EVALUATION OF THE CONDYLAR SHAPE AND POSITION IN PATIENTS WITH TEMPOROMANDIBULAR JOINT DISORDERS USING CONE BEAM COMPUTED TOMOGRAPHY

Konik Işınlı Bilgisayarlı Tomografi Kullanılarak Temporomandibular Eklem Bozukluğu Olan Hastalarda Kondiller Şekil ve Pozisyonunun Değerlendirilmesi

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ABSTRACT

Background: Temporomandibular joint (TMJ) disorders are common and often self-limited in the adult population. In epidemiologic studies, up to 75 percent of adults show at least one sign of joint dysfunction on examination and as many as one third have at least one symptom. The present study was conducted to investigate the position and shape of the condyle in patients with TMD divided into two groups (a group with disc displacement and a group with osteoarthritis) and based on their Cone Beam Computed Tomography (CBCT) images.

Materials: The present study was conducted on 45 patients (5 men and 37 women) aged 13 to 82 (with a mean age of 37.5) known by their clinical examinations to have TMD type II (disc displacement) and type III (osteoarthritis). To investigate the shape and position of the condyle and the slope of the articular eminence in the sagittal, coronal and axial planes, CBCT images were taken from the patients' TMJ on both sides at maximum dental occlusion.

Results: The result of this study showed the lack of a normal distribution of the data in the quantitative analysis of the horizontal condylar position with the mouth closed (post+ante/post-ante). The compare this indicator in the RDC and the TMD groups, revealing a significant difference between the two (p=0.002). In group II, the condyle showed a greater tendency toward the posterior position. A significant relationship was found between the mediolateral condylar position (central, medial and lateral positions) and the RDC or TMD group type (p=0.02), and the condyle showed a greater tendency toward the lateral position in both groups. However, a significant relationship between the sagittal shape of the condyle and the RDC or TMD group type (p=0.02).

Conclusion: The results obtained indicate that adolescent disc displacement and osteoarthritis can cause the condyle to change its position and shape in the fossa.

Key words: Temporomandibular joint disorder (TMD), CBCT, condyle, toothache

ÖZ

Amaç: Temporomandibular eklem (TME) rahatsızlıkları sıklıkla görülmektedir ve erişkin popülasyonunda sınırlıdır. Epidemiyolojik araştırmalarda yetişkinlerin %75'inde muayene sırasında en az bir adet eklem disfonksiyonu belirtisi görülürken, üçte birinin en az bir semptomu vardırBu çalışma, iki gruba ayrılan TMD'li hastalarda (disk yer değiştirmeli bir grup ve osteoartritli bir grup) kondilin yerini ve şeklini Konik Işınlı Bilgisayarlı Tomografi (CBCT) görüntülerine dayalı olarak araştırmak için yürütülmüştür.

Gereç ve Yöntem: Bu çalışma, klinik muayene ile TMD tip II (disk yer değiştirmesi) ve tip III (osteoartrit) olduğu saptanan 13 ila 82 yaşları arasındaki (Ort. 37.5) 45 hastada (5 erkek ve 37 kadın) gerçekleştirildi. Kondil şekli ve pozisyonu ile birlikte artiküler eminensin sagital, koronal ve eksenel düzlemlerde eğimini araştırmak için, hastaların maksimal dental oklüzyonunda temporomandibular eklemden her iki taraftan CBCT görüntüleri alındı.

Bulgular: Ağız kapalı (post+ante/post-ante) yatay kondil pozisyonunun kantitatif analizinde verilerin normal dağılımının olmamasını gösterdi. RDC ve TMD gruplarındaki bu göstergenin ikili karşılaştırılmasında iki grup arasında istatistiksel olarak anlamlı bir fark vardı (p = 0,002). Grup II'de, kondil posterior pozisyona doğru daha büyük bir eğilim gösterdi. Mediolateral kondüler pozisyon (merkez, medial ve lateral pozisyonlar) ile RDC veya TMD grup tipi arasında anlamlı bir ilişki bulundu (p=0,02) ve kondil her iki grupta lateral pozisyona daha büyük bir eğilim gösterdi. Bununla beraber kondilin sagital şekli ile RDC veya TMD grubu tipi arasında anlamlı bir ilişki görüldü (p = 0,02) .

