Correlation between temporomandibular disorders pain and magnetic resonance imaging finding: A systematic review.

Original Article

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ABSTRACT

Background: Temporomandibular joint (TMJ) pain is the most chief complain of temporomandibular disorders (TMD) patients. Magnetic resonance imaging (MRI) is the golden standard for diagnosis of TMJ disorders. The purpose of this study was to conduct a literature review to correlate TMD pain and MRI finding.

Material and methods: A review was performed using electronic databases PubMed, scopes and web of science for articles published from 2000 to 2022. A predetermined inclusion and exclusion criteria were used for filtering the scientific papers.

Results: MRI imaging for patients with TMJ pain showed that 70.4% had ID and 29.6% had normal disc position while osteoarthritis was present in 69% of joints and absent in 31% of joints, moreover, temporomandibular joint effusion was reported in 55% of joints and absent in 45% of joints.

Conclusion: Joint pain is much more common with internal derangement, osteoarthritis and joint effusion than with bone edema and condylar bony changes.

Key Words: Temporomandibular joint; Temporomandibular disorders; pain; Magnetic resonance imaging.

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INTRODUCTION

Temporomandibular joint (TMJ) is defined as the area where the mandible condyle articles with the temporal bone and considered It is a diarthrodial joint [1].

Temporomandibular disorders (TMD) is a term that is usually used to describe a number of clinical problems that involve the masticatory muscles, TMJ and surrounding structures [2].Patients with TMD most frequently present with pain, sound in TMJ area, limited mouth opening and deviation of the mandibular [3].

Among these symptoms, TMJ pain is the most reason that patients were referred to clinics for treatment [4].

In TMD patient, symptoms are most affected in young to middle ages between the age of 20 and 40 years [5].

Furthermore, the prevalence of TMD in population gender has been reported to be four times higher in female to male patient [6]. The diagnostic process of TMD mainly depends on clinical examination and requires imaging modulates to reach the final diagnosis. Research Diagnostic Criteria for temporomandibular disorders (RDC/TMD) which published at 1992 was widely a clinical examination used for diagnosis TMD [7].

Magnetic resonance imaging (MRI) is an advanced imaging technique that provides excellent imaging modalities in diagnosis soft tissues without radiation or surgical invasion and considered as the gold standard for the diagnosis of TMD [8,9].

Therefore, MRI is widely used to examine the disk position and its configuration, posterior disk attachment, and condyle marrow status, and the presence of joint effusion [8].

The aim of study was to review correlation between MRI finding of TMD patient with pain.

MATERIALS AND METHODS

Application Protocol and Website Recording Data

Protocol registered on the PROSPERO website, an international prospective register of systematic reviews. ID: CRD42023390847.

This review followed the preferred reporting items for Systematic reviews and Meta-Analyses (PRISMA) guidelines.

Search Strategy

A thorough literature review was done by the following databases: PubMed, Scopus and Web of Science.

Core Collection electronic databases using the following keywords ((TMJ OR TMD OR TMDS OR Temporomandibular joint disorder* OR Temporomandibular joint disc* OR temporomandibular joint disorder* complication*) AND (pain OR Suffer OR discomfort*) AND (MRI OR magnetic resonance imaging*)). Reference list of the included publications were also reviewed for additional studies.

Study selection

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Inclusion criteria:

- Studies published in English language.
- Journal articles published till January 2022.
- Studies including TMJ assessment using MRI where patients complained of joint pain.
- Diagnosis process based on the research diagnosis criteria for temporomandibular disorder (RDC/TMD).
- Studies conducted on adult human subjects.

Exclusion criteria:

- Studies concerned with TMJ trauma, tumor or surgery.
- Studies on systemic diseases (e.g. rheumatoid arthritis, fibromyalgia patients).
- Case reports.

Screening process:

First, title and abstract screening was done by two independent reviewers (M.M, C.K), all of the screening depended on inclusion criteria and any disagreement was resolved by discussion.

Then their evaluations and analyzed differences through comparing the manuscripts and consulting a third experienced senior independent reviewer (R.G) when a consensus could not be reached.

Last articles full text screening by one reviewers (M.M) and also their references were searched for any relevant articles.

