Alveolar ridge preservation with guided bone regeneration and a synthetic bone substitute or a bovine-derived xenograft: a randomized, controlled clinical trial.

Mardas N, Chadha V, Donos N.


Abstract

OBJECTIVES:

The aim of this randomized, controlled clinical trial was to compare the potential of a synthetic bone substitute or a bovine-derived xenograft combined with a collagen membrane to preserve the alveolar ridge dimensions following tooth extraction.

METHODS:

Twenty-seven patients were randomized into two treatment groups following single tooth extraction in the incisor, canine and premolar area. In the test group, the alveolar socket was grafted with Straumann Bone Ceramic (SBC), while in the control group, Bio-Oss deproteinized bovine bone mineral (DBBM) was applied. In both groups, a collagen barrier was used to cover the grafting material. Complete soft tissue coverage of the barriers was not achieved. After 8 months, during re-entry procedures and before implant placement, the horizontal and vertical dimensions of the residual ridge were re-evaluated and trephine biopsies were performed for histological analysis in all patients.

RESULTS:

Twenty-six patients completed the study. The bucco-lingual dimension of the alveolar ridge decreased by 1.1+/−1 mm in the SBC group and by 2.1+/−1 in the DBBM group (P<0.05). Both materials preserved the mesio-distal bone height of the ridge. No differences in the width of buccal and palatal bone plate were observed between the two groups. The histological analysis showed new bone formation in the apical part of the biopsies, which, in some instances, was in direct contact with both SBC and DBBM particles. The coronal part of the biopsies was occupied by a dense fibrous connective tissue surrounding the SBC and DBBM particles.

CONCLUSION:

Both biomaterials partially preserved the width and the interproximal bone height of the alveolar ridge.
**Radiographic alveolar bone changes following ridge preservation with two different biomaterials.**

Mardas N, D’Aiuto F, Mezzomo L, Arzoumanidi M, Donos N.


**Abstract**

Objectives: The aim of this randomized controlled trial was to evaluate radiographical bone changes following alveolar ridge preservation with a synthetic bone substitute or a bovine xenograft. Methods: Alveolar ridge preservation was performed in 27 patients randomized in two groups. In the test group (n=14), the extraction socket was treated with Straumann bone ceramic(®) (SBC) and a collagen barrier membrane (Bio-Gide(®) ), whereas in the control group (n=13) with deproteinized bovine bone mineral and the same barrier. Standardized periapical X-rays were taken at 4 time points, BL: after tooth extraction, GR: immediately after socket grafting, 4M: 16 weeks, 8M: 32 weeks post-operatively. The levels of the alveolar bone crest at the mesial (Mh), and distal (Dh) and central aspects of the socket were measured at all time points. All the radiographs obtained were subtracted from the follow-up images. The gain, loss and unchanged areas in terms of grey values were tested for significant difference between the two groups. Results: In the test group, the Mh and Dh showed a mean difference (± standard deviation) of 0.9 ± 1.2 and 0.7 ± 1.8 mm, respectively, among BL-8M. In the control group, the Mh and Dh showed a mean difference of 0.4 ± 1.3 and 0.7 ± 1.3 mm, respectively (P>0.05). Both treatments presented similar gain in grey values between BL-GR, BL-4M and BL-8M. The SBC presented less loss in grey values between BL-4M and BL-8M (P<0.05). Radiographic assessment underestimated the intrasurgical measurements (mesial and distal) of an average 0.3 mm (95% CI, 0.02-0.6). Conclusion: Both types of bone grafts presented similar radiographic alveolar bone changes when used for alveolar ridge preservation.

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**Effect of coating Straumann® Bone Ceramic with Emdogain on mesenchymal stromal cell hard tissue formation.**

Mrozik KM, Gronthos S, Menicanin D, Marino V, Bartold PM.

