

Micro-hardness of enamel and dentine of schoolchildren's temporary teeth, residing in endemic condition for goiter

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Summary

Temporary teeth with intact enamel of schoolchildren aged 7-12, born and residing in an endemic region for goiter were examined. It was discovered that the micro-hardness level of enamel and dentine of temporary teeth is twice lower than that of permanent ones. Also, it was discovered that the micro-hardness of the enamel and dentine located above and below the equator of teeth are identical. **Key words:** micro-hardness of enamel and dentine, endemic conditions for goiter, resistance of teeth hard tissues.

Introduction

It is well known that micro-hardness is one of the major features characterizing the resistance level of teeth hard tissues [1, 2, 3, 4, 5, 6, 7, 8].

As a result of previous research, direct dependence between the concentration of fluoride and some other cariostatic microelements existing in the sources of drinking water and the micro-hardness of the enamel and dentine of permanent teeth was found [7]. It was revealed that the highest level of micro-hardness of teeth enamel and dentine pertains to persons residing in conditions of fluorosis (enamel - 432.9-348.2, dentine 85.4-58.6 kg/mm²; F - 1.8 ppm), and the lowest one to persons residing in endemic conditions for goiter (enamel - 367.4-274.4, dentine 66.2-40.3 kg/mm²; F - 0.05 ppm).

Related to the application of the program designed for dental caries prophylaxis concerning schoolchildren in endemic regions for goiter, by using of fluoride-iodine cooking salt, within a complex of caries-preventive measures, a series of indices characterizing teeth resistance level was determined. Data on the micro-hardness of enamel and dentine of temporary teeth are presented in the research.

Materials and methods

Temporary teeth with intact enamel of schoolchildren aged 7-12, born and residing in an

endemic region for goiter were investigated. The fluoride content of drinking water was equal to 0.05 ppm and of iodine - 0.0033-0.005 ppm.

The micro-hardness of enamel and dentine was assessed using grinded surfaces of 47 temporary teeth. After extraction, teeth were fixed in a 10% neutral formalin solution. Cross section in the middle of the teeth was carried out using a special device, containing disk-shaped hard alloy saws. Each half of the teeth was located in the disk filled by self-hardening acrylic resins. Grinding and polishing was carried out using grinding machines with cooling physiological solution. All groups of teeth were investigated (incisors - 17, canines - 10, molars - 20). 6 topographic zones were investigated on each tooth: the surface and middle layer, enamel at the enamel-dentine border, dentine at the enamel-dentine border, middle layer of dentine and near-to-pulp layer of dentine. 24 prints were affected per grinded surface, 12 of them above the tooth's equator and 12 below. The micro-hardness of the enamel and dentine was determined using a device of MTI-3M type on Vickers Hardness Test. The micro-hardness index was expressed in kg per square mm (kg/mm²). Calculation was carried out using the following formula:

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

where F = normal load, effected to diamond header; d = average arithmetical length of both diagonals of square type print, in mm.

The micro-hardness indices of enamel and dentine of schoolchildren teeth, residing in the endemic region for goiter are presented in *Table 1*.

The highest micro-hardness level is found on the surface layer of enamel: in incisors - 157.2, canine - 171.3, molars -151.7 kg/mm². The lowest indices of enamel are found at the enamel-dentine border: 139.2 in incisors, 149.4 in canines and 135.5 kg/mm² in molars. The micro-hardness level of the middle layer of enamel holds intermediate position compared to the surface layer and the layer near to the enamel-dentine border (150.0 in incisors, 160.4 in canines and 142.3 kg/mm² in molars).

Having analyzed the indices of dentine micro-hardness, we have found the highest level in the middle layer: 31.4 in incisors, 33.5 in canines and 31.2 kg/mm² in molars. The lowest indices are found in the dentine near to the pulp: 22.1 in incisors, 24.6 in canines, and 21.9 kg/mm² in molars. The micro-hardness indices of the

dentine layer located at the enamel-dentine border hold intermediate position between the middle and near-to-pulp layers, though in incisors, between the indices of the layer located at the enamel-dentine border and the middle layer the differences were not significant.

During this research, held on all groups of teeth, a comparative analysis of indices of enamel and dentine micro-hardness, respectively for below (*Table 2*) and above (*Table 3*) the equator zones was carried out.

The analysis of the above-equator zones presents higher importance due to two reasons: the absence of appropriate data and the attempt to clear up a question: are the resistances of the cervical and occlusal surfaces of enamel and dentine the same?

