and therefore not independent. It is primarily a question of sutura metopica (retention of the medio-frontal suture), which is correlated with the presence of sutural bones in different sutures, together with other traits. A whole field of basic research lies open here, even if some researchers deny that the traits are correlated. (See for example Sjøvold 1978 and literature there cited).

That the metopic suture is correlated with certain sutural ossicles is old news, demonstrated, for instance by Torgersen (1952). Significant correlation was also found by Berry & Berry (1967) in this case. Sjøvold (1978) actually stated (p.136):

> Concerning non-metrics, experience has shown that most traits act as if they were uncorrelated with one another. This result had previously been found in the mouse.

The important words in the sentence are "as if", indicating the hypothetical situation, and "uncorrelated", which from a statistical point of view does not necessarily mean independent. It is referred to Berry & Berry (1967), Kellock & Parsons (1970), Corruccini (1974), McWilliams (1974), Suchey (1975), Berry (1976) and Truslove (1961). This actually means that the number of significant correlations found when comparing pairs within a large battery of traits is generally of the same size that would have been expected from chance alone. After describing the genetic-environmental model for the occurrence of the traits, Sjøvold (1978) continued:

> Therefore, it was not surprising that a number of significant trait-by-trait correlations found when studying 19 traits on 2,352 skulls of the Red fox (Vulpes vulpes L.) were found to be significant (Sjøvold 1977). The possibility of detecting significant associations is, however, highly dependent on sample size. The majority of correlations found in that study would hardly have been detected with "normal" sample sizes, and their possible effect when treating the traits as uncorrelated is therefore negligible in such cases.

These statements could hardly be taken as a denial of correlation.

Following this misunderstanding, Iregren continues:

> These problems have given rise to a re-evaluation of the metrical methods of investigation. Methodological important studies have been carried out by, amongst others, Howells (1966) and Crichton (1966).

(the name being mis-spelt both in text and in the reference list). Actually, Howells and Crichton utilized methods developed during the 1930-ies. On the other hand, should the "problems" with the non-metrical traits have caused such a re-evaluation, it was quite remarkable by them to publish their papers in 1966, given that Iregren believes that non-metrics was introduced in anthropology for the first time by Berry & Berry in 1967.

In a brief section, the Vivallen cemetery is introduced. It mainly consists of 16-17 individuals, of which 7 are children. 5 adults have been sexed, 2 males and 3 females. These five individuals had reasonably well preserved skulls, and the skulls and teeth were better preserved than extremity bones and other skeletal elements. The study of jaws and teeth, as well as pathological malformations in addition to hip joint malformations is reported to have been analysed by other experts. However, the number of individuals is small, and Iregren's comment on a very small body of material upon which to draw upon for hypotheses and published results should be kept in mind.

The next section concerns Comparison between individuals at Vivallen and other populations. As indicated above, no such comparison is given, and the section should perhaps be denoted Populations for comparison.

In this section one paragraph reads as follows:

> Per Holck has published metrical data for skeletons from churches at Mære (1970) and Alstahaug (1974). The specimens from Alstahaug cannot be regarded as representative for the area, as only one family grave was examined. In the Mære material there are skeletons from different periods, partly from the 11th and 12th centuries and partly from the post mediaeval time. The former area is probably representative, since these burials took place at an early timber church with a central position in the parish. These skeletons are also from a period which makes them suitable as subjects for comparison.

Iregren's comment on the Alstahaug material shows that she has not read the publication. Holck mentions that among the skeletons there was an identified family grave, the remains from which were published earlier (Holck 1969). The 100 skulls and skeletons which happened to remain in addition, were published in Holck's later (1974) publication. Concerning the Mære church, the skulls being dated to the 11th and 12th century amount to five males and three famales, along with some three individuals on which two or three measurements could be taken. This would hardly be enough for a proper comparison, particularly because Iregren later states:

> It is also clear for statistical reasons that material for comparison must consist of a sufficiently large number of individuals.

