Differences in functional variables, fillings, and tooth wear in two groups of 19-year-old individuals

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Fifty-one individuals (28 girls and 23 boys) who had received orthodontic treatment were compared with 47 subjects (19 girls and 28 boys) without such treatment as to maximal mandibular mobility, chewing muscle tenderness, morphologic occlusion, occlusal/incisal state, and degree of tooth wear. All were 19 years old. There were no statistically significant differences between the groups except for the number of teeth present and maximal mouth opening, which were both smallest in those who had received treatment. The first finding is evident, extraction of premolars being an accepted mode of orthodontic treatment. The reduced mouth opening capacity was related to an increased number of individuals with four or more palpably tender muscle sites in that group of individuals. □ *Clinical study; function; muscle tenderness; occlusion; orthodontics; temporomandibular joint*

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Maximal mandibular mobility has long been studied (for a review, see Ref. 1), and recording of maximum mobility of the mandible is considered imperative in the evaluation of jaw function (2). Maximum jaw opening capacity has been accepted as being smaller in women than in men, but Pullinger et al. (3) have stated that when adjusted for body size, these values become more equal.

The effects on jaw function of introducing interferences in the occlusion have clearly been demonstrated (4–6). Kampe (7) has claimed that dental restorations are responsible for the development of signs and symptoms of mandibular dysfunction. Otherwise, the literature offers only sparse information about possible muscular and dental consequences of any particular form of dental treatment. Dahl et al. (8) reported the functional state in accordance with Helkimo's indices in a group of orthodontically treated and a group of orthodontically untreated individuals 19 years of age. Although subjects who had not received orthodontic treatment reported most subjective complaints, there were no substantial differences as to signs and symptoms of craniomandibular disorders between the groups. The aim of the present study was to compare findings concerning maximal mandibular mobility, chewing muscle tenderness, morphologic occlusion, occlusal/incisal state, and degree of tooth wear in the same two groups.

Subjects and methods

The individuals in this study comprised 28 girls and 23 boys (group A) who had received orthodontic treatment and 19 girls and 28 boys (group B) who had not (8). In addition to answering a questionnaire concerning the functional state of their masticatory system, palpation of jaw muscles and temporomandibular joints was carried out, and measurements of interincisal distance, vertical overbite, overjet, laterotrusion to both sides, protrusion, and retrusion were done (9). The body height was also recorded.

Muscle tenderness was registered by a physiotherapist specially trained in the palpation of chewing muscles. The patient reaction was not graded; either the muscle was tender or it was not. The following sites were

palpated: anterior and posterior parts and the insertion of the temporal muscles, superficial and deep parts of the masseters, medial and lateral pterygoids, and anterior and posterior digastrics.

The morphologic occlusion was registered by an orthodontist in accordance with criteria defined by Lundström (10). The occlusions were classified as good or as malocclusions in accordance with Angle. Slight deviations from the ideal such as small rotations and space deficiencies smaller than 2 mm were accepted as good occlusions. The number of teeth present and the number of teeth in contact in the intercuspal position were assessed by clinical inspection.

Registration of the occlusal/incisal state and of the degree of tooth wear was carried out as described by Øilo et al. (11). This rating system comprises three categories of satisfactory degree of wear: Romeo (R), representing no wear; Sierra (S); and Mike (M); and two categories in which the degree of wear is not acceptable—that is, Tango (T) and Victor (V)—all except R containing subgroups. The subgroups recorded in this study were SOF: occlusal or incisal wear facets in the enamel; SDF: small areas of exposed dentin without change of hardness or sensitivity, and MLR: obvious length reduction of tooth.

Statistics

The data were processed in an IBM personal computer, using the SPSS/PC+ program. Statistical calculations of differences were performed by means of Student's t test or the chi-square test (occlusal/incisal state and degree of tooth wear). Level of significance has been given in each case.

Results

Mandibular mobility and number of teeth

There was a statistically significant difference in interincisal distance (girls, 49.0 mm; boys, 52.4 mm; $p < 0.02$) and in maximum jaw opening (girls, 52.2 mm; boys, 55.9 mm; $p < 0.01$) between girls and boys in general, the girls presenting with the lowest values.

When the two groups were compared (Table 1), there was a statistically significant difference in the following variables: interincisal distance (group A, 48.5 mm; group B, 53.2 mm; $p < 0.002$), maximum jaw opening (group A, 51.9 mm; group B, 56.2 mm; $p < 0.008$), and number of teeth present (group A, 27.2; group B, 29.0; $p < 0.001$). This was also the case when comparing girls in group A with girls in group B, although the figures were different (interincisal distance: group A, 47.0 mm; group B, 51.9 mm; $p < 0.007$; maximum jaw opening: group A, 50.3 mm; group B, 54.6 mm; $p < 0.04$; number of teeth: group A, 27.1; group B, 28.6; $p < 0.005$). No statistically significant differences in variables were found when comparing treated boys versus treated girls and untreated boys versus untreated girls. When treated boys were compared with untreated boys, there was a statistically significant difference in the number of teeth present ($p < 0.001$).

