

# Clinical Application of a Modified Lip Bumper

RAPHAEL L. GREENFIELD, DDS, MSD

**A**lthough the literature supports the efficacy of lip bumpers in producing as much as 8mm of arch development in mixed-dentition cases with mild-to-borderline crowding,<sup>1-16</sup> this versatile appliance remains widely misunderstood. Lip bumpers have been shown to recover arch length by means of:

- Increased mandibular arch perimeter<sup>2-5,17-24</sup>
- Leeway space maintenance<sup>22</sup>
- Reinforcement of molar anchorage<sup>9-11</sup>
- Spontaneous leveling of the curve of Spee<sup>12,21</sup>
- Interruption of pernicious habits<sup>13-16,25-27</sup>

The lip bumper is contraindicated when:

- Second permanent molar root formation is less than 50%
- The first permanent molar roots are not fully developed
- Permanent molars are ankylosed or periodontally compromised
- The first and second permanent molars are already upright sagittally and transversely

A lip bumper produces expansion in either arch by altering the functional pattern of the tongue, lips, and cheeks with buccal shields and an .045" labial bow. Contracting muscle forces are negated, allowing the dental arch to be expanded by forces of the tongue—an effect similar to the Frankel expansion concept<sup>28,29</sup> that was later de-

scribed by Grossen and Ingervall as a “slow expansion from the consequence of natural forces”.<sup>2</sup> Both dentoalveolar and apical-base expansion are produced in the incisor, canine, and premolar regions.<sup>27</sup> In addition, the lip bumper can produce posterior “mechanical” expansion through buccal expansion of the labial bow. Even though the mandible has no suture, recent studies using metallic bone markers are disproving the long-held belief that the mandible is incapable of stable transverse apical-base and alveolar expansion.<sup>30,31</sup>

This article describes my modifications of the traditional lip bumper, illustrating variations for different types of malocclusions and growth patterns.

## Greenfield Lip Bumper

The Greenfield lip bumper\* comes in two configurations: “high-angle” (Fig. 1A), for patients with hyperdivergent growth patterns or dentoalveolar open-bite tendencies, and “normal” (Fig. 1B), for all other conditions.

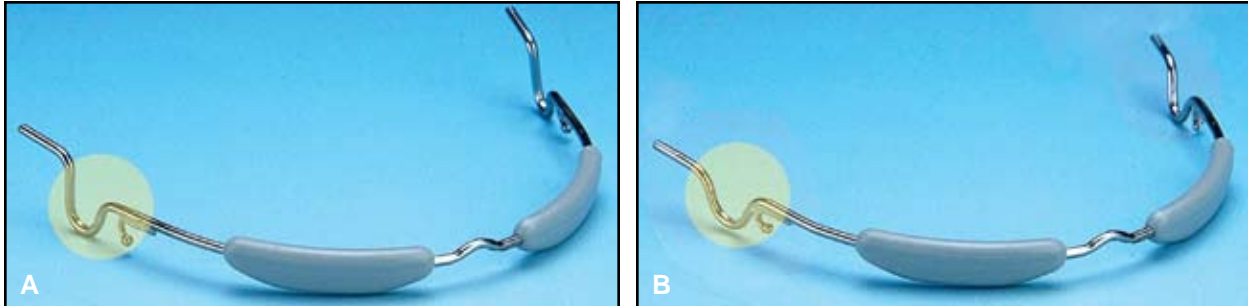
The feature that differentiates the two configurations is the stop loop. The “normal” stop loop has mesial and distal legs 5mm in height and 5mm in width; the “high-angle” stop loop’s distal leg is twice the height of the mesial leg, thus stepping down the lip-bumper wire to rest more deeply in the vestibule. Each configuration has low-profile “muscle shields” attached to an .045" stainless steel wire, with an inverse midline V-bend to accommodate the labial frenum. The stop loops of both designs diverge 10° at the buccal ends to avoid soft-tissue impingement. Stainless steel or ceramic hooks can easily be bonded to the labial shields for attachment of elastics.

The more *occlusal* the height of the labial

Dr. Greenfield is in the private practice of orthodontics at 1232 Seaspray Ave., Delray Beach, FL 33483; e-mail: drg@nextortho.com. He has no financial interest in the Greenfield Lip Bumper or CG molar tubes. The material in this article was adapted from a chapter in his book, *Non Ex Factors: 98.5% Non-extraction Therapy Using Coordinated Arch Development*, DaehanNarae Publishing, Inc., Seoul, Korea.



\*Part No. 09-045-50, Dentsply GAC International, 355 Knickerbocker Ave., Bohemia, NY 11716; www.gacintl.com.



**Fig. 1** Greenfield lip bumper. A. “High-angle” lip bumper designed for patients with hyperdivergent growth patterns and dentoalveolar open-bite tendencies. Longer distal leg of stop loop creates step-down to place bumper deeper in vestibule. B. “Normal” lip bumper configuration for all other situations.

