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CASE REPORT Mandibular Symphyseal Distraction Osteogenesis

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Distraction osteogenesis can be used to lengthen the ramus and the body of the mandible, as well as for alveolar ridge augmentation.1-12 It can protract the maxilla or, if necessary, the entire midfacial complex in cases of severe deformity, as in patients with Crouzon, Apert, and Pfeiffer syndromes.13-15 Distraction of the mandible in the midsympheal region now provides a viable alternative for the correction of transverse deficiencies through true skeletal mandibular widening.16-27

The following case involved expansion of both arches--the mandibular with midsymphyseal distraction and the maxillary with conventional rapid palatal expansion.

Diagnosis and Treatment Plan

An 11-year-old female presented with a symmetrical face, lip competence, no gingival exposure in smiling, and a convex profile with an obtuse nasolabial angle (Fig. 1, Table 1). Clinical examination revealed severe crowding in both arches, with the lower right lateral incisor blocked out lingually. The patient had a Class I molar relationship, a 90% overbite with palatal impingement, and a maxillary transverse deficiency with a deep palatal vault. Cephalometric analysis showed a normally positioned maxilla, a slightly recessive mandible, and retrusive and retroclined upper and lower incisors.

The initial treament plan involved palatal expansion to address the maxillary transverse problem, followed by extraction of four first bicuspids to resolve the severe arch-length discrepancy. However, once the rapid palatal expansion was completed and the maxilla had a more ideal archform with a normal intermolar width, there was enough space in the maxillary arch to align the unerupted upper left cuspid without extractions (Fig. 2). Cephalometrically, the upper incisors were in the proper position with respect to their basal bone and the cranial base, and the nasolabial angle was normal.

We therefore decided to proceed with a nonextraction approach involving distraction osteogenesis in the mandibular arch. The lower dentition was prepared for the osteotomy by diverging the roots of the mandibular central incisors to facilitate access and avoid damage to the roots during surgery (Fig. 3). The intraoral mandibular distraction appliance was cemented one day before surgery.

Surgical Procedure

Under general anesthesia, an incision was made inferior to the mucogingival junction from the area of the lower left cuspid to the area of the lower right cuspid. The mucoperiosteum was elevated to identify the inferior aspect of the parasymphysis and the apices of the mandibular central incisors.

The osteotomy was made from the inferior aspect of the symphysis to the apices of the mandibular central incisors. The cut was continued between the central incisors through only the labial bone,

stopping short of the crest of the ridge. A small spatula osteotome was then used to deepen the osteotomy between the incisor teeth. Finally, a large osteotome was inserted in the midline of the symphyseal osteotomy and torqued to complete the separation of the segments. The distraction appliance was activated to verify separation, then deactivated.

Mandibular Distraction

After a five-day latency period, the distraction appliance was activated .25mm four times a day for five days, until enough space had been created for alignment of the blocked-out incisor (Fig. 4). The appliance was then sealed. After a two-month consolidation period, x-rays showed a cortical outline within the regenerate. The mandibular distraction device was then removed.

Post-Distraction Orthodontic Treatment

The third molars were extracted. The second molars were banded, and the lower right lateral incisor was bonded. After leveling and alignment, an .017" × .025" stainless steel archwire was placed, and the blocked-out lateral incisor was brought into the arch with power thread. Routine finishing and detailing were then carried out (Figs. 5A, and 5B, Table 1).

Discussion

Latency period: This is the "waiting period" after surgery, during which a fibrovascular bridge is allowed to develop before distraction is begun. The younger the patient, the shorter the latency period required. Too short a latency period can result in the appearance of fibrous tissue, however, and a poor osteogenic response with decreased vascularity. Too long a latency period can cause premature ossification. The usual period is five to 10 days, as in this case.

