The Skeletal Frog Appliance for Maxillary Molar Distalization

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Appliances typically used for molar distalization in Class II cases—removable plates and various types of headgear—require a high degree of patient motivation. This disadvantage has encouraged the development of a wide range of "non-compliance" devices.[1-7] With the introduction of the Pendulum* appliance in 1992, Hilgers established the basic principle of placing the active elements in the palate.[8] To counteract the appliance's side effects of mesial rotation and distal tipping of the molars,[9-13] a subsequent "K Pendulum" modification incorporated toe-in bends in the horizontal plane, an uprighting activation in the sagittal plane, and a distal screw for continuous reactivation.[14-16]

A relatively easy-to-use alternative is the Simplified Molar Distalizer, also called the "Frog appliance"** in German-speaking countries.[17] The basic framework comprises a special screw for distal movement of a palatal arch connected to the molars. The device is retained by composite rests in the longitudinal fissures of the premolars, attached to an acrylic palatal button. As with similar appliances, however, the Frog appliance's mesially loaded arm support produces the side effect of anterior protrusion (Fig. 1A).

To eliminate the need for dental anchorage and its undesirable side effects on the anterior arch,[18-23] we have designed the Skeletal Frog, an innovative mini-implant-supported molar-distalization appliance that requires no dental support or acrylic palatal button (Fig. 1B).

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Appliance Design and Fabrication

We chose the Frog as a base appliance because of its compact design and simple handling. Its active components are a distalizing screw, an .032" stainless steel or Betaflex** preformed transpalatal arch, and a hex key for activating the screw (Fig. 2). The transpalatal arch can be removed from the screw housing after distalization is complete.

The anterior palate provides reliable anchorage when mini-implants are placed just behind a line connecting the first premolars at the mesial contact point or, in cases of missing canines or mesially migrated premolars, about 6mm behind the incisal papillae.[23,24] The miniscrews should be less than 3mm away from the midpalatal suture to ensure adequate bone thickness (Fig. 3). With the Skeletal Frog, two mini-implants (OrthoEasy**)

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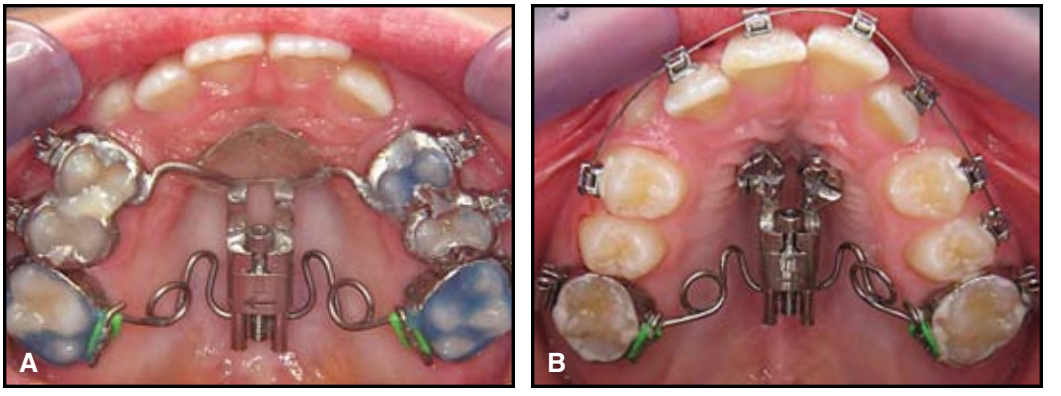

Fig. 1 A. Toothborne distalization with standard Simplified Molar Distalizer (Frog) appliance. B. Skeletal Frog eliminates dental side effects by using mini-implants in anterior palate for anchorage.

