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CORRELATING FEATURES BETWEEN DENTAL AND PULMONARY DISEASE

O.Y. Komarytsia¹, A.V. Paliy¹, I.O. Krukovskiy¹, A.A. Krupnyk², O.Y. Kordiyak³

¹*Department of surgical and prosthetic dentistry of the faculty of postgraduate education, Danylo Halytskyi Lviv National Medical University, Ukraine.*

²*Department of Pediatric Dentistry, Danylo Halytskyi Lviv National Medical University, Ukraine.*

³*Department of therapeutic stomatology, periodontology and stomatology of the faculty of postgraduate education, Danylo Halytskyi Lviv National Medical University, Ukraine.*

ORCID: 0000-0002-7063-7694, e-mail: i.kom.2182@gmail.com

ORCID: 0000-0002-5550-640X, e-mail: a.paliy7@gmail.com

ORCID: 0009-0001-8344-5544, e-mail: krukovskyy98@gmail.com

ORCID: 0000-0001-9859-5417, e-mail: anna.krupnyk@gmail.com

ORCID: 0000-0003-3035-3299, e-mail: kordiyakolenab68@gmail.com

Abstract. The article reviews the factors of dental exposure that may have a potential risk for the development of pulmonary diseases.

Objective. To analyze the current national and foreign literature on the relationship between dental health and pulmonary disease, while exploring current data and future research directions.

Materials and Methods. The study used analytical and bibliosemantic methods. The search for scientific information on the medical research topic was conducted in the databases of the following search engines: the electronic library of abstracts and theses of the Vernadsky National Library of Ukraine, PubMed, Medline, MedNet, Embase, BMJ Group, Free Medical Journals, Free Medical Book, Scirus.

Research results and discussion. The analysis of literature data provides evidence of a host-pathogen interaction associated with the oropharyngeal microbiome and its metabolites.

Cross-species interactions between microorganisms create a symbiotic relationship with the host macroorganism by acting as a "sensor", "mediator" and "killer" of pathogens to prevent pathogens from colonising and integrating into the host. Conversely, the immune response of the macroorganism must balance between inflammation to destroy the pathogen and prevent unwanted immune responses against host tissue and its own microorganisms. When the composition, activity and function of the oral microbiome is disturbed, it causes dysbiosis. In the presence of orthopaedic structures in the oral cavity, the eubiotic balance is more or less shifted to a pathogenic state.

The article analyses the influence of structural materials and methods of their production, which are mainly used in prosthetic dentistry, on the formation of biofilm, changes in the oral microbiome, and the spread of an inflammatory reaction in the prosthetic bed.

The oral cavity is the first line of defence of the immune system against most foreign pathogens, which can affect the immune and inflammatory reactions of the body as a whole. This factor can spread systemic inflammation that affects other organs, including the lungs. The oral microbiota can influence the microbial community in the lungs through microaspiration and dispersal. In general, the oral-pulmonary axis can exchange components of its microbiome

The most common respiratory diseases associated with dust among dentists and its irritating effects on the respiratory system are also analyzed.

In general, ultrafine and nanoscale airborne particles have been studied for a long time, but with the development of new technologies, their acute or chronic effects on the health of healthcare workers associated with dental practice require more detailed study.

Conclusion. Understanding the relationship between oral health and systemic diseases, including pulmonary diseases, and studying a multidisciplinary approach to the treatment of a particular disease can be important in terms of extending healthy life expectancy and improving its quality. For effective health management, it remains an unsolved issue whether it is possible to prevent systemic diseases by influencing oral diseases (and vice versa).

Keywords: microbiome, dysbiosis, bacterial adhesion, pulmonary diseases, oral health, biofilm, aerosols, nanoparticles, prosthetic materials, cross-species interaction of microorganisms.

Introduction. Recent research has revealed a bidirectional relationship at the microbiome level between oral health and lung disease. The proximity and continuity of the oral cavity and airways allow the oropharyngeal microbiome to be the main determinant of the lung microbiome[1]. At the same time, dentists are exposed to aerosol pollution and dental dust for many years, which contributes to the development of various respiratory diseases [2].

Objective. To analyze the current domestic and foreign literature on the association between dental health and pulmonary disease, while exploring current data and future research directions.

Materials and Methods. The study applied analytical and bibliosemantic methods. The search for scientific information on the medical research topic was conducted in the databases of the following search engines:

the electronic library of abstracts and dissertations of the Vernadsky National Library of Ukraine, PubMed, Medline, MedNet, Embase, BMJ Group, Free Medical Journals, Free Medical Book, Scirus.

Research results and discussion. More than three centuries ago, Antonie van Leeuwenhoek was the first person to observe microbes with a microscope [3]. Nobel Prize winner Joshua Lederberg first coined the term "microbiome" as a community of symbiotic and pathogenic microorganisms [4]. It is known that the microbiome is present in almost every part of the human body, and comprises about 48 primary microbial environments, among which 34% of all primary microbial sites are associated with human skin, 25% with the gastrointestinal tract, and 20% are associated with the head and neck cavities. [5].

