A Simple Solution for Vector Control in Vertical Alveolar Distraction Osteogenesis

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One of the important and frequent complications in alveolar distraction osteogenesis is vectorial change of the transport segment. This report presents a simple solution for vector angulation control by placing intermaxillary fixation screws intraoperatively. Advantages of the technique are also discussed.

Key Words: alveolar distraction, complication, vector, segment, implant

INTRODUCTION

Alveolar bone is affected by various pathologies of the jaw. Pathologies that involve bone volume loss may complicate functional restoration and esthetic outcome. In most cases, surgical correction is required to attain a sufficient quantity of bone before the placement of dental implants. Alveolar ridge defects may be reconstructed using several grafting techniques, including guided bone regeneration, onlay grafting, and interpositional grafting.[1–4] Recently, augmentation of the alveolar bone using distraction osteogenesis has become a useful alternative to grafting.[5,6]

Distraction adds new bone to the alveolar process while enabling the neogeneration of surrounding soft tissue through a mechanism referred to as distraction histogenesis.[7] Vertical alveolar distraction (VAD) adds an adequate amount of bone along with the required soft tissue. To ensure that new bone is positioned suitably for implant placement, it is essential for the distraction device to be properly aligned. However, special care must be taken to control the vector of movement during distraction because even if the distractor is correctly orientated, it is not uncommon for the bone to be misdirected due to the forces exerted by surrounding muscle and tight connective tissue, especially in the symphyseal and maxillary regions.[8]

This study describes the intraoperative placement of intermaxillary fixation screws (IMFSs) as a method of vector control that can be used to direct angulation of the segment during alveolar bone distraction.

PATIENTS AND METHODS

VAD surgery was performed before implant placement on 3 patients (2 male, 1 female; age range, 22–54 years) with insufficient alveolar bone height due to periodontal tooth loss (1 patient); an unsatisfactory, postcancer-surgery iliac crest bone graft (1 patient); and periodontal-related tooth loss, multiple impacted teeth, and cyst surgery (1 patient), as shown in Table 1.

Distraction was initiated at 5–7 days postsurgery, with a rate of 1 mm/day. Total distraction amounts ranged between 12 and 20 mm. Implant surgery for implant-supported fixed prosthetics was performed after a consolidation period of at least 12 weeks.

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TABLE 1

Demographic, etiologic, and surgical details of patients

Patient	Sex	Age, years	Region	Condition	Distraction, mm	No. of implants
1	Male	22	Mandible ant-premolar	Cyst surgery, multiple impacted and periodontally diseased tooth loss	14	3
2	Male	45	Mandible-molar	Loss of teeth as a result of severe periodontal disease	12	2
3	Female	54	Mandible-premolar-molar	Insufficient vertical bone height of iliac crest bone graft after cancer surgery	20	4

Surgical method

Surgery was performed under intravenous sedation and local anesthesia. A horizontal incision between 15 and 20 mm in length was made in the vestibular sulcus 5 mm below the junction of the attached gingival and alveolar mucosa. A subperiosteal dissection was performed below the inferior border of the mandible to identify the neurovascular bundle of the mental nerve and minimize dissection of the crestal front line of the alveolus. Alveolar distraction devices (KLS Martin Track Plus, Jacksonville, Fla, and Medartis Modus, Basel, Switzerland) were contoured to fit the surgical area, and a trapezoidal osteotomy line was prepared using oscillating and reciprocal saws under sterile saline cooling. Holes were drilled for placement of 1.5-mm mono- and bicortical screws to stabilize the device. The distractor device was removed, and a full osteotomy was completed using a spatula osteotome. The distractor was reinserted and stabilized with the screws, and the transport segment was checked for movement. An 11-mm IMFS (Medartis Trauma, Basel, Switzerland) was placed on each side of the distractor near the intersection of the vertical and horizontal osteotomy lines. A 0.3-mm wire was attached to one IMFS, drawn over the distraction device rod and attached to the other IMFS, laid carefully on the rod, and then tightened to elevate the distractor to the correct angle (Figure 1). Connections between the wire and the screws and the wire tension were tested; any possible mucosal irritations caused by the wire or screws were controlled for during the procedure, and a tension-free primary closure was achieved using 4.0 propylene horizontal mattress sutures.

The patient was given postoperative instructions regarding diet and prescribed nonsteroidal anti-inflammatory drugs for analgesia. Patients were also prescribed oral penicillin (1 g, 2× daily) for 7 days and instructed to use a chlorhexidine gluconate mouthrinse (15 mL, 2× daily) for 2 weeks postoperatively.

No complications were observed during latency, distraction, or follow-up periods. Screws and wire tension were checked every 2 days during distraction and consolidation to control for vectoral changes of the segment, and the wire was

FIGURE 1. Location of the screws and wire connection in relation to the distraction device on the model.

