Adjustable Traction Hooks for Anterior Torque Control with Miniscrew Anchorage

EDUARDO YUGO SUZUKI, DDS, PHD
BOONSIVA SUZUKI, DDS, PHD

Miniscrew implants have several advantages over other orthodontic anchorage techniques, including ease of implantation and removal, relatively low cost, and availability for immediate loading.[1-3] Orthodontic miniscrews are generally narrow enough to be implanted in the alveolar bone between the roots of adjacent teeth.[1-11] This allows the use of relatively simple force-delivery systems, involving either elastomeric materials or nickel titanium closed-coil springs.[1-6]

In extraction cases requiring anterior space closure, however, where miniscrew anchors are placed well above the usual line of action of the retraction forces, it is difficult to control anterior torque and avoid undesirable palatal tipping of the upper incisors.[1-3,11] This article describes an adjustable traction hook with a long power arm that provides more precise anterior torque control during retraction.

*Y&B Products, L.P., Huay Keaw Soi 3, Amphur Muang, Chiang Mai 50200, Thailand; www.yb-products.com.

Adjustable Traction Hook

The adjustable traction hook,* made from a 7mm length of rigid .024" stainless steel wire, can be securely attached to a stainless steel or nickel titanium archwire without the risk of sliding (Fig. 1). A Gurin lock makes it easy to reposition the hook at any point along the archwire with a manual screwdriver, either inside or outside the patient's mouth. The hooks are available in left and right versions for attachment to power chain or nickel titanium closed-coil springs (Fig. 2), and can easily be adjusted to prevent impingement of the springs on the soft tissue.

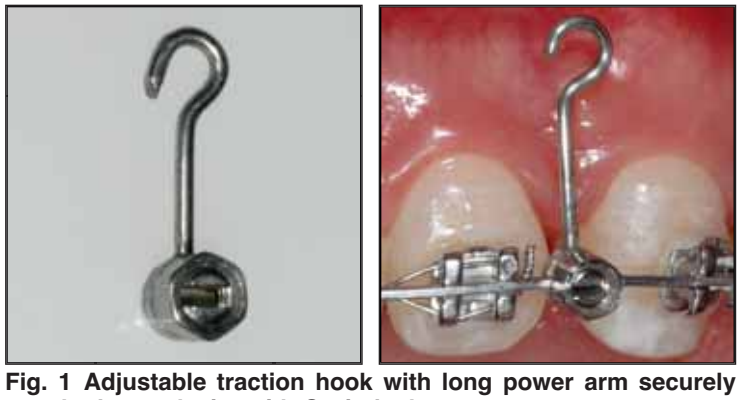

Fig. 1 Adjustable traction hook with long power arm securely attached to archwire with Gurin lock.

Fig. 2 Right and left versions of adjustable traction hooks for attachment to either nickel titanium closed-coil springs (pictured) or power chain.

The authors are instructors, Department of Orthodontics, Faculty of Dentistry, Chiang Mai University, Suthep Road, Amphur Muang, Chiang Mai 50270, Thailand. They have a financial interest in the adjustable traction hook and 3D Surgical Guide. E-mail Dr. Boonsiva Suzuki at boonsiva@chiangmai.ac.th.

Dr. E.Y. Suzuki

Dr. B. Suzuki

For optimal torque control of the anterior teeth during retraction, the point of force application and the line of action of the retraction force must be carefully planned by adjusting the positions of the traction hook and the miniscrew implant with respect to the center of resistance of the anterior segment (Fig. 3). Vanden Bulcke and colleagues found that the center of resistance of the six anterior teeth was located 7mm apical to the interproximal bone level between the central incisors (measured perpendicular to the occlusal plane).[12]

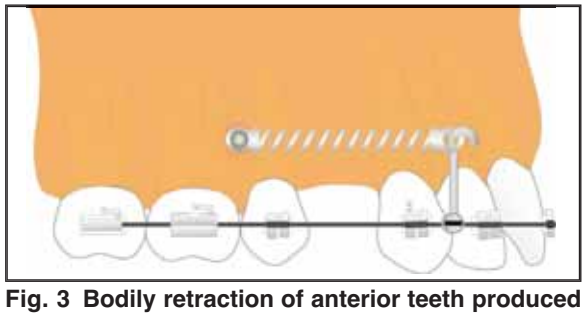

Fig. 3 Bodily retraction of anterior teeth produced by attaching power arm to miniscrew, parallel to occlusal plane.