Sonuç: Elde edilen sonuçlar ergen disk yer değişikliği ve osteoartritin kondilin fossa içindeki yerini ve şeklini değiştirmesine neden olabileceğini göstermektedir.

Anahtar Kelimeler: Temporomandibuler eklem bozukluğu (TMD), CBCT, kondil, diş ağrısı

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INTRODUCTION

Temporomandibular joint (TMJ) disorders are common and often self-limited in the adult population. In epidemiologic studies, up to 75 percent of adults show at least one sign of joint dysfunction on examination and as many as one third have at least one symptom.[1,2] However, only 5 percent of adults with TMJ symptoms require treatment and even fewer develop chronic or debilitating symptoms[3] and involve muscular pain, joint pain, limited mandibular range of motion and joint clicks as their clinical symptoms based on the type of disorder presenting. A clinical examination does not suffice for making an accurate diagnosis of the variety of diseases that affect the TMJ.

In most cases, the etiology and treatment of the condition can be ascertained using imaging examinations. A series of clinical examinations and TMJ imaging are therefore essential in the diagnosis of TMD.

As a major part of the TMJ, the condyle takes a variety of shapes in different ages and in different individuals. These variations are affected by evolutionary variations, malocclusion, trauma and other developmental disorders and diseases.[4,5] In its superior view, the condyle can be flat, round or substantially convex, while in its mediolateral view, it is often slightly convex and symmetrical. Radiographic studies classify the condylar shape into five main categories, including the concave, convex, angled, flattened and round shape categories.[6]

The articular eminence is located in the anterior glenoid fossa and its posterior slope varies in different people and is affected by masticatory and developmental forces and the displacement of the articular disc.[7-9] The articular eminence is 90-94% developed by age 20.[10] Many studies examined the morphological and slope variations in the articular eminence, showing the largest part of the morphological variations to be associated with aging, often manifested in the form of flattening.[9,11]

In addition to morphological studies, the examination of the TMJ requires the superior articular space of the condyle to be carefully examined in TMJ imaging. Different studies have used CBCT imaging to estimate the size of the articular space in normal individuals who had already had their size confirmed in an MRI. Learning the size of these articular spaces is essential, as studies have shown that disc displacement can also occur in the absence of clinical symptoms.[12,13] With the increasing use of MRI, disc displacement has been shown to not be a very rare phenomenon and is reported to occur more than previously imagined, even in children.[14] Tomography and MRI studies have demonstrated that, in the anterior displacement of the disc, condyles move in the posterior direction[15,16] and tend more toward the medial or lateral positions of the glenoid fossa. An examination of the CBCT images and the measurement of the articular spaces can help estimate potential disc displacement and the onset of degenerative articular diseases.[17,18]

As the early diagnosis and treatment of TMD is crucial to the successful control of bone degradation,[19] the present study was conducted to investigate the position and shape of the condyle in patients with TMD in two groups, a group with disc displacement and a group with osteoarthritis, based on their CBCT images.

MATERIALS AND METHODS

It was a cross sectional study approved by the Research Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran (540).

The present study was conducted on 45 patients (5 men and 37 women) aged 13 to 82 (with a mean age of 37.5) known in their clinical examinations to have TMD type II (disc displacement) and type III (osteoarthritis). To investigate the shape and position of the condyle and the slope of the articular eminence in the sagittal, coronal and axial planes, CBCT

images were taken from the patients' TMJ on both sides and at maximum dental occlusion using a Dental CBCT PLANMECA PROMAX in the radiology department of Mashhad School of Dentistry. The classification proposed by Kinzinger *et al.*[20] was used in investigating and classifying the condylar shape in the three planes. The mediolateral position of the condyle (the coronal plane) was classified into the central, lateral and medical groups based on the study conducted by Ikeda *et al.*[18] To calculate the superior, posterior and anterior spaces, the condylar position in the sagittal plane was assessed qualitatively and quantitatively based on a study conducted by Tsiklakis.[21] Moreover, the slope of the articular eminence was measured based on the study by Zabarovi *et al.*[22] All the images were ultimately examined by an oral and maxillofacial radiologist.

