Changes in Immunological Parameters in Patients Treated Using Direct and Indirect Restorations of the Hard Tissues of the Anterior Teeth in Combination with an Antioxidant

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Abstract

The problem of aesthetic restoration of the hard tissue defects in the anterior teeth and the choice of materials for quality restorations, which can include direct composite or indirect ceramic restoration, in particular ceramic veneers, is currently extremely important in clinical dental orthopedics. Currently used composite and ceramic materials are known to have different effects on the conditions of the marginal periodontium and the local immunity in the oral cavity. Therefore, we propose a new approach to treatment, which is the use of indirect ceramic restorations in combination with an antioxidant. The purpose of this article is to increase the effectiveness of treatment in patients with defects in anterior teeth using indirect ceramic restorations with antioxidants. To study the intensity of immune reactivity in patients with existing defects of the coronal part of the anterior teeth, we analyzed the levels of lysozyme and sIgA in the oral fluid. The results of the studies confirm the advantages of indirect ceramic restorations over direct composite ones in the treatment of hard tissue defects in the anterior teeth, taking into account the levels of immunological reactivity and using an antioxidant drug Resverasin.

Key words: *peroxide compounds, bactericidal effects, caries, tooth tissues.*

Introduction

With food and air, we consume a significant amount of different types of exogenous bacteria which can cause certain diseases in the body. The first barrier is the surface of the mucous membranes, including the oral cavity. The main specific protective mechanism of these surfaces is the production of lysozyme and secretory sIgA.[1,2,3,4] Protection of the oral mucosa is due to specific and non-specific protective mechanisms. The main factors in the humoral protection of the mucous membranes are sIgA and a number of protein-carbohydrate compounds, which include saliva anti-proteases, lysozyme, lactoferrin and mucus glycoproteins. Antibody deficiency – the main specific immunity factor – is a consequence and integral manifestation of the impaired cellular quantitative composition and their functional characteristics in the process of immunogenesis where the lymphoid and non-lymphoid cells and cytokine regulation play an important part.[5,6,7]

The cytokines formed during an inflammatory process damage the tissues of the periodontium and result in the alveolar bone resorption, which is clinically manifested as the symptoms of generalized periodontitis. Therefore, a comprehensive study of the clinical symptoms of periodontal tissue pathology with determination of such local immunity parameters as sIgA and lysozyme levels in the oral fluid seems reasonable.[8,9]

The immune system, along with the endocrine system, plays a leading role in the relationship between the human body and the environment.[6,7,8] This is implemented through nonspecific resistance factors at different stages (barrier – skin, mucous membranes, histogematic barriers; cellular and humoral) and specific immune response (through cooperation among antigen-presenting cells, T and B lymphocytes). The oral cavity shows a wide range of immunological reactions, especially considering constant antigen stimulation by microorganisms.[7,8] With age and in pathological processes, as well as in cases of various orthopedic and orthodontic structures, immune changes occur, which

are manifested at different levels, first of all, at the level of intercellular interactions.[7,8,9] The barrier properties of the oral cavity are associated both with the protective mechanisms of the saliva (oral fluid) and structural features of the mucous membranes. The oral fluid has pronounced bactericidal properties. The following factors are the most important: immunoglobulins, lysozyme and other saliva enzymes, leukocytes and leukocyte factors.[9]

Lysozyme is one of the most important factors in antimicrobial protection in the oral cavity. It shows both antibacterial activity and stimulates immunoglobulin secretion, enhancing their bactericidal activity. There is an association between the amount of lysozyme and immunoglobulins in the oral fluid: in insufficient lysozyme amounts, more immunoglobulins are secreted into the oral cavity. Lysozyme is a necessary component of the local immunity, as in its absence, according to many investigators, the immune response with sIgA is impossible.[6,7,8,9]

The main source of lysozyme in the oral cavity are the salivary glands (80%) and, to a lesser extent, leukocytes in the oral fluid (20%). Oral bacteria also produce a part of lysozyme, although their contribution to the total amount of synthesized lysozyme is very small. In the salivary glands, lysozyme is formed in the epithelial cells of the ducts. Total lysozyme activity in the mixed saliva is 4 times higher than its activity in the blood plasma and its secretion increases when salivation is stimulated. Lysozyme activity depends on the acid-base balance in the oral cavity. The optimum activity of lysozyme is observed at pH 5-7. An important stimulus for lysozyme formation and secretion is an increase in microflora in the oral cavity, and vice versa, with a decrease in the number of microorganisms, the amount of lysozyme formed decreases sharply.[5,6,8,9]

