

# Clinical Study of Guided Bone Regeneration and/or Bone Grafts in the Treatment of Ligature-induced Peri-implantitis Defects in Dogs

Francisco H. NOCITI Jr.<sup>1</sup>  
Raul G. CAFFESSE<sup>2</sup>  
Enilson A. SALLUM<sup>1</sup>  
Maria Ângela N. MACHADO<sup>1</sup>  
Cristine M. STEFANI<sup>1</sup>  
Antonio Wilson SALLUM<sup>1</sup>

<sup>1</sup>Department of Prosthodontics and Periodontics, Division of Periodontics, School of Dentistry at Piracicaba, UNICAMP, Piracicaba, SP, Brazil

<sup>2</sup>Department of Stomatology, Division of Periodontics, University of Texas-Dental Branch, Houston, TX, USA

This study evaluated, by clinical analysis, the hard tissue response following treatment of ligature-induced peri-implantitis defects in 5 dogs. The mandibular premolars were removed from both sides of the jaw. After 3 months of healing, two titanium implants were placed on each side of the mandible. Following abutment connection, 3 months later, experimental peri-implantitis was induced by the placement of cotton ligatures in a submarginal position. Ligatures and abutments were removed after one month and the bony defects were randomly assigned to one of the following treatments: debridement (DE), debridement plus guided bone regeneration (GBR), debridement plus mineralized bone graft (BG) and debridement plus guided bone regeneration associated with mineralized bone graft (GBR+BG). The peri-implant bone defects were clinically measured before and 5 months post-treatment. Results showed a higher percentage of vertical bone fill for GBR+BG ( $27.77 \pm 14.07$ ) followed by GBR ( $21.78 \pm 16.19$ ), BG ( $21.26 \pm 6.87$ ), DE ( $14.03 \pm 5.6$ ). However, there were no statistically significant differences between any of the treatments proposed (one way repeated measures analysis of variance,  $P=0.265$ ).

Key Words: peri-implantitis, bioabsorbable membrane, bone graft.

## INTRODUCTION

The long-term predictability of osseointegrated implants has been documented (1). Nevertheless, a significant number of early and late complications have also been reported (2). Current hypothesis associates bacterial infection and/or biomechanical overload as etiologic factors of late implant failure (3). Progressive bone loss around functioning dental implants is of special concern, because it may jeopardize the long-term prosthetic prognosis. The peri-implant bone destruction observed during the implant maintenance phase (peri-implantitis) has symptomatology similar to that of periodontitis, i.e., redness, increased probing depth, suppuration, radiographic bone loss. Several

procedures have been described for the treatment of the inflammatory component and the resulting bony defect associated with infection of the peri-implant mucosa, including antimicrobial therapy, resective or regenerative procedures (4-7). Optimal treatment of peri-implantitis must include regeneration of lost bone in direct contact with the implant surface previously exposed to bacterial products. Clinical studies using guided bone regeneration for the treatment of peri-implantitis defects present inconclusive results (4,5,8-10). Therefore, the purpose of the present study was to clinically evaluate the hard tissue healing in terms of defect fill following treatment of experimentally ligature-induced peri-implantitis defects using a bioabsorbable membrane (Bio-Guide®, Osteohealth Co.,

New York, USA) and/or heterologous mineralized bone graft (Bio-Oss®, Osteohealth Co.).

