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CRITERIA FOR CHOOSING ORTHODONTIC APPLIANCES IN CHILDREN 8–11 YEARS OLD WITH MALOCCLUSION AND TYPE 1 DIABETES MELLITUS

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ABSTRACT. Introduction. Type 1 diabetes mellitus (DM1) in children requires a special approach in orthodontic treatment, as the disease affects the condition of the tissues of the oral cavity and makes it difficult to correct malocclusion. The article discusses the criteria for choosing orthodontic equipment and methods of treatment for children with DM1, taking into account their metabolic characteristics. Metabolic disorders that lead to dry mouth (xerostomia), an increased risk of caries and periodontal diseases, as well as delayed tissue healing complicate the choice of orthodontic devices and require special attention to oral hygiene. **The aim of the study** was to determine the criteria for choosing orthodontic devices for patients aged 8–11 years with occlusion anomalies and DM1. **Materials and methods.** The study involved children aged 8–11 years: 17 patients with DM1 and 38 children without this disease. Clinical examination methods were used, such as questioning, examination, examination of the oral cavity and teeth, as well as the parotid soft tissues. **Results.** Patients with DM1, compared with children who do not have this disease, were more likely to experience discomfort caused by the pressure of orthodontic devices on the mucous membrane, which required an increase in the number of unscheduled visits and adaptation of therapeutic measures to the existing condition. To reduce the load on the tissues, the elements of the devices were alternately activated, which helped reduce the risk of complications. Special attention was paid to careful monitoring of glucose levels before starting treatment, which reduced the likelihood of complications, secondary infections and delayed tissue healing at the contact points of the device parts. **Conclusion.** Patients with DM1 often had changes in the color of the mucous membrane, bleeding gums and long-term non-healing wounds, therefore, it was recommended to use devices made of soft and elastic materials that minimally affected the soft tissues during support and provided comfortable wearing. It is necessary to avoid structures made of plastic with sharp edges that can injure the mucous membrane and regularly to check the condition of the gums and mucous membrane to prevent the development of periodontal diseases and caries. Orthodontic treatment of children with DM1 requires a carefully individualized approach, including interdisciplinary collaboration and the use of minimally invasive techniques. It is necessary to take into account the psychoemotional state of children with DM1, provide them with regular orthodontist supervision, and support from dental specialists. This approach will help minimize the risks of complications and ensure the successful outcome of orthodontic correction of malocclusion, improving the quality of life of patients and their families.

KEYWORDS: type 1 diabetes mellitus, mucous membrane of the oral cavity, orthodontic treatment, malocclusion pathology, OT-orthodontic correctors, orthodontic devices

КРИТЕРИИ ВЫБОРА ОРТОДОНТИЧЕСКОЙ АППАРАТУРЫ У ДЕТЕЙ 8–11 ЛЕТ С АНОМАЛИЕЙ ПРИКУСА И САХАРНЫМ ДИАБЕТОМ 1-ГО ТИПА

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РЕЗЮМЕ. Введение. Сахарный диабет 1-го типа (СД1) у детей требует особого подхода при ортодонтическом лечении, так как заболевание влияет на состояние тканей полости рта и затрудняет процесс коррекции аномалий прикуса. В статье рассмотрены критерии выбора ортодонтической аппаратуры и методы лечения детей с СД1, учитывающие их метаболические особенности. Нарушение обмена веществ, которое приводит к сухости во рту (ксеростомии), повышенному риску кариеса и пародонтальных заболеваний, а также замедленному заживлению тканей, усложняет выбор ортодонтических аппаратов и требует особого внимания к гигиене полости рта. **Цель исследования** — определение критериев выбора ортодонтических аппаратов для пациентов 8–11 лет с аномалиями окклюзии и СД1. **Материалы и методы.** В исследовании участвовали дети в возрасте 8–11 лет: 17 пациентов с СД1 и 38 детей без этого заболевания. Использовались клинические методы обследования, такие как опрос, осмотр, исследование полости рта и зубов, а также окологубных мягких тканей. **Результаты.** Пациенты с СД1 по сравнению с детьми, у которых отсутствует данное заболевание, чаще испытывали дискомфорт, вызванный давлением ортодонтических аппаратов на слизистую оболочку, что требовало увеличения количества внеплановых посещений и адаптации лечебных мероприятий к существующему состоянию. Для уменьшения нагрузки на ткани проводилась поочередная активация элементов аппаратов, что способствовало снижению риска осложнений. Особое внимание уделялось тщательному контролю уровня глюкозы перед началом лечения, что снижало вероятность осложнений, присоединения вторичных инфекций и замедленного заживления тканей в местах контакта деталей аппарата. **Заключение.** У пациентов с СД1 часто наблюдались изменения цвета слизистой оболочки, кровоточивость десен и длительно незаживающие раны, поэтому рекомендовалось использовать аппараты, выполненные из мягких и эластичных материалов, которые минимально воздействовали на мягкие ткани при опоре и обеспечивали комфортное ношение. Нужно избегать конструкций, выполненных из пластмассы, с острыми краями, способных травмировать слизистую оболочку. Важно регулярно проверять состояние десен и слизистой оболочки, чтобы предотвратить развитие пародонтальных заболеваний и кариеса. Ортодонтическое лечение детей с СД1 требует тщательно индивидуализированного подхода, включающего междисциплинарное взаимодействие и использование минимально инвазивных техник. Необходимо учитывать психоэмоциональное состояние детей с СД1, предоставлять им регулярное наблюдение ортодонта, поддержку со стороны специалистов стоматологического профиля. Такой подход поможет минимизировать риски осложнений и обеспечит успешный результат ортодонтической коррекции аномалий прикуса, улучшая качество жизни пациентов и их семей.

