The informational content of hair biochemistry in children after treatment with a fixed orthodontic appliance

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Abstract. Orthodontic treatment degrades the enamel surface. The use of braces not only creates a cosmetic defect but also visible signs of early-stage caries. It's crucial that the affected enamel still appears intact on the surface and there are no visible signs of enamel damage. Therefore, treatment at this stage is essential to prevent further development of caries and its complications.
Instrumental neutron activation analysis of hair is performed not only for various hair problems but also as a complementary test to detect general diseases and demineralization of hard dental tissues.

The aim of the study was to examine the impact of hair biochemistry in children treated with fixed orthodontic appliances.
Materials and Methods: A comparative clinical assessment of hair mineral content was conducted in two patients, both without associated pathologies and dentally treated.
Results: An instrumental neutron activation method was used to determine the mineral composition of the patient's hair. Institute of Nuclear Physics, Academy of Sciences of the Republic of Uzbekistan.
Orthodontic treatment in children aged 10–14 years is, to some extent, a preventative measure against caries. However, after orthodontic treatment, new areas of destruction of hard dental tissues appear.
The presence of braces, ligatures, and wires in the oral cavity easily disrupts the delicate biological balance. Additional retention sites create conditions for plaque accumulation and formation [3,4].
Not only dental plaque but also fixed orthodontic appliances contribute to the development of this pathological situation in the oral cavity, leading to demineralization of the surface layers of enamel and intensive destruction of hard dental tissues. This pathological condition in the oral cavity occurs after the completion of orthodontic treatment.
In this study, we examined the direct and inverse correlations between the amounts of trace elements in hard dental tissues and hair in children.
Instrumental neutron activation hair analysis (INA) is a test that provides a wide range of information **(Table 1):**
- the amount of macro- and microelements;
- the presence of various chemical elements and toxins in the body;
- the presence of metabolic disorders;
- environmental influences.

Each hair lives on average 2-4 years. It grows approximately 0.4 mm per day, and 1 cm per month. Having reached a certain length, the hair gradually falls out and is replaced by new ones. On average, a healthy person loses 40-50 hairs per day. In people who have had an infectious disease, and especially in those with endocrine diseases, hair loss increases sharply. Hair diagnostics are performed not only for various hair problems but also as a complementary test to identify general diseases and demineralization of hard dental tissue.

The aim of our study was to examine the chemical composition of tooth enamel and hair, comparing it with the microelement content that forms hard dental tissue in children treated with fixed orthodontic appliances.

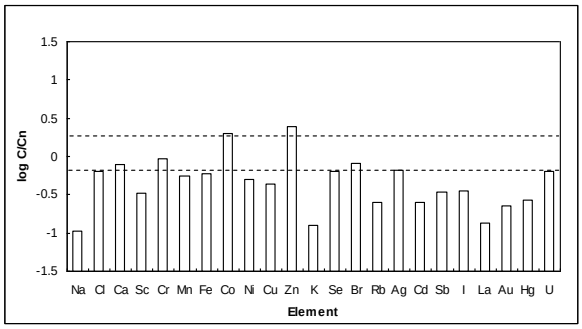
Materials and Methods: Hair samples (n=2) were analyzed from otherwise healthy patients aged 10–14 years (2 females) with varying degrees of dental caries. Samples of intact permanent teeth (n=4) were extracted for medical reasons.

Hair donation procedure for microelement analysis.

For this, a small lock of hair at least 3 cm long, containing 100 mg, is cut from the occipital region, 3-5 places from the root, end-on (Figs. 3-4). If the hair has been dyed or chemically treated, this will give incorrect results. If there is no scalp hair, axillary or pubic hair can be used as samples. The entire procedure is completely painless (Figs. 1-2). According to the literature, there is an inverse correlation between the data: if hair contains a lot of the chemical element Ca, it has been shown that the blood contains much less of this element. If the chemical element Zn is present in excess, it indicates cancer; if it is below the normal range, the patient is not developing properly [5].

Hair analysis results.

Akhmedova G.M. Patient No. 103. Date of selection: February 2014. (Table 1).

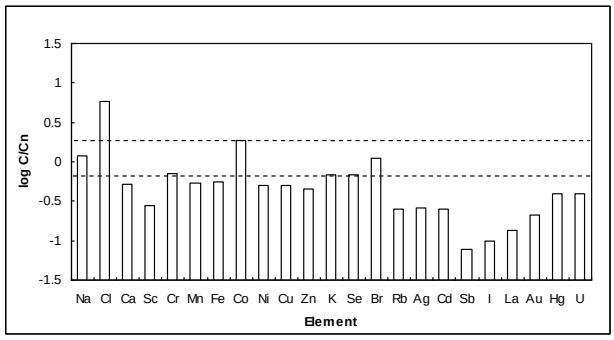


Na	Cl	Ca	Sc	Cr	Mn	Fe	Co	Ni	Cu	Zn	K
53	630	1160	0.0033	0.47	0.28	15	0.14	5.0	8.8	440	100

Se	Br	Rb	Ag	Cd	Sb	I	La	Au	Hg	U
0.32	1.6	0.5	0.1	0.03	0.044	0.36	0.02	0.0069	0.053	0.19

Logarithm of the ratio of the obtained values to the mean. (The dotted line indicates the normal range of concentrations).
Conclusion: Iodine deficiency. Take iodine supplements. Consult a urologist. Get an electrocardiogram. Potassium deficiency. Deficiency of copper, manganese, selenium, and iron. Take potassium supplements, selenium supplements with vitamins A and E, iron supplements with vitamin C, and multivitamins with copper and manganese. Increased zinc levels. Determine the cause. Pay attention to the cardiovascular system. Possible gastrointestinal (liver) problems.

