Original Article

Outcomes of two-phase orthodontic treatment of deepbite malocclusions

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ABSTRACT

Objective: The objective of this prospective controlled study was to assess the outcomes of two-phase treatment of deepbite patients revaluated at the end of circumpubertal growth, 1 year after the end of a phase-2 treatment.

Materials and Methods: A sample of 58 subjects with deepbite (mean age 9.7 years, overbite greater than 4.5 mm) was treated consecutively with a two-phase protocol. Lateral cephalograms were taken before treatment (T1), at the completion of phase 1 (T2), and 1 year after the completion of phase 2 with fixed appliances (T3, mean age 15.8 years). The T1-T2, T2-T3, and T1-T3 changes were compared with those of the 29 subjects (mean age at T1 = 9.1 years) with untreated deepbite (*t*-tests for independent samples). Prevalence rates for improved overbite during the T1-T3 interval and for corrected overbite at T3 were contrasted in the treated vs untreated groups (z tests on proportions).

Results: Overbite was reduced by 1.9 mm in the treated group as a result of overall treatment; this group also displayed a significant reduction in the interincisal angulation (-6.6°) due to a significant proclination of upper incisors (4.1°) and a significant increase in the projection of the lower incisors (2.0 mm).

Conclusions: The average amount of deepbite correction 1 year into retention was modest, and it was mainly due to a significant proclination of the incisors. The prevalence rate of subjects with a corrected overbite in the treated sample at T3 (74%) was not significantly different from that of the untreated sample (52%). (*Angle Orthod.* 2011;81:945–952.)

KEY WORDS: Deepbite; Early treatment; Two-phase treatment; Overbite

INTRODUCTION

An increased overbite (deepbite) is highly prevalent in the general population. Approximately 50% of non-Hispanic white adolescents in the United States present with an overbite greater than 4 mm, and over 10% of them present with an overbite greater than 6 mm.[1] Despite this large prevalence, deepbite is not considered usually as a specific malocclusion, and it is regarded often as an attribute of other discrepancies in the sagittal plane, with special regard to Class II division 1 and division 2 malocclusions.[2] On the other hand, unfavorable consequences of an untreated deepbite include an increase in anterior crowding, maxillary dental flaring, and associated periodontal sequelae.[3–5]

The literature addressing short- and long-term results of single-phase or two-phase orthodontic treatment specifically aimed at deepbite correction is also scarce. The few studies[6–8] that have dealt with the topic indicate that active treatment is able to induce a moderate improvement of the overbite, which is generally followed by tendency toward relapse. Unfortunately, the few investigations on the effects of orthodontic treatment in deepbite patients either did not include untreated control subjects[6,7,9] or used controls with normal overbite values.[8]

The aim of the present study was to assess the outcomes of two-phase treatment of deepbite patients

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Table 1. Demographics of the Treated and Untreated Groups[a]

	Age at T1, y		Age at T2, y		Age at T3, y		T1-T2 Interval, y		T2-T3 Interval , y		T1-T3 Interval, y	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Treated group (n = 58, 38 females, 20 males)	9.7	1.6	12.5	1.3	15.8	1.8	2.8	1.3	3.3	1.5	6.1	2.0
Untreated group (n = 29, 14 females, 15 males)	9.1	0.9	12.3	0.8	15.2	0.9	3.1	0.9	2.9	0.9	5.9	1.1

[a] T1 indicates before treatment; T2, T2, at the completion of phase 1; T3, 1 year after the completion of phase 2 with fixed appliances; and SD, standard deviation.

revaluated at the end of active circumpubertal growth, 1 year after the end of phase-2 treatment. The treatment results were compared to longitudinal changes in a group of subjects with untreated deepbite malocclusions.

