Lingual Lever-Arm Technique for En Masse Translation in Patients with Generalized Marginal Bone Loss

RAYMOND E. SIATKOWSKI, DMD

Two mechanical difficulties make orthodontic treatment of patients with generalized marginal bone loss particularly demanding:

1. The centers of resistance of the teeth move toward the apices about 65% of the amount of marginal bone loss—in other words, .65mm of apical movement for each millimeter of bone loss.[1] This movement requires increasingly higher moment-to-force ratios at the brackets to achieve translation.
2. The area of the supporting periodontal ligament and alveolar bone decreases substantially,[1] meaning that the magnitude of forces and moments applied to the teeth must be reduced proportionately to keep the resulting stresses and strains at physiologic tooth-moving levels without damaging the tissues. Further, pure tipping mechanics must be avoided, because they produce localized high stresses that increase the risk of tissue damage.

Patients who have periodontal surgery before orthodontic treatment usually return with increased crown, and even root, exposure. That additional exposure allows the brackets to be placed more gingivally than their usual positions, by 65% of the amount of marginal bone loss. Doing so allows clinicians to use their normal translatory mechanics, but with a reduced magnitude of applied forces and moments to allow for the reduced tissue support area. Because of the amount of play between wires and brackets[2] and the usual variations in crown anatomy, such a change in bracket height will have minimal impact on the mechanics, even with preadjusted brackets and tubes.

Patients whose periodontal health is maintained solely by scaling and root planing, without surgical intervention, are more problematic because their bracket levels usually cannot be more apical. Generally, only a sophisticated mechanical approach will produce net en masse translation in such patients.[1] This article, however, shows an approach, based on the lingual lever-arm technique of Fontenelle[3] and Bantleon and colleagues,[4,5] that is simple to use and provides excellent anchorage control while producing pure translation.

Anchorage Considerations

The common terminology for anchorage requirements while translating groups of teeth is used here:

Group A—Maximum anchorage required. The posterior teeth should move the least possible distance mesially, while most of the space is closed by en masse distolingual translation of the anterior teeth.

Group B—Moderate anchorage required. The posterior and anterior segments are translated an equal amount to close the space.

Group C—Minimal anchorage required. The posterior teeth should translate mesially while the anterior teeth maintain their positions.

Procedure

The initial stages of treatment, leveling and alignment, are accomplished first. Bonded brackets and tubes can be used on all the teeth, including first molars. The lingually attached appliances are then made indirectly as follows:

1. Separate the first molars using Self-Locking Separating Springs* of the appropriate size (medium, long, or extra-long). Debond any existing first molar tubes in that arch.
2. Fit first molar bands with lingual sheaths attached, and take an alginate impression. Place elastomeric separator rings to maintain contact-area spacing until the next visit. Wax the bands in place in the impression, then pour the plaster.
3. In the laboratory, construct a passive trans-

Dr. Siatkowski is an orthodontist at P.O. Box 287, Picton, New Zealand.

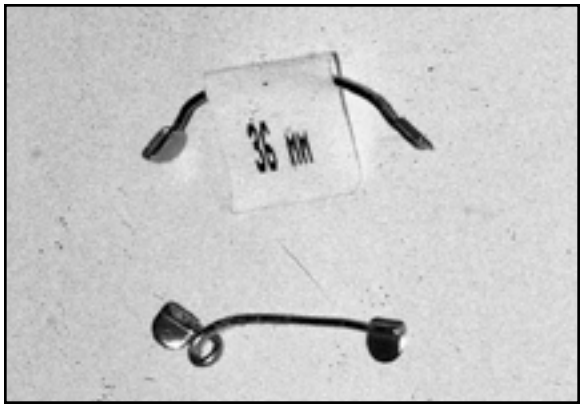


Fig. 1 Lever arm bent from preformed bondable lingual retainer.

palatal arch (TPA) with helical wire segments soldered at appropriate vertical levels (when viewed sagitally). Each hook should end in an open helix, 7mm distal to the TPA. Bend lingual lever arms to fit from preformed, bondable lingual canine-to-canine retainers* with the apical bonding pads removed (Fig. 1).

