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ASSESSMENT OF THE TEMPOROMANDIBULAR JOINT MORPHOLOGY IN CLASS II MALOCCLUSION USING CONE BEAM COMPUTED TOMOGRAPHY

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ABSTRACT

Introduction: the morphology of the temporomandibular joint (TMJ) in people with diverse forms of malocclusion has not been properly examined. **Aim:** To assess the temporomandibular joint morphology in Class II Malocclusion using Cone Beam Computed Tomography. **Material and methods**: A total of 48 CBCT scans were collected and divided into two groups according to the divisions of Class II malocclusion. The TMJ morphology in patients with class II malocclusion and comparison between groups 1 and 2 was done as well as right and left TMJs in each scan. The following measurements are made on the CBCT images. Measurements in The Corrected Sagittal Plane. Measurements in the Axial Plane. **Results**: results of the current study showed that there were no statistically significant differences between the right and left sides in each group regarding the anterior joint space, superior joint space, posterior joint space, and depth of glenoid fossa associated with sagittal plane. In addition, there were no statistically significant differences between the groups regarding the anterior joint space, superior joint space, posterior joint space, and depth of glenoid fossa associated with sagittal plane. **Conclusion**: Temporomandibular joint morphology did not differ between Class II division 1 and Class II division 2.

INTRODUCTION

Temporomandibular joint (TMJ) morphology has not been studied adequately in subjects with various types of malocclusion, and it is not known if TMJ morphology and facial morphology are related [(1)]. CBCT images allowing the concurrent visualization of the TMJ and assessment of the maxillo-mandibular relationships and occlusion provide the opportunity to visualize and quantify the local and regional effects associated with the TMJ abnormalities [(2)].

Class II malocclusion is divided to two divisions: Class II Division 1 is identified when the lower incisor edges lie posterior to the cingulum plateau of the upper incisors, there is an increased overjet and the upper central incisors are proclined. Class II Division 2 is identified when the lower incisor edges occlude posterior to the cingulum plateau of the upper incisors which will be retroclined so the overjet will be minimal[(3,4)].

According to the posstle's envelop of motion, the incisors inclination and the condylar rotation coincide in the process of opening the mandible so the incisal inclination could affect the modification of the morphology of the articular eminence[5]. Katsavarias[1] mentioned that class II division 2 have larger masticatory muscles and they are more anteriorly oriented. This affects the magnitude of loading on their TMJ.

Lombardo et al.[6] compared the features of the glenoid fossa and the upper incisor inclination in orthodontically untreated individuals with different facial types. There are no differences between the features of the glenoid fossa and the upper incisor inclination in subjects with different facial types. The aim of the present study is to assess the temporomandibular joint morphology in Class II Malocclusion using Cone Beam Computed Tomography.

SUBJECTS AND METHODS

In this retrospective study, 48 CBCT scans were collected from the archive of Radiology Department, Faculty of Dentistry, Suez Canal University after the approval of the Ethical Committee serial number: 149/2018. The clear CBCT scans were imported into DICOM (Digital Imaging and Communications in Medicine) format and handled by Proplan CMF Imaging (Proplan CMF, Materialize, Belgium). The lateral cephalometric images were extracted from the CBCTs using Dolphin software. (Dolph in Imaging & Management Solutions, U.S.A.) The scans were divided into two groups according to the divisions of Class II malocclusion.

Group 1:

- Class II division 1 malocclusion with mandibular retrusion.
- Overjet > 5 mm
- Class II or end-to-end molar relationship.

Group 2*:*

- Class II division 2 malocclusion with mandibular retrusion.
- Overbite > 3.5 mm
- Palatally inclined upper incisors (U1-SN <107°).
- Class II or end-to-end molar relationship.

Measuring the condylar morphology using Proplan software. The TMJ morphology in patients with class II malocclusion and comparison between the groups 1 and 2 was done as well as right and left TMJs in each scan.

The following measurements are made on the CBCT images.

Measurements In the Corrected Sagittal Plane : Anterior joint space, Superior joint space, Posterior joint space, and depth of the mandibular fossa.

Measurement In the Axial Plane: Anteroposterior width of the condylar process, Mediolateral width of condylar process, Lateromedial plane angle of condylar process, Axial condylar angle, Anteroposterior differences of the condylar processes.

Statistical analysis of the data:

Significance of the obtained results was judged at the 5% level. The used tests were Student t-test: For normally distributed quantitative variables, to compare between two studied groups. Mann Whitney test: For abnormally distributed quantitative variables, to compare between two studied groups.

