

# A New Lingual Straight-Wire Technique

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To overcome several limitations of the lingual mushroom-arch technique introduced by Fujita in the 1970s,<sup>1,2</sup> Takemoto and Scuzzo developed the lingual straight-wire (LSW) technique in 1995.<sup>3,4</sup> Mushroom archwires typically require vertical steps and insets between the canines and first premolars, necessitating complicated wire bends that can affect treatment outcomes. The LSW method eliminated this problem, but the thickness of the lingual brackets was found to result in shorter interbracket spans, gingival impingement, and tongue irritation (Fig. 1A).

We have developed a new LSW appliance that uses a planar archform to make arch coordination less difficult and permit the use of simpler mechanics, such as sliding techniques (Fig. 1B).

## Appliance Design

The Scuzzo-Takemoto bracket (STb\*) was developed in 2003 to improve the comfort, speed, and reliability of lingual treatment. Because the modified LSW method requires the brackets to be much closer to the gingival margins and lingual tooth surfaces, however, a new STb Light Lingual System\* bracket was introduced in 2009 (Fig. 2A). Its .018" × .025" horizontal slot, made of milled 17-4PH stainless steel, is narrower mesiodistally than the previous version, which increases the interbracket distance and thus reduces both the force transmitted by the archwire and the resistance to sliding mechanics.<sup>5</sup> The thinner bracket pad, made of 316 L stainless steel, places the bracket slots much closer to the lingual tooth surfaces,

further increasing the interbracket distance. Both the original and the new STb incorporate a .33mm passive-ligation step on each side of the bracket slot to prevent ligatures from binding the archwire against the slot base, thereby reducing friction when using .012" or .013" main wires (Fig. 2B).

The new gingival-offset slot position reduces in-out thickness, enhancing patient comfort and avoiding occlusal trauma from the opposing teeth (Fig. 3). With the LSW system, the thickness of



Fig. 1 Lingual straight-wire (LSW) systems. A. 1990s version. B. New technique.

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composite between the tooth and bracket pad can be minimized—even for the canines, it is less than 2mm in most cases. Differences in resin base thickness of as much as 2mm do not affect the strength of indirect bonding.<sup>6</sup>

The new STb design eliminates the need for inset bends between the canines and first premolars, simplifying sliding mechanics and making leveling and alignment more effective. The gingival hook is more easily tied with metal or elastomeric ligatures, reducing chairtime compared with conventional lingual appliances.

To allow for the shorter distance between the

tooth surfaces and the bracket slots, the archwire must also be kept closer to the lingual surfaces of the teeth. Therefore, the new LSW archform is squarer than the rounded 1990s version (Fig. 4). The new archform is based on the lingual straight plane (L-S), which is the plane of vertical bracket slot positions formed by connecting the centers of the posterior lingual clinical crowns and extending this line to the anterior segment. The maxillary L-S plane lies at about one-third of the clinical crown height from the gingival margins 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 premolars are small or irregularly shaped, in which case the plane runs more incisally.



Fig. 2 A. Old and new Scuzzo-Takemoto brackets (STb). B. Passive ligation steps on both sides of bracket slot.

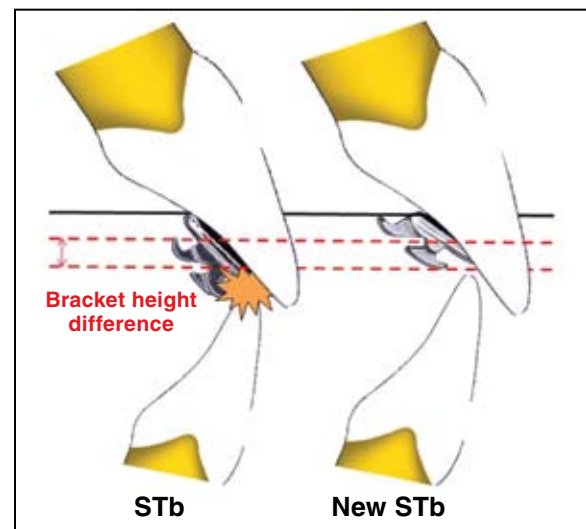


Fig. 3 New gingival offset slot position reduces in-out thickness.

