Peri-implantitis. Part 3: Current modes of management

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IN BRIEF

- Explores current management strategies for peri-implantitis.
- Informs there is currently no optimal management strategy.
- Suggests current understanding purports that peri-implantitis might be best managed non-surgically in the aesthetic zone but a surgical approach supported by decontamination of the implant surface may provide the best outcome.

PRACTICE

Peri-implantitis is an inflammatory condition fuelled by the presence of bacteria on the implant surface. As such, in a similar manner to periodontal disease management, the removal of biofilm from the implant surface should result in regression of the disease process. The optimal manner with which this is achieved has yet to be realised. This may be unsurprising due to the relative surface complexity of the implant surface when compared to natural tooth root. Other management strategies include surface decontamination, the removal of implant threads known as implantoplasty, and in severe cases the need to explant. Favourable defects can be reconstructed utilising guided bone regeneration techniques. The current review appraises some of the techniques for the management of peri-implantitis.

INTRODUCTION

Peri-implantitis presents a significant challenge to both the clinician and to the patient.[1] The implant surface has a high surface energy and surface area, which aids osseointegration. This is best exemplified by comparing the surface area of natural teeth and implants; the root surface area of a mandibular central incisor has been shown to be approximately 250 mm^2 while implants can have surface area of 650 mm^2 or greater (Fig. 1).[2,3] However, the methods used to increase surface area and surface energy may also make the implant more vulnerable to peri-implantitis since the surface itself, once exposed, is populated rapidly by microorganisms and provides an ideal environment for the formation of extensive and robust biofilms.[4]

Currently the management of peri-implantitis is based on methods used to treat periodontal disease.[5] Unfortunately, despite a number of studies into a variety of techniques, there is neither a strong consensus or a recognised treatment modality that will predictably eradicate peri-implantitis.[6–8] This is largely due to an absence of high quality evidence into the efficacy of current treatment modalities.[6–8] Despite these shortcomings there is some merit in appraising currently available methods.

NON-SURGICAL MANAGEMENT

Periodontal instruments have continually developed over the course of the last 100 years or so. These have largely been designed to instrument a relatively flat surface. It seems slightly strange that instruments used to treat teeth are now engaged to debride a surface that is markedly different to that for which they were originally designed. Indeed instrumentation utilising a sickle scaler shape generally begins at the bottom of the pocket moving upwards to remove biofilm on a root surface with each stroke. This cannot be achieved with implants due to the presence of threads that bring an abrupt stop to any such motion. These mechanical aspects of implants provide significant challenges in achieving effective non-surgical debridement. Standard metallic scalers utilised for root surfaces result in damage to the titanium oxide surface, which can result in the corrosion of the implant and subsequent breakdown.[5,9,10] Moreover utilisation of standard metal scalers may result in a surface that is even more plaque retentive due to microscopic groove development.[5,11] Local factors may also further compromise debridement such as the presence of bulky restorations. These may require removal before instrumentation (Fig. 2).

Due to the above issues modifications and innovations have been made to periodontal instruments used for peri-implantitis.

For example scalers made from plastic have been produced to prevent damage to the surface of the implant. These, in the author's experience, make debridement of the implant surface difficult. The purchase produced is poor as is the rake angle to dislodge retentive

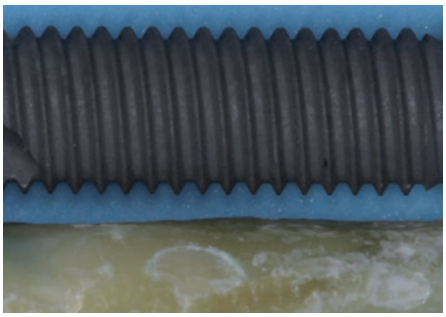

Fig. 1 An implant and a root surface. The relative differences in the surface characteristics are clear in that the implant surface is rougher with an increased surface area. The thread arrangement provides a perfect sheltered niche for bacteria to populate when compared to the relatively smooth surface of a natural tooth. The implant presents a difficult surface to decontaminate and disinfect

