

# Toothborne Orthopedic Maxillary Protraction in Class II Patients

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**R**apid maxillary expansion is commonly combined with facemask therapy to achieve maxillary protraction in growing Class III patients.<sup>1-3</sup> Only about 1.5-3mm of protraction per year can be achieved with such treatment,<sup>4-6</sup> however; this may be because the devices are toothborne and their effects are mostly dental,<sup>7</sup> or because the maxillary suture is not adequately separated. One author has stated that 5mm of maxillary expansion is enough to produce orthopedic results,<sup>6</sup> but others maintain that at least 12-15mm is needed.<sup>8,9</sup> In any case, the purpose of expansion should be to disarticulate rather than overexpand the maxilla.

This article presents an effective technique for orthopedic maxillary protraction using only

toothborne devices.<sup>10</sup>

## Appliance Design

A new double-hinged rapid maxillary expander\* is designed to expand and rotate each half of the maxilla outward for greater anterior displacement with less risk of bone resorption behind the maxillary tuberosities<sup>10,11</sup> (Fig. 1). Similar to a W-appliance, it consists of a central jackscrew held by two bolts, an anterior body connecting the bolts, and two posterior hinges.

\*Best Medical & Dental International, Inc., 2nd Floor, 96 Nan Hwa Road, Kaohsiung, 800, Taiwan; bestdent@ms66.hinet.net. Double-hinged expander: U.S. Patent No. 6334771 B1; protraction springs: U.S. Patent No. 6273713 B1.



Fig. 1 Double-hinged rapid maxillary expander.

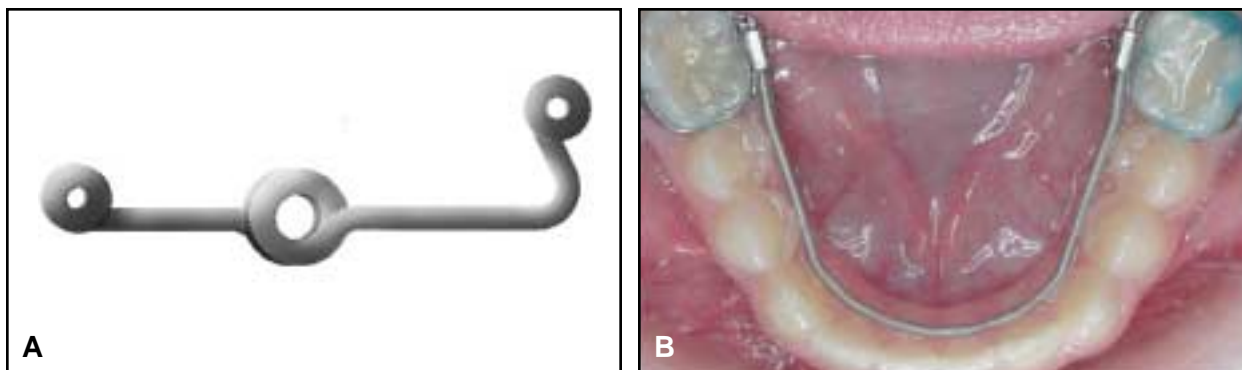


Fig. 2 TMA maxillary protraction spring (A) and mandibular lingual holding arch (B).

