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AGE DYNAMICS ANALYSIS OF THE DEPTH OF THE OSSEOUS TISSUE LAYERS IN THE MAXILLARY ALVEOLAR PROCESS AND THEIR RATIO IN ADULT INDIVIDUALS

Abstract. *Premature loss of teeth is a serious medical problem. Its effective solution depends, to a large extent, on the understanding of the features of age adjustment of the maxillary alveolar sections while maintaining the integrity of the dentition and in various types of adentia.*

Key words: computed tomography, maxillary alveolar process, linear dimensions, adulthood.

Introduction. Premature loss of teeth due to various genesis (periodontal disease, complications of carious lesions, traumas) not only has aesthetic value, but is also a serious health problem because it leads to disorders in the digestive system, whose functioning largely determines the condition of the body as a whole [1, 7, 8]. Massive dental defects can cause deformities of the face, provoke changes in the psyche of patients, especially young people, which moves the problem into the category of social ones [2, 5, 9, 12]. Planning rehabilitation of dentition in the functional, aesthetic and phonetic aspects, in partial or complete loss of teeth under conditions, as a rule, of insufficient amount of bone tissue, is one of the most critical and complex problems of modern dentistry [3, 4, 6, 10, 11]. Its effective solution depends, to a large extent, on the understanding the features of the age adjustment of the maxillary alveolar sections while maintaining the integrity of the dentition and in various types of adentia. Many clinical and experimental studies have been devoted to the study of age adjustment of the facial area of the head, which is manifested mainly in changing the height of different parts of the face [1, 2, 4, 9]. These changes take place both due to loss of teeth, and because of resorption of alveolar jaw sections that occurs not only in adentia, but also, to a lesser extent, while maintaining the integrity of the dentition. It is obvious, that the restructuring of the alveolar jaw areas affects not only their height, but other dimensions as well. That is why the objective of our research was to study the features of age evolution of the thickness of the maxillary alveolar process compact and spongy bone layers and their ratio in adult people of different sexes.

Objective: of our research is to study the features of age dynamics of the depth of the compact and spongy osseous tissue layers in the

maxillary alveolar process and their ratio in adult individuals of different sexes. The study involved 20 males and 22 females aged 22-60 years with no history of diseases, that could affect the bone. The study was performed on 16-row spiral detector computed tomographic scanner TOSHIBA Activion 16. Scanning was carried out in the axial plane parallel to the alveolar edge of the jaw or parallel to the occlusal plane. The thickness of the bone tissue layers in the maxillary alveolar process (BT MAP) was measured at the level of the oral part and that of the body. The studies have shown, that in most adult people the spongy layer is the thickest, while the external compact plate of the alveolar process is the thinnest. The thickness of the external and internal compact plates vary slightly, with the average thickness of the internal compact plate higher than the external one (except the areas of the large molars). The ratio and age dynamics of absolute figures of the thickness of the maxillary alveolar process bone tissue layers at the level of the oral part and the body in adults differ in men and women. In the women of both age groups and the men of the first age group at the level of the oral part and at that of the body the amount of spongy bone tissue increases gradually from the incisive segment to the segments of large molars, the parts of the internal and external compact plates are gradually decreasing as well, while the part of the internal compact plate is bigger than that of the external one. The men in the second age group had a unilateral decrease in the proportion of spongy bone tissue and an increase of the part of the external compact plate of the segments in the molar area on the left at the level of the oral part and a slight decrease of the part of the spongy bone tissue in the area of the small molars on the right at the level of the body. In all examined areas

(except the maxillary body in the men of the second age group) both absolute figures of the thickness and specific parts of the studied maxillary alveolar process bone tissue layers are obviously asymmetric.

