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ORIGINAL RESEARCH ARTICLE

Relationship between Mandibular Condyle Position and Pain in Patients with Disc Displacement with Reduction

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Abstract

Purpose: This study aimed to compare the condyle position of the temporomandibular joint (TMJ) in patients with disc displacement with reduction (DDWR) between with and without arthralgia using cone-beam computed tomography (CBCT).
Materials and Methods: A total of 39 adult patients were examined retrospectively and were divided into three groups: 14 patients (21 joints) with TMJ DDWR and arthralgia, 14 patients (14 joints) with TMJ DDWR without arthralgia, and 11 asymptomatic patients (22 joints). Joint space measurements and condyle position were assessed using sagittal and coronal CBCT images. The radiographic data were correlated between the subgroups. One-Way ANOVA test was used for the analysis of normally distributed data, Kruskal Walis H test was used for non-normally distributed data in comparisons between three or more groups. The relationship between categorical data was examined with Chi-Square analysis. A descriptive statistical method (Mean, Median, Standard Deviation, Minimum-Maximum) was used while evaluating the study data. The confidence interval was set at 0.05.
Results: There was no significant difference in age and gender between subgroups. The mean posterior and lateral joint space distance was found significantly higher in the painful DDWR group than in the painless DDWR group, and the incidence of anterior condylar position was significantly higher in the painful DDWR group than in the control group and painless DDWR group respectively. However, there was no significant difference in mediolateral condyle position variables among subgroups.
Conclusions: Anterior condyle position may be correlated with pain in disc displacement disorders.

Key words: arthralgia; condyle position; cone-beam computed tomography; disc displacement with reduction; temporomandibular joint

Introduction

Temporomandibular joint (TMJ) disc disorders (DD) are among the most prevalent types of TMJ disorders. These disorders occur when the disc is dislocated between the condyle and the fossa of the TMJ.[1] One type of DD is disc displacement with reduction (DDWR), which refers to the anterior displacement of the disc against the condyle when the mouth is closed.[2,3] Common symptoms of DD include pain, joint sounds, and difficulty with jaw movement.[4] According to the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), clinical diagnoses without imaging have a sensitivity of 0.34-0.80 and a specificity of 0.79-0.98.[1] Patients with temporomandibular disorders (TMD) often seek medical help due to pain.[5] DD rarely cause pain in the jaw joint, and this pain can be caused by a variety of factors.[4] In many cases, the pain is due to joint inflammation, but it can also be caused by degeneration of the joint components.[5,6] Studies have investigated the relationship between the morphology of various components of the TMJ and TMJ pain.[5,7,8] However, the relationship between these factors and the development of arthralgia in DDWR cases is still unclear. The extent to which the relationship between the condyle and the fossa in the temporomandibular joint (TMJ) is important for understanding and treating TMJ disorders is a topic of debate.[9] Some studies found an association between an abnormal condylar position and temporomandibular disorder (TMD), leading to the recommendation of procedures to correct the position in certain patients.[10–12] However, other research did not find a significant correlation between condylar positioning and TMD.[7] Therefore, this study aimed to compare the condyle position in patients with DDWR with and without arthralgia using cone-beam computed tomography (CBCT).

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Material and Methods

This retrospective study was approved by the Ethics Committee of Ankara Yıldırım Beyazıt University (2022-983). The present study included adult patients with TMJ disorders who applied at the Oral Diagnosis and Dentomaxillofacial Radiology Clinic at XXXXXX University Faculty of Dentistry from 2018 to 2021. The study comprised 39 patients undergoing CBCT in the radiology clinic. Patients were divided into 3 groups: Group 1 included 14 patients (21 joints) with unilateral/bilateral TMJ DDWR and arthralgia, Group 2 included 14 patients (14 joints) with unilateral TMJ DDWR and without arthralgia, and Group 3 included 11 control patients (22 joints). Inclusion criteria for the DDWR groups were to be diagnosed with unilateral/bilateral TMJ DDWR according to the Diagnostic Criteria for Temporomandibular Disorders (DC-TMD), to be in age 20 years or older with completed skeletal maturation. Inclusion criteria for the control group were to be age 20 years or older, not diagnosed with TMD for any reason or having no history of TMJ complaints and admitted to our hospital with odontogenic problems.[1] Exclusion criteria for the study groups were having neuromuscular disease or systemic arthritis affecting TMJ, collagen tissue disease, having a history of TMJ surgery, history of trauma in the head and neck region, showing osteoarthritic changes (erosion, subchondral cyst, osteophyte formation, generalized sclerosis) of joints in CBCT images and having dental pain.

