En-Masse Retraction Using Skeletal Anchorage in the Tuberosity and Retromolar Regions

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Anchorage conservation has always been a challenge in orthodontics, especially when multiple teeth are moved simultaneously. Headgear and intermaxillary elastics have traditionally been used in such situations, despite the unpredictability of headgear, the side effects of incisor extrusion and excessive rotation of the occlusal plane from Class II or Class III elastics, and the difficulty of obtaining patient compliance.[1-3]

These drawbacks have been overcome with the advent of miniscrew anchorage, which offers the further advantages of simple placement and removal, a variety of insertion sites to achieve different angles of force, immediate loading, minimal patient discomfort, and avoidance of residual surgical defects.[4] For distalization of the entire dentition, miniscrews have been placed in sites including the buccal interdental spaces between the first and second molars or the first molar and second premolar, the midpalate, and the infrazygomatic crest.[5-11]

Although buccal miniscrew placement has frequently been advocated, inadvertent root contact during insertion or root interference during distal movement can lead to root damage or restrict tooth movement unless the screw is repositioned. Even stable miniscrews can migrate into contact with the roots of adjacent teeth.[12] From a biomechanical standpoint, a screw placed apical to the dentition may be optimal for intruding teeth, but its ability to anchor movement of the entire dentition without producing rotation of the occlusal plane is questionable. Midpalatal skeletal anchors can be used for molar distalization, but this approach is technique-sensitive, carries a risk of perforation of the nasal cavity, and cannot be used for distalization of the entire maxillary arch.[13-15] In addition, molar distalization followed by anterior retraction generally involves prolonged treatment time. Extensive surgical procedures are required for both placement and retrieval of either miniscrews placed in the infrazygomatic crest or zygoma ligatures.[16] The same is true of miniplates, which have been to shown to have an 89-92.5% success rate in providing skeletal anchorage.[17,18]

The maxillary tuberosity appears to be a biomechanically feasible location for miniscrew placement when en-masse retraction of the upper dentition is desired. Even though the bone quality in the tuberosity or the lower retromolar areas is not as ideal as in other potential sites, good results can be achieved if proper protocol is followed in terms of both miniscrew placement and biomechanics.

Case Report

An 18-year-old female presented at our clinic with the chief complaint of proclined upper incisors, protrusive lips, and spacing in the lower arch (Fig. 1). She reported having undergone orthodontic treatment with fixed appliances two years earlier, following upper and lower first premolar extractions.

Clinical examination showed a convex profile, posterior divergence, incompetent lips with incisal exposure of 5mm at rest, average nasolabial and mandibular plane angles, a deep labiomental sulcus, and a normal lower facial height. Intraoral examination revealed Class II molar and Class I canine relationships on the left side and end-on molar and canine relationships on the right side, with an overjet of 4.5mm and an overbite of 4mm. All third molars were erupted. The patient had