The main class of the immunoglobulins in the oral cavity is IgA. From 50 to 250 mg of IgA are secreted with the saliva, which is 5-10% of the total amount of Ig of this class. The saliva contains secretory sIgA, which consists of two IgA molecules bound to the secretory component (SC). The concentration of immunoglobulins in the saliva does not always correlate with their amount in the blood. IgA enters the oral cavity with the saliva with the highest concentration observed in the secretions of the parotid glands and a 2-fold lower concentration in the saliva of the sublingual and submandibular glands. Secretory IgA has a pronounced bactericidal, antiviral

and antitoxic activity. The amount of IgA in the saliva is a factor that determines the occurrence and nature of pathological processes. As for the cariogenic flora, IgA inactivates the enzymatic activity of cariogenic streptococci and reduces the adhesion of microorganisms to the tooth tissues, thus preventing the formation of caries. In addition, sIgA prevents the development of inflammatory diseases in the oral mucosa.[5,7,9]

Materials and Method

Foreign bodies, dental prostheses, are believed to be one of the factors that negatively affect local immunity in the oral cavity. When non-removable precious metal prostheses are used, a rapid normalization of the content of IgA and sIgA is observed, which is due to the bactericidal effects of metal ions. The number of microbial antigens in the saliva decreases. This effect is not observed when the prostheses are made of steel or plastic.[2,5,7,8] Therefore, to determine the effectiveness of treatment with the proposed metal-free dentures, we conducted immunological studies, i.e. lysozyme and IgA levels in the oral and crevicular fluids, during Resverasin administration.

Antioxidants are drugs that can inhibit free radical oxidation processes in the body or eliminate reactive oxygen species and peroxide compounds. During this process, non-toxic products (H_2O and CO_2) are formed in the body. In dental practice, intensification of free radical oxidation processes is observed in gingivitis, periodontitis, ulcerative stomatitis, and inflammatory processes of the soft tissues and bones.[8,10,11] The development of free radical lipid peroxidation (LPO) with oxygen can be stopped using the inhibitors that restore free radicals to a stable molecular form that is unable to continue the auto-oxidation chain. LPO inhibition in the body is carried out by an antioxidant system that includes a chain of antioxidants that can inhibit free radicals and a group of enzymes that eliminate reactive oxygen species and peroxide compounds.[10,12,13,14]

Resverasin, a phytoalexin, a polyphenolic natural compound that is produced by some plants (grapes, Japanese knotweed, peanut) may become an effective product. Interest in resveratrol increased after an epidemiological study conducted in the 1970s and 1980s, known as the "French paradox".[14,15,16] Resveratrol (active substance) has the ability to prolong life, shows powerful antioxidant, anti-inflammatory, cardioprotective, neuroprotective,

antitumor and antidiabetic effects.[16,17,18,19] Wine extract contains organic acids, polyphenols and minerals such as magnesium, zinc, potassium and manganese. Polyphenols contained in red wine have antioxidant and anti-inflammatory effects, prevent platelet aggregation and improve lipid metabolism. Trace elements contained in wine extract are able to enhance the activity of the body's antioxidant system via antioxidant enzyme and immune cell catalysis.[13,14,19]

The initiation of systematic treatment with antioxidants, lutein complexes and vasoactive drugs is able to slow down the progression of dystrophic changes, preserve and improve functions. The use of methyl ethylpyridenol in dental orthopedics for indirect restorations and in studies of immunological parameters shows the effectiveness of this drug, especially in concomitant periodontal tissue diseases.[16,20,21]

Results and Discussion

Thirty six patients, divided into 2 groups, were treated and followed up. The results of the study confirm that indirect ceramic restorations have a number of significant advantages over direct composite restorations. Use of ceramic veneers in combination with Resverasin had positive effects on the immune reactivity in the oral cavity which resulted in a significant increase in the levels of lysozyme and sIgA in the oral fluid, compared to direct light cure polymer restorations. Based on our data immediately after treatment and after 3 and 6 months of follow-up, we can confirm the durability of the structures and a satisfactory aesthetic result, provided the correct

assessment of the clinical situation and strict adherence to the stages of veneer production. Therefore, the results obtained justify a significant expansion of the indications for indirect restorations in dental orthopedics.

