Surgical Alternatives for Treating Peri-implantitis

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The objective of this case series was to describe surgical approaches that can be used to efficiently and effectively treat peri-implantitis as measured by positive changes in clinical parameters. A total of 32 patients with 45 implants were treated surgically to eliminate peri-implantitis. Baseline clinical parameters measured prior to surgery were compared to those made 6 months postsurgery to evaluate the efficacy of each procedure. Implants demonstrating signs of peri-implantitis were treated by one of three approaches: (1) regenerative surgery, (2) osseous resective surgery, or (3) apically repositioned flap surgery. In all instances, the exposed implant surfaces were debrided and decontaminated. Relative to baseline values, regenerative surgery yielded statistically significant changes in probing depth (PD) (7.21 ± 0.27 mm to 4.09 ± 0.14 mm) and percentage of sites exhibiting bleeding on probing (BoP) (100.0% ± 0.0% to 10.6% ± 3.3%) as measured at the 6-month recall visit (P ≤ .05). The decrease in probing depth was not dependent on the type of graft material used (P ≤ .05). Resective surgery yielded statistically significant changes in PD (5.86 ± 0.23 mm to 3.63 ± 0.14 mm) and the percentage of sites exhibiting BoP (100.0% ± 0.0% to none) (P ≤ .05). Finally, the implants treated via apically repositioned flap surgery demonstrated statistically significant decreases (P ≤ .05) in both PD (6.79 ± 0.27 mm to 4.32 ± 0.16 mm) and BOP (100.0% ± 0.0% to 14.3% ± 6.7%) (P ≤ .05). Regenerative, resective, and apically positioned flap surgery can be utilized to successfully treat peri-implantitis.


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Peri-implantitis is defined as an inflammatory process affecting the hard and soft tissues around an osseointegrated implant in function, resulting in radiographic evidence of progressive peri-implant bone loss and bleeding on probing (BoP). It has been reported that up to 47% of implant failures result from inflammation-induced bone loss. In a recent systematic review, Atieh et al reported an estimated prevalence for peri-implantitis of 18.8% for patients and 9.6% for implants. Although the prevalence rates vary between studies, there is no debate that peri-implantitis occurs with a clinically alarming frequency. Numerous factors contribute to the etiology of the condition, including residual subgingival cement, improper implant positioning, and absence of peri-implant attached gingiva. In many patients, the accumulation of a bacterial biofilm is responsible for eliciting the inflammatory reaction that culminates in bone resorption. The microflora associated with biofilm-induced peri-implantitis contains many of the same anaerobic, Gram-negative bacterial species thought to be involved in the pathogenesis of periodontitis, although recent publications suggest that there may also be organisms unique to peri-implantitis lesions. While the diagnosis is not indicative of implant...
In light of the fact that multiple factors contribute to the etiology of the disease, it is likely that a single therapeutic approach is insufficient for treating all patients and that different modalities of treatment are needed. This case series presents distinct surgical approaches the authors have used to treat peri-implantitis and reports the outcomes achieved with each relative to changes in probing depth (PD) and percentage of sites exhibiting BoP.

Materials and Methods

Subjects

A total of 32 patients with 45 implants underwent surgical therapy for treatment of peri-implantitis. Included patients were nonsmokers and were systemically healthy. All of the patients received a comprehensive periodontal evaluation that included recording of PD, BoP, and extent of peri-implant soft tissue inflammation. Only sites with an initial PD ≥ 5 mm and BoP with progressive bone loss qualified as severe peri-implantitis warranting surgical intervention. The measurements were repeated at the 180-day follow-up. Baseline and follow-up (6 months postsurgery) radiographs were taken to document changes in crestal bone heights. Prior to surgery, all implants exhibiting classical signs of peri-implantitis underwent nonsurgical therapy that included subgingival manual debridement of the implant surfaces using titanium curettes and local delivery of 1 mg minocycline microspheres (Arestin, Valeant Pharmaceuticals) (Fig 1). All patients were informed about the potential surgical and postsurgical complications, including the need for implant removal, soft tissue recession, or exposure of implant threads. All infected implants were then classified into five etiologic groups for treatment planning purposes: (1) biofilm-induced, (2) exogenous irritants, (3) extrinsic pathology, (4) iatrogenic factors, and (5) implants presenting without attached gingiva. In those individuals lacking attached gingiva adjacent to their implant(s), free gingival grafts were done prior to surgical treatment of peri-implantitis.

