Original Article

Early Treatment with a Maxillary Lip Bumper-Bite Plateau Combination

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ABSTRACT

Objective: To evaluate the intra-arch displacements of the molars and the change in molar relationship following the use of a maxillary lip bumper combined with a bite plate.

Materials and Methods: The material comprised study casts taken before and after the treatment of 40 consecutive patients with mixed dentition. The sagittal and transversal displacements were evaluated by a three-dimensional digitizer using the palatal rugae as an indirect fixed reference. The displacements were expressed as translation mesiodistally and buccolingually and rotation around the long axis and tipping mesiodistally. The change in molar relationship was measured to the nearest millimeter at the level of the occlusal plane.

Results: The tooth movements were predominantly of distal rotation (mean, 9.7°; range, 6.5° to 26°) and distal tipping (mean, 5°; range, 5.8° to 18°). The distal displacement was a modest mean (mean, 0.3 mm; SD, 1.6 mm) and more pronounced to the buccal (mean 1.6 mm; SD, 1.5 mm). The molar relationship improved in all but four sites, and a full Class I was obtained in 65 of 80 sites.

Conclusions: The early treatment with the lip bumper and bite plate can be recommended from a cost-benefit point of view.

KEY WORDS: Early treatment; Lip bumper; Bite plate

INTRODUCTION

Correction of Class II malocclusion is probably the most important single component of present orthodontics. A large number of different treatment approaches have been suggested, ranging from variable types of functional appliances aiming at skeletal correction to a constantly increasing number of ways to distalize molars. The selection of appliance should logically be based on a differentiation between skeletal and dental deviations.

Although a gold standard for differential diagnosis does not exist,[1] the sagittal jaw relationship frequently has an impact on the choice of treatment approach. In the treatment of growing individuals, however, the general routine of the particular office often has determined the treatment approach more than a differential diagnosis has. Recommended treatment approaches include molar distalization by means of different types of headgear,[2–4] Class II elastics,[5–7] and an increasing number of noncompliance appliances such as Pendulum appliances,[8,9] Jones Jig,[10] distal jets,[11–13] magnets,[14–16] and various types of Herbst appliances,[17,18] to mention only a few. As absolute anchorage cannot be obtained by any of these anchorage systems. Skeletal anchorage is playing an increasing role in the correction of Class II malocclusions both as direct anchorage by means of mini-plates or mini-implants[19–23] and as indirect anchorage by means of palatal implants[24] or onplants.[25]

An appliance that has received only limited attention is, however, the maxillary lip bumper. Hasler and Ingervall[26] described the effect of the maxillary lip bumper on the molar as a moderate distal tipping and a reduction of the intramaxillary anterior movement. In addition, the incisors were significantly proclined and the arch widened. All these effects can be considered desirable in the treatment of patients with mixed dentition and crowding and a tendency toward a Class II relationship. The built-in distal rotation with the addition of a bite plateau would allow for the forward growth of the mandible and thereby further contribute to the correction of the Class II malocclusion.

Since no data on the effect of the lip bumper-bite plateau combination could be retrieved, we decided to

