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Short communication

Salivary biomarkers in periodontal disease: a biochemical perspective

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Introduction

Periodontal disease is a chronic inflammatory condition characterized by progressive destruction of the tooth-supporting tissues. Its pathogenesis involves a complex interaction between dysbiotic oral biofilm, host immune activation, and biochemical tissue injury. Persistent inflammatory stimulation promotes the release of cytokines, reactive oxygen species, and tissue-degrading enzymes, which together contribute to connective-tissue breakdown and alveolar bone loss (de Molon et al., 2026; Foroughi et al., 2025).

In this context, saliva represents a clinically accessible biological matrix that may reflect inflammatory, enzymatic, and redox-related changes occurring in the periodontal environment. Salivary biomarkers, including cytokines, matrix metalloproteinases, tissue-injury enzymes, and oxidative-stress markers, have therefore attracted increasing interest as complementary indicators of periodontal disease activity (Radu et al., 2025). Taken together, salivary biomarker profiling may provide a useful biochemical framework for understanding periodontal inflammation, tissue injury, and redox imbalance.

Saliva as a biochemical matrix

Saliva is increasingly recognized as a biologically informative matrix for evaluating periodontal disease because it contains locally derived and systemically influenced components. In addition to secretions from major and minor salivary glands, whole saliva includes gingival crevicular fluid, desquamated epithelial cells, immune mediators, bacterial products, enzymes, and metabolites released from periodontal tissues. This composition allows saliva to reflect dynamic changes within the oral inflammatory environment (Radu et al., 2025).

From a practical perspective, saliva collection is noninvasive, painless, inexpensive, and suitable for repeated sampling, which makes it attractive for longitudinal monitoring. However, its diagnostic and monitoring value depends on careful interpretation, since salivary composition may be influenced by sampling conditions, oral hygiene, systemic factors, disease stage, and analytical methodology (Foroughi et al., 2025; Radu et al., 2025). Therefore, saliva should be considered not only as a convenient diagnostic fluid, but also as a biologically complex matrix requiring standardized evaluation before reliable clinical application.

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Salivary biomarker patterns

Several groups of salivary biomarkers have been investigated in periodontal disease, including inflammatory mediators, enzymes related to tissue injury, and oxidative-stress markers. Cytokines such as IL-1β, IL-6, and TNF-α reflect activation of the host immune-inflammatory response and have been associated with periodontal tissue destruction and disease progression. Among enzymatic biomarkers, matrix metalloproteinases, particularly MMP-8, are of special relevance because of their role in collagen degradation and connective-tissue breakdown. Other salivary enzymes, such as lactate dehydrogenase and alkaline phosphatase, may also provide information on cellular injury, tissue turnover, and periodontal destruction (de Molon et al., 2026; Foroughi et al., 2025). Oxidative-stress biomarkers represent another important biochemical dimension of periodontal disease. Increased levels of malondialdehyde, advanced oxidation protein products, and 8-hydroxy-2'-deoxyguanosine indicate oxidative damage to lipids, proteins, and DNA, whereas reduced total antioxidant capacity reflects impaired antioxidant defense mechanisms. Together, these changes suggest that periodontal disease is not reflected in saliva through a single biomarker, but through combined patterns of inflammation, enzymatic tissue injury, and redox imbalance (Radu et al., 2025).

Clinical interpretation and therapeutic monitoring

The clinical value of salivary biomarkers depends not only on their detection, but also on their biological interpretation. In periodontal disease, increased inflammatory mediators, tissue-degradation enzymes, and oxidative-stress markers may reflect active tissue injury, while their changes after therapy may indicate modulation of inflammatory, enzymatic, and redox-related pathways. In this sense, salivary biomarkers may provide insight not only into disease activity, but also into the biochemical pattern of host response following periodontal intervention. This is particularly relevant for enzymatic biomarkers, since markers associated with connective-tissue breakdown, cellular damage, and tissue turnover may complement conventional clinical parameters such as probing depth, bleeding on probing, and clinical attachment loss (Radu et al., 2025).

Despite this potential, salivary biomarker interpretation remains incompletely standardized. Differences in saliva collection protocols, patient characteristics, disease classification, analytical methods, and biomarker combinations may influence reported findings and limit direct comparison between studies (Foroughi et al., 2025; Radu et al., 2025). Therefore, salivary biomarkers should currently be considered complementary biochemical indicators rather than standalone diagnostic or therapeutic-monitoring tools. Future studies should focus on integrated biomarker panels that combine inflammatory, enzymatic, and redox-related markers with clinical periodontal assessment.

Conclusion

Salivary biomarkers provide a biologically meaningful framework for understanding periodontal disease as a process involving inflammation, enzymatic tissue injury, and redox imbalance. Rather than reflecting disease activity through a single marker, saliva appears to capture combined biochemical changes occurring within the periodontal environment. Current evidence supports the potential of salivary biomarker profiling as a complementary approach to conventional periodontal assessment. However, its clinical use remains limited by variability in sampling, analytical methods, biomarker selection, and interpretation. Further standardized studies using integrated biomarker panels are needed to clarify the role of saliva in periodontal therapy monitoring and personalized periodontal care.

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