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Effect of amniotic membrane versus collagen membrane on sticky bone graft in lateral sinus lifting with simultaneous implant placement (Clinical and radiographic study)

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***Abstract*---**Objectives: to compare of effect amniotic membrane versus collagen membrane on sticky bone with simultaneous implant placement after lateral sinus lifting procedure. Patients and methods: Seven patients with bilateral sever bone resorption undergone immediate implant after lateral sinus lifting and placement of sticky bone. In G (I): Collagen membrane covered sticky bone and implant while in G (II): Amniotic membrane covered sticky bone and implant. Surgical sites were evaluated clinically for any signs of infection, wound dehiscence, or exposure of implant threads. Also, Implant stability and bone density were obtained at 0, 3, 6 and 9 months.

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Results: Amniotic group revealed statistically significant value in percentage increase of bone density. Conclusion: The application of sticky bone with amniotic membrane was more likely proved to have the ability to assist and accelerate bone healing and osseointegration.

Keywords---sinus lifting, sticky, implant, collagen membrane, amniotic membrane.

Introduction

Placement of dental implants in posterior atrophic maxilla is of a great challenge owing to inadequate volume of bone (1). After a direct sinus elevation treatment, bone substitutes are thought to have a little role in bone production, and the Schneiderian membrane contains osteoprogenitor cells that aid bone growth (2). Various materials have been used to graft floor of sinus and achieve desired bone height. Grafting materials can be categorized based on their source, as autograft, xenograft, allograft, and alloplastic. These different types of grafting materials may be used alone or in any combination (3).

Commercially available collagen membranes have varying resorption times and were designed for bone regeneration. Collagen membranes facilitate healthy healing by reducing the danger of membrane exposure, angiogenesis to improve blood supply, space maintenance to establish a bed for undifferentiated mesenchymal cells, and clot stability to allow these cells to mature properly. Bone regeneration is aided by selective permeability and a space-making function (4).

Amniotic membrane is known to stimulate epithelial cell motility, adhesion, and differentiation, and it's also an excellent substrate for promoting epithelial progenitor cell development and longevity. Finally, amnion has been employed as an allograft in reconstructive surgery, an autograft in newborn reconstruction surgery, and a scaffold in tissue engineering research (5).

In general, membranes must be used in combination with a bone graft material to maximize regenerative outcomes (6). Accordingly, several studies had used sticky bone combined with guided tissue regeneration or no to reconstruct bone defect, socket preservation and alveolar ridge augmentation (7-10). The aim of this study was to evaluate amniotic membrane versus collagen membrane with sticky bone and simultaneous implant placement after lateral maxillary sinus lifting procedure.

Subjects and Methods

Study design: This study involved 7 patients who were in need for dental restoration of upper posterior missing teeth bilaterally by dental implants and had maxillary sinus pneumatization. They were selected from out-patient clinic Faculty of Oral and Dental Medicine, Al-Azhar University Boys Assiut. All patients were informed about scope of study and signed an informed written consent form.

Inclusion criteria:
1. Healthy adult patients free from any compromising systemic diseases.
2. Patients need implant insertion in maxillary premolar or molar area.
3. Residual bone height of 4-6 mm.
4. Healthy maxillary sinuses as assessed from radiographic and clinical examination.
5. Possibility of achieving adequate primary stability in residual bone.

Exclusion criteria:
1. Uncontrolled systemic diseases which retard bone healing.
2. Patient who had taken bisphosphonates.
3. Presence of any pathology in site of operation.
4. Heavy smokers.

Sample size:
According to a previous study by Rios et al (11), The mean bone density was 1742.44±20.23 using lyophilized amnion membrane in comparison to 1711.2 ±15.53 using collagen membrane. A total sample size of 14(7 in each group) will be sufficient to detect an effect size of 1.73 at an actual power (1-β error) of 0.8 Using a two-sided hypothesis test and Significance level (α error) 0.05.

Patients grouping:
Patients were randomly divided into two equal groups, each group contained the same 7 patients subjected to sinus lining elevation that received dental implants as following: Group (I) (sticky bone &collagen membrane) Group (II) (sticky bone &amniotic membrane).

Surgical procedures:
Implant placement was dependent on diameter & length of bone at surgical site; this was primarily predetermined radiographically by cone beam CT measures. Upper and lower impression were taken and sent to dental lab for fabrication of dental casts which was sent with CBCT to radiologist for fabrication of surgical guide stent. Patients that received dental implants as following: Group (I) (sticky bone &collagen membrane) Patients were operated upon for maxillary sinus lining elevation through lateral approach followed by implant placement and augmentation by sticky bone covered by collagen membrane. Group (II) (sticky bone &amniotic membrane) Patients were operated upon for maxillary sinus lining elevation through lateral approach followed by implant placement and augmentation by sticky bone covered by amniotic membrane. As sticky bone was a stable fibrin bone graft it had its own body and was easy to be handled and can be molded into desired shape, then covered by collagen membrane or amniotic membrane according to group of patients.

