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EVALUATING OPTICAL DENSITY OF ALVEOLAR BONE IN PATIENTS WITH DIABETES MELLITUS USING CONE-BEAM COMPUTED TOMOGRAPHY

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ABSTRACT — The study involved an analysis of optical density of the maxillary and mandibular bone tissue based on cone-beam computed tomography data. It has been shown that the structure and bone tissue density depend on the severity of diabetes mellitus and complications. The results of the study revealed a significant decrease in the bone tissue optical density at the tooth necks in people suffering from diabetes mellitus, whereas fewer changes were manifested at the middle third of the dental roots. Minor changes or even an increase in the optical density were observed at the dental root tips.

KEYWORDS — diabetes mellitus, dental computed tomography, alveolar bone tissue, optical density.

INTRODUCTION

The past decade has witnessed an increase in the number of diabetic patients in Russia by more than 1 million people, yet the true prevalence of the disease is 2–3 times as high [1].

Diabetes mellitus is a metabolic disease entailing a high level of complications [2–8]. The literature claims [9–11] that violated connections of protein and mineral components, as well as deteriorated trophic tissues in case of diabetes mellitus lead to delayed remodeling of bone tissue, which is the factor determining its density. Diabetic arthropathies represent a fairly common complication of diabetes mellitus and affect, as has been described in a number of publications, 58% of patients with Type I diabetes and 24% of patients with Type II diabetes [12]. The endocrine system has a complex effect on the musculoskeletal tissues structure and function, which suggests that either insufficient or excessive production of a particular hormone will lead, sooner or later, to pathological changes in bones, joints and muscles [13–15].

At the same time, apart from changes involving the quantitative features of bone tissue, it is important to investigate the qualitative parameters of bone, including in patients with diabetes mellitus. In particular, experiments on animals with insulin deficiency followed by a histomorphometric analysis of the obtained data indicate a decrease in the bone tissue development rate [16–18]. Besides, there was a decrease observed in the length of bone trabeculae, as well as in the periosteal and endocortical surfaces of the osteoid-covered cortical plate. At the same time, a decrease was observed in the number of osteoblasts, and a disturbance in their function, as well as an increase in the apoptosis rate [19–21].

Diabetes mellitus has been found to be a factor predisposing to the onset and progress of destructive periodontal diseases that lead to the loss of the dentogingival junction [25]. The current concept [24] holds it that in patients suffering from Type II diabetes mellitus, the primary role in the pathogenesis of inflammations affecting the alveolar part belongs to microangiopathies and acidosis due to high blood glucose content. Insulin insufficiency leads, on the one hand, to a decrease in the synthesis of collagen and alkaline phosphatase by osteoblasts, while the produced substances are involved in the development and mineralization of the intercellular matrix, and, on the other, to disturbances in the calcium absorption by the small intestine microvilli and its increased excretion from the body with urine. Hypocalcemia, in turn, stimulates the synthesis of parathyroid hormone, which results in thinning of the compact layer and in the bone tissue resorption.

Therefore, diabetes mellitus is accompanied with disturbed metabolic processes in the bone, disrupted functioning of its cellular elements and organic structure, which leads to violated biomechanical properties and, consequently, a greater risk of fractures. The potentially involved mechanisms that at least offer a partial explanation to the causes behind bone deterioration in case of diabetes, include hyperglycemia and microangiopathy. Bone tissue fragility is an effect of insufficient exposure to insulin, and not a complication of diabetes mellitus [23]. This means that the mechanisms underlying the developing bone fragility are the same for both types of diabetes. Besides, it has no direct relation to diabetes and can occur long before its clinical manifestations.

Jaws bone tissues differ little from the rest of the skeleton in terms of their chemical composition and structure. However, the alveolar bone has internal restructuring processes going on faster than in other bones of the skeleton. Normally, the height of the alveolar ridge is maintained by the physiological balance between bone formation and resorption, which is regulated not only with systemic, yet also with local factors [26–29].

