Analysis of possible factors influencing the occurrence of occlusal tooth wear in a young Saudi population

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The purpose of this study was to attempt to correlate possible etiologic factors with the occurrence of occlusal tooth wear in a young Saudi population. The material comprised 90 individuals with a mean age of 22 years within a range of 19–25 years. A dentition wear index, in addition to anterior and posterior wear subindices were derived from tooth-by-tooth evaluations of casts. Factors found to correlate significantly with increased occlusal wear were bruxism, biting habits such as pen- and nail-biting, use of an indigenous chewing-stick called *miswak*, and high intake of fruit juices. There was no correlation between subjects from differing geographic and/or climatic habitats and the severity of tooth wear. The common element of a harsh desert terrain may constitute the dominant passive abrasive etiologic factor in the present sample. □ *Attrition; etiology of tooth wear; wear index*

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The subject of occlusal tooth wear has received considerable attention in the literature (1–8). Studies on its occurrence and severity have been conducted on both skeletal material and human subjects (4–6, 9, 10). In the latter category, primitive and contemporary human populations show differing severities of occlusal tooth wear (3), and this has prompted some authors to speculate on the possible influences of dietary, occupational, and environmental factors on tooth wear (1).

A possible corroboration for the supposed correlation between harsh living conditions and severe tooth wear is the evidence that contemporary and urban Australian aborigines have less wear than their rural counterparts (7). There would, therefore, seem to be a basis for the observation that, even in dry, sandy environments, the severity of tooth wear decreases with urbanization and/or 'cultural development' (11).

In a recent report we (8) studied the prevalence and severity of occlusal tooth wear among a selected young Saudi population. Using a scoring method modified from one used in a similar study on a Swedish population (5), we found the severity in occlusal tooth wear to exceed significantly that which was found in similarly aged Western populations (6, 12–14).

Given the contemporary and urban nature, yet desert environmental conditions, of the sample reported (8), the causes of occlusal wear remain unclear. While numerous efforts have been made to implicate various factors in the etiology of tooth wear (5, 7, 12, 15–25), the evidence in the literature is inconclusive. Furthermore, the multifactorial character of occlusal tooth wear and those etiologic factors, and combinations thereof, which may contribute to the wear experienced by a given individual remain difficult to identify (5, 6). The purpose of this study was therefore to investigate, by means of a tooth wear index and a questionnaire, the role of various possible factors in the occurrence, severity, and distribution of tooth wear in a young Saudi population.

Materials and methods

The sample comprised 90 dental students

with a mean age of 22 years (range, 19–25 years). There were 50 men and 40 women, with mean ages of 22.5 years and 21.5 years, respectively. A set of maxillary and mandibular study casts were obtained for each individual as part of a within-group clinical training exercise. Alginate impressions (Jeltrate, L.D. Caulk Co., Milford, Del., USA) in perforated metal stock trays (Stok Trays, Coe Laboratories Inc., Chicago, Ill., USA) were obtained for each student and poured in vacuum-mixed diestone (Die-Keen, Columbus Dental, St. Louis, Mo., USA). The quality of the casts was ensured, by repetition as necessary, for the attainment of a standard commensurate with a diagnostic mounting on a semi-adjustable articulator. A few teeth with complete occlusal restorations were excluded, as were third molars. As a result of exclusions and missing teeth, the mean number of teeth per individual to be examined for occlusal or incisal wear was 27.4, with a median of 27 teeth per individual and a range of 24–28.

Evaluation of wear was performed on a tooth-by-tooth basis using a modified ordinal scale (Table 1). The conditions of examiner calibration, the achievement of examiner concordance and method reliability have previously been described (8).

From the raw tooth-by-tooth data, medians, ranges, and standard deviations were calculated. Median data were derived for each tooth group—that is, incisors, canines, premolars, and molars for each arch. Similarly, a mean occlusal wear index was derived for each individual's dentition, as were segmental subindices for differing areas of the dentition—in the present case, anterior (including incisors and canines) and posterior (including premolars and molars) subindices. Differences between overall and segmental wear indices were tested with the Wilcoxon signed-rank test.

