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CHRONIC PERIODONTITIS IN PATIENTS WITH FUNCTIONAL DYSPEPSIA: POSSIBLE ORAL–GUT INTERACTIONS AND BIOCHEMICAL MECHANISMS

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Abstract

Chronic periodontitis is a multifactorial inflammatory disease characterized by persistent inflammation of the periodontal tissues, destruction of the periodontal ligament, and progressive alveolar bone loss. Functional dyspepsia is a common gastrointestinal disorder characterized by upper abdominal discomfort, early satiety, postprandial fullness, and epigastric pain or burning in the absence of an identifiable structural disease. Although these conditions affect different anatomical systems, increasing evidence suggests that they may be interconnected through inflammatory, microbial, metabolic, and neuroimmune mechanisms. The oral–gut axis represents one possible pathway linking periodontal inflammation with gastrointestinal dysfunction. Periodontal pathogens and their products may enter the gastrointestinal tract through swallowed saliva, while systemic inflammatory mediators may influence gastrointestinal homeostasis. This article discusses the possible relationship between chronic periodontitis and functional dyspepsia, with particular attention to oral and intestinal microbiota, cytokines, oxidative stress, bacterial lipopolysaccharides, and the intestinal barrier. Current evidence supports a biological plausibility of this association, although further clinical and longitudinal studies are required to establish causality.

Keywords: chronic periodontitis, functional dyspepsia, oral microbiome, gut microbiota, oral–gut axis, inflammation, cytokines, oxidative stress, lipopolysaccharide.

Introduction

Chronic periodontitis is one of the most common inflammatory diseases of the oral cavity. It develops as a result of a complex interaction between dysbiotic subgingival microorganisms and the host immune response. Clinically, periodontitis may lead to gingival bleeding, periodontal pocket formation, tooth mobility, connective tissue destruction, and alveolar bone resorption.

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Functional dyspepsia (FD), in contrast, is a gastrointestinal disorder characterized by symptoms such as epigastric pain, epigastric burning, early satiety, and postprandial fullness without an adequate structural explanation. The pathogenesis of FD is complex and may involve impaired gastric accommodation, abnormal gastric emptying, visceral hypersensitivity, psychological factors, disturbances of the gut–brain axis, and gastrointestinal microbiota alterations. Frontiers

Recent research has suggested that oral and gastrointestinal diseases should not always be considered as completely independent conditions. The oral cavity is continuously connected with the gastrointestinal tract through swallowing, and microorganisms from the oral cavity can reach the stomach and intestine. Reviews of the oral–gut axis indicate that periodontal disease may be associated with alterations in gut microbial composition and systemic inflammatory processes. PubMed+1

Therefore, the coexistence of chronic periodontitis and functional dyspepsia may represent an important clinical and research problem.

Chronic Periodontitis and Systemic Inflammation

Periodontitis is initiated by a dysbiotic microbial community located in the dental biofilm. Important periodontal microorganisms include *Porphyromonas gingivalis*, *Fusobacterium nucleatum*, *Treponema denticola*, *Tannerella forsythia*, and other anaerobic bacteria.

Bacterial components stimulate periodontal cells and immune cells through pattern-recognition receptors, including Toll-like receptors (TLRs). One important bacterial component is lipopolysaccharide (LPS), which is present in the outer membrane of Gram-negative bacteria.

A simplified biochemical pathway can be represented as:

Bacterial LPS → TLR activation → NF-κB activation → pro-inflammatory cytokines → tissue inflammation

Activation of inflammatory signaling pathways may increase the production of cytokines such as interleukin-1β (IL-1β), interleukin-6 (IL-6), and tumor necrosis factor-α (TNF-α). These mediators contribute to periodontal connective tissue destruction and stimulation of osteoclast activity.

The inflammatory response is therefore not limited to the periodontal pocket. Bacteria, bacterial products, and inflammatory mediators can enter the systemic circulation, particularly during chewing, tooth brushing, or periodontal inflammation.

Functional Dyspepsia and Gastrointestinal Microbiota

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The pathophysiology of functional dyspepsia is multifactorial. One of the mechanisms currently being investigated is gastrointestinal dysbiosis.

The intestinal microbiota participates in digestion, production of metabolites, regulation of epithelial barrier function, and interaction with the immune and nervous systems. Alterations in the composition or metabolic activity of intestinal microorganisms may influence mucosal immunity and gastrointestinal sensitivity.

Research has suggested that dysbiosis may affect the intestinal barrier and immune response and may also interact with the microbiota–gut–brain axis. Frontiers

This is particularly relevant because chronic inflammatory conditions in the oral cavity may modify the microbial and inflammatory environment of the gastrointestinal tract.

The Oral–Gut Axis

The oral–gut axis describes bidirectional interactions between the oral cavity and gastrointestinal tract. One of the simplest mechanisms is the continuous swallowing of saliva containing oral microorganisms.

In healthy individuals, many oral bacteria are unable to establish themselves in the lower gastrointestinal tract. However, changes in the oral microbiome, gastric environment, intestinal barrier, or immune response may alter this relationship.

Recent reviews have identified *F. nucleatum* and *P. gingivalis* among periodontal microorganisms of particular interest in oral–gut interactions. Oral microorganisms or their components may contribute to intestinal dysbiosis and inflammatory signaling. PubMed+1

At the same time, changes in the gastrointestinal microbiome may potentially influence systemic immune regulation and, indirectly, periodontal health. Thus, the relationship may be bidirectional rather than a simple one-way pathway.

