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Evaluation of temporomandibular joint spaces and condylar position: A CBCT study

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Abstract
Temporomandibular joint (TMJ) is a unique joint. The dimension joint space is determined by the optimal Condylar position. Conventional radiographs cannot exactly show the relationship hence MRI and CT are being used frequently for imaging of TMJ. CBCT has recent advancement into technology especially in this field as helped to analyse the TMJ in more comphrehensive manner. The aim of this study is to assess the position of condyle in TMJ with patients of TMDs. The importance of relationship between condyle and glenoid fossa remains controversial. The CBCT utilizes less radiation and as higher resolution than normal CT. The position of condyle in the glenoid fossa is measured with high accuracy using CBCT technique for reconstruction and imaging of the TMJ. It provides reliable and accurate images. The study was designed to compare the condylar morphology in symptomatic and asymptomatic patients with TMD s.

Keywords: Temporomandibular joint, TMJ, CBCT

Introduction
A retrospective study was conducted on patients having TMD s. The study sample consisted of 62 patients with age range from 18-65 years. Group 1 with symptomatic TMDs and Group 2 with asymptomatic TMDs. CBCT scans and evaluation was performed for forty patients with symptomatic TMDs who showed signs and symptoms such as clicking / crepitation, joint pain, muscle pain, limited mouth opening and non harmonic movement of the joint and twenty two asymptomatic patients.
The exclusion criteria are patients with systemic disease with bony changes, osteoarthritic changes, patients with trauma to orofacial complex, undergoing orthodontic appliance therapy, scans with artifacts, pregnant females and children. Two oral and maxillofacial radiologists assessed this study.

Measurements
All the CBCT scans were taken using a standard exposure. The axial slice of 0.2mm was selected for measuring mediolateral and anteroposterior dimension. The joint spaces, eminence height and eminence inclinations were measured using saggital slice of thickness of 1mm from medial condyle to orbitale.

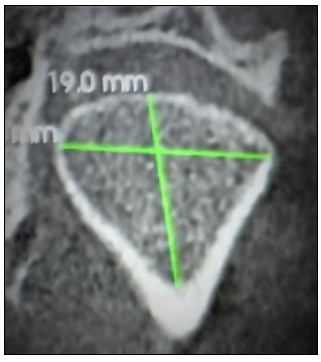

Fig 1: Measurement of ML- Medio-Lateral width of condyle and AP- Antero-Posterior width of condyle

The saggital image were measured to assess the position of the condyle(superior joint space -Sjs,Posterior joint space -Pjs and anterior joint space - Ajs).A horizontal line was drawn from R to Cu. The R point was connected to A and P tangentially to glenoid fossa. As a result, measurement of the S point and the superior prominent point of the condylar head reflected the Sjs. If the Ajs / Pjs ratio was > 1, the condyle was noted as being in a posterior position. If the same ratio was < 1, the condyle was assessed as being in an anterior position.

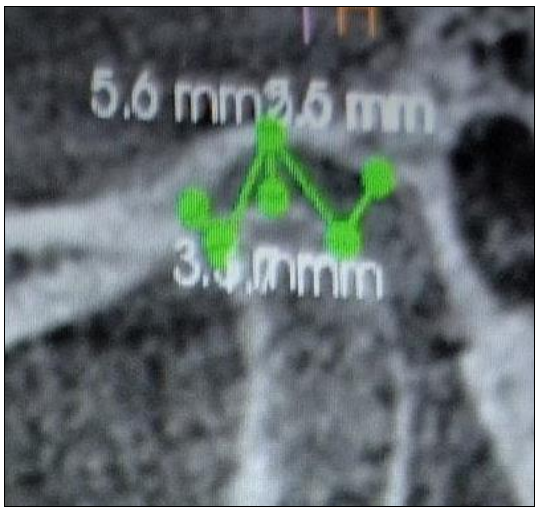

Fig 2: Measurement of Sjs-Superior joint space, Ajs-Anterior joint space and Pjs- Posterior joint space.

