Occlusal changes from adolescence to adulthood in untreated patients with Class II Division 1 deepbite malocclusion

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Abstract: A sample of 47 untreated children (M 32:F 15) with Class II Division 1 (II/1) deep-overbite malocclusion was collected from a group of patients who declined orthodontic therapy. Longitudinal records consisted of plaster dental casts and lateral cephalograms at original diagnosis and plaster dental casts at a follow-up observation in adulthood, an average of 11.5 years later. To study retrospectively natural changes in dental occlusion during this interval, plaster-cast millimetric measurements were recorded of sagittal dental relationships (first molar and canine), overjet, overbite, and crowding/spacing at the two registrations. Results showed statistically significant improvements in untreated II/1 deepbite malocclusion from adolescence to adulthood for all measured occlusal variables except development of mild crowding. Therefore, assumptions that untreated II/1 distoclusion will worsen with age appear to be unfounded. The evidence indicates that the absence of orthodontic correction for adolescent patients with Class II Division 1 deepbite malocclusion will not usually lead to measurable occlusal deterioration in young adulthood.

Key Words: Longitudinal study, Malocclusion, Class II, Overbite, Treatment need

Treatment of an Angle Class II Division 1 (referred to as II/1) malocclusion with a deep overbite is a common procedure in clinical orthodontics due to a high prevalence of such conditions in the population.[1] Reported benefits associated with corrective treatment of this malocclusion include the prevention of dental problems later in life, such as further deepening of the overbite with the likely development of anterior crowding, maxillary dental flaring or periodontal sequelae[2]; temporomandibular joint disorders (TMD) due to the Class II molar relationship and severe anteroposterior jaw disharmony[3]; and traumatic injuries due to proclination of the maxillary incisors and incompetent lip closure.[4] However, little factual evidence exists in the literature on the natural consequences of aging in Angle II/1 malocclusion.

It is important to recognize the various components that contribute to the diagnosis of II/1 moderate-to-deepbite malocclusion. Several cross-sectional studies have identified an array of components that contribute to Class II occlusal discrepancies.[5-8] Some of the findings in previous studies may be distorted from using "generic," mixed Class II samples—pooling Class II Division 1 with Class II Division 2 cases, a totally distinct anatomical entity.[9] Common features found in II/1 cases are an orthognathic maxilla with protruding maxillary incisors and a retrognathic mandible. Correlation between vertical and horizontal growth aberrations has been pointed out,[10,11] as have morphological characteristics when either vertical or horizontal growth dominates.[12,13] No studies have been found that examine the morphologic characteristics of the specific combination of Angle II/1 malocclusion and deep overbite in untreated individuals. Today, in medically advanced societies, the majority of screened adolescents with II/1 deepbite malocclusion receive orthodontic treatment, significantly reducing the chances of collecting long-term data on the natural, untreated outcome of this occlusal discrepancy.

Carter[14] reported on untreated II/1 patients who were followed cephalometrically from 12 to 17 years of age. Only small changes in dental relationships were found—minor reductions of overjet and overbite were not statistically significant. Using plaster dental casts, Fröhlich[15] studied changes in occlusion in an untreated sample of individuals with Class II malocclusion, aged 7 to 12 years. Compared with normal subjects,[16] the malocclusion subjects appeared to have greater overbite and overjet, indicating that orthodontic treatment

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was justified in these cases. In a recent study, Ingelsson and Hagberg[17] noted significant increases in overbite and overjet after following untreated children with II/1 malocclusion from 7 to 14 years of age. Bishara et al.[18] compared dentofacial changes cephalometrically from the deciduous to the permanent dentition in untreated II/1 and normal subjects. The changes from childhood to adolescence in overjet and overbite within the II/1 group, compared with the normative reference sample, were small, but statistically significant ($p \leq 0.05$): Overjet decreased slightly and overbite increased slightly.

The paucity of orthodontic knowledge about dental occlusal changes beyond adolescence and into adulthood is the basis for undertaking the present study. The aim of this study was to report on the natural occlusal changes from adolescence to adulthood in a group of untreated patients with Angle Class II Division 1 malocclusion having moderate to deep overbite.

Table 1
A four-grade scale for orthodontic treatment need developed by the National Swedish Board of Health.