With conventional sliding mechanics, where the line of force does not pass through the anterior center of resistance, a moment is created that causes incisor rotation (Fig. 4A). If the retraction force is applied directly between a miniscrew and the anterior teeth, the result will be a simultaneous rotation and intrusion (Fig. 4B). On the other hand, the long power arm of the adjustable traction hook applies the retraction force parallel to the occlusal plane and the center of resistance, permitting bodily movement of the anterior segment (Fig. 4C).

Case Report

A 35-year-old female presented with a Class II skeletal pattern and moderate dentoalveolar bimaxillary protusion (Fig. 5). Cephalometric analysis showed an ANB angle of 7.0°, a mandibular plane angle of 22.6°, and an occlusal plane angle of 6.8° (Fig. 6). The overjet and overbite were 4.5mm and 3mm, respectively.

After the four first premolars were extracted, leveling was initiated with .018" × .025" preadjusted appliances. Six weeks later, miniscrews

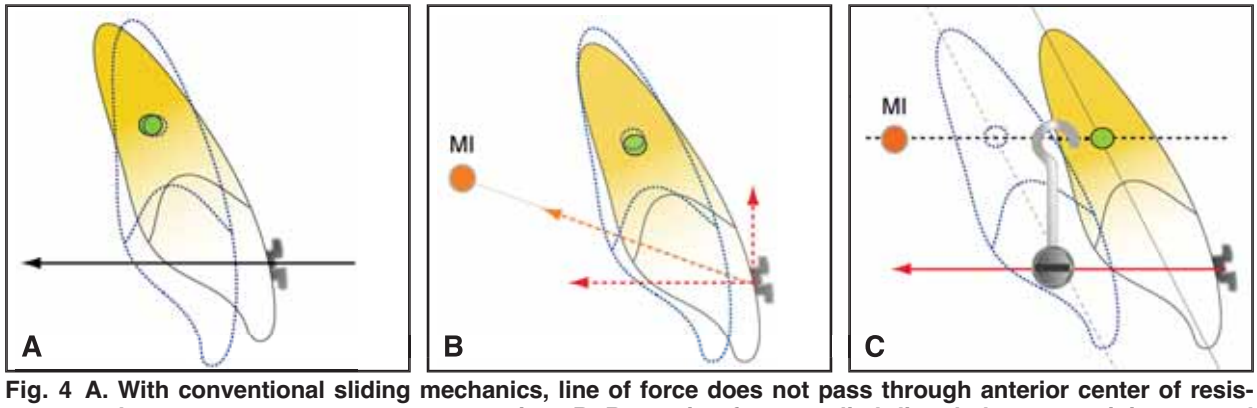

Fig. 4 A. With conventional sliding mechanics, line of force does not pass through anterior center of resistance, and consequent moment causes rotation. B. Retraction force applied directly between miniscrew and anterior teeth produces simultaneous rotation and intrusion. C. With miniscrew attached to long power arm, line of force is parallel to occlusal plane and anterior center of resistance, resulting in bodily tooth movement.

(1.6mm in diameter, 8mm long) were inserted bilaterally into the buccal alveolar bone between the maxillary first and second molars, using a 3D Surgical Guide* (Fig. 7).[10]

To relieve anterior crowding before bonding the incisors, canine retraction was performed for two months with 50g nickel titanium closed-coil springs. An .016" × .022" improved superelastic nickel titanium archwire** with adjustable traction hooks was then placed, and nickel titanium closed-coil springs were attached to the long power arms to retract the maxillary anterior teeth with 50g of force (Fig. 8). Significant profile improvement was observed during the first six months of treatment.

After 18 months of treatment, the patient showed an acceptable occlusion with a Class I

*Y&B Products, L.P., Huay Keaw Soi 3, Amphur Muang, Chiang Mai 50200, Thailand; www.yb-products.com.
**L&H Titan, TOMY, Tokyo, Japan.

