Osteometry of Mandibular Joint Surface

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Abstract

Anatomically and functionally, temporomandibular joint (articulatio temporomandibularis) is specific, It consists of incongruent joint surface. The size of mandibular joint surface and its position in relation to facies articularis fossae mandibularis in different positions of mandibulae (central occlusion, central relation) are still subject to the interest of prosthetics. The aim of the research is measuring the lower joint surface by special 3D device that enables acribic precise measuring. Macerated human skulls, property of the Anatomy Institute, Faculty of Medicine, University Sarajevo, were used for the research that has been carried out. Results of measuring of articulating surface caput mandibulae along longer axis (mediolateral diameter) indicate that there are no differences in size of this surface between right and left joints. Results of measuring of articulating surface caput mandibulae along shorter axis (anteroposterior diameter) indicate differences in values of this diameter between right and left sides. Judging by statistical evaluation, differences are highly significant on the level of probability $p<0,01$. The research has shown differences in the size of this joint surface, on right and left sides, but only in antero-posterior direction. This original scientific work will help better of relationship of TMJ surfaces, what is necessary for treatment of TMD and occlusal imbalances.

KEY WORDS: Articulating surface caput mandibulae, longer axis (mediolateral diameter), shorter axis (anteroposterior diameter)

Introduction

Anatomically and functionally, temporomandibular joint (articulatio temporomandibularis) is specific joint, articulatio condylaris (ellipsoidea). It is divided into joint bodies including joint surfaces (facies articularis fossae mandibularis and articulating surface caput mandibulae), discus articularis, capsula articularis and ligaments. To date, many researches pertaining to shape, size and position of joint bodies in relation to vertical, horizontal and sagital planes have been carried out (1,2,3,4,5,6,7). Numerous works involved close, inevitable relation of temporomandibular joint with existence of teeth and/or type of occlusion. Two antagonizing dental rows constitute the factor that plays dominating role in ascertainment of mutual positions of joint bodies within the joint; in their final relation, they determine definite

spatial relation of craniomandibular relationship (9, 10, 11). Speaking about temporomandibular joint as an anatomic entity or speaking about it in gnathological occlusal concept means having the possibility of multiple, but definitely not complete, approach to this issue. In this research, the attention will remain focused on morphology of joint bodies, more precisely on morphology of lower joint surface. Position of this joint surface within joint is labile; it is defined by the occlusion of lateral teeth (11). Lower joint surface is located on caput mandibulae. Its mediolateral diameter is approximately 20 millimeters while anteroposterior one is 10 millimeters. However, many researchers agree that there are individual variations in the size of this joint surface.

Aim

Aim of research is obtaining data on size and morphological features of articulating surface of caput mandibulae through osteometry in the position of maximum intercuspidation.

Materials and Methods

Macerated human skulls of both genders, age between 30 and 45, were subject to the research. These skulls belonged to Caucasian Race. The sample was composed of 17 congruent skulls that were included in the research through target selection. Highly precise electronic 3D measuring machine DEA-A001 was used for osteometry. This machine belongs to family R measuring system, type R-08. It provides spatial coordinates X, Y and Z for each referential point on the subject of measuring and/or its numerical values (Figure 1). For the purposes of this research, measuring head of the system was equipped with electronic sound with conical diamond tip which could have been precisely applied on any desired point of measuring surface (Figure 2). Considering that the aim of the research was measuring lower joint surface and perceiving its morphological features from gnathological occlusal aspect, primary and basic task was bringing mandible into central occlusal position through occlusal surfaces of mandible and maxilla dental rows. Subsequently, each sample skull was placed on the desk of DEA machine where coordination system of the skull was harmonized with coordination system of measuring machine. Hence, the skull, including the lower jaw which had been previously brought into central occlusal position in relation to maxilla and fossae mandibularis ossis temporalis on the right and left sides of the skull, was placed in the position "norma frontalis". Frankfurt horizontal line (FH) was

FIGURE 1. Highly precise electronic 3D measuring machine DEA-A001

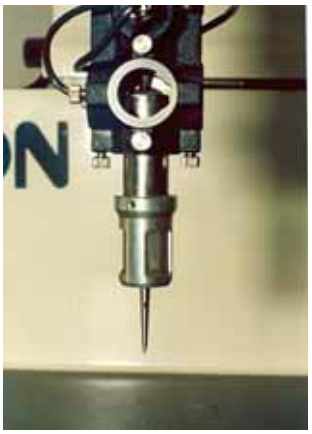

FIGURE 2. Measuring head of the system was equipped with electronic sound with conical diamond tip

used as a starting point for adjustment of coordination systems. Firstly, FH was determined for each skull and placed in position where it was parallel to Y coordinate and XY plane of Euclid space of measuring system. Subsequently, the skull was severed from mandible which remained on plastic pedestal, oriented in space in its natural position in relation to horizontal, vertical and sagital planes of the skull (Figure 3). In this manner, it was achieved that surfaces chosen for analysis and measuring were accessible to diamond head on measuring sound. For each measured point along three coordinates, contacts were transformed into electric impulses which were then transformed through appropriate transmitters into numerical values shown on display. We were able to calculate all vertical, horizontal and sagital distances between referential points from these values, as well as slopes and angles relevant to ascertainment of their position in space. It is important to note that sound signal was received during the contact of diamond head with

