

A Follow-up Study of Early Treatment of Pseudo Class III Malocclusion

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Abstract: This study investigated the long-term outcome of 27 consecutive young patients diagnosed with pseudo Class III malocclusion treated with simple fixed appliance (2×4 appliance), which resulted in a positive overjet in all cases. Of the original sample of 27 patients, 25 patients (93%) were examined at the five-year follow-up. Two patients dropped out soon after the active treatment was completed. Of the remaining 25 patients, 20 patients had had no other treatment other than treatment with 2×4 appliance, and the other five patients had undergone additional comprehensive fixed appliance therapy because of crowding. Lateral cephalograms were obtained before and after active treatment with the 2×4 appliance and at five-year follow-up. The long-term results showed that at the five-year follow-up all 25 patients still maintained a positive overjet. The immediate treatment outcome in the sagittal plane was the same for those who had had 2×4 appliance treatment only and those who had had additional treatment with comprehensive fixed appliance treatment, but lower face height increased ($P < .01$) and the mandibular plane angle opened ($P < .05$) more in those who had had additional treatment, comprehensive fixed appliance treatment. During the five-year follow-up period, the dental compensation and the growth of the jaw were similar in both groups. In conclusion, in young patients diagnosed with pseudo Class III malocclusion and treated early with a 2×4 appliance, the overjet was corrected, and the treatment result was maintained in the long term. (*Angle Orthod* 2004;74:465–472.)

Key Words: Class III malocclusion; Orthodontics; Interceptive

INTRODUCTION

In the Chinese population, the prevalence of Class III malocclusion is comparatively high, involving one of 20 individuals. Of these, more than half have pseudo Class III malocclusion.¹ The diagnosis of pseudo Class III malocclusion differs from that of skeletal Class III malocclusion because it is defined as functional forward displacement of the mandible as a result of retroclined maxillary incisors.^{2–6} Because the major underlying cause of pseudo Class III malocclusion

is the inclination of the maxillary incisors, the treatment objectives aim to change the inclination of those incisors.

In general terms, the goal of interceptive orthodontics is to prevent an existing problem from getting worse. Specifically for pseudo Class III, the goals of early treatment are to correct the anterior displacement of the mandible before the eruption of the canines and premolars so that they can be guided into Class I in the proper mandibular position, to provide space for the eruption of the buccal segments as a result of proclination of the upper incisor, and to provide a normal environment for the growth of the maxilla, eliminating the anterior crossbite.^{1,4,7}

Various appliances have been devised for early treatment of a pseudo Class III, such as removable plates with springs, fixed or removable inclined planes, functional appliances, chin-cups, and simple fixed appliances.^{5,8,9} One popular type of simple fixed appliance is the 2×4 appliance, which is composed of bands on the first permanent maxillary molars, brackets on the maxillary incisors, and a wire with advancing loops.⁹

Most clinical studies seemingly are based on retrospectively selected samples with favorable results, and this is

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TABLE 1. Age (y) at Start of Treatment (T0), End of Treatment (T1), and Five-y Follow-up (T2); and Duration of the Treatment/Observation Period (y) of 27 Patients Treated by Simple 2 × 4 Fixed Appliance

Group	n	Age at T0	SD	Age at T1	SD	Duration of Treatment (T0-T1)	Age at T2	SD	Duration of Follow-up (T1-T2)
Initial sample	27	10.1	1.54	10.7	1.50	0.63	—	—	—
Present group	25	10.2	1.53	11.0	1.50	0.64	16.5	2.25	5.6
Group with 2 × 4 treatment only	20	10.2	1.31	10.8	1.30	0.63	16.1	1.91	5.3
Group with extended treatment	5	10.3	2.41	10.9	2.33	0.65	18.0	3.10	7.1
Dropout	2	8.7	1.14	9.2	0.42	0.55	—	—	—
P value		.423 ^a		.344 ^a		.950 ^a	.097 ^b		.006 ^b

^a ANOVA.
^b t-test.
 ** P < .01.

