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MORPHOMETRIC INDICATORS OF CARIES AMONG ADOLESCENTS OF KHOREZM REGION

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Abstract. In this article the data of morphometric studies of caries conducted among young men living in Khorezm region. 514 boys and girls of schoolchildren aged 11 to 17 years living in the city of Urgench were studied, morphometric studies of caries detected in the subjects were conducted and analyzed.

Key words: young men, morphometry, dentin, predentin.

Introduction

The development of dental caries is one of the most important problems of the world health system, affecting children and adults alike. The prevalence of primary teeth in children is 46.2% (95% CI: 41.6–50.8%) worldwide, and that of permanent teeth is 53.8% (95% CI: 50–57.5%) [Amiri S, Veissi M.2017]. The World Health Organization (WHO) describes childhood caries as a global problem with a prevalence of 60% to 90% [Kazeminia M, Abdi A, 2020]. According to statistical data provided by European countries, at least 1 tooth is affected by caries among children aged 6 to 12 years, which is a major socio-economic problem. In view of this, the study of caries in children and adolescents is of great interest. The purpose of the scientific work. Study of the development and spread of caries among adolescents of the Khorezm region, conducting morphometric examinations.

Material and methods. The material was 514 adolescents aged 11 to 17 years from schools in the city of Urgench, who were examined, and the depth and location of the detected caries were analyzed using morphometric measurements.

Results. During the examination, the average thickness of the enamel of the upper and lower molar teeth of adolescents on the chewing surfaces was 2.3 ± 0.03 mm, on the lateral surfaces - 1.8 ± 0.03 mm, and in the cervical area - 0.4 ± 0.01 mm. It was observed that the thickness of dentin is different in molar teeth: it is thicker on the chewing surfaces and is equal to 2.6±0.05 mm on average, on the lateral surfaces it is on average 1.8 ±0.06 mm, and the thickness of dentin on the neck area is less, it was noted that it is 1.3±0.04 mm on average. It was found that predentin thickness of molar teeth in adolescent children is equal to 17.1 ± 0.5 mm, cementum thickness is 0.2 ± 0.02 mm, and width of dentin tubules is equal to 2.2 ± 0.1 (table 1). The average area of odonoblasts in the control group was 132.7±2.1 µm, and the area of nuclei was 38.6±0.38. The number of odontoblast tumors was 22±0.40 per 100 µm. The core-cytoplasmic ratio in the teeth of children in the control group ranged from 0.35 to 0.69, with an average of 0.47±0.02.

When determining the activity of the caries process in the tooth according to the Green Vermillion index, it was found that in healthy children it was on average 0.3. The PMA index in children in the control group was on average 2.0%.

In adolescent children, the enamel thickness in the initial period of caries was on average 2.1 ± 0.05 mm. During this period of caries, it was shown that the thickness of the enamel of the teeth of healthy children did not change significantly (8.1%). By the middle period of caries, a

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significant decrease in the thickness of the enamel was observed by 19.0% and amounted to an average of 1.9 ± 0.03 mm. In cases of deep caries, almost complete loss of enamel was observed, sometimes the enamel was completely absent or up to 1.5 mm thick and amounted to an average of 0.9 ± 0.3 mm. This showed a reliable decrease compared to the control group.

Because the average thickness of dentin was not significantly damaged in the initial period of caries, the thickness was not significantly different from that of the control group and was on average 2.5 ± 0.04 mm. Later, by the middle period of caries, damage to dentin was clearly reflected, and it was found that the thickness decreased up to 5.5 times. During this period of caries, the thickness of dentin was 0.5 ± 0.05 mm. By the deep period of caries, it was found that the dentine shrinks and does not exist at all. [1]

It was found that the thickness of the dentine is different in different stages of caries. In the initial period of caries, it did not differ from that of children in the control group and was on average 17.1±0.2 mm. By the middle period of caries, it was observed that the thickness of predentin decreased by 11.9% and was equal to 15.3 ± 0.7 mm on average. In the deep period of caries, the predentin becomes even thinner, and as a result of the process moving to the deep layers, it was found to be reduced by 33.7% compared to the control group, equal to 12.8 ± 0.5 mm on average.

