ISSN: 1812–1217

Temporomandibular Joint Assessment of Pre and Post Prosthetic Treatment of Partially Edentulous Patient (Radiographic Examination)

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الخلاصة

أهداف البحث: تتناول هذه الدراسة موقف اللقمة في الحفرة الصدغية للمرضى ذوي الأسنان الكاملة وفاقدي الأسنان بصورة جزئية قبل وبعد العلاج التعويضي، والمقارنة في موقع اللقمة بين الجهة اليمنى واليسرى في كلا المجموعتين عن طريق الفحص الشعاعي. المواد والطرق: اثنين وعشرين مريضا من ذوي الأسنان الكاملة (20–28) سنة، وثلاثين مريضا من فاقدي الأسنان بصورة جزئية (35–65) سنة تستوفي معايير الدراسة. لكل مريض تم تصنيع طقم جزئي بلاستيكي بالطريقة الاعتيادية. باستخدام جهاز التصوير الشعاعي الرقمي planmeca (فنلندا)، تم تصوير المفصل الفكي الصدغي بالأشعة الرقمية في وضع الفتح والإطباق للفم بطريقة البانوراما الخاصة للمفصل الفكي الصدغي للمجموعتين (قبل، في، ومرحلة ما بعد الإدراج من بدلة الأسنان). بوساطة برنامج (Dimaxis) تم قياس موقع اللقمة في الحفرة الصدغية أمامياً وخلفياً وزاوية ميلان نتوء التمفصل في وضع الإغلاق للفم ، تم استخدام برنامج Spss للتحليل الإحصائي.النتائج : بينت النتائج أن 76,5% من مرضى كاملي الأسنان لديهم موقع اللقمة في مركز الحفرة الصدغية ، ومعظم مرضى فاقدي الأسنان بصورة جزئية لديهم انحراف في موقع اللقمة إلى الخلف وبعد التعويض الصناعي للأسنان وجد تغيير في موقع اللقمة بصورة معنوية إذ أن (P=0,015) للجهة اليمنى و(P=0,032) للجهة اليسرى. وهناك فرق بين موقع اللقمة في الجهة اليمنى و الجهة اليسرى لكنه غير معنوي وزاوية ميلان نتوء التمفصل مختلفة بصورة معنوية بين كاملي الأسنان وفاقدي الأسنان بصورة جزئية. الاستنتاجات : انحراف القمة في الحفرة الصدغية الى الخلف سببه فقدان الأسنان الخلفية. بالنسبة للمرضى الفاقدي الأسنان بصورة جزئية فالتعويضات الصناعية ضرورية في حفظ موقع اللقمة في الحفرة الصدغية لأنها قللت من انحراف موقع اللقمة الخلفي، وأن ارتياح المريض بعد تعويض الأسنان الخلفية حصل عندما أصبح موقع اللقمة في منتصف الحفرة الصدغية (+ 0,35 ملميتر)، وان زاوية ميلان نتوء التمفصل ليس لها ارتباط مع موضع اللقمة في حاله فتح الفم. تسبب فقدان الأسنان ادى الى تغيير الميلان في زاوية ميلان نتوء التمفصل.

ABSTRACT

Aims: This study investigates the condyle position in temporal fossa of completely and partially dentated patients pre and post prosthetic treatment, and compares between right and left condyles in both groups by radiographic Examination. **Materials and Methods:** Twenty two completely dentate patients (20-28) years old, and thirty partially dentate patients (35-65) years old meet the criteria of the study. For each patient a temporary removable acrylic partial denture was constructed. By using planmeca digital radiography device (Finland), the radiograph for TMJ were taken by special panoramic technique in open and close mouth position for both groups (Pre, at, and Post insertion of dental prosthesis). By using Dimaxis software program the linear measurements of the narrowest anterior and posterior joint spaces made by using program tools, the articular eminence inclination angle in closed mouth position also measured, and statistical analysis by using SPSS program version 11.5 for all data. **Results**: The results showed that in completely dentated patient, 76.5% had condyles in concentric position, patients who had lost posterior teeth support showed a predominance of posterior condylar positions and significant decreased in displacement after prosthodontic treatment (P=0.015 for right side and P=0.032 for left side) at significant level 0.05. Asymmetry in concentric position of condyle between right and left side, but insignificant value P>0.05. There is significant difference in the inclination of articular eminence angle between completely and partially dentate patients P=0.01 for the right side and P=.005for the left side. **Conclusions:** Posterior displacement of the condyle associated with loss of posterior teeth. Significant change in the condylar position occurred after prosthetic rehabilitation, patient's comfort obtained when the position of condyle in glenoid fossa is (concentric position ± 0.35mm). The loss of teeth caused remodeling of articular eminence inclination.

