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ORIGINAL ARTICLE

Assessment of Articular Disc Position in Normal and Pathologic Temporomandibular Joints Using MRI

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ABSTRACT

Aim: The aim of this study was to determine the TMJ disc position in asymptomatic, normal TMJs and in joints with TMD (Temporomandibular disorders) using MRI.

Material and Methods: The study was performed on forty TMJs of 20 symptomatic patients and twenty TMJs of 10 asymptomatic volunteers. Intermediate Zone (IZ) Criterion is used to interpret disc position. The readers of MRI images were blinded to each other's MRI analysis and clinical diagnosis. Data analyses included Kappa statistics for inter observer reliability correlation.

Results: Scan results of 20 asymptomatic joints revealed ADDWR in one joint. Out of 26 joints clinically diagnosed as internal derangement (ID), 4 joints showed ADDWOR and 8 joints confirmed ADDWR. One joint showed ADDWR in patient with MPDS and two joints of fibrous ankylosis demonstrated ADDWOR.

Conclusion: From our study, we could conclude that in most of the asymptomatic normal TMJs, disc will be in normal position with few exceptions. Joint tenderness was the most common clinical symptom and among displaced discs, ADDWR is the most frequent MRI diagnosis in patients with ID.

Keywords: Temporomandibular joint, Articular disc position, Temporomandibular disorders, Magnetic resonance imaging (MRI)

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INTRODUCTION

Temporomandibular disorders (TMD) is a broad term for a number of clinical signs and symptoms involving temporomandibular joint (TMJ), masticatory muscles and associated structures (1). They result when the muscles used in mastication and the joints of the jaw fail to work in combination with each other (2). Disc displacement, congenital and developmental disorders, inflammatory disorders, hypermobility, ankylosis, fractures and tumors are some of commonly encountered TMD in clinical practice (3). The fact that they are the prime cause of non-dental pain in the orofacial region (4) made the clinician to utilize various imaging modalities to discover the underlying pathology.

Imaging studies are significant because they provide added information about the structure and function of various joint apparatus. Using panoramic and other TMJ radiographs, clinician could recognize changes only in the bony architecture of the joint structure. With the introduction of TMJ arthrography, it was possible to visualize articular disc by injecting dye into the joint space (5). However, several disadvantages exist with this technique. First of all, it is an invasive procedure; secondly, it is not always possible to accurately inject dye into the joint space and finally, the introduction of fluid into the joint has the potential for causing a distorted image. To overcome these difficulties, attempts have been made to visualize the disc by computed tomography (CT) (6). Even though the use of CT involves exposure of the

patient to radiation, it does eliminate the need for dye injection into the joint. Unfortunately CT scanning of the disc has never achieved its anticipated diagnostic potential. Magnetic resonance imaging (MRI), on the other hand, has overcome most of the disadvantages of the previous diagnostic imaging procedures. It is beneficial both to the patients, requiring neither radiation nor injection, and to the clinician, providing a clean and undistorted image of the disc and other tissues (7). MRI is considered as gold-standard for identifying the TMJ disc position and also gives a reasonable image of the hard tissues of the joint in the sagittal and coronal planes (8). Studies of TMJ using MRI (9-11) proved the accuracy of MRI with respect to disc position up to 97%.

Displacement of articular disc, commonly referred to as ID, is one of the common disorders of TMJ. It is characterized by an abnormal relationship between the articular disc, mandibular condyle and articular eminence (12). Many a times, this condition may be associated with clicking, locking, limited or deviated mouth opening and/or tenderness in the TMJ area. The objective of this consecutive study was to determine articular disc position in asymptomatic, normal TMJs and in joints with different types of TMD using MRI.