TABLE 2. Description of Five Patients who had 2 × 4 Appliance Treatment Followed by Comprehensive Fixed Appliance (FA) Treatment (Extended Treatment Group) During the Five-y Follow-up. Age (y) at Start of Treatment (T0), End of 2 × 4 Appliance Treatment (T1), and at Follow-up (T2)

	Age at T0	Age at T1	Age at T2	Age at Start of FA	Malocclusion	Treatment
Extended treatment group						
1 L S C	9.5	10.1	16.1	After T1	Crowding	Extraction 14, 24, 34, 44
2 L W C	7.7	8.3	15.6	After T1	Malalignment	Nonextraction
3 T P M	8.8	9.6	15.7	Two y after T1	Malalignment	Nonextraction
4 Y H Y	13.7	14.2	22.4	After T1	Impacted 13	Nonextraction
5 Y Y H	11.6	12.4	20.1	One y after T1	Malalignment	Nonextraction

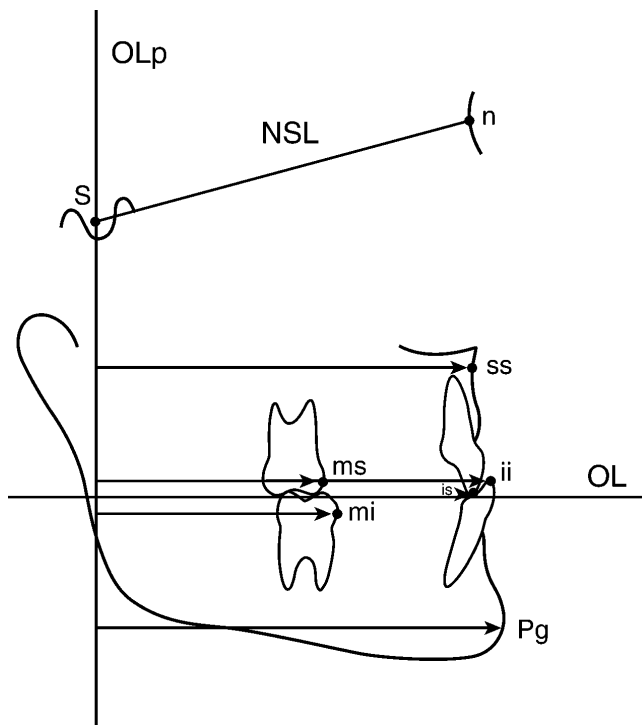


FIGURE 1. Cephalometric analysis in the sagittal dimension: overjet (is-ii'), maxillary base (OLp-ss), mandibular base (OLp-Pg), base relationship (ss-Pg), maxillary incisor (ss-is), mandibular incisor (ii-Pg), maxillary molar (ms-ss), and mandibular molar (mi-Pg) (Pancherz¹⁴ and Hägg et al¹⁷).

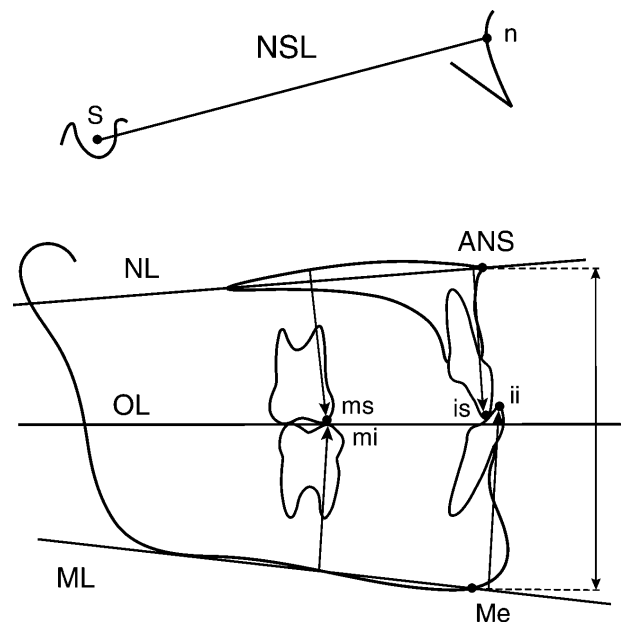


FIGURE 2. Cephalometric analysis in the vertical dimension: overbite (is'-ii), lower facial height (sp-gn), maxillary central incisor (is-NL), mandibular central incisor (ii-ML), mandibular plane angle (ML/NSL), maxillary plane angle (NL/NSL), maxillary occlusal plane angle (OLi/NSL), and mandibular occlusal plane angle (Pancherz¹⁵ and Hägg et al¹⁷).

