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PRACA ORYGINALNA
ORIGINAL ARTICLE

X-RAY ANALYSIS OF THE MANDIBLE IN PATIENTS WITH CROSSBITE AND MANDIBULAR DISPLACEMENT

Lyubov V. Smahlyuk, Nelia V. Kulish, Alevtyna M. Bilous, Olena V. Luchko

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ABSTRACT

Introduction: Significant morphological and aesthetic disabilities of the face, observed during the formation of a cross bite in combination with the displacement of the mandible, prompt the doctors – orthodontists to study carefully the morphogenesis of this anomaly.

The aim: Analysis of the mandible structure in patients with a cross bite and lower jaw displacement based on the analysis of orthopantomograms.

Materials and methods: For this study, the orthodontic examination of 20 patients, 18-22 years old, was made they complained about facial asymmetry, displacement of the lower jaw and a violation of the cosmetic centers. A diagnosis of the buccal cross bite form in combination with the displacement of the lower jaw was put according to the Uzhumetskiene classification. The methods used do not contradict the conclusions of the ethics commission.

Results: The analysis of the obtained data indicates that the angle of the mandible has more variable ($p \leq 0,05$). Go120,8° and 125,1°. Significant of the angles of the canines according to the basal arch of the lower jaw of 102,8° and 105,4° ($p \leq 0,01$) and the angle of inclination of the first permanent molars of 89,6° and 91,4°, respectively ($p \leq 0,01$).

Conclusions: The obtained data indicate that there is no clear correlation between changes in the studied parameters and the localization of anomalies (left-sided, right-sided). Indicators of the angle of the lower jaw are significantly altered from the opposite direction of its displacement. The change in the angles of inclination of the canine and the first permanent molars, as occlusive compensation, is determined reliably. The more the angle of the mandible changes, the more the lower jaw moves in the transversal direction. Perhaps this is due to the asymmetric tone of masticatory muscles.

KEY WORDS: cross bite, lower jaw, orthopantomograms

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INTRODUCTION

National researchers report that in the structure of dentoalveolar abnormalities crossbite has prevalence on the average of 8%; however, morphological and aesthetic disorders that occur as a result of the progression of this pathology can lead to significant deformations of the facial skeleton [1]. These changes are especially prominent in crossbite, combined with mandibular displacement, which suppresses patients by physical inferiority and depressively affects their psyche [2]. A great variety of types of crossbite has the corresponding clinical manifestations [3, 4] and its elimination is not always possible through the use of orthodontic devices. Numerous studies have shown that orthodontic treatment of these patients is impeded due to the increase in the degree of age-related disorders and deformation of the facial skull bones, which lead to disharmonic development of the face [5].

Consequently, further improvement of the methods of study and analysis of morphological and aesthetic disorders that accompany this pathology, and the possibility of their correction in the age-related aspect is crucial.

It is the asymmetries of the face that are most often noticed by patients and their neighborhood, encouraging orthodontic treatment. Correction of asymmetries of gnathic growth is rather complicated part of the orthodontic treat-

ment of crossbite [6]. This is due to the numerous manifestations of morphological disorders and, consequently, a large number of options for their elimination. Since the maxilla develops in close conjunction with the structures of the skull base, it is less unstable. The mandible has certain autonomy of development, due to the greater influence of the action of functional factors and is more prone to asymmetric deformations. In this regard, orthopantomogram is sufficiently accessible and informative method for the analysis of the symmetric and proportional development of the mandibular complex as the major component in the formation of crossbite with mandibular displacement according to classification suggested by I. I. Uzhumetskiene.

The study of this issue is relevant, as it will help to correctly perform differential diagnosis of disorders, choose an adequate method of treatment of crossbite, predict its course, which in turn will contribute to the restoration of the morphology and function of the dentoalveolar apparatus, improvement of the patients' appearance, achievement the physiological optimum.

