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Plaque Biofilm: Microbiome, Disease, and Interventions

Elena Kostas*

Dept. of Geriatric Dentistry, Athens Dental School, University of Athens, Athens, Greece

***Corresponding Author:** Elena Kostas, Dept. of Geriatric Dentistry, Athens Dental School, University of Athens, Athens, Greece, E-mail: ekostas@adsua.gr **Received:** 01-Nov-2025, Manuscript No. johh-25-174153; **Editor assigned:** 03-Nov-2025, PreQC No. johh-25-174153(PQ); **Reviewed:** 17-Nov-2025, QC No. johh-25-174153; **Revised:** 24-Nov-2025, Manuscript No. johh-25-174153(R); **Published:** 01-Dec-2025, **DOI**: 10.4172/2332-0702.1000517

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Abstract

This collection of research underscores the critical role of dental plaque and the oral microbiome in oral health and disease, including periodontal issues and caries. It delves into microbial composition, biofilm characteristics, and the transition from health to disease, highlighting specific bacterial profiles as diagnostic indicators. Studies explore various therapeutic strategies, such as microbiome modulation with probiotics and advanced plaque control methods, alongside novel diagnostic and treatment technologies. The findings collectively emphasize the importance of understanding microbial interactions for developing effective preventive and interventional approaches to maintain oral health.

Keywords

Dental plaque; Oral microbiome; Periodontal disease; Biofilm; Probiotics; Oral health; Therapeutic strategies; Diagnosis; Treatment; Gingivitis

Introduction

This article systematically reviews and meta-analyzes the microbial composition of dental plaque, differentiating between periodontally healthy and diseased individuals. It highlights distinct microbial profiles associated with periodontal health and disease, offering insights into potential diagnostic markers and therapeutic targets based on the specific bacterial species found in dental plaque [1].

This body of work emphasizes that understanding these distinct microbial profiles is crucial for developing potential diagnostic markers and effective therapeutic targets.

This comprehensive review delves into the intricate role of the oral microbiome in both dental plaque formation and the progression of periodontal disease. It details how specific microbial communities contribute to dysbiosis, leading to inflammatory responses and tissue destruction, emphasizing the importance of understanding these interactions for targeted therapeutic strategies [2].

The complex interplay between these microbial communities and host immune responses dictates the trajectory of oral health, necessitating targeted interventions based on a deeper understanding of these microbial interactions.

This article provides a current perspective on the complex relationship between oral microbiota and dental plaque. It discusses how the dynamic microbial community in plaque contributes to oral health and disease, highlighting advances in understanding biofilm formation, microbial interactions, and their implications for preventing and treating oral infections [3].

Such a perspective underscores the importance of advanced insights into biofilm formation and the dynamics of microbial interactions for improving the prevention and treatment of oral infections.

This review synthesizes recent research on the role of specific oral microorganisms in the pathogenesis of periodontal disease and

dental caries, both of which are initiated by dental plaque. It discusses how certain bacterial species contribute to dysbiosis, biofilm formation, and subsequent tissue destruction, offering insights into targeted prevention and treatment strategies [8].

Insights gained from this research are vital for the development of targeted prevention and treatment strategies against these widespread oral health issues.

This review explores the mechanisms by which oral microbiota contribute to both health and disease, including plaque formation and periodontal issues. It discusses various therapeutic strategies aimed at modulating the oral microbiome, such as probiotics, prebiotics, and antimicrobial approaches, to maintain oral homeostasis and prevent pathology [5].

Exploring these mechanisms and therapeutic avenues is paramount to maintaining oral homeostasis and preventing pathology, making the modulation of the oral microbiome a central theme in contemporary oral healthcare.

This study employs advanced imaging and spectroscopic techniques to characterize the complex biofilm matrix within dental plaque. It reveals detailed insights into the structural and chemical composition of the extracellular polymeric substances, which are crucial for plaque stability and microbial survival, informing strategies for effective plaque control [4].

These detailed insights into the structural and chemical composition of the extracellular polymeric substances are indispensable for formulating effective plaque control strategies, highlighting the biophysical aspects of dental plaque.