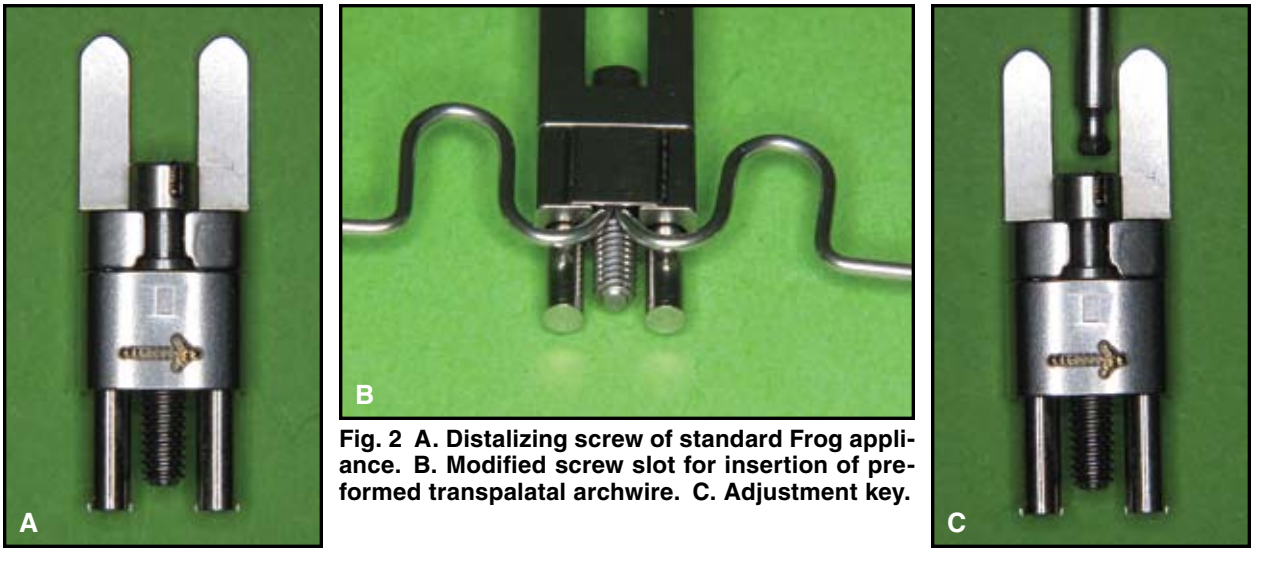

Fig. 2 A. Distalizing screw of standard Frog appliance. B. Modified screw slot for insertion of preformed transpalatal archwire. C. Adjustment key.

placed according to these parameters provide stable, four-point support for the appliance.

In our original design, a Nance button was anchored to the mini-implants in the palate. Problems with hygiene and subsequent localized irritation of the covered mucosa prompted the development of an abutment that allows direct connection of the mini-implants to the distalizing screw body and that is also used to transfer the mini-implant location to the plaster cast (Fig. 4).

Two transfer screws are inserted into their copings and fixed in the impression before pouring with high-strength dental stone. The cast will thus contain two screw heads in positions identical to those in the patient's mouth. The abutments are fitted over the screw heads, then soldered to the anterior tabs of the distalizing screw (Fig. 5). In the patient's mouth, the transpalatal legs of the appliance are fixed to the lingual sheaths of the molar bands with glass-ionomer cement, and the abutments are tied to the mini-implant heads with ligature wire (Fig. 6). Because the caps completely cover the screw heads and the framework

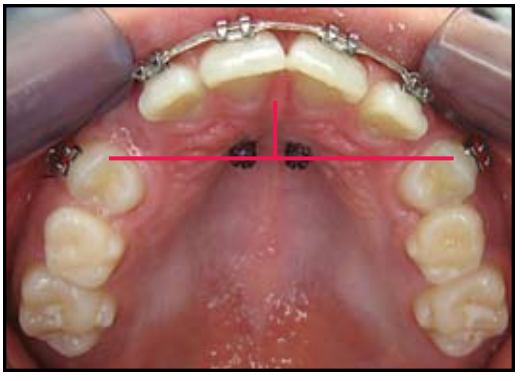

Fig. 3 Ideal locations of mini-implants for Skeletal Frog appliance: just behind line connecting first premolars at mesial contact point, about 6mm behind incisal papillae, and less than 3mm on either side of midpalatal suture.

