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## MORPHOLOGICAL RATIONALE OF ADVISABILITY FOR ULTRASOUND TEETH PREPARATION IN PEDIATRIC DENTISTRY

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**Summary :** Carious cavity preparation is an important step in the treatment of dental caries. Usage of traditional methods of preparation is often accompanied by negative patient response to manipulation, especially children and patients with labile psycho-emotional sphere.

The presence of alternative ways of preparation is an urgent problem for modern dentist and pediatric dentist in particular. Our studies provide an opportunity to recommend an ultrasound method application for children and patients with labile psycho-emotional sphere.

**Key words :** teeth preparation, caries, morphological structure, dentin, enamel.

Teeth preparation is an integral part of surgical treatment of caries and is characterized by the action of physical factors on the hard tissues of tooth in order to remove pathologically altered tissues with appropriate carious cavity formation that provide convenient filling, maintaining the biophysical characteristics of the tooth, as well as strength, reliable fixation, aesthetics and efficiency of restoration [2,3].

The basic principle that is guided in cavity preparation is removal of pathologically altered tissue and sparing attitude to healthy tissue [4,5].

Restoration of anatomical peculiarities of occlusal surfaces and cutting edges with preserving of physiological state of teeth largely depends on the quality of teeth preparation.

During treatment of dental caries dentists use various methods of preparation: a traditional - classic usage of rotary instrument and alternative, innovative - laser, ultrasound, air-abrasion.

The traditional preparation of hard tissues causes thermal and mechanical stimulation, which leads to micro cracks of enamel destruction of enamel-dentin junction, the formation of "wounded" dentin surface [6,10,12].

Enamel micro cracks and open dentinal tubules are pathways of microbial infection, while alternative carious cavity preparation somewhat minimize these negative effects [1,8,9].

The main criteria of a method choice of dental hard tissues preparation is not only the quality and speed of carious cavity preparation, but also the intensity of the subjective feelings during manipulations that are carried out. The above-mentioned criteria together should ensure minimal stress during

dental treatment procedures. Herewith the surface of hard tissue after teeth preparation and antiseptic treatment should have retention properties for optimal adhesion of filling material [7,11].

The use of traditional methods of preparation is often accompanied by negative patient response to manipulation, thus relevant in the clinic of therapeutic dentistry is the presence in the arsenal of a dentist alternative ways - first of all, ultrasonic preparation.

**The aim of our study** was to evaluate the morphological structure of the hard tissue of teeth under the influence of ultrasonic and classical methods of preparation in comparative perspective.

**Materials and methods.** Intact permanent molars extracted due to orthodontic indications, as well as, teeth that had improper position and impacted teeth ceased to erupt, served for morphological study material.

Before the start of research, teeth were cleaned and subjected to one of the methods of cavity preparation. In the extracted teeth a carious cavity was shaped by Black principles of Class I, within mantle dentin.

Test sample of teeth were divided into two groups based on the methods of preparation. The first group is consisted of teeth treated with the traditional method of preparation, using air turbine handpiece with speed range of cutting bur up to 300,000 rev / min using water and forced air cooling and spherical diamond burs (NTI) with blue color coding. The second group consisted of teeth, prepared by ultrasound with special tips - «E Woodpecker 9" for dental burs, both tungsten carbide and diamond grit, with Ø 1,6 mm for device "Woodpecker UDS-P» with the minimum oscillation frequency of 28 kHz ± 3 that is generated by ultrasonic

generator based on the inverse piezoelectric effect.

During preparation were used spherical diamond burs (NTI) with blue color coding and was provided a permanent cooling by distilled water.

Teeth samples for histological examination were made by the following procedure. Researched material was placed in a 10-15% solution of formalin and fixed for 4 weeks. Then decalcification of teeth is conducted by 10% solution of nitric acid for 6 days followed by neutralization with 5% solution of alumino- potassium ammonium during day and night. Dehydration of material was carried out in alcohols with a gradual increase in concentrations from 70 to 96%. Then examined material was processed by chloroform, followed by 6-hour saturation of paraffin. Then teeth were inserted in paraffin blocks. Preparation of paraffin blocks was carried out with the aim of slicing teeth in the microtome and production of micropreparations with 7 microns thickness. Totally it was studied 6 serial sections of molar crowns in the transversal plane. Staining was performed with an aqueous solution of hematoxylin and eosin alcohol solution.

**Results of investigations.** Hard tissues of the tooth crown in preparation zone using traditional way are characterized by the presence at the bottom and the walls of small invaginations, alternating with evident spikes, flat areas are not visible.

Obliquity of the spikes is approximately 600, the maximum height of spike is 2.2 mcm, in the area of the bottom and walls of the carious cavity in the limits of preparation is defined an unstructural smeared layer as a thin sharply basophilic line. On the occlusal surface is visualized a prepared carious cavity with conglomerates of microorganisms colonies (Fig. 1).