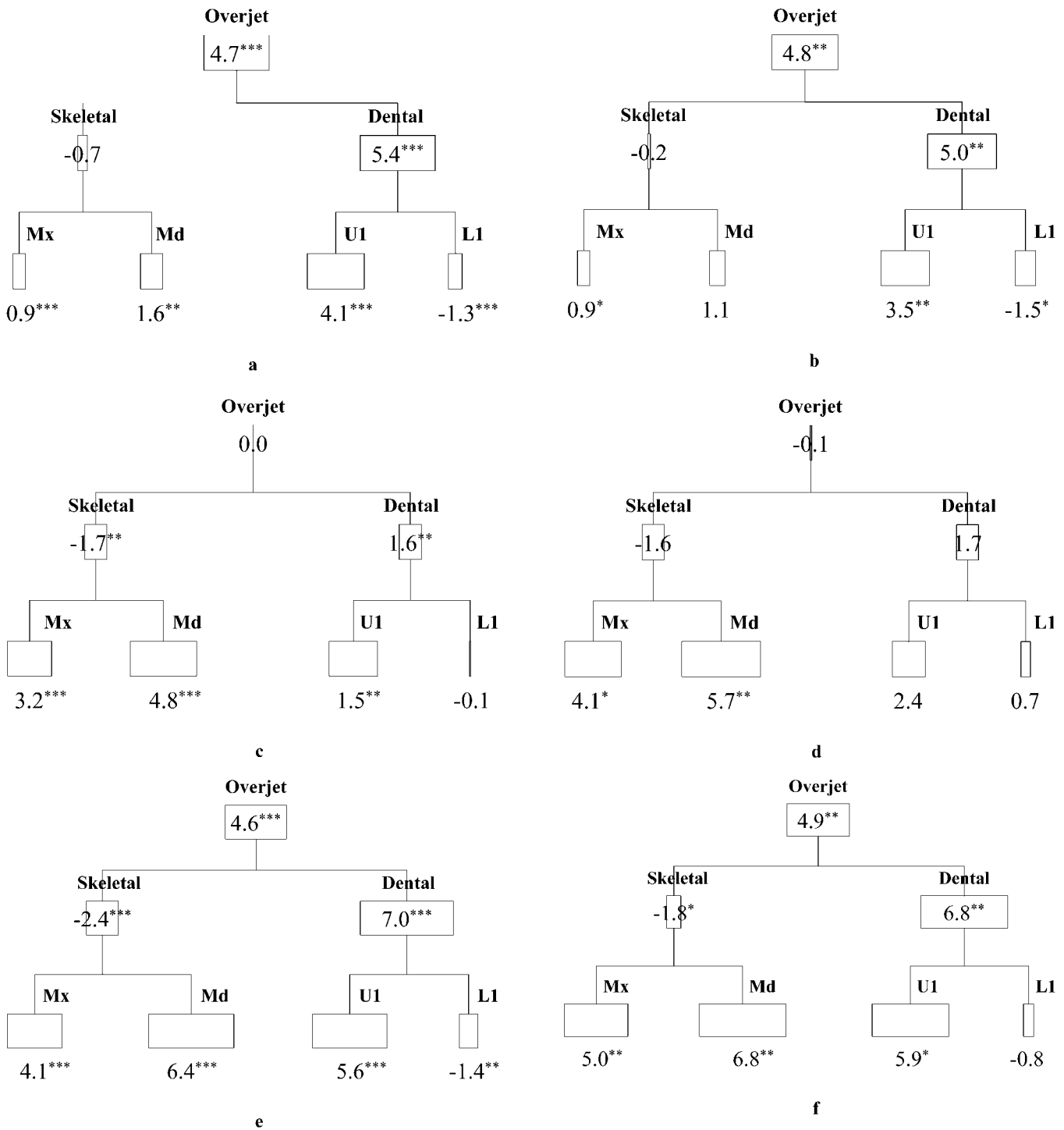


FIGURE 3. Overjet: treatment changes (T0-T1) in the 2 × 4 appliance only group (a) and the extended treatment group (b); posttreatment changes (T1-T2) in the 2 × 4 appliance only group (c) and the extended treatment group (d); total changes (T0-T2) in the 2 × 4 appliance only group (e) and the extended treatment group (f).

