Influence of Two Different Machined-Collar Heights on Crestal Bone Loss

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Purpose: The purpose of this trial was to evaluate crestal bone level changes radiographically in a standardized fashion over a period of 12 months in humans for implants with a 0.7-mm machined collar (implant type A) versus type B implants with a 1.5-mm machined collar. Material and Methods: Twenty-five patients with multiple missing teeth in posterior sectors were randomly assigned to one of the two groups: A (0.7-mm machined-collar implants) or B (1.5-mm machined-collar implants). Changes at crestal bone level were assessed by measuring the shoulder-crest distance (SCD) on the mesial and distal aspects of each implant on customized periapical radiographs, which were taken on the day of surgery and 3, 6, and 12 months after surgery. Results: Eighty-one implants were included in the study. Mean SCD was 0.54 ± 0.53 mm at baseline and 1.49 ± 0.40 mm after 12 months. For 0.7 mm–collar implants, mean SCD was 1.40 ± 0.39 mm, while it was 1.56 ± 0.40 mm for 1.5 mm–collar implants. Statistically significant differences were found only between the two types of implants for distal measurements at 3 and 12 months after placement. Conclusion: Both 0.7- and 1.5-mm machined-collar implants can be used with predictable results, as changes in peri-implant crestal bone levels are similar for both implant types and do not seem to be significant from a clinical point of view. The SCD may well depend more on the location of the abutment-implant interface than on machined-collar height. Int J Oral Maxillofac Implants 2014;29:xxx–xxx. doi: 10.11607/jomi.3583

Key words: bone resorption, dental implants, implant stability, marginal bone levels, surface properties

In the early years of modern implantology, the Brånemark classic protocol, using two-piece submerged implants, prevailed. In this protocol, the top of the implant is aligned with the crestal bone level according to standard surgical procedures, using a completely machined titanium surface.1,2 However, Schroeder et al advocated for a nonsubmerged placement approach using an implant with a roughened endosseous portion in combination with a machined portion located within soft tissues. In accordance with standard surgical procedures, the rough/smooth interface (RSI), ie, the implant border between the coronal (machined) portion and the apical part, should be aligned with the crestal bone level, resulting in the top of the implant located at or slightly below the gingival margin.3–8

Several studies have proven that the two main factors in crestal bone remodeling after placement of implants with a polished collar are the location of the RSI and the microgap between the abutment and polished collar.9–13 These factors also have an influence on soft tissue dimensions (biologic width)14–16 and on the degree of peri-implant inflammation. Alomrani et al17 and Hermann et al18 demonstrated that the coronal displacement of the RSI lead to decreased bone loss, whereas if it was placed more apically the bone loss increased, indicating that there is a physiologic reaction to the presence of the RSI. The reason for this reaction to the interface is possibly related to the presence of microbial contamination19–21 or micromovement of the interface between the implant and the abutment or secondary implant components.
University of Seville approved the trial, and all patients gave written informed consent before the study commenced. Patients were randomly assigned to one of the two groups by tossing a coin after implant osteotomy preparation.

Subjects had to fulfill the following inclusion criteria: (1) partially edentulous adult patients with no more than four teeth missing in the molar and premolar region; (2) bone crest healing period > 4 months prior to implant placement; (3) opposing dentition present (natural teeth or tooth/implant–supported fixed prosthesis); (4) stable occlusion, verifiable in study models. The exclusion criteria were as follows: (1) pregnant women; (2) those needing bone grafting before or after implant placement; (3) smoking > 10 cigarettes/day; (4) drug abuse; (5) untreated periodontitis; (6) medically compromised patients (metabolic diseases, immunodeficiencies or treatment with immunosuppressive therapy, previous or current use of oral or intravenous bisphosphonates, radiation therapy, etc) or those with any other local factor that could contraindicate implant surgery; (7) lack of primary stability; (8) bruxism; and (9) temporomandibular disorders.

