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A Brief Review on Healing Of Extraction Sockets with And Without Regenerative Materials

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Abstract: Tooth loss is one of the major problems that is prevalent worldwide since the tooth place a major role in the masticatory function thus aiding in digestion. Tooth can be extracted or removed for various reasons such as caries, periodontitis, fractures etc. The lost tooth should always be replaced so that the functions become normal. The process of extraction generally results in resorption of the bony sockets during the healing period. Hence to restore the lost teeth the bone should be in a proper condition. This review provides an insight on a technique called as socket preservation and the materials which have been used for this process and their mechanism in healing of extraction sockets.

Keywords: Socket Healing, Bone Substitutes, Platelet Concentrates

INTRODUCTION

We know that a lot of essential functions are dependent on the teeth. The teeth are mainly responsible for mastication. Also, the teeth affect our ability to speak and so on. But the teeth are generally more prone to infection and are extracted easily. The indications for extractions are due to many reasons. Sometimes it is necessary because of pain, infection, bone loss or fracture of the tooth. Infection or disease. The bony socket of the teeth often gets damaged when an infection or disease occurs resulting in the resorption of the underlying bone. That is the extraction of teeth produces many defects on the surrounding bone, gums and shrink them and the bone recedes quickly causing defects on lips and cheeks. The loss of alveolar bone may be attributed to a variety of factors, such as endodontic pathology, periodontitis, facial trauma, and aggressive procedures during extractions. These defects in the jaw will cause problems while restoring with either implants, dentures, or bridges. The deformities produced by tooth extraction can be prevented and repaired by the socket preservation. This review is aimed to give an insight on the materials used for socket preservation and their role in healing.

BIOLOGY OF WOUND HEALING AFTER EXTRACTION

After the extraction of tooth, a series of events takes place inside a socket. This healing process after extraction involves certain vascular alterations; inflammatory activation; migration, proliferation, and differentiation of different cell populations; production of extracellular matrix and its maturation; formation remodeling and modeling of bone helping in the restoration of the lost tissues. It mainly comprises of:

1. Coagulation and haemostasis, which immediately follows the teeth extraction.
2. Inflammation, that is initiated shortly thereafter.
3. Proliferation, initiated in the subsequent days and incorporating most of the healing process.
4. Modeling and remodeling of the alveolar bone, aiming to restore the lost architecture and functionality, and lasting for several months.

Haemostasis and coagulation

The first step of haemostasis is when blood vessels constrict to restrict the blood flow. In the next process the platelets stick together to seal the break in the wall of the blood vessel. Finally, coagulation occurs and reinforces the platelet plug with threads of fibrin which are like a molecular binding agent.

The second phase

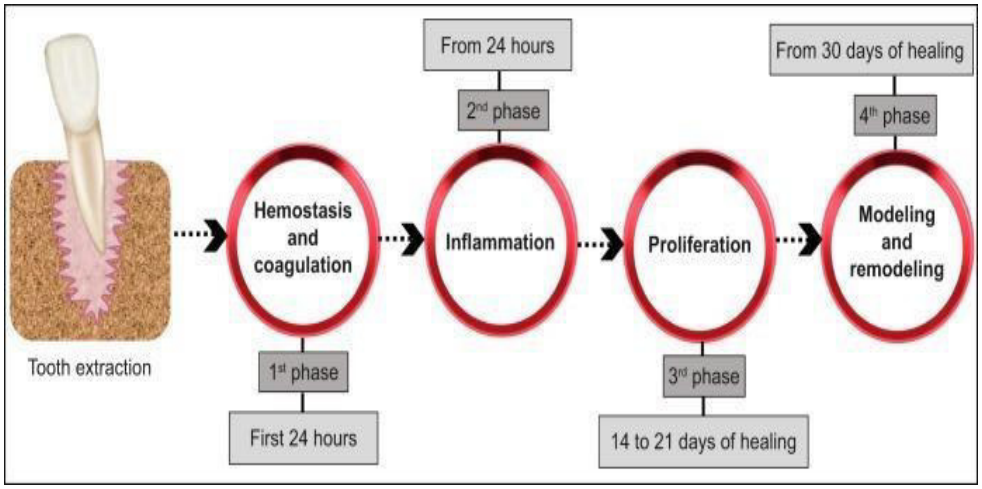
The inflammatory phase occurs for about 3-5 days after tooth extraction. This phase is characterized by formation of a fibrin plug by aggregation of the circulating platelets which is represented by vasoconstriction of the injured vasculature. This creates the stage for the formation of a provisional matrix which occurs by haemostasis.[1] When haemostasis is established, the plasma from the blood and other mediators of healing pass through the walls of the vessels since the vascular permeability is altered. This process is called as diapedesis. Swelling, redness, heat and pain are represented as the important clinical features in this phase.

