

ASSESSMENT OF OXIDATIVE STRESS AND THE LIPID PEROXIDATION–ANTIOXIDANT DEFENSE SYSTEM IN PATIENTS WITH SECONDARY EDENTULISM

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Abstract

Secondary edentulism is a common dental condition that affects oral function, masticatory efficiency, nutritional habits, and quality of life. In addition to its mechanical and functional consequences, tooth loss may be accompanied by changes in the oral environment, periodontal inflammation, and alterations in local biochemical processes. Oxidative stress, resulting from an imbalance between reactive oxygen species and antioxidant defense mechanisms, is an important factor in the pathogenesis of various oral diseases. Lipid peroxidation can damage cellular membranes and generate reactive products that contribute to tissue injury. This article reviews the significance of evaluating oxidative stress and the lipid peroxidation–antioxidant defense system in patients with secondary edentulism. Particular attention is given to malondialdehyde, antioxidant enzymes, total antioxidant capacity, and the potential role of saliva as a diagnostic medium. Understanding these biochemical parameters may contribute to a more comprehensive assessment of oral health and the biological response to prosthetic treatment. However, the relationship between secondary edentulism itself and oxidative stress requires further investigation using standardized clinical and laboratory protocols.

Keywords: *Secondary edentulism, oxidative stress, lipid peroxidation, antioxidant defense system, malondialdehyde, reactive oxygen species, saliva, prosthetic dentistry, oral health.*

Introduction

The loss of natural teeth represents a significant clinical problem in modern dentistry. Secondary edentulism may develop as a consequence of dental caries, periodontal diseases, trauma, and other pathological conditions. Depending on the number and location of missing teeth, this condition can impair mastication, speech,

facial appearance, and overall quality of life. Timely prosthetic rehabilitation is therefore essential for restoring oral function and preventing further complications. Traditionally, the assessment of patients with secondary edentulism has focused on clinical examination, the condition of the remaining teeth, periodontal tissues, alveolar bone, and the selection of appropriate prosthetic constructions. Nevertheless, biochemical processes within the oral cavity may also provide valuable information about tissue condition and inflammatory activity.

Oxidative stress occurs when the production of reactive oxygen species (ROS) exceeds the capacity of antioxidant defense mechanisms to neutralize them. Although ROS participate in normal cellular signaling and immune responses, their excessive accumulation can damage lipids, proteins, and nucleic acids. Research on oral diseases has demonstrated the relevance of oxidative stress to inflammatory processes and periodontal tissue damage (Brock et al., 2014).

The lipid peroxidation–antioxidant defense system is particularly important because cellular membranes contain polyunsaturated fatty acids that are susceptible to oxidative damage. Evaluating this system may help researchers better understand the biological conditions accompanying tooth loss and prosthetic rehabilitation.

Oxidative Stress and Lipid Peroxidation in Oral Tissues

Lipid peroxidation is a chain reaction initiated when reactive species attack susceptible lipids in cellular membranes. This process can alter membrane permeability, disrupt cellular functions, and generate secondary products capable of interacting with proteins and other biomolecules.

Malondialdehyde (MDA) is one of the most frequently investigated markers of lipid peroxidation. Its concentration can provide indirect information about oxidative damage, although interpretation depends on the biological sample, analytical method, and clinical context. Another commonly studied marker is 8-isoprostane, which is formed through the oxidation of arachidonic acid and can be used to investigate lipid oxidative damage.

In dentistry, oxidative stress has been studied extensively in relation to periodontitis and other inflammatory oral conditions. Increased oxidative activity and changes in antioxidant capacity have been reported in patients with periodontal

disease, suggesting that redox imbalance may contribute to tissue injury (Brock et al., 2014).

However, it is important to distinguish the effects of tooth loss from those of the diseases that caused it. Secondary edentulism does not necessarily indicate oxidative stress in every patient. The biochemical profile may be influenced by periodontal inflammation, age, smoking, diabetes, nutritional status, medication use, and systemic diseases. Therefore, these factors should be considered when interpreting laboratory findings.

The Antioxidant Defense System

The human body possesses several mechanisms for limiting oxidative damage. These include enzymatic antioxidants, such as superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx), as well as non-enzymatic antioxidants, including glutathione, uric acid, and certain vitamins.

Superoxide dismutase converts superoxide radicals into hydrogen peroxide, while catalase and glutathione peroxidase help eliminate hydrogen peroxide and other peroxides. These mechanisms work together to maintain redox balance and protect tissues from excessive oxidative reactions.

When antioxidant activity is insufficient relative to oxidant production, cellular structures may become more vulnerable to damage. In the oral cavity, local inflammation, microbial activity, and exposure to dental materials may influence the balance between oxidative processes and antioxidant protection. Reviews of dental materials have also highlighted the potential for some restorative and prosthetic materials to affect oral redox homeostasis, although the effects vary according to material composition and clinical circumstances (Brock et al., 2014; *The Effect of Selected Dental Materials*, 2021).

For patients with secondary edentulism, the assessment of antioxidant defense may therefore complement conventional clinical examination. Nevertheless, a single biochemical marker should not be used independently to establish a diagnosis or determine the need for prosthetic treatment.

Laboratory Assessment and Clinical Significance

A comprehensive investigation may include the measurement of lipid peroxidation products and antioxidant parameters in saliva, blood, or other clinically appropriate biological samples. Saliva is particularly useful in dental research because it can be collected non-invasively and reflects aspects of the local oral environment.

Potential laboratory parameters include MDA, 8-isoprostane, SOD, catalase, glutathione peroxidase, and total antioxidant capacity. Using several complementary markers may provide a more informative picture than measuring a single parameter. Clinical studies should clearly define participant selection criteria, the extent of tooth loss, periodontal status, systemic health, smoking history, and prosthetic treatment history. Where possible, researchers should include an appropriate comparison group and use standardized sample collection, storage, and analytical procedures.

Longitudinal assessment before and after prosthetic rehabilitation may help determine whether treatment is associated with changes in oxidative stress markers. For example, a study of removable complete dentures investigated MDA, advanced oxidation protein products, catalase, and the inflammatory regulator NF- κ B in the oral cavity, illustrating the relevance of biochemical assessment in prosthetic dentistry (*The Influence of Removable Complete Denture*, 2024).

Such investigations may help clarify whether observed biochemical changes reflect inflammation, adaptation to a prosthesis, the properties of the materials used, or broader systemic influences. At present, oxidative stress markers should be regarded as complementary research and assessment tools rather than established stand-alone diagnostic tests for secondary edentulism.

Conclusion

Assessment of oxidative stress and the lipid peroxidation–antioxidant defense system may broaden the understanding of oral tissue conditions in patients with secondary edentulism. Markers such as malondialdehyde and 8-isoprostane, together with antioxidant enzymes and total antioxidant capacity, offer potential approaches for investigating oxidative balance in the oral cavity.

Their interpretation requires consideration of periodontal inflammation, systemic health, lifestyle factors, and the characteristics of prosthetic treatment. Further well-designed clinical studies are needed to establish reliable reference values, clarify the relationship between tooth loss and oxidative stress, and determine whether biochemical monitoring improves treatment planning or outcomes. Integrating laboratory findings with clinical examination may ultimately support a more comprehensive and individualized approach to prosthetic rehabilitation.

References

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