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CLINICAL ASSESSMENT OF THE STATE OF LOCAL IMMUNE MECHANISMS OF THE ORAL CAVITY IN PATIENTS AT DIFFERENT STAGES OF ORTHODONTIC TREATMENT

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Abstract: This article presents the results of a clinical observation aimed at studying the response of local immune mechanisms in the oral cavity of patients undergoing orthodontic treatment using fixed orthodontic appliances. A total of 147 patients aged 21–29 years were examined. Unstimulated oral fluid was used as the study material, in which lysozyme activity, secretory immunoglobulin A levels, and interleukin-1 β and interleukin-4 concentrations were determined. The results demonstrated that fixation of orthodontic appliances is accompanied by changes in the immunological profile of oral fluid, reflecting the development of an adaptive inflammatory response. The application of extended preventive measures contributes to a more favorable course of the adaptation period and promotes restoration of local immune balance.

Key words: orthodontic treatment, oral fluid, local immunity, immunological parameters, inflammation.

Annotatsiya: Maqolada nesyomli ortodontik konstruksiyalar qo'llanilgan holda ortodontik davolash olib borilayotgan bemorlarda og'iz bo'shlig'idagi mahalliy immun mexanizmlarining reaksiyasini o'rganishga qaratilgan klinik kuzatuv natijalari keltirilgan. Tadqiqotda 21–29 yoshdagi 147 nafar bemor ishtirok etgan. Tadqiqot obyekti sifatida stimullanmagan og'iz suyuqligi olingan bo'lib, unda lizotsim faolligi, sekretor immunoglobulin A darajasi, shuningdek interleykin-1 β va interleykin-4 miqdori aniqlangan. Ortodontik apparatni mahkamlash og'iz suyuqligining immunologik profilida o'zgarishlar yuzaga kelishiga olib kelib, adaptatsion yallig'lanish reaksiyasining rivojlanishini aks ettiradi. Kengaytirilgan profilaktik chora-tadbirlarni qo'llash adaptatsion davrning yanada qulay kechishi hamda mahalliy immun muvozanatning tiklanishiga xizmat qiladi.

Kalit so'zlar: ortodontik davolash, og'iz suyuqligi, mahalliy immunitet, immunologik ko'rsatkichlar, yallig'lanish.

Аннотация: В статье представлены результаты клинического наблюдения, направленного на изучение реакции местных иммунных механизмов полости рта у пациентов, проходящих ортодонтическое лечение с применением несъемных ортодонтических конструкций. Обследованы 147 пациентов в возрасте 21–29 лет. В качестве объекта исследования использовалась нестимулированная оральная жидкость, в которой определяли активность лизоцима, уровень секреторного иммуноглобулина А, а также содержание интерлейкина-1 β и интерлейкина-4. Установлено, что фиксация ортодонтической аппаратуры сопровождается изменением иммунологического профиля оральной жидкости, отражающим развитие адаптационной воспалительной реакции. Применение расширенных профилактических мероприятий способствует более благоприятному течению адаптационного периода и восстановлению локального иммунного равновесия.

Ключевые слова: ортодонтическое лечение, оральная жидкость, местный иммунитет, иммунологические показатели, воспаление.

INTRODUCTION

Fixed orthodontic appliances are currently the primary means of correcting dentoalveolar anomalies in young patients. Their clinical effectiveness is well established; however, the period of adaptation to orthodontic appliances is often accompanied by functional and biological changes in the oral cavity. These changes are caused both by the mechanical impact of appliance components and by alterations in the microbial environment.

The system of local immunity plays a particularly important role in shaping the response of oral tissues, as it provides primary protection of the oral mucosa and periodontal tissues. Any intervention that alters the habitual conditions of the oral environment affects the activity of immune factors, which may contribute to the development of inflammatory processes.

Oral fluid represents a dynamic biological medium that is highly sensitive to external and internal influences. The study of its immunological parameters makes it possible to assess the nature of adaptive processes during orthodontic treatment and to identify factors that influence the severity of inflammatory reactions. In this regard, analyzing changes in local immunity indicators over the course of orthodontic treatment is a relevant and important task in modern clinical orthodontics.

LITERATURE REVIEW

The study of the state of local immune mechanisms of the oral cavity is one of the key areas of modern clinical dentistry and orthodontics. In the works of A. K. Bazin and co-authors, it is emphasized that preventive measures and early correction of dentoalveolar anomalies play an important role in preventing inflammatory processes associated with disturbances in hygienic balance and immune reactivity of oral tissues. The authors point to a close relationship between the condition of the dentofacial system and the activity of protective factors of the oral environment.

A significant contribution to the study of inflammatory mechanisms and microbial aggression has been made by the research of A. I. Grudyanov, V. V. Ovchinnikova, and N. A. Dmitrieva, in which the possibilities of antimicrobial and anti-inflammatory therapy in dentistry are examined in detail. It has been shown that the effectiveness of therapeutic and preventive measures largely depends on the state of local immunity, which determines the resistance of the oral mucosa and periodontal tissues to bacterial load, especially during the use of orthodontic appliances.

A number of studies are devoted to the analysis of biochemical and immunological characteristics of oral fluid as an indicator of adaptive processes. In the works of A. V. Ivanova and co-authors, changes in the levels of free radicals, antioxidant potential, and immune components of saliva were identified in various types of dental interventions. These data confirm that oral fluid is a sensitive medium reflecting the functional state of local defense mechanisms.

Special attention in the literature is paid to the cellular and humoral components of local immunity. K. O. Samoilov, in his studies, demonstrated that changes in neutrophil activity and antimicrobial factors of oral fluid accompany chronic inflammatory processes in periodontal tissues. Of particular importance for assessing the antimicrobial potential of saliva is the determination of lysozyme activity, the methodology of which is described in detail in a patent of the Russian Federation authored by G. Storozhuk, I. V. Safarova, and V. V. Erikhev.

