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# Bone-Screw Anchorage for Pendulum Appliances and Other Fixed Mechanics Applications

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The pendulum appliance has proven to be an effective therapeutic choice for moving maxillary molars distally, but anchorage problems are associated with its use: (1) flaring of the anterior teeth, (2) difficulty maintaining the distal position of the molars, and (3) tendency to "round-trip" the molars when buccal segments are retracted. Headgears, as well as Nance appliances, have been used as supplemental anchorage after molars are retracted, however, all conventional methods are problematic in effectively controlling molar anchorage when the anterior teeth are retracted. Osseointegrated palatal implants are effective supplemental anchorage, but are relatively expensive procedures with multiple time-consuming steps. The present report demonstrates that nonintegrated, infrazygomatic bone screws are adequate anchorage devices for pendulum appliances. The treatment of a challenging malocclusion is presented to demonstrate the utility of the proposed method. It is concluded that there is a promising future for pendulum appliances, supplemented with bone screw anchorage. Additional clinical applications for bone screw anchorage are demonstrated for noncompliant correction of intermaxillary molar relationships. (Semin Orthod 2006;12:284-293.) © 2006 Elsevier Inc. All rights reserved.

Since the dawn of modern orthodontic therapy, it has been challenging to gain space in the maxillary arch to correct crowded anterior teeth, particularly in the presence of a Class II molar relationship. Several appliances, with varying requirements for patient compliance, have been proposed. The pendulum appliance was first developed by Hilgers<sup>1</sup> to move maxillary molars distally to gain space to alleviate anterior crowding and/or correct Class II

molar relationships. The method is broadly applicable to patients with developmental and/or congenital malocclusions (Fig 1). The basic structure of the intraoral device is a palatal resin base with a pendulum arm attached to the lingual surface of the first molar band. The force generated by the pendulum arm was about 230 g when the appliance was inserted initially and decayed to about 90 g after 5 mm of molar distalization. Advantages of the appliance are that patient acceptance is good, minimal compliance is necessary, it is relatively simple to fabricate, one activation is usually all that is required, and it can be modified to correct minor transverse or vertical molar problems.<sup>1-3</sup> Despite the use of the palatal resin base as anchorage, anterior tipping of the premolars and incisors is usually unavoidable, as the molars are pushed distally. In addition, there is a rebound tendency immediately after removal of the appliance.

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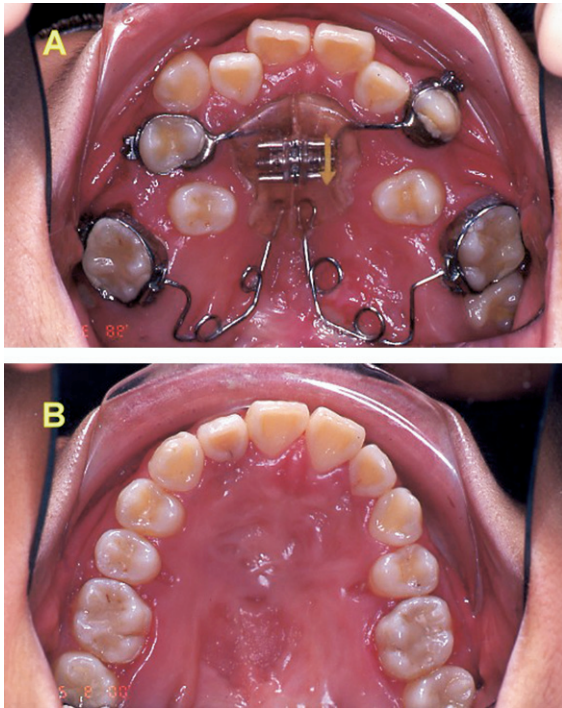
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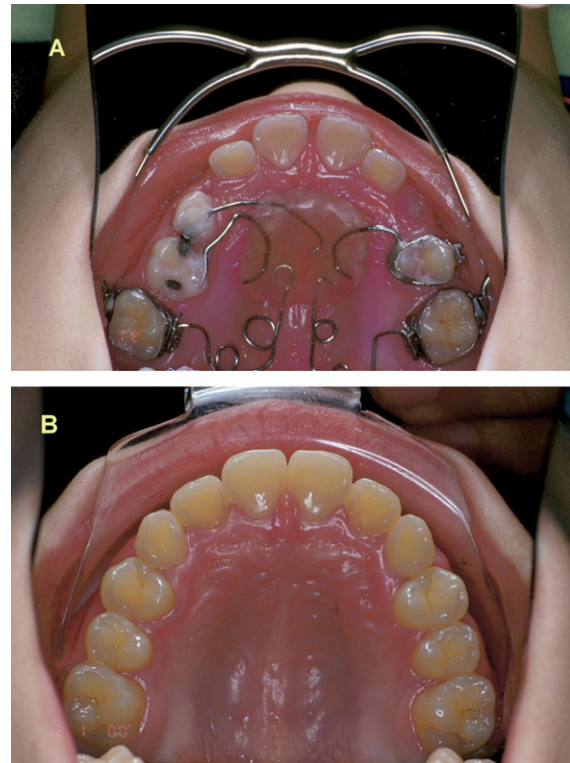
**Figure 1.** A 12-year 8-month-old female was treated with a pendulum appliance: (A) pretreatment and (B) posttreatment. (Color version of figure is available online.)

Utilization of distalized molars, for anchorage to retract the maxillary teeth, has not been effective. Supplemental anchorage in the posterior maxillary segments is essential.

Many supplemental anchorage devices have been proposed to support maxillary posterior molars after retraction with a pendulum appliance: headgear, and Nance and Herbst appliances.<sup>2,3</sup> Headgears can be used, beginning about 1 month after the pendulum appliance is inserted (Fig 2A), to supplement the force system to move the maxillary molars distally and help prevent flaring of the anterior teeth (Fig 2B). In effect, the headgear (1) opposes the force of the pendulum appliance to move incisors anteriorly, (2) holds the retracted molars in the desired position, and (3) provides anchorage to retract the anterior teeth. However, patient compliance is the critical factor for the treatment success. If the patient does not cooperate adequately with the headgear, the positive effects of the pendulum appliance are compromised.

A Nance appliance has an acrylic button that contacts the anterior hard palate. It is commonly used to stabilize molars that have been moved distally with a pendulum appliance. Typical problems, associated with a Nance appliance as supplemental anchorage, are as follows: (1) palatal tissue is often inflamed during pendulum appliance treatment, so a Nance button, installed immediately after molar retraction, does not fit well, (2) waiting for the soft tissue to recover delays treatment, (3) it is difficult to hold the molar position during the tissue recovery period, and (4) even after soft tissue recovery, a Nance appliance is not very effective anchorage, particularly when the palate is relatively flat.

Two-stage osseointegrated palatal implants are effective for correcting the anchorage limitations of pendulum appliances.<sup>4,5</sup> Despite the efficacy of these devices,<sup>6</sup> they are relatively expensive and require advanced surgical and re-



**Figure 2.** The combination of a headgear and a pendulum appliance was used to prevent anterior flaring: (A) one-month after the insertion of the pendulum appliance, and (B) posttreatment. (Color version of figure is available online.)

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