Use of Bonded Power Arms for Interdental Space Closure

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The arch perimeter is the key consideration in cases with small lateral incisors and normal overbite and overjet. The perimeter should be maintained during space closure (Fig. 1A), and the space created by mesial movement of the central incisors should be filled with appropriate-size porcelain crowns for the lateral incisors. Orthodontic retraction of the maxillary incisors will reduce the arch perimeter (Fig. 1B) and, if the overjet is insufficient, will cause premature contact of the anterior teeth,[1] as evidenced by tooth mobility.

If the arch perimeter is to be maintained, the whole maxillary arch should be reinforced with a rigid rectangular archwire and a transpalatal arch. A round wire is too flexible, and may cause the maxillary incisors to move slightly lingually when they are retracted by power chain.[2] Although stop loops positioned in front of the main molar tubes can prevent a reduction in arch length, these positions are difficult to maintain because of the wire's lack of rigidity.

Furthermore, when periodontal disease is involved, the alveolar bone level between the maxillary central incisors will be lower than normal,[3] causing the centers of resistance of the involved teeth to move apically (Fig. 2). This means that a force applied only to the brackets

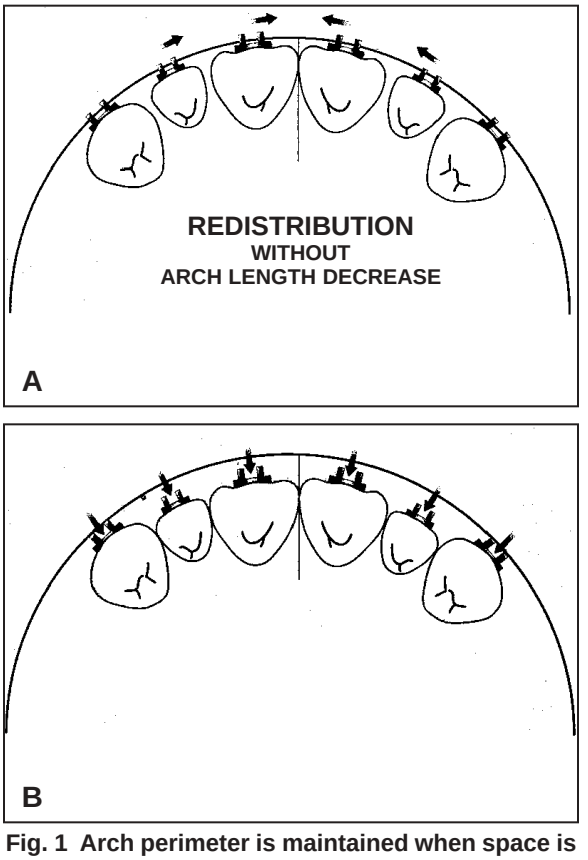

Fig. 1 Arch perimeter is maintained when space is redistributed (A), but reduced when space is closed by retraction (B).

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will produce more tipping than translation.[4-6] When an .016" stainless steel wire is engaged in .018" bracket slots, the incisal area of the space will be easily closed, but the roots will not move as much as the crowns, leaving a black triangular space in the cervical area. If a V-bend is placed in the archwire between the maxillary central incisors, tooth movement will be hindered by the increased friction of sliding mechanics.[7,8] Loop mechanics will be even more problematic, however, because any imprecision in three-dimensional wire bending may create further esthetic problems in the finishing stages of treatment.[9]

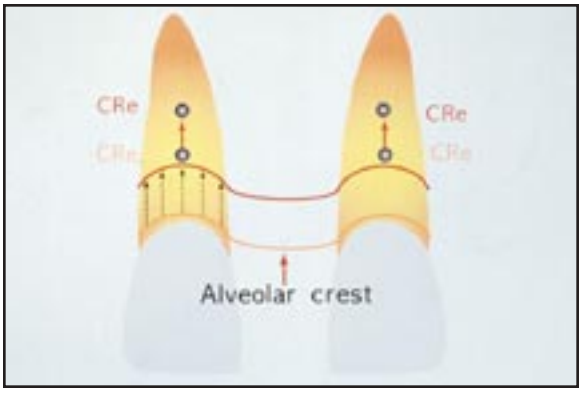

Fig. 2 Centers of resistance of periodontally involved teeth moved apically by alveolar bone resorption.

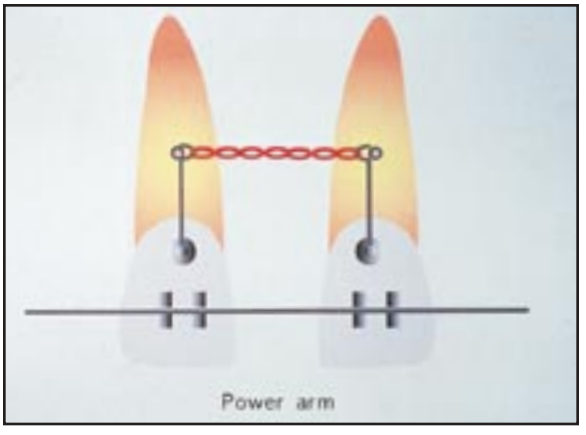

Fig. 3 BPA buttons placed on cervical portions of crowns, with hooks placed at centers of resistance of teeth connected by elastic for translation.