The eminence inclination was measured using the best- fit line method and top-roof line method.The best- fit line method measures the angle between Ebf and F,top-roof line method measures the angle between Etr and F.The eminence height (h) was measured by line drawn from the minimum point of the articular eminence to the maximum point of the fossa.

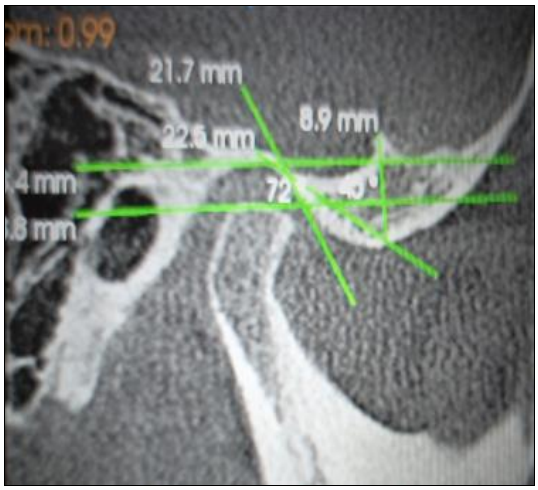

FIG 3: Measurement of EBFA- Eminence Best Fit Angle, ETRA- Eminence Top Roof Angle,F-Frankfort horizontal line and EH- Eminence Height

Results

62 CBCT images with temporomandibular joint disorders of 34 males and 28 females with age ranging from 18 - 65 years of age with an mean value of 40.75 and 29.55 in symptomatic and asymptomatic patients with TMJ disorders respectively with significant P-value of 0.002 by using the mann whitney test. [Table-1].

Table 1: Age and gender distribution among 2 groups

Variable	Category	Symptomatic		Asymptomatic		P-Value
		Mean	SD	Mean	SD	
Age	Mean	40.75	15.04	29.55	7.87	0.002*[a]
	Range	20 - 63		20 – 40		
		n	%	n	%	
Sex	Males	24	60.0%	10	45.5%	0.27[b]
	Females	16	40.0%	12	54.5%	

Note: a. Mann Whitney Test; b. Chi Square Test

Table 2: Comparison of mean values of diff. study parameters among Symptomatic TMD patients based on age groups using Kruskal Wallis Test fld. by Mann Whitney Post hoc Test

Parameters	20-30 Yrs. (n=14)		31-40 Yrs. (n=06)		> 40 Yrs. (n=20)		p-value	Mann Whitney Post hoc Test		
	Mean	SD	Mean	SD	Mean	SD		A1 vs A2	A1 vs A3	A2 vs A3
MLWC	18.17	2.31	18.63	3.06	16.71	2.91	0.32	..	..	..
APWC	14.38	3.83	10.73	4.00	13.02	4.05	0.14	..	..	..
AJS	4.26	1.75	3.65	2.16	3.49	1.40	0.41	..	..	..
PJS	3.65	1.12	3.98	2.22	3.75	1.35	0.99	..	..	..
SJS	2.90	1.05	2.55	0.79	2.78	0.94	0.64	..	..	..
EH	9.38	3.12	9.18	1.95	7.27	2.57	0.04*	0.87	0.04*	0.04*
EBFA	44.21	41.07	47.67	17.53	42.70	27.95	0.59	..	..	..
ETRA	53.57	37.70	48.17	13.93	106.80	56.32	0.02*	0.97	0.01*	0.04*

*Statistically Significant

Note: MLWC - Medio-Lateral Width of Condyle, APWC - Anteroposterior Width of Condyle, AJS - Anterior Joint Space, PJS - Posterior Joint Space, SJS – Superior Joint Space, EH - Eminence Height, EBFA - EBF Angle, ETRA - ETR Angle

In Table-2 Comparison of mean values of diff. study parameters such as MLWC - Medio-Lateral Width of Condyle, APWC - Anteroposterior Width of Condyle, AJS - Anterior Joint Space, PJS - Posterior Joint Space, SJS – Superior Joint Space, EH - Eminence Height, EBFA - EBF Angle, ETRA - ETR Angle was done among Symptomatic TMD patients based on age groups using Kruskal Wallis Test fld. by Mann Whitney Post hoc Test shows statistically significant P-value of 0.04 and 0.02 in EH and ETRA respectively.

