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**The Pendulum Appliance for Class II Non-Compliance Therapy**

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Orthodontists have long sought methods of correcting Class II malocclusions without straining the lower arch and without the need for strict patient compliance. In the 1990s, noncompliance therapies in various forms have become more prominent than ever before.

This article describes a new mechanism for Class II non-compliance treatment. The Pendulum Appliance ([Fig. 1](#)) is a hybrid that uses a large Nance acrylic button in the palate for anchorage, along with .032" TMA springs that deliver a light, continuous force to the upper first molars without affecting the palatal button. Thus, the appliance produces a broad, swinging arc--or pendulum--of force from the midline of the palate to the upper molars.

**Fabrication**

The right and left Pendulum springs, formed from .032" TMA wire, consist of a recurved molar insertion wire, a small horizontal adjustment loop, a closed helix, and a loop for retention in the acrylic button ([Fig. 2](#)).

The springs are extended as close to the center of the palatal button as possible to maximize their range of motion, to allow for easier insertion into the lingual sheaths, and to reduce forces to an acceptable range ([Fig. 3](#)). The springs are also mounted as close as possible to the distal aspects of the Nance button, which still permits access to the acrylic for polishing. Tongue irritation during swallowing is minimized by extending the springs distal to the button. The lingual sheaths on the upper molars should be .036" so that the .032" wire fits loosely.

The anterior portion of the appliance can be retained in several ways. In the first appliances that were made, the Nance button was held in place with occlusally bonded rests on either the deciduous molars or the first and second bicuspid. Although this worked well, I was concerned that if the bonds fractured, there would be little to hold the appliance.

At present, the most stable method of retention is to band the upper first bicuspid or first deciduous molars, solder a retaining wire to the bands, and use these teeth as the major anterior anchorage for the appliance. Occlusally bonded rests on the upper second bicuspid or second deciduous molars add even more stability to the Nance button; these stops can be removed later in treatment to allow the second bicuspid to drift distally. Banding the first bicuspid is not difficult, since the molar and bicuspid portions of the appliance are cemented individually.

The Nance button should be made as large as possible to prevent any tissue impingement. It should extend to about 5mm from the teeth, to avoid the highly vascular cuff of tissue near the teeth and to allow adequate hygiene.

The button can be made in the office using light-cured acrylic and a Triad machine ([Fig. 4](#)). The anterior retention loops are fixed in place on the model with putty, then soldered to the bicuspid bands. A rounded ball of acrylic is pressed up against the palatal vault. The Pendulum springs are then inserted, and the acrylic is smoothed with a moistened finger and trimmed with a Bard-Parker knife. The acrylic is cured for five minutes in the Triad machine, and the edges of the button are rounded and highly polished.

If expansion of the upper arch is needed, a midpalatal jackscrew can be incorporated into the center of the Nance button ([Fig. 5](#)). The acrylic should be cut with a Joe Dandy disc before the jackscrew is opened. The screw is activated one-quarter turn every three days, after a week or so for patient adjustment, to produce a slow, stable expansion.

This version of the appliance is called a "Pend-X". The Pendulum springs are so efficient in expanding and rotating the upper first molars that I use the Pend-X for three or four months at the beginning of treatment whenever any expansion or change in anterior archform is indicated ([Fig. 6](#)).

**Preactivation and Placement**

Although the Pendulum springs can be activated intraorally, it is much more efficient to preactivate them before appliance placement. If significant distal molar movement is required, the springs should be bent parallel to the midline of the palate (or perpendicular to the body of the appliance, [Fig. 7](#)). This might seem to be an overactivation, but I have found that about one-third of it is lost in placement, and the remaining pressure is tolerated easily by the patient.

The molar bands are cemented without the springs engaged, and the anterior portion of the appliance is then cemented in place. If the appliance is to be bonded rather than banded, a syringe can be used to dispense the adhesive over the rests on the appliance, and the Nance button can be held in place with finger pressure while the adhesive sets. The adhesive should be smoothed out with a sealant mixture and a styrofoam mini-sponge after being extruded by the syringe.

The patient should be cautioned that the Pendulum springs will be close to the palate while the Nance portion of the appliance is being cemented. Most patients tolerate this procedure well if it is explained beforehand, especially when care is taken to prevent impingement of the springs on the palate.