likely to result in biased results.¹⁰⁻¹² To better evaluate a success rate, it is necessary to follow consecutively treated cases for a reasonable time and also to describe the inevitable dropout. Ideally, one would like to follow patients treated at a young age until growth ceases. However, be-

cause pseudo Class III is characterized by dental problems and the early treatment is aimed at correcting the angulation of the upper incisors, the follow-up period should be extended until the eruption of all the permanent dentition except the third molars. Accordingly, we decided to follow-

TABLE 3. Dentofacial Morphology of the Pseudo Class III Subjects at the Start of Treatment (T0), End of Treatment (T1), and Five-y Follow-up (T2)

Variable	Original (n = 27)		Dropout (D) (n = 2)	Present (P) (n = 25)		P-D ^a	T0				Diff ^b
	Mean	SD		Mean	Mean		SD	2 × 4 Only (n = 20)		Extended Treatment (n = 5)	
			Mean					SD	Mean	SD	
Pancherz's analysis											
Sagittal plane											
Overjet	-1.7	1.07	-3.5	-1.6	0.96	1.9*	-1.4	0.76	-2.5	1.22	1.15*
Maxillary base	72.1	3.60	71.0	72.2	3.74	1.2	72.4	3.92	71.4	3.11	0.95
Mandibular base	80.5	3.47	81.3	80.4	3.61	-0.8	80.2	3.64	81.2	3.77	-1.00
Base relationship	-8.4	2.87	-10.3	-8.2	2.93	2.0	-7.9	3.08	-9.8	1.60	1.95
Maxillary incisor	7.3	1.61	7.0	7.3	1.67	0.3	7.3	1.77	7.5	1.37	-0.25
Mandibular incisor	0.6	2.68	0.3	0.6	2.78	0.4	0.8	3.04	0.2	1.48	0.55
Maxillary molar	-21.6	2.08	-21.0	-21.7	2.16	-0.7	-21.8	2.20	-21.2	2.14	-0.63
Mandibular molar	-27.9	2.74	-25.0	-28.1	2.70	-3.1	-28.1	3.06	-28.4	1.95	0.32
Molar relationship	-2.1	1.95	-6.3	-1.8	1.57	4.5***	-1.6	1.62	-2.6	1.14	1.00
Vertical plane											
Overbite	1.1	1.75	3.0	1.0	1.73	-2.0	0.7	1.76	2.0	1.22	-1.3
Lower facial height	61.6	3.55	59.5	61.8	3.61	2.3	62.1	3.58	60.6	3.91	1.5
Maxillary incisor	27.3	2.03	26.0	27.4	2.00	1.4	27.4	2.03	27.4	2.07	-0.05
Mandibular incisor	40.9	1.94	40.3	41.0	1.98	0.7	40.7	1.87	42.2	2.17	-1.53
Maxillary molar	21.3	2.55	21.3	21.3	2.65	0.1	20.8	2.46	23.2	2.77	-2.38
Mandibular molar	31.3	3.04	27.5	31.6	2.94	4.1	31.7	3.21	31.1	1.60	0.63
Mandibular plane angle	35.6	5.75	37.5	35.4	5.87	-2.1	35.3	6.22	36.0	4.74	-0.75
Maxillary plane angle	8.7	3.23	11.0	8.5	3.27	-2.5	8.3	3.46	9.2	2.59	-0.88
Maxillary occlusal plane angle	20.5	5.19	20.5	20.5	5.35	0.0	20.8	5.87	19.2	2.28	1.63
Mandibular occlusal plane angle	17.0	5.50	11.0	17.5	5.40	6.5	18.3	5.38	14.6	4.93	3.65

^a P - D difference between the present subjects (n = 25) and dropout group (n = 2).

^b Diff, difference between 2 × 4 appliance treatment only group and extended treatment group.

* P < .05; ** P < .01.

up all consecutively treated patients for a period of five years.

