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An anthropological examination of a group of medieval Danish skulls, with particular regard to the jaws and occlusal conditions.

By

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Material.

This investigation has been carried out on a group of medieval skeletons discovered in the burial places of the Aebelholt Monastry in Själland, and brought to light by VILHELM MÖLLER-CHRISTENSEN, Roskilde. As a result of the exemplary care and thoroughness with which the excavation work was pursued the material was preserved and the teeth retained to an extent that is seldom encountered in skull collections.[1]

The Aebelholt Monastery (MÖLLER-CHRISTENSEN, 1948) was founded about 1175 and condemned to demolition in 1561. The skeletons are thought to have been of monks, local inhabitants, pilgrims and merchants. The end of the 12th century saw much traffic to the monastery and there is evidence that about a hundred wayfarers a day were fed. There are no means of judging the extent to which foreigners are represented in the material, nor is it possible to say whether people in ill-health made pilgrimages to the monastery where they perhaps died and were buried. The collection cannot therefore be considered as representative of the Middle Ages in Denmark. It is impossible to decide with any degree of certainty whether any such lack of representativeness would result

[1] The authors wish to express their indebtedness to Dr. MÖLLER-CHRISTENSEN for the opportunity of examining the material.

in deviations from the population value for anthropological properties or dentitional characteristics. There is however no real basis for such an assumption. No definite signs of rickets or other pathological conditions that might be suspected to be related to jaw growth, could be recognised among the crania. The lively intercourse in which the monastery was engaged would have reduced the isolation that often distinguishes ancient settlements. This might thus have improved the representativeness of the material.

There were about 800 crania in the collection, 121 of which were selected for the investigation. The selection was based primarily on the number of teeth present in the crania and the absence of post mortem impairment. Senile crania were not included since loss of teeth during lifetime is fairly common among them and precludes anthropological measurements on the dentition. No child crania were included.

The age and sex were determined (by MÖLLER-CHRISTENSEN) as recommended by MARTIN. The 121 cases were distributed as follows:

	Males	Females	Males or females	Total.
Juvenile	3	3	5	11
Adult	16	13	8	37
Mature	37	20	16	73
Total	56	36	29	121

The lower jaw was missing completely from nine crania, while large parts (with the teeth 8— . . . —3) were absent in one further case. Teeth were, furthermore, missing to the extent given in Table 1.

The third molar was frequently missing *intra vitam*, mainly on account of aplasia, it would seem. This might also have been the reason for the absence of one 5 + where the 05 + remained. Radiographic examination, which was not possible on the occasion of the study, would be required to decide for certain whether there was no retention in some of the cases mentioned. In the majority of doubtful cases where the third molar was missing a small hole was drilled in the jaw bone in the region where the tooth would most likely have lain, a procedure which would probably have revealed any retained third molars. As none were found it is fairly safe to assume that in these cases the M_3 were missing. The missing M_1 and M_2 were probably lost either as a result of caries or of abrasion with pulplesions and subsequent abscess.

Table 1.

Teeth missing in the investigated crania.

	Tooth no.		1	2	3	4	5	6	7	8
Missing intra vitam	Upper jaw	right					1	3	1	10
		left						3	1	10
	Lower jaw	right	1					2	1	18
		left						2	1	17
Lost post mortem	Upper jaw	right	14	5	3	1		1	2	4
		left	11	5	5				5	7
	Lower jaw	right	4	2		1	2	1		2
		left	4	1	1	1			1	2
Lost post mortem or intra vitam	Upper jaw	right	1	1	1	1	1	1	2	1
		left	2	1					1	1
	Lower jaw	right							1	1
		left					1			

The anthropological determinations performed might be divided into the following groups:

1. *Cranial length and width, facial width and height* (upper + total), *width of mandible* (at angulus). Measurements have been performed by the method due to MARTIN. The results obtained have been collected in Table 2. The figures relate to men, women and the whole material of men + women + sex undetermined. It is possible but, of course, not by any means certain that the proportion of males to females in the whole material was the same as for the crania for which the sex could be determined with reasonable certainty.

The width-length index for the head lies on the average between the mesocephalic and dolichocephalic types (4 hyperdolichocephalic, 41 dolichocephalic, 29 mesocephalic and 8 brachycephalic). The facial index suggests an average mesoprosopia (2 hypereuryprosopic; 10 euryprosopic, 17 mesoprosopic, 10 leptoprosopic and 8 hyperleptoprosopic). Similarly, the average of the upper facial

Table 2.

Mean ($\bar{x}$), standard error of the mean ($\varepsilon(\bar{x})$) and standard deviation (s) for some anthropological measurements (in mm.) and indices of the cranium.

N = number of crania. Measurements numbered according to Martin.

