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The influence of soft tissue thickness on crestal bone changes around implants. A 1-year randomized controlled clinical trial

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Introduction

It is well documented in the literature that two-piece dental implants overgo early crestal bone loss within the first year after delivery of the restoration (Albrektsson et al., 1986). Many factors have been advanced as possible reasons for this phenomenon. Overload, microgap, implant polished neck (Wiskott et al., 1999) and other have been extensively disccused in the literature but the stability of crestal bone still remains a controversial issue.
One more factor, responsible for early crestal bone loss could be the formation of biologic width around implants. It's been suggested that there is a minimum width of peri-implant mucosa required for stable epithelial and connective tissue atachment to form. If this dimension is not satisfied, bone loss may occur. The formation of biologic width and subsequent bone changes could be depended on soft tissue thickness, as it was shown in an animal study (Berglundh and Lindhe, 1996). Therefore, the question is still open whether gingival tissue thickness plays a role in etiology of early crestal bone loss.

Objective

The aim of the study was to evaluate the effect of gingival tissue thickness on crestal bone changes around implants.

Materials and Methods

Two implants (Prodigy, BioHorizons, Alabama, USA) were placed adjacent to each other. Test implant was placed 2 mm supracrestally and control implant was positioned at the crestal level (Fig. 1). The randomization of the test and control implant in terms of position was performed in a following way: the most anterior implant was randomly allocated as a test or control implant, the test one being 2 mm above the bone crest and the control at the bone level. Patient birth year was used for randomization, which implant will be placed supracrestally.
The flap was raised in two stages: (a) palatal-lingual flap was raised and mucosal thickness was measured with periodontal probe (Fig. 2); (b) buccal flap was raised to expose implant site. After implant placement, healing abutments were connected. Prosthetic procedures were initiated following 2 months of healing in the lower jaw and 4 months in the upper jaw (Fig. 3). Impressions were taken with open-tray technique, using open-tray impression transfers. If fixed partial denture was fabricated, impressions transfers were splinted together with cold-cured resin (Pattern resin, GC, Japan). A -polyvinylsiloxane (Flexitime, Germany) was used as an impression material. Porcelain-fused-to-metal fixed restorations were fabricated and cemented with resin modified glass-ionomer cement (Fuji Plus, GC, Japan).
All test implants (placed 2 mm supracrestally) were divided into 2 groups according to the thickness of mucosa at the time of their placement. Patients with thin mucosa were allocated to group A (9 cases) and patients with thick mucosa were allocated to group B (14 cases) Radiological evaluation and measurements were performed using RVG Windows Trophy 5.0 software measurement program with a magnification (x 3) by one examiner. Two images were selected for calculation of crestal bone changes; (1) after implant placement and (2) of implants after 1 year post reconstruction. Before calculation of the crestal bone changes, the calibration of RVG images was performed, using calibration program in Trophy RVG software. Statistical analysis: descriptives, paired samples T-test, one-way ANOVA tests were done with SPSS ver. 14 (SPSS Inc., Chicago, Il) in order to compare means of crestal bone loss between groups ($P<0.05$).

