

Treatment of Skeletal-Origin Gummy Smiles with Miniscrew Anchorage

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Excessive gingival display during smiling, or a “gummy smile”, may result from a variety of etiological factors. Proper diagnosis is critical before beginning treatment.¹⁻¹⁰ In adult patients, when the condition has a skeletal origin such as anterior vertical maxillary excess, surgical-orthodontic treatment is often the best approach.¹¹⁻¹⁴ Because of the risks, costs, discomfort, and psychological impact of surgery, however, the orthodontist sometimes needs alternative treatment methods.

Orthodontic treatment with miniscrew skeletal anchorage has become increasingly popular,¹⁵⁻²¹ and temporary anchorage devices (TADs) have been successfully used to reduce vertical maxillary excess.²² The present article describes the treatment of skeletal-origin gummy smiles using a combination of miniscrew anchorage and periodontal crown lengthening in two adult patients and miniscrew anchorage alone in an adolescent patient.

Case 1

A 26-year-old female presented with the chief complaint of a gummy smile (Fig. 1). Initial evaluation revealed excessive gingival display in smiling due to vertical maxillary excess, a convex profile, an acute nasolabial angle, a retrognathic chin, a short upper lip, and lip incompetence. The patient had multiple missing teeth and a skeletal Class II malocclusion, with 11mm of overjet and 4mm of overbite.

Two treatment options were discussed with the patient. The first was traditional orthodontic treatment combined with Le Fort I surgery to reduce the maxillary height, which would in turn reduce the gingival exposure. The second was orthodontic intrusion of the maxillary arch using miniscrew skeletal anchorage. After a review of the risks and benefits of the two options, the patient chose the more conservative method.

Fixed preadjusted appliances were placed to



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begin leveling and alignment of the dentition. After five months of treatment, two LOMAS Quattro* miniscrews^{17,19} (2mm in diameter, 7mm in length) were inserted into the alveolar ridge bilaterally, and another two LOMAS Quattro miniscrews (1.5mm in diameter, 9mm in length) were placed in the alveolar bone above the root apices, between the upper lateral incisors and canines. Immediately after miniscrew insertion, 200g of retraction force was applied using standard

elastic power chain from each posterior miniscrew to hooks on the upper archwire. In addition, 50g of intrusive force was applied from each anterior miniscrew to the archwire (Fig. 2). The goal was en masse intrusion and retraction of the maxillary dentition to correct the Class II malocclusion and improve the smile line.

After 10 months of miniscrew treatment, the

*Mondeal North America, Inc., P.O. Box 500521, San Diego, CA 92150; www.mondeal.us.