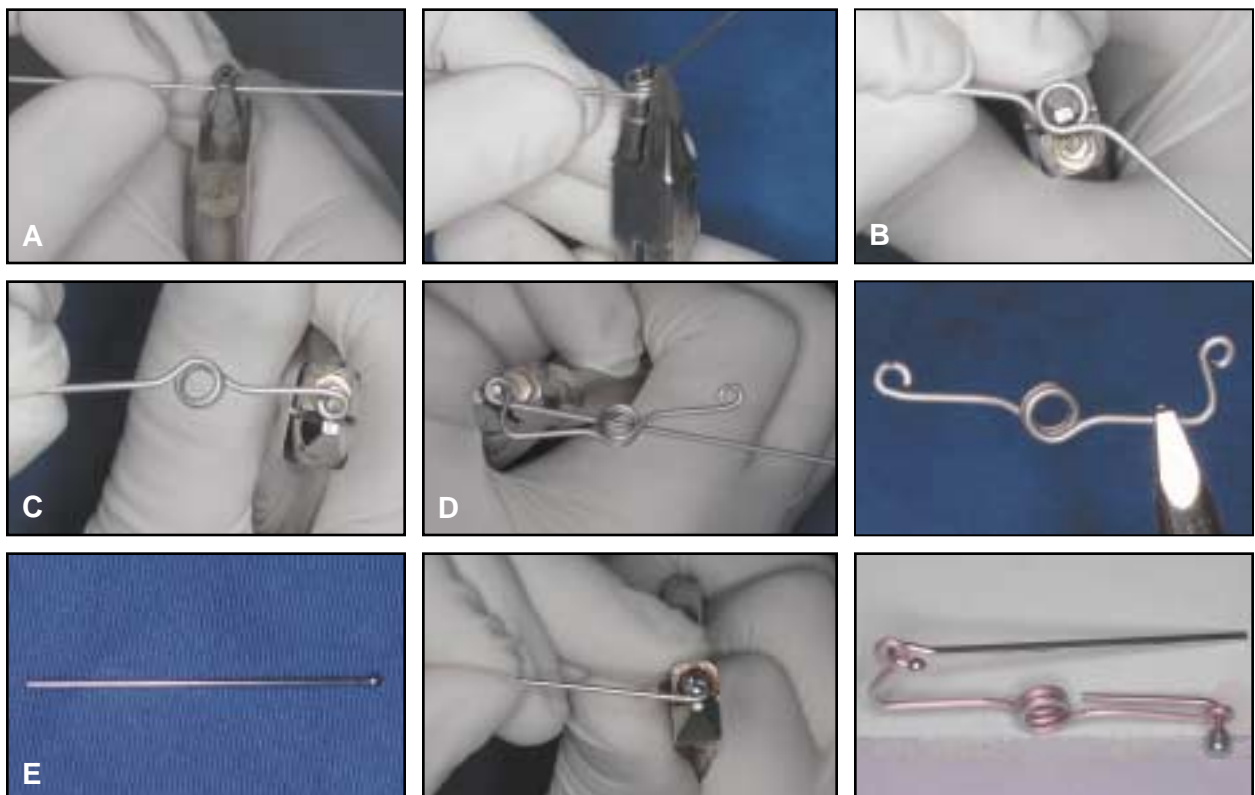


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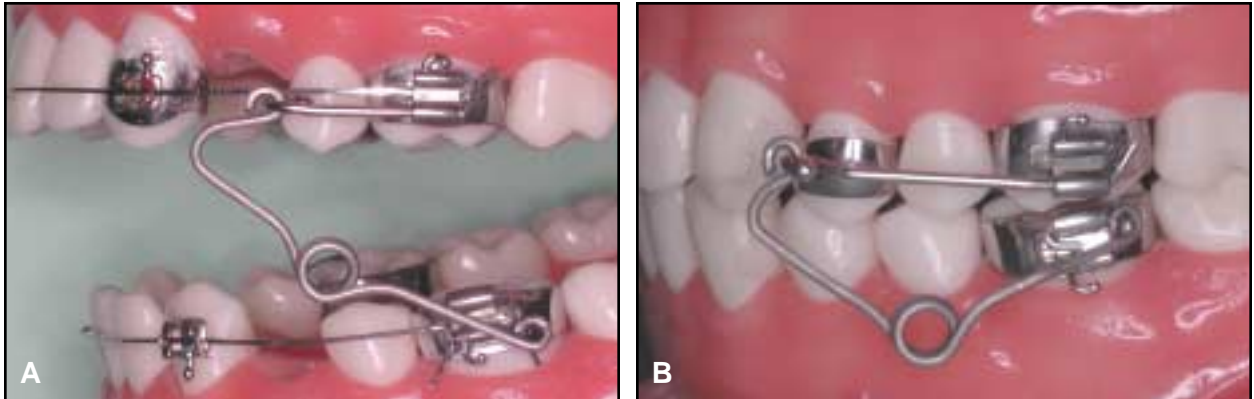
The maxillary suture is opened by a protocol of Alternate Rapid Maxillary Expansion and Constriction<sup>10,11</sup> (Alt-RAMEC). The maxilla is expanded 1mm per day (four turns) for one week, then constricted 1mm per day for the next week. This process is repeated for seven to nine weeks, until sufficient disarticulation has been achieved. The rationale is similar to that of simple tooth extraction, in which the tooth is rocked buccally and lingually until it is “loosened” from the alveolar socket.