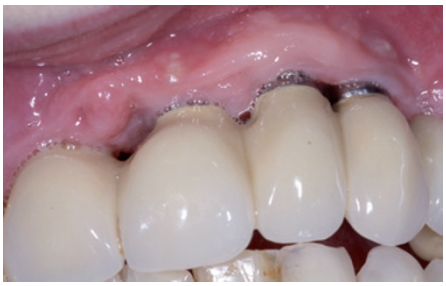

Fig. 2a Implant retained bridge spanning with implants in the 11, 21, 22 and 23 sites. The patient found interproximal cleaning difficult to achieve

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pieces of calculus. The instruments themselves tend to lose their sharpness. In contrast Teflon coated scalers have been utilised with some success (Fig. 3). These are more rigid than the wholly plastic scalers and confer less damage than the respective stainless steel scalers. One innovation allowing ultrasonic powered instrumentation has been the use of plastic inserts to maintain ultrasonic driven power without the damage associated with metal tips (Fig. 2b).

The effectiveness of non-surgical management has been evaluated recently by Renvert and co-workers.[12] Thirty-seven patients with one implant presenting with peri-implantitis were randomised into two groups. One group was provided with titanium scaler hand instrumentation while the other ultrasonic powered device. The mean pre-treatment probing pocket depth was measured at 5.1 mm. The results of the randomised controlled trial showed that bleeding and plaque scores improved with non-surgical management but there were no detectable differences on pocket probing depths. The study failed to demonstrate that the treatment provided changed the total bacterial load. Although this may seem disappointing when compared to the results of surgical management there are some significant advantages of the non-surgical approach especially when considering the nature of implants. The exposure of titanium post-surgery due to recession is likely to be less acceptable than recession defects on teeth. As such non-surgical management may be considered the first treatment option for the infected implant especially in the aesthetic zone.

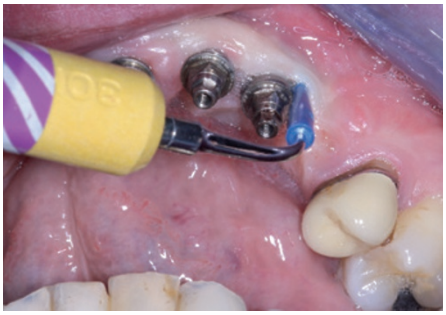

Fig. 2b Due to the bulky nature of the bridge restoration effective non-surgical access could only be achieved on bridge removal. An ultrasonic device was utilised with plastic inserts to prevent damage to the implant surface

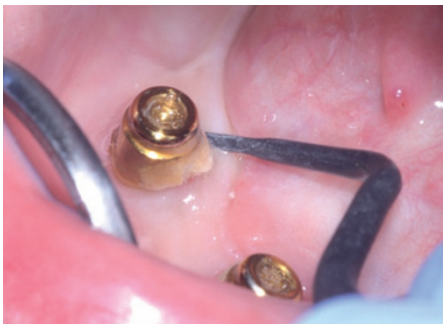

Fig. 3 The use of a Teflon coated scaler to remove calculus from a locator abutment

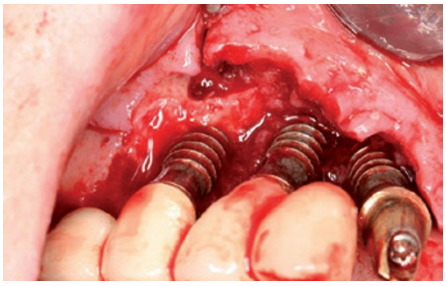

Fig. 4a Surgical access to implants in the 12, 14 and 15 sites. Direct visualisation revealed a large bolus of cement and positive overhangs

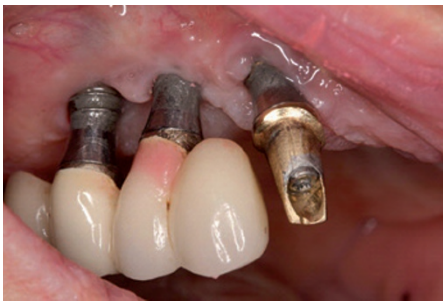

Fig. 4b Four weeks post treatment. The peri-implant tissues had decreased bleeding on probing and inflammation. The embrasure spaces are now more accomodating for self administered inter-proximal cleaning. Due to the patients low smile line exposure of metal was not a concern

SURGICAL MANAGEMENT

Access and closure

Difficult access and visibility of the implant surface for thorough debridement may explain why non-surgical management has shown indifferent results. Although the implant surface is consistent in shape and texture when compared to root morphology the relative complexity of the surface makes complete debridement without direct vision difficult. Surgical access provides greater visibility of the implant surface but has obvious co-morbidities (Figs. 4 and 5).

