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CASE SERIES

Sagittal Distraction of Edentulous Maxillary Skeletal Base Prior to Implant Therapy

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ABSTRACT

Edentulous patients presenting with atrophic ridges and severe prognathic ridge relation are difficult to rehabilitate. Correction of the malrelation of the jaws is an absolute prerequisite for their successful prosthetic rehabilitation. A majority of the established surgical techniques to correct combined sagittal and vertical discrepancies of edentulous jaws are often prolonged and complex with attendant morbidity. However, distraction of the edentulous atrophic maxilla by an internal appliance has been found to be a simple, predictable and stable option for the treatment of these patients. This article presents a report of sagittal distraction of edentulous maxillary skeletal base to correct preprosthetic ridge discrepancies in two patients.

Keywords: Edentulous, Distraction osteogenesis, Internal distractors, Preprosthetic surgery, Ridge resorption.

INTRODUCTION

The resorption pattern of the maxilla and mandible vary. With progressive resorption, the maxillary arch becomes narrower and the mandibular arch becomes broader.[1,2] Residual ridge resorption in the anterior maxilla occurs mostly on the labial and inferior aspects of the alveolar ridge so that the crest moves posteriorly. Upper lip support is progressively lost as the anterior maxilla decreases in size. This, combined with a relative anterior movement of the mandibular ridge, results in a Class III facial form and ridge relationship. The reduction of the lower facial height associated with advanced jaw atrophy, and overclosure of the mandible brings about an increase in chin prominence. The facial alterations that accompany ridge resorption includes loss of nasolabial and labiomental support, collapse of facial muscles leading to obtuse nasolabial angle and decreased commissure width.

An edentulous patient may present with a mandibular prognathism due to normal resorption pattern which creates a prognathic tendency or due to a developmental deformity. Mild skeletal base discrepancies are generally well camouflaged in the dentate patient due to dentoalveolar compensation.[3] The excessive proclination of maxillary anterior teeth and the retroclination of mandibular anterior teeth contribute towards this concealment. However, when these patients become edentulous, the malrelationship of the arches become prominent.

The aim of maxillofacial rehabilitation is to provide the best possible quality of life, which includes restoration of form and function in a stable manner. Severe maxillo-mandibular malrelations compromise denture function, stability and esthetics.[4] The abnormal ridge relationship transmits an excessive maxillary load to the anterior maxillary denture base producing increased maxillary alveolar bone resorption and abnormal mobility of the soft tissues. One of the main criteria for preventing this is to provide an orthoalveolar ridge form.[5] It is defined as idealized alveolar bone positioned in class I relation axially aligned with the opposing arch.

There have been many techniques for the vertical augmentation of the atrophic ridges, and have been extensively described by many authors.[6,7] However, the sagittal corrections of the malopposed ridges have received far less attention. Combined treatment of the sagittal and vertical discrepancies of the edentulous ridges has been most popularly treated using a Le-Fort I osteotomy with interpositional bone grafting.[8-10] Hierl et al[11] have described the use of an external distraction device to correct ridge relations by anteriorly distracting the maxilla, and recently Malik et al[12] has described a technique using internal distractors.

Distraction osteogenesis using internal devices at the Le-Fort I level is a well-accepted method of correcting sagittal discrepancies in cases of dentate maxillary hypoplasia with stable long-term results.[13-15] This article aims to describe a simple and stable method of correction of edentulous, severely retruded maxilla (more than 15 mm) by sagittal distraction of edentulous maxillary dentoalveolus at the Le-Fort I level to correct preprosthetic ridge discrepancies.

