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PREVALENCE OF DENTAL ENAMEL HYPOPLASIA IN THE NEOLITHIC SITE OF WADI SHU'EIB IN JORDAN

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ABSTRACT A study of Neolithic Pre-Pottery B materials from Wadi Shu'eib revealed that 38.40% of the examined teeth have dental enamel hypoplasia (DEH). Sixty percent of the anterior teeth exhibit DEH while only 21.40% of the posterior have the defect. The most affected teeth are the maxillary central incisors (72.73%) and the lower canines (62.5%). The most prevalent type of defect is the groove which is present in 68.75% of the teeth with DEH. One notable case is a lateral incisor with a slight deep and sharp groove. The sharpness and the deepness of this groove may indicate a severe stress which caused DEH to occur in a very short period. The most likely causes of DEH were general nutritional stresses. Another cause may have been environmental stresses.

INTRODUCTION

Historical Background

The site of Wadi Shu'eib dates to the Pre-Pottery Neolithic B (7,500-6,000 BC) (Rollefson, 1987). It is approximately 22 km west of Amman on the Salt Shuna road, 8 km south of Salt city, and less than a kilometer north of the village of Wadi Shu'eib (Simmons et al., 1989). The site is situated at an altitude of 375 m above sea level on a moderately steep slope near the Wadi Margin (Rollefson, 1987). Wadi Shu'eib is one of the few sites with Neolithic cultural remains known in the Levant.

MATERIALS AND METHODS

Mandibles and maxillae (complete and incomplete) representing eight individuals and loose teeth recovered from a salvage excavation at Wadi Shu'eib were examined. Sex determination was not possible because of loose teeth and small fragments of mandibles. One hundred and twenty five permanent teeth, many of which were loose teeth, were examined for DEH.

The teeth were first cleaned by using dry toothbrushes and fresh water. Then two well-trained anthropologists using a Nicon lens (x10mm) under a sufficient light observed and recorded DEH defects macroscopically in the archaeological laboratory of The Institute of Archaeology and Anthropology at Yarmouk University. The occurrences of DEH on the clear and cleaned permanent teeth were coded. If wear and calculus were present on a tooth, DEH was not recorded. However, the tooth was counted in the total tooth number. Dental enamel hypoplasia was classed as pits, lines and/ or grooves following the method of El-Najjar et al. (1978). Estimation of the age of DEH was based on the crown development at the incisal, mesial, and cervical zones of the teeth following Massler (1941) and modified from Goodman and Armelagos (1985).

RESULTS

The prevalence of DEH in the permanent teeth of the Wadi Shu'eib sample is relatively high for Neolithic people. Forty eight-defects were recorded in 125 (38.44%) teeth (Table 1). The mandibular teeth show greater prevalence of DEH (40.84%, 29/71) than do the maxillary teeth (35.18%, 19/54).

DEH Frequency by Tooth Class and Location

The most affected tooth showing DEH is the upper central incisor (72.73%, 8/11) followed by the mandibular canine (62.50%, 5/8). Maxillary first and second premolars and second molars are free of DEH. By tooth region, the

TABLE 1. The prevalence distribution of DEH by tooth class.

Tooth Class	x	y	%
Maxilla			
Central incisors	11	8	72.73
Lateral incisors	5	3	60.00
Canines	6	3	50.00
First premolars	3	0	0.00
Second premolars	4	0	0.00
First molars	10	3	30.00
Second molars	8	0	0.00
Third molars	7	2	28.57
Mandible			
Central incisors	9	5	55.56
Lateral incisors	16	9	56.25
Canines	8	5	62.50
First premolars	6	2	33.33
Second premolars	6	1	16.67
First molars	13	2	15.38
Second molars	8	3	37.50
Third molars	5	2	40.00
Total	125	48	38.40

x is the number of teeth. y is the number of hypoplastic teeth. % is the frequency of y/x.

anterior teeth are more affected by the DEH (60.00%, 33/55) than are the posterior teeth (21.43%, 15/70) (Table 1).

Types of DEH

The type of DEH most often exhibited in the teeth of Wadi Shu'eib people is the groove. Thirty-three of 48 defects are grooves (68.75%). On the other hand, lines occur less frequently (25.00%, 12/48) than do grooves (Table 2).

Age at DEH Occurrence

The age at the time of DEH occurrence was estimated by noting DEH at a specific location in a particular tooth. The most highly involved zone of the most affected tooth is the middle zone on the central upper incisor which develops during the interval of 1.5 to 3.0 years of age (Table 3). The distribution of DEH on the lower central incisor is totally concentrated on the middle third, which develops during the interval of 1.3 to 2.6 years of age. A high frequency also appears on the middle zone of the lower lateral incisor that develops from 1.3 to 2.6 years of age. On the other hand, the least affected tooth, the lower second premolar, shows one defect on the middle third which develops from 3.7 to 5.4 years of age.

Unusual Expression of DEH

One of the lower lateral incisors has a very sharp and thin groove which is exhibited as a labiolingual circle on the crown of the tooth. The shape is similar to that of a cut in glass by diamond. Measurements to the tooth are: 10.7 mm total height from incisal to cervical edge, 4.6 mm from the incisal edge to the position of the groove and, 6.1 mm from the position of the groove to the cervical edge. From the position of DEH, the age peak of the defect at the time of the development of the crown was about 1.7 years of age.

DISCUSSION

The prevalence of DEH in Wadi Shu'eib is relatively high (38.40% of the teeth), especially when the number of the teeth examined are few. Smith et al. (1984) reported that 38.00% of the people of Jericho during Pre-Pottery Neolithic B showed DEH.

The 38.40% prevalence of DEH in the teeth of the people of Wadi Shu'eib is important in determining the influences of DEH in prehistoric populations. In the prehistoric samples DEH is indicative of causes that obstruct the metabolic process and eventually the development of the dental enamel. The pathological causes of DEH cannot be identified directly in prehistoric populations. Studying the archaeological evidence of the nature of the environments in which the people lived might help in determining the factors responsible for a high rate of prevalence of DEH.

Ogilvie et al. (1989) report a difficulty in determining specific agents that cause DEH but consider metabolic stresses as highly reliable causative factors. As a result, they suggest that the nutritional stresses are the main causal agent of DEH. On the other hand, Goodman and Armelagos (1985) suggest that the identification of the etiology of DEH should not be limited to the environmental stress variations and other specific factors should be sought in paleopathological studies.

For the tooth type, the frequency of DEH is high on the upper central incisor (72.73%). This frequency is higher than that on the lower canine (62.50%, 5/8). The percentages are like those reported by Goodman and Armelagos (1985) and Lanphear (1989). The three posterior maxillary teeth are totally free of DEH, whereas all of the mandibular teeth exhibit DEH. These differences in the distributions of DEH by tooth types could be due to the chronology of the development of the enamel during the matrix formation. Each tooth has a different period of time to complete development (Goodman and Armelagos, 1985; Goodman et al., 1991).

TABLE 2. Percentage distribution of the occurrence of DEH by type of defects.

Type	%
Lines	25.00
Grooves	68.75
Pits	6.25

The involvement of the mandibular teeth are significantly greater than that of the maxillary teeth. This result shows noticeable contrasts to many studies (El-Najjar et al., 1978; Hargreaves et al., 1989; Ogilvie et al., 1989).

As it was noted above, grooves occur on most of the hypoplastic teeth (68.75%). This indicates that an acute event resulted in the interruption of the ameloblast in the matrix formation stage (Seow, 1991). The stresses seem to have been arduous and of long duration. This type of defect is a result of causes that have continued for fairly long time. In contrast, Al-Abbasi (1994) concluded that lines were a dominant type of the defects in his study of Jordanian school children among three sectors of the population (Bedouins, villagers, and city dwellers). The difference in the frequency of the types could be due to a variation in the causative factors.

The estimation of the age of occurrence of DEH confirms that the DEH was highly prevalent in the second and third years of age. This is indicative of the weakness in the metabolic process at the time of the occurrence of DEH. Many factors are interrelated in these susceptible years of the child and disrupt or inhibit the enamel matrix formation.