In modern dentistry, X-ray diagnostics methods make up an integral part of a comprehensive medical examination. Computed tomography (CT) is a relatively new method used to study the chewing system that allows obtaining high-resolution 3D images. Compared to 2D X-rays, 3D digital computed tomography can improve significantly diagnostics quality, including differential diagnostics, as well as reduce the risk of errors. All this is due to a higher resolution of the images obtained, as well as to the option, which allows a layer-by-layer examination on the computer screen [14, 22, 30].

Aim

The aim of this study was to identify optical density of the bone tissue in the alveolar parts of the upper and lower jaw in patients with diabetes mellitus using cone-beam computed tomography.

CLINICAL POOL AND STUDY METHODS

The comprehensive study involved 94 patients aged 31–75 (the median age being 53±5, with no gender factor taken into consideration), who were divided into 2 groups. Group 1 included 44 patients with diabetes mellitus (6 patients with Type I diabetes and 38 patients — with Type II diabetes), while Group 2 included 50 patients with no endocrine pathology. A clinical dental examination performed in order to carry out additional diagnostics, prior to orthopedic or surgical treatment, all patients were to undergo a cone-beam computed tomography examination.

The inclusion criteria employed through the study were: age — 18 and above; Type I or Type II diabetes mellitus in the history; lack of dentition issues or the presence of some small (1 to 3 teeth missing) and medium (4 to 6 teeth missing) defects through the dentition length. The inclusion criteria were: endocrine pathology accompanying diabetes mellitus; chronic diseases in the decompensation stage; oncological issues, as well as the following dental diseases identified: pathological tooth abrasion; large dentition defects, periodontitis. The exclusion criterion implied the patient's refusal to undergo the respective examinations.

The examination was performed on a Gendex-GXCB-500 cone-beam computed tomograph using the Icat Vision software. The optical density on the tomograms was estimated using a density window with a side of 3 mm. The measurements within the groups were carried out in the interdental septa of the teeth present in both jaws at the levels of their roots' mid- and top points, as well as the alveoli upper edges. Each of the measurements was performed three times. The average density value was calculated automatically by the software. The optical density was expressed in Hounsfield units (HU). The central trend and data dispersion were calculated with descriptive statistics methods. The quantitative parameters, depending on the distribution type, were presented as the mean value (M) and the mean square deviation (SD), or, when performing the assessment with nonparametric statistics, as the median (Xmed) and the interquartile QR range within the (LQ 25%÷UQ75%) range.

The analysis of the correspondence between the feature distribution type and the law of normal distribution was performed using the Shapiro-Wilk test. The critical level of difference significance when testing the statistical hypotheses was set at $p<0.05$. The nonparametric Mann-Whitney method was employed to analyze the differences between the subgroups identified subject to qualitative clinical and diagnostic features, with the Bonferroni correction factor used to estimate the Student's test values. The statistical processing of the obtained data was carried out using the Statistica 10 software.

STUDY OUTCOMES

As shown in Figures 1–6, the most significant changes affecting bone density could be seen at the tooth necks of the upper and lower jaws. Changes in bone density at the central part of the dental roots were less significant. Patients with this pathology featured an increase in the bone density at the tops of a number of dental roots.

A comparative analysis of the studied values revealed significant differences in the Gauss density in the group of patients, suffering from diabetes mellitus, due to a decrease in the bone tissue optical density, especially in the lower jaw (Tables 1–3).