	Males			Females			Total material		
	N	$\bar{x} \pm \varepsilon(\bar{x})$	s	N	$\bar{x} \pm \varepsilon(\bar{x})$	s	N	$\bar{x} \pm \varepsilon(\bar{x})$	s
Maximum length (1)	42	188.0 ± 0.95	6.2	28	184.0 ± 1.50	7.9	88	186.2 ± 0.77	7.2
Maximum breadth (8)	42	142.4 ± 0.86	5.6	27	137.7 ± 1.20	6.4	87	140.5 ± 0.63	5.9
Total facial height (47) ...	32	117.5 ± 1.28	7.2	26	112.0 ± 1.26	6.4	74	114.8 ± 0.94	8.1
Upper facial height (48)..	36	71.8 ± 0.82	5.0	27	68.8 ± 0.74	3.9	82	70.5 ± 0.55	4.9
Bizygomatic breadth (45).	22	132.9 ± 1.32	6.2	20	127.1 ± 1.17	5.2	42	129.3 ± 0.92	5.9
Bigonial breadth (66)	39	102.0 ± 1.12	7.0	28	96.1 ± 1.35	7.2	91	100.1 ± 0.80	7.6
Cephalic Index (8/1)	40	75.6 ± 0.54	3.4	26	74.7 ± 0.82	4.2	82	75.4 ± 0.42	3.8
Total facial Index (47/45)	19	89.2 ± 1.11	4.9	19	88.2 ± 1.30	5.7	47	88.7 ± 0.78	5.4
Upper facial Index (48/45)	21	54.6 ± 0.61	2.8	19	54.3 ± 0.86	3.6	50	54.2 ± 0.45	3.2

index is the mesenic type (4 euryenic, 28 mesenic, 16 leptenic and 2 hyperleptenic).

2. *Width and length of dental arch, spacing of teeth.* These and the following measurements were performed by methods described elsewhere (see LUNDSTRÖM, 1948). The means and the dispersion for the properties in question are found in Tables 3, 4, and 5. The correlation between the width of the upper dental arch at the first molars and the facial width (bizygomatic width) was determined, the correlation coefficient being calculated to be $r = +0.46 \pm 0.14$ ($0.01 > p > 0.001$).

Table 3.

Width of dental arch at first premolars (B_1) and first molars (B_2); length of dental arch (L) from line joining first molars to incisal edges of central incisors. Palatal height (G.h.) at first molars (all measurements in mm.). Complete material.

		Juv. + Adult			Mature			Total		
		N	$\bar{x} \pm \varepsilon(\bar{x})$	s	N	$\bar{x} \pm \varepsilon(\bar{x})$	s	N	$\bar{x} \pm \varepsilon)\bar{x})$	s
Upper jaw	B_1	45	37.3 ± 0.31	2.1	69	37.0 ± 0.30	2.5	114	37.1 ± 0.22	2.3
	B_2	44	50.3 ± 0.41	2.7	58	49.6 ± 0.40	3.0	102	50.0 ± 0.28	2.9
	L	45	28.3 ± 0.31	2.1	52	27.8 ± 0.28	2.0	97	28.0 ± 0.20	2.0
	G.h.	44	17.7 ± 0.36	2.4	54	18.5 ± 0.35	2.6	98	18.1 ± 0.25	2.5
Lower jaw	B_1	43	26.1 ± 0.28	1.9	62	26.0 ± 0.32	2.5	105	26.1 ± 0.22	2.3
	B_1	42	36.0 ± 0.42	2.8	60	36.3 ± 0.39	3.0	102	36.2 ± 0.29	3.0
	L	41	25.5 ± 0.29	1.9	51	24.8 ± 0.29	2.1	92	25.2 ± 0.21	2.0

Table 4.

Width of dental arch at first premolars (B_1) and first molars (B_2); length of dental arch (L) from line joining first molars to incisal edges of central incisors. Palatal height (G.h.) at first molars (all measurements in mm.). Material divided with respect to determined sex distribution.