Optimal rate of distraction: Stretching the bone at a rate of .5mm per day leads to premature ossification, whereas a rate of 2mm per day produces a regenerate zone filled with fibrous connective tissue rather than bone, as well as deleterious changes within the overlying tissues and loss of cellular metabolic activity, which leads to ischemia. The optimal rate of distraction is 1mm per day.

Distractor activation: A continuous distraction force would encourage maximum new capillary and bone synthesis and would produce the least amount of tissue injury. Because current distraction devices do not allow continuous force application, however, the distractor must be activated .25mm four times a day or .5mm twice a day to achieve the optimal 1mm per day.

Consolidation period: Keeping the fixator in place after distraction has been completed allows the regenerate to mature. The length of the consolidation period depends on the amount of distraction and the age of the patient.

In the present case, the toothborne mandibular distraction appliance provided adequate stability and guidance to the mandibular segments during both the distraction and the consolidation period. True skeletal expansion and concomitant soft-tissue expansion were achieved without the need for a bone graft. Facial balance was also maintained. The distractor was well tolerated by the patient. •

FIGURES

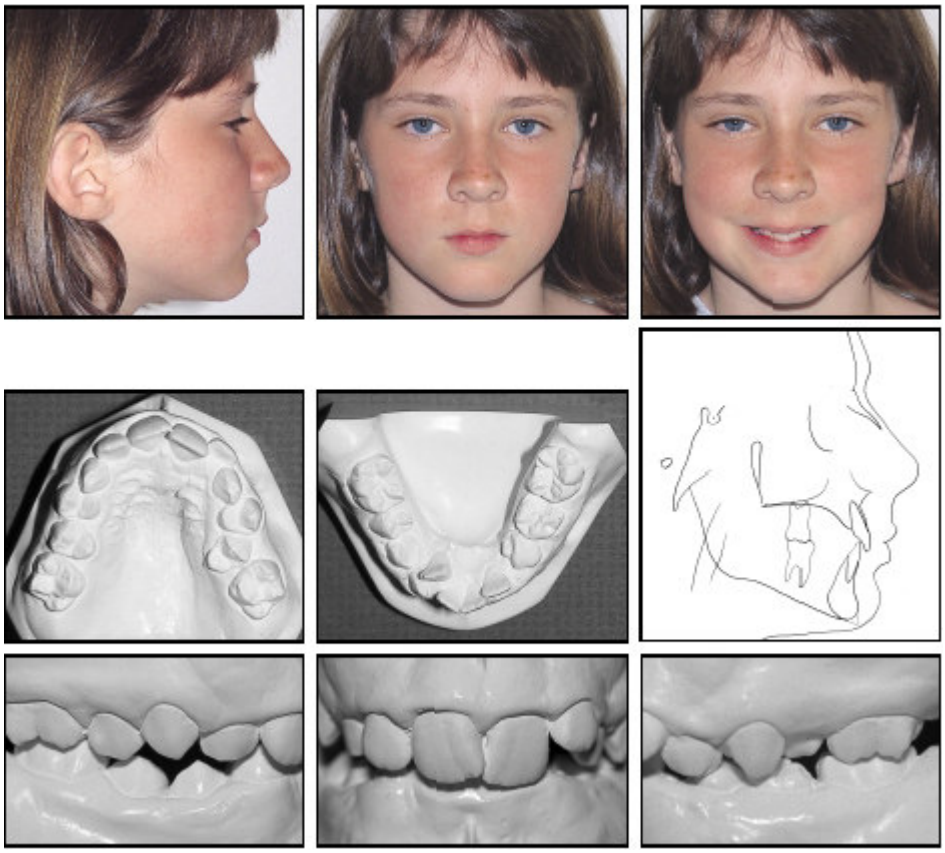

Fig. 1 11-year-old female with severe crowding and maxillary transverse deficiency before treatment.

