

Maxillary Molar Distalization with a Modified Pendulum Appliance

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Correction of a Class II malocclusion without extractions requires maxillary molar distalization by means of intraoral or extraoral forces.^{1,2} Although headgears have proven useful in the correction of skeletal problems, as well as in providing anchorage for extraction cases, they depend heavily on patient cooperation. Various fixed intraoral appliances for molar distalization have been introduced, but none has been completely successful in avoiding undesirable biomechanical side effects.³

An ideal intraoral molar-distalization appliance should meet the following criteria:

- Minimal need for patient compliance
- Acceptable esthetics and comfort
- Minimal loss of anterior anchorage (as evidenced by axial proclination of the incisors)
- Bodily movement of molars to avoid undesirable side effects, lengthening of treatment, and unstable results (Fig. 1)
- Minimal chairtime for placement and reactivations

Among the methods recently introduced, the Hilgers Pendulum Appliance* seems to satisfy these requirements.⁴⁻⁷ Even this device, however, can produce unwanted tipping of the maxillary molars during distalization.⁸

*Ormco/"A" Company, 1717 W. Collins Ave., Orange, CA 92867. TMA is a registered trademark.



Fig. 1 Progressive distalization of maxillary molar: distal tipping of molar crown, uprighting of molar root complex, and final compound bodily movement.

The present article describes a modification of the Pendulum Appliance that can ensure bodily movement of molar crowns and roots.

The Pendulum Appliance

The Pendulum Appliance uses TMA* springs as active components and a modified Nance button (an acrylic plate 1.5-2mm thick) as anchorage support. The Nance acrylic incorporates four occlusal rests that are bonded either to the deciduous molars or to the first and second bicuspid. An alternative method of attachment recommended by Hilgers is to solder retaining wires to bands on the maxillary first bicuspid.⁵

Each .032" TMA spring consists of a closed

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helix, an omega-shaped adjustable horizontal loop, a loop for insertion into the Nance button, and a terminal loop that fits into an .036" lingual sheath on the maxillary molar band. The springs are mounted as close to the center and distal edge of the button as possible to produce a broad, swinging arc (or pendulum) of force and to allow easy insertion into the molar sheaths.

Because TMA exerts half the force over twice the working range of stainless steel, it has excellent formability for fabrication and reactivation of the appliance. Its high capacity of permanent deformation before failure allows a linear increase in applied force from 0-350g over an activation range from 0-90° (Fig. 2).

Hilgers calls for preactivation of the appliance by bending the springs to a 90° angle.⁵ About a third of the bend is lost in the insertion, resulting in a 60° activation, or 250g of distalizing force. Although the spring pressure must be monitored constantly, further activations are not usually required, according to Hilgers. The springs can produce about 5mm of distal movement in three to four months. Loss of anchorage is minimal: 1.5mm in the premolar area and about 1-2° of proclination of the maxillary incisors.

The pendulum arc of the appliance tends to cause crossbite, because the force of the TMA springs is delivered to the molar crowns, leaving the roots in a mesial position. This tipping is especially undesirable if stable anchorage is needed for subsequent labial or lingual multi-bracket treatment. The crossbite effect can be counteracted by adjusting the horizontal loops of



Fig. 2 Forces in grams delivered at 30°, 45°, and 60° of activation (adapted from Hilgers⁵).

the Pendulum springs or by activating the mid-palatal jackscrew of the Pend-X version of the appliance.

The Pend-X is particularly useful in cases with severe narrowing of the maxillary posterior segments. After a three-week break-in period, the patient is instructed to activate the jackscrew one turn every three days, but not more than six to eight times. The resulting activation is usually sufficient not only to correct any transverse discrepancies, but also to control molar rotation during distalization.

The Modified Pendulum

If the horizontal Pendulum loop is inverted, it will allow bodily movement of both the roots and crowns of the maxillary molars. Once distal molar movement has occurred, the loop can be activated simply by opening it. The activation produces buccal and/or distal uprighting of the molar roots and thus a true bodily movement,



Fig. 3 A. Original Pendulum Appliance loop and M-Pendulum inverted loop. B. Schematic diagrams of modified loop action in distalization of maxillary molar.



Fig. 4 M-Pendulum on construction cast and after activation.



Fig. 5 Activation of modified loop.

rather than a simple tipping or rotation (Fig. 3). We call this modification the M-Pendulum (Fig. 4).

Before intraoral placement of the appliance, the Pendulum springs are activated to about 40-45° with a Weingart plier, resulting in about 125g of force on each side. This activation is repeated until the desired distalization of the molars is obtained.

The inverted loop should not be adjusted until the spring has deactivated following each phase of distalization (Fig. 5). In fact, only a passive fit of the distal ends of the Pendulum springs in the lingual sheaths, with no distal force applied to the molar crowns, will allow backward tipping of the molar roots. The terminal ends of the M-Pendulum springs are straight, rather than looped as in the original appliance.

Close attention must be paid to molar rota-

tions. In Class II cases, these usually determine the impact of the root complex on the buccal cortical plate of the maxilla, which can negate the effectiveness of bodily distalization.¹ The Pendulum springs should be activated primarily by a derotational bending of the distal ends, as with a conventional palatal bar. After distalization is complete, the terminal ends of the springs should be deactivated to allow a passive fit in the lingual molar sheaths.

X-rays should be taken at this point to confirm that bodily distalization has occurred and root parallelism has been achieved. Before multi-bracket appliances are placed, the occlusal rests on the second bicuspid should be removed to allow spontaneous distal drift of these teeth from the action of the transeptal fibers.

