



Review Article

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Bone Grafts in Periodontal Regeneration: Factors Impacting Treatment Outcome

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Abstract

Regeneration of the lost periodontium is one of the main goals of periodontal therapy. Bone replacement grafts are widely used to promote bone formation and periodontal regeneration. Bone grafting materials function, in part, as structural scaffolds and matrices for attachment and proliferation of anchorage-dependent osteoblasts. For any graft material to be considered as a successful regenerative material, it should have clear histological, clinical and radiographic evidence of new bone formation.

Keywords: Bone Grafts, Periodontal Regeneration.

Introduction

Periodontal disease is one of the most prevalent afflictions worldwide. The most serious consequence is the loss of the periodontal supporting structures, which includes the periodontal ligament, alveolar bone and cementum resulting in the early loss of teeth. Regeneration of the lost periodontium is one of the main goals of periodontal therapy. Conventional periodontal treatment, such as scaling and root planing are highly effective at repairing disease-related defects and halting the progression of periodontitis. However, they do

little to promote regeneration of the lost periodontium. On other hand periodontal surgery in particular regenerative periodontal surgery aims not only to eliminate pocket depths, but to regenerate a new attachment apparatus and reconstruct the periodontal unit within previously existing normal physiologic limits. Bone replacement grafts are widely used to promote bone formation and periodontal regeneration. Bone grafting materials function, in part, as structural scaffolds and matrices for attachment and proliferation of anchorage-dependent

osteoblasts. Bone replacement grafts (bone grafts and bone graft substitutes) provide a structural framework for clot development, maturation and remodeling that supports bone formation in osseous defects. Bone grafting materials also exhibit a variable capacity to promote the coordinated formation of bone, cementum and periodontal ligament (PDL) when placed and retained in periodontal defects. Bone grafting materials must possess the attributes of biocompatibility (lacking an immunogenic response) and osteo-conductivity (providing a

structure and surface topography that permit cellular attachment, proliferation and migration). Bone replacement grafts may also possess other properties that support osteogenesis (Fig.1).¹ Ideal characteristics of a bone graft are: non-toxic, non-antigenic, resistant to infection, no root resorption or ankylosis, strong and resilient, easily adaptable, ready and sufficiently available, minimal surgical procedure, stimulate new attachment and be able to trigger osteogenesis, cementogenesis and formation of a functional periodontal ligament.^{2,3}

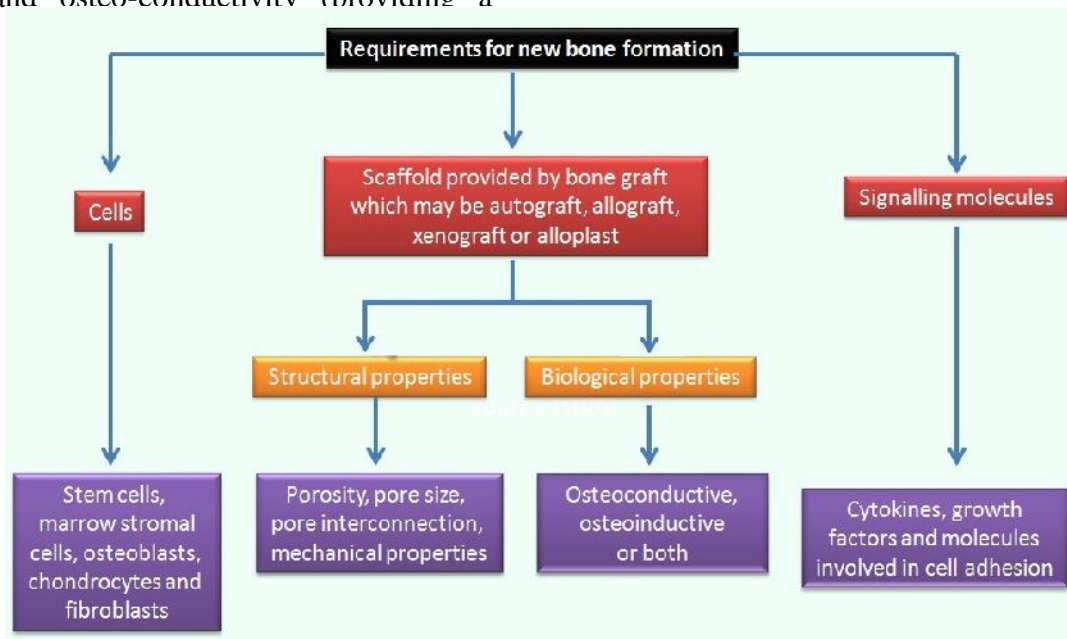


Fig.1: Requirement for new bone formation

Criteria for Evaluation of Graft Success for Periodontal Regeneration: For any graft material to be considered as a successful regenerative material, it should have clear histological, clinical and radiographic evidence of the following criteria:⁴

1. **Biologic acceptability:** the graft should not have any side effects or cause any unwanted tissue reaction.
2. **Resorbability:** the graft should resorb slowly and be replaced by the patient's own bone.

