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Assessment of density and mandible bone structure in patients with generic osteoporosis symptoms

Opinions on coexistence of osteoporosis changes in main structure bones are not common: according to von Wowern et al. (17), changes in stomatognathic system bones show a low correlation with changes appearing in main structure bones. In contradistinction to the above, Kribbs et al. (13) pointed out a significant correlation between mandible bones weight and main structure bones weight both in patients with osteoporosis changes and in healthy persons. The opinion that patients with osteoporosis changes risk more frequent occurrence of paradontium diseases (16) resulting from the main structure bones changes, and more frequent loss of alveolar processus (1, 5) seem to be proven by research tests confirming total teeth loss in patients with osteoporosis changes (3). And on the other hand, the direct influence of osteoporosis changes on the metabolic processes of the mandible and jaw bones seems to be contradicted by research on implants osteointegration, which did not show significant changes in successful treatment both in healthy patients and generic osteoporosis changes (4). According to Klementi et al. (11) density and stomatognathic system bone structure are related in a greater degree to its functionality conditioned by muscular activity than to generic osteoporosis changes.

The goal of the research was to conduct the comparative examinations of mandible bone density and structure in healthy persons and in patients with diagnosed osteoporosis changes.

MATERIAL AND METHODS

The research was performed on the population of 130 patients with diagnosed osteoporosis changes, treated in osteoporosis outpatients' surgery of the Rural Medicine Institute and in a control group without osteoporosis changes including patients of the De-

partment of Dental and Maxillofacial Surgery of Medical University and in healthy patients.

Table 1. Quantity of the researched according to gender, age and diagnosed osteoporosis

		With osteoporosis					Without osteoporosis				
		age in years				total	age in years				total
		<21	21-40	41-60	>60		<21	21-40	41-60	>60	
Female	N	3	13	33	57	106	23	14	10	7	54
	%	100.0	81.25	80.49	81.43	81.54	54.76	48.28	41.67	46.67	49.09
Male	N	-	3	8	13	24	19	15	14	8	56
	%	-	18.75	19.51	18.57	18.46	45.24	51.72	58.33	53.33	50.91
Total	N	3	16	41	70	130	42	29	24	15	110
	%	2.31	12.31	31.54	53.84	100	38.18	26.36	21.82	13.64	100

Osteoporosis has been diagnosed upon clinical and radiological examination and in case of 82 patients it was confirmed by densitometric measurements of distal epiphysis of the forearm bone (dr Jabłoński and dr Gorzelak, Institute of Rural Medicine). In the control group osteoporosis was ruled out upon anamnesis and clinical examination.

Characteristics of the researched group and control groups considering gender and age is shown in Table 1. Density and structure of mandible bones were assessed upon an analysis of radiovisiographic pictures made by X-ray camera produced by Trophy company. Pictures were made in the area of premolar teeth on the left hand side using the right angle method (7) recorded by CCD sensor and digital image was saved as a file on the computer disk. Image analysis was performed using Radiograph Workshop program (disseration submitted for a degree of assistant professor) defining all three bone density coefficients (BMC, BMD and BD) and seven bone structure coefficients (STN, STV, STD, STL, STW, STH and STA)

Research results were analyzed using Statistica 5.1. Discrepancies of appraised coefficients were evaluated using test t for independent tests, assuming statistically significant values $p<0.05$, and correlation between selected coefficients were analyzed defining linear regression evaluated with the Pearson's test.

RESULTS

Average results of conducted densitometric tests in the control group and in patients with diagnosed osteoporosis changes, considering patients' gender are shown in Table 2, Figs 1-6. The radovisiographic densitometric analysis showed highly significant differences in bone mineral contents (BMC), bone mineral density (BMD) and relative mandi-

Table 2. Bone mineral content coefficient (BMC), bone mineral density (BMD) and mandible bones relative density (BD) in groups defined according to gender and diagnosed osteoporosis symptoms