Once the appliance is in place, each Pendulum spring is brought forward with finger pressure, the mesial end of the recurved loop is grasped with a Weingart plier ([Fig. 8](#)), and the spring is seated in the lingual sheath. The small horizontal adjustment loop allows for some lingual compression of the spring during placement. If molar rotation has been built into the recurved portion of the spring, it may be easier to grasp the base of this portion with the plier. Distal pressure holds the spring in the sheath quite effectively, but an elastic "O" ring can be used if desired to make sure the spring doesn't come out during toothbrushing.

As the molar is driven distally, it moves on an arc toward the midline of the appliance--in other words, toward crossbite ([Fig. 9](#)). This tendency can be counteracted by opening the adjustment loop slightly to increase the expansion and molar rotation. Distal root tip can also be produced by adjusting this horizontal loop on the Pendulum spring. Tipping back the recurved portion of the spring at the loop causes a more direct distal movement of the molars.

**Reactivation and Stabilization**

The patient should be seen about every three weeks so the spring pressure can be checked. If reactivation is needed, the spring is removed from the lingual sheath. The center of the helix is then held with a bird-beak plier, and the spring is reactivated by pushing it distally toward the midline ([Fig. 10](#)). It is then reinserted in the sheath.

Once the molars have been moved distally, they must be stabilized in their new positions or they will rapidly drift back mesially. It is also important to move the buccal segments into a Class I relationship to harness the full advantages of the appliance. The upper molar bands need not be removed with the rest of the appliance; this can be helpful if the clinician wishes to place a transpalatal bar or Nance appliance immediately after removal of the Pendulum.

The molars can be stabilized in any of four ways:

1. The Nance portion is removed and a full upper fixed appliance is bonded. An upper utility arch holds the molars back with the incisors as anchorage. The buccal segments are then retracted, usually with elastomeric chain, to consolidate the spaces that have been opened ([Fig. 11](#)).

2. After removal of the Pendulum Appliance, a smaller, easier-to-clean Nance button ("Insta-Nance") is placed immediately to hold the molars back and allow the upper buccal segments to drift distally as the transseptal fibers reorient. An .036" preformed lingual crib is inserted into the lingual sheaths ([Fig. 12](#)). A small ball of Triad light-cured acrylic is formed over the retention loop of the crib in the vertical portion of the palatal vault, smoothed with a moistened finger, and cured with a light source for one minute. I have

found this Insta-Nance to be the most stable and dependable way to maintain molar positions, and it can be fabricated at chairside at the same appointment as the Pendulum Appliance removal.

3. The entire upper arch is bonded or banded, and a continuous archwire with omega loops mesial to the upper first molar tubes is placed. Thus, the entire arch is used for anchorage while the buccal segments are moved distally, and the first molars are prevented from moving mesially along the wire (Fig. 13). This approach can be combined with the Insta-Nance (Fig. 14).

4. A headgear is worn for a few months while the buccal segments drift distally. Although this method requires some patient compliance, it is typically for a shorter period than we traditionally have used headgear.

#### Diagnostic Criteria

Since the Pendulum Appliance drives the upper molars distally (with slight lingual tipping) quite rapidly, there is a tendency for the anterior bite to open. This open bite generally corrects itself in brachyfacial patients, but it can be a problem in dolichofacial types, especially those with tongue-thrust habits. I still recommend treating vertical growth patterns conservatively with extractions, directional headgears, and transpalatal bars. The bite-opening tendency can be encouraged in brachyfacial patients by bonding the Nance portion of the appliance to the occlusal surfaces of the bicuspid or deciduous molars, thus freeing the occlusion somewhat.

Distal movement of the molars appears to be most efficient before the upper second molars have erupted, which places some emphasis on treatment timing. However, as seen in several of the cases in this article, the molars will still move even after the second molars have fully erupted. When a great deal of distal movement is needed and it is preferable not to extract the upper first bicuspid, it may be beneficial to remove the upper second molars and let the third molars drift into place. This creates room in the cortical trough and eliminates the buttressing effect of the upper second and third molars against the first molars.

I have also found that the molars can be moved much more effectively when they are being actively expanded, as with the Pend-X version of the appliance. The rest of Class II treatment is made easier when as much of this tooth movement and expansion as possible is accomplished in the initial phase of treatment.

Unilateral Class II patients also benefit greatly from Pendulum therapy. Although most unilateral Class II malocclusions are really bilateral once the occlusion has been freed, there are some cases where forward positioning of one molar, due to early loss of deciduous teeth and mesial drifting of the molar, is the root cause of the malocclusion. A Pendulum spring on one side can regain space without putting undue strain on other parts of the upper arch.

