Implantoplasty Enhancing Peri-implant Bone Stability Over a 3-Year Follow-up: A Case Series

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Implantoplasty has been claimed as a promising strategy to treat peri-implantitis and prevent progressive peri-implant bone loss. Consequently, the aim of the present case series is to exhibit the clinical outcomes of a 3-year-follow-up resective and implantoplasty therapy applying a novel platform-switch concept to preserve peri-implant tissue integrity and counteract progressive bone loss. Four patients who underwent dental implant therapy and were diagnosed with peri-implantitis were treated through access flap surgery, a modified implantoplasty, bone recontouring, and surface decontamination. The radiographic and clinical parameters recorded before and during the 3-year follow-up were: marginal bone loss (MBL) as the primary endpoint, bleeding on probing index (BOP), probing depth (PD), presence of suppuration, pain, mobility, and fracture. The 3-year follow-up exhibited peri-implant bone stability in all cases (100%) showing radiographically an MBL reduction (mean) of 0.8 ± 0.5 mm (mesial) and 0.5 ± 0.3 mm (distal). Mean PD reduction was 4.75 ± 1 mm and mean BOP was reduced by 71%. Pain and suppuration were resolved in all cases. None of the cases reported implant fracture or mobility after the modified implantoplasty therapy. The present case series demonstrated that this modified implantoplasty can be more than a surface decontamination therapy where the narrow and smooth exposed implant surface can counteract peri-implantitis alterations providing favorable biologic conditions to maintain stability of peri-implant tissues. Int J Periodontics Restorative Dent 2020;40:e1–e8. doi: 10.11607/prd.3849

Peri-implantitis has been defined as a pathologic condition around dental implants, characterized by progressive marginal bone loss and inflammation in the peri-implant connective tissue. Mombelli et al introduced the term peri-implantitis more than 30 years ago, stating that per-implantitis could be considered a site-specific infection involving gram-negative anaerobic rods. The diagnosis of this condition is currently based on signs of inflammation, such as bleeding and suppuration on gentle probing, with the concomitant evaluation of progressive peri-implant bone loss over time and function. Biofilm formation on dental surfaces, history of chronic periodontitis, and erratic maintenance have been suggested to be peri-implantitis risk indicators. Studies have reported that PI incidence fluctuates from 1% to 47%, and thus clinicians face several doubts regarding the diagnosis, treatment, and prevention to counteract this “varying” biologic complication that affects dental osseointegrated implants and jeopardizes health, function, and esthetic outcomes. Several surgical and nonsurgical therapies have been proposed to treat peri-implantitis; however, until now, none of them has been selected as a “gold standard” treatment. Most studies have reported surgical approaches for...
peri-implantitis that include open flap debridement, removal of granulation tissue, and decontamination of the exposed threads. This surgical approach can be performed in combination with regenerative procedures, bone contouring, and implantoplasty (IP). IP is a clinical procedure performed to smooth exposed threads of an implant, establishing a more favorable transmucosal area that will decrease biofilm adherence and possibly enhance fibroblast migration. Regarding biofilm adherence, rough implant surfaces enhance bacteria colonization and biofilm formation, which can provoke inflammatory responses and induce osteoclastic activity, causing crestal bone loss. Several studies have claimed that the IP procedure is difficult to perform, it may induce fracture because the implant diameter is decreased through thread-smoothing, and that released titanium particles may cause peri-implant inflammatory responses. Alternatively, some clinical and in vitro studies have shown that IP reduced peri-implant mucosa inflammation by supporting the adhesion of peri-implant soft tissue and counteracting progressive bone loss when compared to surgical approaches that did not involve IP.

A modified technique to perform IP could replicate the platform-switch concept in the newly conformed transmucosal surface by not only removing and smoothing the implant threads but also by slightly diminishing the implant diameter in the most apical part of the exposed threads, which contact the supporting bone. None of the studies evaluating IP outcomes have previously mentioned this approach or applied this technique in the IP protocol procedure (Fig 1). The present case series aims to demonstrate that the platform-switch concept applied to IP will decrease or stabilize marginal bone loss, thus enhancing peri-implant mucosa biologic conditions.