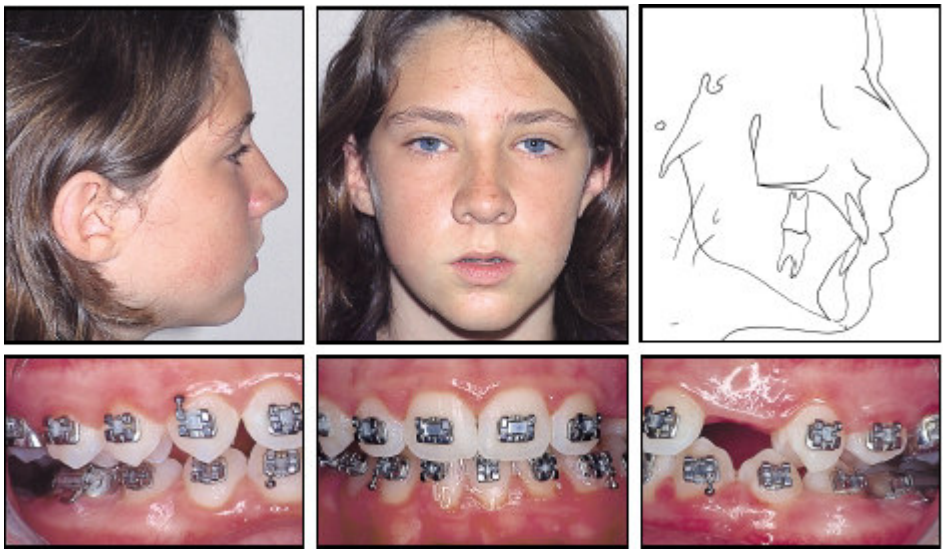

Fig. 2 After rapid palatal expansion.

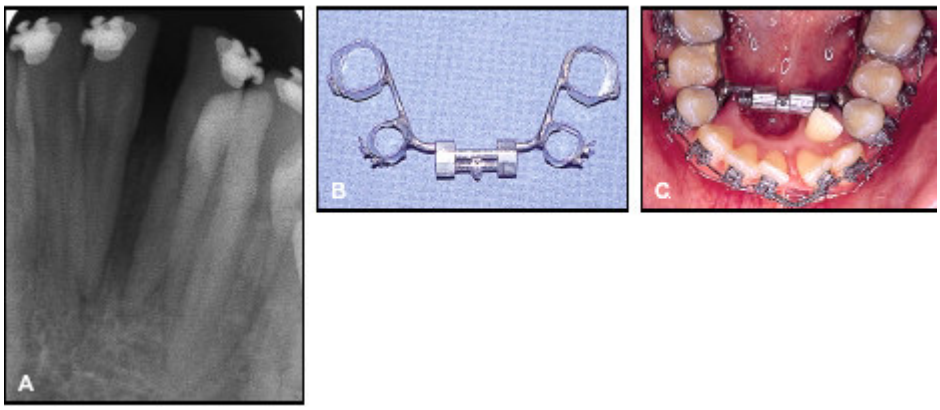

Fig. 3 A. Mandibular central incisor root divergence prior to distraction. B. Mandibular distraction appliance. C. Distractor cemented in place.

Fig. 4 After five days of mandibular distraction.

Fig. 5A Patient after removal of orthodontic appliances.