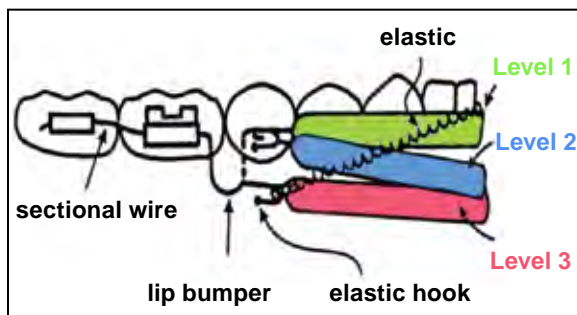
bow, the more extrusion and distal crown tipping will be expressed at the first molar (Fig. 2). Since the premolars and incisors are “shielded” from the lips and buccal musculature, the premolars are free to upright transversely and the incisors labially, especially when the posterior teeth are discluded by an anterior bite plate or bite turbo. The more *gingival* the labial bow, the less extrusion and distal crown tipping will be expressed at the first molar. In this configuration, the incisors are *not* free to upright labially.

At the initial insertion visit, the lip bumper should be placed passively, no more than 1.5-2mm from the labial surfaces of all teeth, making it as comfortable as possible for the patient (Fig. 3A). At the first adjustment visit, activations are initi-

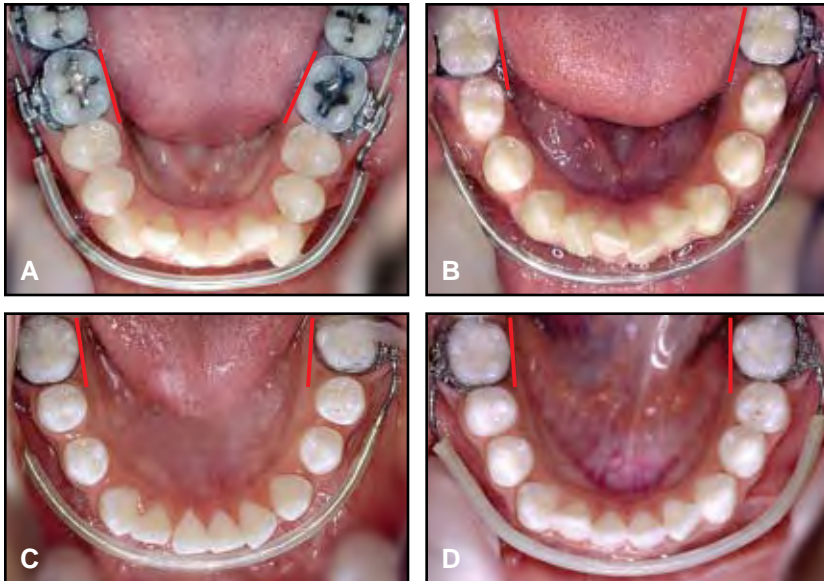
ated in small increments—5-10° of rotation at the distal ends and 2-3mm of molar expansion—with the labial bow positioned 1.5-2mm from the anterior teeth and 2.5-3mm from the premolars (Fig. 3B). Activations are gradually increased at the second and third adjustment visits, until the bow is positioned 3.5-4mm from the premolars (Fig. 3C). These activations should continue until the molars have been uprighted sagittally and transversely and the lingual surfaces of the molars are parallel (Fig. 3D).

Since the lip bumper wire is .045" in diameter, small incremental adjustments can produce significant force changes (Fig. 4). This is why adjustments should not exceed 5-10° of rotation or 2-3mm of expansion. *Expansion should approximate the rate of molar distalization* to maintain the molars well within cancellous bone while seeking the “neutral zone”. Any mandibular expansion should mirror the movements in the maxilla to *coordinate* the arches.

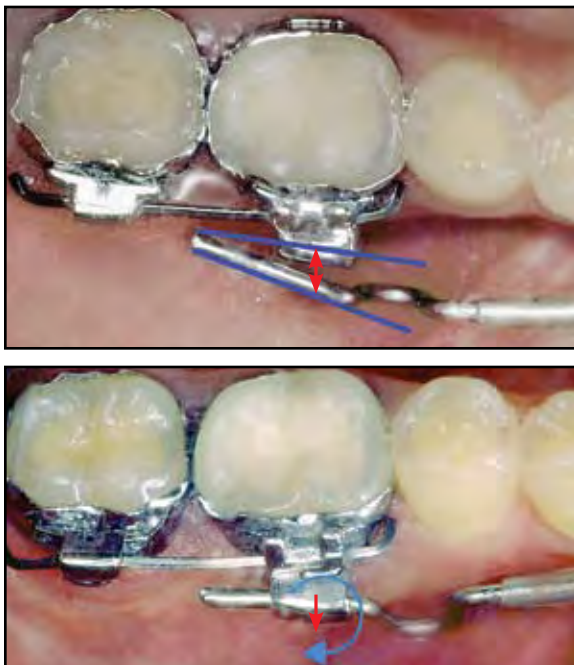
Except in patients with significantly asymmetrical arches, the lip bumper must be symmetrical in the mouth (Fig. 5A). If one side appears closer to the teeth than the other (Fig. 5B), either the labial bow is asymmetrical or the terminal legs need to be adjusted. The terminal legs of the lip bumper should extend at least 3mm distal to the buccal tubes on initial insertion (Fig. 6A). This allows a 2mm stop to be placed mesial to the buccal tube to advance the lip bumper, while still maintaining enough wire beyond the distal end of



