Resective Treatment of Peri-implantitis: Clinical and Radiographic Outcomes After 2 Years

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A prospective case series was performed to examine the clinical and radiographic changes to peri-implant tissues 2 years after resective treatment of peri-implantitis, including an apically positioned flap, osteoplasty, and implantoplasty. In total, 25 patients with 40 titanium implants of multiple brands and advanced peri-implantitis were included in this study. After 2 years, all implants survived, mean probing pocket depth was reduced from 8.7 to 3.3 mm, and bone level remained stable in 92.5% of the implants. Findings suggest the approach of an apically positioned flap combined with osteoplasty and implantoplasty as an effective and reliable strategy against peri-implantitis, although increased gingival recessions may limit its application in esthetic areas. Int J Periodontics Restorative Dent 2018;38:729–735. doi: 10.11607/prd.3386

Peri-implantitis is defined as inflammatory lesions in the peri-implant tissues with loss of supporting bone and consequent deep pocketing.¹,² The etiology of peri-implantitis is complex and multifactorial, including infection, occlusal overload, and compromised healing response. The most validated causal factor is the presence of a biofilm-triggered inflammatory host response.³,⁴ The aim of peri-implantitis treatment is thus focused on reducing the total bacterial load, including improving oral hygiene, removal of bacterial deposits and cement rests from implant surfaces, allowing cleansability of the suprastructure, regular maintenance, and controlling factors that influence host response, such as smoking.

Nonsurgical therapy of peri-implantitis with or without adjunctive antibiotics is ineffective in completely controlling disease progression. The efficacy of submucosal scaling is compromised because of the difficulty of decontaminating implants due to surface roughness and the presence of implant threads. In addition, the form of the suprastructure can limit accessibility for cleaning.⁵ Surgical therapy is considered the treatment of choice and consists of open flap debridement with removal of the inflammatory tissue and mechanical and chemical decontamination of the exposed

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implant surface. Open flap debridement combined with antibiotics in cases of a limited extent of peri-implantitis demonstrated high effectiveness. Recontouring of the bony architecture without removing the supporting bone is defined as osteoplasty and is commonly applied in periodontal surgery. The approach of removing sharp bony edges and leveling angular defects and craters facilitates debridement, allows for apical positioning of the flap, and is efficient in reducing pockets. Similarly, this procedure is effective in treating peri-implantitis, though not in all cases and depending on the initial depth of the defect. The implant surface may influence the development of peri-implantitis, as rough implants have a higher risk for peri-implantitis than do implants with machined surfaces. A systematic review indicated that moderately rough and rough implants lose more bone than minimally rough implants. It is therefore acceptable to assume that smoothing of the implant surface would provide a better environment and may improve infection control. It has been shown that polishing implants with diamond and carbide burs produces a smoother surface. This surface modification approach is referred to as implantoplasty. Romeo et al concluded that implant surface modification of rough implants is more effective in controlling peri-implantitis than resective flap surgery alone. However, at present there is no consensus on which surgical intervention is most predictive and reliable in controlling peri-implantitis. 

The aim of the present prospective case series was to evaluate the 2-year outcome of resective surgery, defined as an apically positioned flap combined with osteoplasty and implantoplasty at advanced peri-implantitis lesions around moderately rough implants.

Materials and Methods

Patients referred for treatment of peri-implantitis to a private periodontal clinic were asked to participate in the study. The study was conducted in accordance with the Helsinki Declaration of 1975 as revised in 2000, and the study protocol was approved by the Ghent University Hospital ethical committee.

Initial treatment consisted of oral hygiene instructions, motivation, and supra- and submucosal implant surface instrumentation with ultrasonic and hand instruments. Suprastructure were adapted when needed to facilitate plaque removal. Patients with persistent peri-implant pocket depth ≥ 6 mm were scheduled for apically positioned flap surgery with osteoplasty and implantoplasty. All patients had a clinical baseline examination prior to the surgery, assessing bleeding on probing (BoP), probing pocket depth (PD), and suppuration at four sites around every implant (mesial, distal, buccal, and lingual). A conventional periapical radiograph was taken of each implant using the long cone paralleling technique. An effort was made to attain clearly visible threads. The consecutive inclusion criteria to participate in this prospective case series were as follows: (1) BoP at the affected implant, (2) PD ≥ 6 mm, and (3) radiographic evidence of bone loss ≥ 3 mm below the expected bone-implant contact. Exclusion criteria were as follows: (1) implants with machined titanium surface; (2) implants with clinically visible mobility; and (3) severe systemic diseases, diseases affecting bone metabolism, hematologic disorders, psychiatric disorders, any form of malignant cancer, patients under high-dose bisphosphonate therapy, and all other medical contraindications for oral surgery.