Previously, we reported a series of consecutive young patients with pseudo Class III malocclusion, in whom the simple 2 × 4 appliance efficiently corrected the malocclusion. In that sample, the selection criteria were a Class III

incisor relationship (at least two incisors in crossbite) in centric occlusion, in the early mixed dentition, without exfoliation of the second primary molars, exhibiting mandibular displacement and the patients did not have orthodontic therapy before the treatment related to the study.⁷ These patients were successfully treated with the simple 2 × 4

TABLE 4. Sagittal Treatment Changes (T0-T1), Posttreatment Changes (T1-T2), and Total Changes (T0-T2) in 2 × 4 Appliance Only Group (n = 20) and Extended Treatment Group (n = 5)

Variable	T0-T1					T1-T2				
	2 × 4 Only		Extended Treatment		Diff ^a	2 × 4 Only		Extended Treatment		Diff
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Pancherz's analysis (sagittal plane)										
Overjet	4.7***	0.97	4.8**	1.10	-0.1	0.0	1.19	0.1	1.08	-0.1
Maxillary base	0.9***	0.45	0.9*	0.55	0.0	3.2***	1.87	4.1*	2.19	-1.0
Mandibular base	1.6**	1.83	1.1	0.89	0.5	4.8***	1.44	5.7**	2.68	-0.9
Base relationship	-0.7	1.84	-0.2	0.57	-0.5	-1.7**	1.96	-1.6	1.52	0.0
Maxillary incisor	4.1***	1.65	3.5**	1.22	0.6	1.5**	2.19	2.4	3.61	-0.9
Mandibular incisor	-1.3***	1.35	-1.5*	1.00	0.2	-0.1	1.78	0.7	2.77	-0.8
Maxillary molar	-1.6***	1.45	-0.3	0.91	-1.3	1.5**	1.81	1.9	1.56	-0.4
Mandibular molar	-0.2	1.36	-0.7	1.30	0.5	0.5	1.56	2.2	2.14	-1.7
Molar relationship	-2.1**	2.70	0.2	1.15	-2.3	-0.7	1.55	-1.9	1.92	1.3

^a Diff, difference between 2 × 4 appliance treatment only group and extended treatment group.

* P < .05; ** P < .01; *** P < .001.

TABLE 3. Extended

T1		T2		Diff d	T1		T2		Diff d
2 × 4 Only (n = 20)		Extended Treatment (n = 5)			2 × 4 Only (n = 20)		Extended Treatment (n = 5)		
Mean	SD	Mean	SD		Mean	SD	Mean	SD	
3.3	0.78	2.3	0.76	1.00*	3.3	1.40	2.4	0.82	0.88
73.3	3.92	72.3	2.95	0.95	76.4	4.58	76.4	3.13	0.00
81.8	4.12	82.3	3.93	-0.50	86.6	4.86	88.0	4.57	-1.40
-8.6	4.14	-10.0	2.12	1.45	-10.2	4.14	-11.6	1.52	0.73
11.3	2.42	11.0	1.17	0.32	12.8	2.48	13.4	3.94	-0.58
-0.5	3.50	-1.3	1.92	0.78	-0.65	3.65	-0.6	3.75	-0.05
-23.4	3.00	-21.5	2.06	-1.88	-21.9	2.99	-19.6	1.52	-2.30
-28.3	3.06	-29.1	2.66	0.85	-27.8	3.37	-26.9	1.78	-0.88
-3.7	2.47	-2.4	1.85	-1.28	-4.3	2.28	-4.3	1.67	-0.03
1.7	0.80	2.2	0.45	-0.55	1.8	1.07	1.5	0.71	0.25
63.9	3.49	64.6	4.98	-0.72	69.1	5.06	68.8	4.66	0.33
28.0	1.96	27.1	3.09	0.88	29.2	2.39	28.4	2.68	0.80
42.3	1.66	46.7	3.60	-4.43**	46.0	3.37	50.0	3.48	-4.00*
21.4	1.88	23.7	2.28	-2.33	23.8	2.46	26.0	1.22	-2.18
32.8	3.10	36.0	2.45	-3.18**	36.1	4.85	39.6	1.95	-3.50*
36.9	5.51	36.2	4.44	0.67	36.1	4.74	37.2	4.32	-1.83
8.4	3.54	10.4	2.97	-2.05	8.1	3.10	11.0	2.35	-2.95
20.1	5.44	16.7	4.47	3.40	18.4	5.19	17.0	3.81	1.43
16.9	4.63	14.0	3.00	2.93	15.2	5.26	12.8	2.28	2.40

appliance¹³ and were followed-up for one year.⁷ Subsequently, this study aims to present the long-term follow-up of consecutive young patients with pseudo Class III malocclusion treated with the simple fixed 2 × 4 appliance.