Implant Design
Alumina-particle abraded and acid passivated rough-surfaced (Shot Blasting, Klockner Implant System) screw-shaped implants (Essential Cone, Klockner Implant System) were used with two different machined-collar heights: 0.7 mm (Group A) and 1.5 mm (Group B). Implant diameters were 3.5, 4.0, and 4.8 mm (diameters at platform level were 4.5, 4.5, and 6 mm, respectively) with lengths of 8, 10 or 12 mm (Fig 1).

Surgical Procedure
Antisepsis was performed extraorally with 2.0% chlorhexidine solution and intraorally with 0.12% chlorhexidine rinse for 1 minute (Perioaid). Local infiltration with 2.0% lidocaine solution with 1:100,000 epinephrine was used for anesthesia. Prophylactic antibiotic coverage (amoxicillin 1500 mg and clindamycin 600 mg) was given 1 hour prior to surgery. Briefly, a supracrestal horizontal incision was performed, with a mesial vertical releasing incision if necessary. Mucoperiosteal flaps were elevated, the crestal bone was inspected and planed if necessary, and the osteotomy was performed under abundant irrigation with sterile saline solution. Implants were placed according to the manufacturer’s protocol (one-stage surgery, Essential Cone, Klockner Implant System). Implants from both groups were placed maintaining the same shoulder-crest distance (SCD), meaning that in group B (1.5-mm machined-collars) implants, 0.8 mm of the machined collar was placed subcrestally. The implant shoulder and the adjacent root surface were at least 1.5 mm

 MATERIALS AND METHODS

Study Design
Twenty-five patients were selected from the clinic of the master’s degree program in Periodontics and Implant Dentistry at the Dental School of the University of Seville, Spain. The Ethics Committee at the University of Seville approved the trial, and all patients gave written informed consent before the study commenced. Patients were randomly assigned to one of the two groups by tossing a coin after implant osteotomy preparation.

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size, using image analysis software (Photoshop CS6, Adobe). Radiographic analysis was completed by an independent researcher who did not know to which group each implant belonged. The same examiner measured a subset of 10 radiographs on three separate occasions, 3 days apart, to determine the intraexaminer reproducibility. The interclass coefficient was 0.99 ($P < .05$).

Prosthetic Procedure
Eight weeks after surgery, impressions were taken (Impregum, 3M ESPE) and screw-retained metal-ceramic restorations made. The Octacone 12-degree abutments (Klockner Implant System) were torqued to 30 Ncm; restorations were torqued to 15 Ncm. Occlusion was checked and adjusted, if required.

Statistical Analysis
A power analysis was conducted, using the nQuery Advisor 4.0 program (Statistical Solutions), to determine the necessary implant number to detect mean crestal bone differences of $0.5 \pm 0.72$ mm, with $P < .05$ and a power of 85%, at 6 months according to Tan et al.\textsuperscript{23} Therefore, a minimum sample group of 39 implants was determined. However, the total sample number was increased to 81 implants, as an estimated 4% dropout rate was expected during the first year.

Frequency and ratios for qualitative variables and average quantitative variables and standard deviations were determined globally and by groups (collar height 0.7 mm vs 1.5 mm). For comparison of numeric variables between both groups, the parametric Student $t$ test was used for independent samples or the Mann-Whitney nonparametric $U$ test for normal distributions. When significant differences were obtained, 95% confidence intervals

Variables
The present study focused on assessing crestal bone level changes according to the type of implant used. Changes at crestal bone level were assessed by measuring SCD on the mesial and distal aspects of each implant. Periapical radiographs were taken using a parallel technique with customized film holders (Rinn XCP, Dentsply Rinn), to ensure a reproducible radiographic analysis. The customized film holder was made using vinyl polysiloxane bite registration material (Normosil Adiccion Putty Normal) on the bite block of the film holders, thus favoring radiograph reproducibility. Radiographs were taken on the day of surgery (day 0 or baseline) and 3, 6, and 12 months after surgery (Fig 2).

