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THE STUDY OF TEMPOROMANDIBULAR JOINT IN DENTOFACIAL ABNORMALITIES USING CONE BEAM COMPUTED TOMOGRAPHY

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Abstract

The article deals with the symmetry of dentofacial abnormality of temporomandibular joint, the position of mandible and rotation edges of temporomandibular joint heads in dentofacial abnormalities.

The aim of the investigation is to compare the analysis of temporomandibular joint symmetry, the position of mandible and rotation edges of temporomandibular joint heads in dentofacial abnormalities based on the first and the second type of classification by Angle.

The investigation was carried out among 27 patients with dentofacial abnormalities using cone beam computed tomography. The patients were divided into two groups based on types of malocclusion - the first type of occlusion by Angle and the second one by Angle's classification.

While studying the distance from the middle of articular heads on the right and on the left to midline, passing through pterygoid processes of sphenoid bone it was determined that in the second class of Angle's classification of dentofacial abnormalities, articular heads are situated posteriorly to cranial basis on 2.45-3.47 mm ($p<0.005$).

The difference between the rotation edges of temporomandibular joint heads is more than 5° of the 1st class according to classification and it occurred in 23.08% of patients; the second class occurred in 64.29%. The range of maximal difference of the rotation edge of the 1st class contains 5.2°, and the 2nd class of Angle's classification includes 15.2°, that determines the severity of dentofacial abnormality of the second classification by Angle.

In the second type of Angle's classification articular heads of temporomandibular joint are situated posteriorly that confirms the pathogenesis of distal bite. Proposed methods of measurement can be used for differential diagnosis of skeletal forms of second type dentofacial abnormalities according to Angle's classification. With increase of dentofacial abnormality severity, rotation of temporomandibular joint heads also increases. In the second type of Angle's classification asymmetry of articular heads occurs on the right and left, three times more often in comparison with the first class.

Keywords: *dentofacial abnormalities, temporo-mandibular joint, cone beam computed tomography.*

Introduction

In XXI century dentofacial abnormalities have a tendency of significant prevalence among population of all countries. Dentofacial abnormalities occur from 82% to 90% among adults [*Kaskova L et al., 2015*]. More than 60% of the patients with dentofacial abnormalities have the 1st class malocclusion. Abnormalities of the 2nd class occur in 24.5% of cases, meanwhile 38.5% of the cases present unilateral malocclusion [*Kuroedova V, Makarova A, 2013*]. This can be caused by both heredity and complication of odontogenic infection [*Kuong V et al., 2014*].

Such asymmetric correlation of molars (distal and neutral) is the most difficult variant of bite pathology of occlusion by Angle's classification. The prevalence of dentofacial abnormalities has been stable over 100 years. The etiological pathogenesis of such disorders has not been studied yet [*Kuroedova V, Makarova A, 2013*].

Based on the literature data, from 27% to 76%

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of the patients, who seek for dentist help, complain of discomfort, gnash, crepitus during speech and meal intake as well as pains in the region of temporomandibular joints [*Kuroedova V et al., 2017*].

Adaptive ability to occlusive disorders varies in different patients. Some of them adapt to significant malocclusion painlessly and others have serious symptoms of muscular dysfunction in insignificant morphological problems.

According to different data, the spread of temporomandibular joint abnormalities occurs in 65% of population and it is one of the most frequent causes of visit to dental clinics [*Kuroedova V et al., 2017*]. The appearance and development of this pathology is influenced by patients' conditions and lifestyle, the state of their chewing system and a number of other factors [*Arev A et al., 2007*; *Melchior M et al., 2012*]. Pathology of temporomandibular joint dysfunction (TMJ) is observed in 20-25% of cases with various dental diseases. Among orthodontic patients, dysfunction of temporomandibular joint occurs in 70-75%. [*Ishmurzin PV, 2012*].The malocclusoins, in particular distal and deep bite, play an important role in the etiology and pathogenesis of TMJ disorders [*Andreeva I et al., 2013*].

Diseases of temporomandibular joint develop in early infancy. Orthodontic treatment is associated with the change of ordinary occlusion and mandible displacement which might lead to temporomandibular joint function disorder [*Kuroedova V et al., 2017; Schiavoni R et al., 2017*]. Some authors point to a correlation between the position of the condyle and the kind of malocclusions in 34-87% of cases, depending on the number of subjects [*Silin A, 2003*]. On the other hand, other authors regard that the condyle position is independent of the type of occlusion [*Petrosov Yu, 2007; Shipika D, 2012*].

