# Early Treatment of Pseudo-Class III Malocclusion: A 10-Year Follow-Up Study

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Pseudo-Class III malocclusion is defined as a functional forward displacement of the mandible as a result of retroclined maxillary incisors.[1-6] About 5% of the Chinese population is affected by Class III malocclusion, and more than half of these cases are pseudo-Class III.[7]

A crossbite associated with a displacement is a functional indication for orthodontic treatment. Early treatment of a pseudo-Class III malocclusion has a number of advantages: it facilitates the eruption of canines and premolars into a Class I occlusion[5]; it eliminates traumatic occlusion to the incisors[8,9] (which may lead to dehiscence and gingival recession), providing a normal environment for growth of the maxilla[10]; and it often improves the child's self-esteem.[11-13]

Several techniques have been recommended for early treatment of pseudo-Class III malocclusion, including removable appliances, functional appliances, reverse headgear, and simple fixed appliances.[14-21] These clinical studies have been based on retrospectively selected samples, however, and have not documented long-term stability.

We have found a simple 2 × 4 appliance with bands on the first molars, brackets on the incisors, and an archwire with advancing loops to be as effective as a reverse headgear in producing forward movement of the maxilla without mesial movement of the upper molars[8] (Fig. 1). Because the appliance is fixed, its success does not depend on patient compliance. We previously reported the successful initial results of this appliance in 27 consecutively treated young patients with pseudo-Class III malocclusion.[22] In that study, the patient selection criteria were: Class III incisor relationship (at least two incisors in crossbite) in centric occlusion; early mixed dentition, with the second deciduous molars still present; mandibular displacement; and no prior orthodontic therapy. A five-year follow-up of these patients was described subsequently[23]; the present article documents a 10-year follow-up of the same group.

## Materials and Methods

Of the 27 patients (12 female and 15 male) in the initial study, 18 (9 male and 9 female) were examined 10 years later (Table 1). Fifteen of the 18 patients had undergone no further treatment after the 2 × 4 appliance; the other three had been

**TABLE 1**
**AVERAGE AGE (YEARS) AT START OF TREATMENT (T0), END OF TREATMENT (T1), AND 10-YEAR FOLLOW-UP (T2)**

| | N | Age (T0) | S.D. | Age (T1) | S.D. | Treatment Duration | Age (T2) | S.D. | Follow-Up Period |
|---|---|---|---|---|---|---|---|---|---|
| Initial sample | 27 | 10.1 | 1.54 | 10.7 | 1.50 | 0.63 | NA | NA | NA |
| Follow-up group | 18 | 9.8 | 1.20 | 10.6 | 1.32 | 0.80 | 21.4 | 3.55 | 10.8 |
| Dropout group | 9 | 10.4 | 1.64 | 10.8 | 2.00 | 0.40 | NA | NA | NA |

  

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**Fig. 1 Pseudo-Class III case showing how malocclusion can cause attrition. A. Patient with deep overbite and reverse overjet could achieve edge-to-edge bite, but had functional shift. Malocclusion contributed to severe attrition of upper right central incisor. B. Upper 2 × 4 appliance, using .016" round stainless steel archwire with advancing loops. C. Patient after eight months of treatment with the 2 × 4 appliance.**

