

THE ROLE OF SALIVARY OXIDATIVE STRESS BIOMARKERS IN PERIODONTAL INFLAMMATION AND TOOTH LOSS

S. J. Kuralov

Abstract

Oxidative stress is an important biological mechanism involved in inflammatory diseases of the oral cavity. An imbalance between reactive oxygen species and antioxidant defense mechanisms may contribute to periodontal tissue damage and increase the risk of tooth loss. Saliva provides a convenient, non-invasive biological sample for investigating oxidative stress biomarkers. This article examines the role of salivary malondialdehyde, total antioxidant capacity, and antioxidant enzymes in periodontal inflammation and the development of conditions associated with tooth loss. Understanding these biochemical processes may improve the assessment of periodontal health and support the development of more individualized preventive and therapeutic approaches.

Keywords

Oxidative stress, saliva, periodontal inflammation, tooth loss, malondialdehyde, antioxidants, periodontal disease.

Introduction

Periodontal diseases are among the major causes of damage to the tissues supporting natural teeth. Chronic inflammation can lead to periodontal attachment loss, alveolar bone resorption, tooth mobility, and eventual tooth loss. Although bacterial biofilm initiates periodontal inflammation, the host immune response significantly influences the severity of tissue destruction.

Oxidative stress has attracted considerable attention in periodontal research because excessive production of reactive oxygen species (ROS) may damage cellular structures and intensify inflammatory reactions. Investigating oxidative stress biomarkers in saliva may provide additional information about the biological processes occurring in periodontal tissues.

Oxidative Stress in Periodontal Inflammation

Reactive oxygen species are naturally produced during cellular metabolism and immune responses. Under physiological conditions, antioxidant mechanisms regulate their activity. However, excessive ROS production during periodontal inflammation can overwhelm these protective mechanisms.

This imbalance promotes lipid peroxidation, protein oxidation, and cellular damage. Malondialdehyde (MDA), a product of lipid peroxidation, is frequently investigated as a marker of oxidative damage. Increased salivary MDA concentrations have been associated with periodontal disease, although values may vary according to disease severity and laboratory methods.

A systematic review and meta-analysis by Chen et al. (2019) reported increased levels of several oxidative stress markers and reduced total antioxidant capacity in the saliva of patients with chronic periodontitis. These findings support the potential value of biochemical markers in periodontal research, while highlighting the need for standardized assessment procedures.

Salivary Antioxidant Defense

Saliva contains enzymatic and non-enzymatic antioxidants that help protect oral tissues against oxidative damage. Important antioxidant enzymes include superoxide dismutase (SOD), catalase, and glutathione peroxidase (GPx). Total antioxidant capacity reflects the combined activity of multiple antioxidant components.

Changes in these parameters may indicate disturbances in the oral redox balance. However, individual enzymes do not always demonstrate consistent changes across different studies. Therefore, combining several biomarkers with clinical periodontal measurements may provide a more reliable assessment.

Saliva collection is relatively simple, painless, and suitable for repeated sampling. Nevertheless, results can be influenced by salivary flow rate, food intake, oral hygiene, smoking, medications, systemic diseases, and sample handling.

Clinical Significance

Salivary oxidative stress biomarkers may complement conventional periodontal examination by providing information about local biochemical

conditions. Their potential applications include monitoring inflammatory changes, evaluating responses to periodontal treatment, and investigating factors associated with progressive periodontal destruction.

However, these biomarkers should not replace established clinical assessments, including periodontal probing, bleeding on probing, attachment-level measurements, and radiographic evaluation when indicated. Furthermore, an association between oxidative stress and periodontal disease does not establish that oxidative stress alone causes tooth loss.

Future clinical studies should investigate biomarker changes before and after periodontal therapy and determine whether these measurements improve diagnostic accuracy or predict disease progression.

Conclusion

Salivary oxidative stress biomarkers offer promising research tools for investigating periodontal inflammation and processes associated with tooth loss. Malondialdehyde, total antioxidant capacity, and selected antioxidant enzymes may contribute to a broader understanding of oral redox balance. Their clinical interpretation requires standardized laboratory methods and consideration of individual patient characteristics. Further longitudinal studies are necessary to establish their diagnostic and prognostic value in periodontal practice.

References

1. Chen, M., Cai, W., Zhao, S., et al. (2019). Oxidative stress-related biomarkers in saliva and gingival crevicular fluid associated with chronic periodontitis: A systematic review and meta-analysis. *Journal of Clinical Periodontology*, 46(6), 608–622. <https://doi.org/10.1111/jcpe.13112>
2. Wang, Y., Andrukhov, O., & Rausch-Fan, X. (2017). Oxidative stress and antioxidant system in periodontitis. *Frontiers in Physiology*, 8, 910. <https://doi.org/10.3389/fphys.2017.00910>
3. *The Emerging Role of Salivary Oxidative Stress Biomarkers as Prognostic Markers of Periodontitis: New Insights for a Personalized Approach in*

Dentistry.

(2023).

Antioxidants.

<https://pmc.ncbi.nlm.nih.gov/articles/PMC9964692/>