International Journal of Zoology and Applied Biosciences **ISSN: 2455-9571**
Volume 11, Issue 6, pp: 22-29, 2026
https://doi.org/10.55126/ijzab.2026.v11.i06.004 **http://www.ijzab.com**

Review Article

PERI-IMPLANTITIS MANAGEMENT: EVIDENCE-BASED NONSURGICAL AND SURGICAL TREATMENT STRATEGIES A NARRATIVE REVIEW

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Article History: Received 21st August 2026; Accepted 13th October 2026; Published 1st November 2026

ABSTRACT

The global proliferation of dental implant therapy has been accompanied by a concurrent rise in biological complications, most notably peri-implantitis an inflammatory condition characterized by progressive destruction of the peri-implant supporting tissues with associated marginal bone loss. Large-scale meta-analyses highlight a significant oral health burden with about 19.53% of implant patients and 12.53% of individual implants affected by peri-implantitis. Results of the 2024 Academy of Osseointegration/American Academy of Periodontology (AO/AAP) consensus conference, which systematically evaluated 102 studies, paved the way for an undeniable consensus framework for prevention and therapy of PIPs. The factors that were identified as risks include an obesity status, smoking, inadequate biofilm control, poorly controlled diabetes mellitus, and history of periodontitis, which were found to be critical modifiable risk factors. Therapeutic spectrum includes conservative, nonsurgical mechanical debridement methods used for reversible Peri-implant mucositis, and personalized surgery methods used to treat established Peri-implantitis. The outcome of surgery is consistently excellent with disease resolution and prevention of continued bone destruction at most patients' treated sites as shown in long-term surgical outcomes. In addition, adjunctive modalities such as erbium-doped yttrium aluminum garnet (Er:YAG) laser therapy, implant plasty and antimicrobial photodynamic therapy (aPDT) have been shown to have clinical potential as ancillary treatments. This review aims to combine the current evidence to help clinicians adopt systematic, personalized impressions to treat peri-implantitis.

Keywords: Biofilm management, Bone loss, Dental implants, Laser therapy, Mechanical debridement.

INTRODUCTION

The success of dental implants has led to an exponential rise in their use as a successful solution to replace missing teeth. Nearly 90% of all patients have had dental implants placed in the past five to ten years, and around 78% of all patients have had them placed in the past twenty years (Wang *et al*., 2025). This unprecedented increase in implant therapy has shown to have a corresponding increase in the clinical relevance of biological complications, in particular peri-implantitis, the most relevant threat to long-term success of implants. Periimplantitis is a plaque- induced inflammatory disease affecting the tissues that are surrounded by osseo-integrated implants. A comprehensive meta-analysis reported a pooled prevalence of 19.53% at the patient level and 12.53% at the implant level, highlighting its considerable clinical burden (Diaz *et al*., 2022; Rakic *et al*., 2018). These data indicate the growing significance of peri-implantitis and emphasize the need for effective strategies aimed at its prevention, early diagnosis, and management. The 2024 AO/AAP Consensus Conference marked a significant milestone in the evidence-based management of peri-implant diseases (Wang *et al*., 2025). A panel of international experts systematically reviewed 102 studies in order to collate the available evidence, standardize diagnostic criteria, and develop evidence-based clinical algorithms for the prevention and management of peri-implant diseases. This current literature review aims to collate the comprehensive evidence on the current management of peri-implantitis, including treatments that have been tried and used to evaluate the predisposing, risk and failure factors and any novel therapeutic advancements.

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The critical appraisal focuses on the effectiveness of nonsurgical and surgical treatments, whether adjunctive therapy is beneficial, and the long-term outcomes of surgery, and emphasizes the need for adopting recent systematic reviews, meta-analyses, and consensus statements to guide evidence-based clinical practice. Traditional mechanical debridement techniques are not consistently predictable in the treatment of established peri-implantitis, such as deep pockets and/or advanced bone loss (Berglundh *et al.,* 2018; Hong *et al*., 2024). The constraint has given rise to significant research into techniques using laser therapy, antimicrobial photodynamic therapy, systemic and localized antimicrobial agents, and surgical techniques. Modern therapeutic concept encourages individualized therapy based on the evidence and the landscape of disease, defect morphology and patient specific risk profile.

