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Original Article *Özgün Araştırma*

THE EFFECT OF MANDIBULAR CONDYLE SIZE ON DISC DISPLACEMENT AND GENDER RELATIONSHIP

Mandibular Kondil Boyutunun Disk Deplasmanına Etkisi ve Cinsiyet İlişkisi

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ABSTRACT

Objective: Our aim in this study is to analyze the association between anterior disc displacement and mandibular condyle size. It was also aimed to examine the influence of gender factor on condyle size.

Material and Methods: Images of patients who underwent magnetic resonance imaging of the temporomandibular joint in the radiology department between January 2018 and November 2021 were analyzed retrospectively. The articular disc was evaluated in terms of displacement on sagittal oblique images in closed and open mouth positions. Following, anteroposterior and mediolateral dimensions were measured at the head of the mandibular condyle.

Results: Among the 200 individuals in the study, 44 were male and 156 were female. A total of 400 temporomandibular joints of 200 patients were analyzed. In 279 joints, the disc was in its normal position, and there was no disc displacement. There was disc displacement with reduction in 54 joints and disc displacement without reduction in 67 joints. The anteroposterior and mediolateral sizes of the mandibular condyle were higher in the group with normal disc position compared to the groups with disc displacement. In the disc displacement without reduction group, the mean values of anteroposterior and mediolateral dimensions were the lowest (p=0.001). Male individuals had a mandibular condyle anteroposterior size of 6.706±2.588 cm while female subjects had a size of 5.786±1.288 cm, which was significantly lower in females (p=0.001). Mandibular condyle mediolateral size was 18.779±2.848 cm in male subjects, 17.016±2.290 cm in female subjects, and was significantly lower in females (p=0.001).

Conclusion: We determined that the mandibular condyle size was smaller in joints with anterior disc displacement than in joints with normal disc position. In addition, we observed that the condyle size was significantly lower in females than in males. Low mandibular condyle size may be a risk factor for anterior disc displacement.

***Keywords**: Temporomandibular joint, condyle size, disc displacement, gender relationship*

ÖZ

Amaç: Bu çalışmadaki amacımız, anterior disk deplasmanı ile mandibular kondil boyutu arasındaki ilişkiyi ve kondil boyutuna cinsiyet faktörünün etkisini incelemektir.

Gereç ve Yöntemler: Ocak 2018 ve Kasım 2021 tarihleri arasında radyoloji ünitesinde temporomandibular eklem manyetik rezonans görüntülemesi çekilen hastalara ait görüntüler retrospektif olarak incelendi. Kapalı ve açık ağız pozisyonda sagital kesitlerde eklem diski deplasman açısından değerlendirildi. Daha sonra mandibular kondil baş kısmında ön-arka ve mediolateral boyutlar ölçüldü.

Bulgular: Çalışmaya alınan 200 hastanın 44'ü erkek, 156'sı kadındı. Toplamda 200 hastaya ait 400 temporomandibular eklem değerlendirildi. İncelenen 279 eklemde disk normal pozisyonda olup, disk deplasmanı yoktu. Elli dört eklemde redüksiyonlu disk deplasmanı ve 67 eklemde ise redüksiyonsuz disk deplasmanı vardı. Disk pozisyonu normal olan grupta mandibular kondil ön-arka ve mediolateral boyutları disk deplasmanı olan gruplara göre yüksekti. Ön-arka ve mediolateral boyutları ortalama değerleri redüksiyonsuz disk deplasmanında en düşüktü (p=0.001). Erkek deneklerde mandibular kondil ön-arka boyutu 6.706±2.588 cm, kadın deneklerde 5.786±1.288 cm olup, kadınlarda belirgin düşüktü (p=0.001). Erkek deneklerde mandibular kondil mediolateral boyutu 18.779±2.848 cm, kadın deneklerde 17.016±2.290 cm olup ve kadınlarda belirgin düşüktü (p=0.001).

