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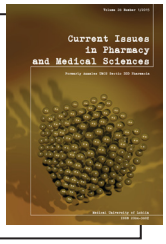

Temporomandibular joint assessment in patients with articular disc displacement by way of computed tomography - radiological parameters of shape, size and location of mandibular heads

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ABSTRACT

Conventional and modern methods of radiological imaging are often used in the diagnosis of temporomandibular joint disorders, and the CT technique is particularly characterized by an excellent visualization of bony structures. The aim of the study was to show the importance and role of CT in the evaluation of TMJ bone structures in both patients with articular disc displacement and in a group of healthy subjects. Both study groups were assessed with the use of the transverse plane. Herein, multi-slice spiral computed tomography was performed in 47 subjects. These individuals were qualified for CT by way of magnetic resonance imaging, due to their being diagnosed with a displacement of their temporomandibular joint disc. The product of our study is presented as a set of tables. These are comparisons of radiological parameters based on the shape, size and location of the mandibular head, in the examined patients, in a control group, and with regard to sex. The results of our work indicate that CT can be successfully used in the imaging of TMJ bone structures, specifically, the condylar process of the mandibular head and the joint socket. However, statistically significant differences of the utilized parameters between patients with articular disc displacement and controls, warrant further analysis of this issue.

INTRODUCTION

Diagnostic imaging procedures are an important supplement to clinical examination in patients with temporomandibular joint (TMJ) disorders. Classical radiographic projections, as well as modern imaging modalities, are used to visualize structures of TMJ, as well as a wide range of other pathologies [10,14]. Among modern imaging techniques, multi-slice computed tomography (MSCT) allows for the optimal visualization of bony structures with regard to TMJ.

The aim of the study was to analyze the effectiveness of MSCT for assessing the bony structures of TMJ, both in patients diagnosed with dislocation of articular disk (AD), and in the general population, with the applied measurements performed in the axial plane. Objective parameters were used for description of shape, size and position of mandibular head in the AD patients and in a control group, with regard to gender.

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MATERIALS AND METHODS

The studied group consisted of 47 patients (33 females (70.21%) and 14 males (29.79%). Herein, the diagnosis of dislocation of AD was based on an MRI examination (this being a modality of choice for AD visualization). The clinical examination of the studied group included their medical history, an assessment of the pain they experience in the temporal region or TMJ, and their range of mandible movement.

The control group included 10 patients, 6 males (60%) and 4 females (40%). These individuals were diagnosed for pathologies not related with TMJ, and the range of

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examination included TMJ. Clinically, no signs of masticatory dysfunction were observed.

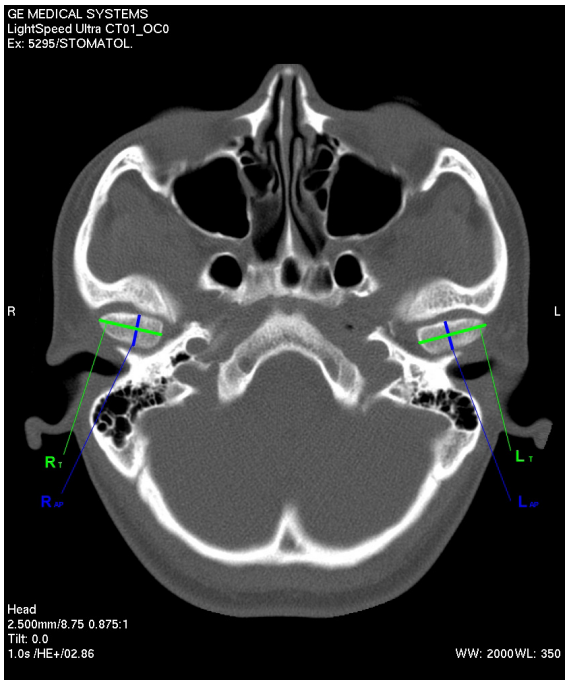

Figure 1. Maximal transverse and anteroposterior diameter of the condylar process of the mandible

Scanning was performed in the plane perpendicular to the base of the skull, with the set of followed parameters being: matrix:512×512 mm, kv:120, mAs:60-160, pitch:0.875:1, table feed:8.75 mm, slice thickness:0.5-1.25 mm, window: WW:2000HU, WL:350HU. Post-processing utilizing the Advantage Windows 4.2 workstation, created a set of axial images which consisted of multi-planar reformations (MPR). This allowed for the visualization of TMJ in all planes,