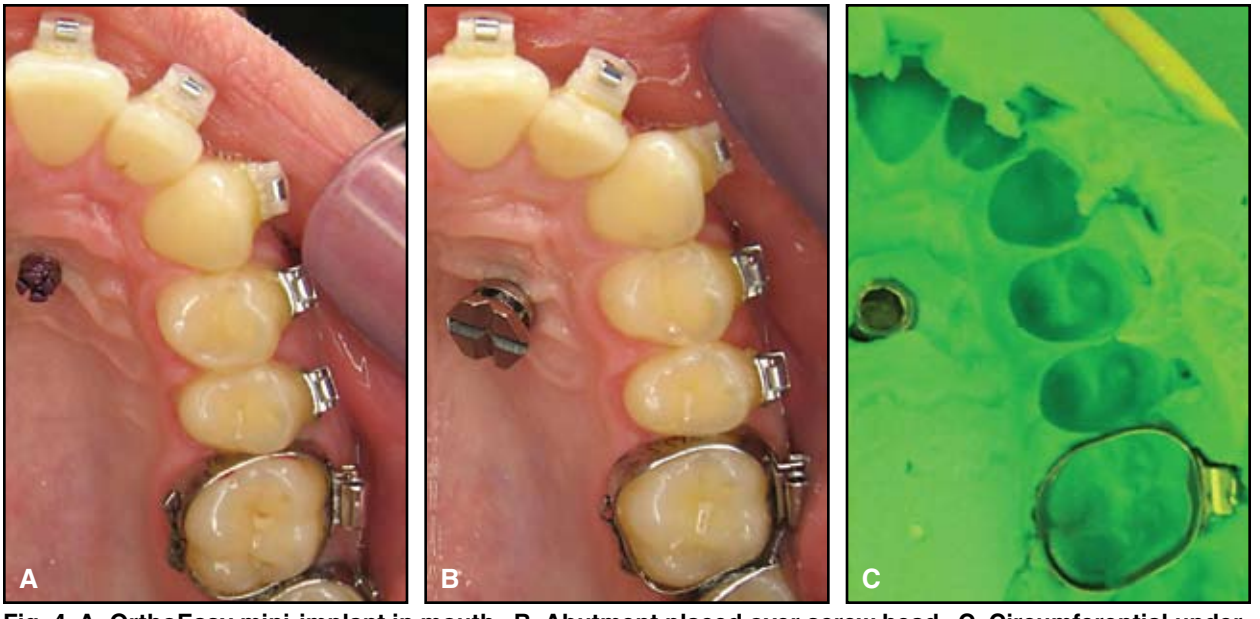

Fig. 4 A. OrthoEasy mini-implant in mouth. B. Abutment placed over screw head. C. Circumferential undercut in outer casing of abutment ensures adequate retention in impression material and reliable repositioning on plaster cast.

Fig. 5 Fabrication of Skeletal Frog appliance. A. Working cast poured in high-strength dental stone, with abutments and bands. B. Anterior tabs of distalizing screw soldered to abutments. C. Frog appliance in place.

Fig. 6 OrthoEasy miniscrew attached to abutment, with undercut for retention and ligation to screw head.