A questionnaire was designed to assess the role of various factors in the eitology of occlusal tooth wear. The derivation of those factors included in the questionnaire was based on clinical experience, a review of the literature, and a pilot analysis. In investigating the potential contributions of the various geographic, environmental, dietary, parafunctional, and habitual influences, an attempt was made to assign frequency, duration, and history with regard to each factor.

The wear indices, in their capacity to rank individuals by degree of wear, were used as a dependent variable to correlate factors associated with occlusal wear, using the Mann–Whitney U-test.

Table 1. Ordinal scale used for grading severity of occlusal wear

0	No visible wear facets in the enamel. Occlusal/incisal morphology intact
1	Marked wear facets in the enamel. Occlusal/incisal morphology altered
2	Wear into the dentin. Dentin exposed occlusally/incisally or another tooth surface. Occlusal/incisal morphology changed in shape with height reduction of the tooth
3	Extensive wear into the dentin. Large dentin area (>2 mm^2) exposed occlusally/incisally or another tooth surface. Occlusal/incisal morphology totally lost locally or generally. Substantial loss of crown height

Results

In the assessment of occlusal tooth wear, both examiners (A. Johansson and K. Fareed) achieved intra-examiner concordances of 89%, while inter-examiner concordance was 91%.

From the pooled data (Table 2) it was found that, in both arches, anterior teeth generally showed greater wear than did posterior teeth. An exception was the mandibular first molar, which had a median score of 2, similar to that for the incisor and canine groups. All other tooth groups had a median score of 1, corresponding to 'marked wear facets in the enamel', compared with the 'wear into dentin' for score 2. The mean dentition wear index and the subindices derived from anterior and posterior tooth groups are shown in Table 3. Statistical comparison of the anterior and posterior subindices showed a significantly higher value for the former ($p < 0.001$). The anterior subindex was also significantly higher than the dentition index ($p < 0.001$); the dentition index similarly showed a significantly higher value when compared with the posterior sub-

Table 2. Medians and ranges of occlusal wear scores for different tooth groups within the sample ($n = 90$)

	Maxilla				Mandible			
	Molars	Premolars	Canines	Incisors	Molars	Premolars	Canines	Incisors
Median	1	1	2	2	1	1	2	2
Range	1–3	0–3	1–3	0–3	1–3	0–3	0–2	0–3

index ($p < 0.001$), In comparing the occlusal wear in men and women there was no statistically significant difference between the mean occlusal wear index for men (1.40) and women (1.43); nor were there statistically significant differences in the anterior and posterior subindices between men and women.

In response to questions relating to periods of residence in differing climatic and geographic locations, most of the respondents ($n = 49$) had lived in Riyadh for longer than 10 years. Compared with the rest ($n = 41$), who had spent most of their lives in coastal, mountainous, humid, or cool environments, there was no difference in mean occlusal wear on the basis of geographic variations.

Table 4 lists the subjects' responses with regard to frequency of consumption of various dietary items included on the questionnaire. The daily consumption of carbonated cola drinks and frequent consumption of apples and fruit juices by a large number of the subjects is evident. In the case of fruit juices, an anterior tooth wear subindex of 1.81 was found in the group of daily consumers ($n = 16$), compared with a subindex of 1.58 of the nil consumption group ($p < 0.01$). Positive responses to questions on vomiting/acid regurgitation (21 subjects), dryness of the mouth (7 subjects), and the consumption of strictly vegetarian diets (8 subjects) showed no significant association with degree of wear.

Biting habits (for example, nail- or pen-biting) were reported by 49% of the sample investigated. Among the positive respondents, the mean anterior tooth wear subindex was 1.74, which was significantly higher than the 1.62 subindex mean in those who reported no biting habits ($p < 0.01$); there was similarly a difference between the dentition tooth wear indices for those with and without the habits ($p < 0.05$). However, there was no difference in the posterior subindices of these groups.

