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INITIAL CARIOUS LESIONS OF THE HARD TISSUES OF TEETH AND THEIR DIAGNOSIS

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Abstract: An overview of diagnostic methods for initial carious lesions of the hard tissues of the tooth is given. Manual techniques using dental instruments and hardware techniques using quantitative light fluorescence, electrometry, and fibrooptic transillumination are considered.
Keywords: enamel caries, quantitative light fluorescence, electrometry, diagnostic algorithm.

The current level of fundamental scientific knowledge leaves no doubt that the initial stages of the carious process in enamel are associated with its demineralization due to the direct effect of organic acids produced by plaque microbes on the tooth surface. Their formation is largely stimulated by the presence of easily fermentable dietary carbohydrates. In the clinic of therapeutic dentistry, the diagnosis of initial caries is difficult, especially in the presence of a small "chalk spot", since the surface layer of enamel remains clinically intact. The surface of a wet tooth is smooth and shiny, and chemical or thermal stimuli do not cause subjective pain. Diagnosis is possible only with the use of additional research methods or with a significant increase in the size of the lesion. The affected enamel loses its luster and becomes opaque, hence the term "chalk stain". The essence of this phenomenon is explained by a change in the optical properties of enamel due to an increase in its porosity. Most researchers, describing morphological changes in enamel in superficial caries, identify several zones with varying degrees of demineralization and porosity. Thus, the surface zone (pseudointact layer) is characterized by relative integrity and a higher degree of mineralization due to constant remineralization by ions of the oral fluid, the deeper the underlying layers. Nevertheless, the loss of inorganic substances in this layer reaches 1-10%, and the volume of microspaces is at least 5%. In the central zone (the lesion body is the site of the greatest demineralization), pathological changes are maximally pronounced: an increase in intercrystalline spaces, a violation of the orientation, size and shape of crystals in the hydroxyapatite structure, and the appearance of crystals atypical for normal enamel.

The loss of calcium in this area reaches 20-30%. The pore volume is 5-25% (porosity of healthy enamel is 0.1–0.2%). There is a dark zone (layer) located on the periphery of the lesion body. The pore volume in it is 2-4%, and the pore size is small due to partial remineralization of hydroxyapatite crystals. The transparent zone (layer) is a site of progressive demineralization located on the border of the carious focus with intact enamel. In this layer, the enamel has a porosity of up to 1%, but the pore size is larger than in the dark zone. As a rule, there are no changes in the deeper layers of the enamel, the area of the enamel-dentinal border, the dentine and the pulp of the tooth. In the International Classification of Diseases (ICD-10), initial and superficial caries have a common code (K02.0 Enamel caries, stage of "white (chalky) spot"), however, they differ morphologically and clinically.

Caries in the spot stage (initial caries)

As a rule, patients have no complaints of pain, but they may indicate a cosmetic defect in the form of a white or pigmented spot. There may be a feeling of stubbornness. It is possible to find out from the medical history that the spot appeared recently (days, weeks, pigmented – months).

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The size and intensity of the staining increase. The white spot may become pigmented. During the examination, a whitish area of enamel or enamel pigmentation is found. White teeth are more typical for children, pigmented spots for adults. Localization: cervical areas of the tooth, pits, fissures, proximal surfaces. Strict symmetry of the lesions is not typical, multiple caries is possible. Drying enhances the dullness and whiteness of the stain. Probing: the surface of the enamel is not clinically altered, the probe does not linger, slides

There is no roughness on the surface. There is no soreness. Thermometry: physiological sensitivity is not changed (the tooth does not react to cold). Percussion – the reaction is negative. The affected area of the enamel is stained with methylene blue. Transillumination reveals the area of dimming of the glow. Electrical excitability of the tooth is within the normal range (2-5 μA). There are no changes in the hard tissues and periodontium on the X-ray.

Superficial caries.

Patients complain of pain from chemical irritants (from sweets). A cosmetic defect is detected in the form of a shallow cavity, discoloration. The roughness of the enamel is detected.