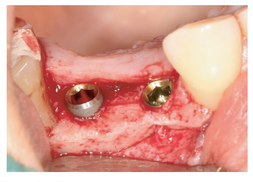

Fig. 1. Test and control implants

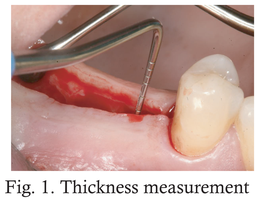

Fig. 1. Thickness measurement

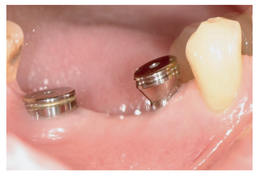

Fig. 1. Healing abutments

Results

Totally, 46 implants (23 test and 23 control) were placed. A pair of implants (test and control) was considered as one case. Mandible received 20 cases (40 implants in total; 87%), while in maxilla 3 cases were placed (6 implants; 13%). By quadrant of the jaws the implants were distributed in a following way: I quad. – 1 case (4.3%), II – 2 cases (8.7%), III – 11 (47.8%) cases, IV – 9 cases (39.2%). All 46 implants integrated successfully. Six single crowns (23.1%), twelve 2-unit (46.2%) and eight 3-unit (30.7%) fixed partial dentures were fabricated afterwards. Overall, the implant success rate after 1 year of function in test and control groups was 100%. No prosthetic complications were recorded at follow-up visits.
Bone loss around test implants in A group (thin mucosa) was 1.61 mm ± 0.24 SE (0.9 – 3.3 mm) on mesial and 1.28 mm ± 0.167 SE (0.8 – 2.1 mm) on distal measurement. Mean bone loss in test group B (thick mucosa) implants was 0.26 ± 0.08 mm (0.2 -0.9 mm) on medial aspect and 0.09 ± 0.05 mm SE (0.2 – 0.6 mm) on distal aspect of the implant. Mean bone loss control implant mesially was 1.8 ± 0.164 (range, 0.6 – 4.0) and 1.87 ± 0.166 (range, 0.0 – 4.1) on distal site. ANOVA test revealed that there was a significant difference in terms of bone loss between test A (thin) and B (thick) groups in medial site ($F1,21= 38.7$; $P<0.001$) and on distal ($F1,21=34.0$; $P<0.001$) site as well (Fig. 4). T-paired test showed no difference between test group A (thin tissues) and control group both mesdially ($P<0.474$) and distally ($P>0.415$). In contrast there was a significant difference in crestal bone loss amount between test group B (thick tissues) and control group both mesially ($P<0.001$) and distally ($P<0.001$).

Fig. 4. Graphical visualisation

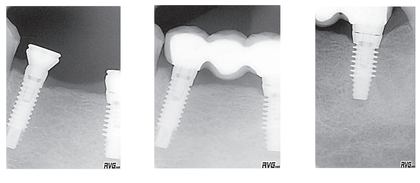

Fig. 5. Bone loss in thin tissues

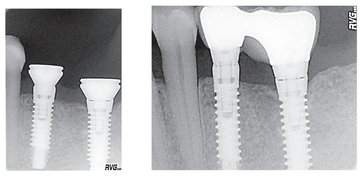

Fig. 6. No bone loss in thick tissues

Discussion

The present study focused on the influence of initial gingival thickness on crestal bone changes around non-submerged implants after 1 year follow-up. The main observation was that if thin gingival tissues were present, placement of an implant 2 mm supracrestally did not prevent crestal bone loss. All implants in test group with initially thin tissues overcame additional bone loss both mesially and distally (Fig. 5). In contrast, implants in test group with thick tissue had significantly less bone loss, compared to thin tissue test group and control implants. In addition, there was no reliable difference between test implants in thin tissues and control implants (Fig. 6). The bone loss around control implants was expected, as placement of microgap and polished collar at crestal level can cause marginal bone loss. The results of current clinical experiment are in agreement with an animal study, which showed the potential of the thin tissues to cause crestal bone loss in process of biologic width formation (Berglundh and Lindhe, 1996). The authors explained that the minimum dimension of biologic width was not satisfied and bone resorbtion took place to allow a sufficient soft tissue attachment to form. Our observations are partly contrary to opinion that positioning of an implant/abutment junction above the bone level can prevent apical migration of bone (Hermann et al, 1997, 2001). Stable crestal bone was maintained only in thick tissue pattern. In thin tissues there was a major marginal bone loss. The explanation of this disagreement might be the lack of registration of initial mucosal thickness at a time of implant placement in microgap studies.

Conclusions

Within the limitation of the present study it can be concluded, that initially thin mucosal tissue can cause early crestal bone loss after implant installation. In thick tissues (3 mm or more), marginal bone recession could be avoided, if implant/abutment junction is positioned approximately 2 mm above the bone level. Therefore, it can be recommended to avoid supracrestal placement of the implant, if thin biotype of mucosa is present in implant site. Furthermore, the measurement of gingival thickness should be mandatory in any experiment of marginal bone loss. Another point could be thickening of thin tissues before implant placement.