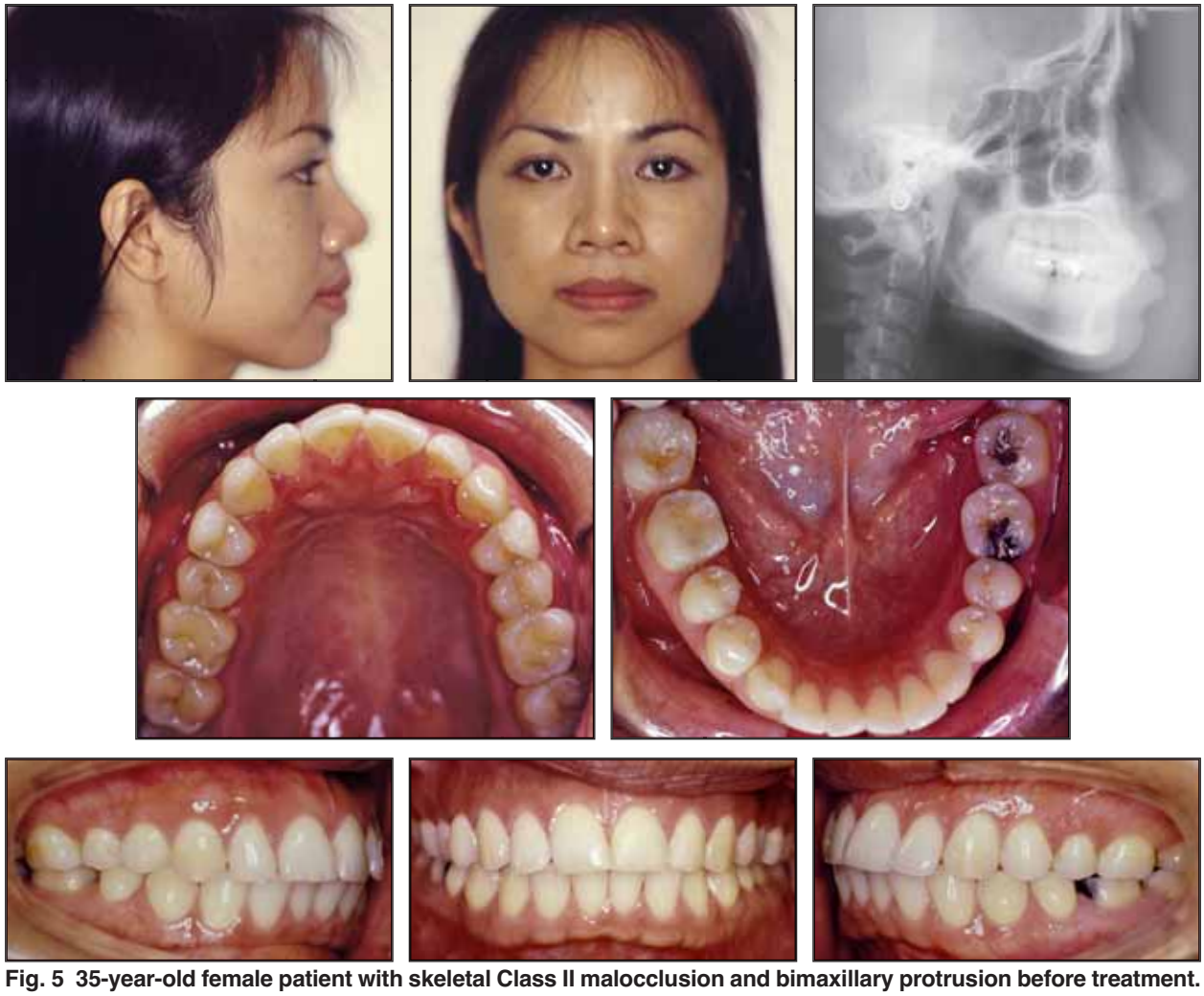

Fig. 5 35-year-old female patient with skeletal Class II malocclusion and bimaxillary protrusion before treatment.

molar relationship (Fig. 9). The profile was significantly improved, with ANB reduced to 4.3°. The proclined mandibular incisors were uprighted by 14°, and the maxillary incisors by 10.6° (Fig. 6). Cephalometric superimposition demonstrated a bodily retraction of the maxillary anterior teeth. The maxillary posterior teeth were uprighted without any significant molar movement. The mandibular molars were also uprighted, but showed a small amount of mesial movement.