## Technique

The LSW technique requires a manual or computerized setup model (Fig. 5), which must include the following:

- Torque, angulation, height, and rotation (Fig. 6). Although overtorque and overangulation are needed in extraction treatment, excessive torque of the anterior teeth on the setup model will position the brackets nearly at the gingival margins.
- Occlusal plane (Fig. 7).
- Archform (Fig. 8).

The Kommon base, developed by Komori in 2008,<sup>7,8</sup> is the latest indirect-bonding method for lingual orthodontics. In this system, an anatomical extension of the resin pad between the bracket base and tooth surface allows customization of the lingual

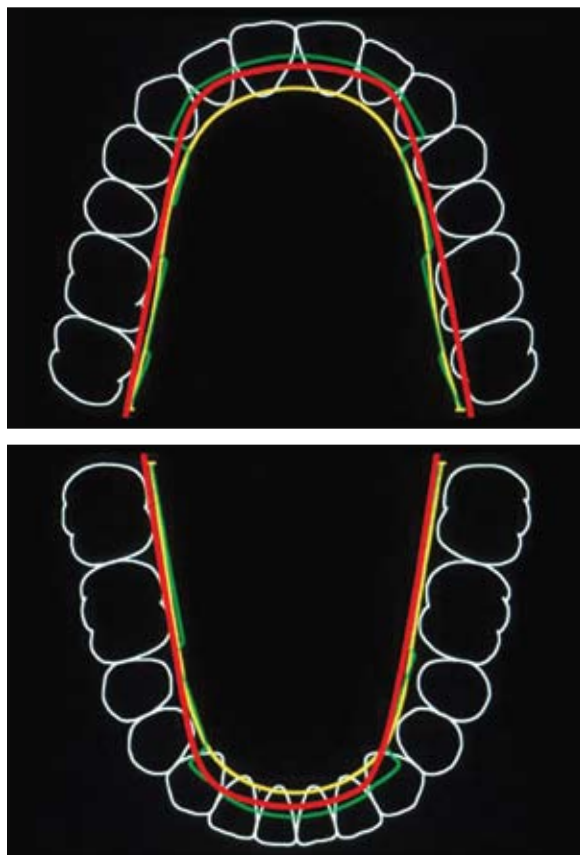


Fig. 4 Mushroom (green), 1990s LSW (yellow), and new LSW (red) archforms.

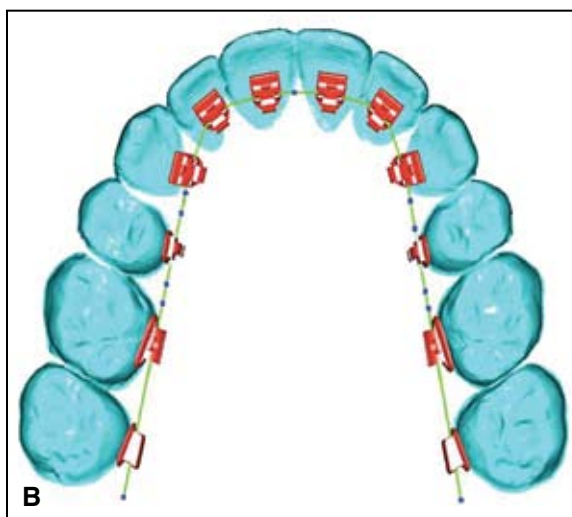


Fig. 5 LSW setup. A. Manual. B. Digital.



Fig. 6 Lingual bracket torque established with manual setup.