Maxillary protraction is produced by a pair of fixed, toothborne .036" TMA\*\* helical springs, with mandibular anchorage from an .036" TMA lingual holding arch<sup>10,11</sup> (Fig. 2). Each spring is attached to the maxillary headgear tube with an .040" ball pin, and to the mandibular headgear tube with an .020" ball pin (Fig. 3). The ends of the ball pins are annealed for easier cinch-back.

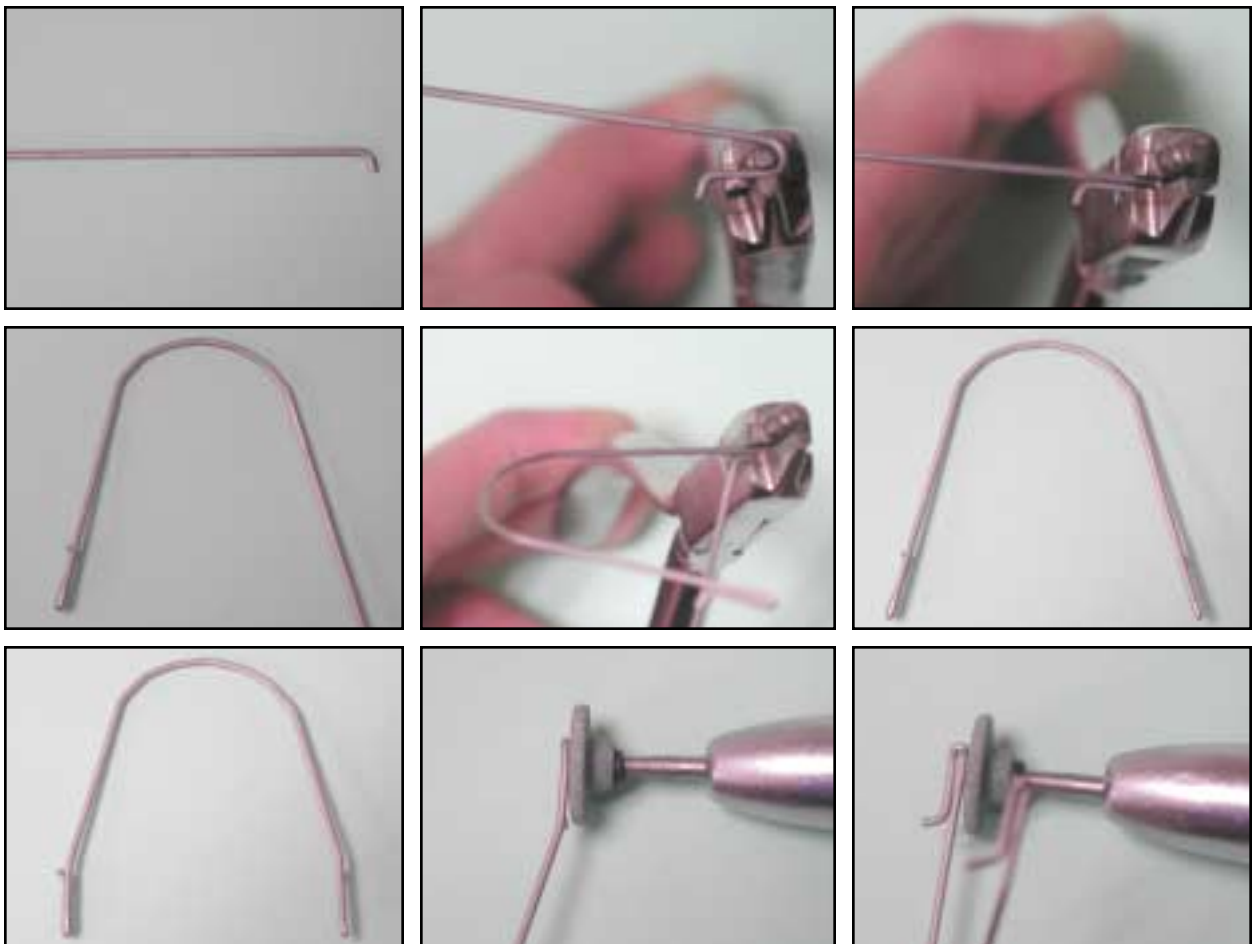
\*\*Registered trademark of Ormco/"A" Company, 1717 W. Collins Ave., Orange, CA 92867.



