

Change in the Mineral Composition of Mixed Saliva in Patients with Fluorosis, after Applying the Complex of Therapeutic and Prophylactic Measures

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Abstract

Aim and Scope: In recent decades, the main areas of the research are the issues of prevention and treatment of dental caries. The problem of prevention, diagnosis, and treatment of non-cariou diseases continues to be one of the actual and completely unresolved problems of modern dentistry. **Materials and Methods:** All participants of the study had undergone two procedures of the enamel microabrasion, at interval of a week, using the composition, containing hydrochloric acid, carborundum, and silicone gel. **Result and Discussion:** As a result of our studies, we found some differences in the mineral composition of mixed saliva, in patients with dental fluorosis after esthetic dental treatment. This plays an important role in the planning of therapeutic and prophylactic measures, aimed at correcting the condition of hard tooth tissues. **Conclusion:** An important role in the formation and maintenance of enamel resistance is played by the mixed saliva. The daily rhythm of the biochemical parameters of saliva is characterized by a constant content of calcium and phosphorus; that is, important for maintaining the homeostasis of dental tissues. In this connection, we defined the concentration of total and ionized calcium, total phosphate, potassium, magnesium, iron, and chlorides, using the automatic analyzer "Olimpus," in the samples of mixed saliva of patients with the diseases of hard tooth tissues.

Key words: Enamel microabrasion, fluorosis, remineralizing therapy

INTRODUCTION

In recent decades, the main areas of research are the issues of prevention and treatment of dental caries.^[1,2] The problem of prevention, diagnosis, and treatment of non-cariou diseases continues to be one of the actual and completely unresolved problems of modern dentistry.

The pathology of hard tissues of non-cariou origin occurs during the development of teeth (enamel hypoplasia, teeth fluorosis, and tetracycline teeth) and after their eruption (dentine hyperesthesia, wedge-shaped defect, and enamel erosions).

Thus, the prevalence of fluorosis in the Moscow region is 13–88%. The studies of Riordan^[3] demonstrated the effectiveness of preventive measures in Australia, the result of which was a decrease in the prevalence of fluorosis by 2.8 times.

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According to our data (Krikheli and Korshunova;^[4] Krikheli and Rabadanova^[5]), at present, the dentists use whitening systems, containing concentrated preparations of hydrogen peroxide and carbamide, less often – the method of enamel microabrasion, with the aim to correct the color of the vital teeth, including with fluorosis.

However, every year there is an increase in the number of non-carious diseases, contributing to the discoloration of teeth among various population groups. This requires the improvement of the level of treatment of patients with dental discoloration.

According to the data of Borovsky and Leontiev, the biology of the tooth tissues is closely interrelated with the oral fluid. The role of saliva in maturation, mineralization, and remineralization of tooth enamel is proved.^[6] According to the opinion of Akhmetzyanova *et al.*,^[7] the mineral components, entering the enamel from saliva, not only increase its resistance to caries but also delay its initial manifestations, enhancing the processes of remineralization. Another important feature of saliva is the excess of the phosphate concentration over the calcium concentration. Due to this, the dynamic balance of the elements in the tooth tissues is normally maintained. Potassium and sodium are important components of saliva. The quantitative ratio of these elements among themselves is important for maintaining the function of biological tissues of the body.

Remineralizing potential of saliva in individuals is different and depends on the age, general condition of the body, diet, and the past diseases. According to the opinion of Komarov *et al.*,^[8] artificial saliva containing 250 ppm of calcium, 100 ppm of phosphate, and 500 ppm of fluoride has a pronounced remineralizing effect on erosive enamel.

Thus, the change in the concentration of mineral substances in the saliva affects the homeostasis of the oral cavity and the remineralizing potential of the oral fluid. Therefore, it is very important to conduct the investigations in this direction; this will increase the level of prevention of complications after microabrasion of tooth enamel in patients with fluorosis.

MATERIALS AND METHODS

To solve the set tasks, a complex of clinical dental examination was conducted for 40 people, 18–35-year-old, with dashed and spotted forms of fluorosis (K00.3-mottled teeth), caries intensity according to the def caries index - 2.20 ± 0.25 , with a color 3.60 ± 0.24 according to the scale Vita, with normal sensitivity of teeth. All participants of the study had undergone two procedures of the enamel microabrasion, at interval of a week, using the composition, containing hydrochloric acid, carborundum, and silicone gel. The abrasive mixture was applied to the teeth with a special handpiece. Removal of spots from the teeth was carried out with rubber cups. The toothpaste with calcium and a 5% suspension of hydroxyapatite were used as preventive remedies during 15 days.

In the course of our work, we studied the composition of the oral fluid, which we collected before the start of treatment (on an empty stomach or 3 h after eating), after the procedure of enamel microabrasion and remineralizing therapy. In oral fluid samples, we studied the concentration of total and ionized calcium, phosphate, potassium, and iron.

