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Bone graft in a Crux

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ABSTRACT

While the conventional periodontal therapies achieve management of periodontal diseases by repair, they are insufficient in reconstructing the lost structures. One major goal of periodontal surgical therapy includes regeneration of lost periodontal tissues including periodontal ligament, cementum and alveolar bone. The prerequisites for bone regeneration are cells, molecules, scaffold, and blood supply. Bone grafts provide the cells or may act as a scaffold for new bone formation. The search for an ideal bone graft perpetually continues. The following article presents an overview of the commonly used bone grafts in the management of periodontal affliction touching upon the topics of objectives and indications of bone grafts and their classification.

Keywords— *Periodontal Diseases, Bone Graft, Regeneration*

1. INTRODUCTION

"If the alveoli have really been destroyed in those cases of loose teeth… whether they have a power of renewing themselves is analogous to that power by which they first grow…"

-John Hunter (1803)

The most consequential sequel of periodontal disease is the loss of periodontal support system which includes the cementum, periodontal ligament and alveolar bone.[1]

While the traditional periodontal treatments are efficacious in repairing disease-related defects and suspending the progression of the periodontitis, they are insufficient in promoting the regrowth of tissue that restores the architecture and function of the lost periodontium.[2]

Albeit the reconstruction of osseous defects caused by inflammatory periodontal disease is a perpetual challenge, the science of biomaterial has witnessed significant development in the arena of periodontal regeneration. The most often used regenerative techniques involve (1) the use of bone inductive graft materials, (2) a guided cell repopulation using a barrier membrane and (3) coronally positioned flaps in which the flap margin is secured at an appropriate distance from the healing site.[2]

Bowers (1989) had concluded that histologic evidence in humans indicated that bone grafting was a more predictable method for regeneration of the periodontium coronal to the base of a previous osseous defect.[1]Osseous grafting therapy has been shown to be clinically successful for time intervals exceeding 20 years when plaque control is practised rigorously.[3]

The following review presents a gist of commonly used bone grafts for periodontal regeneration.

2. BONE GRAFT

Bone grafting is a surgical procedure that replaces the missing bone with material from patients' own body, an artificial, synthetic, or natural substitute.[4]

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2.1 History

- Hegedus (1923): Attempted the use of autogenous tibial grafts for the reconstruction of the deficient alveolar ridges.[5, 6]
- Buebe and Silvers (1936): Successfully repaired intrabony defects in using boiled cow bone powder.
- Nabers and O'leary (1965): Shavings of cortical bone removed by hand chisels during osteoplasty and osteotomy to treat one, two‑wall defect.[7]
- Langhorne: Gave histological proof that autogenous grafts were advantageous in bone repair in comparison to open flap debridement.[6]

2.2 Clinical objectives of bone grafting

Following are the objectives of bone grafting procedures for patients with periodontitis:

- Probing depth reduction
- Clinical attachment gain
- Bone fill of the osseous defect
- Regeneration of new bone, cementum and PDL as determined by histologic analysis.[3]

The ideal graft material is yet to be found, however, a bone graft should be able to fulfil more than one of the criteria.

3. INDICATIONS OF BONE GRAFT[2]

- Deep infrabony defects associated with chronic inflammatory periodontal disease may be treated with bone grafts. Increased bone support for a tooth may restore sufficient functional stability to make it an acceptable abutment.
- Use of bone grafts in patients with localized aggressive periodontitis has eliminated the extraction of involved teeth and has often regenerated almost the entire amount of previously lost bone.
- Maintenance of, or esthetic transformation of, gingival margin height may be an important goal of bone grafting.

Yukna also concluded some other factor important while considering patients for bone grafting procedures[8]:

- Patients who have time for rigorous treatment regimen and post-surgical maintenance program.
- Patients who are highly motivated and demonstrate good plaque control.
- Economic factors.
- The clinical expertise of the practitioner.

It is of utmost importance for the clinician to understand the properties and origin of the bone graft and it falls upon them as their duty to explain to their patients the source of graft since the latter may have religious restrictions as to the type of the graft material that is being used in their mouth.[9]

3.1 Bone formation after grafting

It is characterized by following ways of bone growth[10]:

- **Osteogenesis:** Formation of new bone by osteoblasts derived from the graft material itself.
- **Osteoinduction:** The ability of a material to induce the formation of osteoblasts from the surrounding tissue at the graft-host site, which results in bone growth.
- **Osteoconduction:** The ability of a material to support the growth of bone over a surface.
- **Osteopromotion:** Involves the enhancement of osteoinduction without the possession of osteoinductive properties. For example, enamel matrix derivative has been shown to enhance the osteoinductive effect.[7]
- **Osteoneutral Graft:** Type of graft which merely fills the bone defect without producing any effect and often gets encapsulated.[9]

Although not directly responsible for bone formation, an additional characteristic is an osseointegration, which is the ability of the bone tissue to directly adhere to the surface of the implanted biomaterial without forming a fibrous interface.