**Fig. 3** Procedure for fabricating maxillary protraction spring. A. Double helix bent into .036" TMA wire with Young's plier. B. Both ends of helix bent 180°, avoiding sharp bends to prevent breakage. C. Circle bent 15mm away from double helix to hold ball clasp at mandibular headgear tube. D. Swan-neck bend ending in circle made 15mm from double helix to hold ball clasp at maxillary headgear tube. E. Ball clasps attached to spring.



**Fig. 4 A.** Maxillary protraction spring is passive on mandibular opening. **B.** Spring compresses to 100-120° angle on mandibular closing, generating 300-400g of horizontal and upward force.



**Fig. 5** Mandibular lingual holding arch fabricated from .036" TMA wire, with molar crown torque and mesial angulation built in. Both ends are reduced by grinding to facilitate insertion into lingual sheaths.

When the mandible opens, the springs straighten into a passive position (Fig. 4A); when the mandible closes, the springs are compressed to an angle of 100-120°, generating 300-400g of horizontal and upward force on each side (Fig. 4B). Lingual molar crown torque and mesial angulation should be added to the lower holding arch to compensate for the buccal crown torque produced by the protraction springs (Fig. 5).

### Treatment Procedure

The total treatment time is six months, involving three stages:

1. Seven to nine weeks of Alt-RAMEC to open the maxillary suture.
2. One to two months of active maxillary pro-

traction with the intraoral springs.

3. Two to three months of maintenance, with no additional activation of the protraction springs.

The maxillary first premolars and molars are banded, and an impression is taken for fabrication of the double-hinged expander. The expander is soldered to the molar and premolar bands, with .045" stainless steel anterior arms extending bilaterally from the premolar bands toward the central incisors (Fig. 6A). These arms and the inner surfaces of the premolar and molar bands should be sandblasted before placement. After the bands are cemented, the extension arms are bonded to the anterior teeth with composite resin.

One day later, the double-hinged expander is activated according to the Alt-RAMEC proto-



**Fig. 6 A.** Double-hinged maxillary expander and mandibular lingual holding arch placed in 11-year-old female patient. Maxillary suture opened after nine weeks of Alt-RAMEC. **B.** Maxillary protraction springs in place. After one month of protraction, patient experienced 6.5mm of maxillary advancement at A point and 5mm of downward and backward mandibular rotation.