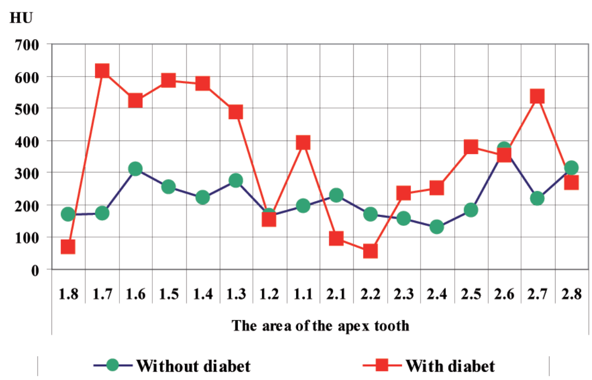

Fig. 1. Comparative characteristics of the maxillary bone tissue optical density by the Gauss density value at the tooth apices

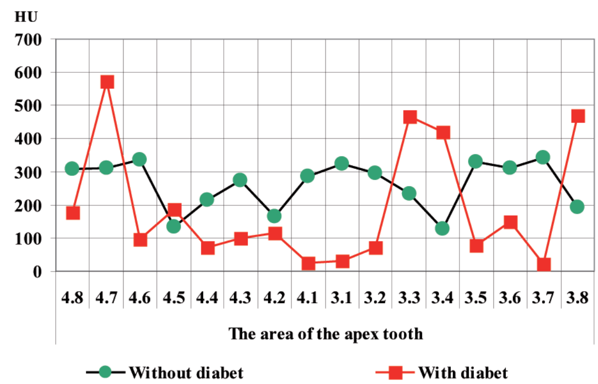

Fig. 2. Comparative characteristics of the mandibular bone tissue optical density by the Gauss den-sity value at the tooth apices

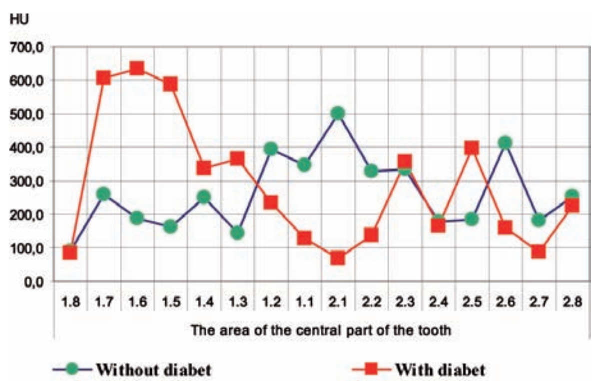

Fig. 3. Comparative characteristics of the maxillary bone tissue optical density by the Gauss density value at the central part of the dental roots

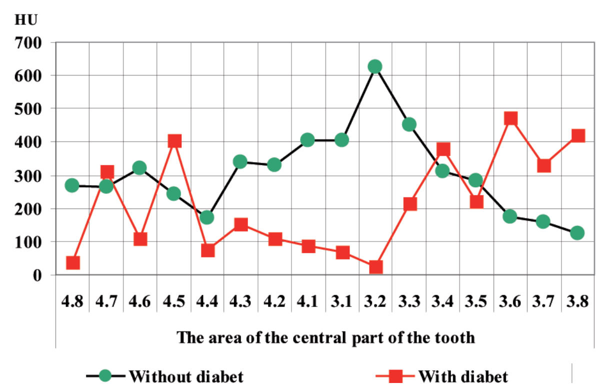

Fig. 4. Comparative characteristics of the mandibular bone tissue optical density by the Gauss density value at the central part of the dental roots

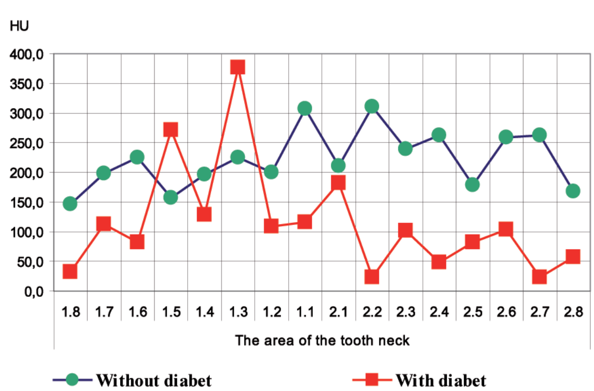

Fig. 5. Comparative characteristics of the maxillary bone tissue optical density by the Gauss density value at the tooth necks