Key Words: condyle, articular eminence, edentulous and digital radiography**.**

Hatim NA, Jameel NG, Shehab MM. Temporomandibular Joint Assessment of Pre and Post Prosthetic Treatment of Partially Edentulous Patient (Radiographic Examination). *Al–Rafidain Dent J*. 2011; 11(1):12-23.
Received: 30/3/2009 ***Sent to Referees:*** 30/3/2009 ***Accepted for Publication:*** 27/5/2009

INTRODUCTION

The need to replace missing teeth is debatable and dependent on many factors include; aesthetics function and the prevention of undesirable tooth movement. The importance of each of these factors must be considered[1].

The teeth provide a stable vertical and distal relation of mandible to maxilla and provide guiding planes for movement of the mandible anteriorly and laterally in the range of the mandibular movement during which the teeth are in contact. Loss of posterior teeth followed by loss of occlusal curve may tip the balance from adaptation with functional harmony towards disordered function[2]. The condyle of the mandible can be considered a mirror that reflect functional disturbance of the occlusion of the teeth[3].

Hattori *et al* [4] state that the shorten dental arches (dental arch with missing posterior teeth) is not a risk factor for TMD, the explanation of these findings, on the other hands is that neuromuscular regulatory mechanisms protect the joints from over loading. Patients with prosthetic rehabilitation to stabilize the occlusion and reduced tooth contact intensity have greater effect to relief pain of TMDs[5-8] .

The TMJ is one of the most difficult areas in the body to image because the bony structures of the joint are small at least partially obscured by the more massive cranial bones[9]. The radiographic examination of suspected TMJ problem, considered as a part of the total evaluation of the patient[10,11]. A number of imaging modalities have been used in the past and still used to examine patients with TMJ problems[12,13]. Digital radiography system for use in dental practice have been available for almost two decades[14]. Digital radiography is computer technology have resulted in unique (filmless) imaging system unlike conventional dental radiography "no film or processing chemistry is used"[15]. Digital image actually is a solid-state sensor and phosphor plate sensors that produces the X-ray information on the monitor screen, printer or other viewing devices (electron sensor and computerized imaging system)[16].

Different methods have been used to determine the condylar position according to relative dimensions of anterior and posterior joint spaces between the fossa and condylar surface. Three type of condyle position can be identified[17]: (Condylar concentric position in which the anterior and posterior joint space are equal, posterior condylar position in which the posterior joint space is smaller than anterior joint space, and anterior condylar position in which the posterior joint space is greater than anterior joint space).

The aims of this study by using digital radiography - special panoramic technique - to evaluate the condylar position in the temporomandibular fossa and inclination of articular eminence angle of normal dentate subjects and partially dentate patients. Also condylar position in the temporomandibular fossa and inclination of articular eminence angle for partially dentate subjects pre and post prosthodontic treatment comparing between right and left condyle in closed mouth position.