Discussion

Several authors have demonstrated the use of long traction hooks for bodily movement of the anterior teeth without undesirable intrusion and tipping.[1-6] Soldering stainless steel hooks to the archwire requires chairside or laboratory equipment, can be time-consuming, and may cause annealing of the archwire.[13-16] Preposted wires overcome these disadvantages, but require a large inventory.[14] Crimpable archwire hooks are easy to place at any position on the archwire,[17] but tend to slide on stainless steel wires because of the low friction involved.[18] Moreover, excessive force during crimping can distort the archwire and introduce unwanted forces.[19]

The results we obtained by using the adjustable traction hooks with long power arms were similar to those shown by Park and colleagues in the treatment of a skeletal Class I patient with bialveolar protrusion.[20] In their report, however, long traction hooks were soldered to the arch-

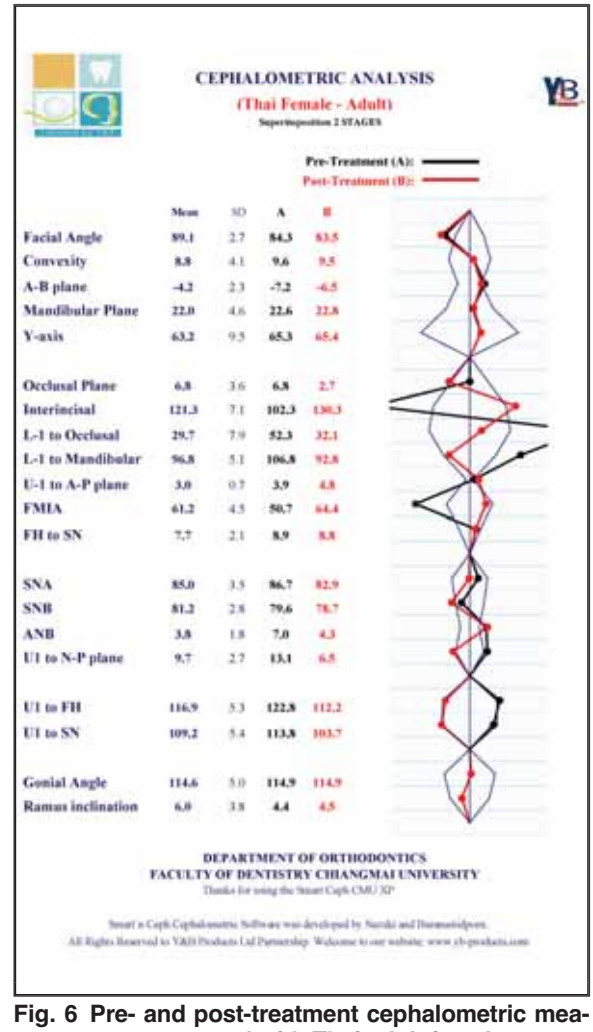

Fig. 6 Pre- and post-treatment cephalometric measurements compared with Thai adult female norms.

Fig. 7 Miniscrew inserted into buccal alveolar bone between maxillary first and second molars using 3D Surgical Guide.

Fig. 8 Adjustable traction hook with long power arm attached to maxillary .016" x .022" superelastic nickel titanium archwire; 50g of anterior retraction force applied with nickel titanium closed-coil springs connected to miniscrews.

wire. This would not have been possible in our case, where superelastic nickel titanium wires were used with relatively light retraction forces.

Conclusion

The adjustable traction hooks described in this article can be firmly clamped on either stainless steel or nickel titanium archwires with minimal patient discomfort. They offer a number of clinical advantages, including the possibility of removal from the main archwire, thus allowing it to be reused for passive retention after the anterior retraction. Therefore, these adjustable traction hooks can save costs in both time and materials.