Lanphear (1990) argued that in prehistoric populations the prevalence of DEH occurred at an earlier peak age in agricultural groups than in hunter-gatherers. The hunter-gatherers were assumed to be weaning their children at later ages than were the agricultural groups. The Wadi Shu'eib people were agricultural and in some seasons practiced pastoralism. The high prevalence of DEH at the second and the third years indicate some nutritional stresses at the time of weaning.

TABLE 3. The Prevalence distribution of DEH on developmental zones by tooth types.

	Incisal Zone		Mesial Zone		Cervical Zone	
Tooth Type	n	%	n	%	n	%
Maxilla						
Central incisors	3	37.5	5	62.5	0	0.0
Lateral incisors	3	100.0	0	0.0	0	0.0
Canines	1	33.3	2	66.7	0	0.0
First premolars	0	0.0	0	0.0	0	0.0
Second premolars	0	0.0	0	0.0	0	0.0
First molars	3	100.0	0	0.0	0	0.0
Second molars	0	0.0	0	0.0	0	0.0
Third molars	0	0.0	2	100.0	0	0.0
Mandible						
Central incisors	0	0.0	5	100.0	0	0.0
Lateral incisors	3	33.0	4	44.5	2	22.2
Canines	1	20.0	4	80.0	0	0.0
First premolars	2	100.0	0	0.0	0	0.0
Second premolars	0	0.0	1	100.0	0	0.0
First molars	1	50.0	1	50.0	0	0.0
Second molars	0	0.0	2	50.0	0	0.0
Third molars	0	0.0	0	0.0	0	0.0

x is the number of DEH. % is the frequency.

The sharp thin groove observed on one lower lateral incisor suggests the occurrence of a very severe cause for a short period of time, which may have sharply slowed down the process of metabolism during the time of enamel matrix formation. A similar case was found in a lateral incisor of a Neolithic skull in Sweden (During and Nilson, 1991). Sometimes, fevers are thought to be related to the whole nutritional status of the population (Neiburger 1990). Al-Abbasi (1994) has found a significant correlation between pathological effects, mainly measles and diarrhea ($t=3.98$; $t=3.68$ at $P>0.01$ respectively), and DEH in recent Jordanian populations. Since a nutritional stress needs a longer period of time to affect the metabolic process than do diseases, it might be discarded as the causative factor.

Hillson (1997, personal communication) agreed that this kind of groove is indeed a hypoplastic defect and suggested that a microscopic examination for the tooth would help in grasping the mechanisms of the this kind of enamel defect. Because the groove is so thin, the causative factor was likely a very acute disease that happened during childhood and severely affected the metabolic rate for a very short period. Some environmental diseases affect the metabolic rate and are actually related to the presence of DEH.

CONCLUSION

Dental enamel hypoplasia is one of the most coherent contributors used by anthropologists and paleodemographers for reconstructing the image of nutritional and health conditions of past people. The revolution of agriculture during the Neolithic period did not help the people of Wadi Shu'eib to avoid nutritional or other ecological stresses. The high frequency of DEH in the eight individuals examined expresses the instability of the living conditions of these people when they were alive. The high incidence of large grooves indicates that the people were suffering some long periods of multiple hard times, especially in their early lives. Weaning stress could have been among other environmental factors of the etiology of DEH. However, determining a single cause may be impossible because of the variability of DEH occurrence.

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WHO WERE THE NATUFIANS? A DENTAL ASSESSMENT OF THEIR BIOLOGICAL COHERENCY

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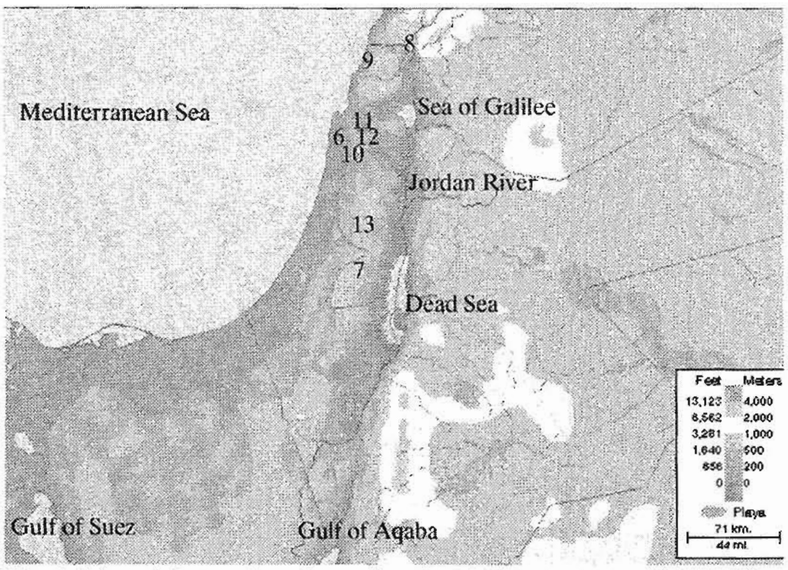

Fig. 1. Map of the southern Levantine sites from which the samples in this study originated. Key: 6-El-Wad, 7-Erq el-Ahmar, 8-Eynan, 9-Hayonim Cave and Terrace, 10-Kebara, 11-Nahal Oren, 12-Rakefet, 13-Shukba.

ABSTRACT The Natufians were complex, semi-sedentary hunter-gatherers who intensively exploited wild plant resources in the southern Levant 12,800 to 10,200 BP. They represent the human culturo-behavioral transition from simple, mobile hunter-gathers to fully sedentary agriculturalists. The Natufians have been the subject of much archaeological and biological study because of their pivotal position in human prehistory. Previous studies of Natufian population biology, which employed osteometrics, craniometrics, and odontometrics, qualitatively supported the following archaeologically-defined hypothesis. Every human skeletal sample found at each Natufian site belonged to a biologically coherent population.

The present study tests the hypothesis of Natufian biological coherency by analyzing their dental morphology. The data were collected from nearly all available Natufian dental material, using the Arizona State University Dental Anthropology System. The results of the multivariate Mean Measure of Divergence statistical analysis support the biological coherency of the Natufian population.

INTRODUCTION

The Natufian techno-complex (C_{14}-dated between 12,800 and 10,200 BP) (Henry, 1989) represents an unprecedented change in the human lifestyle in the southern Levant from highly mobile, simple hunting and gathering to semi-sedentary, complex hunting and gathering. The transition likely involved the movement of people to new areas, as well as the fusion of more numerous, smaller, and more mobile groups (from the period preceding the Natufian) into less numerous, larger, and more sedentary groups (in the Natufian). Therefore, this period in the

TABLE 1. Natufian dental samples.

Sample Site Name	Date BP[1]	N[2]	Facility
El-Wad	11,920	90	HVD
Erq el-Ahmar	12,800-10,500	3	TAU
Eynan	11,500	14	TAU
Hayonim Cave	12,175	90	TAU
Hayonim Terrace	11,920	12	TAU
Kebara	11,150	26	HVD
Nahal Oren	10,046	44	TAU
Rakefet	10,780	8	TAU
Shukba	12,800-10,500	4	HVD

[1]Dates are based on either published absolute dates (Bar-Yosef, 1980; Henry, 1989; Hovers and Marder, 1991) or archaeologically derived dates.
[2]Sample size estimates are based on the number of individuals dentally represented. HVD is the Peabody Museum, Harvard University. TAU is the Department of Anatomy and Anthropology, Tel Aviv University.

southern Levant may well have involved some momentous changes in human population relationships.

The Natufians have been hypothesized to represent a coherent archaeological entity and biological population (Vallois, 1936; Smith, 1970; Bar-Yosef et al., 1971-72; Arensberg, 1973; Bar-Yosef, 1981; Henry, 1989; Bar-Yosef and Belfer-Cohen, 1989; Belfer-Cohen, 1991). That is, as classified on the basis of archaeological and biological criteria, the Natufians represent a natural and logical grouping. According to biological analyses, the Natufians were not an amalgam of individuals from various contemporaneous, but biologically distinct populations.