MATERIALS AND METHODS

The present study was conducted jointly in the department of Oral Medicine and Radiology, Yenepoya Dental College and in A. J. Hospital and Research Centre, Mangalore, India. A total of 30 patients were selected for the study who attended Yenepoya Dental College for various treatments. The study was based on 40 joints of 20 symptomatic patients with various TMD (study group) and 20 joints of 10 asymptomatic volunteers (control group). Ethical clearance was obtained from ethical committee of Yenepoya Dental College and Hospital. All patients were assessed using Research Diagnostic Criteria for Temporomandibular disorders (RDC/TMD) (13) with RDC and health questionnaire. Asymptomatic subjects were accepted for the study after successfully completing the following evaluation:

- A subjective questionnaire to document the absence of jaw pain, joint noise, locking and history of TMD.
- Clinical TMJ and dental examination for signs and symptoms usually associated with internal derangement.
- A detailed medical and dental history to confirm the absence of any parafunctional habits as well as systemic diseases.

Inclusion criteria for the study group were based on the presence of following clinical characteristics:

- Restricted mouth opening
- Deviated opening and/or closing of the mandible
- TMJ pain at the pre-auricular region during mandibular movement
- Tenderness of masticatory muscles on palpation
- Crepitation/clicking during mouth opening and/or closing movement

The exclusion criteria for both the groups were as follows:

- Claustrophobic, uncooperative or pregnant patients
- Patients with cardiac pace maker, metallic prosthesis heart valves, cerebral aneurysm clip or ferromagnetic foreign bodies
- Patients with obvious skeletal jaw deformity, history of traumatic extraction, history or undergoing orthodontic treatment

After obtaining informed consent, bilateral TMJ MR Images of open and closed mouth were obtained from all patients included in the study by means of 0.2 T (Ge Signa) MRI unit of A. J. Hospital and research Centre. Patients were placed in supine position on scanning couch. The maximum intercuspation position was used for closed mouth images and maximum opening for open mouth images. A rubber bite block was used to maintain open mouth position. Pulse sequences were obtained on sagittal T_1 weighted and Gradient Echo (GRE) / T_2 weighted images. By using head coil, sagittal images of the joints were obtained with the following parameters: Repetition time-2400msec, Echo time- 19/31msec, Number of excitation- 2, Field of view- 12cm and Slice thickness- 3mm without spatial gap in between.

The criterion used to interpret the disk position in closed as well as open mouth was intermediate zone (IZ) criterion (14). The condition of each joint was categorized according to the following diagnosis:

- No disc displacement (NDD)
- Anterior disc displacement with reduction (ADDWR)
- Anterior disc displacement without reduction (ADDWOR)

Position of the disc in closed mouth (Figure 1A) was considered normal (NDD), when IZ was located between anterior-superior aspect of the condyle and posterior-inferior aspect of articular eminence in mid-