In foreign studies, particularly in the works of F. A. Scannapieco, the systemic significance of inflammatory processes in the oral cavity and their association with general somatic pathology are emphasized. Recent publications also confirm the relevance of a comprehensive approach to the prevention and treatment of dental diseases, including orthodontic treatment, taking into account the state of local immunity and microbial balance. These concepts form the theoretical basis for the clinical assessment of immunological changes at different stages of orthodontic treatment.

RESEARCH METHODOLOGY

The study included 147 patients aged 21–29 years who were undergoing orthodontic treatment with fixed appliances. At the start of treatment, none of the patients showed signs of acute inflammatory diseases of the oral cavity or pronounced systemic pathology.

Depending on the scope of preventive measures applied, the patients were divided into three clinical groups. The first group consisted of 49 patients who received standard instruction in individual oral hygiene. The second group included 48 patients whose hygiene measures were supplemented with courses of local antimicrobial intervention. The third group comprised 50 patients in whom preventive measures included a combination of antimicrobial intervention and non-pharmacological methods aimed at stimulating local protective responses.

Unstimulated oral fluid was collected before the initiation of treatment, as well as 2 weeks, 2.5 months, 6 months, and 12 months after the placement of orthodontic appliances. In the collected samples, lysozyme

activity, the concentration of secretory immunoglobulin A, and the levels of interleukin-1 β and interleukin-4 were determined. Data analysis was performed using parametric statistical methods, and the significance of differences was assessed at a p-value of less than 0.05.

ANALYSIS AND RESULTS

The analysis of oral fluid parameters revealed pronounced immunological changes already at the early stages of orthodontic treatment.

During the first two weeks after the placement of fixed orthodontic appliances, most patients exhibited signs of functional strain in local defense mechanisms. In this period, lysozyme activity decreased by an average of 15–25% compared with baseline values, indicating a reduction in the antimicrobial potential of oral fluid. Simultaneously, a decrease in the concentration of secretory immunoglobulin A was observed, reflecting a weakening of the humoral component of local immunity. Against the background of these changes, an increase in interleukin-1 β levels was recorded, indicating activation of inflammatory responses, while the concentration of interleukin-4 showed a moderate upward trend.

In the group of patients who received only hygienic support, the restoration of the studied parameters was slow and uneven. Normalization of lysozyme activity and secretory immunoglobulin A levels was observed mainly by the sixth month of treatment.

In patients whose hygienic measures were combined with antimicrobial intervention, positive dynamics were observed at earlier stages. However, the most stable parameters and values closest to baseline were recorded in patients who received comprehensive preventive measures, including correction of local immunity. In this group, recovery of immunological parameters occurred more rapidly and was maintained throughout the entire observation period.

The obtained results indicate that the placement of fixed orthodontic appliances is accompanied by the formation of an adaptive response of the oral immune system. At the initial stage of treatment, local defense mechanisms function under increased load, which is manifested by decreased activity of antimicrobial factors and changes in the cytokine profile.

A reduction in lysozyme activity and in the concentration of secretory immunoglobulin A can be regarded as a reflection of intensive utilization of immune resources in response to increased microbial and antigenic load. At the same time, elevated levels of pro-inflammatory cytokines indicate activation of cellular immune mechanisms and involvement of inflammatory cascades.

The severity and duration of these changes largely depend on the extent of preventive measures implemented. The use of a comprehensive approach, including antimicrobial intervention and stimulation of local immune mechanisms, contributes to a reduction in the intensity of inflammatory reactions and accelerates the restoration of immune balance in the oral cavity. This has important clinical significance, as it minimizes the risk of inflammatory complications and creates more favorable conditions for orthodontic treatment.

CONCLUSIONS AND RECOMMENDATIONS

The conducted study demonstrated that the placement of fixed orthodontic appliances has a significant impact on the immunological status of the oral cavity. At the early stages of orthodontic treatment, pronounced changes in the composition of oral fluid are observed, characterized by a decrease in the activity of local innate immune factors, including antimicrobial peptides and secretory immunoglobulin A, as well as an increase in the concentration of pro-inflammatory mediators.

The identified immunological shifts indicate the development of an adaptive inflammatory response of the oral mucosa to the mechanical and microbiological effects of orthodontic appliances. In the absence of adequate preventive measures, these changes may contribute to an increased risk of inflammatory diseases of the periodontium and soft tissues of the oral cavity.

At the same time, the results of the study confirm that the use of comprehensive preventive measures—including individualized oral hygiene, the application of antiseptic and immunomodulatory agents, and regular dental monitoring—promotes faster recovery of local immunity parameters. This is manifested by a reduction in inflammatory markers and normalization of the protective properties of oral fluid during the course of orthodontic treatment.

Recommendations:

1. It is recommended to implement a comprehensive preventive program for patients with fixed orthodontic appliances, aimed at maintaining immunological homeostasis of the oral cavity at all stages of treatment.
2. Regular monitoring of immunological parameters of oral fluid at the early stages of orthodontic treatment is advisable to ensure timely detection of inflammatory changes and appropriate adjustment of therapeutic and preventive measures.

3. In clinical orthodontic practice, wider use of locally acting agents with anti-inflammatory and immunocorrective effects, tailored to the individual characteristics of the patient, is recommended.

4. A promising direction for future research is an in-depth study of the dynamics of immunological parameters of oral fluid in different types of orthodontic appliances, as well as the development of personalized protocols for the prevention of inflammatory complications.

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