PATIENTS AND METHODS

Two patients with severe reverse jet of the edentulous arches had reported to the surgical department because they could not be satisfactorily treated with compete dentures without correction of the adverse maxillomandibular relationship. Both the patients were conscious of their appearance and

had revealed that they thought they had a larger lower jaw, which became evident when their teeth were lost. One patient had rheumatoid arthritis and was under prednisolone therapy. The protocol for management of these patients consisted of a preoperative diagnostic and prosthodontic phase (including preparation of guiding splint) followed by a surgical phase of Le-Fort I osteotomy and distraction, and then a follow-up and final restorative phase.[12]

Preoperative Prosthetic and Diagnostic Phase

Clinical assessment of the patients revealed reverse jets of 15 and 17 mm. Panoramic radiographs, lateral cephalogram with tracings and CT scans with 3D reconstruction were obtained.

Diagnostic casts were prepared which were mounted on semiadjustable articulators to evaluate the interarch relationship. It was then decided to surgically advance the maxilla at the Le-Fort I level using internal distraction devices.

Preparation of Guiding Splint

For optimal planning and to assess the progress and stability of the end procedure, guiding splints were fabricated on both the arches. Impressions were taken with relief given in the area of the tuberosity and in the upper buccal flange to accommodate the distraction device. Casts were poured and articulated at the optimum vertical relation using a semi-adjustable articulator (H2 Hanau, Hanau Eng. Co., Buffalo, New York, USA). A pair of trial acrylic dentures was prepared. Another pair of working dentures were prepared with only the anterior teeth arranged with a flat occlusal posterior bite plane. The anterior teeth brought about the esthetic component as well as the evaluation of the progress of distraction. The posterior surfaces were left flat for smooth distraction without any occlusal interference. A radiopaque marker was placed in the midline and occlusal plane, so that it would be discernible during radiographic assessment.

Surgical Phase and Distraction

The operations were performed under general anesthesia with nasoendotracheal intubation. The upper and lower guiding splints were wired to the maxilla and mandible using peralveolar and circummandibular wiring. Two maxillary vestibular incisions were made on either side along with a small midline incision with minimal periosteal stripping for access. Standard Le-Fort I level osteotomies were performed and the edentulous maxilla downfractured. Two indigenous, intraoral maxillary distractors (AK Instruments, Mumbai, India) were adapted on each side with anchorage on the superior aspect at the zygomatic buttress region and inferiorly fixed to the residual ridge below the transverse osteotomy cut using monocortical screws (Fig. 1). The vector of distraction was planned to be in an anterio-inferior direction by having a similar angulation during osteotomy and device placement. All patients received Ampicillin 500 mg/IV/6 hourly and Gentamycin 3 mg/kg/day immediate preoperatively and postoperatively for 5 days.

Fig. 1: Stainless steel internal maxillary distraction device. Internal maxillary distraction device in place following Le-Fort I osteotomy. (Also published in[12] Malik NA, Kumar VV, Bora P. Le-Fort I distraction osteogenesis of the edentulous maxilla. Int J. Oral Maxillofac Surg.2010. doi:10.1016/j.ijom.2010.09.024)

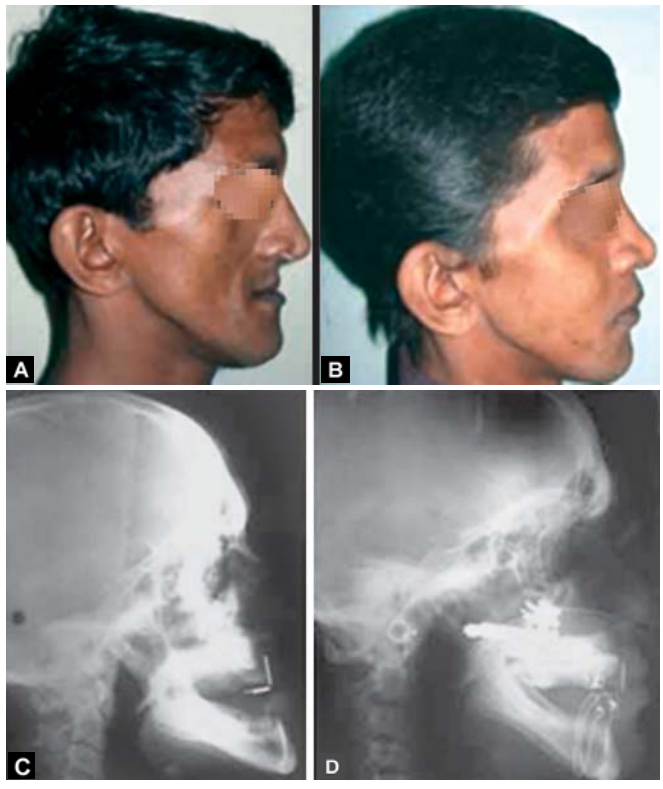
After a latency period of five days, distraction was commenced by turning the distraction rods at a rate of 1 mm daily till the ideal sagittal relationship was achieved. A slight overcorrection of 1 mm was performed. Lateral cephalograms and panoramic radiographs were taken postoperatively on completion of distraction, on removal of the device, and one year postdistraction.