Thus, according to the results of the research, comparing the average width size of the condyles in the sagittal plane, an asymmetry increased from the class I malocclusions to class III, which indicates changes in the shape of the condyles depending on the position of the mandible in sagittal plane [*Kuroedova V et al., 2017*].

Visualization and objective evaluation of temporomandibular joint in children is necessary to determine clinical disorders of structure and functions of the joint [*Bogatova E, 2013*].

The method of cone beam computed tomography (CBCT) of temporomandibular joint is the most informative. It helps to detect and visualize all elements of temporomandibular joint which is impossible with other traditional method of X-ray investigation [*Vitral R et al.,* 2011].

Viazmin A.Ya. (1999) suggested to use the reconstruction of CBCT in coronary projection [*Bogatova E, 2013*]. To detect distal dislocation of articular heads it is necessary to reconstruct of CBCT in axial and sagittal projections.

The analysis of modern foreign and native literature showed that there are many methods of CBCT scoring in different pathological conditions of temporomandibular joint, however the evaluation in cephalometric positions and characteristics of edges of rotation of temporomandibular joint heads of different dentofacial abnormalities has not been found.

The aim of the investigation is to evaluate the symmetry of temporomandibular joint, the position of mandible and edges of rotation of temporomandibular joint heads in dentofacial abnormalities of the first and the second classes by Angle's classification. The high prevalence of TMJ dysfunction in modern population, the lack of a unified view on the influence of malocclusions on development of TMJ dysfunction makes the topography study of the condyles an actual scientific problem [*Kuroiedova V et al., 2017*].

Material and methods

The investigation was carried out among 27 patients with dentofacial abnormalities who seek for dentist help in Poltava regional dental clinic. Patients were divided into two groups based on malocclusion types. The first group consisted of 13 patients with the first class of Angle's classification and the second one included 14 patients of the second class. Among examined patients there were 15 females and 12 males with mixed bite and 15 ones with permanent one.

All patients underwent cone beam computed tomography. This procedure was carried out by means of dental computer tomograph PAX-ZENITH 3D (VATECH, USA), with 1 *mm* step of scanning. The duration of scanning is 15 *secs* with general beam load of 50 *μSv.* CT analysis was per-

formed in the Ez3D2009 program.

Measurement methods. During the CBCT study in Ez3D2009 program 3-D reconstruction of facial skeleton as well as the projection of maxilla-facial area in three areas - coronal, sagittal and axial can be received on the monitor. Before the investigation of TMJ parameters it is necessary to identify tomographic sections, which can pass to the centre of articular head. All further measurements of CBCT were carried out on axial section, on which the length of the articular head (AD) – between the most disposed points A and D in mesiodistal direction and the width of the articular head (CB) between C and B in anterior and posterior direction was depicted. Points of transections AD and CB were depicted as centres of TMJ heads – O_L and O_R on the left (L) and on the right (R). The connection of points O_L – O_R is called an articulated axis Sh.

Vertical line of symmetry (Sm) is made in the centre of pharyngeal spine of occipital bone (point Basion) and basis of vomer. The line of symmetry Sm passes in the projection of sagittal joint and cephalometric points Ba (Basion), Op (Opistion), Bo (Bolton Point).

Points F were defined on the left (L) and on the right (R) on anterior edge of pterygoid process of sphenoid bone F_L and F_R (Figure). The combination of points F_L and F_R received pterygoid line K, concerning them.

It is known, that sphenoid bone takes part in the formation of cranial vault and pterygoid processes are stable areas and this allows to study the position of mandible in anterior and posterior directions to cranium.

To determine the rotation of mandible and position of TMJ perpendiculars were made from pterygoid line K to the centre of articular heads of TMJ – $O_{L;}$ O_R and KO_L.; $KO_{R.}$ lines were received.

Edges of rotation ($\angle R_{L;}$ $\angle R_R$) of TMJ heads were formed by line symmetry (Sm) and prolonged line AD- parameter of the length of the TMJ head.

Investigation results were processed using statistic pack of "Statistica© for Windows 6.0" licensed program as well as "Microsoft Excel 2003" with accuracy the level of $p<0.05$.

