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SOME FEATURES OF THE FUNCTIONAL STATE OF ORGANS AND TISSUES OF ORAL CAVITY AMONG THE INDUSTRIAL AREAS POPULATION OF SAKHA REPUBLIC (YAKUTIA)

ABSTRACT

Complex of clinical and laboratory dental research of industrial areas population of North-East of Russia was conducted. Severe climatic conditions of the population have a negative impact on the functional state of organs and tissues of oral cavity. So, the biophysical properties of oral fluid changes due to reduction of salivary flow rate were revealed with a predominance of second and third type of microcrystallization, increasing of saliva viscosity, a decreasing of calcium and phosphorus concentration, and also decreasing of alkaline phosphatase activity and remineralizing potential of oral fluid. These changes at influence of aggressive factors of external and internal environment can create the preconditions for the emergence and development of major dental diseases. Besides this we conducted x-ray spectral microanalysis, investigation of microhardness and hard tissue density of intact teeth of school age children identified certain changes characterizing quantitative and qualitative changes in their composition and properties. Herewith violations of the structural hard tissue homogeneity of intact teeth with changes in calcium and phosphorus index and the presence of enamel micro- and macrocracks were established, in case of cariogenic situation they can contribute the development of pathological processes of teeth hard tissues of demineralizing character. Identified specific regional risk factors of dental diseases cause a high prevalence and intensity of pathological processes of organs and tissues of oral cavity. In key age groups of 12 years old children and 35-44 years old adults we determined high level of dental caries intensity, and a high prevalence of pathological processes of periodontal tissues of inflammatory-destructive character among 15years old teens. The revealed changes of functional status of organs and tissues of oral cavity among different age groups of industrial areas population of Yakutia are specific regional risk factors for the formation and development of dental diseases.

Described above dictates the necessity of development and implementation of complex program of dental diseases prevention in practical health care of the region and improvement of medical aid to the industrial provinces population of Sakha Republic (Yakutia), taking into consideration the revealed changes of composition and properties of oral fluid and hard tissue of intact teeth.

Keywords: Density, structural homogeneity, microhardness of hard tissue of intact teeth, viscosity, microcrystallization of oral fluid, salivary flow rate, dental caries, periodontal disease.

At this time one of the priorities of the government is socio-economic development of regions and the country in whole [5,6]. Regarding this, special attention is given to strengthening and preserving of population health [2, 11]. The living conditions of population in the North leave a negative impact on the functional status of organs and tissues of oral cavity [2, 3, 4, 7, 8, 10]. The investigations aimed at specific regional risk factors for the formation and developments of dental diseases are actual.

It should be noted that the improvement of dental care to the population based on knowledge of clinical and epidemiological features of disease and biological and environmental factors determining the frequency and severity of pathological processes [1, 9, 12]. Similar studies in the industrial provinces of Yakutia were not evaluated, which determines their theoretical and practical significance in dentistry.

Purpose of research. On the basis of comprehensive dental studies to identify biological risk factors of dental diseases formation and development.

MATERIALS AND METHODS

Clinical and epidemiological investigation of 1,580 people aged 3 to 44 years residing in the industrial uluses (districts) (Tomponsky, Oymyakonsky, Nyurbinsky, Anabarsky) of Sakha Republic (Yakutia) was conducted. Thus, in accordance with the classification there were formed following key age groups: 3, 6, 12, 15, 35-44 years old. Assessment of dental status was performed using standard indexes and criteria. Standard card recommended by WHO (1997) was used for the survey. The study of the susceptibility of the hard tissues of the tooth by caries was conducted on the prevalence and intensity of dental caries. During the examination of the group we determined the arithmetic mean value. The periodontal status was determined on the basis of performance of communal periodontal index CPI (1995).

The composition and properties of oral fluid was determined in terms of saliva flaw rate, the viscosity of oral fluid using viscometer VC-4 according to the method of Zimkin N. I. and his co-authors (1955), the types of microcrystallization by the method of P. A. Leus (1977) (n=420), calcium and alkaline phosphatase content, acid-base balance on photocolorimetry-5010 (Germany) (n=229), cationic-anionic mixed saliva electrophoresis carried out in the apparatus of capillary electrophoresis system "Capel-104T" (Russia) (n=178).

