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ANALYSIS AND COMPARISON OF AGE DYNAMICS OF THE MINERAL CONTENT AND MANDIBULAR OSSEOUS TISSUE DENSITY IN SCHOOL AGE CHILDREN

Abstract. *The cause of occurrence of a number of pathologies associated with disorders of eruption and position of the teeth can be the quality of the osseous tissue of jaws depending on the degree of mineralization and the content of mineral component, and to the opinion of different authors – calcium content in particular. Detection of the mineral content of the osseous tissue requires application of complicated biochemical methods which is not always possible under conditions of a hospital. Although the results of numerous studies are indicative of the fact that density is a universal sign of the osseous tissue quality, that can be detected by means of modern methods of radiological examination of patients, and dental radiovideography in particular.*

Therefore, the objective of the study was to investigate and compare age dynamics of the mineral content and density of the mandibular osseous tissue in school age children.

The mineral content of the osseous tissue was examined by means of atomic-absorption spectrum analysis of 70 fragments of the mandibular cellular process osseous tissue in children under the age of 6. All the material was distributed into 5 age groups – under 6 months, under 1 year, under 2 years, under 4 years and under 6 years, 7 fragments in every group (boys and girls respectively). The content of eight mineral elements was studied: calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na), iron (Fe), strontium (Sr), copper (Cu), manganese (Mn), and barium (Ba). The investigations were carried out on the atomic-absorption spectrophotometer C-115.

To determine the density of the mandibular cellular process osseous tissue 100 children were examined at the age under 6 years (including 50 girls and 50 boys) without dental pathology, with physiological development of the mandibular-facial area and without diseases able to effect the condition of the osseous tissue in anamnesis. Radiovideographic examination was carried out on the device for dental radiovideography of Siemens firm with Trophy Radiology software.

The results of the study were indicative of the fact that the mandibular osseous tissue of school age children contains calcium, phosphorus, magnesium, sodium, iron, strontium, copper, manganese and barium in the amounts adequate for measuring. Age dynamics of sodium, manganese, barium, strontium and magnesium in the content of the mandibular cellular process osseous tissue in children of different sexes is similar, but age dynamics of calcium, phosphorus, iron and copper possesses gender peculiarities. The density of the mandibular cellular process osseous tissue in school age children is different in different areas (the main part, lateral and central parts of the cellular part) and possesses gender peculiarities of age dynamics. Poor correlation relations are found between the osseous tissue density of the lateral part of the mandibular cellular process osseous tissue and manganese in children of both genders, density of the central part of the mandibular cellular process osseous tissue and the content of manganese in it in girls, density of the main part of the mandible and manganese content in it in girls and sodium in boys. Correlation relations between the density of the osseous tissue and the content of other examined elements in it were not found.

Key words: *mandible, osseous tissue, density, mineral content, dynamics.*

Introduction. The growth and rebuilding of the mandibular-facial area in children are closely associated with the processes of eruption and second dentition [1, 8, 14]. The anlage, development and mineralization of the dental

germs, their growth and displacement in the thickness of the jaws, formation of the dental roots after eruption their crowns in the oral cavity depend considerably on the quality of the mandibular cellular process osseous tissue. As

many researchers consider it is the quality of the osseous tissue surrounding the dental germs can be a cause of occurring a number of pathologies associated with disorders of eruption and position of the teeth [6, 8, 10, 12, 13, 14]. The quality of the osseous tissue, in its turn, depends on the degree of its mineralization and the content of its mineral component, and calcium content in particular, as certain authors suggest [3, 4, 5, 11, 15]. Detection of the mineral content of the osseous tissue requires the use of complicated biochemical methods which is not always possible under conditions of a hospital, in particular, due to the necessity to take material for examination of fragments of the osseous tissue [4, 15]. Although the results of numerous studies are indicative of the fact that a universal index of the osseous tissue quality is its density that can be determined by means of modern methods of radiological examination of patients, and dental radiovideography in particular [2, 3, 6, 7, 9].

The objective of our investigation was to study and compare the age dynamics of the mineral content and the mandibular osseous tissue density in school age children.

Materials and methods. The mineral content of the osseous tissue was examined by means of atomic-absorption spectrum analysis of 70 fragments of the mandibular cellular process osseous tissue in children under the age of 6 (post-extraction material and material obtained during surgery regarding injuries of the lower jaw), received in children departments of dental polyclinics in Lviv. All the material was distributed into 5 age groups – under 6 months, under 1 year, under 2 years, under 4 years and under 6 years, 7 fragments in every group (boys and girls respectively).