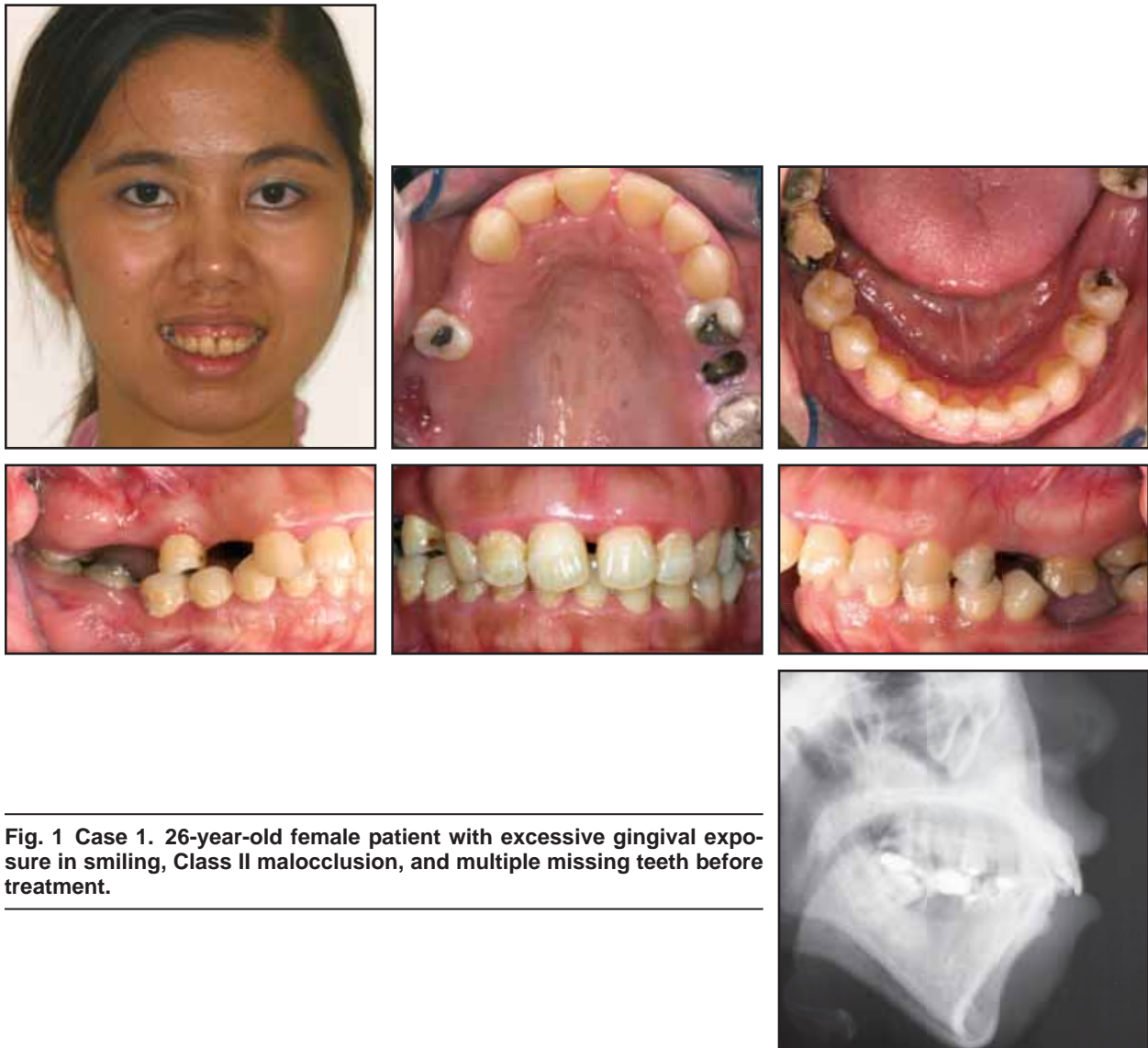


Fig. 1 Case 1. 26-year-old female patient with excessive gingival exposure in smiling, Class II malocclusion, and multiple missing teeth before treatment.



Fig. 2 Case 1. A. Intrusion and retraction biomechanics used in upper anterior segment with direct miniscrew anchorage. B. LOMAS miniscrews inserted after five months of treatment, with power chain from miniscrews to hooks on upper archwire.



Fig. 3 Case 1. Progress of gummy smile correction. A. After five months. B. After 10 months. C. After 15 months.

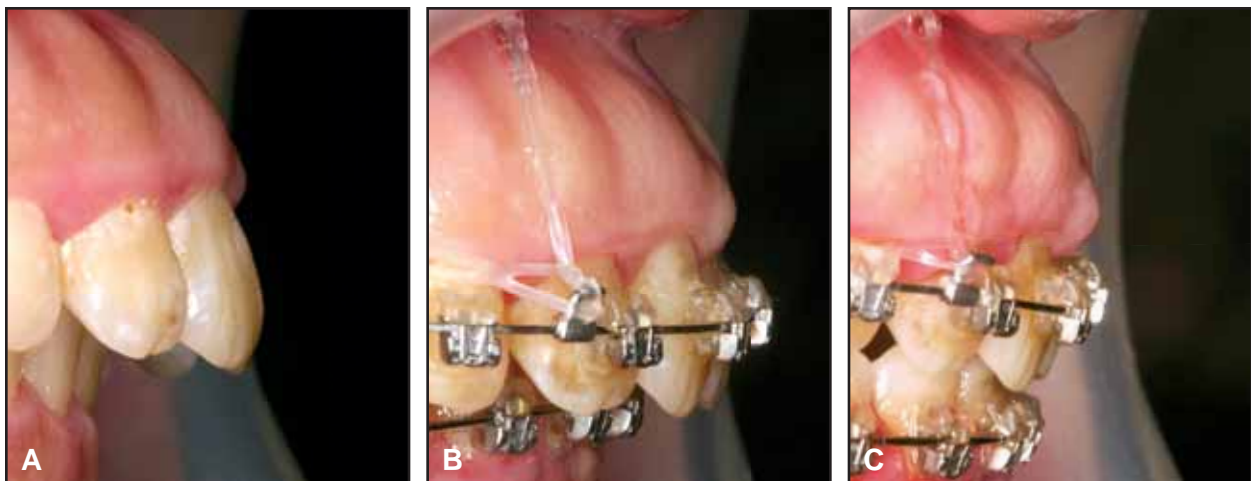


Fig. 4 Case 1. Progress of overjet and overbite correction. A. Before treatment. B. After five months. C. After 15 months (upper anterior teeth were adequately intruded and retracted after 10 months).

