Case Report

Unilateral Mandibular Widening with Distraction Osteogenesis

Ki Chul Tae[a]; Kyung Hwa Kang[b]; Sang Cheol Kim[c]

Abstract: Mandibular widening with distraction osteogenesis (DO) has been shown to be an acceptable and stable treatment modality. Mandibular widening with DO is useful in relieving crowding and for restoring a rotated mandibular arch segment to its original condition. This is especially true when a patient has a unilateral medial displacement of the proximal segment of the mandible or a unilateral Brodie bite. This case report shows the application of mandibular widening with DO for skeletal reconstruction and prosthodontic preparation in a patient with unilateral medial displacement of the proximal segment of the mandible. The design of the osteotomy line and the placement of the distractor must be taken into consideration in a detailed procedure for unilateral mandibular widening of the mandible. (*Angle Orthod* 2005;75:1053–1060.)

Key Words: Mandibular widening; Distraction osteogenesis; Unilateral medial displacement

INTRODUCTION

Mandibular symphyseal fractures often lead to a lingual rotation of the skeletal mandibular arch, multiple tooth loss, and require intermaxillary fixation to ensure continuity of the arch.[1] A lingually rotated mandibular arch form, however, also induces unilateral or bilateral crossbites after union of the fracture. The resulting unilateral skeletal crossbite causes difficult orthodontic problems.

In these situations, orthognathic surgery has been recommended for rehabilitation, but surgery requires adequate rigid fixation and the necessity of a graft. Alternatively, mandibular widening with distraction osteogenesis (DO) is a substitute modality of treatment.[2,3] Recently, mandibular widening with DO was introduced to solve transverse deficiencies. This technique gradual stretches the healing callus after the osteotomy is performed and applies Ilizarov's[4] principles, including the need for a latency period, rhythm and amount of traction, consolidation period, and the rigidity of the distractor necessary during distraction.

In 1990, Guerrero[5] reported using DO with a straight osteotomy at the symphysis in 10 patients for the first successful mandibular widening. A mid-symphyseal osteotomy of the mandible was indicated for a bilateral crossbite during DO, but the same mechanics are not acceptable for unilateral crossbites. The patient in this report was treated with DO and a stepwise symphyseal osteotomy and a custom-made distractor.

CASE REPORT

Diagnosis

A 30-year-old Asian man presented with a unilateral, lingually rotated lower arch. The patient reported that he had a mandibular symphyseal fracture with teeth 13, 14, and 31 avulsed and a crown fracture on tooth 15. He was treated with intermaxillary fixation with a plate and wire. After union of the fracture, he went to a local clinic for prosthodontic treatment for an edentulous area in the upper arch. At this point, a general dentist referred the patient for evaluation of the unilateral medially displaced proximal segment of the mandible.

Pretreatment records included facial and occlusal photographs; panoramic, periapical, occlusal radiographs; and study models. The panoramic radiograph showed the close proximity between tooth 41 and tooth 32 and plate fixation on the right inferior border of the mandible (Figure 1A). The occlusal radiograph

[a] Chairman and Associate Professor, Department of Orthodontics, School of Dentistry, Dental Institute, University of Wonkwang, Iksan, South Korea.

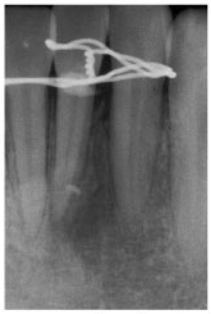
[b] Assistant Professor, Department of Orthodontics, School of Dentistry, University of Wonkwang, Iksan, South Korea.

[c] Professor, Department of Orthodontics, School of Dentistry, University of Wonkwang, Iksan, South Korea.

Corresponding author: Ki Chul Tae, DDS, MSD, PhD, Department of Orthodontics, School of Dentistry, Dental Institute, University of Wonkwang, Iksan, South Korea.
(e-mail: kkojji@wonkwang.ac.kr)

Accepted: October 2004. Submitted: July 2004.

