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EVALUATION OF TEMPOROMANDIBULAR JOINT ANTERIOR DISC DISPLACEMENT WITH REDUCTION: CLINICAL VERSUS MAGNETIC RESONANCE IMAGING FINDINGS

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ABSTRACT

Our study aimed to assess whether magnetic resonance imaging (MRI) results of different degrees of severity of disc displacement were correlated to the pain and joint sounds in patients with TMJ anterior disc displacement with reduction (ADDwR).

Materials and Methods: A prospective study in which sixty patients of both genders with age ranges from 16 to 55 years old were selected from the TMJ outpatient clinic of the Oral and Maxillofacial Surgery Department. Clinical and magnetic resonance imaging examinations were performed for the TMJ to assess its condition by recording the joint sounds, visual analogue scale and the anteroposterior disc position.

Results: There was a statistically significant relation between the degree of internal derangement and joint sounds. All patients with either mild or severe degrees of internal derangement suffered from pain but there was no statistically significant relation between the degree of internal derangement and the severity of pain.

Conclusion: Evaluation of Temporomandibular Joint ADDwR showed a significant correlation between the clinical parameters and MRI findings.

KEYWORDS : TMJ , Pain, Clicking, Anterior disc displacement, MRI

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INTRODUCTION

Temporomandibular joint disorders (TMDs) are defined as "A collective term embracing some clinical problems that include the masticatory muscles, temporomandibular joint (TMJ), and associated structures or both", Furthermore, according to the American Academy of Orofacial Pain, TMDs encompass a wide range of articular and/or muscle problems in the orofacial region.

TMJ is a pressure-bearing compound double synovial joint. **Anatomically**, the disc lies between the articular surface of the temporal bone and the condyle and compensates for the lack of conformity between articular surfaces. It divides the TMJ capsule into superior and inferior joint spaces. **Histologically**, the disc collagen fibers (type I and III) show a wavy course that allows collagen fibers to stretch during compression, making the disk able to withstand the force applied. **Biomechanically** It is held in place between the condylar head and the articular eminence by a thick rim with specific viscoelastic qualities. [1].

One of the frequent disorders of TMJ is disc displacement, known also as internal derangement. It can be manifested as a dyssynchronous relationship between the condyle and the disc during opening and closing [2].

Furthermore, disc displacement may be either anterior displacement with reduction (ADDwR), anterior displacement without reduction ADDwOR, or posterior displacement [3]. In ADDwR, the disc is positioned anteriorly to the condyle while the jaw is closed and returns to its usual position when the jaw is opened [4].

ADDwR is usually associated with clicking and popping. In the closed mouth position, the disc is positioned anteriorly and medial to the condyle; clicking occurs during the opening as the condyle moves over the posterior band of the disc and eventually restores the normal condyle-disc relationship, during the closing, the disc is displaced back anteriorly where a reciprocal click can be manifested. Moreover, the pain has been reported to be a comorbid symptom of TMJ disorders which is usually localized in the preauricular area and/or the muscles of mastication [5,6].

Magnetic resonance imaging is known to be beneficial for studying the disc and soft tissues of TMJ, it is useful in diagnosing internal derangements because it permits direct visualization of the disc in both open and closed jaw positions [7]. It provides information regarding the disc's position, shape, and signal intensity. Furthermore, the amount of synovial fluid, bone marrow, peri-articular tissues, and posterior attachment can be assessed [2,4,8].

MRI has been reported to be 95% accurate in the assessment of disc position [9,10]. For a valuable illustration of the spatial condyle-disc relationship and other structures of TMJ, sagittal and coronal views were recommended. These MRI demonstrations can be correlated to the pain and dysfunction of patients with temporomandibular joint disorders and thus, it can be considered an essential tool in formulating the treatment plan [2,4,11].

Management of TMJ-related disorders was based on an appropriate diagnosis of the position and shape of the TMJ disc in several studies. However, in terms of the correlation between clinical and MRI findings, there have been few investigations on whether the disc-condyle connection is a significant determinant in the initiation of TMJ-related pain and dysfunction. Moreover, considerable histologic and biochemical research work has been done to provide basic information about the nature of TMJ biology. Some studies have been conducted to study the diagnosis of TMDs clinically, while others tackled the disorders radiographically, but controversy continues to grow over the management of disc displacement with or without reduction [12-21]. Hence, our study aimed to evaluate whether MRI findings of different degrees of disc displacement were cor-

related to the presence of pain and joint sounds in patients with TMJ anterior disc displacement with reduction.

PATIENTS AND METHODS

Subjects:

A prospective study in which sixty patients of both genders with age ranges from 16 to 55 years old were recruited from the TMJ outpatient clinic of the Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Assiut University.

