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CORRELATION BETWEEN CLINICAL AND RADIOGRAPHIC FINDINGS OF TEMPOROMANDIBULAR JOINT DISORDERS USING PANORAMIC RADIOGRAPH

Rana M. Afifi[1*] BDS, Hassan M. Aboelkhair[2] PhD, Aly M. Atteya[3] PhD

ABSTRACT

BACKGROUND: Temporomandibular disorders (TMDs) are common conditions affecting the jaws with a prevalence rate ranging between 28%-88%. Finding a link between the temporomandibular joint (TMJ) morphology and the prevalence of TMDs may aid in the early identification and treatment of these disorders.

Study objective: The aim of this study was to correlate between clinical and radiographic findings of TMDs using panoramic radiographs.

MATERIALS AND METHODS: The study included patients complaining of TMDs, who had been categorized into three groups based on Helkimo clinical dysfunction index: mild, moderate and severe TMD. Panoramic radiographs were taken for all patients to evaluate its diagnostic efficacy in TMD patients.

RESULTS: A sample of 30 patients (24 females and 6 males) were included in the current study. There were statistically significant differences in linear measurements between the three TMD groups (mild, moderate and severe), but no statistically significant differences were detected in the angular measurements.

CONCLUSION: Based on the study findings, it can be concluded that some panoramic parameters provide valuable information that can aid clinicians in formulating proper treatment and follow up plans for TMD patients.

KEYWORDS: Temporomandibular joint, Panoramic variables, Clinical dysfunction index, Temporomandibular joint disorders.

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1 BDS, 2015, Faculty of Dentistry, Alexandria University, Egypt

2 Professor of Oral Medicine, Oral Periodontology, Oral Diagnosis and Oral Radiology, Oral Medicine, Oral Periodontology, Oral Diagnosis and Oral Radiology Department, Faculty of Dentistry, Alexandria University, Alexandria, Egypt

3 Lecturer in Maxillofacial and Plastic Surgery, Maxillofacial and Plastic Surgery Department, Faculty of Dentistry, Alexandria University, Alexandria, Egypt

***Corresponding author:**
rana.afifi1993@gmail.com

INTRODUCTION

The temporomandibular joint (TMJ) is one of the most complicated joints in the body. It is an articulation between the temporal bone's glenoid fossa above and the mandibular condyle below (1). Pain in the joint or its surrounding mandibular tissues or clicking during motion are features of temporomandibular joint disorders (TMDs) (2).

The most frequent cause of non-dental pain in the head and neck is TMD. It is a multifactorial complex disorder associated with stress, tooth loss, occlusal interferences, masticatory muscular dysfunction, postural deviation, internal and external changes in TMJ component, and their numerous interactions (3).

The prevalence of TMDs ranged from 28% in young Swedish men in 1976 (4) to 88% in the north of Finland in 1974 (5). The reported prevalence among female dental students in Egypt was 28.5% in 2022 (6). TMDs are twice as common in women as in men between the ages of 20 and 40 years old, and their incidence increased over time (7). The high incidence of TMDs makes it necessary to promote diagnostic and treatment approaches (8).

Signs and symptoms of TMDs vary widely, so it would be advantageous to develop a simple and fast tool for their diagnosis in primary care. The Helkimo Clinical Dysfunction Index (HCDI) was established in 1974 and has been routinely used to clinically diagnose TMDs. It is a short and easy tool that evaluates mandibular movement, discomfort, and joint function (9, 10).

Clinical examination is the most crucial stage in the diagnosis of TMDs, however due to the complicated anatomy and pathology of the region, special imaging modalities are required. Panoramic radiography has become an extremely common radiographic modality which has proven to be a useful technique for assessing the condylar morphology (11). It permits a rapid analysis for both dental and bony structures (12). The technique is simple with a minimal radiation dose equivalent to three or four periapical radiographs (13).

Aim of the current study was to assess the panoramic parameters that provide information about TMDs, and correlate these parameters with HCDI.

The null hypothesis of this study was that there would be no correlation between HCDI and the measurements obtained from tracings of panoramic radiographs.

MATERIALS AND METHODS

The study was carried out in accordance to the Helsiniki Declaration guidelines for human research (14) and after obtaining the ethical approval from the Research Ethics Committee, Faculty of Dentistry, Alexandria University (IRB No: 00010556 – IORG:0008839).

Sample size was estimated assuming 5% alpha error and 80% study power. The mean (SD) condylar height in patients with normal TMJ as evaluated by panoramic x-ray was 24.5 (6.3) mm. The minimum required number of patients was calculated to be 10. The sample was stratified by TMD severity into three strata, so the total required sample size = number of patients × number of strata =10 × 3=30 patients.

