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Distraction osteogenesis of basal mandibular bone for reconstruction of the alveolar ridge

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SUMMARY. **Alveolar distraction is being used increasingly for alveolar bone reconstruction in patients with severe mandibular defects. When there has been total loss of alveolar bone, distraction of the mandibular basal bone is necessary. Distraction osteogenesis is considerably more challenging in mandibular basal bone than in alveolar bone. The low level of the cut increases the technical difficulty and may result in a poor outcome. We describe three cases in which more than 10 mm of distraction of mandibular basal bone was required. Semirigid distraction devices were used to reconstruct the alveolar structures in each case.**

INTRODUCTION

Reconstructing alveolar bone in patients with severe mandibular defects is difficult. The methods that are currently used include guided bone regeneration and augmentation procedures.[1] However, when the defect is large, results with these techniques are usually less than satisfactory.[2]

Block *et al*.[3] and Chin and Toth[4] were the first to investigate alveolar distraction osteogenesis clinically and experimentally in 1996. Since then, promising results with this approach have increased its popularity; however, this mode of treatment is still in the preliminary stages of development. Since the initial reports, larger series with as many as 9 and 14 patients have been published.[5–7]

The risks of distraction in the mandible parallel the proportion of alveolar bone that has been lost. When no alveolar bone remains, the basal bone of the mandible must be distracted. The low level of this cut increases the technical difficulty of the procedure and may jeopardise the outcome.

We describe three patients who had sustained total loss of the alveolus as a result of trauma or excision of tumour, making it necessary to distract the mandibular basal bone for reconstruction.

SURGICAL TECHNIQUE

Semirigid alveolar distractors (Chin type, Leibinger, MI, USA) were used in all three cases, and the operations were done under sedation and local anaesthesia. A horizontal incision was made in the buccal vestibule to expose the bone at the level of the planned osteotomy site. The gingiva covering the crest of the ridge was not reflected. The periosteum on both sides of the incision was dissected superiorly and inferiorly to enable preparation of a bone segment more than 4 mm high. In all areas (including the vertical bone cut sites), dissection was kept to a minimum to ensure adequate blood supply through the periosteum above the horizontal bone incision. A box-shaped osteotomy that included the lingual cortex was done using surgical burs, an oscillating saw, and osteotomes. After the bone segment had been mobilised, a threaded rod, a transporting plate, and a base plate were put in place. Finally, we ensured that the distraction device could be activated, and then closed the flap primarily. The patients were prescribed a week of antibiotic treatment (amoxycillin 500 mg three times a day) and 0.25% chlorhexidine rinses, and were also provided with an analgesic (paracetamol 500 mg) to be used as needed.

Distraction was applied according to a modified version of the protocol described by Hidding *et al*.[8] After 7 days of latency, bone lengthening was started at a rate of 0.8 mm/day (two full revolutions of the rod). After the desired transport was achieved, the threaded rod was left in place for another 5 weeks. It was then rotated counter-clockwise and removed. The site was allowed to consolidate for an additional 7 weeks, and then a total of eight dental implants were placed in two of the three patients. Case 3 was treated with a conventional

Table 1 Features of the patients and distraction

Case number	Age (years)	Sex	Diagnosis	Number of distractors	Amount of distraction (mm)	Rate (mm/day)	Implants
1	25	F	Giant cell granuloma	2	11	$2 \times 0.4 = 0.8$	4, 4.1 × 14 mm
2	34	M	Eosinophilic granuloma	2	13	$2 \times 0.4 = 0.8$	4 (1 failed), 4.1 × 14 mm
3	41	M	Trauma	1	12	$2 \times 0.4 = 0.8$	None

Chin type distractors were used in all cases.

prosthesis. Implants were placed bicortically in the transported segment and the mandibular basal bone. After the implants had been inserted, the mucoperiosteal flap was repositioned and the same hygienic regimen as after the previous operation was prescribed, but the antibiotic was prescribed for 5 days.[9]

PATIENTS

Basal bone distraction was undertaken in three partially edentulous patients with alveolar defects (Table 1). The 25-year-old woman (case 1) had had an operation for giant cell granuloma at another clinic. The 34-year-old man (case 2) had been operated on for eosinophilic granuloma at our clinic 4 years earlier. Neither of these patients had dentures. The 41-year-old man (case 3) had lost the teeth and the adjacent alveolar bone from his anterior mandible in a traffic crash about 20 years earlier. This patient was wearing a removable partial denture at presentation, and complained about its appearance and function.