Ethical approval: This study was approved and granted by Assiut University Research Ethics Committee. It was carried out in accordance with the Helsinki principles and their variations. All patients who participated in this research provided written informed consent before the procedure to participate in this study.

Inclusion criteria:

1. Absence or presence of at least clicking during opening with or without reciprocal clicking during closing.
2. Pain on palpation of the TMJ.
3. MRI confirming the presence of ADDwR.

Exclusion Criteria:

1. Patients with main diagnostic features of ADDwOR. (Closed-lock phenomena preceded by a history of clicking)
2. The presence of systemic diseases affecting TMJ (i.e., rheumatoid arthritis)
3. History of recent trauma to the TMJ
4. Previous TMJ surgery
5. Patients demonstrate an absolute contraindication for MRI examination (Patients with pacemakers, and those who experience claustrophobia)

Clinical diagnosis:

- Clinical symptoms were classified into TMJ pain and TMJ sounds (clicking or popping)
- The intensity of pain was evaluated using the visual analogue scale (VAS) **[Figure 1]** while TMJ sounds were evaluated by a single examiner by palpating the joint during mouth opening and closing.

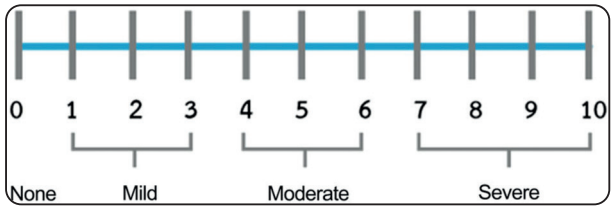

Fig. (1): The VAS scale

MRI examination:

The MRI system used had a magnetic field of 1.5 Tesla. It was used to capture sagittal bilateral MRI images. Every image was taken with the mouth closed. The Proton density weighted images were evaluated in 2mm slices. Image field of view was 20*20 mm2. For the TR it was 2500 ms while the TE was 20 ms. Photos were obtained with Philips 3.0 software. The photos were captured in sagittal dimensions.

The disc position was evaluated in a closed-mouth position. If the posterior band of the disc was situated with respect to the condyle at the 12 o'clock position, then the position of the disc was considered normal, hence, no internal derangement. If not, then the disc was anteriorly displaced and subsequently, an internally deranged joint was diagnosed **[Figure 2]**.

Internally deranged joints with meniscus interior displacement were classified into two groups according to the Meniscus Posterior band position. It was considered mild disk displacement when this band was at a position between 10 to 11 o clock. On the other hand, the displacement was considered to be significant when the posterior was then positioned between 8 to 9 o clock [22, 23].

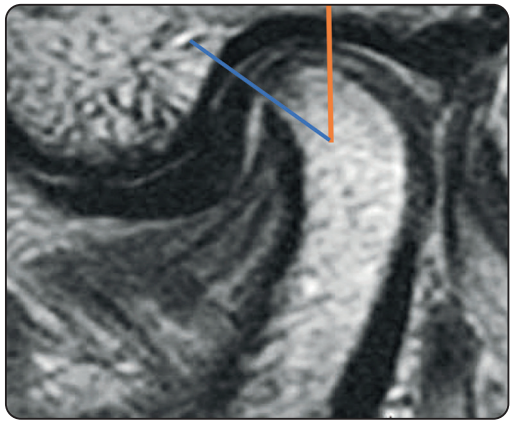

Fig. (2): TMJ corrected sagittal MRI with ADDwR where the orange line represents the 12 o'clock position and the blue line represents the posterior band of the meniscus.

Statistical Analysis

Qualitative data were presented as frequencies and percentages. The chi-square test or Fisher's Exact test was used for comparisons between cases with and without internal derangement as well as to study the association between the degree of internal derangement, joint sound, and severity of pain. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

RESULTS

Degree of internal derangement

Among 60 cases with internal derangement, 36 cases (60%) had mild internal derangement and 24 cases (40%) had severe internal derangement.

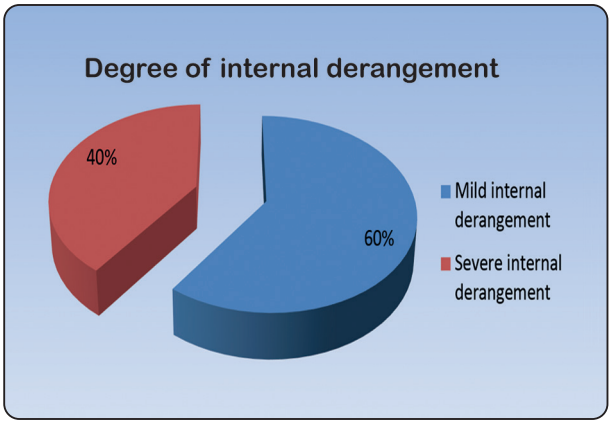

Fig. (3) Pie chart representing the degree of internal derangement.

