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Effect of age and gender on the condition of bone tissue of stomatognathic system

Metabolic homeostasis resulting in usual histomorphical structure of bone tissue undergoes physiological changes during the ageing process and in pathological trauma as well as during diseases processes. Morphological changes in bone tissue displayed different degree of mineralization, changes in the trabecular structure of the spongy bone as well as changes in the correlation between the trabecular bone and compact bone. The above described changes could be the root cause of loss of bone resistance to mechanical impact.

Loss of bone tissue in accordance to age related process is physiological. After reaching peak bone weight at the age of 25-35, there can be observed loss of 1-2% per year, in people of both genders, independently of race, economic situation and living location (19). Similar changes undergo most probably in maxillary and mandibular bones, but it is not defined in what degree they influence dentition and function of the stomatognathic system. It is considered that in people over 50 years old the main reason of tooth extraction are the periodontical diseases (8, 9, 18), and loss of alveolar processus is mainly connected with loss of teeth during carietic process (1, 2, 3, 7, 14). Objective evaluation of changes in density and structure of mandible bone tissue during the ageing process, may provide new information concerning their influence on the stomatognathic system.

MATERIAL AND METHODS

For the bone tissue evaluation there was utilized a device made by Trophy Radiology type IRIx 708. Radiographic pictures registered with CCD sensor cover premolar teeth area on the left side using right angle methods (10). Registered digital pictures trans-

ferred to the computer were converted to the graphical display and revived by Radiograph Workshop (22).

The results of research were developed using the program Statica 5.1. Differences between the assessed features were evaluated by test t assuming statistically significant values $p < 0.05$. Correlations between the selected indices were analysed by defining linear regression rated by the Pearson's test.

The study comprised 240 people, including 160 female and 80 male patients. Statistical analysis patients were classified to one of four age subgroups: up to 40, 41–50, 51–60 and above 60 years of age. Detailed quantities in every subgroup of the treated population are shown in Table 1.

Table 1. Amount of treated according to age and gender

	Age group				All
	I	II	III	IV	
Female	26	27	43	64	160
Male	19	18	22	21	80
Together	45	45	65	85	240

RESULTS

Average results related to the mandible bone density factor in the groups divided according to gender and age are shown in Table 2. In all population of patients there was concluded age–related moderate lowering of densitometry measurements showing statistically significant changes between the age subgroup younger than 41, and that over 50. The same changes were observed in the subgroup divided according to genders, they were only less significant in the group of the treated male patients. Correlation between densitometry measurements and age, confirms the described in Figures 1-3 analysis of regression curves of BMC, BMD and BD according to the age of the treated showing slight, but statistically significant deterioration correlated with age.

The carried out researches point out differences in measurements correlation with the gender of the treated. In the group aged 41-50 differences between the subgroups of males and females are not statistically essential, but considering results in all the subgroups and in all population male mandibular bones are characterised by little higher coefficient of mineral content, mineral density and higher biological density than in females (Figs 4–6).

Results of analysis of radivisiographic measurements of the mandible bone structure are showed in Table 3. Considering all the surveyed population it was concluded that the

Table 2. Bone mineral contents (BMC), bone mineral density (BMD), relative mandible bone density (BD) in the group divided according to gender and age

	Density Factor	Age group				All
		I	II	III	IV	
Female	BMC	0.536	0.542	0.478*	0.479*	0.499
	BMD g/cm^2	1.206	1.220	1.090*	1.078*	1.126
	BD g/cm^3	1.448	1.462	1.310*	1.314*	1.360
Male	BMC	0.606	0.577	0.568	0.517*	0.565
	BMD g/cm^2	1.397	1.356	1.221*	1.234*	1.297
	BD g/cm^3	1.556	1.565	1.542	1.454	1.527
Total	BMC	0.565	0.556	0.508*	0.489*	0.521
	BMD g/cm^2	1.287	1.274	1.134*	1.116*	1.183
	BD g/cm^3	1.494	1.503	1.389*	1.349*	1.416
Significance of differences acc. to gender	BMC	<0.009	ns	<0.001	ns	<0.001
	BMD g/cm^2	<0.002	ns	<0.020	<0.005	<0.001
	BD g/cm^3	ns	ns	<0.001	<0.050	<0.001