The content of eight mineral elements was studied: calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na), iron (Fe), strontium (Sr), copper (Cu), manganese (Mn), and barium (Ba). The investigations were carried out on the atomic-absorption spectrophotometer C-115, the concentration of the elements studied in the samples of the osseous tissue was indicated in mg/g.

To determine the density of the mandibular cellular process osseous tissue 100 children were examined at the age under 6 years (including 50

girls and 50 boys) without dental pathology, with physiological development of the mandibular-facial area and without diseases able to effect the condition of the osseous tissue in anamnesis. The group of the research included children from preschool institutions in Lviv undergoing dental preventive examinations at the Department of Infant Dentistry at Danylo Halytsky National Medical University. The children under study were distributed into 5 age groups – under 6 months, under 1 year, under 2 years, under 4 years and under 6 years, 7 fragments in every group. Radiovideographic examination was carried out on the device for dental radiovideography of Siemens firm with Trophy Radiology software. The density of the osseous tissue was detected in the standard units of dullness (SUD).

Results and discussion. Age dynamics of sodium, manganese, barium, strontium and magnesium in the content of the mandibular cellular process osseous tissue in children of different sexes is similar (Tables 1, 2). Sodium content in the examined children decreases sharply to 1 year as compared to 6-month children, it increases gradually to the age of 4, and decreases inconsiderably to the age of 6. Manganese content in the osseous tissue of children of both genders increases gradually to the age of 4 and decreases during the following two years. Barium content decreases to the age of 2, increases in 4-year-old children and decreases in 6-year-old ones, strontium content increases to the age of 1 year, decreases in 2-year-old children and increase gradually to 6 years, and manganese content decreases to 1 year and increase gradually to the age of 6.

In the examined samples the age dynamics of calcium, phosphorus, iron and copper possesses gender peculiarities (Tables 1, 2). In boys the amount of calcium in the osseous tissue increases to the age of 4 and decreases inconsiderably in 6-year old children. In girls calcium content in the osseous tissue increase to the age of 1 year, decrease inconsiderably at the age of 2, increase again to the age of 4, and decreases inconsiderably at the age of 6. Phosphorus content decreases till the age of 1 year in girls, and till the age of 2 years in boys. During the following age periods it increases twice in 6-year-old

Table 1.

The content of mineral elements in the mandibular osseous tissue of school age girls

Age	Ca	Na	Mg	P	Sr	Fe	Cu	Mn	Ba
6 months	29428,57± 10473,16	11642,86± 4912,15	7957,14± 815,16	1585,71± 488,79	27,86 ±5,49	99,86± 20,33	1,29±0,59	16,86±4,77	91,43± 19,83
1 year	36000,00± 6817,34	7014,29±3 042,38	8228,57± 1263,19	1292,86± 463,13	29,57 ±7,72	51,71±5,39	1,03±0,57	13,86±4,06	68,00± 22,67
2 years	35857,14± 3448,16	10085,71± 992,76	8514,29± 1238,61	1264,29± 458,11	27,14 ±8,85	60,43± 15,74	1,60±0,37	14,00±3,75	48,29± 16,46
4 years	40142,86± 2560,82	12100,00± 1370,44	12928,57± 1454,53	2192,86± 534,71	62,14 ±15,64	70,29± 13,12	1,57±0,34	16,14±2,78	98,14± 28,49
6 years	39285,71± 3257,64	10785,71± 1702,34	10114,29± 977,29	3642,86± 560,37	62,29 ±8,83	63,86±6,96	1,51±0,42	19,00±4,39	78,71± 9,17

p ≤ 0,05

Table 2.

The content of mineral elements in the mandibular osseous tissue of school age boys

Age	Ca	Na	Mg	P	Sr	Fe	Cu	Mn	Ba
6 months	28642,86± 8391,36	12142,86± 2634,16	8028,57± 872,56	1514,29± 384,04	28,14±5,21	99,29±9,23	1,60±0,43	17,00±2,39	88,86± 14,87
1 year	35142,86± 6581,77	7185,71± 2164,84	8285,71± 738,63	1227,14± 370,73	30,57±5,22	49,43±5,55	0,91±0,42	12,43±3,38	59,43± 19,21
2 years	35571,43± 1844,28	9821,43± 130,67	8571,43± 635,03	1297,14± 261,20	27,14±3,94	60,14± 10,60	1,67±0,14	14,00±2,35	45,14±8,69
4 years	39857,14± 3583,79	12100,00± 1015,12	13457,14± 1153,76	2085,71± 353,02	62,57± 11,51	71,57±7,04	1,57±0,25	16,43±1,99	95,86± 13,69
6 years	37571,43± 3881,76	10914,29± 1159,17	11135,71± 575,17	3500,00± 400,00	65,14±9,29	71,57± 10,86	1,89±0,47	19,57±4,04	81,00±7,22

p ≤ 0,05

children than that in the 6-month ones.