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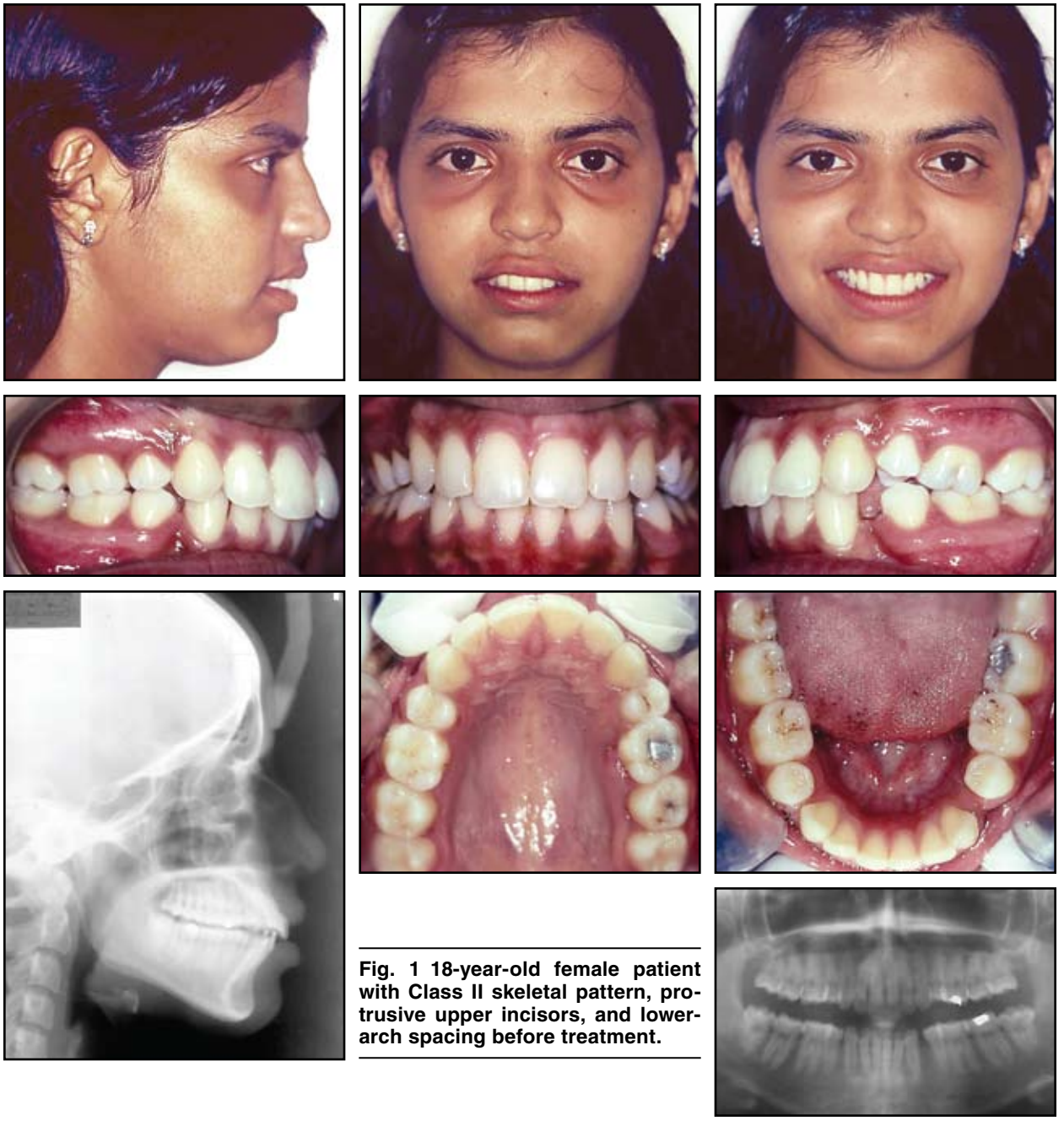

Fig. 1 18-year-old female patient with Class II skeletal pattern, protrusive upper incisors, and lower-arch spacing before treatment.

TABLE 1
CEPHALOMETRIC DATA

	Pretreatment	Post-Treatment	Difference
SNA	83.0°	81.5°	1.5°
SNB	77.0°	76.0°	1.0°
ANB	6.0°	5.5°	0.5°
SN-GoMe	32.0°	32.5°	0.5°
U1-SN	110.0°	100.0°	10.0°
IMPA	102.0°	98.0°	4.0°
Wits appraisal	2.0mm	1.0mm	1.0mm
Upper lip to E-line	–1.5mm	–4.5mm	3.0mm
Lower lip to E-line	4.0mm	0.0mm	4.0mm
Nasolabial angle	92.0°	100.0°	8.0°

mesially tipped upper posterior teeth and proclined upper and lower incisors, with residual extraction spaces of 3mm in the lower left quadrant and 1mm in the lower right quadrant. There were no signs of TMJ problems. Cephalometric analysis indicated a Class II skeletal pattern (Table 1).

The treatment objectives were to reduce the lip protrusion and improve the soft-tissue esthetics, establish Class I molar and canine relationships, upright the mesially tipped upper premolars and molars, and close the residual extraction spaces in the lower arch. These objectives could be achieved by retracting the upper and lower anterior teeth, using one of three options. The first was to extract the upper and lower first molars, but the disadvantage of this plan was that the first molar plays an important role in mastication. The second option was to extract all four second molars; in this case, however, the positions of the third molars were unfavorable. The third option was to extract all the third molars and retract the entire maxillary and mandibular dentition into the extraction spaces, using miniscrew anchorage.[19] We recommended this treatment plan, and the patient accepted.

