Improving Incisor Torque Control with Nickel Titanium Torque Bars

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Although rectangular archwires in edgewise bracket slots are an effective means of providing static tooth control, they are an inefficient method of delivering continuous and progressive torquing forces. Such torquing would require repeated reactivation of the archwires, which is not only tedious and time-consuming, but also uncomfortable for the patient.

Looped torquing auxiliaries have been used for progressive torquing of the incisor roots since the 1950s.[1] These auxiliaries deliver light, continuous forces without reactivation and produce little, if any, patient discomfort. Despite their advantages, however, some orthodontists refrain from using them because of esthetic and hygienic concerns.

The continuous action of torquing spurs can also be a problem. A tooth contacting a torquing spur can be displaced lingually within a few days if its attachment to the main archwire is broken, due to either a bond failure or the loss of a ligature (Fig. 1). Overtorquing can occur if a patient misses several consecutive appointments while a looped torquing auxiliary is in place. In severe situations, a reverse torquing auxiliary may be required to bring the incisors back to their proper inclinations, adding several months of treatment.

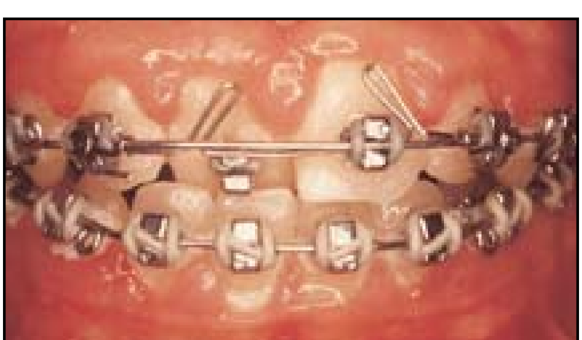

Fig. 1 Tooth contacting looped torquing spur can quickly move palatally if bond fails or ligature is lost.

Nickel Titanium Torque Bars

Nickel titanium Torque Bars* overcome the disadvantages associated with both conventional edgewise torquing mechanics and looped torquing auxiliaries[2] (Fig. 2A). Torque Bars are formed in the ribbon-arch plane from rectangular sections of nickel titanium wire. Bars for conventional edgewise archwire slots are .022" × .018" and are preformed with 0°, 20°, or 30° of torque. For maximum torquing effectiveness, the 30° version is generally recommended (Fig. 2B).

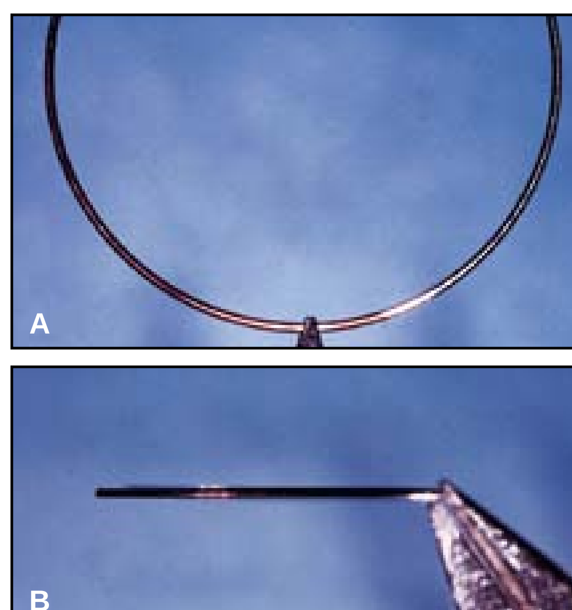

Fig. 2 A. Torque Bar made from .022" × .018" nickel titanium wire (other dimensions are available for .018" archwire slots or ribbon-arch brackets). B. Torque Bar with 30° of activation, recommended for active torque in most edgewise applications.

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Torque Bars for ribbon-arch brackets are .025" × .019" with 45° of torque.