Jolly and White (1995; p.52) define a Mendelian population as, ". . . a group of organisms whose members are *more likely* (their italics) to mate with each other than with outsiders." They also note that large Mendelian populations can include smaller ones that exchange genes by interbreeding.

The present study will classify the Natufians, if and where appropriate, as a biologically coherent population. Members of this population were more likely to mate with each other than with non-Natufians, and were comprised of smaller populations among whom interbreeding occurred. Given the state of biological classification today, this may most accurately classify the Natufians and explain how they have been viewed by the scholars who have studied them.

The present study tests the hypothesis of the Natufian population's biological coherency by quantifying the dental relationships between the skeletal samples from Natufian sites.

MATERIALS AND METHODS

The samples (Table 1, Fig. 1) are comprised of nearly all the Natufian dentitions currently available. The Natufian data for this study come from Lipschultz (1996). Data collection followed the standard method described by Turner et al. (1991), using the dental trait, ranked-scale plaster plaques and definitions of the Arizona State University Dental Anthropology System (ASU DAS), for scoring the dental morphology of the adult human dentition. Data were collected for all 42 scoreable dental traits of the ASU DAS.

STATISTICAL ANALYSIS

C.A.B. Smith's multivariate Mean Measure of Divergence (MMD) statistic, employing the Freeman and Tukey angular transformation (Berry and Berry, 1967; Sjovold, 1973; Green and Suchey, 1976) to correct for small sample sizes, was used. The MMD statistic offers a quantitative measure of biological divergence between samples, based on the degree of phenetic similarity for the entire suite of dental traits. A higher MMD value indicates a greater degree of phenetic dissimilarity (and thus genetic distance) than does a lower value. Using the MMD statistic, it is assumed that phenetic similarity closely approximates an underlying cladistic relationship (Scott et al., 1983).

To determine if MMD values are statistically significant, each MMD value is compared to its standard deviation. If the MMD value is greater than two times its standard deviation, then the null hypothesis of the samples being identical is rejected at the 0.025 significance level (Sjovold, 1977). Conversely, an insignificant MMD value indicates that it is impossible to distinguish between the two samples because (1) the samples are phenetically indistinguishable because they are from the same populations or are from two populations with the same dental trait distribution, or (2) the size of one or both samples is small, which can result in an excessively large standard deviation (Sjovold, 1977).

In the Natufian inter-sample MMD comparison, trait selection included 25 of the 29 dental traits of the ASU DAS that Turner (1987) has found to best differentiate between populations at different levels of geographic comparison. Trait presence/absence break-point selection also followed Turner (1987). The data and presence/absence frequencies are given in Table 2.The MMD analysis includes the maximum number of dental traits common to *all* the samples in a given matrix.

TABLE 2. Frequencies of 25 dental morphological traits used in the Natufian inter-sample MMD's in Table 4.

Traits	Grades +	El-Wad N	El-Wad K	El-Wad %	Eynan N	Eynan K	Eynan %	Hayonim N	Hayonim K	Hayonim %	Nahal Oren N	Nahal Oren K	Nahal Oren %	AHKRS N	AHKRS K	AHKRS %	Natufians (all) N	Natufians (all) K	Natufians (all) %
Winging UI1	1	13	0	0.0	8	0	0.0	1	0	0.0	5	0	0.0	14	0	0.0	31	0	0.0
Shoveling UI1	3-7	16	0	0.0	22	0	0.0	14	1	7.7	3	0	0.0	4	0	0.0	59	1	1.9
Double-shovel UI1	2-6	26	3	11.5	30	1	3.3	25	4	16.0	9	2	22.2	10	2	20.0	12	100	12.0
Interruption groove UI2	1	31	2	6.4	24	1	4.2	19	7	36.8	9	0	0.0	9	2	22.2	92	12	13.0
Tuberculum dentale UI2	1-6	23	23	100.0	19	16	84.2	11	11	100.0	4	4	100.0	4	4	100.0	61	58	88.5
Mesial ridge UC	1-3	18	1	5.6	22	6	27.3	10	1	10.0	5	0	0.0	3	0	0.0	58	8	13.8
Uto-Aztecan UP1	1	36	0	0.0	31	0	0.0	22	0	0.0	10	0	0.0	10	0	0.0	109	0	0.0
Hypocone UM2	2-5	51	50	98.0	39	36	92.3	25	22	88.0	16	16	100.0	16	15	93.7	147	136	94.5
Cusp 5 UMI	1-5	60	1	1.7	54	5	9.2	34	5	14.7	18	1	5.5	23	2	8.7	189	14	7.4
Carabelli's trait UM1	2-7	23	19	82.6	28	23	82.1	19	13	68.4	8	7	87.5	12	11	91.7	90	30	81.1
Parastyle UM3	1-6	51	0	0.0	31	1	3.2	20	0	0.0	14	0	0.0	17	0	0.0	133	1	0.7
Enamel Extension UM1	2-3	49	0	0.0	46	0	0.0	31	0	0.0	14	0	0.0	16	0	0.0	156	0	0.0
>-root UP1	1	6	1	16.7	5	3	60.0	13	6	46.1	3	1	33.3	6	0	0.0	33	11	33.3
3-root UM2	3	7	6	85.7	16	14	87.5	13	13	100.0	3	3	100.0	7	7	100.0	46	43	93.5
Peg/reduced UM3	1-2	51	22	43.1	31	18	58.1	20	10	50.0	14	7	50.0	18	10	55.5	134	167	50.0
Odontome U/L P1/P2	1	50	0	0.0	47	1	2.1	28	0	0.0	16	0	0.0	20	0	0.0	161	1	0.6
>1 lingual cusp LP2	2-9	28	18	64.3	23	12	52.2	24	13	54.2	14	8	88.9	9	8	88.9	98	59	60.2
Y groove pattern LM2	Y	47	17	36.2	37	11	29.7	32	8	25.0	24	8	33.3	14	3	21.4	154	47	30.5
6-cusp LM1	6	50	6	12.0	43	8	18.6	24	7	29.2	18	4	22.2	21	6	28.6	156	31	19.9
4-cusp LM2	4	51	36	61.0	44	32	72.7	32	19	5934	25	9	36.0	16	8	50.0	176	104	59.1
Deflecting wrinkle LM1	3	9	0	0.0	12	0	0.0	9	0	0.0	2	0	0.0	5	0	0.0	37	0	0.0
Distal trigonid crest	1	35	0	0.0	32	0	0.0	23	0	0.0	12	0	0.0	17	0	0.0	119	0	0.0
Protostylid LM1	1-7	49	7	14.3	39	5	12.8	20	3	15.0	16	3	18.7	22	3	13.6	146	21	14.4
Cusp 7 LM1	1-5	54	2	3.7	42	3	7.1	32	0	0.0	21	0	0.0	21	0	0.0	170	8	4.7
1-root LM2	1	3	0	0.0	8	0	0.0	7	0	0.0	4	0	0.0	11	0	0.0	33	0	0.0

Abbreviations: N is the number of observable dentitions with at least one tooth containing trait. K is the number of dentitions with trait, based on the tooth with the high grade of the trait in cases of unequal antimere expression. UI1 is maxillary central incisor. UI2 is maxillary lateral incisor. UC is maxillary canine. UP1 is maxillary first molar. UM1 is maxillary first molar. UM2 is maxillary second molar. UM3 is maxillary third molar. U/L is upper/lower. P1/2 is first/second. LP2 is mandibular second premolar. LM1 is mandibular first molar. LM2 is mandibular second molar.

TABLE 3. Frequencies of 26 dental morphological traits used in the Natufian-Nubian MMD's in Table 5.