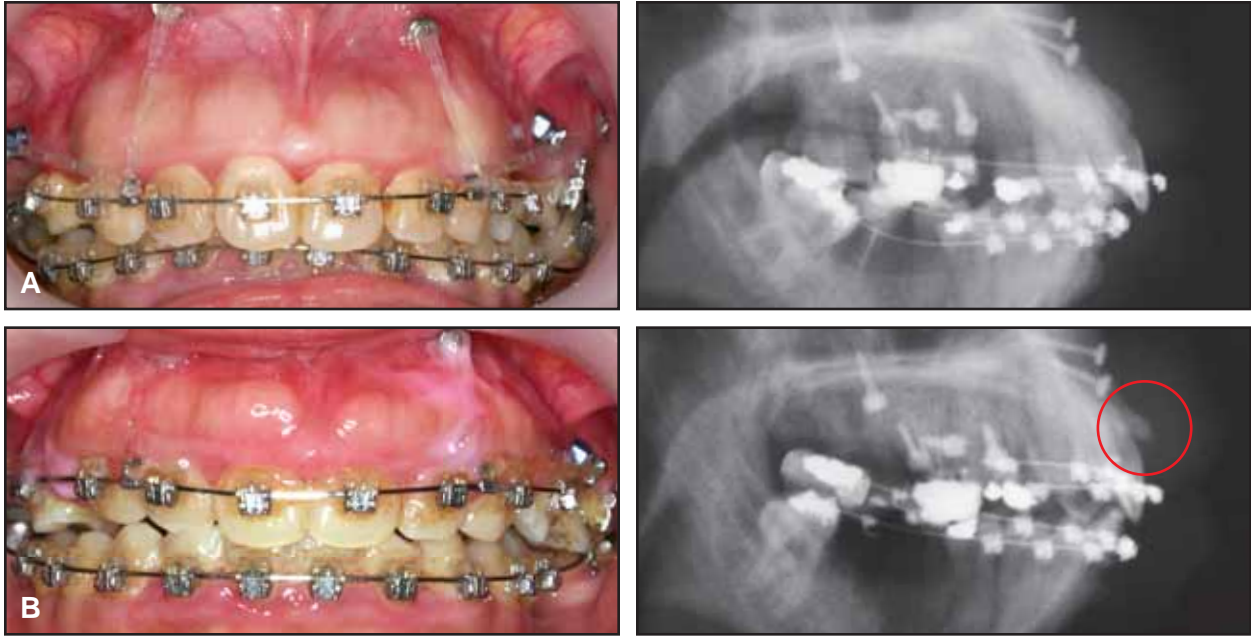


Fig. 5 Case 1. Progress of intrusion and retraction of upper anterior teeth. A. After five months. B. After 15 months. Note reduced clinical crown height of upper anterior teeth and protuberance of alveolar bone near gingival margin.

