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Periodontitis and Implant Failure: Current Trends and Literature Review

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Abstract

The severity and specificity of periodontal and peri-implant diseases depend on various factors - the level of oral hygiene, the interaction between the bacterial agent and the local and general immune response, as well as the presence of various risk elements such as genetic factors, diabetes, immunosuppression, smoking, etc. Periodontal and peri-implant diseases are treatable conditions with timely detection and treatment, which includes non-surgical, surgical and supportive periodontal/peri-implant therapy together with the patient's motivation to achieve and maintain excellent oral hygiene.

Periodontitis and peri-implantitis have a specific bacterial etiology and cause the release of immuno-inflammatory mediators involved in the destruction of periodontal/peri-implant tissue, and a good understanding of the mechanisms can lead to the development of new therapeutic methods and tools for the prevention, stabilization or slowing of the progression of periodontal/peri-implant disease. In this review, we track current trends in the periodontal-implant system relationship, understanding the mechanisms mediating periodontal/peri-implant tissue destruction, peri-implant complications and their management, modulation by the innate immune response, and modern treatment strategies.

Keywords: implants, implant failure, periimplantitis, periodontitis

Introduction

In contemporary clinical practice, dental implant treatment plays a crucial role in restoring both the aesthetic and functional aspects of oral health. It offers a versatile solution for rehabilitating partial or complete edentulism (1). Since the introduction of dental implants by Brånemark in the 1970s, they have become a widely accepted treatment modality for diverse patient populations worldwide (2). Periodontitis is recognized as a major contributor to tooth loss, necessitating replacement options; however, its impact on implant therapy remains a subject of concern. Successful implant outcomes depend on multiple factors, while various biological and technical complications may contribute to treatment failure (1,3). Implant failures are generally classified as early or late, depending on the timing of functional loading. Early failures occur before functional loading, whereas late failures arise after occlusal loading is applied or following the initial removal of a provisional restoration in cases of immediate implant loading (4). The role of periodontitis in implant complications has been extensively explored in the literature, particularly considering the 2018 Classification of Periodontal and Peri-Implant Diseases and Conditions, which categorizes periodontitis based on stages, distribution, and grades (5). Over the past decades, implant therapy has gained increasing popularity; however, a concurrent rise in peri-implant diseases has been observed, highlighting the need for further

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investigation and improved management strategies (6). Dental implants are a reliable treatment for tooth loss, but periodontitis increases complications, necessitating further research.

Aim

This review aims to summarize scientific findings on the relationship between periodontitis and implant failure.

Material and methods

Search methods: The authors have searched the following electronic databases: PubMed and MEDLINE mainly from 2007 to 2025. Only English language articles were included in periodontology and implantology and hand- searched reference lists of the studies were retrieved.
Selection criteria: We included randomised controlled trials, literature reviews involving periimplantitis, periodontitis and dental implantology. Studies were directed to relationship between periodontitis and biological complications of dental implants.
Data collection and analysis: Three review authors independently extracted data from selected studies. This literature review will summarize the current up-to-date information about a connection between periodontitis (in its various stages, grades and activity) and peri-implantitis.

Results

In recent decades, dental implant treatment has become a widely accepted option for replacing missing teeth in partially or completely edentulous patients. Although generally regarded as a highly predictable procedure, several underlying factors may pose a risk to its long-term success. Dental implant treatment not only restores oral function but also plays a crucial role in enhancing patients' self-esteem and overall quality of life. The loss of natural teeth can significantly impact speech, chewing ability, and facial aesthetics, often leading to reduced self-confidence and social discomfort. By providing a stable and natural-looking replacement, implants help patients regain their smile, improving their psychological well-being and social interactions. Studies have shown that successful implant rehabilitation contributes to greater patient satisfaction, emotional stability, and a more positive self-image, reinforcing the importance of ensuring long-term implant success, especially in patients with a history of periodontitis. Regarding to the periodontitis extensive research has focused on periodontal disease as a potential contributor to both early and late implant failure. The relationship between periodontal disease and implant failure remains a subject of debate. It is unclear whether periodontitis itself directly contributes to implant loss or if the presence of an untreated infection is the primary influencing factor. Since periodontitis, peri-implant mucositis, and peri-implantitis share a common inflammatory nature, there is a strong possibility of an interrelated pathological mechanism that may increase the risk of implant complications (1).
Numerous studies have shown that patients with periodontitis face a significantly higher risk of complications, including bone loss, peri-implantitis, and implant failure, compared to those without a history of periodontal disease (1–3). Several researchers propose that the severity of periodontitis plays a critical role in the likelihood of implant loss. Evidence suggests that as periodontitis becomes more severe, the risk of implant-related complications, including peri-implantitis and implant failure, increases proportionally (4). A meta-analysis conducted by Sgolastra et al. indicates that individuals with periodontal disease are at an increased risk of bone loss around dental implants compared to those with no history of the condition. The authors

