Cantilever Mechanics for Treatment of Impacted Canines

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In the total force system produced by a set of brackets and continuous archwires, the forces placed on each individual tooth cannot be measured by the orthodontist.[1] The major drawback of such a force system is that unknown reactive forces can cause significant undesirable side effects.

Cantilever System

For many orthodontic problems—even some of the most challenging—a simpler cantilever system may be a more efficient biomechanical choice, because all the forces can be measured and thus controlled.[2]

A typical cantilever design is a wire fully engaged in the bracket of one tooth and tied in a point contact to another tooth (Fig. 1). A moment and a force are created at the tooth in which the wire is fully engaged, whereas only a single force is developed at the other end of the cantilever—the single-point contact. The moment results from the couple created by the deflection of the wire in the edgewise bracket or tube.[3]

In a cantilever system, the line of action, magnitude, and point of application of the force can easily be controlled by the clinician. A simple gauge can be used to measure the force generated as the wire is displaced to the point attachment. Knowing the force level and the distance between the two attachment sites, the orthodontist can quickly calculate all the forces and moments involved—not only the active forces, but the reactive forces as well.

It is important to realize that the forces generated at the ends of the wire, while in equilibri-

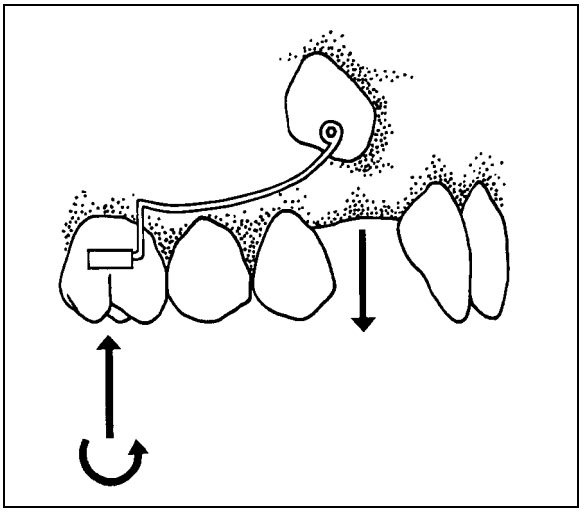

Fig. 1 Cantilever system producing extrusive force at single-point contact with labially impacted canine, and intrusive force and counterclockwise moment at first molar tube.

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um, may produce different moments relative to various centers of resistance. The magnitude and clinical effect of such a moment can readily be adjusted by moving the point of attachment in relationship to a given center of resistance. This can be a useful biomechanical tactic in the application of cantilevers.[4]

The one-couple system provides several distinct clinical advantages over continuous archwires. Tooth movement is predictable, since the force system is completely defined. The relatively long interbracket span between points of attachment produces a low load/deflection rate, which allows the delivery of well-defined, relatively constant forces and moments.[5] This, in turn, means that reactivations are needed less frequently.

A cantilever force system can be directed exclusively toward the treatment goal. Potential side effects can be identified and either minimized or negated. Thus, the basic force system produced by the simple cantilever is an ideal approach to dealing with some of our most difficult orthodontic problems, as demonstrated in this article.

Management of Labially Impacted Canines

A single extrusive force for the eruption of a labially impacted canine can be generated easily with a cantilever from the first molar.

Active Force

A cantilever made from .0175" × .025" TMA* can generate the 25-30g of force needed to extrude a canine[6] over a wide range of activation. The cantilever is tied into the auxiliary molar tube or welded directly to the continuous archwire. To prevent the generation of a second couple, the cantilever should be attached to the canine with a single-point contact; an alternative is a compensating bend that allows a passive