Quality assessment

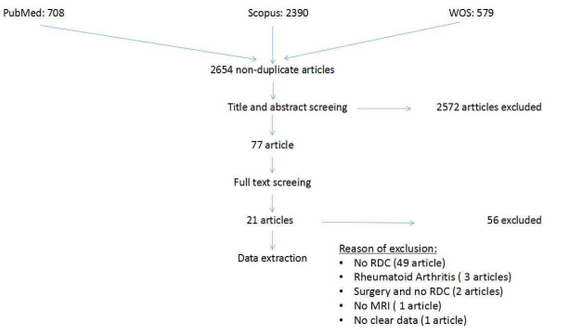
The quality of each study was assessed by two assessment scales developed by two independent authors (M.M, C.K): the first scale for appraisal of potential risk of bias using the methodological index for non-randomized studies (MINORS) tool [10]; the second scale was Jadad scale (the Oxford quality scoring system) for assessment of randomized clinical trials (RCT) [11].

RESULTS

Study selection

The study selection process followed the PRISMA flowchart. Using three electronic data bases searched yielded a total of 2654 non duplicated articles. Application of the selection criteria in title and abstract screening stage yielded 77 articles. In the full text screening stage 56 articles were excluded according to exclusion criteria, to result in 21 included articles (Figure 1).

Figure 1: Study selection process following the PRISMA flowchart.



Study design

The majority of studies were cross section studies 13 from 21 studies, followed by prospective cohort studies 5 form 21 and randomized clinical trials (RCT) 3 form 21 studies.

Study participants:

All included articles reported pain and guideline according RDC/TMD and age range of included patient from 16 to 82 years and average of mean ages from 30 to 45 years old. Gender distribution in 21 studies 1493 female patients, 346 male patient by percentage 81% female to 29% male patients.

Name of authors and year and country of publication, sample size and age range and number of pain all reported in table 1.

While percentage of finding results (internal derangement (ID), osteoarthritis (OA), edema, joint effusion and condylar morphology) in table 2.

Quality assessment:

Quality assessment were performed for non-randomized clinical studies and RCT as showing in table 3 and 4.

Table 1: Information of included studies.

	Authors	Year	Country	Sample size	Age range (years)	Number of pain in samples
1	Emshoff et al [12]	2000	Austria	23	35.8	23 P
2	Emshoff and rudisch [13]	2001	Austria	163	36	137 J
3	Emshoof et al [14]	2001	Austria	48	35.3	48 P
4	Rudisch et al [15]	2001	Austria	41	39.1	41 J
5	Emshoff et al [16]	2002	Austria	113	35.3	55 P
6	Emshoof et al [17]	2003	Austria	109	36.1	46 J
7	Emshoof et al [18]	2003	Austria	169	36.9	165 J
8	Emshoof et al [19]	2003	Austria	42	38.8	42 P
9	Schimitter et al [20]	2003	Germany	61	38.2	61 P
10	Guler el al [21]	2005	Turkey	31	31	16 J
11	Limchaichana et al [4]	2006	Sweden	60	36	60 P
12	Saez-yuguero et al [22]	2008	Spain	66	32.4	34 J
13	De senna et al [23]	2009	Brazil	62	30.7	34 P
14	Limchaichana et al [24]	2009	Sweden	48	36	48 P
15	Lin WC et al [25]	2012	China	65	30.1	65 J
16	Badel et al [26]	2012	Croatia	50	53	29 P
17	Abdelnabi and Swelem [27]	2013	Egypt	46	61.3±5.6	25 P
18	Kumar et al [28]	2015	India	44	26.55±6.82	22 P
19	Wurm et al [29]	2017	Germany	91	41.4	91 P
20	Takabara et al [30]	2017	japan	323	44.8	222 J
21	Masubara et al [31]	2018	Japan	425	49	375 J

P: patients J: joint

Table 2: Finding results of included papers

	Study	Finding			
1	Emshoff et al [12]	Internal Derangement: Normal 34.4% DDWR 34.4% DDWOR 30.4%		Osteoarthritis: Present 58.7% Absent 41.3%	
2	Emshoff and rudisch [13]	Internal Derangement: Normal 25.6% DDWR 22.6% DDWOR 51.8%			
3	Emshoof et al [14]	Internal Derangement: Normal 8.3% DDWR 12.5%a DDWOR 79.2%		Osteoarthritis: Present 62.5% Absent 37.5%	
4	Rudisch et al [15]	Internal Derangement: Normal 19.2% DDWR 22% DDWOR 58.5%		Joint Effusion: Present 58.5% Absent 41.5%	
5	Emshoff et al [16]	Internal Derangement: Normal 9.1% DDWR 14.5% DDWOR 76.3%			
6	Emshoof et al [17]	Internal Derangement: Normal 43.5% DDWR 17.4 % DDWOR 39.1%			
7	Emshoof et al [18]	ID: Normal 26.7% DDWR 21.2% DDWOR 82.8%	Osteoarthritis: Present 82.8% Absent 18.2%	Edema: Present 24.8% Absent 75.2%	Joint Effusion: Present 44.2% Absent 55.8%
8	Emshoof et al [19]	Internal Derangement: Normal 11.9% DDWR 9.5% DDWOR 78.6%	Osteoarthritis: Present 85.7% Absent 14.3&		Joint Effusion: Present 45.2% Absent 54.8%
9	Schimitter et al [20]	Internal Derangement: Normal 41% DDWR 24.5% DDWOR 34.5%		Osteoarthritis: Present 41% Absent 59%	