MATERIALS AND METHODS

Review Protocol and Literature Search Strategy

This is a narrative review to pool and synthesizes up-to-date evidence regarding the peri-implantitis management. The following MeSH terms and free-text keywords were used for bibliographic research on PubMed, Scopus, Google Scholar and ResearchGate: peri-implantitis', 'implant surface decontamination', 'nonsurgical therapy', and 'surgical management of peri-implant disease'.

AETIOLOGY AND RISK FACTORS

Fundamental Etiological Concepts

Peri-implantitis is a multifactorial disease in which bacterial biofilm exerts the primary aetiological role, modulated by complex interactions among systemic conditions, behavioral determinants, local anatomical variables, and implant-related factors. The 2024 AO/AAP meta-analysis, encompassing 102 studies involving 13,030 patients and 39,991 implants, provides robust quantitative evidence substantiating the contribution of multiple risk factors to disease development and progression (Wang *et al.,* 2025; Galarraga-Vinueza *et al.,* 2025).

Systemic and Behavioral Risk Determinants

A history of periodontitis constitutes the most significant systemic risk factor, with pooled meta-analytic data indicating that patients with prior periodontal disease have 4.05-fold greater odds of developing peri-implantitis compared to periodontally healthy individuals. Tobacco use is of comparable significance, with smokers exhibiting 2.27-fold greater odds of peri-implantitis; individual studies have reported odds ratios as high as 31.58 (Galarraga-Vinueza *et al.,* 2025).Diabetes mellitus, particularly when inadequately controlled, impairs neutrophil function, disrupts angiogenesis, and reduces collagen synthesis, collectively compromising peri-implant tissue healing and host defense. Obesity has emerged as an important contributing risk indicator, attributable to systemic low-grade inflammation characterized by elevated concentrations of pro-inflammatory cytokines, including interleukin-6 (IL-6), tumour necrosis factor-α (TNF-α), and C-reactive protein. Inadequate oral hygiene and deficient biofilm control represent the most directly modifiable causal risk factors for the initiation and progression of peri-implant disease (Wang *et al.,* 2025).

Local and Implant-Related Risk Factors

Implant malposition compromises soft tissue architecture and may precipitate unfavourable emergence profiles and excessive biomechanical loading (Wang *et al*., 2025). Residual subgingival cement associated with cement-retained restorations is significantly correlated with peri-implantitis, as it provides a persistent bacterial reservoir (Montevecchi *et al*., 2025). Over contoured prosthetic restorations hinder effective oral hygiene by creating anatomically inaccessible recesses. Implants with rough surfaces exhibit higher rates of disease recurrence and implant loss following treatment compared to machined (turned) surfaces, attributable to the inherent difficulty of thorough decontamination (Wang *et al.,* 2025). The peri-implant soft tissue phenotype, particularly the width of keratinised mucosa (KM), represents a significant and modifiable local risk factor receiving increasing recognition in contemporary clinical guidelines (Wang *et al.,* 2025). Mahardawi *et al* conducted a systematic review and meta-analysis, and revealed that a low KM was associated with developing peri-implantitis (OR = 2.78, 95% CI: 2.07-3.74; $p < 0.00001$), findings which were consistent for fixed prostheses and those who attend regular maintenance programmes. Insufficient KM breaks down the oral hygiene ability, promotes development of mucosal recession, and reduces resistance to inflammatory challenge of the tissue. Therefore, soft tissue assessment of the peri-implant phenotype needs to be part of both the pre-implant treatment plan and its risk stratification (Wang *et al.,*2025; Mahardawi *et al*., 2023).