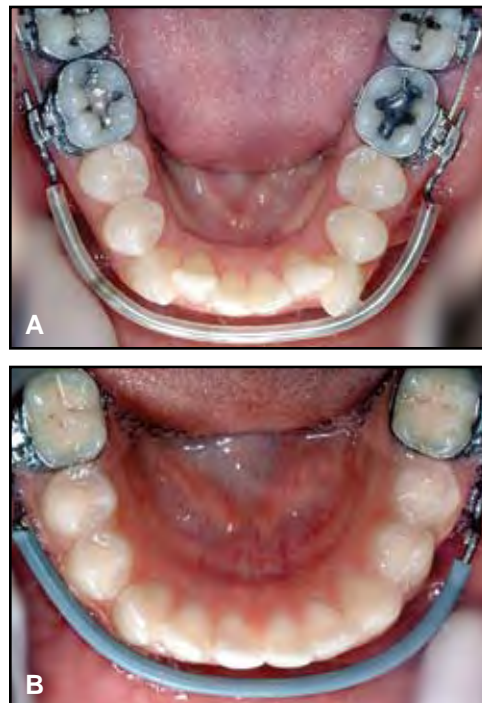
**Fig. 2** Levels of labial bow used with Greenfield lip bumper: Levels 1 and 2 are variations of “normal” stop-loop configuration; Level 3 uses “high-angle” stop-loop configuration.



**Fig. 3** A. At initial insertion appointment, lip bumper is placed passively, 1.5-2mm from all tooth surfaces. Note mesiolingual rotation of first molars before activation of lip bumper. B. At first adjustment appointment of different patient, 5-10° of molar rotation and 2-3mm of molar expansion are applied; lip bumper is positioned 2.5-3mm from premolars. Some mesiobuccal molar rotation can already be seen in this patient. C,D. At second and subsequent adjustment appointments, distance of bow from premolars is gradually increased to 3.5-4mm. Photos of third patient were taken 12 weeks apart.



**Fig. 4** Thickness of lip-bumper wire produces significant force changes with only small adjustments.



**Fig. 5** A. Symmetrically positioned lip bumper appears equidistant from right and left tooth surfaces. B. Asymmetrically positioned lip bumper: labial bow may be asymmetrical, or terminal legs may need adjustment.

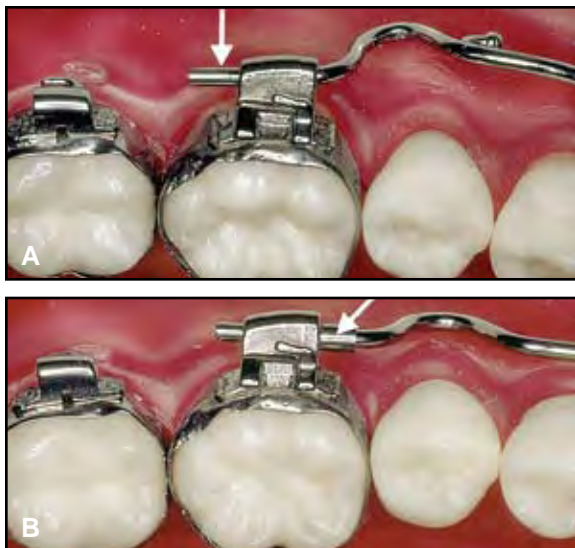
the tube to prevent dislodgement during function (Fig. 6B).

Some years ago, Dr. Norman Cetlin and I developed beveled first molar tubes with 8° mesial offsets\*\* for use with lip bumpers and headgear, even when the molars are severely rotated mesiolingually (Fig. 7). The torque and tip prescriptions retain the overcorrections of Phase I treatment and coordinate the mandibular molars to the maxillary molars. This appliance can significantly reduce treatment time, since molar rotation is not required prior to lip-bumper insertion.

## Timing and Duration of Lip-Bumper Treatment

The ideal time to apply the lip bumper—as well as to initiate nonextraction treatment—is the late mixed dentition, when the roots of the mandibular second permanent molars are more than

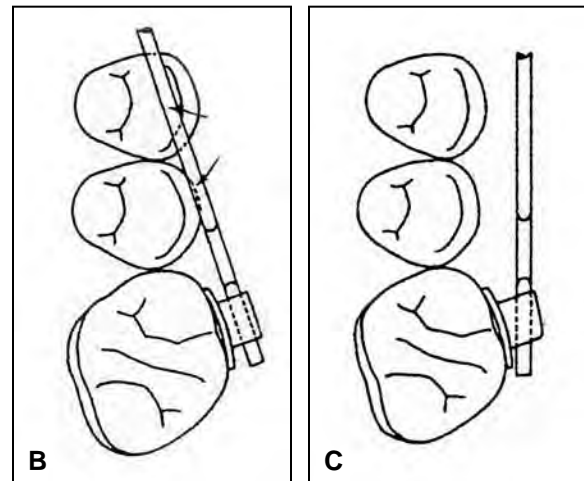
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**Fig. 6** A. Terminal leg of lip bumper extends 3mm distal to buccal tube at initial placement. B. 2mm stop placed mesial to buccal tube to advance lip bumper, with enough wire extending beyond tube to prevent dislodgement during function.

50% complete. “E” space is still available, and within two years the second molars will have fully erupted into occlusion. With few exceptions, there are no distinct advantages to initiating treatment at an earlier age. In fact, if the mandibular second molar roots are less than 50% formed, distal uprighting of the first molars may block the eruption of the second molars. In addition, there are many opportunities to use lip bumpers in adolescents and adults, as shown in some of the cases presented in this article.