Roth-prescription .022" brackets were bonded in both arches. After two months of leveling and alignment, the four third molars were extracted. Four months later, titanium miniscrews (Absoanchor,* 1.4mm diameter × 10mm) were inserted into the third-molar extraction spaces in the maxillary tuberosity and mandibular retromolar areas, as advocated by Sung and colleagues.[16] The screws were placed about 6mm apical to the crest of the alveolar bone, so that their lines of force passed through the centers of resistance of the first and second molars. Retraction was initiated immediately using nickel titanium closed-coil springs** (12mm, 200g) on both sides of the upper and lower arches, extending from the miniscrew to a retraction hook soldered distal to the canine in each quadrant (Fig. 2). Similar forces applied in this manner have been shown to be adequate for en-masse movement of the maxillary or mandibular arches.[6,9,20]

Retraction of the entire maxillary and mandibular dentition was completed in 12 months, for a total treatment time of 20 months (Fig. 3). Post-treatment facial photographs showed a remarkable improvement in the lip profile and facial esthetics resulting from the retraction of the anterior teeth. Class I molar and canine relationships were established, with a 2mm overjet and a 3mm overbite. Cephalometric superimposition showed that the maxillary molars were distalized about 5mm at the crown level and 3mm at the apex level; the maxillary incisors were retracted 6mm, and the mandibular incisors 4mm. The upper lip moved backward about 3mm, and the lower lip about 4mm, with both in the normal range relative to the

*Part No. SH 14-10, Dentos Co. Ltd, Galsan-Dong, Dalseo-Gu, Daegu, 704-900, Korea; www.dentos.kr. Absoanchor is a registered trademark.

**Dentsply GAC International, Inc., 355 Knickerbocker Ave., Bohemia, NY 11716; www.gacintl.com.

E-line (Table 1). The interlabial gap and incisal display at rest were eliminated. Appropriate nasolabial, labiomental sulcus, and interincisal angles were achieved.

Discussion

Miniscrews were placed in this patient four months after extraction of the third molars, coinciding with the end of the leveling and alignment phase. It takes about four months for an extraction socket to remodel enough to become viable for placement of a miniscrew. Placing a screw too soon will lead to instability due to inadequate bone support.[21] According to Chen and colleagues, the critical factors for success of orthodontic miniscrews are initial mechanical stability and bone quality and quantity.[22] Crismani and colleagues observed that placing a miniscrew without loading it immediately could also cause instability.[23] In this patient, miniscrews were placed only when the arches were completely level and there was no chance of binding, which could have created undesirable friction during retraction.

Sung and colleagues recommend using a relatively long miniscrew with a diameter of 1.3-1.5mm in areas with a predominance of cancellous bone and low bone density,[5] such as the maxillary tuberosity.[24] Lee and Baek reported that orthodontic miniscrews with a diameter of 1.5mm or more can cause greater microdamage to the cortical bone, with a negative effect on bone remodeling and miniscrew stability.[25] Therefore, we chose a miniscrew with a diameter of 1.4mm and a length of 10mm. We did not encounter any failures or fractures during placement or removal.