DIAGNOSIS AND CLASSIFICATION

Diagnostic Framework

Peri-implantitis is a clinical diagnosis, and to make an accurate diagnosis, the clinical features and radiologic data must be integrated in a systematic manner. The 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions (Berglundh *et al.,* 2018) have set up the contemporary classification. Peri-implantitis is diagnosed in the presence of both: a) polymorphous different probing depths from the previous examination and/or b) polymorphous different probing depths, including the presence of either bleeding or suppuration on gentle probing and radiographic evidence of bone loss beyond anticipated level of physiologic marginal remodeling.

Clinical Assessment Parameters

From the literature, which often use similar measurements, probing depth ≥6 mm (Berglundh *et al.*, 2018); bleeding on probing (BOP) (Glikman-Bejarin, 2013); and bone loss at a maximum of 3 mm (Glikman-Bejarin, 2013) are usually used. Bleeding on probing is a good marker for peri-implant tissue inflammation, while suppuration is a sign of an active infection found to be related to higher amount of bone loss and bacterial levels.

Radiographic Evaluation

Radiographic assessment is essential for assessing bone level changes, characterizing the configuration of the defect and for assessing the response to the treatment. Radiographic bone loss levels that exceed expected margins by 3 mm or more, are an important diagnostic parameter for peri-implantitis, according to the 2024 AO/AAP consensus (Wang *et al*., 2025). The prognosis of treatment is greatly influenced by the nature of the defect. (Ramanauskaite *et al.*, 2018). They have a crater-like morphology if the defect is circumferential or contained, and has 3 or 4 surrounding bone walls, and also have a high potential to regenerate. Horizontally oriented bone defects involving only one or two bone walls, or defects where the facial bone plate is absent (dehiscence-type defect), can be treated more challenging situations. Based on the data by Khoury et al., it can be said that the morphology of the defect has a significant effect on the clinical results following regenerative therapy, and comparing the data, it can be seen that the defect morphology with containment demonstrates improvement in bone fill and in the reduction of probing depth, when compared with the non-contained defect morphologies (Khoury *et al.,* 2019).

NONSURGICAL MANAGEMENT

Treatment Rationale and Objectives

Non-surgical therapy is the initial treatment for peri-implant disease in order to eliminate bacterial biofilm, reduce the inflammatory burden and create an environment that promotes tissue healing (Suárez López Del Amo *et a*l., 2016; Hong *et al*., 2024). In patients with peri-implant mucositis without associated bone loss, nonsurgical mechanical debridement combined with oral hygiene reinforcement demonstrates high clinical efficacy and should be considered definitive treatment (Wang *et al.,* 2025). The reversible nature of peri-implant mucositis allows for complete resolution through appropriate biofilm management, without recourse to surgical intervention.

Mechanical Debridement

Mechanical debridement represents the cornerstone of nonsurgical peri-implantitis management and entails the systematic removal of supra- and subgingival bacterial deposits and calculus from implant surfaces Various instruments have been evaluated for this purpose: manual plastic curettes minimize the risk of surface damage; ultrasonic devices equipped with plastic or carbon-coated tips effectively disrupt biofilm through mechanical vibration and acoustic cavitation; and low-abrasivity air-polishing systems using glycine or erythritol powders efficiently remove biofilms without inducing significant surface alterations. Despite its status as a standard clinical intervention, nonsurgical mechanical debridement as a standalone treatment demonstrates limited predictability in resolving established peri-implantitis, particularly in cases characterized by deep pockets and significant bone loss (Hong *et al.,* 2024; Berglundh *et al.,* 2018). Yet, although short-term gains in probing depth and bleeding on probing can be obtained after nonsurgical treatment, complete resolution of the disease is not the end goal, and the vast majority of moderate and severe cases eventually require surgical intervention (Berglundh *et al.,* 2018; Suárez López Del Amo *et al*., 2016).