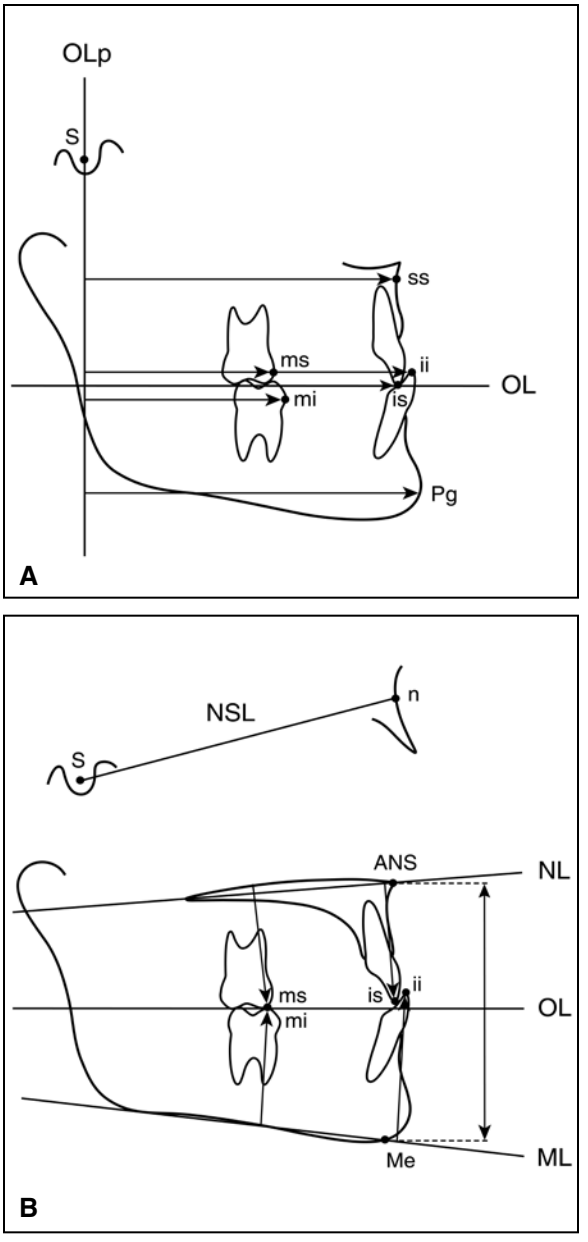


**Fig. 2 Pancherz analysis (developed by Pancherz[24,25] and Hägg and colleagues[28]). A. Horizontal plane: overjet (is-ii), maxillary base (OLp-ss), mandibular base (OLp-Pg), base relationship (ss-Pg), maxillary incisor (ss-is), mandibular incisor (ii-Pg), maxillary molar (ms-ss), and mandibular molar (mi-Pg). B. Vertical plane: overbite (is-ii), maxillary central incisor (is-NL), mandibular central incisor (ii-ML), mandibular plane angle (ML/NSL), maxillary plane angle (NL/NSL).**

subsequently treated with comprehensive fixed appliances due to crowding. One of these three patients had all four first premolars extracted, while the other two were treated without extractions.

Lateral cephalograms were obtained before treatment (T0), after treatment with the 2 × 4 appliance (T1), and at the 10-year follow-up (T2). Cephalometric data were analyzed according to the method of Pancherz[24,25] (Fig. 2). Changes in dentofacial morphology were calculated for T0-T1, T1-T2, and T0-T2 (Fig. 3; detailed data are available in an online appendix to this article). The statistical significance of the differences was analyzed using a two-tailed t-test.

Cephalometric measurements were traced twice, with a two-week interval between data collection. When the systematic error was assessed with a paired t-test, the differences were not statistically significant. The size of the combined method error in locating and measuring the change of the different landmarks was calculated by the formula $SE = \pm \sqrt{\Sigma d^2/2n}$, where d is the difference between two registrations of a pair, and n is the number of double registrations. No error exceeded .5mm.

## Results

### *Pretreatment Dentofacial Morphology (T0)*

The follow-up group started treatment with an average overjet of −1.7mm, an overbite of 1.1mm, and a jaw-base relationship in central occlusion of −7.8mm. None of the mean horizontal or vertical dimensions were significantly different from those of the original sample. The three comprehensive treatment patients showed a more distal mandibular molar position than in the group treated with the 2 × 4 appliance only ($p<.05$).

### *Treatment Changes (T0-T1)*

After 2 × 4 appliance treatment, all patients in the follow-up group had a positive overjet. In the horizontal plane, the overjet improved significantly ($p<.001$, Fig. 3A), along with forward movement of the maxilla ($p<.001$), protrusion of the maxillary incisors ($p<.001$), and retrusion of the mandibular incisors ($p<.01$) and maxillary

