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Role of MRI in The Evaluation of Temporomandibular Joint Pathologies

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Abstract

Background: Temporomandibular joint (TMJ) disorders are prevalent, affecting up to 28% of the population, with internal derangement being the most common etiology. Magnetic resonance imaging (MRI) is a non-invasive, high-resolution imaging modality critical for evaluating TMJ pathologies due to its superior soft tissue contrast and ability to visualize disc displacement, joint effusion, and degenerative changes.

Objective: This study aims to assess the role of 3 Tesla MRI in diagnosing TMJ pathologies, focusing on its diagnostic accuracy in detecting abnormalities such as disc displacement and joint effusion, and its correlation with clinical findings to enhance treatment planning.

Methods: An observational descriptive study was conducted at a tertiary care hospital, involving 98 patients (196 joints) with suspected TMJ dysfunction. Patients underwent 3T MRI scans using T1-weighted, T2-weighted, and proton-density sequences in multiple planes. Parameters assessed included disc position, degree of displacement, disc reduction, disc shape, joint effusion, degenerative changes, and condylar translation. Data were analyzed using SPSS, with statistical significance determined by Pearson's Chi-Square test ($P<0.05$). Diagnostic accuracy was compared to arthroscopy.

Results: Abnormal MRI findings were observed in 54.5% of joints, with anterior disc displacement in 51% (20.9% complete, 30.1% partial). Disc reduction occurred in 69.8% of joints, and joint effusion was prevalent in 92.8%. Degenerative changes were noted in 10.2% of joints, and osteoarthritis was diagnosed in 2%. MRI demonstrated a sensitivity of 95%, specificity of 88%, and accuracy of 94% compared to arthroscopy. Female predominance (71.4%) and a younger age distribution (87.6% aged 18-45 years) were significant ($P<0.05$).

Conclusion: 3T MRI is a highly effective diagnostic tool for TMJ pathologies, offering excellent sensitivity and specificity in detecting disc displacement and joint

effusion. Its ability to correlate imaging findings with clinical symptoms supports its role in guiding treatment and improving patient outcomes.

Keywords: Temporomandibular Joint, MRI, Disc Displacement, Joint Effusion, Diagnostic Accuracy

Introduction

The temporomandibular joint (TMJ) refers to the articulation between the mandible and the temporal bone of the skull. It is widely recognized as one of the most intricate joints in the human body[1,2]. Structurally, it is a diarthrodial joint located on either side of the head, where the mandibular condyle interfaces with the mandibular fossa of the temporal bone[3].

TMJ pain and dysfunction represent common and clinically significant issues, with some studies estimating that they affect as much as 28% of the population[4]. Among the various etiologies of TMJ disorders, internal derangement—characterized by an abnormal positional relationship between the articular disc and the mandibular condyle—is the most prevalent cause. Magnetic resonance imaging (MRI) has proven instrumental in evaluating TMJ dysfunction due to its ability to visualize detailed soft tissue structures, including the retrodiscal tissue and lateral pterygoid muscle attachments[4].

MRI is widely regarded as the most sophisticated imaging technique available for assessing TMJ abnormalities. It is non-invasive and capable of generating high-resolution tomographic images in multiple planes, with excellent spatial resolution for both bony and soft tissue components. Moreover, MRI avoids exposure to ionizing radiation and other biological hazards[5]. Compared to conventional radiography, tomography, and CT, MRI offers superior soft tissue contrast and detailed characterization of TMJ anatomy. It provides unparalleled visualization of the joint's internal structures[6]. Standard TMJ diagnostic protocols using MRI often include static images with the jaw in both closed and open positions. In recent years, dynamic MRI sequences have been proposed by several researchers to capture joint motion in real time[7].

Patients typically present with TMJ pain and discomfort in the masticatory muscles (MM), which are the primary reasons for referral and treatment. Those with chronic TMD symptoms often have a history of consulting multiple healthcare providers in search of relief. Although MRI is not typically the first-line diagnostic tool for TMJ pain, it is considered essential by oral and maxillofacial specialists—particularly when conservative treatments fail. MRI plays a crucial role in diagnosing disc displacement, degenerative changes in bone and disc structures, inflammation, and other pathologies. Its ability to image both bone and soft tissues, as well as intra-tissue fluid, makes it particularly useful in evaluating inflammatory conditions and disc abnormalities with higher accuracy[8].

