Peri-implantitis And Management-A Review


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ABSTRACT

Peri-implant mucositis and peri-implantitis are diseases that affect the tissues surrounding a functional implant. A general concern that the incidence of periimplantitis may increase as more implants are being placed by a greater number of clinicians with varying expertise. Thus, there is a need for research to identify effective protocols for prevention and treatment of peri-implantitis. This paper reviews about various treatment methods which includes Non surgical and surgical approaches for the treatment of peri-implant diseases so as to achieve reossseointegration of the exposed implant surface, being the ultimate goal.

Key words: Classification, Management, Non surgical, Peri-implantitis, Surgical.
INTRODUCTION

Implant dental restoration has become a permanent and promising result for the management of restoring missing natural dentition in routine clinical practice. Dental implants are reported to have high long term cumulative mean implant survival and success rates of 94.6% ± 6% and 89.7% ± 10.2% after mean post functional loading periods of 13.4 years and 15.7 years, respectively. Thus, it has been reported that the annual global dental implant market estimated at around 12-18 million implants sold. In Europe alone, the annual market has been estimated at 5.5-6 million. The number of implants placed per year has increased exponentially and will probably continue to rise as treatment protocols become more predictable and successful over time. Despite of high success in survival rates of dental implants, failures do occur and implant-supported prosthesis may require a substantial periodontal and prosthodontic maintenance over time. However, there are various factors, which have positive (peri-implant health) and negative effect (peri-implant diseases) on peri-implant tissues.

A new classification for peri-implant health, peri-implant mucositis and peri-implantitis was developed by the 2017 workshop. Peri-implant diseases are defined as a ‘collective term for inflammatory reactions in the tissues surrounding the implants’, whereas peri-implant mucositis as ‘a reversible inflammatory change of the peri-implant soft tissue without bone loss. Peri-implantitis is an inflammatory process on hard and soft tissue resulting in pocket formation and loss of supporting bone. A recent meta-analysis estimated that the weighted mean prevalence of peri-implant mucositis and peri-implantitis to be 43% and 22% across Europe and South and North America, respectively. A prospective study revealed that peri-implantitis at patient and implant levels was slightly reduced in Asia, at 19% and 11.2%, respectively. Yet, the treatment success of this condition was at best favorable in the short term, with 75% of the cases unresolved or recurred after 5 years. Hence, there are various treatment protocols, which have been implemented over years in order to treat peri-implant diseases and conditions respectively.

CLASSIFICATION OF PERI-IMPLANTITIS:15

1. Spiekermann 1984 characterized peri-implant defect into the type of bone resorption pattern

   Class I – Horizontal,
   Class II – Hey-shaped
   Class III a – Funnel shaped
   Class III b – Gap-like
   Class IV – Horizontal-circular form


   Class I: - Slight horizontal bone loss with minimal peri-implant defect
   Class II: - Moderate horizontal bone loss with isolated vertical defect
   Class III: - Moderate to advanced horizontal bone loss with broad, circular bony defect
   Class IV: - Advanced horizontal bone loss with broad, circumferential vertical as well as loss of the oral or vestibular bony wall

3. Newman 1992: Based on severity of peri-implantitis and sub classification of non-successful implants. 17
   a. Compromised successful implant: Inflammation, hyperplasia, and fistula formation occur near an otherwise fully osseointegrated implant.
   b. Failing implant: The implant is characterized by progressive bone resorption, but remains functional.
   c. Failed implant: Infection persists around an implant whose function is compromised

4. Nishimura 1997: Based on the amount of bone loss with shaped of defect associated

   Class 1: Slight horizontal bone loss with minimal peri-implant defects
   Class 2: Moderate horizontal bone loss with isolated defects
vertical defects

Class 3: Moderate to advanced horizontal bone loss with broad, circular bony defects.

Class 4: Advanced horizontal bone loss with broad, circumferential vertical defects, as well as loss of the oral and/or vestibular bony wall.