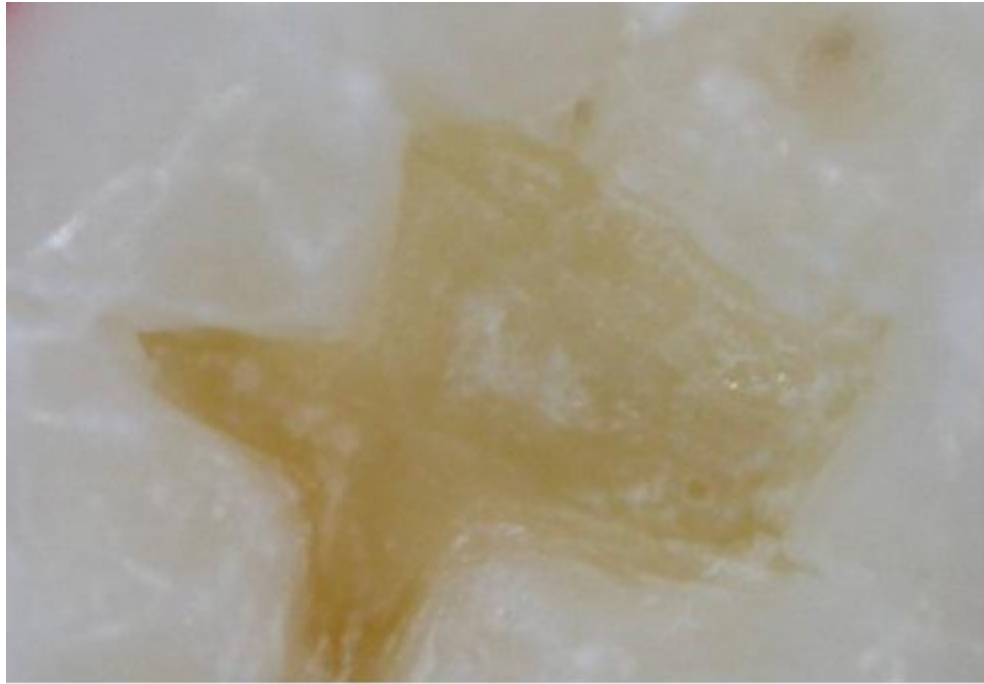
*Fig. 1 Prepared carious cavity by traditional methods of preparation*

Dentinal tubules are thinned to the surface of preparation by canaliculi that penetrate the dentin from pulp chamber to its periphery, have a direct way in circumpulpal dentine and a zigzag direction in mantle dentin with tendency to anastomosis. It is noted a terminal branching of dentinal tubules. At the edge of mantle and circumpulpal dentin are visualized sharp calcified basophilic globules that constitute collagen fibers in this area that have an ability to change the primary orientation.

Circumpulpal layer of dentin in deeper areas is represented by oxyphilic zone, adjacent to the peripheral layer of pulp.

The study of the second group of teeth that were prepared using ultrasound,

showed that in the test sample of tooth crown an enamel is missed. Study of morphological picture in the area of preparation showed that the bottom and wall of carious cavity are finely serrated, on its surface are visualized rare invaginations, smaller in comparison with previous group that dissociate themselves by spikes and flat portions of dentin. The tops of the dentin spikes are smoothed, obliquity is about 80°, the maximum height of the spike does not exceed 1.2 microns. Throughout the bottom and walls of the cavity is observed smeared thin layer of unstructured basophilic line, smaller in size in comparison with similar that is prepared by rotary instruments (Fig. 2).



*Fig. 2 Carious cavity prepared by ultrasound method*

Dentinal tubules are thinned to the surface of preparation by canaliculi that penetrate the dentin from pulp chamber to its periphery, have a direct way in circumpulpal dentine and a zigzag direction in mantle dentin with tendency to anastomosis. The inner surface of dentin, adjacent to odontoblasts is represented by collagen fibers, during staining with hematoxylin and eosin is characterized by severe oxyphilic staining due to the lack of cellular structure.

**Conclusions.** Morphological differences in the structure of hard tissues of teeth were revealed, depending on preparation method using both ultrasonic and classical methods. Comparative morphological and morphometric characteristics have demonstrated lower expression of smeared layer, smoother surface of preparation, high obliquity and more pronounced spikes of dentine, smaller

maximum height of the spikes in the tooth micropreparations, that were processed by ultrasonic preparation.

It should be noted that time of preparation and influence of ultrasound on histo-functional status of enamel-dentin border was not taken into consideration that enables further research perspectives.

Thus, comparative characteristics of teeth' preparation methods makes it possible to consider ultrasonic method of preparation as an alternative for some patient population because it is not only providing a painless preparation, minimal stress during dental intervention, but it is more sparing in terms of morphological characteristics of dental hard tissues.

Prospects of further research. In future it is planned to study the effect of ultrasound of teeth preparation on histological and ultra structural organization of the enamel-dentine border.

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