With respect to non-metrics the next paragraph states:

> From the point of view of population and genetics, however, the Mære skeletons must be disregarded completely since Sjøvold (i.e., 1978) did not separate the different lots with different dating. The

> Alstahaug values are, as we have pointed out, not representative and neither is the Tingvoll material, which includes only those buried in one grave.

The latter statement is, however, wrong. The material from the Tingvoll church was collected during construction work in the grave cellar of the church in 1928, and not from one grave only (Schreiner 1939).

The comments about the Mære skeletons demonstrates a lack of knowledge about the literature, as well as a lack of understanding of how to solve a given problem. The skulls from Mære were pooled by Sjøvold (1978), following Holck (1974), and even because experience from mice had shown that the rate of divergence within a population was slight through a large number of generations (Grewal 1962). Furthermore, it should be kept in mind that the study of human skeletal material differs completely from a study of living subjects. In the latter case it is possible to make a suitable research design before collecting the material, and even to calculate the number of subjects needed in order to reach a conclusion with a certain degree of confidence. When skeletons are studied, on the other hand, a given material is available, which generally cannot be extended. The natural question is therefore if such a material may provide an answer to the problem to be solved. In the connection with the Vivallen project, the main problem seems to be whether or not the population was Saami.

Naturally, one hopes that a comparative material is as close as possible in time and space, but on the other hand this may reduce the sample size to such an extent that what remains may be useless for comparison (if statistically significant differences are wanted). The individuals from Mære, though spanning some 600 years, may be considered to belong to a local community with a limited immigration because of the distribution of farms within the area. From a genetical point of view, genes have been carried on from the one generation to the next. Certainly some genetic drift may have occurred, but in relation to the presumed Saami population of Vivallen (if this is so),the Mære population is still considered Nordic. In contrast to blood groups, with few loci involved, non-metrical traits depend on a large number of loci, and with different loci involved in the formation of several traits (Grüneberg 1963), the actual effect of genetic drift on trait frequencies is reduced. With respect to the number of loci involved, in mice 25 traits scans some 200 loci or more (Berry & Jabobson 1975). The number of loci involved in determining metrical properties is unknown, but probably large. Therefore, as the population of Mære stayed Nordic, the pooled number of useable skulls may be rised from 11 to 78.

The section on methods is denoted Selection of variables for comparison. With respect to the metrical investigations Iregren states that

> I have set out to use 47 measurements of the brain-case and the lower jaw...

What is the meaning of this? Iregren has frankly declared that she has excluded measurements of the facial skeleton of the skull, and restricted the measurements to the neurocranium and the mandible only. According to Schreiner (1935), important characteristics of the Saami skull are particularly confined to the facial skeleton. Hopefully, Iregren's statement is a slip of the mind.

The most remarkable statement is made when dealing with the non-metrical traits. The section starts with the statement

> As already mentioned in the outline of research (see section Research background), it is now known how the majority of the morphological variants are inherited.

According to the section referred to, the heredity of the majority of the traits had not as yet been investigated. Having referred to Sjøvold (1984) in the reference list, though not qouted the paper in the text, as mentioned above, it is unclear which of the contradicting statements is valid according to Iregren's opinion.

In the following paragraph Iregren writes:

> It also emerges from the analyses of the morphological traits that they can show a preponderance in one of the sexes, and that this can vary as between different populations. Berit Sellevold has demonstrated just that, in a material from Iron Age Denmark (Sellevold et.al. 1984). The question is thus highly complicated. Sjøvold (1978, 1982) has, however, not investigated the existence of sexual differences in frequency of minor morphological traits in the Westerhus and Leksand material.

