MINERAL COMPOSITION OF ENAMEL AND DENTIN OF INTACT TEETH IN PATIENTS WITH THYROID GLAND PATHOLOGY IN BELGOROD REGION, RUSSIAN FEDERATION

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Abstract:

Purpose: The purpose of the present study was to investigate the effects of thyroid gland pathology on macro and trace elements of teeth.

Methods: We examined two groups of patients: healthy patients and patients with thyroid disorders. The sample was comprised of 32 extracted teeth for orthodontic and periodontal indications from patients 18 to 50 years old. The changes in macro and micro trace elements (dietary minerals) composition of dental hard tissues in healthy subjects and patients with thyroid disorders were investigated using scanning electron microscopy (FEI Quanta 200 3D, Eindhoven, Netherland).

Results:Major changes were found in the calcium and phosphorus levels. Comparative analysis of the contents of magnesium and sulfur in the enamel and dentin showed that their contents increased in the teeth of patients with thyroid disorders.

Conclusion: We described some visual characteristics of teeth in patients with thyroid gland pathology. These data may be used in diagnostic, treatment, and prophylactic of caries lesion in patients with thyroid gland disorder.

KEYWORDS: thyroid gland pathology, hypothyroidism, teeth, enamel, dietary minerals, scanning electron microscopy

Introduction

Endocrine pathology has a high prevalence in human society. According to WHO (2007), the level of iodine is below the normal range in 2 billion people (34% of the world population) (1). According to the American Association of Thyroid Problems about 20 million Americans have thyroid disease, which about 60% are not diagnosed.

The study of Shalu C. et al. (2011) found some changes in the morphology of the teeth in children such as delayed eruption of primary and permanent teeth, and enamel hypoplasia. The reason of those alterations was hypothyroidism. The hypothyroidism changes the macro and trace elements composition of the dental hard tissues. The hyperthyroidism causes demineralization of the bone tissue, leading to reduction of calcium and phosphorus levels in the skeleton structure including tooth enamel (2).

The thyroid gland is one of the important regulators of metabolism. Scientists have recently started to review relationship between thyroid gland pathology (TGP) and oral-status (2-4). The goal of the present study is to investigate TGP influences on macro and trace element of teeth. We suspect that amount of the elements in hard teeth tissues affects caries resistance among healthy people and people with TGP.

Materials and Methods

The sample for the present study was comprised of 32 intact teeth, which were extracted for orthodontic and periodontal indications from 18 to 50 years old subjects in Belgorod, Russia. The teeth were divided into two groups: healthy patients without thyroid gland pathology (control) and patients with thyroid gland pathology (test). Morphological examination was performed on extracted premolars and molars. Samples were cut by longitudinal or transverse cuttings. The surface of the samples was washed with gel-etching for enamel and dentin.

Samples were monitored examined by a scanning electron microscopy (FEI Quanta 200 3D, Eindhoven, Netherland) with a function of non-contact detection of macro-and trace elements at Center of Nanotechnology of Belgorod State University, Russia.

Results

The present data revealed differences in the mineral composition of the teeth between the test and control groups. The data is presented in the Table 1. Enamel of the control group (42.21 ± 1.57%) contained 4% more calcium than the test group (38.15 ± 2.16%). Teeth of patients with TGP contained less phosphorus (18.88 ± 0.93%) than teeth of patient without TGP (20.01 ± 0.27%). In addition, the results showed a reduction of the Ca / P ratio in the tooth structure of patients with thyroid disorders compared to the control group.

The oxygen content was significantly higher in the enamel of patients with thyroid disorders (39.84 ± 1.26%) compared to that of patients without thyroid disorders (35.76 ± 1.12%). Enamel of the teeth in the test group had two times higher sodium content (1.09 ± 0.21%) than teeth of the control group (0.58 ± 0.16%). The chlorine content in the teeth with thyroid disorders (0.25 ± 0.11%) was 3.4 times less than that of teeth of healthy patients (0.85 ± 0.18%).

A slight presence of sulfur (0.06 ± 0.03%) was found in the enamel of teeth with TGP, but that mineral was absent in teeth without TGP. Furthermore, enamel of healthy teeth did not have silicon, but that of control teeth contained silicon (1.02 ± 0.33%).

We hypothesize that TGP may be the cause of the sulfur appearance in the enamel and dentin; however, the effects of changes in the percentage of sulfur in the solid tissues of the tooth were not thoroughly explored. This change reflected the presence of pathological processes because the exchange of sulfur was controlled by the same factors that regulate protein metabolism (thyroid hormones).

Analysis of the results in the study of macro and trace elements composition in the dentin found statistical differences between the patients with thyroid disorders and control group. The calcium level was significantly lower in the test group compared to the control group. There was statistically significant reduction (3.14%) in phosphorus level in tested group compared to the control group (19.83 ± 0.34%). Moreover, there was higher oxygen content in the test teeth compared to the control teeth. Teeth of patients with TGP revealed silicon content of 0.74 ± 0.28%, while there was no silicon present in the dentin of healthy patients. No significant differences of sodium and potassium in the dentin were found between the two groups.