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further conclude that there is moderate evidence supporting periodontitis as a contributing factor to peri-implantitis, implant failure, and peri-implant bone loss (5). Consistent with these findings, another study reported that patients with periodontitis exhibit significantly higher rates of marginal bone loss, implant failure, and postoperative infections compared to those with healthy periodontal conditions(4,6). All these data align with the suggestion that inadequate management of periodontal disease and untreated periodontal infection play a crucial role in determining the long-term success of dental implants (1). Persistent periodontal inflammation can compromise the stability of the implant by contributing to progressive bone loss, increasing the risk of peri-implantitis, and ultimately leading to implant failure. This is emphasized in a study by Yari et al. that concluded early implant failure was more frequent at sites where implants were placed after tooth extraction due to periodontitis (7). This suggests that a history of periodontal disease may negatively impact the healing process and initial stability of the implant, reinforcing the need for thorough pre-implant disease management.

Scientific evidence indicates a correlation between a history of periodontitis and an increased risk of implant failure. Research suggests that, irrespective of its severity (moderate or severe), periodontitis is linked to a twofold increase in peri-implant bone loss compared to individuals with healthy periodontal conditions (8). In a recent study the authors are concluding that the implant survival is related to a history of periodontitis and other factors such as smoking (9). A retrospective study examined the impact of a history of periodontitis, considering different stages and grades, on the development of peri-implantitis. The findings revealed a significantly higher implant failure rate in grade C patients (with a rapid progression of periodontitis) demonstrating statistical significance ($p < 0.05$). The authors concluded that disease grade may be a risk factor for marginal bone loss. However, a direct correlation between the overall stage and grade of periodontitis and the prevalence of peri-implantitis was not definitively established (10). Scientific evidence highlights a strong link between a history of periodontitis and an increased risk of implant failure, with higher peri-implant bone loss and failure rates observed in affected patients. While factors such as disease severity and progression play a role, the exact correlation between periodontitis staging and peri-implantitis remains inconclusive, emphasizing the need for careful patient assessment and management.

Several studies suggest that with adequate professional intervention and meticulous personal oral care, effective control of periodontal disease can significantly reduce the risk of implant-related complications. This indicates that patients with a history of periodontitis can still achieve successful outcomes with dental implants, provided that their periodontal condition is well-managed and closely monitored (11). Correia et al. suggested that the extent, severity, and rate of progression of periodontitis were not significantly associated with implant failure or treatment outcomes. They further concluded that, with appropriate treatment and effective disease control, patients with periodontitis can achieve clinical outcomes comparable to those of individuals without a history of periodontal disease (11). In another systematic review, the authors stated that the presence or absence of periodontitis does not have a significant impact on implant survival rates. Their findings suggest that both short-term and long-term implant success rates remain comparable between individuals with a history of periodontitis and those with healthy periodontal conditions (12). This implies that, when periodontal disease is properly managed, patients with a history of periodontitis can achieve implant survival outcomes like those without periodontal disease. The general agreement highlights the necessity of properly assessing and managing periodontal disease to enhance the success rates of dental implants. Peri-implantitis and implant failure rates increased in stage IV periodontitis as well as in heavy smokers (13). However, continuous monitoring and maintenance remain essential to ensure long-term success.

In a study by Chatzopoulos and Wolf, which analysed patient records spanning over a decade, no significant association was found between the extent, severity, or progression rate of periodontitis and implant treatment outcomes (14). However, patients with periodontitis, regardless of the disease's distribution, stage, or grade, exhibited an increased risk of implant failure (14). In a cross-sectional study conducted by Ciurescu et al.,

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potential risk indicators for implant failure were examined (15). The findings suggested that certain periodontal health parameters negatively affect implant survival rates. Specifically, poor plaque control, insufficient keratinized tissue (≤2 mm), the time in function, and a history of periodontitis were identified as factors with a statistically significant impact on implant failure (15). In a systematic review with meta-analysis, Annunziata et al. (16) evaluated the risk of peri-implant complications associated with periodontal disease. Their findings confirmed that a history of periodontitis significantly increases the likelihood of implant failure and long-term implant loss. When comparing different stages of periodontitis, a strong correlation was identified between implant failure and severe periodontitis (stages III and IV), whereas no significant association was observed in cases of mild to moderate periodontitis (stages I and II). Additionally, a higher rate of disease progression (grade C) was linked to an increased risk of marginal bone loss and peri-implantitis.