Traits	Grades +	El-Wad N	El-Wad K	El-Wad %	Eynan N	Eynan K	Eynan %	Hayonim Cave N	Hayonim Cave K	Hayonim Cave %	Nahal Oren N	Nahal Oren K	Nahal Oren %	AHKRS N	AHKRS K	AHKRS %	Nubians N	Nubians K	Nubians %
Winging UI1	1	13	0	0.0	8	0	0.0	1	0	0.0	5	0	0.0	4	0	0.0	25	8	32.0
Shoveling UI1	2-7	16	4	25.0	22	0	0.0	14	1	7.1	3	0	0.0	4	1	25.0	22	13	59.1
Double-shovel UI1	2-6	26	3	11.5	30	1	3.3	25	4	16.0	9	2	22.2	10	10	20.0	20	0	0.0
Interruption groove UI2	1	31	2	6.4	24	1	4.2	19	7	36.8	9	0	0.0	9	2	22.2	25	4	16.0
Tuberculum dentale UI2	2-6	23	23	100.0	19	16	84.2	11	11	100.0	4	4	100.0	4	4	100.0	18	7	38.9
Mesial ridge UC	1-3	18	1	5.6	22	6	27.3	10	1	10.0	5	0	0.0	16	15	93.7	23	1	4.3
Hypocone UM2	3-5	51	50	98.0	39	33	84.6	25	20	80.0	16	16	100.0	16	14	93.7	27	25	92.6
Cusp 5 UMI	2-5	60	0	0.0	54	1	1.8	34	4	11.8	18	0	0.0	23	1	4.3	14	4	28.6
Carabelli's trait UM1	2-7	23	19	82.6	28	23	82.1	19	13	68.4	8	7	87.5	12	11	91.7	13	6	46.2
Parastyle UM3	2-6	51	0	0.0	31	0	0.0	20	0	0.0	14	0	0.0	17	0	0.0	34	0	0.0
Enamel Extension UM1	1-3	49	1	2.0	46	2	4.3	31	1	3.2	14	0	0.0	16	2	12.5	35	21	60.0
>-root UP1	2-3	6	5	83.3	5	2	40.0	13	7	53.8	3	2	66.7	6	6	100.0	28	20	71.4
Root # UM2	3-4	7	6	85.7	16	14	87.5	13	13	100.0	3	3	100.0	7	7	100.0	25	18	72.0
Peg/reduced UI2	1-2	37	2	54.0	22	4	18.2	20	10	50.0	9	1	11.1	10	5	50.0	32	1	3.1
>1 lingual cusp LP2	2-9	28	18	64.3	23	18	54.2	24	13	54.2	14	8	57.1	9	8	88.9	15	14	93.3
Y groove pattern LM2	Y	47	17	36.2	37	11	29.7	32	8	25.0	24	8	33.3	15	4	26.7	27	16	59.3
6-cusp LM1	6	50	6	12.0	43	8	18.6	24	7	29.2	18	4	22.2	21	6	28.6	30	9	30.0
5-cusp LM2	5	51	15	29.4	34	2	5.9	27	8	28.6	16	7	43.7	10	0	0.0	33	31	93.9
Deflecting wrinkle LM1	2-3	9	1	11.1	12	0	0.0	9	1	11.1	2	0	0.0	5	2	40.0	10	3	30.0
Distal trigonid crest	1	35	0	0.0	32	0	0.0	23	0	0.0	12	0	0.0	17	0	0.0	14	0	0.0
Protostylid LM1	1-7	49	7	14.3	39	5	12.8	20	3	15.0	16	3	18.7	22	3	13.6	21	6	28.6
Cusp 7 LM1	2-5	54	1	1.8	42	1	2.4	32	3	9.4	21	0	0.0	21	0	0.0	28	1	3.6
Root # LM2	2-3	3	3	100.0	8	8	100.0	7	7	100.0	4	4	100.0	11	11	100.0	36	31	86.1
Palatine torus	2-4	5	1	20.0	4	0	0.0	1	0	0.0	4	1	25.0	2	1	50.0	22	2	9.1
Rocker jaw	1	12	1	8.3	9	2	22.2	7	1	14.3	14	4	28.6	6	1	16.7	38	0	0.0

Abbreviations are the same as those in Table 2. Nubian data are from Turner and Irish (1990).

The MMD statistic is a measure of relative phenetic similarity/dissimilarity, and in addition to an inter-sample comparison among the Natufian sites, it is important to compare each Natufian sample with an outgroup to which they could conceivably be more dentally similar, instead. The best available outgroup in this case is the late Pleistocene Nubian dental sample (18,000-12,000 BP) from Irish and Turner (1990). The Nubian sample is broadly contemporaneous with and geographically proximate to the Natufian samples, and the archaeological evidence suggests the possibility that late Pleistocene Nubian-derived gene flow may have augmented the Natufian gene pool (Lipschultz, 1996).

The Nubian sample thus represents a reasonable outgroup for comparative purposes. Furthermore, the data from the two studies (Irish and Turner, 1990; Lipschultz, 1996) are comparable because the present author was trained in the use of the ASU DAS by Turner, who collected the late Pleistocene Nubian data found in Irish and Turner (1990). Also, to make the Natufian and late Pleistocene Nubian dental data more directly comparable, trait and presence/absence break-point selection followed Irish and Turner (1990). Of the 31 traits Irish and Turner (1990) use, all but torsomolar angle for the lower third molar were scored. Of these these 30 traits, 26 were scoreable for the late Pleistocene Nubian sample and all of the Natufian samples. The data for these 26 traits are given in Table 3.

TABLE 4. Mean measure of divergence values between Natufian dental samples.

Sample	El-Wad	Eynan	Hayonim Cave	Nahal Oren	AHKRS
El-Wad		-0.016	-0.026	-0.133	-0.074
Eynan	(0.038)		-0.029	-0.078	0.026
Hayonim Cave	(0.056)	(0.054)		-0.111	-0.076
Nahal Oren	(0.066)	(0.062)	(0.077)		-0.148
AHKRS	(0.053)	(0.050)	(0.070)	(0.080)	

Values in parentheses are standard deviations. AHKRS represents pooled Natufian samples from the sites of Erq-el-Ahmar, Hayonim Terrace, Kebara, Rakefet, and Shukba. Natufian data are from Lipschultz (1996).

TABLE 5. Mean measure of divergence values between Natufian and late Pleistocene Nubian dental samples.

Sample	El-Wad	Eynan	Hayonim Cave	Nahal Cave	AHKRS	Late Pleistocene Nubians
El-Wad		0.047	-0.045	-0.113	-0.049	0.412
Eynan	(0.044)		-0.022	-0.064	0.124	0.490
Hayonim Cave	(0.072)	(0.072)		-0.105	-0.043	0.354
Nahal Oren	(0.068)	(0.065)	(0.089)		-0.043	0.346
AHKRS	(0.062)	(0.032)	(0.090)	(0.085)		0.446
Late Pleistocene Nubians	(0.034)	(0.032)	(0.062)	(0.057)	(0.052)	

Underlined MMD values are statistically significant. Values in parentheses are standard deviations. Late Pleistocene Nubian data are from Irish (1993). AHKRS represents pooled Natufian samples from the sites of Erq-el-Ahmar, Hayonim Terrace, Kebara, Rakefet, and Shukba. Natufian data are from Lipschultz (1996).

MMD RESULTS

Comparison of the Natufian site dental data with one another shows that all but one of the resulting MMD values are negative (-0.148 to -0.026) and all are statistically insignificant (Table 4). The average MMD value between the Natufian dental samples is 0.003. Caution must be exercised when interpretations of population similarity are based upon negative MMD values, as this can result from the small sample size of one or both of the samples. Despite the fact that the MMD statistic is designed to contend with small sample size, via the Freeman and Tukey angular transformation (Berry and Berry, 1967; Sjovold, 1973; Green and Suchey, 1976), the possibility for error resulting from small sample size should always be explicitly stated, especially when negative MMD values result.

Given this, negative MMD values can generally be treated as being equivalent to a value of 0.000, which indicates no phenetic dissimilarity between samples (Turner, 1994). In the present comparison, the Natufian dental samples are considered to large enough to warrant the interpretation that the negative MMD values between them represent the absence of phenetic dissimilarity.

Including Irish and Turner's (1990) late Pleistocene Nubian dental sample in the analysis, all but one of the Natufian inter-sample MMD values are statistically insignificant, all are small, and all but two are negative (Table 4). Each Natufian/late Pleistocene Nubian comparison yields a statistically significant and large MMD value, especially relative to the Natufian inter-sample MMD values. The average MMD value between the Natufian and late Pleistocene Nubian dental samples is 0.410.

