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Justification of Using an Aero-Abrasive Handpiece in Therapeutic Somatology

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ABSTRACT

Currently, the treatment of caries is reduced to excision of pathological tissues and replacement of the defect with filling material. Improving the quality and efficiency of dental preparation is one of the important problems of modern dentistry, the solution of which will reduce the incidence of caries and reduce the cost of repeated treatment. According to modern data, the use of physiological factors - air-abrasive preparation of teeth is promising. The high flow power provided by the equipment for kinetic preparation technology, combined with a solid grain of powder that increases the intensity of the impact, opens up new prospects for the application of the method.

Key words: Caries, Preparation, Aero-abrasive handpiece

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INTRODUCTION

Caries is one of the main dental diseases of the dentoalveolar system (DAS) by many authors [1-3]. Currently, dental caries is the most common disease of the dentition. In the general structure of the provision of medical care to patients in medical and prophylactic institutions of the dental profile, this disease occurs in all age groups of patients. The prevalence of caries in the adult population aged 35 years and older is 98-99% [4,5]. In the last two decades, there has been a tendency for an increase in the incidence among children, especially in economically developed countries, and by 6-7 years in 80 –90% of children have caries of varying depth.

Dental caries with untimely or improper treatment can cause the development of inflammatory diseases of the pulp and periodontium, loss of teeth, the development of purulent-inflammatory diseases of the maxillofacial region. Dental caries are potential foci of intoxication and infectious sensitization of the body [4]. Untimely treatment of dental caries, as well as tooth extraction as a result of its complications, in turn, lead to the appearance of secondary deformation of the dentition and the occurrence of pathology of the temporomandibular joint. Dental caries directly affects the health and quality of life of the patient, causing disturbances in the chewing process up to the final loss of this body function, which affects the digestion process [4,5]. In addition, dental caries is often the cause of the development of diseases of the gastrointestinal tract. To prevent the above complications, timely and high-quality treatment of caries is very important.

Currently, caries treatment is reduced to excision of pathological tissues and replacement of the defect with filling material. Dissection is the most time-consuming stage, its features depend on the localization of the carious cavity (CC), the extent of the lesion and the group belonging of the tooth, the hygienic state of the oral cavity, the aesthetic requirements of the patient, and the properties of the filling material. Improving the quality and efficiency of tooth preparation is one of the important problems of modern dentistry, the solution of which will reduce the incidence of caries and reduce the cost of retreatment [6-10].

Caries treatment includes two main stages-necrotomy (odontopreparation) and cavity filling. According to a number of researchers, the preparation of hard tooth tissues is one of the most labor-consuming and requiring great medical skill of manipulation in practical dentistry. According to the literature, the durability of the filling, its retention, the state of the enamel-restoration joint depends on the observance of the rules of odontopreparation. Taking into account the possibility of remineralization, it is necessary to preserve as much natural tissue as possible, thereby minimizing further damage to the tooth.

In odontoreparation, there are a number of factors that can cause local and general complications. Common factors include stress, psychoemotional stress, pain, dysfunction of the cardiovascular and neuroendocrine systems, allergic reactions, an infected aerosol cloud. Local complications are mechanical and thermal trauma, vibration, microbial invasion [11,12].

Even with the optimal choice of the bur and the speed of preparation, the kinetic energy transferred by the instrument to the tooth is excessive and unevenly distributed over the surface. Hence, the heating of the tooth tissues, microcracks in the enamel and dentin, vibration and sound, which cause negative emotions in the patient. When cutting with diamond burs without cooling, the temperature increase reaches 225-257°C, and with metal burs 300-320°C. In this case, irreversible changes in tissues occur: violation of odontoblasts, vasodilation, hemorrhages in the pulp, round-cell infiltration, predentinum necrosis, in turn, is the cause of impaired adhesion of filling materials and recurrent caries.

The disadvantages of traditional preparation require the search for new types of processing of tooth tissues, allowing to minimize the violation of their structure. At the same time, the development goes in two directions:

1) Improvement of methods and tools for traditional preparation.

2) Development of alternative technologies: chemomechanical, laser, ultrasonic, air and water abrasive [1,13,14].

According to modern data, the use of physical factors for the removal of pathologically altered tissues (ultrasound, laser, air-abrasive, etc.) is promising. In our opinion, the most attractive is air-abrasive preparation of teeth. The high flow rate provided by the kinetic preparation equipment, combined with the increased intensity of the hard powder grain, opens up new perspectives for the method. We have developed an aero-abrasive tip that has a preparation effect, unlike existing analogues and prototypes, it has the ability to accelerate abrasive materials due to changes in the turbulence of the air flow supplied to the hard tissues of the tooth.

Today in the arsenal of a dentist there are several different methods of preparation of hard tooth tissues and a huge selection of equipment, which allows not only to facilitate the work and improve the effectiveness of the treatment, but also to reduce the psychological barrier associated with the treatment of caries.