Follow-up and Final Restorative Phase

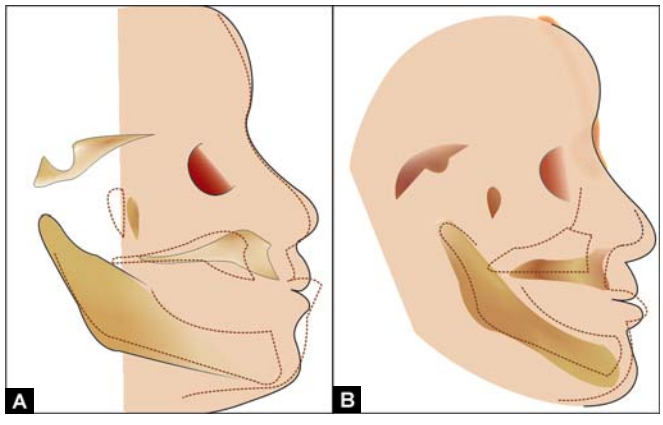
Both the patients treated by intraoral distractors demonstrated marked advancement of the maxilla and correction of the inter-ridge discrepancy. Distraction of 16 mm (Figs 2A to F) was carried out on one and 18 mm on the other (Figs 3A to D), both patients undergoing 1 mm more than what was originally planned. They were discharged from the hospital in 5 days. Postoperative healing was uneventful. The appliances were removed after a consolidation phase of 4 months using the same intraoral incisions and examination of the distracted region revealed good bone formation. Final dentures were fabricated after 2 months of distractor removal. Lateral cephalograms taken one-year postsurgery showed stability of the procedure (Figs 4A and B).

Conventional complete dentures were provided with ideal ridge relation and the patients could eat, drink and speak efficiently. There was a pronounced improvement of the esthetics, self-esteem and quality of life of the patients.

Figs 2A to F: Patient 1 (A) preoperative frontal profile, (B) postoperative frontal profile, (C) preoperative lateral profile, (D) postoperative facial profile, (E) preoperative 3D CT scan of facial profile, (F) postoperative 3D CT scan of facial profile. (Also published in[12] Malik NA, Kumar VV, Bora P. Le Fort I distraction osteogenesis of the edentulous maxilla. Int J. Oral Maxillofac Surg.2010. doi:10.1016/j.ijom.2010.09.024)



Figs 3A to D: Patient 2 (A) preoperative facial profile, (B) post distraction facial profile, (C) preoperative lateral cephalogram, (D) postdistraction cephalograms with the appliance



Figs 4A and B: Super-position drawings of lateral cephalograms; preoperative (dashed light line) and one year postoperative (bold dark line). (A) Patient 1, (B) Patient 2

DISCUSSION

Rehabilitation of the edentulous patient with atrophic alveolar ridge presents a formidable problem for the prosthodontist and the surgeon, especially when compounded with severe interarch discrepancy. Various modalities to treat atrophic ridges include onlay bone grafting, interpositional bone grafts with osteotomies[4,6] and distraction osteogenesis. Most of these have been used for the vertical augmentation of atrophic ridges.

