Reconstruction of a Large Mandibular Defect by Distraction Osteogenesis: A Case Report

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Experimental studies have shown that large corrections of mandibular defects can be done by distraction osteogenesis. Annino et al. investigated the feasibility of trifocal distraction for the reconstruction of symphyseal defects and they obtained 4.5- to 5.5-cm lengthening in canine mandibles by using a rate of 1 mm/day.1 Labbe et al. used distraction osteogenesis in 5 patients who had gunshot wound defects and produced bilateral lengthening of 5 to 10 cm by using an intraoral device. They also noticed that the distraction created an alveolar ridge and attached gingiva. Sawaki et al. used distraction osteogenesis for reconstruction of a 60-mm mandibular segmental defect that resulted from excision of an oral floor cancer. They performed trifocal distraction by using an external device. The gap was almost filled by regenerated bone, and a small free bone graft was placed to complete the continuity.

Generally, large corrections are done by trifocal distraction, and the process usually ends with bone-to-bone contact. The major distinction in this case is that bifocal distraction was used for the correction of a large unilateral mandibular defect. A free proximal bone segment was completely separated from the remaining mandible and was brought in contact with the temporal bone.

Report of Case

A 24-year-old man had a mandibular discontinuity on the left side resulting from a tumor resection when he was 7 years old. Because of the absence of the left mandibular ramus, angle, and part of the body, the remaining mandible was deviated toward the affected side. To compensate for the discrepancy, maxillary growth had caused a hyperplasia of the alveolar process and, consequently an occlusal disharmony as well as a facial asymmetry. The development of right mandible was totally normal (Fig 1).

Distraction osteogenesis by using a bidirectional device was planned for reconstruction of the defect. The purpose of the treatment was to simultaneously lengthen the mandible in the horizontal and vertical planes. To achieve this, osteotomies were performed in the most distal part of the left mandible through an intraoral route (Figs 2A, B). In this way, 3 segments were created. There was a 2-cm segment of bone between the osteotomies, which were at an angle of almost 45° to the vertical plane and to each other. The reason for this angulation was to make upward rotation of the distal segment easier. Two pins, which were at a right angle to the bone surface, were inserted in each fragment. To minimize scar formation, the skin incisions were made directly over the site of pin insertion. The bidirectional device was then attached to the pins (Fig 2C).

Distraction was maintained in fixation for 10 days to allow initial callus formation. After this latency period, distraction was started at a rate of 1 mm/day in both a superior and posterior direction and was continued for 10 days. However, an infection developed around the pins in the middle segment so that the distraction had to be discontinued for 7 days. Oral penicillin was administered during this period, and the infection resolved without any complications.

Distraction was restarted with a rate of 1 mm/day in the posterior direction and 0.5 mm/day in the superior direction (Fig 3). The rate of the posterior distraction was changed because the distance that the segment had to travel toward the temporal bone was almost half of the distance of the middle segment to the mandibular angle. By this change, both the distal and middle segments reached their targets simultaneously. Distraction was continued with these rates for 30 days. After this period, the distractor was left in place for 10 weeks for consolidation to occur (Fig 4).

After removal of the device, the patient was followed up for 12 months to observe the newly formed bone radiologically (Fig 5). Although the length of the bone was satisfactory, the thickness was less than normal in the mandibular angle region. The shape of the right and left mandibular angle was different, and this was causing a persistent asymmetry. To solve the problem, an mandibular angle onlay implant (Medpor; Porex Surgical Inc, Newnan, GA) was placed over the left mandibular angle (Fig 6).
FIGURE 1. Preoperative views of patient. A, Facial view showing the mandibular deviation. B, Lateral view. C, Panoramic radiograph showing the amount of bony deficiency.


FIGURE 3. After 10 days of distraction, the fragments are markedly separated from each other.
Discussion

Bone lengthening by gradual distraction has a low morbidity rate, easy application, and gives satisfactory outcomes. The process of distraction may be divided into 4 steps: 1) osteotomy or corticotomy, 2) latency period, 3) distraction period, and 4) consolidation. The type of osteotomy varies from one surgeon to another. It can either be only a corticotomy, sparing the periosteum and medulla as proposed by Ilizarov, or a complete osteotomy. Although Takato et al. and McCarthy et al. performed only a corticotomy to lengthen the mandible, Constantino et al. performed a complete osteotomy to expand the canine mandible. As Kojimoto et al. have shown, preservation of the medullary blood supply is not essential for the success of the distraction. Therefore, we preferred to reflect a mucoperiosteal flap to provide good vision and performed complete osteotomies without causing any unwanted fractures. The absence of the mandibular canal was a great convenience during the osteotomy process.

The latency period may vary from 7 to 14 days. In this case, it was 7 days. The rate of distraction varies from 0.5 to 1.5 mm/day, with rates under 0.5 mm/day leading to premature union, whereas those over 1.5 mm/day lead to nonunion. In this case, distraction started with a rate of 1 mm/day in posterior and in the superior direction, and this rate continued for 10 days. A lengthening of 20 mm was obtained at the end of this period. However, the distraction had to be stopped after this period because of the pin tract infection and wound dehiscence over the osteotomy sites. The infection was managed with oral penicillin and wound irrigation. Because the pins were stable, they were left in place. After the wounds had healed, distraction was continued at a different rate, which was 1 mm/day in a posterior and 0.5 mm/day in a superior direction. The reason for this was that the distal fragment was closer than the middle fragment to its target, which was an imaginary glenoid fossa. Therefore, by readjusting the rate of the distraction, a simultaneous finish in both sites was obtained. The

FIGURE 4. Completion of the distraction procedure 50 days after the operation. A, The mandibular asymmetry resulting from the bony deficiency has almost disappeared, but the mandibular angle area is still asymmetric. B, Profile view showing the increased distance between the pins.

FIGURE 5. Comparison of the original (A) and reconstructed (B) mandibles on 3D CT scans. Radiologically, there is no difference in terms of bone density.
lengthening with this rate continued for 30 days, and 45 mm of length was achieved. With the previous 20 mm, the total amount of the lengthening reached 65 mm.

Ilizarov\(^{11}\) recommended a consolidation period at least as long as distraction time. In this case, we waited for 10 weeks for consolidation, because the amount of distraction was longer than usual.

Although McCarthy et al\(^{6}\) reported that they used a bite block after distraction for stabilization, we did not use such an orthopedic appliance, and after 20 months of follow-up, there has been no sign of relapse.

When the mandible is underdeveloped unilaterally, such as in hemifacial microsomia, it deviates toward the affected side. This deviation also can cause a cant of maxilla on the affected side. This is a compensation mechanism and, after distraction, a gap develops between the maxilla and the lengthened mandible. In this patient, the posterior openbite was managed by orthodontic therapy.

Although the mandibular deficiency was corrected by the distraction, the bone volume was not equal in the mandibular angle, and this caused a considerable facial asymmetry. Therefore, an alloplastic implant (Medpor) was placed over the angle to correct the asymmetry.

References


FIGURE 6. Final facial (A) and lateral (B) views of the patients after an alloplastic implant placed on the left mandibular angle for correction of the mandibular asymmetry.