The third phase

The third phase is the proliferative phase. This phase occurs for about 14 days postoperatively. This phase comprises of the formation of pink granulation tissue which consists of inflammatory cells and collagen secretion-epithelization, pink color of the tissue and the formation of scar are main clinical manifestations. Excessive collagen formation and scar contracture.

Last Phase

The last phase of socket healing is remodeling phase. It occurs for 6 weeks postoperatively. The main objective for remodeling phaseis to replace weaker typeIIcollagen. This process is called matrix degradation. This is continued by matrix formation which involves the replacement with stronger type I collagen. The matrix metalloproteinases and the serine proteases regulate the collagen fibers and the extracellular matrix of the scar. Clinically this represents a normal tissue color and scar formation.[2] The process of matrix degradation should equal matrix formation which when not equal results in keloid scar or wound dehiscence.



[pc:de Sousa Gomes P, Daugela P, Poskevicius L, Mariano L, Fernandes MH. Molecular and cellular aspects of socket healing in the absence and presence of graft materials and autologous platelet concentrates: A focused review. Journal of oral & maxilla facial research.2019Jul;10(3)]

PRESERVATION OF EXTRACTION SOCKET WITH BONEGRAFT

Ridge preservation, or socket preservation involves placement of graft material within the socket, which may be further combined with a membrane, or rotated flap. The graft materials when they are positioned inside a fresh socket promote the healing process by assisting in the clot stabilization by acting as solid scaffolds.[3] The application of ridge preservation techniques at fresh extractions sites is performed so as to enhance the standard and maximize the number of bone for the location and osseointegration of an implant , and to avoid post extraction alterations of the ridge profile.[4]The biological mechanism for grafting of bone inside the socket is based on: Osteo conduction:It is the process where the bone graft material acts as a scaffold for the formation of new bone which is perpetuated by the native bone.

Osteoinduction

It is the process in which the OPG cells are stimulated to get differentiated into osteoblasts to lay down new bone. BMPs are the most widely studied osteo inductive cell mediators.

Osteogenesis

The bone graft material with this property will have osteoinductive and osteoconductive properties along with the presence of vital osteoblasts that contributes one wboneformation.

Osteopromotion

The materials will promote the osteoinduction even though they do not possess the osteoinductive property. For example, enamel matrix derivative reinforces the osteo inductive effect of demineralized freeze-dried bone allograft (DFDBA) but will not stimulate bone growth alone.

MATERIALS FOR BONE TISSUE SUBSTITUTIONS

The osteoplastic materials can be divided as

Autogenic (the donor is the patient),allogenic(the donor is another person),xenogenic (the donor is an animal) and synthetic (based on calcium salts). There are many different techniques for augmentation by using any of the following :• Bone fillers: freeze-dried bone allograft (FDBA), organic cancellous porcine bone xenograft (CPB), calcium sulfate (CS), magnesium-enriched hydroxyapatite;• collagen sponges: absorbable collagen sponge; : bioabsorbable polylactide-polyglycolide acid sponge (BAS)• recombinant human bone morphogenicprotein-2 growth factor;• membranes: nonabsorbable expanded tetrafluoroethylene membrane (NAM) and bioabsorbable membrane made up of glycolide and lactide polymers (BAM).Synthetic resorbable materials were meant as an affordable substitute for natural bone. artificial graft materials embrace numerous styles of ceramics: tricalcium phosphate; bio glass; hydroxyapatite and its compositions with scleroprote in, sulfated glycosaminoglycans like keratan and chondroitin sulfate similarly like sulphate and orthophosphate. Now, many alternative

sorts of porous nanostructured orthophosphate ceramics, bone cements, biohybrids and biocomposite compounds are created.[5,6]

