

The Straight-Wire Concept in Lingual Orthodontics

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The lingual orthodontic technique of Fujita¹⁻³ uses a mushroom archform because of the morphology of the lingual tooth surfaces.⁴ We found, however, that if we cut the clinical crowns off a plaster cast, the buccolingual distances at the gingival margin did not vary substantially. This led us to conclude that straight archwires could be used in lingual orthodontics if they were placed as close to the gingival margin as possible.

Ideal Measurements

To determine the ideal positions of our lingual brackets, we measured ideal post-treatment casts, using the following references (Fig. 1):

1. Li-Point—the most prominent point of the lingual surface or the tip of the protuberance of each tooth (horizontal bracket position).
2. Embrasure Line—a line connecting all the contact points, as defined by Andrews.⁵
3. Lingual Crown Height (LCH)—the vertical dimension of each clinical crown.
4. Lingual Straight Plane (L-S Plane)—the plane of vertical bracket slot positions, formed by connecting the centers of the posterior lingual clinical crowns and extending the line to the

anterior segment. The maxillary L-S Plane lies about one-third of the clinical crown height from the gingival margin of the anterior teeth; the mandibular L-S Plane meets the anterior teeth at about the center of their clinical crowns. The only exception is when the first bicuspids are morphologically small or irregularly shaped, in which case the plane has to run more incisally.

5. Bracket Height (H)—the distance from the incisal edge to the LS-Plane. Bracket heights did not differ significantly between ideal casts of nonextraction cases and four-first-bicuspid extraction cases (Fig. 2).

Assuming a distance of .5mm from the bracket slot to the lingual surface of each tooth, we calculated the average distances from the Embrasure Line to each Li-Point and from Li-Point to the archwire (Fig. 3). These measurements did not vary substantially from tooth to tooth, demonstrating that a straight archwire could be used instead of a mushroom arch.

New Lingual Brackets

Prototype preadjusted lingual brackets were developed using the above information (Fig. 4). A self-ligating version is currently under

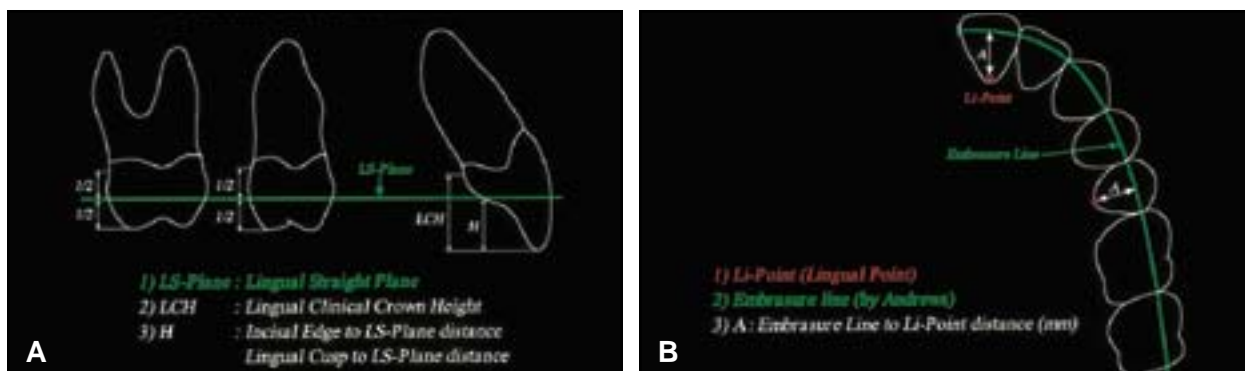


Fig. 1 References used to determine bracket positions from ideal casts. A. Vertical measurements. B. Horizontal measurements.