		Juv. + Adult			Mature			Total		
		N	$\bar{x} \pm \varepsilon(\bar{x})$	s	N	$\bar{x} \pm \varepsilon(\bar{x})$	s	N	$\bar{x} \pm \varepsilon(\bar{x})$	s
Upper jaw	B_1	♂ 18	38.4 ± 0.42	1.8	36	37.3 ± 0.41	2.5	54	37.7 ± 0.33	2.3
		♀ 16	36.4 ± 0.48	1.9	19	36.7 ± 0.60	2.6	35	36.5 ± 0.39	2.3
	B_2	♂ 18	51.1 ± 0.70	3.0	26	50.0 ± 0.62	3.2	44	50.5 ± 0.49	3.2
		♀ 16	49.8 ± 0.65	2.6	18	49.2 ± 0.74	3.1	34	49.5 ± 0.46	2.7
	L	♂ 18	28.8 ± 0.48	2.0	24	28.2 ± 0.33	1.6	42	28.3 ± 0.29	1.9
		♀ 16	27.9 ± 0.44	1.8	15	27.6 ± 0.56	2.2	31	27.7 ± 0.35	1.9
	G.h.	♂ 17	18.2 ± 0.51	2.1	24	18.5 ± 0.54	2.7	41	18.3 ± 0.38	2.4
		♀ 15	17.5 ± 0.61	2.4	17	18.1 ± 0.53	2.2	32	17.8 ± 0.44	2.3
Lower jaw	B_1	♂ 16	26.4 ± 0.46	1.9	34	26.1 ± 0.48	2.8	50	26.3 ± 0.36	2.5
		♀ 15	25.6 ± 0.44	1.7	16	25.1 ± 0.54	2.2	31	25.4 ± 0.35	2.0
	B_2	♂ 15	36.9 ± 0.81	3.1	30	37.0 ± 0.49	2.7	45	36.9 ± 0.42	2.8
		♀ 14	36.0 ± 0.78	2.9	18	35.5 ± 0.77	3.3	32	35.7 ± 0.54	3.0
	L	♂ 14	25.3 ± 0.47	1.7	27	25.2 ± 0.35	1.8	41	25.2 ± 0.28	1.8
		♀ 15	25.2 ± 0.53	2.1	14	24.8 ± 0.57	2.0	29	25.0 ± 0.38	2.1

No relation could be found between the width-length index of the head and the length-width index of the upper dental arch ($r = -0.04 \pm 0.10$) for the whole material.

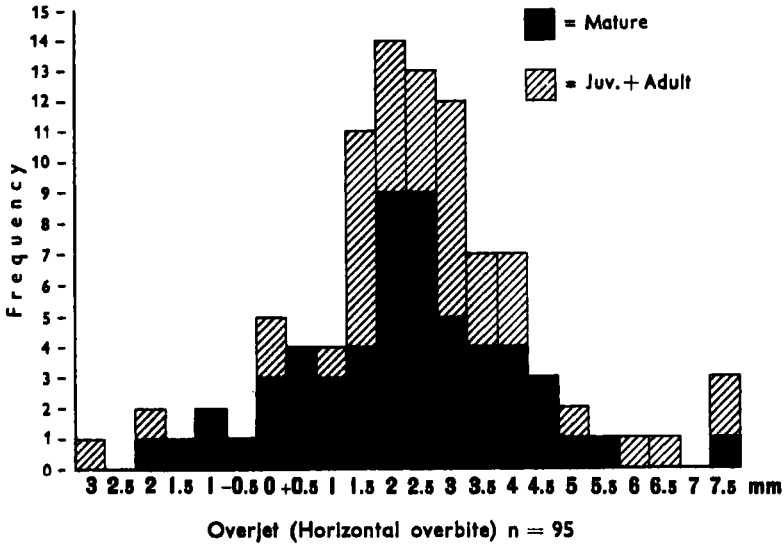
The spacing of the teeth from the first molar on the left to the same tooth on the right is expressed by the space difference. This is defined as the sum of the six sections of the dental arch (each comprising two teeth) *plus* any medial diastema *minus* the sum of the corresponding tooth widths. According to earlier control examinations (LUNDSTRÖM 1951) this method gives a value a little above zero (about + 1 mm) for the regular arch. Table 5 shows that

Table 5.

Mean ($\bar{x}$), standard error of the mean ($\varepsilon(x)$) and standard deviation (s) for space difference (crowding — spacing in mm.).

N = number of crania.

Age-group	Upper jaw			Lower jaw		
	N	$\bar{x} \pm \varepsilon(\bar{x})$	s	N	$\bar{x} \pm \varepsilon(\bar{x})$	s
Juvenile + Adult	37	+ 0.25 ± 0.36	2.2	42	— 1.36 ± 0.49	3.2
Mature	47	+ 0.38 ± 0.37	2.5	51	— 1.01 ± 0.40	2.9
Total	84	+ 0.32 ± 0.26	2.4	93	— 1.21 ± 0.32	3.0



Fig, 1. Histogram showing the distribution of the overjet values (= horizontal overbite).

the mean in the upper jaw is very close to this value while the lower jaw shows a mean crowding of about 2 mm.

Occlusal Relationship — Incisor Inclination.

Variations in the relation between the dental arches have been observed, especially in the sagittal direction. In the front overbite and overjet were recorded. The figures obtained are given in Figures 1 and 2 and in Table 6, which also show the values for the in-

Table 6.

Mean ($\bar{x}$), *standard error of the mean* ($\varepsilon(\bar{x})$) *and standard deviation* (s) *for molar occlusion, overjet, overbite and incisor inclination* (*in mm.*).
N = number of crania.