Similarly, the Pendulum Appliance can be used to regain space lost through mesial drifting of the upper first molars, because of either early loss of the second deciduous molars or impaction of the first molars under the distal crown contour of the deciduous molars. Rapid distalization of the upper first molars and stabilization with an Insta-Nance provide space for the erupting second bicuspid.

#### Conclusion

Patient tolerance of the Pendulum Appliance has been excellent; most adapt to the appliance within a week. If the Pendulum springs are placed distally enough, there is no difficulty with tongue irritation during swallowing.

Initial clinical findings have been encouraging. It is not unusual to see as much as 5mm of distal molar movement in three to four months (Fig. 14). As long as the space is properly maintained, most of the necessary Class II correction--as well as expansion and improvement of archform--can be achieved with little or no need for patient compliance.

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#### Figures

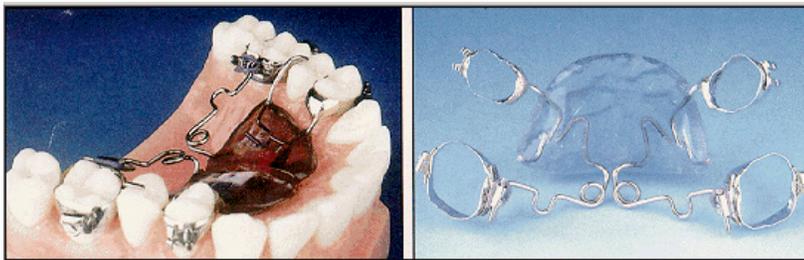
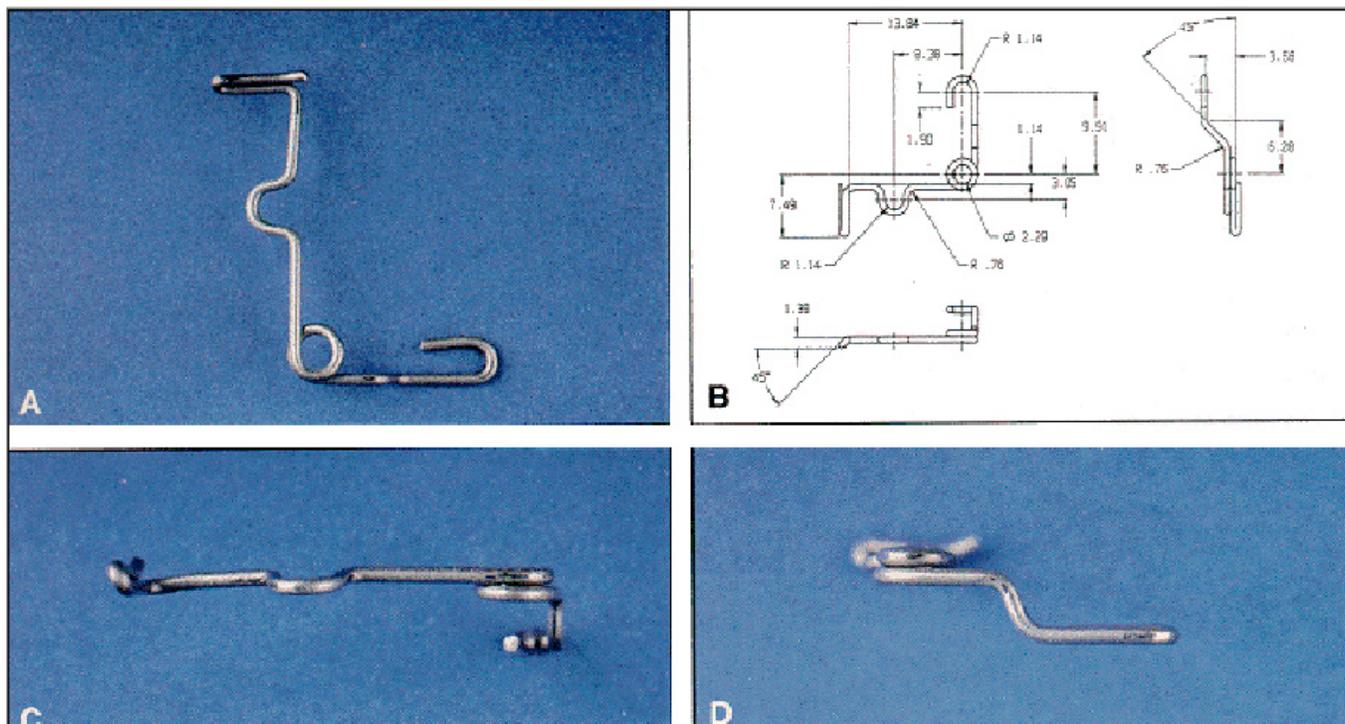
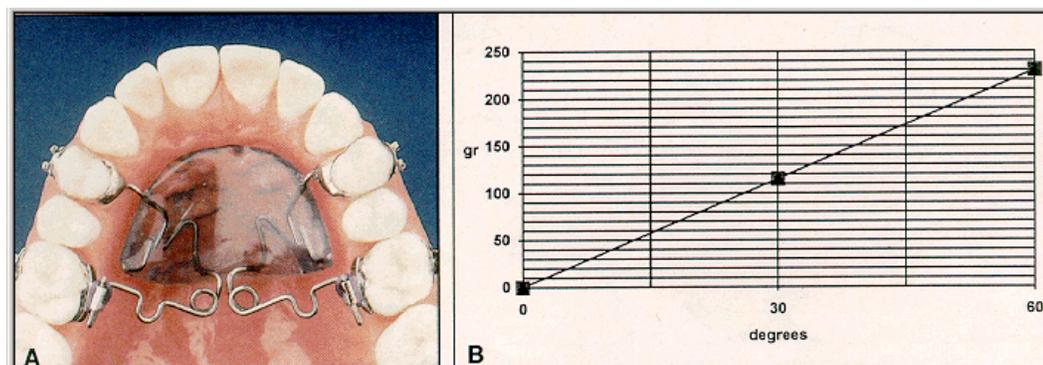