Clinical records

Patients' age and sex, pain in lateral palpation, pain in mandibular movements, joint sounds, limitation in mouth opening (<35mm)[13], TMD diagnosis of each joint according to DC-TMD criteria[1] were noted. All patients were examined in Oral Diagnosis and Dentomaxillofacial Radiology Department.

CBCT reviews

The CBCT images of the bilateral TMJs were obtained with Planmeca a Promax 3D (Planmeca Oy, Helsinki, Finland) device. The image acquisition protocols with an 8x15 cm field of view including TMJs were done according to manufacturer's instructions which were with 9-14 mA and 90kVp and 12-14 seconds scan time. The patients who were standing biting their teeth were in maximum intercuspal position. Reconstructed images were obtained with Romexis Viewer 2.7.0 software with 0.2- or 0.4-mm voxel size of 0.2-1 mm slice thickness.

Measurements of condyle position

The axial section in which the condyle appeared the widest mediolaterally was determined as the reference section. Sagittal and coronal reconstructive images were obtained by drawing a line perpendicular and parallel to the mediolateral axis in the centre of the condyle. The slice thickness was determined as 0.4 mm. Linear joint space measurements[14] were made in both sagittal and coronal reconstructed views using the Romexis software. The antero-posterior condyle position was determined by a method that was previously described by Pullinger and Hollender.[15] The percentage of condyle displacement from centric position in sagittal views is expressed using the formula below; ((anterior linear joint space- posterior linear joint space)/ (anterior linear joint space + posterior linear joint space)) *100. The value of CP represents as Centric condyle position (C): ± 0-12% Anteriorly condyle position (A): < -12% Posteriorly condyle position (P): > +12% The same formula was adapted to determine the mediolateral condyle position by medial and lateral joint space measurements. The negative values represent medial condyle position, positive values represent lateral condyle position, and the value of 0 represents centric condyle position. A single oral diagnosis and dentomaxillofacial radiology specialist with experienced more than ten years in diagnosing temporomandibular disorders performed the clinical and radiological examination. The radiological data were obtained in two separate sessions over at least two-week intervals. The observer was blinded to the patient's characteristics during the assessment of the images. The data obtained in this study were analyzed with the SPSS 22 package program (SPSS Inc, Chicago, IL). The normality was checked based on the Shapiro-Wilk Test. One-Way ANOVA test was used for the analysis of normally distributed data, Kruskal Walis H test was used for non-normally distributed data in comparisons between three or more groups. The relationship between categorical data was examined with Chi-Square analysis. A descriptive statistical method (Mean, Median, Standard Deviation, Minimum-Maximum) was used while evaluating the study data. The confidence interval was set at 0.05 and it was stated that there was a significant difference/relation in p<0.05, and no significant difference/relation in p>0.05. Kappa (κ) coefficients of the intra-observer agreement for the evaluation of osseous changes and measurements were calculated and values of more than 0.7 were denoted as acceptable consistency. Power analysis showed that the number of samples was sufficient for a power of 0.80 with an α error of 0.05.

Results

Description of the clinical features

A total of 29 women and 10 men with a mean age of 35.76± 11.76 was examined in the study. The painful DDWR group was composed of 9 women and 5 men (mean age 36.05±10.22), the painless DDWR group was composed of 12 women and 2 men (mean age34.64±16.07) and the control group was composed of 8 women and 3 men (mean age 34.45±8.64). There were no significant differences in patients' age and gender between the groups (p>0.05). The comparisons of mean age and gender between the groups were demonstrated in Table 1. Of the 14 patients with painful DDWR, 7 had bilateral involvement and 7 had unilateral involvement. 14 were located in the right TMJ and 7 were located in the left TMJ. All patients with painless DDWR had unilateral involvement, with 8 located in the right TMJ and 6 located in the left TMJ. Regarding clinical findings, the painful DDWR group exhibited pain on palpation in 20 out of 21 joints and pain in mandibular movements in 4 out of 21 joints. Clicking noise was present in 20 joints and snapping noise in 1 out of 21. One patient in this group experienced limitation in mouth opening (DDWR with intermittent locking). In the painless DDWR group, clicking noise was found in 11 out of 14 joints and snapping noise in 3 out of 14. One patient in this group also experienced limitation in mouth opening (DDWR with intermittent locking).

