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Review Article

COMPARISON OF ULTRASONOGRAPHY AND MAGNETIC RESONANCE IMAGING IN INTERNAL DISK DERANGEMENT IN TEMPOROMANDIBULAR JOINT: A SYSTEMATIC REVIEW

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ABSTRACT

Objectives: The purpose of this review was to compare ultrasonography with Magnetic Resonance Imaging (MRI) in the diagnosis of Internal Disk Derangement of Temporomandibular Joint (TMJ).

Method: MEDLINE, The Cochrane Library, IndMed and Google Scholar were searched for studies for studies from 1st January 1991 to December 2016. Two reviewers independently screened the articles for eligibility criteria. Studies comparing MRI and Ultrasonography imaging for diagnosing temporomandibular joint disorder (internal disk derangement) were included. Only relevant studies that met the reviewer's objectives were considered.

Results: 7 articles out of 345 articles met the eligibility criteria which showed that the accuracy of ultrasonography ranged from 73.10% - 95%, sensitivity was found to be 65% to 90% and specificity was 72.70% to 100% as compared to MRI.

Conclusions: Both MRI and ultrasonography can be used to diagnose internal disk derangement in TMJ. Further studies should be conducted to make ultrasonography more reliable as a diagnostic tool.

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INTRODUCTION

The temporomandibular joint is a complex, sensitive and diarthroidal synovial joint between the condyle of the mandible and the glenoid fossa of the squamous temporal bone. Joint is divided into upper and lower component by articular disk which is fibrocartilaginous in nature.¹ When jaw is closed the disk is positioned between condylar head inferiorly and articular eminence anteriorly and superiorly. When jaw is open the disk slides between condylar head and articular eminence.² Temporomandibular disorders are a class of degenerative musculoskeletal conditions associated with morphologic and functional deformities. These temporomandibular disorders consist of multiple clinical signs which include TMJ pain, clicking sounds, restricted movement of TMJ and deviation of jaw. One of the most common form of temporomandibular disorder is internal disk derangement.

Internal disk derangement generally refers to an abnormal relationship between articular disk and mandibular condyle, fossa and articular eminence. Internal disk derangement of TMJ may present with a cluster of clinical signs, including temporomandibular joint (TMJ) pain, articular noises (such as clicking, crepitus, popping) and restricted or deviated jaw

function.³ Internal derangement occurs in 28% of adult population.⁴ Despite the prevalence of these disorders, it has been poorly understood and investigated.⁵ The indication for imaging include failure of conservative treatment, worsening of symptoms or atypical symptoms and preoperative assessment.¹ TMJ is one of the most difficult areas in the body to examine through imaging because of the bony structures of joint being small and superimposed by base of the skull. It results in lack of clear delineation of joint when plain film techniques are used for imaging.⁶ Different imaging techniques like plain film radiographs, panoramic radiographs, conventional and computed tomography (CT) and magnetic resonance imaging (MRI) have been used for diagnosing TMJ disorders.

Literature has shown the use of ultrasonography for diagnosis of internal disk derangement. Ultrasonic sound waves travel through the tissue against which they are aimed, and are partly reflected on transiting through dissimilar anatomical structures.⁷ The reflected sound waves are read by the transducer (ultrasound emitting device) and translated into images. This is the principle of ultrasonography.^{8,9} The TMJ region consists of diverse structures that reflect sound waves differently.

Thus considering the available literature, the main aim of this systematic review was to compare and evaluate the reliability

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of ultrasonography and MRI technique in diagnosing internal disk derangement of TMJ.

MATERIALS AND METHODS

Focused Question

Which imaging technique is better for diagnosing internal disk derangement in temporomandibular joint patients?

Search Strategy

Two electronic databases were used to search for appropriate studies that would satisfy the study purpose: PubMed-MEDLINE and the Cochrane Library from 1st January to 31st December 2016, using MeSH terms [Table 1]. Additional sources such as IndMed, Google Scholar and major journals were explored. Contact with authors was done for any unpublished studies.

Table 1 Keywords

Words	Keywords
TMJ	internal disk derangement, disk displacement, TMJ disorders
imaging	MRI, ultrasonography, sonography

Eligibility criteria

1. Studies providing essential data on diagnostic imaging aids for temporomandibular joint disorder (internal disk derangement).
2. Studies conducted in children and adults having symptoms of TMJ disorder.
3. Studies conducted to assess the pattern of articular disk displacement in patients with internal derangement of TMJ with USG and MRI were included.
4. Only papers in English were accepted.

Screening and selection

The papers were independently scanned by two reviewers (SC and DK), first by the title and abstract. If the search keywords were present in the title and/ or the abstract, the papers were selected for full-text reading. Papers without abstracts but with titles suggesting that they were related to the objectives of this review were also selected to screen the full text for eligibility.

