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Clinic for Children and Adolescents with Diseases of the Temporomandibular Joint System

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Abstract: Temporomandibular joint (TMJ) pathology in children and adolescents is influenced by genetic defects affecting bone tissue and its remodeling process. This study explores the role of matrix metalloproteinases (MMPs) in TMJ dysfunction, focusing on MMP-1 and MMP-9 as markers of collagen breakdown. The research involved 103 children and adolescents diagnosed with TMJ pathology, examining their biochemical parameters, including C-reactive protein levels and oxidative stress markers. Biometric, photometric, and radiographic analyses were conducted to assess occlusal anomalies and TMJ dysfunction severity. The study revealed that children with TMJ dysfunction exhibited increased MMP-1 and MMP-9 levels, indicating enhanced collagen degradation. A comprehensive treatment approach incorporating orthodontic interventions and systemic therapy (Wobenzyme and Omega 3-6-9) significantly reduced MMP-1 and MMP-9 levels by 44% and 24%, respectively. Additionally, antioxidant depletion and intensified lipid peroxidation processes were observed, contributing to systemic inflammation. The findings suggest that TMJ pathology involves structural and metabolic alterations in connective tissues, emphasizing the need for advanced diagnostic and therapeutic strategies. The study highlights the effectiveness of complex therapy in reducing inflammatory markers and improving TMJ function, underscoring the potential for early biochemical assessment in clinical decision-making for pediatric TMJ disorders.

Key words: Temporomandibular joint (TMJ) pathology, matrix metalloproteinases (MMPs), collagen degradation, oxidative stress, orthodontic treatment, systemic inflammation, pediatric maxillary anomalies.

Introduction

These processes are determined by the influence of many factors, a feature of the pathogenesis of changes in bone mineral density in children are genetic developmental defects, both of the components of bone tissue and the control system for its remodeling processes. The study of candidate genes is currently mainly focused on genes regulating bone metabolism, such as cytokines and growth factors, matrix proteins and calciotropic hormones. It has also been proven that matrix metalloproteinases (MMPs) play a special role in the development and maintenance of chronic inflammation. These are Zn2+ and Ca2+-dependent endopeptidases, enzymes of catabolism of most extracellular matrix proteins at various stages of the inflammatory process [1]. MMPs, along with other extracellular proteases, are capable of carrying out processes such as coagulation, immune response, and physiological tissue restructuring, and they are secreted from neutrophils, fibroblasts, epitheliocytes, macrophages, smooth muscle cells of endothelial vessels, and osteoblasts . Recently, scientific evidence has often been found that MMP8 and MMP9 are markers of both severity and activity of the pathological condition. It is interesting to conduct further studies of the levels of other MMR markers and their tissue inhibitors in both saliva and blood, as well as to scientifically substantiate the use of the data obtained to assess the severity, clinical features, and effectiveness of therapy for diseases of the maxillary system. In dental practice, patients with temporomandibular joint (TMJ) pathology can be found suffering from pain, hypermobility in the joint, dislocations and subluxations of the meniscus,

disorders in chewing food, difficulties in communicating with other people, at the same time, dental practice has difficulty in diagnosing and treating the causes of TMJ dysfunction [2]. All of the above confirms the need for further study of the clinical manifestations of TMJ pathology in adolescents, and the search for new approaches to diagnosis and treatment. Special emphasis was placed on the characteristic features in the analysis of morphological and functional changes leading to the formation of an intermediate space in the frontal area between the lower and upper dentition, as well as the height of its lower part. According to the indications, in order to characterize ASD in children and adolescents, the following were used: -biometric; -photometric, -telerentgenogrammetric; -orthopantomogrammetric studies; -statistical analyses of the results, as well as the examined were divided into groups according to the type of occlusion in accordance with the classification of L.S.Persin. A total of 103 children and adolescents with TMJ pathologies were used for local orthodontic treatment according to orthodontic indications; springs, screws, arches, myofunctional trainers and systemic braces were used for 3 to 12 months; of these, 58 children and adolescents were treated in parallel with general treatment (complex treatment group) in order to correction of metalloproteinases and markers of connective tissue in the body of children. The results of the biochemical method of investigation in 103 children and adolescents with TMJ pathologies (of which 48 adolescents with formed TMJ dysfunction pathologies (group 3)), venous blood and saliva collection in children was performed in the morning on an empty stomach [3]. For biochemical studies, venous blood was collected from children in the morning on an empty stomach. The blood cells were counted using a Sysmex KX-21 hematology analyzer in capillary blood taken from EDTA. The content of C-reactive protein and parameters of endogenous intoxication in the blood (creatinine, urea, bilirubin, seromucoid, sialic acids, antistreptolysin-0) were studied using a Cobas- 411 biochemical analyzer from ROSH (Switzerland) [4]. For all quantitative data, the group arithmetic mean (M) and the standard error of the mean (m) were calculated, which are presented in the summary tables. The statistical analysis was performed using the Statistica ver program. 7.0. The differences were considered significant at $P<0.05$.

