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PRACA ORYGINALNA
ORIGINAL ARTICLE

CLINICAL AND LABORATORY ASSESSMENT THE LEVELS OF ORAL HYGIENE, TOTAL PROTEIN, HYDROGEN SULFIDE AND NITROGEN METABOLITES IN ORAL FLUID IN THE DEVELOPMENT OF INFLAMMATORY COMPLICATIONS DURING ORTHODONTIC TREATMENT OF CHILDREN

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ABSTRACT

Introduction: Orthodontic treatment often causes inflammatory diseases in the oral cavity.

The aim: To increase the effectiveness of prevention of inflammatory complications in the provision of orthodontic care to children with dentomaxillary anomalies using non-removable orthodontic devices on the basis of study of clinical and biochemical parameters.

Materials and methods: The study was conducted among 100 patients divided into two groups: control and experimental group 2 (50 patients in each). The control group included healthy children without dento-maxillary anomalies. The second group were children aged 9-15 years with dento-maxillary anomalies which used non-removable (bracket systems) orthodontic devices. The oral fluid was collected at the beginning of the medical application of orthodontic devices (at the first day of treatment in the clinic) and after 3 and 6 months of treatment.

The study included the definition of the oral hygiene degree by using the Green-Vermillion index (OHI-S), the modified Fedorov-Volodkin's and Siness-Loe index, the determination of hydrogen sulfide and total protein levels, the content of nitrogen metabolites in the oral liquid.

Results: The use of non-removable orthodontic devices led to signs of inflammation in the oral cavity. This was accompanied by a deterioration of the oral hygiene, increase the total protein, hydrogen sulfide and nitrogen metabolites levels in the oral fluid.

Conclusions: Complex accounting is required of keeping oral hygiene in good condition, level determination of total protein, hydrogen sulfide and nitrogen metabolites for the prevention of the development of inflammatory diseases in the provision of orthodontic care.

KEY WORDS: dento-maxillary anomalies, oral hygiene, total protein, hydrogen sulfide and nitrogen metabolites

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INTRODUCTION

The whole world system of health care in general and dentistry in particular pay more attention to the fight against dental diseases, including dental anomalies [1]. As the study showed [2] morphological deviations in the dento-jaw system are often accompanied by significant functional disorders that lead to periodontal tissue diseases and early teeth loss. This pathology progresses rapidly with age and is accompanied by a deformation of the tooth-skeletal system, as well as aesthetic disorders. In addition to postures and functional disorders in the small circle of blood circulation, delayed psychosomatic development, there are neuroses and neurosis-like conditions associated with dissatisfaction with their own appearance.

Orthodontics is a relatively modern and rapidly progressive section of stomatology that studies the etiology and pathogenesis of dento-maxillary anomalies, the development of methods for their diagnosis, the development of methods for the prevention and treatment of anomalies of the position of the teeth, forms of dental arches, occlusion, jaw growth, normalization of the function of the dento-jaw system, elimination of aesthetic disorders , the influence on the development of adjacent organs and the organism as a whole [3]. The second half of the 20th century and the first decade of the 21st century are characterized by the rapid development of orthodontics, both in Ukraine and in other countries. It is known significant achievements of [4] which are obtained in the development of new methods of differential diagnosis of functional and mechanical methods for treatment of bite anomalies, which are used by more dental practitioners. It has been established that the inflammatory complications often accompany orthodontic treatment of children [5]. Sometimes inflammatory diseases (gingivitis, periodontitis) hinder the continuation of orthodontic treatment [6]. Therefore, effective prevention of inflammatory diseases is a key to successful orthodontic treatment.

THE AIM

To increase the effectiveness of prevention of possible complications in the provision of orthodontic care to children with dento-maxillary anomalies using non-removable orthodontic devices on the basis of study of clinical and biochemical parameters.

MATERIALS AND METHODS

The study was conducted among 100 patients divided into two groups: control and experimental group 2 (50 patients in each). The control group included healthy children without dentomaxillary anomalies, signs of inflammation in the oral cavity and diseases of the gastrointestinal tract. Children aged 9-15 years with dentomaxillary anomalies of the first class by Engle with moving 2-3 teeth which were used non-removable (bracket systems) orthodontic devices were the second group.

The oral fluid was collected at the beginning of the medical application of orthodontic devices (on the first day of treatment at the clinic) and after 3 and 6 months of treatment. The material used for the study was oral fluid (unstimulated mixed saliva), which was collected from patients always on an empty stomach at the same time. The freshly collected samples of oral fluid, which were collected in tubes with a sealed lid, were analyzed, centrifuged and the supernatant was transferred to Eppendorf tubes. Samples of saliva (oral liquid) were kept at -20°C to direct determination of biochemical parameters.