To maintain the arch perimeter while using sliding mechanics, an .017" × .025" stainless steel wire should be engaged in the .018" bracket slots without any 2nd-order bends. An auxiliary attachment can then be bonded to the cervical portions of the involved teeth, allowing the applied force to pass through the centers of resistance.[10]

The Bonded Power Arm (BPA) was developed for this purpose, but the conventional prefabricated version—a hook for elastic attachment soldered to a bracket wing—is too short for effective root movement. We have therefore lengthened the BPA by attaching a rigid orthodontic wire to a button normally used on the lingual (Fig. 3).

Fabrication

1. Microetch the neck of the button to improve retention (Fig. 4A).
2. Bend one end of an .017" × .025" stainless steel or TMA* wire with a birdbeak plier to form an open round loop that will fit over the neck of the button. Microetch this loop for bonding.
3. Bond the microetched surfaces of the wire and

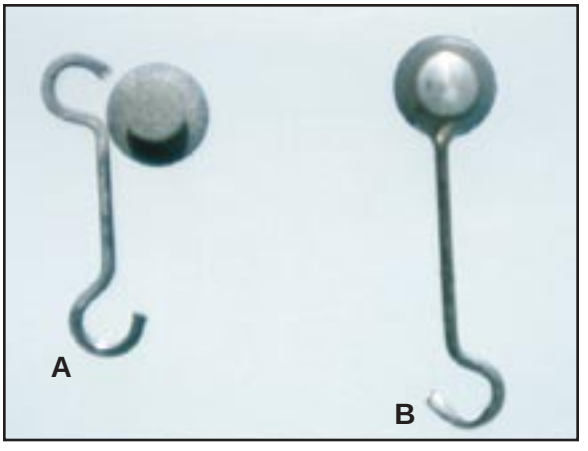

Fig. 4 Neck of button and wire hook microetched to enhance retention (A). Wire and button bonded together with light-cured resin (B).

button together with light-cured resin (Fig. 4B).
4. Measure the length of the power arm on the periapical x-ray of the maxillary incisors by placing the button cervical to the bracket image on the film and marking the tooth's center of resistance on the wire.
5. Using a birdbeak plier, bend an open round loop at the marked point on the wire. This will be used as a hook for attaching the elastic.

Placement

1. A setup model is essential for precise placement of the BPA and adequate control of root movement.
2. Make a transfer tray for each BPA by placing a hard silicone impression material over the BPA wire on the model.
3. Place a small amount of resin under the mesh base of the button. Position the transfer tray with the BPA in the exact desired position relative to the crown, and light-cure the resin.
4. After engaging the power chain over the main archwire, attach an elastic with a force of 80-100g between the hooks of the BPAs. Frenectomy is recommended whenever a high frenum attachment impinges on the elastic.
5. While root movement in the frontal direction will be controlled by the BPAs, the incisors will still have a rotational tendency in the occlusal direction. Therefore, tight ligation is needed to prevent any incisor rotation during tooth movement.
6. Change the power chain every six to eight weeks, and have the patient change the BPA elastic every three to four days.
7. As the space between the maxillary central incisors is closed, measure the newly developed spaces between the adjacent teeth with a vernier caliper. Compare the overbite and overjet with the pretreatment records to ensure they have not been reduced undesirably.
8. Once the space has been completely closed, bond a retainer to the lingual surfaces of the involved teeth. Carefully build up the adjacent lateral incisors with composite as necessary.

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Management of Triangular Spaces

Periodontal disease sometimes causes an unesthetic black triangular space to develop between the maxillary central incisors in an adult patient. The standard procedure for solving this problem is to make the space more rectangular by stripping the proximal surfaces of the involved teeth, then close the space orthodontically. It is important for orthodontists to ensure, however, that this procedure involves effective root movement rather than crown tipping.[11-13]

A 35-year-old woman's chief complaint was a black triangular space between her maxillary central incisors (Fig. 5A). Because there were moderate periodontal problems in this region and no skeletal discrepancy, the diagnosis was that the incisor spacing was due to prolonged periodontal disease. The treatment plan involved stripping the proximal surfaces of the maxillary central incisors and then closing the space without diminishing the arch perimeter. The patient also had small lateral incisors that would require veneer crowns after the space closure.

The widened space was nearly closed orthodontically in two months, but the black triangular space in the cervical area did not completely disappear (Fig. 5B-D). Therefore, BPAs for controlling root movement were bonded as shown (Fig. 5D,E). After two months, the photos and x-rays showed improved root movement (Fig. 5F,G). Once the black space was closed, the adjacent lateral incisors were enlarged with porcelain laminate crowns (Fig. 5F).