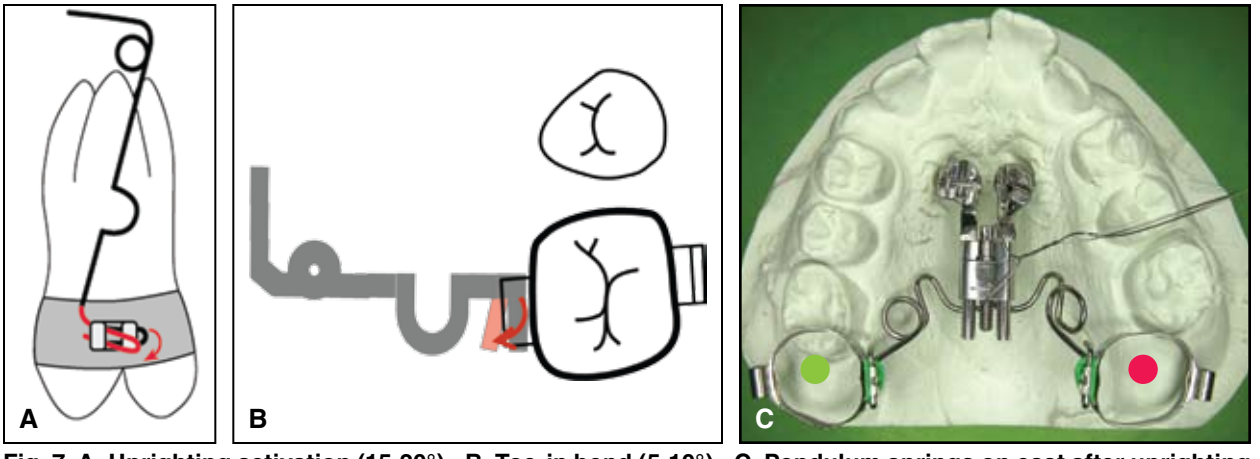

Fig. 7 A. Uprighting activation (15-20°). B. Toe-in bend (5-10°). C. Pendulum springs on cast after uprighting activation and toe-in bend, with additional activation applied for distal movement (green dot indicates ideal activation; red dot indicates lack of expansion).

consists only of metal, the anchorage is stable and rigid. With no Nance button, oral hygiene is easy to maintain.

Appliance Activation

An .032" TMA* wire with a K Pendulum prescription is used (instead of a prefabricated stainless steel arch) and custom-bent into a double-ended Pendulum spring according to Kinzinger's method.[14-16] The end sections are preprogrammed with uprighting activation to counteract the molar-tipping moments and toe-in bends to neutralize the rotation moments (Fig. 7). The two spring arms are preactivated distally with about 200g of force (the applied force can be checked with a Correx*** tension gauge). The Skeletal Frog thus follows the proven biomechanical principles of the K Pendulum (Fig. 8).

According to Walde,[17] reactivation every four to five weeks, with three to five turns of the screw at each appointment, is enough to achieve 1-2mm of distalization per month. Each 360° activation opens the screw body .4mm. Alternatively, the patient or parent can activate the appliance by rotating the screw a quarter-turn every three days, given the accessibility of the control mechanism.

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Case 1

A 13-year-old female presented with a Class II malocclusion and maxillary crowding, including partially blocked-out canines (Fig. 9). The second molars were still in the tooth-bud stage when brackets were placed and a Skeletal Frog appliance was fitted.

After 13 months of treatment, the maxillary anterior teeth had been leveled simultaneously with the molar distalization (Fig. 10). Superimposition of the pre- and post-treatment cephalometric tracings shows distalization of about a half-premolar width without any reactive proclination of the anterior teeth; in fact, a slight retrusion can be seen (Fig. 10B).

Case 2

This 15-year-old female presented with a Class II malocclusion and maxillary anterior crowding (Fig. 11). The maxillary right central and lateral incisors were retroclined, resulting in mandibular retrusion. The protrusive maxillary left central and lateral incisors required retraction.

After 14 months of treatment with the Skeletal Frog and fixed appliances, distalization of about a half-premolar width had been achieved without proclination of the anterior teeth or inordinate transverse expansion (Fig. 12A). Asymmetrical activation produced more molar distalization on the left side. In a superimposition

