The Microbiome of Peri-Implantitis

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This entry aimed to systematically compare microbial profiles of peri-implantitis to those of periodontitis and healthy implants. Therefore, an electronic search in five databases was conducted. For inclusion, studies assessing the microbiome of peri-implantitis in otherwise healthy patients were considered. Literature was assessed for consistent evidence of exclusive or predominant peri-implantitis microbiota. Of 158 potentially eligible articles, data of 64 studies on 3730 samples from peri-implant sites were included in this study. Different assessment methods were described in the studies, namely bacterial culture, PCR-based assessment, hybridization techniques, pyrosequencing, and transcriptomic analyses. After analysis of 13 selected culture-dependent studies, no microbial species were found to be specific for peri-implantitis. After assessment of 28 studies using PCR-based methods and a meta-analysis on 19 studies, a higher prevalence of *Aggregatibacter actinomycetemcomitans* and *Prevotella intermedia* (log-odds ratio 4.04 and 2.28, respectively) was detected in peri-implantitis biofilms compared with healthy implants. *Actinomyces* spp., *Porphyromonas* spp. and *Rothia* spp. were found in all five pyrosequencing studies in healthy-, periodontitis-, and peri-implantitis samples.

Keywords: culture-dependent techniques ; hybridization ; oral pathogens ; PCR ; pyrosequencing

1. Introduction

To date, dental implants have shown high survival rates of up to 99% over 10 years [1][2]. Even if much stricter criteria on success are applied, the concept of dental implantology still appears promising [3][4], despite the fact that certain limitations of the relevant techniques become evident. Besides minor prosthetic complications (such as crown loosening or ceramic chipping, which can mostly be resolved easily, and without big effort) peri-implantitis, as the most common reason for biologic failure, is much more challenging [4][5]. The prognosis of peri-implantitis therapy, however, is far away from satisfactory today [6][7]. The key feature of peri-implantitis is the progressive loss of marginal peri-implant bone as a symptom of chronic inflammation of the peri-implant tissues [6]. While particular co-factors, such as diabetes mellitus [8][9], tobacco smoking [10][11], and insufficient oral hygiene [12][13] were found to accelerate the progress of bone destruction, the primary etiologic reason for the inflammation of peri-implant tissues is the oral biofilm [14]. Peri-implantitis-associated biofilms, colonizing exposed implant surfaces, are composed of a plethora of microbial species [15][16]. Accordingly, any cause-related treatment of peri-implantitis aims at effectively removing established microbial biofilms and preventing new biofilm formation [6]. Like in the therapy of periodontal inflammation, which is also biofilm-induced, mechanical biofilm removal has been proven to be the most efficient treatment modality. Therefore, hand instruments, such as scalers or curettes, ultrasonic tips, or air-abrasive devices [6][17], and sometimes different kind of lasers [18], are used. Moreover, antimicrobials have also been used, yet with limited success [19][20]. Both measures, however, mechanical and antiseptic biofilm control, represent very generic treatment strategies and do not conform to the need for individualized, specific, and sophisticated therapy schemes. In general, both therapeutic approaches show strong limitations. In particular, mechanical access for debridement of submucosal areas and narrow infra-bony defects is difficult and cannot be performed to a satisfactory extent [17][21][22]. Antimicrobial agents, on the other hand, are largely ineffective due to the immanent defense mechanisms of mature biofilms, such as osmotic barrier function and downregulation of bacterial metabolism [23], especially if the biofilm infrastructure had not been destroyed previously by mechanical means [24][25]. Gaining more specific insights into the composition of peri-implant biofilm might trigger the development of targeted treatment approaches and, thereby, improve the prognosis of peri-implantitis treatment. Regarding the composition of peri-implantitis-associated biofilm, a number of key pathogens have been strongly associated with the peri-implant inflammation so far. Since suppuration is a characteristic clinical finding in cases of peri-implantitis, *Staphylococcus aureus* has been suspected to play a major role in the pathology of the disease due to its typical pyogenic potential, which is already well-known in the field of dermatology [26][27]. However, recent studies using modern diagnostic tools and molecular-based identification techniques did not support this hypothesis [28][29]. After comparing the microbiome of healthy and inflamed implant sites, Belibasakis and co-workers found a predominance of three groups of *Treponema* spp. and a *Synergistetes* cluster A around diseased implants [30].

However, there is still some controversy among researchers about whether the composition of biofilm in peri-implantitis is really different from the composition of biofilms in periodontitis-affected sites, or even from the microflora around healthy dental implants [29][31][32]. Accordingly, the aim of the present study is to systemically review the relevant literature regarding the composition of biofilm of diseased peri-implantitis sites and to compare the microbiome of healthy sites to that found at sites affected by periodontitis. Additionally, this systematic review aimed to describe the microbiologic profiles of peri-implantitis, periodontitis, and healthy implants based on culture-dependent and culture-independent methods.

2. Conclusion

In conclusion, the body of evidence does not show a consistent specific profile. Future studies should focus on the assessment of sites with different diagnosis for the same patient, and investigate the complex host-biofilm interaction.

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