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THE EFFECT OF MICROCURRENTS GENERATED BY METALLIC INCLUSIONS ON THE ORAL MUCOSA OF ORAL CAVITY

Given the medical and social significance of the problem of adverse effects associated with metallic inclusions in the oral cavity, intensive research is being conducted into the main mechanisms of its pathogenesis. However, the effect of galvanic currents on the oral mucosa (OM) is ambiguous and remains insufficiently elucidated. It has been proven that in 4–11% of cases, patients with metallic prostheses in the oral cavity complain of discomfort, which sometimes progresses to intolerance to dental prostheses and is most often manifested by subjective symptoms such as galvanosis, toxic stomatitis, allergic reactions to metallic inclusions, and exacerbation of general somatic diseases. **The aim of this study.** was to identify the dependence of the manifestation of microcurrents against the background of different types of metallic inclusions in the oral cavity and the course of somatic diseases. **Material and methods.** Our observation included 52 patients aged 34 to 62 years who, over a period of 4 years, sought care with complaints and symptoms that made it possible to assume the presence of intolerance to metallic inclusions in the oral cavity of electrogalvanic etiology. Among the examined patients, there were 34 women and 18 men. Intolerance to metallic inclusions in patients was established after a general clinical examination and history taking, taking into account the following subjective symptoms: burning sensation of the tongue; a “metallic” taste in the oral cavity; taste disturbances (metallic, sour, bitter, salty taste); sensation of electric current; paresthesia of the OM; changes in salivation; complaints of irritability; sleep disturbances; and deterioration of general well-being. **Results and discussion.** In most cases (92.3%), patients complained of a burning sensation of the OM (most often the tongue) and its dryness. In some cases, the complaints also included headache, sore throat, hoarseness, gingival bleeding, psychogenic disorders (sleep disturbances, irritability), and others. Complications and their spectrum were observed more frequently in women than in men.

Pathological manifestations were constant in 16.7% of men and 35.3% of women. Other patients noted their periodicity, namely during the introduction of metallic objects into the mouth, during meals, and in the morning after sleep. **Conclusions.** The conducted clinical studies provide grounds to note that before prosthetic treatment, greater attention should be paid to preventive measures aimed at minimizing the risk of galvanic interactions in the oral cavity in certain categories of individuals: Patients with general somatic diseases (gastrointestinal diseases, especially those associated with increased acidity; allergic conditions; endocrine and psychogenic diseases; fungal lesions, etc.); Women aged 45–55 years in the premenopausal and menopausal periods; individuals who note discomfort upon contact with metals (at home, at work, or from personal jewellery); Patients who note discomfort in the oral cavity.

Key words: microcurrents, prostheses, metallic structures, oral cavity, mucous membrane.

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ВПЛИВ МІКРОСТРУМІВ ВІД МЕТАЛЕВИХ ВКЛЮЧЕНЬ НА СЛИЗОВУ ОБОЛОНКУ ПОРОЖНИНИ РОТА

З урахуванням медичної та соціальної важливості проблеми побічного ефекту, пов'язаного з металевими включеннями в порожнині рота, проводяться інтенсивні дослідження основних механізмів його патогенезу. Однак, вплив гальванічних струмів на слизову оболонку ротової порожнини (СОПР) неоднозначний і залишається недостатньо з'ясованим. Доведено, що у 4–11 % випадків пацієнти з металевими протезами в ротовій порожнині скаржаться на дискомфорт, який іноді прогресує до непереносимості зубних протезів і найчастіше проявляється у вигляді суб'єктивних симптомів, таких як явища гальванозу, токсичний стоматит, алергічні реакції на металеві включення та загострення загальносоматичних захворювань. **Мета даного дослідження.** Виявлення залежності прояву мікротоків, на тлі різних видів металевих включень в порожнині рота та перебігу соматичних захворювань. **Матеріал та метод дослідження.** Під нашим спостереженням знаходилися 52 пацієнта, віком від 34 до 62 років які протягом 4 років звернулися за допомогою зі скаргами та симптомами, які дозволяли припустити наявність непереносимості металічних

