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# An Update on the Prevention and Treatment of Peri-Implant Diseases

**Abstract:** Peri-implant diseases, especially peri-implantitis, present a growing public health concern owing to their rising prevalence and adverse outcomes, and lead to substantial dental care costs and an overall economic impact. This article outlines the case definitions and diagnoses for peri-mucositis and peri-implantitis and summarizes the EFP S3-level clinical practice guidelines.

**CPD/Clinical Relevance:** Understanding case definitions and diagnoses of peri-implant diseases, including peri-mucositis and peri-implantitis, is essential for dental professionals to provide effective treatment and prevent complications.

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Managing peri-implant diseases, which are linked to considerable morbidity, poses significant challenges. The latest clinical practice guidelines<sup>1</sup> seek to identify optimal interventions for maintaining peri-implant tissue health, aiming to prolong the complication-free survival of dental implants used in tooth replacement. Peri-implant diseases, driven by peri-implant biofilms, manifest as inflammatory conditions affecting peri-implant tissues, with two distinct conditions: peri-implant mucositis and peri-implantitis. Peri-implant diseases, especially peri-implantitis, present a growing public health concern owing to their rising prevalence and adverse outcomes, such as implant and prosthesis loss, leading to substantial

dental care costs and have an overall economic impact.

Peri-implant mucositis, as defined by Heitz-Mayfield and Salvi,<sup>2</sup> is an inflammatory condition affecting the peri-implant mucosa without concurrent marginal bone loss. Clinically, it manifests as bleeding upon gentle probing, accompanied by potential signs of inflammation, such as erythema, swelling and/or suppuration. The condition is associated with increased probing depth, attributed to oedema or diminished probing resistance. Disruption of host-microbial homeostasis at the implant–mucosa interface is the underlying cause, making it a reversible condition when assessed through host

biomarkers. Contributing factors include biofilm accumulation, smoking, and radiation therapy.<sup>3</sup>

In contrast, peri-implantitis is identified as a pathological condition linked to peri-implant biofilms, presenting in tissues surrounding dental implants and characterized by inflammation in the peri-implant mucosa and progressive loss of supporting bone. Clinical signs at peri-implantitis sites include inflammation, bleeding on probing (BOP), suppuration, increased probing depths (PDs), and/or recession of the mucosal margin. Radiographic evidence reveals bone loss compared to previous examinations.<sup>3</sup>

The primary causative factor in the initiation and progression of peri-implantitis is the accumulation of a biofilm on the implant surface. Notable risk factors encompass a history of severe periodontitis, insufficient plaque control, the absence of consistent post-implant therapy supportive care (SPIC), the presence of submucosal cement post-prosthetic restoration, or implant positioning impeding oral hygiene, the lack of peri-implant keratinized mucosa (PIKM), occlusal overload, as well as systemic risk factors, including smoking and diabetes.

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Other factors including the presence of titanium particles in peri-implant tissues, bone compression necrosis, overheating, micromotion, or biocorrosion have been documented;<sup>4</sup> however, further research is required to precisely define their roles.<sup>4</sup>

This review outlines the case definitions and diagnoses for peri-mucositis and peri-implantitis as per the 2017 WWP classification and summarizes the EFP S3-level clinical practice guidelines.<sup>3</sup>

## Periodontitis versus peri-implantitis

Researchers have looked into the pathophysiology of peri-implant diseases by drawing parallels with periodontal diseases. Analogies between peri-implant mucositis and biofilm-induced gingivitis, as well as between peri-implantitis and periodontitis, have been explored. It is important to note that peri-implant tissues differ from periodontal tissues, lacking cementum and a periodontal ligament, comprising only alveolar bone and peri-implant mucosa.

Distinct characteristics of the peri-implant mucosa include a longer epithelial attachment, the absence of connective tissue fibres in the supra-crestal area, and reduced vascularization. Robust evidence from both animal and human studies supports peri-implant biofilms as the primary aetiological factor for peri-implant mucositis.<sup>3</sup> These biofilms develop on hard, non-shedding surfaces, mirroring the formation of dental plaque biofilms on natural teeth.<sup>5,6</sup> Histologically, peri-implant mucositis mirrors gingivitis, presenting as a well-defined inflammatory lesion adjacent to the junctional/pocket epithelium. It is richly infiltrated by vascular structures, plasma cells and lymphocytes, but does not extend apically to the junctional/pocket epithelium or into the supra-crestal area.<sup>2,3</sup>