4. Stress-relieve the TPA at 650°F for 11 minutes in an inlay oven, then eliminate the 2mm or so of expansion that occurs with stress relief. A duplicate TPA can be made at this time for future use in case the patient breaks the original. Having a duplicate ready can save chairtime and treatment time.

5. Cement the first molar bands with the passive TPA attached, and bond the lingual lever arms to the maxillary canines.

6. Place nickel titanium coil springs to begin en masse movement; the required spring force of about 50-80g per side can be achieved with GAC 10-000-25 Extra Light 9mm springs** over a deactivation length of 7mm.[1] The coil-spring eyelets can be bonded to the hook helices to prevent swallowing of components should any become dislodged.

7. Tie in a passive buccal rectangular archwire with tight canine-to-canine figure-8 stainless steel ligation, adding incisor lingual root torque if needed to maintain passive incisor axial inclinations. Posterior stainless steel ligatures will minimize friction and binding as the rectangular wire slides through the posterior brackets and tubes during space closure.

The anchorage class for the desired en masse movement determines the length of the lingual lever arms and the vertical height of the TPA helices:

Group B Anchorage

The space is to be closed by equal mesial movement of the posterior teeth and distolingual movement of the anterior teeth. Therefore, the lingual lever arms and the TPA attachment helices should both be at the vertical level of their respective segments' centers of resistance when viewed sagittally (Fig. 2). The equal and opposite force from the nickel titanium coil spring then passes through or very close to each segment's center of resistance, and the space is closed by equal and opposite translation. The buccal stainless steel archwire prevents lateral force components from being expressed.

Group A Anchorage

Here, the space is to be closed by posterior translation of the anterior segment, with minimal mesial movement of the posterior teeth. The lingual lever arms should be long enough that the coil springs' line of action passes through the anterior segment's center of resistance. The TPA helices are bent apically in the mouth so that when viewed sagittally, the coil springs' line of

*TP Orthodontics, Inc., 100 Center Plaza, LaPorte, IN 46350.

**GAC International, Inc., 185 Oval Drive, Central Islip, NY 11722.

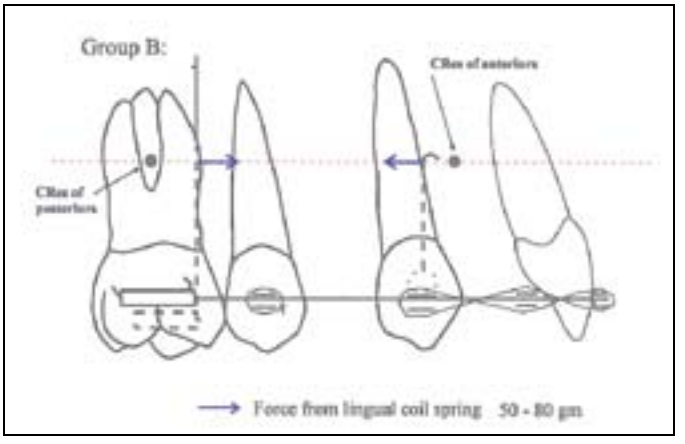
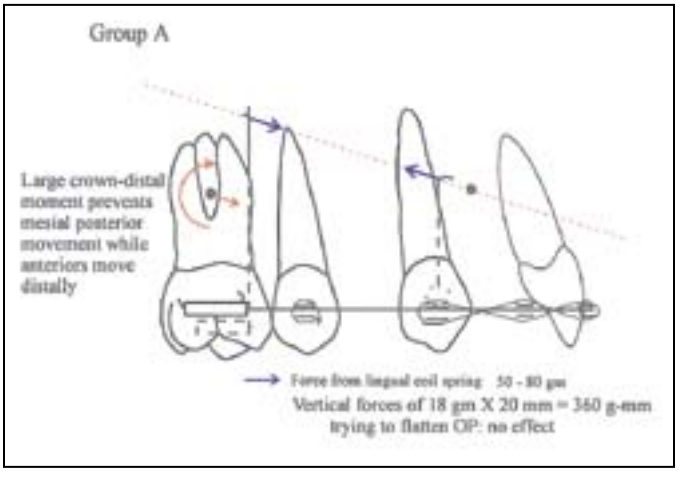


Fig. 2 Group B anchorage mechanics. Any lateral forces are prevented from expressing by buccal rectangular stainless steel archwire.