Iron content decreases in children of the second age group and increases till the age of 6 in boys, and in girls it increase till the age of 4 and then decrease till the age of 6.

Copper content decrease in 1-year-old children, it increases to the age of 2 and decrease till the age of 6 in girls, and in boys it decreases to the age of 4, and again increases in 6-year-old children.

Conducted radiovideographic examination enabled to detect the density of the mandibular osseous tissue in boys and girls of different age groups on the level of the main part of the mandibular body and the cellular part in the central and lateral areas (Tables 3, 4).

The density of the main part of the mandibular body was found to increase till the age of 1 year, and it decreases gradually during the following age periods. The dynamics of the mandibular cellular process osseous tissue is different. In the central part the examined index is minimal at the age of 6 months, it increases gradually till the age

of 2 years achieving its maximal value and decreases to the age of 6 years. In the lateral area of the mandibular cellular part in girls the density of the osseous tissue decreases to minimal values at the age of 1 year and increases gradually in the following age periods, reaching to the maximal value at the age of 6 (Table 3).

In boys the density of the main part of the mandibular body increase to maximum at the age of 1 year, decrease till the age of 4, and increase again at the age of 6 years (Table 4).

In the central part of the mandibular cellular part the examined index is the lowest at the age of 6 months, it increase till the age of 2, decrease inconsiderably at the age of 4 and increase to maximum at the age of 6 years. In the lateral part of the mandibular cellular part the density of the osseous tissue decrease to minimum at the age of 1 year with further its increase to maximum at the age of 6 years (Table 4).

The final stage of our study was comparison of the age dynamics of the mandibular body osseous tissue density and the content of the examined

Table 3.

Age dynamics of the osseous tissue density in various areas of the lower jaw in girls (SUD) (M±m).

Age	The main part	Cellular part	
		Central part	Lateral part
6 months	198,50 ± 12,57	167,50 ± 23,44	175,00 ± 20,00
1 year	200,71 ± 16,54	175,00 ± 26,28	156,43 ± 19,36
2 years	197,86 ± 6,85	194,29 ± 10,56	172,14 ± 9,22
4 years	197,14 ± 9,22	193,57 ± 10,40	175,00 ± 9,26
6 years	190,00 ± 16,18	189,29 ± 8,00	204,29 ± 7,38

p ≤ 0,05

Table 4

Age dynamics of the osseous tissue density in various areas of the lower jaw in boys (SUD) (M±m).

Age	The main part	Cellular part	
		Central part	Lateral part
6 months	194,29±14,55	166,71±23,04	180,00±16,33
1 year	200,71±16,54	177,86±20,91	162,14±15,10
2 years	190,71±9,86	192,86±8,12	173,57±8,92
4 years	167,29±50,80	191,43±10,63	173,57±12,86
6 years	189,29±11,00	194,29±10,10	210,00±8,73

p ≤ 0,05

mineral elements in it in children of different genders. The results of the conducted comparison were indicative of the poor correlation relations available between the density of the lateral part of the mandibular cellular part and manganese content in it in children of both genders, density of the central part of the mandibular cellular part and its manganese content in girls, density of the main part of the mandible and its manganese content in girls and sodium in boys. Correlation relations between the density of the osseous tissue and the content of other examined elements in it were not found.

Conclusions.

1. The osseous tissue of school age children contains calcium, phosphorus, magnesium, sodium, iron, strontium, manganese and barium in the amounts adequate for measuring.

2. Age dynamics of sodium, magnesium, barium, strontium and manganese in the content of the mandibular cellular process osseous tissue in children of different sexes is similar, and age dynamics of calcium, phosphorus, iron and copper has certain gender peculiarities.

3. The density of the mandibular cellular process osseous tissue in school age children is different in different areas (the main part, lateral and central parts of the cellular part) and possesses gender peculiarities of age dynamics.

4. Poor correlation relations are found between the osseous tissue density of the lateral part of the mandibular cellular process osseous tissue and manganese in children of both genders, density of the central part of the mandibular cellular process osseous tissue and the content of manganese in it in girls, density of the main part of the mandible and manganese content in it in girls and sodium in boys. Correlation relations between the density of the osseous tissue and the content of other examined elements in it were not found.

Prospects of further studies. The results of comparison of the standard indices of the content and age dynamics of certain mineral elements and the indices of the osseous tissue density in children of different age groups will enable to find correlation relations between the examined indices, predict the development and course of pathological processes associated with the osseous tissue of the jaws, carry out their early diagnostics, prevention and effective correction.

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