Elements	Control		Test	
	Enamel (%)	Dentine (%)	Enamel (%)	Dentin (%)
O	35,76 ± 1,12*	37,65±2,15*	39,84± 1,26*	47,10±1,19*
Na	0,58±0,16	0,76±0,15	1,09±0,21	0,6±0,14
F	0,024±0,003	0,028±0,002	0,020±0,002	0,021±0,003
Mg	0,11±0,05*	0,26±0,06*	0,36 ± 0,05*	0,9±0,18*
Si	-	-	1,02 ± 0,33	0,74±0,28
P	20,01±0,27*	19,83±0,34*	18,88 ±0,93*	16,69±1,14*
S	-	-	0,06 ± 0,003	0,6±0,2
Cl	0,85±0,18*	0,71±0,19*	0,25± 0,011*	0,18±0,06*
K	0,45±0,05	0,38±0,15	0,33±0,017	0,34±0,09
Ca	42,21±1,57*	40,37±1,11*	38,15± 2,16*	32,83± 1,16*

Table1

Mineral composition of enamel and dentine of intact teeth in patients with and without thyroid gland pathology

*- the differences are significant to the group of healthy teeth at p <0.05

Discussion

The purpose of this study was to determine the effects of TGP on the amount of macro and trace elements in tooth structure. The present study identified that some group elements are affected by the pathological changes. The first group elements includes calcium, phosphorous, chlorine, and sulfur; the second group - oxygen; third - sodium. The data revealed a statistically significant decrease in calcium content and a tendency to decrease in phosphorus content of the enamel, which is an unfavorable sign corroborated by scanning electron microscopy.

Our data revealed a change in the ratio of the mineral composition of dental hard tissues in patients with TGP. The structural changes in the hard tissues of teeth occurred in the context of demineralization, especially calcium and magnesium that lead to the insolvency of local compensatory - defense mechanisms. The caries resistance is found to be higher in healthy subjects compared to patients with thyroid pathology. The density depends on the structure of the enamel of high mineral content, and determines the resistance to pathological processes. Magnesium and silicon enhance the mineralization process and affect the densities of enamel.

Teeth of patients with TGP revealed silicon content of 0.74 ± 0.28%, while there was no presence of silicon in dentin of healthy patients. According to Skalniy AV (2003), the increased silicon content indicates a lesion of water-salt metabolism. Silicon promotes the synthesis of collagen and participates in bone morphogenesis. Comparative analysis of the content of magnesium in the dentin showed a 3.5 fold increase in the teeth with thyroid disorders. Our theory is that dysregulation of magnesium exchange was caused by overactive thyroid gland. No significant differences of sodium and potassium contents in dentin of the teeth studied were found.

Among patients with thyroid diseases, we observed that patients reported an increased hypersensitivity of dental hard tissues with localization predominantly in the cervical region, followed by the formation of cavities. These changes were accompanied by a disturbance of mineral metabolism in the hard tissues of the tooth. Identification of structural and functional changes in the affected teeth of patients with thyroid diseases is equally important during the stages of diagnosis and the phases of subsequent treatment. The present findings are consistent with those of Maximovsky YuM (1981) who found changes in the macro and trace element composition of dental hard tissues leads to a higher frequency of cervical carious lesion. We disclose the data confirming that the hyperthyroidism causes demineralization of not only the bone, (2) but also the teeth.

Development of hard tissue lesions of teeth, their early clinical manifestations, and outcome and nature of complications are largely determined by visual observation of hidden factors, which requires new diagnostic tools.

Conclusion

Mineral metabolism in hard tissues has raised more interest in recent years due to the unique properties of the enamel and dentin that must be considered in the prevention and treatment of pathological changes. The present data suggests influence of thyroid disorders in the hard tissues of teeth. The improvement of methods and techniques allows a more in-depth study of the mechanisms of these processes.

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References

1. De Benoist B, McLean E, Andersson M, Rogers L. (2008). Iodine deficiency in 2007: global progress since 2003. Food Nutr Bull, 29(3), 195-202.

2. Kamilov KP, Kostina KK. Features of mineral exchange of enamel at patients with thyroid gland hyperfunction. Vrach-aspirant. 2010;41(4):10-14.

3. Maksimovsky Y. Porajeniya tverdih tkaney zubov pri giper- i gipofunktsii zhitovidnoi jelezi, ih profilactika i lechenie. Avtoref. dis.d-ra med. nauk. Moskwa; 1982.

4. Shalu C, Manish B. Oral manifestations of thyroid disorders and its management. Indian J Endocrinol Metab. 2011;15(Suppl 2):S113-6.

5. Skalny AV. The trace elements excesses and deficiencies in children in Russia // Proceed. of 7th Europ Nutr Conf, Vienna, Hofburg. 1995;76: 24-28.