Table 2 Search strategy

Sr. No.	Search strategy	Number of articles	Number of selected articles	After Duplicate Removal
1	TMJ AND MRI AND IDD	2	0	0
2	IDD AND MRI AND SONOGRAPHY	30	1	1
3	TMJ AND SONOGRAPHY	287	4	3
4	Internal Disk Derangement AND ultrasonography	27	4	2
	Other sources	2	1	1
	Total	347	10	7

After selection, full-text papers were read in detail by two reviewers (SC and DK). Those papers that fulfilled all of the selection criteria were processed for data extraction. Two

reviewers (SC and DK) hand searched the reference lists of all selected studies for additional relevant articles. Disagreements between the two reviewers were resolved by discussion. If a disagreement persisted, the judgment of a third reviewer was considered decisive.

Data extraction

From the collection of papers that met the inclusion criteria, data were extracted with respect to diagnostic imaging aids for temporomandibular joint disorder (internal disk derangement).

RESULTS

Search and Selection Results

Preliminary screening identified 347 unique records, out of which 10 articles were selected by title and abstract (Fig-1).

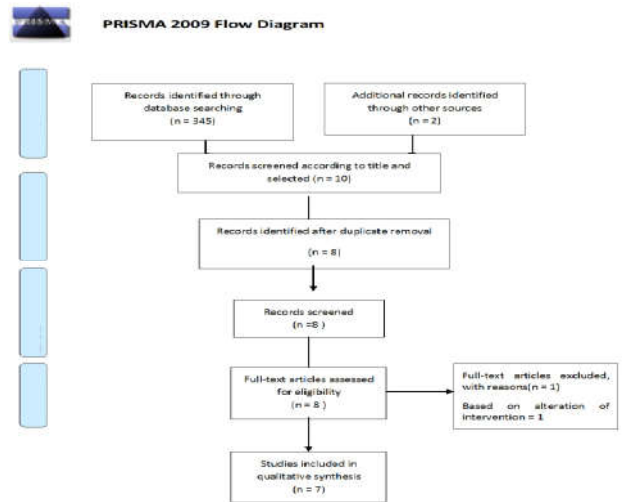


Figure 1 Flow chart summarizing the article selection process

After full-text reading, 3 records were excluded. This exclusion resulted in 7 full-text articles which were processed for data extraction. Additional hand searching of the reference lists of the selected studies yielded no additional records. An overview of the selected studies and their characteristics are presented in Table 3.

DISCUSSION

Summary of Evidence

The purpose of TMJ imaging is to assess the integrity and relationship of the hard and soft tissues, to confirm the extent or state of progression of a known disease and to evaluate the effect of treatment. The most frequent abnormalities that are imaged in TMJ patients are degenerative changes of bone and disk displacement.⁵ Recent development in diagnostic imaging of temporomandibular joint has led to better understanding of temporomandibular disorders.

Internal disk derangement concentrates on imaging of position of the disk with respect to joint. This disc can be visualized by advanced imaging technique. Disk is visible on the sagittal section of MRI.

Table 3 Overview of included studies

Study Id	Authors	Location	Year of publication	Study design	Sample size		Setting	Population	Exposure	Comparison	Sites examined		% of Accuracy		% of Specificity		% of Sensitivity		Conclusion	Remark
					No. of person	No. of tmj examined					No. of tmj examined	MRI	USG	MRI	USG	MRI	USG			
1	Hadeel habashi et al	Israel	2014	cohort study	39	78	medical college	Adult patient with internal disk	MRI and ultrasonography	MRI and ultrasonography imaging	78	100	77.7	100	84	100	74.30	Dynamic high resolution sonography is a potential imaging method for diagnosis of TMJ disk displacement and degenerative diseases.	MRI Is better than sonography	
2	F. Tognini et al	Pisa, Italy	2004	prospective study	41	82	medical college	consecutive patient with tmj disorder	MRI and ultrasonography	MRI and ultrasonography imaging	82	100	73.1	100	80.4	100	65.8	USG proved to be accurate in detecting normal disc position and the presence of abnormalities in disc-condyle relationship	USG is has low cost and less invasive than MRI	
3	Rudiger Emshoff et al	Austria	2001	cohort study	64	128	medical college	patients with symptoms of TMJ internal	MRI and sonography	ultrasonography and MRI imaging	128	100	95.00	100	98.00	100	93	When real-time images are interpreted by expert radiologists, dynamic sonography performed during maximal mandibular range of motion may provide valuable information about disk displacement of the TMJ.	SONOGRAPHY provides valuable information about disk displacement	
4	A. A. K. A. Razeq et al	Egypt	2014	prospective study	20	40	dental college	patients with ID in TMJ	MRI and sonography	ultrasonography and MRI imaging	40	100	77.50	100	72.70	100	79.3	ultrasound has shortcoming of insufficiency to detect disk displacement laterally or medially.	ultrasound is a non-invasive imaging modality used for assessment of anterior and sideway	
5	Takafumi hayashi et al	Niigata	2000	cohort study	18	36	dental college	children with subjective symptoms of TMJ	MRI and sonography	ultrasonography and MRI imaging	36	100	92.00	100	96	100	83.00	Sonography was less sensitive or specific than was MR imaging or helical CT in detecting internal derangement in the TMJ.	sensitivity,specificity and accuracy of sonography was slightly inferior to MRI	
6	Chalko AH et al	J&K, INDIA	2015	case control study	19	11	dental college	Patients with TMJ discomfort	MRI and sonography	ultrasonography and MRI imaging	11	100	90.91	100	100.00	100	90.91	MRI and USG can be used to define the disc and its displacement.	USG is another method to define the disc, its position, and the presence of TMJ	
7	Byahatti SM et al	Bangalore, India	2009	case control study	100	400	dental college	patients with pain, clicking, deviation and	MRI and sonography	ultrasonography and MRI imaging	200	100	78	100	76	100	80.00	high resolution ultrasonography can be used for examination of tmj disorder	MRI and USG can be used to define the disc and its displacement.	