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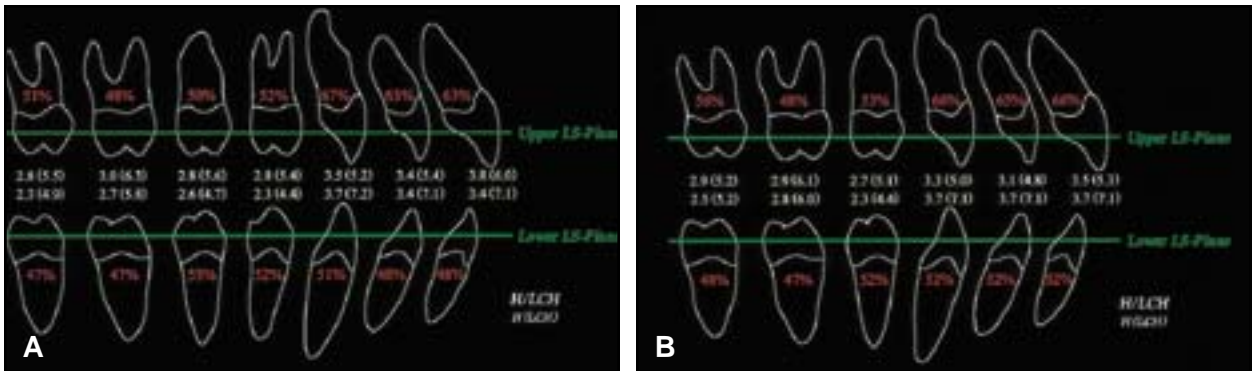


Fig. 2 Vertical bracket height measurements. A. Nonextraction cases. B. Four-first-bicuspid extraction cases.

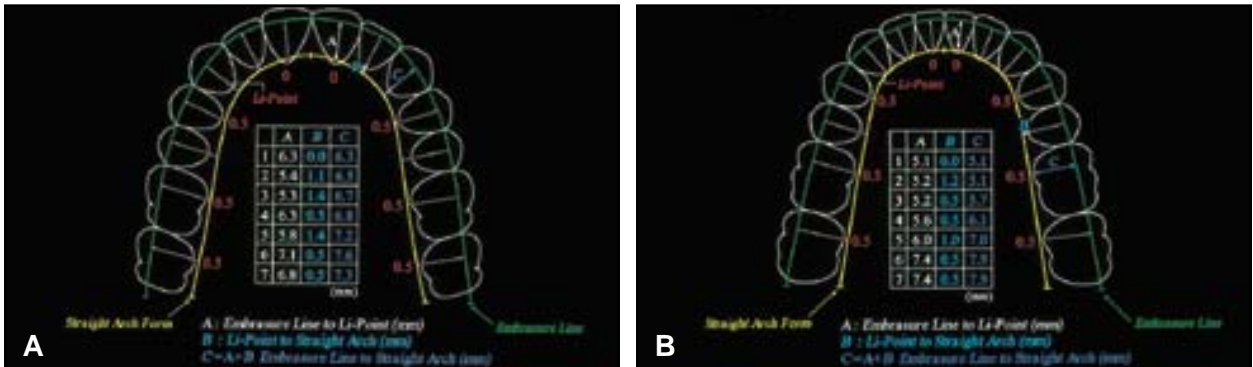


Fig. 3 Horizontal measurements (nonextraction cases). A. Maxillary arch. B. Mandibular arch.

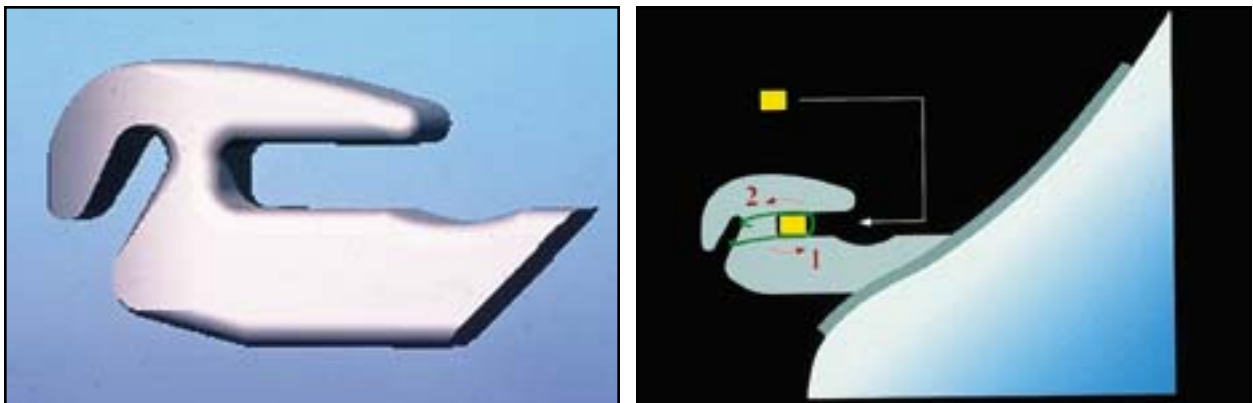


Fig. 4 Prototype lingual bracket with anteroposterior archwire insertion.