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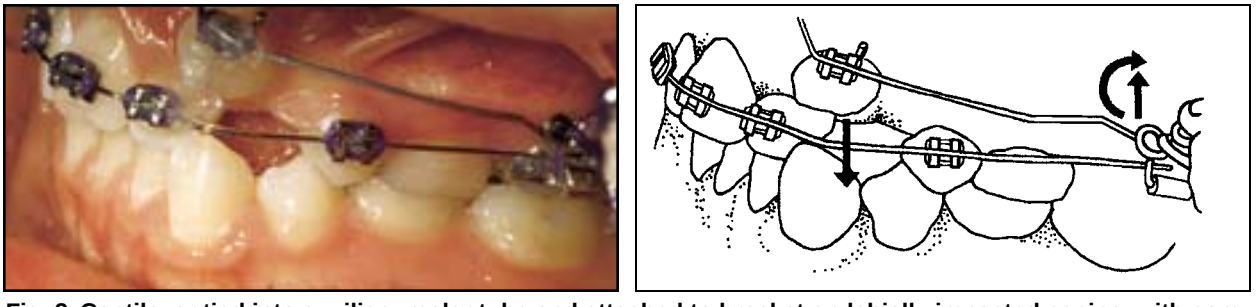

Fig. 2 Cantilever tied into auxiliary molar tube and attached to bracket on labially impacted canine, with compensating bend allowing passive entry.

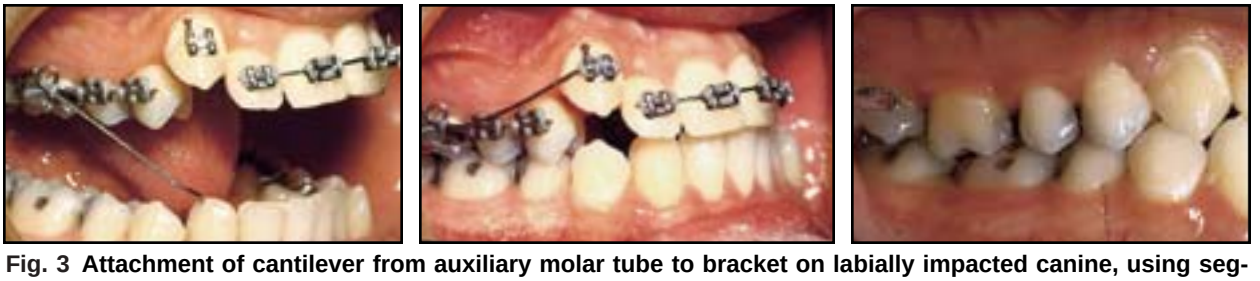

Fig. 3 Attachment of cantilever from auxiliary molar tube to bracket on labially impacted canine, using segmented archwires. Moment helps tip canine palatally to improve its labiolingual position.

angle of entry into the canine bracket (Fig. 2).

Reactive Forces

At the molar, the cantilever will produce an equal and opposite intrusive force, as well as a counterclockwise moment that tends to tip the molar mesially. These two reactive forces do not present a clinical problem, as long as the extrusive force is kept within 25-30g, because they will be dissipated among all the other maxillary teeth attached to the continuous archwire. A full-size stainless steel archwire will be stiff enough to prevent clinical expression of the reactive forces. If either side effect becomes excessive, a short period of headgear wear can control it.

In the frontal plane, with the intrusive force labial to the molar's center of resistance, a moment will be generated that tends to roll the molar crown buccally. This effect will also be countered by the anchorage value of the maxillary teeth. At the canine, where the force is also labial to the center of resistance, a moment will tend to tip the impacted tooth palatally, but this will help correct its labiolingual position (Fig. 3).

Management of Palatally Impacted Canines

Correction of palatally impacted canines requires two separate actions: eruption out of the palate followed by buccal movement into position. Although a cantilever can be inserted into the auxiliary buccal molar tube and crossed over the occlusal plane to reach the canine, occlusal interference can be avoided by attaching the cantilever to the molar on the lingual. An .032" × .032" edgewise bracket welded to the lingual of the molar band, as advocated by Burstone, makes an excellent attachment for the cantilever (Fig. 4).