Tasaki and Wesston reported sensitivity, specificity and accuracy of MRI for visualizing disk position within TMJ which was 90%,100% and 95% respectively.⁸

Chalko AH *et al*³ quoted that MRI provides a clear anatomic picture of the soft tissues of the TMJ area in the sagittal plane. However MRI is not always available, costly and time consuming this lead to finding of alternative method for visualising TMJ. Byahatti *et al*⁵ reported that USG is a non-invasive, static and dynamic imaging technique which helps in determining and confirming position of disk in symptomatic patients. It is used to study the distance between the articular capsule and the lateral surface of condyle.

Emshoff *et al*⁹ were first to compare the MRI and ultrasonography imaging for TMJ in 1997.⁹ It was stated that accuracy for high resolution ultrasound was found to be 95%. They reported that high resolution ultrasound improved diagnostic efficacy because of a more defined tissue differentiation and enhanced near-field clarity. There are many pitfalls for USG as it gives false negative diagnosis when transducer is not placed properly. Disk positioned laterally and medially were not appropriately diagnosed on USG.

Razeq AA *et al*⁵ studied ultrasound imaging in TMJ and concluded that ultrasound is preferred imaging modality used for assessment of anterior and sideway displacement of articular disc in symptomatic patients. They also stated ultrasound examination is accurate method for the detection of normal articular disc. Hayashi T *et al*⁸ stated that ultrasound is less sensitive or specific than MRI. They also stated that internal derangement of the TMJ should be suspected if a distance between the articular capsule and the lateral surface of the mandibular condyle on ultrasound is 4mm or more. Habashi H *et al*¹ reported ultrasound to be potential imaging method for

diagnosis of TMJ disk displacement but further studies are required to make dynamic sonography the first line test for diagnosis of TMJ disk displacement. Tognini *et al*³ compared both imaging techniques and stated that ultrasonography has good accuracy, sensitivity and specificity compared to MRI. Ultrasound accurately detected the presence of abnormalities in disk- condyle relationship but was not useful to detect disk displacement with or without reduction.

Differences were seen among the articles regarding the technique used for examining TMJ by ultrasound. Use of transducer having varied frequencies (from 5 MHz to 20 MHz) resulted in diverse results. Depending on position of placement transducer results varied. Some authors suggested vertical position(parallel to ramus of mandible) of transducer while some suggested horizontal position(parallel to zygomatic arch). Therefore we can conclude that ultrasound is technique sensitive and results vary with change in technique.¹⁰ Differences were also seen in appearance of disc on USG i.e some authors found disc to be hyperechoic, some found isoechoic and some found hypoechoic. This difference reduces the reliability of ultrasonography for diagnosing internal disc derangement through imaging.

Hence, MRI remains gold standard for examination of TMJ disorders. Ultrasonography can be used efficiently in the areas where MRI is not readily available. USG would be a preferable method for imaging in longitudinal studies due to less time consuming and less expensive method. Improvement in technique of USG can make results of USG more accurate, reliable, sensitive and specific which can change the scenario of preference in imaging technique in upcoming years for TMJ examination.

Limitations

Although the major databases were used for the literature search, papers might have been missed because they might not be listed in these sources. The present review encompasses articles published in English language, which may have excluded potentially valuable evidence. Sample size was found to be low in few articles and hence we could not conclude on which imaging method is better. Studies did not mention about technique of imaging used. Only few articles mentioned disk displacement with reduction and without reduction so comparison was not possible. Specific technique for imaging by ultrasonography and MRI was not mentioned in the study. Standardized parameter was not mentioned for checking accuracy, sensitivity and specificity in some articles.

Implications for Future Research

Further studies with longer duration should be carried out to examine ultrasound technique which will reduce the chances of variation. Studies should be done to improve on techniques of ultrasonography so that it can be used more frequently to examine TMJ disorders. More comparative study should be done on this topic. Further longitudinal studies should be done on ultrasonography in TMJ examination so that it can be used frequently to diagnose TMJ disorder.

CONCLUSION

Both MRI and ultrasonography can be used to diagnose internal disk derangement in TMJ. However, ultrasonography is recently advancing non invasive and less expensive technique to detect internal disk derangement of TMJ. MRI which is considered to be a gold standard is expensive, time consuming and not readily available in each institution therefore Ultrasonography can be used as an alternative method.

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