Basic Surgical Protocol

Patients were premedicated with 2 g amoxicillin by mouth 1 hour before their surgical procedure. Patients allergic to penicillin were premedicated with 600 mg clindamycin. Immediately prior to surgery, the patients were required to rinse with 15 mL 0.12% chlorhexidine gluconate (Peridex, 3M ESPE) for 30 seconds. Local anesthesia was administered via nerve block and/or infiltration injections using 2% lidocaine with either 1:50,000 or 1:100,000 dilutions of epinephrine (Septodont). Incisions were initiated via partial-thickness dissection to separate the peri-implant granulomatous tissue from the flap, leaving it in contact with the implant surface (Peri-implant Internal Bevel incision [PIIB]). Once the affected area was bypassed and sound bone was detected, the flap was converted to
Figs 2a to 2h  (a, b) Radiographic and clinical signs of peri-implantitis can be observed. Patient presented with 10-mm pocket depth (PD) on midfacial with bleeding on probing (BoP)/suppuration and severe gingival inflammation. (c) The initiation of the incision began by utilizing the Peri-implant Internal Bevel incision (PIIB) to create a split-thickness flap and bypassing the affected area, leaving the granulomatous tissue attached to the implant surface. (d) Causative factor is residual cement (peri-implantitis induced by exogenous factors). (e to h) Surface decontamination was done using Er:YAG laser and hydrogen peroxide. Bone decortication was also done prior to placing a xenograft bone in combination with platelet-derived growth factor (PDGF) and a barrier membrane.

Figs 2i to 2k  (i, j) Postoperative clinical photograph and radiograph at 1 year show elimination of peri-implant disease. (k) Postoperative cone beam computed tomography (CBCT) scan at 2 years shows buccal bone regeneration.
full thickness and elevated beyond the mucogingival junction (Fig 2). The PIIB incision facilitated removal of granulation tissue and repositioning of the flap during closure. Gross debridement of the implants was performed with an ultrasonic device and an implant protective cap (Cavitron JET Plus Ultrasonic Scaler, Dentsply) and titanium curettes. Fine debridement was achieved by application of titanium brushes (Ti Brush, Straumann) for 60 seconds using an oscillating handpiece under irrigation. Implants were then decontaminated by a two-step process. First, 5% hydrogen peroxide was applied for 60 seconds, followed by copious irrigation with 0.9% sodium chloride solution (Hospira) to remove residual peroxide. The surfaces were then treated with an Er:YAG laser (Tip-PS600T(S) 20pps / 45 mJ, AdvErL Evo Er:YAG Laser, J Morita) for 60 seconds (Fig 3). If implant mobility was detected at any point during the procedure, the patient was informed and explantation was advised. Postsurgical instructions were given, and prescriptions were reviewed with each patient. Radiographs were taken at baseline and at the 6-month follow-up visit (Fig 4).

Regenerative Surgery

On flap reflection via the basic surgical protocol, regenerative therapy was attempted in situations where affected implants exhibited well-contained infrabony defects and/or fenestrations/dehiscences. When possible, the implant-supported prosthesis was removed on the day of surgery and replaced with cover screws or healing abutments. Defects were decorticated as needed and grafted by dense packing of approximately 1 g of anorganic bovine bone (Bio-Oss, Geistlich) combined with one syringe containing a solution of 0.5 mL (0.3 mg/mL) recombinant human platelet-derived growth factor (Gem 21S, Luitpold Pharmaceuticals). A protective membrane (Bio-Gide, Geistlich) was placed over the graft. Tension-free primary closure over the grafted implants was achieved in those situations where the prosthesis was removed. If the prosthesis remained in place, the flaps were repositioned around the implants.

Resective Surgery

Following flap elevation via the basic surgical technique, implants adjacent to ledges of bone and/or exhibiting infrabony defects not amenable to regeneration were treated via osseous resection using a high-speed surgical handpiece with a 16-flute carbide bur (round bur #8, S.S. White) with copious saline irrigation. Minimally, the goal was to reduce the depth of infrabony defects and facilitate apical positioning of flaps to enhance access for optimal oral hygiene (Fig 5).

Apically Repositioned Flap Surgery

For implants exhibiting horizontal bone loss without infrabony defects, flaps were simply repositioned in...
an apical position relative to their presurgical location following completion of the basic surgical protocol. Thick biotype gingival flaps were thinned prior to the apical repositioning.

**Statistical Analysis**

Statistical analyses were performed with a software program (Minitab Statistics) to evaluate the efficacy of each surgical approach by comparing the PD measurements and the percentage of sites exhibiting BoP determined at baseline to those made at the 6-month follow-up visit. Each site with probing depth ≥ 5 mm was used as a data point.
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**Table 1: Probing Depth (PD) (Mean ± SEM) and Bleeding on Probing (BoP) at Baseline and 6 Months Posttreatment**

<table>
<thead>
<tr>
<th>Surgical approach</th>
<th>Baseline</th>
<th>Posttreatment</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td>Regenerative surgery (85 sites, 25 implants)</td>
<td></td>
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<td></td>
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<tr>
<td>PD ± SEM (mm)</td>
<td>7.21 ± 0.27</td>
<td>4.09 ± 0.14</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>BoP (%)</td>
<td>100 (85/85)</td>
<td>10.6 (9/85)</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Resective surgery (22 sites, 5 implants)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PD ± SEM (mm)</td>
<td>5.86 ± 0.23</td>
<td>3.63 ± 0.14</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>BoP (%)</td>
<td>100 (22/22)</td>
<td>0 (0/22)</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Apically positioned flap surgery (28 sites, 9 implants)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PD ± SEM (mm)</td>
<td>6.79 ± 0.27</td>
<td>4.32 ± 0.16</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>BoP (%)</td>
<td>100 (28/28)</td>
<td>14.3 (4/28)</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

PD was compared between baseline and posttreatment using t test; BoP was compared between baseline and posttreatment using chi-square test. SEM = standard error of the mean.