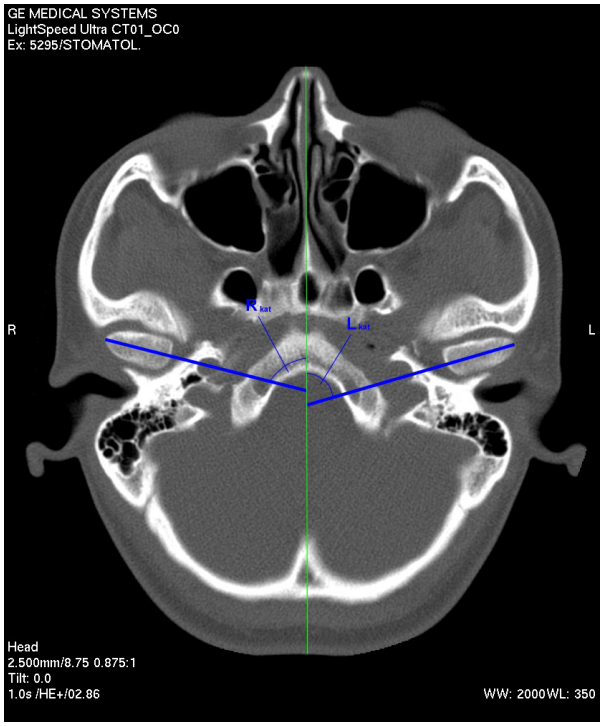

Figure 2. Angulations of long axis of right and left condylar process of the mandible

however, all measurements of TMJ space were performed in the sagittal plane. Complimentary analysis of the shape of mandibular heads was performed by way of the Volume Rendering (VR) application. The generated three-dimensional VR reformations allowed for the complete analysis of the bony structures, including pathological deformations.

The following parameters, introduced by Vitral and Telles [13], were used in the axial plane for analysis of the shape, size and position of the mandibular heads: R_T, L_T: maximal transverse dimension of right and left condylar process of mandible (Fig. 1); R_{AP}, L_{AP}: maximal antero-posterior dimension of right and left condylar process of the mandible; R_{ANG}, L_{ANG}: angle between RL and LT and median plane (Fig. 2); R-L: distance of projections of geometric centers or right and left condylar process to the median plane (Fig. 3).

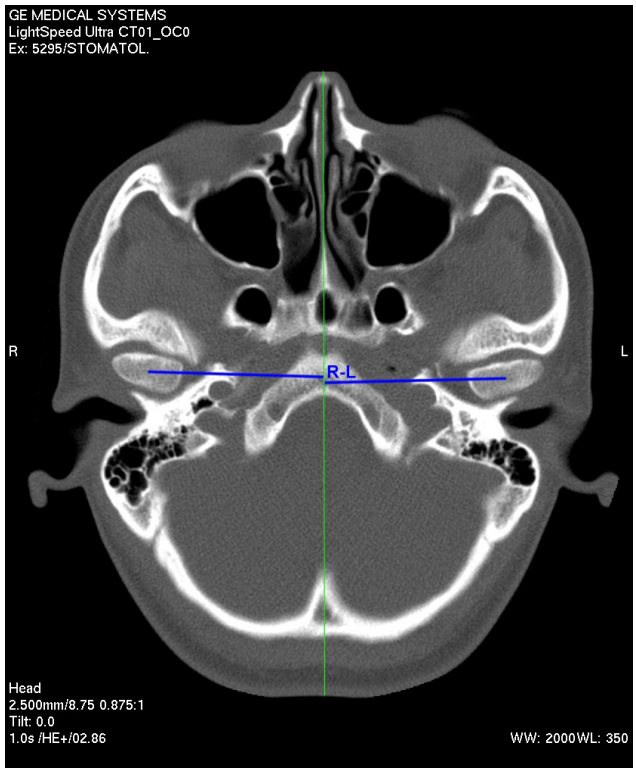

Figure 3. Distance of median projections of the geometric centers of the right and left head of the mandible

Statistical analysis of the obtained measurements was performed utilizing the statistical software package STATISTICA 6.1.