As with gingivitis, evidence exists to support the contention that peri-implant mucositis is treatable, and can be successfully managed by careful control of the peri-implant biofilm. However, if allowed to persist, peri-implantitis develops, as peri-implantitis is always preceded by peri-mucositis.<sup>2,3</sup>

The primary cause of peri-implantitis is the accumulation of peri-implant biofilm, evidenced by human observational studies linking poor biofilm control and

Bone resorption	Periodontitis leads to alveolar bone loss, affecting bone volume and density. This poses challenges to implant support, emphasizing the crucial role of osseous integrity in long-term success
Soft tissue integrity	Periodontal issues can affect peri-implant soft tissues, requiring meticulous management for optimal aesthetic outcomes. Inadequate support may result in complications, such as recession and compromised appearance
Implant placement challenges	Residual periodontal pockets, especially in advanced cases, can complicate implant placement. Careful planning is essential to avoid potential complications
Risk of peri-implantitis	Individuals with a history of periodontitis may face an increased risk of peri-implantitis. Effective maintenance care and meticulous oral hygiene are crucial for minimizing this risk
Systemic health considerations	Periodontitis is associated with systemic health issues. Patients with a history of periodontitis may have additional health considerations to address before implant placement
Treatment planning challenges	Comprehensive planning is vital for cases involving a history of periodontitis. Collaboration among periodontists, implant surgeons, and restorative dentists is often necessary to address both periodontal and implant aspects

**Table 1.** Placing implants in individuals previously diagnosed with periodontitis demands careful examination. Conducting a thorough assessment of the patient's periodontal and overall oral health, addressing potential challenges judiciously, and formulating a tailored treatment plan are crucial for ensuring the efficacy and enduring success of implant placement in individuals with a history of periodontitis. Regular follow-up and vigilant maintenance care are pivotal measures for sustained implant health and longevity in such cases. Key considerations are outlined.

non-adherence to maintenance care to an increased risk of incident peri-implantitis.<sup>3</sup> Peri-implantitis lesions are larger and usually circumferential, compared to peri-implant mucositis or periodontitis, with higher proportions of neutrophils and B cells, resembling immune-inflammatory infiltrates seen in periodontitis. The specific bacteria or pro-inflammatory cytokine profiles associated with these distinctive histological features are yet to be conclusively determined.<sup>3,4,7</sup>

## Prevalence of peri-implantitis and peri-mucositis

A systematic review conducted during the XI European Workshop in Periodontology in 2014 revealed a patient-level prevalence estimate of 43% for peri-implant mucositis and 22% for peri-implantitis.<sup>8</sup> Another review, incorporating 47 studies, reported a prevalence of 46.8% for peri-implant mucositis and 19.8% for peri-implantitis.<sup>9</sup>

A more recent study showed that the prevalence of peri-implantitis was 19.5% at the patient level and 12.5% at the implant level, and it remains highly variable even

following restriction to the clinical case definition.<sup>10</sup> Perhaps we should only be using the definition proposed in the 2017 World Workshop on the classification of periodontal and peri-implant diseases and conditions (Table 1).

Peri-implant mucositis, if promptly addressed, can be successfully treated; however, neglected cases may progress to peri-implantitis, a condition believed to follow a non-linear accelerating pattern, advancing more rapidly than typical periodontitis lesions.<sup>3,4</sup> The progression of peri-implantitis is likely to result in the eventual loss of the affected implant and the implant-supported prosthesis. While the impact of peri-implant diseases on quality of life is not extensively documented, one study found no discernible impact on oral health-related quality of life for either peri-implantitis or its surgical treatment.<sup>11</sup>

## The S3-level guideline

The guideline seeks to establish optimal interventions for preserving peri-implant tissue health, enhancing the long-term success of dental implants

Diagnosis	Detail/criteria
Peri-implant health <sup>3,13</sup>	Absence of clinical signs of inflammation Absence of bleeding or suppuration on gentle probing No increase in PD compared to previous examinations Absence of bone loss beyond crestal bone level changes resulting from initial bone remodelling
	This guideline has also adopted the recent slightly modified definition of peri-implant health, which allows for the presence of a single bleeding spot around the implant <sup>17</sup>
Peri-implant mucositis <sup>2,3</sup>	Presence of bleeding and/or suppuration on gentle probing with or without increased PD compared to previous examinations Absence of bone loss beyond crestal bone level changes resulting from initial bone remodelling
	<b>Update:</b> Presence of bleeding (more than one spot at a location around the implant or presence of a line of bleeding or profuse bleeding at any location) and/or suppuration on gentle probing, in the absence of bone loss beyond crestal bone level changes resulting from initial bone remodelling <sup>17</sup>
Peri-implantitis <sup>3,4</sup>	Presence of bleeding and/or suppuration on gentle probing Increased PD compared to previous examinations Presence of bone loss beyond crestal bone level changes resulting from initial bone remodelling
	However, in the absence of previous examination data, the diagnosis of peri-implantitis can be based on the combination of: Presence of bleeding and/or suppuration on gentle probing PDs of $\geq 6$ mm Bone levels $\geq 3$ mm apical of the most coronal portion of the intra-osseous part of the implant