## MATERIAL AND METHODS

Five 2-year-old mongrel dogs with good general health were used in this study (approximately 15 kg body weight). The animals received 1.5 ml/10 kg of acepromazine (Univet S.A., São Paulo, SP, Brazil) followed by intravenous injection of 25% sodium thio-pental solution (0.5 ml/kg, Cristália Produtos Químicos e Farmacêuticos Ltda., Itapira, SP, Brazil) and local administration of 2% xylocaine (1:50,000 epinephrine, Merrel Lepetit Farmacêutica Ltda., Santo Amaro, SP, Brazil) in all surgical procedures (Figure 1). At the beginning of the experiment, all mandibular premolars were removed. After 3 months of healing, full-thickness flaps were elevated and two screw-shaped CP

titanium implants with rough acid-etched surfaces (Napio System®, Napio, Bauru, SP, Brazil) with a length of 8.5 mm, an outer diameter of 3.75 mm, and a pitch height of 0.6 mm, were placed bilaterally and the mucoperiosteal flaps sutured. Three months later, mucoperiosteal flaps were elevated and titanium abutments were connected. Two weeks after the abutment connection, alginate impressions were taken and occlusal acrylic stents were prepared for pre- and post-treatment measurements of bony defect depth. The stents were reduced and polished for better adaptation. Six points were marked on the surface of the stent around the implant: mesio-buccal, mid-buccal, disto-buccal, mesio-lingual, mid-lingual and disto-lingual. Cotton ligatures were placed in a submarginal position around the abutments and the dogs were fed with a soft diet to promote plaque accumulation and induce peri-implant inflammation with loss of bone. After 1 month of plaque accumula-

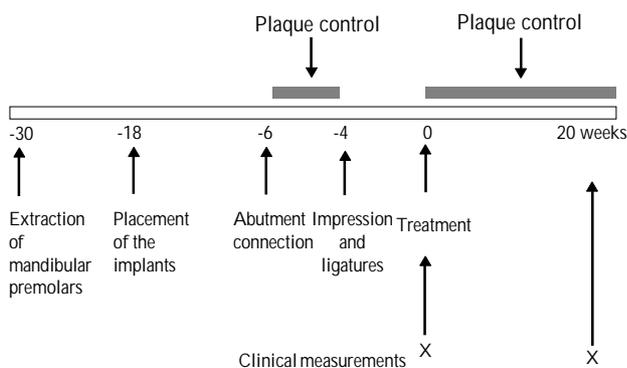


Figure 1. Study design.



Figure 2. Clinical aspect of the peri-implant mucosa 1 month after ligature placement.

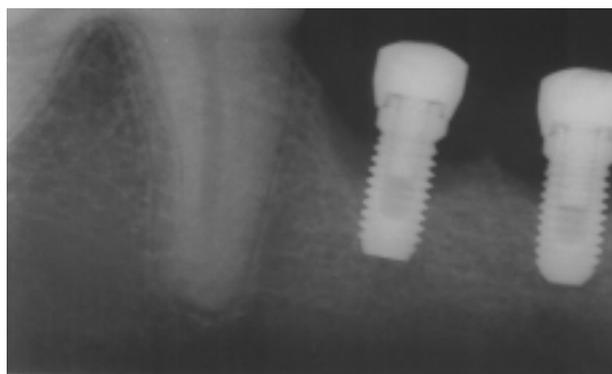


Figure 3. Radiographic appearance of the bone loss around the implants 1 month after placing the ligatures. Note that the morphology of the peri-implant bone defects was wide and circumferential.



Figure 4. Clinical appearance of the bony defects after debridement.

tion, significant inflammation could be seen at the peri-implant mucosa (Figure 2) and bone loss was radiographically detected (Figure 3). At this time, the ligatures were removed, and a plaque-control regime was initiated (hygienic phase) consisting of daily brushing and topical application of 0.12% chlorhexidine gluconate. In addition, metronidazole hydrochloride (250 mg/day, Flagyl, Rhodia Farma Ltda., São Paulo, SP, Brazil) was given systemically for 3 weeks.

Two weeks after the beginning of the hygienic phase, full-thickness flaps were elevated. The abutments were removed and the granulation tissue around the implants was carefully removed using teflon hand cures (Figure 4). The implant surface was treated with an air-powder abrasive instrument (Profi I, Dabi Atlante, Ribeirão Preto, SP, Brazil) for 30 s.