Discussion

Determining the precise length of the BPA by checking the center of resistance on the periapical x-ray or setup model is difficult because the center of resistance is located in three-dimensional space.[1,2] Therefore, it is important to monitor tooth movement closely during space clo-

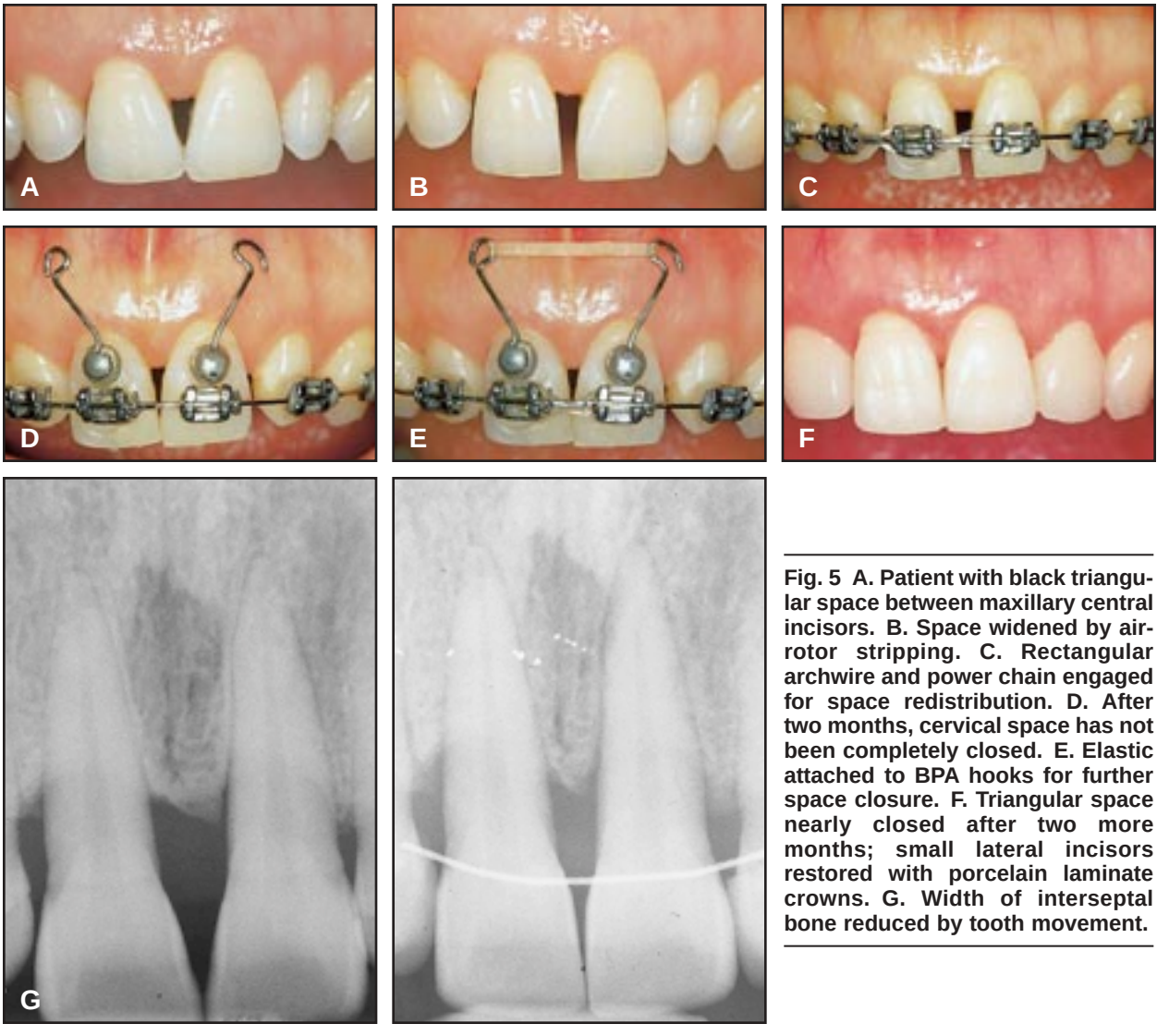

Fig. 5 A. Patient with black triangular space between maxillary central incisors. B. Space widened by air-rotor stripping. C. Rectangular archwire and power chain engaged for space redistribution. D. After two months, cervical space has not been completely closed. E. Elastic attached to BPA hooks for further space closure. F. Triangular space nearly closed after two more months; small lateral incisors restored with porcelain laminate crowns. G. Width of interseptal bone reduced by tooth movement.

sure. If the BPA is not placed accurately, pure translation will not occur, and an incisal step will develop.

When sliding mechanics and power chain are used for space redistribution, some crown tipping will be seen at the beginning of treatment. This tipping will cause the main archwire to bow until the elastic force has completely decayed. When the rebounding force of the main archwire becomes greater than the elastic force, the root will slowly begin to move. Although the rebounding force would be greater over a short interbracket span than over a long span, a force of that magnitude would be harmful to periodontally involved teeth. The force of the elastic engaged in the BPA hooks is lower.[10] Therefore, when the incisors are tipping, the power chain and the elastic should not be engaged simultaneously. The power chain should be removed and the brackets tied with ligature wire while the BPA is engaged.

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