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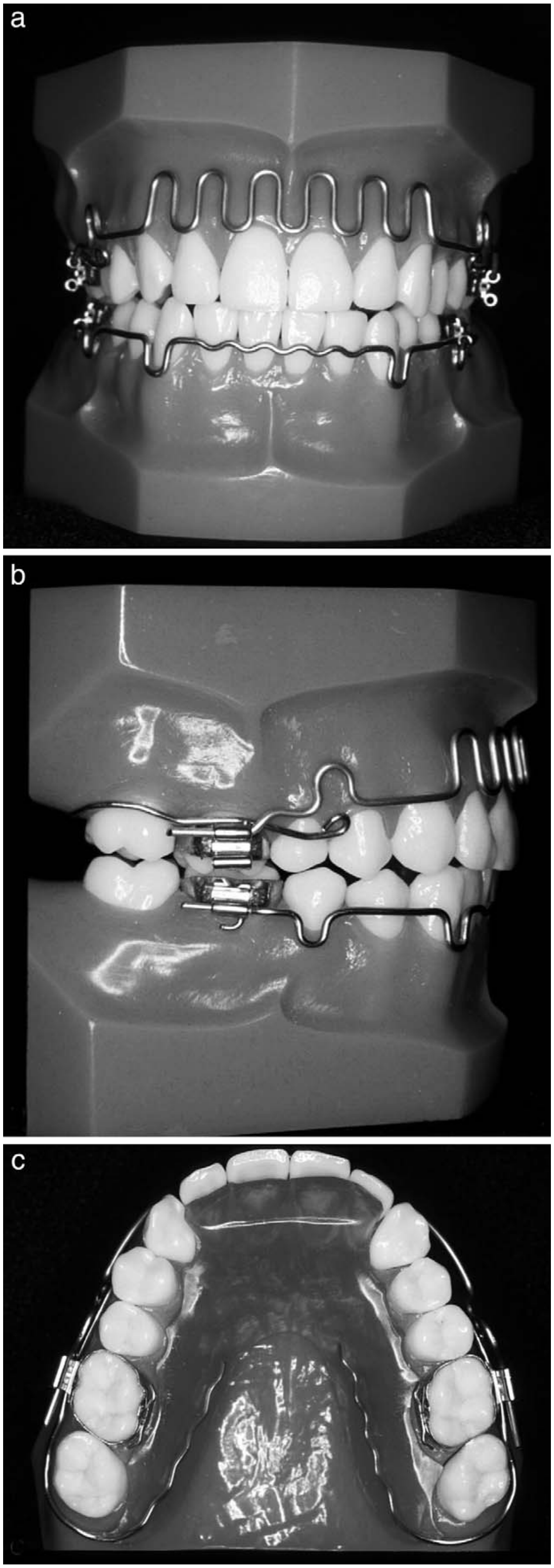

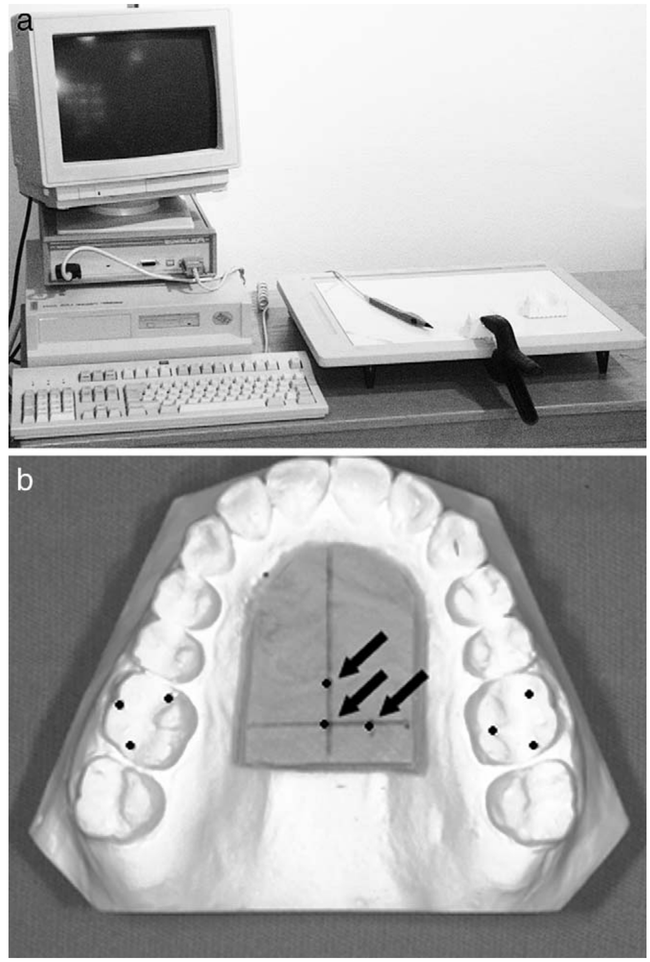

Figure 2. (a) Setup used for measurements. (b) Reference point on the teeth.

describe the intramaxillary displacement of the upper molars secondary to the insertion of a maxillary lip bumper. In addition, we decided to observe the changes occurring in the molar relationship because of the insertion of a maxillary lip bumper combined with a bite plate and a lower lip bumper in a group of consecutively treated Class II patients from the private office of one of the authors.

MATERIALS AND METHODS

The study was carried out on the pretreatment and posttreatment casts of 40 consecutive Class II patients treated with a lip bumper and bite plateau in one private office. Seventeen boys and 23 girls with mixed dentition (age range, 9.3 to 11.5 years) were included in the study. All patients were clinically diagnosed as

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Figure 1. Appliance used. A combination of a maxillary lip bumper and a bite plateau.