RESULTS

As shown in table 1 and according to the Chi-squared test, the qualitative assessment of the condylar position with the mouth closed in all the three central, anterior and posterior positions in group types II and III showed a significant relationship between the horizontal condylar position with the mouth closed and the RDC or TMD group type (p=0.004).

Table 1. Horizontal condylar position with the mouth closed in the RDC and TMD groups (types II and III).

Horizontal condylar position with the mouth closed	RDC/TMD Groups				Total	
	Disc Displacement (Group II)		Osteoarthritis (Group III)			
	Number	Percentage	Number	Percentage	Number	Percentage
Central	11	26	16	34	27	30
Anterior	4	9	15	33	19	21
Posterior	28	65	15	33	43	49
Total	43	100	46	100	89	100
P-Value = 0.004			Pearson's Chi-square = 11.136			

The Kolmogorov-Smirnov test showed the lack of a normal distribution of the data pertaining to the quantitative indicator of the horizontal condylar position with the mouth closed (post+ante/post-ante); (p=0.009). The Mann-Whitney test was thus used to compare this indicator in the RDC and TMD groups, suggesting a significant difference between the two (p=0.002), as the condyle showed a greater tendency toward the posterior position in group II.

The Kolmogorov-Smirnov test was also used to assess the normal distribution of the data pertaining to the superior articular space. As the test showed that p=0.002, the non-parametric Mann-Whitney test was used to compare the superior space in the RDC and TMD groups, suggesting no significant differences between the two groups (p=0.42) and showing the superior space to not be affected by group type.

A significant relationship was found between the mediolateral position of the condyle (central, medial and lateral positions) and group type (p=0.02) and the condyle was found to have a greater tendency toward the lateral position in both the RDC and TMD groups.

The Chi-squared test showed a significant relationship between the sagittal shape of the condyle and the presence or absence of joint clicks and crepitus (p=0.02) and the condylar shape tended more toward anterior flattening in both groups (Figure 1).

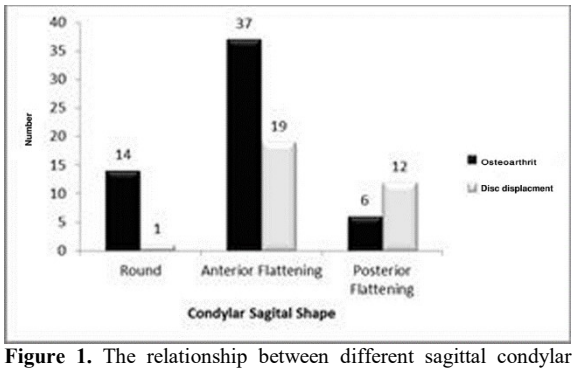

Figure 1. The relationship between different sagittal condylar shapes and the presence or absence of clicks and crepitus

A significant relationship was found between different condylar shapes in the coronal plane and group type, as angled condylar shape was more commonly observed in both groups; however, the relationship between condylar shapes and group type was not significant in the axial plane.

The independent *t*-test showed no significant differences in the mean slope of the

articular eminence (p=0.31) between the RDC and the TMD groups. The ANOVA showed no significant relationships between the mean slope of the articular eminence and different sagittal condylar shapes (p=0.31). No significant relationships were found between the slope of the articular eminence and gender or age in either of the two groups. The mediolateral condyle has three positions, including central, internal and external positions. The Kruskal-Wallis test showed significant relationships between different mediolateral condylar positions and age (p=0.02) and also showed that the lateral position is more common in older ages. The Kruskal-Wallis test showed no significant relationships between the vertical or horizontal condylar positions with the mouth closed and age (p=0.07). The ANOVA showed no significant differences between the mean age in different condylar shapes in the sagittal, axial and coronal planes (p=0.19), and the assessment of the different condylar shapes by gender showed no significant differences between the two groups in either of the three planes (p=0.05).

DISCUSSION

The accurate diagnosis of morphological variations in different parts of the TMJ and condylar position in the glenoid fossa enables the early diagnosis of joint disorders and subsequently a successful treatment; all of these diagnoses rely on having ample knowledge about normal and abnormal joint anatomy.