THE AIM

Based on the orthopantomogram, to analyze the structure of the mandible in patients with crossbite with mandibu-

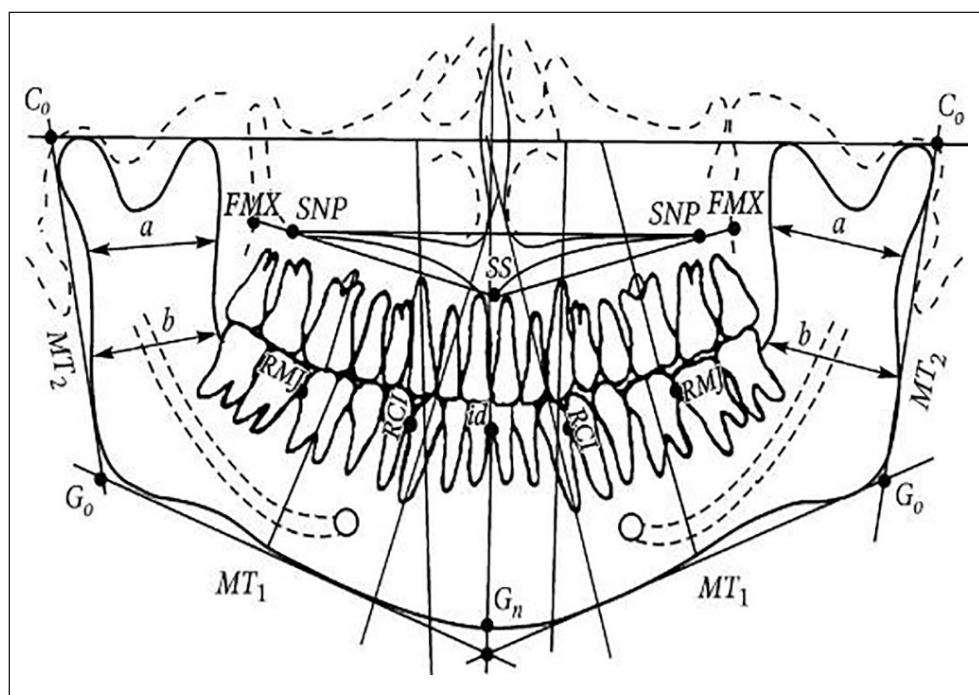


Fig. 1. The pattern of morphometric analysis of the dentoalveolar complex.

lar displacement and to conduct a correlation analysis of the morphometric parameters, as well as to evaluate the nature of morphological disorders according to the degree of mandibular displacement.

MATERIALS AND METHODS

20 patients aged 18–22 years with complaints of mandibular displacement and the cosmetic center disorder, have undergone orthodontic examination. The diagnosis was crossbite, buccal form in combination with mandibular displacement according to Uzhumetskene's classification. All patients underwent comprehensive clinical and paraclinical examination according to treatment protocols (2005).

Basically, the transverse mandibular displacement is possible due to several factors, namely, incoordination of the masticatory muscles activity, irregular occlusal contacts, articular displacement and skeletal asymmetries of the congenital genesis [7, 8]. Consequently, morphogenesis of the mandible, as one of the possible etiological factors, has been selected to study.

The analysis of the orthopantomogram made for all patients has been carried out to analyze the development of the mandible as the major component of the dentoalveolar complex, which directly affects the aesthetics of the face. The state-of-the-art orthopantomographs provide with simultaneous images of the entire dentoalveolar system as a single integral functional complex. Angular distortions are almost absent on the resulting images due to the orthoradial direction of the beam, which allows to study the structure of the mandible in terms of the symmetry of its development.