To fully expose the lesion with a flap the suprastructure may require removal. Due to the consistent circumferential nature of the peri-implant lesion flap retraction to equal extents on both the buccal and the lingual/palatal aspects can be more difficult to achieve than where teeth require open flap management. Indeed flap management needs careful consideration to limit post-surgical changes such as recession. To limit trauma careful flap retraction without vertical relieving incisions, while achieving access is ideal but not always achievable. In addition, tension free closure is likely to contribute to a positive outcome.[13]

In a study by Roos Jansaker and colleagues complete submergence of the implant following debridement aided healing.[14] However, an obvious disadvantage of this technique is the need to disconnect the restoration from the implant for a period. During this period an interim restoration will often be required. In these circumstances a tooth supported restoration such as a resin bonded bridge is preferable to a removable prosthesis to reduce the risk of trauma to the healing site (Fig 5).[15]

On completion of debridement the manner of flap closure also needs consideration. Apical repositioning of the flap will allow for improved access for the patient during daily hygiene measures in addition to further professionally administered debridement. The advantage of apical repositioning needs to be balanced against aesthetic complications.

Decontamination

One seemingly crucial step in treatment of peri-implantitis is decontamination of the implant surface. Total surface decontamination may be unrealistic although some form of attempt to decrease bacterial load is required in addition to the removal of gross deposits. A number of techniques have been investigated.

Chemical

Numerous chemical forms of disinfection have been described and include the use of chlorhexidine gel, hydrogen peroxide, EDTA and tetracycline.[16] All modes seem to change both the physical and chemical properties of the implant surface. The repercussions of this are not fully known.[16] Despite the large number of options a literature review in 2012 found no difference between mechanical debridement, antiseptics, air abrasion, photodynamic or laser therapy.[17] A further *ex vivo* study comparing a number of topical antiseptics in antibacterial efficacy showed interesting results.[18] When sodium hypochlorite, hydrogen peroxide, chlorhexidine gluconate, citric acid and other commercially available antiseptics were compared, only sodium hypochlorite showed a significant effect on the bacterial species present.[18] Despite the favourable results utilising hypochlorite the toxicity would unfortunately negate its use clinically. The need for further *in vivo* research of this important treatment step is required.

Implantoplasty

One relatively radical form of non-chemical disinfection is the removal of the surface

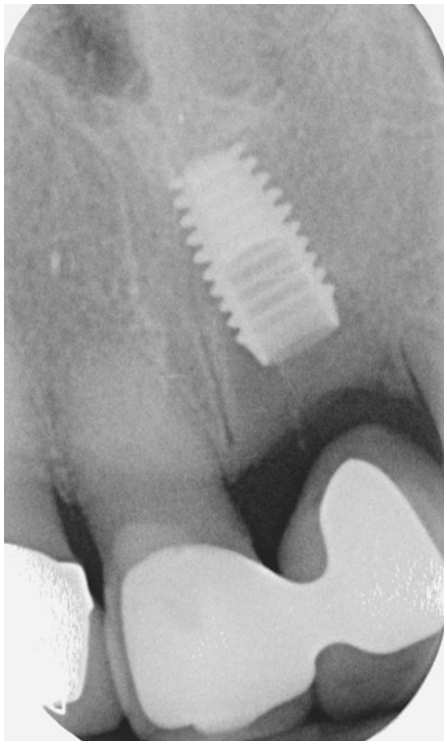

Fig. 5a This patient presented with peri-implantitis of the 21 implant. Note the circumferential funnel shaped bone loss around the cervical margin of the implant

