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RESEARCH ARTICLE

A Comparative Study to Assess the Quality of Bone following Ridge Augmentation with Autografts and Allografts: A Prospective Study

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ABSTRACT

Aim: The aim of this study was to investigate the quality of bone at the augmented site in the anterior maxilla and mandible.

Materials and methods: Ten patients with inadequate bone for implant placement were included in this study. Of these 10 patients with inadequate bone volume, five were chosen to be treated with autogenous bone grafts (AT) and rest five patients were treated with freeze dried corticocancellous allografts (AL). Three months following grafting, biopsies of the grafted area were obtained using a 3 mm trephine bur and were histologically evaluated.

Results: Histological analysis revealed areas of new bone formation with thick trabeculae with lacunae containing osteocytes in the autogenous group, whereas the allograft group showed segments of necrotic bone with empty lacunae. Although, the AL group has an inherent advantage of avoidance of a secondary surgical site, showed decreased bone remodeling as compared to the autografts.

Conclusion: All the 10 patients underwent implant placement. The reports regarding the nature of bone obtained during implant placement clearly depicts a comparable histological variation at the grafted site.

Keywords: Autografts, Allografts, Ridge augmentation, Chin graft.

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INTRODUCTION

Oral rehabilitation with dental implants in partially and completely edentulous patients has been practiced for decades and has unveiled remarkable results.[1] Adequate implant stability, ample bone width and bone quality are the three elements influencing the success of implant surgery. Conditions like congenitally missing teeth, dentoalveolar trauma, infection, periodontitis, traumatic extraction, are the main causes of inadequate bone volume. Substantial resorption of alveolar bone upto <4 mm in width and <7 mm in height makes implant placement strenuous. Reduction of 40% in alveolar ridge height and 60% in ridge width was estimated within the first 6 months of tooth exfoliation.[2]

Bone augmentation procedures are necessary to reconstruct the deficient alveolar ridge. Autogenous bone graft is the 'Gold Standard' in alveolar bone augmentation. They are harvested intraorally from the maxillary tuberosity, mandibular ramus and symphysis, whereas the extraoral sites are the calvarium, iliac crest and the tibia.[3] Autogenous bone grafts carry the inherent advantage of osteogenic property. Mandibular symphysis is the most available source of corticocancellous bone graft with an edge over the rest due to the ease of access, relatively short operating time, less morbidity in the donor site.

The second material of choice is the allograft, harvested from a cadaveric source or another individual of the specie. The main advantage is the reduced surgical time and avoidance of surgical site.[4]

Clinical evaluation of the reconstructed ridge is not an indicative for the quantity and quality of bone available for implant placement. Histopathological examination is necessary to make an objective evaluation of bone in terms of healing, nature of bone and remodeling.

The aim and objective of this study was to assess the fate of autografts and allografts using histopathological examination to evaluate the quality of bone at the time of dental implant placement.

MATERIALS AND METHODS

A total of 10 patients (all were men, 19-30 years), who required dental rehabilitation with dental implants and had at least one site with deficient (< 4 mm in width) ridge in the anterior maxilla or mandible in the labio-palatal or labio-lingual aspect were planned and treated by ridge augmentation. Of these, five were treated with autogenous grafts (AT, mandibular symphysis) and the rest five with allografts

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(AL, freeze-dried mineralized corticocancellous). All patients had signed the written informed consent form prior to the procedure. Treatment allocation was randomly assigned.

Following administration with local anesthesia, a crestal incision with relieving incisions were made to expose the defect (Fig. 1). Fine burs were used, under copious irrigation, to allow the vascularization into the grafts. Bone grafts were then obtained from parasymphysis via an intraoral approach (Fig. 2). In the AL group, cortical bone blocks were hydrated by immersing them in saline solution for 10 minutes before the surgical procedure. The extent of the defect was measured with a help of a caliper and a template made of foil. Bone blocks were smoothed and contoured to avoid perforation of the flap and fit the defect. Block grafts were stabilized with 2 mm titanium screws (Fig. 3). Closure was done using 4-0 Vicryl resorbable suture.