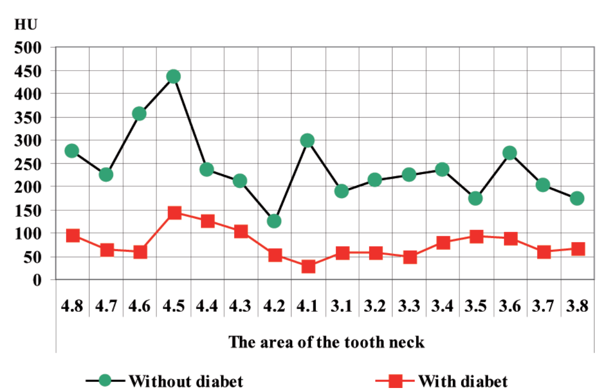

Fig. 6. Comparative characteristics of the mandibular bone tissue optical density by the Gauss density value at the tooth necks

A comparative analysis of optical density parametric data in the mandibular bone tissue in patients of the main and control groups revealed differences ($P<0.05$) at the dental root apices: 3.1, 4.1, 4.3, 4.4, 4.6 4.8; at the central part of the dental roots: 3.4, 3.3, 3.2, 3.1, 4.1, 4.2, 4.3, 4.4, 4.6; and almost at all the tooth necks, except tooth 3.8 (Table 4–6).

A nonparametric analysis helped reveal a range of differences in view of the median and the interquartile

Table 1. Bone tissue optical density parametric data at the apices of the maxillary dental roots, HU

Tooth no.	M±SD	m	M±SD	m	t	P
Patients without diabetes			Patients with diabetes			
1.8	235,2±107,3	87,4	166,7±47,7	32,9	1,626	0,0492
1.7	193,1±124,6	103,2	479,3±362,1	286,1	-3,807	0,0000
1.6	284,0±163,8	140,7	418,7±320,1	250,8	-1,517	0,0223
1.5	302,0±158,6	134,3	566,7±294,9	232,1	-3,426	0,0184
1.4	252,1±138,5	116,1	449,4±348,9	299,9	-2,427	0,0007
1.3	255,3±143,1	124,2	395,6±345,3	288,1	-2,067	0,0001
1.2	187,3±127,3	102,1	238,3±249,0	152,0	-0,932	0,0027
1.1	218,5±133,0	108,5	291,3±283,5	221,8	-1,230	0,0006
2.1	227,1±146,2	124,7	196,6±195,9	137,1	0,540	0,2075
2.2	239,9±191,5	145,7	151,2±75,8	51,4	1,357	0,0095
2.3	270,9±120,8	98,9	306,3±161,8	129,1	-0,850	0,1638
2.4	194,1±104,2	85,1	305,7±170,6	131,0	-2,517	0,0397
2.5	260,6±111,1	87,1	378,1±290,6	208,7	-1,926	0,0001
2.6	358,2±229,9	196,2	411,8±269,1	200,3	-0,580	0,4961
2.7	223,7±127,2	101,3	307,9±258,0	210,7	-1,320	0,0066
2.8	238,9±181,0	148,7	292,5±144,5	129,8	-0,653	0,6504

***Note:** Values at P <0.05 are italicized*

Table 2. Bone tissue optical density parametric data at the central part of the maxillary dental roots, HU