The actual distortion factor of each radiograph was calculated to determine the relationship between implant size in radiographic images and actual implant size; when there were two or more adjacent implants the minimum distance between them was at least 3 mm. Once placed, the implant surface was surrounded by at least 2 mm of bone at all aspects. Primary stability was measured by means of resonance frequency analysis (RFA) (Ostell ISQ Integration Diagnostics). In the event of lack of primary stability, the implant was discarded from the study. Flaps were then repositioned, and interrupted sutures (Supramid 4/0, Assut Sutures) placed so that the cover screw was completely or partially exposed. Antibiotics (amoxicillin 750 mg three times per day (tid) for 8 days or clindamycin 300 mg tid for 8 days in penicillin-allergic patients), a nonsteroidal anti-inflammatory drug (ibuprofen 600 mg tid for 2 days), and a gastric protector (omeprazole 20 mg twice a day for 8 days) were prescribed. Sutures were removed after 15 days.

Fig 2  Sample radiographs illustrating crestal bone level changes over the observation time (baseline, 3 months, 6 months, and 1 year) in (a to d) type A (0.7-mm machined-collar) and (e to h) type B (1.5-mm machined-collar) implants.
Bone Loss
Mean SCD for all implants [AU: OK?] at baseline and at 3, 6, and 12 months after implant placement was 0.54 ± 0.53 mm, 0.25 ± 0.71 mm, 0.76 ± 0.25 mm, and 1.49 ± 0.40 mm, respectively. Irrespective of implant location, no statistically significant differences could be found (Table 2) at any of the observation times. The SCD relative to implant collar height is shown in Table 3. Statistically significant differences were only found between 0.7-mm and 1.5-mm collars distally at 3 and 12 months after placement.

Mean bone loss (BL) for all implants [AU: OK?] at 3, 6, and 12 months after placement was −0.30 ± 0.55 mm, 0.23 ± 0.64 mm, and 0.9448 ± 0.71 mm, respectively. Bone loss relative to implant collar height is shown in Table 3. Statistically significant differences were only found between 0.7- and 1.5-mm collars 12 months after placement.

were determined for average and mean differences (Hodges-Lehman estimation of confidence intervals).

RESULTS
Eighty-one implants were included in the study (40 in the maxilla and 41 in the mandible). The most frequent location was the area of mandibular molars (28 implants), followed by maxillary premolars (22 implants), maxillary molars (18 implants), and mandibular premolars (13 implants).

Features of the implants used (diameter, length, and machined-collar size) are summarized in Table 1.

Regarding bone quality, 1.2% implants were placed in type 1 bone, 76.5% in type 2 bone, and 22.2% in type 3 bone. Implant survival rate was 100% 1 year after implantation.

Table 1 Features of the Implants Used (Diameter, Length, and Machined-Collar Size)

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>Length (mm)</th>
<th>Collar height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>4.0</td>
<td>4.8</td>
</tr>
<tr>
<td>No implants (%)</td>
<td>16 (19.8%)</td>
<td>52 (64.2%)</td>
</tr>
</tbody>
</table>

Table 2 SCD (in mm) According to Implant Location*

<table>
<thead>
<tr>
<th>Upper premolars (22)</th>
<th>Upper molars (18)</th>
<th>Lower premolars (13)</th>
<th>Lower molars (28)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesial</td>
<td>Distal</td>
<td>Mesial</td>
<td>Distal</td>
</tr>
<tr>
<td>Baseline</td>
<td>0.58 ± 0.58</td>
<td>0.60 ± 0.54</td>
<td>0.35 ± 0.48</td>
</tr>
<tr>
<td>3 months</td>
<td>0.23 ± 0.08</td>
<td>0.28 ± 0.10</td>
<td>0.21 ± 0.09</td>
</tr>
<tr>
<td>6 months</td>
<td>0.75 ± 0.14</td>
<td>0.87 ± 0.21</td>
<td>0.66 ± 0.27</td>
</tr>
<tr>
<td>12 months</td>
<td>1.39 ± 0.37</td>
<td>1.68 ± 0.51</td>
<td>1.40 ± 0.42</td>
</tr>
</tbody>
</table>

*No statistically significant differences (P < .05).

