Key Systemic and Environmental Risk Factors for Implant Failure

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KEYWORDS

• Risk factors • Dental implant failure • Systemic disease • Peri-implantitis • Smoking • Marginal bone loss

KEY POINTS

- Dental implant failure is related to several risk factors, including systemic disease, periodontal disease, and environmental factors.
- Poorly controlled disease may contribute to perimucositis and peri-implantitis, potentially leading to implant complications, including failure.
- Although few risk factors are absolute contraindications to implant placement, further research is needed to determine which combination(s) of factors predisposes patients to perimucositis and peri-implantitis, important precursors to implant failure.

INTRODUCTION

Many studies have demonstrated the long-term success of dental implants in replacing teeth missing because of caries or periodontal disease. A significant number of published articles detail the success of various types of implants placed in specific situations, such as those placed in bone-augmented sites. Implant failure has long been understood as the complete loss of the dental implant, but it is becoming apparent that an increasing number of implants are associated with perimucositis or peri-implantitis. Published reports indicate that peri-implantitis affects approximately 10% of implants and 20% of patients[1]; however, the incidence is higher in some reports, depending on the thresholds used to define the condition.[2] Despite the variability in definitions and the wide array of designs of the studies assessing the success or failure of implants, it is reasonable to assume that we will continue to see an increase in the prevalence of inflammatory processes that affect implants and that

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may lead to destruction of connective tissue or bone. This article reviews key systemic, periodontal, and environmental risk factors associated with implant failure, as well as perimucositis and peri-implantitis.

MICROBIOLOGY OF PERI-IMPLANTITIS AND PERIMUCOSITIS AND COMPARISON WITH PERIODONTITIS

The primary etiologic factor for peri-implant mucositis is the oral biofilm. This initial challenge to the host defense mirrors the challenge that affects the natural dentition. The initial adherence of bacteria to the implant surface can vary with the type of surface topography. Implants with rough surfaces enhance the initial bacterial colonization.[3,4] In general, sites affected by periodontitis and peri-implantitis contain more gram-negative bacteria than healthy sites.[5] The types of bacteria associated with healthy implants and failing implants are similar to those associated with healthy and diseased teeth, but there are also some important differences. Kumar and colleagues[6] used 16S pyrosequencing to analyze subgingival and submucosal plaque samples from subjects with healthy implants and from subjects with periodontitis and peri-implantitis. They found that peri-implant biofilms differed between the 2 groups: There was less diversity in the type of bacteria, but, with increasing disease, the numbers of *Prevotella* and *Leptotrichia* were lower and the numbers of *Campylobacter, Actinomyces,* and *Peptococcus* were higher. Cortelli and colleagues[7] found that the frequency of *Porphymonas gingivalis* was higher in cases of peri-implantitis than in cases of perimucositis and that the levels of *P gingivalis and Aggregatibacter actinomycetemcomitans* were similar in periodontitis and peri-implantitis. The levels of *Campylobacter rectus* and *Tannerella forsythia* were higher in healthy gingiva than in gingiva affected by peri-implant mucositis. On the other hand, a study by Koyanagi and colleagues[8] found more bacterial diversity in peri-implantitis sites than in periodontitis sites (198 taxa in peri-implantitis, 148 taxa in periodontitis). *Fusiform bacterium* and *Streptococcus* species were common in association with both peri-implantitis and periodontitis, whereas *Parvimonas micra* were seen only in association with peri-implantitis. Dabdoub and colleagues[9] conducted a patient-specific analysis of peri-implant and periodontal microbiomes associated with implants adjacent to teeth and found significant differences in both the populations and the levels of participant microbes, concluding that the proximity of an implant to a tooth does not account for the bacterial species seen in peri-implant tissues.

The microbial community may have shared attributes and, as discussed, some differences when both natural dentition and implants are present, but what are the microbial characteristics of implants when no natural teeth are present? A study by Kocar and colleagues[10] evaluated partially edentulous patients and found the frequency of 4 of the periodontopathogens assessed (*P gingivalis*, *T forsythia*, *T denticola*, and *A actinomycetemcomitans)* was higher in pockets 4 mm or deeper than in shallow pockets ($\leq$4 mm), but was not different from the frequency of these pathogens in association with implants adjacent to natural teeth. However, none of these bacteria were found in the implant sites of completely edentulous patients. Additional studies are needed to assess the progression of peri-implantitis and the microbial ecology in edentulous patients.

Reported risk factors for perimucositis and peri-implantitis include a history of previous periodontal disease.[2] Presumably, if the periodontopathogens that exist in the peri-implant pocket are similar to those that exist in the natural dentition, then the host response and the subsequent soft tissue and hard tissue destruction would be similar to those for a natural tooth. In comparing the various levels of severity of