The peri-implant bony defects were clinically evaluated and pretreatment depth of the defect, i.e., the distance from the top of the stent to the bottom of the peri-implant bone defect, was recorded using an orthodontic wire (0.8 mm) and an electronic digital caliper (accurate to 0.01 mm) for the six sites around each implant. All linear measurements throughout the study were performed by a calibrated examiner. The defects were randomly assigned to one of the following treatments: DE: debridement, GBR: debridement plus guided bone regeneration (Bio-Guide®), BG: debridement plus mineralized bone graft (Bio-Oss®), GBR+BG: debridement plus the association of guided bone regeneration and bone graft. The flaps were repositioned and sutured. Systemic metronidazole administration (250 mg/day, Flagyl) was continued for the following week, and 0.12% chlorhexidine gluconate spray was topically

applied twice a day for the next 5 months. At that time, a mucoperiosteal flap was elevated and post-treatment measurements were obtained by the same method previously described.

The experimental design used (complete randomized block design) provided a total of 20 peri-implant defects (five implants per treatment group) for statistical analysis. The six values obtained for each implant were averaged to obtain a mean value for the bony defect depth pre- and post-treatment. Mean hard tissue fill was obtained subtracting post-treatment mean value from pre-treatment mean value for each treatment. The data were statistically analyzed by one way repeated measures analysis of variance (ANOVA).

## RESULTS

Clinical signs of peri-implant inflammation were reduced after 2 weeks of plaque control and systemic antimicrobial administration. In 2 sites, an exposure of the membrane occurred after 3 months of healing. The portion of collagen membrane that was exposed showed a progressive resorption and disappeared after 2 weeks of exposure. The peri-implant tissues around the exposed membranes did not have an inflammatory process. The other 18 sites remained covered by the soft tissues until the end of the experimental period. After 5 months of healing, newly formed hard tissue was observed filling the defects around the implants for all treatments (Table 1). GBR+BG had the best vertical bone fill followed by GBR, BG, and DE; however, the differences among treatments were not statistically significant.

## DISCUSSION

The number of longitudinal studies evaluating different treatment options for peri-implantitis bony defects is limited, probably due to the fact that the frequency of late implant failures is relatively low. Many different approaches have been tested to reduce inflammation at the peri-implant mucosa including subgingival irrigation of the peri-implant area with antiseptic agents (11), systemic antimicrobial treatment (12) and controlled-delivery devices for local application of tetracycline (13).

In the present study, as suggested by Hürzeler et al. (5), an association of local and systemic treatment was used resulting in a marked reduction in clinical

Table 1. Percentage of vertical bone fill according to treatment.

Treatment	Vertical bone fill (%)
DE	14.03 ± 5.60
GBR	21.78 ± 16.19
BG	21.26 ± 6.87
GBR + BG	27.77 ± 14.07

Means ± SD (ANOVA, P=0.265).

DE: debridement; GBR: debridement plus guided bone regeneration; BG: debridement plus mineralized bone graft; GBR + BG: debridement plus guided bone regeneration/mineralized bone graft.

signs of inflammation in the peri-implant mucosa. Once the inflammatory process is controlled, an attempt can be made to improve or re-establish osseointegration using regenerative procedures.

An increasing number of reports have been trying to document the predictability of using regenerative procedures to treat bone defects around implants, however the results have been inconclusive. Grunder et al. (4) evaluated the treatment of ligature-induced peri-implantitis defects using guided bone regeneration around submerged and nonsubmerged implants in dogs. They concluded that guided bone regeneration did not enhance clinical parameters or bone formation around "diseased" implants. These results were in disagreement with findings reported by Dahlin et al. (14), Becker et al. (15) and Zablotsky et al. (16), showing new bone formation around exposed implant surfaces after the procedure. Factors such as plaque-contaminated implants, premature membrane exposure and type of bone defect may help to explain the different results.