**Table 2.** Case definitions for peri-implant health, peri-implant mucositis and peri-implantitis.

in replacing missing teeth. It provides evidence-based recommendations for the prevention and treatment of peri-implant diseases, intending to improve the quality of interventions globally. The objectives include enhancing preventive and therapeutic approaches, reducing dental implant loss from peri-implantitis, and, ultimately, minimizing medical and dental costs while enhancing patient quality of life. Developed by the European Federation of Periodontology (EFP), it relies on 12 systematic reviews to support its development.<sup>1</sup> The guideline categorizes interventions based on distinct stages of peri-implant tissue management, aligning with various phases of implant therapy:

- Patients awaiting dental implant rehabilitation (pre-operative);
- Patients undergoing dental implant rehabilitation (peri-operative);
- Patients with existing dental implant/s (post-operative).

### Diagnosis of peri-implant diseases

Successful implant-supported rehabilitation requires regular assessment to facilitate early diagnosis of peri-implant diseases. This is evident in the case definitions for peri-implant health, peri-implant mucositis, and peri-implantitis established by the 2018 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions (Table 2).<sup>2-4,12-14</sup>

### Specific care pathways according to diagnosis of peri-implant condition

It is important to correctly diagnose peri-implantitis and peri-implant mucositis because they are treated differently. Peri-implant mucositis is treatable and can be prevented by taking the same steps as those used to prevent peri-implant

diseases in general. Treating peri-implant mucositis is also the best way to prevent peri-implantitis. The goal of the S3-level guidelines is to keep dental implants and the prostheses they support healthy and functioning by preventing and treating peri-implantitis.<sup>1</sup> However, once peri-implantitis has developed, it is not possible to fully restore the tissue around the implant, even if the inflammation is controlled.

### Pre-operative interventions

Owing to the high prevalence of peri-implant diseases, any patient receiving dental implants should be considered at risk of developing some form of peri-implant disease. Upon exposure of the dental implant/abutment complex to the oral environment and subsequent prosthetic loading, biofilm accumulation can trigger inflammation, potentially causing peri-implant diseases. Hence, preventive measures should begin during treatment planning and persist through implant placement and prosthetic rehabilitation. Pre-operative interventions must address established risk factors, including smoking, diabetes, untreated periodontitis and inadequate oral hygiene practices, to mitigate peri-implant disease development. Primordial prevention essentially aims to prevent the establishment of risk factors rather than addressing them after they have developed. Interventions for primordial prevention are for patients awaiting dental implant rehabilitation and therefore, before implant placement. The interventions include improving glycaemic control in people with diabetes, educating the patient about the importance of their adherence to SPIC (supportive peri-implant care) visits and home care, provision of regular supportive care, cessation of cigarette smoking (including e-cigarettes), improved oral hygiene and reducing bruxing/parafunctional habits and periodontal therapy to eliminate gingivitis and achieve periodontal stability (Table 3).

### Peri-operative interventions

This includes interventions before dental implant placement that are carried out during surgical implant placement and during implant-supported prosthesis design/preparation/placement. Scientific literature highlights the common

Before implant placement	Conduct a thorough patient risk assessment and address modifiable risk factors for peri-implant diseases
	Ensure stable treatment endpoints for gingivitis and periodontitis, following supportive periodontal care (SPC) before proceeding with implant placement
Three-dimensional implant positioning planning	Ensure sufficient buccal/lingual bone thickness for guided placement with primary stability
	Maintain an adequate mesio-distal distance for prosthetic components and oral hygiene access
	Position the implant platform appropriately, considering the emergence angle to avoid an excessively deep mucosal sulcus ('tunnel') and ensure a favourable shoulder for optimal prosthetic components
Prosthetic treatment planning recommendations	Provide good access for patient oral hygiene aids and professional monitoring
	Plan for favourable prosthesis contours with an optimal emergence angle and shoulder to facilitate effective plaque control and prevent peri-implant diseases

