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PUBLISHED PAPER'S TITLE : MAGNETIC RESONANCE IMAGING OF THE TEMPOROMANDIBULAR JOINT: LITERATURE REVIEW.

Authors : Chandresh Jaiswara(First Author) Assistant Professor, Faculty Of Dental Sciences, Banaras Hindu University, Varanasi

Dr Mohammad Faisal(Corresponding Author); Associate Professor, Jamia Millia Islamia, New Delhi;

Corresponding Author:Dr. Mohammad Faisal; Associate Professor, Jamia Millia Islamia, New Delhi.
Email : faisalomfs@yahoo.co.in.

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Research Paper

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MAGNETIC RESONANCE IMAGING OF THE TEMPOROMANDIBULAR JOINT: LITERATURE REVIEW.

Chandresh Jaiswara1 , Dr Mohammad Faisal2

Declaration

The Declaration of the author for publication of Research Paper in Asian Journal of Modern and Ayurvedic Medical Science (ISSN 2279-0772) We Chandresh Jaiswara1 , Dr Mohammad Faisal2 the authors of the research paper entitled MAGNETIC RESONANCE IMAGING OF THE TEMPOROMANDIBULAR JOINT: LITERATURE REVIEW. declare that ,we take the responsibility of the content and material of my paper as we ourself have written it and also have read the manuscript of our paper carefully. Also, we hereby give our consent to publish our paper in ajmams , This research paper is our original work and no part of it or it's similar version is published or has been sent for publication anywhere else.we authorise the Editorial Board of the Journal to modify and edit the manuscript. we also give our consent to the publisher of ajmams to own the copyright of our research paper.

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Abstract :

Internal derangement is a general orthopedic term implying a mechanical fault that interferes with the smooth action of a joint. For the temporomandibular joint (TMJ) the most common internal derangement is displacement of the disk. Magnetic resonance imaging has been used to image the temporomandibular joint since 1984 and imaging quality has continuously improved since then. The soft tissue differentiation of MRI is superior to all other imaging modalities along with the advantage of absence of patient radiation. Several imaging techniques have been used to diagnose internal derangement of TMJ with much confusion as to which is most useful. The indications for an imaging study of the TMJ are the same for MRI, CT and arthrography, only those for plain film radiography differ. The aim of this study is to review the diagnostic value of MRI with conventional imaging method and saggital section CT Scan of TMJ.

Introduction:

Magnetic Resonance Imaging: MRI is a non ionizing radiation from the radiofrequency (RF) band of the electromagnetic spectrum. To produce an MR image, the patient is placed inside a large magnet, which induces a relatively strong external magnetic field. This causes the nuclei of many atoms in the body, including hydrogen, to align them with the magnetic field. After application of a radiofrequency signal, energy is released from the body, detected and used to construct the MR image by computer. The high contrast sensitivity of MRI to tissue differences and the absence of radiation are the reasons MRI for most part has replaced CT for imaging soft tissue.

Magnetic resonance imaging of Temporomandibular joint:

Because high-resolution anatomical detail is a critical feature for temporomandibular joint imaging, surface-coil imaging is essential for adequate investigation. Magnetic resonance images using surface-coil technology provide a non-invasive mechanism for clearly depicting the meniscus and its attachment *in vivo*. Preliminary results suggest excellent correlation between arthrographic findings in a patient with meniscal displacement with reduction and MR images. Asymptomatic subjects showed the anticipated meniscal configuration and position relative to the condylar head with the jaw closed. With jaw opening, the thin zone of the meniscus was noted to be in the anticipated location relative to the convex surface of the condylar head inferiorly and the convex surface of the articular eminence superiorly. A clear demarcation was noted between the fibrocartilagenous disc tissue anteriorly and the fibrofatty vascular bilaminar zone posteriorly. Less clear demarcation was noted between disk tissue and bilaminar zone in the abnormal condition, raising the possibility of histologic and/or biochemical changes in this region (Katzberg *et al.*, 1989)[1].

Review of literature:

Rudisch *et al*[2]., in their study assessed the validity of Clinical Diagnostic Criteria for Temporomandibular Disorders, compared the clinical diagnosis with the magnetic resonance imaging diagnosis of temporomandibular joint internal derangement and osteoarthrosis in a patient pain group in a blinded fashion. They observed that the classification system of the Clinical Diagnostic Criteria for Temporomandibular Disorders provides insufficient reliability for determination of the temporomandibular joint internal derangement and osteoarthrosis.

