A New Appliance for Mandibular Widening by Distraction Osteogenesis

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Although most of the articles published to date on craniofacial distraction osteogenesis have involved treatment of syndromic patients,[1-5] these have laid the foundation for bringing distraction osteogenesis into the orthodontic practice as a viable treatment option.

Unlike mandibular lengthening, true skeletal mandibular widening does not have an orthognathic alternative. In adapting the concepts of many authors who have performed mandibular widening, however, we have found distraction osteogenesis to be highly successful, predictable, and affordable.[6-9] In fact, it may well be the best treatment option for some patients, as the present case of a 31-year-old female patient (Fig. 1) will demonstrate.

Distraction Appliance

A new distraction appliance, the Distrax,* is a custom-made hybrid distractor consisting of four arms and a telescopic expansion screw** (Fig. 2). The two superior arms are toothborne, while the two inferior arms are attached to the bone. The Distrax can be constructed with either the standard 12mm screw or with a larger 18mm screw.

This distractor can be utilized in patients with severe deformities as well as in more common orthodontic patients. Indications include:

- Nonextraction treatment.
- Moderate to severe mandibular crowding.
- Maxillomandibular transverse discrepancy (combined in adults with rapid palatal expansion or surgically assisted rapid palatal expansion).
- Narrow mandibular arch with buccal crossbite.
- Retreatment of crowding after previous premolar extractions.

The Distrax is constructed in the laboratory to eliminate the need for chairside adjustments by the oral and maxillofacial surgeon. Lab requirements include lateral and anteroposterior cephalometric x-rays and a mandibular alginate or polyvinyl siloxane impression with a deep vestibular reflection in the anterior area. A submental vertex x-ray is recommended, but not required. An index for surgical placement is sent with the Distrax from the laboratory. A maxillary

*Trademark of Accutech Orthodontic Lab, Inc., 420 Southlake Blvd., Richmond, VA 23236.

**ORTHOdesign, 744 Falls Circle, Lake Forest, IL 60045.

Fig. 1 31-year-old female patient before treatment.

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impression is taken to construct a biteplane, which eliminates occlusal interferences and prevents the maxillary anterior teeth from contacting the loops on the superior arms during the distraction phase. A diagnostic setup (Fig. 3) or occlusogram may also be utilized to determine the amount of distraction needed, to measure arch-width discrepancies, or to more precisely calculate the amount of crowding or protrusion.

Treatment follows the distraction protocol of tension-stress initially developed by Ilizarov[10,11] and later refined by other authors.[12,13] The phases of this distraction treatment are:

Fig. 2 Distrax appliance.

Fig. 3 Diagnostic setup used to determine mandibular transverse discrepancy.

1. Pre-Distraction Orthodontics

The pre-distraction orthodontic phase is similar to preparing a patient for conventional orthognathic surgery (Fig. 4). If necessary, a rapid palatal expander can be used in the maxillary arch. It is advisable to diverge the roots of the teeth adjacent to the surgical site—usually the mandibular central incisors (Fig. 5). Alternatively, a step osteotomy may be performed between the central and lateral incisors, or even between the lateral incisors and the canines, without opening space between the crowns.

Fig. 4 Pre-distraction orthodontic appliance, using selective bonding to reduce proclination and crowding.

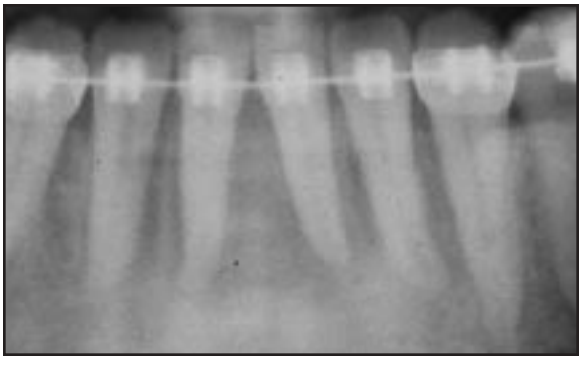

Fig. 5 Root divergence of mandibular central incisors induced adjacent to osteotomy site.

