

**THE EVALUATION OF HEADS OF TEMPOROMANDIBULAR JOINT (TMJ) POSITION IN PATIENTS WITH MALOCCLUSION****STASIUK A.A., VYZHENKO YE.YE., MAKAROVA A.N.,  
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*Received 14.01.2019; accepted for printing 03.12.2019***ABSTRACT**

*This article is concerned with the evaluation of temporomandibular joint position, symmetrical heads position, timely diagnostics of dentofacial abnormalities. The aim of the investigation is to study position and evaluate symmetry of condyles of temporomandibular joint of dentofacial abnormalities based on Angle's classification of malocclusion (the first class includes normal jaw relations; the second one contains distal position of mandible, the third class includes medial position of mandible).*

**Materials and methods.** 70 patients were involved in the investigations that have dentofacial abnormalities. cone beam computed tomography was also used. Based on Angle's classification, all patients were divided in three groups: 1<sup>st</sup> group included 34 patients (the first class), 2<sup>nd</sup> group included 30 patients (the second class), 3<sup>rd</sup> group included 6 patients (the third class), 34 male patients and 36 female patients were involved in the investigation aged from 8 to 29 years old. The reveal of heads of temporomandibular joint position was done by H Gelb in medial sagittal plane of joint.

**Results.** Based on results of our investigation, it has been established that patients having bite abnormalities and correct position of temporomandibular joint heads on either side of position 4/7, only 8 patients are involved in this group (11.43 %). Based on Angle's classification (the 1<sup>st</sup> class) symmetrical position of heads of that joint in 4/7 was indicated 17.65 %, the second class includes 6.67 %, the third one contains no one case was established. Despite bite abnormality, number of patients with correct position of condyles in segment 4/7 from 20 % to 5 % is decreased. Besides pathology is caused by increase of asymmetrical correlations of condyles of the joint in the segments with 6.67 % to 50 % (based on Gelb).

**Conclusions.** Despite class of bite pathology symmetrical position of heads in position 4/7 is occurred only in 11.43 % cases, and it indicates the correlation between dentofacial abnormalities and temporomandibular joint pathology, correspondingly complex approach to treatment of orthodontic patients is simply correct. Number of patients with optimal position of heads of the joint in segment 4/7 with 17.65 % based on 1<sup>st</sup> Angle's classification, to 6.67 % based on 2<sup>nd</sup> Angle's classification, absence of patients of the 3<sup>rd</sup> class is decreased. Age dynamics of rotational displacement of the centre of condyles is pointed, and it can affect negatively joint function.

**KEYWORDS:** Malocclusion, dentofacial abnormality, temporomandibular joint, cone beam CT.**INTRODUCTION**

The problem of medical rehabilitation of patients with bite abnormalities (malocclusion) has

attracted the attention of dentists for several decades, because this problem is explained by the constant increase in its prevalence in children, adolescents and adults [Kuroedova VD et al., 2017c].

Dental abnormalities create aesthetic disorders and are accompanied by functional disorders of the maxillofacial organs, play a role in the pathogenesis of the temporomandibular joint (TMJ) disease.

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According to literature data, from 27% to 76% of patients who addressed to dentist, they complain of discomfort, gnashing, crunching when talking and eating, crepitus, pain in the area of TMJ [Kuroedova V et al., 2017a]. A number of scientists the occurrence of sleep apnea (obstructive sleep apnea) is associated with the position of the lower jaw and tongue [Jefferson Y, 2009].

Michael L Gelb indicates that the position of the TMJ and occlusive factors affect the airway passage. According to this philosophy of "Airway Centric TMJ Philosophy," therapeutic measures should be aimed at normalizing breathing: firstly the respiratory tract, then the joint and muscles, and finally the occlusion [Huang Y, Guilleminault C, 2009].

Orthodontists – advocates of the FACE philosophy, consider the normal functioning and position of the TMJ as one of the most important goals of orthodontic treatment, along with facial aesthetics, dental aesthetics, healthy periodontal tissues and airways [Friction J et al., 1995].

Diseases of the TMJ are a common pathology of the maxillofacial area, which in terms of frequency takes the third place after caries and periodontal disease. According to the results of studies by many authors, from 36% to 75% of the population have various dysfunctions of the TMJ [Gelb M, 2014]. The inconsistency of data on the prevalence of clinical manifestations of TMJ dysfunction is due to a number of reasons: the lack of diagnostic algorithms and standard clinical and supplementary examination methods, accepted concepts for treating patients with TMJ dysfunction syndrome.