This narrative review explores various current strategies for controlling dental plaque, ranging from mechanical methods like brushing and flossing to chemical agents such as antimicrobial mouthwashes and innovative approaches. It discusses their efficacy and limitations, offering insights for both clinical practice and future research in maintaining oral hygiene [6].

Evaluating the efficacy and limitations of these diverse strategies provides a foundation for enhancing both clinical practice and future research directions in oral hygiene maintenance.

This systematic review and meta-analysis evaluates the efficacy of various toothpastes in reducing dental plaque and gingivitis. It synthesizes evidence on the active ingredients and formulations that are most effective, providing clinicians and consumers with evidence-based recommendations for selecting toothpastes to improve oral hygiene [7].

Such evidence-based recommendations are essential for guiding clinicians and consumers in selecting the most effective toothpastes to improve oral hygiene and prevent associated diseases.

This article explores emerging technologies for both diagnosing and treating dental plaque-related diseases. It covers innovations in diagnostic tools, such as advanced imaging and molecular diagnostics, as well as novel therapeutic approaches like targeted antimicrobials, photodynamic therapy, and nanomaterials, aiming for more precise and effective interventions [9].

These advancements promise to revolutionize interventions, moving towards more precise and effective management of dental plaque-related diseases through innovative diagnostic and therapeutic modalities.

This narrative review examines the antagonistic activity of various probiotics against common oral pathogens found in dental plaque. It highlights how beneficial bacteria can inhibit the growth and virulence of cariogenic and periodontopathic microbes, suggesting probiotics as a promising adjunctive strategy for preventing and managing dental plaque-related diseases [10].

Collectively, these studies highlight the multifaceted nature of dental plaque, from its microbial inhabitants and structural integrity to its impact on oral health and disease. The continuous pursuit of novel diagnostic and therapeutic approaches, alongside refined preventive strategies, remains a cornerstone of dental research, aiming to improve global oral health outcomes. These efforts are unified by the goal of combating dental plaque's detrimental effects through a comprehensive understanding of its biological underpinnings and effective clinical management.

Description

This article systematically reviews and meta-analyzes the microbial composition of dental plaque, differentiating between periodontally healthy and diseased individuals. It highlights distinct microbial profiles associated with periodontal health and disease, offering insights into potential diagnostic markers and therapeutic targets based on the specific bacterial species found in dental plaque [1]. This systematic review and meta-analysis specifically differentiates microbial profiles between periodontally healthy and diseased individuals, pinpointing specific bacterial species that act as potential diagnostic markers and therapeutic targets. This comprehensive review delves into the intricate role of the oral microbiome in both dental plaque formation and the progression of periodontal disease. It details how specific microbial communities contribute

to dysbiosis, leading to inflammatory responses and tissue destruction, emphasizing the importance of understanding these interactions for targeted therapeutic strategies [2]. The review highlights how distinct microbial communities contribute to dysbiosis, triggering inflammatory responses and subsequent tissue destruction, which underscores the need to comprehend these interactions for developing targeted therapeutic strategies. This article provides a current perspective on the complex relationship between oral microbiota and dental plaque. It discusses how the dynamic microbial community in plaque contributes to oral health and disease, highlighting advances in understanding biofilm formation, microbial interactions, and their implications for preventing and treating oral infections [3]. This ongoing perspective explores the dynamic microbial community within plaque and its implications for both oral health and disease, emphasizing advances in understanding biofilm formation and complex microbial interactions. This review synthesizes recent research on the role of specific oral microorganisms in the pathogenesis of periodontal disease and dental caries, both of which are initiated by dental plaque. It discusses how certain bacterial species contribute to dysbiosis, biofilm formation, and subsequent tissue destruction, offering insights into targeted prevention and treatment strategies [8]. Recent research further synthesizes the role of specific oral microorganisms in the pathogenesis of periodontal disease and dental caries, explaining how bacterial species contribute to dysbiosis, biofilm formation, and tissue damage, thus guiding targeted prevention. This ongoing research continuum continually seeks to unravel the complexities of oral microbiota, providing foundational knowledge for future preventive and restorative dental practices.