Property	Juvenile + Adult			Mature			Total		
	N	$\bar{x} \pm \varepsilon(\bar{x})$	s	N	$\bar{x} \pm \varepsilon(\bar{x})$	s	N	$\bar{x} \pm \varepsilon(\bar{x})$	s
Molaroccl. right	38	+ 0.50 ± 0.24	1.48	48	+ 0.26 ± 0.26	1.80	86	+ 0.37 ± 0.16	1.51
» left	39	+ 0.80 ± 0.24	1.49	51	+ 0.77 ± 0.25	1.80	90	+ 0.78 ± 0.17	1.65
Overjet	39	+ 2.51 ± 0.34	2.11	56	+ 2.06 ± 0.24	1.80	95	+ 2.24 ± 0.20	1.95
Overbite	39	+ 2.82 ± 0.26	1.64	55	+ 1.57 ± 0.25	1.82	94	+ 2.09 ± 0.20	1.84
Incisor inclin. .	44	13.31 ± 0.13	0.90	61	13.76 ± 0.10	0.75	105	13.64 ± 0.08	0.82

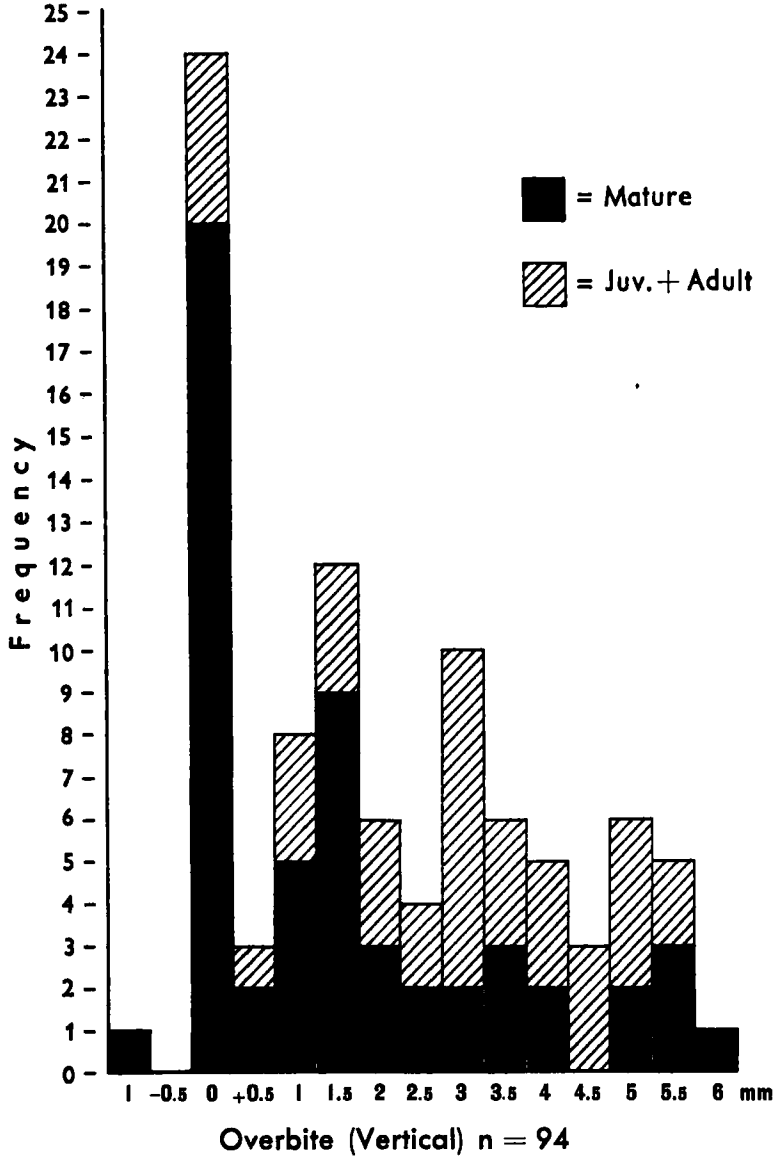


Fig. 2. Histogram showing the distribution of the overbite values (vertical overbite).

clination of the upper central incisors, a property that is considered to vary widely in persons with post-normal occlusion of the mandible.

The difference between the age groups as regards overbite (= 1.25 mm**) is probably no random effect ($0.01 > p > 0.001$). The figures for molar occlusion are similar for the two groups. This might be interpreted as meaning that the effect of abrasion is more local, with no notable effect on the total relation of the dental arches. Displacement of the lower arch in an anterior direction, often ascribed to severe abrasion, can thus not be confirmed in this material.

There is some indication ($0.02 > p > 0.01$) that the upper central incisors project less in mature persons than in juveniles + adults. The difference, with the recording method employed, is 0.45 mm* (= 4°.0 approx.)

Comparison with Earlier Investigations.

The opinion is often ventilated that the presence of malocclusion is characteristic of highly civilized people of modern times, while earlier periods in the history of man following a more "natural" mode of life, would be largely free from these phenomena, at least in their more pronounced forms. In the discussion of these questions it is of course of primary interest to try as possible to decide the type and order of magnitude of any differences.