Materials and methods. The study involved 20 males and 22 females aged 22-60 without any diseases in their history, which could have influenced the condition of their bone tissue (chronic systemic diseases, metabolic disorders). All the surveyed were patients in Dr. Dakhno dental clinic "(Kyiv). Computer-tomographic examination of patients was carried out exclusively according to the medical indications. The surveyed were divided into two age groups: the first group of 22-35 year-old ones, the second group of 36-60 year-old ones. The study was performed on 16-row spiral detector computed tomographic scanner TOSHIBA Activion 16. Scanning was carried out in the axial plane parallel to the alveolar edge of the jaw or parallel to the occlusal plane. The data in DICOM format were processed by means of a graphical dental Computer Program SIMPlant (Materialise Software, Belgium) by building multiplane, orthopantomographic 3D reconstructions. On the computer tomograms performed in the horizontal plane, the thickness of the bone tissue layers in the maxillary alveolar process (BT MAP) was measured at the level of the oral part and that of the body and the features of their ratio and age dynamics in the individuals of two sexes were studied (Fig. 1).

Results and discussions. Analysing the linear dimensions of of the bone tissue layers in the maxillary alveolar process (BT MAP) showed that in women and men the spongy layer is the thickest, and the external compact plate is the

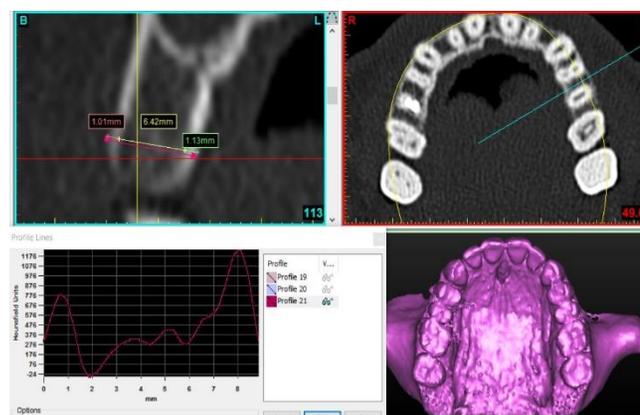


Fig. 1 Determination of linear dimensions in the maxillary alveolar process bone tissue layers at the level of the alveolar arch in the area of the small molars (a CT image of a 54 year-old man)

thinnest. The thickness of the external and internal compact plates vary slightly, with the average thickness of the internal compact plate higher than that of the external one (except the areas of the large molars) (Table. 1, 2).

In women of the 1st and 2nd age groups the thickness of the bone spongy layer in the oral part of the alveolar process is minimal in the area of the incisive segment on the left (Table. 1). All along the AP one can see a clear asymmetry - the layer of spongy bone tissue at the level of all segments is thinner on the left than on the right.

Table 1

Thickness of the BT MAP layers at the level of the oral part in adults (mm.) (M±m).

The group under study		Dentofacial segments	Right side			Left side		
			External compact plate	Spongy bone tissue	Internal compact plate	Internal compact plate	Spongy bone tissue	External compact plate
women	Age group 1	1-2	1,167±0,21	4,408±1,10	1,575±0,43	1,833±0,54	3,942±1,05	1,667±0,31
		4-5	1,192±0,36	6,717±1,32	1,575±0,54	1,733±0,74	6,4±1,09	1,25±0,34
		6-7	1,175±0,21	10,875±1,41	1,442±0,66	1,475±0,34	10,833±1,55	1,158±0,25
	Age group 2	1-2	1,15±0,19	5,08±1,47	1,59±0,39	1,89±0,40	4,67±1,16	1,19±0,17
		4-5	1,18±0,21	6,44±0,74	1,77±0,64	1,69±0,24	6,27±1,13	1,22±0,16
		6-7	1,13±0,13	10,82±2,22	1,35±0,31	1,49±0,30	10,31±2,37	1,16±0,22
men	Age group 1	1-2	1,31±0,23	5,9±0,94	1,88±0,65	2,19±0,72	5,41±0,78	1,33±0,27
		4-5	1,22±0,23	7,33±0,95	1,62±0,39	1,6±0,43	7,23±1,20	1,27±0,19
		6-7	1,27±0,25	10,27±3,62	1,58±0,41	1,47±0,26	12,16±1,43	1,24±0,24
	Age group 2	1-2	1,32±0,27	5,46±1,78	2,15±0,76	2,44±0,81	5,07±1,67	1,25±0,36
		4-5	1,14±0,17	6,55±1,84	1,82±0,42	1,82±0,45	5,7±2,33	1,05±0,12
		6-7	1,15±0,19	19,62±28,33	1,46±0,42	1,78±0,68	9,57±2,78	11,03±31,26