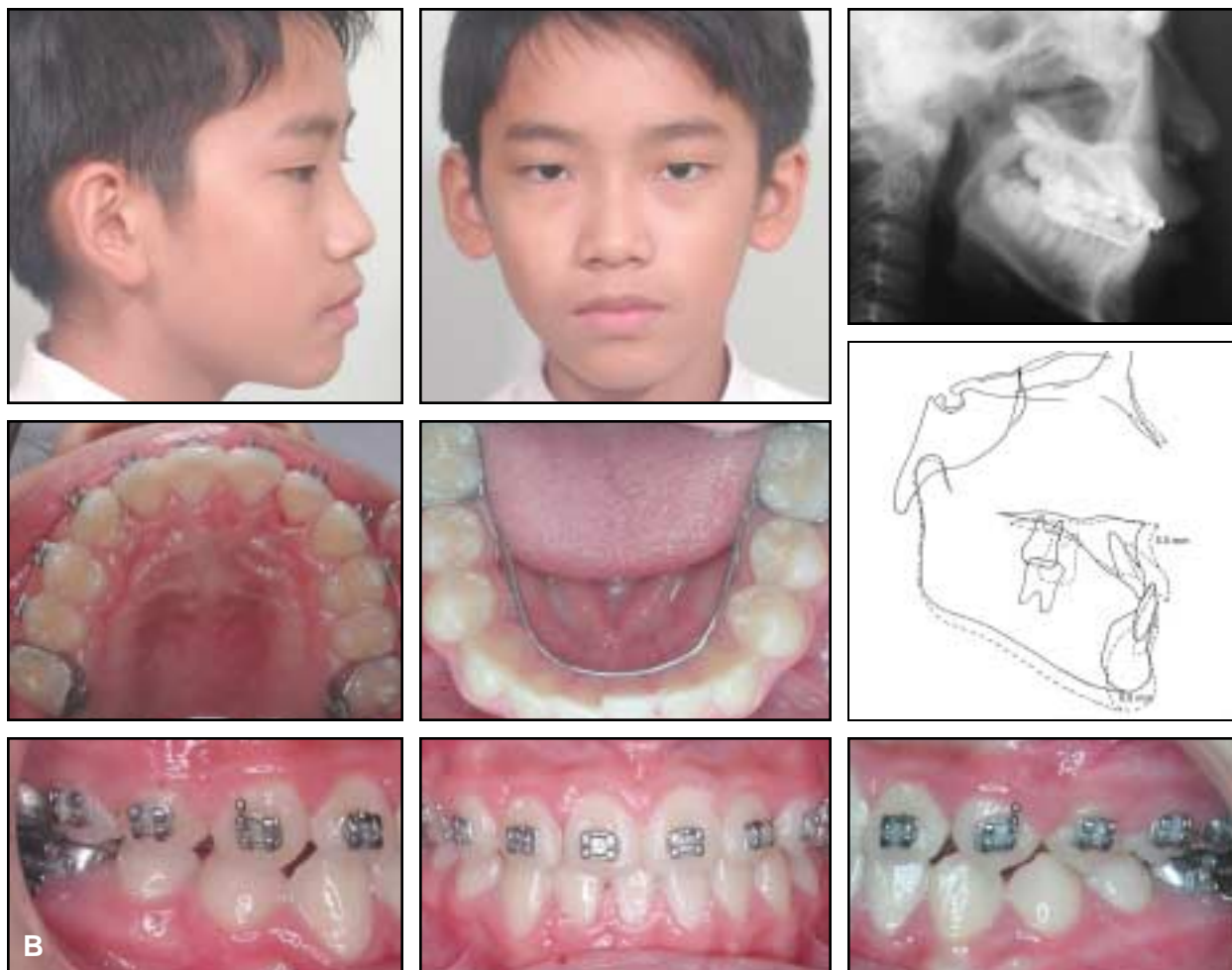
**Fig. 7 A.** 12 year-old male patient with Class III malocclusion and maxillary hypoplasia before treatment (continued on next page).

col. A chart of the weekly sequence of expansion and constriction should be given to the parents to record the daily activations of the expander, as well as any discomfort. The patient should be seen once a month to review the chart and check for loosening of the maxilla. This can be verified by holding the patient's head in one hand and rocking the expander up and down with the other.

Maxillary protraction should not proceed until after the maxillary suture has been opened. It is our clinical observation that an expanded maxilla allows more effective protraction than a constricted maxilla. Any space that has opened between the central incisors can be used to relieve anterior crowding or to compensate for proclination of the incisors.

Once the suture has been separated, the intraoral maxillary protraction springs and TMA lingual holding arch are placed (Fig. 6B). The patient is then seen once a month for adjustment or replacement of the springs if they become distorted or broken. We recommend overprotraction of the maxilla to compensate for future mandibular growth. After the passive retention period, the double-hinged expander and protraction springs are removed.