5. Vanden Bogaerde 2004- Based on the bone defects adjacent to dental implants highlighting the defect anatomy in the progression of the regenerative process

CLOSED DEFECTS – It is characterized by the maintenance of intact surrounding bone walls.

OPEN DEFECTS – it is the one, which lack one or more bone walls.

6. Lang NP et al 2004- classification included treatment part in its Classification

STAGE A- PD<3mm, plaque and/or bleeding on probing; Mechanical cleansing and polishing, oral hygienic maintenance instructions

STAGE B- PD4–5mm, radiologically no bone loss; Mechanical cleansing and polishing, oral hygiene maintenance instructions plus local anti-infective therapy.

STAGE C- PD >5mm, radiologically bone loss <2mm; Mechanical cleansing and polishing, microbiological test, local and systemic antibiotic therapy

STAGE D -PD >5mm, radiologically bone loss >2mm; Resective or regenerative surgery

7. Schwarz et al 2008-depending on the configuration of the bony defect as:

Class I defect – Intraosseous

Class II defect – Supra-alveolar in the crestal implant insertion area.

8. Froum and Rosen 2012:9

- Early: PD ≥ 4 mm, bleeding and/or suppuration on probing, Bone loss < 25% of the implant length
- Moderate: PD ≥ 6 mm, bleeding and/or suppuration on probing, Bone loss 25% to 50% of the implant length
- Advanced: PD ≥ 8 mm, bleeding and/or suppuration on probing, Bone loss > 50% of the implant length

9. Carl E Misch 2014:

- Group 1 (success/optimum health) Normal maintenance-No pain or tenderness upon function, no mobility, < 2 mm radiographic bone loss from initial surgery, Probing depth < 5 mm, No exudate history.
- Group 2 (survival/satisfactory health) Reduction of stress, Shorter intervals between dental hygiene appointments, Gingivoplasty and Yearly radiographs-No pain, No mobility, 2 to 4 mm radiographic bone loss, Probing depth 5 to 7 mm, No exudate history.
- Group 3 (survival/compromised health) Reduction of stress, Drug therapy, Surgical reentry and revision, Change in prosthesis or implants-No pain upon function, no mobility, Radiographic bone loss >4 mm, Probing depth >7 mm, May have history of exudate
- Group 4 (failure/clinical/absolute) Removal of implants-Pain upon function, Mobility, Radiographic bone loss >1/2 the length of the implant, Uncontrolled exudate, No longer in mouth.

10. Zhang L et al 2014 demonstrated classification of peri-implant bone defects (PIBDs) on the basis of their Panoramic radiographic shapes in patients with lower implant-supported overdentures:
1. Saucer-shaped defects
2. Wedge-shaped defects
3. Flat defects
4. Undercut defects
5. Slit-like defects

11. Ata Ali 2015: Combined Classification of peri-implant mucositis and periimplantitis
- Stage A - Probing Depth 4mm and Bleeding on probing and/or suppuration, with no signs of loss of supporting bone following initial bone remodeling during healing
- Stage B - Probing Depth >4mm and Bleeding on probing and/or suppuration, with no signs of loss of supporting bone following initial bone remodeling during healing
- Stage I - Bleeding on probing and/or suppuration and bone loss <3mm beyond biological bone remodeling
- Stage II - Bleeding on probing and/or suppuration and bone loss >3mm and <5mm beyond biological bone remodeling
- Stage III - Bleeding on probing and/or suppuration and bone loss <5mm beyond biological bone remodeling
- Stage IV - Bleeding on probing and/or suppuration and bone loss <50% of the implant length beyond biological bone remodeling

12. Shah Rucha 2016: Retrograde Periimplantitis:
Class I – Mild – Extends < 25% of the implant length from implant apex.
Class II – Moderate – Extends 25–50% of the implant length from implant apex.

**MANAGEMENT OF PERI IMPLANTITIS:**

**FIGURE 1:** Various methods of treatment of periimplantitis.

**NON-SURGICAL TREATMENT:**
To reduce infection, resolve inflammation, and render the surface capable of bone regeneration and re-osseointegration.