Sonuç: Anterior disk deplasmanı olan eklemlerde mandibular kondil boyutunun disk pozisyonu normal olan eklemlere göre daha küçük olduğunu saptadık. Ayrıca kadın bireylerde, erkeklere göre kondil boyutunun belirgin düşük olduğunu gözlemledik. Düşük mandibular kondil boyutu anterior disk deplasmanı için bir risk faktörü olabilir.

***Anahtar Kelimeler**: Temporomandibular eklem, kondil boyutu, disk deplasmanı, cinsiyet ilişkisi*

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INTRODUCTION

The temporomandibular joint (TMJ) is a synovial joint formed by the squamous part of the temporal bone and the mandibular condyle. Complaints originating from TMJ are quite common in the population, and the most common symptoms are jaw pain, limitation of joint movements and difficulty in chewing. Internal derangement is defined as a functional defect secondary to the abnormal interaction of the articular disc, mandibular condyle, and articular eminence. Although diseases of the glenoid fossa, mandibular condyle, and masticatory muscles can induce internal derangement, joint disc disorders, particularly disc displacements, are the most common causes. Disc displacements can occur anteriorly, anterolaterally, anteromedially, laterally, medially, and posteriorly. The most common site for disc displacement is anterior, and the least common site is posterior (1).

Imaging methods such as direct radiography, ultrasonography and computed tomography are used in the evaluation of TMJ and its pathologies. However, magnetic resonance imaging (MRI) is the gold standard approach in the assessment of disc-related pathologies in TMJ (1). In the etiology of anterior disc displacement, many predisposing variables such as effusion, bone marrow edema, condyle position, and mandibular asymmetry have been studied (2-5).

In this cross-sectional retrospective study, our aim was to analyze the relationship between anterior disc displacement and mandibular condyle size. We also aimed to examine the effect of gender factor on condyle size.

MATERIALS AND METHODS

Images of patients who underwent temporomandibular joint MRI in the radiology unit between January 2018 and November 2021 were retrospectively analyzed. Patients with artifactual images, medial, lateral, anterolateral, anteromedial, and posterior disc displacement, severe degenerative changes and ankylosis, remarkable bone marrow edema, clinical history of degenerative or inflammatory arthritis, and TMJ-related surgery or trauma were excluded from the study. A total of 400 TMJs were investigated from 200 patients who did not match the exclusion criteria. After receiving approval from the institutional ethics committee, the study was initiated (Van Yüzüncü Yıl University Ethics Committee of Non-interventional Research, date: 21/01/2022, issue number: 2022/01-12).

Imaging was performed with a 1.5 T MRI scanner using a superficial coil (Magnetom Amira, Siemens Healthineers AG, Germany). First, in the mouth-closed position, coronal, and axial T2-weighted images (WI) were acquired. In the closed and open mouth positions, oblique sagittal T1 and T2 WI were obtained using the axial T2 image as a localizer. Parameters for axial T2 WI: repetition time (TR) 3540 ms, echo time (TE) 92 ms, matrix 484x574, field of view (FOV) 22x22 cm, slice thickness 3 mm. Parameters for sagittal T2 WI: TR/TE 3170/69 ms, matrix 574x574, FOV 14x14 cm, slice thickness 3 mm. Parameters for sagittal T1 WI: TR/TE 402/12 ms, matrix 574x574, FOV 14x14 cm, slice thickness 3 mm.

Mediolateral (ML) mandibular condyle size was measured from the medial to lateral linear hypointense areas representing the cortex on the axial T2-weighted image of the condyle head. On the sagittal T2-weighted image, the anteroposterior (AP) dimension was measured from the midsagittal part of the condyle at the level of the condyle head, from the posterior cortical line to the anterior cortical line.