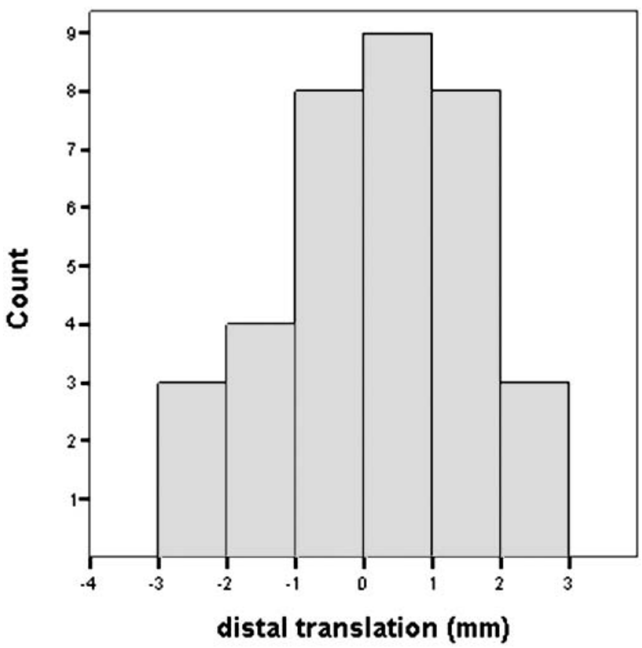

Figure 3. Distribution of distal translation of the molars.

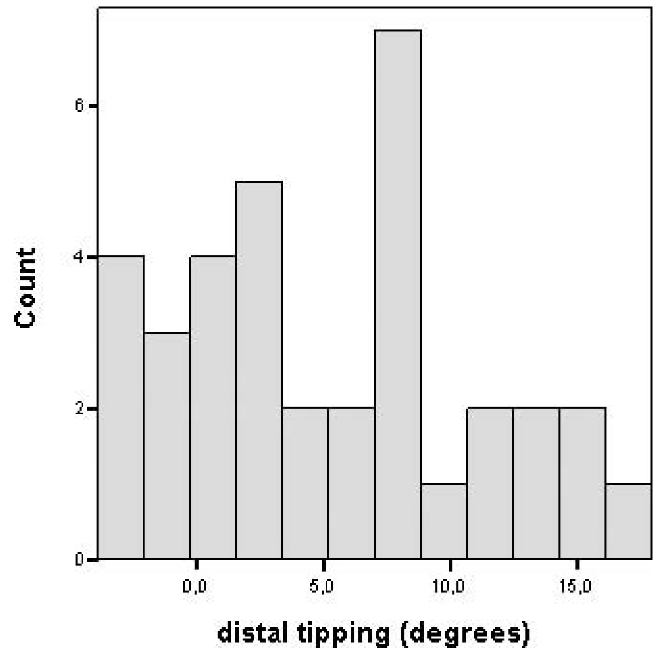

Figure 4. Distribution of the mesiodistal tipping of the molars.

Angle Class II of varying severity with moderate or severe crowding.

Study casts were taken before and at the termination of the use of a maxillary lip bumper. The lip bumper was first described by Korn and Shapiro[27] and is manufactured by American Orthodontics from a flexible 0.040-in. stainless-steel wire and incorporates mucolabial loops, buccal adjustment loops, and a molar tube bayonet bend that acts as a stop (Figure 1). The anterior loops offer lip contact, and adjustment potential is thus fabricated to center on the labial frenulum and avoid tissue irritation and impingement. The lip bumper was adapted to be inserted into molar bands fitted to the upper first molars.

The lip bumper fabrication is such that it is 1 to 3 mm away from the dentoalveolar structures and high in the anterior mucolabial fold, establishing as much lip contact as possible. Toe-in rotational bends of 2° to 3° are employed at the bayonet bends to effect molar rotation. Lip contact and lip seal exercises are given. In addition to the lip bumper, which was used full-time (apart from tooth brushing), a removable bite plateau was inserted, and the upper deciduous canines and molars were extracted after orthopanoramic radiographs ensured that all permanent teeth were present. The interval between the pretreatment and posttreatment records was a mean of 18 months, ranging from 12 to 30 months.