ACKNOWLEDGMENTS: The authors acknowledge the assistance of Dr. M. Kevin O'Carroll, Professor Emeritus of the University of Mississippi School of Dentistry and Faculty Consultant at Chiang Mai University Faculty of Dentistry, in the preparation of the manuscript.

REFERENCES

1. Kyung, H.M.; Park, H.S.; Bae, S.M.; Sung, J.H.; and Kim, I.B.: Development of orthodontic micro-implants for intraoral anchorage, J. Clin. Orthod. 37:321-329, 2003.
2. Lin, J.C. and Liou, E.J.: A new bone screw for orthodontic anchorage, J. Clin. Orthod. 37:676-681, 2003.
3. Carano, A.; Velo, S.; Leone, P.; and Siciliani, G.: Clinical applications of the Miniscrew Anchorage System, J. Clin. Orthod. 39:9-24, 2005.
4. Bae, S.M.; Park, H.S.; Kyung, H.M.; Kwon, O.W.; and Sung, J.H.: Clinical application of micro-implant anchorage, J. Clin. Orthod. 36:298-302, 2002.
5. Paik, C.H.; Woo, Y.J.; and Boyd, R.L.: Treatment of an adult patient with vertical maxillary excess using miniscrew fixation, J. Clin. Orthod. 37:423-428, 2003.
6. Park, H.S.; Kwon, O.W.; and Sung, J.H.: Micro-Implant Anchorage for forced eruption of impacted canines, J. Clin. Orthod. 38:297-302, 2004.
7. Creekmore, T.D. and Eklund, M.K.: The possibility of skeletal anchorage, J. Clin. Orthod. 17:266-269, 1983.
8. Kanomi, R.: Mini-implant for orthodontic anchorage, J. Clin. Orthod. 31:763-767, 1997.
9. Costa, A.; Raffaini, M.; and Melsen, B.: Miniscrews as orthodontic anchorage: A preliminary report, Int. J. Adult Orthod. Orthog. Surg. 13:201-209, 1998.
10. Suzuki, E.Y. and Buranastidporn, B.: An adjustable surgical guide for miniscrew placement, J. Clin. Orthod. 39:588-590, 2005.
11. Hong, R.K.; Heo, J.M.; and Ha, Y.K.: Lever-arm and mini-implant system for anterior torque control during retraction in lingual orthodontic treatment, Angle Orthod. 75:129-141, 2005.
12. Vanden Bulcke, M.M.; Burstone, C.J.; Sachdeva, R.C.L.; and Dermaut, L.R.: Location of the centers of resistance for anterior teeth during retraction using the laser reflection technique, Am. J. Orthod. 91:375-384, 1987.
13. Park, Y.C.; Choy, K.C.; Lee, J.S.; and Kim, T.K.: Lever-arm mechanics in lingual orthodontics, J. Clin. Orthod. 34:601-605, 2000.
14. Johal, A.; Harper, C.R.; and Sherriff, M.: Properties of crimpable archwire hooks: A laboratory investigation, Eur. J. Orthod. 21:679-683, 1999.
15. Johal, A.; Loh, S.; and Heng, J.K.: A clinical investigation into the behaviour of crimpable archwire hooks, J. Orthod. 28:203-205, 2001.
16. Alger, D.W.: Arch marking technique for soldering intermaxillary hooks, J. Clin. Orthod. 21:538-539, 1987.
17. Evans, R.D. and Jones, M.L.: A laboratory evaluation of surgical ball hook crimping pliers, Int. J. Adult Orthod. Orthog. Surg. 6:57-60, 1991.
18. Griffin, J.T. and Ferracane, J.L.: Laboratory evaluation of adhesive crimped surgical ball hook, Int. J. Adult Orthod. Orthog. Surg. 13:169-175, 1998.
19. Nattrass, C.; Ireland, A.J.; and Sherriff, M.: An investigation into the placement of force delivery systems and the initial forces applied by clinicians during space closure, Br. J. Orthod. 24:127-131, 1997.
20. Park, H.S.; Bae, S.M.; Kyung, H.M.; and Sung, J.H.: Micro-Implant Anchorage for treatment of skeletal Class I bialveolar protrusion, J. Clin. Orthod. 35:417-422, 2001.