	Coefficients densitometric	Group		Difference (p<)
		control	with osteoporosis	
Female	BMC	0.575 - 0.071	0.461 - 0.083	0.0001
	BMD g/cm^2	1.270 - 0.184	1.053 - 0.194	0.0001
	BD g/cm^3	1.553 - 0.195	1.262 - 0.229	0.0001
Male	BMC	0.610 - 0.086	0.462 - 0.053	0.0001
	BMD g/cm^2	1.372 - 0.211	1.121 - 0.171	0.0001
	BD g/cm^3	1.615 - 0.211	1.322 - 0.187	0.0001
Total	BMC	0.593 - 0.081	0.461 - 0.078	0.0001
	BMD g/cm^2	1.322 - 0.204	1.065 - 0.191	0.0001
	BD g/cm^3	1.585 - 0.205	1.273 - 0.222	0.0001
Significance of differences according to gender	BMC	p< 0.021	ns	
	BMD g/cm^2	p<0.008	ns	
	BD g/cm^3	ns	ns	

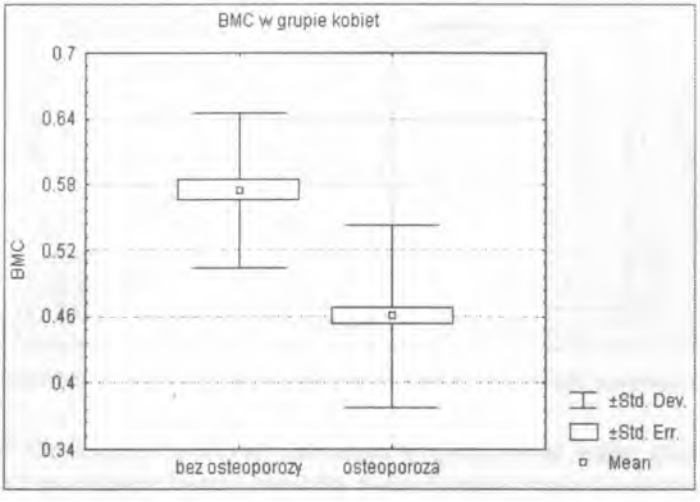

Fig. 1. Average coefficient BMC in females without and with osteoporosis

ble bone density (BD) between the group of patients with diagnosed osteoporosis and patients not burdened with this illness. The differences were discovered in the subgroup of female and male patients. In the control group average indexes of BMC and BMD