Subjects and Study Protocol

The present case series collection of data was approved by the ethics committee in human research (no. 1.771.462) of the Federal University of Santa Catarina, School of Dentistry (CEPID-UFSC), Brazil, and is in accordance with the Helsinki Declaration of 1975 (revised in 2014). The diagnosed and treated participants signed a consent form that authorized the collection of personal data and performance of the clinical evaluation. Before the intervention, the patient had to fulfill the following criteria: (1) aged 18 years or older, (2) diagnosed with peri-implantitis, (3) candidate for resective and implantoplasty surgical treatment, and (4) no implant mobility. The exclusion criteria prior to the surgical treatment were the following conditions: (1) general contraindications for dental or surgical treatments, (2) current bisphosphonate therapy, (3) history of radiotherapy or chemotherapy within the past 5 years, (4) pregnancy or lactating condition, and (5) affected implant of a narrow diameter (less than 4 mm).

This case series included four subjects (two men and two women) who were diagnosed with PI at the Federal University of Santa Catarina, School of Dentistry (CEPID-UFSC). The subjects were clinically and radiographically analyzed fulfilling peri-implantitis multifactorial diagnosis criteria established in previous studies, described as: progressive crestal bone loss > 3 mm (at least one point), bleeding on probing (BOP), presence of suppuration, and probing depth (PD) > 5 mm (at least one point). The patients were notified of their diagnosis and explained in detail the surgical treatment (applying a modified implantoplasty technique) to treat their condition.

A single calibrated examiner (B.C.) performed all clinical measurements with the use of a periodontal probe (probing force of 0.5 Ncm; PCV12PT, Hu-Friedy) to determine BOP index and PD parameters. Measurements for BOP index and PD were obtained at six sites around the implant (distobuccal, midbuccal, mesiobuccal, distolingual, midlingual, and mesiolingual). Presence of suppuration, pain, and mobility upon palpation were classified with a dichotomic index (positive or negative). Digital periapical radiographs (EVO, Micro Imagem) were taken to analyze progressive marginal bone loss, comparing through a computerized radiograph analysis software (ImageJ, National Institutes of Health) the mesial and distal bone change from baseline. The measurement analysis scale was set by means of the known implant height.

The present case series report considered the checklist items as proposed in the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement.
Surgical Procedure

Patients received oral amoxicillin 500 mg for 7 days beginning 1 day before surgery. Full-mouth disinfection was performed with the concomitant removal of calculus and soft deposits of plaque prior to surgical intervention. Patients were locally anesthetized (2% lidocaine, 1:100,000 epinephrine). After removing the implant’s screw-retained prosthesis, a surgical incision was made on the crest of the ridge, extending through an intrasulcular incision around the implant and adjacent teeth. Full-thickness mucoperiosteal buccal and lingual flaps were raised. The granulation inflammatory tissue and biofilm accumulation adhered to the implant exposed threads were removed through mechanical debridement using a curette (Prichard, Hu-Friedy) (Figs 2a and 2b).

Bone recontouring was performed to remove alveolar bone peaks and to induce bleeding points around the peri-implant bone defects through a spherical bur (contrangle...
handpiece, Kavo; 40,000 rpm) under affluent water irrigation. After the exposed implant threads and bone defect were thoroughly debrided, the surgical area was rinsed with a saline solution. Implantoplasty (Fig 2) followed a sequence of steps and use of burs (Fig 2c), as previously reported\textsuperscript{7,15}: The first step was to smooth the implant’s threads and perform a platform-switch area in the most apical part of the exposed implant body using a bud-shaped diamond bur (grit size 106 mm; Intensiv) at 200,000 rpm. This platform-switched area was accomplished by forming a bottle neck format, beginning from the most apical part of the exposed implant body. Polishing of the rough surfaces was continued with flame-shaped fine (grit size 46 mm) and extra-fine (grit size 25 mm) diamond burs (Intensiv) at 40,000 rpm. After thread removal, an Arkansas stone bur (white aluminum oxide; Jota) was used at 20,000 rpm to remove irregularities from the implant surface. A mini point-shaped abrasive, impregnated silicone polisher (Greenie, Shofu) at 20,000 rpm was used until the smoothed areas looked evenly smooth to the naked eye. Every mentioned step was performed under copious water irrigation. Throughout the IP procedure, the external hexagon platform was carefully preserved to avoid future problems with the prosthetic connection. The surgical site was rinsed extensively with saline solution to clean titanium and other residual particles delivered during the procedure. In addition, decontamination of the smoothed surface was performed through the application of citric acid (20%; Farmácia Extrato Vital) for 3 minutes followed by rinsing with a saline solution (Fig 2d). Finally, the mucoperiosteal buccal and lingual flaps were repositioned and fixed with single sutures (nylon 4.0). A periapical radiograph was taken after the surgical procedure as the baseline for marginal bone loss (MBL) analysis. Patients were instructed to rinse daily with chlorhexidine digluconate (0.12%) for 1 week. Suture removal and prosthesis placement took place 10 days after surgery.