To study the intensity of immunological reactivity in patients with existing defects of the coronal part of the anterior teeth, we analyzed sIgA and lysozyme levels in the oral fluid. 36 patients were selected for the study and divided into groups as follows: Group 1 – 12 patients aged 18 to 45 years with proposed indirect restorations – ceramic veneers; Group 2-12 patients aged 18 to 45 years with direct restorations performed with Estet X HD light cure polymer materials (Dentsply, USA); and control group – 12 patients aged 18 to 45 years without carious lesions and clinically healthy periodontium.

The method used for the crevicular fluid study is as follows: the area to be examined was carefully cleaned of plaque, isolated with cotton swabs and air-dried. Gum fluid was collected using standard paper pins by immersing them effortlessly in the gingival crevice for 1 minute in the area of the upper and lower incisors. The crevicular fluid was collected prior to treatment, immediately after treatment and 3 and 6 months after treatment.[9] The analysis of the data obtained in the study groups showed the differences in the parameters and their dependence on the chosen treatment method. As shown in Table 1, the level of lysozyme in the oral fluid increased after treatment, compared to the level before treatment, and was 105.2 + 6.3 μg/mL in Group 1 and 99.4 + 5.2 μg/mL in Group 2 respectively.

Table 1. Lysozyme and sIgA levels in the oral fluid in patients with direct and indirect restorations

Treatment method	Control group		Lysozyme content in the oral fluid				sIgA content in the oral fluid			
	Lysozyme content in the oral fluid mg/mL	sIgA content in the oral fluid g/L	Before treatment	After treatment	3 months after	6 months after	Before treatment	After treatment	3 months after	6 months after
Veneers (Gr.1)			64.3+ 4.3	105.2 +6.3	99.4+5.4	91.7+6.1	0.97+0.14	1.67+ 0.12	1.56+0.16	1.39+0.13
Direct restorations (Gr. 2)	111.6+7.3	1.78+0.12	67.1+3.9	99.4+5.2	88.7 +4.4	72.8 +2.3	1.02+0.1	1.52+ 014	1.42+0.15	1.12+0.11

Six months later, lysozyme levels in the oral fluid was 91.7 + 6.1 μg/ml in Group 1 following the use of Resverasin and 72.8 + 2.3 μg/ml in Group 2, where treatment was performed using direct restorations, respectively. Changes in immunoglobulins (sIgA) had the following pattern: sIgA level, which was 0.97 + 0.14 g/L in the oral fluid before treatment in Group 1 treated with Resverasin, significantly increased to 1.67 + 0.12 g/L immediately after treatment. In Group 2, the parameters after treatment were as follows: 1.82 + 0.11 g/L in the crevicular fluid and 1.52 + 0.14 g/L in the oral fluid. Three months later, sIgA levels in Group 1 treated with Resverasin were 1.56 + 0.16 in the oral fluid, and after 6 months of follow-up we observed stabilization of the parameters at the level of 1.39 + 0.13 g/L in the oral fluid. Following direct restorations, 3 months after treatment, an increase to 1.42+ 0.15 g/L in the oral fluid was observed, but after 6 months of follow-up, there was a significant decrease in sIgA to 1.12 + 0.11 g/L in the oral fluid, respectively.

Therefore, the analysis of the immune reactivity following the use of direct composite restorations and ceramic veneers in combination with Resverasin for the treatment of patients with hard tissue defects of the anterior teeth showed the superiority of the latter. The use of ceramic veneers for indirect restorations resulted in the increase in lysozyme and sIgA levels in the oral and crevicular fluids immediately after treatment and their stabilization 6 months later, which was not observed after direct light cure polymer restorations.

Conclusions

The study confirms that indirect ceramic restorations have a number of significant advantages over direct composite restorations. Ceramic veneers have no effects on the immune reactivity in the oral cavity and may be a recommended construction of choice in the treatment of the coronal defects in the anterior teeth of carious and non-carious origin. The analysis of immune reactivity in patients with defects in anterior teeth following direct composite restorations and ceramic veneers confirms the advantage of the latter in combination with Resverasin.

The use of ceramic veneers had positive effects on immune reactivity in the oral cavity resulting in a significant increase in the levels of lysozyme to 91.7 + 6.1 μg/ml and sIgA to 1.39 + 0.13 g/L in the oral fluid 6 months after treatment, which was as close as possible to normal, in combination with Resverasin. According to the results of our clinical studies, Resverasin significantly shortens the duration of the adaptation period and increases immune reactivity in the oral cavity, especially in combined pathology, i.e. defects of the hard tissues of the anterior teeth and diseases of periodontal tissues.

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