Hürzeler et al. (5) evaluated the treatment of ligature-induced peri-implantitis defects clinically and histologically using guided bone regeneration and/or two types of bone grafts compared with an instrumented control. They observed different degrees of hard tissue fill. Guided bone regeneration and the association of membrane and bone grafts resulted in the greatest hard tissue fill of the defects.

The present investigation can be considered the first clinical study, in an animal model, to evaluate the treatment of bone defects resulting from ligature-induced peri-implantitis using regenerative procedures with a bioabsorbable membrane (Bio-Guide®) and a heterologous mineralized bone graft (Bio-Oss®) separately or in combination. Pre- and post-treatment clinical evaluations showed a nonsignificant variable degree of hard tissue fill of the bone defects after all treatment procedures ( $P=0.265$ ). The chronic circumferential bone defects observed around the implants in the present investigation, after 1 month of plaque accumulation, were similar to those reported by Hürzeler et al. (5), and different from those reported by Grunder et al. (4).

Therefore, it would be reasonable to affirm that one of the most critical factors for predictable hard tissue fill around dental implants previously exposed to contaminants is the peri-implant bone defect morphology. Incomplete surface detoxification could be another

negative factor for bone growth onto a previously exposed implant surface. In the present study, the observation of defect fill by a bone-like tissue indicated that the procedures used to eliminate contaminants from the implant surface might have been efficient. However, the bone-implant contact cannot be clinically determined.

Although there have been many clinical reports (4,5,8-10) showing hard tissue fill of bone defects around implants, some questions still remain to be answered: How much newly formed bone is in contact with the previously exposed implant surface? How much bone to implant contact is necessary to improve the prognosis of the implant? Is it really necessary to use local and/or systemic antimicrobials to treat peri-implant infections? Could any growth factor be used alone or in combination with other regenerative therapies to improve bone formation around the exposed implant surface? What is the impact of individual variability on the bone regeneration achieved around dental implants exposed to contaminants?

Within the limits of the present investigation, it can be concluded that no difference could be detected between the treatments. Nevertheless, due to the small sample size used, the findings should be considered with caution.

## RESUMO

Nociti Jr FH, Caffesse RG, Sallum EA, Machado MAN, Stefani CM, Sallum AW. Estudo clínico da utilização de regeneração óssea guiada e/ou enxerto ósseo no tratamento de defeitos ósseos resultantes da peri-implantite induzida em cães. *Braz Dent J* 2001;12(2):127-131.

O presente estudo avaliou, clinicamente, a resposta do tecido ósseo após o tratamento de defeitos resultantes da peri-implantite induzida por ligaduras em cães. Cinco cães foram utilizados. Os pré molares inferiores foram extraídos de ambos os lados da mandíbula. Após três meses, os intermediários foram conectados aos implantes e a peri-implantite induzida através da colocação de ligaduras em posição submarginal. Um mês mais tarde, as ligaduras e os intermediários foram removidos e os defeitos ósseos resultantes foram aleatoriamente divididos entre os seguintes tratamentos: descontaminação (DE), descontaminação associada a regeneração óssea guiada (GBR), descontaminação associada ao enxerto ósseo (BG) e descontaminação associada a regeneração óssea guiada e ao enxerto ósseo (GBR+BG). Os defeitos ósseos peri-implantares foram clinicamente avaliados antes e após 5 meses do tratamento. Os resultados demonstraram uma maior porcentagem de preenchimento ósseo vertical para GBR+BG ( $27,77 \pm 14,07$ ) seguido por GBR ( $21,78 \pm 16,19$ ), BG

(21,26 ± 6,87), DE (14,03 ± 5,6). Entretanto, a análise de variância não detectou diferenças estatísticas em qualquer um dos tratamentos propostos (P=0,265). Assim, dentro dos limites do presente trabalho, concluiu-se que não há diferença entre os tratamentos investigados.

Unitermos: peri-implantite, membrana absorvível, enxerto ósseo.

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