Assessment:
Clinical evaluation: Surgical sites were evaluated clinically for any signs of infection, implant stability, wound dehiscence, or exposure of implant threads. CBCT scans will be obtained 0, 3, 6 and 9 months postoperatively for measurement of bone density around implant interface & at sinus floor.

Statistical analysis of data:
Data were fed to computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data were described using number and percentage.

Results

Seven patients ranged in age between 39.00-52.00 years with a mean age of 43.14± 3.76 years. Study groups had 2 males and 5 females. Postoperative clinical assessment showed acute postoperative complications as pain, swelling, edema were observed in both groups during 1st week postoperatively which disappeared gradually after administration of analgesic, anti-edematous agents and antibiotics. Three patients two in group I and one in group II had developed infection of surgical site which was controlled by increasing period of antibiotic administration and improving oral hygiene measures. Sinusitis was observed at 2 patients of both sides which were controlled by adding nasal decongestant agent. Emphysema, wound dehiscence, graft loss or migration, loss of fixture and oroantral fistula were not seen in both groups.

According to table (1) at 3 months there was a statistically significant difference in Osstell measurements at two groups (p=0.006, p=0.049), and p=0.006 respectively). Amniotic group showed higher Osstell measurements than collagen group. According to table (1) at 3 months, there was a statistically non-significant difference in mean bone density in the two groups (p=0.602). At 6 and 9 months there was a statistically significant difference in mean bone density in the two groups (p=0.033, 0.019) respectively. Amniotic group showed a higher bone density than Collagen group.

Table (1): Comparison between the two studied groups according to demographic data, Ostell measurements, and Bone density with different times in each group

	Collagen (n = 7)	Amniotic (n = 7)	Test of Sig.	p
Sex				
Male	2 (28.6%)	2 28.6%)	x^2= 1.000	^{FE}p= 0.720
Female	5 (71.4%)	5(71.4%)		
Age (years)	43.14± 3.76	44.29± 4.64	0.506	0.622
Ostell				
at baseline	60.43 ±3.69	63.00±5.09	1.081	0.301
3 months	59.14±2.47	63.57±2.44	3.369	0.006*
6 months	63.71±3.54	67.29±2.56	3.180	0.049*
9 months	64.42±3.04	68.57±1.13	3.371	0.006*
P0	0.014*	0.002*		
Bone density				
at baseline	289.65±131.77	391.72±182.30	1.201	0.253
3 months	323.58±166.01	379.77±222.54	0.535	0.602
6 months	364.27±49.80	504.71±145.85	2.411	0.033*
9 months	367.48±48.76	524.07±145.41	2.701	0.019*
P0	0.524	0.313		

χ^2: Chi square test FE: Fisher Exact t: Student t-test
p: p value for comparing between the studied groups
p0: p value for comparing between different times in each studied group
*: Statistically significant at p ≤ 0.05.

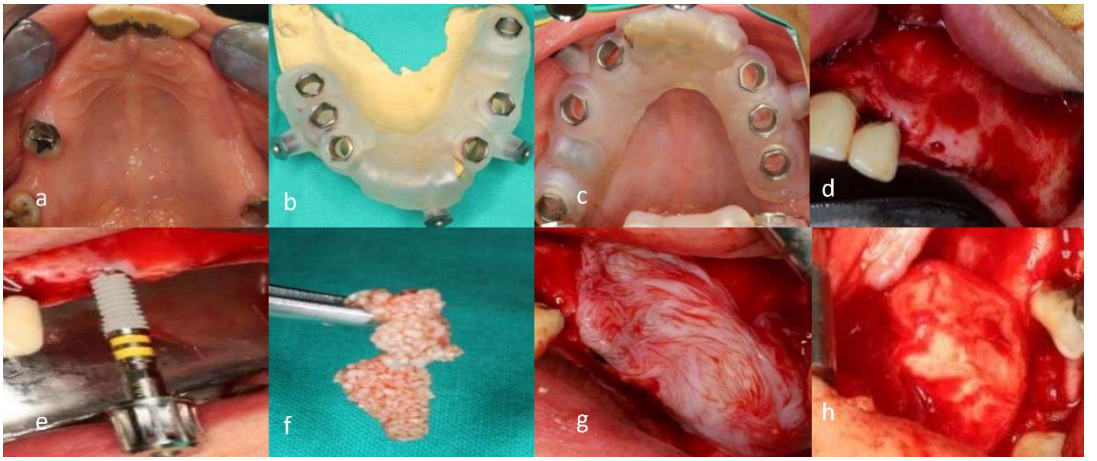

Figure (1): a, bilateral presurgical implant site., b, surgical guide stent, c, adaptation of surgical guide in patient's mouth., d, Rflap design, e, g implant insertion, f, prepared sticky bone, g, daptation of amniotic membrane G. (II), and h, adaptation of collagen membrane G.(I).