FIGURE 3. Scull in norma lateralis position

referential point meaning that values of measuring point were obtained without compression exhorted upon subject of measuring. On other hand, values could not have been obtained if contact was not made. In acribic terms, this indicates high degree of accuracy of measuring. The following were measured: articulating surfaces caput mandibulae of the right and left joints in mediolateral (along longer axis) and anteroposterior (along shorter axis) directions. Output data pertaining to all referential points on bone structures of articulating surface caput mandibulae were printed on metalized tape as alphanumerical values. They were entered into working charsts, as well as analyzed and processed statistically.

Results

The outcome of the research is presented in Charts based on statistical evaluation of data. Through the interpretation of results shown in the Charts, the answer to the set goal of the research was obtained. The overview of average values on longer axis of articulating surface caput mandibulae (mediolateral diameter), standard deviation, variation quotient, significance of differences in terms of this feature between right and left sides, correlation between sides and significance of correlation have been provided in Table 1. It is clear from the Table that the average value of articulating surface caput mandibulae along longer axis is 18,6625 mm on the right side and 18,7795 mm on the left side of skull. Surfaces on the right and left sides vary, as shown in the Chart. Value of t test indicates that these differences are insignificant. Correlation quotient between right and left sides is visible. Found values obtained through measuring of longer axis, as well as lack of differences between right and left sides, correspond to other authors' results; 15 – 20 mm (12); 19,7 mm (7). Table 2. provides an overview of average values obtained through measuring of mandibular joint surface along its shorter axis (values obtained in y-plane), standard deviation, value of t test, significance of differences between sides, correlation between sides and significance of correlation. The results showed that the average value of measured surface along shorter axis

PARAMETERS OBSERVED	SIDES	STATISTICAL PARAMETERS					Value of t test significance of differences between sides	Correlation between sides and significance of correlation
		Number of units in sample (n)	Arithmetic average (x)	Standard deviation (ox)	Standard error (ox)	Variation quotient (v)		
Articulating surface CAPITIS MANDIBULAE LONGER AXIS	R	17	18,6625	1,1824	0,2868	0,0634	t=0,3914 (p>0,05) Differences are insignificant	r=0,4683 Visible t=2,0527 (0,05<p<0,10) Significant
	L	17	18,7795	1,1353	0,2754	0,0605		

TABLE 1. Average value, significance of differences, correlational relationship, strength of correlational relationship and significance of correlation of observed parameters, X –AXIS

PARAMETERS OBSERVED	SIDES	STATISTICAL PARAMETERS					Value of t test Significance of differences between sides	Correlation between sides and significance of correlation
		Number of units in sample (n)	Arithmetic average (x)	Standard deviation (ox)	Standard error (ox)	Variation quotient (v)		
Articulating surface CAPITIS MANDIBULAE SHORTER AXIS	R	17	6,3254	0,9931	0,2409	0,1570	t=2,9895 (p<0,05) Differences are significant	r=0,6425 Visible t=3,2474 (p<0,01) Significant
	L	17	5,7372	0,8388	0,2034	0,1462		

TABLE 2. Average value, significance of differences, correlational relationship, strength of correlational relationship and significance of correlation of observed parameters, Y –AXIS

(anteroposterior diameter) on the right side was 6,3254 mm, while on the left side it was 5,7372 mm. The found values indicate the differences between right and left sides, statistically very significant, on the level of probability p<0,01. The results correspond to the results of research of some authors who pointed out the differences in size of this joint surface (13), while they are in contravention with the research of some authors who did not find significant differences between right and left sides (7). With regard to the average values of anteroposterior diameter obtained through this research, it can be said that they correspond with the opinions of other researchers (2, 12), Values obtained through this research are somewhat lower than values obtained through Jerolimov's research from 1978; (6,6 mm).

Conclusion

Results of measuring of articulating surface caput mandibulae along longer axis (mediolateral diameter) indicate that there are no differences in size of this surface between right and left joints. Results of measuring of articulating surface caput mandibulae along shorter axis (anteroposterior diameter) indicate differences in values of this diameter between right and left sides. Judging by statistical evaluation, differences are highly significant on the level of probability p<0,01.

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