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EVALUATION OF CONDYLE-DISC-FOSSA RELATIONSHIP IN RELATION TO DIFFERENT ORTHODONTIC SKELETAL RELATIONS, CLINICAL AND RADIOGRAPHIC STUDY

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ABSTRACT

Objective: In Class I, Class II, and Class III cases, disc and condylar locations, as well as joint spaces were evaluated and compared. The goal of this study was to see how likely the three groups were to develop temporomandibular disorders (TMDs). **Materials and Methods**: Certain inclusion and exclusion criteria were used to select a sample of 90 cases, with 30 cases in each of the three classes (Class I, Class II, and Class III). In the sagittal plane, magnetic resonance imaging (MRI) was used to study the location of the articular disc, condyle, and joint spaces using a closed mouth approach. **Results**: The morphology of the temporomandibular joint (TMJ) was altered in both Class II and Class III patients, with the greatest disparity in Class II patients. In Class II patients, an MRI revealed a tendency for anterior disc displacement with condyles positioned more anteriorly. In the Class III patients, the disparity was smaller. **Conclusions**: Class II patients are more likely to develop TMDs and it is advised to evaluate the TMJ before beginning orthodontic treatment to identify and stop an asymptomatic TMD from progressing to a more severe form.

KEYWORDS: Magnetic resonance imaging; TMD; Temporomandibular joint; Malocclusion; Orthodontics

INTRODUCTION

Stress is increasing among individuals noticeably especially with the coronavirus outbreak [1]. Stress is considered one of the most important reasons for the increased possibility of having a TMD [2,3]. TMD may result in unstable occlusion and severe occlusal changes that can have deleterious effects on the patient and orthodontic treatment.

To achieve and maintain good health of the jaws, teeth and their supporting tissues, static and dynamic occlusion must be achieved orthodontically. Gnathostatic evaluation is a term described by Roth

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in 1996 that refers to that determining orthodontic treatment stability depend on evaluating the condylar position [4,5].

The skeletal relations between the maxillary and mandibular jaws (class II or class III relations) might affect the different TMJ structures either in the condylar position or in the disc position or the condyle- disc relationship [6,7,8].

One of the most common TMD problems is internal derangements in which the condylar disc relationship is altered [9].

MRI is considered the best method of evaluation for the TMJ structures as it provides excellent contrast for the evaluation of the soft tissue which cannot be examined using other types of radiographs [10].

Therefore, this study was conducted to evaluate the relationships between different orthodontic skeletal relations and their effect on the TMJ structures.

MATERIALS AND METHODS

The study was carried out on 90 cases ranging from 18 to 23 years old. Routine clinical and orthodontic radiographs (Panoramic and Lateral Cephalometric X-rays were taken for all patients. Cephalometric X-rays were traced and analyzed using the web-ceph application and, according to the results of the analysis (Table 1), the cases were grouped into three groups of 30 each: class I group, class II division 1 group, and class III group.

TABLE (1): Cephalometric measurements used

	Class I	Class II	Class III
Mean ANB* (degree)	1.4	5.7	-3
Mean Wits** (mm)	-0.5	3.3	-2.8
Mean Overjet (mm)	1.45	4.1	-1.8

ANB is the difference between SNA and SNB angles
****Wits is measured by calculating the difference between perpendiculars dropped from point A and point B on the occlusal plane***

Ethical committee approval was obtained from the Institutional Review Board of the faculty of Medicine in Assiut University, Egypt

The mean overjet for Class I cases was 1.45 mm, for Class II cases 4.1 mm and for Class III cases -1.8 mm.

The oral and maxilla-facial surgeon performed a thorough clinical examination for the TMJ of each case and three variables were recorded: 1-joint palpation to check pain and joint noise, 2-trigger zones at muscles of mastication, and 3-range of mouth opening in assisted and unassisted openings. (Table 2)

Inclusion criteria were female patients aged from 18 – 23 years old, with skeletal relations that fall under one of the study groups (class I or II div 1 or III).

Exclusion criteria were cases with a history of TMJ surgery, systemic conditions, cases that had orthodontic treatment, claustrophobic patients, restorations, and appliances that might interfere with the MRI scan

Sagittal bilateral MRI images were taken using 1.5 Tesla MRI basic system. all images were taken in closed mouth technique. High proton density-weighted images were used, with a slice thickness of 2 mm, a field of view 20–20 mm2, a repetition time of 2500 ms, an echo time of 20 ms, and a 256 x 256 matrix. A 1.5-GB SIEMENS magnetic optical disc was used to store the MRIs. Philips 3.0 software was used to obtain photos. Sagittal dimensions were used in capturing the images.