What was stated by Sjøvold was "pooling of the sexes because of minor sexual dimorphism in trait incidences..."(1978) and "generally very rarely significantly different frequencies among the two sexes..."(1982). It is therefore important to look at what Sellevold actually found. She defined three populations (Early Roman, Late Roman and Viking Ages), and tested a battery of 54, mainly cranial traits for sexual dimorphism (bilateral traits regarded separately for right and left side). With respect to Early Roman population, significant sex difference was found for the right and left preauricular sulcus only, with respect to the Late Romans, again for the right and left preauricular sulcus as well as the left tympanic dehiscence (left foramen of Hüschke), and with repect to the Viking Age population, the right and left preauricular sulcus, the palatine torus and left lambdoid ossicles. Setting aside the preauricular sulcus, which actually is often used as a sex indicator, between 0 and 2 significant sex differences remain among 52 traits, or less than 4% in any population. In a similar manner as with respect to the apparent uncorrelatedness between traits, such a low number of sex differences is regarded as the result of chance factors, given that obvious sex indicators (such as, the auricular sulcus of the pelvis) are excluded.

Briefly, the Mean Measure of Divergence (Sjøvold 1973,1977) is mentioned, with the following comment:

> Other methods are also possible, such as discriminant analysis and multivariate methods.

What is lacking in the paper, however, is a clear statement about the problem to be solved and a suggestion about how it may be solved. The Mean Measure of Divergence and discriminant analysis are designed in order to solve completely different problems. In connection with the 47 measurements and 20 indicies to be used, no indication about suitable methods is given at all.

The dental material is to be treated by another expert, and Iregren in this connection just mentiones briefly different problems that may be elucidated by means of the study of the jaws and teeth.

The last sub-section within what might be regarded as the Methods section concerns blood group studies. Here Iregren complains about the Hungarian researcher Lengyel, several of his papers being cited, because the chemical analyses carried out by him "are not, unfortunately, reported methodologically, in such a way as they can be repeated by other scientist." However, the book by Lengyel (1975) referred to on the matter can not have been understood by Iregren, but on the other hand, the chemical methods require some skill to carry out, so that blood typing of skeletal tissue is not a task for anybody.

Relating, at last, to studies on blood groups in living individuals, Iregren cites Beckman (1959) concerning the high frequency of the A_2 gene in northern Sweden as an indication of a Lappish component in the population, Unfortunately, however, Beckman's distribution map (Beckman 1959 p. 136), demonstrates that the A_2 frequency at Vivallen is about the limit of an area with the lowest frequency observed. I bone tissue, A_2 has not yet been possible to identify, neither by means of direct nor by means of indirect methods (S. Borgognini-Tarli, Pisa, pers. comm.)

The last paragraph indicates that Beckman (1959) made use of information gained as a result of paternity studies. It might, for completeness, be added that the paternity material was less than 5% of his total material.

This incomplete paper is followed by a huge reference list. However, one requirement in published works is that journals or publication series should be referred to in a standardised way throughout the list of references, generally so that either the full title of the journal or publication series is given, or a proper abbreviation. The two publications by Holck (1970, 1974) cited by Iregren are actually from the same publication series, but in the one case the publication series is given, and not the publisher, and in the other case the publisher without mentioning the publication series. Another reference of the same series is referred to in a third way. Similar contrasts exist with respect to the Am.J.Phys. Anthrop., which in one case is written in full, and in two cases abbreviated, and there has been some confusion among the three references to the Annales Academiæ Scientarium Fennicæ, Ser. A, where the series number has been omitted in two cases, but included in one. And finally, there are some cases of the mis-spelling of names. Crichton is spelt Chrichton and Subow is spelt Zoubov in text and reference list.

The question about the prehistory, origin and previous distribution of the Saamis is certainly interesting, but deserves to be treated in a competent way. It is therefore a pity that an osteologist after a professional career of more than a dozen years treats basic information in such a careless manner.

The paper is included in a Festschrift, in which it may be assumed that authors are honouring the subject of the Festschrift with papers to the best of their ability, or at least according to their usual standard. However, according to the circumstances, it may also be pertinent to recall the proverb, that every bird pipes its own lay.

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N-G GEJVALL

BERIT JANSEN SELLEVOLD, ULLA LUND HANSEN and JØRGEN BALSLEV JØRGENSEN: Iron Age Man in Denmark, Prehistoric Man in Denmark, Vol. III. Nordiske Fortidsminder Serie B, Bind 8. Det Kongelige Nordiske Oldskriftselskab — København 1984, 308 pp. ISBN-87-87-483-42-4, ISSN 0105-578X.