The pretreatment and posttreatment maxillary casts were evaluated by a three-dimensional (3D) digitizing system. Before performing the measurements, silicon indices of the palate of the pretreatment cast were taken. These indices served as spatial reference for the evaluation of the intramaxillary displacement of the upper molars and were produced with silicone impression material from Laborsil (Dreve-Dental GmbH, Unna, Germany).

After the impression material was placed, the cast was inverted with the occlusal surfaces on a flat board while the silicone was hardening. Following hardening of the silicone index, a line indicating the midsagittal plane was drawn on the occlusal surface, and the index was trimmed so that the posterior surface was perpendicular to the midsagittal line. When it was en-

Table 1. Descriptive Statistics of the Various Tooth Movements

	Translation					
	Buccal, mm	Distal, mm	Distal Tip, °	Buccal Tip, °	Distal Rotation, °	Change in Intermolar Distance, mm
Mean	1.6*	0.3	5.0**	4.4**	9.7**	3.3**
SD	1.6	1.5	5.8	4.2	6.5	2.8
Maximum	5.5	2.9	18.0	15.1	26.1	9.0
Minimum	−0.9	−2.9	−3.9	−2.8	−2.1	−1.3

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

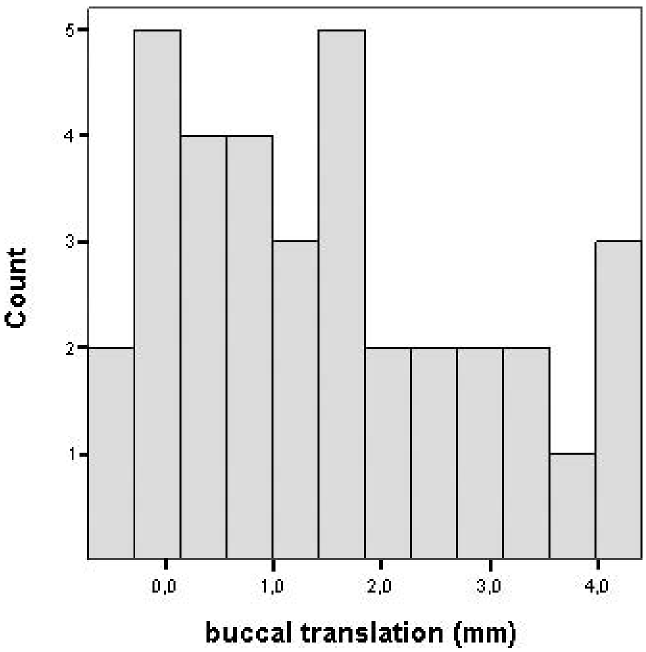

Figure 5. Distribution of the buccolingual translation of the molar.

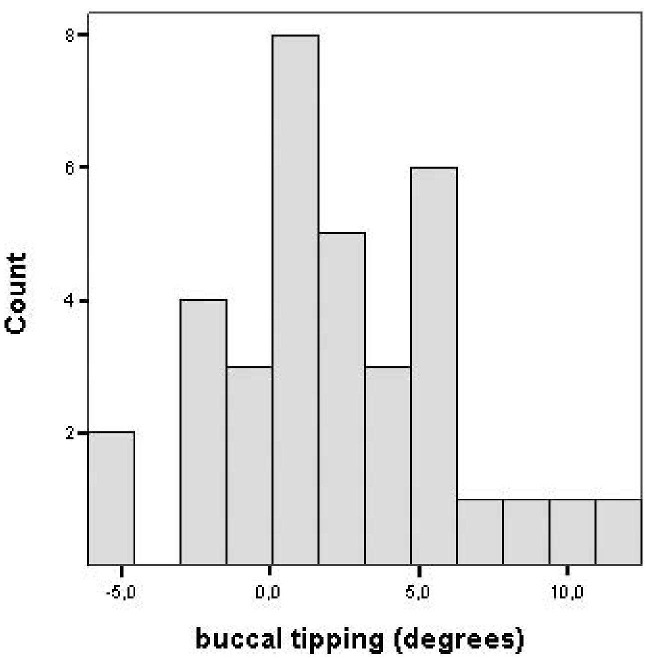

Figure 6. Distribution of the buccolingual tipping of the molar.