All patients who presented with TMDs to Maxillofacial and Plastic Surgery Department, Faculty of Dentistry, Alexandria University between 2021 and 2022 were clinically examined according to HCDI. This study involved 30 patients, who met the inclusion and exclusion criteria.

Panoramic radiographs were taken for all the included patients. Images were collected using Morita Veraviewepocs 3D R100 panoramic model (J Morita Mfg. Corp., Kyoto, Japan) in a private radiology center. All patients were imaged using a standardized protocol with fixed exposure settings of 80 Kvp, 10 mA and 8.1 seconds exposure time.

The following inclusion criteria were applied:
Patients between 20 and 40 years old (15).
Patients having all their permanent teeth, whether they had a third molar or not.
Normal Class I occlusion (16).

The following exclusion criteria were adopted:
TMDs secondary to malocclusion (16).
Positive history of tempromandibular surgery.
Pathology or a fracture in the tempromandibular area.
Congenital craniofacial abnormalities (17).

The following parameters were assessed for every patient:

Clinical parameters:

Patients were evaluated based on the HCDI criteria (18-20). Accordingly, clinical assessment included mobility of the mandible, TMJ function, TMJ tenderness, muscle discomfort, and pain with movement. Each parameter was graded on a scale of 0 to 5. (Figure 1)

Clinical Dysfunction Index (DI) scores for the patients were divided into three categories: I (1-4 points, mild TMD), II (5-9 points, moderate TMD), and III (10–25 points, severe TMD) depending on the clinical dysfunction score.

Radiographic parameters:

The condyle and ramus were traced on both sides of the panoramic radiograph. Six variables (three linear, one angular, and two ratios) were determined from each side of the seven landmarks that were digitized on each side. The linear measurements included ramus height (RH), condylar height (CH) and condylar head height (CHH). The angular measurement was condylar head angle (CHA), while condylar-height to ramus-height ratio (CH/RH) and condylar-head-height to ramus-height ratio (CHH/RH) were the two ratio measurements.

RH was the distance between the perpendicular projection of the deepest point between coronoid process and condylar process on a ramus tangent and the intersection point between the ramus tangent and inferior mandibular. CHH was the distance between a point intersecting the perpendicular projection of the most superior point of condylar head and ramus tangent, and outermost point of condylar head. CH was the distance between a point intersecting the perpendicular projection of the most superior point of condylar head and ramus tangent, and the perpendicular projection of deepest point between coronoid process and condylar process on ramus tangent. CHA was the angle between condylar axis and ramus tangent. (21) (Figure 2, 3)

Statistical analysis

Normality was checked using the Shapiro Wilk test, boxplots, and descriptive statistics. It was observed that all variables were normally distributed. Groups were compared using One Way ANOVA, followed by Tukey's post hoc test with Bonferroni Correction. Comparisons between the left and right values were done using paired t-test. Pearson's correlation was done between clinical parameters and panoramic findings, while Spearman correlation was performed to correlate between panoramic findings and HCDI. The significance level was set at a p-value of 0.05. All tests were two-tailed. The Intraclass Correlation Coefficient was calculated for intra-examiner reliability. Data were analyzed using IBM SPSS Statistics for Macintosh, Version 28.0. Armonk, NY: IBM Co.

Clinical characteristics			Score
1. Muscle tenderness			
No pain on palpation			0
Tenderness to palpation in 1-3 palpation sites			1
Tenderness to palpation in 4 or more sites			5
2. TMJ pain			
No tenderness to palpation			0
Tenderness to palpation laterally			1
Tenderness to palpation posteriorly			5
3. Pain during mandibular movement			
No pain			0
Pain in 1 movement			1
Pain in 2 or more movements			5
4. TMJ function impairment			
Smooth movement without sounds and deviation on opening or closing ≤2mm			0
Sounds in one or both joints and/or deviation ≥2 mm on opening or closing			1
Locking and/or luxation of the TMJ			5
5. Range of mandibular mobility			
A. Maximum opening of mouth			0
>40 mm	0		1
30-39 mm	1		5
<30 mm	5		
B. Maximum lateral movement to the right			
≥7 mm	0	Sum A+B+C+D	
4-6 mm	1	0 points 1	
0-3 mm	5	1-4 points	
C. Maximum lateral movement to the left		5-20 points	
≥7 mm	0		
4-6 mm	1		
0-3 mm	5		
D. Maximum protrusion			
≥7 mm	0		
4-6 mm	1		
0-3 mm	5		
Sum of 1+2+3+4+5			Di