Anamnesis: the sensations appeared recently (weeks). Previously, there was a change in the color of the enamel on a separate area of the tooth. ” When the pain from sweets appears on the altered area of pigmentation, it may disappear. Examination: a defect within the enamel is a whitish or pigmented area. Localization – areas of low enamel resistance (cervical and proximal areas, pits, fissures). The probe detects surface roughness, but there is no soreness. Thermometry and percussion are painless. The enamel around the defect is stained with methylene blue. Transillumination reveals dimming of the glow. The electrical excitability of the pulp is within the normal range (2–5mkA). There are no changes in the periodontal fissure on the X-ray. The use of magnifying devices, such as magnifying glasses, binocular lenses, and surgical microscopes, also makes it possible to increase the effectiveness of diagnosing initial carious lesions at the stage of clinical examination of the dentition. It has been established that by resorting to magnifying devices, it is possible to increase the accuracy of diagnosis of latent caries by up to 75%. Vital coloring. One of the additional methods is staining the enamel of the tooth under study with a 2% aqueous solution of methylene blue. Normally, the enamel does not stain. In the presence of foci of subsurface demineralization (caries, acid necrosis), a blue tint of varying intensity appears, depending on the degree of damage. The affected area is measured in mm2. A standard 10-point scale produced by the printing industry is used to assess the intensity of dental tissue staining.

Transillumination.

Fiber Optic Transillumination (FOTI) can be used to diagnose caries in the proximal areas of the chewing and anterior teeth. This method involves the use of a halogen lamp and a fiber-optic element, which creates a powerful beam of cold light. The tooth is illuminated by light, and carious defects appear as dark spots. The effect is based on the different porosity and the difference in the refractive index of light in healthy and infected tissues. With an intact crown, the light passes evenly through the hard tissues without giving a shadow. In case of caries in the affected area, there is a dimming of the glow due to a change in the optical density of the tooth. The most effective use of this technique is for the examination of frontal teeth.

The laser fluorescence method uses an infrared laser with a wavelength of 655 nm as an energy source. The fluorescence intensity is quantified by a photodiode. In light fluorescence using VistaProof (Dürr Dental), LEDs emitting light of the visible spectrum with a wavelength of 405–

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488 nm are used as an energy source. The prismatic structure of the enamel promotes deep penetration of rays and, thanks to this, makes it possible to diagnose latent carious lesions. Caries-affected areas fluoresce in the red region of the spectrum, and healthy tooth tissue has its own green fluorescence. The ratio of fluorescence intensity in the red and green spectral regions is used as a criterion for bacterial activity and, accordingly, the degree of destruction of hard tooth tissues. Using an intraoral camera allows you to combine the anatomical image and the fluorescent radiation of the tooth tissues, demonstrating the condition of the enamel and dentin over the entire surface under study. It is combined with the DBSWIN software, which allows you to color-code carious lesions according to their activity on a scale from 0 to 5, orienting the doctor to choose a specific tactic (observation, remineralizing therapy or invasive intervention). The results of the control histological analysis show that the sensitivity of the QLF diagnosis of caries exceeds 90%, while the clinical examination has a significantly lower (76.9%) informative value.

Visualization and fixation of changes in the fluorescence of various areas of teeth, as well as obtaining an enlarged image of the tooth on a computer monitor, provide the dentist with important clinical information, identify changes invisible to the naked eye, provide new opportunities for diagnosis, drawing up an individualized treatment plan and further patient supervision.

Conclusions:

The images obtained during the study can be shown to the patient in real time, which helps the doctor to justify the diagnosis and treatment tactics, and the patient to evaluate the results before and after treatment. They can also be used to create an "electronic dental patient card" containing information about diagnostic results, quality control of preparation and filling, and long-term treatment results. The use of light fluorescence, a modern diagnostic method and a new type of visualization of carious lesions of teeth, is indispensable as part of minimally invasive dentistry and complements the previously proposed methods for detecting enamel demineralization at the subclinical level (luminescent diagnostics, electrodontometry, etc.). Localization of the studied area (proximal areas, smooth surfaces, fissures, etc.) is of great importance for choosing the optimal diagnostic method. the root of the tooth). To monitor the condition of teeth, it is best to use methods that allow you to obtain quantitative, reproducible and easily interpretable data, as well as eliminate the risk of tissue damage.

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