Modified Intrusive Mechanics in Lingual Segmented-Arch Treatment

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Deep overbite correction usually involves extrusion of the posterior teeth, intrusion of the anterior teeth, or both.[1] In patients with mesofacial and dolichofacial patterns, molar extrusion may produce undesirable side effects that can be difficult to control, and the extrusion tends to relapse after treatment.[2] On the other hand, it is difficult to position labial brackets to achieve anterior intrusion without incisor flaring (Fig. 1).

The utility arch used in Ricketts Bioprogressive therapy[3] may not produce true intrusion because of the force system generated by full engagement of the archwire in the anterior brackets.[4] The intrusive mechanics of Burstone's segmented-arch leveling technique can overcome this limitation.[1]

The following case shows a slight modification of Burstone's system to allow lingual orthodontic treatment of a Class II deep-bite case.

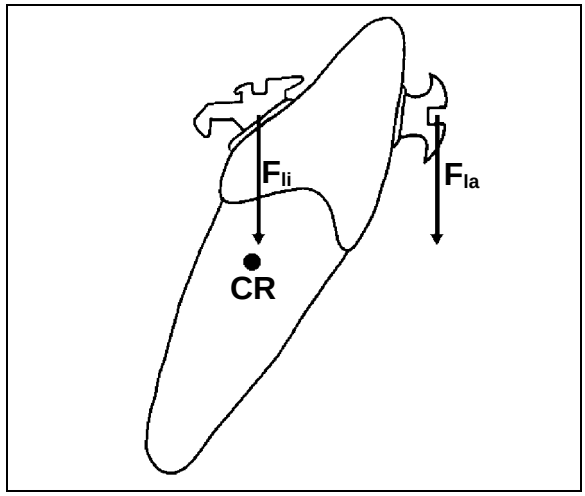

Fig. 1 Effects of bracket position and point of force application on tooth movement. In labial system, intrusive force against incisors (F_{la}) is applied anterior to center of resistance (CR), and incisors tend to tip forward as they intrude. Lingual intrusive force (F_{li}) is applied close to CR of incisors for true intrusion with little flaring.

Case Report

A 29-year-old female presented with the chief complaint of upper lip protrusion and lower anterior crowding. The patient exhibited a convex profile and a slight Class II canine and molar relationship, with an overjet of 5.1mm and an overbite of 4.2mm (Fig. 2). She had 3.6mm of crowding in the mandibular arch. Her smile arc showed an ideal relationship of the upper anterior incisal edges to the lower lip line.

Cephalometric analysis revealed a skeletal Class II malocclusion and a mesofacial pattern (Table 1). The upper and lower incisors were within a normal distance to Frankfort horizontal.

Treatment objectives were to obtain an optimal overbite-overjet relationship, correct the Class II canine and molar relationship, resolve the lower anterior crowding, and improve the

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profile. Extraction of the upper first and lower second premolars was proposed, followed by lingual orthodontic treatment. Because the patient was concerned about lingual tipping of the upper incisors during orthodontic retraction, a maxillary anterior segmental osteotomy was planned.

To avoid occlusal interference from the upper anterior lingual brackets, the lower arch was indirectly bonded and banded first.[5] An .012" nickel titanium mushroom archwire was inserted for initial retraction of the lower first bicuspids and bite opening by intrusion of the lower anterior teeth (Fig. 3A). The Burstone segmented-arch technique was then used for simultaneous intru-

TABLE 1
CEPHALOMETRIC DATA

	Norm	Pre-Treatment	Post-Treatment
Skeletal			
SNA	81.6°	82.3°	79.8°
SNB	79.2°	76.0°	75.3°
ANB	2.5°	6.3°	4.5°
FMA	24.3°	22.1°	23.3°
NPo-FH	89.1°	89.2°	88.7°
Dental			
Overbite	1.8mm	4.2mm	1.9mm
Overjet	3.5mm	5.1mm	2.3mm
1-FH	116.0°	115.6°	106.8°
FMIA	59.8°	57.2°	61.2°
IMPA	95.9°	100.7°	95.5°
Interincisal	123.8°	115.6°	135.0°
Soft tissue			
Upper lip-E-line	–0.9mm	3.7mm	0.2mm
Lower lip-E-line	0.6mm	0.9mm	–1.2mm

Fig. 2 29-year-old female with upper lip protrusion and lower anterior crowding before treatment.

sion of the lower incisors and canines (Fig. 3B).

