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Can TMJ morphological alterations impede TMJ agony?

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***Abstract*---**Introduction**:** The relation between temporomandibular joint morphology and its incoordination is an arena which is not ventured in much even though many researches have been done but still it is a drop in the ocean of such a vast and complicated structure of the human TMJ anatomy. Objective: To evaluate morphological variations of temporomandibular joint in healthy and disorder patients using computed tomography. Study Design: A total of 20 temporomandibular joint disorder patients and 10 patients with normal TMJs and Class I occlusion were studied. The study was conducted at SUM Hospital and Oral Medicine and Radiology department, IDS Bhubaneswar with TMJ as chief complaint during a period from September 2016 to November 2016. Symptomatic group and asymptomatic group based on according to the Research

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Diagnostic Criteria for Temporomandibular Disorders (RDC/ TMD) were selected. The present research on TMJ morphology has been designed to investigate parameters like shape of condyle, glenoid fossa and articular eminence in relation to various temporomandibular disorders (TMD).The patients were enrolled with symptoms or signs such as pain, restricted mouth opening, deviation, clicking. A series of morphological parameters with teeth in maximum intercusspation were studied in CT scan. Result: Angled, pointed and round shapes have been found to be significantly associated with TMD. Depth and width of glenoid fossa is positively correlated with same as well as contralateral side. Articular eminence angle and width fossa of same side are positively correlated. Conclusion: Angled, round shapes in coronal and pointed, erosion in sagittal with any other shapes of condyle may impede TMJ agony whereas articular eminence angle and width of fossa may be inversely related leading to TMDs.

***Keywords*---**condyle, mandibular disc, temporomandibular joint, temporomandibular disorder.

Introduction

Temporomandibular joint is a movable joint with articulation between the condyle and squamous portion of temporal bone at the base of skull. Morphologic changes of the mandible may be a developmental variability and remodelling phenomenon to accommodate the variations, malocclusion, trauma and diseases [1]. An understanding of morphological variations of TMJ and its relation with development of TMD is crucial to deciphering the pathology of TMJ. TMD or internal disorders of TMJ is an abnormal positional relationship between condyle-disc complex, articular eminence and articular fossa [2,3]. Articular eminence morphology with greater eminence inclination is a predisposing factor for TMDs and has been established in the literature by many authors [3,4].

TMJ is preserved by disc interposition between eminence and condyle head as disc acts as shock absorber absorbing the resultant articular movement forces [5]. The disharmony of any factor with movement; the articular disc is the first to be remodelled and if the disc escapes this remodelling to support the TMJ then other structures like condyle shape, eminence inclination etc. would absorb this movement force resulting in greater extent of changes in morphology of TMJ [6].

Methodology

A prospective case control observational study was conducted for a period of around one year in the department of Oral Medicine and Radiology and Department of Radiodiagnosis. Sample size is calculated for paired t tests as the basic purpose is to compare mean parameters between up-right and supine position. The input parameters have been taken as Effect size =0.5, α error probability = 0.05, power (1-β error probability) = 0.90.The minimum required sample size comes out to be 36. However, we have a sample size of 30. The computation has been made using G* Power 3.1.9.4 software. The present study included 20 diagnosed cases of age over 20 years with complaints of TMJ satisfying the TMD criteria and 10 patients with normal TMJs and Class I occlusion belonged to control group who were referred to the Oral and Maxillofacial Radiology Department.

Samples were chosen on the basis of following criteria:

1. Reported with a complaint of chronic temporomandibular joint pain.
2. Patients with complaints of clicking, deviation during mouth opening with or without reduction, limited mouth opening, and tenderness of the lateral regions of the TMJ and masticatory muscles.
3. Patients willing to participate in the study and given informed consent.

Samples were excluded under the following criteria:

1. Systemic, rheumatic, neurologic/neuropathic, endocrine, and immune/autoimmune disease
2. history of radiation treatment
3. history of TMJ surgery
4. History of trauma
5. Prosthetic rehabilitation, orthodontic treatment.