КЛЮЧЕВЫЕ СЛОВА: сахарный диабет 1-го типа, слизистая оболочка полости рта, ортодонтическое лечение, патология прикуса, ОТ-ортодонтические корректоры, ортодонтические аппараты

INTRODUCTION

Type 1 diabetes mellitus (DM1) is a chronic autoimmune disease characterized by absolute insulin deficiency due to destruction of the β -cells in Langerhans pancreatic islets. The disease is most often diagnosed in childhood and adolescence, which makes it important to consider its impact on various aspects of health, including dental status and orthodontic correction of bite abnormalities.

Orthodontic treatment of children with type 1 diabetes mellitus requires a special approach due to complications related to metabolic changes. Diabetes mellitus leads to metabolic disorders, which affects the condition of the tissues of the oral cavity. Children with DM1 are susceptible to a number of changes in the oral cavity, such as xerostomia, an increased risk of developing caries, periodontal diseases and delayed wound healing of tissues in the oral cavity [1, 2]. This may later limit the specialist in the choice of appliances, complicate the process of orthodontic treatment, require a special approach and interdisciplinary interaction of clinicians. Diabetic microangiopathy, decreased blood flow in the oral tissues and impaired bone remodeling worsen the condition of the entire maxillofacial region, which makes treatment more complex and requires careful monitoring and adaptation of treatment methods. Modern research emphasizes the need to take into account the systemic characteristics of patients with DM1 to ensure successful orthodontic treatment and minimize the risk of complications.

It has been established that type 1 diabetes mellitus is one of the most common forms of diabetes in children and adolescents. In the United States, about 5% of all cases of diabetes are type 1, and, as a rule, this type of diabetes develops in childhood or adolescence [3].

According to the US Centers for Disease Control and Prevention, if incidence rate continues to increase, the number of children and adolescents with type 1 diabetes could increase by 65% by 2060. Even if the current trend continues, the incidence will remain significant, requiring special attention to preventive measures and raising awareness of the disease among parents and healthcare professionals [4]. In addition, there is an increase in the number of diabetic compli-

cations in children, including impaired immune system function and an increased risk of ketoacidosis. These factors significantly affect the quality of life of children and require

According to various Russian sources, the prevalence of type 1 diabetes among children in Russia has also increased significantly in recent years. On average, the incidence is 15–20 new cases per 100,000 children per year [5]. These rates may vary by region of the country, with higher incidence rates in certain areas, such as the Tula, Kemerovo, and Ulyanovsk regions.

According to the National diabetes register, there are more than 30,000 children and adolescents with type 1 diabetes in the Russian Federation, and the number of new cases continues to grow every year, with an average annual increase of 2.8. The disease is characterized by an acute onset with pronounced symptoms such as thirst, weight loss, and frequent urination. These data emphasize the importance of early diagnosis and high-quality monitoring of children at risk of developing diabetes, as well as the need to develop prevention and timely treatment programs.

In the North-West region of the Russian Federation, including St. Petersburg, the prevalence of DM1 among children is even higher than in other regions of the country. Studies show that the incidence of DM1 in the Northwestern Federal District (NWFD) is 15.66 per 100,000 children. This figure is the highest among all federal districts of the Russian Federation, which indicates the importance of monitoring and prevention in this region and requires attention to issues of diagnosis and provision of high-quality medical care to children suffering from this disease.