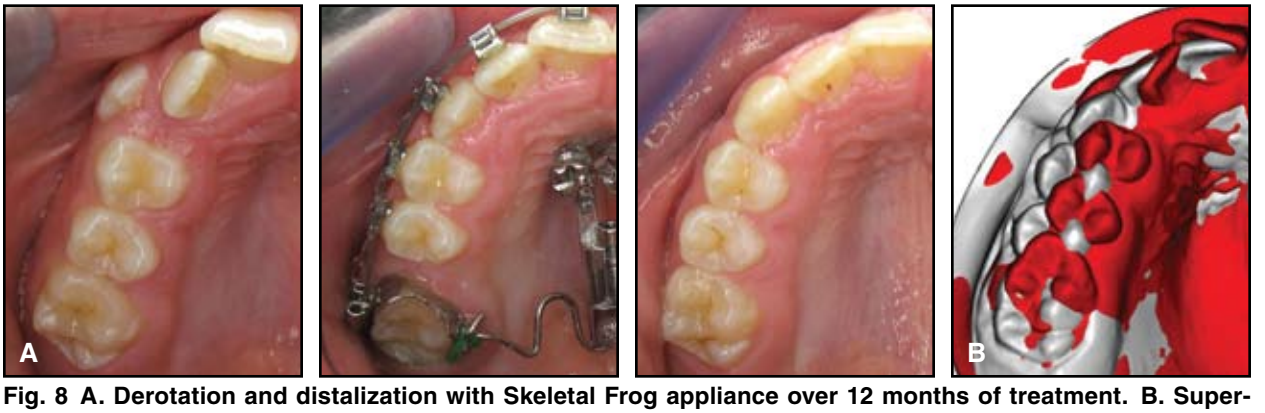
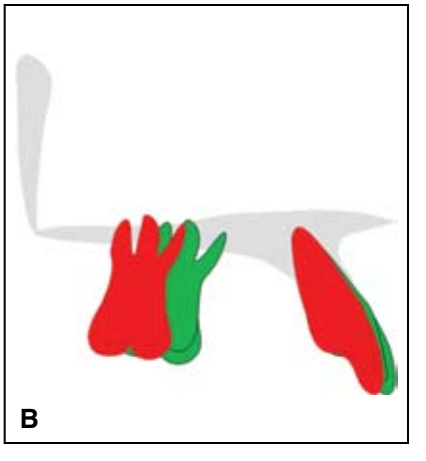


Fig. 8 A. Derotation and distalization with Skeletal Frog appliance over 12 months of treatment. B. Superimposition of pretreatment (red) and post-treatment (gray) casts.

Fig. 9 Case 1. 13-year-old female patient with Class II malocclusion and maxillary crowding. A. Mini-implants inserted in anterior palate and brackets bonded. B. Skeletal Frog appliance in place at start of molar-distalization phase.

Fig. 10 Case 1. Patient after 13 months of treatment. A. Distalization of half-premolar width was achieved without reactive proclination of anterior teeth or excessive transverse expansion. B. Superimposition of pre- and post-treatment cephalometric tracings; note slight retrusion of anterior teeth.