включень в порожнині рота електрогальванічної етіології. Серед обстежених були 34 жінки та 18 чоловіків. Непереносимість металевих включень у пацієнтів встановлювали після проведення загально-клінічного обстеження, збору анамнезу, враховуючи суб'єктивну симптоматику: печію язика; «металевий» присмак у порожнині рота; зміни смаку (металевий, кислий, гіркий, солоний присмак); відчуття електричного струму; парестезії СОПР; зміна слиновиділення; скарги на дратівливість; порушення сну; погіршення загального самопочуття. **Результати дослідження та їх обговорення.** В більшості випадків (92,3%) хворі скаржились на відчуття печії СОПР (найчастіше – язика) та її сухість. В деяких випадках серед скарг відзначали – головний біль, біль у горлі, осиплість голосу, кровотечу ясен, порушення психогенного характеру (порушення сну, дратівливість) та ін. Ускладнення та їх спектр у жінок відзначали частіше ніж у чоловіків. Патологічні явища були постійні у 16,7% чоловіків та 35,3% жінок. Інші хворі відзначали їх періодичність – при введенні металевих предметів до рота, під час прийому їжі та з ранку після сну. **Висновки.** Проведені клінічні дослідження дають підставу відзначити, що перед протезуванням слід більшої уваги приділяти профілактичним заходам направлених на мінімізацію ризику гальванічних зв'язків в ротовій порожнині певного контингенту осіб: Хворим на загально соматичні захворювання: (захворювання шлунково-кишкового тракту, особливо з підвищеною кислотністю; алергічні стани; ендокринні та психогенні захворювання; грибові ураження та ін.). Жінкам віком 45-55 років, в передклімактеричному та клімактеричному періоді; Особам, які відзначають дискомфорт при контакті з металами (вдома, на роботі, з індивідуальними прикрасами); Пацієнтів, які відзначають дискомфорт в порожнині рота.

Ключові слова: мікроструми, протези, металеві конструкції, порожнина рота, слизова оболонка.

It has been established that metallic dental prostheses, implants, and fillings that are in direct contact with the tissues of the oral cavity may influence the onset and development of pathological conditions affecting both the oral tissues and the organism as a whole [2, 5, 6].

Given the medical and social significance of the problem of adverse effects associated with metallic inclusions in the oral cavity, intensive studies are being conducted on the principal mechanisms of their pathogenesis. However, the effect of galvanic currents on the oral mucosa (OM) is ambiguous and remains insufficiently elucidated [4, 16].

It has been proven that in 4–11% of cases, patients with metallic prostheses in the oral cavity complain of discomfort, which sometimes progresses to intolerance to dental prostheses and is most often manifested by subjective symptoms such as galvanosis, toxic stomatitis, allergic reactions to metallic inclusions, and exacerbation of general somatic diseases. Thus, 40% of patients using metallic dental pros-

theses report complaints of a metallic taste, burning sensation, tingling of the tip or lateral surfaces of the tongue, distortion of taste sensitivity (bitterness, sour sensation), hypersalivation or dry mouth, sore throat, teeth grinding, redness, and swelling of the soft facial tissues (eyelids, nose, lips, cheeks) [9]. In the publications of Arakelyan M. (2022), it is noted that in patients with metallic structures in the oral cavity, a burning sensation was observed with a frequency ranging from 17% to 33% [8].

According to Kitagawa M. et al. (2019), manifestations of intolerance to metallic inclusions in the oral cavity in patients who sought therapeutic and consultative dental care amounted to 42.4% [13].

Galvanic currents (galvanosis) in the oral cavity represent a pathological process that arises due to a difference in potentials between various structures (crowns, implants, prostheses) in saliva, which acts as an electrolyte. The potential difference depends on the physicochemical properties of the structural components of metals, the quality of prostheses, the amount of oral fluid, and its biochemical, physicochemical, and rheological properties [1, 3].

In vitro studies have established that galvanic current exerts three harmful effects on the patient's organism: microdischarges, corrosion, and dispersion of metal ions or their oxides [10].

Other scientific studies suggest that tissue damage is caused by the following mechanisms: (1) cytotoxicity of metal ions, (2) allergic reaction to metal ions, and (3) the effect of galvanic current arising between different metallic structures [6, 11, 13]. Galvanic current develops between metallic structures made of different alloys through saliva, which serves as an electrolytic medium [12]. The strength of galvanic current depends on the potential difference between the alloys and saliva [7]. The current density in galvanically coupled titanium implants/suprastructures in artificial saliva may range from 0.5 to 12 $\mu\text{A}/\text{cm}^2$ depending on the suprastructure alloy [14]. On the one hand, galvanic current intensifies corrosion and the release of ions from metallic structures [15], while on the other hand, it may itself contribute to destructive effects on the tissues of the oral cavity [6].

The occurrence of microcurrents between different alloys, especially in soldered prostheses, and the resulting microcurrents cause irritation of the OM, impair the sensitivity of the lingual mucosa, and are associated with characteristic clinical signs, including metallic taste, burning sensation, hypersalivation, and others [2, 4].

It has been established that, under normal conditions, the oral cavity exhibits potentiometric indices

of certain values. These are the so-called physiological indices. They are determined by complex biochemical and physiological processes occurring in the oral cavity of a healthy individual. The maximum potentiometric values considered normal for healthy individuals are as follows: potential difference up to 60 mV, current strength up to 5–6 μA , and electrical conductivity of oral fluid up to 5–6 μS [5].