A study conducted by Ikeda *et al.*[23] reported a significantly larger anterior space in patients with disc displacement and a significantly smaller posterior space in both full and partial disc displacements. The superior space was significantly smaller in cases of full disc displacement compared to in normal cases and a thinning was visible; that is, a superior posterior shift was observed in the condyle in the glenoid fossa. In the coronal sections, the lateral space was significantly larger in cases of lateral disc displacement compared to in normal cases and the central and medial spaces were significantly smaller than in normal cases. In cases of medial disc displacement, the condylar position was the exact opposite of the previous position. In the present study, the condyle was more inclined toward a posterior position in group II (disc displacement) compared to in normal cases.

Hongchen *et al.*[24] studied the variations in the position of the condyle in the glenoid fossa and the variations in the superior, anterior and posterior articular spaces and found condyle to have a significant disposition to move in the posterior direction. In the present study, a posterior condylar position was more frequently observed in the disc displacement group compared to in the osteoarthritis group.

In the present study, compared to the fossa, the condyle was seen with equal frequencies in the central (34%), anterior (33%) and posterior (33%) positions in group III (osteoarthritis). One of the reasons for the lack of a relationship between the horizontal condylar position with the mouth closed and the osteoarthritis group was the effect of chronic displacements on the position and shape of the disc in this group, which could not be investigated due to the unavailability of MRI images.

Reportedly, discs react to improper positions by an obvious increase or reduction in thickness, which undoubtedly affects the condylar position and the articular spaces.[20]

No significant relationships were observed between the superior articular space and the RDC and TMD group types with the mouth closed (p=0.42), which was inconsistent with the results obtained by Alexiou *et al.*[25], who reported a reduced articular space as the most common complication in patients with osteoarthritis observed markedly in 50% of the joints and a bone contact between the condylar head and the glenoid fossa observed markedly in 22% of the joints. The disparity of findings can be attributed to the cited study's larger

sample size and/or the severe type of osteoarthritis observed in its patients.

Ikeda *et al.*[18] studied the condylar position in the axial, coronal and sagittal planes in normal cases and concluded that articular spaces are not affected by age. They also found that the lateral articular space is smaller compared to the medial and central articular spaces and attributed it to the variations in disc thickness in normal people in response to functional diversities. In the present study, the condylar position in the coronal plane had a greater tendency toward lateral positioning and was unaffected by age in both groups.

In the present study, the condylar shape was significantly different between the two groups in the coronal and sagittal planes and was affected by group type. In the coronal plane, the condyle had a greater tendency toward the angular shape; in the sagittal plane, it showed an anterior flattening. In one study, Katsavrias *et al.*[26] concluded that the condylar shape is significantly different in patients with osteoarthritis compared to in asymptomatic individuals and is smaller in all the planes except in the anterior plane compared to in the control group. The flattening bone change was more evident than all other changes in the condylar head, which could be associated with the findings of the present study in that the condylar shape has a greater tendency toward anterior flattening in the sagittal plane and toward the angular shape in the coronal plane in both disc displacement and the osteoarthritis groups.

Previous study[26] on condylar morphology have shown that variations in the condylar shape can be closely associated with the slope of the condylar head, variations in the shape of the glenoid fossa and the slope of the articular eminence; however, the present study found no significant relationships between the condylar shape and the slope of the articular eminence.

The slope of the articular eminence is 90-94% developed by age 20. Several studies conducted in the past have shown morphological variations of the eminence structure to be linked with age, mostly manifested in the form of flattening.[9,11] Dilhan *et al.*[27] and several other researchers, however, found no significant differences in the variations in the slope of the articular eminence with age, which is consistent with the results of the present study in that no relationships exist between articular slope and age.

In the study by Dilhan *et al.*[27], the slope of the articular eminence was assessed in relation to gender and was found to be significantly greater in men than in women. However, the present study found no significant relationships between the two, which may be attributed to the study's smaller number of male subjects compared to female subjects.

Osteoarthritis is an age-dependent disease, and previous studies found morphological and bone variations of the condyle and the glenoid fossa to increase with age[25]; however, the present study found morphological and bone variations of the condyle and the articular eminence to not be affected by age, which may be attributed to its small sample size and the failure to categorize participants by age.

CONCLUSION

The results obtained indicate that adolescent disc displacement and osteoarthritis can cause the condyle to change its position and shape in the fossa.

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