MATERIALS& METHODS

Two hundred forty six patients and students diagnosed during the research period from clinics of University of Mosul, Dentistry College using the basic method of dental examination[18]. Only one hundred eleven persons were suitable for the criteria of the study, but only fifty two of them continue until completing the course of treatment. The sample is divided into two groups. The first group: (22) dentate students (control) aged between (20-28) years, completely asymptomatic (super normal)[19], person with Angle Class (I) occlusion, who has no history of orthodontic treatment, teeth extraction, cast restoration or fixed partial denture and good general health. The second group: (30) partially edentulous patients without paired teeth, aged between (35-65) years old, the period of extraction between (1-5) years and

without previous prosthesis. Temporary removable maxillary and mandibular partial dentures (TRPD) were constructed in conventional method.[20, 21]

The finished denture was placed in patient mouth, any discomfort or injury troubled to the patient was removed, any pressure area was relived. The appearance and speech of the patient with TRPD also checked.

Each subject in this study was radiographed in two positions, in the closed mouth position and in the maximum opening (Figure 1 A, B) using specialized panoramic TMJ projection for both right and left sides, with planmeca digital radiographic machine (type Cephpan) and planmeca Dimaxis pro and classic imaging software (Finland). After selecting an existing patient; insertion the data base, from the control panel of the device converted to the system need, adjust the exposure dose of radiation for adult male (Closing 74 kVp, Opening 72 kVp) while for adult female (70 kVp and 68 kVp) respectively. Ten mA and 6.3 sec. exposure time for each position. When the digital radiograph is exposed, the image is transmitted to a computer processor immediately converted to digital format.

(A) (B)

Figure (1): A:closed mouth position. B: maximum opening position.

The radiographs taken in three intervals. Pre-construction of dental prosthesis: in closed mouth position (centric relation) is a horizontal reference position of the mandible can be routinely assumed by patients under the direction of the dentist (learnable and reproducible)[18]. The patient was asked to open and close the mandible several times, asked him to phonation some words with /s/ sound after that the radiographic was taken in centric relation position, and two to three months interval after final adjustment of the dental prosthesis.

To enhance the digital radiographic image (Dimaxis soft ware), four types of manipulation tools were applied, normal radiography-without manipulation- reverse gray scale, pseudo-coloring and gradient. The anterior and posterior intra-articular space are measured in pre and post dental prosthesis insertion for each patient in the study, also the anterior and posterior intra-articular space for control group is measured. Using the linear measurement of the closest joint space described by Pullinger and Hollender[19]. In close mouth position measures as follows (Figure 2): Draw two parallel lines, one line tangential with more prominent point of condyle and other line tangential with inner border of fossa. The distance between two parallel line is measure and represented the intra-articular space.

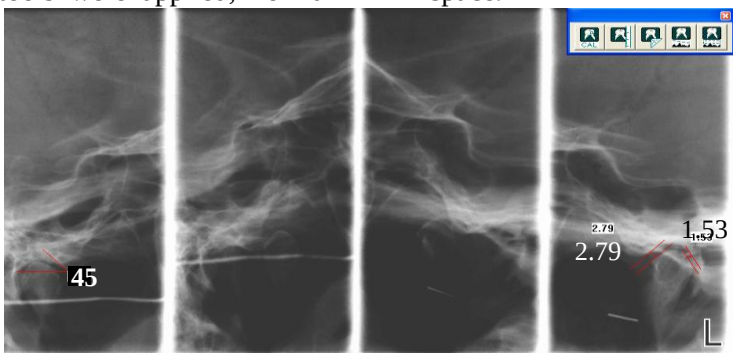

Figure (2) Radiographic image, linear and angular measurement. A and D TMJ in closed position , B and C TMJ in opened position . A: angular measurement , D: Linear measurement

Data collected from these examination were transferred to the following formula[22].

$$X = \frac{P - A}{P + A} \times 100$$

P = posterior joint space.
A = anterior joint space[(22)].

Measurement of articular eminence inclination is as described by Matsumoto and Bolognese (1993). All these measurement done on (Dimaxis software / 3.2.1) on the computer program designed by Planmeca company. Statically analysis was done by using SPSS program version 11.5.

RESULTS

Two-hundred twenty four temporomandibular joints examined radiographically in closed mouth position for both partially dentate patients and completely dentate patients and, Data collected from these examination and tests undergo different statistic analysis methods, for more investigation of the significant difference at $P \leq 0.05$ degree at least.