p ≤ 0,05

In women of both age groups the thickness of the external compact plate of the oral part of the MAP is practically the same, instead, the thickness of the internal compact plate varies inversely proportional to the thickness of the spongy bone layer. The maximum thickness of the internal compact plate was found at the level of the left incisive segments, and the minimum one - at the level of the segments of the large molars symmetrically on both sides.

Both in men and in women in both age groups in the oral part of the AP the figures of the external compact plate thickness are the smallest and yet most stable. It was established that the internal compact plate is the thickest and the sponge layer

is the thinnest in the incisive segment area. Both in women and in men in the incisive segment area one can clearly see a marked asymmetry in the thickness of the bone tissue layers in the maxillary alveolar process.

While the structure of the BT MAP in the oral part is similar in men and women of both surveyed groups the study of the structure of its body showed the presence of sexual characteristics and pronounced age dynamics, first of all it concerns the thickness of the spongy bone tissue (Table. 2). In the first age group of women all along the body of the maxillary alveolar process the spongy layer of the bone tissue is thinner on the left side than on the right one.

Table 2

Thickness of the BT MAP layers at the level of the maxillary body in adults (mm.) (M±m).

The group under study		Dentofacial segment	Right side			Left side		
			External compact plate	Spongy bone tissue	Internal compact plate	Internal compact plate	Spongy bone tissue	External compact plate
women	Age group 1	1-2	1,517±0,25	5,742±2,04	1,792±0,55	2,008±0,69	4,958±1,75	1,5±0,33
		4-5	1,442±0,50	6,333±1,59	1,875±0,52	1,983±0,47	6,075±1,52	1,442±0,27
		6-7	1,283±0,41	11,492±1,32	1,242±0,29	1,617±0,86	10,742±1,73	1,375±0,32
	Age group 2	1-2	1,41±0,15	5,67±1,68	1,77±0,39	1,76±0,49	5,72±1,78	1,34±0,20
		4-5	1,33±0,27	6,85±1,78	1,64±0,34	1,67±0,33	6,41±1,39	1,24±0,23
		6-7	1,22±0,23	10,78±1,84	1,26±0,20	1,43±0,43	10,38±2,17	1,3±0,24
men	Age group 1	1-2	1,43±0,13	7,03±1,48	1,71±0,41	1,79±0,48	7,23±1,37	1,49±0,13
		4-5	1,46±0,25	7,19±1,61	1,78±0,58	1,79±0,41	7,19±1,61	1,51±0,34
		6-7	1,26±0,28	11,93±1,52	1,38±0,30	1,42±0,23	12±1,30	1,2±0,22
	Age group 2	1-2	1,55±0,25	7,59±1,99	2,22±0,92	1,72±0,48	7,75±2,55	1,63±0,21
		4-5	1,36±0,30	6,82±2,12	2,2±0,82	2,11±0,75	16,16±29,54	1,35±0,40
		6-7	1,42±0,33	11,29±2,97	1,25±0,49	1,51±0,45	10,87±3,24	1,23±0,25

p ≤ 0,05

There was no clear asymmetry in the second age group women, instead, it was established that the spongy layer of the bone tissue was the thinnest at the level of the incisive segment on the right.

In the first age group men the thickness of the spongy layer of the bone tissue in the AP body is practically the same at the level of the incisive segments and those of the small molars on both sides, only increasing at the level of the large molar segments. The men of the first age group are characterized by a symmetry of the linear dimensions of the BT MAP body. In the men of the second age group the spongy layer of the bone tissue in the body of the alveolar process was the thinnest at the level of the small molars (it is thinner on the left than on the right). It is somewhat thicker at the level of incisive segments

and the thickest one at the level of the large molar segments.