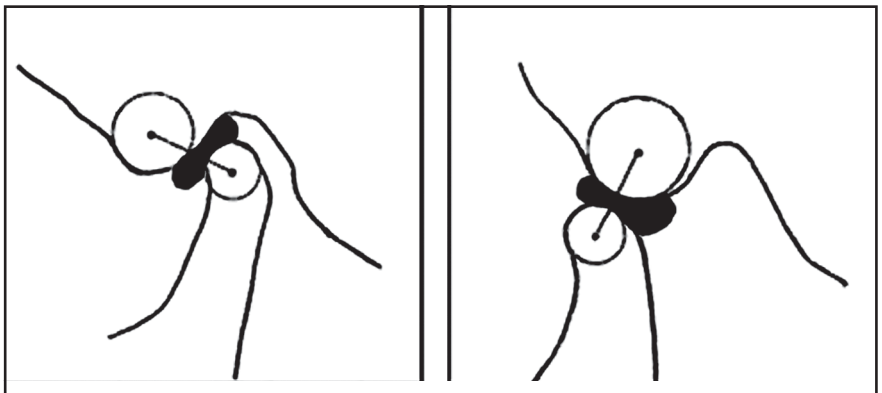

Figure 1: *Normal disc position in closed (A) and open (B) mouth*

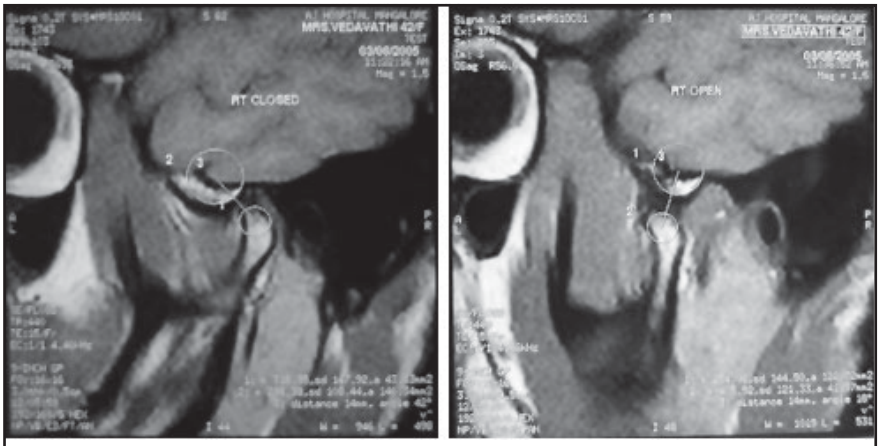

Figure 2: *MRI images of a patient with NDD (closed and open mouth)*

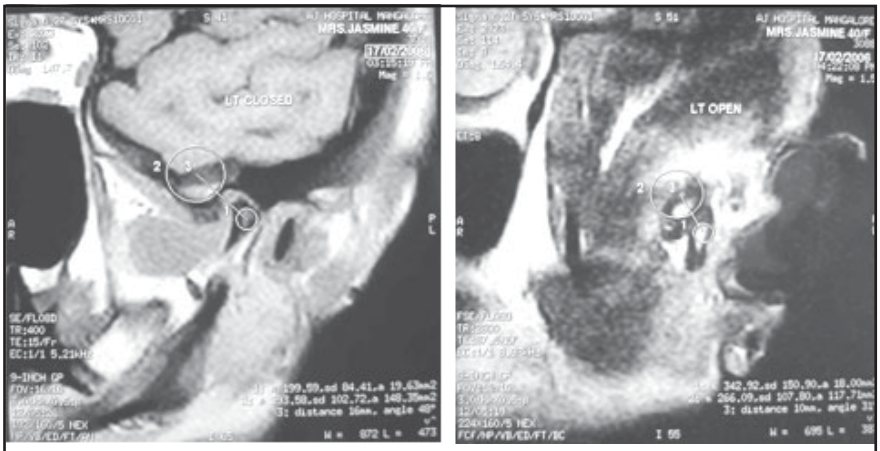

Figure 3: *MRI images of a patient with ADDWR (closed and open mouth)*

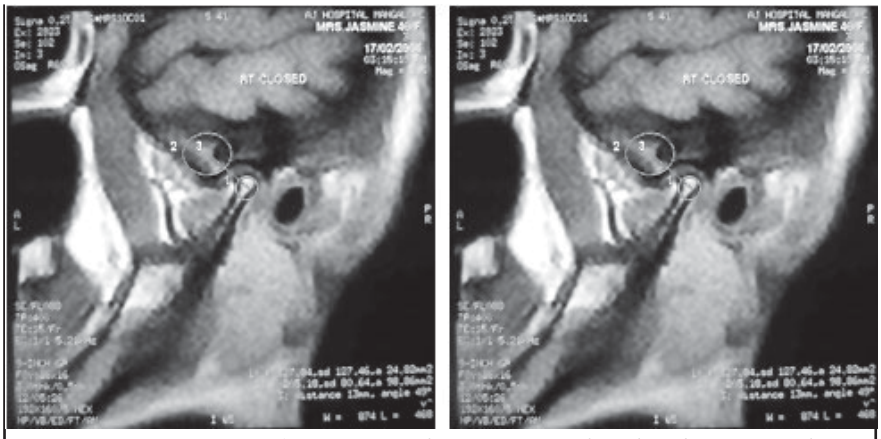

Figure 4: *MRI images of a patient with ADDWOR (closed and open mouth)*

dle or above a line that joined centers of 2 imaginary circles fitted to these structures. In the open mouth (Figure 1B), disc position was considered normal (NDD), if IZ of the disc was located between condyle and articular eminence in middle of a line that joined centers of 2 imaginary circles fitted to these structures (14). In either of the positions, the circles were drawn to closely approximate condyle and eminence outlines. Upper limit of eminence circle was set to be within bone boundary to cranial cavity (Figure 2).