1. **Mechanical Debridement:**
Aims on removal of biofilm and deposits around the implant, which includes;
- Teflon, Plastic, carbon fiber, or titanium curettes
- Modified tips for ultrasonic systems (polyether ether ketone-coated, carbon fiber, silicone, plastic)
- Air abrasive systems (low-abrasive amino-acid glycine powder)
- Rubber cups
Mechanical decontamination of the implant surface plays an important role in achieving resolution of mucosal inflammation. However, due to differences between natural dentition and dental implants, debriding and decontaminating peri-implant surfaces are more challenging than those around teeth. Therefore, adjunctive treatments have been proposed to improve the condition.

2. Chemical/Antimicrobial approach

This includes: 0.2% Chlorhexidine, 0.05% Cetylpyridinium chloride, Citric acid, 3% hydrogen peroxide, 24% Iodine, 35% phosphoric acid, sodium hypochlorite, Probiotics and enamel matrix derivatives.

Menezes et al. 2016 concluded there is no clinical difference between the antiseptic and placebo solution was detected with respect to the number of bleeding on probing positive sites.

Hallström et al. 2017 concluded that there was a statistically significant lower percentage of residual pockets (PD >4mm) in 0.2% chlorhexidine group than the controls after 12 weeks, in spite of positive bleeding on probing after final evaluation.

Pulcini et al. 2019 concluded that use of solution containing chlorhexidine 0.03% + 0.05% cetylpyridinium chloride as an adjunct resulted in resolution of bleeding on probing in 58% of the cases.

Local or systemic drug delivered antimicrobials

Persson in 2006 concluded that the use of Arestin for the treatment of periimplantitis showed lower microbial levels of bacteria like A. actinomycetemcomitans, Tannereilla forsythia, P. gingivalis, and Treponema denticola up to 4 months.

Renvert et al. (2008) stated the improvements in periodontal pockets using minocycline with mechanical debridement that were significantly different from controls and were sustained for 6 months.

Systemic antibiotics such as Metronidazole, Ornidazole, Amoxicillin, and Azithromycin are also administered adjunctively to mechanical debridement in order to attain effective antimicrobial levels in the peri-implant crevicular fluid and therefore to aid the antibacterial mechanical effect.

Schar et al. in 2013 concluded that nonsurgical mechanical debridement with adjunctive use of Photodynamic therapy is equally effective in the reduction of mucosal inflammation as with the use of minocycline microspheres up to 6 months. Hence, Photodynamic therapy can be an alternative therapy in the treatment of periimplantitis.

3. Photodynamic therapy

Photodynamic therapy has bactericidal effects against both aerobic and anaerobic bacteria such as Aggregatibacter actinomycetemcomitans, Porphyromonas gingivalis, Prevotella intermedia, Streptococcus mutans and Enterococcus faecalis.

The only prospective randomized clinical trial in 2014 by Bassetti et al. After 12 months, the number of periopathogenic bacteria and level of IL-1 decreased significantly in both photodynamic therapy and minocycline microspheres into implant pockets after manually debrided by titanium curettes and glycine powder without significant differences between them.

4. Lasers

Using lasers has been broadly frequent in the treatment of peri-implantitis due to their anti-infective, physical and ablation properties. CO2, Diode-, Er: YAG and Er, Cr: YSGG lasers are used as a treatment modality (Laser Assisted Periimplantitis Protocol-LAPIP) in the management.
of peri-implant diseases. 3,11

A systematic review by Muthukuru in 2012 to evaluate the efficacy and safety of nonsurgical treatment of peri implantitis suggested that submucosal debridement with adjunctive local delivery of antibiotics, glycine powder air polishing / Er: YAG laser treatment may reduce inflammation of perimplant mucosa to a greater extent relative to submucosal debridement using curettes with adjunctive irrigation with chlorhexidine.14

A recent randomized clinical trial by Aimetti et al 2019 - A 3× diode laser application as an alternative treatment of 220 implants did not show any statistically significant clinical effects when compared with mechanical debridement alone.