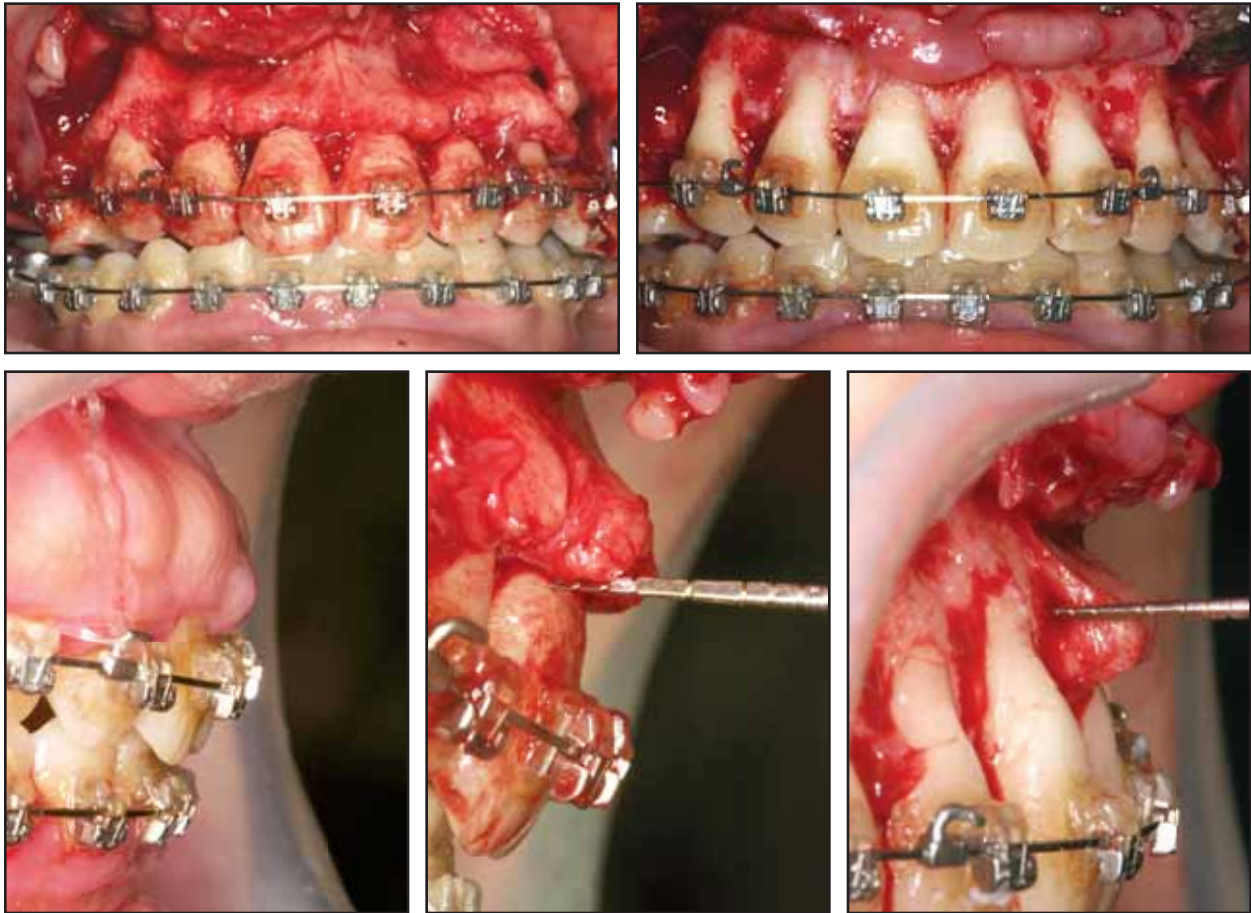


Fig. 6 Case 1. Crown-lengthening procedure performed to eliminate excess alveolar bone and recover pre-treatment clinical crown height.



Fig. 7 Case 1. A. Significant improvement in smile line, correction of malocclusion, and achievement of normal overjet and overbite after 20 months of treatment. **B.** Superimposition of pre- and post-treatment cephalometric tracings, showing significant upper incisor intrusion and retraction.

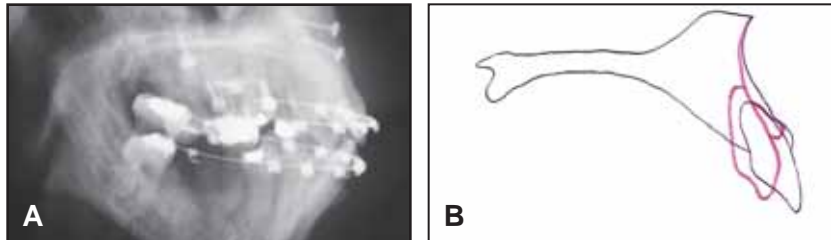


Fig. 8 Case 1. Post-treatment periapical radiographs, showing only minor root resorption of upper incisor apices.

patient's gummy smile and overjet were almost fully corrected (Figs. 3,4). An unintended side effect was a reduction in the clinical crown height of the upper anterior teeth as the teeth were intruded. In addition, a protuberance of alveolar bone near the gingival margin was noted (Fig. 5). Because of the possibility of these effects, continuous intrusive forces should be used only in patients with healthy periodontal tissue.²³ In this case, an esthetic crown-lengthening procedure was performed to eliminate the excess alveolar bone and recover the pretreatment clinical crown height (Fig. 6). At the same time, the gingival margins of

the upper anterior teeth in the patient's smile line were coordinated with the lower border of the upper lip.

Post-treatment records showed a dramatic improvement in the smile compared with the pre-treatment records (Fig. 7). Superimpositions of cephalometric tracings made before and after treatment showed significant retraction and intrusion of the maxillary teeth. Post-treatment periapical radiographs indicated only minor root resorption of the upper incisor apices (Fig. 8). The total treatment time was 20 months.



Fig. 9 Case 2. 22-year-old female patient with protrusive profile and excessive gingival display before treatment.

Case 2

A 22-year-old female presented with the chief complaint of excessive gingival display and a protrusive profile (Fig. 9). Initial evaluation revealed a severe gummy smile, a convex lateral profile, an acute nasolabial angle, a retrognathic chin, a short upper lip, and lip incompetence. The patient had Class I canine and molar relationships with normal overbite and overjet. Cephalometric

analysis indicated a skeletal Class II and dental Class I malocclusion with vertical maxillary excess. As in Case 1, the surgical and nonsurgical treatment options were presented to the patient, who also chose the nonsurgical approach.

All four first premolars were extracted to provide space to resolve the dental crowding and to permit retraction of the anterior dentition, reducing the bimaxillary protrusion. Full fixed appliances were placed to begin leveling and alignment.