More researchers consider that occurrence of abnormalities of the TMJ disease results as the impact of a combination of a number of adverse factors that can reinforce each other [Badel T et al., 2012]. The most significant of them: dysfunction of the masticatory muscles, the presence the hypersthenia, spasm, the occurrence of trigger points in the muscles [Trezubov VN et al., 2005]. According to some authors, up to 73% of patients with symptoms and signs of functional disorders of the TMJ have the same etiological factors as the main disorders of occlusion, which are associated with the presence of premature contact and a decrease

in interalveolar height [Luther F, 2007].

One of the important points of stability of orthodontic treatment are therapeutic measures aimed at creating a central position of the heads of the mandible and stable occlusion, that is, there is an inextricable link between occlusion and the position of the TMJ heads. There are many publications proving that orthodontic treatment can reduce the symptoms of TMJ dysfunction [Michelotti A, Iodice G, 2010; Coelho T, Caracas H, 2015].

One of the most significant problems in modern dentistry is the timely diagnosis of TMJ pathology, which is associated with certain difficulties: the complexity of the anatomical structure of the joint, the multifactorial nature of the occurrence of TMJ dysfunctions. Therefore, for the diagnosis of diseases of the TMJ, along with clinical and laboratory research methods (survey, examination, palpation, auscultation, anthropometric methods), different X-ray and instrumental methods are used [Petersson A, 2010; Currie R, 2011; Kai Y et al., 2011; Kuroedova V et al., 2017b].

At present, diagnostic uses have increased significantly due to the use of modern instrumental and technical methods, such as magnetic resonance imaging (MRI), cone-beam computed tomography (CBCT), arthrography, which allow obtaining images in different planes, as well as visualizing not only bone, but also soft tissue structures of the joint, which makes it possible to develop new approaches in the treatment [Reiter S, 2007; Kuroedova V et al., 2018a]. The most informative method of X-ray study of the TMJ is CT, which gives basic information about bone structures and the ability to measure the size of the joint gap [Scherbakov A et al., 2013; Shepitko V, 2014; Kuroedova V et al., 2018b]. This information determines the topicality of the chosen topic and the necessity for this study.

The aim of the investigation is to study position and evaluate symmetry of condyles of TMJ of dentofacial abnormalities based on Angle's classification of malocclusion (the first class includes normal jaw relations; the second one contains distal position of mandible, the third class includes medial position of mandible).

### MATERIALS AND METHODS

The study was carried out on dental cone beam computed tomography (CBCT) data of 70 patients who applied to the Department of Postgraduate Education of Orthodontists of UMSA.

By gender, the distribution of patients was uniform: 34 men and 36 women, aged from 8 to 29. CT examinations of the jaw bones were performed on a VATECH PAX-ZENITH 3D dental computer tomograph, with 1 mm scanning step, 15 sec. scanning time and the total radiation load of 50  $\mu$ Sv. The study of the position of the articular heads was performed in the Ez3D2009 program. According to Angle's classification, all patients were divided into three groups: Group 1 – the I<sup>st</sup> class by Angle, 34 patients (18 men, 16 women), Group 2 – the II<sup>nd</sup> class, 30 patients (12 men and 18 women), Group 3 – the III<sup>rd</sup> class, 6 patients (4 men and 2 women).

Depending on the period of bite development, all patients were divided into two groups: Group A – with mixed occlusion, 30 patients aged 8–12 (18 men and 12 women), and Group B – 40 patients with permanent occlusion aged 13–29 (18 men and 22 women).

A written parental agreement was obtained for the examination of patients from the 1<sup>st</sup> group. Determination of the position of the TMJ heads was carried out by H. Gelb method in the midsagittal plane of the joint [Gelb H, Arnold G, 1959]. The first one is a horizontal line with respect to the upper part of the articular fossa. The second hori-

zontal line is drawn with respect to the lower part of the fossa in the region of the slope of the articular tubercle parallel to the first horizontal line. The third horizontal line is formed by dividing the distance between the first and second horizontal lines parallel to them – the middle parallel line (Fig. 1).

The first vertical line starts from the highest point of the fossa and goes perpendicular to the first horizontal line. The second vertical line starts from the intersection point of the middle horizontal line with the front surface of the articular fossa downwards parallel to the first vertical line. As a result of all line's intersection we get 8 segments – the Gelb 4/7 grid.

