ORIGINAL RESEARCH PAPER

Medical Science

SYNTHETIC HYDROXYAPATITE BONE GRAFT SUBSTITUTE IN SINUS AUGMENTATION – A HISTOLOGICAL ANALYSIS

KEY WORDS: bone grafting, sinus lift, dental implant

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ABSTRACT

Aim: To see the effect of synthetic Hydroxyapatite bone graft substitute in sinus augmentation. **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 8 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 site healed well. G-Bone has shown good bone growth histologically. **Conclusion:** The surgical site healed well. G-Bone has shown good bone growth histologically.

INTRODUCTION:

Placing dental implants in posterior maxilla has always been a challenge due to inadequate bone height after loss of posterior teeth. This occurs due to increase in the size of maxillary sinus, as a result, procedures like maxillary sinus augmentation are done to increase the height of the bone for the placement of the implants. And in today's time, maxillary sinus augmentation (also known as sinus floor elevation) procedures have become increasingly popular. In 1970s, Hilt Tatum used maxillary sinus cavity to increase available bone using graft material, which allowed greater implant to bone contact area once the bone graft matured[1]. With time there have been many modifications in the procedure which was originally described by Boyne and James[2]. They first described maxillary sinus graft using autogenous bone from the iliac crest, due to its osteogenic, osteoinductive, and osteoconductive properties.

For sinus lift procedures, there are many techniques and many materials which are being used for augmentation procedures. In the techniques, Direct Sinus lift remains the most common procedure, as it gives direct view of the operating site and the placement of the bone graft, in short during the procedure, a bony window is cut on the buccal aspect of the maxilla in the region of maxillary I/II molar, where the implant has to be placed, the sinus membrane is carefully lifted and bone graft and collagen membrane is placed, which is then sealed back and the soft tissue is sutured. Other technique is indirect sinus lift.

When it comes to bone augmentation, bone graft materials are generally evaluated based on their osteogenic, osteoinductive or osteoconductive potential[3]. autogenous bone is considered the gold standard for maxillary sinus grafting. However, the autogenous bone resorbs very fast and has the tendency of excessive shrinkage. As a result there are various commercially available bone grafts substitutes with predictable results. The advantage of using a synthetic graft is its easy availability and the quantity. Another advantage is the choice of The advantage of using G-bone is that it is made of multiphasic calcium hydroxyapatite and is absorbed faster by the body as compared to a xenograft.

MATERIAL AND METHOD:

g-bone was grafted in a total of 20 patients requiring a sinus lateral wall augmentation based on the following inclusion and exclusion criteria:

Inclusion Criteria:

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

Exclusion Criteria:

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

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 will also be 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 8 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.

Histological Evaluation:

METHODOLOGY:

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 fibro cellular Connective tissue stroma is seen on scaffold of remnant graft material. The mature bone showed lamellations, lined by bone lining cells and entrapped osteocytes with in the osteocytic lacune. Thick bundles of collagen fibers are seen encircling newly formed mature bony trabeculae. 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. Very few areas show the Vascularity and areas of new blood vessel formation in the histology of the section. (figure 1,2 and 3)

