Short Communication

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. Important factors affecting treatment outcome include numerous patient factors including plaque control, residual periodontal infection, tobacco smoking and the patient’s compliance to systemic conditions including diabetes. Amongst others, the morphology of the defect, selection of graft material, and the surgical technique used, are of utmost significance. Herein, we are presenting a review discussing all such factors, that affect treatment outcome, in detail.

Keywords: Bone Grafts, Periodontal Regeneration, Treatment Outcomes

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 the 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 the 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 osteoconductivity (providing a structure and surface topography that permit cellular attachment, proliferation and migration). Bone replacement grafts may, also, possess other properties that support osteogenesis (Figure 1) (Reynolds et al., 2010). Ideal characteristics of bone grafts include their being non-toxic, non-antigenic, resistant to infection, and a tendency of not leading to root resorption or, ankylosis, being strong and resilient, easily adaptable, sufficiently available, and requiring minimal surgical procedure, stimulating new attachment and being able to trigger osteogenesis, cementogenesis and formation of a functional periodontal ligament (Rosenberg and Rose, 1998; Nasr et al., 2000).

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: (AlGhamdi et al., 2010).
1. Biologic acceptability: the graft should not have any side effects or, cause any untoward 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 a functional periodontal ligament;
4. Defect fill: the graft should have evidence of bone fill; and
5. Stability: with the outcome of the treatment should be stable at re-evaluation 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) (Cortellini and Tonetti, 2000).

**Table 1. Factors Influencing Graft Success**

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<td>(1)</td>
<td>The patient</td>
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<td>The morphology of the defect.</td>
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<td>The healing period</td>
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**Patient factors**

The scientific literature clearly shows that plaque control (Cortellini et al., 1994), residual periodontal infection, tobacco smoking (Tonetti et al., 1995) and the patient’s compliance (Wilson et al., 1984), are significant.
Table 2. Selection of graft material is guided by

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<td>Predictability</td>
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<td>Resorbability</td>
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<td>Clinical feasibility</td>
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<td>Minimal operative hazards</td>
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<td>Minimal postoperative sequelae</td>
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<td>7. Patient acceptance</td>
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 prognostic factors in the regenerative periodontal therapy. Other factors include conditions such as diabetes, hyperparathyroidism, thyrotoxicosis, osteomalacia, osteoporosis, Paget’s disease and some drugs, which may all affect the healing process (AlGhamdi et al., 2010).

The morphology of the defect

Amongst the defect anatomy-associated factors, depth of the intra-bony component of the defects and/or, probing depth is consistently found to be relevant (Tonetti et al., 1996; Cortellini et al., 2001). The number of residual bony walls defining the defects seem to affect treatment outcomes to a significant level. Defects with two-and three-bony wall components respond more favorably to treatment than do one-wall defects (Froum et al., 1976; Sepe et al., 1978). Also, periodontal regeneration has been found to be more successful in deep-narrow defects than in shallow-wide defects (Dragoo and Sullivan, 1973).

Selection of graft material

When bony reconstruction is presented to the surgeon, many choices must be weighed before a proper graft material is chosen (Table 2) (Kuo et al., 2007).

A range of 125-1,000µm is acceptable with 250-750µm most commonly available for particle size of grafts used in periodontal treatment. A minimal pore size of 100µm is needed between particles to allow vascularization and bone formation. Particles less than 100µm in size elicit a macrophage response and are rapidly resorbed with little and/or, no new bone formation (Zaner and Yukna, 1984).

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 secondary infections and the graft material from displacement. Intra-sulcular incisions are the common choice with emphasis on preserving inter-dental tissues. Flaps are reflected full thickness to expose the underlying osseous defects and allow access for a thorough debridement of the defects followed by a meticulous root planing. New surgical techniques have, also, been developed to optimize primary closure as well as to minimize the surgical trauma in the reconstructive procedures of periodontal intra-osseous defects. Off-late, a minimally invasive procedure, the single-flap approach (SFA), specifically indicated when the defect extension is prevalent only on the buccal and/or, palatal/lingual side, has been introduced. The basic principle of the SFA technique is the elevation of a flap to access the defect only on one side (buccal and/or, palatal/lingual) leaving the opposite side intact (Trombelli et al., 2009; Trombelli et al., 2010). Once the defect has been debrided of the 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 (Hanes, 2007). 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, sequestrate. Flaps are closed and sutured for primary closure and complete coverage of the bone replacement graft. Sutures are advisable to be removed in 7-10 days.

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 phase at 3-month intervals (Hanes, 2007). Adequate time for healing must be provided to allow regeneration of the new bone. 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 (Misch and Dietsh, 1993).

CONCLUSION

Failures are not uncommon in periodontal regenerative procedures. The significant clinical outcomes include secondary infections and heavy bone resorption and necrosis. Gingival recession is another significant problem apart from further loss of clinical attachment and root and bone exposure in the treatment areas. There are certain factors that play a significant role in avoiding such sequel apart from ensuring successful treatment outcomes. The above review discusses such factors which can help increase success of periodontal regeneration procedures.

REFERENCES


