

Microhardness of enamel and dentine of white rats' teeth under different conditions of the thyroid gland

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Summary

The microhardness of enamel and dentine of rats' teeth was investigated under normal and hypofunctional states of the thyroid gland; also the change of microhardness was assessed, after applying different caries preventive remedies: infusion of Azerbaijan black tea with 10 ppm F⁻ and 3% Remodent with fluoride varnish.

The results of the research led us to recommend Azerbaijan black tea with 10 ppm F⁻ and also a combination of 3% Remodent with fluoride varnish as effective caries preventive remedies for persons with hypofunction of the thyroid gland and for children living in endemic regions for goiter.

Key words: microhardness of enamel and dentine, hypofunction and normal states of the thyroid gland, infusion of Azerbaijan black tea with 10 ppm F⁻, 3% Remodent, fluoride varnish, caries prevention.

Introduction

In the majority of local and foreign researches, devoted to the effect of the endocrine system pathology to the condition of teeth hard tissues, the important role is given to the functional pathology of the thyroid gland, particularly to hypothyroidism, under which increased affection of teeth by caries is noted [2, 3, 4, 5, 6, 7, 8, 9, 12, 13].

It is well known that the use of prophylaxis methods and remedies against caries should have distinctive peculiarities regarding their application in the endemic regions for goiter, where the drinking water and soil are characterized by deficit of fluoride, iodine and other microelements [8, 10]. The epidemiological research held according to the WHO method in all seven climatic and geographic zones of Azerbaijan has revealed different levels of prevalence and intensity of caries. The highest index of caries level among school children is revealed in the endemic regions for goiter. The prevalence of caries in 12 year-old children is equal to 92.5 – 0.74% and the intensity of caries of permanent teeth varies from 4.45 – 0.23 to 6.01 – 0.31, which according to the WHO levels are considered as high [2].

It is well known that an important role in the occurrence of dental caries is given to the resistance of enamel [8, 14]. The resistance of teeth is determined by various features of enamel, one of which being the microhardness [11, 12, 13, 17, 18, 21].

In this regard, the question concerning the effect of the thyroid gland hyperfunction on the microhardness of enamel and dentine of teeth and also the dynamic caries prophylaxis means, including the infusion of Azerbaijan black tea with 10 ppm F⁻ is highly important.

Materials and Methods

The hypothyroidism was formed by administering Merkasolil (sin. Thiamazole) to the body in a proportion of 5 mg for each 100 g of the body weight, during a fortnight and then the dosis was decreased 2 times.

An elementary model of dental caries was induced by using *Stephan-580* cariesogenic diet. The duration of the experiment was 31 days. Experiments were held on 80 rats of Vistar line, weighing 35-40 g, aged nearly 4 weeks. All rats were held separately, in individual cages.

The animals of Group A have been given cariesogenic diet, Merkasolil, and infusion of

Azerbaijan black tea with 4-5 ppm fluoride as drinking water. The animals' teeth were cleaned with a medium hardness brush, 6 times a week, with tea infusion containing 10 ppm Ffl, the duration of the procedure being 60-70 seconds.

The animals of Group B have been given cariesogenic diet, Merkasolil, distilled water. The animals' teeth were cleaned 6 times a week with 3% Remodent during 60-70 seconds and 2 times during the experiment a fluoride varnish application was carried out.

Animals of Group C (control I) have been given cariesogenic diet, Merkasolil, distilled water. The teeth of animals of this group were cleaned with distilled water 6 times in a week. The Group D contained rats fed in line with usual ration of vivarium (control II).

Our choice concerning the possibility of using the Azerbaijan black tea infusion as caries preventive remedies is based on various published data and the results of our biochemical investigations showed high contents of active F in various sorts of seed leaf tea, which were equal to 3.01-4.69 ppm, i.e. higher than in other foreign sorts of black tea [1, 15, 16, 22].

In order to determine the microhardness of enamel and dentine, blocks of lower jaw of 10 animals from each group were investigated. At the end of experiment and after decapitation of rats, extracted lower jaws were fixed in a 10% neutral formalin solution. Further, the jaws were washed with distilled water, soft tissues were excluded, incisors and distal zones of the jaws were cut, molars were cleaned from food remnants and soft tissues using toothbrush and distilled water and then were dried. A cross section was carried out in the middle of the molars, using a special device. The halves of the jaw blocks with teeth were located in a rectangular form made from self-hardening acrylic resins. Grinding and polishing were carried out with special grinding machines, applying a cooling physiological solution.