The implants included in the study were treated surgically, as described below (Figs 1 to 3) by the same clinician (E.E.). Screw-retained suprastructures were removed prior to surgery and were replaced after suturing. Cemented crowns and fixed or removable partial dentures were not removed. Full-thickness mucoperiosteal flaps were raised, and pocket epithelium and granulation tissue were removed. During this process, an attempt was made to preserve a band of keratinized tissue when present. Correction of the bony architecture and smoothing of angular defects and bony craters was performed with rotating diamond burs under copious irrigation (osteoplasty). The aim was to remove the angular component of the defect as much as possible. Afterward, the implant surfaces were debrided with carbon fiber hand curettes and with ultrasonic implant cleaning scalers (PI instrument, EMS). The implant surface was modified by removing the implant threads and surface coating by means of diamonds burs and Arkansas stones, followed by a
polish with brown and green polishing rubber flame-shaped burs under irrigation. This procedure is defined as implantoplasty. The implants were thoroughly cleaned afterward with gauze embedded in chlorhexidine and saline. The surgical site was further irrigated with saline to remove titanium particles from the surrounding tissues. Finally, the flaps were trimmed and positioned as apically as possible.
Following surgery, the patients were advised to take 3 g amoxicillin per day for 1 week and rinse with 0.12% chlorhexidine solution two times a day. Analgesics (ibuprofen or paracetamol) were prescribed. The sutures were removed after 2 weeks postoperatively. All the patients were recalled between 1 and 3 months after therapy. Afterward, the recall frequency varied from 2 to 4 times per year based on individual needs. At every recall appointment, the exposed implant surfaces were supra- and submucosally cleaned without anesthesia using carbon fiber curettes, ultrasonic implant cleaning scalers, rubber cups, and gauze with polishing paste. After 2 years, the same clinical and radiologic examinations as at baseline were performed. Outcome variables included BoP, suppuration, mean PD of four sites per implant, deepest PD value per implant, mean and the deepest radiographically visible bone loss mesial and distal at every implant, and gingival recession. Descriptive statistics on the outcome variables included frequency distributions and mean and median values, when applicable, with the implant as the experimental unit. Nonparametric statistics evaluated changes between baseline and 2-year follow-up using Wilcoxon signed rank test. All statistical analyses were executed using SPSS 22.0 (SPSS Statistics for Windows, IBM) with a preset significance level of $P \leq .05$.

### Results

A total of 25 patients with a mean age of 66.2 (SD 9.1) years, including 8 men (9 implants) and 17 women (31 implants), were treated. In total, 40 moderately rough surface implants were treated: 17 Nobel Biocare, 8 Straumann, 8 Ankylos, 1 Biomet3i, and 2 each of Astra, Zimmer, and IMZ.

A total of six patients with 13 implants were smoking at the time of implant placement and continued to do so during the 2-year follow-up. One patient had Crohn’s disease. All other patients were reported to be healthy. All patients but one had signs of a history of periodontal disease and radiographically visible bone loss. They had undergone previous periodontal therapy and periodontal maintenance. For edentulous patients, periodontal bone loss was diagnosed from previous dental records and radiographs. Of the affected implants, 8 supported a solitary crown and 13 supported fixed partial dentures, while 13 implants had implant-supported complete fixed dentures and 6 implants had overdentures. A total of 8 implants were located in the anterior maxilla and 14 in the posterior zone; 9 implants were in the anterior mandible and 9 implants in the posterior.

No implants were lost, and no implants were surgically retreated during the 2-year follow-up. Plaque was present on 13 of 40 implants at the final assessment. The majority of patients (38 of 40) had plaque scores of $< 10\%$ at every control visit. Only two patients had scores $> 40\%$. At the end of the examination period, 13 of 40 implants had PD $\geq 5$ mm and 27 implants (67.5%) had PD $\leq 4$ mm. The difference in PD before and after therapy was statistically significant ($P \leq .001$). BoP was present on all implants at baseline.

### Table 1 Probing Pocket Depth (PPD) and Marginal Bone Level (BL) Prior to Treatment and at the 2-Year Follow-up

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Prior to treatment</th>
<th>2 y</th>
<th>Treatment effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Median</td>
</tr>
<tr>
<td>PD Mean value</td>
<td>8.7</td>
<td>1.6</td>
<td>8.5</td>
</tr>
<tr>
<td>Deepest site</td>
<td>9.5</td>
<td>1.8</td>
<td>9.0</td>
</tr>
<tr>
<td>BL Mean value</td>
<td>5.1</td>
<td>1.6</td>
<td>5.0</td>
</tr>
<tr>
<td>Deepest site</td>
<td>5.4</td>
<td>1.7</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Statistical analysis of the treatment effect performed by means of Wilcoxon signed rank test with $P < .05$ as statistically significant.
as it was an inclusion criterion, but 2 years after therapy only 10 of 40 implants (25%) showed BoP. Suppuration was present at 28 of 40 implants (70%) at baseline, and only 1 implant (2.5%) remained with purulent exudate at 2 years post-therapy. The clinical parameters at implant level are summarized in Table 1.

Therapy failed in only three implants in terms of further bone loss of ≥ 2 mm and a PD ≥ 6 mm at the 2-year evaluation. One of those demonstrated suppuration. These three failing implants belonged to two patients with plaque scores > 40% (Fig 4). Increase of gingival recession from baseline (after initial therapy) was observed at all implants and was expected due to the resective therapy. The mean increase was 2.5 (SD 0.85), and the median was 2 mm (range 2.00 to 3.00).