The grid segments are numbered: 1<sup>st</sup> segment is in the anterosuperior part of the fossa, 2<sup>nd</sup> segment is in the posterosuperior part of the fossa, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> segments are located in the middle of the grid, where the 3<sup>rd</sup> one is in the anterior part, the 5<sup>th</sup> one is in the posterior one. Segments 6, 7 and 8 are located in the lower part of the grid: 6 – in the anteroinferior, 8 – in the posteroinferior section. According to the Gelb 4/7 grid, there are 4 main positions of the TMJ head: 2/5 position – posterior-superior position, 1/5 – superior position, 1/4 – anterior-superior position and 4/7 – inferior-forward position, which is considered to be the optimal position for a healthy TMJ. The software package "Microsoft Office 2010" was used to process the research results.

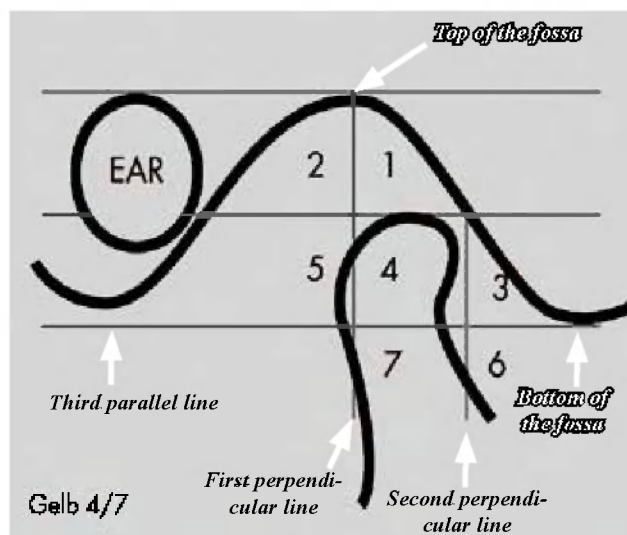


FIGURE 1. The position of the TMJ head according to [Gelb H, Arnold G, 1959].

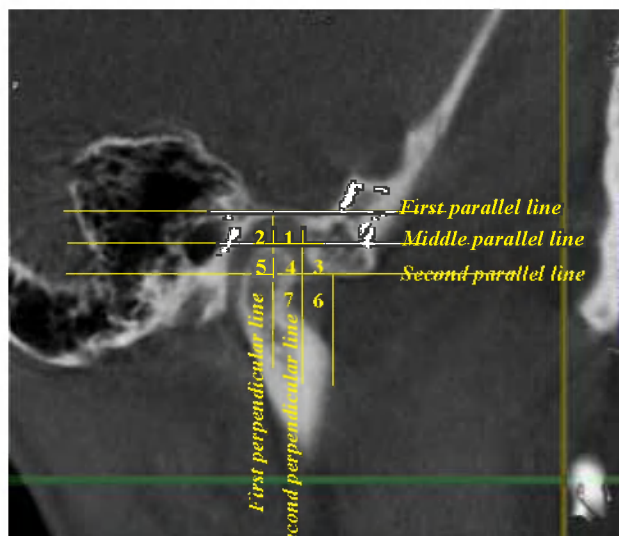


FIGURE 2. Studying the position of the articular head on the right of patient M. on CT.

**RESULTS AND DISCUSSION**

According to the results of our research, it was established that, regardless of the malocclusion, there are only 8 patients (11.43%) who have the right position of the TMJ on the left and right in 4/7 position (Fig. 2).

In patients of Group 1 (Class I malocclusion by Angle’s classification), correct, i.e. the symmetric, position of the TMJ on the left and right in 4/7 position was found only in 6 patients (17.65%). Unilateral position of the articular head was found in 4 cases, and they all are on the right only (Table 1).

The most common is the symmetric position of the articular heads in 1/4 position – 10 patients (29.41%), the asymmetric position was found in 8 cases on the left and in 2 on the right in combination with another position on the opposite side of Gelb’s grid. Four patients (11.76%) have the symmetric position of heads in 2/5 segment. The asymmetric position of at least 1 joint is established in 8 cases. In 1/5 position any person doesn’t have symmetrical position of the heads, the asymmetric unilateral position was found in 6 cases.

Symmetric position of the articular heads was found in 20 patients (58.82%) in total. In patients of Group 2 the symmetric position of the TMJ heads in 4/7 position was found in 2 people (6.67%), with any asymmetric cases. For patients with Class II malocclusion by Angle’s classification this position is the least characteristic. The most common is the symmetric position of the articular heads in 1/4 position – 12 patients (40.0%), the asymmetric posi-

tion with other positions is established in 6 cases, on the left only. The symmetric position of the articular heads in 1/5 position is found in 8 patients (26.67%), the asymmetric one is in 4 cases, on the right only. In 2/5 segment the symmetric position of the TMJ heads was observed in 2 cases (6.67%), the asymmetric one is in 2 cases on the right.