Table 3: Comparison of mean values of different study parameters among Asymptomatic subjects based on age groups using Mann Whitney Test

Parameters	20-30 Yrs. (n=12)		31-40 Yrs. (n=10)		Mean Diff	p-value
	Mean	SD	Mean	SD		
MLWC	18.45	2.40	16.10	2.29	2.35	0.06
APWC	13.25	3.95	12.63	2.25	0.62	0.97
AJS	4.92	1.60	4.68	1.32	0.24	0.82
PJS	4.99	1.49	4.27	1.54	0.72	0.20
SJS	3.12	0.81	3.00	0.89	0.12	1.00
EH	8.95	2.20	8.80	3.38	0.15	0.79
EBFA	50.50	19.49	32.30	14.03	18.20	0.03*
ETRA	46.50	29.11	51.40	34.09	-4.90	0.64

In Table-3 Comparison of mean values of different study parameters among Asymptomatic subjects based on age groups using Mann Whitney Test shows statistically significant P-value of 0.03 in EBFA.

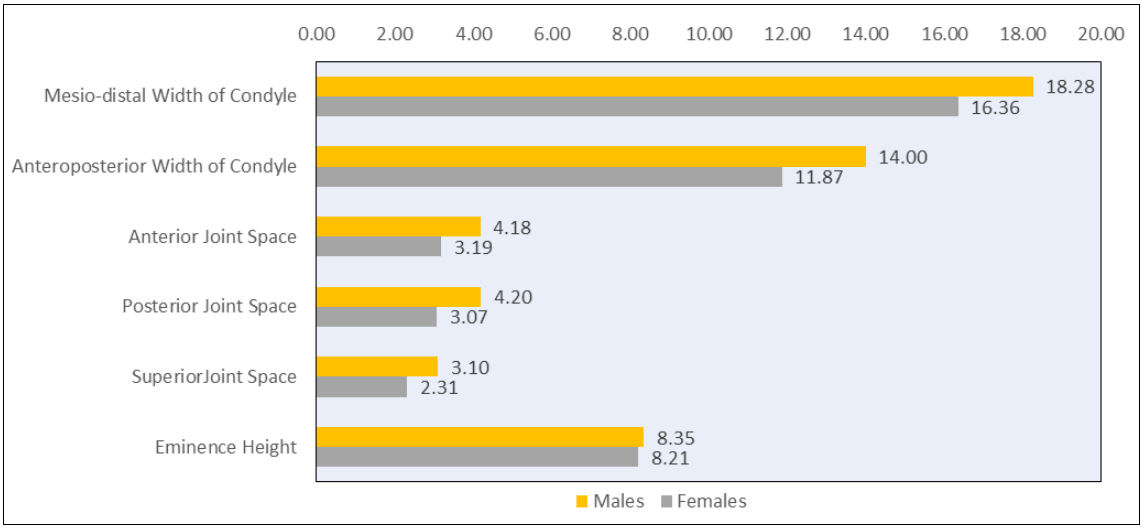

Chart 1: Mean values of different study parameters among Symptomatic TMD patients based on Gender

Among all the parameters in symptomatic TMD patients based on gender males had higher value compared to females.