4	Very urgent need. Functionally and/or psychologically handicapping anomalies, e.g., cleft lip and palate; extreme postnormal (Class II) occlusion; impacted incisors; extensive tooth agenesis.
3	Urgent need, e.g., prenormal (Class III) forced bite; deepbite with gingival irritation; extreme openbite; crossbite causing transverse forced bite; scissor-bite interfering with articulation; severe frontal crowding or spacing; impacted canines, functionally and/or esthetically severe tooth rotations.
2	Moderate need, e.g., esthetically and/or functionally severe proclined or retroclined incisors, deepbite with gingival contact but without gingival irritation, severe dental crowding or spacing, infraocclusion of deciduous molars and permanent teeth, moderate frontal rotations.
1	Little need. Mild deviations from normal (ideal) occlusion, e.g., prenormal (Class III) occlusion with minimal negative overjet, postnormal (Class II) occlusion without other anomalies, deepbite without gingival contact, openbite with minimal frontal opening, crossbite without transverse forced bite, mild crowding or spacing, crossbite of single teeth without forced bite, mild tooth rotations of only minor cosmetic and/or functional significance.

Material and methods

The study sample initially consisted of 71 patients with Angle II/1 malocclusion and moderate to deep overbite who had declined orthodontic treatment during the period 1977 to 1980 at the Department of Orthodontics, Institute of Dentistry, Linköping, Sweden. Initial diagnostic records, consisting of plaster dental casts and lateral cephalograms, were available for all subjects.

The 71 patients, who were children at the time initial records were collected, were recalled as young adults for follow-up, after an average interval of 11.5 years. The age of the patients at recall ranged from 20.2 to 28.7 years. At this visit, new plaster casts were made and an interview was conducted to assess the adult subjects' present attitudes regarding orthodontic treatment. Due to institutional limitations on human medical experimentation, it was not possible in the present study to construct adult cephalograms for longitudinal evaluation.

For each of the 71 untreated patients, the objective need for orthodontic treatment had been assessed as at least "grade 3—urgent," according to a four-grade scale endorsed by the National Swedish Board of Health (Table 1). Other criteria for inclusion of an untreated subject in this study were:

1. The degree of distoclusion (Class II relationship) had to be equal to or more than one-half cusp width at the first permanent molars. In a few cases with ectopic displacement of these molars, the sagittal intermaxillary canine relationship had to be observed at least in a cusp-to-cusp relationship.

2. As the criterion for deep overbite, the lower incisal edges in centric occlusion had to contact at least in the fourth quarter of the palatal surface of the upper central incisors (Figure 1). This means that the minimum overbite qualifying as deepbite was approximately 75% of the clinical crown height of the maxillary central incisors.

3. Neither orthodontic treatment nor tooth extractions were performed

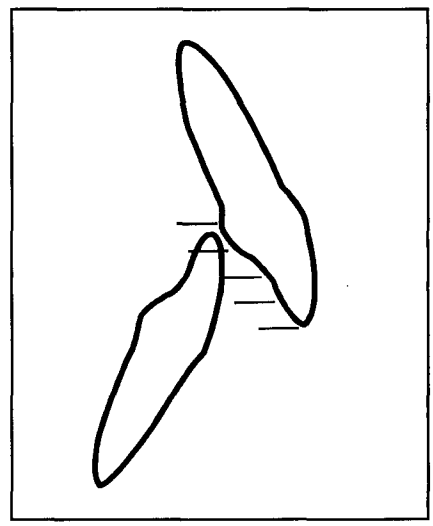

Figure 1
Registration of overbite in terms of quarters of the palatal surface of the upper central incisor clinical crown. This figure illustrates an overbite registered in the fourth quarter (4/4). In this classification, four zones of overbite depth are delineated from the mildest category near the maxillary central incisal edge (1st quarter, 1/4) to the deepest category at the cervicogingival junction (4th quarter, 4/4).

during the observation period.

4. Angle Class II Division 2 malocclusions (based on incisor relationships, especially retroclination) were excluded from the sample.

At the time of follow-up, 15 of the original 71 II/1 patients had received some degree of orthodontic treatment and thus were excluded from the study. In addition, another 5 subjects were unavailable for follow-up and 4 more refused to participate. Thus, the longitudinally examined II/1 material consisted of 47 sets of records with initial cephalograms and initial and final plaster dental casts. The sample comprised 32 boys and 15 girls. The mean age at the first registration (T1) was 12.4 years and ranged from 9.3 to 16.1 years.