**Results**

Four subjects (two men and two women; mean age: 53 ± 3 years) were treated in the present case series report. One of them had a history of aggressive periodontal disease (Case 2), and two of them (Cases 3 and 4) were smokers who reported
consumption of more than 6 cigarettes per day. All treated implants had an external hexagon connection and supported metallic-ceramic crowns. One case (Case 4) supported a prosthesis with a distal cantilever, and the other three cases supported single-crown prostheses. The mean implant time in function was $5 \pm 1$ years before IP treatment. All cases reported suppuration; however, only one case had pain symptoms before IP. Implant length, implant region, and other patient characteristics were also evaluated (Table 1).

After the 3-year follow-up, radiographic and clinical outcomes indicated that all four cases were resolved after performing the platform-switched IP (Tables 1 and 2). Peri-implant MBL, which was the primary studied outcome, was stable in all cases after IP therapy (Table 1). Moreover, one of the cases (Case 2) exhibited a significant MBL reduction, as observed in the peri-apical radiographs in Table 1. The secondary outcomes, mean PD and mean BOP (%), were also reduced significantly in all cases (Table 2). Suppuration and pain were resolved in all four cases after the follow-up period. Clinically, the peri-implant mucosa of all cases exhibited a healthy condition when compared to the initial peri-implantitis condition.

### Table 1: Clinical and Radiographic Evaluations Showing Peri-implant Bone Stability of all Cases from Baseline to the 3-Year Follow-up of Platform-Switched Implantoplasty

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Diagnosis parameters</th>
<th>Baseline</th>
<th>3-y follow-up</th>
<th>Before IP</th>
<th>1 wk after IP</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MBL, mm</td>
<td>M: 4.1</td>
<td>M: 4</td>
<td>D: 4.0</td>
<td>D: 3.9</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>BOP, %</td>
<td>83</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PD, mm (mean ± SD)</td>
<td>5 ± 0.2</td>
<td>1 ± 0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pain</td>
<td>–</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suppuration</td>
<td>+</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>MBL, mm</td>
<td>M: 6</td>
<td>M: 3</td>
<td>D: 7</td>
<td>D: 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BOP, %</td>
<td>100</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PD, mm (mean ± SD)</td>
<td>7 ± 0.5</td>
<td>1 ± 0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pain</td>
<td>+</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suppuration</td>
<td>+</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>MBL, mm</td>
<td>M: 4.5</td>
<td>M: 4.5</td>
<td>D: 4.7</td>
<td>D: 4.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BOP, %</td>
<td>83</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PD, mm (mean ± SD)</td>
<td>6 ± 0.2</td>
<td>1 ± 0.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pain</td>
<td>–</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suppuration</td>
<td>+</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>MBL, mm</td>
<td>M: 4.7</td>
<td>M: 4.5</td>
<td>D: 4.6</td>
<td>D: 4.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BOP, %</td>
<td>66.6</td>
<td>16.6</td>
<td></td>
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<tr>
<td></td>
<td>PD, mm (mean ± SD)</td>
<td>5 ± 0.4</td>
<td>2 ± 0.1</td>
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<tr>
<td></td>
<td>Pain</td>
<td>–</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suppuration</td>
<td>+</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IP = implantoplasty; MBL = marginal bone loss; BOP = bleeding on probing index; PD = probing depth; M = mesial; D = distal; + = positive; – = negative.
Case 1 is a 44-year-old man with a 10-mm implant in the posterior mandible, placed in 2013.
Case 2 is a 45-year-old woman with a 12-mm implant in the posterior mandible, placed in 2012.
Case 3 is a 63-year-old man with a 13-mm implant in the posterior mandible, placed in 2009.
Case 4 is a 58-year-old woman with a 10-mm implant in a maxillary premolar area, placed in 2010.
Fig 3. Additionally, none of the cases reported implant fracture or mobility after the IP surgical procedure was executed.

Discussion

A modified peri-implantitis treatment through resective surgery, decontamination, and IP applying a platform-switch concept demonstrated promising results to counteract progressive bone loss and enhance peri-implant tissue adaptation around the treated implant surface in a 3-year follow-up period. The four peri-implantitis cases were resolved after IP therapy, and no implant removal was needed.