RESULTS

In our inquiry, we compared MSCT-based parameters describing the shape, size and position of mandibular heads. The result of such work was that descriptors of the largest transverse dimension of the right and left condylar process of the mandible (R_T and L_T), as well as the largest antero-posterior dimension of the right condylar process (R_{AP}) were not statistically different in the study group and in the control group. However, a statistically significant difference ($p = 0,02$) was observed for the antero-posterior dimension of the left condylar process (L_{AP}). No statistically significant differences of angles between the long

axis of the right and left condylar process and the median plane, as well as distance between the geometric centers of the mandibular heads (R-L) were observed between the study group and the control group (Tab. 1).

Table 1. Comparison of radiological measurement of shape, size and position of the mandibular head in the study and in the control group

Parameter	Group	Mean	SD	Median	Min.	Max.	Upper quartile	Lower quartile	p
R_T	s	18.87	2.17	19.00	14.8	23.9	17.5	20.2	t=-0.63
	c	19.34	2.05	18.70	16.9	23.4	18.1	21.2	p=0.53
R_{AP}	s	7.61	1.32	7.60	4.8	10.5	6.5	8.3	t=-1.18
	c	8.16	1.37	8.05	5.9	10.3	7.3	8.7	p=0.24
L_T	s	18.28	2.54	18.50	12.6	23.4	16.2	20.0	t=-1.48
	c	19.58	2.35	18.85	17.1	24.4	17.8	21.2	p=0.14
L_{AP}	s	7.77	1.37	7.90	5.1	10.4	6.7	8.9	t=-2.46
	c	8.89	0.92	8.70	7.1	10.3	8.4	9.5	p=0.02
R_{ANG}	s	69.76	5.74	69.00	60.8	88.0	66.0	73.0	t=-1.27
	c	72.61	9.11	68.30	63.3	87.4	66.0	82.0	p=0.21
L_{ANG}	s	69.68	7.14	68.00	57.0	87.0	64.1	75.5	t=0.83
	c	67.60	7.06	68.35	58.4	77.8	60.7	73.9	p=0.41
R-L	s	-0.06	3.16	-0.45	-6.3	6.5	-2.9	2.6	t = 1.41
	c	-1.53	1.87	-1.70	-4.0	2.4	-2.7	-0.6	p = 0.16

Gender differences of the utilized parameters were not statistically significant, yet, the values of linear measurements in males were larger (Tab. 2). Moreover, a comparison of parameters of describing the size, shape and position of the right and left mandibular head in the control group according to the gender of subjects did not reveal any statistically significant differences (Tab. 3).

Table 2. Comparison of radiological measurement of shape, size and position of the mandibular head in the study group, and in males and females (F/M – 33/14–70.2%/29.8%)

Parameter	Group	Mean	SD	Median	Min.	Max.	Upper quartile	Lower quartile	p
R_T	F	18.75	1.97	19.00	14.9	23.9	17.5	20.0	t=0.58
	M	19.15	2.65	18.95	14.8	23.3	17.6	20.9	p=0.57
R_{AP}	F	7.58	1.32	7.50	4.8	10.2	6.7	8.3	t=0.24
	M	7.69	1.37	7.65	5.6	10.5	6.5	8.4	p=0.81
L_T	F	18.02	2.19	18.30	13.9	22.4	16.2	19.5	t=1.06
	M	18.89	3.24	19.30	12.6	23.4	16.5	21.7	p=0.29
L_{AP}	F	7.78	1.39	8.20	5.1	9.9	6.8	8.9	t=-0.07
	M	7.75	1.38	7.85	5.1	10.4	6.7	8.7	p=0.95
R_{ANG}	F	69.84	6.36	69.00	60.8	88.0	65.0	73.0	t=-0.14
	M	69.57	4.28	68.85	61.0	76.0	67.0	73.9	p=0.89
L_{ANG}	F	70.63	7.77	68.00	57.0	87.0	64.8	77.7	t=-1.38
	M	67.41	4.89	66.50	60.1	76.0	64.0	72.0	p=0.18
R-L	F	-0.03	3.19	-0.30	-6.3	6.0	-3.2	2.7	t=-0.07
	M	-0.11	3.23	-1.50	-3.5	6.5	-2.8	1.2	p=0.95