The use of *miswak*, a special wooden chewing-stick/toothbrush (26) was also reported. Subjects ($n = 7$) reporting daily *miswak* use showed a significantly higher anterior subindex than those ($n = 45$) who reported infrequent use ($p < 0.01$); with abstinence ($n = 38$), the anterior subindex was again significantly lower ($p < 0.05$).

Individuals who reported bruxism showed a significantly higher mean dentition wear index ($p < 0.001$) and anterior tooth wear subindex ($p < 0.01$) than those who did not (Table 5). No such difference between the posterior tooth wear subindices was found.

Thirty-eight individuals considered their

Table 3. Means, standard deviations (SD), and ranges of overall and segmental wear indices of the sample ($n = 90$)

	Dentition index (all teeth)	Anterior subindex (incisors/canines)	Posterior subindex (premolars/molars)
Means	1.41	1.68	1.21
SD	0.18	0.30	0.20
Range	0.96–1.93	0.42–2.17	0.93–2.13

Table 4. Dietary habits of the sample ($n = 90$)

Does your diet include?	Never	Several times weekly	Daily
Citrus fruits	12	51	21
Apples	17	64	8
Tomatoes	16	54	18
Grapes	28	54	2
Olives	29	48	10
Coke/Pepsi	9	31	50
Fruit juices	10	60	16
7-Up, etc.	45	35	9

Table 5. Differences in anterior, posterior, and overall indices for those reporting and not reporting bruxism

Do you suffer from bruxism?	n	Dentition index	Anterior subindex	Posterior subindex
No	66	1.38	1.64	1.18
Yes	24	1.52	1.80	1.30
		$p < 0.001$	$p < 0.01$	NS

teeth to be worn, and this was reflected in the higher, but not significantly so, mean dentition wear index of 1.47 for this group, compared with a mean of 1.37 for those who did not consider their teeth to be worn. Self-perception of tooth wear was also associated, but not significantly so, with a higher anterior wear subindex of 1.77, compared with a subindex of 1.61 for those who did not consider their teeth to be worn. Eight individuals subjectively related experiences of pain and esthetic and masticatory impairment to the presence of tooth wear.

Discussion

The applicability of the ordinal scale used in the study, over a wide range of degrees of wear, and its reliability, as shown by the good intra- and inter-examiner concordances achieved, give it considerable advantages over alternatives (6, 27). Having been obtained as part of a supervised student exercise, the casts showed high quality and facilitated sharp discrimination even between lower grades of wear. The inherent difficulty of discriminating early enamel wear has, however, previously been documented (6).

The use of a wear index was considered justified by the nature of the sample; the presence in the sample of full or near-full dentitions in young individuals reduced the possible errors that might have been introduced with a less homogeneous sample. Similarly, subindices may provide greater insight into the various etiologic factors and their effects.

The mean dentition wear index was 1.41 within a range of 0.96–1.93 for the present sample; this concurs with that of a larger previously reported group (8). It is considerably higher than that reported for similarly aged Western samples (6, 12–14). The distribution of wear in the dentition was not even, as is evidenced by the difference between the anterior and posterior subindices (Table 3). The significantly greater wear anteriorly than posteriorly, and anteriorly than overall, prompts speculation as to the roles of functional or parafunctional habits/patterns of mandibular movement, occlusal relationships and schemes, disclusive contacts, abrasive and erosive environmental factors, and the quality of natural teeth. Whereas no association could be found between occlusal wear and various occlusal factors in a recent report (12), it is noteworthy that the sample studied showed rather mild wear compared with that found in the present sample. Consequently, an overall mild and narrow range of the wear indices may have precluded the accurate evaluation of the possible role of the various etiologic factors' influence on wear. On the other hand, an association between bruxism and tooth wear has been reported (15). In the present study bruxism awareness was also associated with a significantly higher dentition wear index and anterior wear subindex than unawareness of bruxism (Table 5). There was, however, no association between the posterior wear subindex and bruxism awareness. Other habits, including nail- or pen-biting and use of the *miswak* chewing-stick, were similarly associated with a higher dentition wear index and anterior wear subindex; there was again no difference

in the posterior wear subindices for those with positive and negative responses to these habits, possibly because these habits generally take place in the anterior region. From the raw data, a pattern whereby individual teeth appeared to be representative of the overall index emerged. While not verified, such a trend may suggest the possibility that certain teeth are potential indicators for a tooth wear index. In a recent report (13) an abrasion index based on four selected teeth was described.

