Surgical Treatment of Severe Peri-Implantitis Using a Round Titanium Brush for Implant Surface Decontamination: A Case Report With Clinical Reentry

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The most common cause of peri-implantitis is the accumulation of plaque and the formation of a biofilm on the implant surface. Terminating the development of the disease requires the biofilm to be removed from the implant surface. This paper describes 2 cases of severe peri-implantitis lesions treated through surgical approaches. Complete mechanical debridement with a round titanium brush was mainly performed to detoxify and modify the affected implant surface. A regenerative approach was then performed. In both cases, the surgical procedure was effective in arresting the peri-implantitis, and clinical reentry revealed uneventful healing of the existing bone defect. No further radiographic bone loss was observed over the 2-year follow-up period. This technique has the advantage of effective cleaning the contaminated implant surface, producing positive clinical and radiological results. However, further studies involving more cases are necessary to verify the reliability and validity of this technique.

Key Words: debridement, dental implant, peri-implant disease, regeneration

INTRODUCTION

Peri-implantitis is an irreversible inflammatory disease that affects both the soft and hard tissues of a dental implant; if left untreated, it will result in implant failure in most instances. There have been wide variations in the previously reported prevalence rates of peri-implantitis, due to the use of different study designs and limited patient populations. In a recent systematic review, Derks et al. found that peri-implantitis was present at 14–30% of implant sites.

The most common cause of peri-implantitis is the accumulation of dental plaque and formation of a bacterial biofilm on the implant surface. Terminating the development of the disease requires removing the bacterial biofilm from the implant surface. Various conservative and surgical therapies have been introduced for decontaminating the implant surface. Although conservative therapies that include the use of metallic curettes with an adjunct of local or systematic antibiotics, and laser and ultrasonic devices have been effective in removing the bacterial biofilm from the surface of an implant, difficulties with access and visibility impeded the thorough debridement in cases with moderate or severe infection.

Surgical approaches are commonly more appropriate and suitable for the thorough decontamination of moderate or severe peri-implantitis. Several decontamination protocols have been presented in the literature. In a prospective human study, Roos-Jansäker et al. reported that bone fill using a bone substitute with or without a resorbable collagen membrane could arrest disease progress for 3 years after decontamination. In an ongoing randomized clinical trial, Wohlfahrt et al. described a regenerative protocol incorporating open-flap debridement of the implant surface, decontamination using 24% EDTA gel, grafting with porous titanium granules, and resubmersion of the implant, proving effective during a 12-month follow-up period. However, there is currently limited evidence of the effective of these surgical procedures.

A round titanium brush comprising titanium alloy bristles (R-Brush, NeoBiotech, Seoul, Korea) was recently developed for detoxifying and modifying an implant surface contaminated with severe peri-implantitis. The instrument can be used for bone defects of class Ie (circular bone resorption while under maintaining the buccal and lingual bone) or class II (supracrestal defect). The R-Brush for treating peri-implantitis was
found to be easier, faster, and more effective than any other conventional instrument.

The purpose of the present case report was to describe the surgical procedure for treating severe peri-implantitis with a regenerative approach, focusing on decontamination of the implant surface using the R-Brush.

CASE 1

A 52-year-old male patient was referred to a local clinic in March 2014. His chief complaint was a dull aching pain from an implant in the maxillary posterior region. The patient initially received implant treatment in July 2006. Three external-connection implants were placed and then fixed using a screw-retained prosthetic restoration from the maxillary left second premolar through to the maxillary left second molar (Figure 1a). All 3 implants had a diameter and length of 4.0 and 13 mm, respectively. The patient had a bone density of D3 19 at the implant positions. The 3 fixtures were inserted with good primary stability; implant stability quotients of 40, 60, and 55. However, the patient had not been followed up after the prosthetic restorations were delivered. The implant had been in function at least for 7 years. Clinically, no swelling, purulence, or mobility was recorded in any of the implants, but a probing depth of 10.0 mm was found in the implant positioned at the maxillary left first molar. A radiographic examination showed a crater defect at this implant position (Figure 1b). No bone loss was observed in the 2 neighboring implants.

Surgical procedure

To access the bone defect and allow mechanical debridement of the infected implant surface, the 3-unit prosthesis was removed (Figure 2a). Surgery was performed under local anesthesia (1:100 000 epinephrine), and a mucoperiosteal flap was reflected buccally in the implant positioned at the maxillary left first molar. A radiographic examination showed a crater defect at this implant position (Figure 1b). No bone loss was observed in the 2 neighboring implants.