The air-abrasive method has a number of advantages: painless, non-contact preparation with the predominant removal of only affected tissues, which eliminates vibration, overheating of tissues, reduces the risk of microtrauma, chips and cracks in enamel and dentin, makes it possible to prepare ultra-small cavities and deeply clean fissures without opening them. The treated surface remains dry, rough, a thick lubricated layer does not form, which increases the efficiency of adhesive systems [2,6,14-18]. In the treatment of fissure caries, the air-abrasive method provides complete cleaning with the creation of a local rough enamel surface without a smeared layer. This creates conditions for ideal microretention when working with modern composites without additional etching. The treatment does not involve local anesthesia, does not cause overheating and preserves healthy

tooth tissues as much as possible. Dynamic observation of the results of treatment using the air-abrasive method showed its effectiveness, the absence of relapses and complications in the long term. After preparation, scientists did not find changes in mineral metabolism and microstructure of enamel and dentin, and remineralization of enamel occurred 1.5 times faster than when exposed to burs [2,6,7,19].

Compared to the traditional drilling method, the benefits of abrasive particle airflow are numerous and include the following:

- ✓ Air abrasives do not produce sound, pressure or vibration.
- ✓ No overheating of the prepared tissues, since there are no rotating and rubbing parts in the tip.
- ✓ No need to etch enamel and remove the "smeared" layer of dentin.
- ✓ The ability to visually control the volume of prepared tissues.
- ✓ Air abrasives leave much more healthy tissue in the treated tooth.
- ✓ Minimal damage to healthy tooth tissues surrounding the cavity.
- ✓ Minimal trauma to the gums and oral mucosa.
- ✓ Ease of antiseptic processing of tips and nozzles.
- ✓ Durability and reliability of working systems.
- ✓ The ability to prepare ultra-small cavities.
- ✓ The possibility of preparation with one tip without replacing the instrument of various tooth tissues, up to the removal of fillings from any filling materials.
- ✓ Air abrasives reduce the need for anesthesia, especially if the tooth is shallow.
- ✓ Air abrasives leave the working area relatively dry, which is an advantage when inserting composite fillings.
- ✓ Air abrasives reduce the risk of microcracks and tooth crushing.
- ✓ Low likelihood of developing secondary caries.
- ✓ Significant acceleration of preparation time due to efficient particle flow.
- ✓ Air abrasives allow the dentist to treat multiple teeth in one visit.

In addition, the air-abrasive technique for the favorable emotional impact on patients has no equal among the means of mechanical processing of hard tooth tissues.

Currently, the opportunities for improving the quality of dental care have increased significantly. On the one hand, this is directly related to the dynamic development of medicine, since science does not stand still, therefore, each industry, in turn, should develop in parallel with the pace.

Taking into account the above literature data, we have proposed a new type of air-abrasive handpiece for tooth preparation. Which allows you to radically excise pathologically altered dental tissues. At the same time, it allows you to adhere to the principle of preparation within the limits of biological expediency. According to many researchers, the technical implementation of the currently used methods of treating deep caries does not always provide a stable positive result, and the prospects of the rotary method for preparing hard tooth tissues are limited by a number of clinical and morphological factors.

The inevitability of the temperature effect on the tooth tissues often leads to inflammatory processes in the pulp. The formation of a lubricated layer reduces the strength of the adhesive adhesion of the retention surface to the filling material, and dentinal chips and microcracks arising during the treatment of carious cavities serve as additional foci of infection, provoking irreversible metabolic disorders in dentin and pulp.

As a solution to these problems, modern cariesology considers the search for alternative, effective and clinically justified, methods of surgical excision of dental hard tissues.

One of the promising directions in such research is the use of aero-abrasive preparation method. The experience of the experimental use of the dental apparatus on its basis revealed an almost complete absence of temperature effects on the tooth, high retention properties of the treated surface, as well as relative painlessness.

In this regard, we at the Department of Therapeutic Dentistry of KazNMU developed and patented an aerosive-abrasive tip. We carried out experimental studies on which the following conclusions were made. The nature of microstructural changes in the pulp tissues

resulting from the preparation of deep carious cavities by traditional and alternative methods. By morphological study of the pulp, we found that the use of an aero-abrasive handpiece for the preparation of deep carious cavities does not lead to significant functional disorders in the tooth tissues. At all stages of the experiment, after preparation using the handpiece, we observed a stable tendency towards reparative dentin formation and formation of a dense layer of odontoblasts. In contrast to the baseline study, in the comparison groups, we did not reveal cases of tooth damage and irreversible changes in its tissues.

It was also revealed that the condition of the teeth that were prepared using our apparatus remained relatively stable throughout the entire period of clinical observations. Our experimental comparative studies showed more favorable results in the treatment of deep caries in those groups where cavity preparation was carried out using the microstructure of the bottom and walls of cavities prepared using traditional and alternative methods was studied. In the latter case, we observed a significantly better state of the retention surface, devoid of chips, microcracks, and remnants of softened dentin. At the same time, the quality of the restorations after the preparation of deep carious cavities, regardless of their localization, using the device, showed higher rates of marginal adaptation and safety of the fillings to the surface of the tissues of the teeth subjected to preparation. Sterility and the absence of a "smeared layer" on the surface were revealed. During the year, patients undergoing treatment for deep caries found positive results.

The expediency of using the proposed apparatus in the treatment of the bottom of carious cavities, covered with even a thin layer of dentin, has been substantiated. Through experimental observations, we found that in our case the risk of temperature stress on the enamel is significantly lower than when treating a carious cavity with a boron [20-31].

In the process of research, a complex technique of surgical excision of hard tissues of teeth was applied, involving the consistent use of air-abrasive preparation methods.

Thus, surgical excision of dental hard tissues with the use of the handpiece we proposed is an effective and justified method of choice for the preparation of deep cavities of carious origin.

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