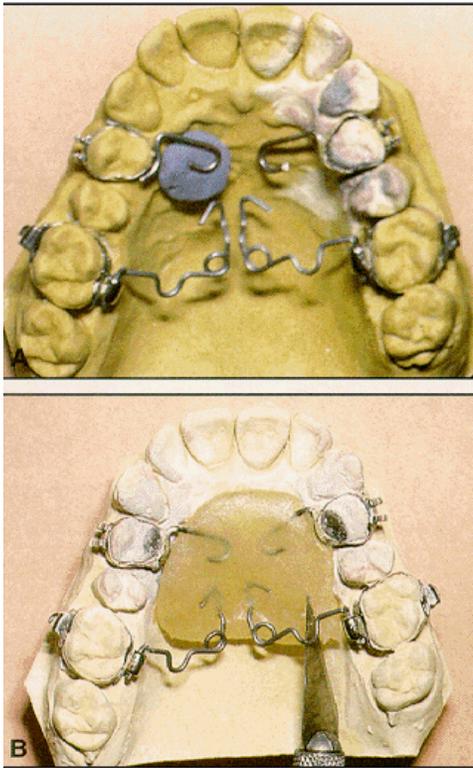
Fig. 1 Standard Pendulum Appliance.



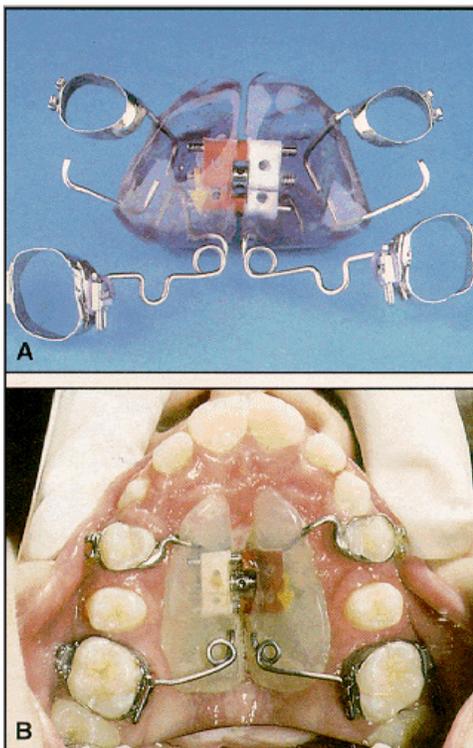
**Fig. 2** A. Occlusal view of Pendulum spring, with small horizontal adjustment loop at midspan. B. Dimensions of average-size Pendulum spring in mm (actual span depends on palatal width). C. Distal view of spring; recurved portion that fits into lingual sheath is vertically oriented. D. Lateral view of spring; note stepup from retentive portion, allowing spring to be placed more occlusally and reducing extrusive forces.