The mechanism by which Torque Bars deliver active torquing forces can be understood by thinking of a torquing spur that has been reduced in length to .022". Such a spur still delivers the same action as a conventional torquing auxiliary, but it is "contained" within the .022" dimension of the edgewise Torque Bar. As long as an active force is continuously delivered by the auxiliary, the length of the torquing spur is irrelevant, because the desired interaction occurs between the root of each tooth and the surrounding bone, rather than between the spur and the surface of the tooth.

This concept works only with alloys that have high shape memory, such as nickel titanium. Stainless steel would be permanently deformed and thus deactivated immediately upon insertion into the bracket slot. Harder alloys would also be more uncomfortable, due to their extreme forces, and would require the same repeated reactivations as with conventional edgewise torquing.

Eliminating the need for torquing spurs improves hygiene and esthetics and simplifies inventory requirements. It also prevents lingual displacement of teeth if they become disengaged from the archwire. The range of torque is limited to the amount formed into the auxiliary plus any built into the bracket slot. Torquing forces dissipate as the inclinations of the teeth approach the degree of the preprogrammed torque.

The effectiveness of Torque Bars has been clinically proven over the last decade. Today they are the preferred torquing auxiliaries for Tip-Edge* treatment. They have also become popular with conventional edgewise techniques, particularly to overcome loss of torque during incisor retraction in extraction cases.

*TP Orthodontics, 100 Center Plaza, La Porte, IN 46350. Tip-Edge and Side-Winder are registered trademarks.

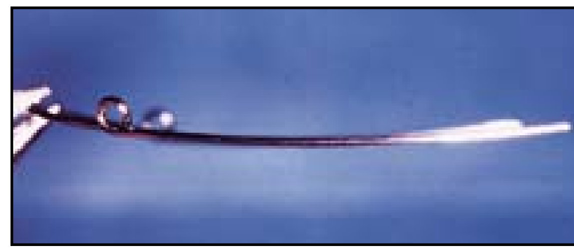

Fig. 3 As with all torquing auxiliaries, base archwire must be largest and stiffest (high-tensile) round wire possible to counteract adverse secondary forces. Note mild bite-opening curves distal to cuspids to prevent deepening of anterior overbite.

Base Archwires for Torque Bars

All torquing auxiliaries generate adverse secondary forces that tend to extrude the incisors and expand the molars. To fully counteract these forces, the base archwire must be the hardest and largest-diameter round wire available. If an .022" high-tensile stainless steel wire is used, it is not necessary to constrict the base archwire to prevent widening of the molars.

Smaller-diameter archwires or wires formed from softer stainless steel alloys must be constricted to provide adequate molar control. The constriction should begin at the midline, because if only the areas distal to the cuspids are curved, the archform will be distorted. A mild curve of Spee should be placed in any maxillary base archwire to prevent deepening of the anterior overbite during torquing (Fig. 3).

Placing and Engaging Torque Bars

The following procedure will minimize the tendency of the Torque Bar to "roll" inside the bracket slot during initial engagement. The bar is first engaged under the main archwire in only the

Fig. 4 To keep Torque Bar from slipping within bracket slot, it must be tightly ligated into central incisor bracket slots, under main archwire, prior to engagement in lateral incisor bracket slots. For palatal root torque, ends of Torque Bar should lie gingival to lateral incisor brackets.

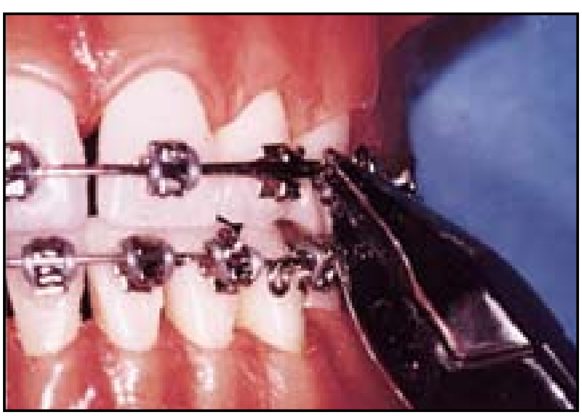

Fig. 5 Activation occurs as ends of auxiliary are pulled down and engaged under main archwire in lateral incisor bracket slots.