The increase in the incidence of DM1 in recent decades and the improvement in the prognosis of the disease lead to an increase in the number of children who require orthodontic treatment. However, despite the increasing attention to this issue, there is a lack of systematic data on the specific features of orthodontic care for children with DM1 [6].

Thus, type 1 diabetes mellitus in children is a serious problem that requires special attention to diagnosis, treatment and management of the disease. Global trends show an increase in the prevalence of this disease among children, which makes it an important topic for medical research and the development of

new approaches to treatment and prevention. DM1 in children and adolescents not only affects metabolism, but can also significantly impact the development of dentofacial anomalies (DFA). Numerous studies show that predisposition to DFA in children with DM1 may be associated with genetic and epigenetic factors [7].

In DM1, growth retardation is also common, which leads to disturbances in the formation of the jaws and teeth [8].

Increased susceptibility to periodontal diseases in DM1 also affects the development of DFA. Periodontitis can cause gum recession and loss of dental tissue at an early age, which in turn leads to disruption of the anatomy of the stomatognathic system. Scientific studies conducted in 2015–2024 discussed the high prevalence of periodontal diseases in children with diabetes and their association with DFA [9–11].

Chronic hyperglycemia, characteristic of DM1, can lead to impaired tooth mineralization and decreased tooth strength. This increases the risk of caries and other dental diseases that may contribute to the development of anomalies. Many studies emphasize the relationship between glucose levels and the condition of tooth enamel [12]. It has also been established that changes in the composition and properties of oral fluid affect tooth mineralization [13].

AIM AND TASKS

The aim of this study is to analyze the characteristics of orthodontic treatment of children with DM1, identify specific problems and develop recommendations for optimizing orthodontic treatment approaches in this group of patients.

Tasks

1. Assess the condition of the oral cavity and the stomatognathic system in children with DM1.
2. Identify common malocclusion among this category of patients.
3. Study the impact of DM1 on the course and results of orthodontic treatment.
4. Compare the characteristics of orthodontic treatment of children with DM1 to control group without this disease.
5. Develop recommendations for orthodontists on the management of patients with DM1.

MATERIALS AND METHODS

The study involved patients of a dental clinic who had visited an orthodontist for an initial consultation. Based on the results of the survey (filling out a health questionnaire), a control group was determined, which did not include patients with an established diagnosis of DM1. The first group included 38 patients aged 8–11 years. The second group consisted of 17 patients of the same age with an established diagnosis of DM1. All patients sought orthodontic treatment.

RESULTS

When identifying complaints from patients (their legal representatives) of the second group, compared to the control group, not only the main complaint about the presence of malocclusion was identified, but also complaints about *dry mouth (xerostomia)*. The presence of xerostomia in children and adolescents with diabetes is associated with disorder of salivation, which can be a consequence of both the disease itself and the use of hypoglycemic drugs. This situation is confirmed by the data of a study conducted in 2019 [14]. It indicates that most patients with DM1 have symptoms of dry mouth, which increases the risk of caries and infections.

Change in mucous membrane color. In children and adolescents with DM1, a change in the color of the mucous membrane is often observed. It can acquire a pale or yellowish tint, which is associated with disruptions in the microcirculation and metabolic processes. This is confirmed in one of the studies published in 2017 [15], which noted changes in the vascularization of the mucous membrane in diabetic patients.

Bleeding gums by tooth brushing.

Presence of long-term non-healing wounds, especially during professional dental cleaning, which may be associated with metabolic and vascular innervation disorders. Such processes indicate slowing healing of the oral mucosa as a result of chronic hyperglycemia.

During clinical check-up of patients in the second group, compared to the control group, it was found that the oral mucosa in patients had a number of characteristic changes.

Changes in the structure and color of the mucous membrane, presence of gingivitis. This is explained by the high risk of periodontal diseases in this group of patients. According to an analysis of scientific literature, including the results of one study conducted in 2016, the prevalence of gingivitis in children with DM1 is 75%, which is significantly higher than in healthy children. In turn, chronic gingivitis and susceptibility to infection can lead to loss of dental tissue and caries [16].

Some patients came to the clinic with symptoms of *stomatitis*. As is known, patients with DM1 are also at increased risk of infectious diseases of the oral mucosa, such as stomatitis and *candidiasis*. This is due to immune system disruption and increased salivary glucose level, which creates favorable conditions for the growth of pathogenic flora. Many studies have noted that up to 40% of patients with diabetes suffer from fungal infections [17].