A facemask could be used for protraction if patient compliance is not an issue. We have found, however, that a facemask takes more time to produce the same amount of protraction as the intraoral springs.



**Fig. 7 (cont.) B.** Patient's maxilla protracted 5.5mm after six months of treatment, including nine weeks of Alt-RAMEC and 15 weeks of maxillary protraction and maintenance (continued on next page).

### Treatment Effects

Results of this orthopedic maxillary protraction technique were evaluated in a clinical study.<sup>10</sup> The average amount of maxillary advancement was 5.8mm horizontally at A point. Most of the advancement occurred during the first three months of treatment; in general, the maxillae were displaced 2mm anteriorly during the nine weeks of Alt-RAMEC and then rapidly protracted another 3-4mm in the first month after placement of the springs.

Other skeletal effects included an upward tilting of the palatal plane and downward and backward rotation of the mandible. Dental effects

were an upward canting of the maxillary occlusal plane, proclination of the maxillary incisors, retroclination of the mandibular incisors, mesial tipping of the maxillary molars, and distal tipping of the mandibular molars. These minor dental effects usually resolved themselves shortly after removal of the expander and protraction springs.

### Case Report

The clinical application of this technique is shown in a growing Class III patient (Fig. 7). The patient's expansion and protraction has remained stable at least two years after treatment.



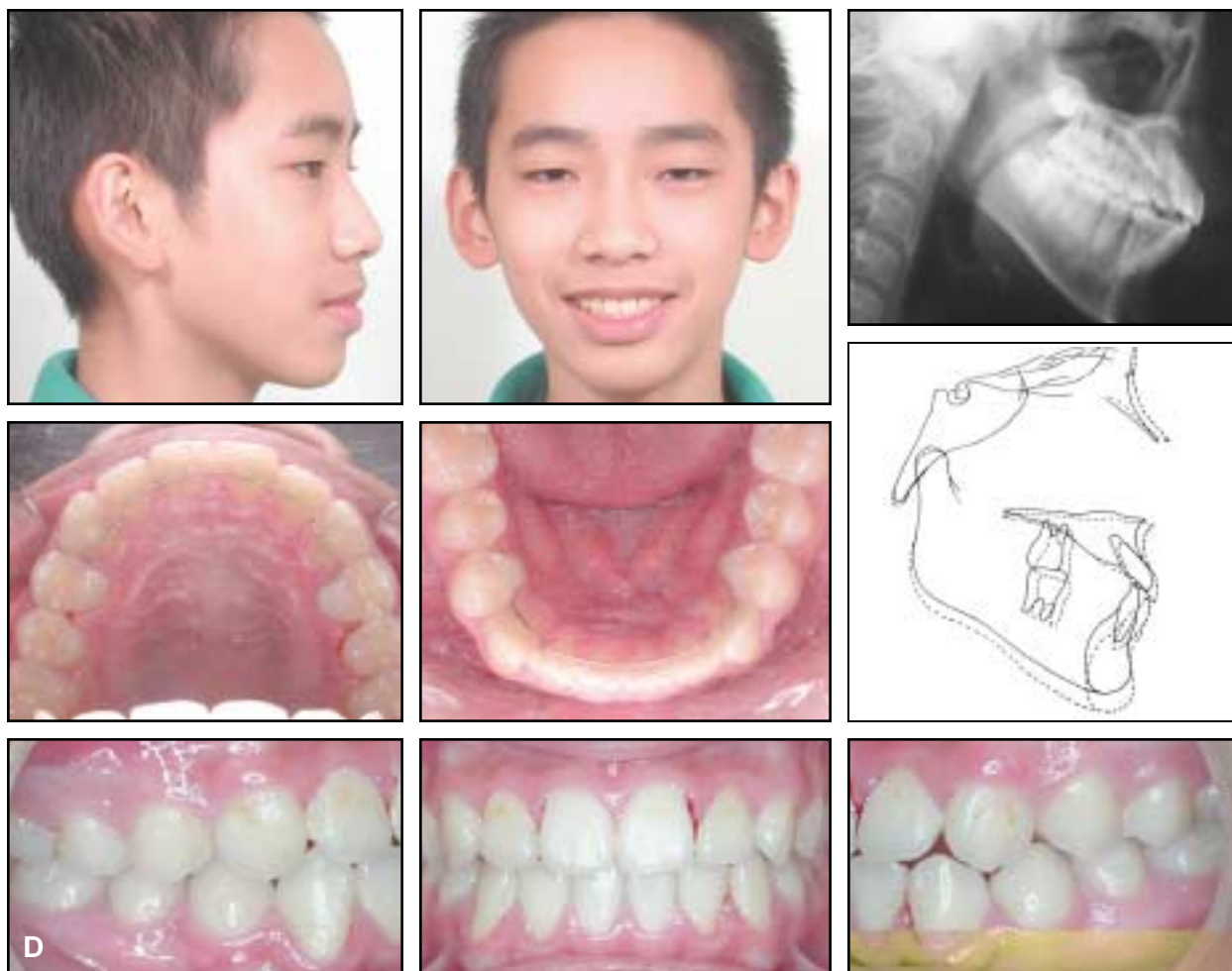
Fig. 7 (cont.) C. Patient after six months of orthodontic tooth alignment (continued on next page).

