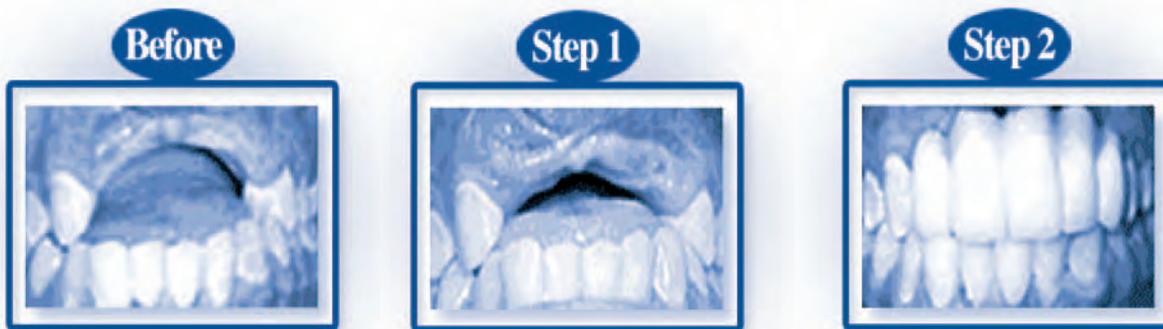


## Augmentation in Two Stages of Atrophic Alveolar Bone Prior to Dental Rehabilitation: A Case Report

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### Abstract

**Aim:** The aim of this report is to describe a significantly deficient case of alveolar bone that was managed by alveolar bone augmentation using a technique of distraction osteogenesis and onlay bone grafting prior to dental implant placement.

**Background:** Injury to the teeth and alveolar ridge of the maxillary anterior region can cause a severe alveolar ridge deficiency resulting in ridge atrophy and maxillary retrognathism. The loss of these teeth and alveolar bone together with fibrotic scar formation can result in adverse changes of the interarch space, occlusal plane, arch relationship, and arch form which complicates rehabilitation and can compromise the esthetic outcome. While implant dentistry has become a new paradigm in oral reconstruction and replacement of missing teeth, ideal implant positioning can be compromised by inadequate alveolar bone in terms of bone height, width, and quality of the bone itself. Correction of osseous deficiencies with ridge augmentation allows ideal implant placement and creates a more natural soft tissue profile which influences crown anatomy and esthetics.

**Report:** A 20-year-old female presented with a complaint of poor esthetics resulting from oral injuries incurred in a traffic accident six years previously. In addition to a mandibular parasymphiseal fracture, five maxillary anterior teeth and the most of the alveolar ridge were lost. Clinical examination revealed severe loss of bone in the maxillary anterior region, an absence of a labial sulcus, loss of upper lip support, and a slight over eruption of the mandibular anterior teeth. In preparation for dental implants a distraction osteogenesis surgical procedure was done to lengthen the height of the alveolar ridge. After a three-month healing period, the width of the residual ridge was found to be insufficient for implant placement. To correct this deficiency, a bone graft

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of a corticocancellous block was harvested from the chin and fixed to the labial aspect of the ridge. To facilitate revascularization, small perforations were made in the cortical bone of the alveolar ridge at the recipient site before cancellous bone retrieved from the donor site was gently placed between the bone block and the ridge. The patient was then appropriately medicated and healing was uneventful. After three months, the width of the residual ridge was assessed to be adequate for endosseous implants.

**Summary:** The clinical result reported here has shown several procedures may be necessary for the rehabilitation of a trauma patient. Distraction osteogenesis per se may not always satisfactorily improve the anatomical alveolar anatomy but it has advantages over other methods of augmentation. It can improve the height and also expand the soft tissue for further bone grafting. Augmentation of the alveolar bone with an onlay bone graft often provides the desired gain of bone, allows for the ideal placement of dental implants, and improves any discrepancy between the upper and lower arches.

