Bone Repair in Periodontal Defect Using a Composite of Allograft and Calcium Sulfate (DentoGen) and a Calcium Sulfate Barrier

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Deep bone defects are caused by the progression of periodontal disease, which breaks down bone and connective tissue that hold teeth in place. In this case, a 37-year-old male patient presented a deep bone defect with advanced periodontal disease around an upper canine. Medical-grade calcium sulfate was mixed with demineralized freeze-dried bone allograft and used to repair and regenerate the defect. Analysis of the radiographs at the 5-month time point showed the bone had completely regenerated.

Key Words: periodontal disease, calcium sulfate, allograft, composite

INTRODUCTION

Periodontal disease can result in the destruction of soft tissue and bone that support the teeth, leading to tooth loss. An estimated 75% of American adults are affected by this disease, of which 25% to 30% have severe forms.1,2 Periodontal disease is caused by highly organized bacterial biofilms that can trigger a destructive inflammatory response by the host.3,4 Factors such as smoking, diabetes, stress, genetic susceptibility, and so forth further aggravate periodontal disease.5,6 Some studies have also shown chronic periodontal disease to be correlated with systemic conditions such as coronary heart disease and stroke.7–9 To combat periodontal disease, an improvement in oral hygiene and removal of bacterial deposits are essential. In severe cases, surgical repair is necessary.

Surgical repairs using bone replacement grafts is a common method used to rapidly repair and regenerate bone. These grafts have been shown to statistically significantly increase bone and clinical attachment levels and reduce probing depths, as compared with open flap debridement procedures.10–13 In a study by Paolantonio et al,14 it was shown that when using pure calcium sulfate (CS) with a membrane barrier, there is a significantly greater improvement when compared with open flap debridement.14

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Allogenic tissue, such as demineralized freeze-dried bone allograft (DFDBA), can also be used in combination with CS as a bone-filling binder. A CS or synthetic membrane barrier is then added to prevent ingrowth of cells. Nonresorbable synthetic membranes, such as expanded polytetrafluoroethylene, are far more invasive and time-consuming than is a resorbable CS membrane. Calcium sulfate, a material that has been used as a bone-filling material for more than 110 years, has been shown to be completely bioabsorbable, to be osteoconductive, to allow fibroblast migration, to not cause an inflammatory response, and to not elevate serum calcium levels. Recently, it has been shown that CS can be manufactured into a granular composite of CS and poly-L-lactic acid to decrease the degradation rate if the application calls for a slower dissolution. Strocchi et al observed significantly more blood vessel growth in defects filled with CS than those filled with autograft, proving its angiogenic properties. Blood vessels provide nutrition for growing bone and accelerate bone growth. Two parallel series of mechanisms are triggered by the degradation of CS into deep bone defect (Figure 1). The first mechanism involves the release of calcium and sulfur ions in the biological environment, which results in carbonate apatite formation and calcium ion stimulation of cellular activity. The second mechanism is the precipitation of calcium phosphate, which leads to a transient, local drop in pH. This causes surface demineralization of existing bone resulting in exposure of bioactive molecules and the release of growth factors such as transforming growth factors and bone morphogenetic proteins, which stimulates the growth of bone in defects filled with CS. Calcium sulfate has been used as a bone graft by itself, in combination with other bone grafts, and also as a barrier to treat extraction sockets.

**Case Report**

A 37-year-old male patient presented with advanced periodontal disease around an upper canine. A deep bone defect of 8 mm was found in the distal aspect of the tooth, as seen grossly and by radiograph in Figure 2a and b. The deep bone defect was accessed by elevating the full mucoperiosteal plate. The defect was debrided of all granulation tissue, and the root surface was carefully planed. DFDBA was mixed with medical grade CS (trade name DentoGen, Orthogen, LLC, Springfield, NJ) at a ratio of 75:25 (DFDBA: DentoGen; Figure 3a). Fast-setting solution was added to this mixture to form the bone graft composite. The composite was grafted into the deep bone defect using a spatula, as shown in Figure 3b. It was tightly compressed to thoroughly fill the defect. The defect was closed with a pure CS (DentoGen) barrier to prevent the ingrowth of soft tissue. Fast-setting solution was added to CS to form the putty, which was implanted as a barrier (Figure 3c). Nonresorbable suture was placed to reposition the flap (Figure 3d). Preoperative digital radiographs of the deep bone defect were taken to facilitate comparison with future time points. Digital radiographs of the grafted site were taken at 1- and 5-month intervals.
postoperative time points. A standard bite holder was placed while taking a radiograph. The patient was followed every month for up to 6 months.

When observed grossly, the site was healing well at the 1-month time point, and radiographs showed the grafted material was slowly resorbing (Figure 4a). At the 5-month postoperative time point, the site was grossly observed to have healed well, and the deep bone defect observed in the preoperative radiograph was now replaced with bone, as evidenced by radiographs (Figure 4b).
A severe form of periodontal disease has been surgically treated using a 75% DFDBA/25% CS composite graft and a pure CS membrane barrier. Because CS has significant bone regeneration properties of its own as a bone graft, it not only acts as a binder that prevents DFDBA from migrating out of the deep bone defect but also further aids in bone growth by depositing a calcium phosphate trellis, preventing ingrowth of soft tissues, stimulating blood vessel formation, and affecting the release of growth factors.

When comparing the gross initial bone defect to the 5-month time point, a complete healing of the bone with no gingival recession was noted. At both the 1- and 5-month time points, the patient showed no signs of discomfort, and no infection was observed. Analysis of the radiographs verified the gross observations as the bone showed signs of remodeling at the 1-month time point and complete bone growth at the 5-month time point. As DFDBA underwent remodeling, CS degraded and slowly resorbed, leading to the formation of a calcium phosphate trellis, which further stimulated bone growth. This resulted in the deep bone defect’s being filled with regenerated bone at the 5-month postoperative time point.

These results were similar to previous clinical studies on 19 patients with chronic periodontitis, which indicate that CS, used as a binder and barrier in combination with DFDBA, supports significant clinical improvement in intrabony defects. The authors observed that after 6 months, there was a reduction in probe depth, gains in clinical attachment level, and defect fill and resolution. A similar study by Harris and colleagues evaluated a CS porous hydroxyapatite and tetracycline binder combined with DFDBA and a CS barrier in 100 patients. Their technique also found a decrease in probe depth and an increase in clinical attachment.
level after 6 months. A long-term, 6-year study of 12 patients by Orsini et al also yielded similar results. They used a combination of autogenous bone grafting plus CS as a binder and barrier and compared it to a defect treated with a bioabsorbable membrane. After 6 years, there was no significant difference found between the two techniques. There was also a decrease in probe depth and an increase in clinical attachment level. It was also observed that there was no statistically significant difference when comparing the long-term, 6-year results to their short-term, 6-month data.

CONCLUSION

In this surgical case report, medical-grade CS mixed with DFDBA was found to be a biocompatible composite graft with the ability to provide radiographic evidence of hard-tissue repair of a periodontal intrabony defect. The incorporation of CS improves the handling characteristics of DFDBA as well as the cost-effectiveness of the procedure.

ABBREVIATIONS

CS: calcium sulfate
DFDBA: demineralized freeze-dried bone allograft

REFERENCES