The Head of the Anthropological Laboratory in Copenhagen, Dr. J. Balslev-Jørgensen together with its former chief, Dr. Kurt Brøste, in 1965 published the monography "PREHISTORIC MAN IN DENMARK, A STUDY IN PHYSICAL ANTHROPOLOGY", Vol. I-II, Stone Age and Bronze Age (of the author reviewed in FORNVÄNNEN 1959, Vol. 1-2). This for its time advanced study was considered as the first one in a series on Denmark's physical anthropology, but Dr. Brøste's sudden decease delayed its continuation. The three above listed authors now have completed this important study, and their joint declaration already initially that this book is the result of close collaboration between anthropologists and archaeologists is a good omen.

The considerably reduced but still readable tables document the total material in chronological order as well as according to sex and in age sequences, and in agreement with the topographic sequency of the National Museum within each age group. The archaeological catalogue is extremely detailed covering 113 pp. and it should satisfy all wishes of information of every archaeologist. This is also the case with the comparative metric table part of 35 pp. ad modum Martin-Saller (1957). The pictures are of good quality, their choice also, and the statistical treatment includes tests of mean values and standard deviations, made after Student's test with t- and F-tests. For the small anatomical traits, the "dainties" of anthropology of today, mostly known as "discontinuous variables", Chi-square-tests and "Mean Measures of Divergence-tests" have been used.

In all 1039 skeletons have been studied, and the datings were usually made conventionally. 34 C14-datings complete the picture, and the chapter of the C14-datings versus the archaeological datings is very impressive and interesting reading. C14-values are corrected with C13-tests.

Since the 1039 individuals spread over more than 1500 years and for the best represented periods, Roman Iron Age and Viking time, are only 1.6 and 1.3 individuals per year, the original population behind is strongly underrepresented, thus heavily influencing the demographic conclusions. This is also stressed by the authors.

334 males and 246 females could be sexed, 172 individuals were children, 884 adults (over 20) and 23 skeletons could not be assessed to sex or age.

The Pre-Roman Iron Age is represented by only 12 skeletons, 4 of which belong to males and 6 to females. The stature was calculated for 3 individuals, and is comparably high.

The Older Roman Iron Age has delivered 359 individuals, 16.2% are children, 134 males and 80 females, the resting indeterminable. This period is characterized by dolichocraneous, narrow skulls, the stature lies at 174.1 cm for males and 161.7 cm for females.

The Younger Roman Iron Age graves have given 199 skeletons, 20.3% of children, 120 sexed individuals, 66 males and 54 females. Skulls are still oblong and narrow, stature 177,3 for males and 162.9 for females.

From the entire Roman Iron Age there are 90 individuals only datable to this era 0-400 A.D. 26.8% were children, 42 adults, (24 males and 18 females), stature 170.1 cm and 169.9 cm respectively.

The Older German Iron Age gave only 9 skeletons, one neonatal, 8 adults, 3 males and 3 females, and their stature agree with or superpass the mean value for the three large Iron Age groups.

The Younger German Iron Age is represented with 30 individuals, 12 of which are children, 12 are males and 12 females, 4 of 5 skulls are considered to be narrow and the stature

lies within the upper region of the total material from the three large Iron Age groups. From the Viking Era we find 320 individuals, 9 without sexing, only 8.1% are children, 158 sexed adults, 85 males and 73 females. Skulls more brachycranic (74.6% for both sexes) and stature 172.6 for males and 158.1 cm for the females. Through the entire Danish Iron Age there is a type conformance of the skulls, and only 9 really brachycephalic individuals have been found (12 females from Preroman time in Rislev, one male from Øiby from Younger Roman Iron Age, one female from Slusegård, Roman Iron Age, with microcephalic, i.e. pathological cranium, furthermore one female from Older Roman Iron Age in Slusegård, and one Viking Age female from Hesselbjerg.
The Roman Iron Age skulls in Denmark fit well into the series of bachycephalic and dolichocephalic crania found in middle Europe and north and south from this region already at the beginning of this century which has also been confirmed through research in modern time.

