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Case Report
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Stem Cell Bone Allografts in Maxillary Sinus and Ridge Augmentation, Report of a Case

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Abstract

Maxillary sinus and ridge augmentation were performed using the allograft cellular matrix containing live stem cells (Osteocel)*. The results were evaluated via a postoperative Cone Beam Computer Tomography (CBCT) scans and periepical radiographs. The sinus augmentation case was evaluated in 10 weeks in which the radiographic bone tomography was similar to that of the native bone. The ridge augmentation case resulted in a 3-4 mm vertical ridge augmentation. Even though histological examination was lacking, the clinical and radiographic feel of the cases were promising. This presentation will show the clinical and radiographic documentation of both cases in addition to discussing the potential benefits of stem cell bone matrix with its future promises.

Keywords: Stem cells; Allografts; Ridge augmentation; Maxillary sinus augmentation

Introduction

Maxillary sinus and ridge augmentation procedures using stem cells allografts have been performed with predictable results [1,2]. Several bone graft materials are currently used with different outcome based on the size of the defect and the desirable bone width and height to achieve [3]. Stem cell research is one of the forgoing projects now in the medical and dental fields to regenerate human cells which in turn can repair different body tissues including bone [4]. In dentistry, allograft cellular bone matrix containing mesenchymal stem cells has been available in the last few years and the product results in a viable bone matrix due to its osteoinductive, osteoconductive and osteogenic properties.

Case Presentation

A 49 years old woman presented for ridge and maxillary sinus augmentation prior to implant insertion. Medical history reviewed and showed no complications to oral surgical treatment. The dental history revealed patient wearing full maxillary and mandibular dentures for more than ten years. She was unaware of the reason of the extraction however relates it to severe caries and lack of care. Her chief complaint is loose maxillary denture. This was followed by CBCT scan of the maxilla to determine the bone height and width in addition to any abnormal findings in the right and left maxillary sinuses. The intra-oral examination revealed severe atrophy of the premaxilla horizontally in addition to bilateral pneumatized maxillary sinuses (Figure 1 and 2). Patient indicated a previous unsuccessful attempt of maxillary left sinus augmentation by a dentist and the scan also showed bone mass in the floor of the left maxillary sinus measuring 2-3 mm in height however no other abnormal findings in the sinuses (Figure 1). The width of the premaxillary ridge measured 4mm in

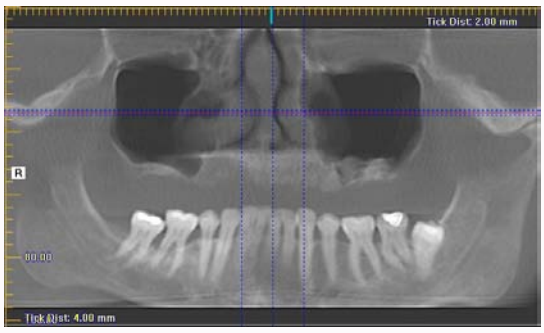

Figure 1: Pneumatized bilateral maxillary sinuses.

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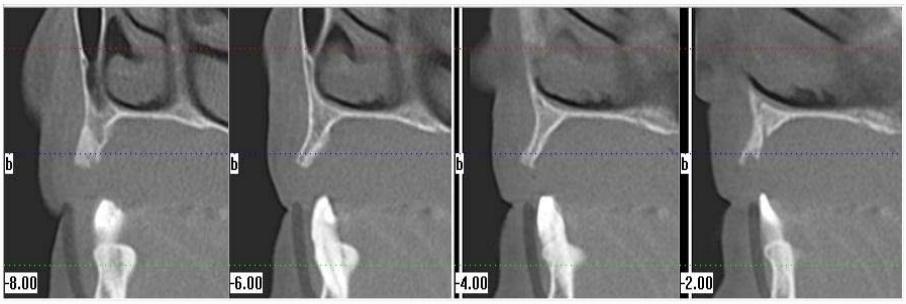

Figure 2: Horizontal ridge deficiency of the premaxilla.