The results regarding MBL, which was the primary outcome, showed generalized peri-implant bone stability with no signs of progressive MBL over a 3-year period. These results are of clinical relevance since they demonstrate that a possible treatment for peri-implantitis could be a modified IP technique to counteract progressive bone loss. Previous research evaluating peri-implantitis bone pathology has reported that cells derived from osseointegrated implants diagnosed with peri-implantitis have a fibro-osteoblastic phenotype and an increased expression of fibrocyte markers. Also, it has been revealed that the transcription factors of mature osteoblasts RUNX2 are decreased in peri-implantitis bone defects.\(^\text{19}\) This finding regarding peri-implantitis molecular pathophysiology is important to understand the probable causes of marginal bone loss and bone graft complications at peri-implant defects. Accordingly, its osteoblast potential might be inferior and thus unable to induce bone formation in bone grafted areas.\(^\text{19\text{–}21}\) In the present case series, the peri-implantitis defects revealed mainly a suprabony defect configuration. As follows, no augmentation procedures were performed since the defect’s features may not be favorable for stability and nutrition of the grafted areas. Certain studies have shown favorable results of bone grafting applications in peri-implantitis treatment\(^\text{20}\) and have also claimed that rough surfaces enhance a re-osseointegration response as opposed to smooth ones.\(^\text{21,22}\) Since re-osseointegration is the main and pursued goal in the management of peri-implantitis alterations, future research with more significant study samples is needed to validate that this platform-switch concept applied to IP therapy can

Table 2. Mean ± Standard Deviations of the Diagnosis Parameters in All Four Cases from Baseline to the 3-Year Follow-up

<table>
<thead>
<tr>
<th>Diagnosis parameters</th>
<th>Baseline</th>
<th>3 y</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBL, mm (M)</td>
<td>4.8 ± 0.8</td>
<td>4 ± 0.7</td>
<td>0.8 ± 0.5</td>
</tr>
<tr>
<td>MBL, mm (D)</td>
<td>5 ± 1.3</td>
<td>4.5 ± 0.4</td>
<td>0.5 ± 0.3</td>
</tr>
<tr>
<td>PD, mm</td>
<td>6 ± 0.9</td>
<td>1.25 ± 0.5</td>
<td>4.75 ± 1</td>
</tr>
<tr>
<td>BOP, %</td>
<td>83 ± 13</td>
<td>12 ± 15</td>
<td>71 ± 14</td>
</tr>
</tbody>
</table>

MBL = marginal bone loss; M = mesial; D = distal; PD = probing depth; BOP = bleeding on probing index; SD = standard deviation.
enhance re-osseointegration without bone grafting applications.

This case series showed promising clinical results regarding peri-implant mucosa health and stability. Peri-implant PD, bleeding, and inflammation decreased considerably after the platform-switched IP, and important reductions in mean PD, BOP (%), suppuration, and pain were accomplished in a long-term period in all treated cases. These results could be supported by previous evidence suggesting that a smoothed and narrowed surface enhances fibroblast adherence, creating in this way a peri-implant biologic width around the new transmucosal area that will protect peri-implant bone from external injurious factors. It has been claimed that the quality and condition of peri-implant mucosa are decisive factors in preventing bone loss, as this tissue creates the desired “seal” between the external and internal medium.

The 3-year follow-up of the treated implants did not show any complications such as mobility or fracture after being in function. This observation is of clinical relevance since there is controversy regarding implant survival and fracture resistance after implantoplasty. However, various studies have shown that even though implantoplasty is a difficult and demanding procedure, it does not alter fracture resistance on standard-diameter implants. For this reason, the present case series had narrow-diameter implants as an exclusion criterion, since only standard-diameter implants have been tested to be resistant to fracture in previous studies.

Beyond the fact that a rough exposed surface will increase bacteria colonization and will protect it from shear forces, peri-implantitis treatment should also focus on creating a biologic space where cells can proliferate and heal in the affected region. As follows, through the eradication of granulation inflammatory tissue, bone defect recontouring, decontamination of the implant area, and smoothing and narrowing the implant exposed body in a waist-like shape, a possible standardized protocol could be established to treat peri-implantitis. Previous studies have reported that resective and IP therapies can positively influence the survival of peri-implantitis–diagnosed implants in terms of peri-implant bone stability and reduction of inflammatory response.

Conclusions

The present case series demonstrates that the platform-switch concept applied to IP is promising in terms of peri-implant bone and mucosa stability over a 36-month observational period. Future research is needed to prove that this modified IP therapy is effective to treat peri-implantitis over a long-term period.

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References