The measurements that were used on the MRIs are: (1) position of articular disc antero-posteriorly, (2) position of the condyle (condylar concentricity), and (3) joint spaces both anterior and posterior (AJS and PJS).

Evaluation of Disc position antero-posteriorly

The disc position was assessed in the MRIs

TABLE (2): Clinical findings after TMJ clinical examination

	Joint Palpation		Trigger zones	Range of mouth opening	
	Pain during joint palpation	Joint noise		Vertical unassisted	Vertical assisted
Class I	No pain (VAS scale 0)	No clicking during opening or reciprocal clicking during closing No crepitus	No trigger zones at any muscle	41 mm	43 mm
Class II	8 cases had severe pain (VAS scale 9) 2 cases had moderate pain (VAS scale 5)	8 cases had clicking during opening and reciprocal clicks during closing 2 cases had only reciprocal clicking	All cases had trigger zones at masseter and temporalis muscles.	32 mm (Less than normal range)	35 mm (Less than normal range)
Class III	4 cases had no pain (VAS scale 0) 3 cases had mild pain (average Vas scale 2) 3 cases had moderate pain (average VAS scale 5)	4 cases had no clicking. 3 cases had no clicking. 3 cases had clicking during opening and infrequent reciprocal clicks	7 cases had no trigger zones at any muscle. 3 cases had trigger zones at masseter and temporalis muscles.	37 mm (Almost Normal range)	39 mm (Almost Normal range)

using the 12 o'clock position method which was given and used by [11] to determine the disk position relative to the condylar head.

A line passing through the center of the condylar head parallel to the posterior condylar line was referred to as the 12 o'clock line. The intersecting point between this line and the roof of the fossa was constructed to determine the position of the disc relative to the condylar head. (figure 1)

The disc's posterior band was then measured at an angle to the 12 o'clock line. The disc position was divided into three categories based on the posterior band position: anterior, normal, and posterior displacement. The normal range of the position of the sagittal disk specified by Silverstein [12] is 25.7° to –18.7°.

Assessment of Position of the condyle (Condylar Concentricity)

According to Silverstein[12], the anterior joint space (AJS) is the shortest distance between the condylar head and the eminence, and the PJS is the