The aim of this study was to identify the relationship between the manifestation of microcurrents, against the background of different types of metallic inclusions in the oral cavity, and the course of somatic diseases.

Material and methods Our observation included 52 patients aged 34 to 62 years who, over a period of 4 years, sought care with complaints and symptoms suggestive of intolerance to metallic inclusions in the oral cavity of electrogalvanic etiology. Among the examined patients, there were 34 women and 18 men.

Intolerance to metallic inclusions in patients was established after a general clinical examination and history taking, taking into account the following subjective symptoms: burning sensation of the tongue; a “metallic” taste in the oral cavity; taste disturbances (metallic, sour, bitter, salty taste); sensation of electric current; paresthesia of the oral mucosa (OM); changes in salivation; complaints of irritability; sleep disturbances; and deterioration of general well-being. To study the biopotentials of the oral cavity, we used a biopotentiometer M1690 A, No. 19018. The potential difference was assessed between the terminal points of the metallic prosthesis (metal–metal) and between the metallic inclusion and the OM.

All patients who sought care with complaints had metallic inclusions of different designs, including crowns, stamped-soldered and cast bridge prostheses, removable partial denture frameworks, clasps in partially removable laminar prostheses, and amalgam fillings. The patients underwent examination using special clinical methods, including skin tests to detect reactions to metals (patch tests for nickel, chromium, and cobalt), radiological examination of the dentoalveolar apparatus, determination of the Fedorov-Volodkina hygiene index, complete blood count, microbiological examination of oral mucosal scrapings for the detection of yeast-like fungi of the genus *Candida*, and consultation with physicians of other specialties.

Results and discussion. In most cases (92.3%), patients complained of a burning sensation of the oral mucosa (OM), most often of the tongue, and dryness. In some cases, the complaints also included headache, sore throat, hoarseness, gingival bleeding, psy-

chogenic disorders (sleep disturbances, irritability), and others. Complications and their spectrum were observed more frequently in women than in men. Pathological manifestations were constant in 16.7% of men and 35.3% of women. Other patients noted their periodicity, namely during the introduction of metallic objects into the mouth, during meals, and in the morning after sleep.

Objectively, in 80.8% of patients, hyperemia and edema of the OM in contact with metallic inclusions (mucosa of the tongue, cheeks, and gingiva) were detected, while in 7.7% of the examined patients, a fine vesicular eruption, desquamation, and mucosal erosions were observed.

It is noteworthy that in 26.9% of the examined patients who had from 2 to 4 metallic inclusions in the oral cavity, lichen planus and leukoplakia were diagnosed on the oral mucosa of the cheeks and lips. The current intensity between metallic inclusions ranged from 10 μA to 80 μA . Two patients showed manifestations of a lichenoid reaction.

History taking revealed that in 90.4% of the examined patients, manifestations of intolerance to metallic inclusions were noted after repeated or additional prosthetic treatment, more often in women aged 45–55 years.

In this cohort of patients, the most frequent concomitant somatic pathology was gastrointestinal disease, observed in 48.1% of the examined individuals. The proportion of women of premenopausal and menopausal age amounted to approximately 36.5% of the examined patients. The current intensity between metallic inclusions in the oral cavity was recorded within the range of 20–95 μA . The general symptomatology in this condition was associated with changes in neurological status, including irritability, fatigue, apathy, insomnia, chronic fatigue, weakness, and decreased mental performance and working capacity.

It should be noted that in 8 patients, signs of galvanism that appeared in the first days after prosthetic treatment and manifested as taste disturbances (metallic taste, bitterness, sour taste, taste distortion) and a sensation of “current passage” disappeared within several days (3 cases) and within several months (5 cases) after placement of prostheses or artificial crowns.

In 44.2% of cases, patients who sought care did not focus on active dental treatment because of the pathological symptoms, associating them either with general diseases or with the “natural” behaviour of metal in the mouth.

All patients in whom electrogalvanic disorders were detected underwent prosthetic treatment with

metallic structures made of individually selected alloys. Follow-up examination 6–24 months after re-prosthetic treatment demonstrated a good condition of the OM and the absence of complaints.

Conclusions. The conducted clinical studies provide grounds to note that before prosthetic treatment, greater attention should be paid to preventive measures aimed at minimizing the risk of galvanic interactions in the oral cavity in certain categories of individuals:

1. Patients with general somatic diseases (gastrointestinal diseases, especially those associated with increased acidity; allergic conditions; endocrine and psychogenic diseases; fungal lesions, etc.);

2. Women aged 45–55 years in the premenopausal and menopausal periods;

3. Individuals who note discomfort upon contact with metals (at home, at work, or from personal jewellery);

4. Patients who note discomfort in the oral cavity (metallic fillings, implants, etc.).

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