Therefore, even after adjunctive application of laser might result in greater reduction of bleeding on probing in short-term, due to the lack of long-term data, its routinely use to manage peri-implant mucositis seems unpredicatable.22

Diagnosis and non-surgical treatment of peri-implant diseases and maintenance care of patients with dental implants – Consensus report of working group 3 (Renvert 2019)

Non-surgical therapy should always be the first step as this allows the clinician time to evaluate the healing response of the tissues and the patient’s ability to perform effective oral hygiene measures. Mechanical therapy can be supplemented with locally delivered antibiotics. This treatment will result in an average of 0.5–1.0 mm pocket depth reduction and 15%–40% reduction in bleeding on probing. Non-surgical treatment of periimplantitis usually provides clinical improvements in reduced bleeding tendency (20%–50%) and in some cases pocket reduction (≤ 1 mm). However, in advanced cases, complete resolution of the disease cannot be achieved.21

SURGICAL TREATMENT:

Various surgical techniques are recommended:

1. Access for cleaning and decontamination of the implant surface (access flaps);

2. Access for cleaning and decontamination plus exposure of the affected surfaces for cleaning (apically repositioned flaps); and

3. Access for cleaning plus aiming for bone regeneration and re-osseointegration (regenerative techniques).

1. Non-augmentative/Resective:

This concept involves reduction or elimination of pathological peri-implant pockets, the apical positioning of a mucosal flap, or recontouring bone with or without implants surface modification.6

INDICATION- Supra-crestal bone defects (horizontal bone loss) with exposed threads in aesthetically non-demanding areas based on patient needs and satisfaction. It is also advisable to perform an access flap for proper mechanical and chemical decontamination of the implant surface in case of peri implant mucositis.

Implantoplasty, that is, the mechanical modification of the implant, including thread removal and surface smoothening, has been proposed during surgical peri-implantitis treatment. This method pursuits for implant surface smoothening, thereby altering the rough implant surface to a polished surface, which is amenable for oral hygiene maintenance. Implant topography is altered using high-speed diamond burs and polishers which creates smooth continuous surfaces. This technique is performed before any osseous resective therapy and is used with profuse irrigation.

Philip et al (2018) This systematic review states that surgical non-regenerative modalities treating periimplantitis can reduce the amount of inflammation in the short-term follow-up, but seem
less effective in the long-term perspective. Using implantoplasty in surgical non-regenerative treatment leads to a significant decrease in BOP and PD and may result in improvement of clinical and radiographic parameters up to 3 years after surgery compared with mechanical debridement alone.

A recent systematic review by stavropoulos et al (2019) stated that preclinical in vivo and clinical evidence, implantoplasty seems not associated with any remarkable mechanical or biological complications on the short- to medium-term. Based on the currently available—relatively weak—evidence, implantoplasty appears to yield positive clinical and radiographic results, that is, low bleeding rates, shallow probing pocket depths, increased clinical attachment levels, and increased or stable bone levels on the short- to medium-term.25

2. Augmentative/Regenerative:

GBR-Guided bone generation-Regenerative procedures using bone graft substitutes combined with resorbable membrane, or with bone substitutes alone.12

INDICATION-Recurrence after non-surgical treatment and presence of intra-bony peri-implant defects.

The 2-years result by Schwarz et al. (2008) demonstrated that both nanocrystalline hydroxyapatite and application of the combination of natural bone mineral and collagen membrane were efficacious in providing clinical significant reduction of the pocket probing depth and gain in clinical attachment level.

Then, 4 year study of Schwarz et al. (2009) application of the combination of natural bone mineral and collagen membrane were more efficacious in clinical improvement as compared to nanocrystalline hydroxyapatite.