RESULTS

Measurements in the axial plane

Table (1): Illustrates comparison between the two groups in the axial plane using the following measurements anteroposterior width of the condylar process (mm), Mediolateral width of the condylar process (mm), Lateromedial plane angle of condylar process (°), Axial condylar angle (°), Distance (mm), and the results showed no significant difference between Class II Div1 and Class II Div2.

Measurements in the sagittal plane

Table (2) compares the following measurements in the sagittal plane, anterior joint space (mm), superior joint space (mm), Posterior joint space (mm), Depth of glenoid fossa (mm), there was a statistically non-significant difference between Class II Div1 and Class II Div2.

Table (1): Shows comparison of the measurements between the two studied groups in the axial plane

	Class II Div1	Class II Div2	p
Anteroposterior width of the condylar process (mm)			
Right	5.71 ± 1.09	5.43 ± 1.37	0.511
Left	5.68 ± 0.99	5.65 ± 1.46	0.958
Mediolateral width of the condylar process (mm)			
Right	14.45 ± 2.38	14.95 ± 3.91	0.665
Left	14.11 ± 2.44	13.97 ± 3.39	0.894
Lateromedial plane angle of condylar process (°)			
Right	64.92 ± 6.05	61.19 ± 7.27	0.346
Left	64.61 ± 5.13	63.60 ± 6.93	0.625
Axial condylar angle (°)			
Right	27.03 ± 9.63	31.35 ± 8.72	0.181
Left	25.73 ± 8.21	29.55 ± 8.98	0.508
Distance (mm)			
Right	45.34 ± 8.32	49.23 ± 2.46	0.089
Left	45.91 ± 7.19	48.23 ± 3.37	0.256
Anteroposterior diff of the condylar processes (mm)	3.03 ± 1.74	4.06 ± 2.09	0.139

Data was expressed using Mean±SD. **t: Student t-test, P***: p-value for comparing between the studied groups.*

Table (2) *Compares between the two studied groups according to anterior joint space (mm), superior joint space (mm), Posterior joint space (mm), Depth of glenoid fossa (mm).*

	Class II Div1	Class II Div2	p
Anterior joint space (mm)			
Right	2.16 ± 0.48	2.34 ± 0.56	0.301
Left	2.47 ± 0.67	2.17 ± 0.54	0.168
Superior joint space (mm)			
Right	2.72 ± 0.87	3.33 ± 1.66	0.207
Left	2.65 ± 0.54	3.09 ± 1.41	0.266
Posterior joint space (mm)			
Right	2.95 ± 0.79	2.88 ± 0.99	0.817
Left	2.99 ± 0.93	2.78 ± 1.06	0.547
Depth of glenoid fossa (mm)			
Right	7.66 ± 0.75	8.29 ± 1.76	0.209
Left	8.01 ± 1.07	7.97 ± 1.67	0.937

Data was expressed using Mean ± SD. t: Student t-test
p: p-value for comparing between the studied groups

DISCUSSION

The idea of the study was derived from the results from other researchers who found a correlation between the articular eminence inclination and the upper anterior teeth in different malocclusion classes together with normal bite and deep bite patients[6]. Therefore, it was thought that the retroclined upper incisors would affect the articular eminence inclination during the aging and remodeling process. Superimposition of other structures are eliminated by using 3D imaging which facilitated the process of obtaining accurate measurements. According to Hilgers et al.[7], CBCT measurements are reproducible and significantly more accurate than the measurements from conventional cephalograms. The study was conducted by examining CBCT and conventional radiographic measurements of temporomandibular joint images in 25 dry skulls.

Individuals with a 6-7-mm overbite, anterior open bite, unilateral cross bite, or five or more missing teeth are considered to be the risk group of TMD. Although, there is no solid proof that orthodontic anomalies and treatments are etiological factors for TMDs [8].

A systematic review to study the role of malocclusion in the etiology of temporomandibular disorder (TMD). As there has been recent controversion as to whether there is an association between malocclusion and TMDs [9]. Hence was the purpose of this study to investigate three dimensionally the TMJ morphology in Class II malocclusion using CBCT.

In a study done by Vitral et al. [10] it was found that the visualization of articular skeletal anatomy is best shown through a CT scan. Accordingly, this type of X-ray was chosen to evaluate the condyle fossa relationship of the TMJ since it best shows the details of bony structures. It was also stated by Rodrigues[3] the superimposition of neighboring structures has always been a factor that jeopardized the visualization of the TMJs on conventional radiographic examination. The real dimensions of the structures under study are ideally captured through CT imaging, which focuses on the areas of interest without superimposition and opens new perspectives for analyzing these joints. The CBCT image slices was deemed the most appropriate method to view the Condylar symmetry when studied from the axial plane. This is because it shows both condyles in the same image and allows the determination of reference planes such as the median sagittal plane [2].