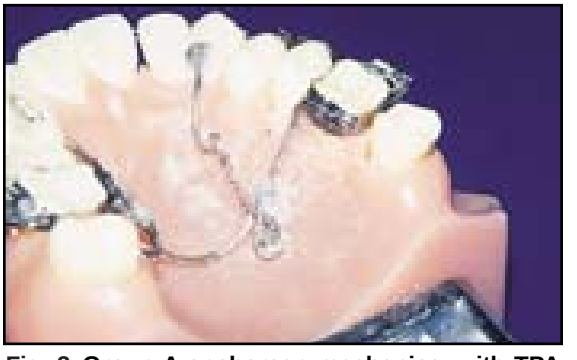
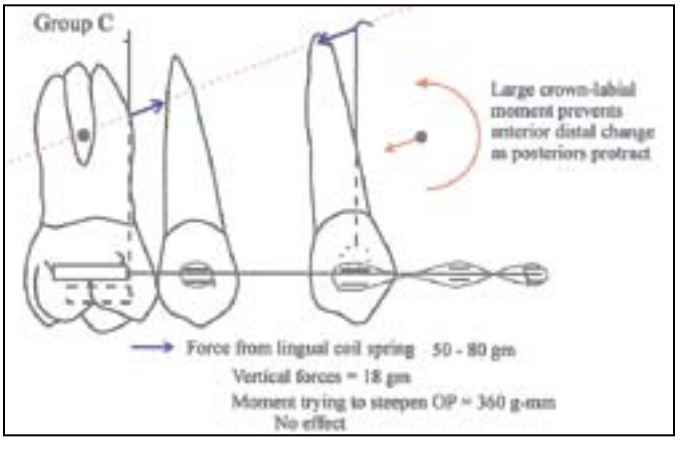


Fig. 3 Group A anchorage mechanics, with TPA hook bent apically from Group B level to change coil spring's line of action, allowing mid-treatment change of anchorage if needed.



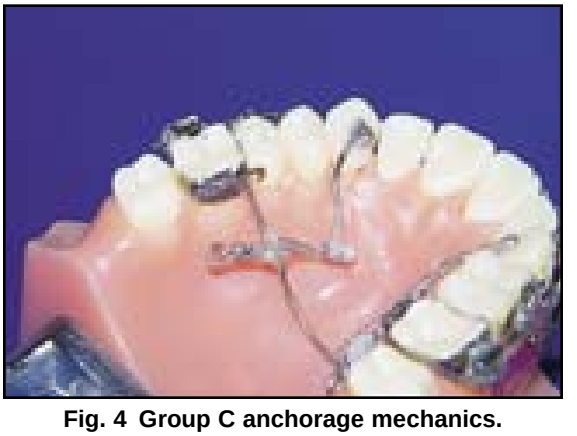


Fig. 4 Group C anchorage mechanics.

action passes far apical to the posterior segment's center of resistance. This induces a large crown-distal moment at the posterior center of resistance that will inhibit the mesial movement of those teeth while the anterior teeth are translating posteriorly (Fig. 3). Minor vertical forces will create a small moment that tends to steepen the occlusal plane, but the stiffness of the rectangular stainless steel archwire will prevent vertical movement between the segments at low force levels, so the occlusal plane remains unaltered.

Group C Anchorage

In this situation, the posterior teeth are to move mesially while the anterior teeth remain in position. The TPA attachment helices are placed so that the coil springs' line of action passes through the posterior segment's center of resistance. The lingual lever arms should be long enough that their helices are high in the palate. The equal and opposite coil spring forces will then pass through the posterior center of resistance and produce mesial translation. They will also pass far apical to the anterior segment's center of resistance, creating a large crown-labial moment that resists posterior movement of the anterior teeth (Fig. 4). Again, the small vertical forces generated will not create side-effects.