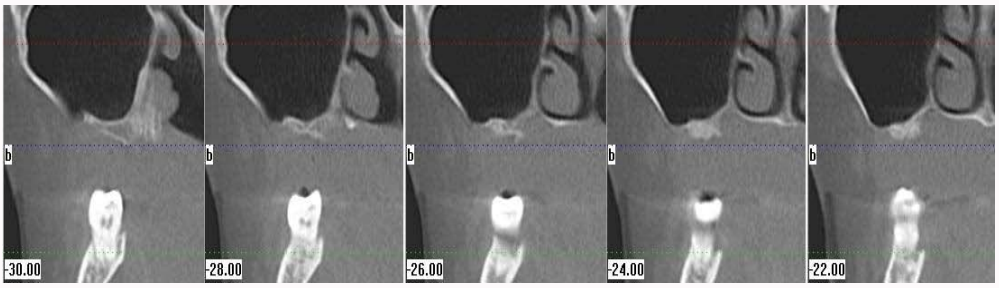

Figure 3: Vertical ridge deficiency of the right maxillary sinus.

the incisors area and 2 mm in the canine area (Figure 2). The height of the posterior edentulous space of the posterior maxilla measured 2mm (Figure 3). A consultation was set with patient to discuss the findings and the treatment plan recommended in addition to bone graft material choice. The treatment plan was right maxillary sinus augmentation in addition to premaxillary ridge augmentation. Stem cell allograft was recommended due to its aggressive nature and to expedite the bone formation process.

Bone graft source and preparation

Harvested from cadavers within 24 hours of death with rigorous safety testing and donor screening is performed. Cortical bone is separated and processed into demineralized bone particles. The remaining viable MSCs and osteoprogenitorcells remain attached to the cancellous bone matrix. The selective immunodepletion removes unwanted cells from the remaining cell-rich cancellous bone fluorescence-activated cell sorting (FACS) testing is performed to confirm that nearly all remaining cells are positive for cluster differentiation the cortical demineralized bone particles are added back to the cell-containing cancellous bone component. A cryopreservation solution is added and the product is stored at -80C, permitting a 5-year shelf life. Quality testing is performed on every lot to validate a minimum cell count of 50,000cells/ml and a minimum cellular viability of 70%.

The bone graft material was shipped to the clinic on dry ice and prepared as per the manufacturer's recommendation. The graft was thawed using a water bath at room temperature 37˚C. After the cryopreserved cells were thawed, the liquid was decanted, and the cell containing graft was ready to be implanted, with a working window of 4 hours (Figure 4).

Procedure

A crystal incision was carried out in the premaxillary attached gingiva and to the hamular notch of the right maxillae. Following the manufacture recommendation for the use of stem cell allograft the material was prepared immediately prior to the surgical appointment.

Figure 4: The prepped bone graft material at the time of surgery.

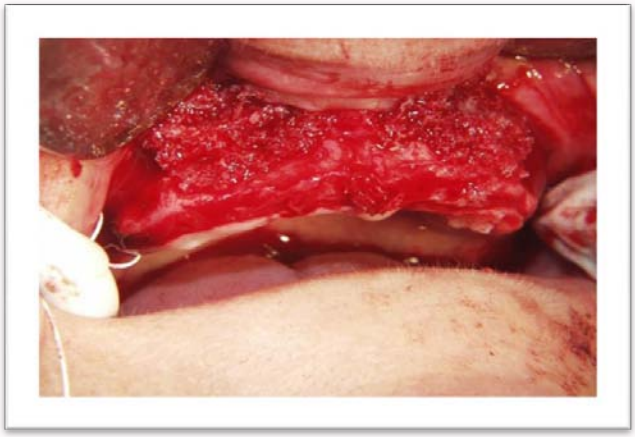

Figure 5: The bone graft material is applied to the premaxillary ridge buccal with no membrane.

At that time attention was turned to the premaxilla where the native bone was decorticated to allow ample blood supply and the bone graft material applied with light condensation and no membrane (Figure 5). The buccal flap was undermined to allow suturing without tension and suturing was accomplished using Polytetrafluroehylene

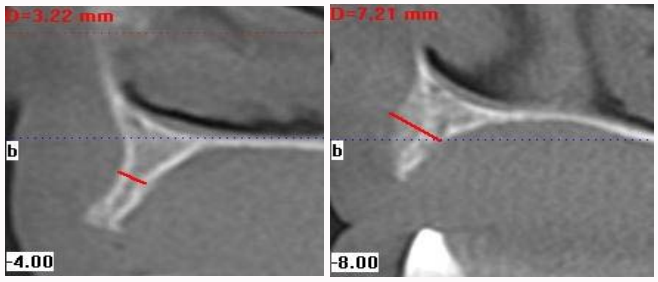

Figure 6: Before and after CT scan of the premaxilla showing significant increase in bone width.