**Fig. 3** A. Pendulum Appliance with springs engaged. B. Force delivered by .032" TMA spring with varying amounts of activation.



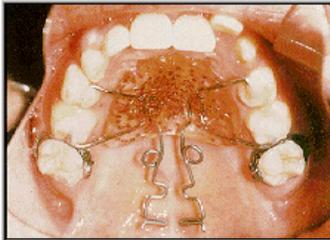
**Fig. 4** A. Anterior retention loops fixed in place with putty, then soldered to bicuspid bands. B. Acrylic ball pressed against palate, Pendulum springs inserted into sheaths, and acrylic smoothed and trimmed.



**Fig. 5** A. Pendulum Appliance with palatal expansion screw ("Pend-X"). Note stabilizing occlusal rests to improve appliance retention. B. Eight weeks after appliance placement, upper arch length has been increased by 9mm, and slight expansion has improved upper archform.



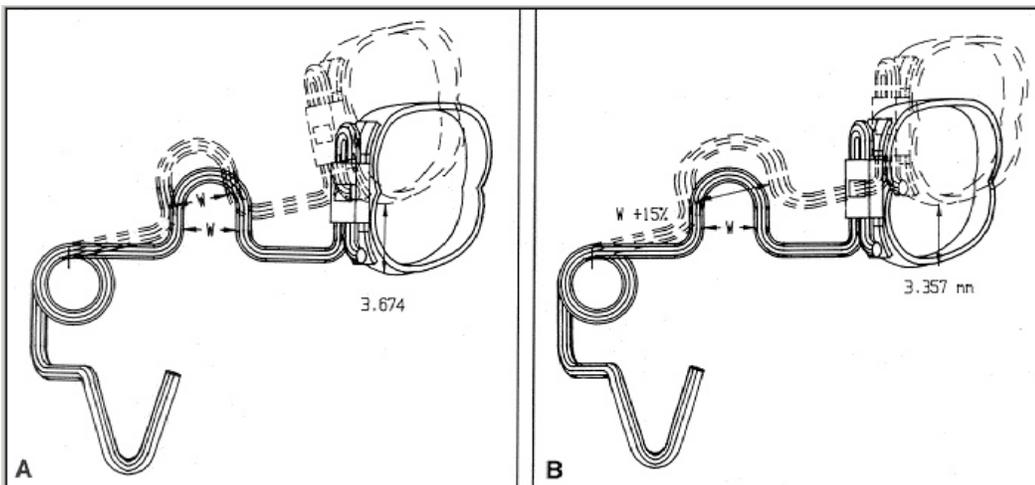
**Fig. 6** A. Pend-X version immediately after placement. B. Four weeks after placement. C. Eight weeks after placement.



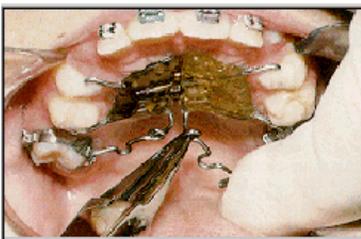
**Fig. 7** Pendulum Appliance after cementation and before insertion of springs. Springs are preactivated to lie parallel to midsagittal plane, which produces 60° of activation after insertion into lingual sheaths.



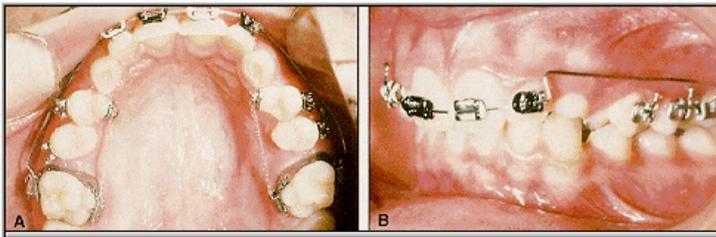
**Fig. 8** Pendulum spring brought forward with finger pressure, and mesial end of recurved loop grasped with Weingart plier for insertion into sheath.