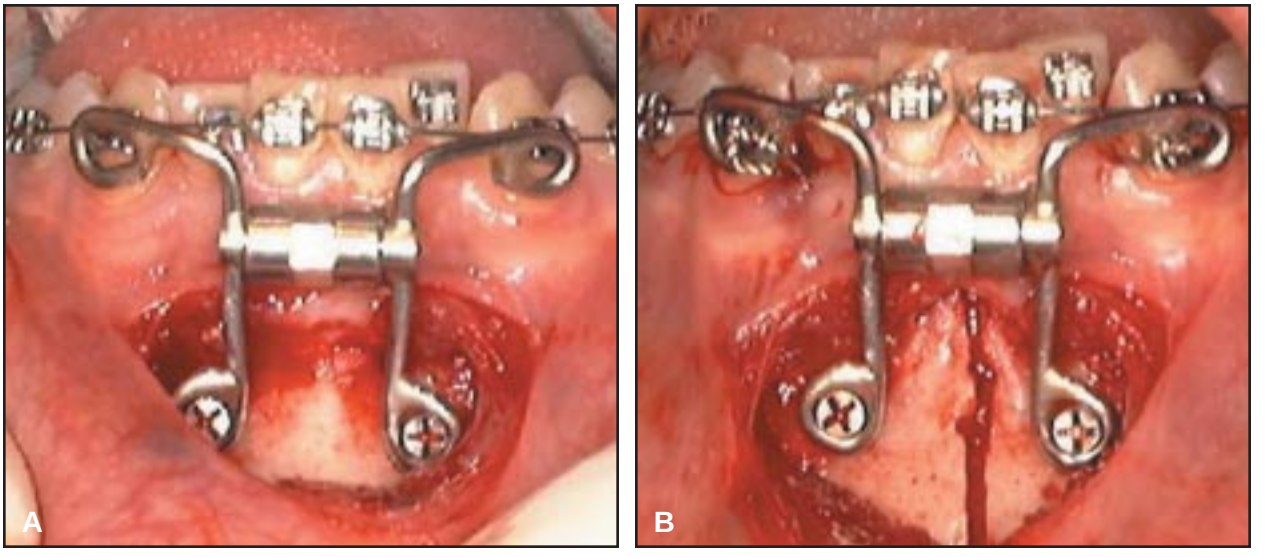

Fig. 6 Surgical placement of Distrax. A. Attachment of bone screws. B. 24-gauge circumdental wire looped around mandibular canines; mid-symphyseal osteotomy started from inferior border of symphysis to root apices.

2. Mid-Symphyseal Osteotomy

Unless other medical problems exist, this procedure can generally be performed in the oral and maxillofacial surgeon's office. With the patient in a semireclined position, intravenous general anesthesia is administered, along with local anesthesia for hemostasis and post-operative pain control. A horizontal incision is made with a No. 15 blade approximately 8mm from the mucogingival reflection extending from the right canine to the left canine. The incision is carried through the mucosa, sub-mucosa, muscle, and periosteum. A full-thickness subperiosteal flap is elevated inferiorly, and the symphysis is completely degloved, including the inferior border.

The Distrax is placed adjacent to the anterior teeth and secured to the bone of the symphysis with two 2mm × 10mm bicortical bone screws through the loops of the inferior distractor arms (Fig. 6A). After the Distrax is checked for correct positioning of the superior arms and loops, it is attached to the canine (or other designated tooth) on either side of the planned osteotomy with 24-gauge stainless steel circumdental wire and light-cured resin (Fig. 6B). A flowable composite such as Kerr Revolution*** or Transbond LR† works well.

A tunnel is developed in the midline, beneath the attached gingiva, up to the gingival margin. The midline of the mandible is scored vertically with a bone bur, and a reciprocating bone saw is then used to create a vertical midline osteotomy cut from the inferior border of the mandible up to the apices of the incisors. A narrow osteotome and mallet are used to complete the cut between the roots of the central incisors (or other teeth if a step osteotomy is being performed). The two halves of the mandible are then mobilized.