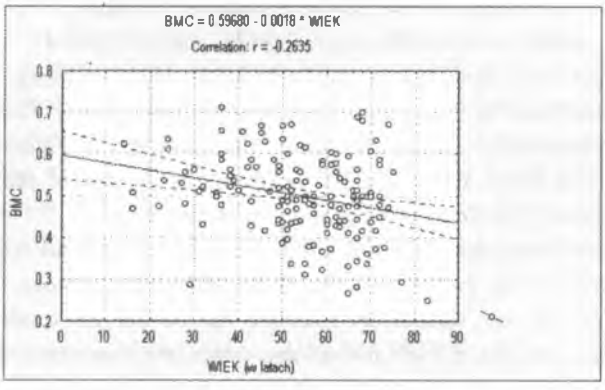

Fig. 1. Correlation between bone mineral contens and age

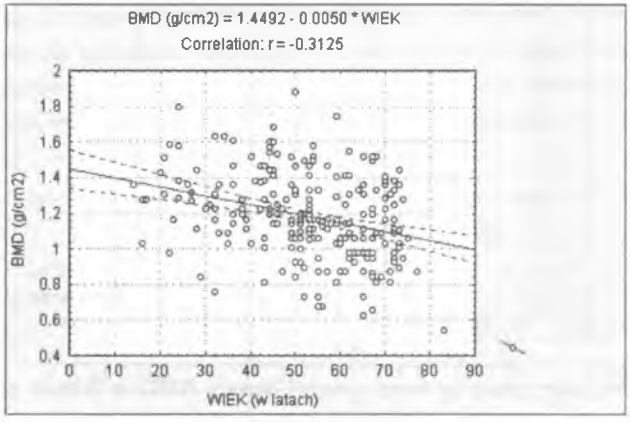

Fig. 2. Correlation between bone mineral density and age

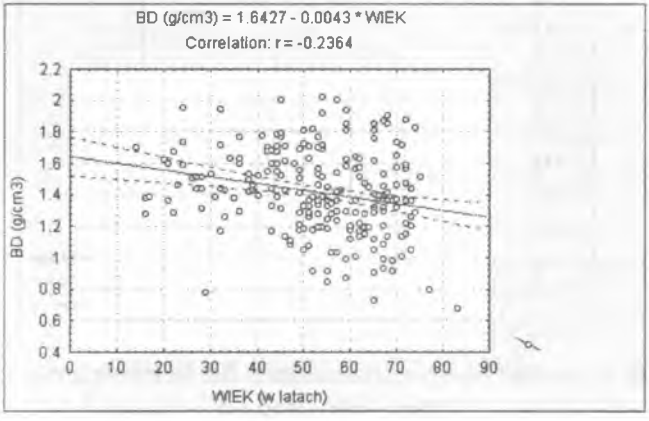

Fig. 3 Correlation between mandible bone density and age

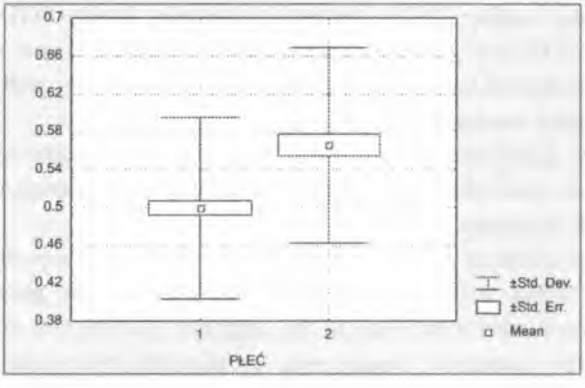

Fig. 4. Average results of bone mineral contents BMC in female group (1), male group (2)

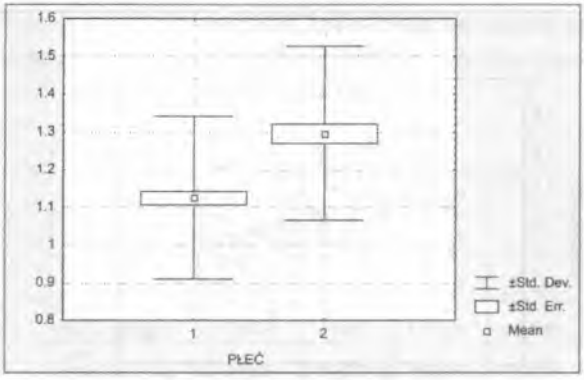

Fig. 5. Average results of bone mineral density BMD in female group (1) and male group (2)

