Causal relation between malocclusion and periodontal health

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The purpose of this 20-year follow-up study was to assess whether persistent traits of morphologic malocclusion imply an increased risk of periodontal disease. In 1965–66 malocclusion was recorded in 176 adolescents who were re-examined in 1986–87 at the age of 33–39 years. Markedly healthier periodontal conditions were found in women than men, in the higher social group than the lower one, and in the maxilla than the mandible. Subjects with specified malocclusion traits at both examinations were compared with subjects without malocclusion for the occurrence of calculus, gingivitis (bleeding), and pocketing. Controlling for the effect of sex and social group, periodontal disease was significantly more frequent in the maxilla in connection with crowding, extreme maxillary overjet, and cross-bite ($p < 0.05$). No association was found in the mandible. The presence of certain malocclusion traits in adolescence may probably often call for special professional efforts of oral hygiene education rather than orthodontic therapy. □ *Follow-up clinical study; oral hygiene education; orthodontic treatment need; social groups*

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It has been hypothesized that malocclusion predisposes to periodontal disease, primarily because it seems likely that certain morphologic traits of malocclusion may impede oral hygiene and self-cleaning and, thus, lead to increased accumulation of bacterial dental plaque. Conflicting results have been obtained, however, in the numerous studies of associations between malocclusion and periodontal disease (1).

Mostly, no association has been found when the amount of plaque, calculus, gingivitis, or pocketing is related to Angle's classification or various indices of malocclusion (2–6). However, a few authors have reported such relationships (7, 8). Studies of single traits of malocclusion would be expected to give more accurate information than studies based on malocclusion expressed in general terms. Indeed, associations have been found between periodontal disease and increased maxillary overjet or overbite (9–11), but, again, negative findings have also been reported (12, 13). Understandably, crowding of the teeth has attracted special attention, and increased risk of gingivitis or pocketing as a result of crowding has often been described (14–17). However, here too, other investigators failed to observe significant associations (9, 18). It is noteworthy that relationships between crowding and periodontal disease were obscured in cases of high or low levels of oral hygiene (2, 19, 20).

The contradictory findings may be explained, in part, by methodologic differences in the recordings for malocclusion and periodontal disease. Furthermore, usually only cross-sectional samples have been examined, often comprising teenagers or young adults. An adverse effect of malocclusion on periodontal health may, in any case, not manifest itself until mature age. At that time, however, it may be difficult to distinguish between cause and effect, since periodontitis may in itself have caused malocclusion—for example, increased maxillary overjet and spacing of the teeth. Longitudinal studies from childhood to adulthood in subjects with persistent traits of malocclusion may therefore provide more valid information.

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

Materials and methods

Initially, in 1965–66, the occurrence of malocclusion was recorded in teenagers with adolescent dentition in a region where orthodontic treatment was uncommon (21). 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 among subjects without malocclusion in 1965/66. The sample and the criteria of selection have been described in detail previously (22).

The registrations of malocclusion in 1965/66 and in 1986/87 were performed in accordance with the same criteria (23) and by the same examiner (S. Helm). In addition, at both examinations missing teeth were recorded, and the subjects were asked whether they had had orthodontic treatment, including orthodontic extractions. The periodontal conditions were registered by the other author (P. E. Petersen) in accordance with the criteria of the WHO (24) on the mesio-facial aspect of the maxillary teeth and the mesiolingual aspect of the mandibular teeth. The WHO probe with two graduations, one at 3.5 mm and one at 5.5 mm, was used. At variance with WHO's recommendations, the assessment was made on all teeth present.

The 1986/87 examination was 'blind' in the sense that the examiners worked independently and were unaware which criteria had caused inclusion of a given subject.

The subjects were asked about their occupation and subdivided into five social groups in accordance with occupational rank (25). Subsequently, to avoid small subgroups, they were dichotomized into a higher social group, with, for example, higher education, self-employed, and salaried employees (white collar), and a lower social group, with, for example, skilled and unskilled workers (blue collar).