Fig. 5 Prototype self-ligating lingual bracket.

development* (Fig. 5).

Compared to commercially available lingual brackets, archwire insertion is in the opposite direction, from the top instead of from the bottom. The new bracket offers the following



Fig. 6 Flossing made easier with gingivally placed lingual brackets.

advantages over previous systems:

- Flossing is easier because the archwire is farther from the lingual surface and incisal edge (Fig. 6). Hygiene is not difficult at the gingival margins, due to the lack of hooks and severe undercuts.
- Bracket thickness is virtually the same, but

*Ormco/"A" Company, 1717 W. Collins Ave., Orange, CA 92867. Straight-Wire Appliance and TMA are registered trademarks.

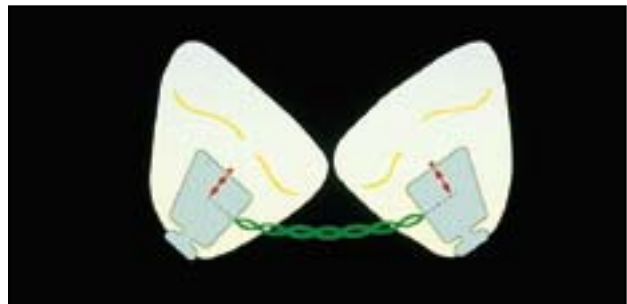
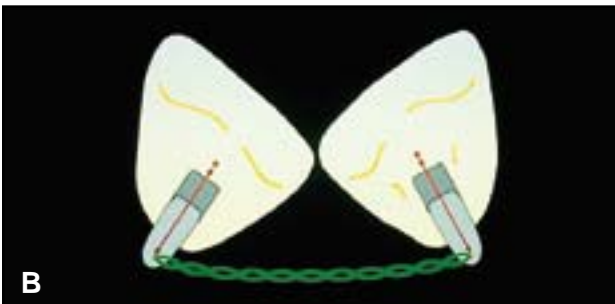
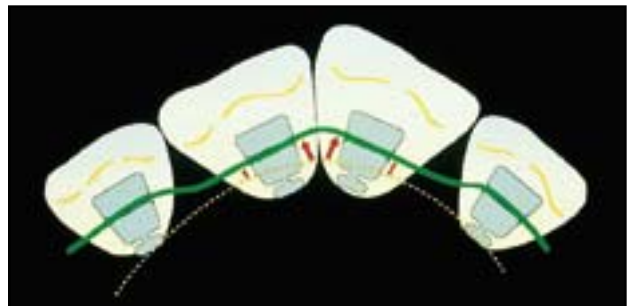
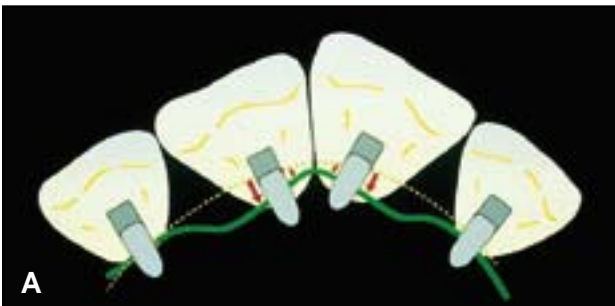


Fig. 7 A. Tooth rotation with new lingual brackets (left) compared to other lingual brackets (dotted line = passive archwire; red line = ligated archwire). B. Rotation correction with new lingual brackets (left) compared to other lingual brackets.