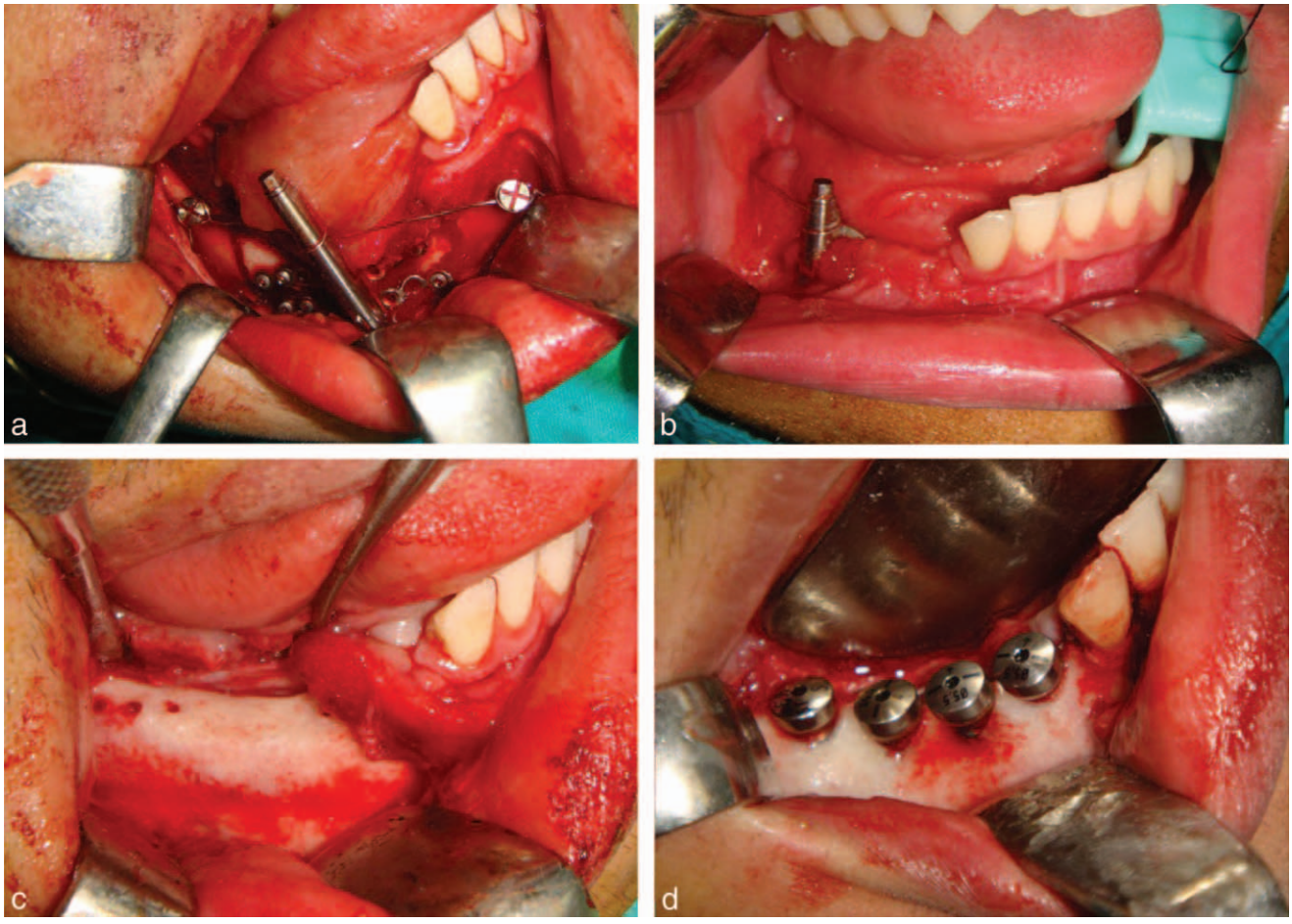

Figure 2. A patient treated with vertical alveolar distraction in the posterior mandible. (a) Intermaxillary fixation screws and wire used simultaneously to prevent rod tipping. (b) Proper orientation of the transport segment at the end of consolidation. (c) Excellent bony healing for implant insertion observed at re-entry. (d) Implant inserted as desired.

compressed or released as necessary. At the end of the latency period, vectoral changes were mitigated in all three patients, and dental implants were placed successfully, with adequate bone height and at the ideal vector to the occlusion (Figure 2).

Discussion

Despite the suggestion that surgical correction of alveolar defects using vertical distraction osteogenesis offers no great advantages over other augmentation techniques,[9] VAD still seems to be the only technique able to achieve improvements in soft tissue without the need for additional surgery or material.

VAD is a somewhat more complicated procedure than other bone augmentation techniques, requiring detailed planning, step-by-step implementation of surgical procedures, appropriate timing of the different stages of treatment, and sufficient patient motivation for enduring discomfort caused by the distraction device. The success of occlusal rehabilitation requires insertion of the implant along the correct axis within the vertically reconstructed bone.

Unwanted changes in the transport segment vector during distraction are a frequent complication, occurring most often with more atrophic mandibles, and such changes have been attributed to lingual muscular traction.[10–14] These complications usually require secondary surgical correction, which increases the overall cost of treatment, and may be difficult for patients to accept after a long period of rehabilitation.

Several solutions have been reported to handle this problem. Bidirectional distractors are available and have been suggested as a means of steering the distraction rod along the desired vector; however, these devices may not always be success-

ful. Numerous studies have shown that neither juxtaosseos nor intraosseous devices can prevent vectoral changes.[9,15–22] Recently, studies have reported on the use of a custom-made acrylic device or screw-supported orthodontic traction to reorient the segment into the correct position at the end of the distraction period.[23,24] However, the literature contains few reports on preventing and/or correcting vectoral changes of the transport segment throughout the entire course of the distraction process, from surgery through consolidation. The technique reported here offers a simple solution for both the prevention and correction of vectoral deviation in all stages (latent, distraction, and consolidation) of VAD.

VAD requires regular follow-up sessions to adjust the wire traction forces to correct any vectoral changes. Given their relatively small size in comparison to the distraction hardware in the mouth, the IMFS heads should be well tolerated by patients; however, care should be taken when placing the screws so as to avoid damaging adjacent anatomical structures. The procedure described here involving the use of IMFSs together with wire traction of the distractor rod to guide it along the desired axis during the distraction stage and to realign any deviated segments during the consolidation period was found to be an effective and useful method for preventing vectoral deviation, and it is relatively easy to implement and cost-effective compared with other surgical and nonsurgical interventions. However, the procedure is somewhat more complicated than the procedures that involve VAD solely; so, trained professionals would be able to get better results.

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