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Dental Morphology and Pathology of Middle Bronze Age Populations in Israel: Sasa and Jebel Qa'aqir

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Introduction

Tooth size and morphology are genetically determined and except for the third molar, their development is completed in early childhood (Moorrees, Fanning and Hunt 1963). This means that tooth form is more influenced by genetic than by environmental factors. For this reason tooth size and morphometric traits of the teeth have been extensively used to identify and distinguish between populations (Garn, Lewis and Kerewsky 1967; Rosenzweig 1970; Rosenzweig and Smith 1971, Sofaer et al. 1972; Smith 1977; Sofaer, Smith and Kaye 1986). They have been studied here to assess genetic affinities between the Middle Bronze Age II (MB II) population of Sasa and Middle Bronze Age I (MB I) populations, represented here by skeletal remains from Jebel Qa'aqir. For the context of the Sasa sample, see Ben-Arieh, this volume, Tomb 1 and Smith, this volume; for Jebel Qa'aqir, see Smith 1982.

In addition to their importance as genetic markers, the teeth are also valuable indicators of diet and methods of food preparation, as there is a high correlation between food and eating habits, and certain dental pathologies (Brothwell 1959). Abrasion reflects the physical content of the diet and, for example, has been shown to differ between nomadic hunters/gatherers and early agriculturists (Smith 1972; 1989a; 1989b). Primitive methods of grinding flour, using querns and mortars, result in the inclusion of silica from stalks and husks as well as grit from the mortars and querns into the flour. This, like ash or dirt adhering to baked foods, adds abrasives to the food ingested and causes severe abrasion (Smith, Bar-Yosef and Sillen 1984; Smith and Kolska-Horwitz 1998). Boiled and stewed cereals contain sticky carbohydrates, which form plaque and calculus. Such soft and retentive food has been shown to cause more periodontal disease than hard food (Pennel and Keagle 1977), as well as dental caries in the presence of bacteria. Hypoplastic tooth structure results from malnutrition or infections in infancy and early childhood and provides additional information on environmental stress during life (Brothwell 1959; Smith and Peretz 1986).

Materials and Methods

Teeth in jaws of 20 individuals aged 7–60 years from Sasa, and 30 individuals aged 7–60 years from Jebel Qa'aqir were compared with respect to the following:

Morphology: crown size, presence of shoveling, cusp arrangement in molars, presence of protostylid (in mandibular molars), paramolar cusps, oblique ridge, Carabelli's cusp, and parastyle and metastyle (in maxillary molars).

Pathology: presence of hypoplasia, periodontal disease, calculus, abscesses, caries and abrasion.

Missing teeth, and damaged or abraded teeth limited the various types of observations that could be made. For this reason measurements of teeth from individuals of both sexes were pooled.

Findings

Morphology

Tooth loss and severe abrasion in the teeth of older individuals limited the number of

observations that could be made. Mean values for tooth size tended to be larger at Sasa than at Jebel Qa'aqir, and the differences were statistically significant for 5 teeth in the maxilla and one tooth in the mandible (Table 1). Most of the differences were present in buccolingual diameters of the teeth and are unlikely to be related to possible differences in abrasion which rapidly reduces mesiodistal diameters. Morphological traits could be scored for relatively few teeth. Thus, although differences were found in trait frequencies, sample sizes

Table 1. Tooth Size at Sasa and Jebel Qa'aqir

		Sasa			Jebel Qa'aqir		
Tooth		N	Mean	SD	N	Mean	SD
11	MD	8	5.6	0.3	3	5.9	0.2
	BL	9	6.4	0.5	8	5.7	0.4
12	MD	14	6.0	0.5	6	5.7	0.7
	BL	20	6.7	0.8	11	6.0	0.3
C	MD	18	6.6	0.3	9	6.7	0.3
	BL	21	7.8	0.6	16	7.4	0.4
PM1	MD	16	6.8	0.4	13	6.8	0.4
	BL	19	7.7	0.2	17	7.2	0.5
PM2	MD	8	7.0	0.4	10	7.0	0.2
	BL	10	8.0	0.4	12	7.9	0.4
M1	MD	11	11.6	0.4	21	10.9	0.6
	BL	16	10.8	0.5	25	10.3	0.8
M2	MD	13	10.8	0.4	19	10.8	0.7
	BL	18	10.1	0.6	24	10.0	0.5
M3	MD	7	10.8	0.5	7	10.4	0.7
	BL	7	10.0	0.6	9	9.5	0.2
Maxilla							
11	MD	6	8.4	0.5	3	8.5	0.5
	BL	10	7.3	0.7	7	7.1	0.4
12	MD	8	6.3	0.5	3	6.5	0.1
	BL	9	6.9	0.4	3	6.3	0.2
C	MD	15	7.5	0.5	7	7.4	0.3
	BL	17	8.4	0.8	7	8.2	0.5
PM1	MD	5	6.8	0.6	4	6.5	0.4
	BL	11	9.0	0.5	4	8.9	0.5
PM2	MD	8	6.9	0.6	6	7.0	0.1
	BL	12	9.0	0.3	8	9.0	0.5
M1	MD	14	10.5	0.4	10	10.1	0.7
	BL	19	11.4	0.5	12	11.2	0.5
M2	MD	9	9.5	0.3	7	9.1	0.8
	BL	15	11.6	0.5	8	11.0	0.8
M3	MD	6	9.0	0.5	2	8.6	0.1
	BL	7	11.2	0.3	3	10.0	0.6