In this study the Danish Iron Age skeletons are compared with its Late Neolithic ones. The differences between these Late Neolithics and the three Iron Age groups are for both sexes larger than the differences between the groups of the Roman Iron Age and the Viking era. The Roman ones have longer, narrower and lower skulls than the Late Neolithic ones, those from the Viking era are principally lower than the Late Neolithic ones. The Roman ones have the longest extremity bones, the Viking-time individuals the shortest ones, something worth consideration as the main idea is that the Vikings were big and tall. The skeleton of the Late Neolithics was of robust built, the Roman Iron age one hade the most gracile extremity bones, and males and females of the Roman era were of the highest calculated stature.

31 nonmetric anatomical traits are taken into this study, 22 of which are bilateral. The result shows no statistically significative differences between the groups of the different periods.

As for the age distribution the main expectance of the males turned out to be almost the same in all Iron Age groups. In the Roman era however the females were more short-lived than the males. The opposite situation existed during the Viking time.

Of totally 1016 age-determined individuals only 172 (16.9%) were children. The explanation given is that only the higher social groups buried their children. Usually infants under 3 years had no burial gifts. Astonishing and unexpected is also that through the entire three Iron Age groups there are more males than females.

In the large sample of pathological finds we already mentioned the female from Slusegård (microcephalic skull with a capacity of only 950 cm^3). There are furthermore three probably intentionally deformed skulls, three cases of trepanation and at least four cases of decapitation. We also find benign tumors, different articular diseases, loose vertebral arches, a series of dental disorders as parodontosis and caries.

The stated differences between the statures seldom arrive at statistical significance, and the differences within a population is considered to mirror social status and depending on nutritional variation. The present study seems to support this view.

The Danish team finally has made a thorough going control of the entire outfit and the finds contra the skeletal remains in every grave, and some interesting examples of Older Roman graves with imported finds have delivered males as well as females with high stature. The same is valid for the Older as well as for the Younger Roman Iron Age and the Viking era. The main number of finds per grave in infant graves from Older and Younger Iron Age is high, higher during the Younger than during the Older Iron Age. Furthermore the group of senile females from Viking time present a rich flora of findings, and the authors wonder whether the males more seldom than the females arrived in this age group and/or the female therefore was considered as the head of the family.

In this monumental work we find for the first time a synthesis and comparation between anthropologically sexed and age-determined skeletons and the belonging archaeological finds of a large material. For the specialist - the archaeologist - this must be a priceless access, a mine of information and pleasant reading.

PIA BENNIKE: Palaeopathology of Danish Skeletons, A Comparative Study of Demography, Disease and Injury, 272 pp. Illustrated. Akademisk Forlag a.m.b.a. Postbox 54, 1169 København K, Denmark. ISBN 87-500-2571-6.

In this highly recommendable book almost 2000 skeletons from archaeological sites in Denmark, some of which are going back more than 7000 years, are subject to an investigation with special emphasis on disease changes and injuries.

The author who has a masters degree in physical anthropology, has also earned her a medical Ph.D. at the Faculty of Medicine at the University of Copenhagen. Pia Bennike is a regular participator in international and local congresses and symposia dealing with palaeopathology, and she has provided this now very actual part of science with very important contribution.

Using a new computer registration system the author has carried out comparative studies of the different categories of disease observed, of degenerative conditions such as osteoarthritis, pathological dental conditions, traces of lesions during the different prehistoric and ancient periods of her material. When sexing and age determination was possible these were related to the various skeletal anomalies. The stature of the population was calculated for the entire 7000 years covered by the material.

Another first treatment is that prehistoric skulls with traces of surgery of trepanation are studied together which means that the practice of trepanation in Denmark can now be viewed in respect of distribution, technique and cause.

An unexpected find was made in a Stone Age skull with a drilled molar, so far the only evidence of dental treatment with flint drills.

The author also presents a rich flora of various patterns of violence in nice agreement with the changes in weapons through the ages.