Correlations of sagittal CBCT measurements among subgroups

The comparisons between subgroups for CBCT variables in sagittal views were presented in Table 2. High consistency of intra-observer agreements was detected for all variables ($k \geq 0.90$). There was no significant difference in the superior and anterior joint space variables of sagittal views between the study groups (p>0.05). There was a significant difference in posterior joint space measurements among subgroups (p<0.05). The mean posterior joint space distance was found significantly higher in the painful DDWR group (2.87±0.86) than in the painless DDWR group (2.13±0.67) (p<0.05). There was a significant difference in the mean sagittal condyle position measurements among subgroups (p<0.05). The mean measurements of the sagittal condylar positions showed more posterior condylar positioning in the painless DDWR group (11.48±18.7)

Table 1. Correlations of patients' demographics

		N	Mean	Median	Minimum	Maximum	SD	*H	P
Age	Painful DDWR	21	36.05	39	21	55	10.22	1.1587	0.560
	Painless DDWR	14	34.64	30	20	76	16.07		
	Controls	22	34.45	37	21	47	8.64		
	Total	57	35.24	35.5	20	76	11.76		

		Female N (%)	Male N (%)	$^{\tau}X^2$	P
Gender	Painful DDWR	9 (64)	5 (36)	1.707	0.425
	Painless DDWR	12 (86)	2 (14)		
	Controls	8 (73)	3 (27)		
	Total	29 (74)	10 (26)		

N, noun; SD, standard deviation; DDWR, Disc displacement with reduction; *, from Kruskal Walis H test; τ, from Chi-Square testtly different between painful DDWR -painless DDWR groups (p=0.031); τ , from Chi-Square test

Table 2. Correlations of sagittal CBCT variables

		Sagittal view variables							
		N	Mean	Median	Minimum	Maximum	SD	*F	P
Superior joint space	Painful DDWR	21	3.45	3.2	1.22	5.97	1.25	2.337	0.106
	Painless DDWR	14	2.80	2.60	1.22	4.71	0.89		
	Controls	22	3.59	3.51	2.01	5.22	0.97		
	Total	57	3.37	3.16	1.22	5.97	1.09		
Anterior joint space	Painful DDWR	21	2.5	2.28	0.89	5.28	1.07	0.558	0.558
	Painless DDWR	14	2.72	2.34	1.44	4.12	0.83		
	Controls	22	2.44	2.36	1.22	4.66	0.86		
	Total	57	2.53	2.28	0.89	5.28	0.93		
Posterior joint space		N	Mean	Median	Minimum	Maximum	SD	¥H	P
	Painful DDWR	21	2.87	2.78	1.46	4.2	0.86	4.921	#0.085
	Painless DDWR	14	2.13	1.89	1.34	3.72	0.67		
	Controls	22	2.67	2.62	1	4.6	1.10		
	Total	57	2.63	2.55	1	4.6	0.96		
Sagittal condyle position measurements		N	Mean	Median	Minimum	Maximum	SD	*F	P
	Painful DDWR	21	-8.6	-5.66	-44.72	27.36	21.83	3.438	ω0.039
	Painless DDWR	14	11.48	12.59	-13.51	48.26	18.7		
	Controls	22	0.73	4.75	-49.91	60.46	22.18		
	Total	57	-0.48	2.21	-49.91	60.46	22.29		

		Anterior	Centric	Posterior	Total	$^{\tau}X^2$	P
		N (%)	N (%)	N (%)	N (%)		
Sagittal condyle position classification	Painful DDWR	10 (48)	7 (33)	4 (19)	21 (100)	10.6741	0.030
	Painless DDWR	1 (7)	7 (50)	6 (43)	14 (100)		
	Controls	4 (18)	14 (64)	4 (18)	22 (100)		
	Total	15 (26)	28 (49)	14 (25)	57 (100)		

N, noun; SD, standard deviation; DDWR, Disc displacement with reduction; *, from One-Way ANOVA test; ¥, from Kruskal Walis H test; #, significantly different between painful DDWR -painless DDWR groups (p=0.029); ω, significantly different between painful DDWR -painless DDWR groups (p=0.031); τ , from Chi-Square test

($p<0.05$). Accordingly, the incidence of anterior condylar position was significantly higher in the painful DDWR group (48%) than in the control group (18%) and painless DDWR (7%) group respectively ($p<0.05$). The incidence of posterior condylar position was significantly higher in the painless DDWR (43%) group than in the painful DDWR group (19%) and in the control group (18%) respectively ($p<0.05$).