To objectify the results, we converted absolute figures of the bone tissue layers thickness into per cents and determined the relative proportion of the thickness of each layer in the total thickness of the alveolar process (Fig. 2-9).

The results of the analysis of the specific part ratio of the thickness of BT MAP layers in adults showed, that in women of both age groups and in men of the first age group the part of of the spongy bone tissue is gradually increasing from the incisive segments to those of the large molars at the level of both the oral part and of the body, the parts of the internal and the external compact plates are becoming thinner too while the part of the internal compact plate is thicker than that of

the external one. (Fig. 2-4, 6-8). In the men of the second age group there was a unilateral reduction of the part of spongy bone tissue and an increase in the part of the external compact plate segments

in the area of large molars on the left at the level of the oral part and a slight decrease in the spongy bone proportion in the area of the small molars on the right at the level of the body (Fig. 5 9).

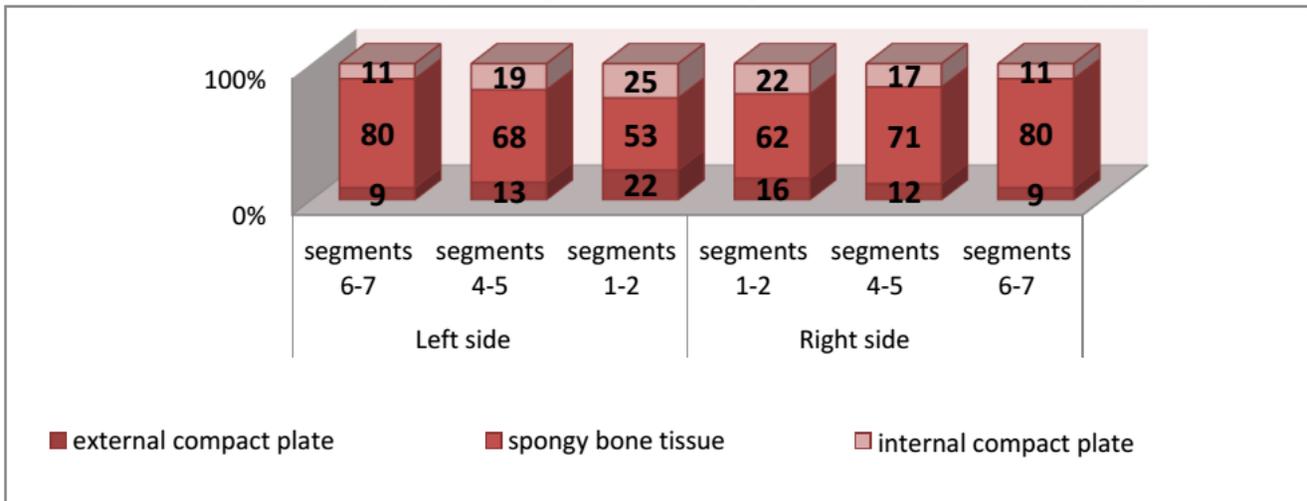


Fig. 2. Ratio of specific parts of the thickness in the BT MAP layers at the level of the oral part in the women of the first age group (%)