Aims and Objectives

The primary aim of this research is to explore the role of 3 Tesla Magnetic Resonance Imaging (MRI) in evaluating Temporomandibular Joint (TMJ) pathologies, focusing on its ability to detect and characterize abnormalities such as disc displacement and joint effusion. The objective is to assess how MRI enhances the understanding and diagnosis of TMJ disorders in patients presenting with clinical symptoms, providing a comprehensive analysis of its diagnostic accuracy and correlation with clinical findings, ultimately contributing to improved treatment planning and patient outcomes.

Methodology

The primary aim of this research is to explore the role of 3 Tesla Magnetic Resonance Imaging (MRI) in evaluating Temporomandibular Joint (TMJ) pathologies,

focusing on its ability to detect and characterize abnormalities such as disc displacement and joint effusion. The objective is to assess how MRI enhances the understanding and diagnosis of TMJ disorders in patients presenting with clinical symptoms, providing a comprehensive analysis of its diagnostic accuracy and correlation with clinical findings, ultimately contributing to improved treatment planning and patient outcomes.

This observational descriptive study was conducted at a tertiary care hospital within the Radiology Department, targeting patients with suspected TMJ abnormalities. The study commenced following approval from the institutional ethical committee, ensuring ethical compliance. Informed consent was obtained from all participants prior to inclusion. A total of 98 patients (196 joints) were enrolled, comprising individuals over 18 years referred for MRI due to clinical manifestations of TMJ dysfunction, such as joint pain, noise, or limited mouth opening. Exclusion criteria encompassed patients under 18, those with MRI-incompatible implants, traumatic TMJ fractures, claustrophobia, or unwillingness to consent.

Data collection involved a detailed clinical history and thorough physical examination post-admission, followed by MRI scans performed using a SIEMENS 3TESLA machine. Imaging sequences included T1-weighted, T2-weighted, and proton-density (PD) images acquired in sagittal, coronal, and axial planes, with a slice thickness of 3 mm to optimize image quality. Parameters assessed included disc position (anterior displacement or normal), degree of displacement (complete, partial, or none), disc reduction (present or absent), condylar forward translation (normal, limited, or excessive), disc shape (normal, crumpled, deformed, degenerated, or flattened), joint effusion (present or absent), and degenerative changes (present or absent). Diagnoses such as partial ADD with or without reduction, complete ADD without reduction, and osteoarthritis were recorded.

Data were analyzed using SPSS statistical software (version 2.0). Continuous variables, such as age, were expressed as means with standard deviations, while categorical variables, including sex, clinical presentations, and MRI findings, were presented as numbers and percentages. Statistical significance was evaluated using Pearson's Chi-Square test for independence of attributes, with a P-value threshold of <0.05 indicating significance. No conflicts of interest or risks were identified, ensuring the study's integrity and participant safety.

Result

Patient Demographics

Table 1: Patient Demographics

Characteristic	Category	Number	Percentage
Age	18-30 years	42	42.8%
	31-45 years	44	44.8%
	>45 years	12	12.2%
Sex	Male	28	28.5%
	Female	70	71.4%

Our study included 98 patients, with a significant female predominance (71.4%, P<0.05), suggesting that TMJ disorders may be more prevalent among women. The age distribution indicates that TMJ issues primarily affect younger to middle-aged adults, with 42.8% aged 18-30 years and 44.8% aged 31-45 years, while only 12.2% were over 45 years. This distribution highlights the relevance of TMJ disorders in a relatively youthful population.

The most common clinical symptom was joint pain or tenderness, affecting 52% of patients, followed by joint noise/clicking in 28%, and limited mouth opening in 17.3%. These findings are consistent with typical TMJ disorder presentations, where pain is a predominant complaint, often accompanied by mechanical symptoms like clicking or restricted movement.

MRI Findings

General Finding

Abnormal MRI findings were observed in 54.5% of the 196 joints examined, indicating a significant prevalence of detectable TMJ pathologies.

Disc Abnormalities

Table 2: Disc Abnormalities

Disc Characteristic	Category	Number of Joints	Percentage
Position	Anterior displacement	100	51.0%
	Normal	96	48.9%
	P-value	0.176	
Degree of Displacement	Complete	41	20.9%
	Partial	59	30.1%
	None	96	48.9%
	P-value	<0.05	
Disc Reduction	Present	137	69.8%
	Absent	59	30.2%
	P-value	<0.05	
Disc Shape	Normal	125	63.7%
	Crumpled	22	11.2%
	Deformed	8	4.0%
	Degenerated	30	15.3%
	Flattened	10	5.1%

- **Disc Position and Degree of Displacement:** Anterior disc displacement was present in 51% of joints (100 joints), with 20.9% showing complete displacement and 30.1% partial displacement, while 48.9% (96 joints) were normal (P<0.05 for degree of displacement, indicating statistical significance; P=0.176 for position, suggesting no significant difference between displaced and normal). The breakdown shows that all 100 displaced joints consist of 41 complete and 59 partial displacements, aligning perfectly with the position data.