After two months of bite opening, Fujita lingual brackets were bonded indirectly in the upper arch from first molar to first molar, and the teeth were aligned with a progression of mushroom archwires, from .012" nickel titanium to .016" × .016" stainless steel (Fig. 3C).

The maxillary anterior segmental osteotomy was performed after retraction of the lower anterior teeth. Six weeks after surgery, an .018" ×

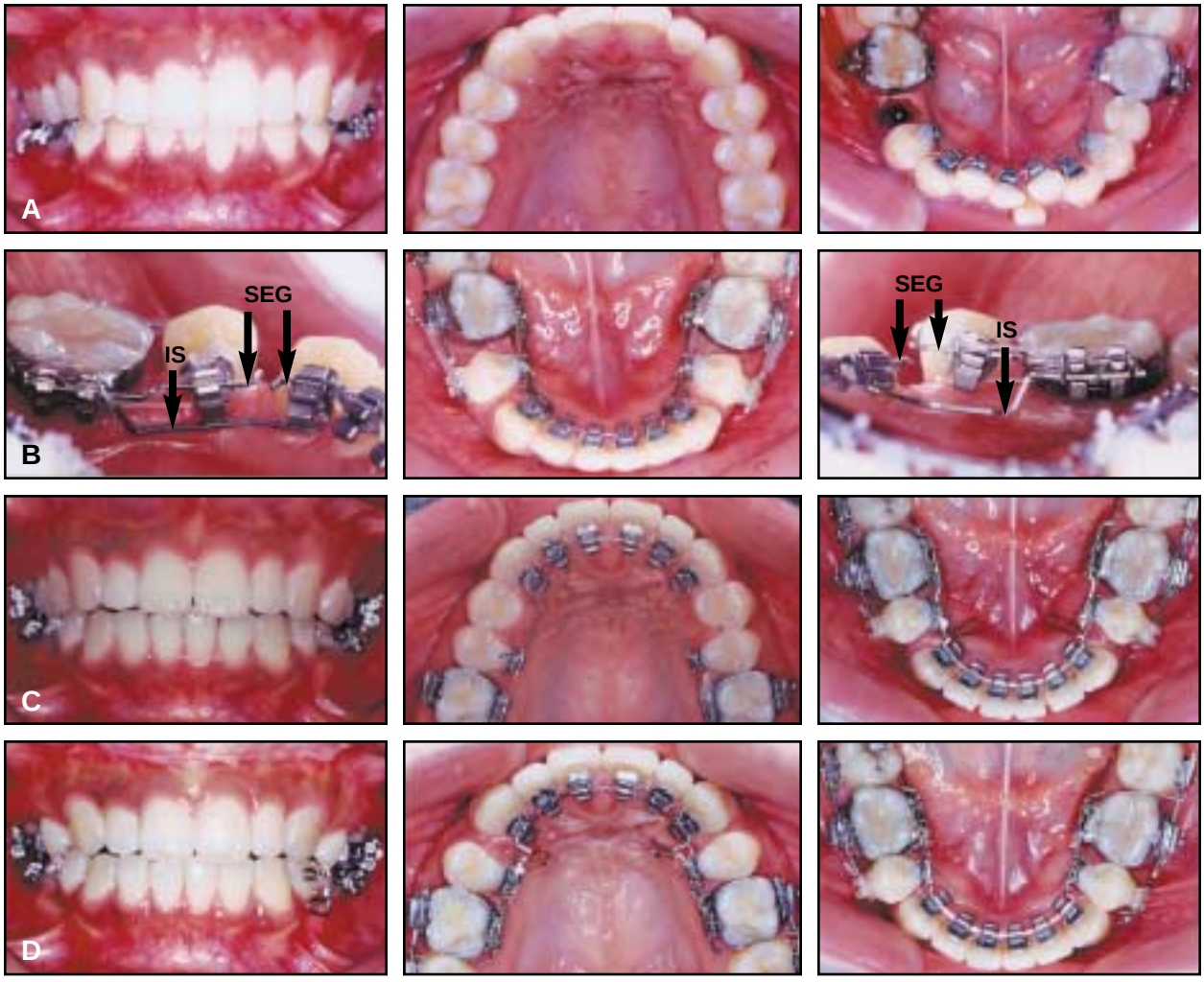

Fig. 3 A. .012" nickel titanium mushroom archwire placed in occlusal slots of lower lingual brackets. B. Slightly modified intrusive mechanics of Burstone's segmented arch technique used for simultaneous intrusion of lower incisors and canines: .017" × .025" TMA intrusive springs (IS) engaged in inner lingual slots of first molar brackets and hooked to anterior segment between lateral incisors and canines; .018" × .018" stainless steel segments (SEG) placed in occlusal slots of anterior and posterior segments; .016" × .022" stainless steel buccal segments engaged in first and second molars. As