

MICROFLORA OF THE ORAL CAVITY: COMPOSITION, FUNCTIONS, ROLE IN MAINTAINING HEALTH AND PATHOLOGY DEVELOPMENT

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Annotation

The microflora of the oral cavity is one of the most complex and dynamic microbial ecosystems of the human body. Normally, it forms a stable community of microorganisms involved in maintaining colonization resistance, metabolic balance, local immune defense, and preservation of tissue homeostasis. The oral cavity includes several ecological niches — the surface of teeth, tongue, gingival furrow, cheek mucosa, palate, saliva — each of which is characterized by a specific microbial profile. Under the influence of exogenous and endogenous factors, the composition of microbiocenosis can change, which leads to the development of dysbiotic conditions. The most studied clinical consequences of dysbiosis are caries, gingivitis, periodontitis, halitosis and candidiasis of the oral cavity. In recent years, special attention has been paid to the relationship of the oral microbiome with systemic diseases, including cardiovascular pathology, diabetes mellitus, inflammatory bowel diseases and some neurodegenerative processes. The purpose of the article is to summarize current data on the composition of the oral microflora, the mechanisms of its physiological action, factors that disrupt microbial balance, as well as the clinical significance of changes in the oral microbiome. The article shows that the microflora of the oral cavity is not a simple set of microorganisms, but is a highly organized biosystem closely related to the state of local and general health. Understanding the patterns of formation and transformation of the oral microbiota is important for the prevention, early diagnosis and pathogenetically based treatment of dental diseases.

Keywords: oral microflora, oral microbiome, biofilm, dysbiosis, caries, periodontitis, saliva, colonization resistance, oral mucosa.

Introduction

The microflora of the oral cavity is an essential component of the general human microbiota and is second only to the intestinal ecosystem in terms of diversity. Modern molecular genetic methods have significantly expanded the understanding of the composition of the oral microbiome and have shown that hundreds of bacterial taxa, as well as fungi, viruses and archaea, are present in the oral cavity. According to the expanded Human Oral Microbiome Database, hundreds of taxa are described in the database, of which more than 500 are considered primarily oral. This emphasizes that the oral cavity is not just an anatomical part of the digestive tract, but an independent highly organized microbial ecosystem.

The interest in the microflora of the oral cavity is due not only to its importance in the development of dental diseases, but also to the growing number of data on its role in systemic pathology. Normally, the microorganisms of the oral cavity coexist with the macroorganism in conditions of biological equilibrium. At the same time, the state of health is determined not by sterility, but by the stability of the microbial community, its functional consistency and its ability to withstand external damaging factors. Therefore, the study of the oral microflora should be considered as the most important area of modern dentistry and clinical medicine.

Purpose of the article



The purpose of this article is to summarize modern scientific ideas about the composition of the oral microflora, its physiological role, factors affecting oral microbiocenosis, as well as the importance of dysbiotic changes in the pathogenesis of diseases of the oral cavity and the body as a whole.

Materials and methods

The work is carried out in the format of a review scientific article. The analysis of modern publications on the oral microbiome problem presented in international scientific sources and specialized databases, including works on the normal microflora of the oral cavity, the expanded Human Oral Microbiome Database, reviews on microbial ecology, caries, periodontitis, as well as studies on the relationship of oral microbiota with systemic diseases. When selecting sources, the scientific significance of the publication, citation, relevance and relevance to the research topic were taken into account.

The main text of the article

1. General characteristics of the oral microflora

The oral cavity is a heterogeneous environment where microorganisms co-exist, adapted to different conditions of humidity, aeration, pH, mechanical stress and availability of nutrient substrates. Individual biotopes — the dental surface, gingival sulcus, dorsal surface of the tongue, cheek mucosa, hard and soft palate, saliva — are populated by different microbial communities. That is why it is more correct to speak not about a single microflora of the oral cavity, but about a set of interconnected microbial niches. Early molecular studies have shown that even in clinically healthy individuals, the microflora is characterized by high individual and site-specific variability, with representatives of the genera *Streptococcus*, *Veillonella*, *Actinomyces*, *Neisseria*, *Haemophilus*, *Gemella* and *Granulicatella* being the most common.

An important feature of the oral microflora is its existence mainly in the form of biofilms. A biofilm is not a random cluster of microbes, but a spatially organized community enclosed in an intercellular matrix and possessing its own system of interspecific interactions. Such an organization provides microorganisms with resistance to environmental changes, the action of antimicrobial substances and local protection factors. Clinically, it is the biofilm that underlies the formation of plaque and subsequent inflammatory and destructive processes.

2. The physiological role of the oral microbiota

Contrary to the outdated idea of microbes solely as the cause of infection, the normal microflora of the oral cavity performs a number of useful functions. It participates in the maintenance of colonization resistance, preventing the excessive growth of exogenous and opportunistic microorganisms. In addition, the oral microbiota is involved in the metabolism of food substrates, the regulation of local redox potential, as well as in the formation and modulation of the immune response of the mucous membrane. The balance between microorganisms and host tissues is maintained through the complex interaction of microbial communities with saliva, secretory IgA, antimicrobial peptides, and cellular mechanisms of innate immunity.

Saliva plays a special role in maintaining microbial balance. It provides mechanical cleansing of the oral cavity, buffers acidity, supplies calcium and phosphate ions, contains enzymes, mucins, immunoglobulins and other protective factors. With impaired salivation, changes in the viscosity or composition of saliva decrease the ability of the oral cavity to self-clean, which creates conditions for the accumulation of biofilm and the growth of acid-resistant or proteolytic microorganisms. Therefore, hyposalivation and xerostomia are naturally considered as serious risk factors for oral dysbiosis.