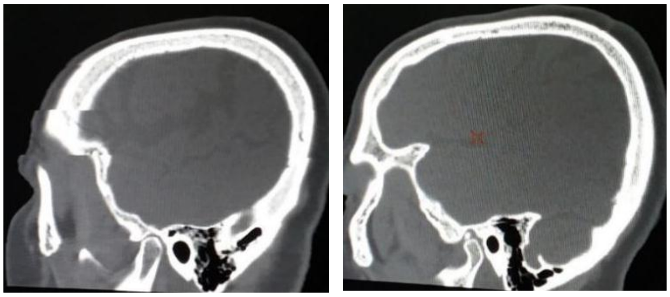
Ethical Consideration

The protocol of the study has been approved by Scientific and Ethical Committee of IMS, SOA University, Bhubaneswar, India. Each subject was explained about the entire procedure of the study. Those subjects who were ready to participate in the study signed an informed consent. The Helsinki declaration was also duly signed by them. GE (128 slice) Multidetector spiral computed tomography scanner was used for morphometric evaluation of TMJ. The shape of the condyle in coronal and sagittal slice were recorded and articular eminence shape in sagittal slice were compared with four basic shapes i.e. box, sigmoid, flattened and deformed. The glenoid fossa depth, width and articular eminence angulation in sagittal slice were recorded. The condyle shape in coronal section of CT scan was grouped under flat, convex, angled and round whereas in sagittal slice was categorised as convex, flat, angled, erosion and pointed.

Figure 1: Shape Of Condyle In Coronal Section

FLAT ANGLED ROUND

Figure 2: Condyle Shape: Sagittal Section
The central sagittal slice of the condylar process



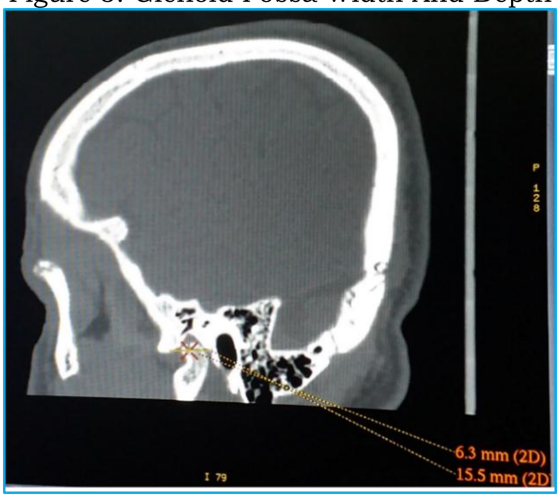
CONVEX FLAT

ANGLED EROSION POINTED

Glenoid Fossa Width and Depth: Sagittal Section

The glenoid fossa depth was established by measuring the perpendicular distance between the highest point of fossa and the line passing through the most inferior point on the articular eminence and the posterior glenoid process [5,6].

Figure 3: Glenoid Fossa Width And Depth



Articular Eminence Angulation: Sagittal Section

The articular eminence inclination was measured by top-roof line method, i.e., the angle between Frankfort plane and the plane passing through the highest point in the roof of glenoid fossa and the lowest point at the crest of the articular eminence [7].

Figure 4: Articular Eminence Angulation

Results

The statistical analysis was performed using licensed version of STATA v 12.0 SE software and Word Excel sheet 2013. Proportions, standard error, frequency and probability (percentage) was estimated for each shape of condyle in two sections and articular eminence angle for both right and left side of TMJ. Combinations of shapes of condyle and eminence angle was studied for both sides using Pearson Chi-square test and Fischer exact test.

Table 1: Shape of Condyle: Right (Coronal)

CORONAL SHAPE: CONDYLE (Right)	Proportion	Standard error
FLAT		
Cases	0.4	0.112
Control	0.45	0.157
CONVEX		
Cases	0.5	0.114
Control	0.54	0.157
ANGLED		
Cases	0.05	0.05
Control	No observations	
ROUND		
Cases	0.05	0.05
control	No observations	

Table 2: Shape Of Condyle- Left

CORONAL SHAPE: CONDYLE (LEFT)	PROPORTION	SATANDARD ERROR
FLAT		
Cases	0.55	0.114
Control	0.36	0.15
Convex		
Cases	0.35	0.109
control	0.54	0.157
Angled		
Cases	0.05	0.05
Control	0.09	0.09
Pointed		
Cases	0.05	0.05
control	No observation	

Angled, pointed and round shapes which are found only in study group but not in control group may be a consequence of TMD rather than for causing TMD.