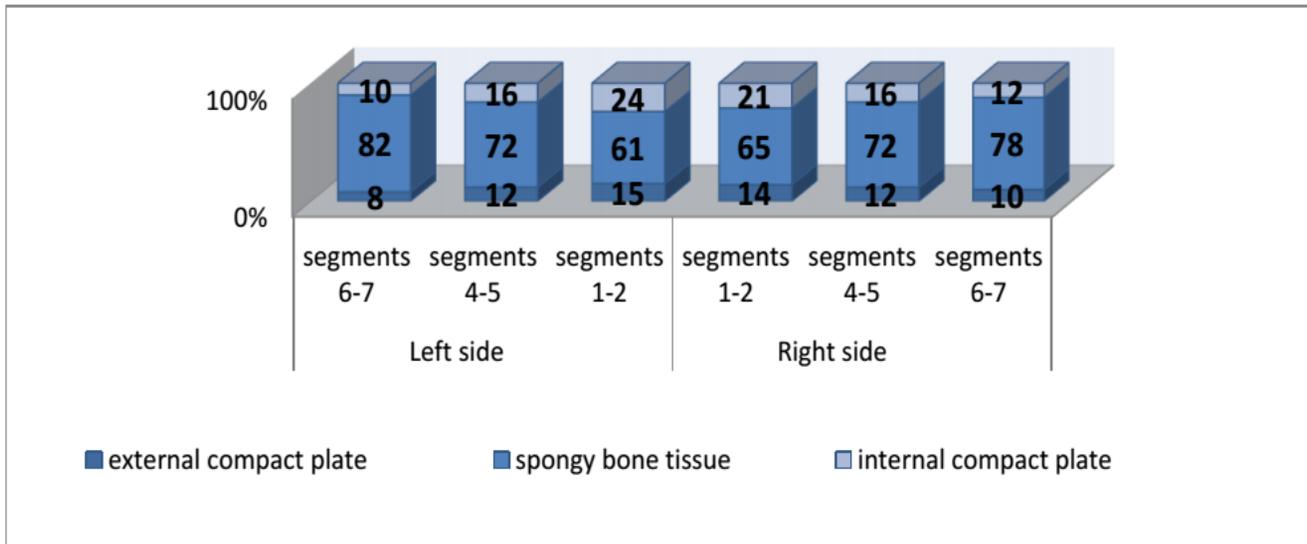


Fig. 3. Ratio of specific parts of the thickness in the BT MAP layers at the level of the oral part in women of the second age group (%)

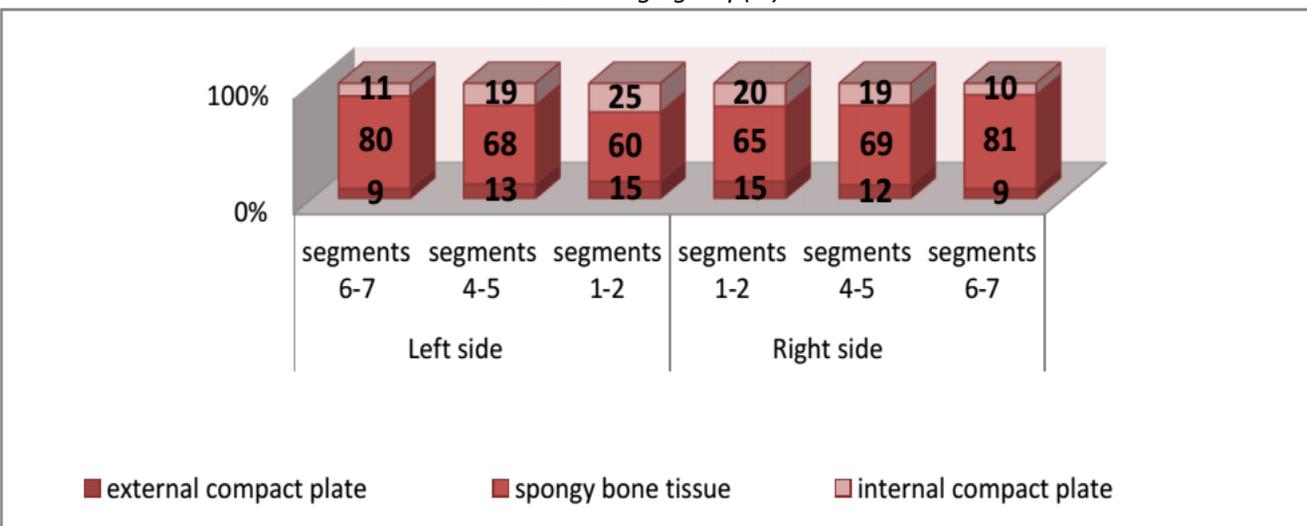


Fig. 4. Ratio of specific parts of the thickness in the BT MAP layers at the level of the oral part in the men of the first age group (%)