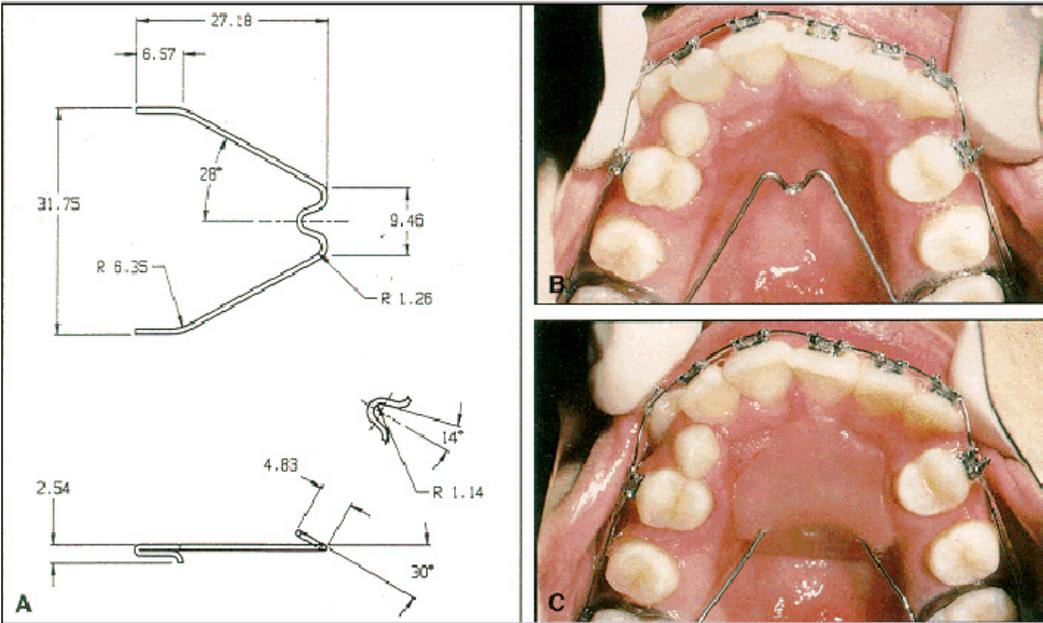
**Fig. 9** A. Spring moves molar on pendulum arc, producing crossbite tendency. B. Periodic expansion of horizontal adjustment loop (in this case, 15%) compensates for lingual molar movement.



**Fig. 10** For intraoral reactivation of Pendulum spring, center of helix is held with bird-beak plier while spring is pushed distally.



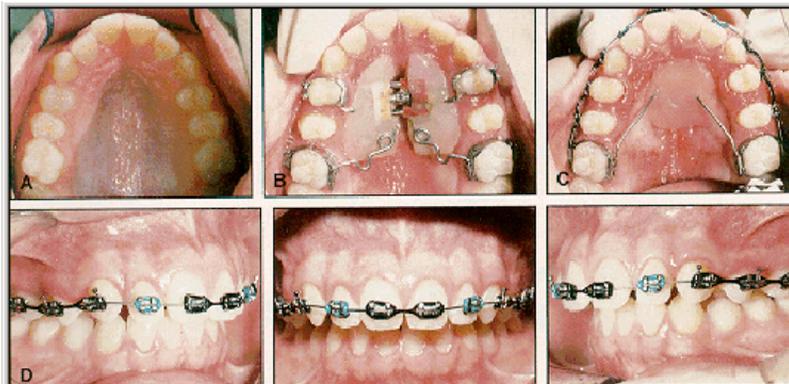
**Fig. 11** A. Upper arch bonded after removal of Pendulum Appliance. B. Utility arch holds molar positions while buccal segments are retracted with elastomeric chain.



**Fig. 12** A. Dimensions of typical Insta-Nance crib made of .036" stainless steel wire (mm). Three preformed sizes meet most needs. B. Preformed crib inserted into lingual sheaths, with wire kept away from palatal vault. C. Small ball of light-cured acrylic placed in palatal vault and wire bent into acrylic. Acrylic is smoothed and rounded with finger pressure, then cured with a light source.



**Fig. 13** A. Upper arch completely bonded after removal of Pendulum Appliance. B. Continuous archwire with omega stops mesial to molars is placed, and elastomeric chain is used to retract buccal segments. C. Space consolidated distal to lateral incisors.



**Fig. 14** A. Class II patient before treatment. B. After 10 weeks of treatment with Pend-X Appliance. C. Insta-Nance appliance and fully bonded upper arch after removal of Pend-X. D. Correction of Class II malocclusion and widening of upper arch immediately after Pend-X removal.

**Footnotes**

1. TMA: Registered trademark of Ormco Corporation, 1332 S. Lone Hill Ave., Glendora, CA 91740.
2. Triad: Registered trademark of Dentsply International Inc., York, PA 17405.