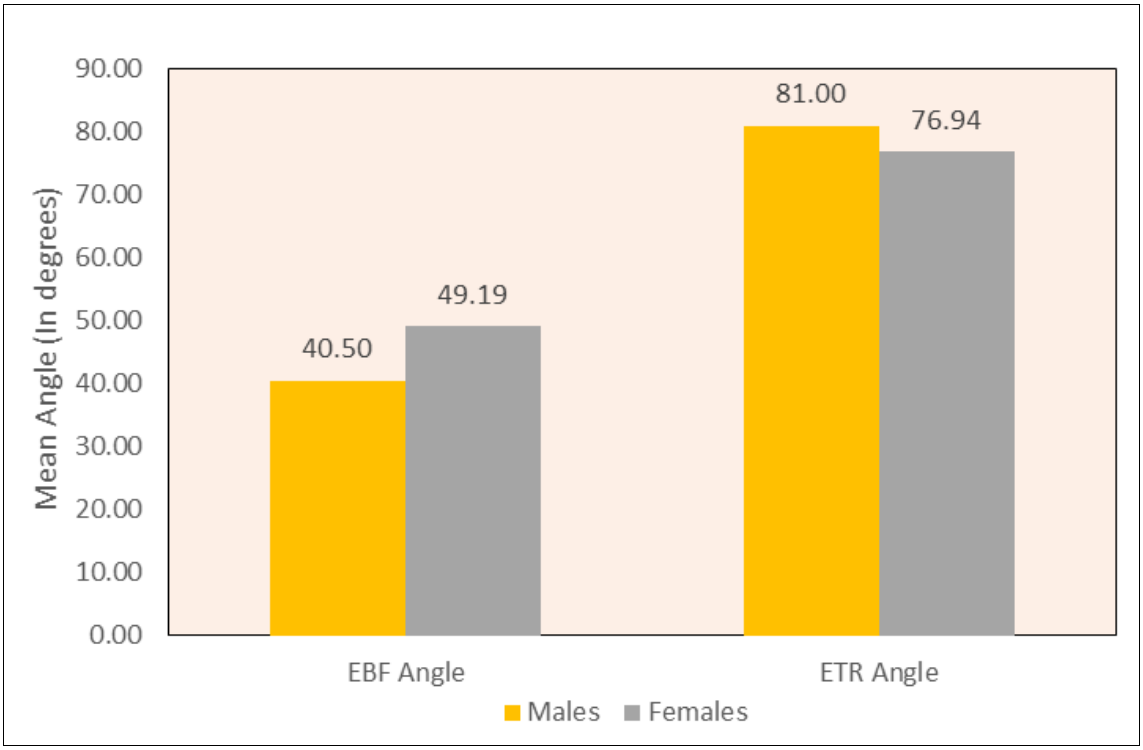

Chart 2: Mean EBF & ETR Angle among Symptomatic TMD patients based on Gender

In symptomatic TMD patients based on gender the mean angle of EBF is more in females when compared to males and mean angle of ETR is more in males compared to females.