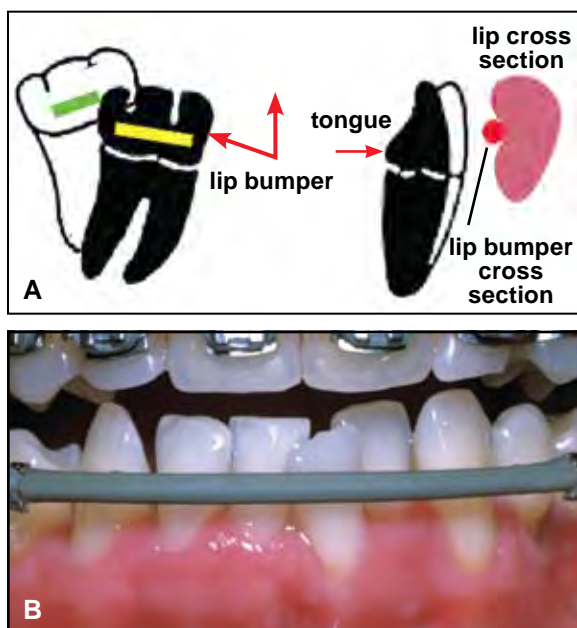
The patient is required to wear the lip bumper 24 hours per day. The progression of archwires should be designed according to the archform



**Fig. 7** A. CG System first molar tube\*\* with 8° mesial offset. B. On mesiolingually rotated molar, path of wire insertion is impeded by using tube with no bevel or mesial offset. C. Interference eliminated with CG System tube.

produced by the lip bumper to reflect functional increases in arch length and width.

Recommended treatment duration varies considerably. In a retrospective study, Murphy and colleagues observed that 50% of the total expansion was achieved within the first 100 days and an additional 40% in the next 200 days, concluding that “it is unnecessary to have the appliance in place for longer than 300 days”.<sup>32</sup> Still, treatment should at least be long enough to reeducate the muscles and function and thus obtain true “functional expansion”, to level the curve of Spee, to gain sufficient space for alignment within the “neutral zone”, and to retract the anterior segment and improve the profile. Retaining the lip-bumper force against the molar crown during the archwire progression will torque the root underneath, resulting in a net bodily movement of the molar. If the lip bumper is removed too soon, the molar crown will relapse mesially rather than the root torquing distally.



**Fig. 8** Level 1 variation. A. Significant extrusion and distal crown tipping are expressed at first molar, along with significant labial incisor tipping. B. Labial bow placed at middle third of labial surface to alter lip forces.

### Level 1 (Normal Configuration)

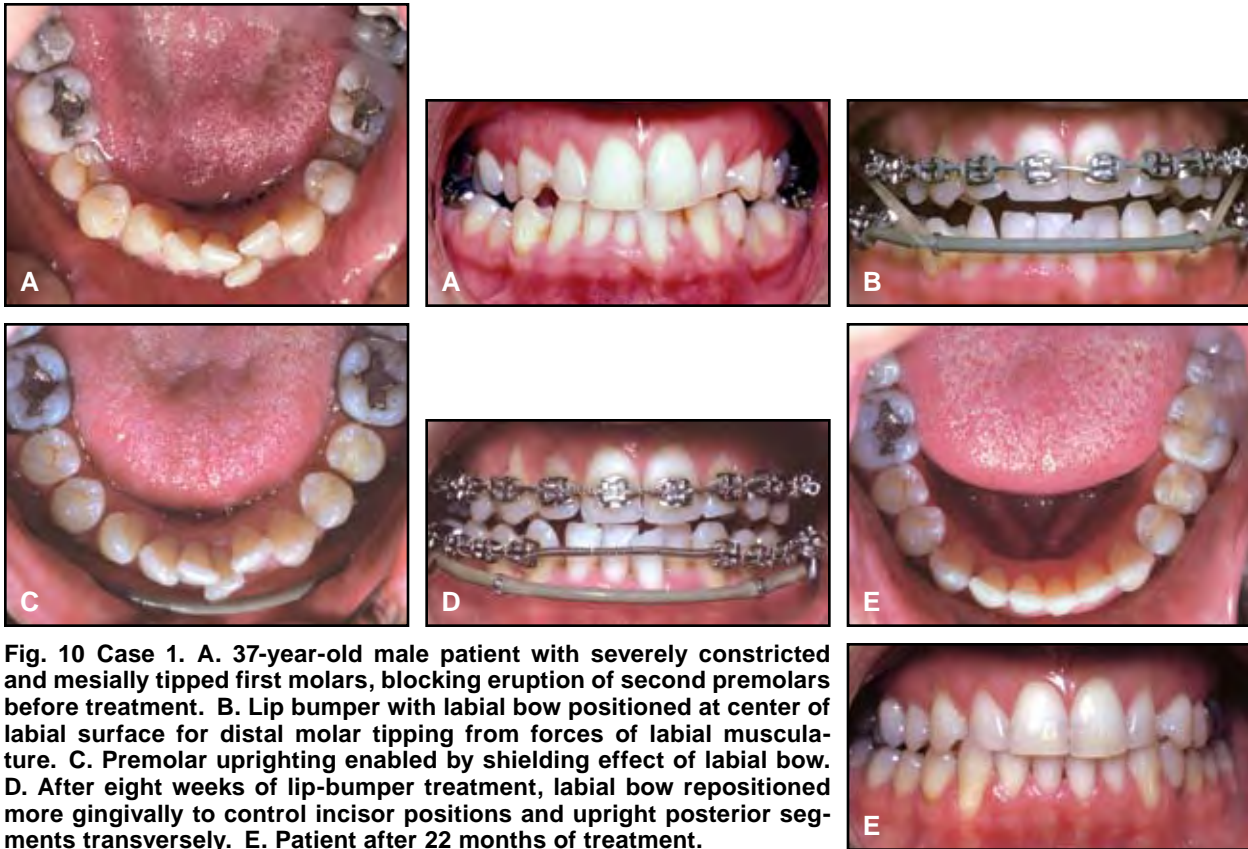
A labial bow placed occlusally using the normal stop-loop configuration, called a Level 1 variation (Fig. 8), is desirable in rare situations involving retroclined incisors and/or undererupted and/or mesially tipped first permanent molars. Excessive distal tipping and extrusion of the first molar and impaction of the second molar are potential side effects (Fig. 9), due to the tendency of the lip to raise the anterior section of the bow. The labial bow must therefore be repositioned inferiorly, to the middle third of the labial incisor surfaces, and anteriorly, 2mm anterior to the incisors, every four to five weeks. Excessive first-molar extrusion may also occur, which is undesirable in high-angle cases.