MATERIALS AND METHODS

The treated group consisted of patients treated consecutively with a two-phase nonextraction protocol at the Department of Orthodontics of the University of Florence in Italy. In order to be enrolled in the study the subjects had to present with deepbite (overbite of >4.5 mm).[2,4,8–11] A total of 58 subjects were enrolled: 30 subjects were in the intermediate mixed dentition, and 28 subjects were in the late mixed dentition. Twenty-six subjects were Class I, 25 subjects presented with Class II division1 malocclusion, and seven subjects showed Class II division 2 malocclusion before treatment. The patients underwent a phase-1 treatment either with a removable upper plate with anterior bite plane (26 subjects) or with headgear associated with an anterior bite plane (32 subjects). No subject dropped out of the study after phase-1 treatment; therefore, all 58 patients underwent phase-2 therapy. Phase-2 treatment was accomplished with fixed appliances (0.022-inch slot, preadjusted brackets). The duration of active phase-1 treatment was 23 months on average, with an ad interim interval before phase 2 ranging from 6 to 22 months, during which patients wore a removable upper plate with anterior bite plane at night. The duration of active phase-2 treatment with fixed appliances was 20 months on average, followed by a posttreatment retention period of 13 months, on average. As a retention protocol all subjects wore upper and lower Hawley retainers.

Lateral cephalograms were taken in all patients at T1 (before phase-1 treatment), T2 (before phase-2 treatment), and T3 (at least 1 year after the completion of active phase-2 therapy with fixed appliances). Permission for the study was obtained from the Ethical Committee of the University of Florence. Demographics of the treated sample are reported in Table 1. Treatment included the pubertal growth spurt in all subjects, since no subject had experienced the adolescent growth spurt prior the beginning of phase-1 treatment and at the completion of active circumpubertal growth (CS6, according to the cervical vertebral maturation method)[12] at the final observation.

The files of the University of Michigan Growth Study (UMGS, n = 706) and of the Denver Child Growth Study (DCGS, n = 155) were searched for availability of longitudinal records of orthodontically untreated subjects with deepbite malocclusion. Both the treated and untreated groups comprised white subjects. Lateral cephalograms of good quality of 29 subjects at three consecutive developmental intervals (T1 through T3) corresponding to the three observations in the treated group were selected (Table 1).

Cephalometric Analysis

Cephalograms were traced by one investigator (Dr Franchi) and then verified for landmark location, anatomical contours, and tracing superimpositions by a second investigator (Dr Baccetti). Any disagreements were resolved by retracing the landmark or structure to the satisfaction of both observers. A customized digitization regimen and analysis provided by Viewbox 3.1 (dHAL Software, Kifissia, Greece) was utilized for all of the cephalograms that were examined in this study.

The magnification of the three data sets was different, with the lateral cephalograms from the Department of Orthodontics of the University of Florence showing a magnification of 8%, those from UMGS showing a magnification of 12.1%, and those from the DCGS showing a magnification of 4%. Therefore, the lateral cephalograms from the two growth studies of the untreated group were corrected to match the 8% enlargement factor of the treated group.

The examiners who analyzed lateral cephalograms of treated and untreated patients at T1, T2, and T3 were blind with regard to the origin of the films and to the group to which individual subjects belonged.

Error of the Method

A total of 40 lateral cephalograms randomly chosen from all observations were re-traced in random order and re-digitized to calculate method error by means of

Dahlberg's formula.[13] The operator who re-traced and re-digitized the cephalograms was blinded with regard to time period and group. The error for linear measurements ranged from 0.25 mm (overjet) to 0.75 mm (Pg to Nasion perpendicular), while the error for angular measurements varied from 0.55° (Ar-Goi-Me) to 1.40° (interincisal angle).

Statistical Analysis

Descriptive statistics of craniofacial measurements in both treated and untreated samples at T1, as well as the T1-T2, T2-T3, and T1-T3 changes, were calculated. The Kolmogorov-Smirnov test revealed normality of distribution for the measurements used in the study. Therefore, parametric statistics (Student's *t*-tests for independent samples) were utilized. The following comparisons were carried out for the dentoskeletal variables:

1. Treated group vs untreated group at T1 (comparison on starting forms);
2. T1-T2 changes in treated group vs untreated group (effects of phase-1 treatment);
3. T2-T3 changes in treated group vs untreated group (effects of phase-2 treatment); and
4. T1-T3 changes in treated group vs untreated group (effects of overall comprehensive treatment).