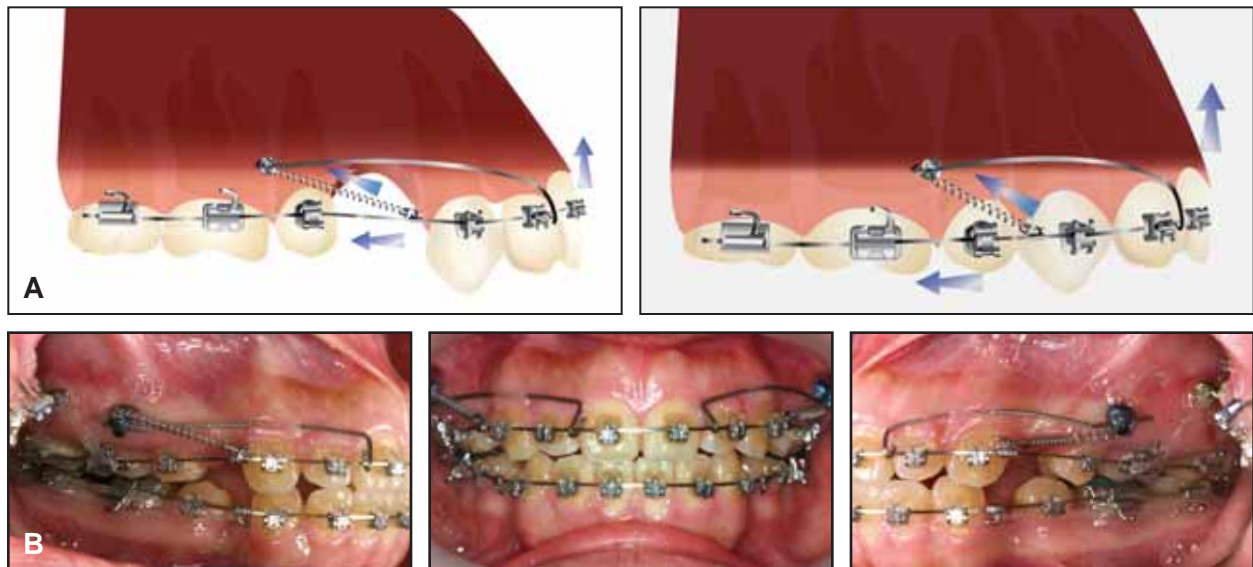


Fig. 10 Case 2. A. Intrusion and retraction biomechanics used in upper anterior segment with indirect miniscrew anchorage. B. LOMAS Quattro miniscrews, intrusion lever arms, and superelastic closed-coil springs in place after four months of treatment.

Fig. 11 Case 2. Reduced clinical crown height of upper anterior teeth and irregular bony tori after treatment. Infrazygomatic miniscrews were also used to intrude maxillary molars.



Four months later, two LOMAS Quattro miniscrews (2mm in diameter, 9mm in length) were inserted between the roots of the maxillary second premolars and first molars. This is one of the most common locations for TAD placement because of the amount of interradicular bone typically available.

The miniscrews were immediately loaded, and intrusion lever arms, fabricated from sections of .017" × .025" TMA** wire, were inserted into the rectangular edgewise tubes on the miniscrew

heads. The intrusion arms were then hooked onto the base archwire, and an intrusive force of 50g was applied bilaterally (Fig. 10). Superelastic closed-coil springs were placed from the miniscrews to hooks on the base archwire to produce 200g of retraction force per side.

Eleven months later, the gummy smile was dramatically improved, and the anterior teeth had been retracted to the desired overbite/overjet rela-

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Fig. 12 Case 2. Crown-lengthening procedure performed to eliminate excess alveolar bone and recover pre-treatment clinical crown height.



Fig. 13 Case 2. A. Significant improvement in profile and gummy smile after 24 months of treatment. B. Superimposition of pre- and post-treatment cephalometric tracings, showing significant retraction and intrusion of maxillary anterior teeth.

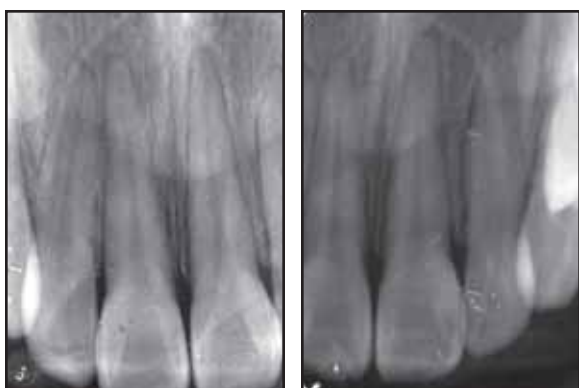


Fig. 14 Case 2. Post-treatment periapical radiographs, showing no significant root resorption.

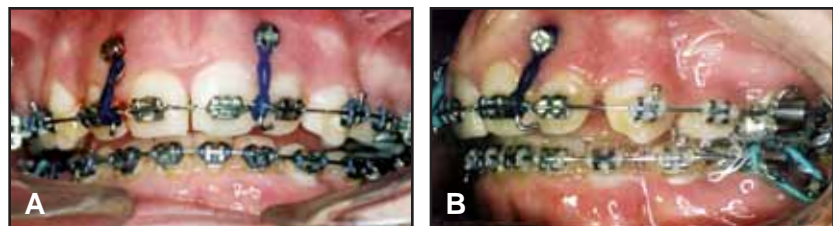
tionship. As in Case 1, the clinical crown height of the upper anterior teeth was unintentionally reduced, and some irregular bony tori were noted (Fig. 11). A crown-lengthening procedure was performed to correct these conditions (Fig. 12).