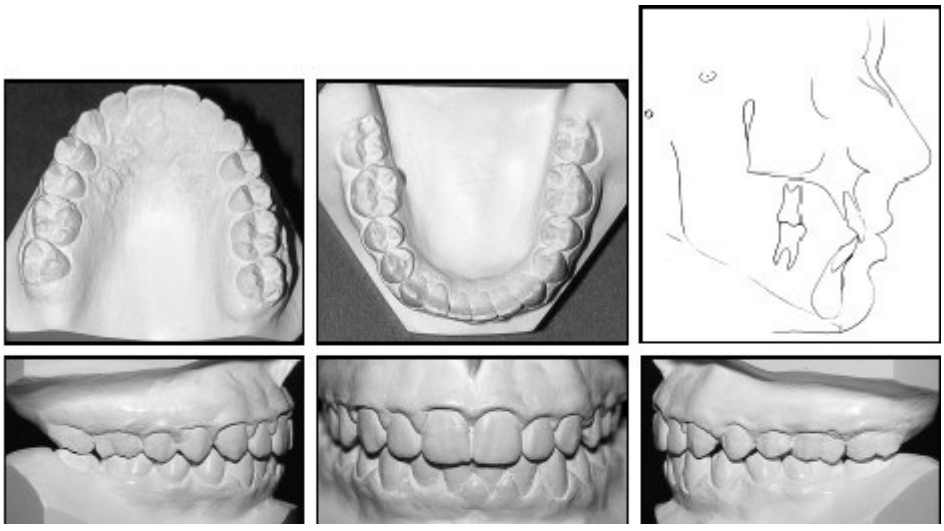

Fig. 5B Patient after removal of orthodontic appliances.

TABLES

TABLE 1
CEPHALOMETRIC DATA

	Before Treatment	After RPE	After Debonding
SNA	82°	81°	79°
SNB	78°	78°	77°
ANB	4°	3°	2°
1-SN	96°	103°	102°
1-NA	13°	21°	23°
1-NA	2.0mm	3.5mm	5.0mm
Y-axis	58°	59°	60°
FH-NA	91°	90°	88°
ANP	5°	4°	2°
Pg-NB	2.0mm	2.5mm	1.5mm
FH-NP	89°	81°	87°
MP-SN	33°	35°	36°
MP-FH	24°	26°	26°
T-NB	15°	21°	31°
T-NB	2.5mm	5.0mm	5.5mm
T-MP	84°	89°	98°

Table. 1

REFERENCES

1 McCormick, S.: Osteodistraction, Sel. Read. Oral Maxillofac. Surg. 4:2-27,1993.

2 Van Sickels, J.E.: Distraction osteogenesis versus orthognathic surgery, Am. J. Orthod. 118:482-484, 2000.

3 McCarthy, J.G.; Schreiber, J.; Karp, N.; Thorne, C.H.; and Grayson, B.H.: Lengthening the human mandible by gradual distraction, Plast. Reconstr. Surg. 89:1-10, 1992.

4 Klein, C. and Howaldt, H.P.: Mandibular distraction osteogenesis as first step in the early treatment of severe dysgnathia in childhood, J. Orofac. Orthop. 57:47-54, 1996.

5 Stucki-McCormick, S.U.: Reconstruction of the mandibular condyle using transport distraction osteogenesis, J. Craniofac. Surg. 8:48-53, 1997.

6 Klein, C. and Howaldt, H.P.: Correction of mandibular hypoplasia by means of bidirectional callus distraction, J. Craniofac. Surg. 7:258-266, 1996.

7 Chin, M. and Toth, B.A.: Distraction osteogenesis in maxillofacial surgery using internal devices: Review of five cases, J. Oral Maxillofac. Surg. 54:45-53, 1996.

8 Constantino, P.D.; Friedman, C.D.; Shindo, M.L.; Houston, G.; and Sisson, G.A. Sr.: Experimental mandibular regrowth by distraction osteogenesis, Arch. Otolaryngol. Head Neck Surg. 119:511-516, 1993.

9 Niederhagen, B.; Braumann, B.; Schmolke, C.; Appel, T.; von Lindern, J.J.; and Berge, S.: Tooth-borne distraction of the mandible, Int. J. Oral Maxillofac. Surg. 28:475-479, 1999.

10 Sawaki, Y. et al.: Mandibular lengthening by distraction osteogenesis using osseointegrated implants and an intraoral device: A preliminary report, J. Oral Maxillofac. Surg. 54:594-600, 1996.

11 Molina, F. and Ortiz Monasterio, F.: Mandibular elongation and remodeling by distraction: A farewell to major osteotomies, Plast. Reconstr. Surg. 96:825-840, 1995.