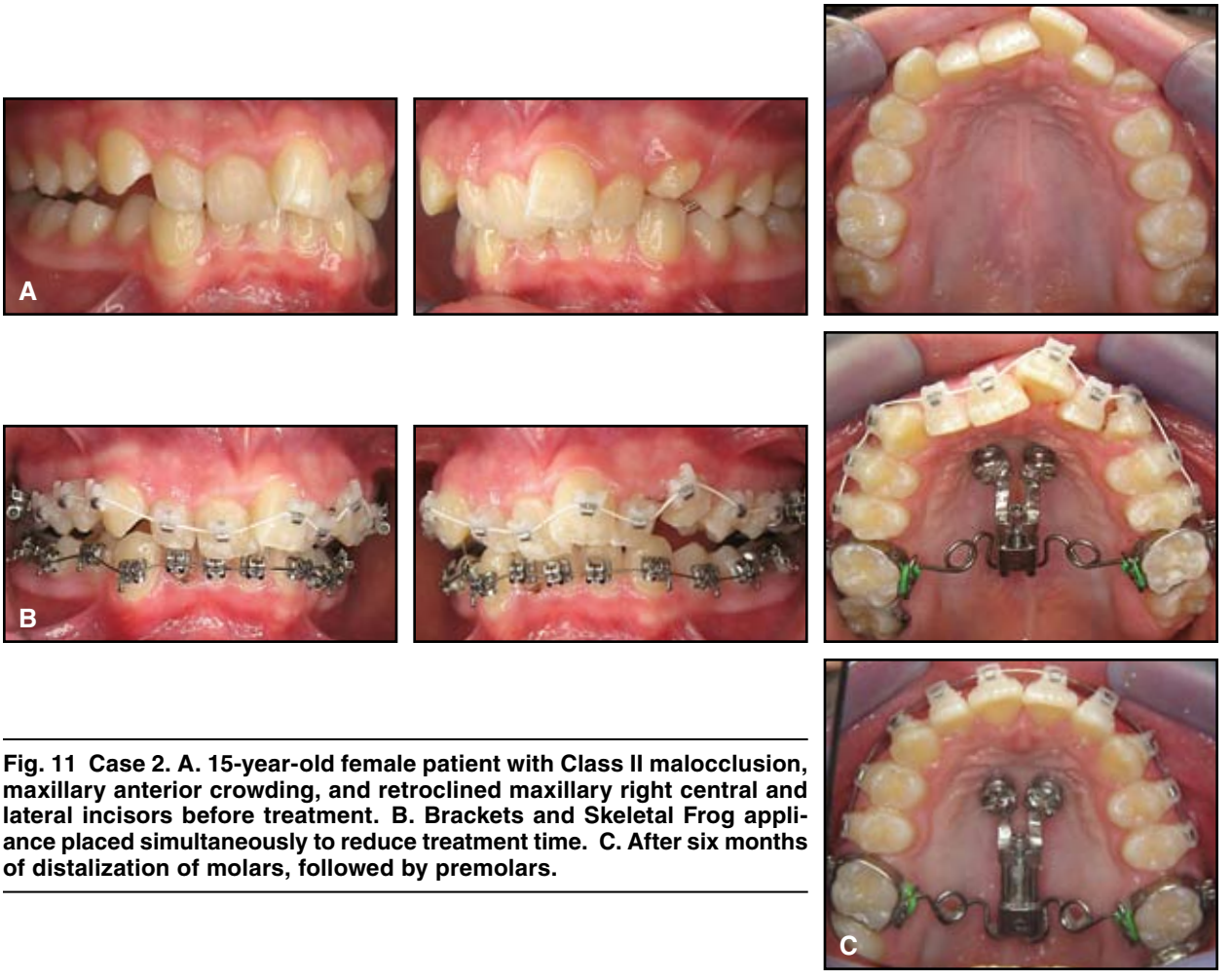


Fig. 11 Case 2. A. 15-year-old female patient with Class II malocclusion, maxillary anterior crowding, and retroclined maxillary right central and lateral incisors before treatment. B. Brackets and Skeletal Frog appliance placed simultaneously to reduce treatment time. C. After six months of distalization of molars, followed by premolars.

Fig. 12 Case 2. A. Patient after 14 months of treatment. Distalization of half-premolar width was achieved without reactive proclination of anterior teeth or excessive transverse expansion; asymmetrical activation produced more distalization on left. B. Superimposition of pre- and post-treatment low-dose computed-tomography scans showing areas of –4mm change (dark blue), +4mm change (red), and no change (green). Retromolar area was distalized and bone added (red) without maxillary expansion.

of pre- and post-treatment low-dose computed-tomography scans, development of the retromolar area can be seen in the dark-red areas (Fig. 12B).

Conclusion

The Skeletal Frog appliance has shown great promise as a means of treating common Class II malocclusions. This simple, hygienic appliance, easily fabricated in the dental laboratory, incorporates the biomechanical principles of the K Pendulum to provide molar distalization without undesirable side effects. It also reduces treatment time by allowing leveling and alignment of the maxillary arch to proceed simultaneously with the distal movement.

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