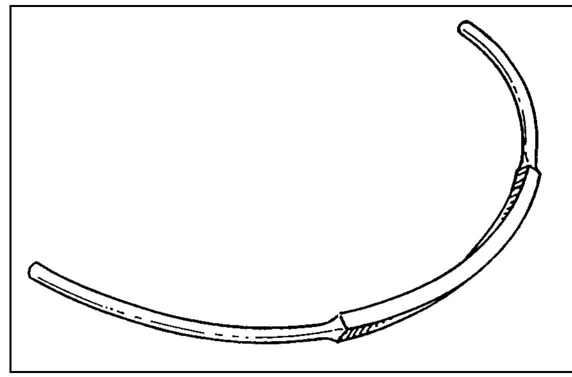

Fig. 6 Torque Bar can be rounded with heatless stone to deliver torquing forces only to selected teeth. Shaded areas of rectangular segment contact occlusal and gingival surfaces of respective bracket slots.

Fig. 7 Viewed from occlusal, Torque Bar should appear to be same width as or narrower than .022" base archwire. If bar appears wider, it has rotated within bracket slot and will not produce adequate torquing forces.

central incisor bracket slots, so that the ends of the auxiliary lie gingival to the lateral incisor brackets (Fig. 4). For maximum torque, both wires should be tied as tightly as possible to the central incisor brackets with a ligature-tying plier, using stainless steel ligatures. In most patients, however, elastomeric ligatures are sufficient.

Activation of the Torque Bar occurs as the ends are pulled down and engaged in the bracket slots of the lateral incisors. This is done by rotating the auxiliary behind the main archwire, using a lightwire or bird-beak plier, until each end drops down behind the main archwire into the slot of its lateral incisor bracket (Fig. 5).

The auxiliary and main archwires are then ligated into the lateral incisor bracket slots in the same way. The auxiliary should normally extend only from lateral incisor to lateral incisor. Torquing forces can be increased by extending it from cuspid to cuspid, but in that case the ends of the bar engaging the cuspid bracket slots should be rounded with a diamond wheel or heatless stone to prevent undesirable palatal torquing of the cuspid roots. Selected areas of the Torque Bar can be rounded if torque is needed for only one or two teeth, rather than all four incisors (Fig. 6).

To check for proper engagement, the auxiliary should be viewed from the gingival or incisal. From this perspective, the Torque Bar should appear to be the same width as or slightly narrower than the base archwire. If it looks wider, it has slipped within the bracket slot and will not produce the desired torquing forces (Fig. 7).

When using Torque Bars with Tip-Edge appliances, special "deep groove" maxillary incisor brackets should be used to prevent slippage. These brackets have conventional preadjusted edgewise slots cast into the bottom of the Tip-Edge bracket slots. Early in treatment, the "deep groove" slot is filled with a cap that assures one-point contact between archwire and slot to facilitate bite opening and retraction. The cap is removed at the start of active torquing mechanics, and the Torque Bar can then be securely engaged within the deep groove.

To prevent space opening and flaring of the incisors, the ends of the main archwire should be annealed and bent around the distal of the molar tubes. If spaces develop between the incisors during torquing, they can be closed by engaging an elastomeric link or power chain from cuspid to cuspid.

Case Report

A 12-year-old female sought orthodontic treatment to correct her lower anterior crowding and deep anterior overbite. Clinical examination showed a Class II, division 2 malocclusion with 100% anterior overbite and 1mm of overjet. The mandibular incisors were moderately crowded, but the maxillary arch was relatively well aligned (Fig. 8). The maxillary right and left deciduous cuspids were present and solid; the mandibular right deciduous cuspid was present and mobile. The mandibular right second bicuspid was congenitally missing, but the mandibular right second deciduous molar was present and solid. Both mandibular first permanent molars exhibited hypoplastic enamel.