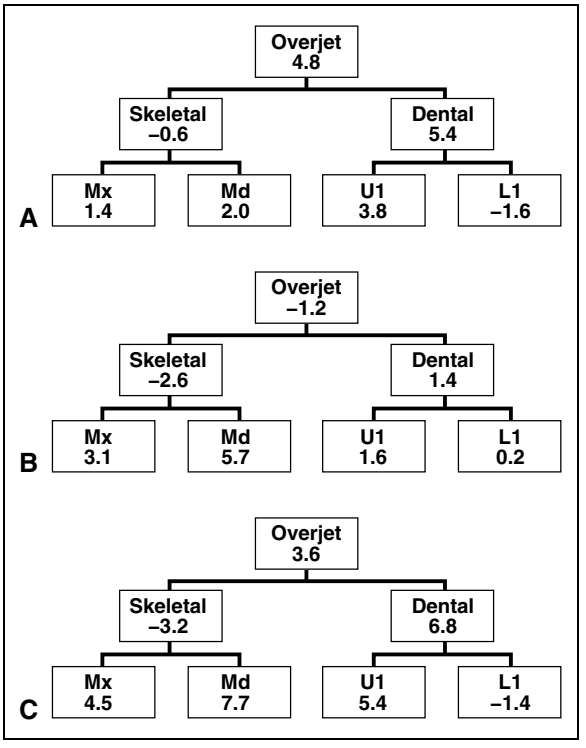


**Fig. 3 Changes in patients treated with 2 × 4 appliance (millimeters). A. Changes during active treatment (T0-T1). B. Changes from post-treatment to 10-year follow-up (T1-T2). C. Changes from pretreatment to 10-year follow-up (T0-T2).**

molars (p<.05). There was a significant increase in lower facial height, accompanied by extrusion of the mandibular incisors (p<.001). The 2 × 4 appliance-only group showed significantly more forward movement of the maxilla (p<.001) compared to the comprehensive treatment group, which showed significantly greater forward movement of the mandibular molars (p<.05), extrusion of the maxillary incisors and molars (p<.05), and extrusion of the mandibular molars (p<.001).

### *Post-Treatment Changes (T1-T2)*

At the 10-year follow-up, 17 of the 18 (94%) patients had a stable overjet. Because mandibular growth was significantly greater than maxillary growth during the post-treatment period, overjet decreased significantly (p<.01), even though the

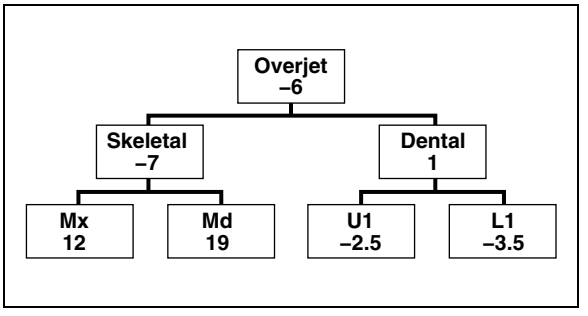


**Fig. 4 Post-treatment changes (millimeters) for patient who developed reverse overjet (T1-T2).**

maxillary incisors moved forward (Fig. 3B). In the vertical plane, there was a significant increase in lower facial height (p<.001), associated with extrusion of the incisors and molars in both arches (p<.001). Forward mandibular movement was similar in the 2 × 4 appliance and comprehensive groups, but forward movement of the maxilla was significantly less in the 2 × 4 appliance group (p<.05). The maxillary molar moved forward in the 2 × 4 appliance group, but not in the comprehensive treatment group (p<.01).

In the single patient who had a reverse overjet at T2, the lower incisors moved 3.5mm backward during the post-treatment period. This patient showed much more mandibular growth than the average for the treatment group (19mm vs. 5.7mm), accounting for the reverse overjet (Fig. 4).

### *Total Changes (T0-T2)*

During the total observation period, there were significant changes in overjet, maxillary base, mandibular base, base relationship, and maxillary and mandibular molars and incisors (Fig. 3C). In the vertical plane, all parameters except the overbite, mandibular plane angle, and maxillary plane angle changed significantly. Horizontal molar movement was significantly different in the 2 × 4 appliance-only and comprehensive treatment groups, with greater forward movement of the maxillary molars in the 2 × 4 appliance patients (p<.01) and greater forward movement of the mandibular molars in the comprehensive patients (p<.05). In the vertical plane,