From the anthropological point of view there has certainly been evidence of a considerable increase in physical height, especially in more recent times. It is conceivable that in association with this there have been other changes and the phenomenon is therefore of interest when considering the dentition from the point of view of history.

Comparative investigations have been said to indicate that facial width was greater in earlier times than it is at present. In Sweden MELLQUIST & SANDBERG obtained for 96 male crania of medieval times from Halland a mean bizygomatic width of 133.3 ± 0.61 mm (a value which, as with the other anthropological measurements, shows good agreement with the values for the present Danish material — Table 2). LUNDBORG & LINDERS in their large investigation of conscripts, obtained a mean for Southern Sweden of 136.5 ± 0.05 mm. If this value is reduced by 6 mm for the soft tissues a value is obtained that is about 3 mm narrower for modern times than the Middle Ages. As far as this reduction of 6 mm can be considered as correct, this difference is significant.

Similarly, comparisons of the height of the face reveal an increase to the present time of about 6 mm (5.8 mm***). GEORGE (1928) reached practically the same result in a comparison between English crania from 700—1500 and from 1600—1800 (cit. BRASH)

Width of the Upper Dental Arch.

Measurements made by KEITH (1924) of the width and length of the upper dental arch of 25 male crania from the 12th century, and of 25 students showed the latter to have arches that were about 1 mm longer and 1 to 2 mm narrower. The palatal vault was also 1 to 2 mm higher in the case of the students. The differences were not significant, however.

LUNDSTRÖM (1946) found significant differences of about 2 mm at the first premolar and 2 to 4 mm at the first molar, when comparing a collection of 57 male and 32 female medieval crania with relatively large materials of the present day (Table 7) the arches being narrower at present than formerly. With regard to the difficulty of deciding the representativeness of the Middle Ages material, LUNDSTRÖM was unable to decide whether a reduction had taken place in the width of the dental arch from the Middle Ages to the present time.

In Table 7 a comparison has been made between various investigations of the width of the upper dental arch using corresponding measurement techniques. LUNDSTRÖM's present day figures lie somewhat higher than SEIPEL's. The difference is significant** for the 13-year-old boys for the width at the first premolar (= B_1) and the first molar (B_2), and for 13-year-old girls at the first molar. It is of course conceivable that systematic differences in measurement have contributed to this result. Such errors might be suspected to influence the present day figures, particularly, where fissure fillings might render the measurement points difficult to locate with certainty. One factor that must also be taken into consideration in this connection is the loss of certain parts of the material through extraction of teeth involved in the measurement. This loss is less in SEIPEL's material (about 12 per cent.) than in LUNDSTRÖM's (about 20 per cent.). It is probably safe to assume that the majority of the extractions were due to deep carious lesions without correlation to the size of the dental arch. In a small proportion of cases, however, the extractions were per-

Table 7.

Comparison between present-day, Stone Age and medieval material in respect of width of dental arch at first premolars (B_1) and first molars (B_2) of the upper jaw (in mm.).

The means used for comparison were the largest examined present-day material (figures in italics). These means were subtracted from the other means and the significance for the difference [Diff. ($\bar{x}$)] indicated in the usual manner: *, **, *** (p = 0.05 to 0.01, 0.01 to 0.001, < 0.001 resp.)

Period	Material	Author	B_1			B_2		
			N	Diff. ($\bar{x}$)	s	N	Diff. ($\bar{x}$)	s
			Males					
	Swedes							
Present day	Boys, 13 yr.	SEIPEL	214	*35.7*	2.7	215	*46.4*	2.8
»	» , 13 yr.	LUNDSTRÖM	112	+ 1.0**	2.4	111	+ 1.0**	2.5
»	Men, 21 yr.	SEIPEL	57	+ 0.4	2.3	55	+ 0.2	2.5
»	Men	LUNDSTRÖM	48	— 0.8	3.0	41	+ 0.9	2.4
Stone Age..	»	»	14	+ 1.1	2.0	16	+ 2.5*	3.5
Mevedial ...	»	»	43	+ 1.5**	2.3	57	+ 3.1***	2.9
	Danes							
Medieval ...	Men	LUNDSTRÖM LYSELL	54	+ 2.0***	2.3	44	+ 4.1***	3.2
			Females					
	Swedes							
Present-day	Girls, 13 yr.	SEIPEL	204	*34.3*	2.3	203	*44.9*	2.7
»	» , 13 yr.	LUNDSTRÖM	67	— 0.1	2.8	66	+ 1.1**	2.8
»	Women, 21 yr	SEIPEL	142	0.0	2.2	135	0.0	2.8
Stone Age ..	»	LUNDSTRÖM	5	(+ 1.3)	—	7	(+ 3.2)	—
Medieval ...	»	»	14	+ 2.3**	2.6	32	+ 4.3***	3.0
	Danes							
Medieval ...	Women	LUNDSTRÖM LYSELL	35	+ 2.2***	2.3	34	+ 4.6***	2.7

formed as treatment for crowding in narrow or short jaws. This factor might have given rise to a certain displacement of the means in the direction of too wide arches, in comparison with the true mean of the population. The higher percentage loss in LUNDSTRÖM's material might thus have given a somewhat higher mean than SEIPEL's.