CONCLUSIONS

First, the dental samples from each Natufian site are phenetically similar to, and are statistically indistinguishable from one another when compared using the multivariate MMD statistic. Second. the close Natufian inter-sample dental relationship is supported when each is compared with an out-group, the late Pleistocene Nubians. All of the Natufian dental samples are significantly different from the late Pleistocene Nubian dental sample. Third, the phenetic similarity between the Natufian dental samples supports the hypothesis, defined by previous archaeological and biological investigations, that the Natufians are a biologically coherent population.

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LEHs in MEDIEVAL SCANDINAVIA: PRELIMINARY ANALYSIS

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ABSTRACT The development of enamel defects is a topic of considerable interest among skeletal biologists. Linear enamel hypoplasias (LEHs) are commonly studied, as they are generally thought to represent stress-induced growth disruptions. The present research uses the frequency of LEH in spatially dispersed but chronologically compact samples to document regional differences in growth stress.

Analysis of 1,068 teeth representing the permanent dentition of 921 individuals from six medieval sites in Denmark, Norway, and Greenland showed that the highest frequency of LEH occurred in the mandibular canine (29.13%) followed by the maxillary central incisor (27.51%). Comparison of these results with developmental charts, showing that maxillary incisor and mandibular canine crowns are completely formed between 4 and 7 years of age, indicated that early childhood was likely a stressful time for medieval Scandinavians. Overall, LEHs were more common in maxillary teeth than in mandibular teeth. Although statistically significant differences in LEH frequencies were not found between males and females, locations did differ significantly.

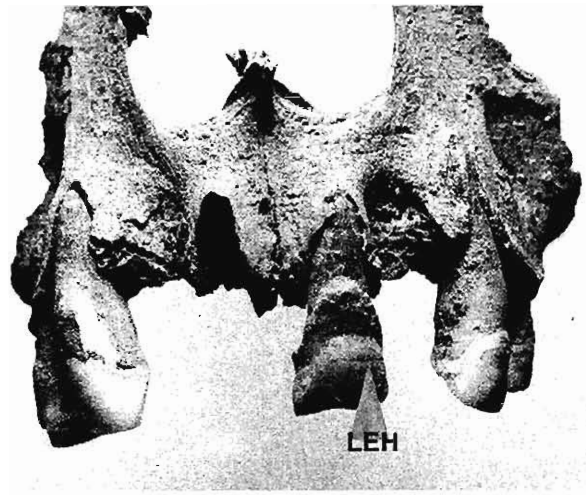

Fig. 1. LEH on maxillary incisor.

INTRODUCTION

Linear enamel hypoplasias (LEHs) are defects in enamel thickness resulting from disruptions of amelogenesis. While the specific etiology of LEHs is unknown, they are generally considered to be sensitive markers of developmental stress. Many types of stressors, such as nutritional deprivation, poor pre- and neonatal conditions, or illness can provoke growth arrest and LEH. Therefore LEHs are indications of nonspecific stressors. However, unlike bone which also exhibits the scars of developmental stressors, dental enamel does not remodel once formed (Goodman et al., 1985a,b). Thus LEHs bequeath a permanent record of developmental trauma . Furthermore, LEHs have the advantage of being macroscopically observable and recordable without expensive equipment under often difficult field situations.

MATERIALS AND METHODS

LEHs were operationally defined as lines or bands of decreased enamel thickness (Fig. 1). All defects included in this study were distinguished macroscopically and scored as "present" or "absent" by the senior author. A score of present denotes one or more obvious hypoplastic lines. In an attempt to control for loss of observability due to attrition or incomplete crown exposure, only teeth having reached the occlusal plane and with less than Stage 4 attrition (Brothwell, 1981) were included in the present analyses.

The samples represent medieval Scandinavian populations from Norway (Trondheim, Bergen and Oslo), Denmark (Viborg), and Greenland (Herjolfsnes, Gardar, and Sandnes) (Fig. 2). The maximum temporal range for these samples is from 1150 to 1624 AD, although the majority of the teeth date from 1150 to 1381 AD.

The sizes and sex distributions of the samples are presented in Table 1. All age and sex determinations were done by the senior author and corroborated with earlier publications: Greenland (Hansen, 1924; Fischer-Møller, 1942; Nørlund, 1924, 1929; Bröste and Fischer-Møller, 1944); Viborg, Denmark (Vellev, 1978); Bergen (Hanson, 1986), Trondheim (Hanson, 1986), and Oslo (Haugen, 1976), Norway.

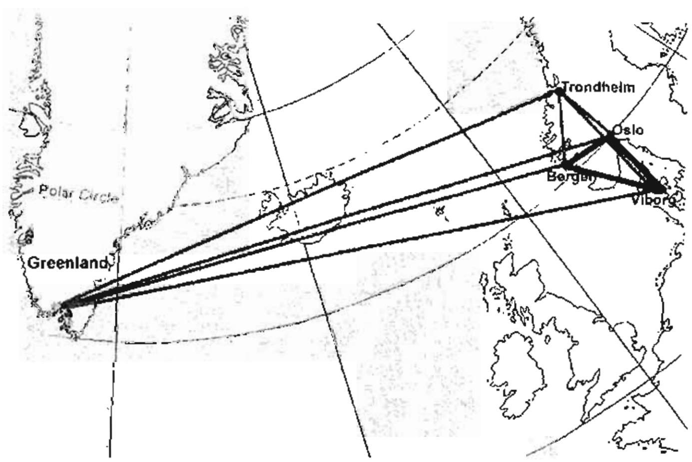

Fig. 2. Map showing sample locations. Lines connect sites between whom LEH frequencies differed significantly. Dark lines connect sites between whom LEH frequencies did not differ significantly (Oslo, Bergen, Viborg).

TABLE 1. Size and sex distribution of individuals and number of teeth.

Samples	n	% of total	Males	Females	Unknown
Bergen	68	6.67	22	26	23
Trondheim	527	49.43	71	90	366
Oslo	228	21.35	117	109	2
Viborg	50	4.68	19	27	4
Greenland	48	4.49	7	5	36
Number of teeth	1068		285	306	477

No statistically significant differences between males and females were found in either tooth presence or in the presence LEH frequencies per antimere (Chi-square tests, $\alpha = .05$, df=1). Thus, the sexes and "unknown" individuals were pooled in the comparative analyses.

The current research found high association of presence or absence of LEHs between antimeres (McNemar's Test for Significance of Changes, $\alpha = .01$). Thus, only one side, either right or left depending on presence, was used for analysis. This was necessary as the archaeological material was, as is usually the case, fragmentary.

RESULTS

The current research found LEH frequencies that were much lower than those reported by Scott et al. (1992), even though some of the same individuals were included in both studies. This may be attributed to interobserver error, a persistent and perfidious problem in LEH studies (personal communication, Jacobi, Dental Workshop, PPA meeting, Denver CO, 1994; Danforth et al., 1993). Since the present research found low frequencies, these must be considered as the conservative end of the range and the LEH relatively more pronounced in order to be scored as present. However, intraobserver error in the current investigation has been established as relatively low (Hanson, 1986).

Although any tooth can exhibit a LEH, it is most common on the maxillary central incisor and mandibular canine and least common on the maxillary third molar (Table 2, Fig. 3). This is a widespread pattern reported by many other authors (Goodman and Armelagos, 1985a,b; Goodman et al., 1987; Goodman, 1988; Duray, 1996).

Wilcoxon Rank Sum Tests examined the null hypothesis of no significant differences in LEH frequency by tooth type. Not surprisingly, the LEH frequency differed by tooth ($\alpha = .05$). Goodman and Armelagos (1985a) also found distinct LEH susceptibilities for different teeth. They found that the earlier-developing tooth crowns tended to have more hypoplasias than did later-developing crowns. Significant differences in LEH frequencies also occurred among tooth crowns that develop at the same time. These workers discovered that the maxillary central incisors were 1.7 times as susceptible to LEH as were the first molars, even though the crowns are all developing between birth and 3.5 years.

TABLE 2. Frequencies of one or more hypoplastic lines for each tooth class.