We assessed the biophysical properties and composition of hard tissue of intact teeth removed for orthodontic indications. There were studied 88 sections of incisors, canines, premolars and molars. Contact and lateral surfaces, vestibular and oral sides and tops of cheek, oral bumps, fissures of the chewing surfaces, contact front and rear surfaces, buccal and oral sides of premolars and molars were studied.

The study of microhardness of hard dental tissues was carried out according to the method of Vickers, regulated by GOST 2999-75. The hardness was measured at loads from 9.8 N (1 kgf) and 980 N (100 kgf) in "DIGITAL MIKROINDENTATION TESTER LM -700" apparatus (Japan). The evaluation was carried out with the measurement at least of 3 points, and then arithmetic mean value was calculated. The study was conducted at the Department of solid state physics of Physical-technical Institute of North-Eastern Federal University named after M. K. Ammosov.

Method for determining the density of hard tissue of intact teeth and hydrostatic weighing regulated by GOST 25281-82 (ST SEV 2287-80) was carried out in the measuring scales VLTE-500 (Russia). Determination of the density of hard tissue of intact teeth was carried out by measuring the linear dimensions of samples and hydrostatic weighing.

The study of the structural homogeneity of inner layers of the enamel and teeth dentin was carried out using the method of x-ray energy-dispersive microanalysis with nonstandard detector with combined device XL 20 (Philips), scanning electron microscope, x-ray microprobe with dispersion energy (Scott V. D., Love G., 1983). Photomicrographs obtained in the secondary electron mode and quantitative analysis was conducted by nonstandard method for obtaining a much larger amount of reliable experimental data.

Statistical processing of clinical material was carried out using standard techniques of variational statistics with calculation of average value, root mean square error using the software packages "Microsoft Excel" 2007 (Microsoft Corporation, 1985-1999). Obtained results were grouped together according to similar characteristics. The critical level of significance while testing of statistical hypotheses is $p \leq 0.05$.

RESULTS AND DISCUSSION

Analysis of the results indicates a high level of prevalence and intensity of dental caries among different age groups. In the age groups of 3 to 6 years old children, the prevalence of caries of deciduous teeth ranged from 37,21±0.63 to 100%. At this age there is a marked increase of KP index, where 3 years old children have the intensity of 2.31±0,06, 7.26± 0,07 for years old. Caries intensity lesions in permanent teeth of 6years old children was at the level of 1.94±0,08, where there are removed first molars of the lower jaw about complications of dental caries (0,79±0,19). In the key age group of 12 years old children prevalence of caries is defined as 100%, where the intensity of dental caries in this group of children is interpreted as high (6,45±0,07). The same situation on the prevalence of dental caries is determined by the 15-year-old children (100%) when the average intensity level of 8.48+0,23. In the age group 35-44 years with 100% prevalence of the severity of carious, sealed and extracted teeth is of 19.72+0,21,

which characterizes a very high level of intensities of tooth decay. At the same time, in the age group of 65-74 years the average intensity of dental caries was 25,60±0,26.

The prevalence of periodontal diseases indicates a its high level, where the rates ranged from 88,89±0.11 to 98,31±0,38%. While in the age group of 65 and older there is a decrease in prevalence (61,43+0,42) that is associated with the logical processes associated with tooth loss. **In** the intensity of destruction of periodontal tissues with age increase in frequency of unrecorded sextants and pathological periodontal pockets, which indicate the severity of periodontal diseases, mainly inflammatory-destructive character.

The high prevalence of dental diseases among the examined groups of people was the basis of the evaluation of organs and tissues the properties of oral cavity, with the aim of identifying risk factors.

The evaluation of the biophysical properties of oral fluid of the examined age groups characterizes the availability of some features. Thus, salivary flaw rate in the preschool and school age (3, 6 and 12 years old) ranged from 0.29±0.04 to 0,33±0,07 ml/min. While for 15 years old teens the rate was 0,35±0,09 ml/min (the optimal value of secretion rate among children of 0.40 ml/min). For 35-44 years adults, mixed salivary flaw rate separation was in the range of values of 0.47±0.08 ml/min (the optimal value of the rate of secretion for adults is 0,70 ml/min.). Evaluation of the data shows the reduction in the rate of saliva secretion in the examined age groups.