Figure (1): Helkimo's dysfunction index

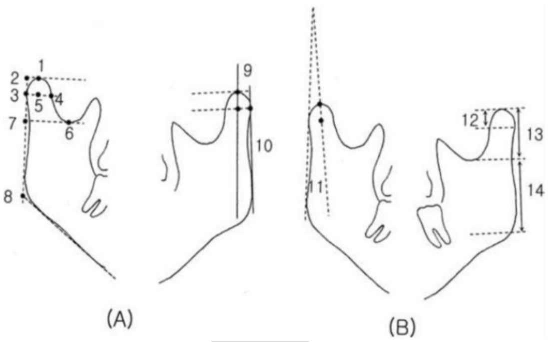

Figure (2): A, Landmarks and reference planes and **B,** measurements used in this study: 1, most superior point of condylar head; 2, point intersecting perpendicular projection of point 1 and ramus tangent; 3, outermost point of condylar head; 4, point intersecting perpendicular projection of point 3 and inner condylar outline; 5, midpoint between points 3 and 4; 6, deepest point between coronoid process and condylar process; 7, perpendicular projection of point 6 on ramus tangent; 8, intersection between ramus tangent and inferior mandibular line; 9, line connecting points 1 and 5 (condylar axis); 10, ramus tangent; 11: (CHA);12: (CHH); 13: (CH); 14: (RH); 15: CHH/RH; and 16:CH/RH.

Figure (3): Panoramic radiograph shows CHH, CH, RH, and CHA

RESULTS

This research was done to evaluate the precision of panoramic radiography for the diagnosis of TMD patients. The study included 30 patients between 20 and 40 years old, with a mean age of 26.1.

Radiographic Results

There was a statistically significant difference between three studied groups (mild, moderate and severe TMD) regarding the linear measurements (CHH, CH and RH). Mean CHH was 9.42, 8.16, 7.44, CH was 23.25, 20.93, 19.97 and RH was 39.33, 36.83, 36.07, for mild, moderate, and severe TMD, respectively.

Nevertheless, there was no statistically significant difference between the three groups in the angular measurement (CHA). The proportion determinations (CHH/RH and CH/RH) in the panoramic radiographs showed a statistically significant difference between the three groups on the left side. (Table 1)

Different superscripted lowercase letters denoted statistically significant difference between groups.

Table 2 showed that there was a statistically significant negative correlation between the HCDI groups and the panoramic parameters CHH ($p<0.0001$), CH ($p<0.0001$), RH ($p<0.0001$) and CH/RH ($p=0.033$). However, there were no significant correlations between HCDI groups and both CHA ($p=0.106$) and CHH/RH ($p=0.006$).

Intra-examiner Reliability Results

Calibration on radiographic measurements was done by examining 10% of the identified patients and re-examining them after two weeks. Intra-examiner agreement was calculated and Intraclass Correlation Coefficient was 0.99 for CHH, CH and RH, 0.93 for CH angle, 0.97 for CHH/RH and 0.92 for CH/RH.

Table (1): Comparison between the three studied groups according to panoramic variables.

		Mild (n=10)	Moderate (n=10)	Severe (n=10)	P value
		Mean (SD)			
Condylar Head Height	Right	9.44 (1.27)^{a}	8.40 (0.82)^{ab}	7.50 (1.39)^{b}	**0.004***
	Left	9.41 (1.05)^{a}	7.91 (0.91)^{b}	7.39 (1.13)^{b}	**<0.0001***
Condylar Height	Right	23.14 (2.21)^{a}	21.05 (1.10)^{b}	20.54 (1.65)^{b}	**0.005***
	Left	23.37 (1.76)	20.80 (1.19)^{b}	19.40 (1.16)	**<0.0001***

		a		b	
Ramus Height	Right	39.56 (1.18)[a]	36.86 (1.78)[b]	36.08 (1.41)[b]	**<0.0001***
	Left	39.10 (1.25)[a]	36.80 (1.91)[b]	36.07 (1.21)[b]	**<0.0001***
Condylar Head Angle	Right	8.13 (1.02)	7.95 (0.98)	7.55 (0.99)	0.431
	Left	7.63 (1.21)	7.86 (0.98)	7.19 (0.79)	0.331
Condylar Head Height to Ramus Height Ratio	Right	23.82 (2.83)	22.77 (1.92)	20.87 (3.62)	0.074
	Left	24.02 (2.15)[a]	21.21 (2.11)[ab]	20.66 (3.23)[b]	**0.014***
Condylar Head to Ramus Height Ratio	Right	58.49 (5.48)	57.11 (1.27)	56.36 (4.05)	0.493
	Left	59.78 (4.51)[a]	56.56 (2.51)[ab]	53.36 (3.29)[b]	**0.002***

*Statistically significant at p value≤0.05

Table (2): Correlation between Helkimo Index (clinical parameter) and panoramic parameters among the three groups.

