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REVIEW ARTICLE

Efficacy of Probiotic Therapy in the Management of Peri-Implant Diseases

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ABSTRACT

Long-term implant success is seriously threatened by peri-implant illnesses, which include peri-implant mucositis and peri-implantitis. These conditions are frequent biological side effects of dental implant therapy. These disorders are mostly biofilm-induced inflammatory illnesses brought on by an overreaction of the host immune system and a dysbiotic peri-implant microbiome. Although mechanical debridement, antiseptics, and adjuvant antimicrobial medications are the mainstays of conventional management regimens, treatment results are still uncertain, especially for peri-implantitis. Instead of indiscriminately eliminating microorganisms, probiotic treatment has become a unique adjuvant strategy that aims to restore microbial balance and modulate host immune responses. The biological justification, experimental data, and clinical results related to probiotic therapy in the treatment of peri-implant disorders are all rigorously assessed in this study. Current evidence suggests that probiotics may be beneficial in managing peri-implant mucositis, while their role in peri-implantitis remains limited and adjunctive.

Introduction

Probiotics are defined as live microorganisms that, when administered in sufficient quantities, provide health benefits to the host [1]. Over the past twenty years, there has been extensive research into probiotics in both medicine and dentistry, focusing on their ability to influence microbial ecosystems and modulate host immune responses. In the oral cavity, probiotics have been suggested as a therapeutic

adjunct for the management of biofilm-associated conditions, such as dental caries and periodontal diseases [2].

Dental implants are commonly used to restore function for patients who are partially or completely edentulous, and they have high reported survival rates. However, there is growing concern about biological complications associated with these implants. Peri-implant diseases are inflammatory conditions that affect the soft and hard tissues around dental implants, and they are categorised into two types: peri-implant mucositis and peri-implantitis [3].

Peri-implant mucositis is characterised by reversible inflammation of the soft tissues surrounding the implant, without any loss of supporting bone. In contrast, peri-implantitis involves progressive bone loss around the implant and can ultimately result in implant failure if not treated promptly [3,4].

The accumulation of microbial biofilm is acknowledged as the primary etiological factor in the onset and progression of peri-implant diseases. The microbiota associated with peri-implants exhibits significant similarities to periodontal pathogens, primarily comprising Gram-negative anaerobic bacteria that can provoke destructive inflammatory responses in the host. Conventional treatment strategies typically emphasise mechanical disruption of the biofilm and decontamination of the implant surface; however, achieving complete resolution of inflammation is often difficult, particularly in cases of peri-implantitis [4,5].

Given these limitations, biologically driven adjunctive approaches such as probiotic therapy have gained increasing attention in peri-implant disease management.

Etiopathogenesis of Peri-Implant Diseases

Various factors, including microbial, host-related, and iatrogenic elements, influence the development of peri-implant diseases. Unlike natural teeth, implants lack a periodontal ligament, which leads to differences in blood supply and immune defense mechanisms. This absence may increase the risk of inflammation surrounding the implants [4].

Histopathological and microbiological studies have shown that peri-implantitis lesions contain complex biofilms primarily composed of anaerobic Gram-negative bacteria, including Porphyromonas gingivalis, Tannerella forsythia, and Treponema denticola. Additionally, opportunistic organisms such as Staphylococcus species are also present [5]. These pathogens trigger the release of pro-inflammatory cytokines and matrix-degrading enzymes, which contribute to the destruction of connective tissue and the resorption of alveolar bone [5].

Biological Rationale for Probiotic Therapy

The rationale for using probiotics in the context of peri-implant diseases is grounded in the ecological plaque hypothesis, which highlights the significance of maintaining microbial balance instead of solely focusing on the elimination of pathogens. Probiotic strains, particularly those belonging to the Lactobacillus and Bifidobacterium genera, can inhibit pathogenic bacteria through mechanisms such as competitive adherence, nutrient competition, and the production of antimicrobial substances like bacteriocins and organic acids [2].

Moreover, probiotics have demonstrated the ability to modulate the host's immune responses by downregulating pro-inflammatory mediators and enhancing the production of anti-inflammatory cytokines, ultimately helping to mitigate tissue damage associated with chronic inflammation [2].

Evidence from In-Vitro and Animal Studies

In vitro studies have shown that certain probiotic strains can inhibit the growth of peri-implant pathogens and decrease biofilm formation on titanium surfaces [2]. Furthermore, experimental animal studies indicate that administering probiotics leads to reduced peri-implant inflammation and bone loss, suggesting a protective effect on peri-implant tissues [5]. While these findings offer valuable mechanistic insights, their direct application to human clinical outcomes remains limited.

Clinical Evidence in Peri-Implant Mucositis

Randomised controlled clinical trials have assessed the role of probiotics as an adjunct to mechanical debridement in the treatment of peri-implant mucositis. One notable study found that the addition of Lactobacillus reuteri lozenges led to significant

reductions in bleeding on probing and peri-implant inflammation compared to a placebo [6]. Subsequent clinical investigations reported improvements in plaque index, bleeding on probing, and peri-implant probing depths following short-term probiotic supplementation, suggesting a notable enhancement in the resolution of soft tissue inflammation [7].

Clinical Evidence in Peri-Implantitis

The role of probiotics in the management of peri-implantitis remains a topic of debate. Clinical trials assessing the effectiveness of probiotic supplementation as an adjunct to non-surgical therapy for peri-implantitis have typically shown minimal additional clinical benefits when compared to mechanical debridement alone [8].
A randomised controlled trial indicated that there were no significant differences in probing depth reduction or radiographic bone gain between the probiotic and control groups, suggesting that probiotics alone are inadequate for addressing advanced peri-implantitis lesions [8].

Evidence from Systematic Reviews

Systematic reviews have consistently highlighted the heterogeneity among studies examining the role of probiotics in peri-implant diseases [9,10]. These reviews suggest that while probiotics may confer short-term clinical benefits in cases of peri-implant mucositis, there is limited evidence supporting their efficacy in peri-implantitis. Narrative reviews further emphasise that probiotics should be regarded as adjunctive agents, rather than replacements for established mechanical or surgical treatment methods [11].

Limitations and Future Perspectives

The existing body of evidence is constrained by small sample sizes, short follow-up durations, and the absence of standardised probiotic protocols [10,12]. Additionally, differences in probiotic strains, dosages, and delivery methods make it challenging to draw comparisons across studies. Therefore, future long-term randomised controlled trials employing standardised methodologies are essential to determine strain-specific efficacy and clarify the clinical role of probiotics in the management of peri-implant diseases [12].

Conclusion

Probiotic therapy offers a biologically plausible adjunctive strategy for managing peri-implant diseases. Current evidence indicates that it can be beneficial in reducing inflammation associated with peri-implant mucositis when combined with traditional mechanical therapy. However, its effectiveness in treating peri-implantitis is still limited and inconsistent. Therefore, at this stage, probiotics should be used solely as a complement to established treatment protocols until more robust clinical evidence is available.

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