MATERIALS AND METHODS

The original sample of 27 consecutive young patients (12 female and 15 male patients) with pseudo Class III mal-

TABLE 4. Extended

2 × 4 Only		T0-T1		Diff
Mean	SD	Mean	SD	
4.6***	1.46	4.9**	1.52	-0.3
4.1***	1.76	5.0**	2.24	-1.0
6.4***	2.04	6.8**	2.84	-0.4
-2.4***	2.37	-1.8*	1.30	-0.6
5.6***	2.40	5.9*	4.20	-0.3
-1.4**	2.11	-0.8	3.63	-0.6
-0.1	1.58	1.6	1.60	-1.7*
0.3	1.90	1.5*	0.94	-1.2
-2.7***	2.59	-1.7*	1.30	-1.0

occlusion⁶ treated with a simple 2 × 4 appliance⁹ was selected using the criteria described earlier by Rabie and Gu.⁶ At the 5-year follow-up, 25 patients (15 male and 10 female patients) participated (Table 1). Two patients dropped out soon after the successful completion of 2 × 4 appliance treatment.

Twenty patients had the 2 × 4 appliance treatment only, whereas the other five patients also underwent comprehensive upper and lower fixed appliance treatment (extended treatment group) because of crowding. Among these five patients, only one of them had all first premolars extracted during the orthodontic treatment, whereas the other four patients had nonextraction fixed appliance treatment (Table 2). In this study, the lateral cephalograms obtained at the start of treatment (T0), at the end of the 2 × 4 appliance treatment (T1), and at the five-year follow-up (T2) were analyzed according to Pancherz's method (Figures 1 and 2).^{14,15} This analyzes dentofacial morphology at the start of treatment (Table 3), treatment changes (T0-T1), posttreatment changes (T1-T2), and total changes (T0-T2) (Tables 4 and 5; Figure 3).

Statistical analysis

For the cephalometric analysis, treatment changes between the treated groups were compared using a two-tailed

TABLE 5. Vertical Treatment Changes (T0-T1), Posttreatment Changes (T1-T2), and Total Changes (T0-T2) in 2 × 4 Appliance Only Group (n = 20) and Extended Treatment Group (n = 5)

Variable	T0-T1					T1-T2				
	2 × 4 Only		Extended Treatment		Diff ^a	2 × 4 Only		Extended Treatment		Diff
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Pancherz's analysis (vertical plane)										
Overbite	1.0*	1.86	0.2	0.84	0.8	0.1	0.87	-0.7	0.97	0.8
Lower facial height	1.8***	1.23	4.0*	2.12	-2.2**	5.3***	3.10	4.2**	1.30	1.1
Maxillary incisor	0.6	1.64	-0.3	2.22	0.9	1.2**	1.66	1.3	1.30	-0.1
Mandibular incisor	1.6***	1.47	4.5*	2.18	-2.9**	3.7***	2.41	3.3*	1.60	0.4
Maxillary molar	0.6*	1.13	0.5	1.58	0.1	2.5***	1.58	2.3*	1.79	0.2
Mandibular molar	1.1***	1.08	4.9**	1.67	-3.8***	3.3***	2.20	3.6**	0.89	-0.3
Mandibular plane angle	1.6***	1.15	0.2	1.10	1.4*	-0.8*	1.50	1.0*	0.71	-1.8*
Maxillary plane angle	0.0	1.44	1.2	3.11	-1.2	-0.3	1.55	0.6	1.52	-0.9
Maxillary occlusal plane angle	-0.7	2.59	-2.5	2.78	1.8	-1.7**	2.00	0.3	2.39	-2.0
Mandibular occlusal plane angle	-1.3*	2.21	-0.6	3.65	-0.7	-1.7	3.70	-1.2	2.05	-0.5

^a Diff, difference between 2 × 4 appliance treatment only group and extended treatment group.

* $P < .05$; ** $P < .01$; *** $P < .001$.

t-test. The level of significance used was $P < .05$, $P < .01$, and $P < .001$.