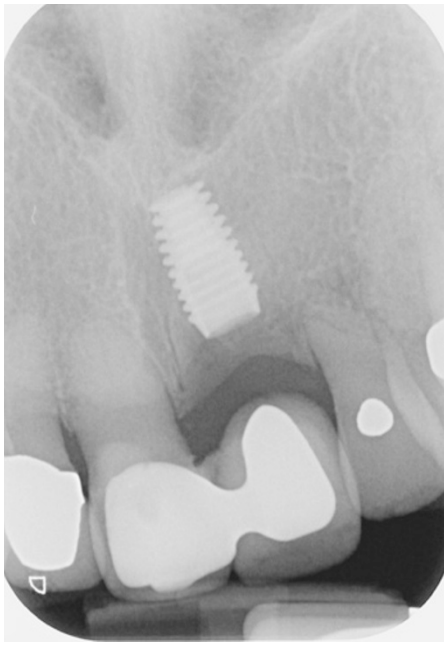

Fig. 5b After open flap debridement, decontamination of the external and internal surfaces of the implant soft tissue closure was achieved. Note the presence of radiographic bony infill. On review she preferred to maintain the resin bonded bridge rather than revisit an implant restoration on the 21

of the exposed implant resulting in thread removal with the aim of producing a smooth surface, otherwise known as implantoplasty. Removal of the threads is likely to remove the biofilm attached to the implant but also reduce further biofilm formation due to the smoothness, which is likely to present a less attractive environment to bacteria. By virtue of the nature of the technique any further true bony re-integration to the smooth surface is considered unpredictable, although bone apposition adjacent to the surface is possible.[19,20] This technique has been shown to reduce peri-implant probing pocket depths and facilitate the formation of a more aerobic and less pathogenic biofilm.[21] An *ex vivo* study examined the use of diamond grit as well as carbide burs, both of which produced comparable polished surfaces.[22] In a study comparing resective surgery with or without implantoplasty the survival rate for fixtures treated with implantoplasty was 100% with compared to 78% for the resection only group.[23] The implantoplasty group also had less further marginal bone loss, improved probing depths and bleeding on probing scores.[23] Schwartz and colleagues examined ten cases where implantoplasty was combined with subepithelial connective tissue graft and a significant reduction in probing depths and soft tissue recession was reported.[24]

It is likely that implantoplasty reduces bacterial adhesion and so biofilm formation rather than true decontamination although as yet no studies have fully investigated this. Obvious co-morbidities exist with this treatment regime, which include heat production, debris spread, damage to the implant surface and weakening of the implant.[16] Greater recession has also been shown to occur with implantoplasty when compared to other techniques.[23]

GUIDED BONE REGENERATION

Once decontaminated and the lesion is fully visualised assessment of the bone topography should commence (Fig. 4). Where a crater defect is present and access is not compromised utilisation of guided bone regeneration in a similar manner to the treatment of periodontal defects can be considered.[25,26]

Implantoplasty may become more of a consideration where the shape of the bony lesion does not favour a regenerative approach. For example, in the absence of a 'walled' defect Aljateeli and colleagues recommend an apically repositioned flap in combination with implantoplasty (Figs 6 and 7).[25] This situation is more likely where the alveolar ridge is inherently thin. Implantoplasty and apically repositioning could be considered easier to achieve technically when compared to guided bone regeneration and with comparable results.[27–29]

A systematic review by Sahrmann and colleagues examined 17 articles involving a total of 173 implants treated using guided bone regeneration.[30] Total radiographic bone infill was achieved in only 10% of

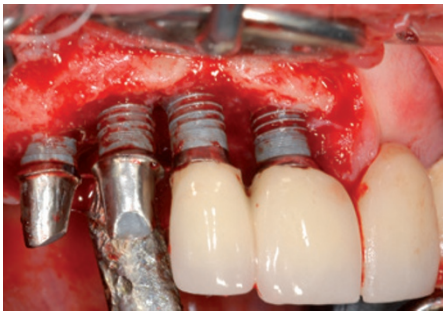

Fig. 6 Surgical access and closure of multiple implants to reveal bone topography. Unfortunately due to the thin nature of the alveolus and the horizontal nature of bone loss, bone regeneration was not possible