Besides the mechanical effects of the force, time, and type of occlusal contacts that may influence the initiation and progression of occlusal wear, chemical and abrasive factors can potentially modify the wear of teeth. With regard to the latter, ambient air pollutants and dietary variables comprised an important part of the questionnaire and subsequent analysis.

Notwithstanding the largely urbanized nature of the study population, the harshness of a desert climate and terrain presents an obvious difference from the conditions under which Western populations live. The significance of such a difference in ambient environmental conditions between the study sample and Western equivalents needed investigation since a fine particulate presence in the air could conceivably constitute an important passive etiologic factor in occlusal wear, by virtue of its abrasive nature (28). Whereas most in the sample were born and/or had lived in Riyadh for more than 10 years, since the age of 6 years, there was a proportion who had experienced the dry, dusty, and hot climatic conditions of Riyadh only since starting at the University, 3 years previously. Closer scrutiny showed that the non-Riyadh individuals were from varied geographic origins, coming mainly from hot and humid coastal cities such as Jeddah and Dammam, or cool, mountainous areas such as Asir. The absence of any correlation between the mean occlusal wear and habitat, while suggestive of a minimal role played by location, is inconclusive on the basis of the relatively small size and variation in habitats of the non-Riyadh sample component. Thus, geographic and climatic variations need not necessarily imply greatly altered passive influences on the occurrence of tooth wear; indeed, airborne particulate matter may constitute a similar presence—and thus abrasive influence—in both humid and dry atmospheric conditions, given the underlying desert terrain. However, such a contention requires further investigation. The finding among contemporary and urban Australian aborigines of less severe wear than among their rural counterparts (7) may provide the basis for a similar comparison to be carried out between urban and nomadic Saudis.

Analysis of the dietary aspect of the questionnaire gave an overall impression that consumption of possibly wear-related dietary factors was high as compared with that for similarly aged Western populations. Table 4 suggests, furthermore, the potentially erosive influence that may be associated with such a high level of consumption. This is confirmed by the positive correlation between higher anterior tooth wear and high intake of fruit juices. In contrast, no such significant correlation could be found between wear and the observed high intake of apples, tomatoes, citrus fruits, grapes, olives, and carbonated beverages. Although this finding may be indicative of a degree of unreliability in the respondents' behavior, it is also possible that the scoring method used is not absolutely discriminant of early erosive wear and that, consequently, such wear is underestimated. In support of the latter contention, fairly commonly reported vomiting, acid regurgitation, and dryness of the mouth produced no greater wear in the positive responders than in the negative responders.

In the present study the greatest degree of wear was found in the incisors and canines of both arches (Table 3). Such a distribution of occlusal wear in modern man differs from that found in primitive people or skeletal material from earlier periods, in which molar tooth wear predominates (8, 16). In accordance with the results found here, this tendency towards greater anterior than posterior wear is apparently compounded in the presence of certain etiologic factors. The relatively small, but significant, increases in mean wear associated with individual factors are suggestive of both the supplementary and cumulative nature of the numerous etiologic

influences. The relative contributions of each, however, remain unclear. Whereas a reasonable degree of homogeneity of the sample has been achieved, the problem of various influences, and reactions thereto, is enormous. It is unlikely that a single approach can provide a completely satisfactory answer.

Although the complementary nature of the various contributory factors is similarly unclear, the role of saliva may be important (5, 18, 30). To what extent salivary composition plays an aggravating or protective role is a question that requires further investigation. Whereas other workers investigating Western populations (5, 6) have reported the slow progression of occlusal or incisal wear, the high degree of tooth wear associated with a relatively low mean age and narrow age range of the subjects investigated in the present study and the statistically significant association of wear with certain highly prevalent etiologic factors suggest a potentially more rapid progression in the present sample. This being so, the future therapeutic implications in such a population may be significant.

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