Table 3: Shape Of Condyle- Right (Sagittal)

SAGITTAL SHAPE: CONDYLE (RIGHT)	PROPORTION	STANDARD ERROR
FLAT		
Cases	0.2	0.091
Control	0.18	0.121
CONVEX		
Cases	0.45	0.114
Control	0.54	0.157
ANGLED		
Cases	0.1	0.068
Control	0.27	0.14
EROSION		0.099
Cases	0.25	
Control	No observations	

Table 4: Shape Of Condyle- Left (Sagittal)

SAGITTAL SHAPE: CONDYLE (LEFT)	PROPORTION	STANDARD ERROR
FLAT		
Cases	0.25	0.099
Control	0.18	0.121
CONVEX		
Cases	0.3	0.105
Control	0.63	0.15
ANGLED		
Cases	0.15	0.081
Control	0.18	0.121

POINTED Cases Control	0.1 No observation	0.068
EROSION Cases Control	0.2 No observation	0.0917

Angled, pointed and erosion shapes which are found only in study group but not in control group may be a consequence of TMD rather than for causing TMD.

Table 5: Articular Eminence Shape: Right

ARTICULAR EMINENCE SHAPE: RIGHT	PROPORTION	STANDARD ERROR
BOX Cases Control	0.55 0.63	0.114 0.15
DEFORMED Cases Control	0.2 0.09	0.091 0.09
SIGMOID Cases Control	No observation 0.09	0.09
FLATTENED Cases Control	0.25 0.18	0.09 0.121

Table 6: Articular Eminence Shape- Left

ARTICULAR EMINENCE SHAPE: LEFT	PROPORTION	STANDARD ERROR
BOX Cases Control	0.6 0.45	0.112 0.157
DEFORMED Cases Control	0.25 0.36	0.099 0.15
SIGMOID Cases Control	0.1 0.09	0.068 0.09
FLATTENED Cases Control	0.05 0.09	0.05 0.09

No particular shape of eminence can be considered to be causing or may be more prone to cause TMD. So this parameter can be excluded or may be given least significance. Flat shape can to some extent contribute for TMDs.

Table 7: Condyle Shape Combinations: Coronal (Cases And Control)

Cases group:

Coronal shape: RIGHT	FLAT- LEFT	CONVEX-LEFT	ANGLED-LEFT	ROUND-LEFT
FLAT	5 (25%)	2 (10%)	1 (5%)	0
CONVEX	4 (20%)	5 (25%)	0	1 (5%)
ANGLED	1 (5%)	0	0	0
ROUND	1 (5%)	0	0	0

Fisher's exact = 0.700

Control group:

Coronal shape: RIGHT	FLAT-LEFT	CONVEX-LEFT	ANGLED-LEFT
FLAT	2(15%)	2(15%)	1(10%)
CONVEX	2(20%)	4(40%)	0

Fisher's exact ratio= 0.740

Shape combinations more prone for TMDs: ANGLED and ROUND shapes with any other common shapes i.e. flat, convex.

Table 8: Condyle Shape Combinations: Sagittal (Cases And Control)
Cases group: Sagittal Shape

SAGITTAL SHAPE: RIGHT	FLAT-LEFT	CONVEX-LEFT	ANGLED-LEFT	POINTED-LEFT	EROSION-LEFT
FLAT	1(5%)	2(10%)	0	0	1(5%)
CONVEX	3(15%)	1(5%)	2(10%)	1(5%)	2(10%)
ANGLED	0	1(5%)	1(5%)	0	0
EROSION	1(5%)	2(10%)	0	1(5%)	1(5%)

Fisher's exact = 0.945

Control group:

SAGITTAL SHAPE: RIGHT	FLAT	CONVEX	ANGLED
FLAT	0	2(15%)	0
CONVEX	1(10%)	3(30%)	2(20%)
ANGLED	1(10%)	2(15%)	0

Fisher's exact = 1.000

Combination of shapes more prone to develop/ causative of TMDs: POINTED, EROSION with any other common shapes like flat, convex, angled.