For all comparisons, description of results, and discussion of the outcomes, changes due to treatment are intended as net differences between treated and untreated groups. The power of the study was calculated on the basis of the sample size of the two groups and on an effect size equal to 1.[14] The power was 0.992 at an alpha level of .05.

Prevalence rates for the following changes in overbite were calculated at T2 and T3, with respect to the initial values at T1 in both groups, and they were expressed in terms of number of subjects showing the change during specific time intervals (T1-T2 and T1-T3), thus: (1) Improvement in overbite equal or greater than −1.5 mm (more negative change) and (2) worsening in overbite equal or greater than +0.5 mm (more positive change).

The prevalence rates of subjects showing correction of deepbite at T2 and T3 in both treated and untreated groups were calculated. Correction of deepbite was assessed when the overbite value was smaller than 4 mm at the specific time point.[15]

In the treated group, a discriminant analysis on the cephalometric variables at T1 with the value of overbite at T3 (classified as "corrected" when overbite was smaller than 4 mm vs "not corrected" when overbite was still larger than 4 mm) as the dependent variable was performed (stepwise method, with *F* to enter 4.00 and *P* to remove 3.99). The aim was to identify T1 predictive variables for favorable/unfavorable individual outcomes in overbite correction.

All statistical computations, comparisons, and analyses were carried out with statistical software (SPSS version 17.0, SPSS Inc, Chicago, Ill).

RESULTS

Starting Forms (Comparison at T1)

No differences were found for the starting forms of the treated and untreated groups, with a few exceptions (Table 2). The gonial angle was larger in the treated group. The overjet was significantly greater in the treated group, with the lower incisors showing a smaller amount of buccal proclination.

Effects of Phase-1 Treatment (T1-T2 Changes)

As shown in Table 3, no significant differences between the treated and untreated groups were recorded for the sagittal skeletal measures. A significant increase of the intermaxillary skeletal divergency (palatal plane to mandibular plane) was found in the treated group, along with a significant increase in the inclination of the mandibular plane to the Frankfort plane and a significant opening of the gonial angle (Ar-Goi-Me). All the between-group differences in the changes of the vertical skeletal relations, however, ranged from 1° to 1.5°.

As for the occlusal changes, both overjet and overbite were significantly reduced in the treated group (−1.3 mm and −2.3 mm, respectively); there was also a significant reduction in the interincisal angulation (−4.7°) due to a significant proclination of the upper incisors (U1 to FH, 3.5°) and a significant increase in the projection of the lower incisors (L1 to APg, 1.7 mm). The molar relation improved significantly in the treated group (1.5 mm).

Effects of Phase-2 Treatment (T2-T3 Changes)

No significant differences between the treated and untreated groups were assessed as a result of phase-2 treatment with fixed appliances (Table 4), with the only exception being a slight but statistically significant difference in the overjet, which was reduced in the treated group (−0.9 mm).

Effects of Overall Treatment (T1-T3 Changes)

No significant differences between the treated and untreated groups were recorded for the sagittal skeletal measures (Table 5). A significant increase in the intermaxillary skeletal divergency (palatal plane to mandibular plane) was found in the treated group (1.5°). No other change in the vertical skeletal dimension was statistically significant.