According to the formula from Pullinger and Hollender[22]. The percentage of anterior or posterior displacement of condyle was smaller than -12. This indicate that the condyles were in a posterior position, results ranging from -12 to +12 indicated that the condyles were in a concentric position, and the results greater than +12 indicate that the condyles were in an anterior position. By percent formula; the condyle position in the mandibular fossa of completely dentate patients in closed mouth position, the results of the concentric position ±12%, in the right side showed (1=4.5%) condyle in posterior position, (6=27.3%) condyles in anterior position, and (15= 68.2%) in concentric position (Table 1 and Figure 3).

Table (1) Number and Percentage of Right and Left Condyle Position of Completely Dentate Patients in Closed Mouth Position by Percent Formula.

Condyle Side	Anterior		Concentric		Posterior		Total
	Number	%	Number	%	Number	%	
Right	6	27.3	15	68.2	1	4.5	22
Left	3	13.6	18	81.8	1	4.5	22

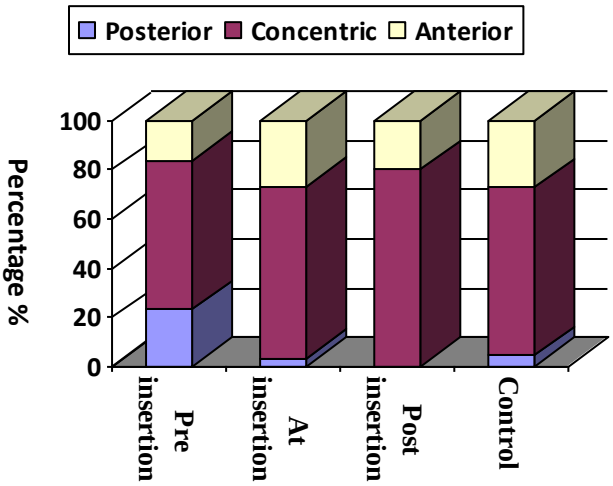

Figure (3) Condyle Position on the Right Side According to Concentric Range ± 12% by Percent Formula

For the left side, by concentric range ±12%, resulted showed (1=4.5%) condyle in posterior position, (3=13.6%) in anterior position and (18=81.8%) in concentric position (Table 1 and Figure 4). In the partially dentate patients, the condyle position in the right and left sides were showed in Table (2) and Figure (3 and 4).

Table (2) Number and Percentage of Right and Left Condyle Position of Partially Dentated Patient at (Pre insertion ,At insertion and Post insertion) of Dental Prosthesis in Closed Mouth Position by Percent Formula.

	Pre insertion		At insertion		Post insertion	
	Number	%	Number	%	Number	%
			Right side			
Anterior	5	16.6	8	26.6	6	20
Concentric	18	60	21	70	24	80
Posterior	7	23.3	1	3	0	0
Total	30	100%	30	100%	30	100%
			Left side			
Anterior	5	16.6	8	26.6	7	23.3
Concentric	17	56.6	18	60	22	74
Posterior	8	26.6	4	13.3	1	3
Total	30	100%	30	100%	30	100%

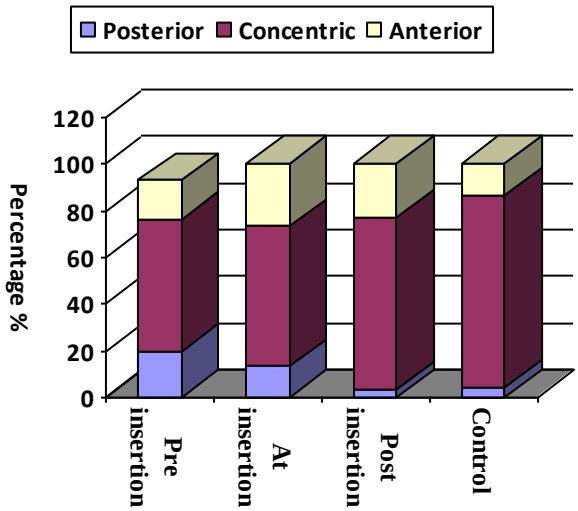

Figure (4) Condyle Position on the Left Side According to Concentric Range ± 12% by Percent Formula