Adjunctive Modalities

Due to its selective ablating and antimicrobial properties, the erbium-doped yttrium aluminum garnet (Er:YAG) laser has drawn a lot of research attention (Mojaver *et al.,* 2025). The Er:YAG laser has a wavelength of 2940nm, and as water and hydroxyapatite are very absorbent, it allows efficient eradication of diseased tissue and bacterial biofilm, with minimum thermal damage to nearby tissues. A recent scoping review demonstrated that Er:YAG laser therapy combined with mechanical debridement yields clinically meaningful probing depth reductions of 1.5-3.2 mm and marginal bone level stabilization at 6-12 months of follow-up, compared to mechanical debridement alone (Mojaver *et al.,* 2025; Huang *et al.,* 2024). Chlorhexidine gluconate (0.12-0.20%) remains the most extensively investigated antiseptic agent in peri-implant disease management; however, systematic reviews indicate that it confers no statistically significant benefit over mechanical debridement alone for established peri-implantitis. A 2023 systematic review identified adjunctive systemic antibiotics as being associated with superior clinical outcomes beyond six months; (Suárez López Del Amo *et al.,* 2016) nonetheless, the 2024 AO/AAP consensus advises against their routine administration in conjunction with nonsurgical treatment, citing antimicrobial stewardship principles and concerns regarding the promotion of resistance. (Wang *et al.,* 2025). Antimicrobial photodynamic therapy (aPDT) combines photo-sensitizing agents such as toluidine blue with targeted red-light irradiation (630-690 nm) to generate reactive oxygen species that exert bactericidal effects (Rahman *et al.,* 2022; Jervøe-Storm *et al.,* 2024). A 2024 Cochrane systematic review reported very low-certainty evidence for the clinical benefits of aPDT in peri-implantitis management (Jervoe-Storm *et al.,* 2024). A 2025 systematic review, however, associated aPDT

adjunctive to conventional therapy with mean probing depth reductions of 1.2-1.8 mm (Yan *et al.,* 2025).

SURGICAL INTERVENTIONS

Indications and Treatment Rationale

Surgical intervention is indicated when nonsurgical therapy fails to achieve disease resolution, or when peri-implantitis is characterized by advanced bone loss and deep peri-implant pockets that are not amenable to effective nonsurgical management (Wang *et al.,* 2025).The European Federation of Periodontology (EFP) S3-level clinical practice guideline recommends that initial nonsurgical treatment be performed to improve peri-implant soft tissue conditions and reduce the microbial burden prior to surgical procedures. The primary objectives of surgical treatment include: (1) direct visualization and thorough decontamination of contaminated implant surfaces; (2) elimination or reduction of peri-implant pockets to facilitate long-term maintenance; (3) correction of unfavorable soft tissue architecture; and (4) regeneration of lost osseous support where clinically indicated.

Standardized outcome criteria are essential for objectively evaluating therapeutic efficacy and enabling meaningful comparisons across studies. In accordance with the EFP S3 clinical practice guideline (Herrera *et al.,* 2023),peri-implantitis treatment success is defined by the simultaneous fulfilment of the following endpoints at a minimum of six months post-treatment: probing depth ≤5 mm, absence of bleeding on probing, absence of suppuration, and no radiographic evidence of progressive bone loss relative to pre-treatment levels (Hong *et al.,* 2024; Herrera *et al.,* 2023) Despite this consensus definition, a systematic review confirmed that disease resolution is achieved in fewer than 50% of treated peri-implantitis cases, underscoring the clinical complexity of this condition and the necessity for individualized, defect-matched treatment protocols (Ramanauskaite *et al.,* 2021).

Long-Term Surgical Outcomes

A retrospective study with up to eleven years of follow-up evaluating surgical peri-implantitis treatment reported mean disease resolution rates of 58.6%, prevention of progressive bone loss in 69.6% of sites, and resolution of bleeding on probing at 59.9% of treated sites (Berglundh *et al.,* 2018). The overall implant survival rate following peri-implantitis treatment across all modalities was 88.6%. Technique-specific survival rates were: 84% for access flap debridement, 90% for resective strategies, and 95% for reconstructive/regenerative modalities (Khoury *et al.,* 2019).