Tooth classes	Bergen	Trondheim	Oslo	Viborg	Greenland	Overall
Maxillary teeth						
Central incisor	7.69	38.10	28.43	23.08	0.00	27.51
Lateral incisor	6.25	22.67	8.26	2.44	0.00	10.86
Canine	16.67	24.22	14.94	10.20	0.00	15.79
First premolar	3.33	12.64	8.24	2.04	0.00	7.39
Second premolar	3.57	10.59	6.01	0.00	0.00	5.66
First molar	3.03	10.09	4.55	0.00	2.78	5.20
Second molar	13.33	12.50	4.02	0.00	0.00	6.04
Third molar	0.00	4.41	3.45	0.00	0.00	2.73
Mandibular teeth						
Central incisor	7.14	21.92	6.35	6.98	0.00	10.14
Lateral incisor	11.11	26.04	9.63	11.11	0.00	14.02
Canine	15.00	43.62	25.87	33.33	0.00	29.13
First premolar	9.09	24.75	10.20	14.58	0.00	13.92
Lateral premolar	9.52	9.00	2.70	6.38	0.00	5.23
First molar	0.00	11.76	1.54	2.27	0.00	4.57
Second molar	0.00	14.55	2.04	0.00	0.00	5.23
Third molar	0.00	6.33	2.59	2.63	0.00	3.23

A similar pattern was found among the Scandinavian samples. Early developing crowns showed relatively high incidences of LEH and not all crowns developing at the same time have equal LEH frequencies. For example, maxillary central incisors were 2.8 times more vulnerable to LEH than first molars, notwithstanding the fact that all the crowns are forming at the same time. This confirms the caveat issued by Goodman and Armelagos (1985b) against comparing results of LEH studies which do not use the same tooth.

Figure 4 shows the distribution of LEHs by age of crown development, taking into account that the permanent enamel does not record the timing of stressor events until about 12 months after crown initiation (Skinner and Goodman, 1992). Estimates of age of occurrence show peak LEH formation occurs between 4.5 and 5.5 years of age. This is later than ranges reported for prehistoric samples (2-6 years), historic samples (2.5-4 years), and modern groups (0-3) (Lanphear, 1990). It is also later than the age of 2, which was the presumed age of weaning during the Middle Ages (Flandrin, 1976). It is even later that the maximum limit (22.5 to 34.5 months) of breast feeding proscribed by the *Borgathing* laws (Benedictow, 1985). It would seem that weaning was not chief among the myriad of LEH causal factors in medieval Scandinavia.

Of course an individual can exhibit a LEH on more than one tooth, and many do. Across all samples 24.9% of individuals have at least one maxillary LEH and 30.8% have at least one mandibular LEH. Multiple expressions of LEH affecting a number of teeth are considered as indications of severe systemic disturbances acting over a period of time, rather than acute stressors (Sciulli, 1978).

One-way ANOVA tests assessed statistically significant differences in LEH frequencies among samples. All samples differed significantly ($\alpha = .05$) from one another with the exception of a Oslo-Bergen-Viborg triad. (Fig. 2). The Trondheim sample is characterized by the highest LEH frequencies. Remarkably, given the general history of the Norse colonies, the Greenland samples show uniformly low frequencies. This may be an artifact of preservation (the Greenland samples are very fragmentary) or due to the nature of LEH formation. LEHs in this study represent adults who were exposed to childhood stressors and recovered. A low LEH frequency may represent either a low level of developmental stress or a high childhood mortality rate. Studies of LEH in deciduous dentition have found a relationship between hypoplastic frequency and relatively lower mean longevity; individuals with multiple LEH tended to die young (Cook and Buikstra, 1979; Goodman and Armelagos, 1988). Conversely, the comparatively high frequency of LEH in medieval Trondheim adults might be interpreted as a mark of survivorship and adaptation. That which does not kill you, makes you strong. Given this interpretation, the low frequencies from Greenland might indicate failure to survive long enough for LEH to form while high frequencies would indicate recovery and resumed growth.

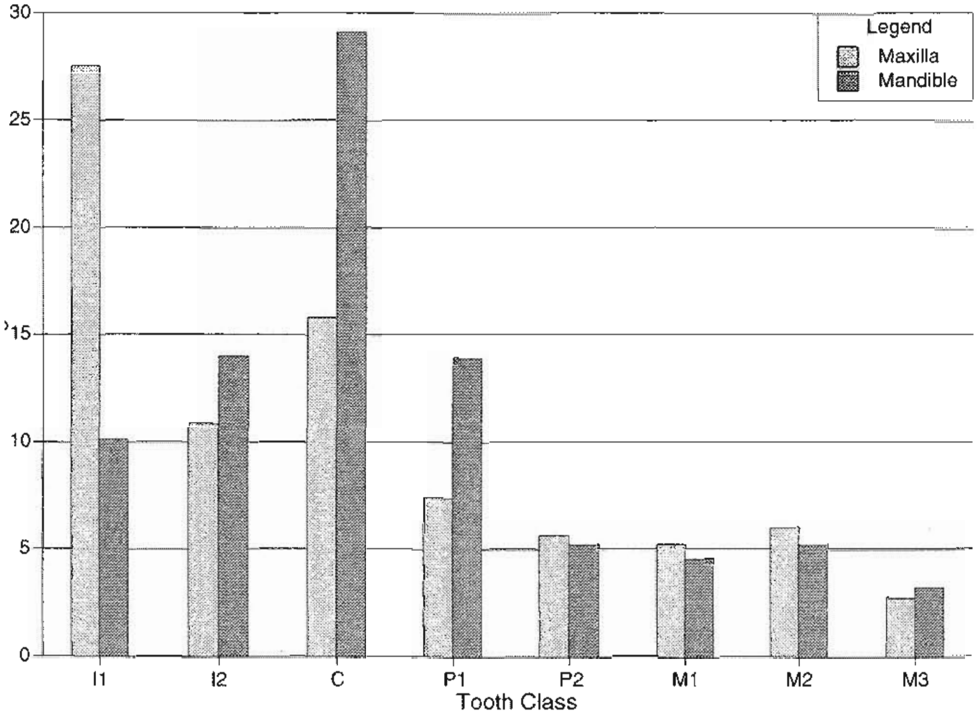

Fig. 3. Comparison of maxillary and mandibular LEH by tooth class.

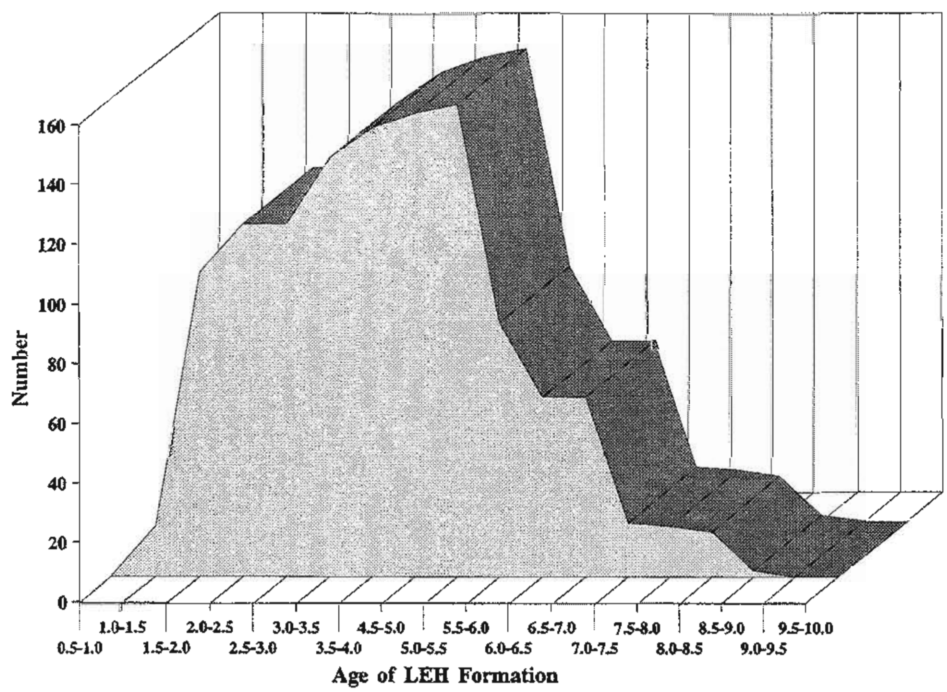

Fig. 4. Distribution of age for LEH formation.