**Table 3.** Recommendations for primordial interventions of peri-implant diseases.

Assessment of peri-implant health	Employ peri-implant probing for BOP, PD and mucosal margin changes
	Conduct baseline probing within 3 months of prosthesis delivery and at every clinical examination
	Use a 0.5-mm diameter tip probe with a light force (0.2N)
	Record probing depths and BOP at six sites
	Assess and record the width of keratinized attached peri-implant mucosa
	Obtain a baseline intra-oral radiograph and follow-up radiographs if PD increases with BOP/suppuration
Main recommendations	Maintain glycaemic control in diabetic patients with peri-implant tissues
	Emphasize regular supportive peri-implant care (SPIC) to reduce peri-implant disease risk
	Use validated smoking cessation interventions to mitigate peri-implant disease risk
	Consider increasing peri-implant keratinized/attached mucosal width for discomfort during brushing
	Uncertainty exists regarding the effectiveness of soft tissue thickness augmentation (<2 mm) in reducing peri-implant disease risk
	Provide specific oral hygiene instructions for patients with dental implants to prevent incident peri-implant diseases
	The impact of managing bruxing or parafunctional habits on peri-implant diseases in healthy peri-implant tissues is unknown
	For peri-implantitis treatment, recommend SPIC for medium- to long-term risk reduction ( $\geq 3$ years)
	The most effective PMPR regimen post-peri-implantitis treatment is uncertain, but potential approaches include various instruments and techniques
	Professional application of adjunctive local antimicrobial agents in SPIC for recurrent peri-implantitis is not recommended

**Table 4.** Recommendations for primary interventions for peri-implant diseases.

occurrence of 'dental implants placed under less-than-ideal circumstances' in routine dental practice, potentially leading to an increased prevalence of peri-implantitis.<sup>3,4</sup> Prosthetic factors are also identified as contributors to the risk of peri-implant disease onset and progression.<sup>4</sup> The 2017 Workshop on the classification of periodontal and peri-implant diseases

acknowledged limited evidence linking peri-implantitis to factors such as post-restorative submucosal cement presence and poorly positioned implants hindering oral hygiene and maintenance.<sup>3</sup>

In light of these findings, preventing peri-implant diseases should be a focal point for the following (Table 4):

- Implant treatment planning, ensuring

prosthetically driven implant placement, and addressing local factors that may hinder ideal placement;

- Designing and installing prosthetic reconstructions, considering local risk factors that may impede oral hygiene access or, if feasible, opting for screw-retained, rather than cement-retained restorations.

Diagnosis	Stage	Aim	Intervention
Peri-implant health	Primary prevention	Reduce risk of incidence of peri-implant diseases	Glycaemic control
			Regular SPC
			Cessation of cigarette smoking
			Augmentation of peri-implant soft tissues
			Improved oral hygiene
			Reducing bruxing/parafunctional habits
Peri-implant mucositis	Peri-implant mucositis treatment	Bleeding on probing reduction	Professionally administered non-surgical mechanical/physical therapy
			Professionally administered: Adjunctive antibiotics with un-sustained release Adjunctive topical antiseptics Adjunctive chemical agents
			Photodynamic therapy used adjunctively
			Self-administered: Antiseptics Probiotics Systemic antibiotics (by oral prescription)
Peri-implant mucositis	Treated for peri-implant mucositis	Not directly assessed	Supportive peri-implant care (SPIC) and same interventions as for peri-implant health
Peri-implantitis	Peri-implantitis treatment (non-surgical step of peri-implantitis therapy)	Inflammation reduction (PD, BoP, SoP)	Non-surgical submarginal instrumentation – mechanical/physical cleaning/decontamination: Submarginal instrumentation Submarginal instrumentation with lasers Submarginal instrumentation with air-polishing
			Non-surgical submarginal instrumentation – chemical approaches for cleaning/decontamination: Submarginal instrumentation with antimicrobial photodynamic therapy Submarginal instrumentation with antiseptic desiccant solution
			Non-surgical submarginal instrumentation – adjunctive therapies: Adjunctive locally administered antimicrobials Adjunctive systematically administered antibiotics Adjunctive probiotics
Peri-implantitis	Peri-implantitis treatment (surgical step of peri-implantitis therapy)	Inflammation reduction (PD, BoP, SoP)	Access flap or resective procedures
			Reconstructive approaches
			Additional methods for implant surface decontamination Photo/mechanical and physical implant surface decontamination procedures Chemical implant surface decontamination procedures
			Adjunctive use of local/systemic antimicrobials Adjunctive systematically administered antibiotics Adjunctive locally administered antibiotics
Peri-implantitis	Secondary prevention of peri-implantitis	Improved peri-implant tissue stability (3 years)	Regular supportive peri-implant care (SPIC)
			Professional mechanical plaque removal (PMPR)
			Specific oral hygiene instructions (OHI)
			Adjunctive local antiseptic agents in SPIC