Surgical Approaches

Access flap debridement involves the elevation of mucoperiosteal flaps to expose contaminated implant surfaces for systematic mechanical and chemical decontamination, without deliberate osseous recontouring. Resective therapy aims to eliminate peri-implant pockets through osteoplasty and apically repositioned flap surgery, creating a bone architecture that is conducive to long-term maintenance (Monje *et al.,* 2022). Reconstructive and regenerative surgery seeks to restore lost bone support through guided bone regeneration (GBR) utilizing barrier membranes and bone grafting materials; this approach has been associated with mean probing depth reductions of 3.78 mm, a 95% implant survival rate, and mean radiographic bone gain of 2.30 mm. Circumferential defects treated with bone grafts and barrier membranes achieve bone fill of 3.5-4.5 mm, compared to 1.0-1.5 mm for horizontal defects (Khoury *et al.,* 2019).

Implant Surface Decontamination

Thorough decontamination of implant surfaces is critical for optimizing surgical outcomes (Monje *et al.,* 2022; Wilensky *et al.,* 2023). Implantoplasty defined as the mechanical polishing of exposed implant threads to create a smooth surface reduces probing depth by 2.1-2.3 mm at 12-24 months following treatment (Mojaver *et al.,* 2025). In the clinic, chemical decontamination agents such as hydrogen peroxide, citric acid, tetracycline hydrochloride and chlorhexidine gluconate are used, but none have yet been shown to be definitively superior (Wilensky *et al.,* 2023).

Implant Removal and Re-Implantation

Explanation represents the definitive endpoint of the treatment continuum for severely compromised implants in which salvage procedures have failed or are unlikely to succeed. Current evidence supports explantation when bone loss exceeds 50% of the implant length, as such cases exhibit substantially reduced rates of success following any surgical intervention. Additional absolute indications include implant mobility, which signifies complete loss of osseointegration, and clinical scenarios where defect configuration or implant malposition precludes adequate access for decontamination (Martin Cabezas *et al.,* 2024). The decision to explant must be individualized, incorporating assessment of defect morphology, restoration type, patient risk profile, and the clinical feasibility of re-implantation. Following atraumatic explanation using reverse-torque removal kits to preserve residual alveolar bone, site rehabilitation with guided bone regeneration prior to re-implantation is recommended. Re-implantation at previously peri-implantitis-affected sites demonstrates favorable outcomes, with a cumulative survival rate of 99% reported at a mean follow-up of 34 months in a retrospective study (Anitua *et al.,* 2021).

Soft Tissue Augmentation

Correction of inadequate peri-implant soft tissue phenotype particularly KM width less than 2mm may be performed concurrently with surgical peri-implantitis treatment to optimize long-term outcomes. Autologous free gingival grafts (FGGs) remain the gold standard for KM augmentation, yielding superior KM gains compared to

xenogeneic collagen matrices; the latter, however, offer advantages in patient comfort and reduced donor-site morbidity (Wang *et al.,* 2025). Soft tissue augmentation enhances hygiene access, reduces the risk of post-surgical mucosal recession, and may contribute to greater peri-implant tissue stability over time, particularly following resective procedures in which apical flap repositioning inherently diminishes KM width (Mahardawi *et al.,* 2023).

EMERGING THERAPIES AND FUTURE DIRECTIONS

A 2025 systematic review and meta-analysis investigating the role of hyaluronic acid in peri-implant disease management reported that hyaluronic acid administered as a monotherapy or as an adjunct to conventional debridement demonstrated promising improvements in clinical outcomes, including probing depth reduction and reduction in bleeding on probing (López Valverde *et al.,* 2025). Host modulation therapy, which targets the attenuation of excessive inflammatory mediator activity, has emerged as a conceptually attractive adjunctive paradigm. Sub-antimicrobial-dose doxycycline (SDD; 20 mg twice daily) inhibits matrix metalloproteinases (MMPs) at sub-bacteriostatic concentrations, potentially reducing connective tissue degradation without conferring selective pressure for antibiotic resistance (Golub *et al.,* 2024).Advanced molecular diagnostic techniques, including next-generation sequencing, enable comprehensive characterization of the peri-implant microbiome, facilitating the rational selection of individualized antimicrobial regimens based on defined pathogenic profiles. Genetic polymorphisms in inflammatory mediator genes particularly those encoding interleukins, TNF-α, and MMPs may contribute to inter-individual variation in peri-implantitis susceptibility, suggesting potential for pharmacogenomic risk stratification and personalized treatment intensification for genetically predisposed individuals.