Neither SEIPEL nor LUNDSTRÖM found any marked change in growth from 13 years to adult ages. This, however, is not confirmed by FRANKE's investigations which indicate about 2 mm growth in the arch width between 12—13 years (57 crania) and 22—50 years (250 crania). These investigations were performed from the alveolar septa and are therefore not fully analogous, but this does not preclude their use for purposes of comparison.

There are obviously certain difficulties in obtaining comparative present-day values for adults.

It would seem reasonable to use SEIPEL's mean for 13-year-old boys and girls as the present-day norm, even if any systematic measurement error and growth from 13 years to adult age would suggest a slightly higher population mean for the adults measured by LUNDSTRÖM & LYSELL (1 to 2 mm?).

The Stone Age values in the table have been obtained from findings in Gotland (Västerbjers and Visby) and are from about 2000 BC. The small number of cases and the possibility that we are concerned here with isolate populations does not permit this material to be considered as representative of Stone Age in Sweden.

The Swedish and Danish medieval figures for the arch width are, on the whole, in fairly close agreement and greater by about 2 mm at the first premolar and 4 mm at the first molars than SEIPEL's values for present-day 13-year-olds. The differences are significant. Since, according to the above, it cannot be excluded that the correct comparative values for adults to-day may lie somewhat (1 to 2 mm?) higher than SEIPEL's child values and with regard to the uncertainty of the representativeness of the medieval material it is probably impossible to justify any definite conclusions from the differences from the Middle Ages to the present time as far as the width of the upper arch is concerned, at least at the first premolar. At the first molar the differences are greater, but still not of such magnitude that they might be said to provide sufficient proof of a definite decrease in the jaw width.

The possibility of a local reduction in the width at the first molars should be mentioned in this connection; this may arise through some foreward migration of these teeth after premature deciduous loss such as might appear especially likely where there is a general tendency to crowding. Such losses are very common in these days and may therefore have caused some decrease in the present-day value, by advance of the first molars into a narrower part of the dental arch. Unfortunately we are insufficiently aquainted with the effect of early loss of deciduous teeth, so that it is impossible to decide whether this might have given rise to any notable mean reduction in the present-day values.

It would seem that no corresponding reduction need be considered in the Middle Ages material. According to DREYER-JØRGENSEN who has examined child skulls from Aebelholt there were no signs of early loss of deciduous teeth (personal communication).

Divergences in the Spacing of the Teeth.

Comparable present-day values for space differences have been given by LUNDSTRÖM (1951) in respect of 111 13-year-old boys. The mean difference here is only 0.5 mm and can very well be random There is, on the other hand, a difference in the dispersion (the present-day standard variation is 3.7 mm, while for the Middle Ages material it is 2.4 mm). The difference (1.3 mm***) is probably not random. One possible explanation is of course that, by reason of its greatly increased frequency, the environmental factor constituted by the loss of the deciduous teeth nowadays increases the dispersion (this factor would seem to be of no consequence in the Middle Ages material). If this factor were determinative a mean difference in the spacing should exist with more frequent crowding in modern times. The above figures indicate no such difference but it cannot be ruled out in view of the fact that about 20 per cent of the present-day material could not be measured on account of loss of teeth. Among these cases with extractions there are, as already mentioned, a number of extreme cases of crowding which, if they could have been recorded, would have shifted the present-day mean somewhat.

Another factor that might have contributed to the observed difference is the marked abrasion of the Middle Ages material that, through wear of the crowns down to smaller tooth widths, may have changed the space conditions — for example, to reduced crowding. The group of 47 mature persons, however, show no less variation in spacing (stand. dev. = 2.5) than the 37 juveniles + adults (stand. dev. 2.2 mm) so that it would seem difficult to find support for this hypothesis.

The fact that one is here concerned with 13-year-old children in one of the groups and with adults in the other may naturally be of some significance, even if nothing is known of a reduction in the space distribution after the age of 13.

A difference of a genetic nature, with more uniform populations in the Middle Ages than to-day, is yet another possible explanation, but its validity is difficult to judge.

Molar Occlusion, Overjet and Overbite.

In Table 8 the Stone Age and Medieval crania have been compared with present-day material in respect of molar occlusion

Table 8.

Comparison between present-day, Stone Age and medieval materials in respect of molar occlusion (in mm.).

The means used for comparison were the largest examined present-day material (cf. Table 7).