Analysis of variance (ANOVA) test for both completely dentate patients and partially dentate patients in pre and post insertion of dental prosthesis in the right and left side is illustrated in Tables (3 and 4). The results show significant difference between groups at $P \leq 0.05$. Duncan test shows the significant difference in condyle position present for the pre insertion of dental prosthesis with post insertion of dental prosthesis and completely dentated patients as illustrated in Figure (5).

Table (3) Analysis of Variance for the Partially Dentated Patients at (Pre insertion, At insertion and Post insertion) of Dental Prosthesis and Completely Dentated Patients in the Right and Left Condyle.

Condyle Side		Sum of Squares	df	Mean Square	F value	P.value
Right	Between groups	1556.366	3	518.789	3.657	.015 Sig
	Within group	15320.744	108	141.859		
	Total	16877.111	111			
Left	Between groups	1580.993	3	526.998	3.036	.032 Sig
	Within group	18745.788	108	173.572		
	Total	20326.781	111			

df: degree of freedom, Sig: Significant Difference at $p \leq 0.05$.

Table (4) Analysis of Variance Between Right and Left Condyle of Partially Dentated Patients at (Pre insertion, At insertion and Post insertion) of Dental Prosthesis.

Condyle Side		Sum of Squares	df	Mean Square	F value	P. value
Right	Between groups	1310.272	2	655.136	4.896	.010 Sig
	Within group	11648.991	87	133.896		
	Total	12959.263	89			
Left	Between group	1300.266	2	650.133	3.721	.028 Sig
	Within group	15202.194	87	174.738		
	Total	16502.460	89			

df: degree of freedom, Sig: Significant Difference at p≤ 0.05

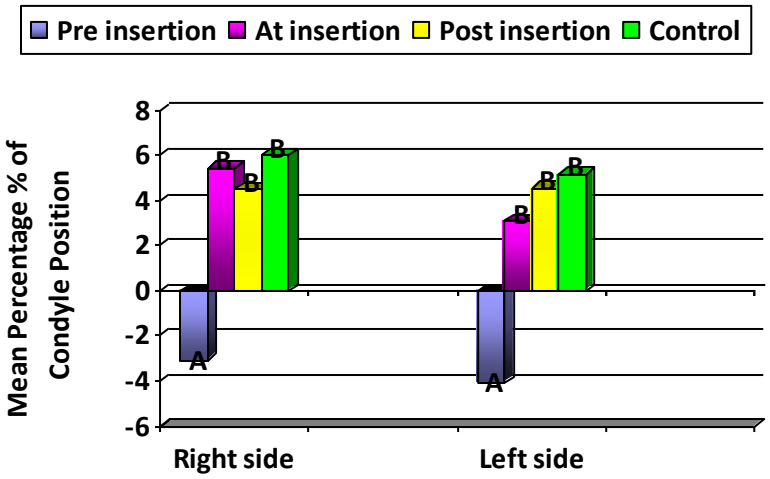

Figure (5) Duncan Multiple Range Test Between the Partially Dentated Patients at (Pre insertion, At insertion and Post insertion) of dental prosthesis and the Completely Dentated Patients (Control). Different Letters Means Significant Different at p≤0.05.

Tables (5) and Figure (6) representing the relationships between right and left Condyle in completely dentated patients and partially dentated patients in (pre, at, and post) insertion of dental prosthesis show no significant difference present at p ≤ 0.05.

Table (5) Paired T-Test Between Right and Left Condyle in Completely Dentated Patients and Partially Dentated Patients in(pre, at, post) insertion of dental prosthesis by Percent Formula, and the Significant Difference at p≤ 0.05 in Closed Mouth Position.