At the initial stage of caries, the thickness of the cementum did not differ from that of the control group. As a result of the development of caries, the inflammatory process reaches the periodontium, and changes in the structure of the cement were observed. In the case of deep caries, the cementum thickened by 0.3±0.02 mm due to inflammation compared to the control group. [2]

Since the process in the initial period of caries is mainly observed in the enamel and dentin, morphometric changes in the pulp are not observed. The width of the pulp does not differ from that in the control group. However, with the transition to the middle and deep stages of caries, the width of the pulp increases significantly: 3.5 ± 0.6 mm in the middle stage, and 8.8 ± 0.4 mm in the deep stage. This indicates that the development of caries has a significant effect on the pulp tissue, and thickening may indicate inflammation or damage.

The expansion of the dentinal tubules also increases with the development of caries. In the initial stage, the width of the tubules is 2.2 ± 0.3 mm, but in the intermediate stage of caries they expand to 4.5 ± 0.8 mm, and in the deep stage to 8.8 ± 0.4 mm. This expansion indicates the spread of lesions and infections through the dentin and can lead to complete destruction of the teeth.

Morphometric parameters of odontoblasts in carious teeth were also observed to change compared to healthy teeth. The area of odontoblasts begins to actively grow in order to cover the damaged dentin in the initial stage of caries and was found to increase by 5.5% compared to the control group and equal to 140 ± 2.2 μm². In the middle period of caries, odontoblast cells decreased by 9.6% and the area decreased by 119.9 ± 1.4 μm², compared to the control group. By the time of deep caries, as a result of destruction of odontoblasts, it was found to be reduced by 37.7% and equal to 87.2 ± 0.98 μm² compared to the control group.

In the initial period of caries, the area of nuclei of odontoblasts is stable and does not differ significantly from that of the control group. In the initial period of caries, odontoblast cells take an active part in the formation of dentin, the nuclei may become slightly larger due to the activation of the cells. A slight increase in the nuclear area (8.8%) and an increase in the functioning of cells in response to initial damage (by 42 ± 0.4 μm²) are observed. [3]

In the middle stage of caries, as a result of the deepening of the lesion in the tooth, a gradual decrease in the area of the nuclei of odontoblasts is observed, but this difference is not as

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significant as in the control group. However, an expansion and increase in the size of the nuclei was detected. At this stage, the area of the nuclei was 40.4 ± 0.6 μm².

In the later, deep stage of caries, when the lesion penetrated the deep layers of the dentin and damaged the pulp, a sharp decrease in the number of odontoblast nuclei was detected. This process is associated with the loss of function of odontoblast cells and their inability to produce dentin properly. In cases of severe damage and inflammation (pulpitis), the nuclei of odontoblasts are degraded and their area decreases. When the cells restore their function, their nuclei become compact and less bright. During this period, it was determined that the area of the nuclei of odontoblasts decreased by 24.9% and was equal to 29 ± 0.56 μm² compared to the control group. [4]

In odontoblast cells, the nuclear cytoplasmic ratio is calculated by calculating the ratio of the nucleus to the cytoplasm in the cell. As a result of observing the activation of cytoplasm in the initial period of caries, it is observed that the cytoplasm core ratio is reduced by 25.5% and the cytoplasm core ratio is equal to 0.35 ± 0.01 compared to the control group. In the middle period of caries, there is an increase in nuclei in odontobalast cells, as a result of a decrease in cell activity, it was observed that the ratio of cytoplasm to nucleus increased by 12.8% and was equal to 0.53 ± 0.05. In deep caries, a reliable 25.5% increase (0.59 ± 0.03) of cytoplasmic core ratio was found (Figure 2).