Method error study

For error measurements, all measurements were retraced twice independently on two separate occasions with a two-week interval. The system error was assessed by the aired *t*-test on the means of the individual variables obtained from the measurements made on the two different occasions. Besides, the size of the combined method error in locating and measuring the change of the different landmarks was calculated by the formula $SE = \pm \sqrt{\sum d^2/2n}$, where *d* is the difference between two registrations of a pair, and *n* is the number of double registrations. There was no significant systematic error, and no error exceeded 0.5 mm.

RESULTS

Pretreatment dentofacial morphology (T0)

In the present follow-up group (n = 25), the average overjet was -1.6 mm, the overbite one mm, the lower facial height 61.8 mm, and the jaw base relationship in central occlusion was -8.2 mm, which was not statistically significant from that of the original sample (Table 3). However, there was a marked difference in the overjet and molar relationship at the start of treatment (T0) between the two dropouts and the present follow-up group. It was also shown that before the start of any orthodontic treatment (T0), the extended treatment group (n = 5) had significantly more ($P < .05$) severe reverse overjet than the 2 × 4 appliance only group (n = 20).

Treatment changes (T0-T1)

All 25 patients in the present follow-up group had a positive overjet after treatment with a 2 × 4 appliances only (T1). During treatment, in the sagittal plane (Table 4), there was a significant improvement of the overjet ($P < .001$) with forward movement of the maxilla ($P < .001$), protrusion of maxillary incisors, and retrusion of the mandibular incisors and maxillary molars ($P < .001$). In the vertical plane (Table 5), there was a significant increase in the lower facial height and mandibular plane angle. In addition, there was a reduction of the inclination of the mandibular occlusal plane and extrusion of the mandibular incisors and molars. Comparison of the 2 × 4 appliance only group and the smaller five-patient group, which later received comprehensive treatment (extended treatment group), showed that there was no difference in the sagittal treatment changes (Table 4; Figure 3a,b). However, in the later comprehensive treatment group (Table 5), in the vertical plane, there was significantly greater increase in the lower facial height and in the extrusion of the mandibular incisors and mandibular molars.

Posttreatment changes (T1-T2)

At the end of the five-year follow-up period, all subjects (n = 25) maintained a positive and unchanged overjet. However, there was a significant change of the jaw base relationship ($P < .01$) because of lesser forward movement of the maxilla than that of the mandible and protrusion of the maxillary incisors during the posttreatment period. The mandibular incisors remained unchanged (Table 4). In the vertical plane, there was a significant increase in the lower facial height and in the extrusion of the incisors and molars in both jaws (Table 5). Comparison of the 2 × 4 appliance

TABLE 5. Extended

T0-T				
2 × 4 only		Extended Treatment		Diff
Mean	SD	Mean	SD	
1.*	1.97	-0.5	1.58	1.6
7.***	3.53	8.2**	1.92	-1.2
1.**	2.51	1.0	2.47	0.9
5.***	2.42	7.8**	1.96	-2.5*
3.***	1.75	2.8	2.39	0.2
4.***	2.42	8.5***	1.00	-4.1**
0.	2.09	1.2*	0.84	-0.4
-0.	2.21	1.8	2.59	-2.1
-2.**	2.95	-2.2	2.95	-0.2
-3.**	4.45	-1.8	4.55	-1.3

only group and the extended treatment group (Figure 3c,d) showed that there was a significant reduction of the mandibular plane angle in the 2 × 4 appliance only group but a significant increase in the extended treatment group, and this difference between the two groups was statistically significant ($P < .05$).

Total changes (T0-T2)

During the total observation period, there were significant changes in both groups in all sagittal parameters (Figure 3e,f) except for the maxillary and mandibular molars (Table 4), and all vertical parameters underwent significant changes except for the maxillary and mandibular plane angles (Table 5). There was significantly more extrusion of the mandibular molars and incisors in the extended treatment group than in the 2 × 4 appliance only group.

DISCUSSION

This study describes the follow-up changes in a sample of consecutively treated patients followed for more than five years after active treatment with a simple 2 × 4 fixed appliance. The original sample consisted of 27 consecutive young patients with pseudo Class III malocclusions due to retroclined upper incisors, who were treated with 2 × 4 appliance according to a prospective protocol.^{7,13,16} The immediate treatment changes and short-term follow-up results have been reported previously.^{7,16} During the five-year follow-up, there was a dropout of two patients (Table 1). Among the five patients who had undergone comprehensive fixed appliance therapy during the follow-up period, ie, after the 2 × 4 appliance treatment, the main reason for the fixed appliance treatment was malalignment, and none of those patients were treated because of a relapse of the reverse overjet (Table 2).