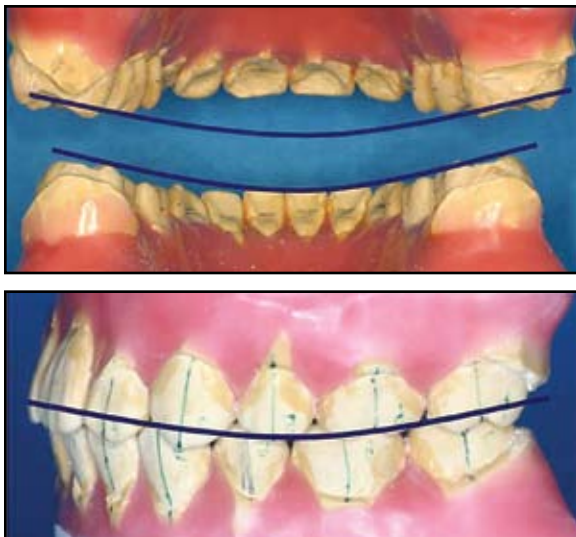


Fig. 7 Mild curve of Wilson and mild curve of Spee on manual setup.

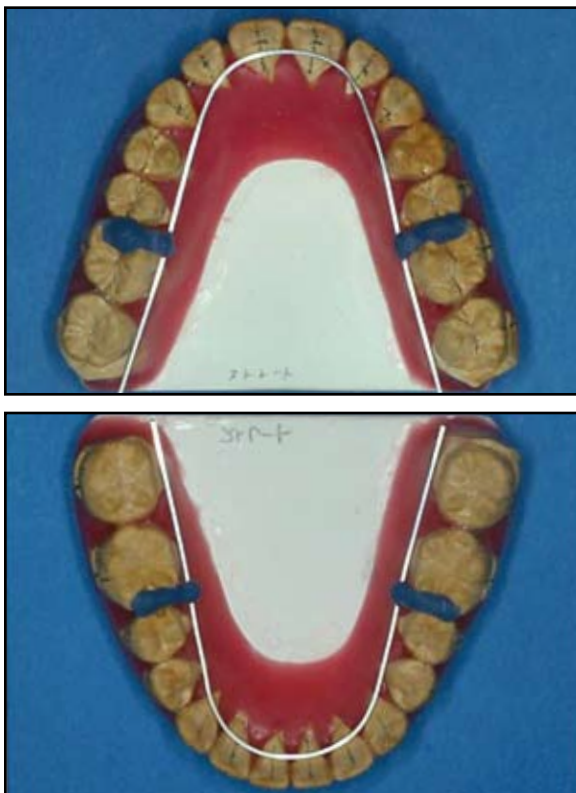


Fig. 8 Simple templates used to confirm symmetrical archforms.



Fig. 9 Kommon base system for indirect bonding.

brackets (Fig. 9). Using a glass ionomer cement\*\* for bonding not only permits working in wet conditions without etching, but also allows direct transfer of the brackets to the teeth without the need for a tray.

Our recommended wire sequence for non-extraction treatment is:

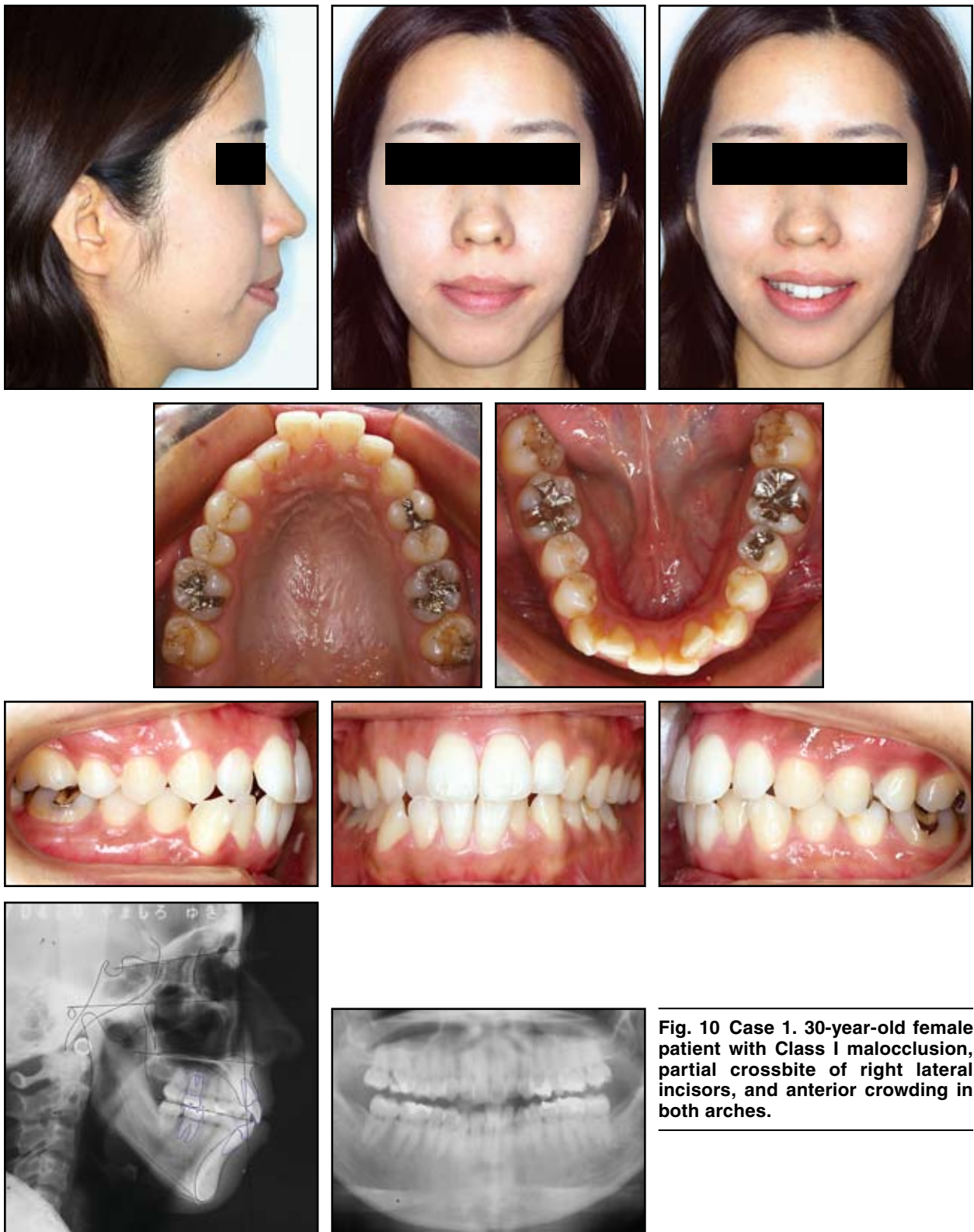
1. Leveling—.012" nickel titanium or .013" copper nickel titanium
2. Rotation control—.014" or .016" × .016" nickel titanium
3. Torque establishment—.017" × .017" or .018" × .018" nickel titanium or .0175" × .0175" TMA\*
4. Detailing—.016" TMA

For extraction treatment:

1. Leveling—.012" nickel titanium or .013" copper nickel titanium
2. Rotation control—.014" or .016" × .016" nickel titanium
3. Torque establishment—.017" × .017" or .018" × .018" nickel titanium or .0175" × .0175" TMA
4. Space closure—.016" × .022" or .017" × .025" stainless steel
5. Detailing—.016" or .0175" × .0175" TMA

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\*\*Fuji Ortho LC, trademark of GC America, 3737 W. 127th St., Alsip, IL 60803; www.gcamerica.com.