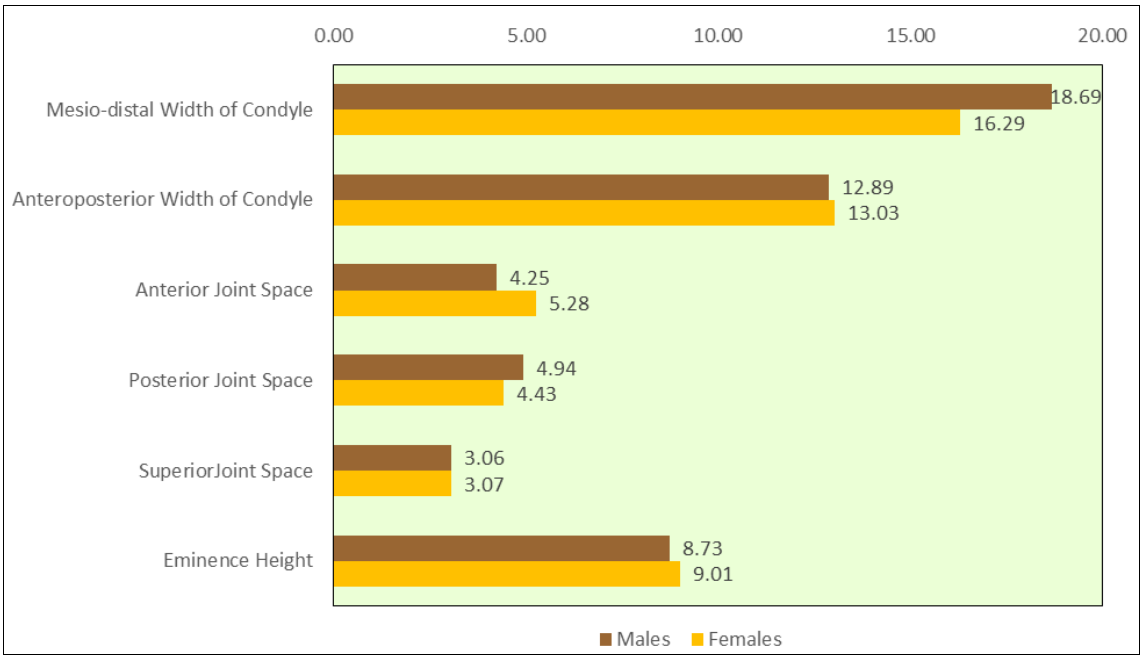

Chart 3: Mean values of different study parameters among Asymptomatic TMD Patients based on Gender

The mean value of mesio-distal width of condyle and posterior joint space is more in males compared to females, anterioposterior width of condyle,anterior joint space,and eminence height is more in females compared to males. Where as the mean value of superior joint space is almost equal in both males and females among asymptomatic TMD patients.

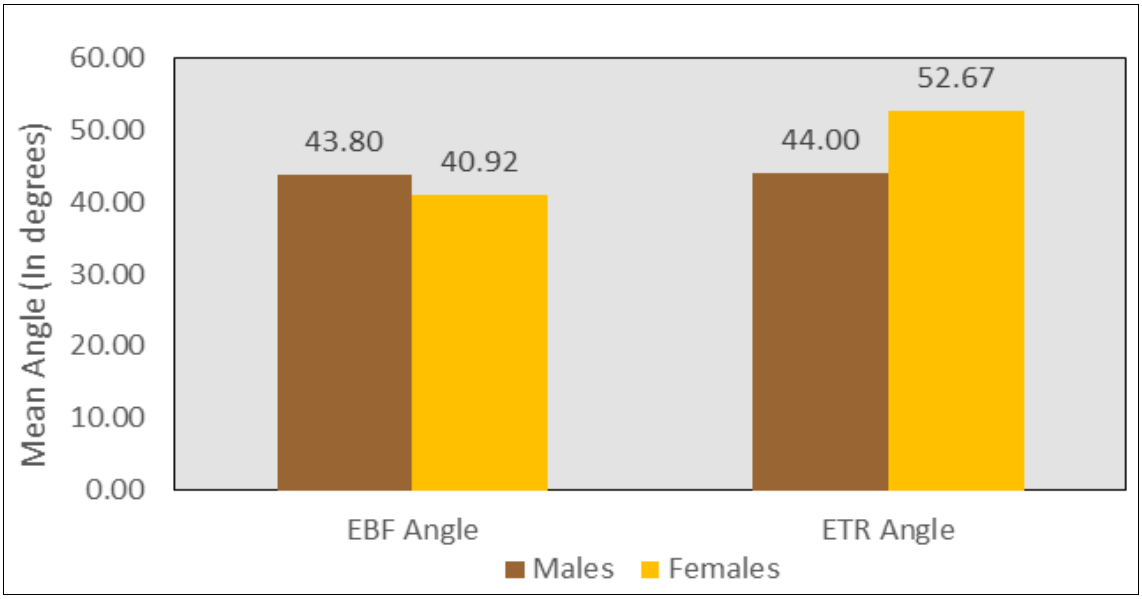

Chart 4: Mean EBF & ETR Angle among Asymptomatic TMD Patients based on Gender

In asymptomatic TMD patients the mean EBF angle is more in males compared to females, and mean ETR angle is more in females compared to males.