lower first bicuspids were retracted, lower six anterior teeth were intruded. C. After bite opening, .012" nickel titanium mushroom archwire placed in upper arch, and .018" × .018" stainless steel closing-loop mushroom archwire in lower arch. D. After surgery, .018" × .018" stainless steel closing-loop mushroom archwire placed in upper arch to close residual extraction spaces.

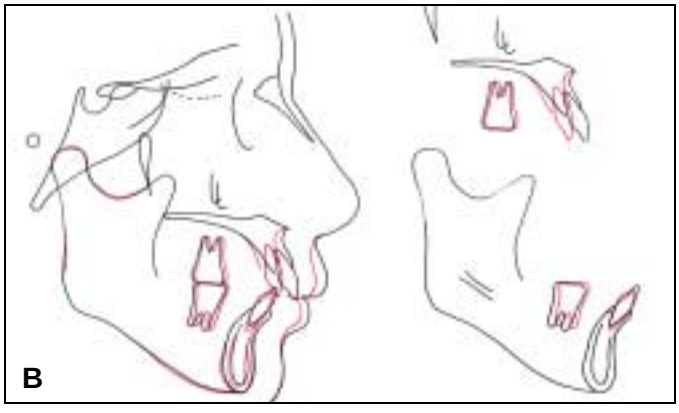

Fig. 4 A. Patient after maxillary anterior segmental osteotomy and 33 months of orthodontic treatment. B. Superimposition of pretreatment (black) and post-treatment (red) cephalometric tracings. Slight downward movement of mandible was accompanied by improvement in lip relationship, with favorable lingual retrusion. Maxillary incisors were favorably retracted, and maxillary molars slightly protracted. Mandibular incisors were significantly intruded, and mandibular molars moved mesially.

Fig. 5 Radiographs taken before treatment (A), after treatment (B), and one year after treatment (C) show improvement in root position.