We used the method of morphometric analysis of the mandible in patients with crossbite [8], which includes the analysis of the most frequently changed morphological

characteristics. Consequently, the parameters of the body MT1 (between the Gn–Go points) and the branch MT2 (between the Go–Co points) on the right and on the left were determined. The deviation of the parameters between the MT2 parameters and MT1 parameters corresponds to the vertical and horizontal component of the asymmetry, respectively. The size of the mandibular Go angle, which is formed by the MT1 and MT2 lines, variations of which are one of the major signs of morphological asymmetry, has been analyzed. The width of branches of the mandible in the upper segment (a) and the lower segment (b) was determined. Dentoalveolar height of the lateral segments, angulation of the cuspids to the basal arc of the mandible, the degree of asymmetry of the dentitions in the lateral segments, angulation of the first permanent molars to the basal arc of the mandible was analyzed. Differences in these parameters may indicate relative hypertrophy of one of the sites (Figure 1). Начало форм Конечная форма

Subsequently, the comparison of the data obtained on the right and left was made and the degree of difference in millimeters and degrees (for angular parameters) was determined. Correlation analysis of the parameters was carried out.

The methods used do not contradict the conclusions of the ethics commission.

RESULTS AND DISCUSSION

All 20 subjects have been assigned into two groups according to the direction of mandibular displacement: 13 individuals with crossbite and mandibular displacement towards the right side and 7 individuals with mandibular displacement towards the left side. The degree of displacement of the mandible was determined in relation to the width of the lower central incisor.

Table I. Morphometric parameters of the mandible in patients with crossbite.

The analysis of the mandible in patients with right-sided crossbite and mandibular displacement																			
Number of patients	The size of the body		Height of the branch		Width of the branch in the upper segment		Width of the branch in the lower segment		Dentoalveolar height		Angle of the mandible		Angulation of cuspids		Angulation of molars		Length of the lateral segment		
	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	
13	116,03	117,2	77	77	36,3	36	30,84	33,69	40,84	41,4	120,8	125,1	102,8	105,4	89,6	91,4	50,1	49,92	
	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	
	12,4	12,9	9,7	9,7	4,3	4,2	2,98	2,03	5,99	4,9	9,24	8,77	13,3	11,08	4,9	6,7	5,3	7,29	
The analysis of the mandible in patients with left-sided crossbite and mandibular displacement																			
Number of patients	The size of the body		Height of the branch		Width of the branch in the upper segment		Width of the branch in the lower segment		Dentoalveolar height		Angle of the mandible		Angulation of cuspids		Angulation of molars		Length of the lateral segment		
	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	
7	122,71	120,0	76,5	76,8	38,28	37,85	37,42	34,71	42,42	41,7	123,7	118,2	97	93,7	93,4	95,57	51,2	51,85	
	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	
	5,88	8,75	8,7	8,96	1,9	6,8	3,68	3,8	4,6	4,06	11,5	2,75	20,5	18,46	6,02	4,46	7,2	4,48	

Note: R-right; L-left.

Group I: in 7 subjects mandibular displacement towards the right side was 1/3 of the width of the crown of the lower central incisor. In 4 subjects mandibular displacement was ½; in 1 subject mandibular displacement was per tooth crown's width.

Group II: in 6 subjects the displacement was 1/3 of the crown of the lower incisor. In 1 subject the displacement was ½ of the crown width. The resulting data are presented in Table I.

The average values showed that in the first group of subjects (right-sided crossbite with mandibular displacement) the size of the body of the mandible was within the limits of physiological asymmetry and accounted for 116,03 mm and 117,2 mm, respectively ($p \geq 0,05$). The height of the branches was almost unchanged and accounted for 77.0 mm and 77.0 mm, respectively ($p \geq 0,05$). The width of the branch on the right and left in the upper segment was 36.3 mm and 36.0 mm, respectively ($p \leq 0,05$). In the lower part of the branch a significant difference in the parameters (30.84 mm and 33.7 mm, respectively), was noted ($p \leq 0,05$), which definitely influenced on the change of the angle of the mandible, judging by the $120,8^\circ$ and $125,1^\circ$ parameters in this study group ($p \leq 0,05$). Therefore, it is evident that one of the factors that cause deviation of mandible in the transversal plane is the unilateral increase in the angle, which is a manifestation of skeletal disorders, which, consequently, affects the symmetry of the face. The proportion of the dentoalveolar height on the left and right is almost preserved and is 40.84 mm and 41.4 mm, respectively ($p \geq 0,05$). Significant variations are observed in the parameters of angulation of cuspids to the basal arc of the mandible ($102,8^\circ$ and $105,4^\circ$) ($p \leq 0,01$) and the angulation of the first permanent molars is $89,6^\circ$ and $91,4^\circ$, respectively ($p \leq 0,01$). The length of the lateral segments is almost the same and is 50.1 mm and 49.92 mm.