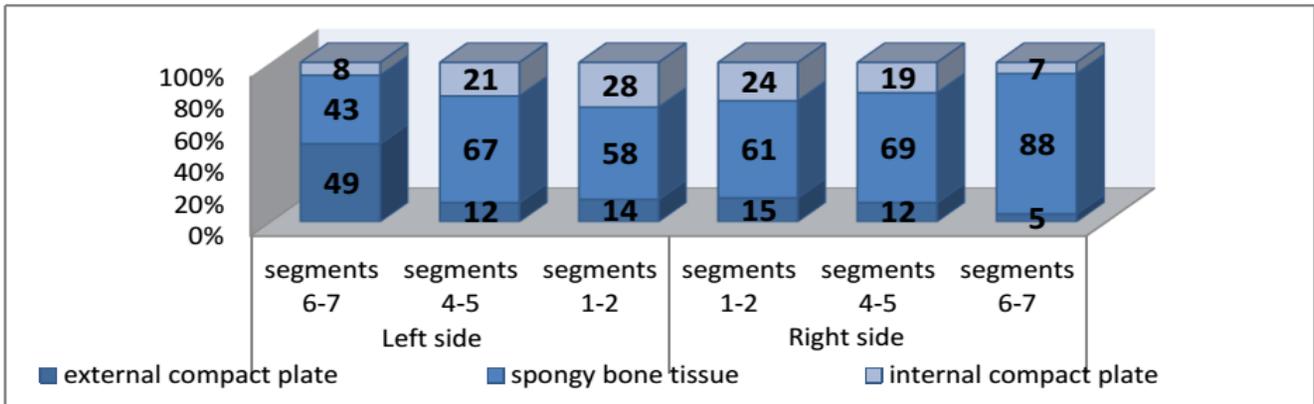


Fig. 5. Ratio of specific parts of the thickness in the BT MAP layers at the level of the oral part in the men of the second age group (%)

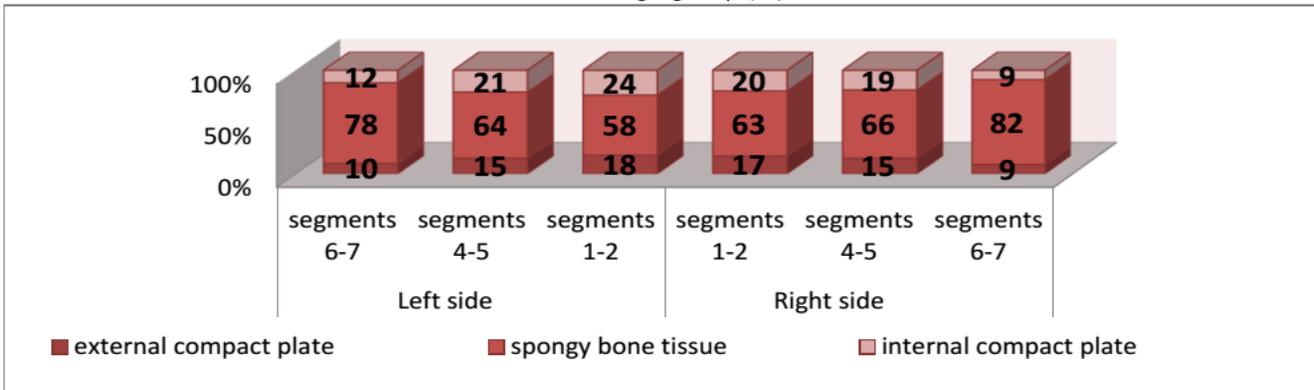


Fig. 6. Ratio of specific parts of the thickness in the BT MAP layers at the level of the body in the women of the first age group (%)