Joint sounds:

There was a statistically significant association between the degree of internal derangement and joint sounds (*P*-value = 0.031, effect size = 0.5). Cases with mild internal derangement showed less prevalence of clicking than cases with severe internal derangement, where all cases with severe internal derangement had clicking.

TABLE (1) Descriptive statistics and results of Fisher's exact test for the correlation between the degree of internal derangement and joint sounds.

Joint sounds	Mild derangement (n = 36)		Severe derangement (n = 24)		*p*-value	*Effect size (odds ratio)*
	n	%	n	%		
Clicking	24	66.7	24	100	0.031*	0.5
No clicking	12	33.3	0	0		

**: Significant at P ≤ 0.05*

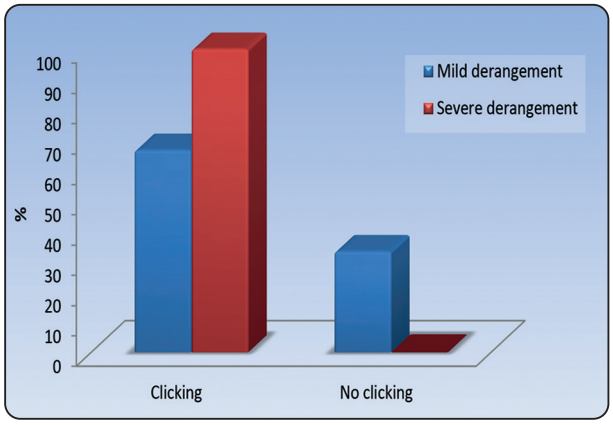

Fig. (4): Bar chart representing the correlation between the degree of internal derangement and joint sounds.

Severity of pain

All patients with either mild or severe degrees of internal derangement suffered from pain but there was no statistically significant association between the degree of internal derangement and the severity of pain (*P*-value = 0.458, Effect size = 1.333).

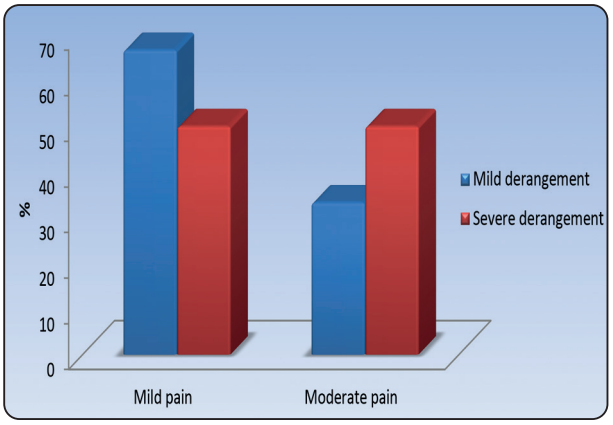

Fig. (5): Bar chart representing the correlation between the degree of internal derangement and severity of pain.

TABLE (2): Descriptive statistics and results of Fisher's Exact test for the association between the degree of internal derangement and severity of pain.

Severity of pain	Mild derangement (n = 36)		Severe derangement (n = 24)		*p*-value	*Effect size (v)*
	n	%	n	%		
Mild pain	24	66.7	12	50	0.458	1.333
Moderate pain	12	33.3	12	50		

: Significant at P ≤ 0.05

DISCUSSION

Patients complaining of TMDs are very common in Maxillofacial Surgery Departments and TMJ clinics, their chief complaints may impact masticatory functions, proper occlusion, and comfort during eating or jaw movements, and eventually their quality of life. Recent improvements in MRI techniques have allowed for the imaging of various craniofacial structures and the correlation of the results to clinical observations, which can help in the early diagnosis of TMDs. Patients with anterior disc displacement could be considered as one of the most common conditions in patients with TMJ problems. Moreover, ADDwR is one of the most frequently seen internal derangements, it is usually associated with joint clicking with/without pain [24].

Conventional treatment of TMDs includes physical therapy, orthodontic appliances, night guards, medications, surgical intervention, conventional approach, and psychological management.

However, during the late stage of TMDs, traditional treatment often results in insufficient relief of symptoms. Indeed, proper clinical and radiographic diagnosis is very crucial for proper management and better treatment outcomes [41].

Despite the fact that numerous authors have argued the degree of disc displacement on MRI and the presence of signs and symptoms of TMJ problems, no clear results have been reached [25]. Hence, our study focused on evaluating the presence of joint sounds and pain in patients with ADDwR and correlating them with MRI findings at different degrees of disc displacement.

Sixty patients with diagnostic criteria of ADDwR of both genders with age ranges from 16 to 55 years were recruited in our study. Out of 60 cases with internal derangement, 36 cases (60%) had mild internal derangement *(mild degree of disc displacement)* where the posterior band of the disc being between 10 and 11 o'clock relative to the condyle and 24 cases (40%) had severe internal derangement *(severe degree of disc displacement)* where the posterior band was located between 8 and 9 o'clock relative to the condyle.