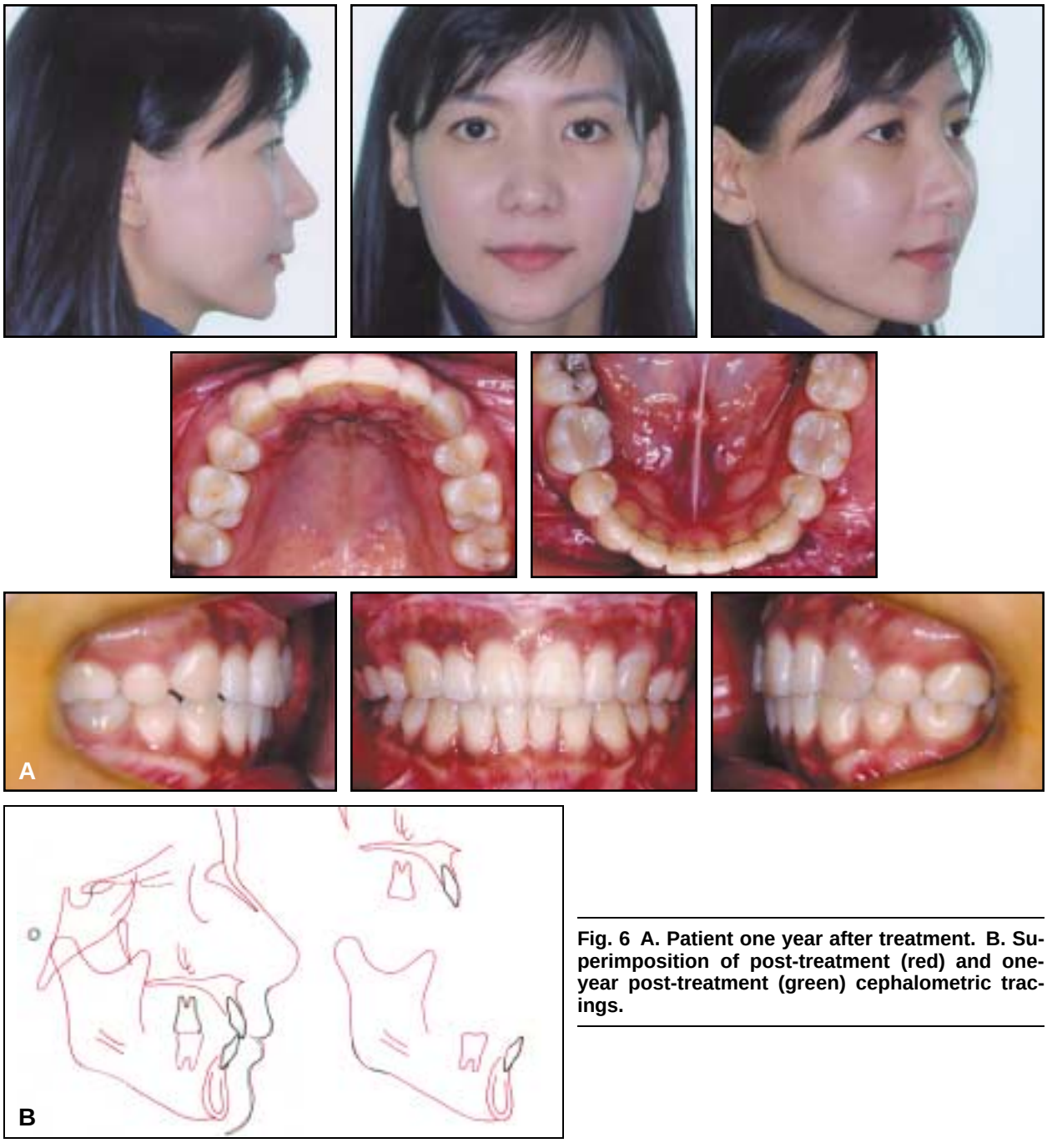

Fig. 6 A. Patient one year after treatment. B. Superimposition of post-treatment (red) and one-year post-treatment (green) cephalometric tracings.

.018" stainless steel closing-loop mushroom archwire was placed in the upper arch to close the residual extraction spaces (Fig. 3D). After 11 months of postsurgical treatment, the patient was debonded. Maxillary wraparound and mandibular fixed retainers were delivered.

Total treatment time was 33 months. The upper lip protrusion was improved, and a Class I occlusion with normal anterior relationships was achieved (Fig. 4). Cephalometric evaluation showed favorable retraction of the maxillary anterior teeth, significant intrusion of the mandibular anterior teeth, reduction of the ANB angle, and improvement in the soft-tissue profile (Table 1). The post-treatment panoramic radiograph showed a good root position (Fig. 5). One year after treatment, the skeletodental and facial results remained stable (Fig. 6).