**Table 5.** Summary of post-operative interventions adapted from the S3 guidelines.<sup>1</sup>

## Post-operative interventions

Following the exposure of dental implants to the oral environment and the loading of prosthetic restorations, the management of peri-implant tissues should be guided by their clinical condition. Given the high reported incidence of peri-implant diseases, patients should promptly enroll in a supportive peri-implant care (SPIC) programme. SPIC programmes should incorporate primary prevention interventions, such as professional removal of supra- and subgingival plaque biofilm, oral hygiene motivation and coaching, and early detection of pathological conditions.

For a summary for interventions to follow please see Table 5, which is adapted from the S3-level guidelines.<sup>1</sup>

## Treatment for peri-mucositis

Interventions for the management of peri-implant mucositis focus on the control of biofilm, which can be self-administered or professionally delivered. Treatment outcomes should be evaluated after 2–3 months, and re-treatment is recommended if the relevant endpoints have not been achieved. These endpoints reflect the re-establishment of peri-implant health, which is essentially identical to the primary prevention of peri-implant diseases and the secondary prevention of peri-implant mucositis. Furthermore, since the treatment of peri-implant mucositis is central to the prevention of the onset of peri-implantitis,<sup>15</sup> this treatment is in fact the most important preventive intervention for peri-implantitis and, as such, represents the main component of professional interventions during SPIC (Table 6).

## Treatment for peri-implantitis

Managing peri-implantitis is a relatively recent focus in research and clinical practice. While there are key distinctions between peri-implantitis and periodontitis, the treatment foundation for peri-implantitis draws from successful periodontitis approaches. Hence, adopting a stepwise approach, akin to periodontal therapy,<sup>14</sup> aligns with proposed interventions for periodontitis.

The primary aim of the non-surgical phase in peri-implantitis treatment is to regulate peri-implant biofilms and inflammation, emphasizing sub-marginal instrumentation. Additionally, interventions targeting supramarginal biofilm control and risk factor management are integral to

Patients with peri-implant mucositis are advised to adopt effective oral hygiene practices along with professional mechanical plaque removal (PMPR)
The consideration of using oral irrigation devices with water as an adjunct to PMPR is suggested for patients with peri-implant mucositis
Various single modes of professional mechanical plaque removal (PMPR), such as ultrasonic with plastic-coated tips, air polishing devices with glycine powder, titanium curettes, or chitosan brushes, may be considered for patients with peri-implant mucositis
It is not recommended to add air polishing devices or diode lasers to conventional PMPR procedures for patients with peri-implant mucositis, despite their efficacy when used alone
Repeat PMPR is recommended within 3 months if desired treatment endpoints are not achieved. Specific endpoints and evaluation times should be adjusted based on the patient's oral hygiene, risk factors and prosthesis cleanability
If the implant-supported prosthesis hinders effective cleaning, it is recommended to consider cleaning, removal or modification of the prosthesis for patients with peri-implant mucositis
The use of locally administered antibiotics or other agents (antiseptics, postbiotics, desiccant gel) adjunctive to PMPR is not recommended
Similarly, the use of other locally administered photodynamic therapy adjunctive to PMPR is not recommended for patients with peri-implant mucositis
Consideration of time-limited self-administration of oral rinse antiseptics (chlorhexidine and herbal-based) or the professionally guided self-administration of probiotics may be considered as adjuncts to PMPR for patients with peri-implant mucositis
The oral administration of systemic antibiotics as an adjunct to PMPR is not recommended owing to concerns about patients' health and the potential impact on public health

**Table 6.** Recommendations for management of peri-implant mucositis. In treating peri-implant mucositis, the recommended treatment goals are achieving implant-level BOP of  $\leq 1$  point and the absence of suppuration. Clinicians should assess these endpoints 2–3 months post-intervention. If  $\geq 2$  BOP sites or  $\geq 1$  site with profuse BOP or suppuration persists, re-treatment is advised.