The differences in vertical overbite, overjet, laterotrusion to both sides, protrusion, retrusion, and number of occluding teeth were not statistically significant either with regard to sex or group.

The average body height was 173.0 cm in group A and 174.1 cm in group B. The difference was not statistically significant.

Muscle tenderness

There were no statistically significant differences in the number of palpably tender muscle sites between the two groups. When considering the whole patient material, 50 individuals had no palpably tender chewing muscles at all, whereas 48 had one or more tender palpation sites. Of these, 20 had 4 or more tender sites, and of these again, 13 belonged to group A and 7 to group B—that is, almost twice as many of those who had received orthodontic treatment had 4 or more palpably tender chewing muscle sites as compared with those who had not received such treatment. The mean maximum opening capacity of these 20 individuals was smaller (50.0 mm in group A and 55.0 mm

Table 1. Maximal mandibular movements (mm) and number of teeth and occluding teeth in both groups

	Group A			Group B		
	Female	Male	Female and male	Female	Male	Female and male
Interincisal opening	47.0	50.4	48.5	51.9	54.0	53.2
Vertical overbite	3.3	3.7	3.4	2.7	3.1	3.0
Overjet	3.2	3.5	3.5	2.7	2.7	2.8
Maximum opening	50.3	54.1	51.9	54.6	57.1	56.2
Laterotrusion right	9.9	9.9	9.9	10.7	10.4	10.5
Laterotrusion left	10.8	10.1	10.5	10.4	11.0	10.7
Protrusion	9.2	9.7	9.4	9.6	10.1	9.9
Retrusion	0.5	0.2	0.4	0.4	0.4	0.4
No. of teeth	27.1	27.3	27.2	28.6	29.2	29.0
No. of occluding teeth	22.6	22.7	22.6	24.7	24.1	24.4

in group B) than the group means (51.9 mm in group A and 56.2 mm in group B). The number of individuals with four or more tender muscle sites was so small and the range of measurements so large that statistical computation was considered unwarranted.

Morphologic occlusion

The percentage distribution of the morphologic occlusion score is presented in Table 2. The differences between the two groups are statistically significant ($p < 0.006$). When the various morphologic occlusions are related to Helkimo's indices (12), only good occlusion was significantly related to any of them—that is, to the clinical dysfunction index. Those with good occlusion in group A had significantly lower values than those in group B ($p < 0.02$).

Occlusal/incisal state

The state of the occlusal/incisal surfaces of the two groups is presented in Table 3. None of the subjects had incisal amalgam fillings in canines or incisors. No canines had tooth-colored fillings either. More lower premolars had received tooth-colored fillings than had the upper ones. In total, upper premolars had received more fillings than lower ones. There were no statistically significant differences between the percentage distribution of the following variables in the two groups: missing teeth, teeth without fillings, teeth filled with amalgam, or teeth filled with tooth-colored material, except with regard to missing teeth, for which group A displayed more missing premolars than group B: 19.7% and 2.1%, respectively, in the upper jaw and 13.2% and 2.1%, respectively, in the lower jaw ($p < 0.001$).

Table 2. Percentage distribution of morphologic occlusion score in both groups

	Group A	Group B
Good occlusion	67.2	31.9
Angle class I	11.8	29.8
Angle class II	25.5	31.9
Angle class III	0	6.4

Tooth wear

The percentage distribution of the various criteria for tooth wear in the two groups is presented in Table 4. In both groups most teeth were classified as SOF—that is, occlusal or incisal wear facets in enamel or filling material. There were no statistically significant differences between the two groups for any of the wear categories recorded. Obvious length reduction of teeth (MLR) was found for the incisors of both groups and for the canines of group A only.

Discussion

The composition of the material has been discussed previously (8). Although the

Table 3. Percentage distribution of occlusal/incisal state (U = upper jaw; L = lower jaw)

		Molars		Premolars		Canines		Incisors	
		Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B
Teeth missing	U	0	2.1	19.7	2.1	0	2.0	1.0	2.6
	L	0	1.0	13.2	2.1	0	2.1	0	2.1
Teeth without filling	U	38.2	42.0	60.4	71.8	100	98.0	94.6	95.9
	L	38.7	39.4	78.0	86.2	100	97.9	100	97.9
Teeth with amalgam filling	U	60.8	52.2	19.6	26.1	0	0	0	0
	L	59.8	58.0	0	0.5	0	0	0	0
Teeth with tooth-colored filling	U	1.0	3.7	0.3	0	0	0	4.4	1.5
	L	1.5	1.6	8.8	11.2	0	0	0	0

material is not composed in a strictly unassailable scientific manner, comparison of the various findings should be allowed.