The Distrax is activated 2mm to ensure adequate separation and mobilization of the osteotomized segments, then deactivated after separation and mobilization are confirmed. The wound should be thoroughly irrigated with nor-

***Kerr USA, 1717 W. Collins Ave., Orange, CA 92867.

†3M Unitek, 2724 S. Peck Road, Monrovia, CA 91016.

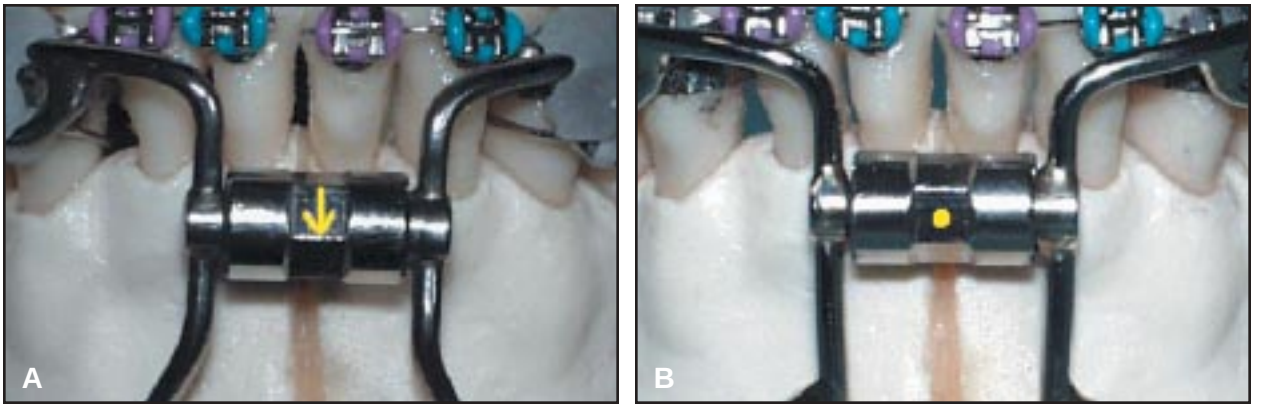

Fig. 7 A. Arrow indicating direction of rotation and .5mm activation. B. Dot indicating further .5mm activation.

mal saline solution. Incisions are closed with multiple interrupted sutures made of 4-0 vicryl, and a pressure dressing is applied. A .12% chlorhexidine oral rinse is prescribed for the patient to use during the week after surgery.

3. Latency Period

The patient should be scheduled to return to the orthodontic office after a seven-day latency period to begin the distraction procedure.

4. Distraction Period

The patient is asked to make two .5mm activations per day. This is easy to do, because one complete revolution of the Distrax hex-screw equals 1mm, and the screw is marked with an arrow (indicating the direction of the turn) on one side and a dot on the other (Fig. 7). Therefore, either the arrow or the dot should be visible after each activation.

During this phase, it is advisable to see the patient every two or three days to ensure that the appliance is being activated and to keep track of the total amount of distraction. The telescopic screw is marked in 2mm increments, which will be visible as the Distrax is expanded (Fig. 8). Although studies have shown little, if any, relapse,[8,14,15] we recommend slight overdistraction.

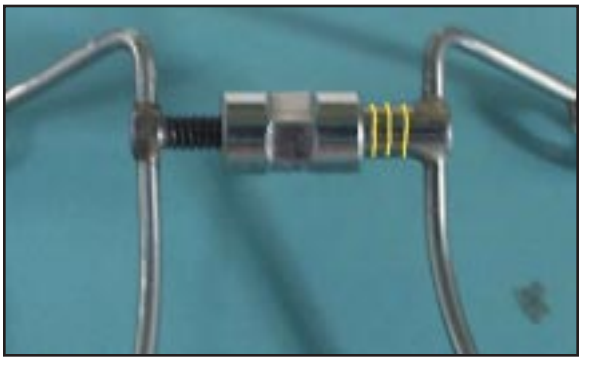

Fig. 8 2mm incremental lines used to calculate total amount of distraction.

Once the desired amount of distraction has been achieved, the anterior portion of the archwire should be cut so that a sectional archwire with a preselected denture tooth can be placed. This will improve cosmetics and support the dentition during the consolidation phase (Fig. 9). A flowable composite should be used to seal both telescopic screws of the Distrax, or a locknut can be ordered on the Distrax prescription, to prevent any back-turning of the screw mechanism (Fig. 10).