6 topographic zones were investigated on each tooth: the surface layer of the enamel; the middle layer of the enamel; the enamel at the enamel-dentine border; the dentine at the enamel-dentine border; the central crown dentine and the near-to-pulp dentine. 24 prints were made on each grinded surface.

The microhardness of the enamel and dentine was determined by the microhardnessmeter

MTI-3M on *Vickers Hardness Test*. Pressing with diamond pyramid was made under a 50 g load, during 5 seconds.

The microhardness index was expressed in kg per square millimeter (kg/mm²). Calculation was carried out using the following formula:

$$HV = \frac{1854 \cdot F}{d^2},$$

where F – normal load, related to the diamond header; d – average arithmetical length of both diagonals of square type print, mm.

The microhardness of enamel and dentine of rats' teeth was investigated under normal and hypofunction states of the thyroid gland and also the change of microhardness was assessed, after applying different caries preventive remedies: infusion of Azerbaijan black tea with F 10 ppm and 3% Remodent with fluoride varnish (*Figure 1*).

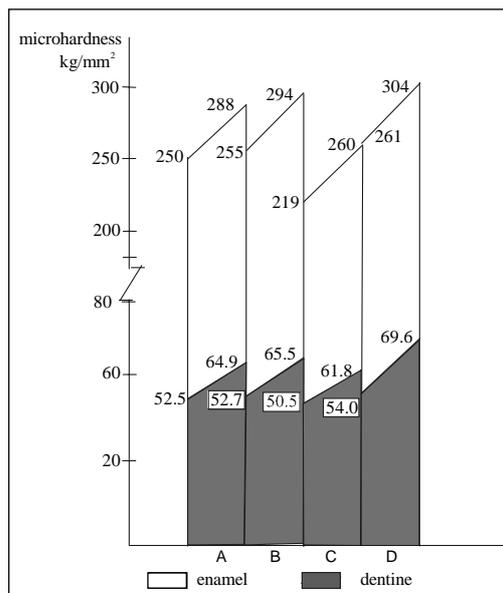


Figure 1. Changes of microhardness of the enamel and dentine of white rats after use of preventive remedies

Group A - hypofunction + cariesogenic diet + tea

Group B - hypofunction + cariesogenic diet + 3% Remodent + fluoride varnish

Group C - hypofunction + cariesogenic diet

Group D - ration of vivarium

Results and discussions

30 days after the beginning of the experiment it was discovered that *the hypofunction of the thy-*

roid gland causes considerable decreasing of microhardness of all layers, both enamel and dentine ($p < 0.01$). The microhardness of enamel decreased from 304 – 5.1 – 261 – 3.8 kg/mm² to 260 – 8.2 – 219 – 9.1 kg/mm² and of dentine from 69.6 – 1.1 – 54.0 – 0.8 kg/mm² to 61.8 – 1.2 – 50.5 – 1.2 kg/mm².

The treatment of teeth by the tea infusion brought to the increasing of microhardness of all layers of enamel ($p < 0.01$) and of two layers of dentine ($p < 0.05$), except the near-to-pulp layer. Microhardness of enamel increased to 290 – 2.8 – 250 – 4.1 kg/mm² and of dentine to 64.9 – 0.9 – 59.2 – 0.7 kg/mm².

Applying 3% Remodent with fluoride varnish brought to the increasing of microhardness indices of all layers of enamel to 294 – 3.9 – 255 – 6.9 kg/mm² ($p < 0.01$) and also of two dentine layers (layer near to the enamel and middle layer) 65.5 – 1.1 – 60.0 – 1.0 kg/mm² ($p < 0.05$ – 0.01).

Having analyzed the dynamic change of the microhardness level of enamel and dentine it can be surely stated that it triggers changes in mineral and albuminous metabolism of the organism, including in hard teeth tissues, weakens the

process of mineralization, which in its turn decreases the microhardness level.

In the same time, on the background of thyroid gland hypofunction, the use of Azerbaijan black tea infusion with 10.0 ppm Ffl as a rich source of fluoride triggers the increase of indices of both enamel and dentine microhardness, which proves the higher remineralizing features of the tea infusion.

The combination of the effect of 3% Remodent together with the fluoride varnish also turned out as an effective remedy. Despite the equal level of effect on the dentine, the level of effect on the enamel was better, gained from use of tea infusion. This can be explained by the presence of higher concentration of calcium in 3% Remodent, which naturally strengthens the effect of fluoride.

The results of the research led us to recommend Azerbaijan black tea with 10 ppm Ffl and also the combination of 3% Remodent with fluoride varnish as effective carries preventive remedies for persons with hypofunction of the thyroid gland and for children living in endemic regions for goiter.

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