Tooth no.	M±SD	m	M±SD	m	t	P
Patients without diabetes			Patients with diabetes			
1.8	237,0±95,1	68,8	133,6±40,4	30,8	2,781	0,0411
1.7	308,6±171,5	134,2	333,7±361,1	289,2	-0,281	0,0058
1.6	434,1±247,0	156,5	329,3±339,4	295,0	0,851	0,2688
1.5	302,8±106,9	87,2	506,6±282,3	228,4	-3,315	0,0002
1.4	447,4±184,1	148,3	364,8±211,3	163,5	0,987	0,5651
1.3	327,7±124,0	95,2	309,3±291,9	229,0	0,317	0,0001
1.2	434,0±222,2	189,0	189,5±193,5	145,8	3,203	0,6912
1.1	363,0±244,2	200,1	210,7±298,3	217,1	1,709	0,3630
2.1	473,6±256,1	227,1	181,1±329,1	193,5	2,982	0,2760
2.2	385,5±210,5	172,9	174,4±106,8	89,1	2,912	0,0480
2.3	475,4±265,8	188,7	314,0±242,2	209,5	2,029	0,4072
2.4	354,5±133,7	103,1	237,9±179,5	137,3	2,228	0,2124
2.5	470,4±224,4	193,8	304,0±244,2	195,8	0,649	0,1660
2.6	254,8±115,9	96,4	227,4±195,3	135,2	2,834	0,7479
2.7	304,5±170,4	143,9	132,4±54,8	44,8	2,712	0,0669
2.8	237,0±95,1	68,8	264,0±223,7	172,4	0,437	0,3879

***Note:** Values at P <0.05 are italicized*

range (QR). Table 7 contains data describing the differences in the upper jaw, while the respective data for the lower jaw are presented in Table 8.

The obtained data point at significant changes affecting the optical density of bone tissue in patients with diabetes mellitus versus the control group due

Table 3. *Bone tissue optical density parametric data at the maxillary tooth necks, HU*

Tooth no.	M±SD	m	M±SD	m	t	P
Patients without diabetes			Patients with diabetes			
1.8	318,5±132,9	89,5	66,9±33,5	23,8	5,244	0,0010
1.7	349,7±177,2	140,8	129,7±72,0	56,8	2,978	0,0490
1.6	400,2±281,6	200,3	176,2±144,1	101,8	1,733	0,1989
1.5	315,3±106,7	85,2	250,3±149,2	125,1	1,370	0,2010
1.4	433,5±184,1	143,3	145,2±67,6	53,4	3,753	0,0339
1.3	350,5±144,2	121,5	174,9±179,4	154,3	3,323	0,3250
1.2	391,5±163,7	131,7	156,0±166,3	98,2	4,077	0,8640
1.1	435,8±220,7	174,9	148,5±152,3	92,2	3,896	0,2350
2.1	430,6±235,4	134,7	130,9±107,1	93,0	5,472	0,4783
2.2	486,7±197,9	172,0	98,3±79,5	53,6	5,748	0,0105
2.3	426,4±463,7	245,7	129,4±118,5	85,5	3,655	0,0260
2.4	488,7±333,3	192,7	115,5±76,0	49,6	5,228	0,0077
2.5	389,5±236,8	146,7	173,8±174,9	111,9	3,018	0,5800
2.6	423,3±165,3	134,1	144,7±109,2	80,1	4,780	0,2184
2.7	281,2±195,6	153,8	101,0±59,6	37,3	2,217	0,0144
2.8	345,1±126,9	96,9	93,3±41,6	29,2	5,081	0,0113

Note: *Values at P <0.05 are italicized*

Table 4. *Bone tissue optical density parametric data at the apices of the mandibular dental roots, HU*

Tooth no.	M±SD	m	M±SD	m	t	P
Patients without diabetes			Patients with diabetes			
3.1	267,7±166,9	138,4	92,3±60,1	40,3	3,088	0,003312
3.2	253,3±195,4	149,4	125,2±90,1	71,4	1,914	0,061267
3.3	265,2±151,2	121,0	285,5±308,0	251,6	-0,317	0,752303
3.4	231,1±128,6	96,0	288,7±255,2	199,8	-1,030	0,307934
3.5	268,9±181,4	154,0	426,4±144,7	96,7	-1,855	0,071230
3.6	265,4±164,7	138,3	264,3±291,9	185,9	0,012	0,990407
3.7	277,1±190,3	163,5	130,8±68,8	45,4	1,681	0,102474
3.8	235,2±151,4	120,2	395,6±305,9	249,7	-1,730	0,096501
4.8	385,0±171,8	146,9	127,7±115,8	93,0	3,482	0,001461
4.7	304,6±198,0	168,3	501,2±371,6	293,8	-1,788	0,083267
4.6	474,9±217,5	180,5	139,7±142,7	98,9	3,526	0,001728
4.5	215,7±94,4	75,0	289,3±166,8	130,1	-1,566	0,125471
4.4	283,4±129,6	109,9	123,0±64,5	46,2	3,778	0,000428
4.3	340,3±187,5	152,9	165,6±176,5	113,9	2,888	0,005603
4.2	181,4±113,4	89,3	115,4±70,3	57,6	1,672	0,100668
4.1	262,7±160,4	131,3	82,3±58,3	42,5	3,304	0,001785