Discussion

The objective of the present study was to evaluate the 2-year outcome of resective surgery defined as an apically positioned flap combined with osteoplasty and implantoplasty for the treatment of peri-implantitis. Various treatments have been suggested for peri-implantitis, ranging from open flap debridement to complex soft and hard tissue grafting. Unfortunately, there is still conflicting evidence on which therapy offers the most predictable outcome. The patients in the present study were recruited from a private specialist and referral clinic and were treated consecutively. It has been emphasized that patients recruited from private or public dental clinics provide information on the effectiveness of the therapy, whereas patients treated in academic settings provide information on the efficacy of the treatment.21 Peri-implantitis was clinically diagnosed by the referring dentist based on peri-implant inflammation and unexpected bone loss. This clinical diagnosis, however, does not explain the etiologic factor inducing the disease. One may discuss whether all cases have a bacterial infection as primary cause and represent true disease or if bone loss was associated with factors such as incorrect implant positioning, traumatic surgical technique, failed bone augmentation, ill-fitting prosthesis, or cement rests. It was the choice of the clinician to treat all cases with the described technique in an effort to achieve the best possible clinical improvement. No cement rests were discovered, but visible calculus was present on the implant surface in almost all cases. This is related to ineffective oral hygiene and often associated with poor accessibility.22 If necessary, the prosthetic construction was adjusted to facilitate plaque control.

Osteoplasty and implantoplasty are technically demanding procedures. Complete removal of the angular component was not always achievable due to anatomical limitations including proximity of natural teeth, neurovascular bundles, or other vital structures. Flattening out of very deep defects would require removal of large amounts of sound bone. In such cases, a residual angular component remained after the therapy. In general, as predicted, small angular defects with a maximum depth of 3 mm were removed, whereas defects deeper than 5 mm were only reduced in depth. Additionally, it was not always possible to access all exposed implant surfaces with rotary instruments. In some cases, implantoplasty was incomplete at the depth of the defect,
especially at the lingual and palatal sides. The coronal portions of the implants were easily accessible and therefore could be adequately polished in all cases. Removal of implant threads should be done with the utmost care since overinstrumentation may weaken the implant and lead to future fractures.

One pitfall of this technique is the time required for the implantoplasty and the concomitant removal of the scattered titanium particles. It is practically impossible to remove all of them from the hard and soft tissues of the surgical site, but the remaining particles do not seem to have a clinically important effect on healing. A recent report suggested that antibiotics may be beneficial for implants with a modified surface. The authors argued that due to the aggressive nature of peri-implantitis and the proximity of the inflammatory lesions to the bone marrow, the use of systemic antibiotics and local antimicrobials could be effective. There were no complications or adverse effects related to the therapy or the use of the prescribed medication.

Ideally, the goal of peri-implantitis treatment would be complete resolution of the disease and reestablishment and maintenance of healthy peri-implant tissues. That would be clinically reflected in a combined outcome of peri-implant PD of < 5 mm without bleeding on probing, no suppurative, and no ongoing bone loss. Since such data are rarely reported in the literature, criteria for successful treatment were proposed, including implant survival, mean PD < 5 mm, and no ongoing bone loss. In the present study, all implants survived and 37 of the 40 implants (92.5%) reached the above-mentioned criteria. When absence of BoP is added to the criteria, the success rate of the treatment decreases to 75%. The observed reduction in PD was attributed to the increase in gingival recession and the increased tissue tonus. In almost all cases, recession resulted in large open embrasure spaces with visible metal of the implant-abutment complex. It is important to inform patients prior to therapy about potential esthetic consequences. Patients with esthetic concerns should be offered alternative treatment options, including the use of bone grafts for filling in peri-implant defects or removal of implants. In cases of extremely advanced bone loss or challenging anatomical situations that limit access for cleaning and instrumentation, one can consider explantation of an alternative treatment. Each therapeutic modality should be evaluated in terms of predictability and economic aspects. A patient-individualized approach should be followed for every particular case.

The results of the present study are slightly inferior to previously reported findings. This may be attributed to the inadequate plaque control at three implants, deeper baseline PD, and deeper initial bone defects. The importance of strict plaque control and of regular supportive therapy is undoubted. The authors’ observations further emphasize the importance of plaque control in the treatment of peri-implantitis. All the implants in patients with low plaque scores remained stable, and the two patients with high plaque scores suffered from progressive bone loss. In addition, the literature has identified smoking as an important influencing factor for the treatment outcome. The present patient group included only six smokers. The authors did not observe any differences in healing response, but the small number of smokers prevents any strong conclusion. Furthermore, it needs to be emphasized that all smoking patients were very compliant with the supportive care program and performed meticulous individual plaque control.

Conclusions
The results of the study suggest that the applied surgical therapy, aimed at pocket elimination with an apically positioned flap, osteoplasty, and implant surface smoothing, is effective and predictable to arrest peri-implantitis progression for a period of 2 years. However, compliance with meticulous daily plaque control is paramount. The esthetic outcome may limit applicability in the anterior maxilla.

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