Possible Biochemical Mechanisms

Several biochemical mechanisms may explain the potential relationship between chronic periodontitis and functional dyspepsia.

1.1. Cytokine-mediated inflammation

Periodontal inflammation is associated with increased production of IL-1β, IL-6, and TNF-α. These cytokines can contribute to systemic inflammatory signaling.

In simplified form:

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Periodontal bacteria → immune activation → IL-1β / IL-6 / TNF-α ↑ → systemic inflammatory signaling

Inflammatory mediators may influence gastrointestinal immune activity and neuronal signaling. However, the exact contribution of this mechanism to functional dyspepsia remains to be established.

1.2. Lipopolysaccharide and TLR signaling

LPS derived from Gram-negative bacteria can activate TLR4-associated signaling pathways. Activation of TLR4 may stimulate NF-κB and increase expression of inflammatory mediators.

The pathway can be summarized as:

LPS → TLR4 → NF-κB → inflammatory gene expression

Periodontal inflammation may increase the systemic exposure to bacterial products. At the same time, intestinal dysbiosis and impaired barrier function may increase exposure to microbial metabolites and endotoxin.

1.3. Oxidative stress

Oxidative stress represents another possible mechanism. Activated neutrophils and other inflammatory cells produce reactive oxygen species (ROS), including superoxide and hydrogen peroxide.

Excessive ROS production may contribute to tissue damage when antioxidant defenses are insufficient.

A simplified relationship is:

Inflammation → ROS ↑ → oxidative damage → further inflammatory signaling

Oxidative stress has been investigated in periodontal disease, including relationships between antioxidant activity and inflammatory mediators. PubMed

This mechanism may be relevant to gastrointestinal disorders because oxidative stress can influence epithelial barrier integrity and inflammatory responses.

1.4. Intestinal barrier dysfunction

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The intestinal epithelium functions as a selective barrier separating the intestinal microbiota from systemic tissues. Dysbiosis and inflammation may increase intestinal permeability.

Increased permeability may facilitate the passage of bacterial components such as LPS into the circulation, potentially contributing to low-grade systemic inflammation.

Recent systematic reviews of the oral–gut axis have discussed the association between periodontitis, gut microbial alterations, intestinal barrier changes, and systemic inflammatory responses. However, most available evidence remains observational. PubMed+1

Potential Relationship Between Periodontitis and Functional Dyspepsia

The relationship between periodontitis and functional dyspepsia can be considered through several interconnected pathways:

1. **Microbial pathway:** periodontal microorganisms may reach the gastrointestinal tract through swallowed saliva.
2. **Inflammatory pathway:** periodontal inflammation may increase systemic concentrations of inflammatory mediators.
3. **Endotoxin pathway:** bacterial LPS may activate TLR-dependent inflammatory signaling.
4. **Oxidative pathway:** chronic inflammation may increase ROS production and oxidative stress.
5. **Microbiota pathway:** changes in the oral microbiome may influence the intestinal microbial ecosystem.
6. **Neuroimmune pathway:** inflammatory mediators and microbial metabolites may interact with the gut–brain axis involved in gastrointestinal symptoms.

A recent systematic review and meta-analysis specifically examining periodontitis and gastric disorders included functional dyspepsia among its research questions, reflecting the growing interest in this association. PubMed

Nevertheless, it is important to emphasize that an association between two diseases does not necessarily prove that periodontitis causes functional dyspepsia. Shared risk factors, diet, medications, smoking, psychological stress, age, and other variables may influence both conditions.

Clinical Significance

Patients with functional dyspepsia may benefit from a comprehensive assessment that includes oral health, particularly when periodontal symptoms are present.

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Conversely, patients with severe or persistent periodontitis may require consideration of their general health and gastrointestinal symptoms.

The potential oral–gut connection suggests that periodontal treatment could have effects extending beyond the oral cavity. However, current evidence is not sufficient to recommend periodontal therapy specifically as a treatment for functional dyspepsia.

Recent systematic reviews indicate that periodontal treatment can improve periodontal clinical parameters and oral microbial profiles, while its ability to consistently normalize gut dysbiosis remains uncertain. PubMed+1

Conclusion

Chronic periodontitis and functional dyspepsia are clinically distinct disorders, but accumulating evidence suggests that they may interact through the oral–gut axis. Periodontal dysbiosis, bacterial translocation, LPS–TLR signaling, pro-inflammatory cytokines, oxidative stress, and changes in intestinal permeability represent plausible biological mechanisms.

The relationship can be summarized as:

Periodontal dysbiosis → chronic inflammation → microbial products/cytokines → systemic effects → possible gastrointestinal alterations

At the same time:

Gastrointestinal dysbiosis → altered immune and metabolic signaling → possible effects on periodontal homeostasis

Current evidence supports biological plausibility but does not yet establish a definitive causal relationship between chronic periodontitis and functional dyspepsia. Most available studies are observational, and differences in patient populations, microbiome analysis, medications, diet, and other confounding factors limit definitive conclusions. PubMed+1

Future research should include prospective clinical studies evaluating periodontal status, functional dyspepsia symptoms, oral and intestinal microbiota, inflammatory cytokines, oxidative stress markers, and intestinal permeability simultaneously. Such studies may clarify whether treatment of periodontal inflammation can influence gastrointestinal symptoms and whether oral–gut interactions have clinical relevance in patients with functional dyspepsia.

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