SUPPORTIVE PERI-IMPLANT MAINTENANCE

After active therapy, the necessity of patients to enter structured supportive maintenance programmes is crucial, aiming at sustaining the good clinical success already achieved, while preventing disease relapse (Roccuzzo *et al*., 2010; Heitz Mayfield *et al.,* 2018). A ten-year prospective cohort study revealed that patients that were not receiving preventive maintenance were at a significantly increased risk of developing peri-implant disease (Roccuzzo *et al.,* 2010). The following elements should be performed during each maintenance appointment: Appropriate surface-specific debridement (plastic curette, carbon-coated ultrasonic tips, and non-metallic scalers); a systematic monitoring of probing depths, bleeding on probing, and suppuration; reinforcement of patient's oral hygiene. Patients at higher risk level, recognized as the ones with a previous history of periodontitis, current smoking, poorly controlled diabetes mellitus, inability to effectively control soft-tissue biofilm, rough surface implants or repeated peri-implantitis, are seen every 3 months whilst the low-risk group with stable peri-implantation is seen once a half year (Monje *et al*., 2016). The results of this narrative review reinforce the idea that peri-implantitis is a complex, multifactorial clinical situation that requires a disease-driven, systemic approach that is delivered in a step-by-step manner and depends on the severity of the disease and patient-related risk factors. Treatment with nonsurgical methods is recommended in all cases, especially when peri-implant mucositis is diagnosed, because the correct biofilm management of the implant structure combined with the proper patient education alone could resolve the disease (Wang *et al*., 2025; Hong *et al*., 2024). It is well established that, when bone loss is substantial and peri-implantitis has been established, nonsurgical treatment is limited in treating the condition (Hong *et al*., 2024; Berglundh *et al.,* 2018). Surgery is indicated in these situations and the choices of surgery access flap debridement, resective surgery or reconstructive surgery should be directed towards the defect morphology and long-term prognosis (Khoury *et al.,* 2019; Monje *et al.,* 2022). For contained circumferential defect regenerative surgery has been shown to be consistently successful while resective surgery for defects with horizontal shrinkage patterns are better suited (Khoury *et al*., 2019; Berglundh *et al*., 2018).

Adjunctive treatments with Er:YAG laser and aPDT have been shown to be clinically promising when used in conjunction with mechanical debridement, but the evidence supporting these treatments is inadequate and high-quality RCTs are needed for routine clinical recommendation (Mojaver *et al.,* 2025; Ramanauskaite *et al*., 2021). Individualized recall intervals are an important component of prevention of disease recurrence and supportive maintenance continues to be the key to long-term therapeutic success (Roccuzzo *et al*., 2010). POs are a vital yet underutilized aspect of peri-implantitis treatment evaluation, in addition to clinical parameters. Oral health related quality of life (OHRQoL) is negatively impacted by peri-implantitis diagnosis and its treatment; most often measured by the Oral Health Impact Profile (OHIP-14) (Jackson *et al.,* 2025; Camps Font *et al.,* 2023). Some studies found oral health issues at baseline and surgical morbidity, especially pain and discomfort during the first surgery week, as the major PRO concern in the short-term. More patient discomfort is observed immediately after reconstructive surgery vs. access flap surgery but most patients have satisfactory results at 3 months post-surgery. One lacking research and currently untouched condition-specific PRO instrument for peri-implantitis is noteworthy (Camps Font *et al.,* 2023). Standardized PRO measures together with clinical endpoints were not included in future investigations and will provide patient-centered assessment of treatment success. A stepwise treatment algorithm supports evidence-based clinical decision-making for peri-implantitis management. Following comprehensive risk assessment and patient education, the protocol commences with nonsurgical debridement and biofilm control. Treatment response is evaluated at 8-12 weeks: resolution of peri-implant mucositis confirms disease control, whereas persistent peri-implantitis with probing depth >5 mm and