Emshoff *et al.*[3] compared the CDC/TMD with MRI findings for patients with disc displacement without reduction and suggested that using CDC/TMD for internal derangement type III is predictive for the presence of an internal derangement but is not sufficiently reliable for determining disc displacement without reduction. Thus a clinical TMJ related diagnosis of internal derangement type III may need to be supplemented by evidence from an MRI to determine functional disc condyle relationship.

Stegenga et al[4]. (1996), in their study of 46 'former' patients with 55 TMJs with a history of osteoarthrosis and internal derangement and 37 contralateral TMJs that were asymptomatic 30 years ago found that 30 years after initial diagnosis there were few clinical signs of osteoarthrosis and internal derangement although MRI findings were extensive.

In the past, arthrography and arthrotomography, contrast-enhanced plain or tomographic radiography have been considered the methods of choice for imaging temporomandibular joint internal derangement **(Wilkes, 1978)[6]**. The location, shape, and movement of the disc can be interpreted by observing the shape of the contrast material on either side of the disc and its flow within its own compartment as the patient opens and closes the mouth **(Kaplan *et al.*, 1987)[7]**. Sideways and rotational displacements of the disc cannot reliably be determined from arthrotomography **(Westesson, 1990)[7, 8]**.

Kaplan *et al.* (1987)[7], in their study of 28 patients, compared the findings of MR images with the findings of respective arthrograms. They found that, the anatomic configuration of the meniscus as seen with MR correlated directly with normal variations of the anterior recess seen with arthrography.

Rohlin, Westesson ,Erikkson (1985)[7] studied co relation of TMJ

sounds with joint morphology in autopsy specimens and concluded clicking of TMJ is caused by the condyle hitting the disc .They regarded that crepitation was comcomitant with arthrosis and is considered to represent abnormal joint morphology and occurs as a result of movement across irregular surfaces. They also found that silent joints also exhibit displacement. They concluded that joints producing sound consistently showed disk displacement which occurred concomitantly with arthrosis in more than half patients. Reciprocal clicking indicated anterior disk displacement and crepitations indicated arthrosis.

Harms, Randall, Wolford, Milam (1985)[9] evaluated that MR definition of soft tissue structures including the meniscus is superior to that of conventional imaging methods . Anatomy of joint is well delineated on T1 weighted images. Marrow fat within the condyle , zygomatic process ,articular eminence has high signal due to short T1 of fat .Bony abnormalities such osteophytes are seen.T2 weighted images demonstrate fluid or inflammatory changes in the joint soft tissues of bilaminar zone and lateral pterygoid attachments have moderate signals. High signal intensity near disc indicates joint inflammation. Disc perforations are demonstrated typically by a separation in disc fragments and require no contrast media. Fibrous adhesions and ankylosis are well demonstrated as thickened hypo intense fibrous connective tissue. Sclerosis of mandibular condyle is seen as replacement of usual high signal fatty marrow by hypo intense sclerotic bone.

Katzberg, Bessete, Talents (1986)[10] demonstrated that MR imaging with a surface coil provided an accurate depection of both normal and abnormal TMJ's. MR provided information about meniscal position morphology and histology that was not available with either ct or arthrography alone. Displacements of the meniscus can be visualized on MR images with an accuracy which is even greater than arthrograms and demarcation between posterior band of the meniscus and the bilaminar zone is distinct.

Westesson, Katzberg, Tallents (1987)[8] compared CT and MR in patients comparing then with autopsy specimen. Their study indicates that MR is superior to CT for depiction of soft tissue changes, whereas CT is superior in showing osseous abnormalities.

Schellas, Wilkes (1988)[11,12] used partial flip angle or GRASS (gradient recalled acqusition in steady state) and either T1 weighted or spur echo long tr/ short length imaging technique for assessent of intra articular fluid and observed it in 88% of the painful joints scanned. GRASS images are highly sensitive to joint effusion detection. They concluded that synovitis and joint effusion frequently accompany internal derangement and that meniscus derangement and joint inflammation may progress to osteochondritis dessicans and a vascular necrosis and ultimately to degenerative osteoarthritis and joint disability.

