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

Mohamed A Maksoud DMD*

Harvard University School of Dental Medicine, Oral Medicine Infection and Immunity, USA

Case Report

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***For Correspondence**

Mohamed A Maksoud DMD, Harvard University School of Dental Medicine, Oral Medicine Infection and Immunity, 188 Longwood Avenue, Boston, Ma, USA, 02115, Tel: 617-432-1452, Tele Fax: 904-731-4310

E-mail: Mohamed_maksoud@hsdm.harvard.edu

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ABSTRACT

Introduction: The aim of this report is to illustrate the role of the Mesenchymal Stem Cell containing allograft in maxillary sinus and ridge augmentation.

Case Presentation: Maxillary sinus and ridge augmentations were performed using an allograft cellular matrix containing live stem cells. The results were evaluated via a postoperative CT scans and periepical radiographs. The sinus augmentation was evaluated in 10 weeks in which the radiographic bone tomography was similar to that of the native bone and the ridge augmentation resulted in a 3-4 mm vertical ridge augmentation.

Conclusion: Even though histological examination was lacking, the clinical and radiographic findings of the case were promising. This presentation will show the clinical and radiographic documentation in addition to discussing the potential benefits of stem cell bone matrix with its future promises.

BACKGROUND

Maxillary sinus and ridge augmentation procedures have been routinely 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. The product results in a viable bone matrix due to its osteoinductive, osteoconductive and osteogenic properties [4].

CLINICAL PRESENTATION

A 49 years old women 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 is unaware of the reason of the extraction however relates it to caries and lack of care. Her chief complaint is loose maxillary denture. This was followed by CT 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 **(Figures 1 and 2).** Patient indicated a previous unsuccessful attempt of maxillary left sinus augmentation by a dentist which is reflected in a 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 4 mm in the incisors area and 2 mm in the canine area **(Figure 2).** The height of the posterior edentulous space of the posterior maxilla measured 2 mm **(Figure 1).** A consultation was set with patient to discuss the findings and the treatment plan recommendations in addition to bone graft material choice. The treatment plan was right maxillary sinus

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augmentation in addition to premaxillary ridge augmentation. Stem cell allograft was recommended due to its aggressive nature and to expedite the bone formation process.

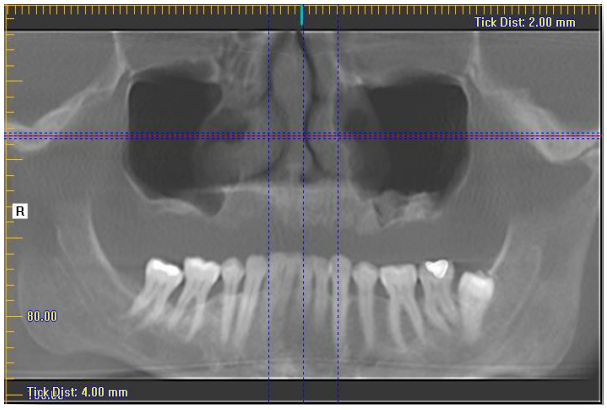

Figure 1. Pneumatized bilateral maxillary sinuses.

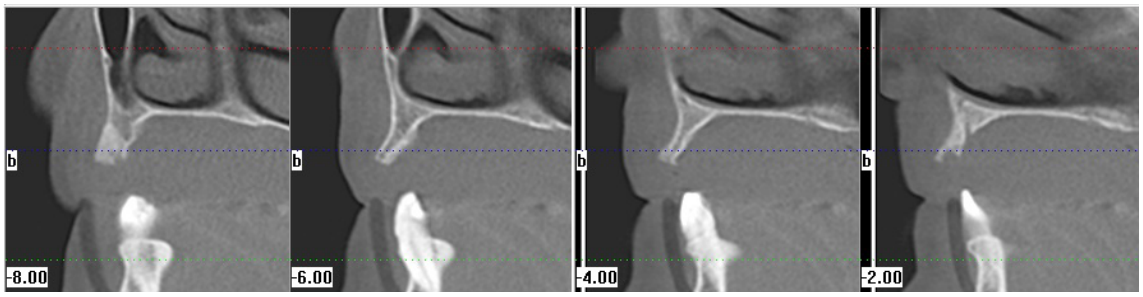

Figure 2. Horizontal ridge deficiency of the premaxilla.

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 mesenchymal stem cells MSC's and osteoprogenitor cells 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 -8°C – 5°C, permitting a 5-year shelf life. Quality testing is performed on every lot to validate a minimum cell count of 50,000 cells/ml and a minimum cellular viability of 70%.