### Case 1

In this adult case, the first molars were constricted and tipped over the second premolars; the anterior segment was severely crowded and labially displaced (Fig. 10A). The labial bow of the lip bumper was placed occlusally to quickly tip the



**Fig. 9** Level 1 labial bow position causing excessive distal tipping of first molar over erupting second molar in late-mixed-dentition patient.



**Fig. 10 Case 1. A.** 37-year-old male patient with severely constricted and mesially tipped first molars, blocking eruption of second premolars before treatment. **B.** Lip bumper with labial bow positioned at center of labial surface for distal molar tipping from forces of labial musculature. **C.** Premolar uprighting enabled by shielding effect of labial bow. **D.** After eight weeks of lip-bumper treatment, labial bow repositioned more gingivally to control incisor positions and upright posterior segments transversely. **E.** Patient after 22 months of treatment.

molar crowns distally and provide space for the second premolars to erupt (Fig. 10B). The shielding effect of the labial bow allowed the premolars to upright transversely and sagittally (Fig. 10C).

Although the mandibular posterior teeth required extrusion to occlude with the maxillary posterior teeth (indicating a Level 1 configuration), mandibular anterior periodontal health was already compromised, making it critical to prevent the incisors from tipping labially. Therefore, after eight weeks, the labial bow was repositioned more gingivally (Level 2) to recruit the lip forces needed to maintain incisor position (Fig. 10D). The final archwire maintained the archform created by the lip bumpers. After 22 months of treatment, the patient's anterior crowding had been resolved, the molars had been rotated and uprighted, and the premolars had fully erupted (Fig. 10E).

## Level 2 (Normal Configuration)

Level 2, with the labial bow positioned 1.5-2mm inferior and anterior to the enamel-gingival junction, is the most commonly used variation, accounting for more than 80% of lip-bumper cases. The first molars will be extruded much less than with Level 1, incisor positions are maintained, and the premolars are free to upright transversely and drift distally with the pull of the transeptal fibers. Anteriorly, a portion of the lip is able to fold over the labial bow of the lip bumper to maintain the position of the incisors, while still providing a distalizing force (Fig. 11).

The Level 2 configuration produces minimal extrusion and distal crown tipping of the first molars and insignificant labial tipping of the incisors. At the first few appointments, the labial bow

will need to be readjusted to its original position, 1.5-2mm inferior and anterior to the gingival-enamel junction, as the first molars upright. If timely adjustments are not made, the labial bow will remain in a Level 1 position, causing the first molars to tip distally over the occlusal surfaces of the second molars or to extrude excessively.

### Case 2

A late-mixed-dentition patient presented with severe mandibular crowding, labially displaced incisors, and a compromised periodontal condition (Fig. 12A). A Level 2 lip bumper was inserted to shield the lower incisors from the lower lip. This removed the forces of the lip from the compromised attached tissue of the labially displaced right central incisor, allowing the tissue to heal as the incisor was uprighted lingually into the space created by the lip bumper (Fig. 12B).

After finishing with fixed appliances (Fig. 12C), the patient completed treatment without the need for an autogenous graft—a common advantage of lip-bumper therapy. Total treatment time was 16 months (Fig. 12D).

### Case 3

A female in the late mixed dentition presented with a deep bite, a constricted and crowded maxilla, and retroclined incisors (Fig. 13A). Distalization was required to open spaces for the unerupted permanent canines and to correct the Class II occlusion. A Level 2 maxillary lip bumper and a transpalatal bar were placed (Fig. 13B); no other Class II appliance was needed.

After 17 months of distalization (Fig. 13C), the lip bumper was removed, and a fixed appliance was placed in the maxilla (Fig. 13D). Total treatment time was 31 months (Fig. 13E).

When used in the maxilla, the labial bow should be placed as deep in the vestibule as possible; if the patient can smile without revealing the bow, he or she will be much more amenable to wearing the maxillary lip bumper full-time.