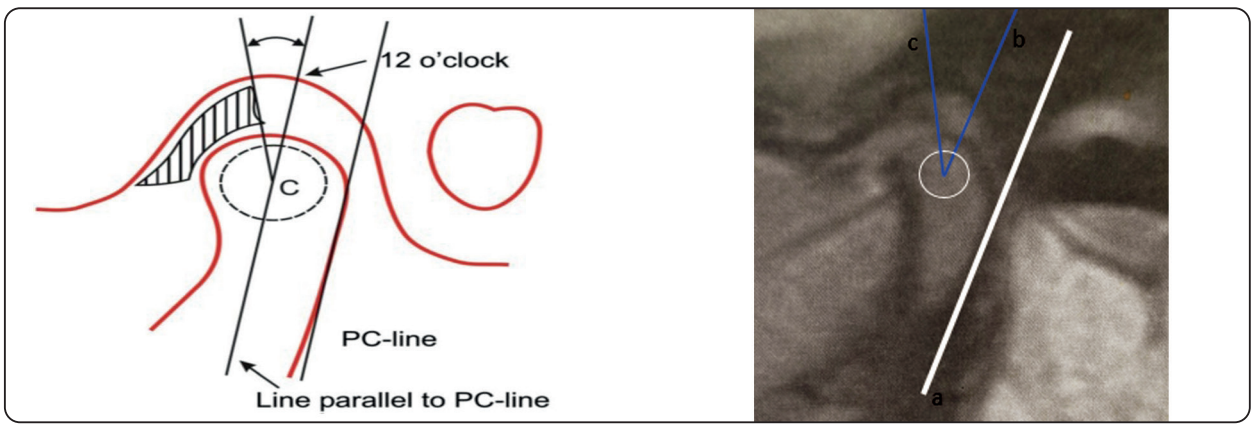

Fig. (1): Diagram showing the 12 o'clock line used to assess the disc position

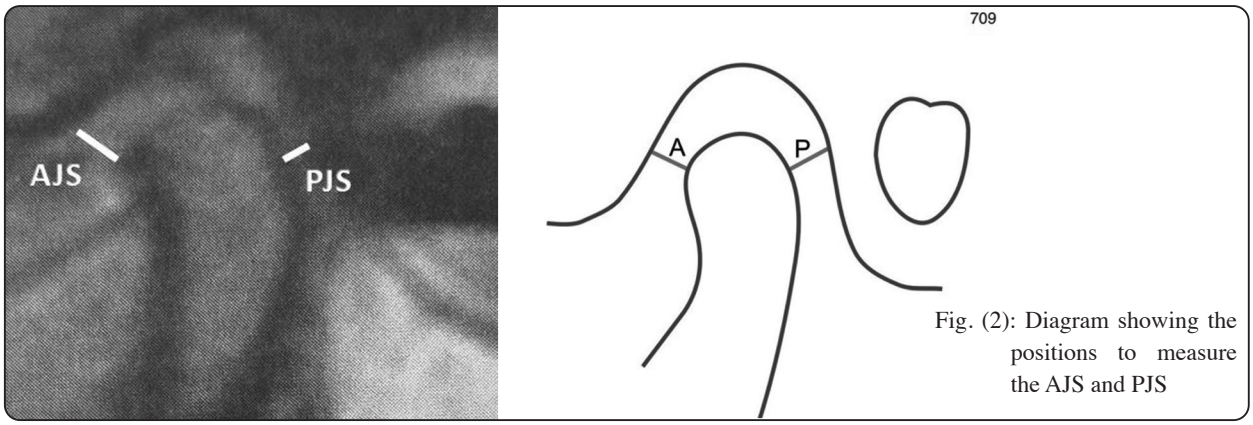

Fig. (2): Diagram showing the positions to measure the AJS and PJS

shortest distance between the posterior glenoidal fossa and the head of the condyle (Figure 2). The values of the AJS and PJS were used in the equation: JSI = [(P – A)/ (P + A)] x 100, where JSI stands for joint space index, A for AJS, and P for PJS. Any positive number suggested a condyle that was anteriorly positioned in regard to the glenoid fossa, whereas a negative value indicated a condyle that was posteriorly positioned.[11]

Assessment of the AJS and PJS

Without employing the JSI equation, the AJS and PJS were measured using the same manner as the condylar concentricity.. (Figure 2)

RESULTS:

The Prism 5 software was used for statistical analyses. The mean differences and the P-value were calculated using, a one-way analysis of variance test. Post hoc analysis was done using Tukey's test to compare the three groups.

Assessment of Disc position in the Horizontal Plane

In the Class I group, the mean articular disc position was 23.27 ± 0.09°, which was within the normal range (Table 3). The Class II group had the greatest mean articular disc position of 30.62 ± 0.15°, which was substantially higher than the other groups, indicating a tendency for anterior disc displacement. The Class III group had a mean articular disc position of 25.85 ± 0.07°, showing anterior disc displacement that was more than the Class I group and outside the normal range, but to a lower extent than the Class II group.

Assessment Position of the condyle (Condylar Concentricity)

In the Class I group, the mean value for condylar concentricity was -4.19 ± 1.53, which was within the usual range (Table 4). The Class II group had the highest mean condylar concentricity of 12.67 ± 0.77, which was substantially higher than the other groups, indicating a larger tendency for an anteriorly positioned condyle. In the Class III cases, the mean condylar concentricity was -11.06 ± 1.57, which was lower than in the Class I and Class II groups, indicating a tendency for a posteriorly positioned condyle.

Assessment of the AJS and PJS

Anterior joint space: The AJS in the Class I group had a mean value of 3.85 ± 0.21 mm (Table 5). The mean AJS in the Class II group was 3.3 ± 0.14 mm, which was significantly lower than the other groups, indicating that the anteriorly positioned condyle was responsible for the lower AJS. Class III cases had a mean AJS of 3.9 ± 0.14 mm, which was higher than the Class I and Class II groups, indicating a slight increase in AJS.

Posterior joint space: The PJS in the Class I group had a mean value of 3.5 ± 0 mm, which was within

the usual range. (See Table 6) The mean PJS in the Class II group was 4.25 ± 0.07 mm, the highest of the groups, indicating that an anteriorly positioned condyle caused greater PJS. The mean PJS in the Class III patients was 3.2 ± 0 mm, which was lower than the Class I and Class II groups, indicating a little decrease in PJS.

