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EVALUATION OF MAXILLARY BONE DIMENSIONS IN SPECIFIC AREAS FOR REMOVABLE DENTURES

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ABSTRACT

Background: Removable prosthetics is a big part of Prosthetic Dentistry. Prosthetic field is very important for successful treatment with partial or complete dentures. Maxillary bone is covered with soft tissues, but its anatomy is essential for retention, chewing stability and comfort of the patients.

Purpose: The study's aim was to evaluate the dimensions of maxillary bone in specific zones for removable dentures.

Methods: Sixteen craniums were measured in 10 different zones. It was used an Electronic Digital Caliper 0-150 mm.

Results: Consistently were applied F-test and Welch t-test for equality of variance and group's comparison mean, respectively. The spread of the data was described by calculating range and standard deviation. The estimated value of range was highest in the FI-A1P, followed by FI-AC and FI-A2P. The smallest amplitude was established in the TM-PP and SNA. The estimated value of standard deviation was 2,57/2,51 in FI-AC zone, 2,46/2,59 in FI-A1P zone and a few smaller 2,08/2,13 in FI-A2P zone. The lowest values were in TM-PP and SNA areas.

Conclusion: Tuber maxillae and Spina nasalis anterior have stable dimensions. The areas of canine and premolars are varied, because the zone is tasked by chewing function.

Key words: maxilla, removable prosthesis, bone anatomy.

INTRODUCTION:

Physiological range of prosthetic field was determined by the following anatomical structures- spina nasalis anterior, crista zygomaticoalveolaris, m. buccinators, m. orbicularis oris, m. incisivus labii superioris. In the distal area this range is placed behind Tuber maxillae to facies infratemporalis maxillae [1]. The maxilla contained less lamellar bone compared with the mandible [2]. There are similar studies for quantitative evaluation module of elasticity and hardness in different anatomical regions, and they were established middle level in frontal area and low in distal zone [3, 4, 5]**.** The cortical density can be measured by Hounsfield units (HU). The investigations proved various levels in cortical and cancellous bone densities. Maxillary tuberosity showed the lowest level [6]. Computed tomography's study of the edentulous posterior maxillae showed porous cortical crest or no cortical bone, although the bone densities varied markedly among individuals [7]. Micro-computed tomography (microCT) is a method to image and quantify bone with very high resolution [8]. Another investigation for determining the cortical thickness, density and elastic properties, proved a big variability in different areas of the upper jaw [9].

Physical properties of the bone are related to resorption. The marginal bone level was, on average, 1.0 mm less from the implant/abutment junction after 1 year [10]. Resorptive process can be considered from the length of incisive canal, which is different value in dentulous and edentulous maxillary bone [11]. It is established gender difference in anatomic features of incisive canal [12]. Monje proved a statistically significant positive correlation between bone volumetric fraction and ridge height and a statistically significant negative correlation between trabecular pattern factor and ridge height [13].

There are different investigations for evaluation the thickness of facial alveolar bone in frontal area, most of them with a cone- beam computed tomography [14, 15, 16, 17, 18]. Cortical bone thickness of the alveolar wall in different facial type patients (low-angle, normal, and high-angle) was the same [19]. Essential for the successful treatment with complete dentures is proper planning, the type of prosthesis and prosthetic design [20].

PURPOSE:

The aim of the study was to evaluate the dimensions of maxilla bone in specific removable prosthetics areas.

MATERIAL AND METHODS:

The current study was conducted in the Department ''Anatomy, Histology and Embryology'', Medical University of Plovdiv. It was made 160 measurements on sixteen craniums, and the results were written in individual work cards.

It was recorded symmetrical dimensions in right and left half: 1- horizontal depth of Spina nasalis anterior (SNA); 2- the distance from lower edge of Foramen infraorbitale to the canine's alveolus (FI-AC); 3- the distance from lower edge of Foramen infraorbitale to the first premolar's alveolus (FI-A1P); 4- the distance from lower edge of Foramen infraorbitale to the second premolar's alveolus (FI-A2P); 5- horizontal gap between Tuber maxillae and (Lamina lateralis) Processus pterygoideus (TM-PP) (fig. 1).

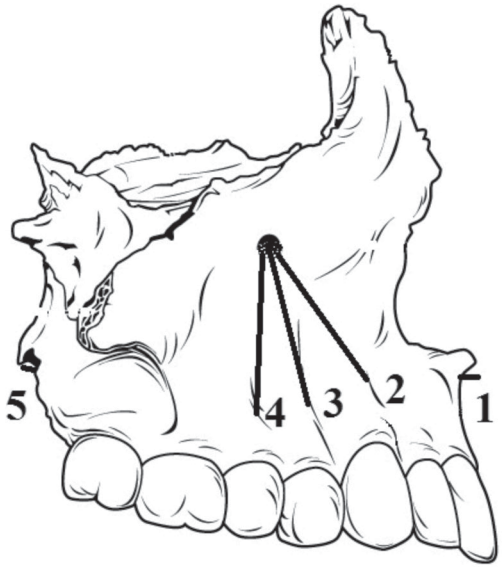


Fig. 1. Lateral view of the upper jaw
Legend: 1 – Spina nasalis anterior (SNA), **2** – Foramen infraorbitale – alveola dens caninus (FI-AC), **3** – Foramen infraorbitale – alveola dens premolaris primus (FI-A1P), **4** – Foramen infraorbitale – alveola dens premolaris secundus (FI-A2P), **5** – Tuber maxillae - Processus pterygoideus (TM-PP)