It took about 4 minutes to treat the 8 exposed threads with the R-Brush. The treated surface was thoroughly examined with a magnifying glass to detect any untreated area (Figure 3a). After a final rinsing, a cover screw was placed and the defect was grafted with freeze-dried allograft (Regenoss, Cellumed, Seoul, Korea), and a resorbable collagen membrane (Genoss, Seoul, Korea) was placed over the grafting material to protect it from penetration by the surrounding soft tissue cells. To achieve primary wound closure, the flap was repositioned with a vertical releasing incision and sutured with a 4-0 monofilament suture material (REXLON Supramid, SM Eng, Busan, Korea; Figure 3b through d). The patient received antibiotic therapy (500 mg of amoxicillin 3 times daily) for 7 days. The patient was also advised not to brush the surgical site and to rinse with 0.12% chlorhexidine solution for 2 weeks to prevent postsurgical infection caused by plaque accumulation.

RESULTS

The sutures were removed 14 days after the surgery. The implant remained without a prosthetic restoration for a 5-month healing period. Maintenance was performed at 3, 6, and 12 months. The patient did not report complaint or discomfort. At a 5-month check-up, a clinical examination revealed uneventful healing of the surgical site (Figure 4b). At reentry 5 months after the treatment, although a part of 1 thread was exposed on the buccal aspect of the implant, solid abundant bone was regenerated, and a periapical radiograph showed that the boundary between the graft and the existing bone was unclear (Figure 4a and c). The final prosthetic restoration was placed again at 5 months after the bone graft surgery. Figure 5a through c show the periapical views at 6, 12, and 24 months after surgery, respectively, indicating that the bone density increased gradually and that no further bone resorption was observed mesially and distally for 2 years.
A 54-year-old male patient presented at a local clinic in January 2014. His chief complaint was food impaction at an implant in the mandibular posterior region. The 3 implants had been inserted 7 years previously in another clinic. A radiographic examination showed a crater defect at the implant positioned at the mandibular right second molar (Figure 6a). Clinically, the implant was stable, but there was a probing depth of 7.0 mm with gingival redness and swelling observed.

**Figure 2.** (a) Intraoral view after removing the prosthesis. (b) After opening the flap, a large vertical defect without buccolingual bony walls was seen. (c) A protective cap was attached to protect the implant platform. (d) A round titanium brush with titanium alloy bristles (R-Brush) was used to decontaminate the implant surface at a rotation speed of about 8000 rpm for 30 sec per thread. (e) Three-dimensional view of the R-Brush instrument.
Surgical procedure

Surgical treatment was applied, comprising reflection of a mucoperiosteal flap, removal of granulation tissue, debridement with an R-Brush, and irrigation with saline (Figure 6 through d). After these surgical steps, a 6-mm–diameter bone harvesting drill (ACM, Auto Chip Maker,NeoBiotech) with a rotation speed of 50–70 rpm was used without saline irrigation to harvest fresh, bloody autogenous bone chips from the cortical bone of the adjacent buccal shelf area (Figure 6e and f). After drilling 3 times, approximately 1 cc of autogenous bone chips was collected, and bone was subsequently grafted into the defect, which was covered by a resorbable collagen membrane (CollaGuide, Bioland, Cheonan, Korea) and mucoperiosteal flap in stepwise fashion. Primary wound closure was achieved using interrupted sutures (Figure 6g through i). After the surgery, the patient received antibiotic therapy for 7 days and was informed about important postoperative protocols.

Uncovery surgery was performed 3 months after the debridement surgery. A clinical examination revealed entire regeneration of the defect site. D2-like cortical bone was detected, and bone grown over the cover screw was harvested as a biopsy sample (Figure 7a). Histological results revealed the deposition of new bone onto the grafted autogenous bone (Figure 7b). The prosthetic restoration was delivered immediately after the uncovery procedure (Figure 7c). The patient was followed up at 3, 6, 12, and 24 months postoperatively, and a gradual increase of radiographic bone density was observed. Figure 7d shows a periapical view at 24 months after surgery. A clinical examination performed at the 24-month follow-up revealed a probing depth of 3 mm on the buccal aspect (Figure 7e). An additional re-entry revealed that the well-matured regenerated bone around the implant had remained stable, and no bone loss and no soft tissue engagement between the implant surface and the bone was detected (Figure 7f).
DISCUSSION

The current treatment methods for peri-implantitis are based on the methods used to treat natural teeth with periodontal disease. Several surgical approaches are used to treat peri-implantitis. However, although these methods are universally applied, there is still no strong consensus or recognized treatment method for completely eradicating peri-implantitis. The present case study applied mechanical decontamination combined with sterile saline to treat the contaminated surface of implants, with the results indicating that utilization of an R-Brush was highly effective at removing dental plaque and biofilm from the implant surface. Furthermore, this technique has been developed to eliminate the contaminated original rough surface and create a new rough surface. Figure 8a through c show the difference of the surfaces between before-and-after treatments with the R-Brush. It has been confirmed that open debridement may result in re-osseointegration, and this integration is more pronounced on rougher implant surface. To date, there is no literature describing the treatment of severe peri-implantitis using such a protocol. However, due to the small number of cases considered, the efficacy of the described method needs further investigation in animal studies or other clinical trials, ideally leading to a predictable and reliable method of treating peri-implantitis and an understanding its effects on the healing process.