Joint sounds were correlated with MRI findings and our results showed that there was a statistically significant association between the degree of internal derangement and joint sound (*P*-value=0.031, Effect size=0.5). Cases with mild internal derangement showed less prevalence of clicking, since out of 36 cases 24 patients (66.7%) demonstrated TMJ clicking while 12 patients (33.3%) showed no clicking. All 24 patients (100%) with severe internal derangement suffered from clicking.

Moreover, in the present study, there was a linear correlation between TMJ pain and MRI findings since all patients with either mild or severe degrees of internal derangement suffered from pain at various levels. However, there was no statistically significant association between the degree of internal derangement and the severity of pain (*P*-value=0.458, Effect size=1.333). Among 36 patients with mild internal derangements, 24 patients (66.7%) suffered from mild pain while the remaining 12 patients (33.3%) had moderate pain whereas 12 patients (50%) with severe internal derangements suffered from mild pain, and the other 12 patients (50%) had moderate pain according to the VAS.

Mechanical overload associated with disc displacement may cause morphological changes in the articular disc which will in turn result in the release of inflammatory mediators within the joint capsule causing pain [26].

Although the association between pain and changes in MRI remains an intriguing topic, numerous findings have been found.

Some studies demonstrated results comparable and in accordance with our results. A study published by Akdag et al. 2018 evaluated the correlation between the degree of disc displacement and pain. They studied 104 patients with unilateral TMJ pain. There was no significant difference between patients who have ADDwR and those who have ADDwOR. Moreover, patients with ADDwR and ADDwOR demonstrated higher pain scores when compared to the normal disc position group [27].

These findings were also coincident with a study done by Farina et al. in 2009 where the results have shown that MRI signal changes in retrodiscal tissue were highly correlated with TMJ pain [28].

Moreover, Sano et al. 2000 found that the intensity of pain in TMJ showing severe osteoarthritic changes is higher than those having a normal condylar appearance on MRIs [29]. Also, Rudish et al. 2001 stated that there is a significant correlation between TMJ pain and TMJ effusion in MRI [30].

Bertram et al. 2001 reported that there was a strong link between pain, disc displacement, and joint effusion in the study they conducted [31].

Evaluation of the relationship between MRI findings and pain was done in a study performed by Takahara et al. 2017 where the authors concluded that MRI findings in patients with ADDwOR or

those with an increase in joint effusion suffered from pain at various levels [21].

According to Maizlin ZV et al. (2010), disc displacement in asymptomatic TMJs is always moderate, whereas disc displacement in patients with TMJ pain and dysfunction is more prevalent [24].

Most of the previous studies demonstrated a linear relationship between the presence of internal derangement shown in the MRI and the presence of TMJ pain, however, the correlation between the degree of disc displacement and the presence of pain is not clearly explained or mentioned.

On the contrary, some studies reported the presence of disc displacement in several asymptomatic patients with no significant associations between TMJ clinical and MRI findings.

In a study done by Kumar et al. 2015, the author's study results showed that 9.1% of asymptomatic subjects presented with disc displacement [32]. This finding agreed with various studies in the literature that reported a higher prevalence of disc displacement in asymptomatic subjects. Among totally asymptomatic patients, Ribeiro RF et al. in 1997 reported that the incidence of disc displacement was 25% [33], while Larheim TA et al. in 2001 showed a 35% prevalence of internal derangement on MRI evaluation [12].

Moreover, Eriksen et al. in 2020 reported that there was no significant association could be found between TMJ pain and MRI findings. The authors explained that limitations such as lack of correlation could be attributed to the limited number of patients needed for the certainty of the results, in addition to other clinical parameters such as joint sounds and range of mouth opening have not been investigated or correlated with MRI findings [34]. This discordance with our results has also been reported in previous studies [11, 35, 36, 37].

Finally, Maizlin ZV et al. 2010 stated that the clinical significance of imaging findings of internal derangement is controversial [24]. A variety of past studies showed that the prevalence of disc displacement among asymptomatic patients was previously reported as nearly 33% [38,39,40], and the prevalence of normal articular disc in symptomatic joints was reported to be 16%-23% [39].

CONCLUSION

1. Evaluation of Temporomandibular Joint ADDwR showed a significant correlation between the clinical parameters and MRI findings.
2. Cases with a mild degree of disc displacement showed less prevalence of clicking than cases with a severe degree of disc displacement indicating a significant association between the degree of internal derangement and joint sounds.
3. All patients with either mild or severe degrees of disc displacement suffered from pain. However, there was no significant association between the degree of disc displacement and the severity of pain.

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