A commonly used method to assess success rate and stability of overjet correction has been to report the status of

the overjet.^{17,18-20} In the present study, all patients achieved a positive and often slightly overcorrected overjet during the active treatment after an average of eight months of treatment. This positive overjet was maintained in all subjects who were followed for five years after active treatment. The overjet remained stable because the corrected upper incisors were kept in place by normalizing the overjet and overbite in the phase 1 treatment. In addition, the proclination of the upper incisors before the eruption of the buccal segment allowed the canines and premolars to erupt into a Class I in centric relations, which also may have contributed to the stability of the occlusion (Table 4; Figure 3b). In this study, the dentofacial changes were assessed mainly by linear^{15,16} rather than angular measurements.²¹ Bookstein²² has shown that linear measurements are more accurate than angular measurements to describe dentofacial changes. Using Pancherz's analysis,^{15,16} all measurements are made in relation to the occlusal plane, ie, close to the "problem area." Pancherz's method has also been reported to be a more suitable method for assessing dentofacial changes as compared with other superimposition methods.²³

One of the benefits claimed for early treatment with 2 × 4 appliance is that space will be provided for the eruption of the canines and premolars in the upper arch, allowing the erupting dentition to be guided into a Class I relationship in centric relation.¹⁷ In this five-year follow up, 75% of the original patients who had 2 × 4 appliance treatment seemingly did not need to have comprehensive treatment. A further study will address the need for second-phase treatment objectively.

Among the five patients with extended treatment, which was offered without additional charge, only one patient had extraction therapy. Thus, early intervention with 2 × 4 appliances in subjects with pseudo Class III required no further orthodontic intervention in the vast majority of the patients treated. Thus, the treatment seems to have served as a good interceptive measure.

During the five-year follow-up, A point moved forward significantly (3.2 mm, $P < .001$) in the 2 × 4 appliance-treated group, which was similar to the reported longitudinal growth changes of the maxilla.²⁴ This indicated that early treatment with 2 × 4 appliance could provide an environment for normal maxillary growth after active treatment to correct the reverse overjet. The forward mandibular growth during the five-year follow-up was about twice that of the maxillary forward growth, which is similar to that reported for cases with stable results after reverse headgear treatment²⁵ and similar to that observed after functional appliances therapy of Class II cases.²⁴

At the five-year follow up, the patients were on average 16.5 years of age, ie, when the majority of the patients were still growing, but usually at a slower rate.²⁶ This supports the success of the treatment because patients showing unfavorable posttreatment changes would be revealed by 16.5 years of age after a five-year follow-up.^{14,18}

The purpose of the current study was to follow-up the cases that received early treatment and to verify the benefits of early treatment with simple fixed appliances. Therefore, there was no direct need for an untreated matched control group. The five-year follow-up showed that by subjective assessment, 75% of the cases treated in the young permanent dentition required no further orthodontic treatment after the initial period of eight months of treatment in the mixed dentition with the 2 × 4 appliance. The remaining 25% that received further comprehensive fixed appliance therapy were all corrected by nonextraction, with the exception of one case who had extraction therapy.

Treatment of pseudo Class III in the mixed dentition in this study has fulfilled the expected objectives of interceptive treatment by either eliminating the need for further treatment or simplifying the second phase of comprehensive treatment. It is important to highlight the fact that the objective of early treatment of a pseudo Class III is not necessary to eliminate the need for second phase of treatment but rather to reduce the difficulty of treatment of phase II if it is needed.

At least two studies^{19,20} have reported that self-correction of anterior crossbite during the transition from primary to early mixed dentition was potentially high. This seems to indicate that very early treatment of anterior crossbite should be implemented with great caution to avoid unnecessary clinical procedures.

CONCLUSIONS

This prospective longitudinal study showed that treatment of pseudo Class III in the mixed dentition, with a simple fixed (2 × 4) appliance as a first-phase treatment, resulted in a positive overjet, which was maintained in the long-term. In a minority of patients, a second-phase treatment with fixed appliance was needed.

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