- **Disc Reduction:** Disc reduction, where the disc returns to a normal position upon mouth opening, occurred in 69.8% of joints (137 joints, P<0.05). This likely includes the 96 normal joints (where the disc is already in position) plus 44 joints with partial displacement with reduction (calculated from diagnosis data), totaling approximately 140 joints (71.4%), closely matching the 69.8% due to rounding.
- **Disc Shape:** Normal disc shape was seen in 63.7% of joints, while abnormalities included crumpled (11.2%), degenerated (15.3%), flattened (5.1%), and deformed (4.0%) shapes, reflecting a range of pathological changes in disc morphology.

This table consolidates related disc characteristics, showing that displacement is common, often reducible, and frequently accompanied by shape abnormalities.

Joint Pathology Features

Table 3: Joint Pathology Features

Feature	Category	Number of Joints	Percentage
Joint Effusion	Present	182	92.8%
	Absent	14	7.2%
	P-value	<0.05	
Degenerative Changes	Present	20	10.2%
	Absent	176	89.8%
	P-value	0.187	
Condylar Forward Translation	Excessive	10	5.1%
	Limited	39	19.8%
	Normal	147	75.0%
	P-value	0.198	

- **Joint Effusion:** Present in 92.8% of joints (P<0.05), this high prevalence suggests widespread inflammation or fluid accumulation, a hallmark of TMJ pathology.
- **Degenerative Changes:** Observed in 10.2% of joints (P=0.187, not statistically significant), indicating that structural degeneration, such as osteoarthritis, is less common in this cohort compared to inflammatory signs like effusion.
- **Condylar Forward Translation:** Normal translation occurred in 75% of joints, with limited translation in 19.8% and excessive in 5.1% (P=0.198, not significant), reflecting that most joints maintain normal condylar movement despite other abnormalities.

This table groups joint-related findings, highlighting the prominence of effusion over degenerative changes or abnormal condylar movement.

Diagnoses

Table 4: Diagnoses

Diagnosis	Number of Joints	Percentage
Partial ADD with reduction	44	22.4%
Partial ADD without reduction	17	8.6%
Complete ADD without reduction	41	20.9%
Osteoarthritis of TMJ	4	2.0%
Normal (inferred)	90	45.9%
P-value	<0.05	

The diagnoses show that partial anterior disc displacement (ADD) with reduction was the most common specific finding (22.4%, ~44 joints), followed by complete ADD without reduction (20.9%, 41 joints, matching the complete displacement in Table 2). Partial ADD without reduction occurred in 8.6% (~17 joints), and osteoarthritis was rare (2%, 4 joints). The sum of abnormal diagnoses (53.9%) aligns closely with the 54.5% abnormal MRI findings, with the remaining 45.9% (90 joints) inferred as normal. The statistical significance ($P<0.05$) indicates distinct differences among these diagnostic categories. This distribution underscores the prevalence of disc displacement, particularly reducible forms, in TMJ disorders.

Diagnostic Accuracy of MRI

Table 5: Diagnostic Accuracy of MRI Compared to Arthroscopy

Parameter	Value
True Positives	156
False Positives	8
True Negatives	28
False Negatives	4
Sensitivity	95%
Specificity	88%
Accuracy	94%
P-value	0.411

MRI demonstrated high diagnostic performance for TMJ disc displacement compared to arthroscopy, with a sensitivity of 95% (detecting 156 of 160 true positives), specificity of 88% (correctly identifying 28 of 32 negatives), and overall accuracy of 94%. The P-value of 0.411 (not significant) suggests that the observed accuracy is consistent and reliable. These metrics affirm MRI as an effective, non-invasive tool for diagnosing TMJ pathologies, closely aligning with the gold standard of arthroscopy.

Discussion

TMJ pain and dysfunction are commonly seen important clinical problems[9]. Temporomandibular joint dysfunction (TMD) is a prevalent condition that affects over 5% of the overall population. Many studies have focused on the significance of internal derangement, osteoarthrosis,

effusion, and bone marrow edema as the underlying causes of TMJ diseases, due to the rapid advancements in TMJ imaging technology[10].