It was used *Electronic digital caliper* 0-150 mm. The results were written in a table (*table 1*), statistical analysis was made by *F-test* and *Welch t-test*, and the study was visualized by *Microsoft Office Excel 2010.*

Table 1. Measurement values on the upper jaw

Ref. marks / No. cranium	*SNA*		*FI-AC*		*FI-A1P*		*FI-A2P*		*TM-PP*	
	dex.	***sin.***	***dex.***	***sin.***	***dex.***	***sin.***	***dex.***	***sin.***	***dex.***	***sin.***
cranium *1*	3,16	3,31	14,78	18,16	17,25	17,75	14,24	16,42	2,07	1,68
cranium *2*	4,26	4,15	20,08	20,6	20,3	19,01	20,49	18,22	2,54	2,15
cranium *3*	2,38	2,6	21,53	22,05	23,27	24,18	19,93	21,48	1,74	1,98
cranium *4*	1,95	1,88	16,35	16,58	16,05	16,64	17,15	15,43	2,15	1,61
cranium *5*	2,61	2,8	17,57	17,52	18,69	16,5	19,94	16,73	1,89	1,38
cranium *6*	2,59	2,31	17,44	17,31	17,66	15,61	18,53	15,27	1,59	1,18
cranium *7*	2,79	1,9	13,3	14,62	15,27	14,77	18,8	16,34	1,63	2,03
cranium *8*	2,72	3,04	16,67	15,66	17,58	17,98	19,45	19,38	1,83	1,72
cranium *9*	3,77	3,94	13,55	15,19	14,76	15,29	15,3	15,74	1,72	2,03
cranium*10*	3,99	3,83	12,54	13,33	13,8	14,79	15,39	14,9	1,68	2,02
cranium*11*	3,03	3,08	14,43	14,89	14,86	15,03	16,34	16,97	1,56	1,7
cranium*12*	4,75	4,6	16,02	16,77	17,65	18,01	19,8	19,97	2,03	2,16
cranium*13*	3,75	3,34	16,78	18,2	17,88	17,84	19,62	19,82	2,34	2,46
cranium*14*	2,06	2,67	19,95	20,94	19,9	21,83	20,46	21,2	1,87	1,98
cranium*15*	2,42	3,02	16	18,75	15,5	16,05	17,65	18,34	1,24	1,37
cranium*16*	2,38	2,4	14,26	14,49	15,54	16,18	15,84	17,09	1,67	1,93

RESULTS:

Initial data from the symmetrical areas were gathered in pairs– (SNA dex. - SNA sin), (FI-AC dex.– FI-AC sin.), (FI-A1P dex.– FI-A1P sin), (FI-A2P dex.– FI-A2P sin.), (TM-PP dex.– TM-PP sin.) and analyzed by ***"R" programming language*** and software environment for statistical computing. The purpose of the analysis was to detect statistically significant differences between the group means. Consistently were applied ***F-test*** for equality of variance and ***Welch t-test*** for comparison group means (Table 2).

Table 2. Results from F-test and Welch t-test

	F-test	*Welch t-test*
SNA dex.-SNA sin.	F = 1.1175, p-value = 0.8324	t = -0.0569, p-value = 0.955
FI-AC dex.–FI-AC sin.	F = 1.045, p-value = 0.9332	t = -0.9603, p-value = 0.3446
FI-A1P dex.–FI-A1P sin.	F = 0.8987, p-value = 0.8388	t = -0.105, p-value = 0.9171
FI-A2P dex.–FI-A2P sin.	F = 0.9604, p-value = 0.9387	t = 0.473, p-value = 0.6397
TM-PP dex.–TM-PP sin.	F = 0.9047,p-value = 0.8488	t = 0.0911, p-value = 0.928

The **Range** is defined as the difference between the maximum and minimum observations, and gives an estimate of the spread of the data. It was highest in FI-A1P, followed by FI-AC and FI-A2P. The smallest amplitude was established in the TM-PP and SNA. In addition, the **standard deviation** is a measure of the spread of the data around the mean.The estimated value of standard deviation (sd) was 2,57/2,51 in FI-AC zone, 2,46/2,59 in FI-A1P zone and a few smaller 2,08/2,13 in FI-A2P zone. The lowest values were in TM-PP and SNA areas (Table 3).