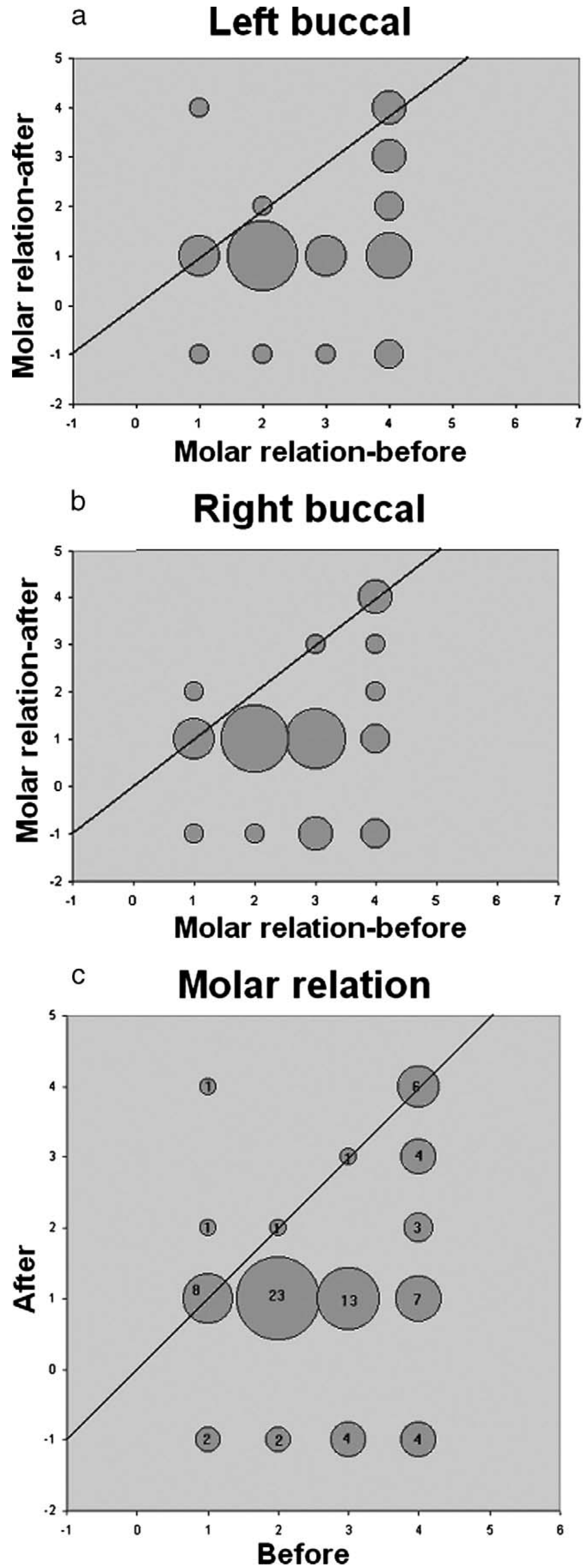

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Figure 7. Distribution of molar relationship (according to the classification by Liu and Melsen[30]) before and after use of combined lip bumper and bite plateau. (a) Left side. (b) Right side. (c) Total.

Figure 8. Example of a typical case.

sured that the index could fit to the palate of the post-treatment cast, two additional lines were then drawn on the index. One was drawn on the occlusal surface of the index perpendicular to the midsagittal line and one bisecting the latter on the posterior surface. The transverse line connecting the molars served as the x-axis, the midsagittal line as the y-axis, and the line on the backside of the index as the z-axis (Figure 2).

Spatial data in the form of x-, y-, and z-coordinates were collected with a Polhemus 3Space/3Draw 3D-digitizing system (Polhemus, Cochester, Vt). The cast with the index was fixed to the measuring table, and the three points on the silicon index were digitized. After the index had been removed, the three recognizable points with a maximum distance in all three planes of space were digitized on the right and left molar. The three points on the molar generated a coordinate system on the molar that allowed for the description of the molars in space. By means of matrix analysis, the intramaxillary displacement of the molars in three planes of space was calculated as a combination of three translations and three rotations, where-

