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Fluoride level evaluation in tooth enamel with acid biopsy in vitro

The analysis of the elements level in the tooth hard tissues provides important information on the degree of mineralization, and as a result, on the tooth susceptibility to dental caries. The assessment of the level of fluorine, as a micro-element constituting one of the elements of fluoroapatite, responsible for the resistance to the acids' attack in the oral cavity seems to be the most significant part of the analyses.

The aim of the study was to measure the fluorine level on the buccal and palatine surfaces in tooth enamel on the selected group of young people in the Lublin region.

MATERIAL AND METHODS

Twenty first upper premolars, extracted for orthodontic indications, constituted the material for the conducted analyses. Persons whose teeth were extracted represented the age group between 12–25, had never been subjects to the collective fluorine prophylaxis and applied standard hygienic methods with the use of traditional agents for the maintenance of the oral cavity hygiene. Teeth constituting the material for analyses were free of cavities, did not undergo any treatment and their crowns were preserved. After the extraction the teeth were cleaned of any soft tissues and preserved in the temperature of 6°C soaked in the solution of physiological saline, which was changed daily. Acid biopsy *in vitro* was carried out with the use of 0.5M perchloric acid applied in the amount of 5 microlitres for the period of 30 seconds. Next sample was flushed with 1 milliliter of distilled water into Eppendorf disposable plastic test-tubes. The place in which the acid was applied was limited with the use of nail varnish and had the diameter of 2 mm. On the buccal surface the biopsy was carried out in the place situated in the half of the height of the dental crown, as measured from the adamantine-dentine line to the top of the buccal tuberculum and in the half of its width. Analogous biopsy spot was pointed on the palatine tooth surface. The fluorine concentration was determined with a fluoride ion selective electrode Orion (ORION Research Incorporated, Boston, MA). The fluoride concentration was obtained by converting the millivolt readings into concentration using a calibration curve. Standard fluoride solution was supplied by Orion Research Inc. A stock standard fluoride solution of 0.1 mol/dm³ was appropriately diluted in redistilled water to obtain standards containing 10⁻², 10⁻³, 10⁻⁴, 10⁻⁵, 7·10⁻⁶, 5·10⁻⁶, 4·10⁻⁶, 3·10⁻⁶, 2·10⁻⁶, 10⁻⁶, 7·10⁻⁷, 5·10⁻⁷, 3·10⁻⁷ mol/dm³. To provide constant background ionic strength, decomplex the fluoride and adjust the pH of solutions, a total ionic strength adjuster buffer (TISAB III, Orion Research Inc.) was added to each sample or standard. All determinations were done in

duplicate. Calibration of the fluoride electrode was done before and after samples measurements. To avoid the risk of exogenous fluoride contamination the plastic ware was used. A magnetic stirrer was stopped at the moment of the potential readings. During measurements the temperature of the solution was maintained at 20°C within $\pm 0.5^\circ\text{C}$ by controlling room temperature.

The obtained analyses' results were subject to the statistical analysis with the application of the Wilcoxon's pairs' sequence test with the significance level $p=0.05$ for assessing the correlation between differences observed.

RESULTS

Molar concentrations (cm) and ppm of fluorine in the tooth enamel as obtained in the course of measurements are presented in Figure 1 and in Table 1.

Table 1. Fluorine concentration in the tooth enamel on buccal and palatine surfaces in moles (Cm) and ppm

Sample number	Buccal surface		Palatine surface	
	Cm	ppm	Cm	ppm
1	0.088	1672	0.055	1044
2	0.083	1580	0.028	523
3	0.071	1345	0.059	1119
4	0.151	2869	0.059	1119
5	0.068	1284	0.074	1408
6	0.079	1508	0.050	952
7	0.068	1284	0.063	1199
8	0.058	1092	0.079	1509
9	0.076	1442	0.102	1944
10	0.069	1314	0.063	1199
11	0.051	974	0.047	889
12	0.060	1145	0.093	1773
13	0.028	536	0.040	756
14	0.066	1255	0.079	1509
15	0.072	1375	0.047	889
16	0.030	574	0.074	1408
17	0.023	445	0.050	952
18	0.040	756	0.044	829
19	0.032	600	0.030	561
20	0.025	477	0.027	522

The lowest F value as observed in the course of measurements for the buccal surface reached the level of 444.6 ppm. The highest concentration for the same surface equalled 2869 ppm (mean value 1176.3 with standard deviation SD 558.5). The minimum and maximum F concentration for the palatal surface equalled respectively 521 ppm and 1944 ppm (mean value 1105.3 with standard deviation SD 397.1). In most of the cases the fluorine content on the palatine surface reached lower values than in the case of buccal surface.

Statistical analysis did not prove any significant differences in the concentration of fluorine ions in tooth enamel between the buccal and palatine surfaces. Obtained parameters are similar to values presented by other authors who used the same method.

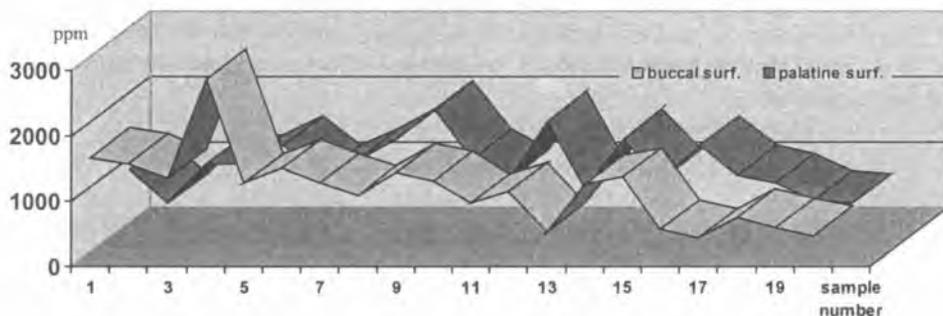


Fig. 1. Differences in the fluorine concentration in tooth enamel on the buccal and palatine surfaces (in ppm)

CONCLUSIONS

1. Distribution of fluorine ions in tooth enamel on the buccal and palatine surfaces is not identical.
2. In most of the cases higher values of F concentration on the palatine surface corresponded to the higher concentration values on the palatine surface.

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SUMMARY

The aim of the study was evaluation of fluoride levels in enamel *in vitro* with acid biopsy. Twenty extracted first maxillary human premolars were treated with 0.5 M perchloric acid on lingual and buccal enamel surface for 30 seconds. The highest fluoride level on buccal surface was 2869 ppm, the lowest was 444.6 ppm. On lingual surface respectively 1944 ppm and 521 ppm. Statistical analysis showed no substantial differences in fluoride levels between both surfaces.

Ocean poziomu fluoru w szkliwie zębów z zastosowaniem biopsji kwasowej *in vitro*

Celem pracy było określenie poziomu fluoru w szkliwie zębów z zastosowaniem biopsji kwasowej *in vitro*. Do badań wykorzystano 20 przedtrzonowców usuniętych ze wskazań ortodontycznych. Biopsję wykonano 0,5 M kwasem nadchlorowym przez 30 s na policzkowej i podniebiennej powierzchni szkliwa. Najwyższe stężenie fluoru na powierzchni policzkowej wyniosło 2869 ppm, najniższe 444,6 ppm. Dla powierzchni podniebiennej wartości te wynosiły odpowiednio 1944 ppm i 521 ppm. Analiza statystyczna nie wykazała istotnych różnic pomiędzy poziomami fluoru na obu badanych powierzchniach.