Causal relation between malocclusion and caries

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In this second report of a follow-up study of long-term adverse oral health effects of malocclusion it is assessed whether various occlusal and space anomalies imply an increased risk of caries. In 1965–66 malocclusion was recorded in 176 adolescents who were re-examined in 1986–87 at the age of 33–39 years. DMFS scores, in the dentition as a whole and in the segments of the dental arches, were compared between subjects displaying specified traits of malocclusion at both examinations and a comparison group comprising subjects without malocclusion at both examinations. No relationship was found between the malocclusion traits and caries prevalence. □ *Clinical follow-up; orthodontic treatment need*

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The recognition of an increased risk of caries as a result of certain traits of malocclusion would augment the indication for orthodontic treatment of these traits. However, a causal relation between malocclusion and caries has not been convincingly demonstrated.

Authors classifying malocclusion in accordance with Angle have reported higher DMF scores among children with malocclusion than in those with a normal occlusion (1, 2), primarily on smooth surfaces (3). These findings are in conflict, however, with lack of association between various malocclusion indices and DMFS scores (4). Among the single traits of malocclusion, deep overbite has been associated with both decreased (1) and increased (5) caries prevalence. More consistent findings have been reported for space anomalies of the incisors. No relationship has been found between incisor crowding and approximal caries experience (5–7), whereas significantly reduced DF scores have been reported in connection with spacing of the incisors (5).

The contradictory findings may partly be explained by the multifactorial etiology of dental caries. Furthermore, usually only cross-sectional samples of children have been examined. Since an adverse effect of malocclusion, such as increased caries incidence, may perhaps not manifest itself until adult life, longitudinal studies from childhood to adulthood may be expected to provide more valid information.

It was the aim of this study to relate caries experience in 35-year-olds to the occurrence of various traits of malocclusion recorded in these persons at adolescence—that is, in the mid-1960s—and again more than 20 years later.

Materials and methods

In 1965–66 the occurrence of malocclusion was registered in teenagers with adolescent dentition in a region where orthodontic treatment was uncommon (8). In 1986–87, a non-representative sample was re-examined, comprising 176 of these subjects, 67 men and 109 women, who were now 33–39 years old (mean age, 35.5 years). Most of the subjects were allocated to the study in order that occlusal and space anomalies of high orthodontic interest, as recorded in 1965/66, would be included. Moreover, a comparison group was selected, consisting of subjects without malocclusion in 1965/66. The sample and the criteria of selection have been described in detail in a preceding paper (9).

The registrations of malocclusion in 1965/66 and 1986/87 were performed in accordance with the same criteria (10) and by the same examiner (S. Helm). In addition, at

both examinations missing permanent teeth were recorded, and the subjects were asked whether they had had orthodontic treatment, including orthodontic extractions. Caries experience was registered by the other author (P. E. Petersen) in accordance with the criteria of the WHO (11) and at the tooth surface level—that is, DMFS. Anterior to the third molars, extracted teeth were designated 'missing owing to caries' (MS), unless the teeth explicitly had been extracted for orthodontic reasons. Missing third molars were consistently designated 'absent' (thus not included in MS score), and so were congenitally absent teeth; congenital absence had been verified radiologically in 1965/66. The 1986/87 examination was 'blind' in the sense that the examiners worked independently and were unaware of which criterion of selection had caused inclusion of a given subject.

The subjects were asked about their occupation and were subdivided into five groups in accordance with occupational rank (12). Subsequently, to avoid small subgroups, a dichotomy was made into a higher (white collar) and a lower (blue collar) social group.

As reported previously (9), the occurrence of the various traits of malocclusion was remarkably stable between 1965/66 and 1986/87. Caries experience was compared between subjects displaying malocclusion at both examinations—that is, both in 1965/66 and 1986/87 ($n = 139$)—and the comparison group without malocclusion at both examinations ($n = 27$). In 10 subjects malocclusion was registered at one of the examinations, whereas no malocclusion was observed at the other. Incidentally, the comparison group consisted of only 7 men and 20 women. Since significantly higher caries experience was observed in the women (Table 1), the comparisons were made by inserting, in turn, the various single traits of malocclusion and sex as independent dummy variables into multiple regression analyses, thus controlling for sex. The distributions with regard to social group, on the other hand, were similar in the comparison and malocclusion groups.