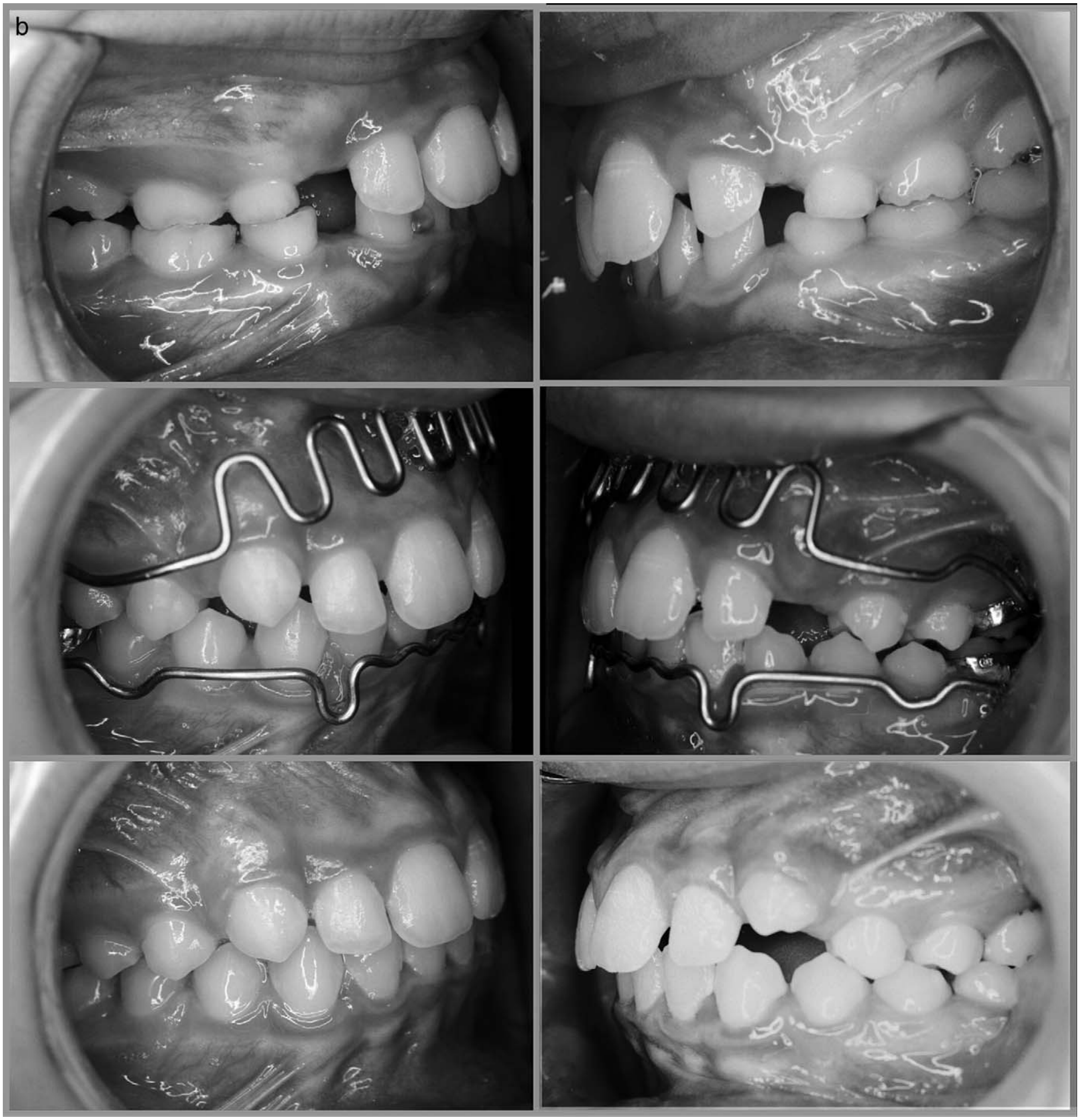

Figure 8. Continued.

by the rotations are expressed as Euler angles.[28,29] As it is known that a vertical development of the palate also takes place, the vertical measurements were considered unreliable, and only mesiodistal and buccolingual displacements were included. The rotations were calculated to be positive in the case of a distal tip, a buccal tip, and a distal rotation. To use the same terminology in the two sides, the notation had to be reversed for the left side.

Statistics

The distribution of the intramaxillary displacements were described statistically, and the displacements on the right and left side were compared by a paired *t*-test. As no significant difference could be verified, the parameters expressing changes occurring in the sagittal and transversal plane were compared to zero by a Student's *t*-test.

Molar Relationship

In addition to the computerized evaluation of the maxillary casts, the molar relation on the study casts was evaluated from both the buccal and the lingual aspects. The classification defined by Liu and Melsen[30] was applied, and the changes in molar relationship during treatment were noted.