It is well known that the oral cavity is the first line of defense of the immune system against most foreign antigens. Accordingly, some oral bacteria affect the immune and inflammatory responses of the body as a whole. [6] Well-known factors that affect eubiotic balance include genetics, lifestyle, immune response, medications, hormonal changes, habitat, nutrition, oral hygiene, pH, salivary rate and volume, molecular biochemistry in the oral biofilm, etc. According to Petersen et al. [7], dysbiosis can be characterized by three different scenarios that are not mutually exclusive: a general loss of microbial diversity; loss of beneficial microbes; and the proliferation of pathogenic microbes.

Thanks to advances in technology, recent studies have revealed a correlation between the oral microbiome and systemic diseases. In particular, *P. gingivalis* and/or *F. nucleatum* have been associated with periodontal disease [8], head and neck cancer [9], pancreatic cancer [10], colorectal cancer [11], Alzheimer's disease [12], atherosclerosis [13], and preterm birth [14]. The anatomical proximity and bi-directionality between the oral cavity and the upper respiratory tract and lungs create conditions for the exchange of microbiome, which is confirmed in clinical studies [15].

The pathophysiological significance of the pulmonary microbiota is increasingly appreciated not only in classical infectious diseases, pneumonia, bronchiectasis, and cystic fibrosis but also in chronic non-communicable lung diseases such as chronic obstructive pulmonary disease, asthma, and fibrosis [16].

The oral cavity is a complicated ecosystem for the survival of microorganisms, as it is subject to daily fluctuations. Numerous literature sources report the impact of orthopedic structures on the development and maintenance of dysbiosis [17, 18]. For example, the presence of minor inaccuracies and impaired density between the tooth and the crown contributes to the accumulation of biofilm, bacterial microleakage, inflammatory reactions, and the development of dysbiosis [17].

There are several theories of the origin of biofilm on implants. Some authors are inclined to believe that the microbiome of the implant and neighboring natural teeth is common, which serves as a kind of depot for biofilms from neighboring implants [15]. On the contrary, there is an assumption based on the difference in the structure of the tooth surface and the implant and, as a result, a different mechanism of biofilm formation [18].

Comparative studies of the surfaces of titanium and zirconium have also been carried out. Groessner-Schreiber B et al. [19] and Scarano et al. [20] state that bacterial fouling is higher on titanium discs compared to zirconium dioxide. On the other hand, in the study by Egawa et al. [21], bacterial adhesion was practically the same for titanium and zirconium surfaces with the same surface smoothness. Therefore, the determining factor in bacterial colonization and adhesion is the surface roughness of the material and the presence of a healthy oral microbiota.

At present, there is no doubt that partial or complete dentures contribute to the occurrence of pathological conditions in the oral cavity. Changes in the microbial balance activate lipid peroxidation processes, lead to a non-specific resistance reaction and the development of inflammation in the tissues of the prosthetic bed and their subsequent atrophy [20]. Favorable conditions for dysbiosis arise due to increased temperature in the prosthetic bed area and impaired heat exchange processes, as well as due to mechanically damaged mucous membrane due to the roughness and inhomogeneity of plastic [22].

There is an opinion that correlates the severity of the condition of patients with chronic obstructive pulmonary disease (COPD) through the connection of the respiratory tract microbiota with the oral microbiota [23]. The prevalence of COPD is increasing worldwide and is currently the third cause of death in the world [24]. Among the reasons that contribute to the spread of the disease is the long-term inhalation of toxic substances, mainly tobacco smoke, which eventually worsens lung function, leading to the development of COPD in adulthood. [25]. Similarly to tobacco smoke, exposure to dental dust is a well-known hazard in the practice of dentists.

Modern studies emphasize the pathogenic load of bioaerosols in dentistry [26]. This has become particularly alarming in light of the severe acute respiratory syndrome pandemic - SARS-CoV-2, when healthcare workers are the first to be exposed to droplet or aerosol contamination [27]. The acute or chronic health effects of ultrafine and nanoscale airborne particles have been studied for a long time; however, their impact on dentistry and dental healthcare workers requires more detailed research [28].

It has been concluded that the concentration of dust in the air of the working area of orthopedic dentists is higher than that of general dentists and pediatric dentists. This is associated with more intensive processing of hard tooth tissues in patients' mouths, and mechanical grinding of materials for prosthetics, compared to dentists of other specialties [29]. Dental practice involves working with a variety of materials. The development of modern materials science, along with progress, creates threats that require the attention of specialists. For example, grinding a nanocomposite material releases nanoparticles, which, when inhaled, form free radicals that contribute to oxidative stress and inflammatory reactions [30]. It is believed that due to its microsize, the material can enter the bloodstream and brain through the olfactory epithelium [31]. Water cooling, which is proposed as an alternative by incorporating nanoparticles into water droplets, thus increases their size but may contribute to aerosolization by increasing the pathogenic load on the working environment [32].