A. panorama radiograph



B. periapical radiograph

C. occlusal radiograph

D. Skull P–A radiographs

FIGURE 1. Pretreatment radiographs.

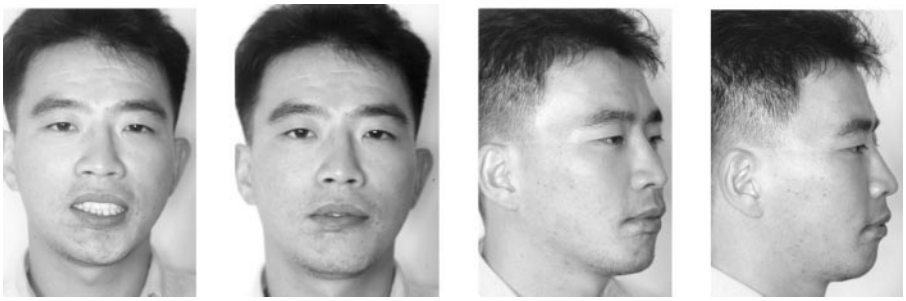


FIGURE 2. Pretreatment facial photos.

FIGURE 3. Pretreatment intraoral photos.

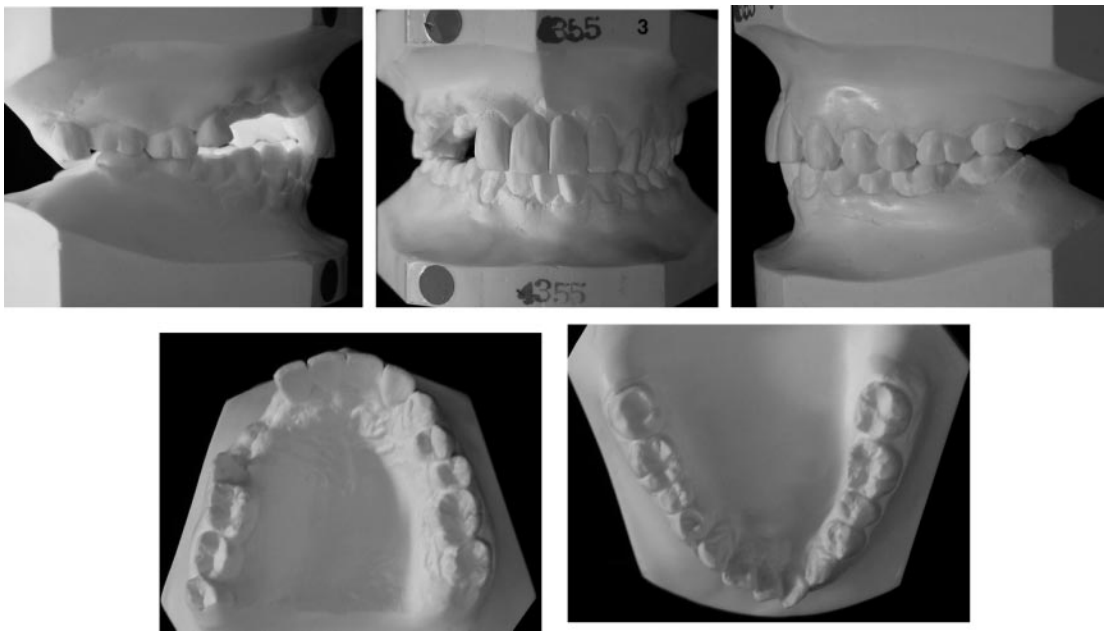


FIGURE 4. Pretreatment dental model.