RESULTS

The intramaxillary displacement of the molars exhibited a large variation (Table 1). In the case of four patients, the measurements on one side were considered unreliable because of their large deviation from the remaining sample. A possible explanation could be deformation of the impression before pouring the plaster model. The displacement was a combination of translation and rotation in all three planes of space, but as the vertical dimensions could be expected to be influenced by growth of a variable degree, the vertical measurements were considered unreliable and therefore not included. The data obtained from the right and the left side were initially analyzed separately, but as no significant difference could be verified, the data were pooled.

The distal translation was practically zero, averaging 0.3 mm with a standard deviation of 1.5 mm (Figure 3). The distal tip averaged 5.0° with a large variation from −3.9° mesial tip to the 18° distal tip. Only 6 of 80 molars tipped slightly mesially (Figure 4). The most pronounced displacement was to the distal rotation, which averaged 9.7°, with a maximum of 26.1°. A significant increase in the arch width was found in 36 of 40 cases, and the 4 cases exhibited a decrease of 1.5 mm or no change. The buccal translation of the individual molars generated by the lip bumper averaged 1.6 mm, and the buccal tipping averaged 4.4°, both of which contributed to the increase in arch width of 3.3 mm. The distribution of these changes occurring during the use of the lip bumper is shown in Figures 5 and 6.

When evaluating the changes in occlusion, the trend was much more general. Sixty-five of the 80 molar relationships approximated a Class I (Figure 7), 5 remained unaltered, and 1 deteriorated. In 67 cases, a full Class I molar relationship was reached. A typical case is displayed in Figure 8.

DISCUSSION

In the case of dentoalveolar Class II, a differential diagnosis should be the determining factor in the decision process when selecting an appliance. However, the routine of the office or the training of the orthodontists often determines whether a distal occlusion should be corrected by distal displacement of the upper molars or forward displacement of the lower molars or the mandible. Most frequently, a distal displacement of the upper molars is attempted with extraoral or intermaxillary appliances. This seems contrary to the statements by Angle[31] in 1899 that the upper first molar should be considered the key to occlusion. The anatomical interpretation of this approach was discussed by Hellman[32] in 1920 and by Atkinson,[33] and recently, a finite element analysis demonstrated that the transfer of occlusal forces to the cranial base could be optimized[34] only when the first upper molar was positioned below the infrazygomatic crest.

A distal molar relationship, as judged from the buccal aspect, may be the result of both tipping and rotation and thus not express the position of the longer and more important lingual root. In a recent analysis of 500 consecutive Class II cases, 73% were Class I or significantly less Class II when analyzed from the lingual aspect.[30] In such cases, the distal rotation of the molars would contribute significantly to the correction of the Class II molar relationship.

The effect of molar rotation on the correction of Class II has been used by Cetlin and Ten Hoeve,[3] who combined a transpalatal arch with a distally directed force from Kloehn headgear. The rotation generated by straight pull headgear was analyzed by McDonald et al,[4] who also used the rugae as a reference system. They found that the distal movement obtained was a combination of tipping and rotation. The effect of a transpalatal arch alone for molar rotation was analyzed by Dahlquist et al.[35] They concluded that the gain in space was unpredictable as the center of rotation was also varying. A theoretical model of the influence of the localization of the center of rotation on the contribution of the molar rotation to the change in arch length was presented by Braun et al.[36] They found that the more lingual the center of rotation was, the more the rotation would contribute to an increase in arch length (Figure 9). This fact was used by Cetlin and Ten Hoeve,[3] who performed expansion combined with distal rotation as part of the correction of Class II malocclusions.

The changes in the molar relationship obtained by the lip bumper combined with the bite plateau should not be compared with that of a transpalatal arch alone but rather to the effect of other intramaxillary appliances.[6–16] All these appliances do, however, also lead to anterior displacement on the anchor units and increase in overjet if not combined with skeletal anchorage. The displacement of the molars alone could not explain the marked improvement of the molar relationship seen with the lip bumper combination. The fact that 67 of 80 molar relationships characterized as Class II before treatment were Class I after treatment