this phase. Following treatment, it is crucial to monitor progress in inflammation and suppuration control, reassessing outcomes. While clear endpoints for therapy have been established in periodontitis treatment, evidence supporting the success of steps 1 and 2 in peri-implantitis treatment is limited.<sup>16</sup>

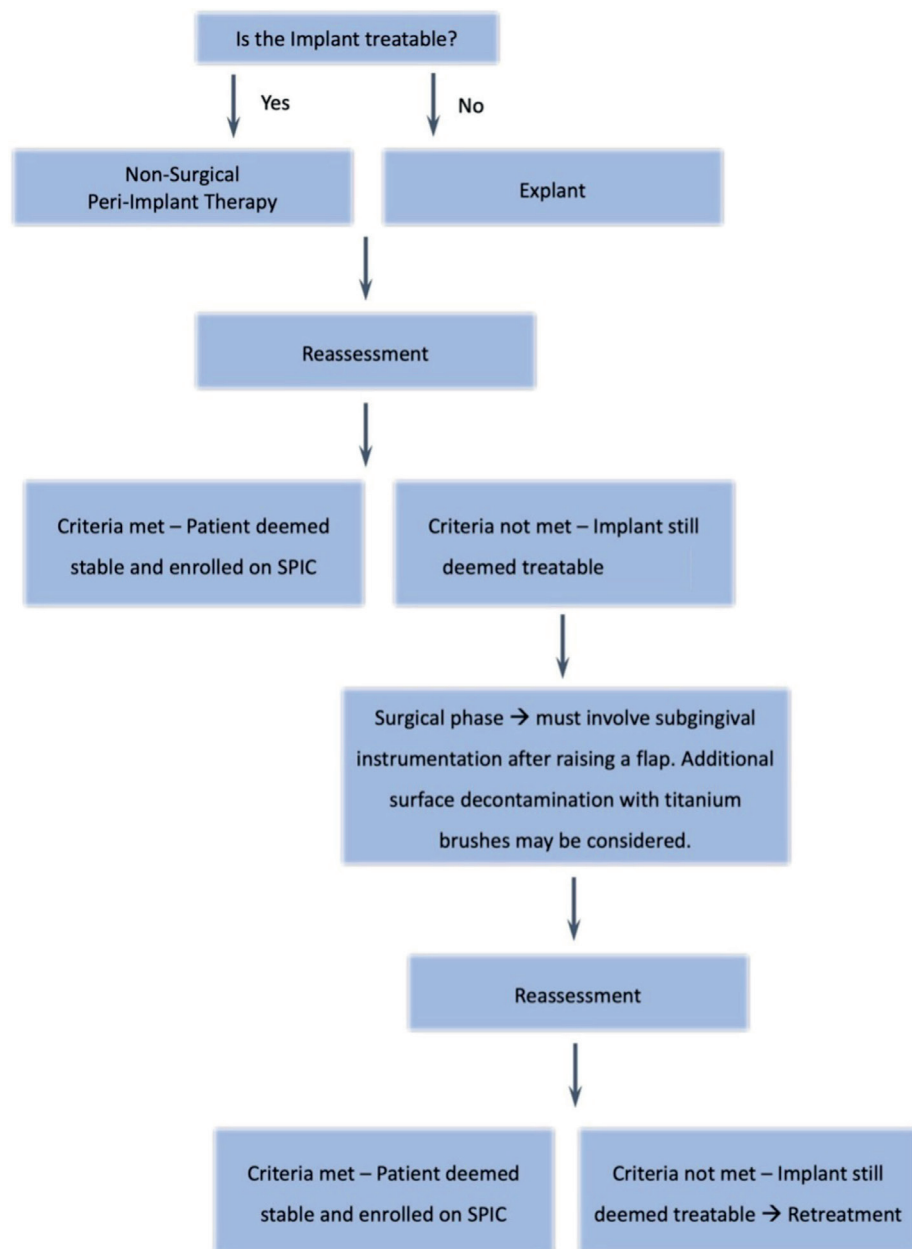
Upon confirming a diagnosis of peri-implantitis, it is imperative to acknowledge two key points:

- Peri-implantitis is an irreversible condition; thus, even successful peri-implantitis therapy results in the assignment of a 'stable' peri-implantitis diagnosis to the particular implant;
- The outcomes of peri-implantitis treatment are contingent upon various factors, including implant fixture and prosthetic characteristics, mucogingival factors, other patient factors, local conditions, disease severity, and bone defect configuration. Consequently,

tailored interventions addressing one or several of these factors are employed in its management, as documented in systematic reviews. The effectiveness of these interventions exhibits variability in treatment outcomes.