MD = mesiodistal; BL = buccolingual; N = number of teeth;
Mean = mean dimension in mm; SD = standard deviation

were too small for assessing the significance of the differences observed. Shoveling was present at lower frequencies at Sasa than at Jebel Qa'aqir (28%:55% in canines and 8%: 15.8% in lateral incisors); Carabelli's cusp was present at lower frequencies in upper first molars at Sasa than at Jebel Qa'aqir (25%: 46%). In both samples four-cusped lower first molars were found. There were no protostylids or paramolar cusps, although the upper first molars had four cusps, with no metacone or hypocone reduction.

Pathology

The percentages of individuals with various pathologies are shown in Table 2. Hypoplasia affected 91% of all individuals at Sasa and 59% at Jebel Qa'aqir, with canines the most frequently affected in both populations. Evaluation of the location of hypoplastic defects revealed that whereas both populations showed signs of hypoplasia in the cervical areas of the teeth, many teeth at Sasa also had hypoplastic lesions in the middle portions of the teeth. As the midportion of enamel forms before the cervical enamel, this suggests that an earlier onset of stresses affected development of teeth in infants from Sasa than in infants at Jebel Qa'aqir.

Abrasion extending into dentine, often with secondary dentine or exposure of the dental pulp, was more common at Jebel Qa'aqir. Periodontal disease and *ante mortem* tooth loss of molars were more prevalent at Sasa.

DISCUSSION

Both tooth form and pathology at Sasa differ from that seen at Jebel Qa'aqir. In terms of microevolution we would expect teeth at Sasa to be either the same size or smaller than those of the earlier population of Jebel Qa'aqir. In fact, teeth at Sasa were larger, despite the increased frequency of hypoplasia present there. Hypoplasia reflects environmental stress during the period of dental development and tends to reduce final tooth size. The association of larger teeth with more hypoplasia in the sample from Sasa, points to genetic differences between the two samples studied. Differences were pronounced in the buccolingual diameter of the teeth, which is relatively unaffected by abrasion. This supports the hypothesis of different ancestry.

Abrasion was less severe at Sasa than at Jebel Qa'aqir, although calculus and periodontal disease were more prevalent. All three conditions are age related and discrepancies in the pattern and severity of dental disease suggest differences in food sources and/or its preparation. The presence of more periodontal disease with less abrasion in Sasa suggests that the inhabitants of Sasa had a softer diet, with more boiled foods than did the population of Jebel Qa'aqir. The high *ante mortem* loss of teeth found at Jebel Qa'aqir was associated with abscesses and severe abrasion of the remaining teeth. This suggests that pulp exposure, resulting from severe abrasion and followed by

Table 2. Percentage of Individuals with Dental Pathology at Sasa and Jebel Qa'aqir

Site	Hypoplasia	Abrasion*	Periodontal Disease	Abscess**	Caries	*Ante mortem* Tooth Loss**
Sasa (N = 20)	91	43	60	14	38	35
Jebel Qa'aqir (N = 30)	59	56	40	18	43	25

* Abrasion into dentine
** Based on M1 only
N = number of individuals

abscessing and bone loss, was the main cause of tooth loss in this group. It is suggestive of an abrasive diet, with baking, rather than boiling, the favored method of cooking. At Sasa, on the other hand, *ante mortem* loss was found in individuals with little abrasion of the surviving teeth, which indicates tooth loss from caries or periodontal disease.

The higher prevalence and greater severity of hypoplasia in Sasa points toward chronic malnutrition or severe infections which interfere with the normal development of the teeth. Interestingly, no hypoplastic lesions were found in the incisal portion of the teeth, the earliest portion of the tooth to be fully calcified. This suggests that in the first months of life, infants, who were normally breast fed, were largely protected from disease. The earlier onset of hypoplasia at Sasa, shown by the presence of hypoplastic defects in the middle third of the teeth, may suggest an earlier age for weaning infants in Sasa. The differences observed in patterns of dental disease in the two samples strongly support the hypothesis of different nutritional habits at Jebel Qa'aqir and Sasa.

This paper has not addressed the issue of how representative the dental morphology and pathology found at Jebel Qa'aqir and Sasa are of MB I and MB II populations in Canaan in general. It does, however, corroborate the archaeological evidence for significant differences between the two periods in dietary adaptations.

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