**Fig. 10 Case 1. 30-year-old female patient with Class I malocclusion, partial crossbite of right lateral incisors, and anterior crowding in both arches.**

**Case 1**

A 30-year-old female presented with a Class I malocclusion, a partial crossbite of the right lateral incisors, and anterior crowding (her chief complaint) in both arches (Fig. 10, Table 1). The upper arch was expanded with a Quad-Helix,<sup>\*\*\*</sup> and the lower arch with a bi-helix expander. After expansion, the new STb brackets were bonded using the Kommon-base indirect method.

Initial .012" nickel titanium wires with the planar archform were used for leveling, with segmental wires used for molar positioning (Fig. 11). Both archwires were then changed to .016" nickel titanium to complete leveling and to .0175" TMA for detailing (Fig. 12). After 11 months of treatment, the malocclusion had been considerably improved (Fig. 13, Table 1).



**Fig. 11** Case 1. .012" nickel titanium archwires with planar archform used for leveling.

**TABLE 1**  
**CASE 1 CEPHALOMETRIC DATA**

	Pretreatment	Post-Treatment
FMIA	41.0°	46.0°
FMA	42.0°	43.0°
IMPA	97.0°	91.0°
SNA	86.0°	88.0°
SNB	77.0°	77.0°
ANB	9.0°	10.0°
Wits	1mm	1mm
SN-GoGn	44.9°	44.8°

<sup>\*\*\*</sup>Rocky Mountain Orthodontics, Inc., 650 West Colfax Ave., Denver, CO 80204; www.rmortho.com.