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According to message of February 27, 1986 from THE CROATIAN ANTHROPOLOGICAL SOCIETY, the next, 12th INTERNATIONAL CONGRESS OF ANTHROPOLOGICAL AND ETHNOLOGICAL SCIENCES will take place in Zagreb, Yugoslavia 24-31 July 1988.

The address of the Organizational Committee is:
Laboratory of Anthropology, Institute for Medical Research and Operational Health, Mose Pijade 158, P.O. Box 291, 41000 Zagreb, Yugoslavia. Telephone (041) 432-186 or 432-286, Monday through Friday, 8:30 A.M. to 1:30 P.M. Yugoslav time.

Deadlines to keep in mind are:

November 1, 1986,	proposals for symposia to be received
November 1, 1987,	title, abstract for volunteered papers to be received
January 1, 1988,	final symposia plan to be received
January 1, 1988,	title and abstract for poster sessions to be received
January 1, 1988,	registration fee of $ 150 for IUAES members and $ 180 for non-members to be received from all participants on the program
April, 1988,	date and time of symposia to be communicated to symposia organizers
July 24-31, 1988,	Congress

Gen. Editor.

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Manuscripts are to be sent to the general editor. The author's permanent and temporary addresses are to be given. The manuscript will not be returned to the author until the article has been printed, and the author is requested to retain a complete copy. Proofs will be sent to the author once; the author is excepted to read them carefully and to return them promptly to OSSA, Nils-Gustaf Gejvall, 162 Himmelstorp, S-260 91 FÖRSLÖV – Sweden. The author will be charged for changes against the manuscript made by him in the proof. Reprints in addition to the 50 free copies are to be ordered with the proofs.

MANUSCRIPT

The manuscript must be typewritten (carbon copy not acceptable) on one side of standardsized paper, double spaced, and with an ample left margin. The text must be clear and concise, and written preferable in English; German manuscripts may be submitted. Manuscripts should be arranged in the following order: (1) Informative but brief title. Avoid titles with interrogative form, abbreviations, formulae, and parentheses. (2) Author's name; one or more of his forenames unabbreviated. (3) A *short* abstract, always in English, not exceeding 1330 letters and spaces, and starting with a repetition of 2 and 1, with a translation in parentheses of non-English titles. (4) The author's professional address and a dating of the manuscript. (5) The main text. Use three or fewer grades of headings. Indicate in the left hand margin the approximate position of figures and tables. The words 'Fig.' ('Figs.') and 'Table' (unabbreviated) are to be written with capital initials in the text. In the main text, OSSA does not use small capitals or bold-face. Instead of footnotes, insert paragraphs which can be composed in smaller type or use parentheses. (6) References shall conform to the examples given below. Abbreviations used should be consistent; necessary editorial changes will adhere to the usage in *International List of Periodical Title Word Abbreviations* (UNISIST/ICSU AB 1970). It is essential that the punctuation conforms exactly with the examples given below. Use ampersand for joint authorship in the text references and entries in the reference list (but not elsewhere). (7) Captions of illustrations, if any. Add an English caption below captions in other languages. *Figure captions and tables must be submitted on separate sheets.* (8) Tables, if any, with captions, numbered with arabic numerals. When possible, try to simplify table material so that it can be run in with the text.

ILLUSTRATIONS

Illustrations should be reducible to a maximum size of 14.0×20.3 cm or less. It is recommended that figures be constructed *either* for the entire width of the type area (14.0 cm) *or* for the column width of 6.7 cm. If possible, avoid figures *between* 10.4 and 14.0 cm. On all figures should be the author's name and the figure number. Do not attach captions to the figure. Photographs are to be clear, sharply contrasted, and printed on white paper with glossy finish. Figures may be composed of several quadrangular units separated by 1 mm broad spaces. The items in composite figures should be similar to each other in tone. If the natural background is to be deleted, blackening is preferred.

All illustrations should be termed figures, even if occasionally covering an entire page, and the items of composite figures should be designated A, B, C, etc. (*not* a,b,c, etc.)

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