Review Article

Multiple Techniques Have Been Proposed To Preserve Alveolar Bone after Tooth Loss

Awni Farhan Ismael Alani*

Department of Oral and Maxillofacial, BPP University, London, United Kingdom

Corresponding author:
Awni Farhan Ismael Alani,
Department of Oral and Maxillofacial, BPP University, London, United Kingdom,
Tel: 9419010363;
E-mail: awnifarhan@yahoo.com

Abstract

In order to prevent a clinical situation wherein adequate aesthetics or restorative treatment cannot be carried out, several researchers have made suggestions as to different surgical procedures such as regenerative techniques to preserve the socket and immediate implant placement. This paper thus is a commentary on multiple techniques that has been proposed to preserve alveolar bone after tooth loss.

Keywords: Alveolar bone; Tooth loss; Multiple techniques

Introduction

Extraction of multiple teeth has been deemed to result in the reduction of the size of the edentulous ridge which can vary among different individuals. [1-7] Even if one tooth in the arch is lost, several serious hard and soft tissue changes have been noted to take place in the affected area of the alveolar ridge. [8,9] The patterns of bone loss have also been observed to be the greatest in the buccal or the facial side rather than the palatal/lingual aspects of the ridge. A subsequent loss of the vertical height of the ridge is also noticed where the loss of height too occurs more on the buccal side. [10-12] The resorption process therefore that occurs at the extraction sites result in narrow and uneven ridges with a reduced vertical height. [13] The long axis is also seen to shift lingually/palatally. This defective ridge then poses problems in the aesthetic treatment of tooth loss thereby not allowing for optimal prosthetic fabrication or placing of implants.

The resorption rate of the alveolar ridges is seen to be faster in the first six months post-extraction. [8,10] From thereon, the rate of resorption occurs at a rate of 0.5-1% per year through the rest of the life of the patient. [3,14] In view of this, the height of the healed socket does not reach the coronal level of the bone with horizontal resorption greater in the molar regions when compared to the premolar regions. [9,15] Majority of the hard and soft tissues have been estimated to occur in three months from the time of extraction. After twelve months the crestal width is lost by 50% where 30% has been stated to occur within twelve weeks of extraction. [9] More recently, it has also been stated that the horizontal bone loss is greater than the vertical bone loss six months from the time of tooth removal. [16] Other research offers the view that 40-60% of alveolar bone shrinkage occurs within 2-3 years of extraction. [14]

In order to prevent a clinical situation wherein adequate aesthetics or restorative treatment cannot be carried out, several researchers have made suggestions as to different surgical procedures such as regenerative techniques to preserve the socket [17-20] and immediate implant placement. [21,22] Several studies (controlled and uncontrolled) have employed several approaches such as bone grafting using xenografts, [23,24] and other barrier membranes, [25,26] and alloplasts and membrane alone and also absorbable types of membranes 28. Membranes with grafting were also taken into consideration. [27] This paper thus is a commentary on multiple techniques that has been proposed to preserve alveolar bone after tooth loss.

Literature Review

Factors affecting the normal healing pattern and result in a defective ridge formation

While results have depicted that each tissue does undergo major changes on the extraction of the tooth it can also be stated that the inter-individual variation of such changes are rather high. It has also been observed that a provisional connective tissue forms within the first few weeks of healing in a consistent manner, whereas mineralized bone is rather subjective and not as predictable. [28] It can be speculated here that the wound healing process is accompanied by several variables such as the dimension of the healing socket. However, the reasons for the variance have not been fully understood yet and can be related to several other factors related to the patient as well as the site. These factors include, smoking, flapless tooth extraction, and the location of the site.

A prospective study of duration of 6 months [28] showed that smoking negatively impacted the dimensional reduction of the tooth socket. As per this study more reduction was seen in patients who were smokers as compared to non-smokers. Mainly, however the mechanisms by which this takes place is not understood fully. A flapless tooth extraction on the other hand has reported a loss in the crestal bone by approximately 0.6mm after 2 months, but after 4 months the loss was observed

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to be the same 0.6mm. [28] More recently however, another study showed that the dimensional alterations between flap and flapless extractions were the same. The conflicting evidence regarding the decrease in crestal bone in flap and flapless extraction may be suggestive of the fact that after a period of six months of being edentulous the effects on the crestal bone are essentially the same even though initial differences between the two do exist.

Studies have also depicted that the location of the extraction site makes a difference to the healing process post extraction. A study has shown that the premolar area of the extraction site shows a small amount of bone loss with a more apically positioned alveolar crest when compared to dentate sites. [28] This finding may be suggestive of the fact that the vertical resorption of the bone occurs differently and at different rates for different sites. Another study further adds credence to the finding as it was deemed that the alveolar ridge resorption was greater in the case of second molar sites as compared with first and second premolar sites. [28]

Conservative and surgical techniques used to preserve alveolar bone

There are several techniques used to preserve the alveolar bone. These include, bone expansion technique and alveolar ridge splitting technique. Bone expansion techniques can involve the techniques of ridge expansion and the use of osteotomes. The main advantages of osteotomes are that while drilling is required to remove additional bone to replace bone, this technique retains the available bone mass as a whole. It also enables for an increase in the ridge width for optimal placement of implants which also allows for the placement of immediate implants at the time of expansion. The viscoelasticity of the bone is used by the osteotomes which further manipulates bone for advantageous use, besides this, a greater tactile sensitivity is also achieved with it being minimally invasive and cost effective. The main disadvantages however are that osteotomes are more of a palm held design that may have limited use for the posterior region due to restricted mouth opening and hence limited access to those areas. They must be used with caution due to the force expended to the apical regions. [29]