Table 4: Comparison of mean values of different study parameters b/w Symptomatic TMD & Asymptomatic groups using Mann Whitney Test

Parameters	Groups	N	Mean	SD	Mean Diff	p-value
MLWC	Symptomatic	40	17.51	2.79	0.13	0.81
	Asymptomatic	22	17.38	2.59		
APWC	Symptomatic	40	13.15	4.05	0.18	0.96
	Asymptomatic	22	12.97	3.23		
AJS	Symptomatic	40	3.79	1.65	-1.02	0.02*
	Asymptomatic	22	4.81	1.45		
PJS	Symptomatic	40	3.75	1.39	-0.92	0.03*
	Asymptomatic	22	4.66	1.52		
SJS	Symptomatic	40	2.79	0.94	-0.28	0.55
	Asymptomatic	22	3.06	0.83		
EH	Symptomatic	40	8.29	2.83	-0.59	0.35
	Asymptomatic	22	8.88	2.73		
EBFA	Symptomatic	40	43.98	31.39	1.75	0.67
	Asymptomatic	22	42.23	19.22		
ETRA	Symptomatic	40	79.38	53.09	30.65	0.04*
	Asymptomatic	22	48.73	30.79		

In table 4 the different study parameters of mean values compared b/w Symptomatic TMD & Asymptomatic groups using Mann Whitney Test shows significant P-value of 0.02, 0.03 and 0.04 in Ajs, Pjs and ETRA respectively.

Discussion

A significant part of the societies are affected by pain in Temporomandibular disorders [2]. The primary goal of treatment is to reduce the symptoms that occurs during function and /or rest for which the patients seek treatment [2]. Progressive internal irregularities are responsible factors of TMDs. Regressive condylar remodeling in TMJ hard tissues are due to excessive loads or Asymmetrical joint surfaces [2]. CBCT,CT magnetic resonance imaging (MRI), conventional/plain CT, plain film radiography are the various radiographic methods that have been used in previous studies to examine the TMJ morphology [1, 3, 5, 6, 9]. Evaluating bone structures are more reliable while using computed tomography (CT) and CBCT.Although high radiation exposure and high cost involving CT [4, 6, 9, 16]. TMJ structures are evaluated ideally by using CBCT [5, 13, 14]. The TMJ image was reconstructed in three planes such that the longitudinal axis of condylar head is considered. It also helped us to evaluate structures without angular and dimensional distortion or superposition.

In this retrospective study, 62 CBCT images with symptomatic and asymptomatic patients with temporomandibular joint disorders was evaluated.34 males and 28 females between 18 - 65 years of age with an mean value of 40.75 and 29.55 in symptomatic and asymptomatic patients with TMJ disorders respectively with significant P-value of 0.002 by using the mann whitney test.

In our study mediolateral width of condyle (MLWC) is more in symptomatic and asymptomatic males and asymptomatic females in the age group of 20-30 yrs. Anteroposterior width of condyle (APLC) was higher in age group ranging from 31-40 yrs asymptomatic females, which was similar to Ribeiro-Dasilva *et al*, [1] suggested that more than male patients female patients were at higher risk of developing TMDs [1]. Chaurasia *et al*, [3] observed significant differences in both males and females in their length and width of the condyle with age. He concluded that the condylar height and width gradually decrease with increasing age in the 20 to 30 age group [3]. Kurita *et al*. [1] found that in patients with disc displacement both the mediolateral and anteroposterior diameters of the condyle were decreased. Gomes *et al*. [1, 2] reported that the mediolateral and anteroposterior diameters of the condyle may be important factors in TMDs because the size of the condyle in patients with OA was clearly decreased in the presence of pathological changes in the bone. Lin *et al*. [1] reported that the condylar head was narrow and long in the high-angle group but wide and short in the low-angle group when measured in the mediolateral diameter of the condyle, anteroposterior diameter of the condyle [1].