Cephalometric analysis revealed that the mandibular incisors were 3mm behind the APo line. This, along with the patient's flat facial profile, led to the decision to treat her without extraction of any permanent teeth. The mandibular right second deciduous molar would be retained, but the patient was advised that a bridge or implant would be required if the molar became loose or submerged.

Tip-Edge appliances were placed in both arches. As is often the case with deep anterior overbites, the patient initially occluded on only the mandibular incisor brackets. Bond failures of mandibular anterior brackets are rarely a problem, however, since the teeth quickly become sensitive, reducing the force of mastication until molar occlusion is reestablished. The biteplane effect of occlusion on the mandibular anterior brackets can facilitate rapid bite opening. In this case, standard Tip-Edge bite-opening mechanics were used: light Class II elastics (1.5oz on each side) in conjunction with .016" Wilcock Australian archwires with bite-opening bends (Fig. 9A). A looped archwire was placed in the mandibular arch to achieve rapid alignment of the incisors.

Treatment was prolonged by the slow eruption of the maxillary permanent cuspids and poor patient cooperation. After one and half years, the maxillary cuspids had fully erupted and were bonded along with all premolars. Bite opening was accomplished with only the light intraoral forces.

A few months later, torquing and uprighting mechanics were initiated using .022" high-tensile stainless steel archwires (Fig. 9B). A progress cephalogram indicated that a significant amount of maxillary incisor torquing would be required to achieve the desired inclinations. Therefore, a nickel titanium Torque Bar was

