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Oral Maxillofacial Surg Clin N Am 19 (2007) 499–512

ORAL AND
MAXILLOFACIAL
SURGERY CLINICS
of North America

# Bone Replacement Grafts for the Treatment of Periodontal Intrabony Defects

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An ultimate goal of periodontal therapy is the regeneration of periodontal supporting tissues that have been lost as a consequence of periodontitis. Wound healing studies have shown that removal of local bacterial etiology by surgical or nonsurgical therapies results in a resolution of inflammation and an improvement in the clinical signs of periodontitis, but it does not result in the regeneration of a periodontal connective tissue attachment [1,2]. Varying amounts of periodontal regeneration have been reported, however, when surgical therapy has included techniques of osseous grafting, guided tissue regeneration (GTR), or growth or amelogenin-type factors [3]. According to the American Academy of Periodontology 2005 position paper, ''periodontal regeneration is defined histologically as regeneration of the tooth's supporting tissues, including alveolar bone, periodontal ligament, and cementum over a previously diseased root surface'' [3]. The limitations inherent in current methods of periodontal examination make it impossible for clinicians to determine whether the healing responses they observe in their patients after various so-called ''regenerative treatments'' actually results in true histologic periodontal regeneration. After nonsurgical and surgical periodontal therapy, the improvements that occur in the clinical signs of periodontitis, such as reduced gingival inflammation and bleeding, reductions in periodontal probing depths, gains in probing attachment levels, and improvements in the architecture of intrabony defects as depicted on radiographs, are all clinical findings that would be expected to occur with or without true periodontal regeneration [4].

To evaluate their attempts at periodontal regeneration, clinicians depend on clinical observations such as reduced probing depths, improvements in probing attachment levels, and bone fill. Bone fill is the clinical restoration of bone tissue in a treated periodontal defect [3]. Quantity of bone fill is usually determined by comparisons of pre- and posttreatment radiographs, bone-sounding with a periodontal probe, or surgical re-entry. As with other clinical means of evaluating periodontal healing responses, bone fill does not address the presence or absence of histologic evidence of true periodontal regeneration. The purpose of this article is to summarize the current information supporting the use of osseous grafting techniques to accomplish periodontal regeneration, focusing on the amount of bone fill that has been reported with various bone replacement grafting materials.

Attempts to regenerate bone by the placement of bone substitutes into periodontal intrabony defects have been reported since the late nineteenth century [5]. Although the rationale for such early attempts at periodontal regeneration was speculative at best, by the latter half of the twentieth century researchers showed that demineralized bone contained bone morphogenetic proteins that could induce bone formation [6,7] and that bone marrow cells in grafts of cancellous bone and marrow could induce new bone formation [8]. Many case series studies and controlled clinical trials conducted over the last half-century testing various types of bone replacement graft materials have shown positive clinical benefits associated with the treatment of periodontal

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1042-3699/07/$ - see front matter 
doi:10.1016/j.coms.2007.06.001

intrabony defects with these agents [9]. Currently, bone replacement grafts, including autografts, allografts, xenografts, and alloplasts, are the most widely used treatments for the regeneration of periodontal supporting tissues lost as a consequence of periodontitis.

### Autogenous bone replacement grafts

Autogenous grafts of cortical or cancellous bone for the treatment of periodontal defects have been harvested from extra- and intraoral donor sites. In a series of case reports from the early 1970s, autogenous and allogenous grafts of cancellous bone and marrow from the posterior iliac crest were shown to have a marked ability to induce new bone formation in periodontal defects. They resulted in closure of seven of eight furcations, complete osseous fill of 11 of 21 one-wall defects and 33 of 33 two-wall defects, mean bone fill in intrabony defects exceeding 3 mm, and more than 2 mm of crestal bone apposition [10,11]. Although these studies demonstrated a marked potential for osseous regeneration in periodontal defects that are generally not considered to be amenable to periodontal regenerative therapy, including furcations, one-wall defects, and crestal bone loss, this type of osseous grafting is not routine in clinical periodontics because of the morbidity of the procedure for harvesting the donor bone and the incidence of root resorption reported with this technique [8,11,12]. A more common practice in contemporary periodontics involves the use of autogenous bone harvested from intraoral donor sites. In a case series, Hiatt and Schallhorn [13] used autogenous bone replacement grafts obtained from the maxillary tuberosity, extraction sockets, or edentulous ridges for the treatment of one-, two-, and three-wall defects. They reported a mean bone fill of 3.44 mm, which was more than 50% of the original defect depth [13]. Ellegaard and Löe [14] used autogenous bone replacement grafts of cancellous and cortical bone from edentulous intraoral sites for the treatment of two- and three-wall intrabony defects and reported complete osseous regeneration in 72% of three-wall and 45% of two-wall defects.

The best results with osseous grafting techniques occurred with the treatment of maxillary or mandibular anterior teeth, and the poorest results occurred in maxillary posterior teeth. In addition to the aforementioned case series studies, at least three controlled clinical trials have compared intraoral autogenous bone replacement grafts with a control treatment of open flap débridement for the treatment of intrabony periodontal defects (Table 1). Carraro and colleagues [15] compared the treatment of intrabony defects with intraoral autogenous cancellous bone replacement grafts to surgical débridement and reported 2.88 mm bone fill at grafted sites compared with 2.18 mm at control sites. Another form of intraoral autogenous bone replacement graft is the osseous coagulum–bone blend graft, which is an autogenous graft of bone shavings and blood clot that are collected during osseous recontouring procedures. Froum and colleagues [16,17] reported 70% fill of intrabony defects treated with osseous coagulum–bone blend compared with 22% fill at sites treated by débridement alone.

A more recent study by Renvert and colleagues [18] reported only 1.2 mm or approximately 25% bone fill of osseous defects after citric acid conditioning of root surfaces and placement of maxillary tuberosity bone replacement grafts. This amount of bone fill was similar to the amount

Table 1
Controlled clinical trials of autogenous bone replacement grafts for the treatment of intrabony defects

| | | | | Osseous regeneration | |
|---|---|---|---|---|---|
| Study | Graft material | Subject (*n*) | Defect (*n*) | Graft | Débridement |
| Carraro et al [15] | Oral auto | 55 | Oral auto = 56<br>Control = 44 | 95% ≥1mm[a] | 82% ≥1mm[a] |
| Froum et al [17] | Oral auto- osseous coagulum | 28 | Oral auto = 37<br>Control = 38 | 70.6%[b] | 21.8%[b] |
| Renvert et al [18] | Oral auto | 19 | Oral auto = 25<br>Control = 28 | 1.2 mm[c] | 0.8 mm[c] |

[a] Percentage of sites with ≥1 mm bone fill.
[b] Percentage resolution of original defect size.
[c] Mean amount of bone fill as measured from base of defect in relation to cementoenamel junction.