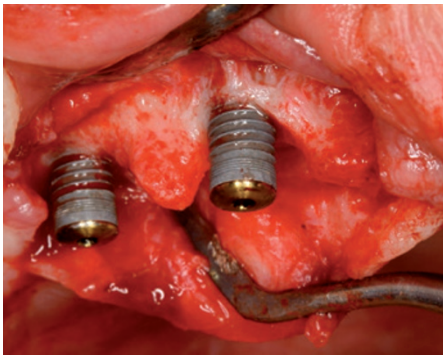

Fig. 7 Surgical access revealing more favourable topography for purposes of guided bone regeneration. The vertical nature of bone loss provides greater scope for the placement of xenograft tissue and subsequent membrane. Photo kindly provided by Matthew Garnett, Newcastle Dental Hospital

cases. Eight-five percent of defects were incompletely filled.[30] In 53% of cases pre- and post-op indices and the inflammatory status of the tissues was suboptimal.[30] Significant heterogeneity was detected as well as a number of low quality studies that prevented the authors from performing a meta-analysis.[30] These results seem to show that guided bone regeneration for peri-implantitis defects may not predictable at the current time.[30]

Newer modes of bone reconstruction include the use of porous titanium granules, which has been recently evaluated. The commercially pure titanium granules are between 0.7 mm and 1.0 mm in size, porous, irregularly shaped and non-resorbable. Studies on this technique are limited, and those that are present are tentative in their conclusions. Wohlfarht and colleagues found favourable results when placement of granules was compared to simple open flap debridement.[31] Greater peri-implant defect infill was found although this did not imply that the granules had osseointegrated or indeed the implant itself had re-osseointegrated.[31] Further evaluation of this option is required.[32]

The complication rate with regenerative procedures around previous peri-implantitis

defects has been reported to be relatively high with infection, implant loss and membrane exposure reported in up to 88% of cases.[33–35] Further questions such as the susceptibility of grafted bone to further microbiological insult also requires evaluation.[36]

Consideration to the environment in which grafting takes place and how this environment has changed when compared to initial disease development is required. Local and patient-related risk factors would ideally require modification to decrease the likelihood of disease recurrence – in some cases where implants are inherently poorly positioned or patients have chronic systemic disease such as diabetes this may not always be possible. It seems as though at the current time guided bone regeneration around dental implants with peri-implantitis requires further evaluation and research.

ADJUNCTIVE TREATMENTS

Systemic antibiotics

The use of antibiotics in the treatment of aggressive periodontitis is an accepted treatment option.[37] The scope and depth of knowledge on the use of antibiotics in peri-implantitis is, however, limited.[38] In a systematic review by Javed and colleagues only one study was identified that utilised non-surgical debridement with adjunctive anitbiotics.[38] This study showed reduction in probing depths and bleeding on probing with ornidazole 1 g daily for 10 days.[39] Unfortunately this prospective follow up study observed only nine patients each with one implant.

Two studies have examined systemic antibiotics in combination with a surgical approach.[40,41] Leonhardt and colleagues examined nine subjects with 44 implants utilising open flap debridement with local disinfection combined with nine different types of antibiotics. Over the observation period of 5 years, seven implants were lost, the results were somewhat poor with a 58% success rate. In another study of 24 subjects with 36 implants treated with open flap debridement and adjunctive amoxicillin and metronidazole with a 12 month follow up significant reduction in probing and suppuration was recorded.[40] Due to the limited evidence available it would seem that the efficacy of systemic antibiotics in the treatment of peri-implantitis needs further investigation.

Local antimicrobials

Local antibiotics for the treatment of peri-implantitis have seemingly a greater body of evidence than systemic forms and as such has greater evidence to prove its efficacy. The mode of delivery that has been investigated most extensively has been minocycline

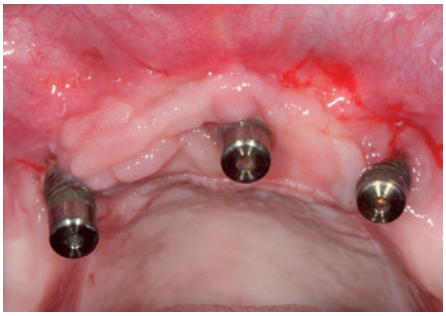

Fig. 8a Three implants in the maxillary arch with severe peri-implantitis resulting in recurrent infection and suppuration

