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Editorial

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Oral Microbiome, Biofilm Control and Precision Dentistry

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Introduction

The oral cavity hosts a complex and dynamic community of microorganisms collectively known as the oral microbiome. These microbes play a crucial role in maintaining oral health, but imbalances in their composition can lead to common dental diseases such as caries, periodontal disease, and peri-implantitis. Dental plaque is a structured biofilm formed by these microorganisms on tooth surfaces. Effective biofilm control is therefore central to preventing oral diseases. Precision dentistry, an emerging concept inspired by precision medicine, integrates biological, behavioral, and technological data to provide individualized dental care. Understanding the oral microbiome and its biofilms is fundamental to this personalized approach [1,2].

Discussion

The oral microbiome consists of hundreds of bacterial species, along with fungi and viruses, that exist in a balanced ecosystem. In health, these microorganisms contribute to immune regulation and prevent colonization by pathogenic species. However, poor oral hygiene, dietary habits, systemic conditions, and environmental factors can disrupt this balance, leading to dysbiosis. Dysbiotic biofilms become more pathogenic, producing acids and inflammatory mediators that damage teeth and supporting tissues [3,4].

Biofilm control remains a primary strategy in preventing oral diseases. Mechanical plaque removal through brushing and interdental cleaning is the most effective method for disrupting biofilms. Chemical agents such as fluoride, chlorhexidine, and antimicrobial mouth rinses support mechanical control by reducing microbial load and inhibiting biofilm formation. Advances in biofilm research have also led to the development of targeted agents that interfere with bacterial communication, adhesion, and metabolism rather than indiscriminately killing bacteria [5].

Precision dentistry builds upon these insights by tailoring prevention and treatment strategies to individual patients. Microbiome profiling allows clinicians to identify specific microbial patterns associated with caries or periodontal disease risk. Combined with genetic, behavioral, and clinical data, this information supports personalized preventive plans, including customized hygiene protocols, dietary recommendations, and targeted antimicrobial therapies. Digital technologies, such as artificial intelligence and chairside diagnostic tools, further enhance decision-making by predicting disease progression and treatment outcomes.

By focusing on maintaining a balanced oral microbiome rather than complete microbial eradication, precision dentistry promotes long-term oral health and minimizes overtreatment. This patient-centered approach also improves treatment efficiency and outcomes.

Conclusion

The integration of oral microbiome science with biofilm control strategies is transforming modern dental practice. Precision dentistry leverages microbiological insights and advanced technologies to deliver individualized care that targets disease risk while preserving microbial balance. Effective biofilm management, combined with personalized prevention and treatment, offers a promising pathway toward improved oral health outcomes and more sustainable dental care in the future.

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