Table 8: Glenoid fossa width and depth, articular eminence angle significance among cases and control

PARAMETERS	MEAN	STANDARD ERROR	P VALUE Chi-square test
Width of glenoid fossa R			
Cases	16.05	0.519	0.98
Control	16.66	1.31	0.53
Width of glenoid fossa L			
Cases	16.32	0.72	0.71
Control	16.9	0.86	0.25
Depth of glenoid fossa R			
Cases	6.85	0.32	0.84
Control	7	0.704	0.35
Depth of glenoid fossa-L			
Cases	7.2	0.34	0.57
Control	6.84	0.58	0.45
Articular eminence angle -R			
Cases	41.3	0.86	0.04*
Control	40	2.41	0.045**
Articular eminence angle-L	40.63	1.36	0.3018
Cases	38.93	1.15	0.25
Control			

Table 9: Correlation Of Variables Among Each Other In Cases

PARAMETERS	Width G. fossa Right	Width of G. fossa Left	Depth of G. fossa Right	Depth of G. fossa Left	Articular eminence angle-R	Articular eminence angle-L
Width G. fossa Right	0.012					
Width of G. fossa Left	0.0021					
Depth of G. fossa Right	0.0004**	0.04*				
Depth of G. fossa Left	0.002	0.015**	0.001			
Articular eminence angle-R		-0.04*	-0.7834			
Articular eminence angle-L	-0.5354	-0.1797	-0.8490	-0.6310	0.0213	

Depth of glenoid fossa is significantly and positively correlated with width of fossa of same as well as contralateral side. Articular eminence angle is negatively correlated significantly with width of fossa of contralateral side.

Table 10: Correlation Of Variables Among Each Other In Controls

PARAMETERS	Width G. fossa Right	Width of G. fossa Left	Depth of G. fossa Right	Depth of G. fossa Left	Articular eminence angle-R	Articular eminence angle-L
Width G. fossa Right	0.034					
Width of G. fossa Left	0.001					
Depth of G. fossa Right	0.015	0.0036**				
Depth of G. fossa Left		0.026**	0.001**			
Articular eminence angle-R	-0.1234	-0.4053	-0.2512	-0.4097	1.000	
Articular eminence angle-L		0.035 *				

Width of glenoid fossa and depth of fossa of contralateral side significantly correlated. Articular eminence angle and width of fossa of same side are significantly correlated.

Discussion

According to Sülün *et al* proposed higher articular eminence as a predisposing factor for the development of TMDs [8,9]. Sümbüllü *et al* and Ilguy *et al* found that eminence inclination and height (fossa depth) values of males were higher than those of females [10]. Larger eminences were more predominant on the side with unequal pattern of shape combinations and shallower eminences were presented with equal shapes according to Fabio Henrique Hirata et al [11].

According to Lindblom the articular eminence angle for right side is 49.8^0 and 52.3^0 for the left side [12]. Lindblom obtained a mean value of 58^0 and range of 44-72^0 for normal TMJs which is in accordance to Matsumoto et al [13]. In our study the mean is 41.3 ^{0} i.e. the steeper inclination angle with increased glenoid fossa depth which is in comparison with the results of Luciana Fonseca et al [14]. Convex type was observed very frequently followed by angled, concave and round in accordance with Ueda et al [15].

Conclusion

Articular eminence angle may be a significant variable determining TMJ agony[16].. Articular eminence inclination with glenoid fossa depth can be one of the major factor determining the occurrence of TMJ disorders [17]. Shape of condyle is deterministic but may not be so with eminence shape [18]. Influence of deviation in the opening and closing movements, rotation and translation movements of each TMJ, unilateral mastication, unilateral pain, and unilateral articular sound must also be considered and can be subject to further research [18,19].

Limitation of the Study

Age of the sample needs to be correlated with variables. The present study finds lacuna of larger sample size and a uniform distribution of data is required for better interpretation of variables. Gender distribution of the sample must be large to find a gender correlation.

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