Table 3 SCD and BL (in mm) for 0.7-mm and 1.5-mm Machined-Collar Implants

<table>
<thead>
<tr>
<th>0.7-mm collar</th>
<th>1.5-mm collar</th>
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<tr>
<td><strong>SCD</strong></td>
<td><strong>BL</strong></td>
</tr>
<tr>
<td><strong>Mesial</strong></td>
<td>Baseline</td>
</tr>
<tr>
<td></td>
<td>3 months</td>
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<td></td>
<td>6 months</td>
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<td>12 months</td>
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<td>Baseline</td>
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<td><strong>Mean</strong></td>
<td>Baseline</td>
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<td>3 months</td>
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<td>6 months</td>
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<td></td>
<td>12 months</td>
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BL = bone loss. *Statistically significant differences (P < .05).
DISCUSSION

The results of the present study suggest that the SCD for 0.7- and 1.5-mm machined-collar implants is similar at 12 months after placement, without statistically significant differences. These results are in agreement with Joly et al., who found no statistically significant differences in SCD between 2.8- and 1.8-mm polished-collar implants (3.82 ± 0.55 mm vs 3.50 ± 0.27 mm). Similarly, Hämmerle et al. found no statistically significant clinical or radiological differences in SCD in 2.8-mm polished-collar implants when placed either with the RSI at bone crest level or 1 mm subcrestally after 12 months. The SCD obtained 12 months after placement was 2.6 ± 0.8 mm and 2.5 ± 0.7 mm, respectively. Also, Tan et al. did not find any statistically significant differences in the SCD 12 months after placement of 1.8-mm polished-collar implants and 2.8-mm polished-collar implants in which the RSI was placed 1 mm subcrestally (2.61 ± 1.03 mm and 2.85 ± 0.64 mm, respectively).

On the other hand, several studies did find statistically significant differences. In an experimental study in dogs Todescan et al. found statistically significant differences between implants placed 1 mm above crestal bone and 1 mm below (SCD was 2.50 ± 0.41 mm and 1.68 ± 0.69 mm, respectively). However, the observation period, 3 months after abutment connection, probably was not long enough to assess the complete remodeling of the bone crest. Another possible confounding factor was the implant connection, as Todescan et al. used external connection implants whereas all the previous studies used internal connection implants. In Negri et al.’s experimental study, immediately loaded implants with 1.5- and 0.7-mm polished collars were placed with the RSI 0.5 mm apical to the bone crest. At 3 months, 1.5-mm polished-collar implants showed a statically significant greater SCD. However the follow-up period was not long enough to determine the final SCD.

Therefore, it seems that the SCD, in which biologic width is established, depends more on the location of the implant-abutment gap rather than the height of the polished collar. Biologic width would be determined according to the gap–bone crest distance and the relationship between the RSI and bone crest. Bone resorption would be an expected event after implant placement and would occur to create the necessary space for connective tissue adaptation.

The greater BL observed in 1.5-mm machined-collar implants may be due to the 0.8-mm subcrestal placement of the RSI. This finding is in agreement with Hämmerle et al., who found greater marginal BL when the polished collar was placed subcrestally for better esthetics. Alomrani et al. studied the effect of the implant polished collar on peri-implant bone levels when

CONCLUSIONS

Within the limitations of the present study, the results suggest that both 0.7- and 1.5-mm machined-collar implants can be used with predictable results. Changes in peri-implant crestal bone levels are similar for both implant types and do not seem to be significant from a clinical point of view. The SCD may well depend more on the location of the abutment-implant interface than on machined-collar height.

ACKNOWLEDGMENTS

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REFERENCES