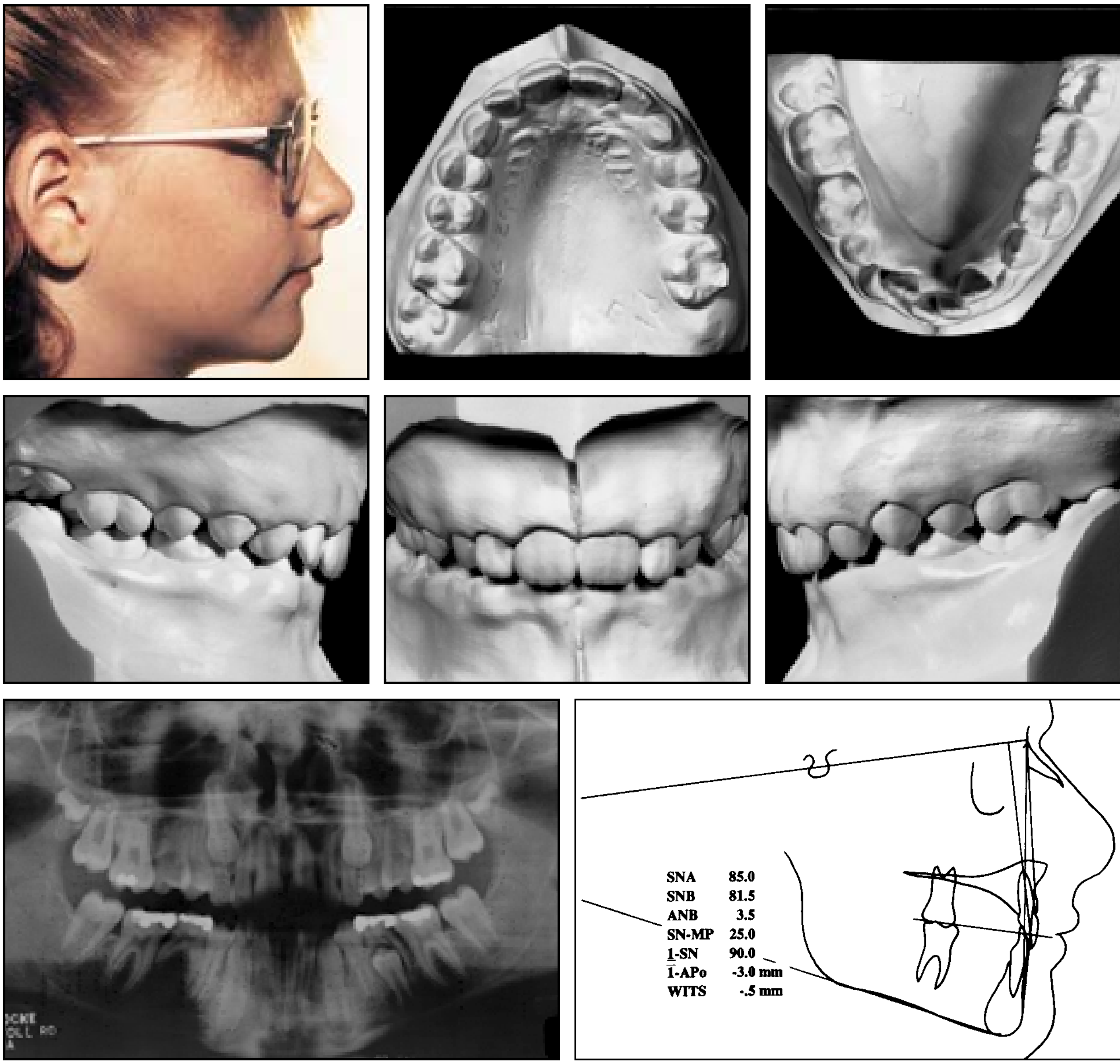

Fig. 8 **Patient with Class II, division 2 malocclusion, 100% overbite, 1mm overjet, and moderate mandibular incisor crowding before treatment.**

inserted under the main archwire into the deep grooves of the maxillary central and lateral incisor brackets. Side-Winder* uprighting springs were also placed on the teeth that required mesiodistal uprighting.

After six months of torquing (Fig. 9C), another cephalogram showed a significant improvement in the inclination of the maxillary incisors (Fig. 10B). The angulation of the maxillary incisor to SN increased from 90.0° to 111.5° (Fig. 10C). Thus, the rate of torque was 3.5° per month over the six-month period (the usual rate seen with Torque Bars is 1.5-2.0° per month).

Six weeks after the last cephalogram was taken, the appliances were removed. Superimposition of before-and-after cephalometric tracings demonstrates that the malocclusion was corrected without the use of extraoral forces or removable appliances to control the vertical dimension. FMA actually decreased from 22° to