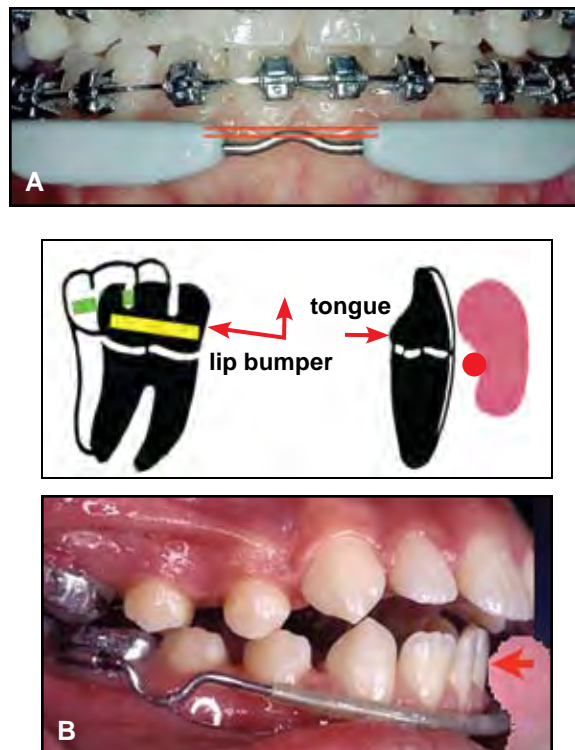
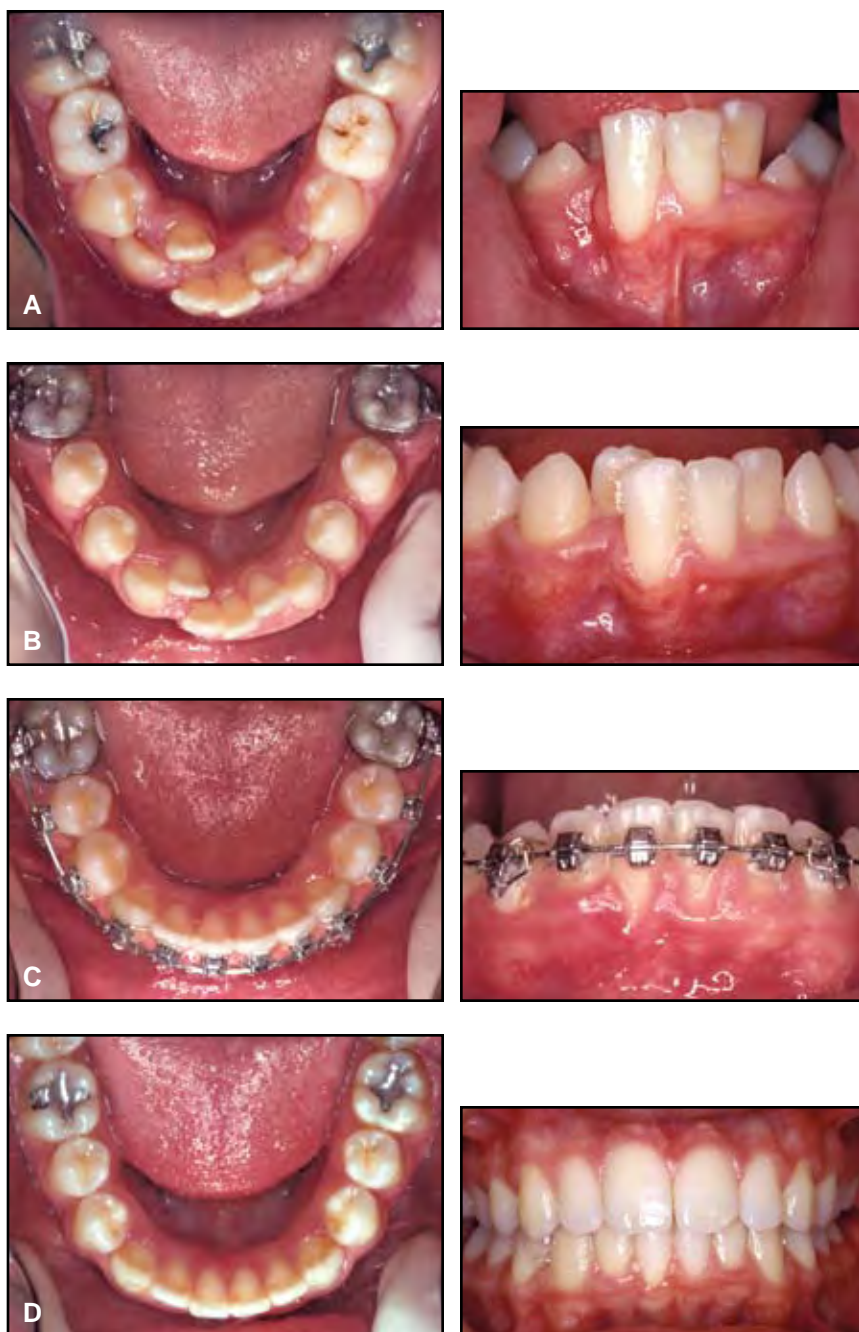


Fig. 11 Level 2 variation. A. Labial bow positioned 1.5-2mm inferior and anterior to gingival-enamel junction. B. Lower lip position restricts labial incisor tipping.