RESULTS AND DISCUSSION

Data of the width of articular heads of TMJ contain 7.3±0.28 *mm*, the length 16.46±0.64 *mm*

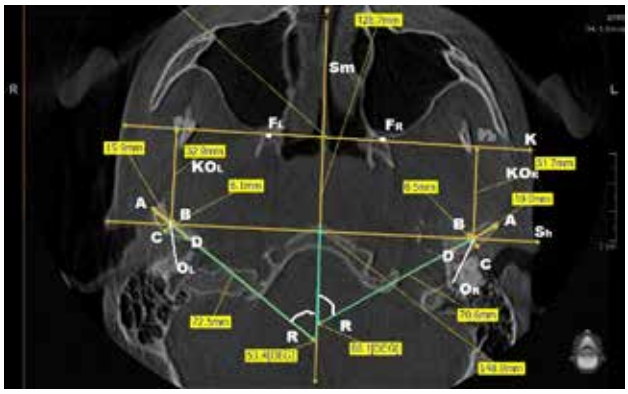

FIGURE. CT parameters measurement scheme of TMJ in axial projection

(the first type of Angle's classification). These indices do not significantly differ and contain 7.33±0.39 *mm*, and 16.45±0.71 *mm* (the second type of Angle's classification). So, the type of dentofacial abnormalities doesn't affect the sizes of articular heads (Table 1).

The sizes of TMJ heads (length and width) on the left (O_L) and on the right (O_R) in both the 1st and in the 2nd groups did not have statistical differences.

Having studied the distance from middle of articular heads on the right (KO_R) and on the left (KO_L) to the line passing through the basis of pterygoid process of sphenoid bone K, it has been concluded that articular heads in the second class dentofacial abnormalities by Angle's classification are situated posteriorly to the basis of cranium on 2.45-3.47 *mm* ($p<0.005$). There is symmetry in sizes of articular heads in both examined groups (Table 2).

Thus, received data on CBCT also confirm etiological and pathological mechanisms in the development of distal bite which are connected with mandible displacement. It is important that presented methods can be used to identify skeletal forms of dentofacial abnormalities of the 2nd class by Angle and their differential diagnosis.

TABLE 1

The width and length of TMJ heads (in *mm*) in different dentofacial abnormalities

I class		II class	
R	L	R	L
The width of TMJ heads			
7.2±0.27	7.4±0.3	7.42±0.35	7.24±0.44
The length of TMJ heads			
16.76±0.66	16.16±0.63	16.57±0.76	16.33±0.67

Table 2

The distance from the centre of the TMJ head to the basis of pterygoid process of sphenoid bone (in *mm*) and the edge of TMJ rotation (in degrees)

I class		II class	
R	L	R	L
The distance from the centre			
25.55±0.87	26.34±1.07	28.±0.66	29.81±0.93
The edge of rotation			
59.74°±1.02°	59.83°±1.02°	56.89°±3.58°	58.94°±3.58°

The edge of the rotation of TMJ articular heads of the 1st class on the right is 59.74°±1.01, and it is 59.83°±1.43 on the left; the second class presents such results on the right – 56.89°±3.58, and it is 58.94°±3.57 on the left. Thus, the difference between edges of rotation of TMJ articular heads of the 1st class is more than 5 degrees in 23.08% patients, and it 3 times exceeds in the 2nd class, making 64.29%. The range of maximal difference of the edge of rotation of the 1st class is 5.2°, and it is 15.2° of the 2nd class. It exceeds in three times in the 2nd class and thus it confirms that with severity of dentofacial abnormalities rotation of TMJ heads increases while sizes are without changes (Table 2). It is important that possibility of asymmetric forms of pathology in the 2nd class increases in threefold.

Such data can determine significant possibilities of TMJ, myofunctional imbalance of which causes the change of the edge of rotation of TMJ heads.

Conclusion

Suggested methods can be used in diagnostics and for the differential diagnosis of skeletal form of the 2nd class dentofacial abnormalities by Angle.

Articular heads of TMJ are situated posteriorly on 2.45-3.47 *mm* in the 2nd class by Angle's classification and it confirms the pathogenesis of this pathology.

Sizes of articular heads of TMJ statistically do not differ from the malocclusion in the 1st and 2nd classes by Angle's classification.

The level of rotation of TMJ heads increases with the severity of dentofacial abnormalities.

Asymmetric forms occur three times more often in the 2nd class in comparison with the 1st class by Angle's classification.

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