Correlations of coronal CBCT measurements among subgroups

The comparisons between subgroups for CBCT variables in coronal views were shown in Table 3. There was no significant difference in the superior and medial joint space measurements of coronal views among the study groups ($p>0.05$). There was a significant difference in lateral joint space measurements among subgroups ($p<0.05$). The mean lateral joint space distance was found significantly higher in the painful DDWR group (2.77±0.87) than in the painless DDWR group (1.9±0.83) ($p<0.05$). However, there was no significant difference in coronal condyle position variables among subgroups ($p>0.05$).

Discussion

Temporomandibular disorders (TMDs) are a common type of chronic pain in the jaw and face area that can negatively impact daily activities and overall quality of life.[16] These conditions are thought to be caused by multiple factors and involve both biological and psychological factors[17,18]. The current research revealed no distinctions in age or gender among patients with DDWR, both with and without arthralgia, compared to the control group. No demographic characteristics were identified as being correlated with the presence of arthralgia in DDWR patients. Different imaging techniques, such as plain film radiography[19], conventional tomography[20], computed tomography[21], cone-beam computed tomography (CBCT)[22], and magnetic resonance imaging[7,23], have been utilized in previous studies to evaluate the condylar position. The use of CBCT is an effective method for evaluating the osseous structure of the TMJ. CBCT was recognised as the preferred method for diagnosis due to its ability to produce high-quality, 3D images without superimposition and with lower radiation exposure compared to traditional CT and medical CT.[24–26] In addition, its diagnostic accuracy has been reported to be 95%.[25] The current study used a CBCT analysis to examine the condyle-fossa relationships in a

Table 3. Correlations of coronal CBCT measurements

		Coronal view variables								
		N	Mean	Median	Minimum	Maximum	SD	*H	P	
Superior joint space	Painful DDWR	21	3.23	3.22	0.89	5.5	1.21	2.4985	0.286	
	Painless DDWR	14	2.85	3.0	0.82	4.2	0.88			
	Controls	22	3.45	3.43	1.81	5	0.87			
	Total	57	3.23	3.35	0.82	5.5	1.01			
Medial joint space	Painful DDWR	21	3.35	3.12	1.72	6.88	1.26	0.455	0.796	
	Painless DDWR	14	3.11	3.05	1.56	4.82	1.04			
	Controls	22	3.44	3.32	1.84	6.25	1.1.4			
	Total	57	3.34	3.12	1.56	6.88	1.16			
Lateral joint space	Painful DDWR	21	2.77	2.97	0.57	4.05	0.87	7.0159	¥0.029	
	Painless DDWR	14	1.9	2.21	0.85	2.72	0.83			
	Controls	22	2.41	2.28	1.28	4.71	0.76			
	Total	57	2.44	2.42	0.57	4.71	0.87			
		N	Mean	Median	Minimum	Maximum	SD	*F	P	
Coronal condyle position measurements	Painful DDWR	21	9.52	15.28	-29.28	50.21	20.64	1.453	0.243	
	Painless DDWR	14	23.73	14.30	-19.29	100	31.95			
	Controls	22	12.66	12.90	-17.56	57.81	20.45			
	Total	57	13.88	14.05	-17.56	100	23.62			
		Medial			Centric	Lateral		Total	$^{\tau}X^2$	P
		N (%)			N (%)	N (%)		N (%)		
Coronal condyle position classification	Painful DDWR	6 (29)			1 (5)	14 (67)		21 (100)	1.753	0.781
	Painless DDWR	3 (21)			1 (7)	10 (71)		14 (100)		
	Controls	7 (32)			0 (0)	15 (68)		22 (100)		
	Total	16 (28)			2 (4)	39 (68)		57 (100)		