Statistical significance of the regression coefficients was tested by means of the t test. Paired t tests were used in the comparisons of means for contralateral segments of the arches in the same subjects.

Results

The total sample was characterized by high caries experience but also a high level of treatment (Table 1). On the average, 40, or 27%, of the total 148 tooth surfaces were decayed, filled, or missing owing to caries. Of the tooth surfaces at risk—that is, among the teeth still present—less than 3 out of 4 were sound; but, on the other hand, only 1 surface was decayed, whereas 33 surfaces were filled.

Significant differences were observed between the sexes (Table 1). The men had more sound tooth surfaces; in particular, they had fewer fillings, but they had more untreated caries than the women.

The total group of 139 subjects presenting with some kind of malocclusion at both examinations did not differ significantly with regard to dental health from the 27 subjects

Table 1. Mean distribution of 148 tooth surfaces in accordance with health status in the total sample, in both sexes, and in subjects with and without malocclusion in 1965/66 and 1986/87

	DS	MS	FS	DMFS	Sound	Orthod. extract.	Absent†	Fracture
Total sample ($n = 176$)	1.0	5.8	33.3	40.1	94.1	1.5	11.9	0.4
Men ($n = 67$)	1.5*	5.4	28.7**	35.6**	100.2**	1.9	9.8**	0.5
Women ($n = 109$)	0.7	6.1	36.1	42.9	90.3	1.2	13.2	0.4
Any malocclusion ($n = 139$)	1.1	6.4	32.5	40.0	93.5	1.6***	12.5	0.5
No malocclusion ($n = 27$)	0.6	4.1	38.4	43.1	94.0	0.0	10.5	0.4

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
† Absent third molars and congenitally absent teeth.

Table 2. Unstandardized regression coefficients in multiple regression analyses controlling for sex, representing mean differences in total mouth DMFS scores (148 tooth surfaces) between subjects with given malocclusion and comparison group ($n = 27$)

Malocclusion	DS	MS	FS	DMFS
Any malocclusion ($n = 139$)	+0.44	+2.44	−5.00	−2.11
Maxillary overjet >6 mm ($n = 20$)	+0.95	+0.73	−4.73	−3.05
Overbite >5 mm ($n = 39$)	+0.32	+1.91	−4.59	−2.36
Cross-bite ($n = 36$)	+0.38	+3.95*	−4.27	+0.05

* $p < 0.05$.

of the comparison group, except that more teeth had been extracted for orthodontic reasons in the malocclusion group (Table 1). The comparison might be biased, however, because the malocclusion group comprised relatively more men (39%) than the comparison group (26%). In the following tables mean differences in DMFS scores are therefore presented between subjects with various traits of malocclusion and the comparison group, controlling for the effect of sex as described above.

After this correction, too, the total malocclusion group did not differ significantly from the comparison group in mean DMFS scores for the total 148 tooth surfaces (Table 2). The malocclusion group showed slightly higher DS and MS values and a somewhat lower FS value. A similar pattern was observed in subjects with increased maxillary overjet and overbite at both examinations, whereas extractions were significantly commoner in the case of cross-bite ($p = 0.031$).

Among the 16 tooth surfaces of the maxillary incisors DFS scores were higher in the subjects with increased overjet and overbite, but not significantly so, in relation to the comparison group (Table 3). The same was true for crowding, both in the maxillary and the mandibular incisor segment; these differences were close to statistical significance ($p = 0.054$ and 0.067, respectively). Spacing of the maxillary incisors, however, was significantly associated with lower DFS scores ($p = 0.037$). No incisors were missing owing to caries.

The effect of crowding was further investigated. DMFS scores were compared between subjects with crowding in the upper and lower arch (74 tooth surfaces each) at both examinations and the comparison group (Table 4). The total DMFS scores were slightly, but not significantly, lower in the subjects with crowding, but they had significantly more untreated caries in the maxilla ($p = 0.025$).