**Keywords:** Ridge augmentation, distraction osteogenesis, atrophic alveolar bone, osseointegration, dental implants

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## Introduction

Injury to the alveolar ridge of the anterior maxilla causes severe alveolar ridge deficiency in horizontal and vertical directions that commonly result in alveolar ridge atrophy and maxillary retrognathism.<sup>1,2</sup> The loss of teeth and alveolar bone together with fibrotic scar formation and the likely changes in interarch space, occlusal plane, arch relationship, and arch form make rehabilitation very difficult and may compromise the esthetic outcomes of any treatment.<sup>3</sup> While dental rehabilitation of such cases is believed to be a complicated procedure requiring multidisciplinary approaches,<sup>4</sup> implant dentistry has become a new paradigm in oral reconstruction and replacement of missing teeth.<sup>5</sup> However, ideal implant positioning can be compromised by inadequate alveolar bone height, width, and quality of bone. Correction of osseous deficiencies using ridge augmentation provides for ideal implant placement and the creation of a more natural soft tissue profile which facilitates favorable crown anatomy and, consequently, the esthetics.<sup>6</sup> The foundation for success of osseointegrated implants is improved through the restoration of the bone-deficient site prior to placement of the implants. Several techniques have been described for augmentation of narrow alveolar ridges. Among them are distraction osteogenesis for bone and soft tissue lengthening and autogenous bone grafting.<sup>7</sup>

The aim of the present report is to describe a significantly deficient case of alveolar bone which was managed by alveolar bone augmentation using a technique of distraction osteogenesis and onlay bone grafting prior to dental implant placement.

## Case Report

### History

A 20-year-old female concerned about the appearance of her dentition presented to the College of Dentistry at King Saud University for treatment. She had a road traffic accident six years previously resulting in loss of teeth numbers,<sup>7,8,9,10,11</sup> and the alveolar ridge of the anterior maxilla. She had sustained a parasymphysial mandibular fracture, which had been fixed with interossous wire. At the same time, the maxillary anterior injury was debrided and surgically repaired. Three months later the missing teeth were replaced with a removal partial denture.

### Diagnosis

The clinical examination revealed severe bone loss of the alveolar ridge of the maxillary anterior region, an absence of a labial sulcus, a loss of upper lip support, and a slight over eruption of the lower anterior teeth (Figure 1). A horizontal

deficiency of the anterior region of maxilla was represented by bone loss in anterior-posterior dimension, which significantly compromised the smile line. It appeared neither a removable nor a fixed prosthesis would yield satisfactory results without corrective surgery of the alveolar bone.

### Treatment

Two surgical procedures were required to prepare the maxillary anterior region prior to the placement of dental implants.

During the first surgery the patient underwent a surgical procedure designed to lengthen the height of the alveolar ridge by means of distraction osteogenesis. A vestibular incision was made and a full thickness mucoperiosteal flap was elevated. A horizontal osteotomy was performed 4-5 mm below and parallel to the nasal floor followed by two vertical osteotomies deep across the alveolar ridge in a slightly divergent pattern (Figure 2).

The osteotomies were performed using a fissure bur and an oscillating saw. A small bone chisel was used to mobilize the alveolar bone segment without damaging the palatine mucoperiosteum. The location of the horizontal osteotomy was calibrated by deterring enough bone to accept the screws for the distracter and the transport plates. The two components of a Martin distracter device (KLS Martin, Jacksonville, FL, USA) were positioned horizontally and in contact with the labial aspect of the atrophic alveolar ridge and secured with 1.2 mm screws. Distraction allowed for a 10 mm increase in height of the alveolar ridge and associated soft tissue. The height of the transport segment was more than 6 mm, which allowed adequate fixation of the device with no risk of fracture (Figure 3).