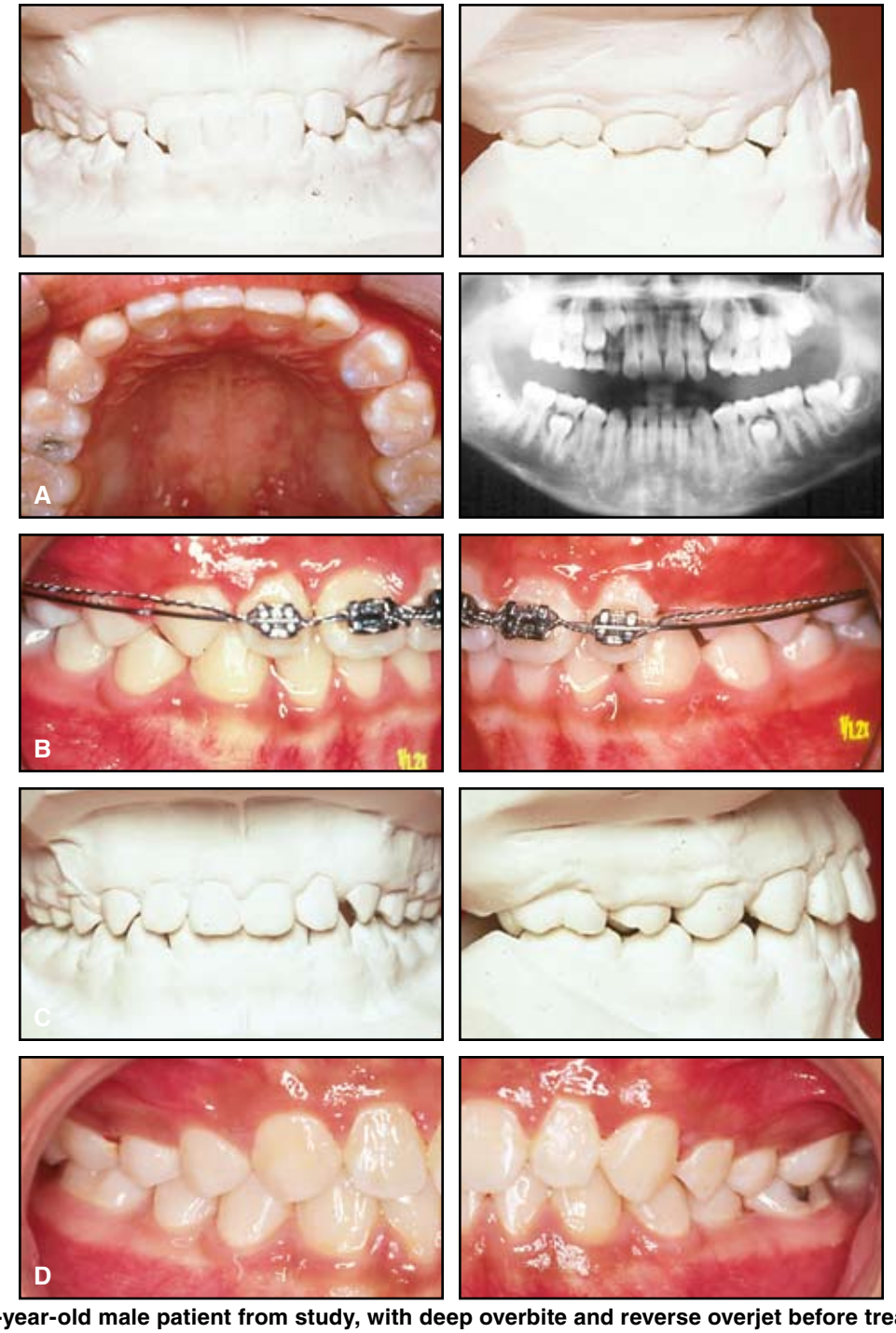


**Fig. 5 A. 10-year-old male patient from study, with deep overbite and reverse overjet before treatment. Note lack of space available for eruption of permanent canines. B. Placement of 2 × 4 appliance. C. Patient after eight months of treatment. D. Patient at five-year follow-up, with positive overjet maintained and dentition guided into stable Class I occlusion.**