Wilkes (1989)[6] developed a staging criteria for internal derangement of TMJ with respect to clinical, radiologic, and surgical findings.

Hasso, Christiansen, Alder (1989)[13] graded internal derangements according to the chronicity of abnormalities into acute, sub acute and chronic derangement and concluded that multiplanar imaging allows a three dimensional analysis of the TMJ, providing a more complete assessment of condyle articular disc fossa relationships.

Shellock *et al.* (1989)[14] advocated simultaneous bilateral temporomandibular joint imaging because

they found bilateral TMJ disorders more frequent. Each TMJ is significantly affected by the contralateral joint. Simultaneous imaging of both joints allows the assessment of side-to-side differences in range of motions and joint structure at the identical points of mouth opening for each side.

Westerson, Brooks[15] (1992) correlated MR evidence of joint effusion in the TMJ in patients with joint pain and presence of disc displacement and arthrosis. TMJ effusions primarily occur in the joints with the disk displacement and are stongly associated with joint pain. The probable causes of joint pain:

- Compression of the highly vascularised and innervated posterior disk attachment
- Stretching and pulling in the capsule and disk attachment
- Inflammatory changes in the joint capsule and disk attachmemt
- Distension of the joint space due to large joint effusion

Matsuda, Yoshimura, Lin (1994)[16] suggested that saggital and coronal MRI of TMJ articulation are complementary. In coronal MRI sideways displacement that is, lateral or medial displacement and saggital MRI shows rotational disk displacement that is a combination of anterior and medial or lateral displacement is seen. They observed rotational disc displacements in eight joints, and the disc tended to be displaced in a lateral direction in 6 joints. Their findings indicated that rotational anterolateral displacements of the disc are more common than rotational anteromedial and medial sideways displacements.

Dorsay, Rush , Youngberg (1994)[17] reported cases of bilateral adherent disks treated successfully with lysis, lavage, manipulation and evaluated post therapeutic joint using Cine MRI technique (Dynamic MRI).

Sano, Westesson, Showa (1995)[18] showed that the average T2 signal from the retrodiskal tissue is higher in painful joints than in non painful joints. This indicates a higher degree of vascularity in the retrodiskal in painful joints. This is in accordance with earlier studies.

Sullivan, Banghart , Anderson (1995)[19] documented the use of MRI in acute soft tissue injuries involving the TMJ after condylar fractures and demonstrated post traumatic presence of joint effusion, presumably haemarthrosis in both upper and lower joint spaces, disruption of disk, disk avulsion ,lateral capsular tears and perforations.

Katzberg, Westesson, Talents and Drake (1996)[20] reported 33% prevalence of disk displacement in asymptomatic volunteers and 77% prevalence of disk displasement in sympyomatic subjects. Also, bruxism was statistically linked to TMJ disk displacement and could explain the anatomic variation in abnormal disk position.

Sato, Kawamura, Motagi [21] studied the morphology of mandibular fossa and the articular eminence in temporomandibular joints with anterior disk displacement. Their analysis revealed no difference between joints with anterior disk displacement and those without dysfunction of joint with respect to mean depth and length of fossa or mean depth: length ratio of the fossa. However the posterior slope of articular eminence was significantly larger among joints with anterior disk displacement than among those without dysfunction. However there was no statistically significant difference between those with reduction and these without reduction.

Leiberman, Gardener, Schwartz (1996)[22] studied the presence of bone marrow signal abnormalities in patients reference for temporomandibular joint MKI and concluded that condylar marrow

abnormalities was not rare in patients referred by TMJ MRI. However the clinical significance that bone marrow edema of condyle is an indicator of a vascular necrosis is insertion.

Murakami, Nishida, Tsuda, Besso (1996)[23] investigated the relationships between TMJ pain and high signal intensity on T2 weighted MRI in 19 patients and observed no significant statistical co relation between pain levels and presence of high signal intensity on MRI

Tasaki, Westerson, Isberg and Tallents (1996)[24] developed a classification system for disk displacement in the TMJ and studied the prevalence of various types in patients and symptom free volunteers. They observed 30% disk displacemrnt in symptom free volunteers. 82% disk displacement was observed in symptomatic patients. Higher prevalence of disk displacement in females in the patient group was observed indicating that chronic inflammation and pain associated with disk displacement develops more frequently in females than in males.