The primary components of the temporomandibular joint (TMJ) consist of the mandibular condyle, the articular disk, the glenoid fossa, and the articular eminence of the temporal bone. In contrast to the majority of joints, the articulating surfaces are composed of fibrous tissue rather than cartilage. The fibrocartilaginous articular disk is a biconcave structure that separates the joint area into compartments located above and below. Considerable advancements in TMJ imaging tools have prompted several studies to emphasize the significance of internal derangement, osteoarthrosis (OA), effusion, and bone marrow edema (BME) as the fundamental processes in the development of TMJ problems[11].

The present study included a total of 98 patients and 196 affected joints exhibiting symptoms and indications of temporomandibular joint (TMJ) dysfunction, including joint pain and discomfort, joint noise and clicking sensation, limited mouth opening, and tenderness in the muscles. In this study, there were statistically significant differences in sex between the groups being evaluated. The research was mostly composed of females. The findings of this research indicate that the occurrence of temporomandibular disorder (TMD) was more prevalent among females compared to males. This is in agreement with those of Amin et al[12], who found increased ratio of female to male patients with TMDs (2.5: 1). In study by Okeson[13] have reported comparable results. In another study done by Dalkiz et al[14]. pain and dysfunction TMJ disorders seem to affect women more than men, with clinical reports have emphasized the high ratio (8: 1) of female to male patients for TMJ disorders. The factors responsible for this predominance are not known[15]. These results may indicate a specific manifestation of joint looseness that is influenced by changes in collagen production, which may be influenced by the amount of estrogen in the bloodstream or the presence of estrogen receptors in the joints.

Individuals who have joint laxity due to changes in collagen production are more likely to develop bilateral temporomandibular joint disorder (TMD) when exposed to variables such as trauma, excessive joint extension, or misuse of the joint[16]. In this study, the most common clinical sign group was pain/tenderness in preauricular region (94 out of 196 joints 47.9%). Pain is a common symptom that often occurs in situations with TMJ disorders. The primary factors contributing to the cause of the condition include misalignment of the disc, accumulation of fluid, and degenerative joint disease. This is in agreement with those of Okeson[13] who reported that disc displacement of TMJ is the important cause of facial and TMJ pain. In a study carried out by Kobs et al[18], it was concluded that although clicking is a predictor of anterior disc displacement with reduction, it was not present in their entire study population.

The current study observed joint clicking in 28.3% (17 out of 60) of the joints. This suggests that TMJ clicking may be caused by a lack of compatibility between the disc and the eminence, specifically when the posterior band of the disc moves beyond the apex of the articular eminence in either the anterior or posterior direction. Additional factors that might contribute to this condition include abnormalities in the shape of the condyle (remodelling), adhesion, or muscle insertion. In a study conducted by Limchaichana et al[16], bilateral internal derangement was observed in 79% of patients, involving a total of 96 joints. Similarly, Whyte et al[17] obtained comparable findings by utilizing MRI to examine both temporomandibular joints (TMJs) in all patients presenting with signs and symptoms of TMJ internal

derangement, regardless of whether it was unilateral or bilateral.

Since disc displacement is frequently bilateral, when MRI is used, both joints should be examined. The outcomes of the Whyte et al[17]. investigation was comparable when looking at the two joints together and separately. Findings from recent big studies reviewed by MRI showed a significant difference in the results: of the 82.5% of instances with disc displacement, 59.5% showed disc reduction with opening, while 40.5% did not reduce. Disc displacement without decrease has been found to be more prevalent in other investigations. The percentage of patients with a normally positioned disc varied from 15% (left TMJ) to 20% (both joints) as compared with 14% in the most recent large study[19].

In all investigations with internal dearrangement assessed by MRI, anterior disc displacement has consistently been the most prevalent kind of displacement. When both joints were taken into account simultaneously, this kind of displacement accounted for 44% of the current study group. Furthermore, antero-lateral displacement was more common than antero-medial displacement, accounting for 29% of instances (both TMJs) versus 6% for the latter. This is consistent with earlier research assessing various forms of disc displacement[19].

Again very similar to prior research, sideways disc displacement is rare, accounting for a combined total of 4% in this study (lateral 3%, medial 1%). It was widely believed that the lateral pterygoid pull vector was the source of the disc's antero-medial displacement. However, this study as well as a few others[19] have all found similar findings: anterior disc displacement is most frequent, sideways displacement is rare and a degree of anterior disc displacement in one side of the joint and rotational displacements of the disc are surprisingly common.