Comparative plaster-cast measurements of sagittal dental relationships, overjet, overbite, and crowding were performed using a vernier caliper with an accuracy of 0.1 mm. The measurements were as follows:

- Anteroposterior relationship between the maxillary and mandibular first molars in mm. Distoclusion is given a positive value, according to the methods of Lundström[19]
- Anteroposterior relationship between the upper and lower canines, in mm
- Overjet in mm
- Overbite in mm
- Overbite recorded in quarters of the palatal surface of the upper central incisor (Figure 1)
- Crowding or spacing with each jaw measured in mm to the nearest 0.5 mm, according to the methods of Lundström.[19] Positive values indicate spacing

Differences between the first (T1) and second (T2) registration were tested for significance with student's paired *t*-test. The null hypothesis to be tested was that the intensity of distoclusion (Angle Class II occlusal relationships), overjet, overbite, and dental crowding would not change significantly between T1 (adolescence) and T2 (adulthood) in the II/1 sample. Statistical significance was set at the 0.05 probability level.

The method error statistic (S_i) was calculated according to the standard formula[20] from duplicate measurements performed on 20 sets of dental casts at different times by the same investigator. The error of the method was 0.13 - 0.18 mm for overjet, overbite, and sagittal molar and canine registrations, and 0.24 mm for arch-space measurements in both jaws, all within expectations for method variabilities.

Table 2
Comparison between initial mean values of occlusal variables for original group (n=71) and the examined group (n=47) with Class II Division 1 malocclusion

Occlusal variables (in mm)	n=71	n=47	*
Molar relationship	3.1	2.8	NS
Canine relationship	4.6	4.6	NS
Overjet	7.7	7.9	NS
Overbite	4.7	4.5	NS
Maxillary arch space analysis	1.4	1.6	NS
Mandibular arch space analysis	0.4	0.4	NS

* Student's *t*-test NS=not significant

Table 3
Angular cephalometric mean values and standard deviations in degrees for untreated Class II Division 1 deep-overbite subjects (n=47)

	Mean	S.D.
SNA	82.5	4.0
SNB	77.1	3.3
ANB	5.4	2.2
SN/NP*	6.0	3.8
SN/MP	32.3	5.6
Is/NA	25.4	7.0
Ii/NB	27.5	6.3

* NP = ANS-PNS (palatal plane)

Results

The initial dental and arch space measurements for the II/1 deepbite subjects are shown in Table 2, comparing the original group (n=71) with the subgroup comprising the final, untreated, study sample (n=47). Evaluation of the initial sagittal cephalograms showed mean values indicating an orthognathic maxilla, a slightly retrognathic mandible, and relatively normal vertical relationships (Table 3). Both the original group and the final subgroup of subjects in the study sample demonstrated comparable mean values for the dental and cephalometric variables studied.

Occlusal changes in the untreated II/1 deepbite sample are presented in Table 4 and Figures 2 to 4. Statistically significant improvements were noted in the following variables: The degree of the Class II molar relationship improved from the first to the second registration ($p<0.01$), as did the canine relationship ($p<0.001$); overjet decreased ($p<0.001$); and overbite decreased ($p<0.001$). In contrast, both upper and lower jaws became more crowded ($p<0.001$). Thus, the null hypothesis was rejected for all dental variables tested.

To demonstrate the natural improvements observed in untreated II/1 moderate-to-deep overbite malocclusions over a 10-year period into adulthood, study casts of the subject (Case SJ) who had the largest improvement in overbite between registrations are presented in Figure 5. The original cephalogram is also reproduced.

Discussion

The present longitudinal study describes the occlusal development from adolescence to adulthood in a

Table 4
Differences in occlusal variables between first (T1 - adolescence) and second (T2 - adulthood) registrations for untreated Class II Division 1 deep-overbite subjects (n=47)

Occlusal variables (in mm)	T1 mean	T2 mean	Difference	SE of mean	*T*-test
Molar relationship	2.8	2.3	-0.5	0.18	**
Canine relationship	4.6	3.7	-0.9	0.20	***
Overjet	7.9	6.8	-1.1	0.19	***
Overbite	4.5	3.9	-0.6	0.16	***
Maxillary arch space analysis	1.6	-0.4	-2.0	0.29	***
Mandibular arch space analysis	0.4	-1.2	-1.6	0.25	***

** $p<0.01$
*** $p<0.001$

group of patients with untreated Class II Division 1 malocclusion combined with deep overbite.