This study employs advanced imaging and spectroscopic techniques to characterize the complex biofilm matrix within dental plaque. It reveals detailed insights into the structural and chemical composition of the extracellular polymeric substances, which are crucial for plaque stability and microbial survival, informing strategies for effective plaque control [4]. This characterization provides essential insights into the structural and chemical composition of extracellular polymeric substances, which are fundamentally important for maintaining plaque stability and microbial survival, informing more effective plaque control measures.

This review explores the mechanisms by which oral microbiota contribute to both health and disease, including plaque formation and periodontal issues. It discusses various therapeutic strategies aimed at modulating the oral microbiome, such as probiotics, prebiotics, and antimicrobial approaches, to maintain oral homeostasis and prevent pathology [5]. This review thoroughly discusses various therapeutic strategies, including probiotics, prebiotics, and antimicrobial methods, all aimed at modulating the oral microbiome to restore and maintain oral homeostasis and prevent pathological conditions. This narrative review examines the antagonistic activity of various probiotics against common oral pathogens found in dental plaque. It highlights how beneficial bacteria can inhibit the growth and virulence of cariogenic and periodontopathic microbes, suggesting probiotics as a promising adjunctive strategy for preventing and managing dental plaque-related diseases [10]. The narrative review specifically focuses on the antagonistic activity of diverse probiotics against common oral pathogens found within dental plaque, suggesting probiotics as a significant adjunctive strategy for preventing and managing plaque-related diseases through inhibition of pathogen growth and virulence.

This narrative review explores various current strategies for controlling dental plaque, ranging from mechanical methods like brushing and flossing to chemical agents such as antimicrobial mouthwashes and innovative approaches. It discusses their efficacy and limitations, offering insights for both clinical practice and future research in maintaining oral hygiene [6]. The narrative review critically examines a range of current strategies for controlling dental plaque, encompassing mechanical approaches like brushing and flossing, chemical agents such as antimicrobial mouthwashes, and other innovative techniques, assessing their efficacy and limitations. This systematic review and meta-analysis evaluates the efficacy of various toothpastes in reducing dental plaque and gingivitis. It synthesizes evidence on the active ingredients and formulations that are most effective, providing clinicians and consumers with evidence-based recommendations for selecting toothpastes to improve oral hygiene [7]. This systematic review and meta-analysis provides an evidence-based evaluation of different toothpastes and their effectiveness in reducing both dental plaque and gingivitis, offering clear recommendations for improving oral hygiene.

This article explores emerging technologies for both diagnosing and treating dental plaque-related diseases. It covers innovations in diagnostic tools, such as advanced imaging and molecular diagnostics, as well as novel therapeutic approaches like targeted antimicrobials, photodynamic therapy, and nanomaterials, aiming for more precise and effective interventions [9]. This article highlights innovations across diagnostic tools, including advanced imaging and molecular diagnostics, and explores novel therapeutic interventions such as targeted antimicrobials, photodynamic therapy, and nanomaterials, all aimed at achieving more precise and effective management of plaque-related conditions.

Conclusion

Dental plaque, a complex microbial biofilm, plays a pivotal role in oral health and disease, particularly in the pathogenesis of periodontal disease and dental caries. Research differentiates microbial profiles in healthy versus diseased individuals, identifying specific bacterial species as potential diagnostic markers and therapeutic targets. The oral microbiome's intricate involvement in plaque formation and disease progression is well-documented, with specific communities contributing to dysbiosis, inflammation, and tissue destruction. Understanding biofilm formation and microbial interactions is key to preventing and treating oral infections. Advanced imaging techniques offer insights into the structural and chemical composition of the extracellular polymeric substances crucial for plaque stability. Therapeutic strategies aim to modulate the oral microbiome, including the use of probiotics, prebiotics, and antimicrobials to maintain oral homeostasis. Current plaque control methods range from mechanical actions like brushing to chemical agents such as antimicrobial mouthwashes, with studies evaluating the efficacy of different toothpastes. Emerging technologies are enhancing the diagnosis and treatment of plaque-related diseases, involving advanced imaging, molecular diagnostics, targeted antimicrobials, and nanomaterials. Probiotics show promise in inhibiting the growth and virulence of oral pathogens, offering an adjunctive strategy for managing plaque-related conditions. Understanding these dynamics is key to developing effective oral health interventions and advanced preventive care strategies.

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