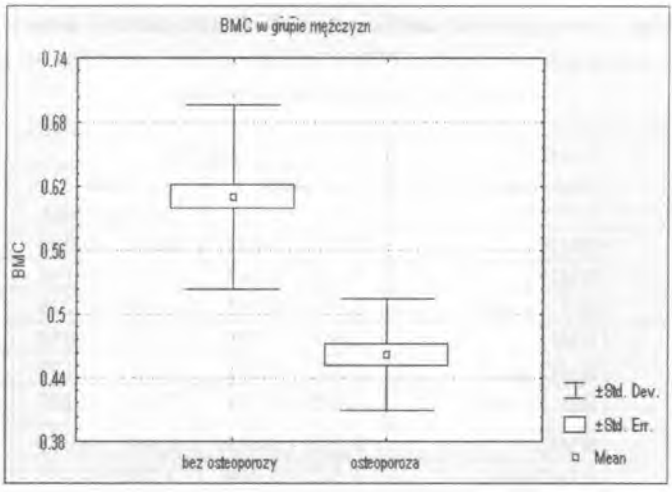

Fig. 2. Average coefficient BMC in males without and with osteoporosis

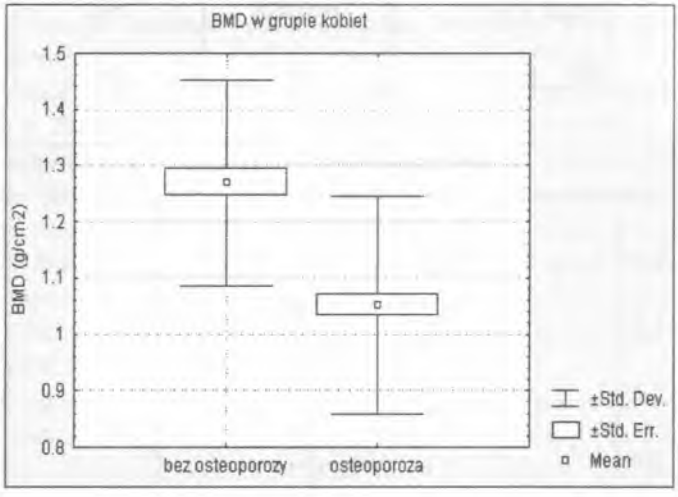

Fig. 3. Average coefficient BMD in females without and with osteoporosis

were significantly higher in the group of males than in that of females, but in the group of patients with osteoporosis gender related differences were insignificant.

The results of computerized analysis of radiovisiograms in accordance with mandible bone structure are showed in Table 3. An analysis of radiophysiographical coefficients of mandible bone structure proved that similarly as amongst females and males there are significant changes in patients with diagnosed osteoporosis and in patients withaut clinic and laboratory features of the disease. In the subgroup of the patients with osteoporosis

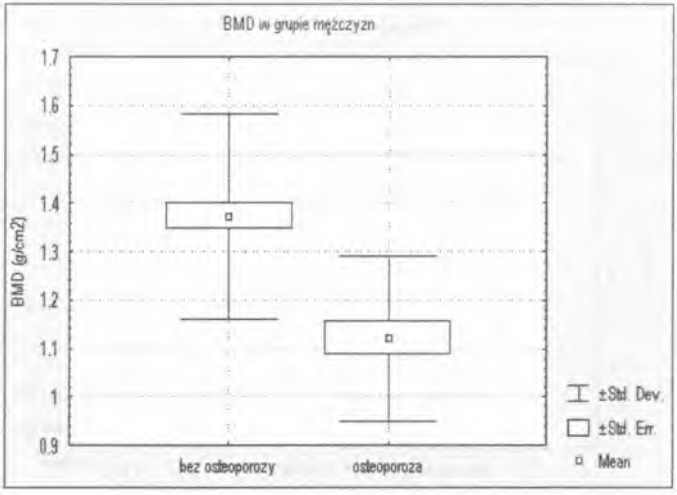

Fig. 4. Average coefficient BMD in males without and with osteoporosis

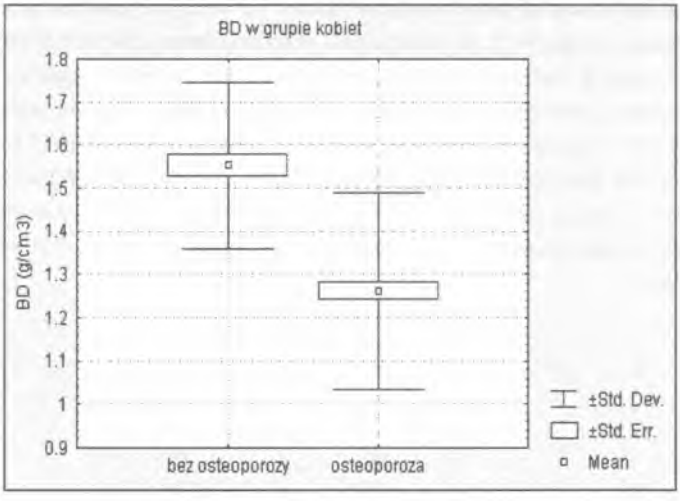

Fig. 5. Average coefficient BD in females without and with osteoporosis

there was observed significantly lower average standard. In the group of patients with diagnosed osteoporosis there was observed a significantly reduced average number of radiological trabeculae per square mm of structure analyzed area (STN), their structure density and structure trabeculare length per 1 mm of length of the analyzed line, however, significantly higher there appeared structure trabecular width shown on the radiovisiograph (STW). Discrepancies in structure trabecular volume proved slightly lower ($p< 0.05$), however there were no significant changes regarding standard trabecular height (STH) and coefficient of standard trabecular area.