The findings from this study indicate that Class II Division 1 occlusal conditions at adolescence do not necessarily lead to age-changes that worsen the sagittal dental relationships or deepen the bite. In fact, the molar and canine sagittal relationships improved significantly during the observation period, as did overbite and overjet (see Table 4). The findings that overjet and overbite displayed statistically significant improvements from ages 12 to 23 years contrast the earlier conclusions of Carter.[14] Studying cephalograms only, Carter showed a slight, nonsignificant decrease in overjet and overbite for untreated individuals with Class II Division 1 malocclusion from 12 to 17 years. However, the individual variation in his study was great.

Overbite reduced significantly, both in millimeters as well as in quarters of the palatal surface of the maxillary incisor crown, representing a functional improvement possibly due in part to the ameliorating effects of occlusal forces and normal attrition. At their follow-up visits in adulthood, eight patients with reduced overbite no longer qualified for the diagnosis of "deep-bite." These results, demonstrating a natural overbite improvement with time, are in agreement with the cephalometric findings of the maturational changes accompanying normal occlusion.[21] Moreover, the present findings correspond with a similar pattern of dentoalveolar height increases in adults observed in cross-sectional samples at various ages,[22] as well as in longitudinal samples.[23,24]

Other investigators have noted occlusal changes occurring between 10 and 17 years of age in patients with normal occlusion,[21] and also between 7 and 14 years of age in children with II/1 malocclusion.[17] These changes indicate a deepening of overbite at an early age. Our findings show that this trend is not a continuous process. Therefore, the potential or inferred risk of worsened conditions for an adolescent patient with II/1 deepbite who declines orthodontic treatment may not be significant by adulthood.

The average subject in the sample had no dental crowding at the initial recordings; instead, slight dental spacing was present (see Table 2). The lack of anterior crowding among these subjects may have been a compelling reason for their rejection of orthodontic treatment. Data analysis indicated that mild dental crowding developed in both jaws during the observation period in most of the untreated patients. These findings of tooth alignment deterioration with age are in agreement with those of Lundström,[11] Sinclair and Little,[25]

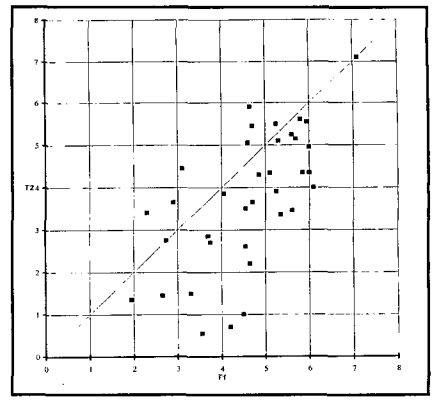

Figure 2
Canine relationship, changes between T1 and T2, in mm (n=36). Unerupted permanent canines at T1 eliminated 11 subjects from this comparison.

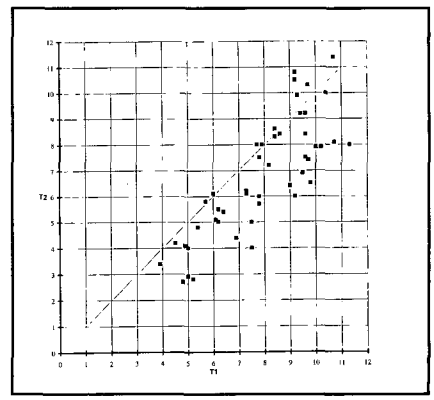

Figure 3
Overjet, changes between T1 and T2, in mm (n=47).

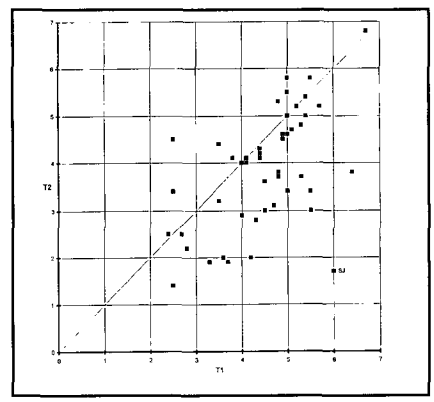

Figure 4
Overbite, changes between T1 and T2, in mm (n=47).