Active Force

A doubled-over .016" × .022" TMA wire will fit precisely into the .032" molar attachment. The cantilever is activated with an extrusive bend and attached to the palatally impacted canine. Once the crown is exposed, the cantilever can be activated to push the canine buccally, again without occlusal interference (Fig. 5).

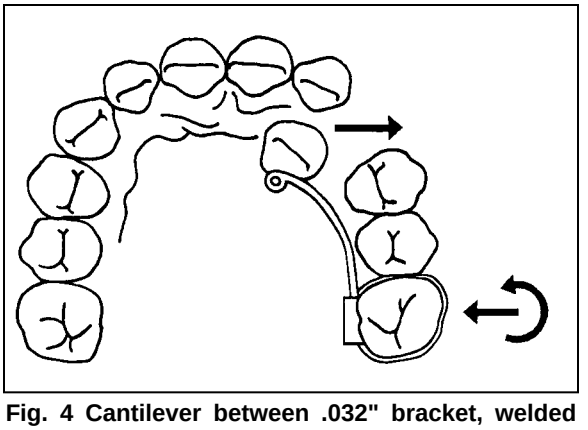

Fig. 4 Cantilever between .032" bracket, welded lingually to molar tube, and single-point attachment to palatally impacted canine.

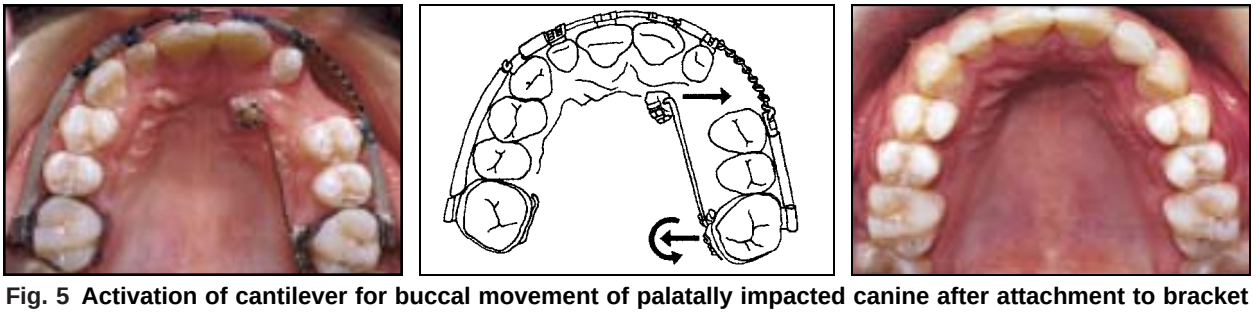

Fig. 5 Activation of cantilever for buccal movement of palatally impacted canine after attachment to bracket on exposed crown.

Fig. 6 Composite cantilever welded to transpalatal arch for movement of bilaterally impacted canines with maximum anchorage.

Final positioning can be accomplished with a labial bracket and continuous archwire. Occasionally, a palatally impacted canine will require buccal root torque for proper axial inclination. This problem can be solved by bonding a mandibular second bicuspid bracket with 22° of built-in torque to the labial surface and using a full-size rectangular wire.

Reactive Forces

The force of eruption will produce an equal and opposite intrusive force on the molar, as well as a moment of the couple that will tend to tip the molar mesially. These reactive forces will be dissipated by the stiff, full-size continuous buccal archwire. Unlike the buccal cantilever, the palatal cantilever will tend to rotate the molar lingually; this side effect will also be controlled by the buccal archwire.

Bilateral Cantilever

In cases requiring more anchorage, such as bilaterally impacted canines, an .0175" × .025" TMA composite cantilever can be welded directly to an .032" × .032" TMA transpalatal arch between the .032" lingual molar brackets (Fig. 6). As with the unilateral cantilever, activations can be made to generate extrusive forces followed by buccal movement. The combination of a stiff buccal archwire and the transpalatal arch provides superior control of the reactive forces and excellent anchorage.

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