Table 2. Descriptive Statistics and Statistical Comparisons of the Starting Forms Between Treated and Untreated Groups[a]

	Treated Group (N = 58)		Untreated Group (N = 29)			
Cephalometric Measures	Mean	SD	Mean	SD	*P*	Significance
Skeletal sagittal						
Pt A to Nasion perp, mm	0.6	3.9	−0.3	3.2	.279	NS
Pg to Nasion perp, mm	−6.8	5.8	−6.7	4.9	.950	NS
WITS, mm	0.4	3.6	0.4	2.2	.945	NS
Skeletal vertical						
FH to palatal plane, °	−1.6	3.3	−2.2	3.2	.461	NS
FH to mandibular plane, °	23.4	5.3	21.1	4.2	.051	NS
Palatal pl. to mandibular plane, °	25.0	6.0	23.3	3.6	.149	NS
Ar to Goi, mm	41.8	4.6	43.7	3.2	.051	NS
ANS to Me, mm	62.8	4.5	61.1	4.6	.109	NS
Ar-Goi-Me, °	123.7	6.8	120.3	5.3	.022	*
Interdental						
Overjet, mm	5.8	2.1	4.1	1.2	.000	***
Overbite, mm	6.0	1.2	5.6	0.6	.135	NS
Interincisal angle, °	136.8	9.3	134.3	8.7	.230	NS
Molar relationship, mm	−0.4	2.0	−0.4	1.7	.956	NS
Maxillary dentoalveolar						
U1 to Pt A vertical, mm	3.5	2.2	3.6	1.7	.849	NS
U1 to FH, °	108.3	7.5	108.5	7.0	.892	NS
Mandibular dentoalveolar						
L1 to Pt A-Pogonion, mm	−1.1	2.2	0.5	1.8	.001	**
L1 to mandibular plane, °	91.5	6.7	96.1	5.5	.002	**

[a] SD indicates standard deviation; NS, not significant; * $P < .05$; ** $P < .01$; *** $P < .001$.

Table 3. Descriptive Statistics and Statistical Comparisons of the T1-T2 Differences Between Treated and Untreated Groups[a]

	Treated Group (N = 58)		Untreated Group (N = 29)				
Cephalometric Measures	Mean	SD	Mean	SD	Difference	*P*	Significance
Skeletal sagittal							
Pt A to Nasion perp, mm	0.4	2.4	1.5	1.8	−1.1	.051	NS
Pg to Nasion perp, mm	2.4	3.8	3.1	2.8	−0.7	.443	NS
WITS, mm	−0.6	5.9	0.5	1.8	−1.1	.309	NS
Skeletal vertical							
FH to palatal plane, °	0.2	2.6	0.2	2.2	0.0	.969	NS
FH to mandibular plane, °	−0.4	2.4	−1.6	2.2	1.2	.034	*
Palatal plane to mandibular plane, °	−0.6	2.1	−1.7	1.9	1.1	.017	*
Ar to Goi, mm	4.4	3.0	4.0	2.5	0.4	.561	NS
ANS to Me, mm	4.2	2.9	3.2	2.0	1.0	.080	NS
Ar-Goi-Me, °	−0.8	2.9	−2.3	2.9	1.5	.023	*
Interdental							
Overjet, mm	−1.1	2.0	0.2	1.1	−1.3	.002	**
Overbite, mm	−1.6	1.5	0.7	0.7	−2.3	.000	***
Interincisal angle, °	−3.1	10.9	1.6	5.5	−4.7	.034	*
Molar relationship, mm	2.3	2.7	0.8	1.1	1.5	.005	**
Maxillary dentoalveolar							
U1 to Pt A vertical, mm	0.8	2.2	0.2	1.1	0.6	.179	NS
U1 to FH, °	2.3	8.2	−1.2	4.5	3.5	.033	*
Mandibular dentoalveolar							
L1 to Pt A-Pogonion, mm	1.3	2.2	−0.4	0.8	1.7	.000	***
L1 to mandibular plane, °	1.1	5.4	1.2	3.4	−0.1	.956	NS

[a] T1 indicates before treatment; T2, at the completion of phase 1; SD, standard deviation; and NS, not significant; * $P < .05$; ** $P < .01$; *** $P < .001$.