In the initial stage of caries, the number of odontoblast growths was 18.2 ± 0.23 per 100 μm, a decrease of 17.3% compared to the control group. The growths were found to be thicker and longer than in the control group. In the middle stage of caries, some odontoblast cell growths were observed, which may lead to a decrease in signal transmission ability. In this stage of caries, the number of cell growths was found to be reduced by 36.4%, and in deep caries by 58.2%. In the middle stage of caries, it was 14 ± 0.25 per 100 μm, and in deep caries, respectively, it was 9.2 ± 0.24.

From the initial stage of caries, increased blood circulation in the tooth, dilation and fullness of blood vessels were observed. In the initial period of caries, 20.5% less than in the control group, 23.7% in the middle stage, and 6.3% less blood vessels in deep caries than in the control group. It was found that the number of blood vessels in different stages of caries is equal to 59.4 ± 0.82 μm² in the initial stage, 61 ± 0.4 μm² in the middle stage and 46.2 ± 0.72 μm² in the deep stage.

In order to determine the level of activity of the caries process, the Green Vermillion index was determined, and it was found that the indicator increased as the caries process developed. At the initial stage of caries, it was on average 0.80 ± 0.08 (0.2-1.2), in the middle stage of caries, this index was on average 1.4 ± 0.08 (0.9-1.9), which allows us to conclude that oral hygiene is in a satisfactory state. In the deep stage of caries, the Green Vermillion index was 2.5 ± 0.09 (2-3). This indicated that oral hygiene is in an unsatisfactory state.

The PMA index, which determines the level of gingivitis development, was 5.9 ± 0.7% (0-10.3) in the initial period of caries, and this indicator was equal to 19 ± 1.2% (0-22.6) in the middle stage of caries. In the deep level of caries, the average was 37.1 ± 4.2% (7.3-55.7). This indicator showed the development of mild and moderate gingivitis in adolescent children at all stages of caries. The analysis of this indicator proved that the more actively the caries process developed, the more pronounced the inflammation in the marginal periodontium.

When measuring the size of carious spots on teeth, it was equal to 3.5±0.07 (3-4) mm in the initial period, 4.2±0.10 (3.4-4.9) mm in the middle period of caries, and 6.0±0.09 (5.2-6.8) mm in the deep period. Reliable statistical differences on this indicator were found between different levels of caries activity ($R < 0.05$).

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The results of the electrical conductivity measurements, which were performed to determine the depth of the degree of demineralization of tooth enamel, were 0.85±0.009 (0.75-0.9) μA in the initial stage of caries, 0.99±0.02 (0.85-1.3) μA in the middle stage, and 1.90±0.05 (1.5-2.3) μA in deep caries. Statistically significant differences were found between the groups in this indicator ($P < 0.05$).

The following data were obtained as a result of studying mineral metabolism in adolescents at different stages of caries activity. No significant changes were detected in the pH of the oral cavity: the pH level was found to be on average 7.05 in mild caries, 6.95 in moderate caries, and 7.03 in deep caries. It was found that the buffer system of the oral cavity works actively even at different levels of caries activity in teenage children. [4]

The amount of calcium in the oral fluid did not show a significant change in the level of caries activity. It was equal to 1.6±0.009 g/l in the light level, and 1.1±0.13 g/l in the medium level. It was observed that it was 0.6 ±0.05 g/l at the heavy level. No reliable changes were observed in the amount of phosphorus in the oral cavity depending on the level of activity.

It was found that the amount of phosphorus is 3.2±0.12 g/l in the mild level of caries, 2.1±0.06 and 1.6±0.03 g/l in the medium and severe levels.

We have identified a correlational relationship in the cases we have studied. It was found that there is a negative (-0.01) correlation between the Green Vermilion index and the amount of calcium in the oral cavity fluid at a mild level of caries, and a slight positive correlation (+3; 0.1) at the middle and severe stages of caries.

A negative correlation was also found between the PMA index and the amount of calcium in the oral cavity fluid. It was observed that the correlation coefficient of calcium was -0.3 for mild caries, -0.1 for moderate and 0.07 for severe caries.

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