3.2 Classification

On the basis of origin, bone grafts are classified into the following[9]:

- **Autografts**: Bone is obtained from the same individual.
- **Allografts:** Obtained from different individuals of same species.
- **Xenografts:** Is obtained from different species usually the bovine or porcine origin.
- **Alloplast:** Synthetic graft materials/ bone substitutes.

4. AUTOGENOUS BONE GRAFT

They are also called autografts/autologous grafts. These grafts are the gold standard to which all other grafting materials are compared because they possess all the characteristics of osteogenesis, osteoinduction and osteoconduction. Because they are from the host itself, there is an absence of antigenicity.[10] They can be cortical or cancellous or both. Cancellous grafts have the ability to revascularize sooner (as early as the fifth day) because of their spongy architecture.[10] Before revascularization, cellular survival in the graft depends on nutrition through plasmatic diffusion. Osteocytes within their lacunae seem to survive if they are within 0.3 mm of a perfusion surface.[10]

Several forms of autografts can be used clinically. They include cortical bone chips, osseous coagulum, bone blend, intraoral and extraoral cancellous bone, and marrow.[5]

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4.1 Cortical bone chips

Nabers and O'Leary reported the use of cortical bone shavings to increase the bone height. Cortical chips, due to their relatively large particle size- 1,559.6 x 183 µm) and potential for sequestration was replaced by autogenous osseous coagulum and bone blend.[5]

4.2 Osseous coagulum and bone blend

Intraoral bone, when obtained with high or low-speed round burs and mixed with blood becomes a coagulum. The rationale for its use is the belief that the smaller the particle size of the donor's bone, the more certain its resorption and replacement with host bone.[1]

The bone blend is the cortical or cancellous bone that is procured with a trephine or rongeurs, placed in an amalgam capsule, and triturated to the consistency of a slushy osseous mass. The resultant particle size is in the range of 210 x 10 5 µm.[5]

4.3 Intraoral cancellous bone and marrow

Intraoral cancellous bone and marrow can be obtained from healing extraction sockets, mandibular retromolar areas, and maxillary tuberosity areas.[5]

4.4 Extra-oral cancellous bone and marrow

The material from anterior or the posterior iliac crest offer the greatest potential for new bone growth.[5,10] However Forum et al found that bone blend and osseous coagulum grafts lead to equally good defect fill.[1] Also, many patients refuse or cannot afford to be hospitalized for extraoral graft procurement.[1]

The disadvantages of autogenous grafts are the amount of available graft material and the morbidity associated with their harvest.[10]

The limitations of autografts paved the path for the development of myriad grafting materials like allografts, xenografts and alloplasts.

5. ALLOGRAFT

These are usually of cadaveric origin and are freeze-dried and treated to prevent disease transmission and are available from commercial tissue banks.[1] It is more acceptable amongst clinicians because it closely matches the recipient in constitutional elements and architecture and is theoretically available in unlimited quantity.[10] Mellonig describes 2 types of allografts viz freeze-dried bone allograft (FDBA) and demineralized freeze-dried bone allograft (DFDBA).[5] Demineralizing and freeze-drying dramatically increases the osteogenic potential of the graft.[1]

- **Importance of freeze-drying[5]:** Freeze drying removes approximately 95% of the water from bone by a process of sublimation in a vacuum. Although freeze-drying kills all cells, the morphology, solubility, and chemical integrity of the original specimen are maintained relatively intact. Freeze drying also markedly reduces the antigenicity of the allograft.
- **Importance of demineralizing[1]:** Removing bone mineral is crucial. This process exposes the BMPs in the graft material that stimulate the formation of new bone by osteoconduction. Although allografts are treated in various ways, the risk of disease transmission still exists.