N, noun; SD, standard deviation; DDWR, Disc displacement with reduction; *, from Kruskal Walis H test; ¥, significantly different between painful DDWR -painless DDWR groups (p=0.01) and painful DDWR-control groups (p=0.04); ω, from One-Way ANOVA test; τ, from Chi-Square test

sample of TMD patients, including those disc displacement with reduction and asymptomatic subjects. The goal was to identify any condylar positional features that might contribute to the development of joint pain in DDWR. To ensure accuracy, only affected joints were included in the CBCT measurements. Arthralgia is caused by the inflammation of the soft tissue around the joint and the masticatory muscles that are tensing up to protect the joint. This reflexive protection of the joint is known as Hilton's law, which states that the nerves that supply feeling to a joint also supply the muscles that move the joint and the skin above it. The pain may also be caused by the deterioration of the bone beneath the cartilage due to the arthritic condition. [27,28] In this case, it is difficult for patients to determine whether the pain they are experiencing is coming from their masticatory muscles or their TMJ. [29] Previous research showed that using a verbal rating scale to assess pain intensity did not accurately reflect the severity of bony changes in the TMJ. [29] However, using palpation to evaluate pain on the TMJ was found to be a more objective method than relying on self-reported pain. [14] Therefore, this study used palpation to assess pain in the TMJ and during mandibular movement. The current study correlated the anteroposterior condylar position in patients with DDWR and found a significant difference between those with painful DDWR and those with painless DDWR. Although the finding of pain in disc dislocation is associated with posterior positioning of the condyle due to anteriorly dislocated disc and pressure of the condyle on the retrodiscal tissues [23,26,30,31], there are studies that do not confirm this. [7,32,33] Conversely, in this study, it was found that the condyle was located anteriorly in the painful group. In addition, in a previous study, it was reported that the condyle position did not differ in patients with painful and painless disc dislocation. [7] Different results may be attributed to imaging technics. MRI was recommended to evaluate disc positioning, as it can detect anterior, medial, and lateral disc dislocation. [7] However, this study utilized CBCT, which is not able to detect disc position Treatment studies aiming at the ideal condyle position by positioning the condyle in the center of the fossa should be reconsidered. [10,11] The study found that the central condyle position is high in the asymptomatic group, but it does not necessarily indicate a link between an eccentric condyle position and pain in DDWR. Chronic pain is a complex issue that involves both physical and psychological factors [17,18], but this study did not take these factors into account. The debate over the importance of condyle position in clinical settings continues. Some studies found a high prevalence of anterior condyle positioning among those without symptoms, but other studies have linked eccentric condyle position to issues such as disc displacement, osteoarthritis, and increased risk for arthrosis. [9,26,34,35] According to the results of this study, the painless DDWR group had the most posteriorly positioned condyles. Studies have shown that patients with severe temporomandibular joint disorder (TMD) have posteriorly seated condyles compared to those with mild to moderate TMD, who have anteriorly and concentrically seated condyles. [9,34] This is likely due to the anteriorly displaced disc in patients with internal derangement pushing the condyle posteriorly. [30] However, one study by Lelis et al. [36] found no significant difference in the anterior-posterior condylar position between patients with TMD and asymptomatic patients but did not differentiate between painful and painless disorders. The current study found that patients with painful disc displacement had significantly more increased lateral joint space compared to those with painless DDWR. This finding supports the theory that the displacement is caused by the pull of the superior lateral pterygoid muscle, as previously suggested by MRI studies [37,38]. Additionally, this conclusion aligns with the research of Al-Rawi et al. [39], who also found that condyles may move upwards and rotate inward during disc displacement. However, this finding contradicts the results of a different study, which reported a different position of the condyles in TMD patients. [40] Limitations of the present investigation include the restricted population in the 3 groups, lack of sex and age matching, and the cross-sectional study design, which makes it impossible to completely rule out an etiologic relationship among TMJ morphology, DDWR, and arthralgia. Ideally, prospective studies should be conducted with larger sample sizes in the future.

Conclusion

In conclusion, patients with painful TMJ DDWR had wider lateral joint spaces and anteriorly positioned condyles, compared to those without pain and to control groups. The correlation between condyle position and pain suggests a link between DDWR pain and condyle position.

Author Contributions

Concept; Design; Supervision; Resources; Data Collection and/or Processing; Analysis and/or Interpretation; Literature Search; Writing Manuscript; Critical Review – EY.

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