Even though bone expansion techniques are quite advantageous their use is restricted to the maxilla. Due to this other methods such as ridge expansion with screws must also be considered. This method makes use of a mallet with serial osteotomes. The main advantages of this technique are that it is a graftless solution to manage atrophy. Also, any implant technique and system can be used with this, it also aids in the atraumatic sequence of expansion of bone. There is also no bone loss during the osteotomy preparation. The disadvantage however is that it is time consuming and requires much dexterity. [29]

Ridge splitting on the other hand is advantageous in that the malfracture occurring due to the technique is controlled and thereby minimized. [30] The blood supply of the buccal (lateralized) segment remains untouched and hence intact. With the advantages and disadvantages of the surgical and conservative techniques listed out, it can be speculated that the surgical procedures that aid in the reduction of trauma, preservation and augmentation of the alveolar ridge are vital to achieve optimal results in implant placement. It can also be suggested that when the clinician can avail the best use of the remaining bone then novel techniques such as ridge expansion and splitting can be considered for bone enhancement in order to facilitate more aesthetic placement of implants.

Role of regenerative techniques in preserving alveolar bone

The employ of regenerative techniques at the fresh site of extraction is done in order to improve the quality and quantity of bone for the optimal placement of a dental implant and to also avoid adverse alteration to the alveolar ridge post extraction.

The use of graft materials has been described in several studies for partial human use. [24,31-33] Major aspects of the bone formation were seen after 6 weeks of bone grafting. The bone density was also increased from the coronal to the apical portion of the socket. [33] The healing of the extraction socket through xenografting and autografting were also reported in other studies where a considerable increase in the bone density was seen after 9 months of grafting. [31] The study by Fickl et al. [34] on the other hand reported that the use of a xenograft had very limited impact on the vertical resportion of the alveolar bone. Furthermore, a limited effect of this type of graft was also found when placed on the buccal cortical region where there was seen anoverbuild up of buccal aspect when combined with socket preservation. Therefore it was not deemed to be of suitable use to control the alteration to tissue following extraction. [35] The evidence on hand however conflicting is clearly demarcated in its partial and full use in humans. In this regard, the findings are however suggestive of the fact those biomaterials can be of considerable use to either prevent or limit the alteration to the tissue post extraction is still severely scarce.

Discussion

The use of barrier membranes at extraction sites can be carried out mainly using two mechanisms such as the exclusion of cells with high proliferation rate and providing space including socket walls that is needed to fill the defect with new bone. This aids in the prevention of the collapse of soft tissues in the extraction site. The use of non- resorbable titanium membrane was evaluated by Pinho et al. [13] The membranes were removed from the socket after 10 weeks when it was observed that a substantial bone fill had occurred. However, a horizontal contraction of the socket wall was also observed. Another study also demonstrated that ridge dimensions were preserved 6 months after following extraction. However, these effects were not seen in areas that had previous exposure of membranes. [17] Another study that evaluated the use of bioabsorbable membranes using the same split mouth technique showed that membrane exposure was not seen for 6 months. After 6 months these sites treated with membranes showed a less alveolar bone loss with respect to height and internal socket bone and also reduced horizontal resorption of the alveolar ridges. These findings are mainly suggestive of the fact that membrane treated sites (with no

membrane exposure) lead to better clinical outcomes as opposed to non-membrane treated sites.

Role of immediate implant placement in preserving alveolar bone

Dimensional alteration of the extraction sites has been studied. Early researchers in this aspect have reported a spontaneous healing of peri-implant defects with filling of bone until completely healed in the case if placement of immediate implants. [36] It was also reported that wider horizontal peri implant defects healed by connective tissue rather than with a bone to implant contact. This connective tissue was seen to seal even the largest of gaps and was resistant to the penetration of probes. [37] More recently however, the healing of the socket with immediate implants were noted 16 weeks after the implant was placed. This study too depicted a full bone fill in the site. [38] Besides this, in order to assess the impact of immediate implants in the fresh sockets, a comparison of implant loading also needs to be considered. There are controlled studies that depict that the changes of the bone levels in the fresh extraction sockets are comparable to those implants that have been placed on healed sockets. Other studies have also reported the same kind of changes with immediate implants. [39,40] Even though immediate implants have shown such results, it has been deemed that the results must be taken with caution especially in the maxillary anterior region as the midfacial gingival margin maintenance has been deemed very difficult to maintain. [41] These findings are hence suggestive of the fact that the immediate implant placement must be treated with caution and also used only in certain areas and with tremendous caution in the anterior zone.

Conclusion

The summary of the data can be listed as below.

• There is an inter-individual variability of each of the tissue component and their rates of healing

• The extent of the ridge healing or the alteration is determined by factors such as smoking, site and technique of extraction

• Immediate implants needs to be used with caution in the anterior regions and can be used only in sites such as the molar region for optimal results

• Even though evidence is limited for the use of graft material membranes do prevent the collapse of horizontal as well as vertical collapse of the ridge post extraction.

Implications for Clinical Practice

The socket preservation techniques have been evidenced to be effective for horizontal and vertical ridge alterations. Major evidence indicates that the use of barrier membranes can aid in the improvement of wound healing in the extraction sites.

Conflict of Interest

All authors disclose that there was no conflict of interest.

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