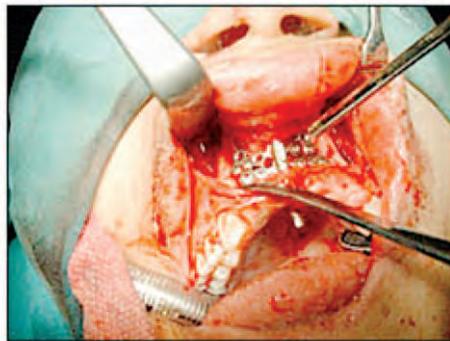
The mobility of the transport segment was confirmed with the device activation test, and the surgical wound was sutured with 3-0 Vicryl sutures. The patient was given postoperative instructions and a course of antibiotics was prescribed. The postoperative course was uneventful. After a seven-day latency period, the alveolar bone was distracted 0.5 mm vertically twice a day for ten days. There was no evidence of infection or breakdown of soft tissue during the distraction period or thereafter. A comparison



**Figure 1.** Severe bone loss secondary to an alveolar ridge injury and loss of maxillary anterior teeth.



**Figure 2.** Osteotomy lines of the alveolar ridge prior to the distraction osteogenesis.



**Figure 3.** Distractor device *in situ*.

of pre-distraction and post-distraction revealed almost 10 mm lengthening of the segment vertically (Figure 4).

Unexpectedly, the width of the residual ridge fell short of preoperative estimates and was found to be insufficient for implant placement following the completion of distraction and a three month consolidation period. To correct this deficiency a second surgery was done to



**Figure 4.** The gain of hard and soft tissue after distraction osteogenesis.



**Figure 5.** Onlay bone graft in recipient site.



**Figure 6.** Residual ridge prior to dental implant.



**Figure 7.** Dental implants with their abutments in acceptable locations and alignment.



**Figure 8.** Final prosthesis in place.

harvest a cortiocancellous block of bone from the patient's chin to use as an onlay graft. The bone block was attached to the labial aspect of the maxillary anterior alveolar ridge using two 1.5 mm self-tapping titanium screws. To facilitate revascularization small perforations were made into the recipient site. Additional cancellous bone retrieved from the donor site was gently compacted against the perforated alveolar ridge and the bone block graft (Figure 5). The patient was then appropriately medicated and healing was uneventful.

After four months, the width of the residual ridge was assessed to be adequate for endosseous implants (Figure 6).

#### **Implant Placement**

A rectangular incision was made and a full thickness flap was reflected to expose the grafted bone. The bone graft was found to be well developed, and three (ITI) osseointegrated screw fixture implants of approximately 13 mm in length and 4.1 mm in diameter were placed using a pre-constructed surgical stent. Implants were placed using a conventional one stage protocol, and they all met initial implant stability requirements (Figure 7).

Four months later the implants were judged to be well integrated so as to be connected to the conical abutment. A porcelain fused to metal (PFM) screw-retained prosthesis was then fabricated and used to restore the occlusion. No significant marginal bone resorption was seen in the augmented bone after implant placement. After completion of the PFM, the peri-implant bleeding and pre-implant probing depth were frequently assessed at regular intervals and found to be clinically satisfactory. The prosthetic treatment achieved created the overjet and overbite with a significant improvement in esthetics acceptable to the patient (Figure 8).

## Discussion

The introduction of implant dentistry has remarkably expanded the use of fixed dental prosthetics even for compromised cases. Nevertheless, several factors should be considered to achieve optimal esthetics and function such as the presence of adequate alveolar bone height and width and the quality of bone itself.<sup>2</sup> Absence of one or more of these factors will inevitably compromise an ideal dental implant and jeopardize the clinical outcome. Although implant dentistry has proven to be highly predictable, the success rate in extremely compromised cases is debatable. As a result, it is necessary to develop an acceptable protocol for treatment in order to achieve predictable functional and esthetic outcomes.<sup>5</sup>

Alveolar ridge augmentation is an extremely elaborate process which is required to favorably restore the anatomical architecture of the alveolus and the interarch relationship in order to create a healthy environment for placement of endosseous implants of maximal size and at the optimal axial inclination.<sup>8</sup> A severely resorbed alveolar crest is considered a difficult condition to rehabilitate, but different procedures for pre-prosthetic bone augmentation are available to improve the condition in preparation for conventional restorative treatment.<sup>7-11</sup> These procedures include the autogenous particulate/block bone graft, guided bone regeneration, allograft, and xenografts to regenerate alveolar bone.