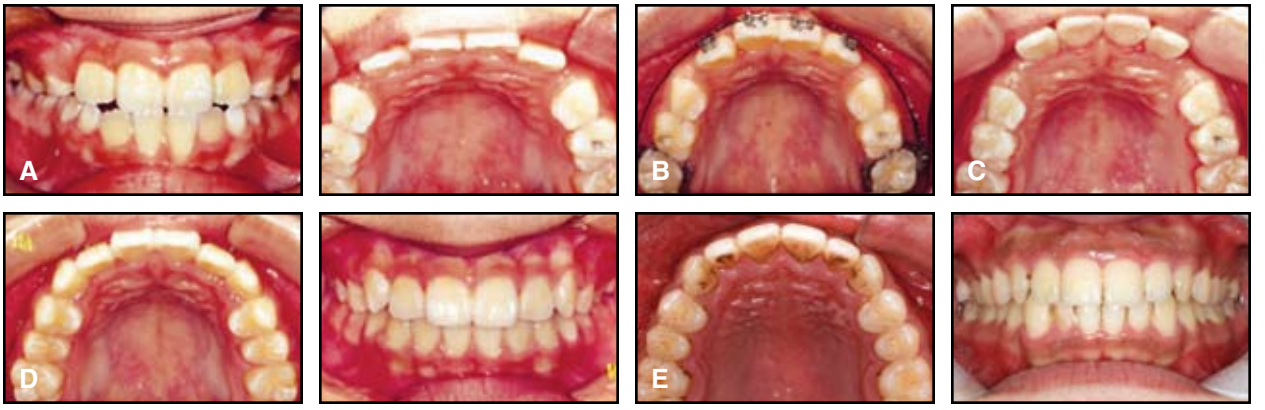


**Fig. 6 A. 9-year-old patient from study, with reverse overjet before treatment (higher-resolution photographs not available). B. Treatment progress using upper .016" round stainless steel archwire with advancing loops. C. Patient after five months of treatment. D. Patient at two-year follow-up. E. Patient at 10-year follow-up.**

the mandibular plane angle decreased significantly more in the 2 × 4 appliance group than in the comprehensive group ($p<.001$).

## Discussion

This study shows that early treatment of pseudo-Class III malocclusion with a 2 × 4 appliance can produce a stable positive overjet in the vast majority of patients, where stability is defined as a lack of reverse overjet 10 years post-treatment.[28-31] Of the 18 patients in the follow-up group, 17 achieved a positive and often slightly overcorrected overjet during the active phase of treatment.

This effect was created by proclination of the upper incisors and slight retroclination of the lower incisors, with the corrected upper incisors kept in place by the normalized overjet and overbite. The interdigitation of the buccal occlusion promoted the growth of the maxillary complex while the mandible was outgrowing the maxilla. Thus, the dental corrections had secondary skeletal benefits that may also have contributed to the stability of the occlusion, as shown in a patient from the five-year follow-up study (Fig. 5). Because the patients were mature adults at the time of the 10-year follow-up (with an average age of 21.4), it is unlikely that unfavorable post-treatment changes would develop later.

Dentofacial changes in this study were assessed predominantly by linear measurements,[24,25] which are reportedly more accurate than angular measurements.[32,33] The Pancherz method of superimposition[24,25] is based on the occlusal plane, which is a more reliable reference than the planes used in other techniques.[34]

During the 10-year follow-up period, A point moved forward 4.5mm in the 2 × 4 appliance group—similar to the results shown by a previous study of longitudinal growth changes in the maxilla.[35] This indicated that early treatment with a 2 × 4 appliance could provide a healthy environment for normal maxillary growth after active treatment to correct the reverse overjet. Forward mandibular growth was much greater than forward maxillary growth during the 10-year follow-up period, but the difference was less than the twofold difference that has been reported to occur after reverse headgear treatment.[28]

One of the benefits of early treatment with a 2 × 4 appliance in patients with pseudo-Class III malocclusion is that space is created for eruption of the upper canines and premolars, allowing the erupting dentition to be guided into a Class I relationship[26] (Fig. 6). In the five-year follow up study, 23 (75%) of the patients treated with a 2 × 4 appliance did not need additional comprehensive treatment. Five patients had extended treatment, but

only one patient had extraction therapy. These results suggest that the majority of pseudo-Class III patients who receive early intervention with a 2 × 4 appliance will not need future orthodontic treatment. Various studies have reported self-correction of anterior crossbite during the transition from the primary to the early mixed dentition,[30,31] suggesting that treatment of anterior crossbite at such an early age should be approached cautiously.

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