Aghazadeh et al. (2012) concluded that regenerative surgical procedures coupled with bovine derived xenograft and placement of collagen membrane have more radiographic evidence of bony defect filled as compared to autogenous bone graft.1

A Retrospective study by wolfram et al (2016) concluded that the mean implant survival rate of 98.6 ± 2.6% was found for bone substitute, 88.6 ± 4.1% for autogenous bone graft and bone substitute and 97.4 ± 2.2% for autogenous bone graft alone.

Porous titanium granules:(PTG)

Porous titanium granule is 700–1000 μm in diameter. The total titanium surface of the ultra-porous granules is approximately 2 cm2, which provides a significant blood-to-titanium contact area. Titanium has also been demonstrated to be a potent activator of the blood coagulation system with thrombus formation, which helps in bone healing and osseous growth.

In 2011, Wohlfahrt et al. provided with human histological evidence that re-osseointegration of a contaminated dental implant with peri-implantitis was biologically possible. Grafting of a peri-implant defect with PTGs may lead to newly formed bone both in close connection with the graft material as well as with the contaminated implant surface.

In 2012 Wohlfahrt et al, RCT, using porous titanium granules as a bone substitute in the corrective surgical treatment of periimplant osseous defects. Grafting of the defects with PTG was compared with open flap debridement alone. No clinical differences between groups were found after 12 months, but a better defect fill was seen on radiographs in the PTG group.26

Heidi Andersen et al (2017) The 7 year follow up study used a non-resorbable, alloplastic material (PTG) in intra-osseous defects as a reconstructed material. This technique attempts to fill the osseous defect and not solve the disease.2
Soft Tissue Management With Peri Implant Disease: (Apically repositioned flap, connective tissue grafts)

INDICATION:

- To facilitate flap management and wound stability.
- To help maintain peri-implant soft tissue health and stability.
- To improve aesthetics.

The study by de Waal et al. (2013) demonstrated that the adjunctive benefits derived from the addition of resective surgical treatment consisting of apically repositioned flap, bone re-contouring and surface debridement and with 0.12 % CHX + 0.05 % CPC to a placebo-solution

(Without CHX/CPC) tend to be greater immediate suppression of anaerobic bacteria on the implant surface than a placebo-solution, but does not lead to superior clinical results.8

Surgical treatment of peri-implantitis – Consensus report of working group 4 (Khoury et al 2019)

Surgical augmentative periimplantitis therapy resulted in mean BOP and PD reduction ranging from 26% to 91%, and 0.74 to 5.4 mm, respectively. The reported mean radiographic fill of intrabony defects ranged between 57% and 93.3%, and defect vertical reduction varied from 0.2 to 3.77 mm. The available evidence to support superiority of augmentative surgical techniques for peri-implantitis management on the treatment outcomes over non-augmentative methods is limited. 10

- Explantation:
  - Indications include suppurative exudate, overt BOP, severely increased periimplant PD (≥8 mm), peri implant radiolucency that may be extending along the outline of the implant (>half length) and mobility.
- Cumulative interceptive supportive therapy (CIST) Protocol

In the course of maintenance, developing perimplant lesions can be treated with Cumulative Interceptive Supportive Therapy (CIST) protocols. It includes mechanical, antiseptic and antibiotic treatment to control ongoing infection. Following this, periimplant bony lesions could also be corrected by regenerative or resective surgical techniques. It is evident that preventive measures need to be reinstituted following such therapy

CONCLUSION:

Peri implant diseases, the challenge for practitioners who place implants for replacement of missing natural teeth. It is conceivable that protocols for surface decontamination may have different effects depending on the macro- and microstructure of the surface, and hence not all methods may work equally well in all instances. It is furthermore presently unknown to what extent bacterial and nonbacterial residues have to be removed from an implant surface to obtain a predictable, stable clinical result after treatment. There should be continued investigation into materials which have the ability to discourage biofilm formation/bacterial attachment and promote osseointegration and the development of the per mucosal seal. Surgical non-regenerative modalities treating peri-implantitis can reduce the amount of inflammation in the short-term follow-up, but seem to have limited effectiveness in the long term. Surgical augmentative peri-implantitis therapy results in improved clinical and radiographic treatment outcomes.

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