Conclusion. The results of the analysis of literature publications show a correlation between the oral

microbiome and systemic diseases, including the lungs. The state of the oral cavity is an important factor influencing the overall health of the body through the interaction between host cells and the oral microbiome. The contiguity of the microbiome from the nasal passages and oral cavity to the upper respiratory tract and lungs allows the components of the microbiome to be exchanged in the course of life. Dysbiosis from the oral cavity causes the migration of pathogens and their metabolites to other parts of the body, including the lungs, which in return causes lung disease. Understanding the relationship between oral health and systemic diseases, including pulmonary diseases, and studying a multidisciplinary approach to the treatment of a particular disease can be important in terms of extending healthy life expectancy and improving its quality. Further studies of the oral microbiota that cannot be cultivated may be important to determine the key influences that initiate and contribute to disease.

Directions for future research. Further study and implementation of salivary microbiota analysis as part of screening during routine dental visits may be a way to address this issue. The study of dysbiosis, diagnosis, and monitoring of treatment using saliva analysis, training of specialists in other specialties, and the formation of interactions to coordinate personalized medicine aimed at prevention is the direction of future research.

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КОРЕЛЯЦІЯ МІЖ СТАНОМ ПОРОЖНИНИ РОТА ТА ЛЕГЕНЕВИМИ ЗАХВОРЮВАННЯМИ

О.Й. Комариця¹, А.В. Палій¹, І.О. Круковський¹,
А.А. Крупник², О.Й. Кордіяк³

¹ кафедра хірургічної та ортопедичної стоматології факультету післядипломної освіти Львівського національного медичного університету імені Данила Галицького, м. Львів, Україна

² кафедра дитячої стоматології Львівського національного медичного університету імені Данила Галицького, м. Львів, Україна

³ кафедра терапевтичної стоматології, пародонтології та стоматології факультету післядипломної освіти Львівського національного медичного університету імені Данила Галицького, м. Львів, Україна.

ORCID: 0000-0002-7063-7694,
e-mail: i.kom.2182@gmail.com
ORCID: 0000-0002-5550-640X,
e-mail: a.paliy7@gmail.com
ORCID: 0009-0001-8344-5544,

e-mail: krukovskyy98@gmail.com
ORCID: 0000-0001-9859-5417,
e-mail: anna.krupnyk@gmail.com
ORCID: 0000-0003-3035-3299,
e-mail: kordiyakolena68@gmail.com

Резюме. У статті розглянуто фактори стоматологічного впливу, що можуть мати потенційний ризик на розвиток легеневих хворіб.

Мета дослідження. Провести аналіз сучасних вітчизняних й іноземних літературних відомостей щодо зв'язку між стоматологічним здоров'ям і легеневими хворобами, одночасно беручи до уваги поточні дані та майбутні напрямки досліджень.

Матеріали і методи дослідження. У дослідженні використано аналітичний і бібліосемантичний методи. Пошук наукової інформації щодо дослідної медичної тематики проводили в базах даних таких пошукових систем: електронної бібліотеки авторефератів, дисертацій ресурсу Національної бібліотеки України ім. В. І. Вернадського, PubMed, Medline, MedNet, Embase, BMJ Group, Free Medical Journals, Free Medical Book, Scirus.

Результати досліджень та їх обговорення. Аналіз літературних публікацій свідчить про взаємодію хазяїн-патоген, який пов'язаний із мікробіомом ротоглотки та його метаболітами. Цей фактор може поширювати системне запалення, яке впливає на інші органи, зокрема легені. У статті проаналізовано вплив конструкційних матеріалів і методів їх виробництва на утворення біоплівки, зміну мікробіому порожнини рота, поширення запальної реакції протезного ложа. Також зацентровано на найпоширеніших респіраторних захворюваннях серед стоматологів, пов'язаних із пилом і його подразнювальною дією на органи дихання.

Висновок. Розуміння зв'язку між здоров'ям порожнини рота та системними захворюваннями, зокрема легеневими, вивчення мультидисциплінарного підходу до лікування окремого захворювання може бути важливим із точки зору продовження тривалості здорового буття та покращення його якості. Для ефективного управління здоров'ям залишається відкритим питання, чи можна, впливаючи на захворювання порожнини рота, запобігти системним захворюванням (і навпаки).

Ключові слова: мікробіом, дисбактеріоз, бактеріальна адгезія, легеневі захворювання, здоров'я порожнини рота, біоплівка, аерозолі, наночастинки, протезні матеріали, міжвидова взаємодія мікроорганізмів, субіотична рівновага.

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