Individual changes in malocclusion from adolescence to 35 years of age

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It was the aim of this follow-up study to assess the extent of individual changes in the occurrence of specific pronounced traits of malocclusion in a sample of 176 subjects who were selected from a catchment population examined in adolescence in 1965–66 and who were re-examined in 1986–87 (mean age, 35.5 years). Orthodontic treatment had been received by 10% of the subjects, and extraction rates were low. Deep overbite and mandibular crowding, especially in the incisor segment, tended to increase in frequency. However, on the whole, the various malocclusion traits remained remarkably stable in the orthodontically untreated individuals. □ *Clinical follow-up; epidemiology; orthodontics*

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Conflicting results have been obtained in the investigations, usually among cross-sectional samples of children, of causal associations between pronounced morphologic malocclusion and potential adverse effects on oral health (1). It has been argued that longitudinal studies, from childhood to adult life, might throw light on the long-term consequences of untreated malocclusions (2, 3). In such studies it is essential that the malocclusion traits examined persist over the study period. It is uncertain, however, to what extent the various traits of malocclusion remain stable over an extended period.

In the mid-1960s the occurrence of malocclusion was recorded in Danish adolescents in a region where orthodontic treatment was uncommon (4). More than 20 years later a follow-up examination was made of a selected sample, mainly comprising subjects who had presented pronounced malocclusion traits in adolescence. It was the aim of this study to assess whether individual changes took place in the occurrence of these traits from adolescence to the mid-thirties.

Materials and methods

Initially, in 1965–66, the occurrence of malocclusion was recorded in the entire population of schoolchildren in a region north of Copenhagen (4). At that time no child dental health service had been established in the region, and orthodontic treatment was uncommon. In school grades 7 through 10, 1252 children, aged 13–19 years, had reached adolescent dentition—that is, dental stage DS 4 (5). From this original population a sample was drawn in two stages: in 1981 and 1986 (Fig. 1).

In the first stage, in 1981, addresses of the individuals were traced through the Danish Central Person Register (CPR). It was possible to locate 977 persons, who received a questionnaire containing questions about orthodontic experience and symptoms of functional temporomandibular joint (TMJ) disorders. Response was obtained from 841 (86%) of the persons, then aged 28–34 years. This representative sample and the results of the questionnaires have been described elsewhere (6, 7).

In the second stage, in 1986, a non-representative sample was selected from these 841 subjects. The main criterion of selection, which was met by 232 subjects, was presence at the initial examination, in 1965/66, of at least one of the following pronounced traits of malocclusion: extreme maxillary overjet > 9 mm; mandibular overjet; deep bite > 7 mm; frontal open bite; cross-bite in canine/premolar and molar segments, uni- or bi-laterally; maxillary or mandibular

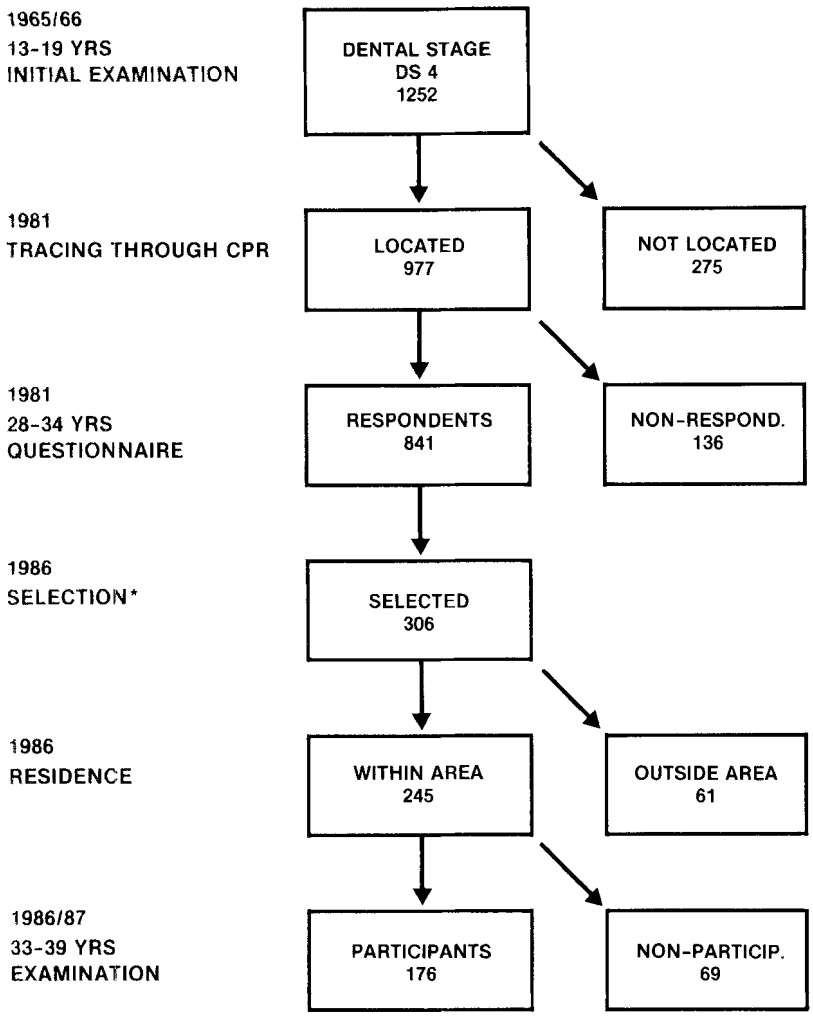

Fig. 1. Flow diagram of selection of subjects. * Criteria of selection: see text.

crowding > 2 mm in incisor and at least one lateral segment; maxillary spacing > 2 mm in incisor segment and/or medial diastema; and congenital absence of one or both maxillary lateral incisors.