Finally, intra-individual comparisons were made between contralateral segments. Unilateral crowding was observed in the same canine/premolar segment at both examinations in 11 subjects. The mean FS score for the 14 tooth surfaces was 0.36 lower in

Table 3. Unstandardized regression coefficients in multiple regression analyses controlling for sex, representing mean differences in DFS scores for incisor segment (16 tooth surfaces) between subjects with given malocclusion and comparison group ($n = 27$)

Malocclusion	DS	FS	DFS
Maxillary overjet >6 mm ($n = 20$)†	+0.31	+1.00	+1.30
Overbite >5 mm ($n = 39$)†	+0.13	+1.26	+1.39
Crowding, maxillary incisors ($n = 33$)	+0.19	+1.30	+1.49
Crowding, mandibular incisors ($n = 38$)	+0.16	+0.72	+0.88
Spacing, maxillary incisors ($n = 16$)	0.00	−1.64*	−1.64*

* $p < 0.05$.
† Maxillary incisors.

Table 4. Unstandardized regression coefficients in multiple regression analyses controlling for sex, representing mean differences in DMFS scores for one jaw (74 tooth surfaces) between subjects with given malocclusion and comparison group ($n = 27$)

Malocclusion	DS	MS	FS	DMFS
Crowding, maxilla ($n = 41$)	+0.48*	+0.20	−2.29	−1.61
Crowding, mandible ($n = 51$)	+0.21	−0.62	−1.30	−1.71

* $p < 0.05$.

the crowded segments; the difference is not statistically significant. DS and MS scores were zero in all segments. A similar comparison was made for unilateral cross-bite between the maxillary canine/premolar/molar segments in 18 subjects. The mean DMFS score for the 29 tooth surfaces was 0.67 higher in the segments with cross-bite (DS = −0.11, MS = +0.28, FS = +0.50); the differences are not statistically significant.

Discussion

The material provided a unique opportunity for testing the hypothesis that malocclusion may increase the risk of caries. The study design was not strictly longitudinal, since extractions only, and not carious lesions and fillings, were recorded at adolescence. Malocclusion, however, was recorded both at adolescence and in adult life, and the criteria for selection ensured that pronounced occlusal and space anomalies were represented (9). If certain malocclusions did, in fact, predispose to caries, this causal relation would be expected to emerge when subjects afflicted with these malocclusions for more than 20 years were compared with subjects whose dentitions were totally free of malocclusion for that period of time. After all, the time sequence between the occurrence of malocclusion and the caries experience of 40 DMFS was evident, since 15-year-olds in 1965, residing in a community adjacent to the region of examination, had a mean score of 16 DMFS (S. Helm; unpublished data).

The mean numbers of decayed and filled tooth surfaces in the 176 subjects were similar to those found in a representative sample of 30- to 39-year-old Danes in 1981–82 (13), whereas extractions were somewhat less frequent in the present material. The sex differences—that is, women showing higher DMF scores and, especially, higher F scores—were also consistent with these previous findings.

With regard to both the dentition as a whole (Table 2) and the separate dental arches (Table 4), the total DMFS scores were almost consistently slightly higher in the comparison group than in the subjects with the various occlusal and space anomalies. The pattern of dental treatment in the malocclusion groups differed somewhat from that in the comparison group. Thus, in the former groups, fewer surfaces had been filled, and untreated carious lesions and extractions were commoner. The differences were small, however, and no explanation is readily available as to why the subjects of the comparison group would have received more comprehensive restorative treatment. As already mentioned, the distributions with regard to social group were similar in the comparison and malocclusion groups. Extractions were particularly frequent among the subjects with cross-bite. However, already in 1965/66, extractions were significantly commoner in the case of cross-bite than in the subjects without malocclusion ($p < 0.025$), which indicates that some of the cross-bites had probably developed early as a result of the extractions (14).

A priori, space anomalies would be considered especially interesting in the present context. However, the DMFS scores were not higher in the crowded dental arches (Table 4), even though crowding in two, or all three, segments of the arches occurred in several subjects. Only crowding in the incisor segments was associated with somewhat

higher DFS scores (Table 3). Even if this association had been statistically significant in the present material, the clinical significance in contemporary adolescents would be questionable, considering the general improvement in dental health. The favorable effect on caries experience of spacing confirms earlier findings (5).

In conclusion, the hypothesis that occlusal or space anomalies predispose to caries was refuted. Consequently, according to the results of this study, increased risk of caries need not be included in considerations of the indication for orthodontic treatment.

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