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Research Paper
Dental Implants

Histomorphometric evaluation of guided bone regeneration around implants with SLA surface: an experimental study in beagle dogs

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Abstract. The aim of this study was to evaluate the efficacy of collagen membranes, either alone or combined with a human demineralized freeze-dried bone allograft (DFDBA) or natural bovine bone graft, in bone defects around dental implants with an SLA (sand-blasted, large grit, acid-etched) surface. The experiments were carried out in three beagle dogs using a split-mouth design. On one side of the jaw, three implants were placed and intra-bony defects were created and covered with a collagen membrane, randomly combined in two of the defects with human DFDBA or inorganic bovine bone graft. A control implant, without membrane covering or defect filling, was also placed. On the other side of the jaw, three implants were placed and the bone defects were treated in a similar fashion, but without membrane covering. The studied variables were the percentage of bone-to-implant contact within the limits of the initial bony defect and percentage of the original bony defect occupied by bone tissue. Although no statistically significant differences were found in this study between the membrane and nonmembrane groups, bone defects augmented with anorganic bovine bone and membranes showed the most promising results from a histological and histomorphometric perspective.

Keywords: guided tissue regeneration; bone formation; osseointegration; bioresorbable membrane; collagen; experimental animal study; demineralized freeze-dried bone allograft; deproteinized bovine bone; SLA surface implants.

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The insertion of dental implants to treat edentulous patients has become a routine clinical procedure. One of the prerequisites for the long-term success of implant therapy is a sufficient quantity and quality of bone. When endosseous implants are placed in sites where the bone volume is equal to or less than the diameter of the implant, or in sites surrounded by defective bone, as occurs when they are placed directly into fresh extraction sockets, part of the surface will not be covered by bone, and this may lead to treatment failure. Guided bone regeneration (GBR) has been successfully applied to treat bone defects associated with dental implants, and to augment the height and width of atrophic alveolar ridges prior to implant placement.

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The use of barrier membranes in GBR is widely accepted, but controversy still exists over the best membrane material or structure to use in these procedures, as well as whether they should be used alone or in combination with other materials[26]. Autogenous bone is unequivocally regarded as the best grafting material because of its osteogenic properties, but several disadvantages and limitations preclude its systematic utilization[31]. This has led to the development of alternative grafting and space-making materials, such as allografts or alloplasts. The membranes most often used for GBR are made of expanded polytetrafluoroethylene (e-PTFE), but these are nonbioabsorbables and need to be removed in a second surgical procedure. When a nonsubmerged approach is used in implant dentistry, absorbable membranes are an option for GBR, because they do not need to be removed after the healing period.

The long-term survival of dental implants depends among other factors on the percentage bone–implant contact, which is related to the implant surface morphology[17]. Surface roughness affects osteoblast proliferation and may increase the rate and amount of bone formation on the implant surface, providing better osseointegration than machined implants[22]. Commercially available since 1998, ITI implants have a macro/micro rough SLA (sand-blasted, large grit, acid-etched) surface[20], and have shown excellent clinical results[1,6]. The purpose of the present study was to histologically and histomorphometrically evaluate the efficacy of collagen membranes, either alone or combined with human demineralized freeze-dried bone allografts (DFDBA) or natural bovine bone graft, in bone defects around dental implants with an SLA surface, in beagle dogs.

Material and methods

The experiments were approved by the Animal Ethics Committee at the University of Oviedo, Spain, and carried out on three male adult beagle dogs (approximate weight 14 kg). All surgical procedures were performed under aseptic conditions

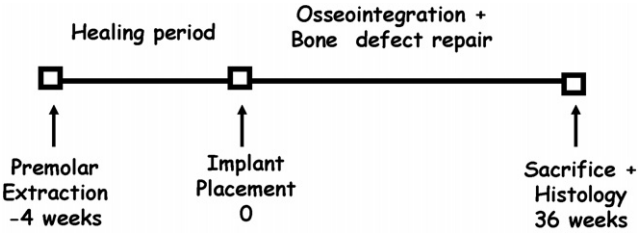


Fig. 1. Study design, with elapsed time shown in weeks.