Note: *Values at P <0.05 are italicized*

to the results of both parametric and nonparametric analysis.

RESULTS AND DISCUSSION

The analysis of the bone tissue optical density results in patients with diabetes mellitus, when com-

Table 5. Bone tissue optical density parametric data at the central part of the mandibular dental roots, HU

Tooth no.	M±SD	m	M±SD	m	t	P
Patients without diabetes			Patients with diabetes			
3.1	487,7±274,1	221,1	135,9±82,0	59,4	3,787	0,000417
3.2	453,1±321,6	285,2	101,7±49,3	33,3	3,246	0,002090
3.3	472,9±237,2	202,0	207,0±256,6	170,9	3,282	0,001808
3.4	412,7±209,5	178,2	212,7±214,9	178,0	2,700	0,009430
3.5	346,0±203,9	164,9	195,2±202,4	160,6	1,551	0,129072
3.6	330,3±135,2	95,6	323,6±241,6	211,5	0,093	0,926849
3.7	351,2±157,3	123,7	302,5±329,3	250,0	0,398	0,692992
3.8	249,8±102,3	79,5	348,5±307,5	258,2	-1,292	0,208338
4.8	422,6±187,3	156,0	238,4±203,7	139,0	2,002	0,049020
4.7	383,1±182,5	137,6	365,2±308,8	224,2	0,183	0,856131
4.6	414,3±222,5	164,6	100,5±64,8	52,8	3,368	0,002551
4.5	347,2±201,0	149,7	314,8±272,6	219,5	0,346	0,731023
4.4	434,8±169,7	132,3	111,7±81,9	55,4	5,823	0,000000
4.3	484,4±266,2	192,2	161,0±172,0	117,0	3,970	0,000218
4.2	396,9±231,3	176,2	114,6±83,3	62,0	3,590	0,000742
4.1	472,0±307,2	243,9	98,3±56,9	51,3	3,608	0,000722

***Note:** Values at P <0.05 are italicized.*

Table 6. Bone tissue optical density parametric data at the mandibular tooth necks, HU

Tooth no.	M±SD	m	M±SD	m	t	P
Patients without diabetes			Patients with diabetes			
3.1	344,1±178,8	119,2	86,2±42,9	34,3	4,268	0,000090
3.2	349,3±202,3	139,3	94,7±54,2	43,3	3,723	0,000492
3.3	360,5±186,1	149,7	98,1±62,2	44,7	4,587	0,000027
3.4	314,5±173,0	135,5	141,9±208,1	120,0	2,728	0,008760
3.5	357,7±168,5	124,4	139,8±95,0	72,6	2,809	0,007734
3.6	348,4±166,8	143,0	153,9±58,7	44,7	2,992	0,006002
3.7	337,4±160,2	132,9	144,0±84,0	59,7	2,853	0,007418
3.8	239,6±109,3	85,5	154,0±142,8	94,0	1,583	0,125902
4.8	355,4±180,8	147,9	91,7±50,5	41,0	3,506	0,001372
4.7	369,4±254,6	166,9	111,4±87,3	61,7	2,217	0,034075
4.6	435,0±226,4	189,3	96,9±45,4	37,6	3,876	0,000681
4.5	496,7±248,8	202,8	155,0±88,6	76,0	3,014	0,004569
4.4	469,9±425,6	228,1	115,5±88,4	70,5	2,601	0,012269
4.3	489,6±439,4	222,9	116,8±69,2	59,7	2,910	0,005275
4.2	298,3±147,5	105,3	77,7±37,0	32,1	4,428	0,000050
4.1	441,6±213,9	165,3	76,6±43,4	32,0	5,058	0,000006