The group of patients with left-sided displacement of the mandible showed the following average morphometric parameters: the variation of the length of the body of the mandible was within the physiological asymmetry and

accounted for 122.7 mm and 122.0 mm ($p \geq 0,05$). The height of the branch on the right and left was symmetrical (76.5 mm and 76.8 mm, respectively). The width of the branch in the upper segment was 38.28 mm and 37.85 mm, respectively. Similarly to the right-sided crossbite, the width of the branch in the lower segment significantly ($p \leq 0,05$) changed, accounting for 37.42 mm on the right and 34.71 on the left, and, accordingly, the angle of the mandible increases from the side of the branch extension in the lower segment, accounting for $123,7^\circ$ on the right and $118,2^\circ$ on the left. Angulation of cuspids on the basal arc of the mandible underwent variations, accounting for $123,7^\circ$ on the right and $118,2^\circ$ on the left. Angulation of molars was $95,57^\circ$ and $93,4^\circ$, respectively. The proportionality was maintained in the dimensions of the length of the lateral segments and was 51.2 mm and 51.85 mm on both sides.

Thus, we can state that in patients of both groups, regardless of the side of localization of the anomaly (right- or left-sided crossbite with displacement of the mandible), the morphometric characteristics of the mandible on the orthopantomogram are the same. Changes in the angle of the mandible underwent significant variations: in the right-sided displacement the angle increases to the left, and in the left-sided localization the angle increases to the right, indicating the skeletal nature of the disorders. The angles of inclination of the cuspids and the first permanent molars change.

The resulting analysis of correlation, aimed at determination whether the variability of one sign in some correspondence with another, indicates that our study shows a correlation between the parameters of the body and the angle of the mandible and is 0.045; 0.006 between the size of the body of the mandible and the angle of the inclination of the cuspids; 0.017 between the size of the body and the angle of inclination of the molars. It can be interpreted as compensations from the side of dentoalveolar system to create maximum stable occlusive relationships, which is important for mastication.

The analysis of the dependence of the severity of morphological disorders and the rate of displacement of the

mandible in the transversal plane indicates that an increase in the angle of the mandible contributes to more significant lateral displacements.

CONCLUSIONS

The findings show that there is no clear correlation between changes in the studied parameters and localization of the anomaly (left-sided, right-sided). Parameters of the angle of the mandible significantly change from the opposite side of its displacement. Significant change in the angles of inclination of the cuspids and the first permanent molars, as occlusive compensation, is determined. The more the angle of mandible changes, the more the mandible moves in the transversal direction. Perhaps this is due to the asymmetric tone of the masticatory muscles.

The situation with unilateral increase in the angle of the mandible requires careful study. Noteworthy, the fibers of the proper masticatory and medial pterygoid muscles are fixed in the zone of the angle of the mandible. And, apparently, it is the unilateral mastication that facilitates such changes.

That is why when planning an orthodontic treatment of crossbite with mandibular displacement it is impossible to rely solely on the data of X-ray examination as the key method of diagnosis of asymmetric development of the mandible. It is necessary to conduct a comprehensive examination, including the analysis of the state of masticatory muscles, as well as the structure of the entire facial part of the skull.

Consequently, the perspectives of further research will encompass mandatory electromyographic study of such patients to determine the symmetrical activity of the muscles. Supposedly, timely coordination of muscle function will prevent significant morphological changes in the formation of the mandible and improve the conditions for aesthetic development of the face.

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