According to the following care pathways, peri-implantitis management should involve the following sequential steps (Figure 1):

- Upon diagnosis, determine whether the affected implant is treatable;
- If treatable, initiate non-surgical therapy, involving submarginal instrumentation;
- After non-surgical therapy, reassess clinical outcomes based on predetermined success criteria. If the success criteria are met, enroll the patient in a SPIC programme. If the success criteria are not met, and the implant is still deemed maintainable,



**Figure 1.** Peri-implantitis management should involve sequential steps.

- proceed with the surgical step.
- The surgical phase of peri-implantitis treatment must always include submarginal instrumentation after raising a surgical flap. Additional implant surface decontamination with titanium brushes may be considered.
- After surgery, evaluate clinical outcomes and ensure compliance with predefined success criteria. If the success criteria are met, enroll the patient in a secondary prevention SPIC programme. If the success criteria are not met, and the implant is still deemed maintainable, recommend re-treatment of the implant.

### Non-surgical management of peri-implantitis

EFP recommends prioritizing implant/prosthesis retention in peri-implantitis treatment, starting with a non-surgical step, followed by re-evaluation.

In the non-surgical step of peri-implantitis treatment, the recommended interventions include (Table 7):

- Oral hygiene instructions and motivation;
- Risk-factor control;
- Prosthesis cleaning/removal/modification, addressing biofilm

- retentive factors and evaluating prosthesis components when necessary and feasible;
- Supramarginal and submarginal instrumentation;
- Concomitant periodontal therapy as needed;
- The endpoints of successful non-surgical therapy of peri-implantitis, assessed 6–12 weeks after therapy. At the implant level: PD ≤5mm, and no BOP at more than one point, and no suppuration. Additional treatment including re-instrumentation, surgical intervention or supportive Peri-Implant Care (SPIC) may be recommended if the above endpoints are not achieved.

### Surgical management of peri-implantitis

The surgical approach in peri-implantitis management aims to enhance access to the implant for effective surface decontamination, ultimately resolving the inflammatory lesion. Surgical intervention targets sites displaying persistent pathology after non-surgical therapy, specifically deep pockets with bleeding on probing or suppuration. A typical surgical procedure involves flap elevation, removal of inflamed tissue, and implant surface cleaning/decontamination, typically employing saline-soaked gauze and curettes for mineralized deposit removal. Additional procedures may encompass managing peri-implant osseous defects through reconstructive approaches for intra-osseous defects ≥3 mm, and employing alternative techniques for implant surface decontamination, such as the use of titanium brushes.

Currently, there is insufficient evidence for the use of local antibiotics as adjuncts in the surgical management of peri-implantitis.<sup>1</sup> Additionally, the S3 guidelines do not recommend the use of systemic antibiotics in the surgical treatment of peri-implantitis.

Effective self-performed oral hygiene is crucial for successful surgical peri-implantitis treatment. Surgery is not advised for patients unable to maintain satisfactory oral hygiene independently. Treatment success hinges on the patient's consistent commitment to proper oral care practices.

Assessment of non-surgical peri-implantitis treatment outcomes includes monitoring residual inflammation, suppuration, and probing depths
EFP recommends implant-level endpoints: residual probing depths $\leq 5$ mm, no BOP at more than one point, and no suppuration
Failure to achieve these endpoints indicates the need for additional treatment
EFP advises re-evaluating outcomes after 6–12 weeks, with prudent and frequent monitoring during the healing phase
EFP recommends non-surgical supra and sub-marginal instrumentations with curettes and/or sonic/ultrasonic devices for peri-implantitis management
EFP discourages the use of lasers, air polishing, antimicrobial photodynamic therapy, desiccant antiseptic gel, locally administered antimicrobials, systemic antibiotics, and probiotics in non-surgical peri-implantitis therapy
These recommendations are based on concerns about patient health, potential systemic antibiotic impact on public health, and insufficient evidence supporting the efficacy of certain interventions in peri-implantitis management