SOCKET HEALING WITH GRAFT MATERIALS

Ridge preservation, or socket preservation involves placement of graft material at intervals the socket, which may be any combined with a membrane, or turned flap. The principle for socket preservation is sustained for the very fact that, once positioned within the recent socket, graft materials act as solid scaffolds that assist on clot stabilization. These materials could also be broadly categorized into slow and fast resorbing grafts. In the slow resorbing category, graft materials maintain their presence and integrity over the future, and graft particles essentially Osseo integrate and have direct contact with newly formed bone. Fast-resorbing materials, work by the degradation of the bone through the osteoclastic -mediation which in turn enhances the process of osteogenesis.[7] The production of extra cellular matrix and its maturation may be enhanced by certain bone graft materials by their direct modulatory effects. The clinical advantages of placement of bone particles in the extraction socket, aiming to preserve the alveolar ridge so that avoiding the bone grafting procedure prior or during implant placement, are largely supported by the available literature and upto date meta-analyticalstudies.[8,9] In the earliest stages of socket healing, xenogenic mineralized grafting materials bio ceramics or seem to interfere. with the degradation of clot and substitution by mature bone tissue or being non resorbable even for long term . Accordingly, residual and/or encapsulated graft particles were found to range from 0% - within fast resorbing materials (e.g., polylactide sponge),[10] to 45,8% - within cortico cancellous xenogenic grafts .[11] The graft particles will have an immediate contact with the mineralised tissue and that they will represent small areas of decalcification on their outer surfaces. future reports addressing residual grafting of dense hydroxyapatite revealed a remaining volume of around 38%, 20 years following the procedure, with direct bone contact and absence of gaps or fibrous tissues at the bone-biomaterial interface .[12] The assessment of DBBM resorption for long term analyses at 8months, 2 years and 10 years showed a high integration with new bone with the presence of slow biodegradation which provides a good scaffold for bone deposition and a good support for future implant placement.[13] Thus, though there were certain hindrances on the initial phases of socket healing the process of socket preservation seems to be very effective in providing a good formation of matured bone thus promoting the preservation of the alveolar ridge which is being limited by physiologic resorption. This technique majorly has a role in preserving mid-buccal or mid-lingual height.

SOCKET HEALING WITH AUTOLOGOUS PLATELET CONCENTRATES

Along with the use of autogenous, allogenic, xenogenic and alloplastic materials, the autologous platelet [APCs] concentrates are found to be promoting the healing of the sockets.[14]APCs refer to a group of products that promotes the regeneration of the tissues which are obtained from the autologous blood .They provide highly concentrated bioactive factors by triggering the natural healing.[15]

The APCs are classified majorly as

1.Pure platelet-rich plasma (P-PRP),
2. Leukocyte- and platelet-rich plasma (LPRP),
3.Pureplatelet-richfibrin (P-PRF),and
4. Leukocyte-and platelet-rich fibrin(L-PRF).[16]