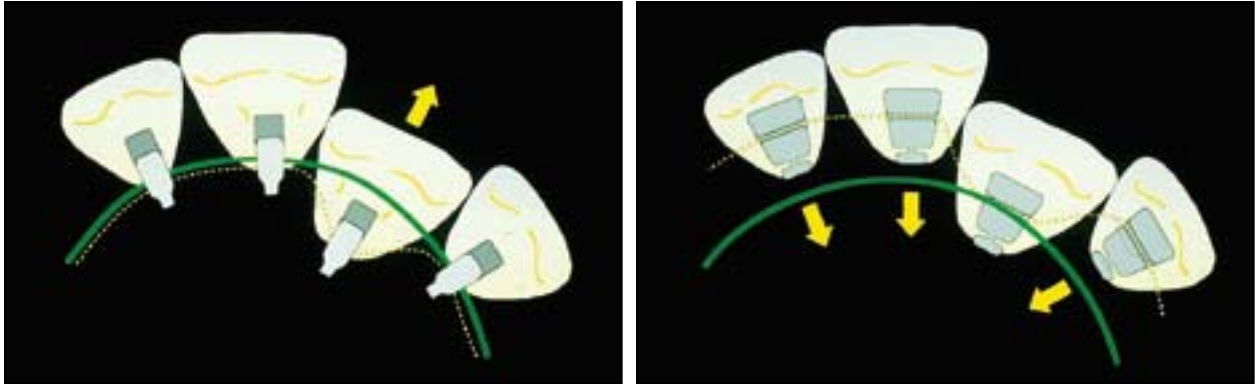


Fig. 8 Anterior expansion with new lingual brackets (left) compared to previous lingual brackets (red line = passive archwire; dotted line = ligated archwire).



Fig. 9 Rebonding lingual bracket with archwire still in place.

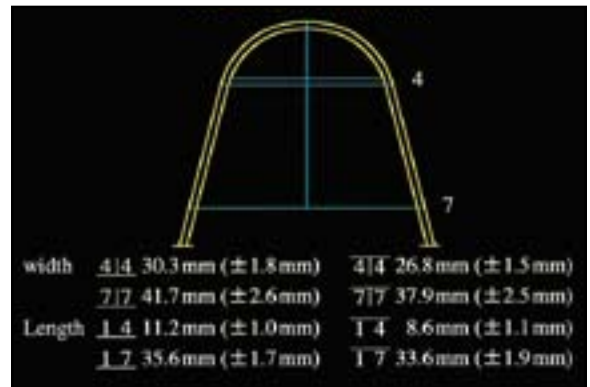


Fig. 10 Example of template used to create straight lingual archform.

mesiodistal width is much smaller, allowing adequate interbracket distances.

- Less composite is needed on the mandibular molars to raise the bite, since the brackets are placed more gingivally.
- Rotations can be more easily accomplished because the archwire can be tied tightly to the bottom of the bracket slots (Fig. 7A). Also, rotations can be more easily corrected because the force is applied over a wider span (Fig. 7B).
- Expansion in an anterior direction is more effective because the most labially positioned tooth is ligated first. The ties are secure enough that the archwire remains stable (Fig. 8).

- Torque control is improved; the reverse slot direction ensures that the archwire seats fully in the bracket slot.
- Rebonding is easier because the archwire does not have to be removed (Fig. 9).
- Interdental stripping can be performed during treatment without removing the archwire.
- Preformed archwires can be used with few additional bends, reducing chairtime and allowing the use of simple sliding mechanics. Until the preformed wires are commercially available, archwires can be adapted with templates (Fig. 10), although we usually bend them on the individual case setups.