		Mild (n=10)	**Moderate (n=10)**	**Severe (n=10)**	**Overall**
RH	R	-0.893	-0.881	-0.721	-0.721
	P value	**<0.0001***	**<0.0001***	**0.019***	**<0.0001***
CHH	R	-0.522	-0.700	-0.315	-0.652
	P value	0.122	**0.024***	0.376	**<0.0001***
CH	R	-0.209	-0.584	0.006	-0.658
	P value	0.562	0.076	0.986	**<0.0001***
CHH/RH	R	-0.348	-0.413	-0.137	-0.489
	P value	0.325	0.235	0.706	0.006
CH/RH	R	0.125	0.515	0.239	-0.390
	P value	0.730	0.128	0.506	**0.033***
CH Angle	R	0.194	-0.240	-0.580	-0.301
	P value	0.591	0.505	0.079	0.106

*Statistically significant at p value≤0.05

DISCUSSION

The main cause of orofacial pain of non-dental origin is TMD (22). Its symptoms might affect the face, head, or jaws whether unilaterally or bilaterally (23). TMDs are often associated with morphological alterations involving the bony structures of TMJ (24). The present study was conducted to assess the relationship between the severity of TMD and the mandibular changes on panoramic radiographs.

Patients who presented with TMD were analyzed in the current study using the HCDI and categorized into mild, moderate and severe TMD (25, 26). Then, HCDI was correlated with panoramic parameters. Some researchers reported that, panoramic radiography serves as a primary diagnostic modality for TMJ imaging. It is a feasible method for evaluating the bony parts of TMJ and the ascending rami of the mandible due to its low cost and practical utility (21, 27).

Additionally, Dahlström and Lindvall in 1996 (28) concluded that panoramic radiography is useful in detecting condylar changes, yet sometimes these changes are present, but the radiography is normal. In these cases, CT will give a more valuable radiograph for definitive diagnosis of the underlying problem.

This study was conducted on 30 patients suffering from TMJ dysfunction. There were 6 males (20%) and 24 females (80%) between 20-40 years old with a mean age 26.1. Our findings indicated that TMDs are more common in females, and this agrees with Ahmed et al., (29) who included 244 patients between 17-68 years old (31 males (13%) and 213 females (87%)). The higher prevalence of TMDs in females might be related to variety of reasons such as joint laxity, hormonal factors, and the use of oral contraceptives (23).

The current study findings revealed a statistically significant difference in CH between the studied groups, which decreases with increasing the severity of TMD. These results went along with the results of Pramanik et al. (30) in 2017 who demonstrated that there were no statistically significant differences between measurements of the morphology of the condyle in the TMJ presented with and without clicking, with the exception of the head of condyle (HOC) heights. Several studies supported the importance of normal disc position, as disc displacement with no reduction (DDNR) resulted in decreased adolescents' TMJ CH, while arthroscopic discopexy stimulated restored growth potential and promoted condylar new bone formation, which was particularly noticeable during the growth period (31, 32).

On the other hand, Ahn et al. (21) in 2006 demonstrated that CH starts to change when internal derangement (ID) advances from normal disc position to disc displacement with reduction

(DDR). It had been demonstrated that cases with DDNR had significantly lower CH than cases with DDR or normal disc position. However, RH did not differ significantly, which contradicts our results that showed a statistically significant difference between the three studied groups. This might be related to the fact that the RH is affected by a number of variables, including the depth and location of the mandibular notch, as well as inclination of the ramus and ramus tangent (21).

Ahn et al. (21) reported that ratio parameters differed significantly between the normal disc position and DDR. Results of the current study revealed a statistically significant difference between the three groups on the left side as most patients had an affected left TMJ with a normal right side.

The current results showed no statistically significant differences in angular measurements (CHA) between the three studied groups. This finding disagreed with the results of Kurita et al. (33) in 2001 and Ahn et al. (21). This could be explained by their larger sample size.

Limitations of the current study was improper distribution between age groups and the relatively small sample size. Further studies are still required to include a broader age range in order to determine the impact of aging on the TMJ morphology.

CONCLUSIONS

Linear measurements of RH, CHH and CH significantly decreased when TMD severity progressed from mild to severe cases. Findings of the current study supported that this method could be utilized for early detection of TMD, with subsequent referral of patients for further investigation and treatment. It also helps in monitoring changes during follow-up visits.

CONFLICT OF INTEREST

We affirm having no economic or personal benefit conflicts.

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