3. Factors affecting the composition of the oral microflora



The composition of the oral microbiota is not fixed. It changes under the influence of age, the nature of nutrition, the level of oral hygiene, smoking, somatic diseases, drug therapy, the state of the immune system, the characteristics of salivation and the presence of orthopedic or orthodontic structures. Diet remains one of the key factors: frequent consumption of easily fermentable carbohydrates contributes to a shift in microbial balance towards acidogenic and aciduric species. On the contrary, stable hygiene, sugar restriction, and preserved saliva function support microbial diversity and relative environmental sustainability of the microbial community.

Behavioral factors also have a significant impact on the microflora. Smoking is associated with changes in plaque composition and a decrease in the protective properties of the mucous membrane, and the uncontrolled use of antibiotics can disrupt natural antimicrobial relationships and create prerequisites for fungal superinfection and the selection of resistant microorganisms. Current data also indicate that the oral cavity can serve as a reservoir of antimicrobial resistance genes, which also gives the problem of dysbiosis a pronounced clinical significance.

4. Dysbiosis and diseases of the oral cavity

Currently, the leading concept of the pathogenesis of most microbe-associated dental diseases is not the idea of the presence of one "main" pathogen, but the idea of dysbiosis. Dysbiosis is a violation of the ecological balance of a microbial community, in which interspecific relationships change, the proportion of microorganisms with pathogenic potential increases, and the damaging effect of metabolites on host tissues increases. The ecological concept is especially important for caries, according to which regular acidification of plaque due to frequent consumption of sugars creates advantages for acid-producing and acid-resistant bacteria, including *Streptococcus mutans*, *Lactobacillus* spp. and a number of other taxa.

Periodontitis, in turn, is considered as a result of polymicrobial synergy and dysbiosis. In this process, not only individual species such as *Porphyromonas gingivalis*, *Tannerella forsythia*, and *Treponema denticola* are important, but also the entire restructuring of the subgingival community with an increased inflammatory response of the host. In other words, the microflora becomes pathogenic not in isolation, but as a result of the coordinated action of the microbial biofilm and impaired immune regulation. This concept is of great practical importance, as it explains why the treatment of periodontitis cannot be limited to the eradication of individual bacteria and should be aimed at restoring microbial and immune balance.

In addition to caries and periodontitis, changes in the microflora of the oral cavity play a role in the development of gingivitis, halitosis, peri-implantitis, candidiasis and inflammatory lesions of the mucous membrane. This is especially evident in patients with reduced immune status, hygiene disorders, diabetes mellitus, xerostomia, prolonged use of removable dentures and after courses of antibacterial therapy. Therefore, the assessment of the microbial status of the oral cavity is becoming an important part of the dentist's clinical thinking.

5. Oral microflora and systemic health

Outside of dentistry, interest in oral microbiota is related to its possible involvement in systemic inflammation and the translocation of microorganisms or their products to other organs and tissues. The scientific literature actively discusses the links of dysbiotic oral microbiota with cardiovascular diseases, metabolic disorders, intestinal diseases, rheumatoid inflammation, adverse pregnancy outcomes and some neurological conditions. At the same time, a cautious approach should be considered the most reasonable: to date, associations and suggested mechanisms have been shown for many conditions, but the degree of direct causation continues to be studied.

Nevertheless, the very idea of an oral-systemic relationship has already changed the clinical understanding of dental health. The oral cavity can no longer be considered in isolation.



The state of its microflora reflects both local disorders and the general condition of the body, and a chronic oral inflammatory focus is able to maintain a systemic load on the immune and vascular systems. That is why early correction of dysbiosis, plaque control, hygiene maintenance and treatment of inflammatory periodontal diseases are becoming important not only as dental, but also as general clinical preventive measures.

6. Clinical significance and modern approaches to correction

The practical importance of studying the microflora of the oral cavity lies in the possibility of more accurate prevention and personalized patient management. Modern concepts shift the focus from simple antiseptic reduction of microbial mass to microbial ecosystem management. This includes professional biofilm control, rational individual hygiene, nutrition correction, treatment of xerostomia, restriction of unjustified use of antibiotics, the use of fluorides and other means that contribute to the stabilization of the microbial community. Microbiome markers, salivary diagnostics, and targeted modulation of the oral microbiota are considered promising areas.

Thus, the microflora of the oral cavity should be considered as a dynamic biosystem, and not as a passive background. This is precisely the position that underlies modern preventive dentistry today: maintaining oral health means maintaining an ecological balance between the host, the environment and the microbial community.

Conclusions

1. The microflora of the oral cavity is a complex, multicomponent and site-specific ecosystem, including bacteria, fungi, viruses and other microorganisms, organized mainly in the form of biofilms.

2. Under physiological conditions, the oral microbiota performs protective, metabolic and immunomodulatory functions, participating in the maintenance of local homeostasis.

3. Disturbance of the ecological balance under the influence of carbohydrate load, poor hygiene, xerostomia, smoking, somatic pathology and other factors leads to dysbiosis, which underlies the development of caries, periodontal diseases and other inflammatory lesions of the oral cavity.

4. The modern concept of the pathogenesis of dental diseases is based on the idea of microbial synergy and dysbiotic restructuring of the community, and not only on the presence of one specific pathogen.

5. Oral microflora is important not only for dental, but also for general health, since dysbiotic changes are associated with a number of systemic diseases and inflammatory conditions.

6. The prospects of modern dentistry are related to the development of methods for early diagnosis and targeted correction of the oral microbiome, which opens up opportunities for more effective prevention and personalized treatment.

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