In patients of group 3 the most characteristic position of the articular head was found in 1/5 segment – 4 patients with the symmetric position (13.33%) and 2 patients with the asymmetric position of the heads in 1/5 segment on the right in combination with 2/5 on the left. The position of the TMJ heads in 4/7 and 1/4 segment in Class III malocclusion has not been established. In mixed

**TABLE 1**  
The position of the articular heads of the temporomandibular joint (TMJ) according to the Gelb 4/7 grid

| Malocclusion class by Angle’s classification |      | The positions of the TMJ heads |   |     |   |     |   |     |   |
|--|------|--------------------------------|---|-----|---|-----|---|-----|---|
|  |      | 4/7                            |   | 2/5 |   | 1/5 |   | 1/4 |   |
|  |      | R                              | L | R   | L | R   | L | R   | L |
| Class I (n=34)                               | uni. | 0                              | 4 | 4   | 4 | 2   | 4 | 8   | 2 |
|  | sym. | 6                              |   | 4   |   | 0   |   | 10  |   |
| Class II (n=30)                              | uni. | 0                              | 0 | 0   | 2 | 0   | 4 | 6   | 0 |
|  | sym. | 2                              |   | 2   |   | 8   |   | 12  |   |
| Class III (n=6)                              | uni. | 0                              | 0 | 2   | 0 | 0   | 2 | 0   | 0 |
|  | sym. | 0                              |   | 0   |   | 4   |   | 0   |   |

Notes: uni - unilateral, sym - symmetric, L - Left, R - Raight

**Table 2**

The position of the temporomandibular jointheads in the mixed and permanent occlusion

|                       |            | Positions |     |     |     |
|-----------------------|------------|-----------|-----|-----|-----|
| Occlusion development |            | 4/7       | 2/5 | 1/5 | 1/4 |
| Mixed (n=30)          | unilateral | 2         |     |     |     |
|                       | symmetric  | 6         | 2   | 4   | 16  |
| Permanent (n=40)      | unilateral | 20        |     |     |     |
|                       | symmetric  | 2         | 4   | 8   | 6   |

occlusion, the correct symmetric position of the TMJ head in 4/7 position is observed in 6 patients (20%). The characteristic feature is also the symmetry of the position of the TMJ head in other segments: 2/5, 1/5, 1/4, which was established in 22 patients (73.33%). Table 2 presents data depending on the occlusion development.

In the permanent occlusion, the symmetric position of the TMJ head in 4/7 position was found in only 2 patients (5%), the symmetry in other segments was found in 18 patients (45%) and the number of patients with asymmetric position of the articular heads increased to 50%.

Thus, the age dynamics of the aggravation of the wrong position of the TMJ head is clearly seen. Regardless of the malocclusion, the number of patients with the correct position of the articular heads in 4/7 segment decreases from 20% to 5%. In addition, the severity of the pathology is exacerbated by an increase in the asymmetric combinations of the TMJ heads position in the segments according to Gelb’s grid from 6.67% to 50%.

**CONCLUSION**

Despite the class of occlusion pathology, the symmetrical position of the TMJ heads in the 4/7 position is found only in 11.43% of cases, which indicates the close relationship between dentofacial abnormalities and TMJ pathology, respectively, an integrated approach in the treatment of orthodontic patients is considered only correct.

Cone beam computed tomography is an informative method in the study of malocclusions and TMJ pathology. With the severity of bite pathology, the number of patients with the optimal position of the TMJ head in the H. Gelb's net, that is, in the 4/7 segment, from 17.65% in the first class in Angle to 6.67% in the second class and absence of patients in the third class decreases. The wide

variation in the different positions of the articular heads in the studied patient groups indicates the asymmetry of the position of the articular heads, the age dynamics of the rotational displacement of the center of the articular heads is clearly visible, which can have a negative effect in the incongruous work of the joint.

With age, all large deviations in the structure and relationships of the structural elements of the joint are detected. According to the results of research, orthognathic bite at any age is only 5-7%, and according to our research, symmetry of the position of the TMJ heads occurs about in 11%, then the question should be revised the norm in orthodontics and the transition to the concept of an individual patient's norm is long overdue.

**Prospects for further investigations**

The paper considers only some of the additional research methods of malocclusion and TMJ. Developments in this direction can be continued.

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