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Research Article

Efficacy and Predictability of a Synthetic Hydroxyapatite in Lateral Wall Sinus Augmentation

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Abstract

Aim: To see the effect of indigenously prepared Hydroxyapatite at the bone grafted site

Material and method: A lateral window was cut on the buccal aspect of the maxilla on the posterior region in the area of molar I/II and after carefully lifting the sinus membrane, bone graft was packed and a collagen membrane was placed on top of it. After a period of 6 months the site was re-entered to take bone sample for histological analysis using a trephine, at the same time, implant (Bioner Top DM, 4/10) was placed at the surgical site.

Results: The surgical sites healed well, and G-Bone demonstrated good clinical results histologically.

Conclusion: G-bone graft material can be used for bone grafting and has acceptable conversion to host bone when healing has completed.

Keywords: Bone Grafting; Sinus Lift; Dental Implant; Bioner Implants

Introduction

Placing dental implants in posterior maxilla has always been a challenge due to inadequate bone height after loss of posterior teeth related to periodontal bone loss, pneumatization of the sinuses or a combination of those two processes. Maxillary sinus augmentation is performed to increase the height of the ridge for the placement of implants. Increasingly, maxillary sinus augmentation (also known as sinus floor elevation) procedures have become increasingly popular in these clinical situations to permit implant placement. In the 1970s, Hilt Tatum pioneered maxillary sinus augmentation to increase available ridge height using graft material, which allowed greater implant to bone contact area once the bone graft matured [1]. With time there have been many modifications to the procedure which was originally described by Boyne and James [2]. They first described maxillary sinus augmentation using autogenous bone from the iliac crest, due to its osteogenic, osteo inductive, and osteoconductive properties.

For sinus lift procedures, there are multiple techniques and various materials which are being used for augmentation procedures. In the techniques, lateral window sinus augmentation remains the most common procedure, as it gives a direct view of the operating site and the placement of the bone graft, During the procedure, an osseous window is cut on the buccal aspect of the maxilla in the region of maxillary I/II molar distal to the zygoma, the sinus membrane is carefully elevated, collagen membrane placed over the medial aspect of the sinus, bone graft is placed to file the area that was created and collagen membrane is placed over the lateral aspect at the osseous window. The soft tissue is then repositioned, and sutures placed. The other technique is indirect sinus lift, also referred to as a crestal sinus augmentation. This technique is utilized when sufficient crestal height is present for initial stability of the implant to be placed at the same surgery, typically 5mm of crestal height. Following flap elevation to expose the crestal bone, an osteotomy is created to 2mm short of the sinus floor. Instruments are then utilized to up fracture the sinus floor and the membrane is

elevated. Graft material is then placed to fill the void increasing the height and the implant is inserted. The soft tissue is repositioned and sutured leaving the implant to integrate before the restorative phase begins.

When it comes to bone augmentation, osseous graft materials are generally evaluated based on their osteogenic, osteo inductive or osteoconductive potential [3]. Autogenous bone is considered the gold standard for maxillary sinus grafting. However, autogenous bone resorbs very fast and has the tendency of excessive shrinkage during healing. As a result there are various commercially available bone grafts substitutes with predictable results. Amongst other types of graft materials are allografts, these are taken from human species but different donors, from bank bone. The main disadvantage is the quality, as age of the donor may influence the quality in different batches of the graft material. Thus, the results are not always the same, patient to patient. Another type of graft material utilized are xenografts, which comes from different species, the most common is the bovine (cow source) and considered identical to the human bone [4] or porcine (pig source) which are both osteoconductive in nature. Synthetic materials have also been commonly utilized and have been reported to provide comparable results to allografts and xenografts but overcome some patient objections and are more cost-effective materials.

In this study, 10 patients were treated with a synthetic hydroxyapatite graft material (G-Bone, Surgiwear, India) and following healing core samples were taken and histology performed to verify conversion to host bone. The advantage of G-bone is that it is made of multiphasic calcium hydroxyapatite and is absorbed faster by the body compared to a xenograft.

Material and Method

Study design

The study was done as part of PhD thesis and it was ethically cleared by the Santosh, to be deemed University, Gaziabad. Ten patient's requiring a lateral sinus augmentation utilizing the following inclusion and exclusion criteria.

Inclusion criteria

- Patients from the age of 18 years and above
- Having deficient bone/intrabony defects with residual probing pocket depth of ≥ 5 mm following phase I therapy in the affected sites/requiring sinus lift procedures
- Compliant patients.
- Who provided with written informed consents.

Exclusion criteria

- Patients with systemic diseases and/or presence of infections contraindicating periodontal surgery.
- Systemic antibiotic therapy in the preceding 3 months.
- Patients on medication known to interfere with periodontal tissue health and healing.
- Pregnant or lactating females.
- Patients with known habit of smoking and tobacco chewing.
- Patients allergic to silica products or to any of the medications used in the study.
- Patients with parafunctional habits.
- Teeth with hopeless prognosis.

Study group

The patients shown in the table below

Number of subjects	Criteria	Treatment
10	2 -3 mm or less of bone height	Direct sinus lift using G-bone

Table 1

Each patient will undergo grafting procedure for sinus augmentation followed by placement of a collagen membrane.