Period	Material	Author	Molar occlusion					
			left			right		
			N	Diff. ($\bar{x}$)	s	N	Diff. ($\bar{x}$)	s
	Swedes							
Present-day	Children, 13 yr	LUNDSTRÖM	186	*— 0.1*	2.1	184	*— 0.4*	2.1
»	Men	»	27	+ 0.8	3.1	27	+ 0.3	2.9
Stone Age..	Men + women	»	17	+ 2.4***	1.4	17	+ 2.3***	1.1
	Danes							
Medieval ...	Men + women	LUNDSTRÖM LYSELL	90	+ 0.9***	1.7	86	+ 0.8**	1.5

values. Both the former periods indicate more positive values, that is, they have more marked mandibular protrusion than the present-day child material. The Middle Ages material differs from the present values for children by 0.9 mm*** on the left and 0.8 mm** on the right side. The question is whether this difference is purely an age difference — that is, whether the same difference occurs to-day between children and adults. The adult material of to-day given in Table 8 certainly does not rule out such a possibility. SEIPEL's (1946) comparison of 13-year-olds and adults with a somewhat different mensuration technique revealed a tendency in the same direction — but not significant (+ 0.4 mm for males and + 0.2 mm for females). BJÖRK's (1947) X-ray profile investigations indicated also that the base of the mandible grows more forwards than that of the upper jaw during the age interval in question. It is therefore probable that the observed difference is at least partly ascribable to age alone.

The overjet and overbite values are compared in Table 9. In the same age-group (13 years) LUNDSTRÖM obtained for boys and girls 0.9 mm*** less overjet and 0.8*** less overbite than SEIPEL for boys only. Since the difference in sex, according to SEIPEL's determinations, appears to be small (0.4 mm* and 0.2 mm) it is conceivable that a systematic measurement difference exists and this possibility must be taken into consideration in any comparison of the Middle Ages material with SEIPEL's present-day ma-

Table 9.

Comparison between present-day, Stone Age and medieval materials in respect of overjet and overbite (in mm.). The means used for comparison were the largest examined present-day material (cf Table 7).

Period	Material	Author	Overjet			Overbite		
			N	Diff. ($\bar{x}$)	s	N	Diff. ($\bar{x}$)	s
	Swedish							
Present-day	boys, 13 yr.	SEIPEL	255	*3.8 ± 0.14*		255	*3.7 ± 0.09*	—
»	males, 21 yr.	»	244	— 1.3***		243	— 0.5**	—
»	girls, 13 yr.	»	245	— 0.4*	2 mm app.	240	— 0.2	—
»	females, 21 yr.	»	250	— 0.4*		249	— 0.2	—
»	boys, girls 13 yr	LUNDSTRÖM	224	— 0.9***	1.8	222	— 0.8***	1.4
»	men	»	52	— 1.0***	1.6	52	— 0.4	2.2
Stone Age..	»	»	15	— 3.9	—	15	— 3.9	—
	Danish							
Medieval...	juv. + adult	LUNDSTRÖM LYSELL	39	— 1.3**	2.1	39	— 0.9**	1.6
» ...	mature	»	56	— 1.8***	1.8	55	— 2.1***	1.8
» ...	total	»	98	— 1.6***	2.0	94	— 1.6***	1.8

terial. For male adults there is in SEIPEL's material a clear decrease in relation to 13-year-olds, with 1.3 mm*** for overjet and 0.5 mm** for overbite while no such tendency is evident for the females. The fact that the overjet is less for the Middle Ages crania than for SEIPELS' 13-year-old boys (— 1.6 mm***) and LUNDSTRÖM's 13-year-old boys and girls (— 0.7 mm**) thus affords no proof that overbite and overjet has increased during historical times, since the difference might be due to reduction in overbite or overjet characteristics of our own times, particularly in males from 13 years to adult ages. The same applies in respect to the corresponding overbite differences of 1.6 mm*** and 0.8 mm***. For the overbite the difference is in respect of the Middle Ages matures where, as already mentioned, the overbite is less than in juveniles + adults. Whether a similar reduction also exists at present has, as far as is known, not been investigated.

The distribution of overjet and overbite in the Danish medieval material is illustrated in Figs. 1 and 2. It is obvious that the overbite values present a skewness with a maximum at the edge-to-edge bite, especially due to the great number of such dentitions among the mature crania.

Summary.

Results are given of an anthropological examination of 121 medieval crania selected from a collection of about 800. The means and standard deviations are given for the following properties (see Tables 2—9):

(1) The width and length of the cranium, the width-length index.
(2) Facial width and height (upper and total height).
(3) Width of mandible (at angulus).
(4) Width and length of dental arch.
(5) Spacing of teeth.
(6) Inclination of upper central incisors.
(7) Occlusal conditions (molar occlusion, overbite and overjet).