Data presented in *Tables 2* and *3* surely prove that the micro-hardness indices of the enamel and dentine located above and below the equator of teeth are identical. Taking into account that micro-hardness is one of the major

Table 1. Micro-hardness of enamel and dentine of temporary teeth
M (min-max) (kg/mm²)

Layer Type of tooth	I	II	P ₁ <	III	P ₁ < P ₂ <	IV	V	P ₄ <	VI	P ₄ < P ₅ <
Incisors n = 17	157.2 133.5-177.9	150.0 130.3-164.4	0.05	140.0 124.8-154.6	0.001 0.01	30.3 26.5-34.3	31.0 25.8-36.4	- 17.7-25.5	22.1 0.001	0.001
Canines n = 10	171.3 159.3-185.9	160.4 153-172.0	0.01	146.3 136.6-158.2	0.001 0.001	30.8 28.7-33.7	33.1 30.6-35.3	0.01	24.6 22.4-26.4	0.001
Molars n = 20	151.1 137.8-175.2	142.3 134.6-160.9	0.005	135.5 127.2-148.3	0.001 0.001	28.8 25.2-34.3	30.8 27.3-34.0	0.005	21.9 18.9-25.9	0.001
p ¹ <	0.05	0.005		0.05		-	-		-	
p ² <	0.001	0.001		0.001		0.05	0.001		0.001	

Table 2. Micro-hardness of enamel and dentine of temporary teeth (below the equator)
M (min-max) (kg/mm²)

Layer Type of tooth	I	II	P ₁ <	III	P ₁ < P ₂ <	IV	V	P ₄ <	VI	P ₄ < P ₅ <
Incisors n = 17	158.6 129.3-184.3	148.9 127.4-164.4	0.01	139.2 120.4-157.7	0.001 0.005	30.0 27.1-33.7	30.6 25.0-34.7	-	22.2 17.4-26.0	0.001
Canines n = 10	173.8 160.9-196.7	163.3 154.6- 183.4	0.01	149.4 138.5-168.1	0.001 0.005	30.2 28.8-31.8	32.7 30.2-34.2	0.005	24.9 22.5-27.7	0.001
p ¹ <	0.005	0.001		0.05		-	0.01		0.001	
Molars n = 20	151.1 137.8-175.2	142.3 134.6-160.9	0.005	135.5 127.2- 148.3	0.001 0.001	28.8 25.234.30	30.8 27.3-34.0	0.005	21.9 18.9-25.9	0.001
p ¹ <	0.05	0.01		-		-	-		-	
p ² <	0.001	0.001		0.001		0.05	0.001		0.001	
p ^{c-o}	-	-		-		-	-		-	

Table 3. Micro-hardness of enamel and dentine of temporary teeth (**above the equator**)
M (min-max) (kg/mm²)

Layer Type of tooth	I	II	P ₁ <	III	P ₁ < P ₂ <	IV	V	P ₄ <	VI	P ₄ < P ₅ <
Incisors n = 17	155.8 127.7-183.4	151.1 127.7-168.8	-	141.6 114.2-161.8	0.01 0.05	30.6 25.4-34.9	31.4 26.2-38.2	-	22.0 17.5-26.7	0.001 0.001
Canines n = 10	168.9 157.7-183.1	157.5 148.3- 175.2	0.005	143.3 125.1-154.6	0.001 0.001	31.5 28.1-37.8	33.5 31.0-36.4	0.01	24.3 20.8-26.7	0.001 0.001
p¹ <	0.05	-	-	-	-	-	-	-	0.01	-
Molars n = 20	152.3 137.1-179.2	142.2 124.9-167.9	0.001	135.4 120.4- 148.3	0.001 0.005	29.8 23.8-35.0	31.2 27.2-36.4	0.05	21.9 19.8-27.3	0.001 0.001
p¹ <	-	0.05	-	0.05	-	-	-	-	-	-
p² <	0.001	0.001	-	0.01	-	0.05	0.005	-	0.005	-

indices of resistance of tooth hard tissues, the following conclusion can be surely drawn: the resistance levels of enamel and dentine of temporary teeth at the cervical and occlusal zones are identical.

The result of comparing our data with the micro-hardness indices of the enamel and dentine of permanent teeth of adult people (aged 35-44), also residing in endemic conditions for goiter, revealed that the micro-hardness level of temporary teeth's enamel and dentine is practically twice lower than the same in permanent teeth [7].

This proves that the resistance of temporary teeth is lower than that of permanent ones.

References

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It is well known that the pathology of the thyroid gland causes the same changes in the mineral and albuminous metabolism of an organism, in particular in teeth tissues. The population of endemic regions for goiter uses drinking water with low content in fluoride and some other important microelements (Cu, Zn and others) with cariostatic effect. The presence of background pathology (dysfunction of the thyroid gland due to shortage of iodine) and consumption of water with low content in cariostatic microelements decrease the process of mineralization, which is possibly expressed in lower micro-hardness indices. Obtained data can be used as testimony of functional stability of teeth hard tissues.

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