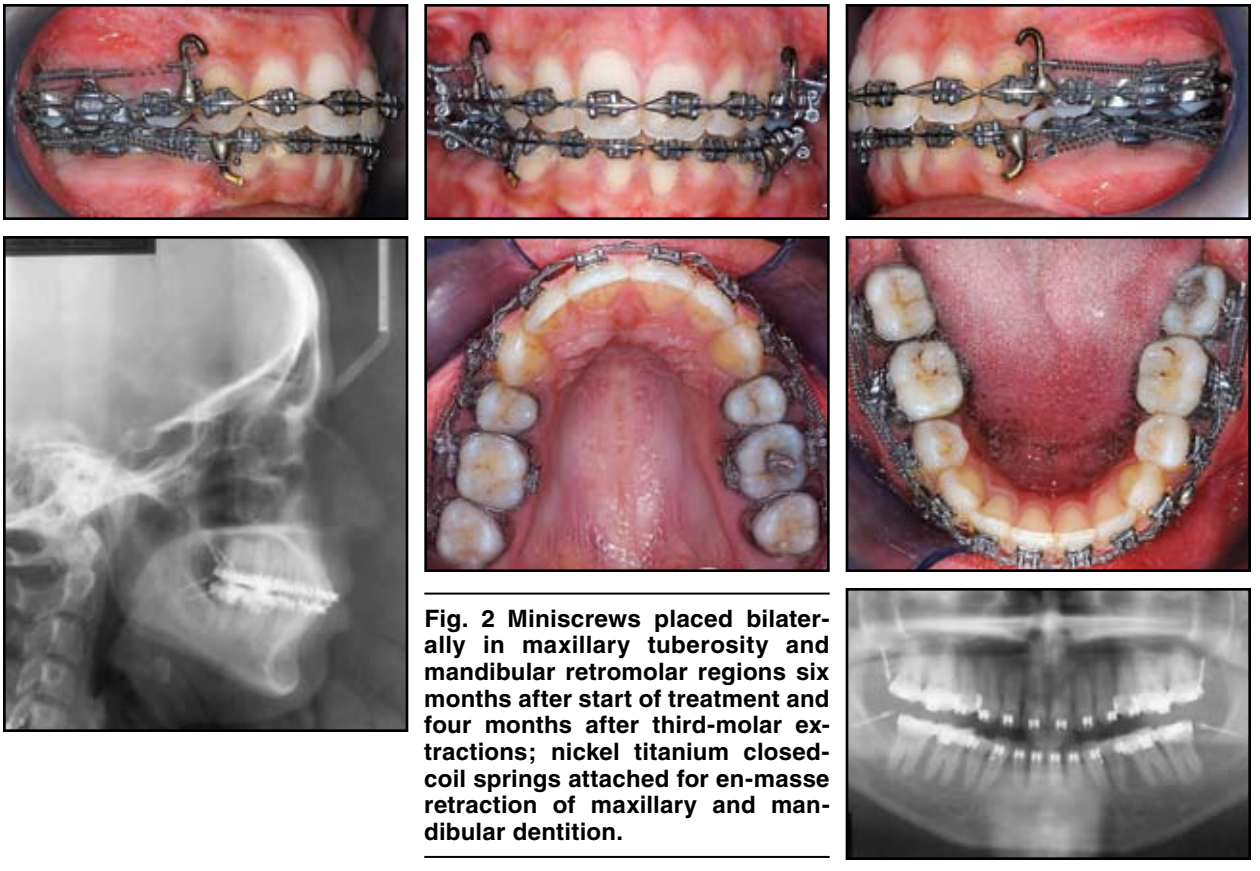

Fig. 2 Miniscrews placed bilaterally in maxillary tuberosity and mandibular retromolar regions six months after start of treatment and four months after third-molar extractions; nickel titanium closed-coil springs attached for en-masse retraction of maxillary and mandibular dentition.