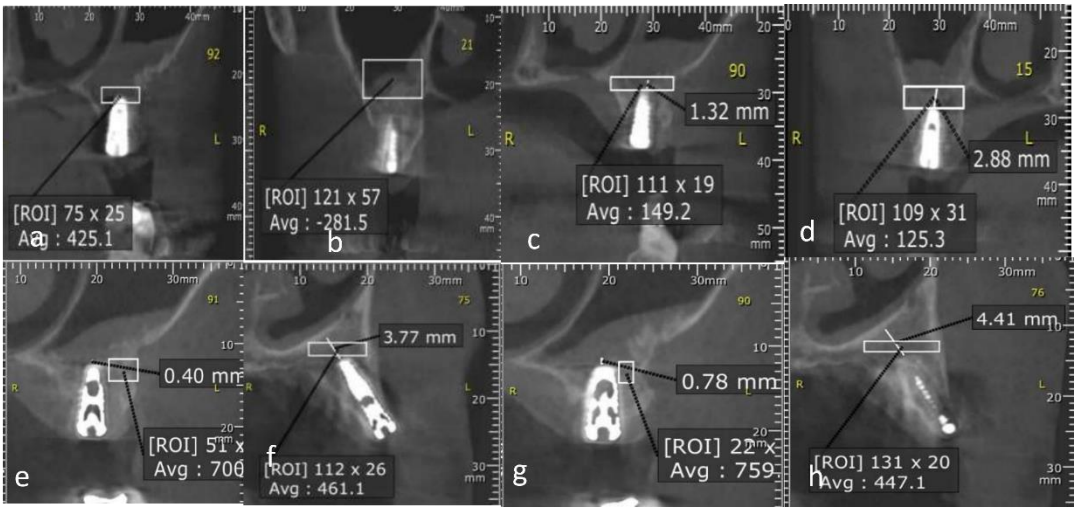

Figure (2): a, b, bone density immediate post operatively at two groups, c, d, bone density after 3 months post operatively at two groups, e, f, bone density after 6 months post operatively at two groups, g, and h, bone density after 9 months post operatively at two groups.

Discussion

In the present study Patients were observed for immediate, 3 months, 6 months and 9 months postoperatively. It was observed that gingival wounds related to

amniotic membrane had showed rapid optimum and early healing if compered to collagen membrane as erythema, inflammation, edema, swelling and pain were less evident at amniotic membrane. This may be attributed to low immune-sensitivity, anti-inflammatory, anti-fibrotic and antimutagenic effect of amniotic membrane rather than collagen one. This was in accordance with Niknejad et al. (12) reported amniotic membrane that had supported early and proper healing with it rather than collagen membrane which was evident in our results where we had got better healing measurers with amniotic membrane although its adaptation had took a longer time than collagen membrane which exposed it for more infection rate in vicinity of oral cavity and saliva. clinical trial had been made by Kumar et al (13) observed an increase in amount of bone fill and decrease in postoperative inflammation. This was the case in our study as we had observed superior wound healing of amniotic membrane GII. Velez et al. (14) had observed a lower number of patients reporting pain and patients were pain-free sooner with amniotic membrane compared to control group. This was the case in our study.

In the present study, at 3, 6, and 9 months there was a statistically significant difference in mean osstell measurements at two groups. Amniotic group had showed a higher Osstell reading than Collagen group which was consistent with data had been reported by Samandari et al (15) who had founded significant increase in bone deposition in cases treated with human amniotic membrane. This also had been confirmed by Anker et al (16) who had demonstrated that bipotential osteogenic differentiation of AM due to its high content of mesenchymal stem cells. Amniotic membrane was found to be capable of rapid wound improvement and bone induction. That might be explained by its content of collagen, fibronectin and laminin, all of which provided a suitable substrate for bone induction. Also, this substrate helped in induction of progenitor cells and/or stem cells in surgical area into osteoblasts through its growth factor content, thus stimulating new bone formation (15).

In the present study, at 6 months there was a statistically significant difference in mean bone density at two groups ($p=0.033^*$). Amniotic group had showed a higher bone density than collagen group which was highly significant at 9 months where difference in mean bone density at two groups ($p=0.019^*$) . Amniotic group had showed a higher bone density than collagen group. This was in accordance with Azuara - Blanco et al (17) who had stated that AM had produced an appropriate substrate, such as laminins for rapid epithelial cells attachment and stimulated rapid proliferation of cells, differentiation, and fibrosis which acted as fibrous tissue proliferation barrier. In addition to stiff character of AM that allowed it to be adapted easily to the defect site over graft material in surgical site without shriveling and suturing (18). AM had demonstrated increased stiffness that enhanced membrane strength necessary to resist stresses induced during growth of tissue (19). In summary, the combination of sticky with amniotic membrane had accelerated healing process and effective in regeneration.

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Conflicts of interest

The authors have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

Regulatory Statement

This study was conducted in accordance with all the provisions of the local human subjects oversight committee guidelines and policies of Al Azhar University Ethical Committee. The approval code for this study is AUAREC20210616-17

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