Different preparation protocols, composition, biological content, and potential application are there for different families of platelet concentrates. The APCs will release certain cytokines and growth factors which are attributed to their beneficial effects in socket healing to promote osteoid formation these are immersed in the fibrin mesh ,platelets and leukocytes.[17] The APCs are available either as liquid solutions or in an activated gel form.[16] The growth factors are generally released within 24 hours of preparation. After the platelet activation L-PRP and P-PRP form loose fibrin meshwork. In contrast, fibrin polymerizes in P-PRF and L-PRF, releases a strong and dense fibrin network for continuous release of the growth factors by trapping the cells, up to 28 days upon application.[18]Fibrinmatrix is described as a favorable scaffold for mesenchymal stem cells proliferation, differentiation, vascular in growth and is safe to be left exposed in mouth to guide the migration of the epithelial cells to its surface, resulting in natural wound re-epithelization by secondary intention healing. Multiple studies have found that when compared to regular blood clot formation there is much promising results for the usage of APCs in case of extraction sockets preservation. The idea of using platelet supplementation to reinforce extraction wound healing is based on the ability of the platelets to trigger healing response upon release of varied growth factors. Platelet growth factors, like the FGF and TGFβ -1, stimulate bone formation during osseous healing. PDGF regulates the migration and proliferation of mesenchymal stem cells within the extraction site and stimulates proliferation of the endothelial, fibroblastic, and osteoblastic cells to stimulate socket healing. Additionally, VEGF, released from platelets, stimulates the proliferation and differentiation of various cell types essential for vascular formation during angiogenesis and vasculogenesis, helping to move nutrients and oxygen mandatory for the extraction wound healing process. The APCs that contain leukocytes are found to reduce the infection -related complications such as dry sockets after mandibular 3rd molar extractions. Monocytes, within L-PRP and L-PRF delivered to the alveolar socket, get differentiated into tissue macrophages. Macrophages function as the key mediators of the wound healing process, which plays an important role in the transition between the inflammatory and repair phase of the wound healing, with particular emphasis on osteogenesis. Macrophage release TGF which in turn stimulate keratinocytes, IL-1, FGF, and TNFα that play a role in collagen production by the fibroblasts and improve the process of angiogenesis. PDGF, can also be produced by macrophages .[19] Socket preservation procedure demands slow resorption and adequate space maintaining biomaterials to stabilize the clot and counteract the post extraction resorption of the ridges. APCs are considered as a weak osteoconductive scaffold and aren't expected to function an osteoconductive biomaterial for ridge preservation alone, in contrastTo slow resorption xenografts, allografts, or alloplasts,are used specifically within socket preservation for therapeutic approaches.

TECHNIQUE TO PRESERVE THE BONE AFTER TOOTH EXTRACTION

After the removal of the hopeless tooth the socket is filled with bone or bone substitute. It is then covered with gum, artificial membrane, or tissue stimulating proteins to encourage the body's ability to repair the socket. With this method of preservation, the healing of the socket will take place without shrinkage and collapse of the surrounding gums and facial tissues. With this method, the socket heals eliminating the post-surgical shrinkage and collapse of surrounding gum and facial tissues. The newly formed bone within the socket also provides a foundation for an implant to replace the lost tooth.[20]

DISCUSSION

The main goal of socket preservation procedures is to preserve the volume of the bone by filling the sockets with bone material substitutes. The process of socket preservation after extraction is found to reduce the healing time[21]. Fotek[22] et al in 2009 conducted a study among 20 patients where test group 1 had their sockets filled with solved preserved mineralized cancellous bone covered with acellular dermal matrix and test group 2 had their sockets filled with solved preserved mineralized cancellous bone d-PTFE membrane and concluded that all sites evaluated showed minimal ridge alterations, with no statistical difference between the two treatment modalities with respect to bone composition and horizontal and vertical bone loss, indicating that both membranes are suitable for alveolar ridge augmentation .Eric Todd Scheyer[23] et al in 2016 conducted a study Forty subjects with extraction sockets Treatments were demineralized allograft plus reconstituted and cross-linked collagen membrane (DFDBA + RECXC) or deproteinized bovine bone mineral with collagen plus native, bilayer collagen membrane (DBBMC + NBCM). Socket dimensions were recorded at baseline and 6 months. Wound closure and soft tissue inflammation were followed post-operatively, and biopsies were retrieved for histomorphometric analysis at 6 months and concluded that DBBMC + NBCM provided better soft tissue healing and ridge preservation for implant placement. Deeper extraction sockets with higher and more intact bony walls responded more favorably to ridge preservation therapy. Thus, socket preservation is better than not preserving them.

CONCLUSION

Thus, the normal process of wound healing that occurs in the extraction sockets are about to produce ridge resorption and bone resorption. The use of different bone graft materials or the usage of the platelet concentrates in the preservation of the extraction sockets provides better post operative results which can be of greater importance for the placement of implants in the future replacing the lost tooth.

CONFLICT OF INTEREST

Conflict of interest declare none.

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