Disc displacement was assessed using oblique sagittal scans in both closed and open mouth positions. Disc displacement classification was done according to the criteria set by Ahmad et al (6). Accordingly, disc displacements were categorized into three groups. Normal disc position: The posterior band of the disc is

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positioned between 11:30 and 12:30 relative to the condyle in the sagittal plane. Anterior disc displacement with reduction (ADDWR): The posterior band of the articular disc is anterior to the 11:30 position in the closed-mouth position in the sagittal plane. The disc returns to its normal location in the open mouth position. Anterior disc displacement without reduction (ADDWoR): During the closed mouth position, the posterior band of the articular disc is anterior to the 11:30 position. However, in the open mouth position, the disc cannot be returned to its normal position.

Statistical Analysis

The mean, standard deviation, minimum, and maximum values were used to express descriptive statistics for continuous variables. One-way analysis of variance (ANOVA) was performed to compare group means in terms of continuous variables. A Duncan multiple comparison test was employed to identify differences between the means after ANOVA. The linear relationship among the variables was investigated using Pearson correlation coefficients. Furthermore, a receiver operating characteristic (ROC) analysis was conducted to establish the effectiveness of mandibular condyle AP and ML diameters in distinguishing patient and healthy groups. A statistically significant difference was defined by a P value less than 0.05. For all statistical computations, SPSS (version 20) statistical software was utilized.

RESULTS

The study included 200 patients, 44 (22%) of whom were male and 156 (78%) of whom were female. The average age of men was 30.8±11.88 years (range 18 to 70 years), while the average age of women was 31.44±11.85 years (range 18 to 73 years), and they were similar in terms of age (p=0.752).

A total of 400 TMJs of 200 patients were evaluated. The disc was in the normal position in 279 joints, and there was no disc displacement. ADDWR was detected in 54 joints, while ADDWoR was observed in 67 joints. The distribution of evaluated TMJs in 3 groups in terms of disc displacement, and mandibular condyle AP and ML diameter values are detailed in Table I. Mandibular condyle AP and ML dimensions were higher in the group with normal disc position compared to the groups with disc displacement (Figure 1).

The ADDWoR group had the lowest mean values for the AP and ML dimensions. The difference in AP and ML dimensions among the three subgroups was significant (p=0.001).

The mean AP size of the mandibular condyle was 6.706±2.588 cm in male subjects and 5.786±1.288 cm in female subjects, which was significantly lower in females (p=0.001). Male individuals had an average ML size of 18.779±2.848 cm, whereas female subjects had an average ML size of 17.016±2.290 cm, which was significantly lower in females (p=0.001).

A positive correlation of 30.3% (r=0.303; p<0.01) was found between age and condyle AP size. However, no positive or negative correlation was detected between age and ML size (r=0.046).

The normal TMJ group was compared to the sum of both groups with disc displacement in ROC analysis. When the cut-off value for the mandibular condyle AP size was accepted as 4.99 cm to distinguish joints with normal disc position from joints with disc displacement, the sensitivity was 87% and the specificity was 70%. At the same time, when the cut-off value for the ML size of the mandibular condyle was taken as 16.55 cm, the sensitivity was 77% and the specificity was 66%.