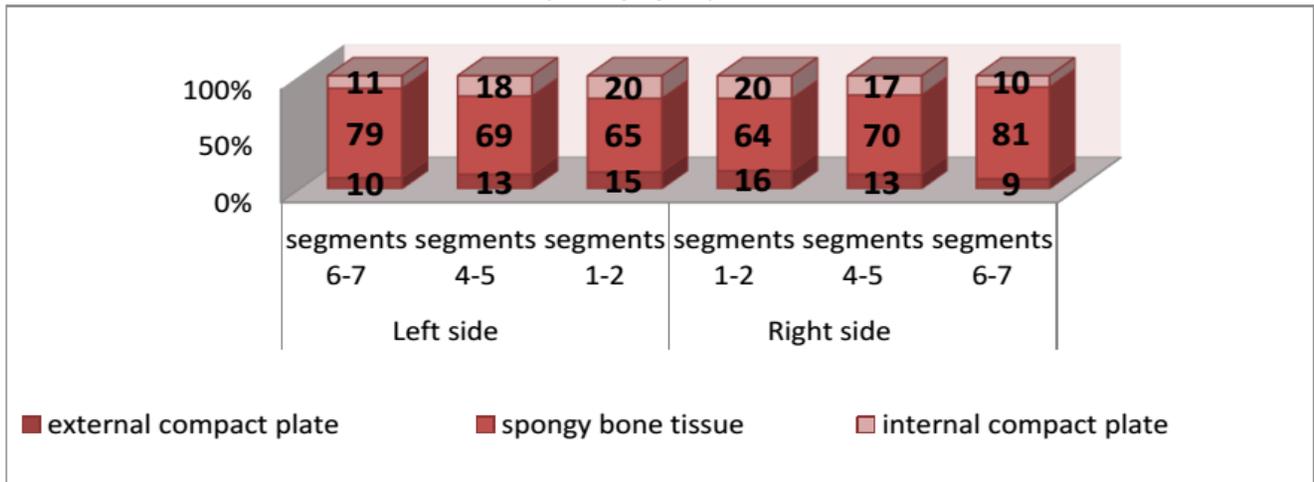


Fig. 7. Ratio of specific parts of the thickness in the BT MAP layers at the level of the body in the women of the second age group (%)

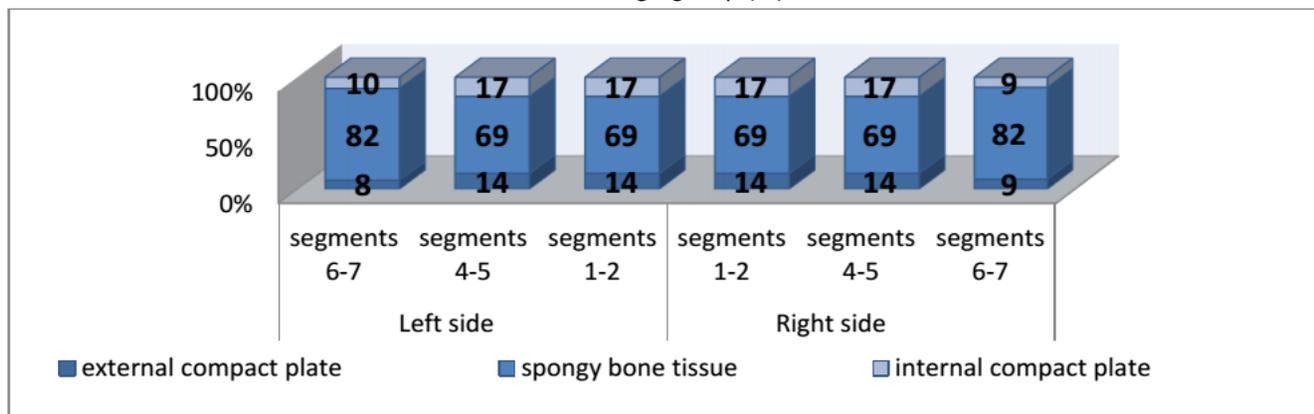


Fig. 8. Ratio of specific parts of the thickness in the BT MAP layers at the level of the body in the men of the first age group (%)