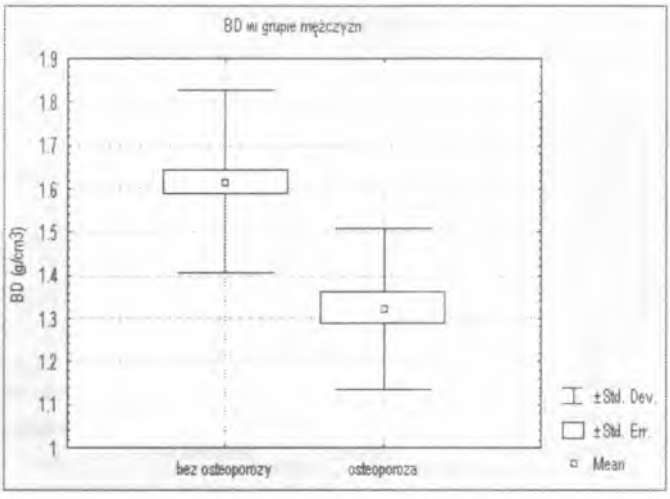

Fig. 6. Average coefficient BD in males without and with osteoporosis

Graphical definition of selected discrepancies between the control group and tested group are shown in Figs 7–12. In radiological mandible bone structure there were discovered gender related discrepancies. In contradistinction to male population with osteoporosis structure trabecular number per square mm (STN), structure trabecular density expressed in % of analyzed area and structure trabecular length (STL) proved to be lower than in sick females. However, structure trabecular width (STW) was proven to be higher in males than in females. In the group without osteoporosis the majority of the appraised coefficients proved to be higher in males than in females, but without statistical significance.

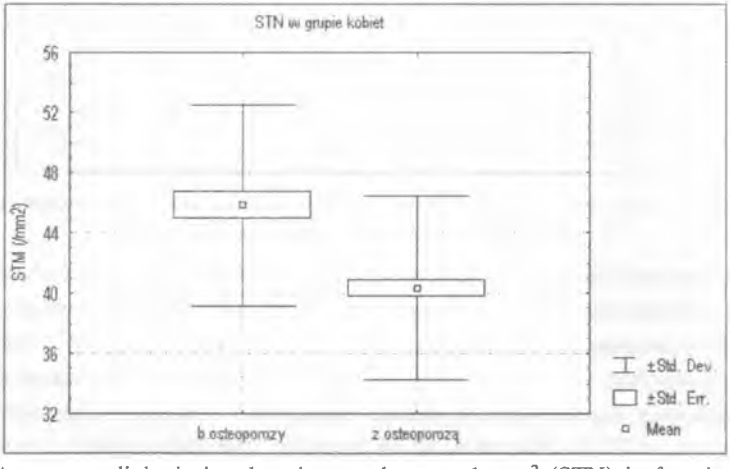

Fig. 7. Average radiological trabecular number per 1 mm^2 (STN) in female groups: control and with osteoporosis

Table 3. Coefficients of mandible bones structure: average number of trabeculae per 1 mm^2 (STN), trabecular volume (STV), density expressed in percentage of area (STD), trabecular number per 1 mm of line (STL), trabecular width in mm (STW), trabecular height (STH), trabecular area (STA) in groups defined according to gender and diagnosed osteoporosis symptoms