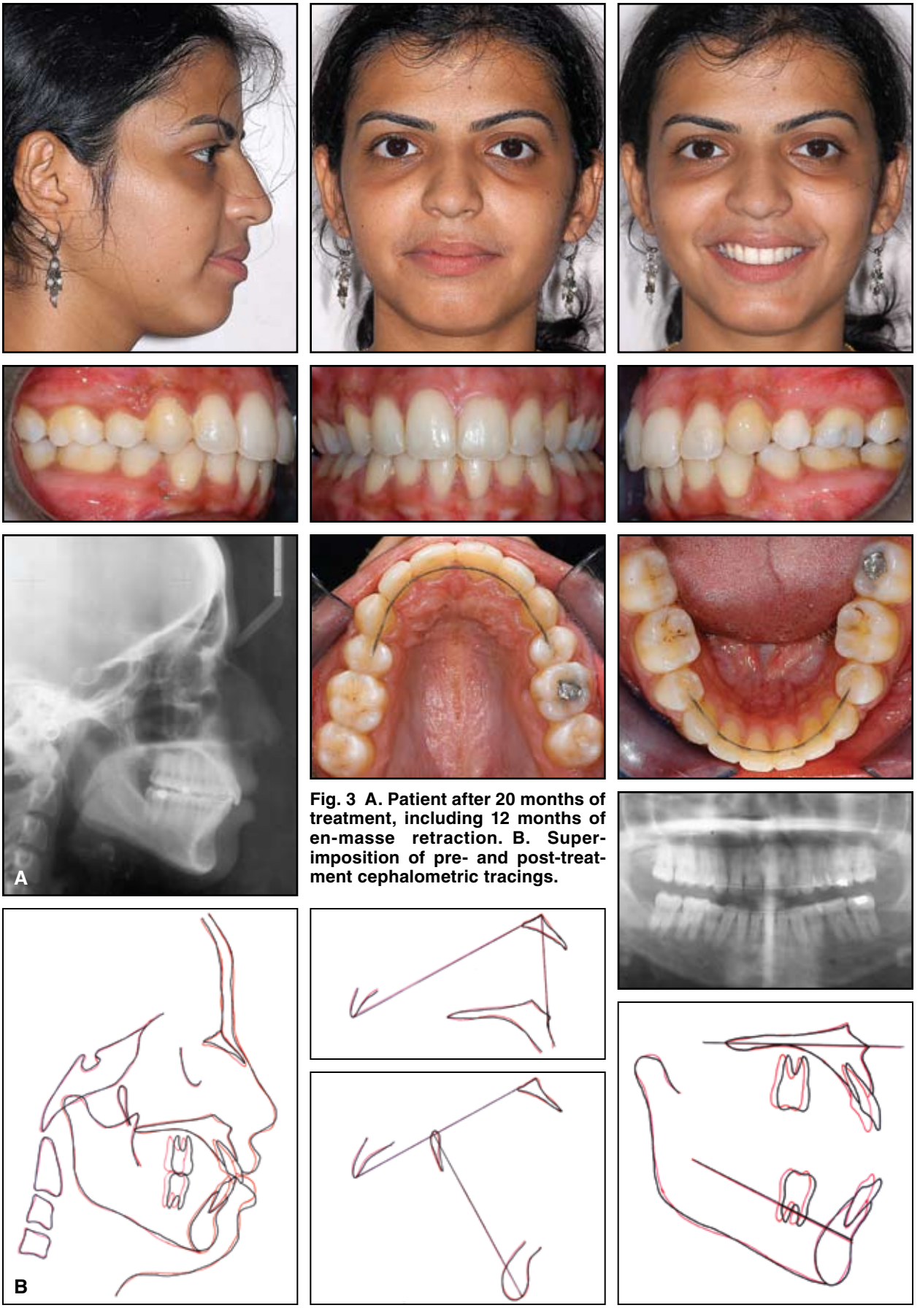

Fig. 3 A. Patient after 20 months of treatment, including 12 months of en-masse retraction. B. Superimposition of pre- and post-treatment cephalometric tracings.

It took only 12 months to achieve a Class I molar relationship, indicating that the force system and mechanics used in this patient were efficient—particularly since the maxillary molars were mesially tipped at the beginning of treatment.

Conclusion

Lim and colleagues recommend that any treatment plan involving anchorage from miniscrews should consider the possibility of failure, since their initial stability cannot be guaranteed or predicted.[26] Although miniscrews placed in the tuberosity and retromolar areas show comparatively high failure rates, they can provide stable and mechanically advantageous anchorage for upper and lower en-masse distalization as long as careful attention is paid to case selection and proper biomechanics.