Post-treatment records showed a significant improvement in the gummy smile and protrusive profile—the patient’s initial chief complaints (Fig. 13). Superimposition of pre- and post-treatment cephalometric tracings revealed significant retraction and intrusion of the maxillary anterior teeth. Post-treatment periapical radiographs showed no significant root resorption (Fig. 14). The total treatment time was 24 months.



Fig. 15 Case 3. 12-year-old female patient with Class II malocclusion and vertical maxillary excess, complicated by vertical facial growth pattern, at time of transfer for continuation of treatment (adhesive dots on intraoral photographs show proposed miniscrew placement sites).

Fig. 16 Case 3. A. Miniscrews inserted between maxillary central and lateral incisors as direct anchorage for intrusion of anterior teeth. B. Miniscrews inserted between mandibular first and second molars as direct anchorage for intrusion of posterior teeth.



Case 3

A 12-year-old female transfer patient presented for the continuation of comprehensive extraction treatment of her Class II malocclusion (Fig. 15). Significant vertical maxillary excess, lip strain, deep overbite, and lingual tipping of the maxillary incisors, complicated by a vertical facial growth pattern, were still unresolved. To reduce the amount of gingival display, LOMAS Quattro

miniscrews were inserted between the maxillary central and lateral incisors as direct anchorage for intrusion of the anterior teeth (Fig. 16A). To maintain the mandibular plane angle and avoid the adverse effects of intermaxillary elastics on the occlusal plane, miniscrews were also inserted between the mandibular first and second molars as direct anchorage for intrusion of the posterior teeth (Fig. 16B). Transpalatal and lingual arches were placed to counteract buccal crown tipping