All three patients had distraction osteogenesis of the mandibular basal bone to reconstruct the alveolus. Cases 1 and 2 had large defects, so we placed two distraction devices as close to parallel as possible. In case 3, only one centrally placed distractor was required (Figs 1–3).

The procedures were successful in all three cases, with distraction lengths of 11, 13, and 12 mm, respectively. After 19–36 months of follow-up (mean 27.5 months), one implant in case 2 had failed during the osseointegration period as a result of inadequate stability.

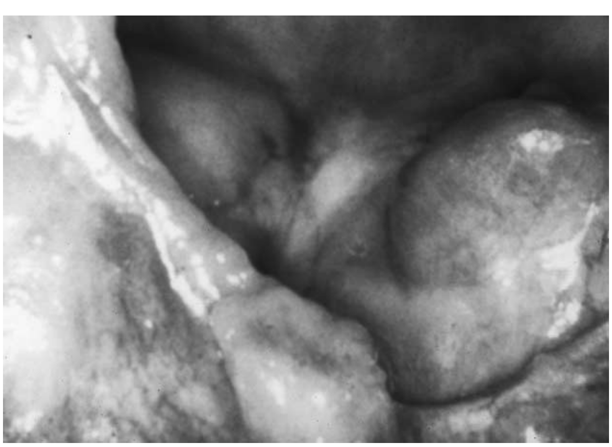

Fig. 1 Severe alveolar deficiency of the anterior mandible as a result of trauma.

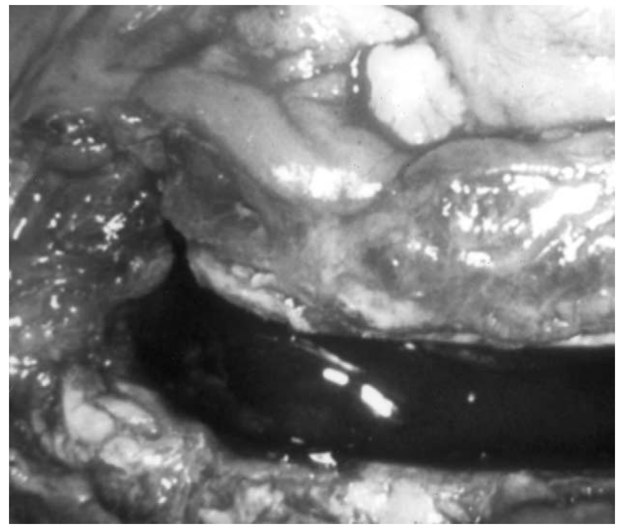

Fig. 2 Operative view showing the horizontal bone incision.

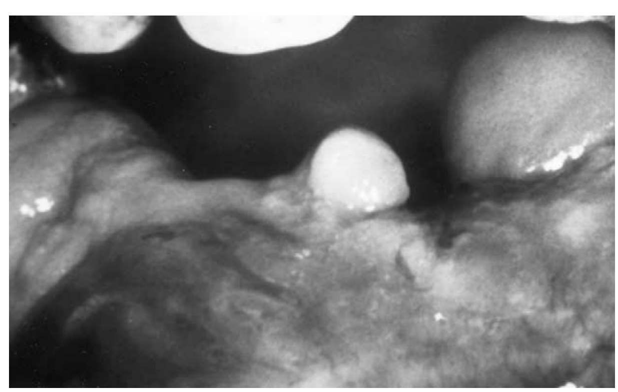

Fig. 3 Intraoral view immediately after removal of rod.

