



Posterior Mandibular Tooth Socket Preservation with Amniotic Membrane and Allograft Bone versus Conventional Methods

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ABSTRACT

Tooth socket preservation has become a key component of contemporary clinical dentistry. This term designates alveolar preservation that achieved by immediate filling of the undamaged tooth socket with biomaterials. Different types of bone substitutions and membranes have been utilized for socket augmentation. Our goal was to evaluate the efficacy of the amniotic membrane, as a new material, on bone density in comparison with conventional methods in this study. In this randomized clinical trial 75 patients (48 females and 27 males) underwent mandibular molar extraction and socket preservation by using allograft bone in control group: allograft bone with collagen membrane in group 1 and allograft bone with amniotic membrane in group 2. All 25 stages of socket preservation procedures in each group were done by the same surgeon and evaluated by the same radiographic machine. The data were statistically analyzed by SPSS software, one-way ANOVA and Tukey post-hoc tests. P value <0.05 was considered as significant. The results of this study showed that after 4 months the mean density difference in extracted site was 1736.88 in control group; for patients who underwent socket preservation with allograft and collagen membrane it was 1746.20 and in cases with allograft in addition amniotic membrane it was 1762.48. The results demonstrated that, compared with control group, both collagen membrane and amniotic membrane showed a higher bone density mean (P Value =/998 and P Value = /918), but this difference was not statistically significant. Whereas amniotic membrane showed a higher bone density than the collagen membrane, there are no significant differences between these two groups (P Value =/994). Although socket preservation methods may be effective on alveolar bone contour stability, we cannot significantly confirm the efficacy of these methods on bone quality and density.

Key words: Amnion, Collagen, Ridge Augmentation, Bone Density

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INTRODUCTION

Alveolar bone loss may be attributed to a variety of factors, such as endodontic pathology, periodontitis, facial trauma and aggressive maneuvers during extractions. Most extractions are done with no regard for maintaining the alveolar ridge, that commonly result in osseous deformities of the alveolar ridge, including

reduced height and reduced width of the residual ridge [1, 2].

Alveolar ridge atrophy may have a considerable impact on tooth replacement therapy, particularly when implant-supported restorations are planned [3]. Consequently, alveolar ridge preservation has become a key component of contemporary clinical dentistry [4].

Socket preservation is a term designating alveolar preservation that is achieved by immediate filling of the undamaged tooth socket with biomaterials

(bone grafting material/Collagen) or autologous bone following extraction. The resorption of the alveolar structures is reduced firstly by stabilization of the intra-alveolar blood coagulum and secondly by augmentation of the cavity. If the bony extraction socket is damaged, the alveolar bone continuity is additionally restored with collagen membranes before/during its filling with biomaterials or autologous bone [5].

Placing various bone graft materials inside a thoroughly debrided fresh extraction socket is the first step in ridge preservation. Grafts are generally classified according to their original source as follows: autograft (oral or extra-oral), allograft (e.g. human freeze-dried bone), xenograft (bovine or porcine), and alloplasts or synthetic materials (hydroxyapatite, tricalcium phosphate, bioactive glass) [6].

The membrane's role is to provide isolation of the clot and the grafted area from migration of gingival epithelial cells, and fibroblasts from the lamina propria. This allows for population of the protected space by osteoprogenitor cells which differentiate into bone producing osteoblasts [7]. Over the past 20 years, numerous non-resorbable and resorbable membranes have been utilized for socket augmentation in preparation for dental implants [8-12]. Nowadays, new membranes have been developed in an effort to overcome the limitations of the common membranes. The new membranes are alginate membranes, new degradable copolymers, hybrid or Nano fibrous membranes, as well as amniotic membranes [13]. Recently allograft placental tissue based membranes, which are sourced from the amniotic sac, have become available for applications throughout the body including anti-adhesion barriers, ocular reconstruction, chronic wounds treatment and in dental surgery [14].

The use of allograft placental tissue has many beneficial attributes not found with other membranes; placental allograft tissue considered immune-privileged, possesses anti-inflammatory and anti-bacterial properties, and provides a protein-enriched matrix to facilitate cell migration [15].