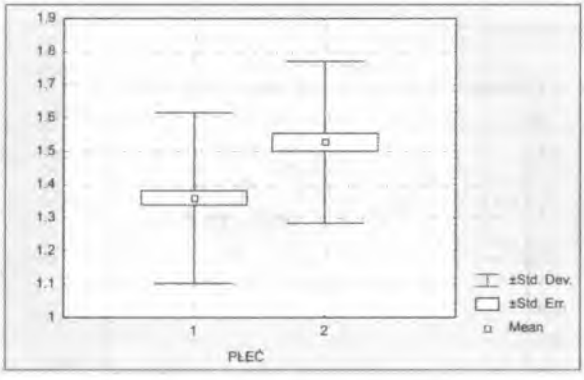

Fig. 6. Average results of bone density BD in female group (1) and male group (2)

structural trabecular number (STN), structural trabecular density (STD), and structural trabecular length (STL) are age-related. Less significant changes were observed in relation to the structural bone volume (STV), but structural trabecular width (STW) showed age-related increasing tendency.

There were no significant changes stated in structural trabecular height (STH) and structural trabecular area (STA), probably due to significant discrepancies of measurements in each age subgroup.

The analysis of evaluated parameters of structure in the subgroups divided by age and gender confirmed similar correlation in female groups, but in male groups there was not concluded age-related correlation. Only in the subgroup aged over 60 structure trabecular length and structure trabecular density were significantly lower than in younger subgroup.

Table 3. Mandible bone structure indices: statistical trabecular number per 1 mm^2 (STN), statistical trabecular volume (STV), statistical trabecular density (STD), statistical trabecular length per 1 mm line (STL), statistical trabecular width in mm (STW) statistical trabecular high (STH) and statistical trabecular are (STA) in groups divided by gender and age

	Indices of structure	Age group				All
		I	II	III	IV	
Female	STN (/mm^2)	47.60	41.80*	41.19*	40.80*	42.18
	STV (%)	2.07	1.67*	1.90	1.84	1.8 6
	STD (%)	42.93	40.82*	40.69*	40.13*	40.85
	STL (/mm)	1.96	1.77*	1.72*	1.74*	1.78
	STW (mm)	0.22	0.23	0.24	0.24*	0.24
	STH (%)	6.31	5.48	6.01	5.93	5.94
	STA	1.11	0.96	1.16	1.12	1.11
Male	STN (/mm^2)	48.15	44.80	43.97	41.30*	44.45
	STV (%)	2.15	2.01	1.92	1.77	1.96
	STD (%)	42.82	41.50	41.70	40.27*	41.55
	STL (/mm)	1.96	1.86	1.79	1.70*	1.82
	STW (mm)	0.22	0.23	0.24	0.24	0.23
	STH (%)	6.68	6.43	6.33	5.96	6.34
	STA	1.14	1.11	1.22	1.08	1.14
Total	STN (/mm^2)	47.83	43.00*	42.13*	40.92*	42.93
	STV (%)	2.10	2.20*	1.91	1.82*	1.89
	STD (%)	42.88	41.09*	41.03*	40.16*	41.08
	STL (/mm)	1.96	1.81*	1.74*	1.73*	1.79
	STW (mm)	0.22	0.23	0.24*	0.23	0.23
	STH (%)	6.47	5.86	6.12	5.94	6.07
	STA	1.13	1.02	1.18	1.11	1.12

* Statistical significant difference for age group I.

† Statistical significant difference between group of males and females.

Contrary to the densitometry coefficient structure measurements the analysis showed no differences in correlation with the gender. Only structural trabecular number in male group independent of age appeared considerably lower than in the group of surveyed females.