As reported previously (22), the occurrence of the various traits of malocclusion was remarkably stable in most individuals between 1965/66 and 1986/87. The periodontal conditions were compared between subjects with malocclusion traits at both examinations, in 1965/66 and in 1986/87 ($n = 139$), and the comparison group without malocclusion at both examinations ($n = 27$).

Incidentally, the comparison group consisted of relatively few men, 7 only, versus 20 women. Sex differences in periodontal health might thus introduce a confounding bias into the comparisons. The various single traits of malocclusion and sex were therefore inserted, in turn, as independent dummy

Table 1. Mean number of teeth in maxilla and mandible with specified periodontal condition and of missing teeth in total sample, both sexes, two social groups, and subjects with and without malocclusion in 1965/66 and 1986/87

	Sound	Calculus	Gingivitis	Pockets >3.5 mm	Missing
Total sample ($n = 176$)	13.9	0.7	11.9	1.6	3.9
Men ($n = 67$)	11.7*	1.0	14.0*	1.7	3.5*
Women ($n = 109$)	15.2	0.5	10.6	1.5	4.2
Lower social group ($n = 91$)	11.3***	0.5	13.6*	2.3**	4.2
Higher social group ($n = 85$)	16.6	0.8	10.2	0.8	3.6
Any malocclusion ($n = 139$)	13.2	0.7	12.2	1.7	4.2**
No malocclusion ($n = 27$)	15.9	0.3	12.4	0.5	3.0

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

variables into multiple regression analyses, thus controlling for the effect of sex. Similarly, multiple regression analyses were carried out to control for both sex and social group. The results of the two series of regression analyses were almost identical, because social group and the occurrence of malocclusion were mutually independent. Only the results of the former series are therefore presented. The statistical significance of the regression coefficients was tested for 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

On the average, only 4 teeth (range, 0–12) were missing in the total sample (Table 1), including 1.5 extractions anterior to the third molars, absent third molars, and congenital absence, which had been verified radiologically in 1965/66. Half of the remaining teeth were periodontally sound. Only 11 pockets deeper than 5.5 mm were found in the total sample, and the pocket scores were therefore combined for all pockets deeper than 3.5 mm. The periodontal scores in Table 1 pertain to 32 teeth, each tooth being included only by its most severe score. Thus, the table does not reveal the fact that, on an average, calculus and gingivitis occurred simultaneously on 5.2 teeth and gingivitis and pocketing on 1.5 teeth.

Significantly better periodontal conditions were observed in women and in the higher social group (Table 1). The 27 subjects of the comparison group had more sound teeth than the 139 subjects presenting some kind of malocclusion at both examinations. The differences between these two groups were statistically significant, however, only with regard to missing teeth. A greater number of missing teeth would be expected in the malocclusion group owing to orthodontic extractions and congenital absence.

Comparison of the two dental arches, each comprising 16 teeth, showed conspicuous differences (Table 2). The scores for calculus and gingivitis, both in the total sample and in all subgroups, were markedly lower in the maxilla than in the mandible. In contrast, the pocket scores and the number of missing teeth were similar.

Because of the differences between the maxilla and mandible, the effect of maloc-

Table 2. Mean number of teeth in maxilla and in mandible with specified periodontal condition in total sample, both sexes, two social groups, and subjects with and without malocclusion in 1965/66 and 1986/87

	Sound	Calculus	Gingivitis	Pockets >3.5 mm	Missing
Maxilla					
Total sample (n = 176)	9.1	0.2	3.8	0.8	2.0
Men (n = 67)	8.4	0.4	4.6	0.7	1.8
Women (n = 109)	9.6	0.0	3.4	0.9	2.2
Lower social group (n = 91)	7.9**	0.1	4.8**	1.2*	2.1
Higher social group (n = 85)	10.5	0.3	2.8	0.4	2.0
Any malocclusion (n = 139)	8.6*	0.2	4.2	0.9	2.2**
No malocclusion (n = 27)	11.4	0.1	2.9	0.2	1.4
Mandible					
Total sample (n = 176)	4.7	0.5	8.1	0.8	1.9
Men (n = 67)	3.3**	0.6	9.4*	1.0	1.7
Women (n = 109)	5.6	0.5	7.3	0.6	2.0
Lower social group (n = 91)	3.4**	0.5	8.8	1.1*	2.1*
Higher social group (n = 85)	6.1	0.6	7.3	0.4	1.6
Any malocclusion (n = 139)	4.7	0.5	8.0	0.8	2.0
No malocclusion (n = 27)	4.4	0.2	9.5	0.3	1.6