	Condyle Side	Mean%	No.	SE	t value	df	P. value
Completely Dentated	Right	6.0232	22	2.81913	.364	21	.720 NS*
	Left	5.1601	22	2.76950			
Partially Dentated Pre	Right	-3.0770	30	2.86073	.417	29	.680 NS*
	Left	-4.1310	30	2.92127			
At insertion	Right	5.4423	30	1.775	1.024	29	.314 NS*
	Left	3.0840	30	2.482			
Partially Dentated Post	Right	4.5113	30	1.43294	-.034	29	.973 NS*
	Left	4.5726	30	1.66662			

N: Number, t: student t- test, SE: Stander error, df: degree of freedom, NS* =not significant.

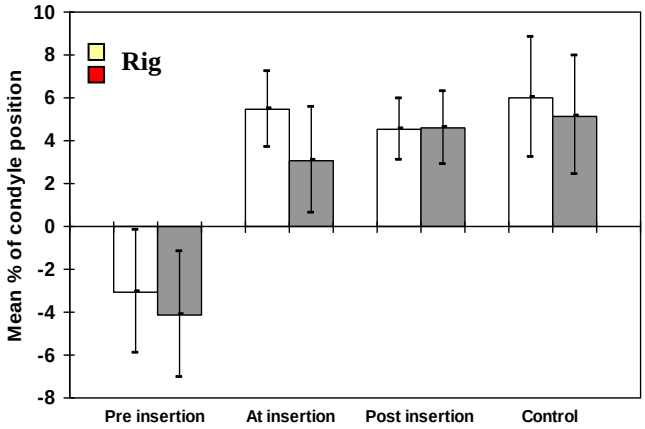

Figure (6) Mean Percentage of Condyle Fossa Relationship Between Right and Left Sides.

Mean, analysis of variance (ANOVA), and Duncan test for the inclination of articular eminence angle among completely dentate patients and partially dentate patients at (Pre insertion, At insertion and Post insertion) of dental prosthesis in the right and left side**,** significant difference at $p \leq 0.05$, results show that there is significant difference between groups at $p \leq 0.05$, illustrated in Table (6 and 7) and Figure (7).

Table (6) Descriptive Statistic with Comparison of Right and Left Inclination of Articular Eminence Angle in the Completely Dentated Patients and the Partially Dentated Patients at (Pre insertion, At insertion and Post insertion) of Dental Prosthesis.

Factor	Condyle Side	No.	Minimum	Maximum	Mean*	SD
Pre insertion	right	30	40	61	49.33	4.604
	left	30	39	60	49.77	4.629
At insertion	right	30	40	60	49.23	4.673
	left	30	41	60	49.70	4.504
Post insertion	right	30	40	60	49.23	4.569
	left	30	40	60	49.73	4.623
Control	right	22	40	60	45.50	4.575
	left	22	40	60	45.68	4.643

*in angular degree ,SD: Stander deviation, N: Number.

Table (7) Analysis of Variance (ANOVA) for the Inclination of Articular Eminence Angle Between Completely Dentated Patients and Partially Dentated Patients at (Pre insertion, Post insertion) of Dental Prosthesis Right and Left Side.

Condyle Side		Sum of Squares	df	Mean Square	F value	P. value.
Right	Between groups	251.020	3	83.673	3.941	.010 Sig
	Within group	2292.900	108	21.231		
	Total	2543.920	111			
Left	Between groups	290.256	3	96.752	4.578	.005 Sig
	Within groups	2282.306	108	21.132		
	Total	2572.563	111			

df: degree of freedom, Sig: Significant Difference at $p \leq 0.05$.