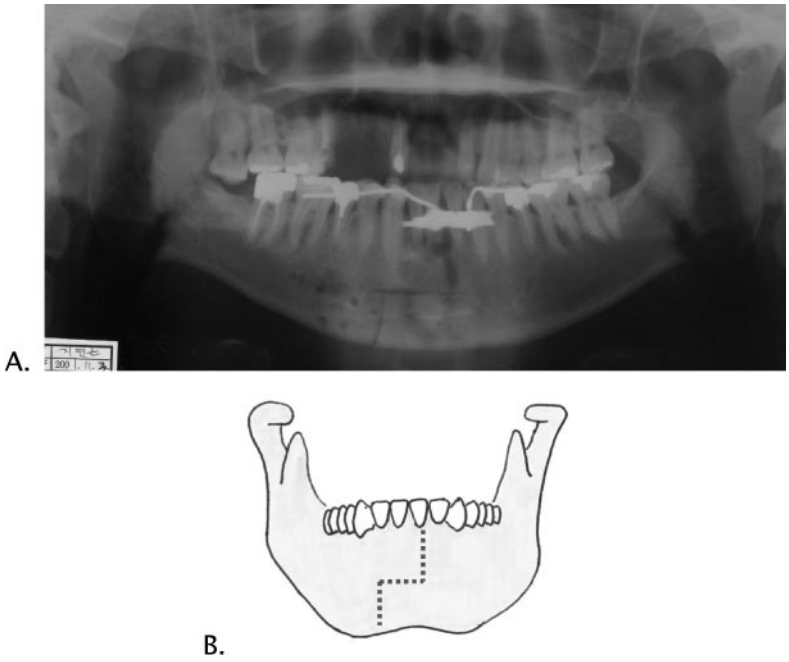


FIGURE 5. Step osteotomy line on panorama radiograph.

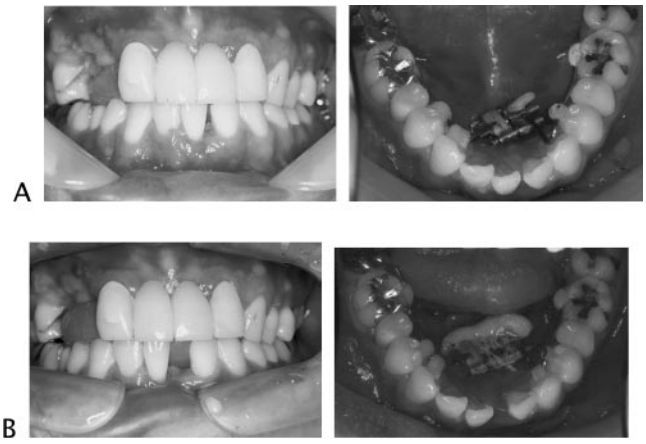


FIGURE 6. Unilateral expansion photos. (A) Device was placed at an approximate 30° angle to midsagittal plane. (B) The right lower arch was expanded, so that arch had symmetric U shape.

showed the right segment of the mandible rotated medially and superimposed imprecisely (Figure 1C).

The patient had a skewed smile line, scar tissue on his lower face, a convex profile, and an asymmetrical facial form (Figure 2). Teeth 11, 13, 14, 21, and 31 were missing. The crown of tooth 15 was fractured with a skewed mandibular arch and a deviation of the dental midline to the left in the lower dentition (Figure 3).

The patient showed a Class II skeletal pattern with a mandibular deficiency. To address his complaints and to treat his skeletal and dental deformities, a treatment plan was implemented that included the application of DO for unilateral mandibular expansion plus adjunctive orthodontic treatment to align the anterior lower dentition.

DO application for unilateral mandibular expansion

We chose to address the transverse problem in this patient with DO to correct the skewed lower arch form without a bone graft. An osteotomy was performed by degloving through the soft tissue incision under general anesthesia. A step osteotomy that consisted of one horizontal and two vertical osteotomies was performed. An upper vertical osteotomy was made from the alveolar crest between tooth 32 and tooth 41 to five mm below the apex of tooth 32. A horizontal osteotomy was made from below the apex of tooth 41 to the apex of tooth 43. A lower vertical osteotomy was made from below the apex of tooth 43 to the inferior lower border of the mandible (Figure 5). Before the step osteotomy, a tooth-borne distractor was placed in the lower dentition for postoperative stability. The patient tolerated the surgery well. Antibiotics were prescribed during the seven-day latency period, and the patient used a chlorhexidine mouthwash.