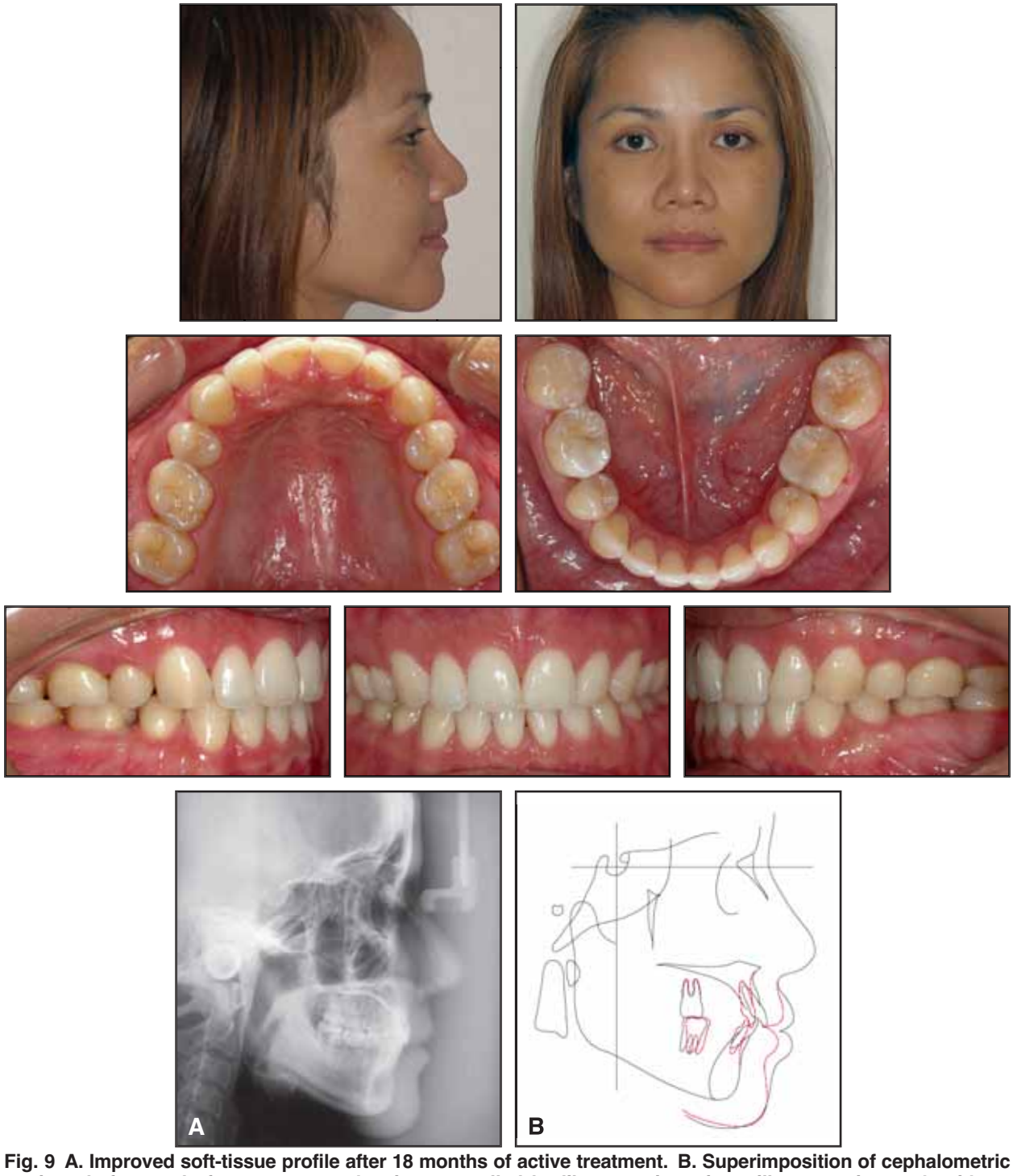

Fig. 9 A. Improved soft-tissue profile after 18 months of active treatment. B. Superimposition of cephalometric tracings before and after treatment, showing controlled bodily retraction of maxillary anterior teeth without anchorage loss.