**Fig. 12** Case 1. .0175" x .0175" TMA archwire used for detailing.

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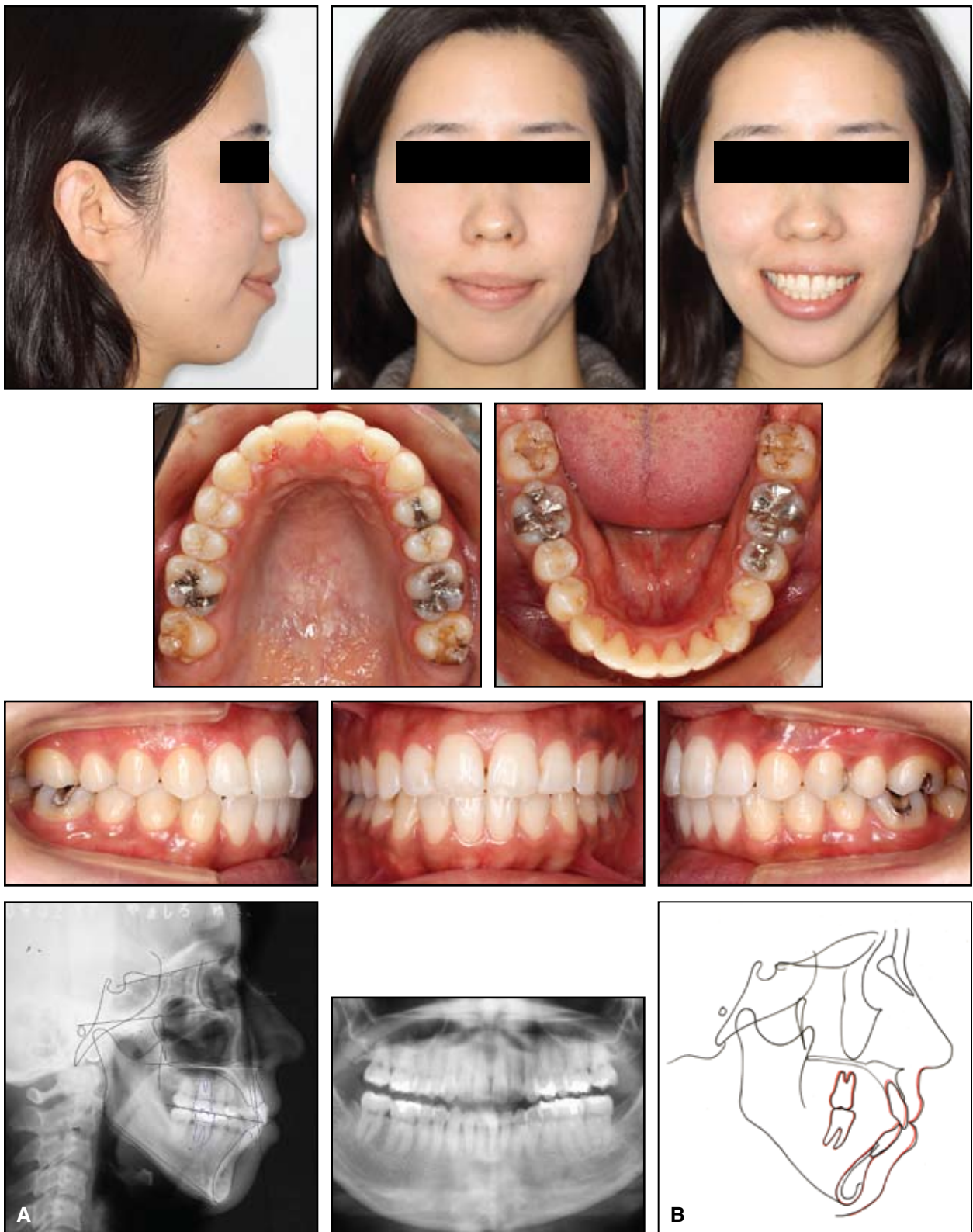
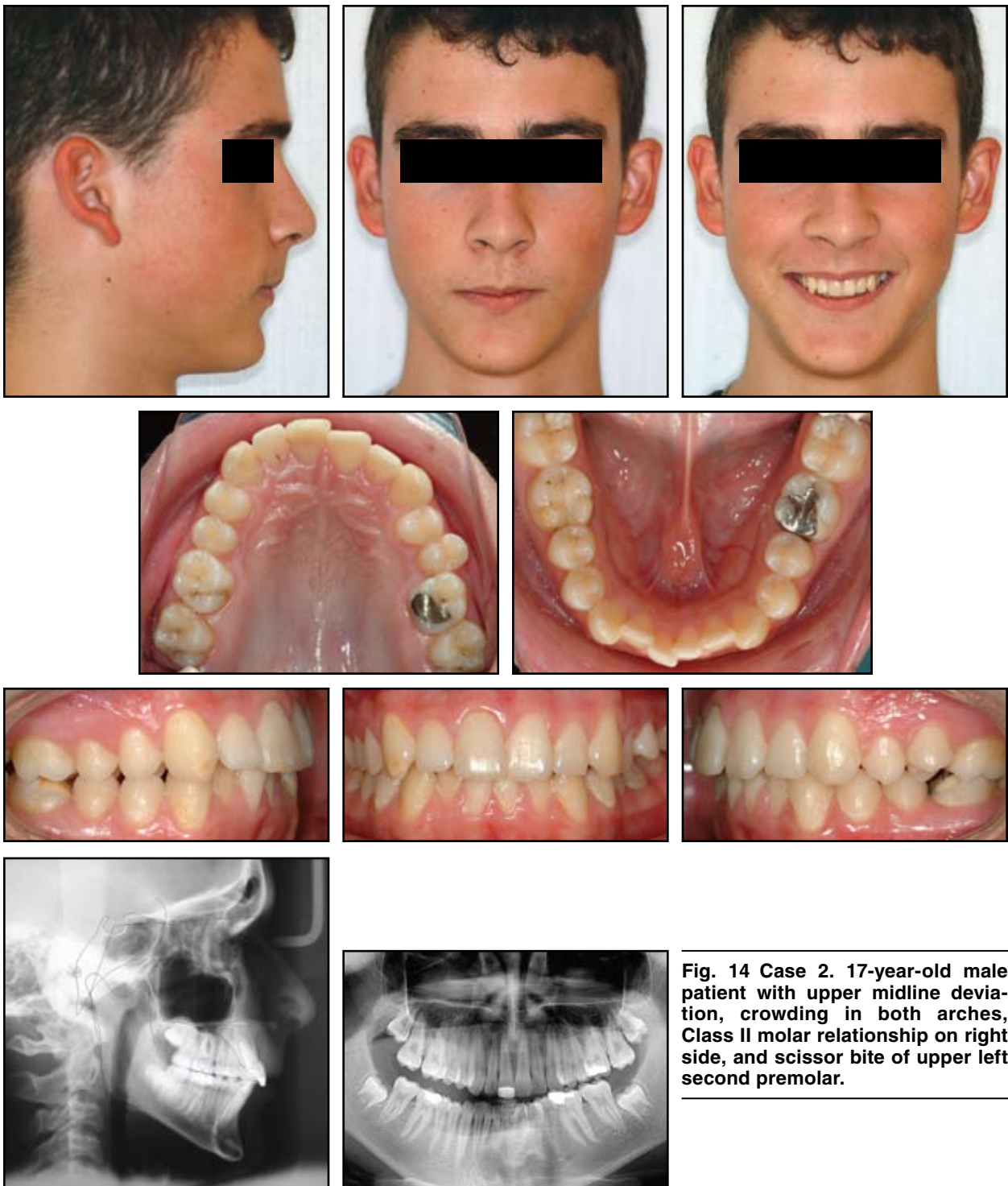