***Note:** Values at P <0.05 are italicized.*

pared to the control group, showed that the most significant changes can be observed at tooth necks. Less significant changes were observed at the middle third of the dental roots. Minor changes or even an increase in the bone optical density were to be seen at the dental root apices. This data is comparable with the data

Table 7. Characteristics of bone tissue optical density nonparametric data for the upper jaw, HU

Tooth no.	Xmed	by QR	Xmed	by QR
Patients without diabetes			Patients with diabetes	
In the area of the apex of the teeth				
1.8	268,0	130,5÷302,0	168,0	141,0÷211,0
1.7	143,0	90,0÷263,0	432,4	187,0÷802,0
1.6	266,0	124,0÷436,0	419,0	117,3÷641,0
1.5	291,0	167,0÷421,0	595,0	314,0÷901,0
1.4	224,0	145,0÷366,0	402,5	123,5÷698,0
1.3	222,5	118,5÷392,0	208,5	152,0÷640,0
1.2	155,0	100,0÷267,0	166,0	98,0÷253,0
1.1	243,5	86,5÷283,0	169,5	83,0÷475,0
2.2	165,5	115,0÷285,5	148,0	115,0÷172,0
2.4	167,5	127,0÷257,5	324,0	155,0÷407,0
2.5	257,0	173,0÷356,5	245,0	128,5÷507,5
2.7	209,0	109,0÷329,0	184,0	81,0÷617,0
In the area of the central part of the roots of the teeth				
1.8	229,0	177,0÷266,5	142,0	88,0÷172,0
1.7	260,5	152,0÷412,0	190,0	47,0÷654,0
1.5	316,0	222,0÷385,0	498,0	238,0÷824,0
1.3	301,0	264,0÷407,5	206,0	77,0÷444,0
2.2	365,5	213,0÷541,0	198,0	86,0÷223,0
In the area of the necks of the teeth				
1.8	299,0	234,0÷380,0	64,0	45,0÷77,0
1.7	308,5	245,0÷444,0	147,0	66,0÷179,0
1.4	421,0	329,0÷526,0	157,5	76,0÷205,0
2.2	504,0	321,0÷631,0	72,0	56,0÷79,0
2.3	293,0	221,0÷461,0	83,0	50,0÷151,0
2.4	461,0	326,0÷589,0	95,0	71,0÷120,0
2.7	229,0	98,0÷361,0	92,5	84,0÷108,0
2.8	309,0	278,0÷445,0	93,0	63,0÷120,0

available in the respective Russian literature (Bondarenko N. N., Balakhontseva E. V., 2012, Nikolayuk V. I., Kabanova A. A., Karpenko E. A., 2015, Chuev V. P. et al., 2017, Khaibullina R. R. et al., 2018).

The upper bone density in the jaw of patients with diabetes mellitus ranged from 151.2 ±75.8 to 566.7±294.9 Hu at the tooth apices; from 132.4±54.8 to 506.6±282.3 Hu — at the central part of the roots, while at the tooth necks it ranged from 66.9±33.5 to 250.3±149.2 Hu. As for the lower jaw bone density, it ranged from 82.3±58.3 Hu to 501.2±371.6 Hu.in at the tooth apices; from 98.3±56.9 Hu to 365.2±308.8 Hu — at the central part of the roots, and from 76.6±43.4 HU to 155.0±88.6 Hu at the tooth necks.