### Case 4

In this young adult patient, a cheek-biting habit caused the right posterior segment to tip lingually and displace mesially (Fig. 14A). The right canine was forced past the lingually tipped lateral incisor into an area of narrower cancellous bone, compromising periodontal support; the left side of the arch was relatively unaffected. A unilateral Level 2 lip bumper was inserted passively for four weeks (Fig. 14B).

On the first adjustment visit, 5° of rotation was applied to the left end of the bumper wire, causing the passive right terminal to relocate distally into the right buccal tube and thus distalizing the right molar and rotating the left molar (Fig. 14C). Unilateral distalization could have been enhanced by bonding the left first and second

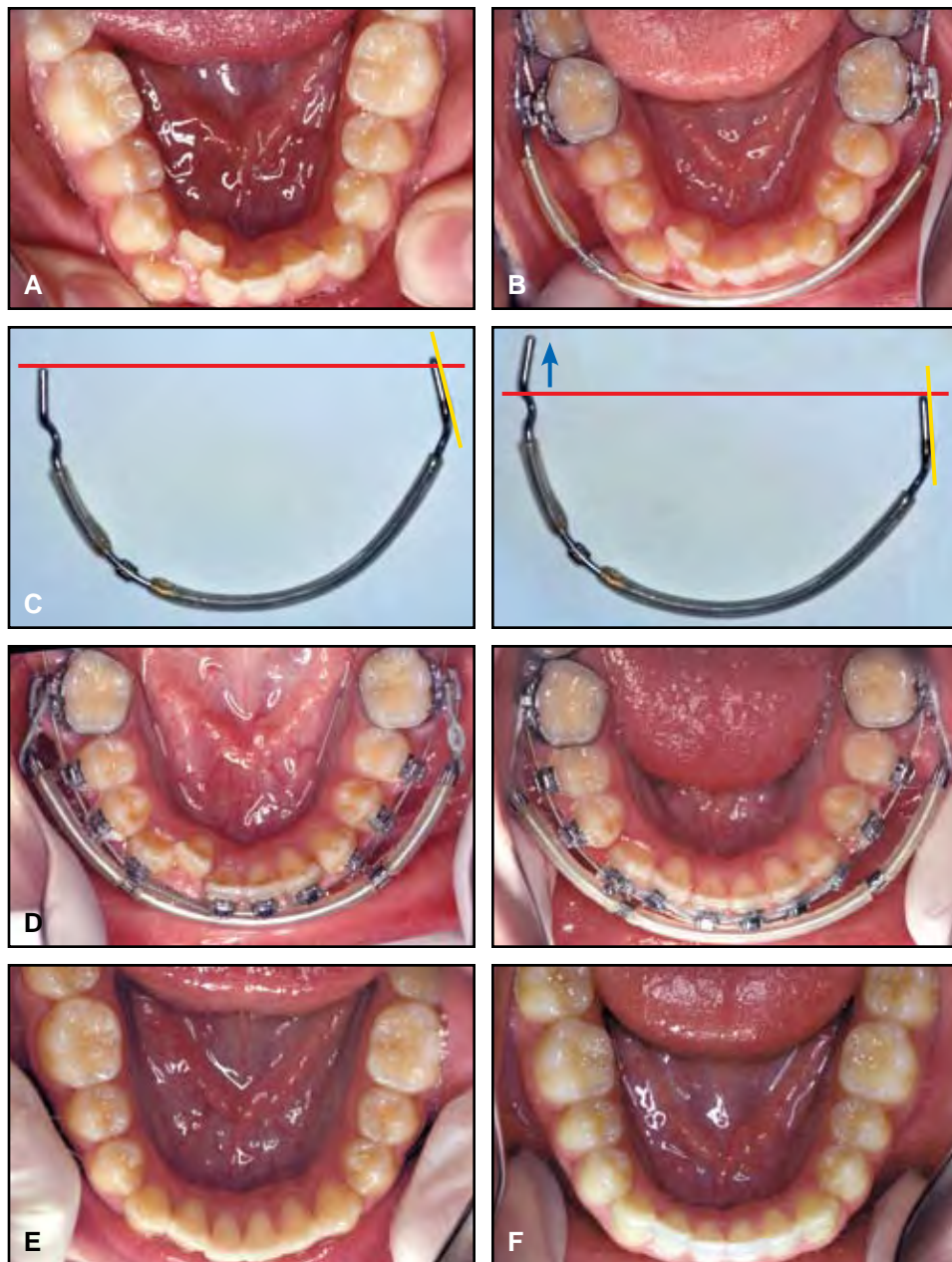


**Fig. 12 Case 2. A. Mixed-dentition patient with severe crowding and compromised periodontal situation before treatment. B. Periodontal status improved and crowding relieved after 19 weeks of Level 2 lip-bumper treatment. C. Fixed appliances placed to complete treatment. D. Patient after 16 months of treatment.**