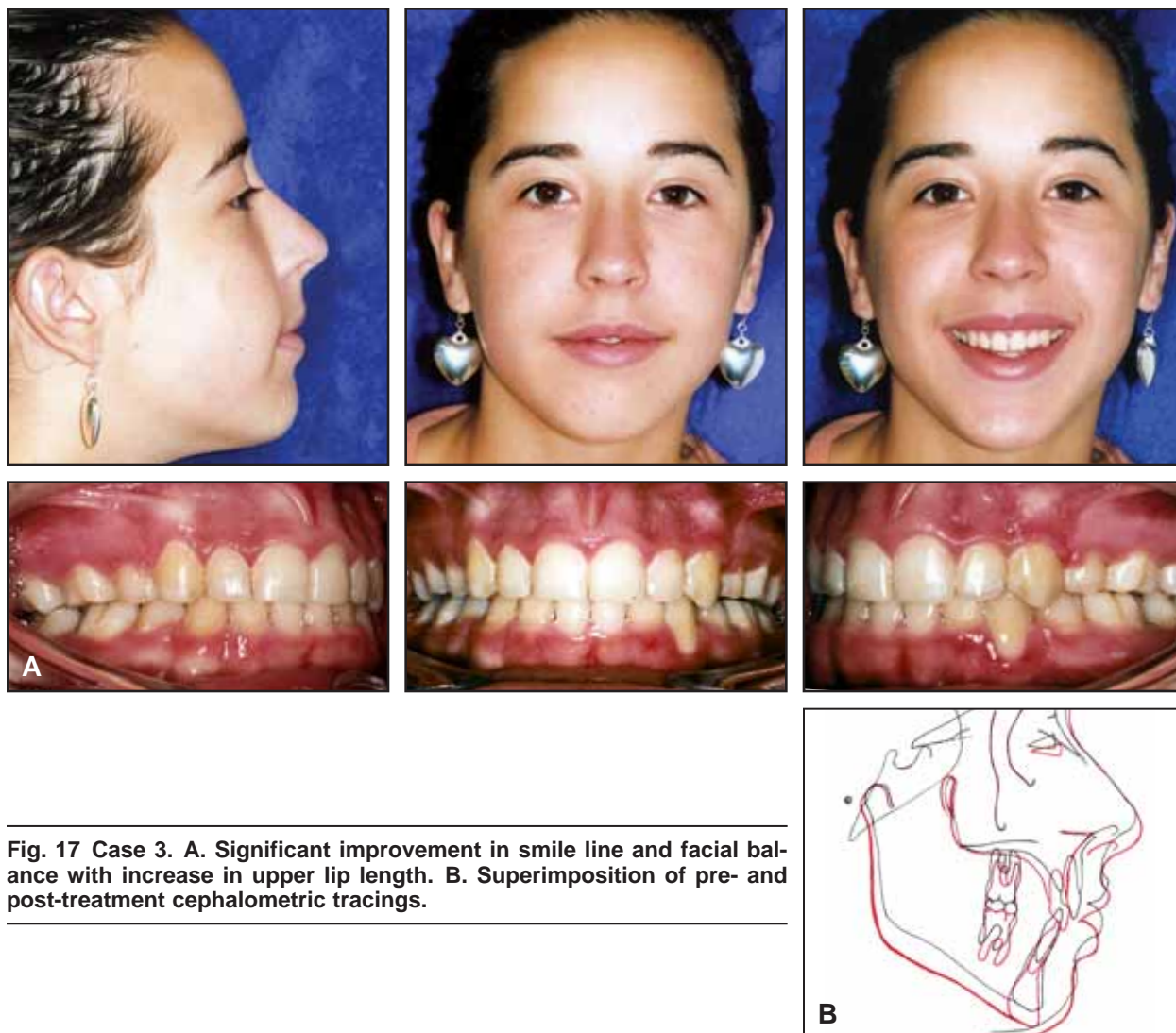


Fig. 17 Case 3. A. Significant improvement in smile line and facial balance with increase in upper lip length. B. Superimposition of pre- and post-treatment cephalometric tracings.

toward the TADs. Because of concerns about patient compliance with oral hygiene, fluoride varnish*** was applied every four months to reduce the potential for demineralization scars.^{24,25}

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††Glenroe Technologies, 1912 44th Ave. E., Bradenton, FL 34203; www.glenroe.com.

Class II elastics, sliding mechanics for space closure, and management of anterior torque progressed over 22 months. Treatment was completed with a custom positioner†²⁶ worn 24 hours a day for one week, followed by Duralight†† overlay retainers. Significant improvement was noted in the smile line and facial balance, with an increase in upper lip drape (Fig. 17). Despite substantial vertical facial growth, the mandibular plane angle was maintained.



Fig. 18 Rectangular slot and edgewise tube on head of LOMAS Quattro miniscrew permit insertion of rectangular archwire for indirect anchorage with simultaneous attachment of elastic chain or superelastic closed-coil springs.

Discussion

In cases involving the correction of excessive gingival display, orthodontic treatment requires more overall time than orthognathic surgery, but is more conservative. Potential risks of jaw surgery include excessive hemorrhaging, infection, loss of tooth vitality, and periodontal loss, as well as the risks inherent to anesthesia. The decisions of the adult patients shown here to pursue nonsurgical treatment were also based on their nasal profiles, since Le Fort I impaction procedures tend to increase nasal alar width. Although both adults underwent periodontal crown lengthening, the risks associated with these procedures are much lower than those of orthognathic surgery. Patients who need less intrusion or have adequate clinical crown heights after orthodontic treatment may not require crown lengthening or may benefit from limited soft-tissue procedures with a diode laser.

Patients 1 and 3 had sufficient interradiacal space for safe miniscrew placement between the roots of the maxillary anterior and posterior teeth for direct anchorage force application. If that space is inadequate or if miniscrews placed in the anterior alveolus might irritate the lip or buccal mucosa, then the miniscrews may be placed between the second premolar and first molar roots for indirect anchorage application, as in Case 2. The LOMAS Quattro miniscrew has a head with a rectangular slot and an edgewise tube (.018" × .025" or .022" × .028") that permits the insertion of rectangular wire segments for indirect anchorage while simultaneously allowing the direct attachment of elastic chain or superelastic closed-coil springs (Fig. 18).

Following the example of Creekmore and Eklund,²⁷ Ohnishi and colleagues²⁸ recently pro-

posed the placement of a single miniscrew between the roots of the maxillary incisors, providing direct anchorage for incisor intrusion to reduce excessive gingival display. They described a patient with a straight profile, a Class II, division 2 malocclusion, and a deep overbite. In such a case, the gummy smile is often primarily dental in origin rather than skeletal, and the treatment mechanics described in this article may not be advisable. Careful diagnosis and treatment planning are always required.

Although miniscrew-based correction of gummy smiles is generally rapid and efficient, Hsu and Liou reported a 30% relapse rate for upper incisor intrusion 14 months after treatment.²⁹ Therefore, each case should be carefully evaluated to determine the need for overcorrection in anticipation of relapse.

Conclusion

Treatment of excessive gingival display using miniscrew anchorage, with or without periodontal crown lengthening, has the following advantages over orthodontic treatment combined with orthognathic surgery:

- Fewer risks
- Simpler orthodontic biomechanics
- Less patient discomfort
- Increased cost-effectiveness
- No increase in alar base width

Miniscrew anchorage represents a paradigm shift in orthodontic biomechanics, enabling more predictable, effective, and efficient tooth movement.³⁰ Use of miniscrew anchorage for maxillary intrusion is a viable alternative to orthognathic surgery for some patients who present with the chief complaint of a gummy smile.