Materials and Method

All the patients were treated keeping Helsinki declaration [5] (2019) into consideration. Before participation patients signed a consent form and were medically checked, only healthy patients without any medical history or controlled medical conditions were selected for the study. A CBCT was also required for each patient for proper planning.

After completion of all the pre-operative formalities, for the surgical procedure a lateral window was cut on the buccal aspect of the maxilla on the posterior region in the area of molar I/II and after carefully lifting the sinus membrane, bone graft was packed and a collagen membrane was placed on top of it. A bur was used to remove the sinus window, the piece of the bone was placed back on the buccal bone and soft tissue was sutured. After a period of 6

months the site was re-entered to take bone sample for histological analysis using a trephine, at the same time, implant (Bioner Top DM, 4/10) was placed at the surgical site.

Histology

3.2 mm trephine core biopsies were obtained and fixed immediately in neutral buffered formalin solution for 24-48 hours. The specimens were processed after decalcifying in mild decalcifying agent (10% EDTA, pH 7.4). The tissues were processed using standard tissue processing laboratory protocol of dehydration, clearing and infiltration with paraffin wax. Embedding and tissue block preparation was done with paraffin wax. 4 micron thick sections were stained with Hematoxylin and Eosin stains. The slides thus obtained were viewed in research microscope (Olympus BX53) and digital images were captured in low and high magnification (Olympus EPL3).

Results

The Hematoxylin and Eosin-stained section showed well-formed areas of mineralized bone with cellular components composed of osteoblasts, osteocytes, osteoid and vascular connective tissue. Abundant areas of mature bone formation with varying degrees of mineralization within a fibrocellular connective tissue stroma with minimal residues of remnant graft material were evident. The mature bone showed lamellations, lined by bone lining cells and entrapped osteocytes with in the osteocytic lacunae (Figure 1, H and E stain, 10x magnification). The sections also showed focal areas showing residual graft particle at the graft- new bone interface. Very mild diffuse inflammatory infiltrate was seen suggesting satisfactory uptake of the grafted biomaterial in the absence of remarkable host inflammatory reaction. Areas showing new bone formation with entrapped osteocytes within the osteocytic lacunae at higher magnification were also seen (Figure 2, H and E stain, 40x magnification).

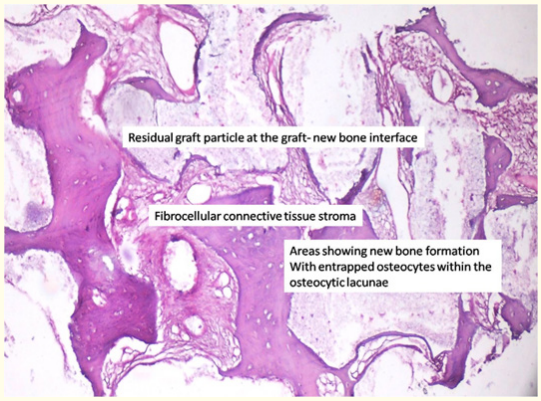

Figure 1: Histological section showing bone formation at lower magnification (10x).

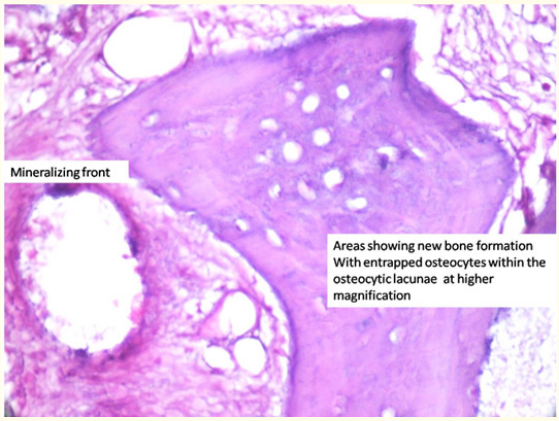

Figure 2: Histological section showing bone formation at higher magnification (40x).

Discussion

Implant placement along with sinus augmentation procedures have become the most common choice of treatment to restore posterior dental function when teeth are missing, or planned extraction will occur in compromised posterior quadrants. However, the choice of bone graft material hugely determines the treatment outcome. As aforementioned, autogenous bone graft with is the gold standard when it comes to bone grafting, but the disadvantage is its limited availability, for which another surgical site is required. This may increase discomfort to the patients with two intraoral surgical sites. This may lead to some patients declining treatment. Hence, the development and use of other types of bone graft materials has become very popular yielding good clinical results. Other types of graft materials, xenograft (different species), allograft (same species but different donor) are both very well tolerated and accepted by the patient with no reported cases of allergic reaction or disease transmission reported so far in the literature [6].

In this study the histology shows well-formed areas of mineralized bone, along with all the cellular components. It demonstrated that the graft was well tolerated by the subjects.

Conclusion

G-bone, a synthetic osseous graft material demonstrated good clinical results with lateral sinus augmentation with conversion of the graft material to viable host bone as shown histologically. The benefits of use of this synthetic osseous graft material is lower cost compared to allograft and xenograft materials. Additionally, a secondary surgical site as needed with autograft usage is avoided and restriction of volume needed is also not a concern with the use of G-bone.

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