After the latency period, the patient returned to the clinic and was instructed about the activation program of the device. The patient was told to turn the device twice in the morning and twice in the evening (one mm of activation per day) on the eighth postsurgical day. The patient was advised to continue turning the appliance in a similar fashion for seven additional days,

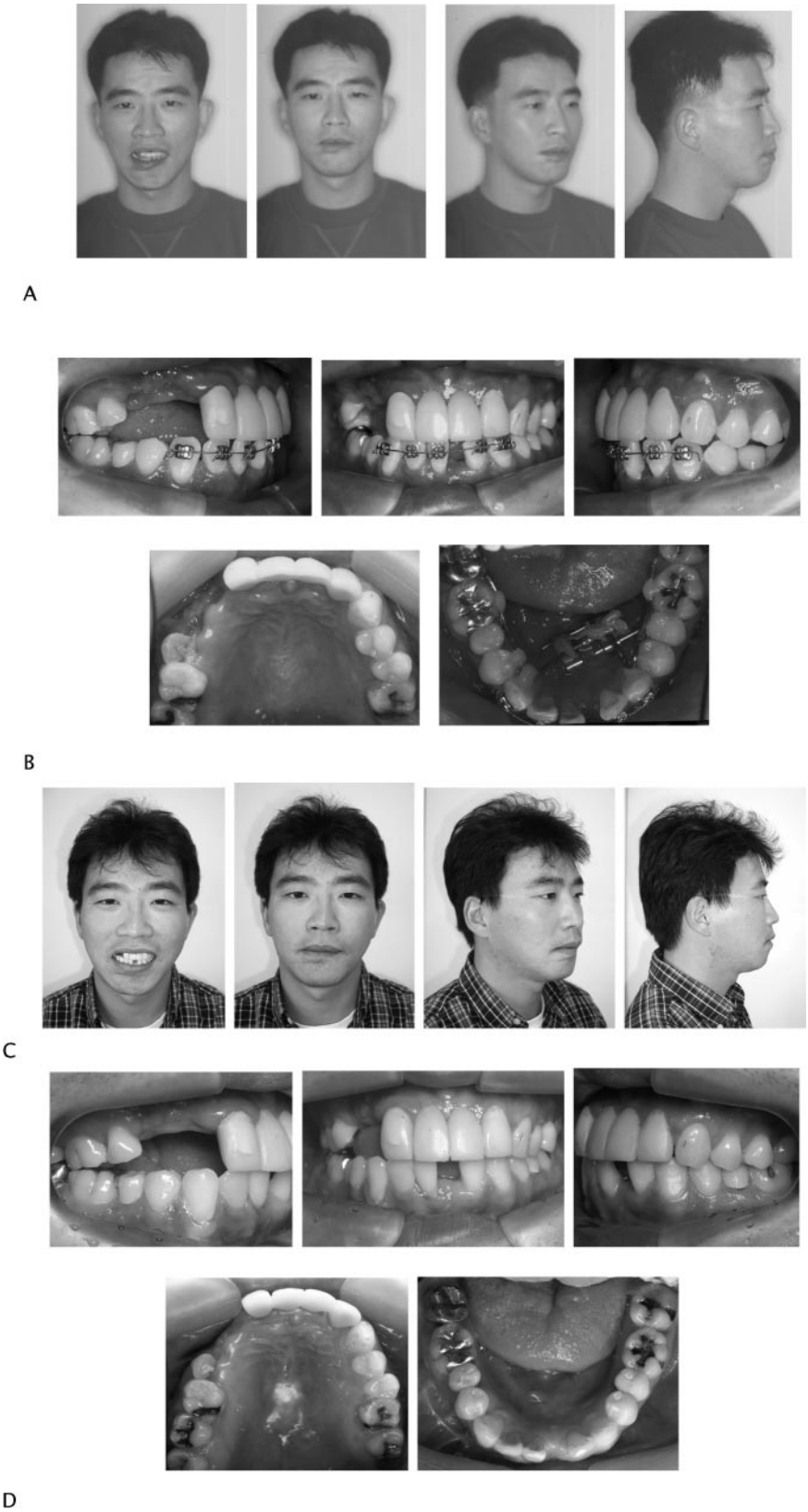


FIGURE 7. Facial and intraoral photos. (A–B) Initial orthodontic treatment period. (C–D) Finished orthodontic treatment period.

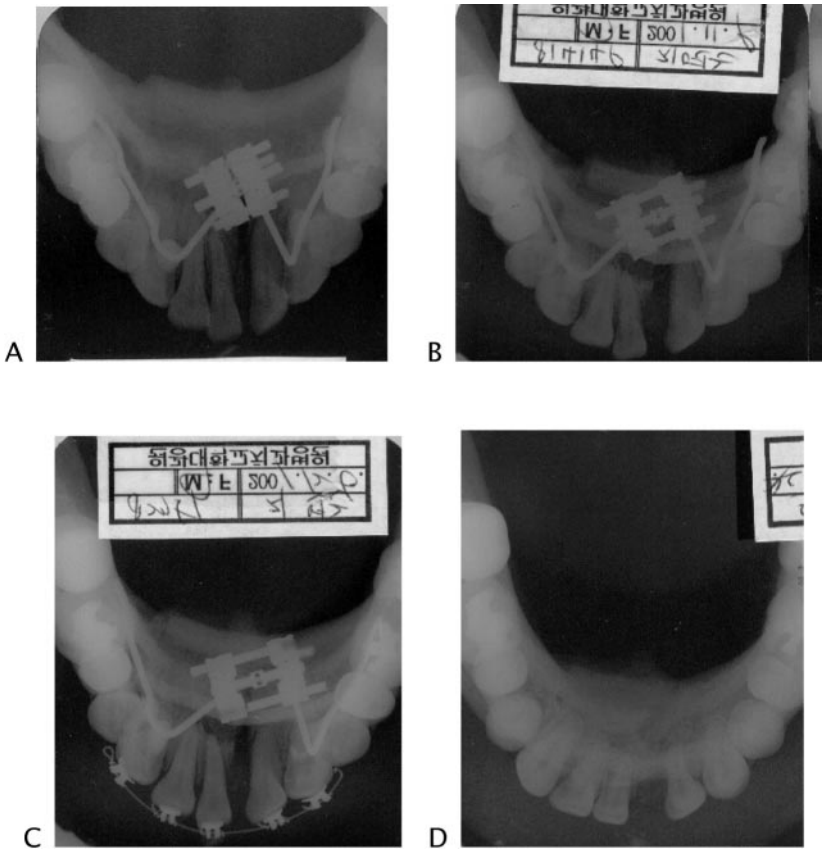


FIGURE 8. Radiograph change during distraction osteogenesis (DO). (A) Postsurgical, (B) distraction period, (C) consolidation period, and (D) postdistraction.