Clin Oral Investig. 2011 May 17. [Epub ahead of print]

**Abstract**

Periodontal tissue engineering requires a suitable biocompatible scaffold, cells with regenerative capacity, and instructional molecules. In this study, we investigated the capacity of Straumann® Bone Ceramic coated with Straumann® Emdogain, a clinical preparation of enamel matrix protein (EMP), to aid in hard tissue formation by post-natal mesenchymal stromal cells (MSCs) including bone marrow stromal cells (BMSCs) and periodontal ligament
fibroblasts (PDLFs). MSCs were isolated and ex vivo-expanded from human bone marrow and periodontal ligament and, in culture, allowed to attach to Bone Ceramic in the presence or absence of Emdogain. Gene expression of bone-related proteins was investigated by real time RT-PCR for 72 h, and ectopic bone formation was assessed histologically in subcutaneous implants of Bone Ceramic containing MSCs with or without Emdogain in NOD/SCID mice. Alkaline phosphatase activity was also assessed in vitro, in the presence or absence of Emdogain. Collagen-I mRNA was up-regulated in both MSC populations over the 72-h time course with Emdogain. Expression of BMP-2 and the osteogenic transcription factor Cbfa-1 showed early stimulation in both MSC types after 24 h. In contrast, expression of BMP-4 was consistently down-regulated in both MSC types with Emdogain. Up-regulation of osteopontin and periostin mRNA was restricted to BMSCs, while higher levels of bone sialoprotein-II were observed in PDLFs with Emdogain. Furthermore, alkaline phosphatase activity levels were reduced in both BMSCs and PDLFs in the presence of Emdogain. Very little evidence was found for ectopic bone formation following subcutaneous implantation of MSCs with Emdogain-coated or -uncoated Bone Ceramic in NOD/SCID mice. The early up-regulation of several important bone-related genes suggests that Emdogain may have a significant stimulatory effect in the commitment of mesenchymal cells to osteogenic differentiation in vitro. While Emdogain inhibited AP activity and appeared not to induce ectopic bone formation, longer-term studies are required to determine whether it promotes the final stages of osteoblast formation and mineralization at gene and protein levels. While used in clinical applications, whether Emdogain and other commercial preparations of EMPs truly possess the capacity to induce the regeneration of bone or other components of the periodontium remains to be established.

The effect of enamel matrix derivative (Emdogain) on bone formation: a systematic review.

Rathe F, Junker R, Chesnutt BM, Jansen JA.


Abstract

This systematic review focused on the question, if and to what extent enamel matrix derivative (Emdogain) [EMD]) promotes the regeneration of bone. The influence of combinations with other biomaterials was additionally evaluated. Twenty histomorphometric studies were included in this systematic review. Main results of the reviewed articles were (i) guide tissue regeneration (GTR) of infrabony defects seems to result in a higher degree of bone regeneration compared to treatment with EMD; (ii) combined therapy (GTR + EMD) of infrabony defects might not lead to better results than GTR therapy alone; (iii) there seems to be no additional benefit of combined therapy (GTR + EMD) in furcation defects over GTR therapy alone; (iv) EMD seems to lead to more bone regeneration of infrabony defects compared to open flap debridement; (v) however, EMD application might result in more bone formation when applied in supporting defects compared to nonsupporting defects; and (vi) EMD does not seem to promote external jaw/parietal bone formation in the titanium capsule model. The results of one study that suggest that EMD increases the initial growth of trabecular bone around endosseous implants by new bone induction need to be confirmed by additional research.
Enamel matrix proteins; old molecules for new applications.

Lyngstadaas SP, Wohlfahrt JC, Brookes SJ, Paine ML, Snead ML, Reseland JE.


Abstract

Emdogain (enamel matrix derivative, EMD) is well recognized in periodontology, where it is used as a local adjunct to periodontal surgery to stimulate regeneration of periodontal tissues lost to periodontal disease. The biological effect of EMD is through stimulation of local growth factor secretion and cytokine expression in the treated tissues, inducing a regenerative process that mimics odontogenesis. The major (>95%) component of EMD is Amelogenins (Amel). No other active components have so far been isolated from EMD, and several studies have shown that purified amelogenins can induce the same effect as the complete EMD. Amelogenins comprise a family of highly conserved extracellular matrix proteins derived from one gene. Amelogenin structure and function is evolutionary well conserved, suggesting a profound role in biomineralization and hard tissue formation. A special feature of amelogenins is that under physiological conditions the proteins self-assembles into nanospheres that constitute an extracellular matrix. In the body, this matrix is slowly digested by specific extracellular proteolytic enzymes (matrix metalloproteinase) in a controlled process, releasing bioactive peptides to the surrounding tissues for weeks after application. Based on clinical and experimental observations in periodontology indicating that amelogenins can have a significant positive influence on wound healing, bone formation and root resorption, several new applications for amelogenins have been suggested. New experiments now confirm that amelogenins have potential for being used also in the fields of endodontics, bone regeneration, implantology, traumatology, and wound care.

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