positive bleeding on probing warrants surgical evaluation. Surgical modality selection is then determined by defect morphology resective surgery for horizontal bone loss and resective combined with reconstructive procedures for intraosseous defects with concurrent KM augmentation where keratinised mucosa width is less than 2 mm. Implant removal is reserved for advanced bone loss exceeding 50% of implant length or confirmed implant mobility (Wang *et al.,* 2025; Hong *et al.,* 2024; Herrera *et al.,* 2023; Martin Cabezas *et al.,* 2024).All treated patients are enrolled in individualized supportive maintenance programmes stratified according to risk level (Monje *et al.,* 2016).

A few of the limitations of this review deserve to be noted. This is a narrative review and the literature selection process was not devoid of selection bias - boxes were not completed under PRISMA and a risk-of-bias assessment was not performed, so it is not possible to perform a formal evidence grade. Significant methodological differences among the included studies exist, including the definition of the diagnostic criteria, measures of outcome, length of follow-up, and patient populations, making direct quantitative comparisons difficult. Most good evidence comes from specialist academic centers, and may be only generalizable to a general dental practice setting. Since only positive treatment outcomes are published, an artificially high estimate of efficacy may result. Further, and now most important, the 2024 AO/AAP consensus (Wang *et al.,* 2025). Some recommendations may be subsequently modified in the light of further evidence as it becomes available over time as the many supporting systematic reviews are recent. Future research should focus on standardized definitions of cases, validated patient reported outcome (PRO) instruments, as well as on long-term RCTs with quality and consistent cases definitions and maintenance regimens for greater quality and comparability in this rapidly evolving field.

CONCLUSION

Peri-implantitis is a prevalent and clinically significant biological complication of dental implant therapy that demands a structured, evidence-based management approach. Nonsurgical mechanical debridement remains the first-line treatment and demonstrates high efficacy for peri-implant mucositis; however, its capacity to resolve established peri-implantitis with bone loss is limited, and the majority of moderate-to-severe cases ultimately require surgical intervention. Surgical management constitutes the cornerstone of definitive peri-implantitis treatment and is indicated when nonsurgical therapy fails to achieve disease resolution, or when severe bone loss and deep peri-implant pockets are present. Access flap debridement provides direct implant surface visualization and decontamination with an 84% implant survival rate; resective surgery achieves 90% implant survival for horizontal bone loss; and reconstructive/regenerative surgery delivers superior long-term outcomes, including a 95% implant survival rate, a mean probing depth reduction of 3.78 mm, and a mean radiographic bone gain of 2.30 mm. Implant removal is indicated for bone loss exceeding 50% of implant length or confirmed implant mobility, and re-implantation at previously affected sites demonstrates a survival rate of approximately 99% with appropriate site rehabilitation (Khoury *et al.,* 2019; Anitua *et al.,* 2021). Long-term success is contingent upon defect-matched treatment selection, meticulous surgical technique, correction of inadequate peri-implant soft tissue phenotype where applicable, and adherence to strict individualized supportive maintenance programmes, recognizing that peri-implantitis is a chronic condition requiring sustained professional management. Prevention through pre-implant risk assessment, comprehensive patient education, and early identification of modifiable risk factors remains the most cost-effective strategy for reducing the global burden of this condition. Key research priorities include the development of standardized outcome definitions, validated patient-reported outcome measures, and long-term randomized controlled trials to further optimize evidence-based protocols for peri-implantitis prevention and management.

ACKNOWLEDGEMENT

The authors express sincere thanks to the head of the Department of Periodontology, SRM Kattankulathur Dental College and Hospital, Faculty of Medicine and Health Sciences, SRM Institute of Science and Technology, Kattankulathur, Chengalpattu for the facilities provided to carry out this research work.

CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

FUNDING

This study received no specific funding from public, commercial, or not-for-profit funding agencies.

AI TOOL DECLARATION

The authors declare that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Not applicable

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