An investigation by the US Centers for Disease Control and Prevention documented at least 25 cases of allograft related infection including HIV, Hepatitis B and C.[10]

5.1 FDBA

FDBAs was first used by Mellonig et al. (1976), although they have been used clinically in orthopaedic therapy since 1950.[7] FDBA, which is not demineralized, works primarily through osteoconduction. Over time, the graft is resorbed and replaced by new bone.[1] Several studies have demonstrated that FDBA, when mixed with autogenous graft, is more efficient at increasing bone fill than FDBA alone.[1]

5.2 DFDBA

DFDBA was first used in dentistry and medicine in 1965 by Urist.[7]It is the best studied and widely used allograft in periodontics because of its availability, safety and proposed osteoconductive and osteoinductive properties. The osteoinductive process involves pluripotent cells from the surrounding natural bone on which the graft is placed. These cells are recruited, then differentiated into bone-forming cells. Over time this allograft is resorbed and the subsequent regenerative process is thought to be induced by bone morphogenic protein (BMP).[1]

6. XENOGRAFTS

Although they carry a theoretical risk of transmission of bovine spongiform encephalopathy, experimental data indicate that the use of these materials does not carry a risk for transmitting the same to humans.[10]

As opposed to DFDBA, the bone mineral has also been produced, which is derived from bovine bone by a special process, which removes its organic components but retains its inorganic structure. This product, a xenograft, is also known as bovine anorganiccancellous bone.[7]

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Bovine bone mineral grafts, when used with barrier membranes, improved clinical and radiographic parameters of deep intrabony pockets. Success in sinus elevation procedures with or without implant placement occurs when used alone or in combination with venous blood, platelet-rich plasma, and autogenous bone.[10]

7. ALLOPLAST

Alloplastic materials are synthetic, inorganic, biocompatible, and/or bioactive bone graft substitutes, which are claimed to promote bone healing through osteoconduction.[7]

These synthetic materials are inert with no or little osteoinductive activity. The advantages of these include an absence of antigenicity, no potential for disease transmission, and unlimited supply.

The bioactive glass was introduced almost 30 years ago as bone substitutes.[7] The designation ‘‘bioactive’’ relates to their ability to bond to bone and enhance bone-tissue formation. When bio glasses are exposed to tissue fluids, a double layer of silica gel and calcium phosphate is formed on their surface. Through this layer, the material promotes absorption and concentration of proteins used by osteoblasts to form an extracellular bone matrix which may theoretically promote bone formation.[7]

8. CONCLUSION

Bone grafting is one of the most routinely employed procedures for regenerative purposes in alveolar defects around teeth, dental implants or for sinus augmentation. As research progresses in the arena of alveolar bone and grafting materials, there are many rousing developments that may have profound impacts on bone grafting. The future is in biomaterials or bioengineering. There is a superfluity of products in the market designed to be used for grafting of human bone. However, understanding the biological aspect of any bone graft is required along with acknowledging the patient factors in order to select the bone graft best suited for the individual.

9. REFERENCES

[1] Vandersall DC. Advances in Periodontics. Dent Clin North Am 1998; 42(3).
[2] Polson AM. Periodontal Regeneration: current status and directions, Chicago, Quintessence.1994.
[3] Schallhorn RG. Long term evaluation of osseous grafts in periodontal therapy. Int Dent J.4:9, 1988. In Mellonig JJ. Autogenous and allogenic bone grafts in periodontal therapy. Crit Rev Oral Biol Med 1992; 3:333-352.
[4] Kumar P, Vinitha B, Fathima G. Bone grafts in dentistry. J Pharm Bioallied Sci 2013; 5(Suppl 1): S125–S127.
[5] Mellonig JJ. Autogenous and allogenic bone grafts in periodontal therapy.Crit Rev Oral Biol Med 1992; 3:333-352.
[6] Pandit N, Pandit IK. Autogenous bone grafts in periodontal practice: A literature review. J Int Clin Dent Res Organ 2016; 8:27-33.
[7] Kumar J, Jain V, Kishore S, Pal H. Journey of bone graft materials in periodontal therapy: A chronological review. J Dent Allied Sci 2016; 5:30-4.
[8] Yukna RA. Synthetic bone grafts in periodontics. Periodontol 2000.1993; 1:92-99.
[9] Kao RT, Takei HH, Cochran DL et al Periodontal regeneration and reconstructive surgery in Newman MG, Takei HH, Klokkevold PR, Carranza FA. Clinical Periodontology. 2nd South Asian ed. St. Louis, Missouri: W. B. Saunders.
[10] Precheur HA. Bone Graft Materials. Dent Clin N Am 2007; 729–746.

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