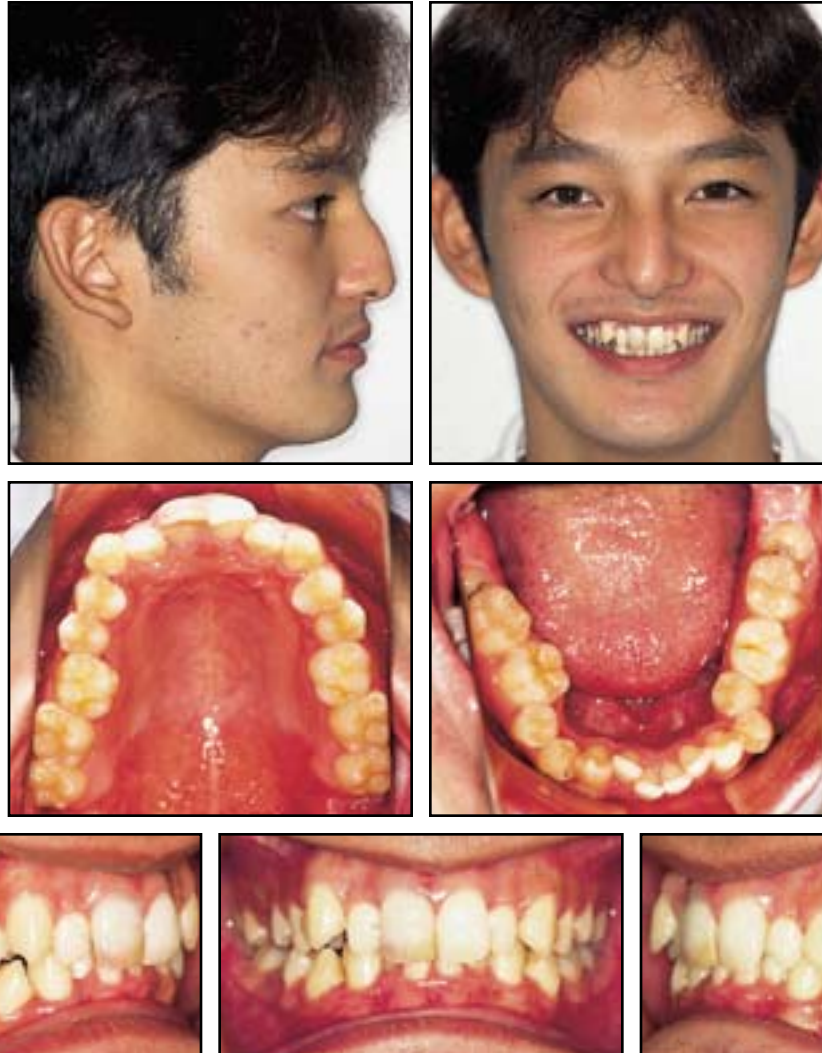


Fig. 11 22-year-old male with Class I malocclusion and severe crowding before treatment.

Case Report

A 22-year-old male presented with a Class I malocclusion, 4mm of overbite, and severe crowding in both arches (Fig. 11). Four first bicusps were extracted, and composite was bonded to the mandibular molars to serve as a biteplane.

Prototype lingual brackets were bonded using Hiro's indirect technique.⁶ The initial .014" Titanal XR** archwires were bent into the arch-

forms needed for leveling (Fig. 12). Because of the reverse slot direction, straight wires can be used even when the maxillary lateral incisors are shifted lingually.

A transpalatal arch was placed to provide maximum molar anchorage during cuspid and incisor retraction. Leveling was continued with

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Fig. 12 Placement of initial .014" Titanal XR leveling archwires.

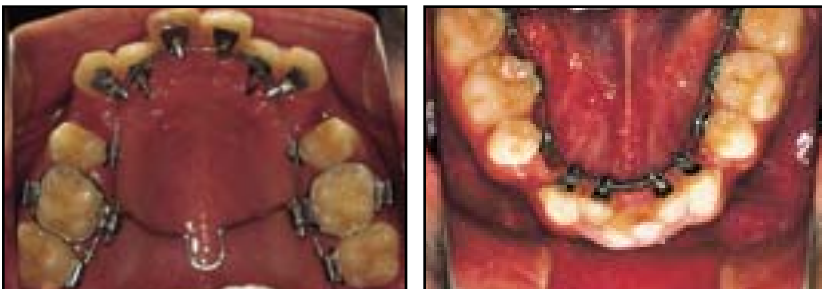


Fig. 13 Transpalatal arch placed for molar anchorage, and leveling continued with .016" Titanal XR maxillary archwire and .016" TMA mandibular archwire.



Fig. 14 Extraction spaces closed with sliding mechanics and Class II elastics.

an .016" Titanal XR maxillary archwire and an .016" TMA* mandibular archwire (Fig. 13).

After four months of leveling, maxillary .017" × .025" TMA and mandibular .017" × .017" archwires were placed for one month of torque control. En masse retraction was then begun with .016" × .022" stainless steel wires in both arches. With the overbite nearly corrected at this point, the mandibular posterior composite was removed.

Sliding mechanics and Class II elastics were used to close the extraction spaces within

10 more months (Fig. 14). The maxillary archwire was then changed to .017" × .017" TMA for detailing.

After 20 months of active treatment, the cuspid relationship had improved to Class I, with torque well controlled (Fig. 15).

Conclusion

At the time of publication, these prototype lingual brackets had been used in 15 cases, both extraction and nonextraction. With some of the cases already finished, it appears that the average treatment time is less than two years.

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Fig. 15 Patient after 20 months of active treatment.

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