	Structure coefficients	Group		Difference (p<)
		control	with osteoporosis	
Female	STN (/mm^2)	45.84 - 6.68	40.31 - 6.10	0.0001
	STV (%)	1.91 - 0.66	1.84 - 0.62	ns
	STD (%)	42.43 - 2.77	40.05 - 3.27	0.0001
	STL (/mm)	1.91 - 0.34	1.71 - 0.28	0.0001
	STW (mm)	0.22 - 0.03	0.24 - 0.03	0.005
	STH (%)	5.97 - 1.83	5.92 - 1.67	ns
	STA	1.06 - 0.40	1.13 - 0.47	ns
Male	STN (/mm^2)	47.49 - 6.15	37.34 - 6.44	0.0001
	STV (%)	2.05 - 0.62	1.74 - 0.59	0.05
	STD (%)	43.22 - 2.56	37.63 - 4.60	0.0001
	STL (/mm)	1.95 - 0.27	1.53 - 0.23	0.0001
	STW (mm)	0.22 - 0.03	0.26 - 0.04	0.0001
	STH (%)	6.51 - 1.67	5.95 - 1.32	ns
	STA	1.13 - 0.39	1.18 - 0.35	ns
Total	STN (/mm^2)	46.68 - 6.44	39.77 - 6.25	0.0001
	STV (%)	1.98 - 0.64	1.82 - 0.62	0.05
	STD (%)	42.84 - 2.68	39.60 - 3.65	0.0001
	STL (/mm)	1.93 - 0.31	1.67 - 0.28	0.0001
	STW (mm)	0.22 - 0.03	0.24 - 0.03	0.0001
	STH (%)	6.25 - 1.77	5.93 - 1.61	ns
	STA	1.09 - 040	1.14 - 0.45	ns
Significance of differences according to gender	STN (/mm^2)	ns	0.05	
	STV (%)	ns	ns	
	STD (%)	ns	0.005	
	STL (/mm)	ns	0.005	
	STW (mm)	ns	0.05	
	STH (%)	ns	ns	
	STA	ns	ns	

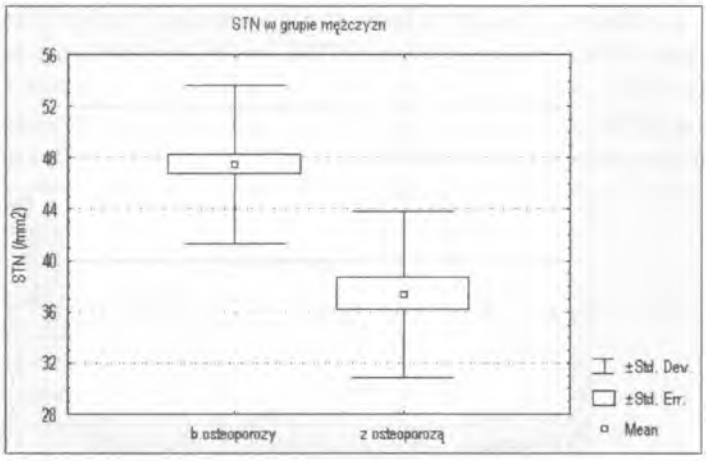

Fig. 8. Average radiological trabecular number per 1 mm^2 (STN) in male groups: control and with osteoporosis

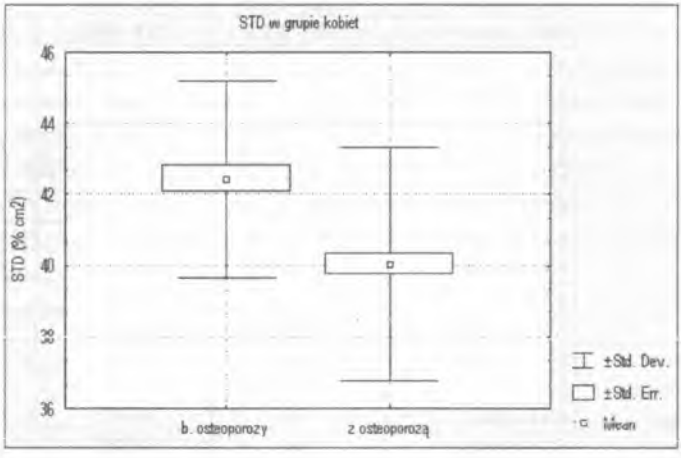

Fig. 9. Average radiological trabecular density expressed as percentage of area (STD) in female groups: control and with osteoporosis