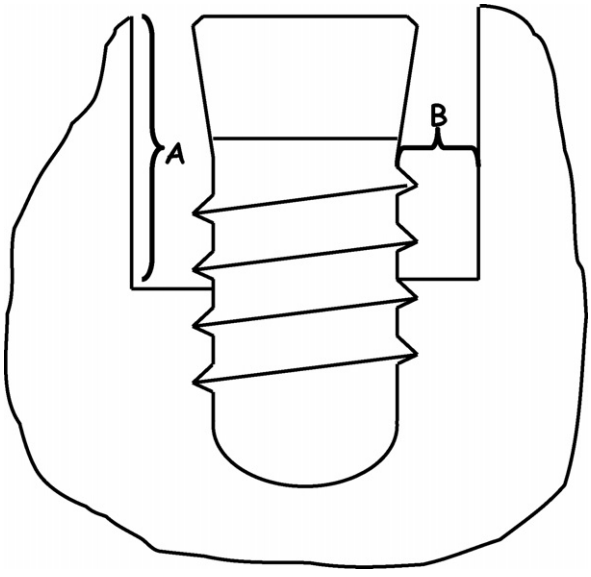
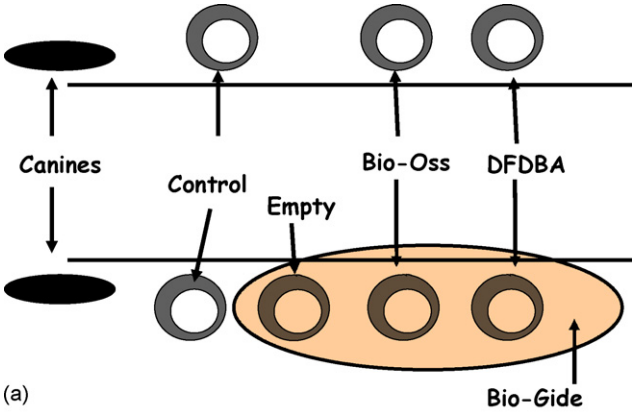


Fig. 2. The ITI implant consists of an endosseous part with an SLA surface and a transmucosal smooth part. The distance from the shoulder of the implant to the divide between the SLA and smooth surfaces measures 2.8 mm. A: Defect depth measured from top of alveolar crest to bottom of defect; B: width of defect measured from bony wall to implant surface.



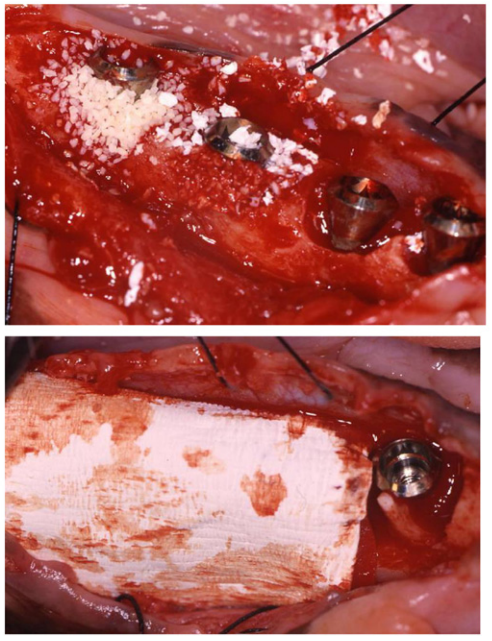


Fig. 3. (a) Study protocol. (b) Clinical appearance of bone defects around dental implants: (upper) filled with DFDBA or Bio-Oss; (lower) Bio-Gide® membrane over implants and defects (except for control), extended on to intact bone beyond the defect border.