* $p < 0.05$; ** $p < 0.01$.

Table 3. Unstandardized regression coefficients in multiple regression analyses controlling for sex, representing mean differences in periodontal scores for maxilla and mandible between subjects with given malocclusion and comparison group ($n = 27$)

Malocclusion	Sound	Gingivitis	Pockets >3.5 mm	Gingivitis and/or pockets	Missing
Maxilla					
Any malocclusion ($n = 139$)	−2.7*	+1.1	+0.7	+1.9	+0.8**
Maxillary overjet >6 mm ($n = 20$)	−3.5*	+2.3	+0.9	+3.2*	+0.4
Mand. overjet/ant. cross-bite ($n = 8$)	−3.7	+3.1	+0.2	+3.3	+0.5
Overbite >5 mm ($n = 39$)	−2.5	+0.5	+0.7	+1.2	+0.6*
Cross-bite ($n = 36$)	−3.5*	+1.9	+1.1	+3.0*	+0.5
Maxillary crowding ($n = 41$)	−4.3**	+2.4	+1.2	+3.5*	+0.5
Maxillary spacing ($n = 16$)	−0.3	−0.6	+0.3	−0.2	+0.7
Mandible					
Any malocclusion ($n = 139$)	+0.6	−1.8	+0.4	−1.3	+0.5
Maxillary overjet >6 mm ($n = 20$)	+0.5	−1.7	+0.7	−1.0	+0.6
Mand. overjet/ant. cross-bite ($n = 8$)	+0.5	−0.5	+0.2	−0.3	+0.1
Overbite >5 mm ($n = 39$)	+0.1	−1.6	+0.5	−1.1	+0.4
Cross-bite ($n = 36$)	−0.7	+0.2	+0.1	+0.3	+0.3
Mandibular crowding ($n = 51$)	+0.3	−1.4	+0.6	−0.8	+0.2

* $p < 0.05$; ** $p < 0.01$.

clusion was assessed for each dental arch separately, after controlling for sex (and social group), as described above (Table 3). Since calculus without simultaneous gingivitis was rare and not in itself a disease, the regression coefficients for calculus have been omitted in the table. In the maxilla the total malocclusion group showed consistently less favorable conditions than the comparison group. The same pattern was observed among subjects with specific malocclusion traits, with the exception of spacing; but none of the differences for gingivitis and pocketing, viewed separately, were statistically significant. However, the combined scores for gingivitis and pockets were significantly higher ($p < 0.05$) in subjects with extreme overjet, cross-bite, and crowding. No significant or systematic differences were found in the mandible (Table 3).

With regard to the incisor segments, the scores for calculus and gingivitis were also considerably lower in the maxilla than in the mandible. Controlling for the effect of sex (and social group), extreme overjet was associated with a significantly higher score for gingivitis and pockets combined in the maxillary incisor segment ($p < 0.05$). There was no 'dose-response' effect, however, as aggravation of the score was not observed in the subjects ($n = 8$) with overjet greater than 9 mm. No other significant difference was found. All differences in the mandibular incisor segment were small; if anything, the malocclusion traits were associated with lower gingivitis scores.

Finally, intra-individual comparisons were made between contralateral segments. Unilateral crowding was found at both examinations in the same canine/premolar segment in 11 subjects. No significant difference and no clear trend were found. A similar comparison was made for unilateral cross-bite between the maxillary canine/premolar/molar segments in 18 subjects. Again, no significant difference or trend was observed.