REFERENCES

1. Peck, S.; Peck, L.; and Kataja, M.: Some vertical lineaments of lip position, *Am. J. Orthod.* 101:519-524, 1992.
2. Peck, S.; Peck, L.; and Kataja, M.: The gingival smile line, *Angle Orthod.* 62:91-100, 1992.
3. Hunt, O.; Johnston, C.; Hepper, P.; Burden, D.; and Stevenson, M.: The influence of maxillary gingival exposure on dental attractiveness ratings, *Eur. J. Orthod.* 24:199-204, 2002.
4. Ackerman, M.B. and Ackerman, J.L.: Smile analysis and design in the digital era, *J. Clin. Orthod.* 36:221-236, 2002.
5. Garber, D.A. and Salama, M.A.: The aesthetic smile: Diagnosis and treatment, *Periodontol.* 2000 11:18-28, 1996.
6. Zachrisson, B.U.: Esthetic factors involved in anterior tooth display and the smile: Vertical dimension, *J. Clin. Orthod.* 32:432-445, 1998.
7. Redlich, M.; Mazor, Z.; and Brezniak, N.: Severe high Angle Class II Division 1 malocclusion with vertical maxillary excess and gummy smile: A case report, *Am. J. Orthod.* 116:317-320, 1999.
8. Allen, E.P.: Use of mucogingival surgical procedures to enhance esthetics, *Dent. Clin. N. Am.* 32:307-330, 1988.
9. Ezquerro, F.; Berrazueta, M.J.; Ruiz-Capillas, A.; and Arregui, J.S.: New approach to the gummy smile, *Plast. Reconstr. Surg.* 104:1143-1150, 1999.
10. Polo, M.: Botulinum toxin type A in the treatment of excessive gingival display, *Am. J. Orthod.* 127:214-218, 2005.
11. Ataoğlu, H.; Uçkan, S.; Karaman, A.I.; and Uyar, Y.: Bimaxillary orthognathic surgery in a patient with long face: A case report, *Int. J. Adult Orthod. Orthog. Surg.* 14:304-309, 1999.
12. Capelozza Filho, L.; Cardoso, M.A.; Reis, S.A.B.; and Mazzottini, R.: Surgical-orthodontic correction of long-face syndrome, *J. Clin. Orthod.* 40:323-332, 2006.
13. Proffit, W.R.; White, R.P.; and Sarver, D.M.: *Contemporary Treatment of Dentofacial Deformity*, Mosby, St. Louis, 2003, pp. 11, 500-506.
14. Reyneke, J.P.: *Essentials of Orthognathic Surgery*, Quintessence, Chicago, 2003, pp. 193-201.
15. Kanomi, R.: Mini-implant for orthodontic anchorage, *J. Clin. Orthod.* 31:763-767, 1997.
16. 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.* 37:321-328, 2003.
17. Lin, J.C.Y. and Liou, E.J.W.: A new bone screw for orthodontic anchorage, *J. Clin. Orthod.* 37:676-681, 2003.
18. Lin, J.C.Y.; Liou, E.J.W.; and Yeh, C.L.: Intrusion of over-erupted maxillary molars with miniscrew anchorage, *J. Clin. Orthod.* 40:378-383, 2006.
19. Liou, E.J.W. and Lin, J.C.Y.: The Lin/Liou Orthodontic Mini Anchor System (LOMAS), in *Temporary Anchorage Devices in Orthodontics*, ed. J.B. Cope, Under Dog Media, Dallas, 2007, pp. 213-230.
20. Lin, J.C.; Liou, E.J.; Yeh, C.L.; and Evans, C.A.: A comparative evaluation of current orthodontic miniscrew systems, *World J. Orthod.* 8:136-144, 2007.
21. Kinzinger, G.S.; Diedrich, P.R.; and Bowman, S.J.: Upper molar distalization with a miniscrew-supported Distal Jet, *J. Clin. Orthod.* 40:672-678, 2006.
22. 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.
23. Melsen, B.: Tissue reaction to orthodontic tooth movement—a new paradigm, *Eur. J. Orthod.* 23:671-681, 2001.
24. Vivaldi-Rodrigues, G.; Demito, C.F.; Bowman, S.J.; and Ramos, A.L.: The effectiveness of a fluoride varnish in preventing the development of white spot lesions, *World J. Orthod.* 7:138-144, 2006.
25. Bowman, S.J.: Use of a fluoride varnish to reduce decalcification, *J. Clin. Orthod.* 34:377-379, 2000.
26. Bowman, S.J. and Carano A.: Short-term, intensive use of the tooth positioner in case finishing, *J. Clin. Orthod.* 36:216-219, 2002.
27. Creekmore, T.D. and Eklund, M.K.: The possibility of skeletal anchorage, *J. Clin. Orthod.* 17:266-269, 1983.
28. Ohnishi, H.; Yagi, T.; Yasuda, Y.; and Takada, K.: A mini-implant for orthodontic anchorage in a deep overbite case, *Angle Orthod.* 75:444-452, 2005.
29. Hsu, S.P. and Liou, E.J.W.: Stability evaluation of en masse maxillary retraction and intrusion by using miniscrews: One year follow up, Taiwan Association of Orthodontists annual meeting, 2005.
30. Ludwig, B.; Baumgaertel, S.; and Bowman, S.J.: *Mini-Implants in Orthodontics: Innovative Anchorage Concepts*, Quintessence, Chicago, 2008.