Power analysis performed at $\alpha = .05$ and $\beta = 0.80$ with an arbitrary probing depth reduction of 2 mm posttherapy determined that at least 19 sites were needed to show significance. Numerical values were analyzed using one-way analysis of variance (ANOVA), and categorical values were analyzed with chi-square test. Differences were considered statistically significant when $P \leq .05$.

**Results**

All the surgical procedures yielded reductions in PD and in percentage of sites exhibiting BoP. Implants treated via a regenerative approach had a mean baseline PD of 7.21 ± 0.27 mm, which decreased to 4.09 ± 0.14 mm when the sites were reevaluated 6 months postsurgery (Table 1). The change was statistically significant ($P \leq .05$). The improvement in the PD was observed regardless of the type of biomaterial used ($P \leq .05$). In addition, there was a statistically significant decrease in the percentage of sites exhibiting BoP decreasing from 100.0% ± 0.0% at baseline to a mean of 10.6% ± 3.3% at the 6-month recall visit ($P \leq .05$).

The resective surgical approach also yielded a statistically significant decrease in PD from a mean of 5.86 ± 0.23 mm at baseline to 3.63 ± 0.14 mm at the 6-month recall visit ($P \leq .05$) (Table 1). Interestingly, BoP was completely absent after resective surgery.

Sites treated by apical positioning of flaps demonstrated a statistically significant decrease in PD, decreasing from a baseline mean of 6.79 ± 0.27 mm to 4.32 ± 0.16 mm at the 6-month recall visit ($P \leq .05$) (Table 1). This surgical approach also yielded a significant decrease in the percentage of sites exhibiting BoP, from 100.0% ± 0.0% at baseline to 14.3% ± 6.7% at the 6-month recall visit ($P \leq .05$).

Six implants were explanted due to implant mobility found at the time of surgical intervention.

**Discussion**

Practitioners often use procedures based on periodontal techniques to treat peri-implantitis, including local debridement, decontamination, and resective surgery.11–13 Recent studies have evaluated the use of lasers or implantoplasty for decontamination of implant surfaces.14,15 Among these, the Er:YAG laser has been shown to be safest and most effective.16 Relative to nonsurgical therapy, the surgical approaches result in more significant improvement in short-term clinical and radiographic parameters.17 However, it remains questionable as to whether surgical treatment can lead to complete resolution or regeneration of peri-implantitis lesions. While many studies have reported positive outcomes with various surgical techniques, no single approach has been shown to be the most effective modality for treating peri-implantitis.18

Among this study’s cohort of patients, the regenerative approach yielded significant decreases in PD and percentage of sites with BoP. There were no differences in the results achieved with the various combinations of regenerative materials used. Schwarz et al19 concluded that a critical factor determining a successful outcome with a regenerative approach is the configuration of the crater or peri-implant defect. When confronted with a well-confined osseous defect adjacent to an implant, regenerative surgery is the procedure of choice. In contrast, when the morphology of a bony defect will not contain a bone graft material, resective...
surgery is a more predictable approach for treating peri-implantitis. However, the predictability of such an approach is variable, and the outcome can have significant esthetic consequences when not successful. Therefore, open flap debridement similar to the basic surgical protocol presented here (with or without apical positioning of the flaps) should be considered for treatment of peri-implantitis in the esthetic zone. The present results demonstrate that this procedure results in statistically significant decreases in PD and the percentage of sites exhibiting BoP. Together, the present results demonstrate that regenerative, resective, and apically positioned flap surgical approaches can be used to successfully treat peri-implantitis. Prior to selecting a surgical technique, it is critical to determine the etiology of the condition on an implant-by-implant basis and to carry out a risk/benefit assessment that takes into account the functional and esthetic outcomes associated with each approach. Once this is done, elimination of the etiology is of paramount importance, followed by restoration of peri-implant soft and hard tissue health.

**Conclusions**

Regenerative, resective, and apically repositioned flap surgical approaches can be used to successfully treat peri-implantitis. The treating clinician should recognize that this condition is not directly analogous to periodontitis and can have multiple etiologies. The goal of surgical therapy should be to eliminate/correct the etiology in a manner that maintains the function and esthetics of the implant-supported prosthesis. This necessitates detailed clinical and radiographic examination of each patient as well as nonsurgical treatment prior to surgery. To ensure optimum long-term outcomes, patients who undergo surgical therapy for peri-implantitis should be seen on a 3-month maintenance recall.

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**References**