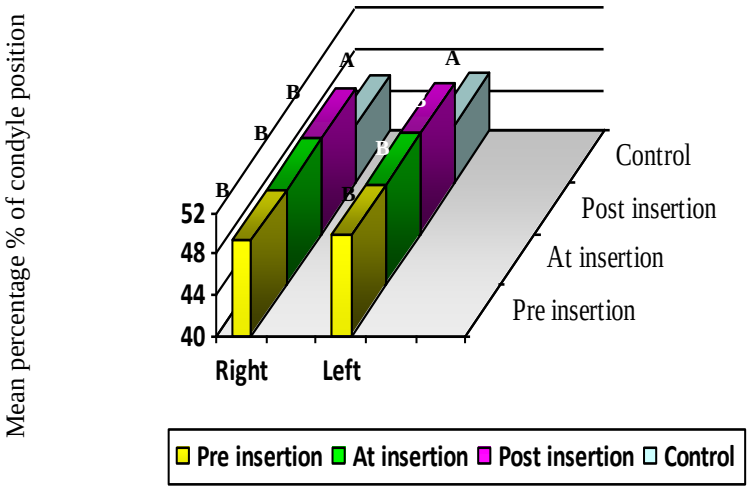

Figure (7) Duncan Multiple Range Test for the Inclination of Articular Eminence Angle Between the Completely Dentated Patients (Control) and Partially Dentated Patients at (Pre insertion, and Post insertion) of Dental Prosthesis, the Different Letters Means Significant Different at $p \leq 0.05$.

DISCUSSION

From analysis Table (1) by percent formula the concentric position is ±12%, 68.2% condyle for the right side (Figure 3), and 81.8% condyle for the left side (Figure 4) in concentric position. This is in agreement with other sciences[19,23], they found radiographically concentric condyles were found in 50% to 86% in an asymptomatic population, the apparent differences in condylar position may represent serial differences in condyle shape (Morphologic variation).

In this study 20-30% have condyle displacement from concentric position (Figure 3 and 4), this is in agreement with other sciences[19,24], who found the same percentage of condyles had displacement from concentric position. Al-Obaidi[26] stated that at centric occlusion the mean value for condyle position for right and left side condyle (9.21%) which is at concentric position – within anterior limits of concentricity – this is in agreement with this study who found the mean value for condyle position for combined right and left side condyle (5.56%) which is at concentric position – within anterior limits of concentricity .

In this study (Table 2, Figure 3 and 4), patients who has lost posterior support showed a predominance of posterior condylar position (reduction of posterior intra-articular space).This is in agreement with other sciences[17,27].When the posterior teeth were not present, the mandible was guided backward by the muscles of mastication, the head of condyle positioned posteriorly, this results in a smaller joint space posteriorly and wider joint space anteriorly[28].

The prosthetic rehabilitation caused changes in condyle / fossa relationship and reducing the incidence of posterior condylar positions and increasing incidence of concentric condylar position, the degree of retrusion was observed to be smaller even when the condyles remained in a posterior position (retrusion). This is in agreement with Amorim *et al*[17], concluded that for partially edentulous mandibular arch showed a predominance of posterior condylar positions in maximal inter-cuspal position, after prosthetic rehabilitation with tomographic examination showing more pronounced decreases in posterior condylar position and increases in concentric condylar position.

Witter *et al*[29] came to concluded that free end removable partial denture that compensate for the loss of molars in the mandible did not prevent temporomandibular disorder, but enlarging the posterior support may be beneficial to improve occlusal stability and masticatory function and potentional to reduce the amount of articular loading .

A comparison of symptomatic subjects and volunteers with normal joints revealed a small but significant increase in the prevalence of missing posterior teeth in the symptomatic subjects with intra-articular TMJ disorders, there is a relationship between an increasing prevalence of TMJ space variations and increasing mandibular dysfunction and age-related reduction in TMJ space is expected because older patient tend to have greater tooth loss, the tooth loss altered the muscular function leading to TMDs other sciences[30-32].