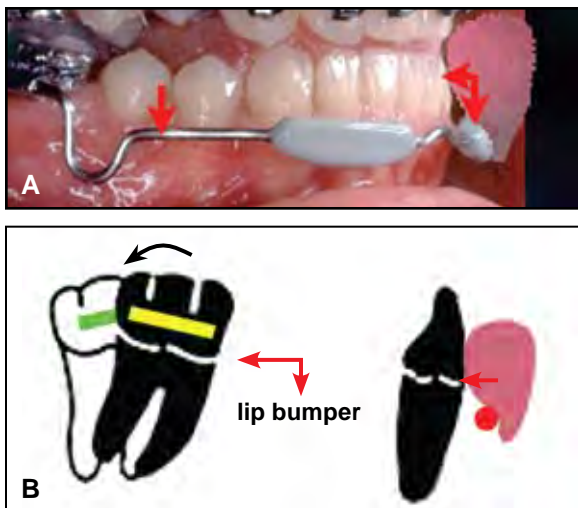




**Fig. 13 Case 3. A.** Female patient in late mixed dentition with crowded maxilla, retroclined incisors, and Class II occlusion before treatment. **B.** Transpalatal arch placed and maxillary lip bumper positioned high in vestibule. **C.** Progress after 17 months. **D.** Placement of fixed appliance. **E.** After 31 months of treatment, patient shows full, radiant smile; lips are supported posteriorly as well as anteriorly, preventing prematurely aged appearance.



**Fig. 14 Case 4. A.** Young adult patient with unilateral cheek-biting habit, causing posterior lingual tipping and displacement on right side of mandible before treatment. **B.** After four weeks of passive unilateral lip-bumper wear. **C.** Left terminal end of lip bumper adjusted with 5° of rotation to distalize right first molar and rotate left first molar. **D.** Lip bumper kept in place during fixed-appliance phase. **E.** Final archform after 21 months of treatment. **F.** Archform maintained five years post-retention.



**Fig. 15 A.** Level 3 variation. “High-angle” configuration places lip bumper deep in vestibule. **B.** Lips and inside of cheek fold over bumper, providing intrusive and distalizing forces. Lip is free to exert lingual force against incisors; first molar intrudes while tipping distally.

premolars and adding a rigid sectional wire to the left first molar. Brackets were placed while the lip-bumper treatment continued (Fig. 14D). The archform created by the unilateral Level 2 lip bumper after 21 months of treatment (Fig. 14E) was maintained for at least five years (Fig. 14F).

### Level 3 (High-Angle Configuration)

The Level 3 variation is indicated for hyperdivergent growth patterns and dentoalveolar open bites. The deep position of the lip bumper in the vestibule, 2-3mm labial to the attached mucosa, allows both the buccal and labial musculature to fold over the entire perimeter of the lip bumper (Fig. 15A). This results in a significant intrusive force against the first molars that can help close a posterior open bite. The lips are allowed to express their maximum force on the incisors, thus uprighting procumbent incisors—a favorable response in cases requiring Class III dentoalveolar correction (Fig. 15B).

Because there is minimal distal tipping of the first-molar crowns, this variation is generally used in early treatment when the second-molar root formation is less than 50%. With the labial bow positioned deep in the vestibule, the posterior shielding effect is insignificant, and there is much less transverse uprighting of the premolars than with levels 1 and 2. Adjustment visits are less frequent because of Level 3’s excellent control of extrusive forces and distal crown tipping, but if necessary, the labial bow may be repositioned inferiorly and 2-3mm anteriorly every eight weeks.

In cases requiring intrusion of first and second molars, brackets should be bonded to the second molars as soon as possible to prevent premature contacts and to align the central fossae and marginal ridges of the first and second molars. Graduated, light-force sectional archwires must be used to intrude the second molar; if the forces exceed the intrusive force of the Level 3 lip bumper, the first molar will extrude before the second molar is intruded.

### Case 5

This adolescent high-angle, open-bite Class III patient was treated using a Level 3 lip bumper, a Hyrax fixed expander, and high-pull headgear (Fig. 16A). The lower first molars were intruded while being uprighted sagittally and transversely (Fig. 16B). Placing the lip bumper as deep in the vestibule as possible allowed all three dimensions to be controlled simultaneously.

The maxillary arch was intruded and developed at the same time using Coordinated Arch Development principles.<sup>33</sup> The Hyrax expander was activated one-quarter turn per week, and the open bite gradually closed (Fig. 16C). After 23 months of treatment, the occlusal plane angle had rotated significantly counterclockwise, and the molars were intruded and uprighted sagittally, indicating that the forces of occlusion were redirected through the long axes of the molars—a considerable enhancement to long-term stability (Fig. 16D).



**Fig. 16 Case 5 A.** Adolescent high-angle Class III patient with open bite before treatment. **B.** Level 3 lip bumper placed deep in vestibule; unilateral, 1oz Class III elastic attached to bonded hook on lingual shield for midline correction. **C.** After 17 months of treatment, showing progress of molar intrusion and arch development. **D.** Patient after 23 months of treatment. Note significant counterclockwise rotation of occlusal plane angle.

## Conclusion

Buschang attributed the lasting effects of lip bumpers to three growth-related mechanisms: leeway space maintenance, transverse expansion of the mandible, and the additional space provided by mesially erupting incisors.<sup>34</sup> Additionally, my experience strongly suggests the establishment of broader archforms through altered muscle patterns and functional changes. As Graber stated, “the treatment results produced by the most precise techniques and the most efficient armamentaria will not stand the test of time when there is a conflict between the morphologic pattern attained and the physiologic structure of the stomatognathic system”.<sup>35</sup>

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