TABLE (3): Comparison of Articular Disc Position (Horizontal) Among the Three Groups

	Sample	Mean (left)	SD	Mean (right)	SD	Difference between right and left	Mean (right and left)	SD	P value
Class I	30	23.20	1.74	23.33	1.86	-0.13	23.27	0.09	< 0.0001*
Class II	30	30.51	1.41	30.73	1.48	-0.22	30.62	0.15	
Class III	30	25.80	1.31	25.90	1.47	-0.1	25.85	0.07	

Significant at P, 0.05, derived from one-way analysis of variance test.

TABLE (4): Comparison of Condylar Concentricity Among the Three Groups

	sample	Mean (left)	SD	Mean (right)	SD	Difference between right and left	Mean (right and left)	SD	P value
Class I	30	-5.28	10.63	-3.11	11.67	-2.17	-4.19	1.53	0.0009*
Class II	30	12.12	5.06	13.21	8.40	-1.09	12.67	0.77	
Class III	30	-12.17	7.39	-9.95	9.04	-2.22	-11.06	1.57	

Significant at P, 0.05, derived from one-way analysis of variance test.

TABLE (5): Comparison of Anterior Joint Space Among the Three Groups (Linear in mm)

	sample	Mean (left)	SD	Mean (right)	SD	Difference between right and left	Mean (right and left)	SD	P value
Class I	30	4.00	1.05	3.70	1.05	0.3	3.85	0.21	0.0645*
Class II	30	3.40	0.69	3.20	0.42	0.2	3.3	0.14	
Class III	30	4.00	0.94	3.80	0.78	0.2	3.9	0.14	

Significant at P, 0.05, derived from one-way analysis of variance test.

TABLE (6): Comparison of posterior Joint Space Among the Three Groups (Linear in mm)

	sample	Mean (left)	SD	Mean (right)	SD	Difference between right and left	Mean (right and left)	SD	P value
Class I	30	3.50	0.52	3.50	1.08	0	3.5	0	0.0003*
Class II	30	4.30	0.67	4.20	0.63	0.1	4.25	0.07	
Class III	30	3.20	1.03	3.20	1.03	0	3.2	0	

Significant at P, 0.05, derived from one-way analysis of variance test.

DISCUSSION

Joint pain, clicking, and limitation in mouth opening are common symptoms associated with anterior disc displacement as shown by [13]. This causes discal compression between the condylar head and articulating fossa, resulting in severe pain, which could be treated with occlusal splint [14]. The results of this study showed that Class II cases had more tendency of turning into TMDs due to altered condylar position, disc position, and joint spaces. TMD symptoms should be examined before, during, and after orthodontic therapy in these cases. During the examination, it was discovered that Class II cases exhibited the most anterior disc displacement among the three groups. In the Class II group, where the condyle was observed to be more anteriorly positioned, the changed condylar position was more significant. In comparison to the other two groups, Class II cases showed the most changes in joint spaces, with a decrease in AJS and an increase in PJS. In Class III cases, mild anterior disk displacement was found, and the condyle was positioned posteriorly, and a mild increase in AJS and reduction in PJS. The anterior disc position was greater compared with the control group but less than the Class II group

The findings matched those of Abdelemam A. [7], who used MRIs to examine TMJ morphology in Class II division 1 cases and discovered that the condyles were positioned anteriorly to the glenoid fossa, lowering the AJS and revealing anterior disc displacement in pretreatment records.

Previously, it was stated that condyles were posteriorly positioned in Class II cases that were misdiagnosed due to a lack of appropriate diagnostic tools. [15]. Pretreatment MRIs demonstrated that the articular disc was shifted anteriorly in a study of Class II division 1 cases by Chavan [16], increasing the probability of TMD development. This could result in irreparable alterations in the articular disc in the form of complete disc displacement if not treated or caught early.

Regarding the results of this study, early diagnosis of any form of TMD in patients that will need orthodontic treatment is very important especially in class II cases. With any signs of TMD, orthodontic treatment shouldn't be started or stopped to avoid the aggravation of the TMD to a severe form. Cases that have mild to moderate TMD signs and symptoms should be evaluated by MRI to check the disc and condyle position before starting orthodontic treatment.

CONCLUSIONS

The locations of the disc, condyle, and joint spaces changed the most in Class II patients. There was a tendency for anterior disc displacement with more anteriorly positioned condyles when compared to other groups. This group had the greatest number of cases with TMD symptoms and signs.

TMD signs and symptoms should be evaluated in Class II patients, and if the clinical assessment reveals positive results, the patients should be submitted to an MRI.

Class III cases, showed less severe anterior disc displacement with posteriorly positioned condyles and a lesser degree of signs and symptoms of TMD.

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