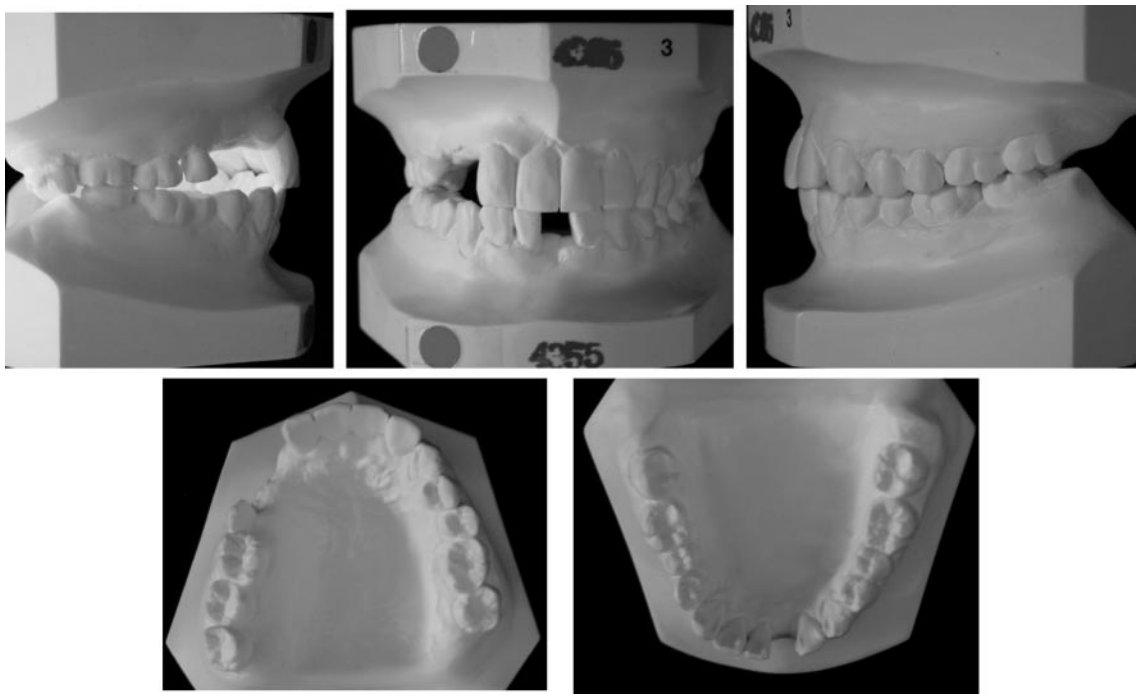


FIGURE 9. Posttreatment study model.

producing a total of approximately seven mm expansion (Figure 6).

Adjunctive orthodontic treatment to align on anterior lower dentition

On the 10th day after activation had been completed, canine to canine orthodontic brackets were bonded in the lower dentition, and a 0.0175-inch multistranded light force wire was seated (Figure 7B). The period of alignment in the lower dentition was about five months. During this period, the device was left in place for retention of the expansion, and the patient had no gingival recession or temporomandibular joint (TMJ) problems.

A subsequent adjunctive orthodontic treatment achieved a good occlusion and created a prosthodontic space in the tooth 31 area (Figures 7D and 9). Radiographic continuity was observed on the occlusal view, and radiopacity was observed at the distraction site (Figure 8D). At that point, the patient was transferred to a local clinic for prosthodontic treatment. The total duration of orthodontic treatment was five months 18 days.

DISCUSSION

A transverse skeletal deficiency in the mandible is associated with a narrowed basal arch and alveolar bone. The problem is often caused by a fracture at the symphysis and a subsequent growth disturbance. In growing patients, lip bumpers[6,7] or functional appliances[8] are often used to correct transverse discrepancies. However, these mandibular expansion appliances are useless in adult patients.

Bone grafts or orthognathic surgery is limited by the need for additional soft tissue grafts and resorption of the graft material. Symphyseal widening, however, has the advantages of stability and better adaptation of soft tissues.[9]

Devices for symphyseal widening are classified as intraoral and extraoral.[10] Because of esthetic demands intraoral devices are commonly used, and these are divided into tooth-borne, hybrid, and bone-borne types. The advantages of the tooth-borne device are the attachment and convenience of tooth movement during the stabilization period. In contrast, the disadvantages of tooth-borne devices are that expansion may be greater at the denture than at the basal skeletal part and a lack of stability. In this patient, we used a tooth-borne device that was obliquely oriented for forward and lateral movement of the right mandibular segment.