## Conclusion

This effective orthopedic maxillary protraction technique can be used in both Class III and cleft lip and palate patients. The most important element is the Alt-RAMEC protocol for loosening the maxillary suture, which allows the maxilla to be protracted orthopedically without substantial dental effects.

## REFERENCES

1. Haas, A.J.: Palatal expansion: Just the beginning of dentofacial orthopedics, *Am. J. Orthod.* 57:219-255, 1970.
2. McNamara, J.A. Jr.: An orthopedic approach to the treatment of Class III malocclusion in young patients, *J. Clin. Orthod.* 21:598-608, 1987.
3. Turley, P.K.: Orthopedic correction of Class III malocclusion with palatal expansion and custom protraction headgear, *J. Clin. Orthod.* 22:314-325, 1988.
4. Williams, M.D.; Sarver, D.M.; Sadowsky, P.L.; and Bradley, E.: Combined rapid maxillary expansion and protraction facemask in the treatment of Class III malocclusions in growing children:



**Fig. 7 (cont.) D.** Patient two years after treatment, showing no relapse of maxillary expansion and additional 3mm of forward and downward maxillary growth.

- A prospective long-term study, *Semin. Orthod.* 3:265-274, 1997.
5. Ngan, P.; Yiu, C.; Hu, A.; Hagg, U.; Wei, S.H.; and Gunel, E.: Cephalometric and occlusal changes following maxillary expansion and protraction, *Eur. J. Orthod.* 20:237-254, 1998.
  6. Alcan, T.; Keles, A.; and Erverdi, N.: The effects of a modified protraction headgear on maxilla, *Am. J. Orthod.* 117:27-38, 2000.
  7. Kim, J.H.; Viana, M.A.G.; Graber, T.M.; Omerza, F.F.; and Be-Gole, E.A.: The effectiveness of protraction face mask therapy: A meta-analysis, *Am. J. Orthod.* 115:675-685, 1999.
  8. Haas, A.J.: Long-term posttreatment evaluation of rapid palatal expansion, *Angle Orthod.* 50:189-217, 1980.
  9. Haas, A.J.: The non-surgical treatment of the skeletal Class III, AAO annual session abstracts, 2000, p. 85.
  10. Liou, E.J.W. and Tsai, W.C.: A new protocol for maxillary protraction in cleft patients: Repetitive weekly protocol of alternate rapid maxillary expansions and constrictions, *Cleft Pal. Craniofac. J.* (in press).
  11. Liou, E.J.W. and Chen, P.K.T.: New orthodontic and orthopedic managements on the premaxillary deformities in patients with bilateral cleft before alveolar bone grafting, *Ann. Coll. Surg. H.K.* 7:73-82, 2003.