Onlay bone grafting to correct sagittal discrepancies is not considered a good method due to its rapid resorption, where 50 to 70 percent of the bone may be resorbed in the first year itself.[4] Pain, ulceration, and exfoliation of necrotic bone are also common. Remodeling of the onlay graft to produce a smooth layer of bone below the mucosa often takes a long time, and sequesteration of small amounts of bone occurs over several months.

The technique of interpositional bone grafting, where a corticocancellous block graft taken from the iliac crest is

interposed between the two fragments following Le-Fort I osteotomy and downfracture, is a well-accepted procedure and the results found to be relatively stable.[4,16,17] Sailer[8] reported on the treatment of atrophic maxilla in a Class III relationship, using bone grafts to the floor of the nose and maxillary sinus after a Le-Fort I osteotomy and inferior repositioning followed by immediate implantation of endosseous implants. This has been a popular method with the advantages of early rehabilitation of the patient in a single operative procedure.[9,10] However, this is a technically challenging procedure with an operating time of around 8 hours even by experienced hands.[10,18] There is also substantial donor site morbidity and discomfort because both medial and lateral dissections are required to procure a bicortical graft. To provide excellent stability, a horseshoe shaped bicortical graft has to be procured, which increases the operative time and donor site morbidity even further. Few authors have modified this procedure by using corticocancellous grafts and inserting implants at a later stage.[19,20] They opine that the placement and angulation of the implants can be better controlled if done at a later date and also reducing the chances of ischemic necrosis. However, this technique renders the patient without dentures for a substantial amount of time and the morbidity of donor site still exists.

Distraction of the maxilla in a sagittal plane has been a well-documented treatment modality for the correction of maxillary hypoplasia in dentate patients as well as for vertical augmentation of edentulous resorbed ridges. Distraction eliminates the need of bone grafts and also provides a stable long-term result.

Distraction has been used to correct sagittal discrepancies in thin, knife edged, anterior maxillary ridges by a segmental split osteotomy and distracting the buccal segment anteriorly as well as for correction of malposition of implants in a three-dimensional manner.[21] These procedures can only be applied to localized areas of the deficient maxilla and cannot be used to correct severe reverse jet in patients with large discrepancies.

Hierl et al[11] have corrected retruded atrophic maxillas by using an external distraction appliance. External distraction devices are cumbersome, may produce an external scar and can bring about physical, psychological and esthetic discomfort for the patient.[15]

The patients treated in this series had large reverse jets of 16 and 18 mm. To correct the ridge relationship using bicortical interpositional grafts would mean that a large amount of bone would be required with an extensive dissection. This would bring about considerable donor site morbidity and could definitely not be applicable to one of our patients who was suffering from rheumatoid arthritis with attendant restricted movements. The patients had a pair of dentures during the procedure, which negated the concerns of not being without one for prolonged periods of time. Le-Fort I distraction is a relatively simple procedure, which does not require a large operative time and is technically easy to perform. Internal devices are more 'patient friendly' than their external counterparts, and the patients could move around freely in social circles even during the phase of distraction and consolidation.[12,13] The vector was decided on careful assessment of the relative amount of vertical and horizontal movement required. In both our cases we had encountered visibly healthy bone regenerations during the removal of the distraction device and found no relapse when comparing the denture occlusion at one year follow-up. Both the patients still use the first pair of dentures that were fabricated confirming the stability of the result.

The technique of Le-Fort I distraction of the edentulous maxilla using an internal device is potentially a predictabe, stable, simple, and convenient option for the correction of severe unfavorable intermaxillary relations especially in old, medically compromised patients.[12] However, this study consisted of only two patients and to establish this method, it has to be performed on more patients with long-term follow-up.

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