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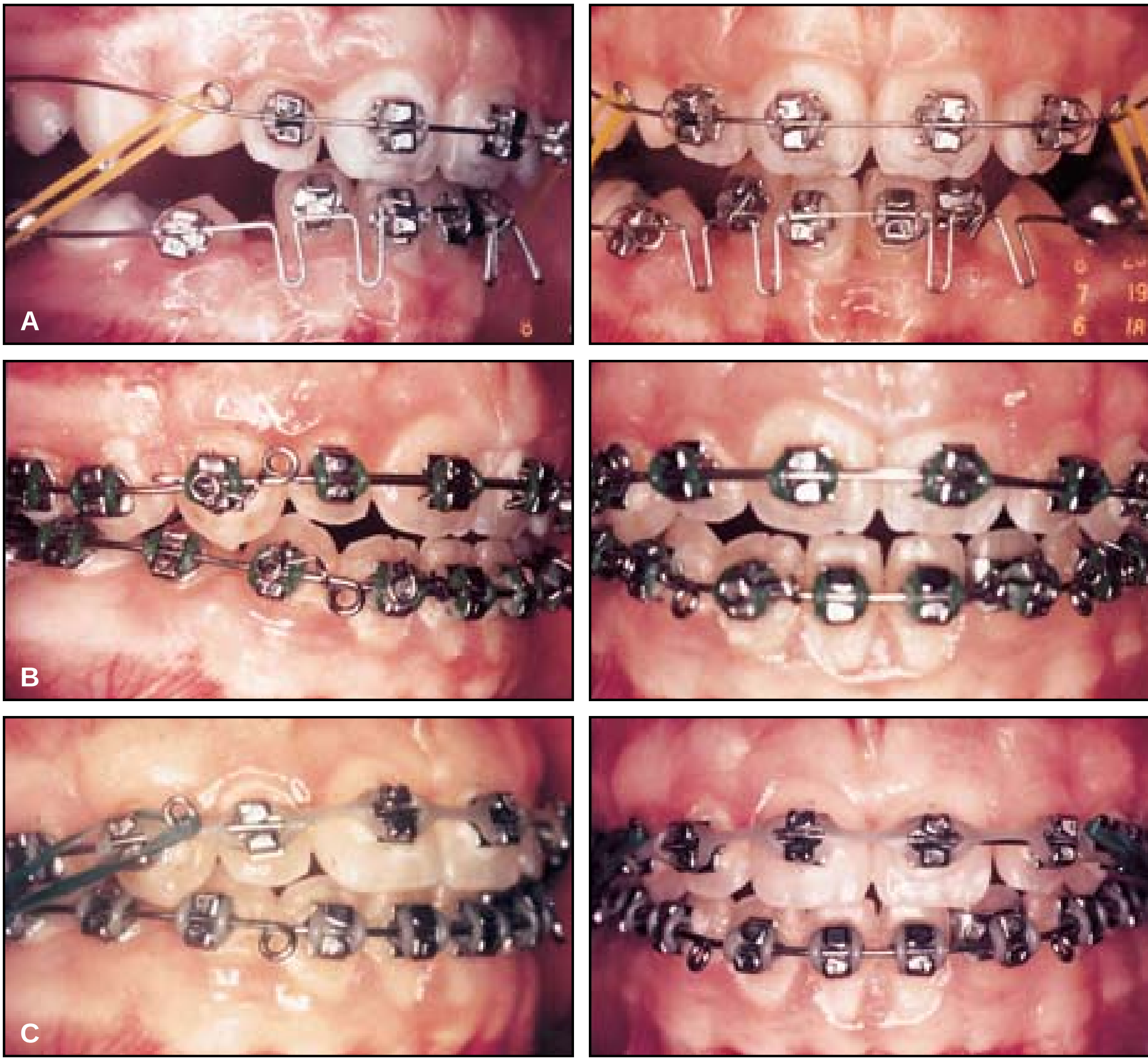

Fig. 9 A. Initial bite-opening with Tip-Edge appliances in both arches, light Class II elastics, and .016" Australian archwires with strong bite-opening bends just mesial to molar tubes. B. Engagement of Torque Bar to begin final torquing of maxillary incisors. Ends of Torque Bar were rounded to eliminate undesirable torquing forces on cuspids (current practice would be to end Torque Bar mesial to canine brackets). C. After about six months of engagement, effectiveness of Torque Bar is clearly seen.

19°, and the mandibular incisors were repositioned from 3mm behind the APo line to 1mm in front of APo. This produced a corresponding improvement in the patient's soft-tissue profile (Fig. 10A).

A tooth positioner was worn for two weeks, after which a maxillary circumferential retainer and a mandibular bonded lingual retainer were placed. The retained mandibular right second deciduous molar was lost several years after the appliances were removed, and a three-unit bridge was then fabricated to replace the missing mandibular right second bicuspid.

Conclusion

Regardless of the technique used for tooth movement, Torque Bars provide a simple yet highly effective means of progressively torquing incisor roots. These auxiliaries also do away with