Thus, there is a direct relationship to be seen between changes affecting bone density at the tooth necks, especially in the molars and incisors, which is explained by deteriorating periodontal trophism, inflammatory issues and a slowdown in bone remodeling. Changes affecting the area at the tooth apices are less significant. The area at the lateral group of teeth featured an inverse relationship, and here the bone density in individuals with diabetes exceeded that in the control group, which can be explained by the effect of reparative processes and the nature of blood supply in this area.

CONCLUSION

1. The bone tissue status of the upper and lower jaw alveolar parts, as could be seen from cone-beam

Table 8. Characteristics of bone tissue optical density nonparametric data for the lower jaw, HU

Tooth no.	Xmed	by QR	Xmed	by QR
Patients without diabetes			Patients with diabetes	
	In the area of the apex of the teeth			
3.1	288,5	73,0÷397,0	81,0	56,0÷86,0
4.8	417,5	214,0÷522,5	89,0	34,0÷211,0
4.6	489,0	314,5÷652,0	82,5	62,0÷157,0
4.4	296,0	163,0÷379,0	97,5	84,0÷156,0
4.3	348,0	212,0÷487,0	112,5	62,0÷160,5
4.1	290,5	75,0÷362,0	66,0	47,0÷72,0
In the area of the central part of the roots of the teeth				
3.1	516,0	264,0÷667,0	127,0	91,0÷161,0
3.2	470,0	134,0÷758,0	96,0	85,0÷109,0
3.3	475,0	248,0÷700,0	89,0	78,0÷292,0
3.4	445,0	236,0÷548,0	93,5	56,0÷436,0
4.6	397,5	239,0÷559,5	84,5	51,0÷161,0
4.4	431,0	329,0÷500,0	83,0	65,0÷140,0
4.3	477,5	294,0÷632,0	106,0	55,0÷207,0
4.2	422,0	167,5÷496,0	107,0	51,0÷161,0
4.1	455,5	254,0÷658,5	64,0	57,0÷146,0
In the area of the necks of the teeth				
3.1	337,5	231,0÷421,0	77,0	51,0÷108,0
3.2	332,0	224,0÷437,5	82,0	68,0÷126,0
3.3	320,0	231,0÷456,0	73,0	62,0÷110,0
3.4	258,0	189,0÷424,0	77,0	36,0÷115,0
3.5	339,0	246,0÷419,0	115,0	82,0÷176,0
3.6	296,0	241,0÷512,0	139,0	116,0÷205,0
3.7	314,0	241,0÷444,0	118,5	109,0÷170,0
4.8	295,5	225,0÷501,5	79,0	50,0÷145,0
4.7	301,0	225,0÷450,5	90,0	56,0÷225,0
4.6	418,5	233,5÷588,0	116,0	60,0÷120,0
4.5	459,0	322,0÷758,0	201,0	81,0÷225,0
4.4	366,0	256,0÷491,0	99,5	39,0÷166,0
4.3	428,0	314,0÷525,5	86,5	71,5÷176,0
4.2	266,0	193,0÷318,5	95,0	46,0÷100,0
4.1	450,0	314,0÷612,5	67,0	53,0÷82,0

computed tomography, showed a significant difference between the control group and the patients with diabetes. In case of diabetes, changes in the bone tissue optical density affected both the upper and the lower jaw, and were symmetrical in nature. Certain specific features identified on the right and on left halves may be explained by some peculiarities in chewing.

2. Patients with diabetes had the most significant changes in the bone tissue at the tooth necks of the upper and lower jaw, while the changes implied a decrease in the optical density.

3. Changes in the bone tissue optical density at the apices as well as at the central part of the dental roots were less pronounced. A decrease in the bone optical density in the patients with diabetes mellitus could be observed at the anterior group of teeth, both in the upper and in the lower jaw. At the molars and premolars of the upper and lower jaws, in the central part of the roots as well as at the dental root apices, there was an increase in the bone optical density.

4. The study outcomes suggest that changes in optical density can be used as an evaluation criterion

for assessing the jaw bone tissue status in people with diabetes mellitus. It could be also viewed as an important sign of early detection and forecasting of the progression of periodontal tissue disease.

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