Implant placement was planned after 90 days of ridge augmentation. Biopsies were obtained from the grafted bone area. A 3 mm trephine bur with copious saline irrigation was used initially at the implant site. The trephined bone measured approximately 2.8 mm outer diameter and 6 to 8 mm and was fixed in 4% formalin solution. The specimens were stored for 1 hour in commercially available decal solution, Osteomoll®, Merck Millipore, Germany. Tissue sections (4 μm) were made and routine hematoxylin and eosin (H&E) staining was done. The slides were cleared in two changes of xylene and slides were mounted with digital picture exchange (DPX).

RESULTS

Specimens corresponding to chin grafts showed thick trabeculae, with lacunae containing osteocytes, and were considered morphologically viable. A regular layer of osteoblasts were noticed, where bone formation was exuberant (Fig. 4). Few sections showed resorptive margins (baylike area containing osteoclasts) containing inflammatory cells mainly plasma cells and lymphocytes. Evident reversal lines

Fig. 1: Alveolar defect exposed

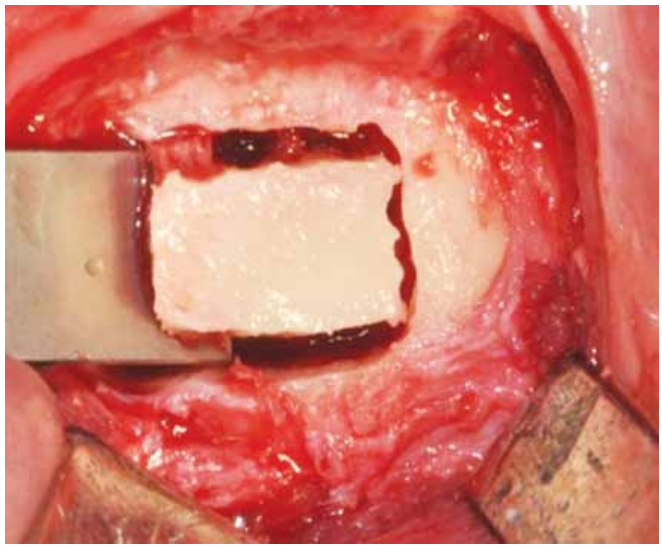

Fig. 2: Harvesting of chin graft

Fig. 3: Graft stabilized with 2 mm titanium screw

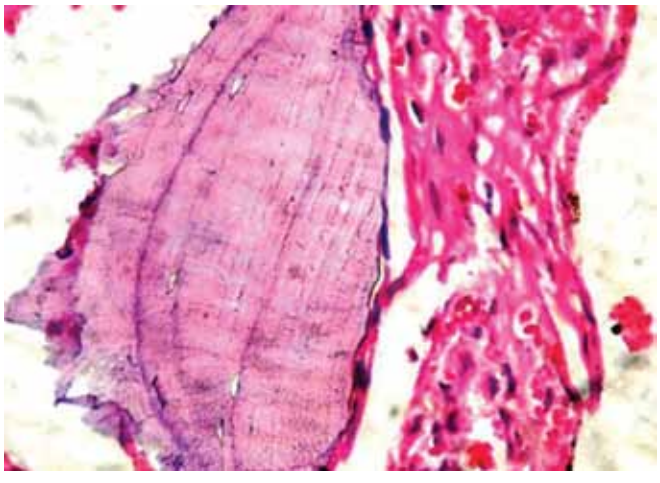

Fig. 4: Newly formed osteoid with osteocytes and lined by osteoblasts (40×, magnification)

were observed in areas of woven bone, indicating new bone formation. In the cortical bone, Haversian systems were noticed showing irregular surfaces, with few areas of new bone formation.

Specimens corresponding to allografts showed, empty osteocytes lacunae with minimal osteoclastic activity (Fig. 5). Spicules of necrotic bone were also seen. These remodeling areas revealed newly formed primary bone. Few sections appeared as meshwork of osteoid tissue. Between the grafted AL and the host site, the remodeling process appeared more advanced. Osteoclastic activity was seen which was surrounded by a connective fibrous tissue.

DISCUSSION

The real challenge is in achieving the height and width of the alveolar bone in the defective regions. Intraoral bone graft is the treatment of choice for reconstructing the critically atrophied alveolar ridge. The autogenous, allogenous and the xenografts are commonly used for bone grafting. Autogenous bone is the most potent graft material for augmentation procedures due to its osteogenic potential.