12 McCormick, S.U.; McCarthy, J.G.; Grayson, B.H.; Staffenberg, D.; and McCormick, S.A.: Effect of mandibular distraction on the temporomandibular joint, Part 1: Canine study, J. Craniofac. Surg. 6:358-363, 1995.

13 Polley, J.W.; Figueroa, A.A.; Charbel, F.T.; Berkowitz, R.; and Reisberg, D.: Monobloc craniomaxillofacial distraction osteogenesis in a newborn with severe craniofacial synostosis: A preliminary report, J. Craniofac. Surg. 6:421-423, 1995.

14 Figueroa, A.A. and Polley, J.W.: Management of severe cleft maxillary deficiency with distraction osteogenesis: Procedure and results, Am. J. Orthod. 115:1-12, 1999.

15 Polley, J.W. and Figueroa, A.A.: Management of severe maxillary deficiency in childhood and adolescence through distraction osteogenesis with an external,adjustable, rigid distraction device,J. Craniofac. Surg. 8:181-185, 1997.

16 Molina, F.: Combined maxillary and mandibular distraction osteogenesis, Semin. Orthod. 5:41-45, 1999.

17 Bell, W.H.; Gonzalez, M.; Samchukov, M.L.; and Guerrero, C.A.: Intraoral widening and lengthening of the mandible in baboons by distraction osteogenesis, J. Oral Maxillofac. Surg. 57:548-562, 1999.

18 Bell, W.H.; Harper, R.P.; Gonzalez, M.; Cherkashin, A.M.; and Samchukov, M.L.: Distraction osteogenesis to widen the mandible, Br. J. Oral Maxillofac. Surg. 35:11-19, 1997.

19 Harper, R.P.; Bell, W.H.; Hinton, R.J.; Browne, R.; Cherkashin, A.M.; and Samchukov, M.L.: Reactive changes in the temporomandibular joint after mandibular midline osteodistraction, Br. J. Oral Maxillofac. Surg. 35:20-25, 1997.

20 Del Santo, M.; Guerrero, C.A.; Buschang, P.H.; English, J.D.; Samchukov, M.L.; and Bell,

W.H.: Long-term skeletaland dental effects of mandibular symphyseal distraction osteogenesis, Am. J. Orthod. 118:485-493, 2000.

21 Braun, S.; Hnat, W.P.; Hnat, T.W.; and Legan, H.L.: Taking the guesswork out of mandibular symphyseal distraction osteogenesis, Am. J. Orthod. 119:121-126, 2001.

22 Guerrero, C.A.; Bell, W.H.; Contasti, G.I.; and Rodriguez, A.M.: Mandibular widening by intraoral distraction osteogenesis, Br. J. Oral Maxillofac. Surg. 35:383-392, 1997.

23 Kewitt, G.F. and Van Sickels, J.E.: Long-term effect of mandibular midline distraction osteogenesis on the status of the temporomandibular joint, teeth, periodontal structures, and neurosensoryfunction, J. Oral Maxillofac. Surg. 57:1419-1425, 1999.

24 Hollis, B.J.; Block, M.S.; Gardiner, D.; and Chang, A.: An experimental study of mandibular arch widening in the dog using distraction osteogenesis, J. Oral Maxillofac. Surg. 56:330-338, 1998.

25 Kisnisci, R.S.; Fowel, S.D.; and Epker, B.N.: Distraction osteogenesis in Silver Russell syndrome to expand the mandible, Am. J. Orthod. 116:25-30, 1999.

26 Braun, S.; Bottrel, J.A.; and Legan, H.L.: Condylar displacement related to mandibular symphyseal distraction, Am. J. Orthod. 121:162-165, 2002.

27 Weil, T.S.; Van Sickels, J.E.; and Payne, C.J.: Distraction osteogenesis for correction of transverse mandibular deficiency: A preliminary report, J. Oral Maxillofac. Surg. 55:953-960, 1997.