Nonsignificant differences among the Oslo, Bergen, and Viborg samples need to be researched further. Possible areas to explore may be in the more southerly aspects of the three localities. Environmental factors such as resource availability, climate, or resource utilization may play a role in LEH frequency. Genetic factors may also be important. Previous research has shown Oslo and Viborg to be virtually indistinguishable based on craniometrics (Hanson, 1986). Or the answer may lie in cultural practices, such as nursing and weaning (Benedictow, 1985). All three localities are known to have been more influenced by continental Europe than the more remote areas of Scandinavia.

SUMMARY

Comparing and contrasting LEH frequencies in medieval Scandinavian samples revealed: 1) antimeres did not differ significantly in LEH frequency; 2) males and females did not significantly differ in LEH frequency; 3) the maxillary central incisor and mandibular canine were the most common sites of LEH; 4) between 24.9% and 30.8% of the samples have at least one LEH; peak LEH formation occurs between 4.5 and 5.5 years of age; 5) all samples were statistically different from one another except for a Bergen-Oslo-Viborg triad; 6) Trondheim had the highest overall frequencies of LEH and Greenland had the lowest of those in the study.

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DENTAL ANTHROPOLOGY ASSOCIATION SECTION

NEWS OF DENTAL ANTHROPOLOGY ASSOCIATION MEMBERS

Donald Johanson (Institute of Human Origins) will move the institute and its associates to Arizona State University, according to an agreement with the Arizona Board of Regents. An update will follow in the next issue. **Alan Mann** (University of Pennsylvania) was honored with the College Alumni Society Outstanding Teaching Award at Pennsylvania. **Phillip Tobias** (University of the Witwatersrand) received the Charles Darwin Lifetime Achievement Award from the American Association of Physical Anthropologists at its annual meeting in April.

MINUTES FROM THE 1997 TWELFTH ANNUAL MEETING OF THE DENTAL ANTHROPOLOGY ASSOCIATION, ST. LOUIS, MISSOURI, APRIL 3, 1997

I. **PRESIDENTIAL ADDRESS** (Phil Walker):

The meeting is called to order at 7:35 p.m. Phil Walker calls for the secretary-treasurer's report.

II. **REPORT OF THE SECRETARY-TREASURER** (Shara E. Bailey)

A. **Status of the Treasury** As of April 18, 1997 the Dental Anthropology Association's net assets are $3,634.57 compared to $2,736.84 one year ago. This balance reflects the dues increase for 1997 as well as the fact that we no longer send newsletters to foreign members who are overdue.

Publishing the winter issue of the DAN cost the DAA $601.51 (32 pages) - an increase of 16% over last winter's issue. The Arizona State University Anthropology Department provides bulk mailing for U.S. members. Foreign postage for the winter issue, however, cost the DAA $141.59.

The estimated annual expenses incurred by the DAA can be broken down as follows: $2,395. for newsletter publication, $575.00 for postage, $300.00 for telephone, and $125.00 for VISA/MC account maintenance. As of April 18, 1997, 44 members have taken advantage of being able to use their credit card to pay membership fees.

B. **Membership Status** As of April 1, 1997 the DAA has 313 members. This number is down 11 from one year ago. During the past year we acquired 47 new members, but were forced to drop 58 for non-payment. Eighteen of our new members were from overseas and 29 were from the US. Six new members came to us via our WEB site: three were from the US and three were from overseas.

One hundred ninety-seven members are from the US and 116 members are from foreign countries. Currently ninety-five regular and student members (78 from US, 14 from foreign countries) or 30% are past due for 1996. The DAA Office continues to contact overdue members in an effort to collect fees rather than drop members. Since last April members have donated $82 to the DAA Foreign Membership Fund. Special thanks go to those who donated to this fund that sponsors foreign members who are unable to pay their own membership fees.

III. **REPORT OF THE NEWSLETTER EDITOR** (A.M. Haeussler)

A. **Peer Reviews** The executive board has decided to send articles out for peer review before publishing them.

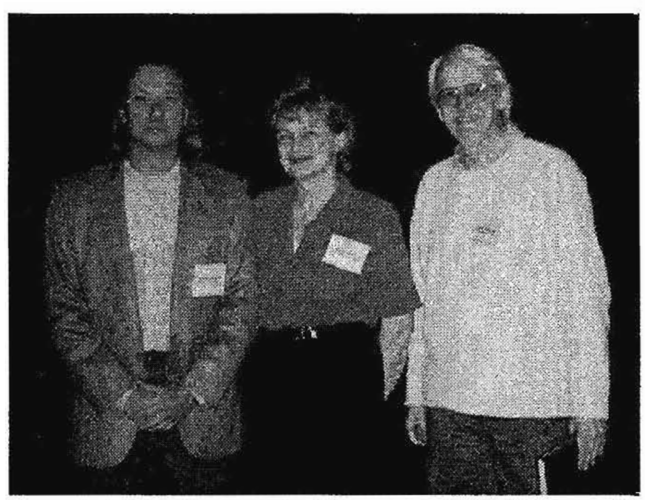
B. **Editorial Board** It was decided to make the editorial board a rotating one, with appointments lasting for five years. Members may be re-elected to the editorial board if they wish to serve additional terms.

C. **Current Publications** A request was made for volunteers to put together the Current Publication section.

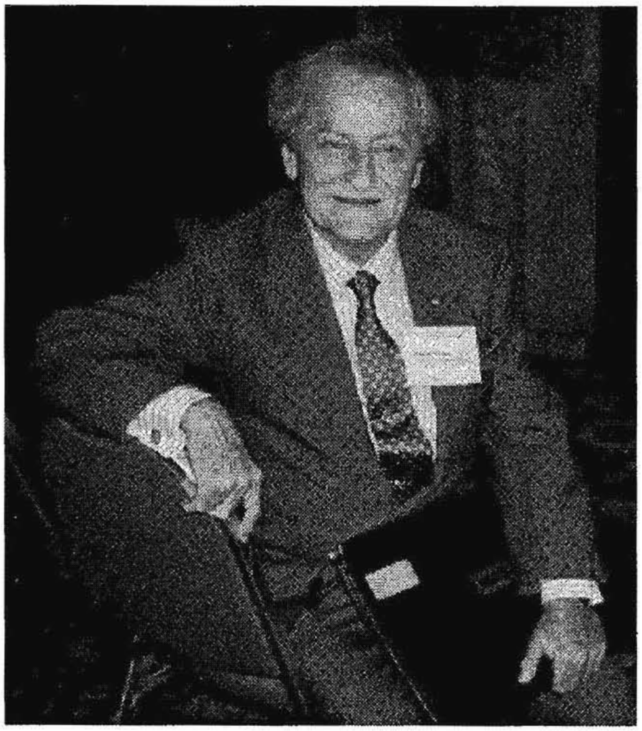
D. **Changing the Name of the DAN** The suggestion was made to change the name of the Dental Anthropology Newsletter to "Dental Anthropology." The feeling is that this will add prestige to the newsletter and perhaps widen our membership base. P. Tobias motioned to change the name. C.L. Brace seconded the motion. A vote was taken and passed unanimously. A.M. Haeussler agreed to looking into registering the Dental Anthropology name and getting an ISBN # for the publication.

IV. **NEW BUSINESS**

A. **Computer purchase** During the executive meeting of the DAA the out-going secretary-treasurer (Shara E. Bailey) suggested that the Dental Anthropology Association should have a computer. Phil Walker introduced the prospect of acquiring a computer for the DAA. A request for donations was made with no immediate offers. However, the suggestion was made that an "exchange section" in the back of the newsletter be set up for equipment donations. It was



From left right, Stephen C. Reichardt (newly elected DAA secretary-treasurer), Ebba During, and John Mayhall (DAA president-elect) at the DAA business meeting. Photograph by Scott E. Burnett.