After two or three months, when there is close contact between the first molars and second bicuspid, the Pendulum Appliance can be replaced by a smaller Nance button,⁵ depending on the need for anchorage control during anterior tooth repositioning.

Patient Selection

Nonextraction distalization therapy is generally preferable in normal or brachyfacial patterns, in which loss of vertical dimension would be undesirable esthetically and functionally. Dolichofacial patients will benefit more from extraction therapy, provided the anterior profile

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is not flat.

It is of critical importance to determine the maxillary space available for first molar retraction by measuring the distance from the maxillary first molar to the Ricketts pterygoid vertical plane on the lateral cephalogram. Normally, this distance—the normal value for the patient's age $\pm 3\text{mm}$ —is a reliable predictor of the likelihood of efficient distalization and the eventual need

for third molar extraction or preservation. The third molar situation must be considered from the beginning of treatment, whether in terms of germectomy or complete extraction. Obviously, a different approach will be necessary in cases involving second molar extractions due to decay or other pathology.

The following three cases illustrate several applications of the M-Pendulum.



Case 1. A. Class II, division 1 patient with anterior protrusion. B. Distalization with M-Pendulum; removal of occlusal rests on second bicuspids. C. After distalization.

Conclusion

The M-Pendulum is an effective and reliable method for distalization of the maxillary molars. Its major advantages are:

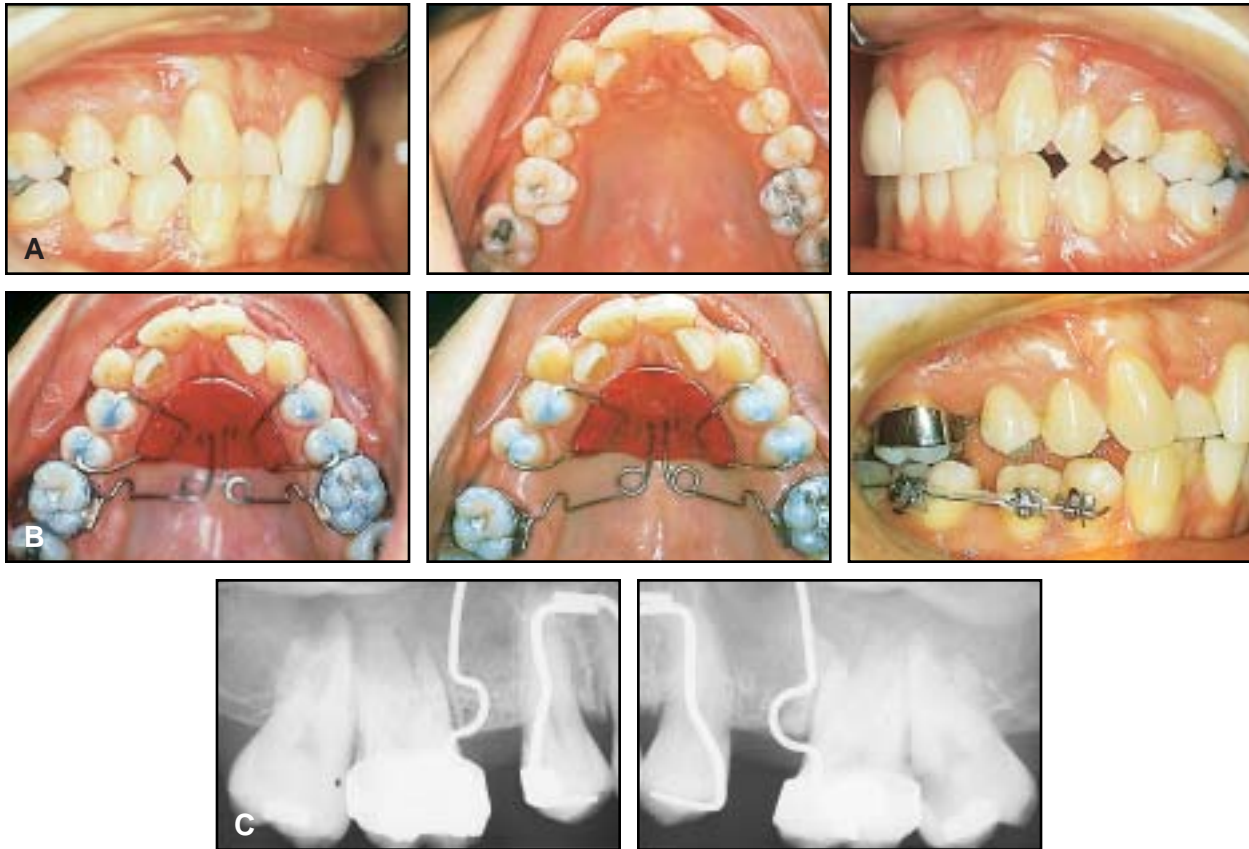
- True bodily molar movement
- Minimal dependence on patient compliance
- Ease of fabrication
- Little need for reactivation

- Patient acceptance

The effects obtained with the M-Pendulum are primarily dental movements. Although simultaneous indirect effects on the skeletal and soft-tissue structures can be detected, this appliance is not to be considered an orthopedic device, and different treatment methods must be devised in cases of skeletal discrepancies.



Case 2. A. Class II patient with anterior deep bite. B. Distalization with M-Pendulum; removal of occlusal rests on second bicuspid. C. After distalization.



Case 3. A. Class II patient with crossbite of left lateral incisor. B. Distalization with M-Pendulum. C. After distalization and removal of occlusal rests on second bicuspids.

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