In many of these 232 subjects more than 1 of the traits, or additional malocclusion traits, had been recorded. For example, several had maxillary overjet greater than 6 mm or deep bite greater than 5 mm. As a comparison group, 48 subjects were selected, comprising every 3rd consecutive subject without any malocclusion in 1965/66. Also added were all persons who, in the 1981 questionnaire, had complained of frequent TMJ clicking/grating and difficulty in opening the mouth widely. This group comprised 26 subjects who were not included in the above malocclusion group or the comparison group and 9 subjects who were already included in one of these groups.

The sample selected thus comprised 306 subjects (232 + 48 + 26). According to the CPR, 245 still resided within or close to the region of their childhood, while 61 had moved to distant parts of the country or could not be traced. The 245 subjects who were accessible for examination constituted the target population of this study.

During 1986–87, the 245 persons were invited by mail to participate in a dental examination at a municipal dental clinic close

to their respective residence. After two reminders, 176 (72%) participated, 109 (78%) women and 67 (64%) men, aged 33–39 years (mean age, 35.5 years). The frequency of the malocclusion traits recorded in 1965/66 did not differ significantly between those who participated and those who did not.

The registration of malocclusion was performed in accordance with the same criteria (5) and by the same examiner in 1965/66 and in 1986/87. In addition, at both examinations, missing permanent teeth were recorded, and the subjects were asked whether they had had orthodontic treatment, including orthodontic extractions. The latter examination was 'blind' in the sense that the examiner was unaware which of the above criteria of selection had caused inclusion of a given subject.

After the examination, logically incompatible recordings were corrected. Subsequently, the 1965/66 and 1986/87 data were merged, and data analysis was carried out by means of the SAS statistical package at the UNI.C Computer Center in Copenhagen.

Results

Orthodontic appliance therapy had been received by 10% of the subjects, equally often by both sexes. Four had been treated in their teens and 14 in adult life.

At the 1965/66 examination the mean number of extracted permanent teeth was 0.54 in boys and 0.66 in girls. During the next 2 decades, however, extractions were somewhat more frequent in men, and at the 1986/87 examination the mean number of extracted teeth (excluding third molars) was identical, 1.46 teeth in each sex. First molars were the teeth most commonly lost.

The changes observed over 2 decades in the occurrence of the various occlusal anomalies are shown in Table 1. Extreme maxillary overjet was quite persistent. Thus, overjet greater than 6 mm was recorded in 20 subjects on both occasions and in 3 persons only at one or the other examination. Moreover, all four individuals whose overjet exceeded 9 mm at one examination only had recordings between 6 and 9 mm at the other examination. The one subject with mandibular overjet only in 1965/66 had developed an open bite in 1986/87; and in the new case at the latter examination, anterior cross-bite of the lateral incisors had been recorded initially. Even if deep overbite in most cases remained constant, a tendency was observed towards increasing frequency and severity. Thus, the overbite exceeded 5 mm in 12 new cases, as compared with 4 reversals; in 9 cases overbite, previously registered between 5 and 7 mm, exceeded 7 mm at the last examination, and only 1 case changed to the contrary. Open frontal bite, on the other hand, showed a slight tendency to disappear with time. Cross-bite and scissors bite

Table 1. Presence of occlusal anomalies in 176 subjects in 1965/66 and 1986/87

Occlusal anomaly	Neither 1965/66 nor 1986/87	1965/66 and 1986/87	1965/66 only	1986/87 only	Unrecordable*
Extreme max. overjet >6 mm	148	20	2	1	5
Extreme max. overjet >9 mm	159	8	2	2	5
Mandibular overjet	171	2	1	1	1
Deep bite >5 mm	115	39	4	12	6
Deep bite >7 mm	150	13	1	9	3
Open bite, frontal	166	5	3	1	1
Cross-bite	118	36	4	9	9
Cross-bite C/P and M segments	146	12	3	2	13
Scissors bite	161	10	2	2	1

* Unrecordable owing to orthodontic treatment or extractions.