Patients and methods

Matrix metalloproteinases type 1 and 9 (MMP-1 and MMP-9), which play a central role in the metabolism of connective tissue proteins and are specific markers of collagen breakdown, were studied in 48 examined adolescents with TMJ. Attention was drawn to a significant increase in the content of MMP-1 in adolescents with TMJ as the main enzyme responsible for denaturation of fibrillar collagen of the extracellular matrix [5]. Similar changes were revealed in the study of the content of MMP-9, the concentration of which in adolescents of the 1st group (OH) was 1.6 times higher than in children of the comparative group (SG), which, according to N.I. Solovyova and O.S. Ryzhakova , may indicate the activation of hydrolysis of type IV collagen. The concentration of TIMP-1 in cases of TMJ decreased when compared with the control group of children. The increased coefficients MMP-1/T1MP-1 and MMP-9/TIMP-1 confirm the possibility that the rate of collagen degradation by matrix proteinases exceeds the rate of its synthesis. Based on the analysis of the results, it can be said that the established differences in the number, distribution and localization of collagen and elastic fibers, along with a violation of the expression of protein-coding genes, in particular, the MMP and TIMP families, determine the multilevel changes in the microarchitectonics of the TMJ of adolescents with TMJ pathology [6]. Using laboratory research methods, we studied the biochemical parameters characterizing the state of homeostasis and the level of nonspecific resistance in adolescents with TMJ pathologies. According to the table, catalase activity in 3 groups in the primary clinical and laboratory study was on average 2 times lower than in children with hypertension. This indicates the depletion of the reserve capacity of the antioxidant system in adolescents in group 3. Considering that in the genesis of TMJ pathology in children, great importance is attached to membranopathological processes at the level of cellular factors, and the process of lipid peroxidation (POL) is an important mechanism leading to the destabilization of cell membranes. In the course of the work, the level of malonic dialdehyde (MDA) in the oral fluid was studied.

Results

The obtained research results showed that in children of the 3rd group, the content of MDA was significantly higher than in practically healthy children [7]. This indicated a local "in the oral cavity" intensification of lipid peroxidation processes in children with TMJ pathologies. The results of the study of the degree of inflammatory processes in the prostate, the intensity of which characterizes the activity of the leukocyte proteolytic enzyme elastase in the prostate. A decrease in catalase activity and a high content of MDA in RYE in group 3 children indicated a violation of the reserve capabilities of

the antioxidant system and the intensification of lipid peroxidation processes in the liver [8]. As is known, the systemic metabolism of connective tissue in patients with TMJ pathologies is characterized by the release of glycoproteins and a decrease in sulfated GAG. In addition, they determine the rheological properties of blood, which explains the occurrence of typical hemostatic disorders in AF, which affects thrombophilia caused by a systemic inflammatory response, which explains the predominance of GAG destruction over their synthesis. As mentioned above, TMJ pathology causes changes at the level of a number of enzymes belonging to the MMP family [9]. This is reflected in the detection of increased MMP concentrations in the saliva and blood serum of patients with TMJ diseases. In our study, the choice of MMP-1, which is an interstitial collagenase, and MMP-9, which acts on the collagens of the basement membranes, was carried out taking into account the fact that the extracellular matrix and the basement membrane have different structures and compositions, and TIMP-1 is able to inhibit both of these proteases. In addition, matrix metalloproteinases type 1 and 9 (MMP-1 and MMP-9) play a central role in the metabolism of connective tissue proteins and are specific markers of collagen breakdown. The traditional treatment of children with anomalies and deformities of the maxillary system and pathologies of the temporomandibular joint was carried out only with orthodontic devices. Based on the preliminary results of the study, a comprehensive treatment method with therapeutic and diagnostic measures has been developed and put into practice [10]. Based on this, the drugs used in the study, namely, in the treatment method, Wobenzyme and Omega 3-6-9 were used as a general treatment, as well as orthodontic treatment as a topical treatment.