Amnion tissue, the inner layer of the amniotic sac, contains collagen types III, IV, V, and laminin [16]. Laminins are the major class of basement membrane proteins that have multiple biological functions including promotion of cell adhesion,

migration, and differentiation of phenotypes [17]. The basement membrane of amnion tissue closely mimics the basement membrane of human oral mucosa and contains a high concentration of laminin-5 [18]. Amnion has been shown to contain cytokines including fibroblast growth factor, epidermal growth factors, platelet derived growth factor, and transforming growth factor beta [19-21]. Amnion tissue is derived from trophoblasts that possess characteristics of stem cells with multipotent differentiation ability that can generate cell development into all three germ layers [22]. Amnion tissue contains glycoproteins and tissue inhibitor of metalloproteinases-1, which inhibits degradation of the extracellular matrix and mitigates inflammation [23, 24]. Amnion possesses immunosuppressive properties, as demonstrated by its ability to suppress the proliferation of splenocytes; a mixture of lymphoid and mononuclear cells, monocytes, and macrophages [25].

In a study by Vilela-Goulart G and colleagues, it is demonstrated that homogenous frozen amnion used to treat oral mucositis in rats prevented bacterial colonization, reduced inflammation and allowed for complete wound closure compared to controls [26].

Therefore, according to applicable features of amniotic membrane such as containing stem cells, having anti-microbial and anti-inflammatory effect and being inert for immune system we have decided to utilize Amniotic Membrane as an alternative to other barrier membranes along with Allograft bone for posterior tooth socket preservation and compare the result of this membrane's effect on bone density with other available methods.

MATERIAL AND METHODS

This randomized clinical trial recruited 75 patients (48 females and 27 males with the age range 19 to 62 years old) that included 3 groups of volunteer patients for mandibular molar extraction and implant placement. All patients were in good general health (American Society of Anesthesiologists physical status I), nonsmokers and non-addicts, in addition to being cooperative with the study and diligent after surgery. There was no local problem such as gingival or periodontal diseases, nor any need for soft tissue regeneration and graft.

Subjects received 2gr Amoxicillin (Toliddaru, Iran) and 400mg Ibuprofen (Zahravi, Iran) one hour prior to the surgery, in addition to 0.12% Chlorhexidine mouthwash (Irannajo, Iran) as the preoperational prophylactic protocol. All procedures started by anesthetizing with 2% Lidocaine and Epinephrine 1/100000 (Darou Pakhsh Pharmaceutical mfg. Co, Iran); followed by sulcular incision with #15 blade (Martin, Germany) and #3 scalpel (Dena Puya, Pakistan) and mucoperiosteal triangular flap reflection via #9 molt periosteal elevator (Dena Puya, Pakistan) and atraumatic mandibular molar extraction with medium-size straight elevator (Dena Puya, Iran) and #17 lower molar forceps (Dena Puya, Iran) with minimal socket bone expansion and without any bone removal. Control group's socket preservation was done after dental extraction by allograft bone (Mineralized & Demineralized Bone Allograft, Iranian Tissue Bank Research Center, Tehran, Iran) and buccal mucoperiosteal flap; in group 1 socket was filled with the same allograft bone, but covered by collagen membrane (Tehran University Tissue bank, Tehran, Iran) and flap, while in group 2 tooth socket was reconstructed with allograft bone along with amniotic membrane (Amniotic Membrane Bank, Namazi Hospital, Shiraz, Iran) and flap. At the end, all surgical sites sutured with 3-0 braided silk suture (Supa, Iran). All patients have been acquainted of postoperative standard instructions and 500mg Amoxicillin capsule (Toliddaru, Iran) was prescribed for all of them every eight hour for 7 days. Immediately after the surgery and graft placement, an initial standardized digital panoramic radiograph was taken from each subject as a source for further analysis and their sutures were removed one week after the surgery.

Post-operative follow-ups included standardized digital panoramic radiograph within four months after surgery. All radiographs have been made using Planmeca Promax Digital Panoramic X-ray Unit (Helsinki, Finland) and phosphor imaging plate (Kodak Ektavision, Rochester, New York, USA). Mean gray values indicator of bone density was measured on the radiographs using the Medecom software (Medical Image Processing and Communication Software, SARL, France) and a personal computer through a gray scale of 256 tonalities. The measurements were obtained at

three sites of extraction site (at the crest, in the middle, and apical third of the panoramic radiograph). The mean of the three measurements were attributed to the bone density of extraction site. Difference in bone density values was calculated between immediately post-extraction imaging and imaging of 4 months follow-up visits. Increase in the difference of mean bone density during this 4 months follow-ups, indicated increase in bone density in the extraction site (increased opacity on the radiograph).