In all three cases, the buccal archwire will begin to poke out distally from the molar tube as the teeth move, and will need to be clipped periodically to prevent tissue irritation. If the hook ends are formed into open helices extending 7mm distal to the TPA, they will be long enough to be bent intraorally with a How plier. The hooks can be bent apically in cases beginning with Group B or C anchorage to change to Group A, or gingivally if changing from Group A to Group B or C in mid-treatment. The lingual arms will need to be replaced by longer ones if going from Group A or B to Group C anchorage, or shorter ones if vice versa.

If a patient has a particularly severe Group A anchorage requirement, I suggest the following approach:

1. Perform initial treatment on the anterior teeth only. Do not bracket or band the posterior segments.
2. To achieve space closure, embed the TPA in the posterior occlusal surface of a bondable acrylic occlusal overlay, constructed on casts mounted in centric occlusion (Fig. 5). Do not place molar bands or brackets on any posterior teeth, but embed a rectangular tube on the buccal of the overlay, at its usual level in the first molar region, to accept the buccal rectangular stainless steel archwire.

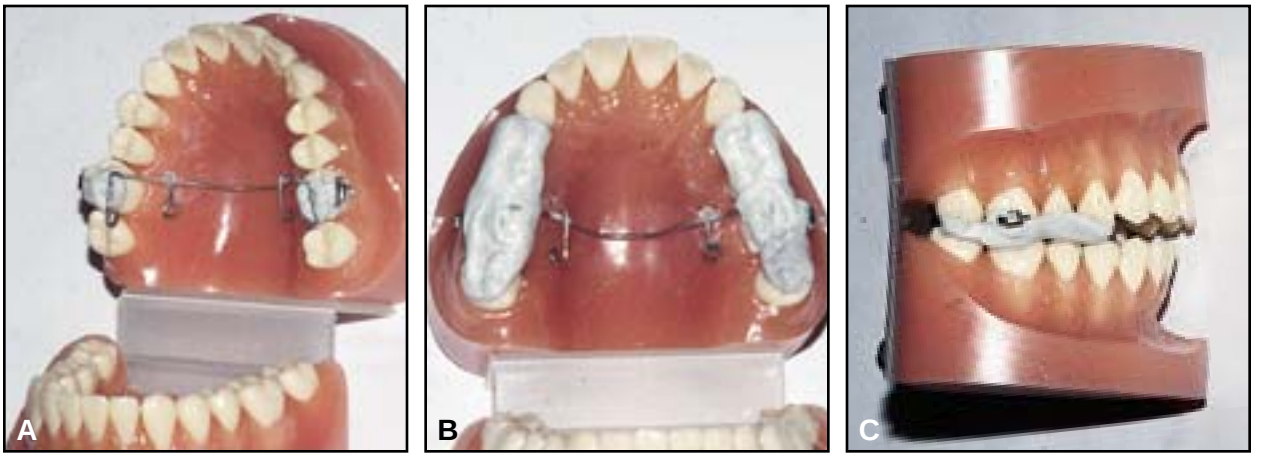


Fig. 5 Construction of transpalatal arch embedded in bondable acrylic occlusal overlay. A. TPA and molar tubes in position. B. TPA and buccal molar tubes embedded in acrylic. C. Completed overlay.

3. Bond the overlay-TPA-tube to the posterior teeth, and proceed with Group A mechanics.

The rationale for this approach is to avoid any movement of posterior teeth prior to space closure. Prior movement will trigger all the cellular phenomena associated with tooth movement, and the periodontal ligament of the posterior teeth will widen, reducing posterior anchorage potential. Occlusal stops or inclines can also serve to increase posterior anchorage as the patient functions.[6] Final alignment of the posterior segments can be performed with bonded brackets and tubes after space closure and removal of the overlay.

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