Last name: Kamoliddinova N. Patient No. 203.
Selection date: March 2014



Na	Cl	Ca	Sc	Cr	Mn	Fe	Co	Ni	Cu	Zn	K
590	582 0	780	002	0.36	0.27	14	0.13	5.0	10.0	81	550

Se	Br	Rb	Ag	Cd	Sb	I	La	Au	Hg	U
0.34	2.2	0.5	0.039	0.03	0.01	0.10	0.02	0.0064	0.08	0.12

Logarithm of the ratio of the obtained values to the mean. (The dotted line indicates the normal concentration range.)
Conclusion: Iodine deficiency. Take iodine supplements. Consult a urologist. Get an electrocardiogram. Potassium deficiency. Deficiency of copper, manganese, selenium, and iron. Take potassium supplements, selenium supplements with vitamins A and E, iron supplements with vitamin C, and multivitamins with copper and manganese. Increased zinc levels. Determine the cause. Pay attention to the cardiovascular system. Possible gastrointestinal (liver) problems.

Element		I	Mg	Cl	Cu	Mn	Na	K	Ca	U	Au	Br	La
Intact tooth	**Patient №-103**	**<0.1**	5190	1620	<1.0	0.57	5980	<100	318000	<0.1	<0.001	<1.0	<0.1
	Patient №-203	**<0.1**	5780	1480	<1.0	1.3	6160	<100	374000	<0.1	<0.001	<1.0	<0.1

Element		Se	Hg	Cr	Ag	Sc	Rb	Fe	Zn	Co	Sb	Sr
Intact tooth	**Patient №-103**	<0.1	<0.01	<0.1	<0.01	<0.001	<0.5	<10	135	0.21	<0.01	215
	Patient №-203	<0.1	<0.01	<0.1	<0.01	<0.001	<0.5	<10	110	0.051	0.36	195

Element content in samples, µg/g (Table 2).

The biological material we used was chosen over the more commonly used blood and urine because hair is one of the most resilient structures to random external influences, not only in the skin but also throughout the body, second only to teeth [3, 4, 5].

At the same time, hair, unlike teeth, is more readily studied as an indicator of environmental changes in the human body. Furthermore, environmental changes affect the chemical composition of hair more quickly than the structure of dental hard tissue (Table 2).

In our country, laboratory studies using instrumental neutron activation analysis of hair and teeth extracted for orthodontic indications to detect demineralization of dental hard tissue (secondary caries) in children after brace treatment have not previously been performed, despite the obvious relevance of this problem. Thus, timely preventive treatment of children after orthodontic procedures is necessary to prevent the spread of the process and the development of secondary caries.

Literature

1. Features of the study of material from the oral mucosa: scientific publication / M.A. Gorshkova, R.A. Pustovalova, Zh.V. Tereshchenko, E.N. Egorova // Problems of Medical Mycology. - St. Petersburg, 2006. - No. 2. - Pp. 32-33.
2. Assessment of the impact of fluoride on the child population of the Irkutsk region / N.V. Efimova, V.B. Dorogova, O.M. Zhurba, V.A. Nikiforov // Occupational Medicine and Industrial Ecology. - Moscow, 2009. - No. 1. - Pp. 23-26.
3. Petrushanko T.A., Chereda V.V., Loban G.A. The role of colonization resistance of the oral cavity in the development of caries: scientific publication // Dentistry. - M., 2013. - No. 1. - pp. 43-45.
4. Aesthetic restoration of upper lip after removal of post-trauma foreign body (orthodontic bracket)/ G.Conti, M.Dolci, A.Borgonovo, C.Maiorana// Eur. J. Paediatr. Dent.- 2012.- Vol.13, N 3.- P.239-40.
5. Ali H., Maroli S. Glass ionomer cement as an orthodontic bonding agent.// J. Contemp. Dent. Pract.- 2012.- Vol.13, N 5.- P.650-4.
6. Al-Twaijri S., Viana G., Bedran-Russo A.K. Effect of prophylactic pastes containing active ingredients on the enamel-bracket bond strength of etch-and-rinse and self-etching systems.// Angle Orthod.-. 2011.- Vol.81, N 5.- P.788-93.
7. Three-dimensional analysis of lip and perioral soft tissue changes after debonding of labial brackets/ H.Jeon, S.J.Lee, T.W.Kim, R.E.Donatelli// Orthod. Craniofac. Res.- 2013.- Vol.16, N 2.- P.65-74/
8. Treated enamel surface patterns associated with five orthodontic adhesive systems--surface morphology and shear bond strength./ M.Shinya, A.Shinya, L.V.Lassila et.al.// Dent. Mater. J.- 2008.- Vol.27, N 1.- P.1-6.