It should be noted that in such properties of mixed saliva as viscosity and types of microcrystallization certain changes that characterize an unfavorable background were observed. Viscosity value of oral fluid of the examined age groups shown its increase, where it ranged from 2,89±0,04 to 3.30 0,04±0,02 units (the optimal rate of 4,16 units). The predominance of the II and III types is determined in the structure of microcrystallization, where their average results were within the numerical values 39,88±1.33 and 47,47±1,17%. Despite the detected changes in the properties of oral fluid of patients, the average pH was within the optimal values (6.77±0,03).

Data analysis of alkaline phosphatase activity in saliva characterizes its reduction, where the rates ranged from 22.70±1,64 to 38.60±of 2.56 u/l (optimal value of 54-114 u/l at pH 7.0 and above).

It is known that quantitative and qualitative changes in the composition of oral fluid in a certain way have an impact on the level and frequency of incidence. Thus, the maximum values of cations were determined in kalium, where the rates ranged from 6,36±0,19 to 7,87 0,19±0,11 mg/l. Further concentration of sodium and ammonium, which average indicators from 3,22+of 0.10 to 6.5±0,26 mg/l. Low concentrations were observed in lithium, magnesium, strontium, barium, which ranged from 0,012±0,02 to 0.95±0.01 mg/l. In the anionic composition of oral fluid data, the concentrations of chloride, nitrite, fluoride, sulphate and nitrate ranged from 0,006+0,005 to 3.21+0.22 mg/L.

It should be noted that the concentration of ionized calcium in oral fluid is considerably 1.94 times lower than inorganic phosphate. Such changes to some extent have a negative impact on mineralizing action of saliva in the examined groups and the peculiarities of composition and properties of oral fluid in combination with other cariogenic factors can contribute to the formation and development of dental diseases.

Spectral microanalysis, characterizing the saturation of hard dental tissues by micro - and macroelements indicate some of their features, their weight ratio and the atomic mass ratio. In the structure of weight ratio indicators calcium and phosphorus play a significant role, which ranged 40,42-41,42 and 18.22-18.64%. The data of fluorine and sodium concentration were within the numerical values of 0.99-1.82 and 0.86-2.31%. Meanwhile, the results obtained by the weight ratio of calcium and phosphorus characterize violations of enamel structural homogeneity of intact teeth among children of school age, as evidenced by calcium-phosphorus molar ratio index, where it was 1.93 (optimal value of 1.67). In this case the average ratios of atomic masses of calcium and phosphorus made up a significant part, and it was 95.48%, where the proportion of calcium was 54,61% and the second component was 40.87%.

Data analysis of hardness of dental tissues measurement by Vickers method characterizes the presence of numeric values variations. In such areas as, the enamel of chewing surfaces of molars and premolars, tooth hardness reached maximum levels and it ranged from 964,3 to 1952,7 N (kgs), the value of enamel surface in the cervical area

reached 305,1 and 548,2 N (kgf). Data of hardness of root dentine and near the apex ranged from 294,7 to 467,8 N (kgf) and from 217,1 to 404,9 N (kgf).

Data of the mass of tissue sections from oral surfaces of intact premolars and molars was obtained in conducting research on measurement method of hydrostatic weighing of hard tissue of intact teeth, where the rate was 0.18 m/g. data Evaluation linear measurements did not reveal the presence of features. Thus, density value of the investigated sections with oral and vestibular surfaces varied from 1,79 to 2.25 g/cm3. Average value was not much different.

From the above analysis it can be seen that the indicators of the biophysical properties of intact enamel of kids and teens permanent teeth have violations of the structural ratio of calcium and phosphorus content, they contribute to the reduction of resistance of teeth hard tissues to aggressive factors of external and internal environment. The microphotography revealed the presence of micro- and macrocracks on the surface of tooth enamel.

CONCLUSION

Peculiar properties of composition and properties of oral fluid and hard tissue of intact teeth in the form salivary flow rate reducing, a predominance of second and third types of microcrystallization, increase of viscosity, decrease of activity of alkaline phosphatase and concentration of calcium, phosphorus in oral fluid, as well as a violation of the structural homogeneity and the ratio of calcium and phosphorus in the hard tissues of intact teeth are specific biological risk factors of dental diseases among the population of industrial regions of Sakha Republic (Yakutia). These facts dictate the need for a comprehensive program of prevention of dental caries and periodontal diseases aimed at its negative impact neutralization or reduction.

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