When the two groups are considered as a whole, maximum mandibular mobility figures were in the range reported earlier (1, 13–15). In the present study a statistically significant difference between the sexes was also displayed. However, no adjustments for body size were made, as suggested by Pullinger et al. (3).

There were significantly higher values for interincisal distance and maximum jaw opening in group B than in group A. This was a rather surprising finding, which seems difficult to explain, there being no statistically significant differences between the sexes in either group. As reported previously (8), there was no statistically significant difference in clinical dysfunction index between the two groups either. None of the participants complained about subjective symptoms of craniomandibular disorders, but more anamnestic symptoms were reported by group B than by group A. It is difficult to single out any one factor causing reduced jaw opening capacity in this material except the closing musculature, which in some cases was tender or painful. In Helkimo's clinical dysfunction index (12) the criterion 'four or more tender palpation sites' gives a score of 5, which is the most severe. In our material almost twice as many had four or more tender palpation sites in group A as in group B, and in both groups these individuals demonstrated a trend towards a reduced maximum opening capacity as compared with the groups as a whole. Therefore, it appears that muscle tenderness is associated with reduced maximum opening capacity of the mandible. The one obvious difference between the groups was that one had received orthodontic treatment and the other had not. Still, it is hard to explain why and how orthodontic treatment per se should cause disturbances leading to such a result. However, any other explanation seems difficult to point out. It should be noted that no other maximal movements were reduced (Table 1) and there was no statistically significant difference in body height between the two groups.

Table 4. Percentage distribution of wear index score (U = upper jaw; L = lower jaw)

Wear index score*		Molars		Premolars		Canines		Incisors	
		Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B
R	U	0	2.1	4.1	1.0	1.0	5.3	2.0	7.0
	L	0	1.0	4.9	2.7	1.0	9.5	3.9	6.9
SOF	U	98.5	96.3	94.5	96.9	81.4	86.2	90.2	86.2
	L	90.2	91.5	94.6	96.3	86.3	85.1	80.4	79.8
SDF	U	1.5	1.6	1.4	1.6	13.7	8.5	7.8	7.0
	L	9.8	7.5	0.5	1.0	12.7	5.4	10.8	6.4
MLR	U	0	0	0	0.5	3.9	0	0	0
	L	0	0	0	0	0	0	4.9	6.9

* R = no visible wear; SOF = enamel facets; SDF = small areas of exposed dentin; MLR = obvious length reduction of tooth.

The finding that individuals in group A had the fewest teeth, also occluding ones, was hardly surprising. Extraction of two or more premolars is a common mode of treatment in orthodontics. It should be noted, however, that the number of occluding teeth was not statistically different in the groups. This, of course, can be due to group B comprising more individuals with an open bite, for instance. Nor was there any difference between the groups with regard to Helkimo's index for occlusal state (8), but then this index is composed of more factors than just the number of occluding teeth.

As expected, there were more subjects with good occlusion (10) in group A than in group B. Yet, there were still quite a few (37%) with malocclusions in accordance with Angle after the orthodontic treatment had been finished. From a functional point of view this is probably satisfactory. No statistically significant differences in the clinical dysfunction index were observed between the two groups (8). Therefore, this study does not indicate a clear causal relationship between occlusal factors and signs and symptoms of craniomandibular disorders.

With regard to group B the prevalence of good occlusion was well within the normal range of between 20% and 40%. In this respect this group could be considered representative, at least for Scandinavian conditions (10).

As to the occlusal/incisal state it is hardly surprising that there were no statistically significant differences between the groups. This is in accordance with the finding that the incidence of filled surfaces from 10 to 18 years of age in orthodontically treated individuals is not significantly different from that in untreated ones (16). Although there were more filled premolars in the upper jaw than in the lower, a finding somewhat contrary to common belief, the low prevalence of filled premolars supports a recent finding by Birkeland & Bragelien (17) concerning Norwegian school children. Otherwise, the figures are difficult to discuss in relation to other reports. So far only two studies have been published in which the same methods for the study of occlusal/incisal state and tooth wear have been applied (11, 18). However, in those studies the composition of the material was so different from the present one that a comparison of the data would be meaningless. It is hoped that the present study along with similar ones will serve as a base for the screening of occlusal/incisal state and tooth wear in populations in general, to better enable the dentist to decide when prophylactic or treatment measures are to be installed in subjects with developing tooth wear.

Table 4 shows that anterior teeth are more worn than posterior ones. This is in line with other findings (19, 20), although different scoring methods had been used. Otherwise, no statistically significant differences between the two groups were disclosed. This must be considered natural, there being no reason why orthodontic treatment should influence the degree of tooth wear.

This study did not disclose any statistically significant differences between the two groups except for interincisal distance, maximum jaw opening, and number of teeth present. The reduced mandibular opening capacity is difficult to explain. A certain correlation to the increased number of individuals with four or more palpably tender muscle sites in group A compared with group B was pointed out as a possible explanation.

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