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REFERENCES

1. Egolf, R.D.; BeGole, E.A.; and Upshaw, H.S.: Factors associated with orthodontic patient compliance with intraoral elastic and headgear wear, Am. J. Orthod. 97:336-348, 1990.
2. Brandão, M.; Pinho, H.S.; and Urias, D.: Clinical and quantitative assessment of headgear compliance: A pilot study, Am. J. Orthod. 129:239-244, 2006.
3. Ellen, E.K.; Schneider, B.J.; and Sellke, T.: A comparative study of anchorage in bioprogressive versus standard edgewise treatment in Class II correction with intermaxillary elastic force, Am. J. Orthod. 113:430-436, 1998.
4. Costa, A.; Raffaini, M.; and Melsen, B.: Miniscrews as orthodontic anchorage: A preliminary report, Int. J. Adult Orthod. Orthog. Surg. 13:201-209, 1998.
5. Sung, J.H.; Kyung, H.M.; Bae, S.M.; Park, H.S.; Kwon, O.W.; and McNamara, J.A. Jr.: *Microimplants in Orthodontics*, Dentos, Daegu, Korea, 2006, p. 70.
6. Park, H.S.; Kwon, T.G.; and Sung, J.H.: Nonextraction treatment with microscrew implants, Angle Orthod. 74:539-549, 2004.
7. Chung, K.R.; Kim, S.H.; and Kook, Y.A.: C-Orthodontic microimplant for distalization of mandibular dentition in Class III correction, Angle Orthod. 75:119-128, 2005.
8. Chung, K.R.; Kim, S.H.; Choo, H.R.; Kook, Y.A.; and Cope, J.B.: Distalization of the mandibular dentition with miniimplants to correct a Class III malocclusion with a midline deviation, Am. J. Orthod. 137:135-146, 2010.
9. Park, H.S.; Lee, S.K.; and Kwon, O.W.: Group distal movement of teeth using microscrew implant anchorage, Angle Orthod. 75:602-609, 2005.
10. De Clerck, H.J. and Cornelis, M.A.: Biomechanics of skeletal anchorage, Part 2: Class II nonextraction treatment, J. Clin. Orthod. 40:290-298, 2006.
11. Paik, C.H.; Nagasaka, S.; and Hirashita, A.: Class III nonextraction treatment with miniscrew anchorage, J. Clin. Orthod. 40:480-485, 2006.
12. Liou, E.J.; Pai, B.C.; and Lin, J.C.: Do miniscrews remain stationary under orthodontic forces? Am. J. Orthod. 126:42-47, 2004.
13. Kang, S.; Lee, S.J.; Ahn, S.J.; Heo, M.S.; and Kim, T.W.: Bone thickness of the palate for orthodontic mini-implant anchorage in adults, Am. J. Orthod. 131(4 suppl):S74-S81, 2007.
14. Ardekian, L.; Oved-Peleg, E.; Mactei, E.E.; and Peled, M.: The clinical significance of sinus membrane perforation during augmentation of the maxillary sinus, J. Oral Maxillofac. Surg. 64:277-282, 2006.
15. Branemark, A.M.; Adell, R.; Albrektsson, T.; Lekholm, U.; Lindstrom, J.; and Rockler, B.: An experimental and clinical study of osseointegrated implants penetrating the nasal cavity and maxillary sinus, J. Oral Maxillofac. Surg. 42:497-505, 1984.
16. Sung, J.H.; Kyung, H.M.; Bae, S.M.; Park, H.S.; Kwon, O.W.; and McNamara, J.A. Jr.: Selection of microimplants sites and sizes, in *Microimplants in Orthodontics*, Dentos, Daegu, Korea, 2006, p. 16.
17. Cheng, S.J.; Tseng, I.Y.; Lee, J.J.; and Kok, S.H.: A prospective study of the risk factors associated with failure of miniimplants used for orthodontic anchorage, Int. J. Oral Maxillofac. Impl. 19:100-106, 2004.
18. Cornelis, M.A.; Scheffler, N.R.; Nyssen-Behets, C.; De Clerck, H.J.; and Tulloch, C.J.F.: Patients' and orthodontists' perceptions of miniplates used for temporary skeletal anchorage: A prospective study, Am. J. Orthod. 133:18-24, 2008.
19. Sung, J.H.; Kyung, H.M.; Bae, S.M.; Park, H.S.; Kwon, O.W.; and McNamara, J.A. Jr.: Biomechanical considerations in microimplant anchorage, in *Microimplants in Orthodontics*, Dentos, Daegu, Korea, 2006, p. 63.
20. Jeon, J.M.; Yu, H.S.; Baik, H.S.; and Lee, J.S.: En-masse distalization with miniscrew anchorage in Class II nonextraction treatment, J. Clin. Orthod. 40:472-476, 2006.
21. Darby, I.; Chen, S.; and De Poi, R.: Ridge preservation: What is it and when should it be considered, Austral. Dent. J. 53:11-21, 2008.
22. Chen, Y.; Kyung, H.M.; Zhao, W.T.; and Yu, W.J.: Critical factors for the success of orthodontic mini-implants: A systematic review, Am. J. Orthod. 135:284-291, 2009.
23. Crismani, A.G.; Bertl, M.H.; Celar, A.G.; Bantleon, H.P.; and Burstone, C.J.: Miniscrews in orthodontic treatment: Review and analysis of published clinical trials, Am. J. Orthod. 137:108-113, 2010.
24. Park, H.S.; Lee, Y.J.; Jeong, S.H.; and Kwon, T.G.: Density of the alveolar and basal cones of the maxilla and the mandible, Am. J. Orthod. 133:30-37, 2008.
25. Lee, N.K. and Baek, S.H.: Effects of the diameter and shape of orthodontic mini-implants on microdamage to the cortical bone, Am. J. Orthod. 138:8.e1-8.e8, 2010.
26. Lim, H.J.; Eun, C.S.; Cho, J.H.; Lee, K.H.; and Hwang, H.S.: Factors associated with initial stability of miniscrews for orthodontic anchorage, Am. J. Orthod. 136:236-242, 2010.