Discussion

Gorman and colleagues stated that the correction of excessive overbite with lingual brackets is usually accomplished by the occlusion of the lower incisors on the upper incisor bracket biteplanes, which creates a posterior open bite and permits eruption of the molars and bicuspids.[6] Fujita found that in a lingual force system, however, the intrusive force is applied close to the center of resistance of the lower anterior teeth and that the anterior teeth are intruded with little flaring[7] (Fig. 1). He recommended bonding the lower arch first and intruding the lower anterior teeth until enough space had been created for placement of the upper anterior lingual brackets without interference. In the case shown here, bite opening was achieved by Fujita's method, with significant intrusion of the lower anterior teeth, and occlusal contact was maintained during bite opening.

The Fujita lingual anterior and premolar brackets have three slots: occlusal (.019"), lingual (.018"), and vertical (.016").[8] The molar brackets have five slots: one occlusal, two lingual, and two vertical. Each of these three types of archwire slots provides different capabilities for tooth movement. In this patient's lower arch, bilateral .017" × .025" TMA* springs were engaged in the inner lingual slots of the first molar brackets for intrusion, while .018" × .018" stainless steel segments were placed in the occlusal slots of the first bicuspid and first molar brackets and buccal .016" × .022" stainless steel segments were added on the first and second molars to stabilize the posterior segments (Fig. 3B). The multiple slots of the Fujita lingual bracket thus allowed us to apply the intrusive mechanics of Burstone's segmented-arch technique to lingual orthodontic treatment.

Intrusion with the segmented-arch approach depends on controlling the point of force application against the six anterior teeth, where the center of resistance is located distal to the canines.[9] In a labial system, the springs must be hooked to a posterior archwire extension to achieve true intrusion of the six anterior teeth. About 80g of force per side is generally recommended to intrude the lower incisors and canines.[1] In Burstone's original technique, with a perpendicular distance of 30mm from the incisors to the center of resistance of the posterior teeth, 80g of force would produce a moment of 2,400g-mm on the posterior segment. Thus, in labial treatment, it is virtually impossible to intrude all six anterior teeth without posterior tipping. In the case shown here, however, an intrusive force of 70g from lingual springs hooked to the anterior segment between the lateral incisors and canines produced simultaneous intrusion of the lower incisors and canines without undesirable side effects on the posterior teeth. This is probably because the lingual intrusive force passes close to the center of resistance of the anterior teeth, and intrusion of the anterior teeth thus occurs more rapidly than tipping of the posterior teeth.

In deciding whether to intrude the maxil-

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lary or mandibular incisors to correct a deep overbite, the clinician must consider the smile arc—the relationship of the incisal edges of the maxillary incisors and canines to the curvature of the lower lip in the posed smile.[10,11] Because this patient had an ideal smile arc, it was important to maintain the maxillary incisor positions without intruding them during any phase of leveling. The deep overbite was corrected mainly with intrusion of the lower anterior teeth, and the pretreatment vertical position of the maxillary incisors was maintained, leaving the patient with a normal incisor display at rest and in the posed smile.

One of the criticisms of premolar extraction has been its tendency to increase the "negative space" in the buccal corridors of the smile. Typically, however, the transverse arch width at any particular location in the buccal segments is maintained or even slightly increased after extraction; what changes is the tooth occupying that space. If first molar arch width decreases after premolar extractions, that is because the first molars have moved forward to a narrower position in the arch. Indeed, one study of patients treated with and without premolar extractions found no significant difference in the ratio of the intercanine width or the width of the visible dentition to the overall width of the mouth.[12] In the present patient, the maxillary molars were slightly protracted (Fig. 4B), so her enlarged "negative space" after treatment was not caused by the premolar extractions, but more likely by an increase in smile width due to the resolution of her chief complaint—the upper lip protrusion.

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