Table 4. Descriptive Statistics and Statistical Comparisons of the T2-T3 Differences Between Treated and Untreated Groups[a]

	Treated Group (N = 58)		Untreated Group (N = 29)				
Cephalometric Measures	Mean	SD	Mean	SD	Difference	*P*	Significance
Skeletal sagittal							
Pt A to Nasion perp, mm	0.1	2.7	−0.3	1.8	0.4	.493	NS
Pg to Nasion perp, mm	0.7	4.4	1.1	3.2	−0.4	.706	NS
WITS, mm	2.1	6.0	0.3	1.8	1.8	.121	NS
Skeletal vertical							
FH to palatal plane, °	0.3	2.8	0.8	2.0	−0.5	.398	NS
FH to mandibular plane, °	−1.0	2.5	−0.9	2.5	−0.1	.853	NS
Palatal pl. to mandibular plane, °	−1.3	2.4	−1.7	2.5	0.4	.478	NS
Ar to Goi, mm	3.4	4.0	5.1	2.6	−1.7	.051	NS
ANS to Me, mm	3.0	2.9	2.9	1.9	0.1	.855	NS
Ar-Goi-Me, °	−2.1	3.3	−1.5	3.1	−0.6	.474	NS
Interdental							
Overjet, mm	−0.7	1.6	0.2	0.9	−0.9	.008	**
Overbite, mm	−1.1	1.2	−1.7	1.2	0.6	.052	NS
Interincisal angle, °	−2.3	8.1	−0.3	5.9	−2	.248	NS
Molar relationship, mm	−0.5	2.2	0.3	1.2	−0.8	.083	NS
Maxillary dentoalveolar							
U1 to Pt A vertical, mm	−0.1	1.8	0.5	1.1	−0.6	.081	NS
U1 to FH, °	1.0	5.3	0.4	3.8	0.6	.602	NS
Mandibular dentoalveolar							
L1 to Pt A-Pogonion, mm	0.5	1.6	0.2	1.4	0.3	.274	NS
L1 to mandibular plane, °	2.2	5.4	0.7	3.6	1.5	.183	NS

[a] T2 indicates at the completion of phase 1; T3, 1 year after the completion of phase 2 with fixed appliances; SD, standard deviation; and NS, not significant; ** $P < .01$.

Table 5. Descriptive Statistics and Statistical Comparisons of the T1-T3 Differences Between Treated and Untreated Groups[a]

	Treated Group (N = 58)		Untreated Group (N = 29)				
Cephalometric Measures	Mean	SD	Mean	SD	Difference	*P*	Significance
Skeletal sagittal							
Pt A to Nasion perp, mm	0.5	2.7	1.2	2.0	−0.7	.234	NS
Pg to Nasion perp, mm	3.2	4.3	4.1	3.7	−0.9	.300	NS
WITS, mm	1.5	3.9	0.8	2.6	0.7	.428	NS
Skeletal vertical							
FH to palatal plane, °	0.5	2.7	1.0	2.6	−0.5	.440	NS
FH to mandibular plane, °	−1.4	2.9	−2.4	2.7	1.0	.112	NS
Palatal pl. to mandibular plane, °	−1.9	2.8	−3.4	2.6	1.5	.018	*
Ar to Goi, mm	7.8	4.2	9.1	2.9	−1.3	.151	NS
ANS to Me, mm	7.3	3.3	6.1	2.7	1.2	.106	NS
Ar-Goi-Me, °	−2.8	3.6	−3.8	4.3	1.0	.252	NS
Interdental							
Overjet, mm	−1.7	2.1	0.4	1.5	−2.1	.000	***
Overbite, mm	−2.8	1.4	−0.9	1.1	−1.9	.000	***
Interincisal angle, °	−5.3	13.1	1.3	8.0	−6.6	.015	*
Molar relationship, mm	1.8	2.4	1.1	1.7	0.7	.140	NS
Maxillary dentoalveolar							
U1 to Pt A vertical, mm	0.7	2.5	0.8	1.3	−0.1	.906	NS
U1 to FH, °	3.3	8.6	−0.8	5.2	4.1	.020	*
Mandibular dentoalveolar							
L1 to Pt A-Pogonion, mm	1.8	2.5	−0.2	1.5	2.0	.000	***
L1 to mandibular plane, °	3.4	6.4	1.9	5.0	1.5	.293	NS

[a] T1 indicates before treatment; T3, 1 year after the completion of phase 2 with fixed appliances; SD, standard deviation; and NS, not significant; * $P < .05$; *** $P < .001$.