Takaker, Sano, Toyoda (1998)[25] compared the MRI findings and pathologic finding in patients with disk displacement were MRI (FISP-3D) three dimensional fast imaging with steady precession sequence (FISP) acquisition technique and concluded that pathologic changes in the disk and retrodiscal times are accurately depicted by FISF 3D.

Emshoff, Rudisch, Bosch (2001)[26] studied then relationship between patients with clinical unilateral internal derangements type III (CDC criteria) in combination with TMJ pain and the MR findings of TMJ internal derangements and TMJ osteoarthritis. They concluded the TMJ pain and dysfunction was associated with a high rate of TMJ internal derangements. They study revealed a significant relationship between TMJ ID-III pain and MR imaging diagnosis of TMJ ID. Predominance of TMJ osteoarthritis in patient with TMJ disk displacement without reduction and in patients without internal derangements.

Larhiem, Westesson, Tsano (2001)[27] investigated the presence of effusion on MRI and associated it with specific categories of disk displacement, bone marrow abnormalities are pairs. They concluded that patients with TMJ effusion represented a subgroup with pain and dysfunction with were seen severe intra articular pathology than those with disk displacement but no other abnormalities.

Emshoff, Schmid, Berthan (2003)[28] studied bone marrow edema, of mandibular condyle related to internal derangements, osteoarthritis and joint effusion. They suggest that a significant increase in bone marrow edema occurred with disk displacement without reduction and osteoarthritis and disk displacement reduction and effusion.

Sato, Nishemura, Demura (2003)[29] elucidated a relation between expression of vascular endothelial growth factor in synovial tissues and the extent of joint effusion seem on MR images in patients with internal derangements of TMJ. They concluded that VEGF in the synovial tissues could be related to the extent of joint effusion seen on MRI in internal derangements of TMJ.

Discussion:

The purpose of imaging assessment of the temporomandibular joint is to graphically depict clinically suspected disorders of the joint and to allow better understanding of the anatomy and pathophysiology of internal derangements related to disk displacements. The need for imaging of the temporomandibular joint should be established on the basis of those symptoms and clinical signs that suggest that a radiographic examination would contribute to the proper diagnosis and treatment plan of the patient.

Most studies have found a female preponderance of as high as 80%. There was a significant prevalence of young females. **Tazaki *et al.* (1995)**[24] in a study of 243 patients with clinical signs and symptoms of internal derangement found a significant higher prevalence among females. Internal derangements of the temporomandibular joint have been noted in 40% to 50% of the general population. However, only a fraction of these individuals require interventional treatment.

Panoramic view X-ray was of no value in interpreting soft tissue as plain radiographs are unable to depict soft tissue images. In hard tissue interpretation by panoramic X-ray, in one patient flattening of condylar head and anteriorly osteophyte were found in the same patient. CT scan and MRI interpreted the same findings in the patient. Flattening of condylar surface was reported in the other patient on a panoramic view. The same was reported on the saggital section of the CT scan of these patients. The same finding was observed in only two patients on a MRI scan.

Brooks *et al.* (1997)[15] in their study, found MRI to be superior to CT scan or panoramic x-ray view, in diagnosing degenerative joint diseases. Moreover, MRI shows early subchondral erosion or disc degeneration, more clearly than by other techniques, which are indicative of early osteoarthritis or degenerative joint diseases. Most studies showed osteophytic changes in as many as 40% patients on their saggital CT section. CT scan was found to be more sensitive than either panoramic X-ray or MRI to osseous changes. In soft tissue interpretation MRI was found to be more specific and sensitive than CT. On the other hand **Westenson *et al***[7,8]found MRI more specific and equally sensitive than CT scan in their study of 15 temporomandibular joint *i.e.* MRI shows the configuration of the disc more clearly, thereby causing less false positive results.

Conclusion:

1. MRI as an imaging modality has been found to be much more sensitive and specific in comparison to panoramic X-ray and CT scan in demonstrating soft tissue structures of the joint.
2. Disc position, disc deformities, integrity of soft tissue attachment of the disc, joint effusions are seen on an MRI unlike a CT scan.
3. Proper clinical correlation of patient's sign and symptoms to diagnostic imaging is warranted as the detailed information available due to present day ultra-modern imaging can easily lead to over-correction and over treatment of the patient.

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