Phillip Tobias at the DAA business meeting on April 3, 1997. The following night Tobias was awarded the Darwin Lifetime Achievement Award by the American Association of Physical Anthropologists. Photograph by Scott E. Burnett.

decided that the DAA will purchase a refurbished computer system for its exclusive use.

B. **Student Award for Dental Anthropology Paper** Phil Walker suggested that an award be given at the annual AAPA meetings for the best student-submitted paper in dental anthropology. He suggested the name "Albert A. Dahlberg Award". All members supported this idea. Walker suggested that the DAA take contributions from members specifically for this award and offered to donate $100 himself. Phillip Tobias suggested we consult with Mrs. Dahlberg before naming the award. A general consensus was reached by all members to establish a fund for the award and to start the process.

A discussion then ensued regarding who would referee student papers: our executive committee or the official AAPA committee. The general consensus was that the decision should be up to the DAA not the AAPA.

C. **Election of a new Secretary-Treasurer** Stephen Reichardt was nominated to serve as the next secretary-treasurer for the DAA. A motion was made and then seconded to close nominations. A vote was taken by show of hands, thus Stephen Reichardt became the new Secretary-Treasurer, replacing outgoing Secretary-Treasurer, Shara E. Bailey.

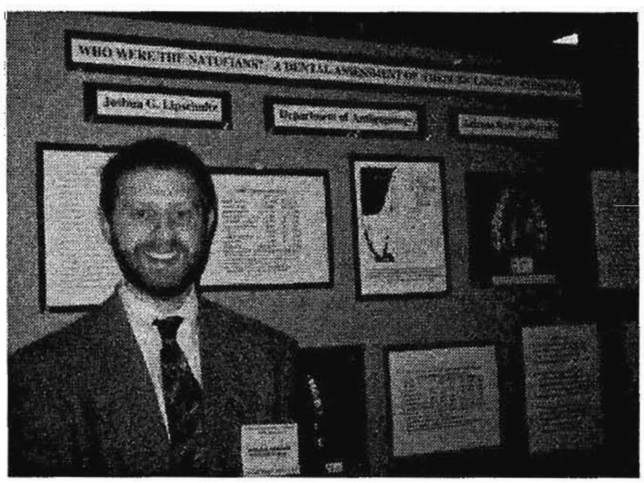
D. **Changing the DAA Name and Logo**: A suggestion was made to change the DAA logo in order to give the journal a new face to go with its new name. This was greeted with a positive response by all members and it was agreed that Phil Walker would be in charge of the new logo design.

V. **WEB News** Recognition and thanks were given to Phil Walker for getting the Dental Anthropology Association on-line. Phil announced plans to expand image archives on-line for members' use.

VI. **ALL OTHER NEWS - ANNOUNCEMENTS**

A. **Charles R. Darwin Lifetime Achievement Award** Phillip Tobias was congratulated for his selection to receive this prestigious award.

B. **Human Ecology/Dental Morphology Meetings** John Mayhall announced that there will be a Human Ecology meeting held in Adelaide, Australia in December, 1997. There will be a large section on dental anthropology at this meeting. The next Dental Morphology Symposium will be held in Finland August, 1998. Members should let John know if they are interested in either meeting.



Joshua G. Lipschultz with his poster on Nubian dental morphology. An enhanced textual version of the poster begins on page 4. Photograph by Scott E. Burnett.

C. **Conference in South Africa** Phillip Tobias announced that he is organizing a conference on human paleontology/human biology to be held in South Africa in 1998. Eighteen colloquia are planned and flyers were available at the business meeting.

The Twelfth Annual Dental Anthropology Association Business Meeting adjourned at 8:30 p.m.

Respectfully submitted,
Shara E. Bailey

PUBLICATIONS

DENTAL ANTHROPOLOGY NEWSLETTER

During the past year 18 articles appeared in the *DENTAL ANTHROPOLOGY NEWSLETTER*. Of these, three were president's reports; 13 were articles; and two were book reviews. The 24 authors represent five countries. Topics of articles included morphological variation, hypoplasia, dental development standards, tooth wear, bite marks, dental bridges, and enamel crystals. The editor is grateful to the authors, to the editorial board members for their assistance, and to the secretary-treasurer for labels and an up-to-date membership list.

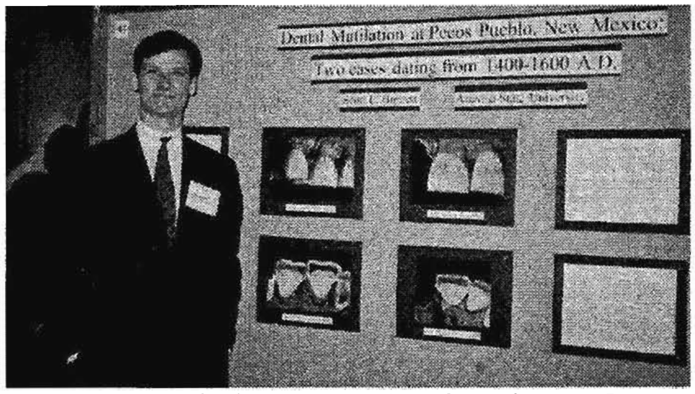
DENTAL ANTHROPOLOGY

Beginning with this issue, the publication of the Dental Anthropology Association is named *DENTAL ANTHROPOLOGY*. A few policies will also change. Beginning with this issue manuscripts are reviewed by members of the editorial board. The editorial board will rotate, with members serving five year terms. The *DENTAL ANTHROPOLOGY* editor is presently exploring a copyright and an ISSN number.

GUIDELINES FOR CONTRIBUTORS

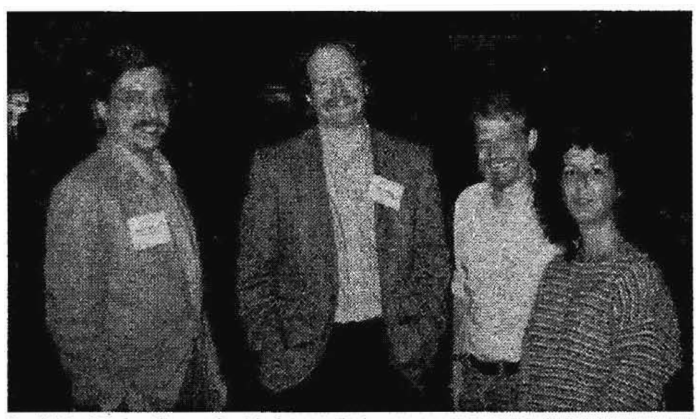
DENTAL ANTHROPOLOGY will use the following guidelines during the upcoming year.

1. Articles will have short abstracts. Text format, citation, and abbreviation styles will follow those used by *American Journal of Physical Anthropology*. However, names of journals that are not familiar to readers should be spelled out. The feature, *Recent Publications*, will contain unabbreviated citations.
2. Illustrations and photographs enhance articles and are encouraged. They will be returned, if the authors so request. Graphs should be accompanied by a table containing the data, even if the table is not to be published. In that way, the editor can construct a new graph if the one submitted presents problems in formatting.
3. Two copies of each manuscript should be submitted. The second copies of illustrations can be photocopies. Contributors are also asked to send a copy of the manuscript on diskette, if possible The newsletter uses IBM© format and *Word Perfect* 6.1©.
4. Deadlines for manuscripts and membership lists for the next issues are August 15, November 15, and March 15. Manuscripts and membership lists received after these dates will be considered for future issues.



Scott E. Burnett with his poster on Dental Mutilation at Pecos Pueblo. Photograph by Joshua G. Lipschultz.

Annalisa Alvrus at the Paleopathology Association meeting, which was held prior to the meeting of the American Association of Physical Anthropology. Alvrus' poster dealt with trauma to the teeth and jaws in three Nubian samples. Photograph by A.M. Haeussler.



Joel D. Irish, Greg C. Nelson, Brian E Hemphill (DAA executive committee member), and Jaymie Brauer after the DAA business meeting. Photograph by Scott E. Burnett.

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