Table 6. Prevalence Rates for Deepbite Subjects Showing Improvement/Worsening/Correction of Overbite During Treatment vs Growth Intervals[a]

	T1-T2, % of Subjects		T1-T3, % of Subjects	
	Treated Group	Untreated Group	Treated Group	Untreated Group
Improvement in overbite ≥ -1.5 mm (more negative change)	52*	0	71*	28
Worsening in overbite $\geq +0.5$ mm (more positive change)	10*	62	3 ns	10
Normal overbite ($\leq$4 mm) at the end of the observational interval	47 (at T2)*	0 (at T2)	74 (at T3) ns	52 (at T3)

[a] * indicates statistically significant vs control group ($P < .01$); ns, not significant ($P > .05$).

Both overjet and overbite were significantly reduced in the treated group as a result of overall treatment (-2.1 mm and -1.9 mm, respectively); there was also a significant reduction in the interincisal angulation (-6.6°) due to a significant proclination of the upper incisors (U1 to FH, 4.1°) and a significant increase in the projection of the lower incisors (L1 to APg, 2.0 mm).

Analysis of Predictors of Treatment Outcome

Discriminant analysis in the treated group on the cephalometric variables at T1 with the value of overbite at T3 as the dependent variable (classified as "corrected" when overbite was smaller than 4 mm vs "not corrected" when overbite was still larger than 4 mm) presented with a classification power of 67.5%. The predictive variable at T1 for favorable/unfavorable individual outcomes in overbite was the inclination of the mandibular plane to the palatal plane. The greater the inclination before two-phase treatment, the more favorable the outcome of treatment in terms of overbite reduction approximately 1 year after the end of therapy. The results of the analysis of overbite correction in the treated and untreated groups are reported in Table 6.

DISCUSSION

The present investigation evaluated the changes in subjects with deepbite (overbite greater than 4.5 mm at an average age of about 9.5 years) produced by orthodontic treatment within a two-phase nonextraction protocol. Specific features of this study include the following:

- Patients were enrolled consecutively for treatment within a prospective design;
- All patients were reevaluated approximately 1 year after the completion of phase-2 treatment with fixed appliances, when they had completed the active phase of circumpubertal growth;
- The study involved an untreated sample of orthodontically untreated subjects with deepbite; and
- The goal of the study was to identify pretreatment predictors of final outcome in terms of correction of deepbite.

The findings of the present study indicate a modest effect of two-phase treatment for the correction of deepbite, with changes confined mainly to the incisor region. The first phase of treatment was able to induce a significant reduction in the overbite (-2.3 mm). The significant improvement in the overbite was the result of upper and lower incisor proclination, leading to a significant reduction of the interincisal angle and to an improvement in the overjet (25 out of 58 patients started treatment with Class II division 1 occlusal relationships). No effects of phase-1 therapy were found with regard to the eruption of the molars and/or the vertical growth of the mandibular ramus. Modifications in these dentoskeletal parameters would have affected the vertical dimension effectively, as indicated in the literature.[10,16] A slight improvement in the inclinations of the mandibular plane both to the palatal plane and to the Frankfort plane was recorded as a consequence of phase-1 treatment (approximately 1° of opening when compared to the untreated subjects).