10	Guler el al [21]	Internal Derangement: DDWR 100%	Joint effusion: Present 75% Absent 25%	Condylar morphology: 19% Normal 31% Osteophyte 19 % Erosion 6% Sclerosis 12% Combination
11	Limchaichana et al [4]	Internal Derangement: Normal 33.3% DDWR 45.2% DDWOR 14.5%	Joint Effusion: Present 28% Absent 72%	Condylar morphology: Erosion 10% Flattening 42.5% Osteophyte 21.6% Pseudocyte 2.5% Sclerosis 19.1%
12	Saez-yuguero et al [22]	Internal Derangement: Normal 30.3% DDWR 37.9% DDWOR 31.8%		
13	De senna et al [23]	Internal Derangement: Normal 30.6% DDWR 51.6% DDWOR 17.7%		
14	Limchaichana et al [24]	Internal Derangement: Normal 32.7% DDWR 51% DDWOR 16.3%	Osteoarthritis: Present 71% Absent 29%	
15	Lin WC et al [25]	Internal Derangement: Normal 5% DDWR 20% DDWOR 75%		
16	Badel et al [26]	Internal Derangement: Normal 57% DDWR 3% DDWOR 40%	Osteoarthritis: Present 58% Absent 42%	
17	Abdelnabi and Swelem [27]	Internal Derangement: Normal 28% DDWR 62% DDWOR 10%	Joint Effusion: Present 80% Absent 20%	

18	Kumar et al [28]	Internal Derangement: Normal 49% DDWR 25.5% DDWOR 25.5%			
19	Wurm et al [29]	Internal Derangement: Normal 40% DDWR 14% DDWOR 19% Disk degeneration 27%		Condylar morphology: Combination 29 joint	
20	Takabara et al [30]	ID: Normal 24.3% DDWR 14.4% DDWOR 61.3%	Osteoarthritis: Present 40% Absent 60%	Joint effusion: Present 45.5% Absent 54.5%	Edema: Present 27.5% Absent 72.5%
21	Masubara et al [31]	ID: Normal 29% DDWR 43% DDWOR 28%	Joint effusion: Present 56% Absent 44%	Edema: Present 15% Absent 85%	Condylar morphology: Absent 65% Present 35%

ID: Internal Derangement DDWR: Disc displacement with reduction. DDWOR: Disc displacement without reduction.

Table 3: Average MINORS score of non-randomized studies.

Study	Score
Emshoff et al [12]	11/16
Emshoff and Rudisch [13]	12/16
Emshoff et al [14]	13/16
Rudisch et al [15]	15/16
Emshoff et al [16]	22/24
Emshoff et al [17]	12/16
Emshoff et al [18]	11/16
Emshoff et al [19]	13/16
Schmitter et al [20]	14/16
Saez-yuguero et al [22]	12/16
Robinson de Senna et al [23]	13/16
Lin WC et al [25]	22/24
Badel et al [26]	13/16
Abdelnabi and Swelem [27]	22/24
Kumar et al [28]	12/16
Wurm et al [29]	14/16
Takahara et al [30]	15/16
Matsubara et al [31]	14/16

Table 4: Jadad scale of RCT studies.

Study	**score**
Güler et al [21]	3/5
Limchaichana et al [4]	3/5
Limchaichana et al [24]	2/5

DISCUSSION

TMJ pain is often the primary chief complaint of patients with TMD [32]. The cause of pain in TMJ and masticatory muscles is not fully clear and cannot be determined by clinical examination only but need treatment algorithms and radiology modalities to reach to final diagnosis. Internal derangement, osteoarthritis, joint effusion, and bone-marrow edema most finding in diagnosis TMD pain patient with MRI [33].

The mean ages of patients ranged from 30 to 45 years old except 2 studies Badel et al [26] and Abdelnabi and Swelem [27] ranged from 55 to 65 old. Arskan et al [34] state that average age of disk displacement was 35 years old.

Regarding the gender of patient, all included studies had more participant in females patient by 81%. According to List and Dworkin [35] 78% of patients were female and 83% according to Emshoff et al [13].