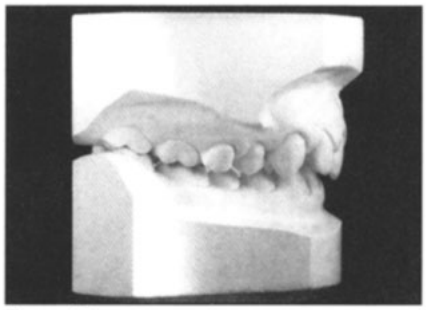

Figure 5A

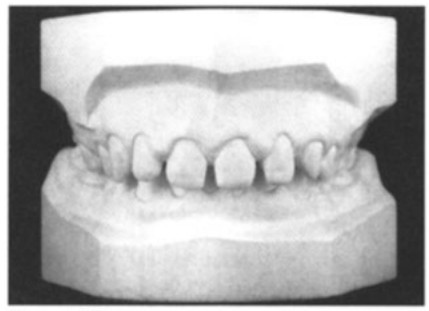

Figure 5B

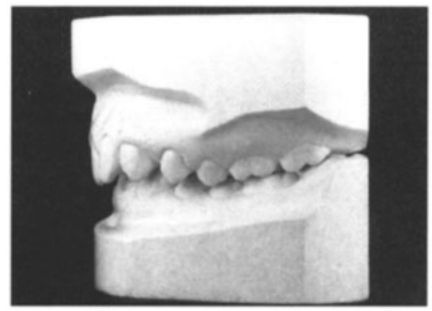

Figure 5C

T1 study casts for subject SJ, who showed the most improvement in overbite between registrations (also see Figure 4: overbite at T1=6 mm; at T2=1.7 mm)

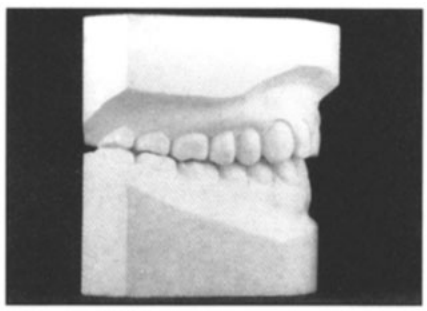

Figure 5D

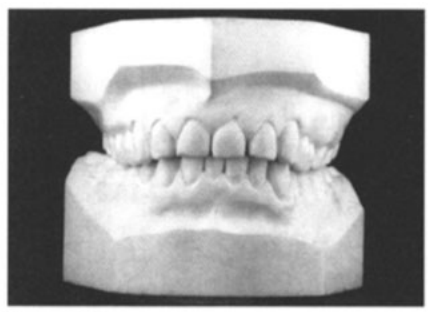

Figure 5E

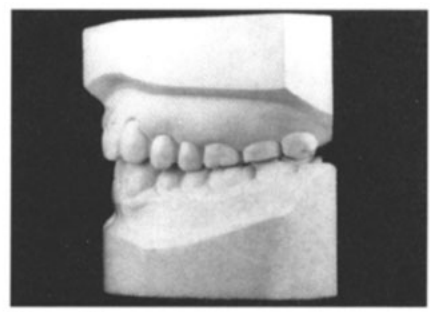

Figure 5F

T2 study casts for subject SJ

Buschang, Stroud, and Alexander,[26] and Bishara et al.,[27] and should be factored into orthodontic treatment planning for the adolescent patient to secure the best long-term outcome.

In collecting the sample, distinctions were made between II/1 and II/2 subjects, and only II/1 untreated malocclusions are examined in this report. Given the specific skeletal and dental characteristics associated with Class II Division 2 malocclusion,[9] a similar longitudinal study of untreated II/2 malocclusions would likely result in long-term occlusal changes markedly different from those found for the II/1 occlusal discrepancy.

According to evaluations using treatment-need indices and cephalometric data, the untreated sample used in this study possessed the anatomical features fully characteristic of Class II Division 1 deep-overbite malocclusion. A majority of this patient type in developed countries today receive orthodontic treatment, which reduces the possibility of scientifically studying the long-term outcome of the untreated malocclusion. In this context, studies such as this one are uncommon and the results should be particularly interesting to clinical orthodontists.

As the comparisons in Table 2 indicate, patients who were excluded from the study due to extractions, orthodontic treatment, unavailability, or refusal to participate did not differ significantly in occlusal variables from the examined group of 47 subjects at the time of initial (T1) registration. The present study therefore appears to be relatively free of internal sampling biases, thus assuring that the results are fully representative of the initial group of 71 patients before any screening.

Figure 5G

Original (T1) cephalogram

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