The phase with fixed appliances (T2-T3 interval) had the main purpose of leveling and aligning the dental arches. In fact, no significant changes in the dentoskeletal parameters were found when the modifications in the treated patients were compared to those of the untreated subjects. Therefore, during the overall observation period (T1-T3 interval) both overjet and overbite were significantly reduced in the treated group as a result of overall treatment (-2.1 mm and -1.9 mm, respectively); there was also a significant reduction in the interincisal angulation (-6.6 mm) due to a significant proclination of the upper incisors (4.1°) and a significant increase in the projection of the lower incisors (2.0 mm). A significant increase in the intermaxillary skeletal divergency was also found in the treated group (1.5°). No other change in the vertical skeletal dimension was significant. When the overall treatment changes were contrasted in the three groups according to the presence of Class I, Class II

division 1, or Class II division 2 malocclusion before treatment, no significant differences were found for any dentoskeletal variable.

The findings of the current study are comparable to those reported in the longitudinal clinical trial by Schütz-Fransson and colleagues,[8] who adopted similar treatment strategies for deepbite correction and found a reduction in overbite of about 2 mm after treatment associated with a 2.3° opening of the intermaxillary divergency angle. The results of both controlled studies seem to recommend a more aggressive therapeutic approach to deepbite in growing subjects facilitated by possibly adding biomechanical details aimed specifically at further improving the vertical occlusal relationships during the phase with fixed appliances or by adopting a more intensive, single phase of therapy.

The relatively modest entity of the overall changes elicited by therapy in deepbite patients has to be interpreted also on the basis of the physiological changes in the dentoskeletal relationships observed in the untreated subjects. The use of subjects with deepbite as controls allowed for a more rigorous appraisal of therapeutic effects with respect to the previous literature that did not include controls[6,7,9] or that used controls with normal occlusal relationships.[8] In fact, untreated subjects with deepbite showed a worsening of the deepbite in the mixed dentition during the prepubertal phases, followed by continued improvement starting at the pubertal growth spurt in the permanent dentition.[4,10] As shown in Table 6, phase-1 therapy (T1-T2 interval) induced significantly greater prevalence rates of improvement or even correction of the deepbite when compared to results in the untreated subjects.

The majority of the untreated subjects (62%) showed a worsening during this period, and none of them showed a correction at the T2 observation period. The nature of the unfavorable changes in the untreated subjects, therefore, amplified the favorable treatment effects of phase-1 therapy. On the contrary, during the following growth interval, in the permanent dentition and after the pubertal growth spurt, untreated subjects with deepbite presented with a significant tendency for self-improvement or even self-correction. As a consequence, when we analyzed the prevalence rates of subjects showing a corrected overbite at the final observation period (T3), no significant difference could be found between treated and untreated subjects (74% vs 52%). It has to be noted, however, that a significantly greater number of improved patients (patients showing a T1-T3 improvement in overbite equal to or greater than 1.5 mm) could be assessed in the treated group when compared to the untreated subjects (71% vs 28%).

The analysis of possible cephalometric predictors of treatment outcome revealed that the predictive variable before treatment for favorable/unfavorable individual changes in overbite was the inclination of the mandibular plane to the palatal plane. The greater the inclination before treatment, the more favorable the outcome of treatment in terms of overbite reduction approximately 1 year after the end of therapy. In terms of a correction of the deepbite 1 year into retention, better outcomes can be expected in subjects showing normal or high-angle rather than low-angle intermaxillary vertical relationships. These findings are corroborated by the significant differences in terms of physiological growth of the dentofacial parameters in untreated subjects with opposite facial types in the vertical dimension, as shown by Nanda.[17,18]

CONCLUSIONS

The present longitudinal, controlled study on the effects of a two-phase treatment protocol in deepbite patients, in comparison with the growth changes in subjects with untreated deepbite, showed the following.

- The average amount of deepbite correction 1 year into retention was about 2 mm more than in the untreated subjects, mainly as the result of a significant proclination of the incisors. However, the prevalence rate of subjects with a corrected overbite at the final observation in the treated sample was not significantly different from that of the untreated sample.
- Phase-1 therapy was not able to have any significant impact on the growth of the mandibular ramus and/or the vertical dimension of the posterior dentoalveolar sectors of the dental arches.
- Overbite correction induced by therapy can be partially predicted on the basis of pretreatment skeletal vertical relationships (inclination of the mandibular plane to the palatal plane).

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