**Table 7.** Recommendations for non-surgical management of peri-implantitis.

Addressing implant-supported prostheses	Vital in peri-implantitis surgical therapy
	Adjustments for hindrance to oral hygiene
	Removal during surgery enhances access and promotes optimal healing
Indications for surgical treatment	Non-surgical therapy endpoints not met (PD $\leq 5$ mm, BOP $\leq 1$ )
	Surgical intervention recommended for effective management
Efficacy of surgical procedures	Access flap or resective procedures recommended
	Aimed at reducing or eliminating pockets
	Both considered effective modalities
Addressing osseous defects	Options: access flap alone or with reconstructive procedures
	No identified evidence of superiority for specific techniques
Reconstructive approach	Applied to intra-osseous defects with depth $\leq 3$ mm
	Preferred materials: bone grafts, with or without barrier membranes
	Uncertain preference for submerged or transmucosal healing
Implant surface decontamination	Air polishing or Er:Yag laser not recommended
	Titanium brushes as an alternative
	Insufficient evidence for implantoplasty recommendation
Chemical implant surface decontamination	Chlorhexidine or photodynamic therapy not recommended
	Lack of evidence supporting improvement in outcomes
Adjunctive antibiotics	Systemically administered antibiotics not recommended
	Concerns about patient health and inconsistent evidence
	Insufficient evidence for locally administered antibiotics

**Table 8.** Recommendations for the surgical management of peri-implantitis.

It is recommended that dental teams offering implant therapy also possess the professional expertise to manage peri-implantitis. Since surgical treatment of peri-implantitis is complex, it is recommended that the surgery is provided by dentists with specific training or by specialists.

Endpoints for successful surgical therapy of peri-implantitis (Table 8):

- At implant level:  $\leq 1$  point of bleeding on probing, absence of suppuration on probing, PD  $\leq 5$  mm, and no progressive bone loss compared to pre-treatment levels;
- Recommended timeline: record clinical parameters 6 months post-treatment, with radiographs at 12 months;
- Long-term evaluation criteria: include complication-free survival of the implant and implant-supported prosthesis, along with patient satisfaction (e.g. aesthetic appreciation).

### Conclusion and key messages

Appropriate interventions for the preservation and/or restoration of peri-implant tissue health should be considered before, during and after the placement of dental implants. Risk-factor assessment and control, as well as the diagnosis and monitoring of the health/disease status of the peri-implant tissues, are essential in selecting the appropriate care pathway for each patient. Successful, long-term maintenance of peri-implant tissue health encompasses behavioural modification, health monitoring, appropriate preventive interventions, and, when necessary, careful treatment planning and execution.

Peri-implant tissue health, peri-implant mucositis, and peri-implantitis form a continuum, with changes driven by inflammation following microbial biofilm accumulation. Controlling inflammation through the removal of plaque biofilm is key to the preservation of health, and prevention and treatment of peri-implant diseases.

Preventive and treatment interventions are organized into specific needs-based care pathways. Prevention aims to achieve and maintain peri-implant tissues and thus promote



peri-implant health. This is achieved by enabling adequate self-performed and professionally delivered oral hygiene measures, which need to be customized according to the design of implant-supported restorations.

SPIC is an essential component in the management of peri-implant diseases. It is critical for preserving peri-implant tissue health and preventing disease onset, and must be offered to every patient who receives dental implants.

The aim of SPIC is to arrest the inflammatory processes within the peri-implant tissues and to control local and systemic risk factors that may perpetuate them. Disruption of the locally accumulating microbial biofilms is a key target.

Treatment of peri-implant mucositis is considered a key strategy in preventing the onset of peri-implantitis. Treatment of peri-implantitis is performed sequentially, and encompasses an initial non-surgical step, followed by a surgical step, depending on the outcomes of the initial treatment. SPIC should always be instituted, particularly upon completion of peri-implantitis treatment.

In conclusion, adopting a step-wise and minimally invasive approach is paramount in the management of peri-implant diseases. Emphasizing good oral hygiene practices, prioritizing the preservation and restoration of peri-implant health whenever feasible, and diligently identifying and mitigating risks before, during and after implant placement are key principles for successful outcomes. By incorporating these strategies, clinicians can enhance patient care and contribute to the long-term success and health of dental implants.

### Compliance with Ethical Standards

Conflict of Interest: The authors declare that they have no conflict of interest.

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## CPD ANSWERS

### MARCH 2024

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|-------------|--------------|
| <b>1. D</b> | <b>6. D</b>  |
| <b>2. C</b> | <b>7. C</b>  |
| <b>3. D</b> | <b>8. D</b>  |
| <b>4. A</b> | <b>9. A</b>  |
| <b>5. C</b> | <b>10. D</b> |