Fig. 9 Denture teeth added prior to consolidation phase.

Fig. 10 Small and large telescopic screws sealed with composite.

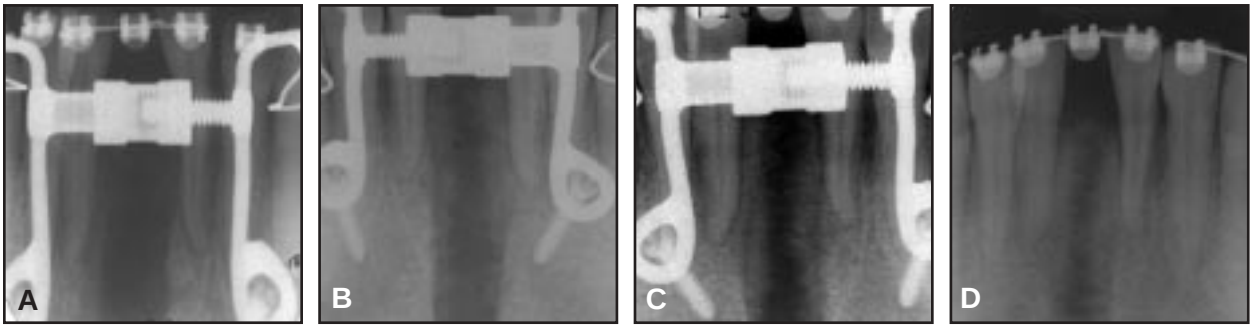

Fig. 11 Progressive periapical x-rays taken on 23-year-old male. A. Two weeks after distraction. B. Five weeks after distraction. C. Nine weeks after distraction. D. Twelve weeks after distraction.

Fig. 12 Patient after treatment, showing 7mm of maxillary expansion and 10mm of mandibular expansion.

5. Consolidation Period

The consolidation period will range from eight to 12 weeks.[19] We monitor remineralization through occlusal and periapical x-rays every three to four weeks[8] (Fig. 11), although some authors suggest more frequent checks.[20,21] The appliance is not removed until bony bridging of the adjacent sides of the osteotomy is complete.[22,23] Some prefer to see radiographic evidence of the mineralization of the inferior cortex before removing the appliance.[24] The Distrax is easily removed with local anesthesia and stab incisions, but brackets will occasionally be broken during the removal.

One of the disadvantages of strictly tooth-borne appliances is that they produce a V-shape regenerate,[25] which may be unstable and prone to relapse.[8] The Distrax produces a parallel regenerate—in other words, a proportionate widening of the dento-osseous segments. Expanding basal bone proportionally to alveolar bone is considered to provide greater stability.[23]

6. Post-Distraction Orthodontics

Several articles have reported successful orthodontic tooth movement immediately following distraction,[26-29] but most clinicians believe that movement of single-rooted teeth into the regenerate should not be initiated for at least eight to 12 weeks after distraction.[24,30] Studies have indicated, and our experience confirms, that tooth movement through regenerate bone occurs at a faster rate than movement through the normal host bone.[27,28]

In the case shown here, the distractor was removed and post-distraction orthodontic treatment was initiated after 12 weeks of consolidation. Because the mandibular central incisor brackets had previously been angulated to produce root divergence, these brackets were rebonded in their proper positions. The maxillary and mandibular central incisors were moved into the regenerate using elastic chain, providing space for alignment of the remaining teeth. An active coil spring was used to gain space for the mandibular left second premolar. With both arches being widened simultaneously, particular care was taken to keep the dental midlines coincident with the facial midline. Final detailing and arch coordination were completed with the usual mechanics (Fig. 12)

The pre-distraction phase took six months and the post-distraction phase about 10 months, for a total treatment time (including the consolidation phase) of 20 months.

Conclusion

Mandibular widening by distraction osteogenesis offers a new treatment option for the contemporary orthodontist. The custom-made Distrax appliance has been shown to be minimally invasive, comfortable, predictable, and affordable.

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