Several studies have shown that re-osseointegration can occur on surfaces previously contaminated by dental plaque and surrounded by a bone defect. The results obtained in the present case study were consistent with these previous studies. However, in those studies, induced peri-implantitis artificially in animal models and the partial implant surface was exposed in the oral environment for a period of time, with the bone defect produced mechanically by a drill when preparing the implant sites. It should be noted that the microbial species populating the implant surface could differ from those for an implant located in the human oral environment.

In the present case study, after debridement with an R-Brush, a regenerative approach was applied with autogenous bone or allograft bone. In such circumstances, the geometry of the bone defect critically affects the clinical outcome. A bone defect characterized by circular bone resorption with the buccal and lingual bone plates preserved has provided a more predictable and effective outcome following the regenerative approach. In this second case, the bone defects were all crater-like defects with preserved circular bone plates. The patients were followed up at 3, 6, 12, and 24 months. Periapical radiographs revealed that the alveolar bone height was stable, and no bone resorption could be observed mesially and distally. However, in the first case in this study, the defect was quite large, and there was no bony wall buccolingually. Surprisingly, this case showed an acceptable vertical bone augmentation (6 mm) and 2-year maintenance without further bone loss and any peri-implant radiolucency. This means that re-osseointegration might be obtained in the grafted implant surface. This result shows that re-osseointegration could be established if the contaminated surface is totally detoxified and decontaminated.

The aim of implantoplasty is to produce a smooth and polished implant surface, thereby reducing the amount of dental plaque that attaches to it as well as remove the implant threads, providing a less attractive environment to bacteria. However, the obvious disadvantage of this technique is that any further re-osseointegration is considered unpredictable. In contrast to implantoplasty, decontamination with an R-Brush...
can produce a well-distributed and rough surface, and moreover preserve the implant threads; this makes the success of the regenerative approach more predictable. Another advantage of this technique is that decontamination with an R-Brush not only reduces chair time for the clinician but also reduces muscle fatigue in the patient associated with prolonged opening of the mouth.

The release of titanium particles from implant fixtures placed onto the peri-implant bone during preparation of the implant bed has been reported. The number of particles were correlated with the roughness of the implant and its topographical configuration. Previous studies have shown that the released titanium particle debris is mainly concentrated at the crestal parts of the bone in contrast to apical areas. Debris amounts reaching 0.2–3.0 mg may induce peri-implant osteolysis, which manifests as early marginal bone loss around the implant. In an animal study, Schliephake et al. reported that loose particles attached to the surface of the bone could be pressed into the bone microenvironment and that intense rinsing of the implant site would still not remove all titanium particles from the bone surface. In the present study, contaminated implant surfaces were debrided using an R-Brush and, after thorough irrigation, a regenerative approach was applied with autogenous or allograft bone. No bone loss was observed during a 2-year follow-up period. Thus, the direct effect of particle debris on peri-implant bone has not been clearly defined. In this case, mechanical debridement plus saline irrigation appears to have been useful in reducing titanium concentration so that reosseointegration was possibly achieved and no bone loss occurred in the early phase. However, further investigation of the titanium particles deposited on the peri-implant bone after debridement may contribute to the recognition of a biological effect.

**CONCLUSION**

The results obtained in the present 2 cases emphasize the importance of mechanical decontamination by eliminating the contaminated surface and creating a new rough surface for a
FIGURE 7. (a) Clinical view at reentry after surgery showing solid and newly formed bone over the cover screw. (b) Biopsy sample obtained from the grafted site (hematoxylin and eosin stain, ×20). The large piece of compact bone showed the new bone attached to the grafted autogenous bone (yellow arrows). This lesion was competent with favorable bony remodeling. (c) Periapical radiograph after the uncovering procedure and delivery of the prosthesis. (d) Periapical radiograph obtained at 24 months after the debridement surgery. (e) At the 24-month follow-up there was a probing depth of 3 mm on the buccal aspect. (f) The newly formed bone around the implant remained stable at the 24-month reentry.
regenerative approach in the treatment of severe peri-implantitis. This technique has the advantages of effective cleaning of the contaminated implant surface and producing positive clinical and radiological results during the 2-year follow-up period. However, further studies are necessary to verify the reliability and validity of this technique.

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NOTE

All of the authors confirm no conflicts of interest.

REFERENCES