DISCUSSION

By using semirigid distraction devices in three patients who required more than 10 mm of bone distraction, we were able to reconstruct the alveolar structure with basal bone. Preparation of the transport segment and placement of the distraction device(s) in basal bone were more difficult than the corresponding steps in alveolar bone distraction. We ensured that the transport segments were about 4 mm high, as the transport segment consisting of cortical bone alone tended to resorb and at the last stage of distraction there was a risk of fracture from increased tension.[7,10] In preparing a transport segment of basal bone, it is necessary to deal with interference from the muscles that attach to the lingual area of the mandible. This was a major problem in case 3, who had dentoalveolar bone loss as a result of trauma and was treated with one distractor. To deal with this, we supported the distractor with an arch-bar fixed to the teeth adjacent to the edentulous region (Fig. 4). This allowed the distractor to work in the desired direction.

We found that the semirigidity of the alveolar distraction device (Chin system) was advantageous, particularly when two distractors were used. In cases 2 and 3, even though the distractors were not exactly parallel, we had no problems activating them at the beginning of distraction. However, when 10 mm of distraction had been achieved, tension on the non-parallel devices increased. At this point, further activation of the distractors was difficult and the patients complained of pain. In any case that requires more than 1 cm of distraction, distractors with increased rigidity should be considered.[8] However, when rigid systems are used for basal distraction, the vertical and horizontal dimensions of the transport segment may not be adequate for fixation of the device. Another advantage of the Chin system is the control over the direction of distraction in the activation and consolidation periods. The bone moves in line with the principles of the floating bone concept.[11]

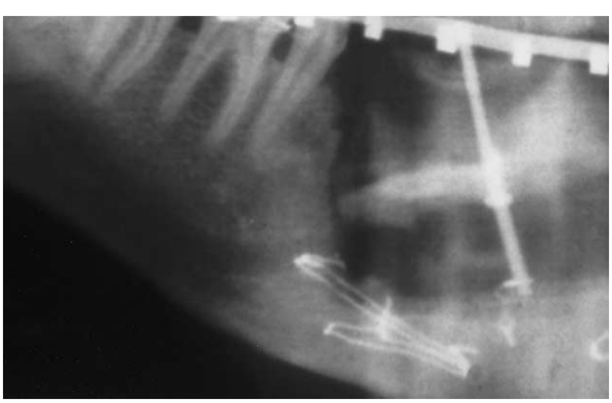

Fig. 4 Repositioning the displaced segment by fixing the rod to an arch-bar. Note the wires that remained from previous treatment of the mandibular fracture.

In all three patients keratinised attached mucosa was totally or partially missing. However, only one patient accepted further surgical treatment to restore keratinised mucosa. All three patients felt some discomfort during the operation, as the bone incision was deep and wide, the insertion of a finger to the genial area to feel the saw blade was disturbing and the duration of the operation was greater than routine alveolar distraction procedures. In case 3, bleeding from the lingual area was controlled by pressure and oxidised cellulose. This bleeding was probably because of the difficulty of genial palpation during some parts of horizontal bone cuts.

Our experience with these three patients shows that distraction of the basal bone of the mandible differs from alveolar bone distraction in the following ways: as there is a risk of resorption of the transported segment because of inadequate spongiosa bone, horizontal osteotomy must be widened as much as possible. However, one must keep in mind that if the remaining bone becomes too thin, the risk of mandibular fracture and nerve damage will also increase.[7] If semirigid devices are used, care must be taken to maintain the desired direction of distraction, particularly in the anterior mandible. In cases of major bone loss, if dental implants are to be placed in the transported bone at the distraction site, long dental implants may be needed to ensure stability. Preparation of the osteotomy site and placement of the distractor may be complicated by intraoperative pain and bleeding.

Various terms have been used to describe aspects of distraction osteogenesis in the alveolar process, namely, alveolar ridge distraction, alveolar distraction osteogenesis, and vertical distraction osteogenesis of the alveolar process. Considering the features of the patients we have presented, we suggest ‘mandibular basal distraction’ as a descriptive term for this procedure.

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