Diagnosis of ADDWR was considered when a displaced disc in the closed mouth position assumed normal position in the open mouth (Figure 3). ADDWOR was considered when displaced disc in the closed mouth position has not achieved normal position in the open mouth (Figure 4). Consensus on inter-observer diagnosis was taken from the three different Radiologists who were blinded to each other's MRI analysis and clinical diagnosis.

Statistics: Data analyses included Kappa statistics for inter observer reliability correlation. The values obtained from three observers were compared to assess the agreement among them regarding MRI diagnoses.

RESULTS

Joint tenderness was the most frequent and joint noise was the least common clinical finding among the symptomatic group (Figure 5). On palpation of the joints, nine patients felt tenderness in joint area bilaterally. Ten patients felt unilateral tenderness in one of their TMJs. One patient did not complain of any pain on either of the joints. Considering the clinical signs and symptoms of patients in this group, the joints of thirteen patients were clinically diagnosed as ID. Three patients with MPDS, two patients with Myositis and one patient each with Osteoarthritis and Fibrous ankylosis comprised of remaining patients in the study group. Out of 40 joints of this group, six joints were diagnosed as ADDWOR using MRI. Nine joints were diagnosed as ADDWR. The remaining twenty five joints did not show any disc displacement; so were classified under NDD. In the control group, out of twenty joints, MRI scan showed one joint as ADDWR and NDD were seen in the remaining. The associations of clinical diagnosis with MRI scan findings in both symptomatic and asymptomatic groups (Table 1) were statistically highly significant (p value-0.001).

Three observers interpreted all MRI scans independently. Observers' associations were analyzed using kappa statistics. The value obtained in comparison between first

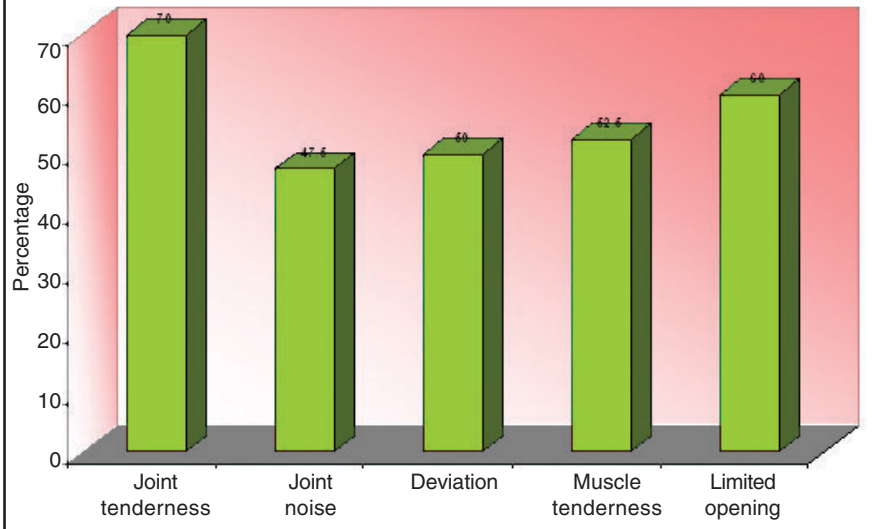

***Figure 5**: Clinical symptoms among study groups*

and second observer, second and third observer and first and third observers were 0.704, 0.677 and 0.751 respectively. These values were indicative of good agreement among observers.