Table 2. Presence of space anomalies in 176 subjects in 1965/66 and 1986/87

Space anomaly	Neither 1965/66 nor 1986/87	1965/66 and 1986/87	1965/66 only	1986/87 only	Unrecordable*
Crowding, maxilla	104	41	6	9	16
Crowding, max. inc. segment	100	33	5	11	27
Crowding, max. lat. segments	116	10	6	3	41
Crowding, max. inc. + lat. segments	111	5	3	2	55
Crowding, mandible	89	51	0	26	10
Crowding, mand. inc. segment	105	38	1	21	11
Crowding, mand. lat. segments	82	35	1	13	45
Crowding, mand. inc. + lat. segments	98	25	2	7	44
Spacing/diastema max. incisors	131	16	6	2	21

* Unrecordable owing to orthodontic treatment or extractions.

remained fairly constant. Four of nine subjects who developed cross-bite had lost first molars between the two examinations, and this was true also in the two new cases with cross-bite in both the canine/premolar and molar segment.

Changes in the occurrence of space anomalies are shown in Table 2. Maxillary crowding exceeding 2 mm in at least one segment was rather persistent, and no clear tendency was observed towards decreasing or increasing occurrence. The same was true with regard to the incisor and lateral segments, viewed separately and in combination, although in these instances many subjects were unrecordable at both examinations or at the later one only owing to extractions. In contrast, mandibular crowding showed a clear trend either to persist or to become commoner among the recordable subjects. In particular, crowding became more frequent in the mandibular incisor segment. Spacing of the maxillary incisors or medial diastema exceeding 2 mm persisted in most cases but had disappeared in six subjects.

In the comparison group without malocclusion in 1965/66, 27 subjects had no malocclusion in 1986/87 either, whereas in one malocclusion had developed (Table 3). Conversely, nine subjects with malocclusion at the first examination showed no malocclusion at the later one; spacing in the maxillary incisor segment was the only trait recorded formerly in five of the nine subjects, and in three the malocclusion had been corrected successfully by orthodontic therapy.

Discussion

The target population was not intended to be representative of the original population examined initially in 1965/66. On the contrary, most of the subjects were allocated to the study in order that pronounced occlusal and space anomalies would be well represented. By this token, the proportion having received orthodontic appliance therapy (10%) was probably higher than in Danes of

Table 3. Subjects with and without malocclusion in 1965/66 and 1986/87

	1986/87		
1965/66	Malocclusion	No malocclusion	Total
Malocclusion	139	9	148
No malocclusion	1	27	28
Total	140	36	176

this age group in general. Incidentally, in the 1981 questionnaire mentioned (6), six subjects who were examined in the present investigation had erroneously reported that they had received orthodontic treatment; in fact, crown- or bridge-work or extractions had been made. Some overreporting of orthodontic experience should thus be expected in questionnaires answered by adults.

The mean number of extracted teeth anterior to the third molars (1.46) was lower than that reported in a representative sample of 30- to 39-year-old Danes (2.99) in 1981–82 (8), which probably reflects both a time trend and geographic variation.

Several factors could be responsible for individual changes in the occurrence of malocclusion between the two examinations. First, the reliability of the registrations must be considered. For the traits of malocclusion included in this investigation, I attained high levels of consistency in a previous study of intra-examiner reliability (9).

Secondly, professional intervention, in particular orthodontic treatment, would obviously be expected to alter the occurrence of malocclusion. However, orthodontic therapy had not been successful in all subjects treated. If, in spite of attempted treatment, a malocclusion trait persisted at the second examination, occurrence of the trait was categorized as unchanged. Otherwise, the subject was omitted as unrecordable in the analysis of that trait, but the subject might still enter in the analyses of other traits. Consequently, various numbers of subjects were omitted from the analyses of the different malocclusion traits. Finally, late growth changes and tooth eruption must be taken into account (10), since in most of the adolescents growth was not complete in 1965/66.

On the whole, when left untreated, the various occlusal anomalies were quite persistent (Table 1). Deep overbite, however, tended to increase in both frequency and severity, which probably reflected the commonest growth pattern of the mandible—that is, forward rotation—combined with unstable incisor occlusion (11). An average increase in vertical overbite during the late growth period has been reported previously in longitudinal series (10, 12). Extraction rates were similar in subjects displaying deep overbite (mean, 1.44 teeth) and the total sample. In contrast, the mean number of extractions was comparatively high in the subjects with cross-bite already in 1965/66 and also in 1986/87 (1.81). This may be explained, mainly, by the frequent loss of maxillary first molars, causing local cross-bite of second molars, which rotated mesially (13).

Changes in the occurrence of the space anomalies were also limited (Table 2), although in many subjects one or more segments of the jaws were unrecordable owing to extractions, especially at the latter examination. In some instances, solicited answers indicated that extractions were the result of orthodontic considerations, but most subjects were unable to recall the reason for extraction. The most conspicuous change observed was the increase in frequency of mandibular crowding, predominantly in the incisor segment, which is in agreement with earlier findings in subjects followed from adolescence to 26–30 years of age (14). Increasing anterior crowding in the mandible would be expected owing to the late growth of the mandible, terminating, on average, 2 years later than that of the maxilla (15).

In conclusion, deep overbite and anterior crowding in the mandible tended to increase in frequency. These changes may be taken to reflect physiologic development. Otherwise, the occurrence of the various traits of malocclusion was remarkably stable in the orthodontically untreated individuals.

The sample was therefore considered suitable for studying long-term effects of malocclusion on oral health in forthcoming reports.

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