In our study Ajs was more in asymptomatic females. Sjs, Pjs and Ajs was more in symptomatic male patients. Idan *et al*. [7] reported that the mean value of Sjs is greater with disk displacement than the normal individual. This results was similar with the results of Gateno *et al*. In patients with disk displacement the head of the condyle was located more posterior and superior in the mandibular fossa when compared with normal individual.Burke *et al*. [6] found that the vertical plane and the Sjs in the long face patients were less than short face patients and there was no correlation between facial morphology and anterior-posterior position of the condyle in glenoid fossa.

Katsavrias *et al*. [5, 9] reported that the Sjs is smaller in class III group who had closer vertical relationship between the condyle and the roof of the fossa.In our study Sjs was greater in symptomatic TMD male patients, when compared to Dalili, *et al*. [9, 5, 10] who found that Sjs was the largest space in class I skeletal category [5].

Cohlmia *et al*. [9, 10] and Seren *et al*. [10] stated that anterior position of the condyle was a more frequently positioned in the class III patients with smaller Ajs in the class III patients than class I. [5, 10] Major *et al*. [11] confirmed that the association of reduced disc length was weaker in the males.Whereas reduced SJS associated with disc displacement and reduced disc length was demonstrated in male and female.AJS and PJS were increased in association with disc displacement. The loss of the thick posterior band of the disc, normally interposed between the superior surface of the condyle, and the height of the articular fossa would allow for superior condylar settling. The increased AJS without reduction of PJS associated with ADD in both the male and females suggests regressive remodeling of the articular eminence rather than a retro positioning of the condyle. There was increased AJS associated with reduced disc length in both the male and female. It is likely that disc shortening is associated with change in disc shape from biconcave to biconvex; this might allow increased AJS [11].

In our study based on age groups the P- value was significant in EH and ETRA with the value of 0.04 and 0.02 respectively among asymptomatic subjects. In our study the eminence

inclination is lower in symptomatic female patients who were > 40 yrs of age. Sülün *et al*. [4, 8] proposed that a steep slope of the eminence forms a basis for the development of reducing disc displacement. Ren *et al*. [11, 15, 12] described that the reduced eminence height could be due to degenerative changes in the bone or in the process of remodeling. A steep slope of the eminence is more apparent in asymptomatic individuals than in patients with TMD s. [4] Previous studies reported a lower eminence height in women compared to men.Keller and Carano reported that in asymptomatic patients a low eminence angle can be a predisposing factor for TMDs and hence angle between the occlusal plane and the eminence ridge is lower in patients with TMDs [4]. MA Sumbullu *et al*. [14] reported that patients with TMJ dysfunction as a higher eminence inclination.Ren *et al*. [12, 9] found the flattening of the articular eminence and eminence and inclination to be steeper in symptom-free patients than in those with internal derangement.Therefore, TMJ disorders can lead to a decrease in the slope of the articular eminence over time by remodeling [9]. Caruso S *et al*. [16] described that prevalence of bone changes increases with age, about 40% of young individuals aged 10–29 years seem to show bone changes in their TMJs and also degenerative changes of the mandibular condyle are undeniably more common in individuals over 40 years old. Liddell *et al*. [12] attributed that dislocation is due to steep eminence. Akinbami *et al*. [12] stated that dislocation can also be due elongated shape of the eminence.

Conclusion

This study highlighted the relationship between morphology of TMJ in symptomatic and asymptomatic TMDs. Significant differences in Medio-lateral width of mandibular condyle, Sjs, Ajs and Pjs could be due to variation in sagittal and axial relationship of mandible. In future studies with larger sample size is needed to along with the soft tissue of the TMJ.

Conflict of Interest

Not available

Financial Support

Not available

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