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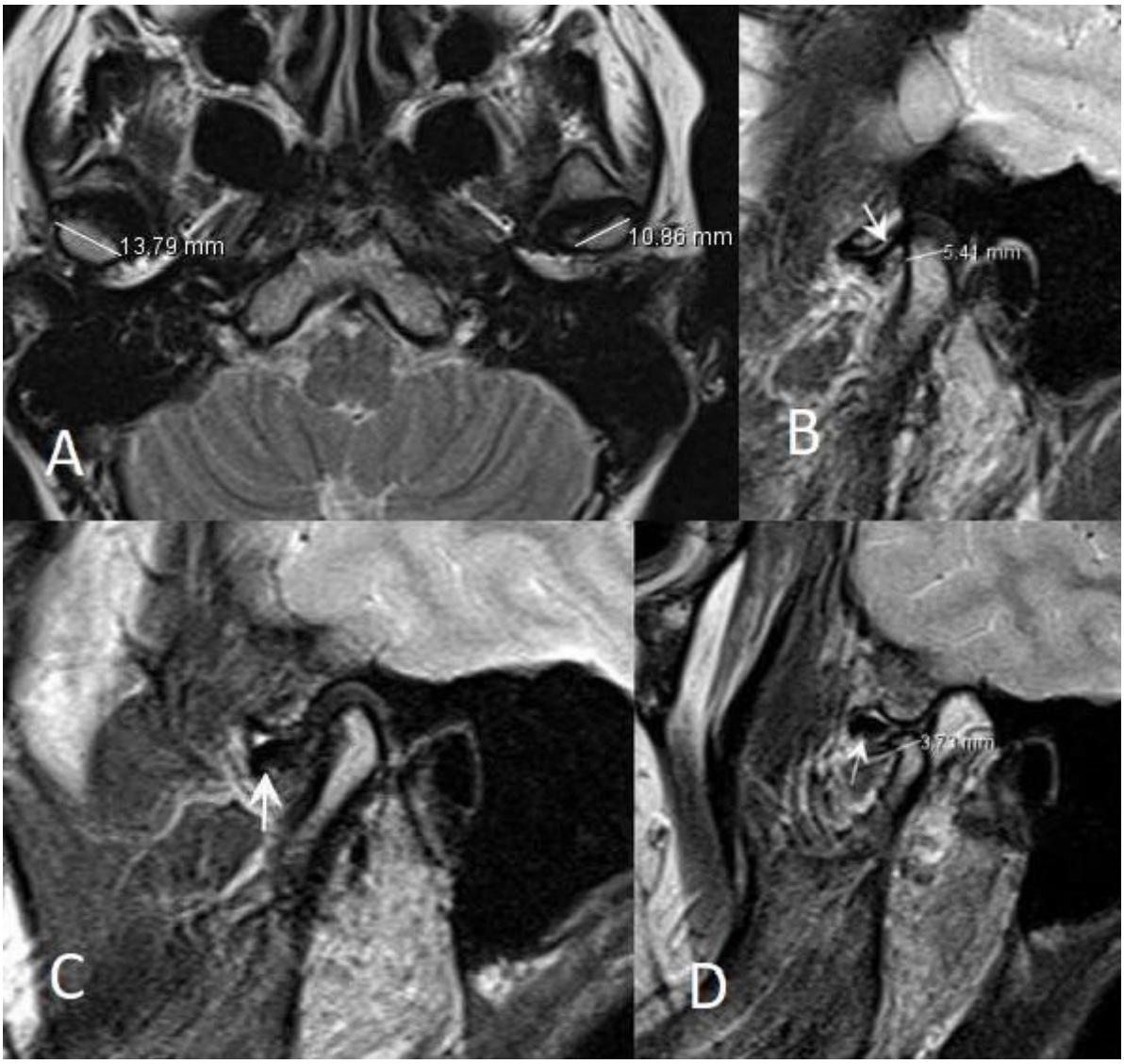

Figure 1: A 24-year-old female patient with a normal right-sided disc and left-sided disc displacement without reduction. A) On the axial T2-weighted image, the ML size of the left mandibular condyle is smaller than the right. B) Sagittal T2-weighted image: The right TMJ disc is in its normal position during the closed mouth view (arrow). C and D) Sagittal T2- weighted images demonstrate anterior disc displacement without reduction. In both closed and open mouth positions, the left TMJ disc is displaced (arrows). On the side with disc displacement, the condyle size seems to be smaller.