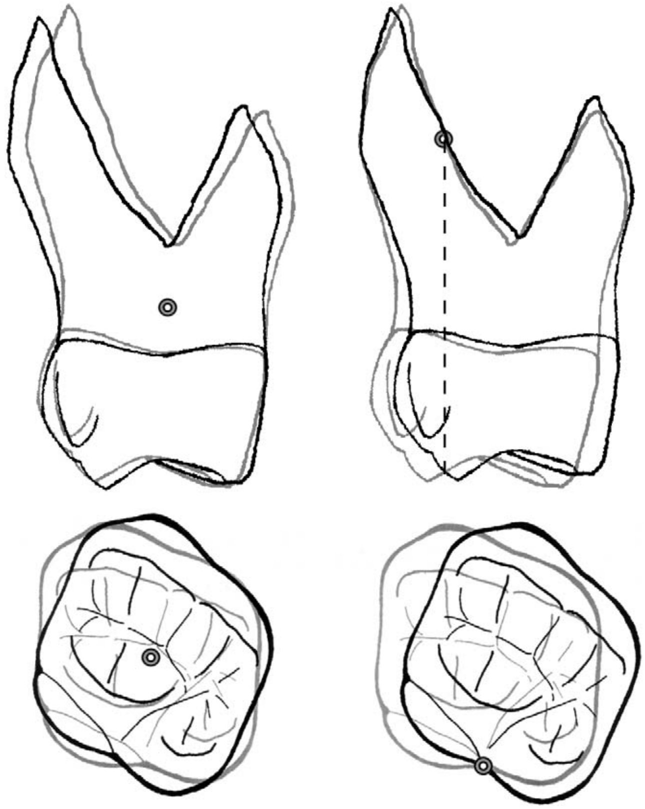

Figure 9. Influence of the center of rotation on the displacement occurring during rotation. (a) Without expansion. (b) With expansion.

most likely expressed the combined effect of the tipping and rotation of the molars and the forward growth of the mandible (Figure 9). The latter was doubtless facilitated by the bite plate. The effect of the lower lip bumper would, on the other hand, be able to weaken the effect on the molar relationship as the lip bumper might hold or even tip the molars back, thereby deteriorating the molar relationship.[37]

In the above-mentioned study by Liu and Melsen,[30] it was demonstrated that the molars that were not mesially rotated in the Class II patients could be identified as skeletal discrepancies. In such case, the small movements of the molars that occurred would have only a limited effect on the molar relationship, and the improvement would be ascribed to a relative forward movement of the mandible. A reduced forward movement of the upper molars because of the distal rotation generated by a transpalatal arch[26] would in itself contribute to an improvement in the molar relationship, as indicated by Voudouris et al,[38] who considered this as a possible contributing factor to the activator effect. These authors based their statements on histological findings from primate studies. Hasler and Ingervall,[26] on the other hand, did not comment on the influence of the treatment on the molar relationship.

Cephalometric analysis of molar displacement has demonstrated that molars are significantly displaced distally by means of extraoral traction but that the molars seem to regain their position below the zygomatic buttress following treatment. The inclusion of cephalometric analysis of these cases would not have brought more information as the distal displacements were minute and the tipping and rotation of the 2 sides cannot be assessed with any kind of validity from a normal headfilm.

The pronounced variation between the effects registered in the individual patient expressed the underlying variation in genetics including growth patterns and function. The appliances were standardized as far as possible, and compliance could not be considered a problem. When the appliance was inserted, the patients were instructed to perform lip-seal exercises according to Fränkel. These comprised holding an edge-to-edge position of the teeth while rolling the vermillion borders of the lips together and squeezing against the bumpers for 10 seconds. The patients were instructed to squeeze for 10 seconds and release for 10 seconds. This is done for 10 minutes three times per day. This develops lip tone in a Class I mode and distributes a distal force against the bumpers. In addition, the patients were instructed to hold the mandible forward a maximum of time when not speaking and eating. After the first days, the lip bumper did not cause any discomfort and was, if placed above the upper incisors, not visible. The intramaxillary tooth movements were small compared with the immediate effect obtained with both headgear and other distalizing appliances. These displacements are, however, temporary, and the neutralization of the molar relationship in the long term could be ascribed to forward growth of the mandible.

The result obtained in the individual patient was influenced by the etiology of the Class II molar relationship, the lip pressure, and the growth pattern in addition to an eventual effect of the exercises.

Despite a large variation in the contribution of the single components to the normalization of the molar relationship, there was an increased space caused by the widening and a general tendency toward a normalization of the molar relationship.

CONCLUSIONS

- The combination of a maxillary lip bumper and a bite plate has a favorable influence on the occlusal development in young children with a Class II molar relationship and space discrepancy.
- The early treatment with the lip bumper and bite plate can be recommended from a cost-benefit point of view.

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