There were no significant differences between the groups in terms of the severity of the anomaly. Patients in all groups had malocclusion to varying degrees that required orthodontic treatment. Basically, starting from the age of 8, the anomalies corresponded to codes K07.0, namely K07.2 Anomalies of dental arch relationships, then, after 10 years, they corresponded to the codes K07.2 Anomalies of dental arch relationships and K07.3 Anomalies of tooth position (according to ICD-10).

When assessing the impact of DM1 on the course and results of orthodontic treatment, it should be noted that in such patients, compared to the control group, a choice was more often made based on indications for

the use of orthodontic devices made of medical soft and elastic materials (Fig. 1).

During the control check-ups, when patients came for activation of the device, the condition of the mucous membrane and adjacent soft tissues, which the device exerts pressure on, was constantly assessed. In cases of using orthodontic appliances in two groups, identical in design with a screw and pushers, protractors, patients from the DM1 group more often came for additional visits, because some parts of the devices exerted pressure on the mucous membrane. Due to this, there were violations of the modes of use and activation of the orthodontic appliances in the DM1 group of patients compared to the control group and, as a consequence, an increase in the treatment time. The measures to activate the screw, pushers and other elements were not carried out simultaneously, but alternately or through visits for the same reasons – to ensure minimal impact on the tissues and enamel of the teeth. And therefore, when treating patients with DM1, the simplest in technical execution designs of orthodontic appliances were chosen, for example, such as OT-orthodontic correctors. Patients were more often recommended to undergo professional dental cleaning and received additional oral hygiene training. With such patients, when they came for control visits, conversations were held and recommendations were given in extremely friendly and solicitous tone, taking into account the above difficulties on their part during the treatment and their special psycho-emotional status.

During the treatment of such patients, periodontal specialists were more often contacted to eliminate problems with soft tissues.

In addition to the recommendations for orthodontic treatment of such patients, it is necessary to conduct a general health assessment, namely: before starting orthodontic treatment, it is necessary to conduct a complete medical check-up, including blood glucose monitoring. This is important, since poor compensation of diabetes can lead to complications such as infections and delayed healing.

When choosing devices, it is necessary to take into account the condition of the gums and teeth. It is recommended to use appliances with minimal load to prevent tissue damage, since diabetes can lead to a decrease in the strength of teeth and tissues.



Fig. 1. The design of the OT-orthodontic corrector

Рис. 1. Конструкция ортодонтического ОТ-корректора



a/a



b/6

Fig. 2. The stages of application of orthodontic devices in the treatment of severe malocclusion: a — on removable devices; b — on fixed appliance

Рис. 2. Этапность применения ортодонтических аппаратов при лечении сложных аномалий окклюзии: а — на съемных аппаратах; б — на несъемных аппаратах

Type 1 diabetes mellitus has a significant impact on the oral tissues and skeletal system, making orthodontic treatment challenging. Research has shown that patients with diabetes have impaired alveolar bone remodeling and increased tooth mobility, which is associated with chronic hyperglycemia and metabolic disorders in the body. This is especially true for patients with poor glycemic control, as such patients are at increased risk of inflammatory diseases and unpredictable tooth movement during treatment. Therefore, complex orthodontic plans should be avoided, broken down into stages, and some limitations in tooth movement should be taken into account (Fig. 2, a, b).

Thus, orthodontic treatment in children with type 1 diabetes requires careful planning, including stabilization of blood sugar levels, monitoring of the condition of the gums and teeth with the use of the minimum possible physiological loads on the teeth to avoid complications and ensure successful treatment.

CONCLUSION

Clinical guidelines and protocols for orthodontic treatment of patients with malocclusion and type 1 diabetes mellitus, approved by the Russian Ministry of Health of the Russian Federation, describe various aspects of diagnosis, treatment and prevention [19–22]. The main focus is on how diabetes affects the stomatognathic system and the importance of taking this influence into account when planning orthodontic treatment.

Our study showed that it is necessary to determine the general health of patients with DM1. Before starting orthodontic treatment, it is necessary to conduct a thorough medical check-up of the patient for the presence of concomitant diseases associated with diabetes. It is necessary to develop an individualized treatment plan and adapt the choice of treatment method to the oral condition of patients with DM1. At the same time, minimally invasive techniques can reduce the risk of complications.

When choosing appliances, preference should be given to devices that do not interfere with oral hygiene and do not have sharp edges in their design that can injure the mucous membrane. The increase in the duration of orthodontic treatment should be taken into account.

It is important to regularly check the condition of the gums and mucous membrane in this group of patients, especially during treatment, to prevent the development of periodontal disease and caries. Given the impact of chronic disease on the psychoemotional state of children, it is recommended to provide support and advice to help cope with stress and improve the quality of life.

ADDITIONAL INFORMATION

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