Over the past few years, alveolar ridge distraction has become a useful technique for ridge augmentation. This technique produces new bone by local guided bone regeneration without the necessity of bone transplants.<sup>12</sup> It has been used successfully for the correction of alveolar ridge defects in cases of severe resorption of maxillary and mandibular bone especially in cases of post-traumatized alveolar bone deformity. It has the advantage of being a versatile technique that can be used in combination with other procedures such as the split technique in the alveolar bone.<sup>11,13,14</sup>

In the present case, the post traumatic bone resorption caused severe alveolar ridge deficiency in both horizontal and vertical directions resulting in an inadequate height of the alveolus and maxillary retrognathism. Restoration of the missing teeth with dental implants or with conventional

removable or a fixed prosthesis without first correcting the anatomy of the alveolar bone would result in a poor esthetic outcome.

The treatment plan in this case was to perform lengthening of the alveolar ridge utilizing the technique of distraction osteogenesis. The advantage of this technique was the likely osteogenesis and the simultaneous expansion of the associated soft tissue.<sup>6</sup> Although the consolidation period for optimum bone maturation of distracted segment is unclear, waiting eight to 12 weeks after completion of distraction before placement of implants is recommended.<sup>15</sup> The alveolar ridge height of the patient in the present case was remarkably improved by about 10 mm after distraction. However, when the patient returned for the implantation procedure, the alveolar crest was too thin in the anterior-posterior dimension to accommodate the implant fixtures. Bone resorption of the transport segment after alveolar distraction is understandable because reflection of the periosteum can lead to the blocking of the blood supply.<sup>16,17</sup>

The clinical picture in this case was further complicated by the discrepancy between the upper and lower arches due to labial bone resorption. The technique used to resolve this problem was the ridge augmentation using an autogenous bone graft which uses material with osteogenic and osteoconductive properties and the ability to resist soft tissue pressure.<sup>6</sup> The procedure was aimed at increasing the alveolar bone width in the anterior posterior dimension. Bone reconstruction was carried out using an onlay made from a corticocancellous bone block harvested from the mandibular symphysis area of the patient. Several factors influenced the donor site selection such as anatomic limitation, access convenience, and proximity to implant site. Vies et al.<sup>18</sup> and others<sup>19</sup> suggest bone harvested from the mandible produces the highest amount of bone gain as a result of minimal resorption, early revascularization, and the potential incorporation in the maxillofacial region and biochemical similarity. Moreover, a corticocancellous bone block is said to be able to withstand the forces of mastication after placement of dental implants and prosthetic reconstruction.<sup>8</sup> This is consistent with a high success rate for long span augmentation, especially when it is used for only grafting.<sup>20</sup>

While the extrusion of the lower incisors was minimal, orthodontic intrusion of incisor teeth appeared to be redundant in the present case. Similarly, the discrepancy in the intermaxillary relationship was corrected with onlay labial augmentation of the alveolar ridge. A Le Fort I osteotomy, a procedure routinely prescribed for edentulous patients with retrognathic maxilla,<sup>21</sup> was found to be unnecessary in this case. The distraction procedure utilized at the first stage of treatment allowed tissue expansion for bone grafting which might be essential when there is limited space for augmentation because of scar tissue.<sup>22</sup>

Although the success rate of endosseous implants placed in distracted bone of an alveolar ridge is not widely reported,<sup>3</sup> enhancement of the alveolar ridge improves the crown-implant ratio by

increasing the implant dimension and decreasing the crown dimension allowing the placement of a wider and longer implant in a better trajectory.<sup>4</sup>

### Summary

The clinical result reported here has shown several procedures may be necessary for the rehabilitation of a trauma patient. Distraction osteogenesis per se may not always satisfactorily improve the anatomical alveolar anatomy but it has advantages over other methods of augmentation. It can improve the height and also expand the soft tissue for further bone grafting. Augmentation of the alveolar bone with an onlay bone graft often provides the desired gain of bone, allows for the ideal placement of dental implants, and improves any discrepancy between the upper and lower arches.

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