3. **Regeneration:** the graft should have evidence of regenerative ability with formation of new bone, cementum and periodontal ligament fibers.
4. **Defect fill:** the graft should have evidence of bone fill.
5. **Stability:** the outcome of the treatment should be stable at reevaluation visits.

Factors Influencing Graft Success: Several studies have investigated the possible sources of variability in the clinical outcomes of bone grafting procedures in periodontal surgery (Table.1):⁵

Table.1: Factors Influencing Graft Success

- (1) The patient
- (2) The morphology of the defect.
- (3) The graft material
- (4) The surgical procedure and
- (5) The healing period

1. Patient Factors: The scientific literature clearly shows that plaque control⁶, residual periodontal infection, tobacco smoking⁷ and the patient's compliance⁸, are important prognostic factors in regenerative periodontal therapy. Other factors include conditions such as diabetes, hyperparathyroidism, thyrotoxicosis, osteomalacia, osteoporosis, Paget's disease and some medications, may all affect the healing process.⁴

2. The Morphology of the Defect: Among the defect anatomy-associated factors, depth of the intra-bony component of the defect and/or

probing depth is consistently found to be relevant.^{9,10} The number of residual bony walls defining the defect seems to affect outcomes. Defects with two and three bony walls respond more favorably to treatment than do one-wall defects.^{11,12} Also, periodontal regeneration was more successful in deep-narrow defects than in shallow-wide defects.¹³

3. Selection of Graft Material: When bony reconstruction is presented to the surgeon, many choices must be weighed before the proper graft material is chosen (Table.2).¹⁴

Table.2: Selection of graft material is guided by:
<ul style="list-style-type: none"> • Biologic acceptability • Predictability • Resorbability • Clinical feasibility • Minimal operative hazards • Minimal postoperative sequelae • 7. Patient acceptance

A range of 125-1,000 mm is acceptable with 250-750 mm most commonly available for particle size of grafts used in periodontal treatment. A minimal pore size of 100 mm is needed between particles to allow vascularization and bone formation. Particles less than 100 mm in size elicit a macrophage response and are rapidly resorbed with little or no new bone formation.¹⁵

4. The Surgical Procedure: The surgical technique for the treatment of periodontal intra-bony defects with bone replacement grafts is essentially the same regardless of the type of graft material being used. Incisions are designed to allow for primary closure of flaps to protect the graft site from infection and the graft material from displacement. Intra-sulcular incisions are the common choice, with emphasis on preserving inter-dental tissue. Flaps are reflected full thickness to expose the underlying osseous defects and allow access for thorough debridement of the defects and meticulous root planning. New surgical techniques have been developed to optimize primary closure as well as to minimize the surgical trauma in the reconstructive procedures of periodontal intra-osseous defects. Recently, we proposed a

minimally invasive procedure, the single-flap approach (SFA), specifically indicated when the defect extension is prevalent on the buccal or oral side. The basic principle of the SFA is the elevation of a flap to access the defect only on one side (buccal or oral), leaving the opposite side intact.^{16, 17} Once the defect has been debrided of soft tissue and the tooth root surfaces thoroughly planed to remove all deposits of dental plaque and calculus, the bone replacement graft material is packed into the defect to fill the defect to the level of the remaining alveolar bone.¹⁸ Space maintenance is paramount to bone formation. If the graft material resorbs too rapidly, compared with the time required for bone formation, the site may fill with connective tissue rather than bone. Therefore the space or contour and size of the augmentation should be maintained until the graft has formed enough bone to maintain the space itself. Absolute graft immobility is paramount to its union to the recipient bone. If pieces of bone graft are mobile, they cannot receive a blood supply, become encapsulated in fibrous tissue and often sequester. Flaps are closed and sutured for primary closure and complete coverage of the bone replacement graft. Sutures should be removed in 7-10 days.

5. The Post-surgical Healing Period: Post-surgical care should include twice-daily rinsing with 0.12% chlorhexidine gluconate for 2 weeks and gentle tooth brushing starting 1 week after the surgery. Systemic antibiotics may be prescribed for 7-10 days after the surgical procedure. Patients should be seen at intervals of 1 week, 2 weeks and 4 weeks after surgery for supra-gingival plaque removal and then should be placed on a periodontal maintenance schedule at 3-month intervals.¹⁸ Adequate healing time must be provided to allow regeneration of the new bone volume. The amount of time required is variable and depends on local factors such as the number of remaining walls of bone, the amount of autogenous bone in the graft and the size of the defect. Larger grafts, less autogenous bone in the graft and fewer bony walls increase the amount of healing time.¹⁹

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