Fig. 13 A. Case 1. Patient after 11 months of treatment. B. Superimposition of pre- and post-treatment cephalometric tracings.



**Fig. 14 Case 2. 17-year-old male patient with upper midline deviation, crowding in both arches, Class II molar relationship on right side, and scissor bite of upper left second premolar.**

### Case 2

A 17-year-old male presented with the chief complaint of unesthetic dental appearance. Intraoral examination revealed an upper midline deviation to the left, with crowding in both arches. A Class II molar relationship was noted on the right side, and the upper left second premolar was in scissor bite (Fig. 14). The lateral cephalogram

showed a skeletal Class II malocclusion with a retrusive profile (Table 2).

A modified Pendulum\* appliance<sup>9</sup> was used to derotate and distalize the upper first molars, while the lower arch was treated with the self-ligating Damon\* appliance (Fig. 15).

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**Fig. 15 Case 2. A. Upper first molars distalized with modified Pendulum. B. Damon brackets bonded in lower arch; composite elastic hooks bonded in upper buccal segments for premolar distalization.**

Upper leveling, alignment, and finishing were completed with the new STb brackets and LSW system (Fig. 16). After 20 months of treatment, a Class I canine and molar relationship and ideal overbite and overjet had been achieved (Fig. 17, Table 2).

### Conclusion

After more than a year of experience with this new lingual straight-wire method, we have observed several advantages over mushroom arches, including the avoidance of complicated handling, archwire bending, and arch coordination. With proper attention to setup, bracket positioning, and indirect-bonding technique, the LSW-STb appliance will not only reduce chairtime, but improve patient comfort.



**Fig. 16 Case 2. Upper arch alignment with new LSW technique.**

**TABLE 2  
CASE 2 CEPHALOMETRIC DATA**

	Pretreatment	Post-Treatment
FMIA	61.0°	53.0°
FMA	27.0°	25.0°
IMPA	92.0°	102.0°
SNA	87.0°	87.0°
SNB	82.0°	83.0°
ANB	5.0°	4.0°
Wits	0mm	0mm
SN-GoGn	29.4°	30.8°