Comparison with material described elsewhere indicates somewhat wider arches for Swedish and Danish medieval skulls than for Swedish present-day material. The possibility of mensuration errors, some uncertainty as to changes in age, and lack of representativeness in the Middle Ages material preclude any definite conclusions concerning the reduction in arch width since the Middle Ages.

The medieval material presents less dispersion of the relative space (crowding — spacing) than boys of to-day. The reason for this difference is not to be found without further investigations.

No definite difference has been revealed between the medieval and present-day molar occlusion, overbite and overjet.

For the Middle Ages material the overbite is somewhat less for mature than for juvenile + adult skulls, this most probably being due to attrition. No corresponding difference in overjet or molar occlusion could be demonstrated.

Zusammenfassung.

In der vorliegenden Arbeit wird über das Resultat von anthropologischen, im Besonderen gebissanthropologischen Untersuchungen von aus dem Mittelalter Dänemarks stammenden Schädeln berichtet. Es wurden insgesamt 121 Schädel untersucht. Der Mittelwert und die Standardabweichungen wurden für folgende Werte gegeben:

1. Breite und Länge des Schädels, Breiten-Längen-Index.
2. Breite und Höhe des Gesichtes (obere sowie Gesamthöhe).
3. Breite der Mandibula (gemessen am Angulus).
4. Breite und Länge der Zahnbogen.
5. Raumverhältnis der Zähne.
6. Inklination der medialen Incisivi des Oberkiefers.
7. Okklusion (Molarokklusion, horizontaler und vertikaler Überbiss).

Im Vergleich mit früher vorgelegtem Material finden sich bei dem aus schwedischen und dänischen Mittelalter im Gegensatz zur Gegenwart etwas breitere Zahnbogen. Die Möglichkeit von systematischen Messfehlern, eine gewisse Unsicherheit betreffs der Altersveränderungen sowie der Mangel an Gemeingültigkeit des vorhandenen Materials aus dem Mittelalter lässt indessen keine sicheren Schlüsse auf eine Verringerung der Zahnbogenbreite vom Mittelalter zur Gegenwart zu.

Das Material aus dem Mittelalter weist im Bezug auf das Raumverhältnis (Engstellung — Weitstellung) eine geringere Streuung auf als sie bei Knabengebissen der Gegenwart gefunden wird. Die Ursache dieses Unterschiedes kann ohne weitere Untersuchungen nicht festgestellt werden.

Sichere Unterschiede zwischen Mittelalter und Gegenwart im Bezug auf Molarokklusion und horizontalen und vertikalen Überbiss konnten nicht nachgewiesen werden. Bei dem Schädelmaterial aus dem Mittelalter liegt ein sichergestellter Unterschied zwischen juvenilen und adulten Schädeln einerseits und maturen Schädeln andererseits mit geringerem vertikalen Überbiss bei den letzteren vor, wobei es sich sicherlich um eine Folge von Abnützung handelt. Für eine entsprechende Verminderung des horizontalen Überbisses oder Veränderung der Molarokklusion konnte der Nachweis nicht erbracht werden.

Résumé.

Dans le travail présent les auteurs rendent compte des résultats des investigations anthropologiques en premier lieu anthropologiques-dentaires des crânes danois du moyen âge. En tout 121 crânes ont été examinés. Des valeurs moyennes et des écarts types sont donnés pour les qualités suivantes (voir les tableaux 2—9):

1. Largeur et longueur du crâne, index largeur-longueur.
2. Largeur et hauteur de la face (hauteur supérieure et totale).
3. Largeur de la mandibule (à l'angle).
4. Largeur et longueur des arcs dentaires.
5. Conditions d'espace des dents.
6. Inclinaision des médiales de la mâchoire supérieure.
7. Conditions d'occlusion (occlusion de molaires, «overjet» et «overbite»).

La comparaison des éléments dont les auteurs ont rendu compte auparavant montre des arcs dentaires un peu plus larges chez les éléments suédois et danois du moyen âge que chez les éléments de notre temps. Cependant, la possibilité d'erreurs de mensuration systématiques, une certaine incertitude de changements d'âge ainsi que des éléments peu représentatifs du moyen âge causent que des conclusions sûres de largeur diminuée des arcs dentaires du moyen âge jusqu'à notre temps ne peuvent pas être tirées.

Les éléments du moyen âge montrent moins de divergence d'espace (occlusion serrée — occlusion espacée) que ce qui concerne des éléments de garçons de notre temps. La raison de cette différence est impossible de fixer sans plus d'investigations.

Aucune différence sûre entre le moyen âge et notre temps pour occlusion de molaires et «overjet» et «overbite» n'a pas pu être prouvée. Pour les éléments du moyen âge il existe une différence assurée entre des crânes juvéniles, adultes et matures avec moins de «overbite» chez les derniers, probablement à cause d'abrasion. Aucune diminution correspondante de «overjet» ou changement de l'occlusion de molaires n'a pas été prouvée.

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