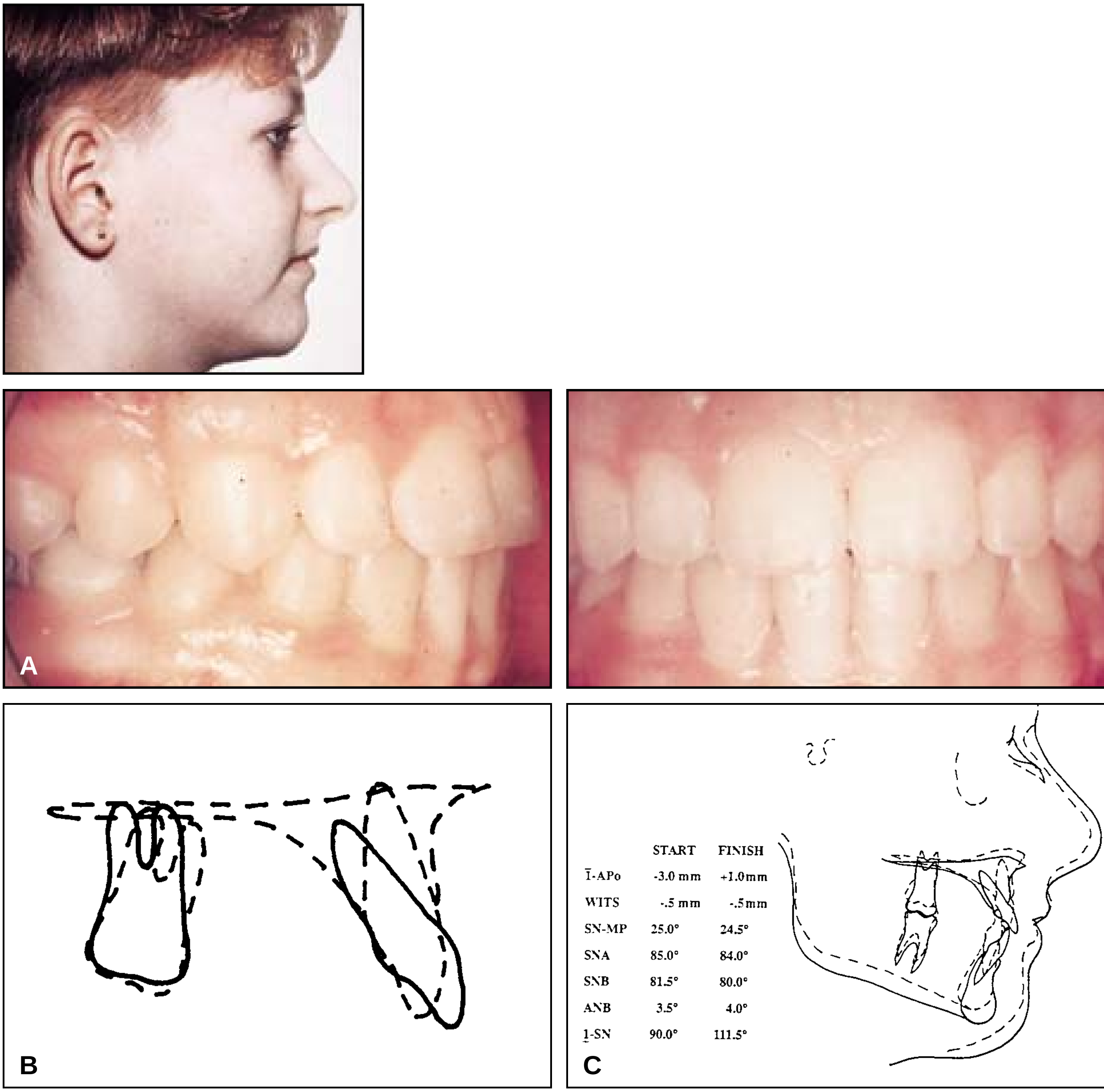

Fig. 10 A. After 29 months of treatment. B. Maxillary superimposition of cephalometric tracings before placement of Torque Bar and six months later shows significant amount of incisor torque achieved without any archwire adjustments. C. Superimposition of cephalometric tracings before and after treatment shows increase in inclination of maxillary incisor to SN from 90.0° to 111.5°.

the potential food traps and poor esthetics associated with conventional looped torquing spurs. Most important, Torque Bars maximize patient comfort through the continuous application of light torquing forces, compared to the discomfort experienced with periodic reactivation and reinsertion of rectangular archwires.

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