All data were statistically analyzed by SPSS software (version PASW 18). One-way ANOVA and Tukey post-hoc tests were used to compare the mean value of bone density between the three groups. P value <0.05 was considered as significant.

This study design was approved by the Standing Ethics Committee of Shiraz University of Medical Sciences (approval number: IR.SUMS.REC.1396.48).

RESULTS

A total of 75 patients (48 females and 27 males aged 19-62 years old, mean 41) have been tested in this study. All 25 socket preservation procedures of each group were done by the same surgeon and evaluated by the same radiographic machine. Table 1 displays the groups division.

DISCUSSION

Dental socket preservation methods are a known and important concept to preserve alveolar bone volume in height and width. But, has there been any improvement in bone quality or bone density in these techniques? Are there any differences between these methods?

This study was designed to compare the effect of amniotic membrane and allograft bone, collagen barrier membrane and allograft bone and also no membrane coverage, on bone density and bone quality in posterior tooth socket preservation.

Table 1: Different bone density between Groups

Used Materials	Mean Difference	Standard Deviation	Minimum	Maximum
Control (Bone)	1736.88	127.42	1499.00	2105.00
Collagen + Bone	1746.20	95.30	1555.00	1945.00
Amnion + Bone	1762.48	83.847	1606.00	1909.00

The results of this study showed the mean difference density in extracted site after 4 months is 1736.88 in control group, 1746.20 in patients who underwent socket preservation with allograft and collagen membrane, and finally was 1762.48 in cases with allograft in addition amniotic membrane.

Many studies have been found effective using a combination of membrane and bone graft in patients with serious periodontal defects or patients requiring bone augmentation for implant surgery [27, 28].

However, some studies have failed in demonstrating the usefulness of the membrane in bone regeneration methods. A systematic review revealed that the best available evidence does not support membrane use [29]. As well as Meijndert et al In a controlled trial, concluded that barrier membranes do not influence bone resorption [30].

Our results demonstrated that both the collagen membrane and the amniotic membrane showed a higher mean bone density, compared with control group (P Value =/998 and P Value = /918), although this difference was not statistically significant.

Although, amniotic membrane showed a higher bone density than group with collagen membrane, but there weren't any significant differences between these two groups too (P Value =/994).

Consistent with our survey, a study was carried out by Ríos et al. This study was performed on a number of rabbits and the aim was to compare bone density of bone defects treated with lyophilized amniotic membrane (LAM) and collagen membrane (CM) at three and five weeks. Results showed no significant differences between LAM and CM in three and five weeks ($p>0.05$) [31].

Even though the collagen barrier membrane is widely used as a commercial product [32]; this membrane is usually placed directly over the grafted material, after filling the bone grafts, to permit bone ingrowth and avoid the invasion of fibrous tissues [33]. Some problems are due to the use of collagen membrane (for example Animal origin) for defect reconstruction [34, 35] and this approach still faces more challenges such as inflammatory response, weak mechanical strength, and control of the degradation rate

during the surgical and postoperative healing phases [36, 37]. According to our study, in comparison with amnion membrane, collagen membrane has less impact on bone density in dental socket preservation methods. However, they did not show significant differences with control group.

Greater average bone density in amniotic membrane method can be justified by the advantages of this membrane over other membranes. The amniotic membrane provides a basal membrane that promotes cell migration and differentiation while reducing inflammation in the area below the membrane [38]. Amniotic membrane is found to have favorable biological properties such as antimicrobial, anti-inflammatory, scar inhibiting, low immunogenicity, stimulating epithelialization, and wound healing [39, 40]. It also prevents the osteogenic potential thereof and causes the repair of bone defects; thus amniotic membrane has a positive effect on the guided bone regeneration process [41].

Moreover, human amnion membranes have recently been reported as a suitable platform in facilitating osteogenic differentiation for both stem cells [42] and apical papilla cells [43]. When covering over the defects on maxillary and mandibular bone, the acellular human amnion membranes were found to promote injury-healing process while improving bone induction [44].

In conclusion, it should be mentioned that even though the average bone density in both collagen membrane and amniotic membrane was higher than control group according to our results and the use of amniotic membrane showed better results than collagen membrane, but we cannot be sure regarding the definitive effect of membrane on density and bone quality for the difference between these three groups was not statistically significant. Moreover, accessibility and lower costs can be considered as the advantages of amniotic membrane in comparison with other membrane. To reach definite results, we need further studies with a greater sample size.

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Conflict of interest

Authors declare that there is no conflict of interest.

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