DISCUSSION

The opinions on differences in density and structure correlated with age are varied. Takeda et al. (21) on the basis of on ultrasonic wave study concluded that in population of young people differences in bone density are insignificant. Other authors showed in their studies that the skeletal bone structure is influenced by various factors gender-correlated, among others: hormonal status, physical activities etc. (17). In densitometry measurements of the forearm bone and thoracic vertebra carried out in a big group of healthy people at the age 50-98 years Blunt et al. (6) proved slightly higher values of bone mineral density in male than in female group. In the carried out researches analysis of densitometry measurements in the groups of male and female patients in comparable age, there were concluded moderated, but significantly higher parameters of BMC, BMD and BD in the group of males, however, no gender-related differences in relation to radiological index of the mandible bone structure were found.

Significantly richer experimental material has been collected in case of changes in densitometry measurements during the ageing process. Many authors confirmed in their researches (4, 6, 12, 24) that in both genders there occurs gradual loss of bone contents, resulting in reduction of bone mineral content and bone mineral density as well as in changes in trabecular structure. These changes appear especially in the group of female patients after menopause (13, 15, 16), frequently leading to bone demineralisation and development of osteoporosis process. Reduction of densitometry coefficient observed mainly in research of vertebra and long bone, is observed in relation to the mandible bone (20, 23).

In own researches a significant decrease in bone mineral contents, bone mineral density and relative bone density of the mandible bone was observed in the group of over 50-year olds, but higher loss was observed in the group of females than in the group of males. This was connected with the fact that in the treated population higher percentage of female patients had diagnosed osteoporosis. Nevertheless, the same direction of changes in densitometry measurements was observed during an analysis of the subgroup of males and females without osteoporosis.

In available literature, there was not found direct correlation concerning the changes in bone structure of the stomatognathic system. In morphological researches of mandible bone samples Hongo et al. (11) pointed out age-related reduction of structural trabecular density. According to their conclusions there was pointed out a reduction of the number and density of radiological trabeculae, accompanied by the increase in width.

The obtained results showed that changes causing deterioration of the stomatognathic system bone structure were brought about particularly by the increase in width of radiological trabeculae. In this respect, they do comply with observations referring to changes developed in long bone structure (5).

CONCLUSION

1. Mandible bone density, mineral density and mineral contents in mandible bone are greater in males than in females.
2. Evaluated densitometry coefficient deteriorating in relation to age was particularly significant in female patients aged over 50.
3. Gender and age of the surveyed in a lower degree influences radiological structure coefficient obtained as the results of the radiography Workshop pictures analysis.

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SUMMARY

The 240 patients, with the mean age 50.3 year for males and 54.4 years for females treated in the Department of Dental and Maxillofacial Surgery Medical University and Institute of Rural Medicine in Lublin had radiovisiographically tested premolar teeth area on the left hand body side. Digital radiovisiographical picture was developed using computer software Radiograph Workshop, and obtained factors of bone mineral density and mandible bone structure were reviewed with regard to gender and age of the treated. It was concluded that relative density, mineral density and bone mineral contents is significantly greater with male than female patients, and is deteriorating significantly with age. Age and gender of the treated in a lesser degree influences on radiological structure factors resulting from radiovisiographical picture analysis using Radiograph Workshop.

Wpływ wieku oraz płci na stan tkanki kostnej narządu żucia

U 240 pacjentów w średnim wieku, mężczyzn 50,3 lat, kobiet 54,4 lat, leczonych w Klinice Chirurgii Stomatologicznej i Szczękowo-Twarzowej AM oraz w Poradni Osteoporozy Instytutu Medycyny Wsi w Lublinie, przeprowadzono badania radiowizjograficzne okolicy zębów przedtrzonowych po stronie lewej. Cyfrowy zapis obrazu rwg opracowano przy pomocy programu komputerowego Radiograph Workshop, a uzyskane wskaźniki gęstości i struktury kości żuchwy analizowano pod względem zależności od płci i wieku badanych. Stwierdzono, iż gęstość względna, gęstość mineralna oraz zawartość minerałów w kości jest istotnie większa u mężczyzn niż u kobiet, a jednocześnie ulega istotnemu zmniejszeniu z wiekiem. Wiek i płeć badanych w mniejszym stopniu wpływa na radiologiczne wskaźniki struktury, uzyskane w wyniku analizy zdjęć RVG programem Radiograph Workshop.