Philips et al[5] stated that the contrast in the behavior of grafts harvested from various sources has either due to the embryologic origin (endochondral or intramembranous) or to microarchitecture (cortical or cancellous). Intramembranous bone grafts are reported to maintain volume better than endochondral grafts, whereas Hardesty et al[6] hypothesized that the volume-retaining differences between a densely cortical calvarial graft and an endochondral graft with a thinner cortex may be related to the three-dimensional (3D) osseous architecture.

The advantages of chin graft include: ease of access, proximity to recipient site to harvest site, minimal patient concern for alteration in the facial contour, avoidance of cutaneous scar and reduced donor site morbidity.[7]

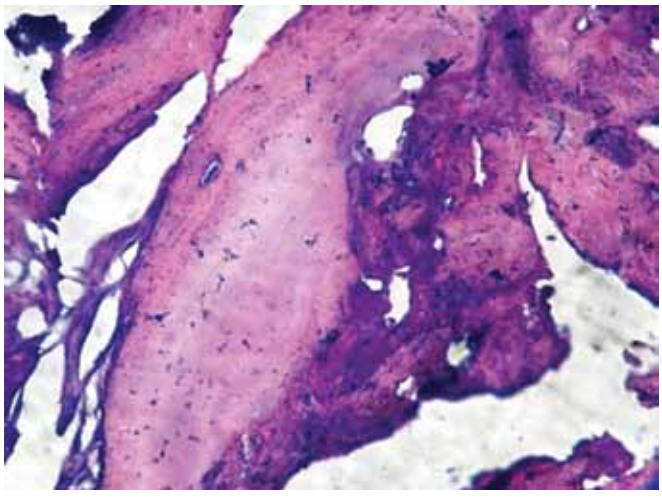

Fig. 5: Bony trabeculae, nonvital bone (40×, magnification)

Cordaro et al[8] retrospectively demonstrated decreased sensory disturbances in relation to the mucosa and teeth when chin grafts were used as a donor site. Also, Sbordone et al[9] assessed the neurosensory disturbances and concluded that the symphyseal bone harvesting procedure is not without side effects, in terms of cutaneous and mucosal neurosensory disturbances. In the present study, we did not encounter any degree of neurosensory disturbances or tooth-pulp sensitivity.

The present study shows the use of autografts (Chin) and allograft on class IV and V[10] ridges as an onlay graft and facilitates for horizontal reconstruction, promoting bone regeneration and implant osseointegration.

Meijndert et al[11] had similar observation and stated that all the chin biopsies showed signs of remodeling with the presence of osteoblasts, apposition of osteoid and resorption lacunae occupied with multinucleated osteoclasts. Few empty lacunae depicted nonvital bone, while the other parts of them clearly showed lacunae occupied by osteocytes.

Zerbo et al[7] concluded that varying quantities of vital and nonvital bone were seen in the biopsy specimen (autograft). Vital bone was composed of lamellar and woven bone, free of inflammatory cells. Bone marrow was strongly vascularized and contained fat cells. The author also reported that nonvital bone is replaced by new vital bone in approximately 2.5 to 7 months. Also, Acocella et al[12] studied the specimens histologically and concluded that all specimens revealed signs of active remodeling and was free of inflammatory cells.

Simpson et al[13] and Wingfield et al[14] stated that 80 of viable cells are preserved following cryopreservation. It was stated by Aho et al (1998)[15] that a major possible consequence of the presence of viable cells is acute allograft rejection responses, however, in our study no acute allograft rejection responses after grafting were seen.

CONCLUSION

All the 10 patients underwent implant placement. The reports regarding the nature of bone obtained during implant placement were examined for histology.

A study of this kind may contain a certain amount of inadequacies that might be because of less sample size, grouping, which may mask the actual changes. Nevertheless, more sample size and further intricate studies like an animal study may be needed to explain the internal microarchitectural changes in order to draw more definitive conclusions about the correct timing of implant placement and also to histologically evaluate the definitive adaptation of the graft to the recipient bed site.

From a clinical point of view, this procedure appears to be simple, safe, effective and versatile for the treatment of localized alveolar ridge defects.

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