The two patterns of osteotomy for symphyseal widening are straight and step line. For unilateral expansion, we chose the step osteotomy line that had different muscular anchorage. Guerrero et al[10] recommended treating unilateral symphyseal widening with a parasymphyseal straight osteotomy on the ipsilateral side, but other clinicians have suggested the use of cross-arch elastics with a straight mid-symphyseal osteotomy to prevent bilateral expansion.[11]

The case reported here was monitored carefully for changes in periodontal pockets and the TMJ condition. During the treatment period, the patient had a consistently healthy periodontal pocket depth (approximately two mm) and no clicking sound or pain in the TMJ area. Many clinicians have reported about the potential effects of TMJ rotation and positional change during and after symphyseal widening, but no change has been reported.[12–15] However, further experimental biological and clinical studies of symphysis widening with DO is necessary to fully understand the short- and long-term effects of TMJ adaptation at the DO.

CONCLUSIONS

- Unilateral mandibular expansion for correction of unilateral medial displacement of the proximal segment of the mandible without using cross-arch elastics is predictable, available, and credible.
- If the orthodontist and surgeon have biologic knowledge and a mechanical consideration of DO, mandibular widening will potentially shorten the treatment time and offer an option to supplement conventional treatment.

ACKNOWLEDGMENT

This article was supported by 2004 grants from the University of Wonkwang.

REFERENCES

1. Archer WH. Fracture of facial bones and their treatment. In: *Oral and Maxillofacial Surgery.* Philadelphia, PA: Saunders; 1975:1031–1062.
2. Harper DL. A case report of a Brodie bite. *Am J Orthod Dentofacial Orthop.* 1995;108:201–206.
3. King JW, Wallace JC. Unilateral Brodie bite treated with distraction osteogenesis. *Am J Orthod Dentofacial Orthop.* 2004;125:500–509.
4. Ilizarov GA. The tension-stress effect on the genesis and growth of tissues Part I. The influence of stability of fixation and soft-tissue preservation. *Clin Orthop.* 1989;238:249–256.
5. Guerrero CA. Expansion mandibular quirurgica. *Rev Venez Ortod.* 1990;1:48–50.
6. Nevant CT, Buschang PH, Alexander RG, Steffen JM. Lip bumper therapy for gaining arch length. *Am J Orthod Dentofacial Orthop.* 1991;100:330–336.
7. Werner SP, Shivapuja PK, Harris EF. Skeletodental changes in adolescent accruing from use of the lip bumper. *Angle Orthod.* 1994;100:330–336.
8. Santo MD, English JD, Wolford LM, Gandini LG. Midsymphyseal distraction osteogenesis for correcting transverse

mandibular discrepancies. *Am J Orthod Dentofacial Orthop.* 2002;121:629–638.
9. McCarthy JG. *Distraction of the Craniofacial Skeleton.* Berlin, Germany: Springer; 1999:21–50.
10. Guerrero CA, Bell WH, Contasti GI, Rodriguez AM. Mandibular widening by intraoral distraction osteogenesis. *Br J Oral Maxillofac Surg.* 1997;35:383–392.
11. Legan HL. Orthodontic planning and biomechanics for transverse distraction osteogenesis. *Semin Orthod.* 2001;7: 160–168.
12. Del Santo M Jr, Guerrero CA, Buschang PH, English JD, Samchukov ML, Bell WH. Long-term skeletal and dental effects of mandibular symphyseal distraction osteogenesis. *Am J Orthod Dentofacial Orthop.* 2000;118:485–493.
13. Mommaerts MY. Bone anchored intraoral device for transmandibular distraction. *Br J Oral Maxillofac Surg.* 2001;39: 8–12.
14. Tae KC, Oh SW, Min SK. Report of mandibular symphysis widening with distraction osteogenesis. *Korea J Orthod.* 2001;31:499–504.
15. Samchukov ML, Cope JB, Harper RP, Ross JD. Biomechanical considerations of mandibular widening by gradual distraction using a computer model. *J Oral Maxillofac Surg.* 1998;56:51–59.