DISCUSSION

In the present study on 20 joints of control group, MRI scan showed one joint as ADDWR, the rest 19 did not show any disc displacement. Louis TK *et al* (15) also found a small percentage of disc displacement in asymptomatic volunteers. In one study by Tallents RH *et al* (16), which involved MRI analysis of disc position in asymptomatic volunteers and symptomatic patients, researchers observed up to 33% of disc displacement in asymptomatic volunteers. The occurrence of such silent displacement of articular discs in asymptomatic, normal joints could be just a variant of joint anatomy or it may be an alarming sign of future TMD.

Disc displacement occurs when articular disc located between condyle and mandibular fossa moves out from these two structures so that the mandible and temporal bone contact is made on other tissue than the articular disc. This is usually very painful, because unlike these adjacent tissues, the central portion of the disc contains no sensory innervations. This could be one of the reasons for the occurrence of joint tenderness as the most common clinical symptom among symptomatic patients in our study. The other reasons could be either micro trauma as associated in chronic muscle hyperactivity and orthopedic instability or macro trauma like blow to the jaw (17) leading to TMJ capsulitis, sinovitis or alteration of retrodisclal tissue.

In the present study on joints of 13 patients diagnosed as ID, MRI showed 8 joints with ADDWR, 4 joints with ADDWOR and the remaining joints did not show any disc displacement. In a similar study on 16 TMJ, Jih CH *et al* (18) observed ADDWR in 8 cases and ADDWOR in 3 cases. Among displaced discs, ADDWR was the most common MRI finding in our study. ADDWR is caused by an articular disc that has been displaced from its position on top of the condyle due to elongation or tearing of the restraining ligaments. An alteration in the form of the disc has also been proposed as a possible factor. A reducing disc displacement is common in the general population, and a clicking or popping joint is of little clinical significance unless it is accompanied by pain, loss of function and/or intermittent locking. Clinicians should be aware that symp-

Table 1: Comparison of clinical diagnosis with MRI scan findings in symptomatic

Clinical diagnosis vs MRI diagnosis in symptomatic and asymptomatic group

			MRI diagnosis			
			ADDWOR	**ADDWR**	**NDD**	**Total**
Clinical diagnosis	ADDWOR	Count	4	0	1	5
		%	80%	.0%	20.0%	100.0%
	ADDWR	Count	0	7	1	11
		%	.0%	63.6%	36.4%	100.0%
	MPDS	Count	0	1	5	6
		%	.0%	16.7%	83.3%	100.0%
	Myositis	Count	0	0	4	4
		%	.0%	.0%	100.0%	100.0%
	NDD	Count	0	1	9	10
		%	.0%	10.0%	90.0%	100.0%
	Osteoarthritis	Count	0	0	2	2
		%	.0%	.0%	100.0%	100.0%
	Fibrous ankylosis	Count	2	0	0	2
		%	100.0%	.0%	.0%	100.0%
	Asymptomatic	Count	0	1	19	20
		%	.0%	5.0%	95.0%	100.0%
Total		**Count**	**6**	**10**	**44**	**60**
		%	**10.0%**	**16.7%**	**73.3%**	**100.0%**

a. X2=72.406 p=.001 vhs

toms of pain and dysfunction associated with ADDWR usually resolve over time with minimal noninvasive therapy (19). In the present study on MPDS and fibrous ankylosis, one joint of MPDS patient showed ADDWR and two joints with Fibrous ankylosis showed ADDWOR using MRI scan. MPDS, characterized by trigger points, which causes local tenderness and referred pain, may be the cause of disc displacement. It could also result secondary to disc displacement or non-disc related (20). TMJ ankylosis presents with restricted mouth opening but no pain. Its mildest form consists of dense adhesions between the condyle and posterior capsule or between the disc and the temporal joint component. The progression of adhesions gradually creates ankylosis. Haemarthrosis secondary to macro trauma or after previous surgery is the most frequent cause of ankylosis in the developed world (21). In our study, as none of the patients underwent surgery of TMJ previously, the most common cause for occurrence of ADDWOR in ankylosis of joints could be macro trauma leading to adhesion of disc to the slope of articular eminence.

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