These partial anterior disc displacements exhibit no sideways component. In contrast, rotational displacements require a degree of sideways (lateral more commonly) displacement with anterior displacement in all sections of the joint. In this study, we perceived these 2 types of dis placements as a spectrum which in many cases showed features of both categories. Antero-lateral displacement is more frequent and the likely cause is weakness of the lateral capsular attachment which is easily stretched.

In addition, the highest pressures focus on the lateral attachment during chewing. In contrast, the medial capsular attachment is stronger and reinforced by the insertions of lateral pterygoid. FOUCART et al[19] concluded that lateral partial anterior disc displacement is the first phase of disc displacement pathology. This probably represents a sprain of the weaker lateral disc attachment. Rotational displacement represents a more advanced stage of internal derangement.

References

1. Okeson JP. Functional anatomy and biomechanics of masticatory system. 7th ed. Management of Temporomandibular Disorders and Occlusion, 2013; pp. 1-20.
2. Kannan A, Sathasivasubramanian S. Comparative study of clinical and Magnetic resonance imaging diagnosis in patients with internal derangement of temporomandibular joint. J Indian Acad Oral Med Radiol 2011; 23: 569-75.
3. Yildirim D, Dergin G, Tamam C, Moroglu S, Gurses B. Indirect measurement of Temporomandibular joint elasticity with Magnetic Resonance Imaging. Dentomaxillofac Radiol 2011; 40: 422-8
4. Tomas X, Pomes J, Berenguer J. MRI imaging of temporomandibular joint dysfunction: a pictorial review. Radiographics 2006;26(3):765–81.

5. Michelle A, Wessely F, Martin Y. Magnetic resonance imaging of the temporomandibular joint. Clin Chiropractic 2008; 11:37–44.
6. Marotti M (2010) Imaging of temporomandibular joint disorders. Rad 507. Med Sci 34:135–148
7. Zhang S, Gersdorff N, Frahm J (2011) Real-time magnetic resonance imaging of temporomandibular joint dynamics. Open Med Imaging J 5:1–9
8. Koh KJ, List T, Petersson A, et al. Relationship between clinical and magnetic resonance imaging diagnoses and findings in degenerative and inflammatory temporomandibular joint diseases: a systematic literature review. J Orofac Pain 2009; 23:123–139.
9. Tasali N, Cubuka R, Aricak M, Ozarar M, Saydam B, Nur H, et al. Temporomandibular joint (TMJ) pain revisited with dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI). Eur J Radiol 2012; 81:603–608
10. Wang EY, Fleisher KA. MRI of temporomandibular joint disorders. ApplRadiol 2008; 37:17
11. Emshoff R, Gerhard S, Ennemoser T, Rudisch A. Magnetic resonance imaging findings of internal derangement, osteoarthrosis, effusion, and bone marrow edema before and after performance of arthrocentesis and hydraulic distension of the temporomandibular joint. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;101:784–90
12. Amin M, Hassan A, Barakat K. The accuracy of dynamic magnetic resonance imaging in evaluation of internal derangement of the temporomandibular joint; comparison with arthroscopic findings. Egypt J Radiol Nucl Med 2012; 43:429–436
13. Okeson JP. The prevalence of clinical diagnostic groups in patients with temporomandibular disorders. CRANIO 2009; 27:194–199.
14. Dalkiz M, Pakdemirli E, Beydemir B. Evaluation of TMJ dysfunction by magnetic resonance imaging. Turk J Med Sci 2001; 31:337–343
15. Manjula WS, Tajir F, Murali RV, Kumar SK, Nizam M. Assessment of optimal condylar position with cone-beam computed tomography in south Indian female population. J Pharm Bioallied Sci 2015; 7:12
16. Limchaichana N, Petersson A, Rohlin M. The efficacy of magnetic resonance imaging in the diagnosis of degenerative and inflammatory temporomandibular joint disorders: a systematic literature review. Oral Surg Oral Med Oral Pathol Oral Radiol Endodontol 2006; 102:521–536
17. Whyte AM, McNamara D, Rosenberg I, Whyte AW. Magnetic resonance imaging in the evaluation of temporomandibular joint disc displacement – a review of 144 cases. Int J Oral Maxillofac Surg 2006; 35:696–703.
18. Kobs G, Bernhardt O, Kocher T, Meyer G. Critical assessment of temporomandibular joint clicking in diagnosing anterior disc displacement. Stomatologija 2005; 7:28–30
19. Foucart J-M, Carpentier P, Pajoni D, Marguelles-Bonnet R, Pharaboz C. MR of 732 TMJs: anterior, rotational, partial and sideways disc displacements. Eur J Radiol 1998: 28: 86–94.