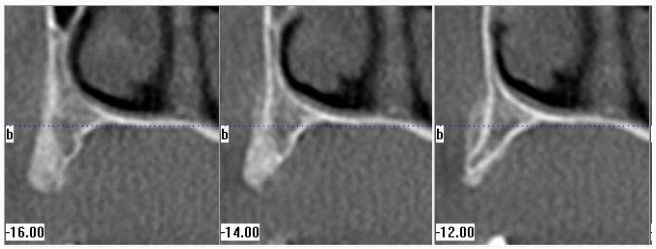

Figure 7: CT scan of the premaxilla following the bone augmentation in the canine area.

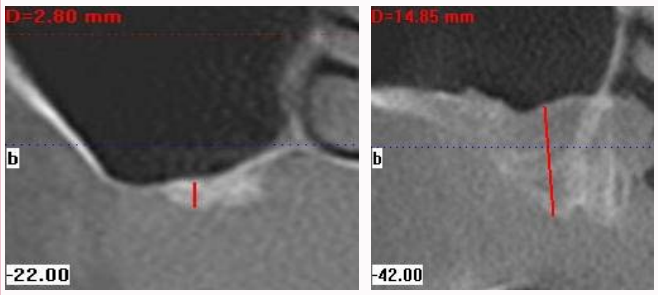

Figure 8: Before and after increase in the bone height following the right maxillary sinus augmentation.

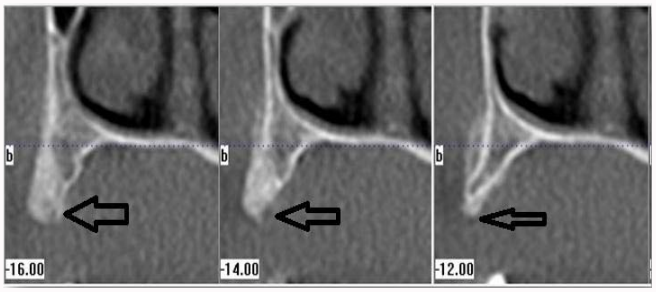

Figure 9: Downwards growth of bone in the premaxilla.

monofilament sutures (PTFE 4-0)** in a continuous sling manner. Patient was advised to discontinue the use of the maxillary denture for eight weeks. Following the healing and at approximately ten weeks following the surgical treatment an additional CBCT scan was taken and examined (Figures 6-9). The scan showed the native and the augmented bone with adequate width to support an implant. The radiographic nature of the augmented bone had a similar texture to the native bone which could indicate a mature bone formation.

Further examination of the scan revealed downward growth of the bone into a vertical direction overlapping the crest of the native premaxillary bone (Figure 9). Although this was not attempted during the surgical procedure it created an observation of great concern to the publisher.

*Osteocel, NuVasive, San Diego, CA; distributed by ACE Surgical Supply, Brockton, MA and processed by AlloSource, Centennial, CO.

**Osteogenics Biomedical, Inc.Lubbock, TX.

Discussion

The role of Mesencymal Stem Cells (MSC) allografts has been documented and showed bone growth in periodontal defects without the traditional use of a membrane in a short period of time [5,6]. Although the literature is lacking histological studies in the use of MSC in periodontal defects, the reliability is mainly based on the nature of the defects which are contained by the tooth structure and the other bony walls [7]. On the contrary the pattern of bone engineering in ridge augmentation is one of the most challenging oral reconstruction procedures. As the results are not predictable the available options for bone graft materials vary in source and their ability to promote bone growth. Several studies in vertical ridge augmentation were not successful in endorsing a reliable and expedited process [3]. The role of bone morphogenic proteins (BMP) is crucial for the maturation of undifferentiated mesenchymal stem cells into osteoblasts which is the sole bone forming cell [8]. As the available particulate and putty bone allografts contains low or no BMP the freeze demineralized bone rely on the native BMP and MSC to form osteblasts. In that case the implanted allografts acts only as an osteoconductive and not inductive in any manner which also applies to xenografts and synthetic. In this case since MSC are implanted into the surgical site and in the presence of the native BMP the process of osteoblasts formation is faster and more predictable. Due to its speed and aggressiveness the bone formation can divert itself into unplanned areas as in this case. The combination of BMP and MSC as an allograft can enhance the process of osteoblasts formation even faster and so produce a potent and reliable way for bone formation.

Conclusion

The role of MSC as an allograft has shown in this case to be a reliable method for ridge augmentation especially in the vertical direction in areas of severe ridge atrophy. Further studies are needed to support this report evidence in more of a guided manner especially for vertical ridge augmentation.

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