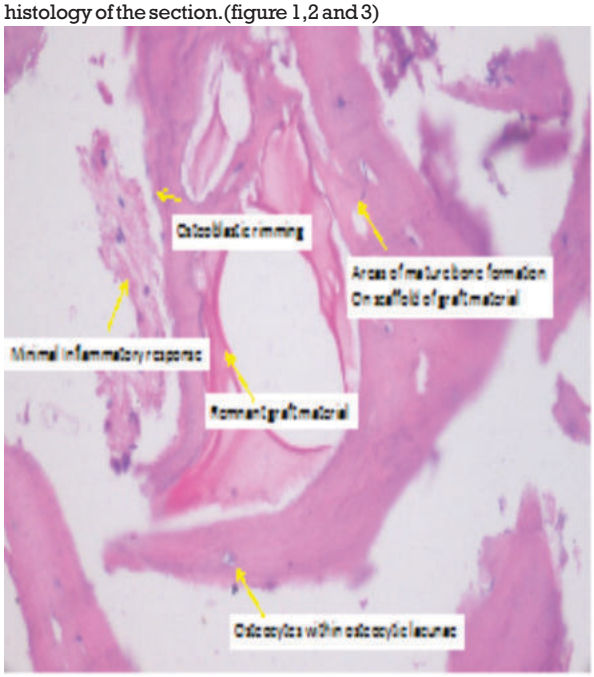

Figure 1

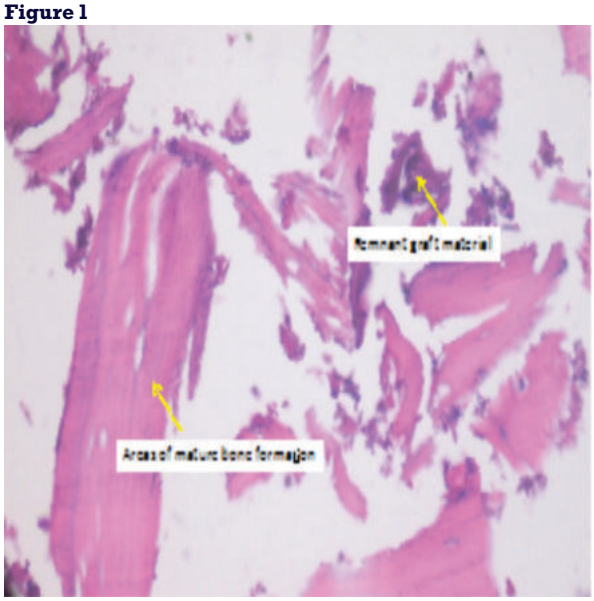

Figure 2

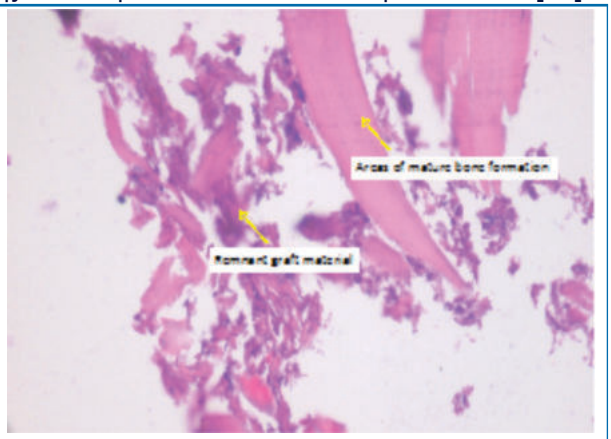

Figure 3.

DISCUSSION:

Bone is continuously modelled and remodelled, and reveals a unique potential for regeneration however, in case of sinus defects, bone graft substitutes are needed to restore the required width and height of he resorbed bone. Bone loss affects the overall health of the patient, thus for functional and aesthetic outcomes, patient's health and long-term survival of teeth, a sufficient amount of healthy bone is required. There are several options for enhancement of bone formation, including (1) osteoinduction by bone grafts or growth factors; (2) osteoconduction by bone grafts or substitute materials that serve as a scaffold for new bone formation; (3) transfer of stem cells or progenitor cells that differentiate into osteoblasts; (4) distraction osteogenesis and (5) guided bone regeneration (GBR) using barrier membranes[6].

Choice of the graft is of utmost importance. A wide range of materials are available which can be used for grafting purposes. They can be classified into four categories: (1) autogenous bone or auto grafts; (2) allografts; (3) xenografts; (4) alloplastic bone grafts[7]. Out of all the grafts available autogenous bone is the gold standard material to use. The main disadvantages are an additional surgical site, high resorption rate and limited availability. To overcome these clinical limitations, other types of bone grafts such as, xenografts and allografts became popular. However, due to controversies regarding osteoinductive potential use of alloplastic materials has become popular.

G-bone, is a synthetic bone graft and contains natural low crystalline hydroxyapatite with collagen. It is available in form of granules, dowels and blocks. It has been stated that when collagen when used in conjugation with other osteoconductive carriers like hydroxyapatite or tricalcium phosphate and further when these composites are combined with autologous bone marrow, it acts as an osteoinductive material[8]. Hydroxyapatite is a highly crystalline form of calcium phosphate procured through a high-temperature reaction. It is chemically similar to the mineralized phase of bone and this similarity elucidate the excellent biocompatibility and osteoconductive capacity of this ceramic[8]. Wahl DA et al[9]., proposed that, the composite of Hydroxyapatite & Collagen (G-Graft) may lead to earlier bone regeneration & greater density of the mature bone. Studies have shown that collagen type I and hydroxyapatite enhances osteoblast differentiation, but in combination, they accelerates osteogenesis[9]. A composite matrix embedded with human-like osteoblast cells showed better osteoconductive properties compared to monolithic HA and produced calcification of identical bone matrix[9]. Studies have stated that G-Graft has a definite regenerative potential and can be used in bony defects, also, the defects treated with G-Graft attain more density initially and enhances bone healing in early stage. Johnson KD et al[10], in their study, reported better results with Collagen-hydroxyapatite composite in

comparison to tricalcium phosphate, and hydroxyapatite used alone, in healing 2.5 cm bony defect created surgically in a canine radius model. In the current study, the graft take-up was good, there was absence of remarkable host inflammatory reaction. Also, there were areas showing new bone formation with entrapped osteocytes within the osteocytic lacunae.

CONCLUSION:

The graft take-up was good, there was absence of remarkable host inflammatory reaction. Also, there were areas showing new bone formation with entrapped osteocytes within the osteocytic lacunae. Hence, it is a good material to be used for sinus augmentation.

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