Clinical examination included questioning, review, palpation, percussion, auscultation. The mother of the child determined her state of health during pregnancy, heredity, the course of birth, how much they were, with what weight at birth, how fed and by what time. Revealed the transmitted diseases and their course, the time of teething, the causes of their premature loss, the time of change in teeth, as well as the age when the child began to walk and talk. After that, the patient's oral cavity was examined: the mucous membrane and the degree of development of the upper and lower lip bridle, tongue, the shape and size of the tongue, the tongue swelling, the depth of the solid palate, the state of the development of the alveolar jaws and the apical basis compared to the dental and alveolar arcs. They studied the shape, size and number of teeth, their condition and location in the tooth ranks, the shape of dental arches, the ratio of jaws and dentitions, and the type of bite.

Comprehensive consideration of clinical examination methods allowed us to form groups with non-removable devices for the treatment of dento-maxillary anomalies, namely, we involved in the study group children of 9-15 years old with the first class of dento-maxillary anomalies by Engl and with moving no more than 2-3 teeth, then we selected the appropriate fixed orthodontic devices. We used bracket systems.

The study determined the degree of oral hygiene by using the Green-Vermillion index (OHI-S), the modified Fedorov-Volodkin's and Siness-Loe index according to the generally accepted method [7]. Patients with poor oral hygiene were excluded from the study at the beginning of treatment.

The oral fluid of the patients to determine the hydrogen sulfide content was collected in a test tube containing 0.5 ml of 1% zinc acetate solution. The content of hydrogen sulfide was determined by the reaction of the formation of thionine using n-phenylenediamine [8].

The study of the level of total protein was carried out according to the generally accepted method [9].

Determination of the content of nitrites in the oral liquid was carried out by measuring the optical density of the colored azo compound formed by the interaction of nitrites with alpha-naphthylamine and sulfanilic Griss in acidic medium, as described previously [10].

The Bioethics Committee of the National Pirogov Memorial Medical University, Vinnytsya found that the research materials did not deny the basic bioethical norms of the Helsinki Declaration, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant provisions of the WHO and the laws of Ukraine.

RESULTS AND DISCUSSION

Clinical examination of the oral cavity of healthy children, children with non-removable orthodontic treatment was performed at the beginning of the study, after 3 and 6 months. It was found that in healthy children at the beginning of the observation, after 3 and 6 months, the mucous membrane of the oral cavity was pale pink, shiny, without pathological changes. In a group of children who used non-removable orthodontic devices for 3 months of observation, the mucous membrane was characterized by slight edema and small events of mild degree of localized catarrhal gingivitis. After 6 months of observation in 75% of children, who used non-removable orthodontic devices, the mucous membrane of the oral cavity was characterized by catarrhal gingivitis.

The level of oral hygiene was determined using the Green-Vermillion Index (OHI-S), the modified Fedorov-Volodkin Index and the Silness-Loe Index. During the study period, oral hygiene in the group of healthy children was almost unchanged. The study of the Green-Vermillion index showed that in the group with treatment with non-removable devices in 3 months of treatment the oral hygiene condition deteriorated 1.7 times. After 6 months the state of hygiene of the oral cavity deteriorated 1.8 times.

The study of the modified Fedorov-Volodkin's index showed that if 3 months of treatment the state of oral hygiene in the group with non-removable devices was 1.5 times worse, then after 6 months the deterioration of the oral hygiene status during the treatment of non-removable devices was 2 times, than at the beginning of treatment.

The study of the oral hygiene status by the Silness-Loe index were correlated with previous studies: at 3rd month of treatment the oral hygiene status was worse 1.66 times, and at the 6th month of observation this index was also worse 1.7 times compared with the beginning of treatment.

Clinical examination of patients, examination of the oral hygiene state were accompanied by oral fluid biochemical study.

Table I. The results of biochemical research

	Healthy children			Treatment patients		
	Start of treatment	3 m	6 m	Start of treatment	3 m	6 m
H_2S, mkm/l	38,05±1,28	39,21±1,38	41,61±1,51	41,13±0,71	63,22±1,66*	88,10±2,33*
NO mkg/ml	0,426±0,04	0,475±0,04	0,591±0,09	0,751±0,66	1,530±0,05*	3,048±0,60*
Total protein, g/l	5,25±0,14	5,68±0,11	6,01±0,14	5,94±0,11	7,26±0,20*	8,27±0,32*

* the difference was statistically significant ($p \leq 0,05$).