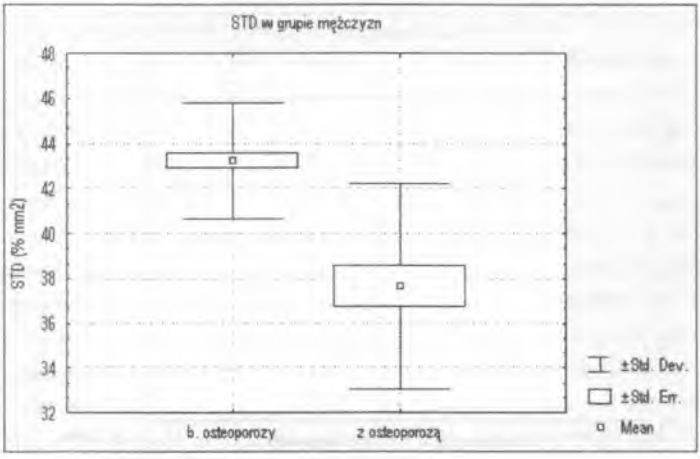

Fig. 10. Average radiological trabecular density expressed as percentage of area (STD) in male groups: control and with osteoporosis

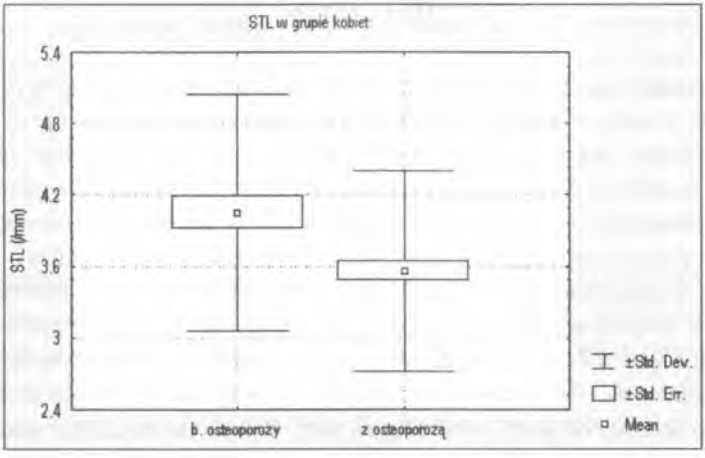

Fig. 11. Average radiological trabecular density per 1 mm of line (STL) in female groups: control and with osteoporosis

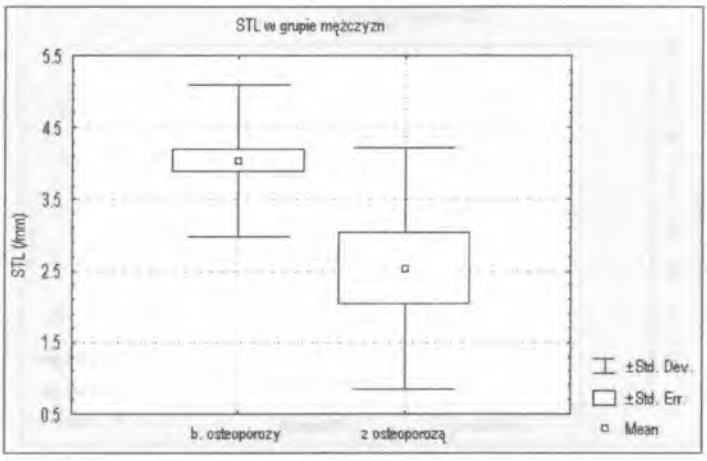

Fig. 12. Average radiological trabecular density per 1 mm of line (STL) in male groups: control and with osteoporosis

DISCUSSION

In the research on density and bone tissue structure in persons with osteoporosis, particularly in females in postmenopausal period it was proven that generic or local osteoporosis processes manifest quantitative radiological changes (2, 10). Quantitative changes are manifested later, accompanied by significant bone weight loss and reduction of mineral contents by at least 40% (2). Much earlier symptoms of osteoporosis are densitometry changes resulting from reduction of bone tissue mineral contents. As a result densitometry measurements are the basic method of early osteoporosis diagnostics (6, 14).