Case Management: 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.

After administering the local anesthesia for the purpose of analgesia and homeostasis, a crestal incision was carried out in the premaxilla attached gingiva and to the hamular notch of the right maxillae followed by reflection of full- thickness mucoperiosteal flaps. Following the manufacture recommendation for the use of stem cell allograft (Ostell*) the material was prepared immediately prior to the surgical appointment. 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 3).** The buccal flap was undermined to allow suturing without tension and suturing was accomplished in a continuous sling manner. Patient was advised to discontinue the use of the maxillary denture for eight weeks.

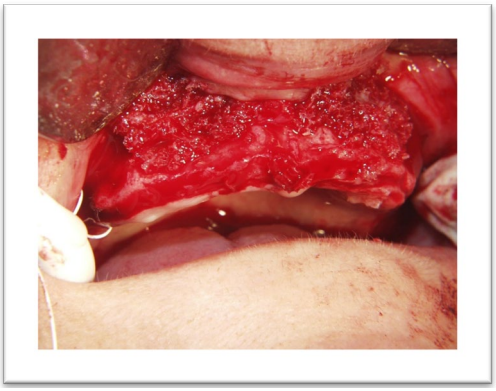

Figure 3. The bone graft material is applied to the premaxillary ridge buccal with no membrane.

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Clinical Outcomes: Following the healing and at approximately ten weeks following the surgical treatment an additional CT scan was taken and examined **(Figures 4-6).**

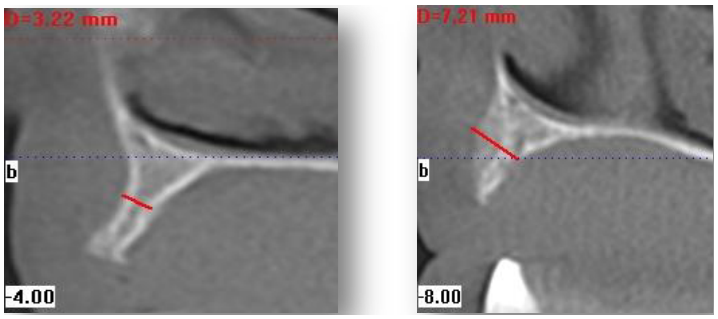

Figure 4. Before and after CT scan of the premaxilla showing significant increase in bone width.

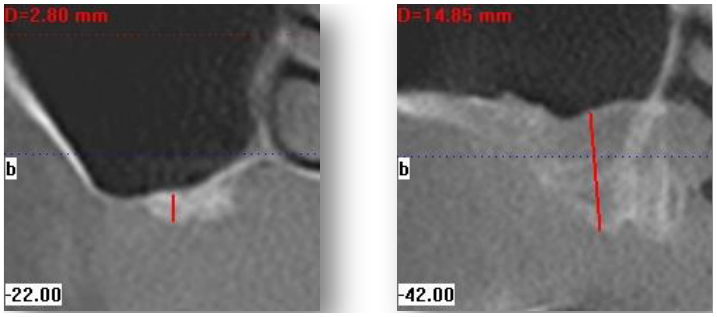

Figure 5. Before and after increase in the bone height following the right maxillary sinus augmentation.

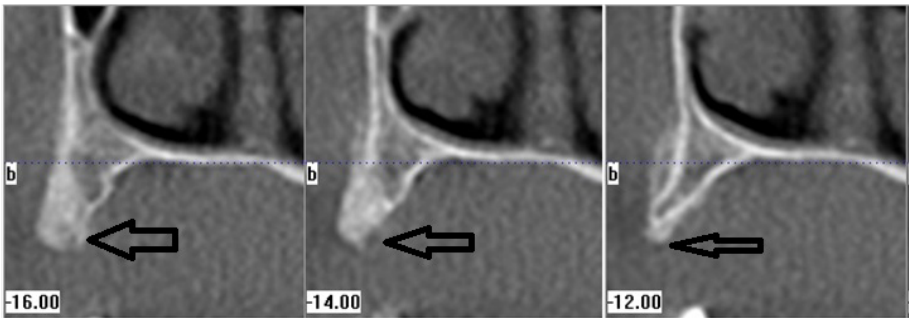

Figure 6. Downwards growth of bone in the premaxilla.

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 6).** Although this was not attempted during the surgical procedure it created an observation of great concern to the publisher.

DISCUSSION

The role of 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 freezed demineralized bone rely on the native BMP and MSC to form osteoblasts. In this 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 [9]. 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. 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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