Discussion

The material provided a unique opportunity for testing the hypothesis that malocclusion may increase the risk of periodontal disease. The study design was not strictly longitudinal, since periodontal conditions were not recorded in adolescence. Malocclusion,

on the other hand, was recorded in adolescence and in adult life, and the criteria for selection ensured that pronounced occlusal and space anomalies were represented (22). If certain malocclusion traits did, in fact, predispose to periodontal disease, this causal relation would be expected to emerge when subjects afflicted with these traits for more than 20 years were compared with subjects whose dentitions were totally free of malocclusion for that period.

The mean numbers of sound teeth and teeth with calculus and with gingivitis (bleeding) in the total sample were similar to those reported in a representative sample of 30- to 39-year-old Danes in 1981–82 (26). Periodontal pocketing, however, was less common in the present material. The differences observed between the sexes and social groups were also consistent with the previous findings (26). With regard to caries, the subjects were characterized by high experience but also a high level of caries treatment (27).

Generally, the subjects with malocclusion, specifically increased overjet, cross-bite, and crowding had higher scores in the maxilla for gingivitis and periodontal pocketing than the comparison group without any malocclusion traits. This probably reflects that tooth crowding and irregularities may impede oral hygiene, which is in keeping with previous observations (15, 28). The less favorable conditions in the maxillary incisor segment in connection with extreme overjet are also in agreement with earlier findings (9–11); lip seal and mouth breathing were not assessed (29).

It is obvious that both in the total sample and in all subgroups the periodontal conditions were markedly worse in the mandible, indicating lower levels of oral hygiene on the lingual aspect of the mandibular teeth than on the facial aspect of the maxillary teeth. This pattern of oral cleanliness could be expected (28, 30). It is possible, therefore, that the lack of association between the malocclusion traits and periodontal disease in the mandible was due to the generally low level of oral hygiene lingually in the mandible obscuring such a relationship (2, 19, 20).

It is noteworthy, however, that in both dental arches the differences in periodontal health between the sexes and between the social groups were, in general, similar to or even greater than the differences between the malocclusion group and the comparison group.

In conclusion, the hypothesis that malocclusion may increase the risk of periodontal disease was confirmed, especially with regard to crowding, extreme maxillary overjet, and cross-bite. The magnitude of this risk would, however, seem to parallel that existing for men compared with women or lower social groups compared with higher. Severe periodontitis was rare, also in connection with the malocclusion traits, and the clinical implication of pocket depths between 3.5 and 5.5 mm on a few tooth surfaces in 35-year-olds will usually be limited to oral hygiene education and scaling (24). Consequently, from a periodontal point of view, the presence of malocclusion in adolescents may call for special professional efforts with regard to motivation and instruction in oral hygiene rather than orthodontic therapy (20, 31).

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References

1. Ramfjord SP. Periodontal significance of orthodontic therapy. In: Derrick DD, ed. The dental annual 1987. Bristol: Wright, 1987;156–66.
2. Beagrie GS, James GA. The association of posterior tooth irregularity and periodontal disease. Br Dent J 1962;113:239–43.
3. Grewe JM, Chadha JM, Hagan D, et al. Oral hygiene and occlusal disharmony in Mexican-American children. J Periodont Res 1969;4:189–92.
4. Geiger AM, Wasserman BH, Thompson RH, et al. Relationship of occlusion and periodontal disease. V. Relation of classification of occlusion to periodontal status and gingival inflammation. J Periodontol 1972;43:554–60.
5. Katz RV. An epidemiologic study of the relationship between various states of occlusion and the pathological conditions of dental caries and periodontal disease. J Dent Res 1978;57:433–9.
6. Buckley LA. The relationships between irregular teeth, plaque, calculus and gingival disease. Br Dent J 1980;148:67–9.
7. Miller J, Hobson P. The relationship between malocclusion, oral cleanliness, gingival conditions