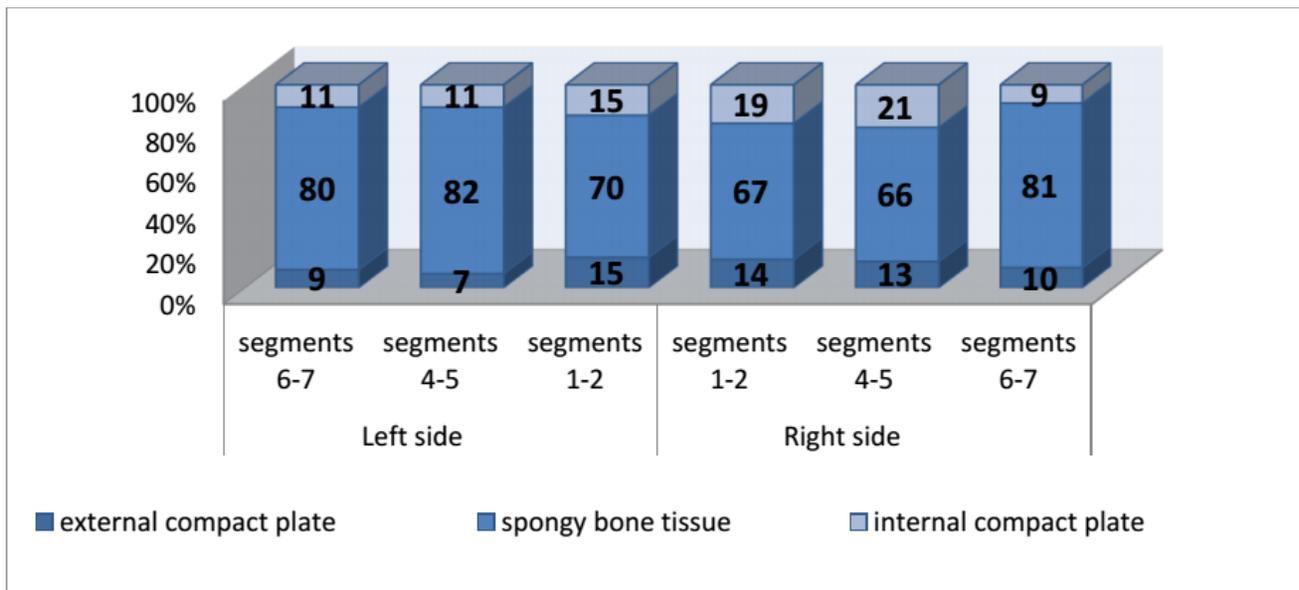


Fig. 9. Ratio of specific parts of the thickness in the BT MAP layers at the level of the body in the men of the second age group (%)

In all examined areas (except the body in the men of the second age group) specific parts of the maxillary alveolar process bone tissue layers are obviously asymmetric.

Conclusions. 1. Both in adult women and in men the spongy layer is the thickest and the external compact plate of the alveolar process is the thinnest. The thicknesses of the external and internal compact plates are not significantly different, however the average thickness of internal compact plate is higher than that of the external one (except the areas of the large molars)

2. Ratio and age dynamics of the absolute thickness of the BT MAP layers at the level of the oral part and the body is different in men and in women.

3. In women of both age groups and in men of the first age group at the level of both the oral part and the body the part of the spongy bone tissue is gradually increasing from the incisive segments to those of the large molars, at the same time the parts of the internal and external compact plates are gradually decreasing, but the part of the internal compact plate is bigger than that of the external one. There was a unilateral decrease of the part of the spongy bone tissue and an increase of the part of the external compact plate in the area of the large molars on the left at the level of the oral part and a slight decrease of the part of the spongy bone tissue in the area of the small molars at the level of the body in the men of the second age group.

4. The specific part of the spongy layer in the total thickness of the maxillary alveolar process

constitutes 53-82% in women, 43-88% in men, that of the internal compact plate 11-25% in women, 10-28% in men, and that of the external compact plate 9-22% in women, and 5-49% in men.

5. In all the areas which were studied (except that of the body in the men of the second age group) absolute figures of the thickness and specific parts of the maxillary alveolar process bone tissue layers are obviously asymmetric.

Perspectives of further investigations. Being able to determine the thickness of the maxillary alveolar process bone tissue layers and understanding the gender features and regularities in the age adjustments of the area under study allows optimizing preparation of the jaws for dental prosthetics, including - dental implants after tooth loss in adults.

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