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Discussion

The study revealed a significant decrease in the amount of matrix metalloproteinase MMP-1 as the main enzyme responsible for denaturing extracellular matrix fibrillar collagen in group 1 children on the background of complex therapy, by an average of 44%. The studied indicator decreased by 24% against the background of complex therapy compared with the group of children before treatment of the underlying disease. The study noted a decrease in the concentration of matrix metalloproteinase (MMP-3) in the group of children examined on the background of complex therapy. However, the matrix metalloproteinase index (MMP-3) tended to decrease by an average of 2.5 times compared with the group of children before treatment [11]. In the course of the study, attention was drawn to a significant decrease in the content of MMP-1 as the main enzyme responsible for denaturation of extracellular matrix fibrillar collagen in group 1 children on the background of complex therapy, by an average of 44%. Similar changes were found in the study of the content of MMP-9, the concentration of which in children before treatment was 1.6 times higher than in healthy children, which, according to N.I. Solovyova and O.S. Ryzhakova , may indicate the activation of hydrolysis of type IV collagen. Against the background of complex therapy, the studied indicator decreased by 24% relative to the group of children before treatment of the underlying disease. In our studies, there was a significant increase in MMP - 3 in children with TMJ pathologies when compared with healthy children. Meanwhile, against the background of complex therapy, a decrease in the concentration of MMP-3 was observed in the examined children [12].

An analysis of the research results on ESR in children with TMJ after complex therapy showed a decrease in ESR levels in all groups of the studied individuals. A significant decrease in the latter was noted in the 3rd group of adolescents, which, in our opinion, is due to an increase in the level of GAG, which adsorbs endogenous toxins in the blood as a polyanion. As mentioned above, high concentrations of C-RB in the examined children with TMJ indicate the role of inflammation in damage to the connective tissue of the TMJ [13]. According to the research results, complex therapy in group 3 was accompanied by a decrease in the level of C-reactive protein in the blood, the severity of which was noted in group 3. Conclusions. The prevalence of maxillary anomalies and deformities in children was 57.5%, of which 36.4% were malocclusion [14]. As a result of maxillary anomalies and deformities, in 16.1% of cases, the occurrence of a violation of the functioning of the TMJ in children was revealed. The possibility of assessing the development of normal or pathological processes in children using anthropometric measurements of the face has been identified. In diseases of the temporomandibular joint caused by anomalies and deformations of the maxillary system, the highest rate of increase in the physiological height of the face was found in boys and girls aged 14-18 years, the lowest rate - at the age of 6-9 years.

Conclusion

This study highlights the significant role of matrix metalloproteinases (MMP-1 and MMP-9) in the pathogenesis of temporomandibular joint (TMJ) dysfunction in children and adolescents. Elevated levels of these enzymes indicate increased collagen degradation, contributing to structural and functional disturbances in the maxillary system. The findings suggest that TMJ pathology is not only a localized disorder but also involves systemic inflammatory responses, oxidative stress, and alterations in connective tissue metabolism. The implementation of complex therapy, combining orthodontic treatment with systemic interventions such as Wobenzyme and Omega 3-6-9, demonstrated notable improvements. The reduction in MMP levels, decreased inflammatory markers, and improved biochemical parameters indicate that a multidisciplinary approach is essential for managing TMJ dysfunction effectively. Furthermore, the study underscores the importance of early diagnosis using biochemical markers, which can provide valuable insights into disease progression and treatment outcomes. Given the widespread prevalence of maxillary anomalies and TMJ dysfunction in children, further research is needed to refine diagnostic criteria and optimize treatment protocols. Future studies should explore additional MMP markers, their tissue inhibitors, and the long-term effects of complex therapy on TMJ function. These findings contribute to the development of more targeted and personalized therapeutic strategies for pediatric patients with TMJ disorders.

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