

Periodontopathogenic Microorganisms in The Development of Periodontitis

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Received: 29 January 2026; **Accepted:** 24 February 2026; **Published:** 17 March 2026

Abstract: Periodontal disease is one of the most common pathologies of the oral cavity. Periodontitis is a chronic inflammatory disease of the tissues surrounding the teeth, accompanied by the destruction of the periodontal ligament and alveolar bone. Microorganisms that form the microbial biofilm of dental plaque play a key role in the development of this pathology.

It has now been proven that the primary cause of periodontitis is exposure to specific pathogenic bacteria capable of causing an inflammatory reaction in periodontal tissues. These microorganisms are called periodontopathogenic. Their activity leads to an imbalance of oral microflora, which contributes to the development of pathological processes.

Studying the role of periodontopathogenic microorganisms is important for the diagnosis, prevention, and treatment of inflammatory periodontal diseases.

Keywords: Oral microflora, anaerobic microorganisms, inflammatory periodontal diseases, toxin, enzyme.

Introduction: The human oral cavity is a complex ecosystem inhabited by over 700 species of microorganisms. Normally, a dynamic equilibrium is maintained between the microflora and the human body. However, various factors (poor oral hygiene, weakened immunity, smoking, and systemic diseases) can disrupt this microbial balance.

This disruption increases the number of anaerobic bacteria, which can cause inflammation in periodontal tissue. The main source of pathogenic microorganisms is dental plaque, a complex microbial biofilm that adheres tightly to the surface of the teeth and gums.

During their life cycle, microorganisms release toxins,

enzymes, and metabolic products that damage periodontal tissue and trigger an inflammatory response. In response to bacterial aggression, the body's defense mechanisms are activated, but prolonged exposure to infection leads to chronic inflammation.

Thus, disruption of the microbial balance in the oral cavity is one of the key factors in the development of periodontitis. Among the numerous microorganisms inhabiting the oral cavity, a group of bacteria has the most pronounced pathogenic potential. The main periodontopathogenic microorganisms include:

- Porphyromonas gingivalis

- *Aggregatibacter actinomycetemcomitans*
- *Treponema denticola*
- *Tannerella forsythia*
- *Prevotella intermedia*
- *Fusobacterium nucleatum*

These bacteria are capable of colonizing periodontal pockets and forming stable microbial communities.

Porphyromonas gingivalis is considered one of the most aggressive pathogens of periodontitis. It is an obligate anaerobic bacterium capable of destroying periodontal tissue by releasing proteolytic enzymes and toxins.

It has the ability to suppress the body's immune response and actively participates in the formation of microbial biofilms. This results in the destruction of connective tissue and the bone structure of the alveolar process.

Aggregatibacter actinomycetemcomitans is particularly frequently detected in aggressive forms of periodontitis. It is capable of producing a leukotoxin that destroys immune cells, leading to a decrease in the body's defenses.

As a result, the bacterium can actively multiply in periodontal tissues and cause severe inflammatory changes.

Tannerella forsythia is an anaerobic bacterium capable of causing periodontal tissue destruction by inducing cell apoptosis. It also participates in the formation of bacterial associations that exacerbate the inflammatory process.

Treponema denticola belongs to the spirochete group and is highly motile, allowing it to penetrate deep into the periodontal tissues.

It secretes enzymes that destroy intercellular matrix and connective tissue, contributing to disease progression.

The "red complex" of bacteria. The so-called "red complex" of microorganisms plays a particularly important role in the development of periodontitis. It includes:

- *Porphyromonas gingivalis*
- *Tannerella forsythia*
- *Treponema denticola*

These bacteria are highly virulent and are often found in severe forms of chronic periodontitis. Their presence is closely linked to the severity of inflammation and destruction of periodontal tissue.

Studies have shown that the number of these microorganisms directly correlates with the severity of

the disease.

Mechanisms of Periodontitis Development

The development of periodontitis is a complex, multi-stage process involving both microorganisms and the body's defense mechanisms.

The main stages of the disease include:

1. Plaque formation

A microbial biofilm containing various bacteria forms on the tooth surface.

2. Colonization by pathogenic microorganisms

Anaerobic bacteria, which are highly pathogenic, begin to predominate in dental plaque.

3. Production of bacterial toxins

Periodontopathogenic bacteria secrete enzymes, lipopolysaccharides, and other substances that cause tissue damage.

4. Inflammatory response
The immune system reacts to the presence of bacteria, resulting in the release of inflammatory mediators.

5. Periodontal tissue destruction

Long-term inflammation leads to the destruction of the periodontal ligament and bone resorption.

This results in the formation of periodontal pockets, which become a favorable environment for the further proliferation of microorganisms.

The development of periodontitis depends not only on the presence of bacteria but also on a number of predisposing factors. These include:

- poor oral hygiene
- smoking
- decreased immunity
- hormonal changes
- systemic diseases (e.g., diabetes)
- genetic predisposition

These factors create favorable conditions for the proliferation of periodontal pathogens and accelerate disease progression.

CONCLUSION

Periodontitis is a complex inflammatory disease, the development of which is closely linked to the activity of periodontal pathogens. Anaerobic bacteria such as *Porphyromonas gingivalis*, *Aggregatibacter actinomycetemcomitans*, *Tannerella forsythia*, and *Treponema denticola* play a key role in the pathogenesis of the disease.

These microorganisms are capable of forming stable microbial communities, secreting toxic substances, and causing destruction of periodontal tissue. Of particular importance is the so-called "red complex" of bacteria,

which is associated with severe forms of the disease.

Understanding the role of periodontal pathogens allows us to develop effective methods for the prevention, diagnosis, and treatment of periodontitis. The main areas of prevention are oral hygiene, regular dental examinations and timely treatment of inflammatory gum diseases.

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