According to Hegde et al. [11] different age groups and individuals have drastically variable appearance of mandibular condyle depending on genetic deviations. There are several factors that affect or cause morphologic changes of condyle including developmental variations, remodeling, various diseases, trauma, endocrine disturbances, and radiation therapy. There are various imaging modalities, but panoramic radiographs are the main screening modality for TMJ abnormalities. Conversely, early functional, and biochemical bone changes are best shown by radionuclide bone scanning; however, CT images are highly accurate for capturing osseous abnormality. If there are bony morphologic changes of mandibular condyles, it is best detected by Cone beam computed tomography images. When evaluating TMJ soft tissue changes, MRI is the examination of choice. The diagnosis of disorders of temporomandibular joint is controlled by the variability in the shapes and sizes of condyles.

The measurements in the sagittal plane:

In the current study, 24 CBCTs of non-growing patients were used in each group. The choice of non-growing patients was to eliminate the growth factor which affects the condylar morphology. In the current study there was statistically no significant difference between the right and left condyles in the same group. This was in accordance with the work of Rodrigues et al. [3] who found that no a statistically significant difference between the right and the left posterior joint spaces in Class II division 1 patients. On the other hand, the current findings were not in agreement with Cohlmia et al. [12] who studied the TMJ morphology on lateral cephalometric radiographs and found that the left condyle was positioned more anteriorly than the right in all malocclusion. This difference could be attributed to the fact that they used 2D lateral cephalograms with all the inherent inaccuracies that accompany this technique. The values of right anterior, superior, and posterior joint spaces in the present study for Class II division 1 were 2.16±0.48mm, 2.72±0.87mm, and 2.95±0.79 mm, respectively. The values of left anterior, superior, and posterior joint spaces in the present study for Class II division 1 were 2.47±0.67 mm, 2.65± 0.54mm, and 2.99± 0.93 mm, respectively. The values of right anterior, superior, and posterior joint spaces in the present study for Class II division 2 were 2.34 ± 0.56 mm, 3.33±1.66mm, 2.88 ± 0.99 mm, respectively.

The values of left anterior, superior, and posterior joint spaces in the present study for Class II division 2 were 2.17 ± 0.54 mm, 3.09± 1.41mm, 2.78 ± 1.06 mm respectively. On the other hand, Ikeda and Kawamura [13], assessed the position of the temporomdibular joint in 22 patients who had healthy optimal joints to obtain the mean anterior, superior, and posterior joint spaces. The resulting conclusion was that the optimal anterior, superior, and posterior joint spaces are 1.3 ± 0.2, 2.5 ± 0.5, and 2.1 ± 0.3 mm, respectively.

Yet in accordance with our present study, no significant difference was found between Class I and Class II patients as per the results of Cohlmia et al. [12], although this could be the result of their utilization of 2D images rather than the 3D imaging used in our present study. Our results showed no statistically significant difference between the groups for anterior, posterior and superior joint spaces. Gorucu-Coskuner and Ciger, [14] examined Class II division 2 patients and Class II division 1 patients and found that the anterior joint space was significantly narrower in Class II division 2 patients. The controversial results could be due to the different ethnic groups and age ranges used between the studies.

Measurements in the axial plane:

The results of the study in hand found no statistically significant differences in the anteroposterior width, mediolateral width of the condyles. In accordance with Ludlow *et al*. [15] and Gracco et al. [16]. As per Gorucu-Coskuner and Ciger, [14], no other studies were concerned with measuring those dimensions in Class II division 1 and division 2.

Regarding distance of condylar process, axial condylar angle from midsagittal plane there was no statistically significant difference between the two groups which is the same results as Gorucu-Coskuner and Ciger [14] and Rodrigues AF, Fraga MR, Vitral RWF [3]. Although one of the limitations of the present study was that functional deviation was not considered, it was due to using archived Cone Beam Computed Tomographys. Yet since no condylar positional asymmetry in the axial plane was observed, this probably means that the included CBCTs had no functional deviations.

From the previously mentioned results, malocclusion can be considered to be either a cause or a consequence of the variations in temporomandibular positions. A better understanding of the temporomandibular joint's anatomy and characteristics is essential. More studies are needed to be done on a larger sample size with different age group with the aid of three-dimensional imaging.

CONCLUSION

Malocclusion can be considered to be either a cause or a consequence of the variations in temporomandibular joint disorders. Temporomandibular joint morphology did not differ between Class II division 1 and Class II division 2.

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