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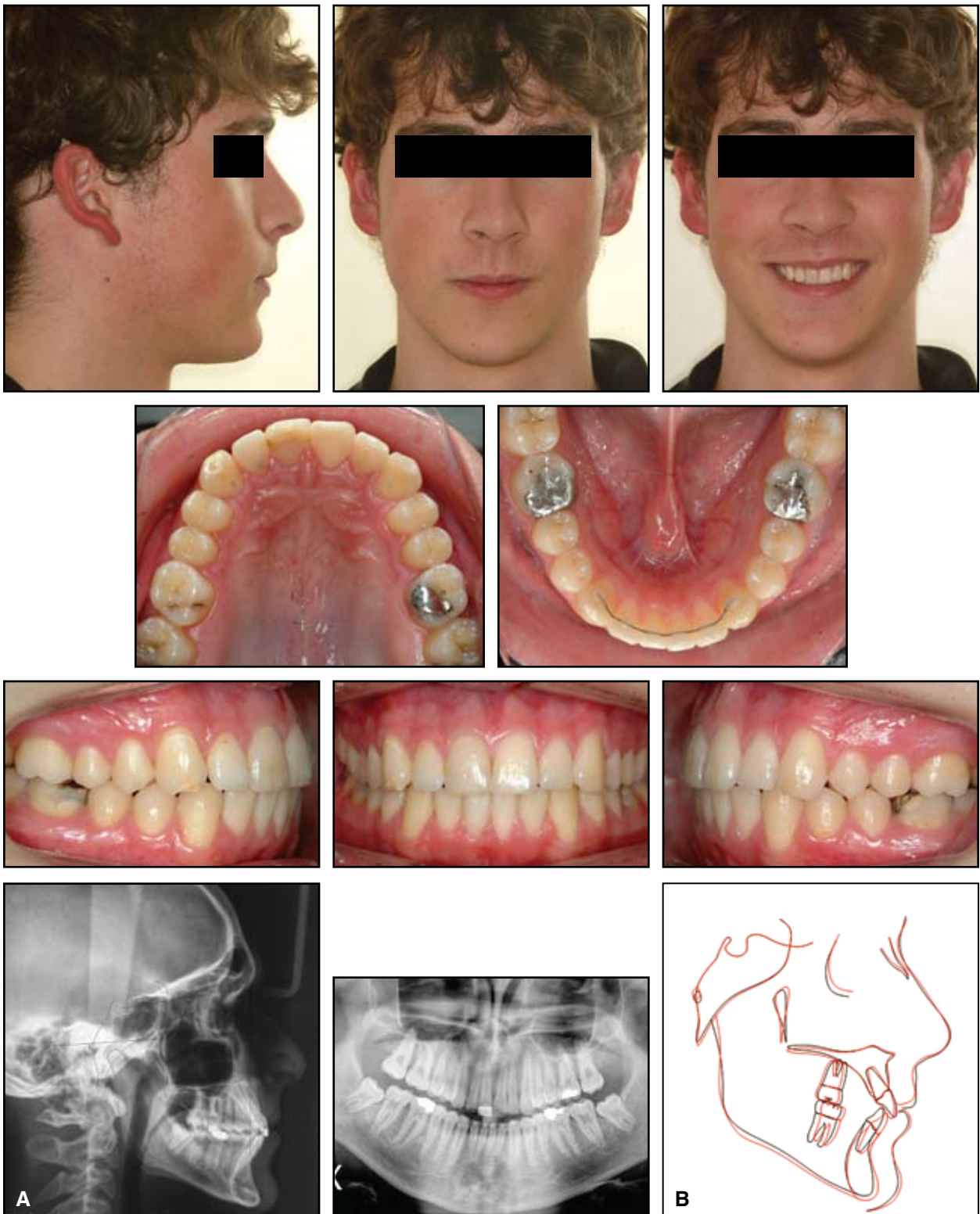


Fig. 17 A. Case 2. Patient after 20 months of treatment, showing Class I canine and molar relationship with corrected overbite and overjet. B. Superimposition of pre- and post-treatment cephalometric tracings.