Table (3 and 4), and Figure (5) show that there was a significant difference of the partially dentated patients (pre insertion of dental prosthesis), with the control group (complete dentated patients) and partially dentated patients in at insertion and post insertion of dental prosthesis, this is in the agreement with other sciences[33,34], stated that the posterior teeth seem to be the most vital factor in maintaining the TMJ. The unilateral or bilateral reduction of vertical dimension of occlusion can result in condylar retrusion. Fabrication of therapeutic removable partial dentures provided for the reestablishment of functions of the stomatognatic system. Recovery of vertical dimension in patient with deep bite, it is believed that a better positioning of the condyle was provided in the glenoid fossa and the clinical signs of mandibular function improved significantly. A specific vertical dimension of occlusion may be necessary in order to have condylar concentrically located in the fossa. Dysfunction is treated by condylar repositioning in TMJ by using acrylic resin for therapeutic centric occlusion is necessary before more durable (metal) prosthetic appliance are constructed.

There is no significant differences between the at insertion of dental prosthesis and post insertion of the dental prosthesis because the condyle displacement is a symptom of whole mandibular displacement that effect the function of the masticatory muscle with the result that muscle spasm, the treatment by prosthetic rehabilitation, the muscle may not have had sufficient time to be reprogrammed to utilize the therapeutic centric occlusion (prosthetic rehabilitation), complete muscle programming usually takes place within 12 months[35,36].

Analysis of Table (5) and Figure (6) showed that there are differences in means between right and left sides condyles in all situations (completely dentated patients and partially dentated patients) except in the post insertion of dental prosthesis but these difference not reach to the significant level. This is in agreement with other sciences[17,19,26,37]. The joint position of any individual subjects left condyle did not appear to be highly associated with (or depend upon) the joint position of his right condyle. In fact, there was a greater than expected degree of independence between asymptomatic subjects left and right TMJ bony relationships. Many subjects were seen in which one joint had an obviously anteriorly or posteriorly positioned condyle, the changes in joint space width may occur through out a patient's life time[37].

Changes in one joint do not necessitate the same changes in the contra-lateral joint. A variety of factors may be responsible for these changes including osseous and soft tissue responses to joint loading, the position and morphology of the disk and three-dimensional posturing of the mandible at the time of evaluation, the asymmetrical joint position between right and left sides it is not understood whether this is random finding or reflection of other systematic facial asymmetries[19,38].

From table (6) the inclination of the posterior slop of the articular eminence had mean value (49.39±SD) angular degree for partially dentated patients, this is in agreement with other sciences[39,40]. They found the inclination of the posterior slop of the articular eminence had the same ranging of mean from (45 - 52.9±SD) in angular degree.

The small difference present between all measurements depend on the method used to measure the steepness or the prominence of the articular eminence are important factors that may have influence on the results, also it is important to use the radiographic technique capable of depicting the slop of the eminence at sagital plane along with condyle translates[41].

Table (7) and Figure (7) showed that, there is significant difference ($p < 0.05$) in both right and left side between partially

dentated patients and completely dentated patients, this is disagree with other sciences[42,43]. This may be the loss of teeth lead to remodeling of the articular eminence inclination or may be the large number of males in control group and the male has steeper articular eminence inclination than female .

There is insignificant difference present between the inclination of articular eminence angle in the right and left sides in both groups, this is in agreement with Jameel and Sammie[44], who found the angle's value are within the same range of this study, the difference present between the right and left lies within the measuring errors or anatomical variation.

CONCLUSIONS

1. In completely dentated patients only 76.5% condyles in concentric position, 20% in the anterior position and 4.5% in the posterior position in temporomandibular fossa.
2. In the partially dentated patients, posterior condylar displacement is associated with loss of posterior occlusal support (missing of posterior teeth) and decrease of vertical dimension.
3. There are significant differences in condylar position between partially dentated patients (pre prosthodontic treatment) and completely dentated patients.
4. There are significant differences in condylar position between partially dentated patients (pre prosthodontic treatment) and post prosthodontic treatment of the same patients.
5. The removable partial dentures are often the method of choice for rehabilitation of occlusal function.
6. There are obvious asymmetry between right and left condyle position in glenoid fossa for both groups (completely dentated patients and partially dentated patients).
7. There are significant differences in the inclination of articular eminence angle between partially dentated patients and completely dentated patients.

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