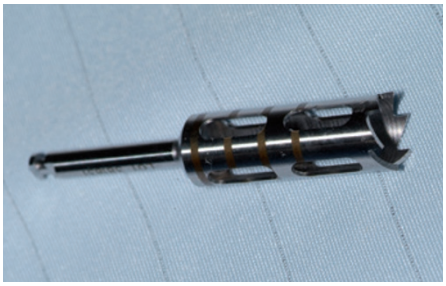

Fig. 8b Utilisation of a trephine bur to remove the implants

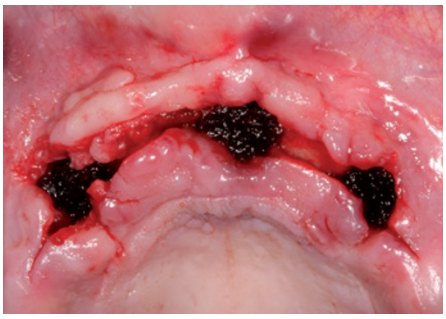

Fig. 8c Post-explantation management may include the need to place a haemostat and primary closure. Depending on the outcome an intermediate restoration such as a denture maybe required

microspheres.[38] These pellets are formulated from a bioresorbable polymeric scaffold within which the antibiotic is contained. The delivery of the antibiotic is achieved via sustained release as the scaffold breaks down over time. The majority of studies have been conducted over a 12 month period with consistent reductions in probing depths across different studies conducted in various environments.[42,43] Although results for this technique are promising, one randomised controlled trial reported a gain in probing depths and increase in bleeding on probing with the locally delivered antibiotic when compared to non-surgical debridement alone.[44] As such further evaluation is required.

Post-treatment susceptibility to recurrence

There is limited evidence on survival and incidence of relapse post-treatment of peri-implantitis. A follow up study evaluated 245 patients over a period of 9 months to 13 years.[36] In over half of the patients the disease was not arrested. Factors shown to be associated with failed treatment were smoking, smoking dose and early disease development. Patients who underwent osseous recontouring of the defects and those that were given antibiotics were more likely to have successful treatment. The results of this study illustrate that peri-implantitis is a disease process that is susceptible to recurrence and cases require frequent follow up as relapse is common.

EXPLANTATION

Where prognosis is considered poor or the level of infection is such that local cellulitis or spreading of infection is a risk there may be no choice but to consider explantation (Fig. 8). In a retrospective study of 134 patients who had surgical intervention for peri-implantitis, 25% required implant removal.[45] In a smaller study of nine patients with 44 implants, 26 of which had peri-implantitis, 7 implants were explanted at 5 years post-surgical treatment.[41]

The decision to remove a fixture cannot be taken lightly since if the implant is partially integrated the process of removal is likely to be traumatic and result in a defect that is either unlikely to be able to accommodate another implant or require a significant amount of additional grafted bone to do so. As such the residual defect might be so extensive that other modes of restoration may also be difficult to provide.

There have been a number of methods described to remove a failing fixture. One method is the use of trephine bur to remove the implant within a cylinder of bone (Fig. 8).[46] This has obvious repercussions due to the removal of otherwise sound bone. Another technique involves a counter torque ratchet capable of applying 200 Ncm to the implant to essentially unscrew the implant.[46] Laser explantation has also been described.[47] Precautions that need to be considered with explantation include the creation of oral antral communication, damage to vital structures such as the inferior dental nerve and vasculature.[48]

CONCLUSION

Although non-surgical instrumentation is successful in the treatment of periodontitis limited results have been recorded for peri-implantitis.[49,50] The peaks and troughs of threads represents a tactile challenge for the most experienced operator. However, improved oral hygiene and professional prophylaxis are still important in prevention and maintenance pre- and post-treatment.

Current understanding suggests that

peri-implantitis might be best managed non-surgically in the aesthetic zone but a surgical approach supported by decontamination of the implant surface, and local antibiotics may provide the best outcome.[51] This may be a reflection of the complicated implant morphology and the need for direct visualisation of the infected surface.

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