Different studies showed that periodontitis and peri-implantitis presented the same top seven bacteria (17) and has a significant impact on the peri-implantitis rate, pocket depth, mean bone loss and survival rate(18-20) Usually there is not association between periodontitis stage or grade and the prevalence of peri-implantitis but when peri-implantitis is detected a relationship between periodontitis grade and severity of peri-implantits or the occurrence of implant failure was found in most of cases (21-23) Proinflammatory cytokines as TNF-α and IL-1β were significantly elevated in peri-implantitis. The microflora involved in peri-implantitis differs from periodontitis and may consist of opportunistic pathogens including: Porphyromonas gingivalis, Prevotella intermedia, Aggregatibacter actinomycetemcomitans, Treponema denticola, Treponema socranskii, Tannerella forsythia, Streptococcus mitis, Staphylococcus anaerobius, Staphylococcus aureus, Staphylococcus intermedius, Epstein–Barr virus, human cytomegalovirus, and human herpesvirus 4 and 5 (24-28).

Building upon these findings, recent studies have further explored the microbiological and immunological aspects linking periodontitis and peri-implantitis. Research has shown that both conditions share the same top seven bacterial species (17), significantly influencing peri-implantitis rates, pocket depth, mean bone loss, and overall implant survival (18-20). While no direct correlation is typically observed between the stage or grade of periodontitis and the prevalence of peri-implantitis, a clear relationship emerges once peri-implantitis develops. Specifically, most studies have reported a connection between periodontitis grade and the severity of peri-implantitis or implant failure (21-23). Additionally, inflammatory markers such as the proinflammatory cytokines TNF-α and IL-1β are significantly elevated in peri-implantitis, underscoring the host immune response's role in disease progression. Interestingly, while peri-implantitis shares some microbial similarities with periodontitis, its microflora composition also includes opportunistic pathogens such as Porphyromonas gingivalis, Prevotella intermedia, Aggregatibacter actinomycetemcomitans, Treponema denticola, Tannerella forsythia, Streptococcus mitis, Staphylococcus anaerobius, Staphylococcus aureus, Staphylococcus intermedius, Epstein–Barr virus, human cytomegalovirus, and human herpesvirus 4 and 5 (24-28). These findings emphasize the complex microbial and inflammatory interactions that influence peri-implant disease progression and highlight the importance of personalized treatment strategies for at-risk patients.

Home message

The evidence overwhelmingly supports the notion that a history of periodontitis is associated with an increased risk of implant failure, peri-implant bone loss, and peri-implantitis. While some studies suggest that disease severity and progression influence implant outcomes, others indicate that, with appropriate management, patients with periodontitis can achieve comparable implant success rates to those with healthy periodontal conditions. The lack of a definitive correlation between periodontitis stage and implant failure highlights the complexity of the relationship and underscores the need for individualized treatment planning. Effective periodontal disease control, professional maintenance, and patient compliance play a crucial role in optimizing implant longevity.

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Conclusion

Despite the growing body of evidence, further research is essential to clarify the exact mechanisms linking periodontitis to implant failure and to establish standardized risk assessment protocols. Large-scale longitudinal studies and well-controlled clinical trials are needed to evaluate the long-term success of implants in periodontitis patients and to develop more precise guidelines for their management. Future research should also explore innovative treatment strategies to mitigate peri-implant complications and improve outcomes for at-risk patients. While a definitive correlation between periodontitis staging and implant failure remains inconclusive, it is evident that effective disease control, professional maintenance, and patient compliance are critical for optimizing implant longevity. Continuous monitoring, smoking cessation, and meticulous oral hygiene should be emphasized to mitigate risks and improve long-term implant survival in periodontitis-affected patients.

Based on the scientific literature, future research should focus on refining risk assessment strategies for dental implant survival in patients with a history of periodontitis. Longitudinal studies with standardized diagnostic criteria are needed to establish a clearer correlation between different stages and grades of periodontitis and implant failure. Additionally, further investigations focused on the role of systemic factors, such as diabetes and genetic predisposition, in implant outcomes among periodontitis patients. Advancements in biomaterials and surface modifications of implants should also be examined to enhance the knowledge about the relation between periodontitis and implant complications, including implant failure.

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