At the initial stage of the carious process, as with gingivitis, researchers observed growth in the content of total protein [6]. As is known, the most important elements of the secretory activity of the salivary glands are substances of proteins, which can be conventionally divided by functional properties into three groups: those who takes part in the processes of digestion, proteins which are associated with local immunity and proteins that perform regulatory functions.

The study showed that in the control group of children the level of total saliva protein varied, namely: after 3 months it was higher by 8% from the initial one, and in samples taken after 6 months, the total protein level was higher by 6% compared with the 3- month of study and 14% compared to the start of the study.

In patients of the experimental group which were used non-removable equipment during the treatment an increase in the total salivary protein level was 1.2 times at the 3rd month of treatment and 1.5 times at the sixth month of treatment (table I).

Increasing the level of total protein can be explained by the fact that the aggressive effect of orthodontic devices causes the formation of a local focus of infection in the oral cavity, sensitization of the mucosa, an increase of autoimmune disorders and aggravation of the course of the underlying disease.

Hydrogen sulfide reduces production of pro-inflammatory substances of protein-like nature, a well-known toxic gas with an unpleasant smell, which is formed mainly during the decay of proteins of animal and vegetable origin. For a long time its role in living organisms was considered only from the perspective of exo- and endotoxicants. Since the late 90s of the XX century, interest in hydrogen sulfide has increased considerably in connection with the establishment of its involvement in the regulation of physiological functions in animals and humans. The results of the studies of K. Abe and H. Kimura (1996), which described the peculiarities of the formation of this metabolite in the rat brain and identified the first molecular target, N-methyl D-aspartate receptors (NMDA receptors), were the impetus for a more in-depth study of the biological role of hydrogen sulfide.

The conducted study showed that the level of hydrogen sulfide in healthy children changed slightly, namely: after 3 months it was higher only by 3% of the initial, and in samples taken after 6 months, the hydrogen sulfide level was higher by 6% compared with 3 month of study and 9% compared with the start of the study (table I).

At 3 months after starting treatment patients of the experimental group who used non-removable devices were experienced an increase in hydrogen sulfide level in 1.5 times compared to the start of treatment and at the 6 month of treatment the level of hydrogen sulfide increased in 2 times compared with the the beginning of treatment (table I).

Scientists believe that in supra-physiological concentrations, hydrogen sulfide induces hyperalgesia, causes tissue inflammation and cell apoptosis [8], which we noted in a clinical examination of patients on the 3rd and 6th months of treatment.

Recent studies have shown that nitrogen metabolites play an important role in regulating the local immune response: together with hydrogen sulfide they are signaling molecules for the regulation of vascular tone and inflammation. Reduction of nitrogen metabolites production leads to increased perception of infection. The nitrogen metabolites synthesized refers to the antimicrobial protection factors, as it destroys bacteria, viruses, fungi. Therefore, the growth of the level of nitrogen metabolites is considered as an important factor of non-specific immunity, necessary for regulatory of cytoprotective processes.

Indeed, in our study, we found that in healthy children, the level of nitrogen metabolites varied, namely: after 3 months it was higher by 12% of the original, and in samples taken after 6 months, nitrogen metabolites level was higher by 27% than the 3- month of study and by 39% compared to the start of the study.

In patients of the experimental group with non-removable orthodontic devices during treatment, there was a significant increase of nitrites (nitrogen metabolites) in the oral liquid: 3 months after starting treatment in 2 times and after 6 months of the beginning of treatment in 4 times. The obtained data may indicate that the multiple increase in nitrogen metabolites level during the use of non-removable orthodontic devices leads to greater activation of the immunological reactivity of the oral cavity.

CONCLUSIONS

We have followed a cascade of interconnected clinical and biochemical changes that occur during the treatment of non-removable orthodontic devices. The presence of met-

al-plastic structures in the oral cavity complicates care and causes a deterioration of the index of oral hygiene. Remains of food, undigested carbohydrates cause disturbances in the oxidative-reducing processes, violation of the buffer properties of the oral fluid. The greater activation of the immunological reactivity of the oral cavity manifest in pathologically high levels of total protein, hydrogen sulfide and nitrogen metabolites.

Therefore, we consider it necessary in the provision of orthodontic care timely complex accounting of keeping oral hygiene in good condition, level determination of total protein, hydrogen sulfide and nitrogen metabolites for the prevention of the development of inflammatory diseases.

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