Table 1: Distribution of patients into three groups, AP and ML dimension values

	AP dimension			**ML dimension**		
Groups	mean±SD	Min.-Max.	P	mean±SD	Min.-Max.	P
Normal (n: 279)	6.365±1.432	3.06-9.67		17.933±2.099	7.32-23.15	
ADDWR (n: 54)	4.904±1.085	3.18-7.67	0.001	16.537±2.415	11.34-21.25	0.001
ADDWoR (n: 67)	4.486±1.171	2.96-9.31		15.047±2.172	8.68-18.29	

ADDWR: Anterior disc displacement with reduction

ADDWoR: Anterior disc displacement without reduction

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DISCUSSION

Internal derangement-related complaints are extremely widespread in the population. Due to its high-resolution capability in showing both bone and cartilage abnormalities as well as pathologies in nearby soft tissues, MRI is an excellent imaging tool in the diagnosis of internal derangement. Disc displacement is the most prevalent cause of internal derangement, and MRI is usually used to diagnose it (1). In this study, the relationship between disc displacement and mandibular condyle size was investigated using MRI. In addition, it was evaluated whether there was a difference in terms of gender.

In our study, we observed that the size of the mandibular condyle was dramatically reduced in joints with disc displacement. When comparing ADDWoR to ADDWR, we discovered that the condyle size dropped much more. According to Xie et al., the prevalence of mandibular asymmetry increased in individuals who had disc displacement (5). The decrease in unilateral condyle size is probably one of the causes of mandibular asymmetry. In a longitudinal retrospective study performed with MRI, it was reported that ADDWoR can develop in follow-up imaging in joints with ADDWR. In the aforementioned study evaluating the condylar height, it was highlighted that as the degree of disc displacement increased, the condylar height decreased. They assumed that the condylar height reduction was due to the overload and condyle resorption secondary to disc displacement (7). In our study, AP and ML dimensions were measured instead of condylar height, and it was observed that condyle dimensions decreased significantly in case of disc displacement. We did not include patients with degenerative changes such as condylar flattening, bone marrow edema, osteophytes, and erosion. Therefore, we speculate that small condyle size may be a facilitating factor for disc displacement. However, comprehensive interdisciplinary studies investigating clinical signs and symptoms, observing patients and obtaining follow-up imaging may more clearly demonstrate that reduction in condyle size is a predisposing factor.

The second important finding in our study is the gender relationship. Condyle sizes were significantly lower in females than in males. The number of female patients in our study was significantly higher than the number of male patients. Likewise, the number of female patients is predominant in published studies (8,9). This indicates that the individuals suffering from TMJ pathologies are mostly women. The TMJ disc is a cartilage structure located between the articular eminence and the mandibular condyle. The small size of the mandibular condyle in women may be a risk factor facilitating disc displacement.

In our study, we assessed the relationship between age and condyle size. It was discovered that there was a positive correlation between age and condyle AP size, and that condyle AP size increased with age. However, we did not determine a significant correlation between age and ML size. Internal derangement of TMJ is frequently encountered among young and middle-aged women. TMJ is a synovial joint that, like other synovial joints, is frequently involved in degenerative osteoarthritis. Degenerative osteoarthritis is a disease that becomes more common and severe as people get older (1,10). Considering that degenerative changes increase with age, condyle size would be expected to decrease with age, that is, to show a negative correlation. However, we determined that condyle AP size was positively correlated with age in our investigation. Therefore, we believe that small condyle size in young individuals, especially in young women, could be a risk factor for disc displacement.

The study presented has some limitations. Primarily, MRI was examined by a single radiologist, so the interobserver variability could not be evaluated. Secondly, the participants included in the study consisted of patients with TMJ-related complaints, and there was no healthy control group without complaints.

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In addition, the vast majority of patients did not have follow-up images, and changes in follow-up could not be assessed.

In conclusion, we determined that the mandibular condyle size is smaller in TMJs with anterior disc displacement than in joints with normal disc position. Furthermore, we observed that the condyle size was substantially lower in females than in males. According to this study, which did not include patients with degenerative arthropathy findings, small condyle size may be a risk factor for anterior disc displacement.

Conflict of Interest: The authors declare that they have no conflict of interest.

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