Internal derangement is the most result finding in MRI and reported in all studies. The prevalence of pain was higher in disc displacement without reduction (DDWOR) than in disc displacement with reduction (DDWR) and normal disc position. DDWOR was more strongly associated with TMJ pain appeared in 9 studies [13:16,18,19,21,25,30]. DDWR was more strongly associated with pain in 6 studies [4,22,23,24,27,31]. Normal disk position was more strongly associated with TMJ with pain in 5 studies [17,20,26,28,29] while Emshoff et al [12] normal disc position and DDWR is more than DDWOR.

Seventeen study reported number of pain in joints and its total results 28.2% normal disc position, 31.3% DDWR and 40.4% DDWOR [4,12:19,21,25,27:31]. According to Koh et al [36] and Emshoff et al [37] reported that there was a strong correlation between TMJ pain and MRI diagnosis disc displacement without reduction. And the other 4 studies [20,22:24,26] reported number of pain in patient and their results was 36% normal disc position, 37% DDWR and 27% DDWOR.

Osteoarthritis was considered to be the second most common finding in our result, this was reported in 8 articles from 21 of the included articles and characterized by degeneration of hard and soft tissues around the joint and the most common symptoms of it was pain [38]. Which in our study which 5 of articles [12,14,18,19,30] result reported with joints present of OA was 60% and absent of OA was 40% while other 3 studies [20,24,26] results found patients in pain was present of OA 55.6% and absent of OA 44.4% and it result was more common with DDWOR with OA. These results were going well with Bertram et al [39] who stated that there was a relation between OA and ID and OA was predominant in DDWOR.

On the other hand, TMJ effusions reported in 8 articles of the included 21 articles. Joint effusion with pain was found in 52% joints and absent 48% joints [4,15,18,19,21, 27,30,31]. This agreed with a previous finding in a study done by Takahashi et al [40] who revealed that joint effusion was demonstrated in 80% as painful joints and 38.5% as pain-free joints. Among others, Westesson and Brooks [41] stated that joint effusion was strongly associated with joint pain, however Güler et al [21] could not confirm any relation between MRI effusion findings and pain. The relationship between joint effusion and pain is not clear.

Condylar bone changes reported in 4 articles; in 59% joints the condyle was normal, in 12.5% joints it was flattened, in 5% joints erosion was observed, about 12.4% joints showed osteophyte, 0.5% joints exhibited pseudocyst and 10.7% joints showed combination [4,21,29,31]. This was consistent with the finding in a previous study designed by Koyama et al [42] who found normal condyle was reported in 40% of joints, flattening in 8%, erosion in 19%, deformity in 19%, and combination between deformity and erosion in 14% of the joints and they stated that there was no correlation between condylar bone changes and TMD.

Bone marrow edema (BME) is the term given to abnormal fluid seen at MRI, three of the included articles reported it. Bone edema was present in only 17.5% joints and about 82.5% joints of these studies were without any sign of edema [18,30,31]. The significant relationship finding between the presence of TMJ pain and the MRI diagnoses of BME reported that the degree of pain in TMJ with bone marrow abnormalities were significantly more than in TMJ with normal bone marrow signal on MR images [43]. BME alone can happen without pain and bone marrow alterations lead to OA.

The quality of a systematic review comes from the individual studies included, therefore, the quality assessment of each article is mandatory to confirm an overall consistent review. In the current review quality assessment was done using two tools with two independent reviewers; the first was MINORS tool for assessment of non-randomized, comparative and non-comparative studies [10] and the second tool was Jadad scale for assessment of RCT [11].

MINORS tool was used in 18 studies which described selection bias (randomization), detection bias (blinded or not) and attrition bias (lost to follow-up percentage). All 18 studies reported blinded assessment, lost follow up percentage and certain inclusion criteria. Jadad scale which described randomization, blinding and dropout, was used in 3 studies, two of them had 35/ as high quality while one study had 25/ as low quality.

CONCLUSION

Magnetic resonance imaging is valuable in diagnosis

temporomandibular disorders associated with pain and MRI can to be suggested to diagnosis TMD disorders. Joint pain is much more with internal derangement, osteoarthritis and joint effusion than with bone edema and condylar bony changes. Lacking correlation between pain grading and MRI finding in all reported studies. Observational studies are the most common studies to evaluate TMJ pain and underlying causes.

RECOMMENDATION

Based on the finding of the review, this study recommends the following: Observational studies with large sample size should be considered to increase the value of the study, studies should include correlation between pain grading and MRI finding in TMD patient and finally early MRI examination of painful patient allow clinicians to evaluate the irreversible phase of dysfunction and chose appropriate therapies.

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CONFLICT OF INTEREST:

The authors declare no conflict of interest

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