The concentration of total calcium in the samples was measured by the complexometric method with an indicator of cresolphthalein (Moorehead, Briggs, 1979). The intensity of the resulting purple color was directly proportional to the concentration of calcium and was scanned photometrically at 560–600 nm, with a maximum absorption at 575 nm. The analysis was considered linear up to 5 mmol/l.^[9]

To determine the total phosphate content, the method of Daly and Ertinghausen (1972) was used in the modification of Wang. As a result of the reaction, a stable phosphomolybdate was formed, measured at a wavelength of 340 nm. The analysis was considered linear up to 5 mmol/l. The sensitivity of the procedure was 0.01 mmol/l of phosphorus.^[9]

Magnesium was determined using the method, proposed by Gindler, Heth, and Khayam-Bashi (1974). The magnesium, existing in the samples, reacts with the calmagite, forming a magnesium-calmagite compound, the absorption of which was measured at a wavelength of 540 nm/500–550/. The sensitivity of the assay was 0.01 mmol/l.^[9]

The iron content was determined using the ferrozine method (Williams H.L., 1977). In acidic medium, the iron dissociates from the transferrin complex and passes into solution as free trivalent iron ions, which are restored by ascorbic acid to divalent ones, reacting with ferrozine, forming an intensely colored purple compound. Absorption is measured at a wavelength of 560 nm, the sensitivity of the assay is 0.2 μ mol/l.^[9]

The ions of potassium and calcium were determined by the ion-selective method, using the apparatus-AWL. Biological sample was placed in an ion-selective electrode, and the results were obtained immediately. Calibration was performed using the standard solutions of potassium and calcium.^[9]

Statistically significant differences between the content of chemicals in the oral fluid of patients with fluorosis were determined using the Student's *t*-test and the criterion χ^2 with a generally accepted level of significance $P = 0.05$.^[10]

RESULTS AND DISCUSSION

The initial content of ionized potassium in the saliva of patients with fluorosis was $11.75 + 0.03$ mmol/l. After microabrasion, the concentration of this macroelement significantly increased ($P < 0.001$) to $14.11 + 0.01$ mmol/l. The use of a complex of prophylactic agents contributed to

Table 1: Chemical composition of mixed saliva in patients with dental fluorosis

Elements	40 patients with dental fluorosis		
	Before the treatment	After the treatment	After the preventive treatment
K ⁺ mmol/l	11.75±0.03	14.11±0.01 <i>P</i> <0.001	10.41±0.02 <i>P</i> <0.001; <i>P</i> ₁ <0.001
Total Ca mmol/l	1.06±0.02	1.15±0.03 <i>P</i> <0.02	1.31±0.02 <i>P</i> <0.001; <i>P</i> ₁ <0.001
Ca ²⁺ mmol/l	0.90±0.002	0.94±0.004 <i>P</i> <0.001	1.10±0.035 <i>P</i> <0.001; <i>P</i> ₁ <0.001
P mmol/l	3.61±0.04	3.73±0.04 <i>P</i> <0.05	3.88±0.06 <i>P</i> <0.001; <i>P</i> ₁ <0.05
Mg mmol/l	0.30±0.01	0.35±0.02 <i>P</i> <0.001	0.39±0.02 <i>P</i> <0.001; <i>P</i> ₁ <0.001
Fe µmol/l	5.20±0.18	2.50±0.12 <i>P</i> <0.001	2.00±0.12 <i>P</i> <0.001; <i>P</i> ₁ <0.001

P: Comparison with the initial data; *P*₁: Comparison with data after the treatment

a decrease (*P* < 0.001) of the ionized potassium content to 10.41 + 0.02 mmol/l [Table 1].

The initial content of total calcium in the mixed saliva of individuals with fluorosis was 1.06 + 0.02 mmol/l. After microabrasion of teeth, the concentration of total calcium significantly increased (*P* < 0.02) to 1.15 + 0.03 mmol/l. The use of a complex of preventive remedies contributed to an increase (*P* < 0.001) of the total calcium content to 1.31 + 0.02 mmol/l [Table 1].

The concentration of ionized calcium in the saliva of patients with dental fluorosis was 0.90 + 0.002 mmol/l. After microabrasion, it increased (*P* < 0.001) to 0.94 + 0.004 mmol/l. The use of a set of prophylactic agents contributed to an increase (*P* < 0.001) of this macroelement content to 1.10 + 0.035 mmol/l [Table 1].

Before the investigations, the total phosphate concentration in patients with dental fluorosis was 3.61 + 0.04 mmol/l. After the microabrasion procedure, it increased (*P* < 0.05) and was equal to 3.73 + 0.04 mmol/l. The use of a set of prophylactic agents contributed to an increase (*P* < 0.001) of the content of this macroelement to 3.88 ± 0.06 mmol/l [Table 1].

Before the studies, the concentration of magnesium in patients with dental fluorosis was 0.30 + 0.01 mmol/l. After the microabrasion procedure, it increased to 0.35 + 0.02 mmol/l (*P* < 0.001). The use of a set of prophylactic agents contributed to significant (*P* < 0.001) increase in the content of this microelement to 0.39 + 0.02 mmol/l [Table 1].

The initial concentration of iron in the mixed saliva of patients with dental fluorosis was 5.20 + 0.18 µmol/l. After the microabrasion procedure, it was significantly (*P* < 0.001) decreased and became equal to 2.50 + 0.12 µmol/l. The use of a set of preventive remedies contributed to a decrease in the content of this microelement to 2.00 + 0.12 µmol/l (*P* < 0.001) [Table 1].

The results of our studies showed that for the treatment of patients with fluorosis it is advisable to apply the method of enamel microabrasion. At the same time, after the esthetic

treatment, the concentration of macro- and micro-elements changed in the oral fluid of patients, indicating about the demineralization of enamel. This dictates the need for the use of calcium and phosphate-containing remineralizing agents after the enamel microabrasion. When applying the recommended set of therapeutic and prophylactic measures, the treatment of dental fluorosis will not only be effective but also safe.

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