Table 3. Comparison of radiological measurement of shape, size and position of the mandibular head in the control group, and in males and females (F/M – 4/6 – 40%/60%)

Parameter	Group	Mean	SD	Median	Min.	Max.	Upper quartile	Lower quartile	p
R_T	F	19.03	1.69	18.70	17.4	21.3	17.80	20.25	t=0.38
	M	19.55	2.40	18.85	16.9	23.4	18.10	21.20	p=0.72
R_{AP}	F	8.00	1.48	7.40	7.0	10.2	7.15	8.85	t=0.29
	M	8.27	1.42	8.35	5.9	10.3	8.00	8.70	p=0.78
L_T	F	19.40	1.70	19.30	17.8	21.2	17.95	20.85	t=0.19
	M	19.70	2.86	18.75	17.1	24.4	17.50	21.70	p=0.86
L_{AP}	F	8.80	1.24	9.10	7.1	9.9	7.90	9.70	t=0.24
	M	8.95	0.77	8.65	8.3	10.3	8.40	9.40	p=0.82
R_{ANG}	F	74.33	11.34	74.00	63.3	86.0	64.65	84.00	t= -0.46
	M	71.47	8.26	68.30	65.0	87.4	66.70	73.10	p=0.65
L_{ANG}	F	67.90	9.77	67.70	58.4	77.8	59.55	76.25	t= -0.1
	M	67.40	5.69	68.35	58.7	73.9	63.30	71.80	p=0.92
R-L	F	-0.73	2.60	-0.80	-3.7	2.4	-2.70	1.25	t=-1.13
	M	-2.07	1.17	-1.85	-4.0	-0.6	-2.70	-1.40	p=0.29

DISCUSSION

Multi-slice computed tomography examination allows for an objective assessment of the distances of mandibular heads, specifically the largest transverse and antero-posterior dimensions of these structures. In addition, multi-slice computed tomography makes it possible to objectively measure the distance of the geometrical centers of the right and left condylar process, from the median plane, as well as the angle between the transverse dimension of the right and left mandibular head and the median plane.

The presented data reveals that only minimal differences in the CT-based measurements of the mandibular heads exists between the study and the control group. However, in patients with no dysfunction of the TMJ, transverse and antero-posterior dimensions of mandibular heads are insignificantly larger than in patients with TMJ dysfunction. Furthermore, no statistically significant gender-related differences of shape, position and size of mandibular heads were observed.

To our knowledge, no previous studies are available in current literature on the configuration of the mandibular head and the joint space in patients with a dislocation of the AD of the temporo-mandibular joints.

However, single reports suggest tentative research has been done on the relationship between the dislocation of AD of the temporo-mandibular joint and the shape of the mandibular head [3,4,11]. Moreover, other authors do confirm that the dislocation of AD of the temporo-mandibular joint leads to the remodeling of the bony structures of TMJ (e.g. deformation and arthritic changes of the mandibular heads), as well as changes of position of the condylar process within the articular fossa [1,2,5,6,7,8,9,12].

Objective assessment of the bony structures of TMJ, plus measurements of the mandibular head and the mandibular fossa, will allow for independent and comparative diagnostics, especially in diseases and dysfunctions of TMJ. In

addition, it will possibly lead to improved objective analysis, and better interpretation of both the etiology and pathology of the disorders of TMJ, as well as the clarification of clinical and radiological findings for improvement of the treatment.

CONCLUSIONS

Application of multi-slice computed tomography allows for the reliable visualization of the bony structures of TMJ: the condylar process of the mandible and the mandibular fossa, the position, size and shape of the mandibular head.

Regarding the utilized parameters, the maximal transverse dimension of the condylar process was minimally larger in the control group and in males in general, as was the maximal antero-posterior diameter of condylar process, albeit to an insignificant degree, However, the angulation of the transverse axis of the mandibular head was minimally larger in females, but comparable in both the study and the control group. This situation was the same with regard to the distance of the projections of the geometric centers of the condylar processes to the medial plane (undertaken to assess possible asymmetry). To conclude, the presented measurements allow for an objective presentation of configuration of the mandibular heads, their shape and size, and enable a detailed analysis of pathologies of bony structures of TMJ.

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