and dental caries in school children. Br Dent J 1961;111:43–52.
8. Poulton DR, Aaronson SA. The relationship between occlusion and periodontal status. Am J Orthod 1961;47:690–9.
9. McCombie F, Stothard D. Relationships between gingivitis and other dental conditions. J Can Dent Assoc 1964;30:506–13.
10. Gould MSE, Picton DCA. The relation between irregularities of the teeth and periodontal disease. Br Dent J 1966;121:20–3.
11. Geiger AM, Wasserman BH, Turgeon LR. Relationship of occlusion and periodontal disease. VI. Relation of anterior overjet and overbite to periodontal destruction and gingival inflammation. J Periodontol 1973;44:150–7.
12. Geiger AM. Occlusal studies in 188 consecutive cases of periodontal disease. Am J Orthod 1962;48:330–60.
13. Alexander AG, Tipnis AK. The effect of irregularity of teeth and the degree of overbite and overjet on the gingival health. Br Dent J 1970;128:539–44.
14. Hellgren A. The association between crowding of the teeth and gingivitis. Trans Eur Orthod Soc 1956;134–40.
15. Behlfelt K, Ericsson L, Jacobson L, et al. The occurrence of plaque and gingivitis and its relationship to tooth alignment within the dental arches. J Clin Periodontol 1981;8:329–37.
16. El-Mangoury NH, Gaafar SM, Mostafa YA. Mandibular anterior crowding and periodontal disease. Angle Orthod 1987;57:33–8.
17. Hörup N, Melsen B, Terp S. Relationship between malocclusion and maintenance of teeth. Community Dent Oral Epidemiol 1987;15:74–8.
18. Geiger AM, Wasserman BH, Turgeon LR. Relationship of occlusion and periodontal disease. VIII. Relationship of crowding and spacing to periodontal destruction and gingival inflammation. J Periodontol 1974;45:43–9.
19. Ainamo J. Relationship between malalignment of the teeth and periodontal disease. Scand J Dent Res 1972;80:104–10.
20. Ingervall B, Jacobsson U, Nyman S. A clinical study of the relationship between crowding of teeth, plaque and gingival condition. J Clin Periodontol 1977;4:214–22.
21. Helm S. Malocclusion in Danish children with adolescent dentition. Am J Orthod 1968;54:352–66.
22. Helm S, Petersen PE. Individual changes in malocclusion from adolescence to 35 years of age. Acta Odontol Scand 1989;47:211–6.
23. Björk A, Krebs AA, Solow B. A method for epidemiological registration of malocclusion. Acta Odontol Scand 1964;22:27–41.
24. World Health Organization. Epidemiology, etiology, and prevention of periodontal diseases. Geneva: World Health Organization, 1978; Technical Report Series no. 621.
25. Friis-Hashé E, Michelsen N. Employment as stated in Identity Cards Register for social group subdivision in social medical investigations. Ugeskr Laeger 1979;141:535–9.
26. Kirkegaard E, Borgnakke W, Grönbaek L. Oral health status, dental treatment need, and dental care habits in a representative sample of the adult Danish population [Thesis]. Aarhus and Copenhagen: Royal Dental Colleges, 1986;194.
27. Helm S, Petersen PE. Causal relation between malocclusion and caries. Acta Odontol Scand 1989;47:217–21.
28. Addy M, Griffiths GS, Dummer PMH, et al. The association between tooth irregularity and plaque accumulation, gingivitis, and caries in 11–12-year-old children. Eur J Orthod 1988;10:76–83.
29. Jacobson L, Linder-Aronson S. Crowding and gingivitis: a comparison between mouthbreathers and nosebreathers. Scand J Dent Res 1972;80:500–4.
30. Shanley DB, Ahern FM. Periodontal disease and the influence of socio-educational factors in adolescents. In: Frandsen A, ed. Public health aspects of periodontal disease. Chicago: Quintessence Publ. Co., 1984;109–20.
31. Paunio K. The role of malocclusion and crowding in the development of periodontal disease. Int Dent J 1973;23:470–5.

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