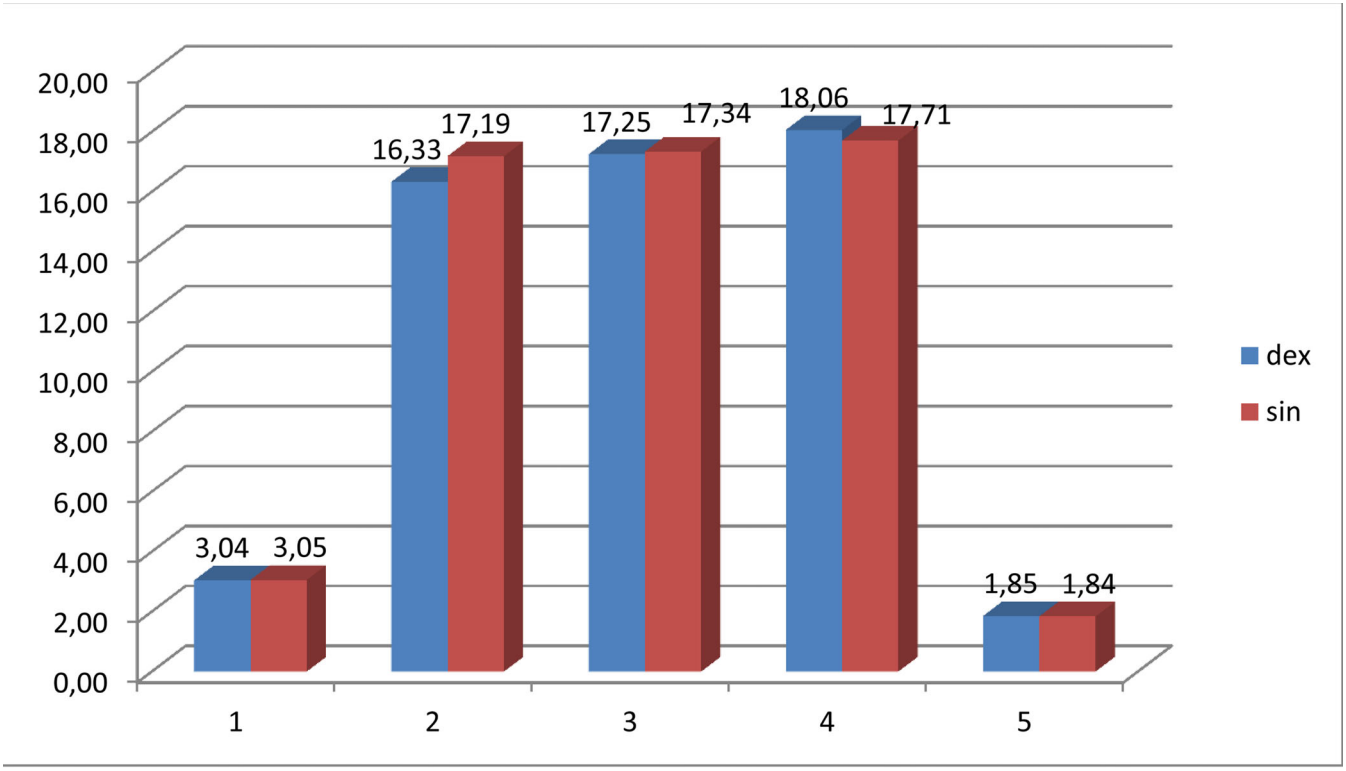
Table 3. Statistical descriptive parameters

Ref. marks / parameter	*SNA*		*FI-AC*		*FI-A1P*		*FI-A2P*		*TM-PP*	
	dex.	***sin***	***dex.***	***sin.***	***dex***	***sin.***	***dex.***	***sin.***	***dex.***	***sin.***
mean	3,04	3,05	16,33	17,19	17,25	17,34	18,06	17,71	1,85	1,84
sd	0,83	0,78	2,57	2,51	2,46	2,59	2,08	2,13	0,32	0,34
min	1,95	1,88	12,54	13,33	13,80	14,77	14,24	14,90	1,24	1,18
max	4,75	4,60	21,53	22,05	23,27	24,18	20,49	21,48	2,54	2,46
range	2,80	2,72	8,99	8,72	9,47	9,41	6,25	6,58	1,30	1,28

DISCUSSION:

From the results, outlined in Table 2, we conclude that a statistically significant difference was not found. This confirms the assumption underlying conservatism of symmetrical areas. The visualization of the percentage is presented in Diagram 1.

Diagram 1. Comparative graphics between the mean values of left and right symmetric region



Based on both statistical indicators (range, sd) characterizing scattering, we can conclude that areas SNA and TM-PP are more conservative in the course of evolution and symmetrically changing. In the variable regions susceptible to evolutionary change are FI-A1P, FI-AC and FI-A2P. In determining the cortical thickness, density and elastic properties, better indicators have been established in frontomaxillary area, where the grain of the cortical bone was aligned vertically from the incisors to the medial external aspect of the orbit [9]. Cortical and cancellous bone density was measured and the result was that the highest cortical bone density was observed between the second premolar and first molar at the alveolar bone level and between the first and second molars at the basal bone level in the maxilla. Maxillary tuberosity showed the least bone density [5].

CONCLUSION:

Areas of the upper jaw, which are with low density (Tuber maxillae) and another with higher density (Spina nasalis anterior), have similar constancy and stability. In the area of the canine and premolars there is variability, related to chewing pressure.

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