Significant interest is given to possible influence of osteoporosis on teeth status and stomatognathic system bone tissue structure. As it is proven by research by Krall et al. (12) and Wactawski-Wende et al. (18) generic osteoporotic changes are the conducive factor to the loss of teeth. According to von Wowern et al. (16) osteoporosis is the conducive factor in the development of paradontium disease, and both phenomena are related to concurrent changes in density and structure of mandibular and maxillary bones. The changes occurring in osteoporosis were confirmed by computerized analysis of pantomographic images (11) as well as absorptive densitometry method and quantitative computer tomography (9, 15). There are also pieces of information suggesting that reduced mandible bone mineral density can be the first symptom permitting diagnosis of generic osteoporosis (8).

In the presented research it was proven that the analysis of radiovisiographic images done by Radiograph Workshop Program shows in patients with osteoporosis significant reduction of bone mineral content, mineral density and relative mandible bone density coefficients.

In females with diagnosed osteoporosis average reduction in bone mineral contents coefficient (BMC) reached 19.8%, bone mineral density (BMD) 17.1%, relative bone density (BD) 18.7%. In male control group and in that with osteoporosis differences of densitometry coefficients are even greater, amounting respectively to: BMC 24.3%, BMD 18.3% and BD 18.1%. It is necessary to emphasize that reduction of densitometry coefficients is greater than the same changes but being age related.

Reduction in mandible bones density in patients with osteoporosis is accompanied by changes in bone structure. The analysis of radiovisiographic images with Radiograph Workshop proved significant reduction of structure trabecular number per square mm on average by 12.1%, structure trabecular density (STD) by 5.6% and average structure trabecular line per 1 mm of length (STL) by 10.5%. Greater by 9% has proven to be average structure trabecular width (STW). Similarly as in case of densitometric coefficients, significantly greater differences between the control group and the group with osteoporosis were shown in male population. Average structure trabecular number per square mm (STN) was lower in patients by 21.4%, their density (STD) by 12.9%, average structure trabecular line per 1 mm of the analyzed line (STL) by 21.5%, and average radiological structure trabecular width (STW) exceeded values from the control group by 18.2%. Explanation of the differences can be found in significant reduction of density and structure of skeletal bones and stomatognathic system bones in females in postmenopausal period, independently of development of proven osteoporosis process.

CONCLUSION

Osteoporosis diagnosed upon clinical examination and densitometric tests of forearm bones is causing significant changes in density and structure of stomatognatic system bones. In comparison with patients without osteoporosis, the sick patients have varying reduction in all densitometric coefficients, and also reduction in the number and density of radiological trabeculae. In persons with osteoporosis the width of radiological trabeculae is increased.

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SUMMARY

In a group of 130 patients with diagnosed osteoporosis and in 110 patients in control group radiovisiographic test of mandible bone structure had been carried out. Digital images analysis was carried out using Software Radiograph Workshop. It proved that in

the group of patients with osteoporosis process in comparison with the control group there has been observed a significant deterioration of mandible bone density, defined as reduced bone mineral contents (BMC), reduced bone mineral density (BMC), and reduced mandible bone density (BD).

Bone structure analysis showed in the control group of the treated patients with osteoporosis lower than in the control group quantity of structure of trabecular number (STN), deterioration of bone trabecular density expressed in % of area and greater structure of trabecular width than that in healthy patients.

Ocena gęstości i struktury kości żuchwy u pacjentów z ogólnoustrojowym procesem osteoporozy

U 130 chorych z rozpoznaną osteoporozą i 110 osób grupy kontrolnej wykonano badania radiowizjograficzne kości żuchwy. Analiza obrazów cyfrowych, przeprowadzona przy pomocy opracowanego programu komputerowego „Radiograph Workshop", wykazała, że u pacjentów z osteoporozą, w porównaniu z grupą kontrolną, obserwuje się znamienne zmniejszenie gęstości kości żuchwy, wyrażone mniejszym równoważnikiem zawartości minerałów (BMC), zmniejszoną gęstością mineralną (BMD) oraz obniżeniem względnej gęstości kości żuchwy (BD).

Analiza struktury kości żuchwy wykazała w grupie chorych mniejszą niż w grupie kontrolnej liczbę beleczek radiologicznych (STN), zmniejszone zagęszczenie beleczek liczone w % powierzchni oraz większą niż u zdrowych szerokość radiologicznych beleczek żuchwy.