

## Imaging Modalities in TMJ Diagnosis- A Review

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### Abstract

Imaging modalities for temporomandibular joint (TMJ) is evolving continuously with the rapid emergence in various imaging techniques. Various imaging modalities depending upon the purpose and pathologic conditions are currently used to evaluate the TMJ. The correct diagnosis of TMJ dysfunction only by clinical examination cannot be made. Various imaging modalities which are routinely used are: routine radiographic examination, magnetic resonance imaging (MRI) and computer tomography (CT). Ultrasonography, arthroscopy and radionuclide examination are the secondary methods used for TMJ imaging. Arthroscopy is grouped as a mode of therapy. In the present paper, attempt is made to focus on the various imaging modalities for TMJ diagnosis and highlight their importance. In order to understand many TMJ pathologies in a better way, relevant normal anatomy of the TMJ has also been discussed.

**Keywords:** Computed tomography, Imaging, Magnetic resonance imaging, Temporomandibular joint.

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### INTRODUCTION

In the general population, temporomandibular joint (TMJ) related pain is very common. Only approximately three to seven percent of patients with TMJ pain seek medical attention [1, 2].

Various imaging modalities are available for TMJ imaging, each with its own advantages and disadvantages. Temporomandibular disorders (TMD) comprise of many clinical problems that involve the muscles of mastication and/or the temporomandibular joint. This term is most frequently used in clinical practice. The purpose to assess the TMJ by imaging the temporomandibular joint (TMJ) is to depict the clinically suspected disorders of the joint graphically. Multiple diagnostic imaging techniques have been helpful to substantiate the temporomandibular joint (TMJ) disorders [1-3]. The requirement for TMJ imaging should be established on the basis of selection criteria. The criteria for selection represent those clinical symptoms and signs that suggest that a radiographic examination would contribute to the proper diagnosis and patient care [4]. It also provides a specific rationale to select among the various imaging

techniques, aiming at obtaining the important diagnostic information with a lesser radiation exposure. The decision on selecting an imaging modality should be considered after taking the history, clinical findings, diagnosis, and cost of the modality and radiation exposure. This review article describes the diagnostic imaging techniques involving TMJ and their appropriate use. Temporomandibular joint is a ginglymoarthrodial synovial joint, the word 'ginglymoarthrodial' is derived from latin word 'ginglymus' meaning hinge joint. TMJ allows translational movements in both forward and backward directions as well as a gliding motion [3]. The articular surfaces of the TMJ are formed superiorly by the glenoid fossa (also known as mandibular fossa) and articular eminence of the temporal bone and inferiorly by the mandibular condyle [4, 5].

### Imaging Techniques

A variety of imaging modalities can be used for imaging the TMJ. This includes non-invasive imaging modalities such as conventional radiographs; Computed tomography (CT), ultrasound and MRI while

invasive imaging techniques such as arthrography. Each imaging modality has its uses [6].

### Plain Radiography

The imaging modality is the most well-established film technique for examination of the TMJ and most common is the transcranial projection of both the right and left sides with opened and closed jaw. In this radiograph, the lateral aspect of the joint is well visualized, but since the X-ray beam is not tangential to the articular surfaces; the central and medial parts of the joint are not clearly seen. These views are done to acquire only a screening evaluation but they are not very useful in depicting the soft-tissue elements of the articulation. Transcranial radiographs taken for those of degenerative joint disease of TMJ depict positive finding in the range of 5-10% [1-5].

### Panoramic Radiography

Previously, orthopantomograph (OPG) was considered a gold standard for imaging TMJ because we can see teeth and supporting structures of the jaws on the image. However, there is restriction in evaluation of the condyle and glenoid fossa in the panoramic image because of the superimposition of the base of the skull and zygomatic arch.

### Tomography

The osseous components of TMJ have been evaluated extensively by the Conventional tomography which is generally combined by lateral orientation but sometimes also in combination with frontal views. Computed tomography has been of great help in revealing a large number of structural variations as compared to oblique transcranial projection. In evaluation of certain autopsied TMJ specimens, it has been found that computed tomography provide more specificity in evaluating the anatomic structures as compared to that of transcranial radiography. However, other investigators in contrast to the above have concluded that the presence or the extent of radiographic signs of osseous pathoses are of little prognostic value in the outcome of treatment and that tomography has little effect on the diagnosis or treatment plan of patients with TMJ disorders [2-5].

### Arthrography

There has been a considerable enthusiasm developed for TMJ arthrography in following years, and the usefulness of this technique was described by a large number of publications. Arthrography is indicated depicting the soft-tissue components of the TMJ, especially the evaluation of disk morphology, position and function in those patients presenting with a suspected internal derangement [5]. Two important imaging modalities for TMJ arthrography are there: single-contrast arthrography and double-contrast arthrography. Arthrography can be an accurate imaging method especially for the evaluation of anterior disc displacement as shown by several studies. Perforation

and also adhesion of the disc can also be evaluated by such techniques.

### Computed Tomography (ct)

In 1980s, Computed tomography (CT) began to be applied for the diagnosis of TMJ ankylosis, osseous changes, disc displacement and condylar fracture [4]. Many literatures have mentioned in various reports that the accuracy of the image observations of CT for the cases of TMJ disc displacement was high i.e., 81% in accordance with the surgical findings. However, the accuracy of the disc displacement was only 40%-67% in CT as seen in studies of autopsied specimens [5]. The accuracy of the osseous changes of TMJ in CT was 66%-87% as compared to cadaver material [6]. Some studies reported that the radiographical evidences of arthrosis might or might not be associated with the clinical symptoms of pain and dysfunction. Therefore, patients even without the osseous changes in TMJ can have pain, and the patients having clear signs of some bone abnormalities may not experience any pain [6, 7].

### Cone Beam Computed Tomography (Cbct)

Diagnostic radiology plays a crucial role in treating the patients with TMD effectively and efficiently. The 1992 version of the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) concludes that the imaging helps in substantiating the clinical impressions [8]. While treating patients with TMJ dysfunctions, these measurements are extremely advantageous in clinical practice [9]. However there is a poor correlation between condylar changes observed on CBCT images and clinical signs and symptoms seen in patients with TMJ osteoarthritis (TMJOA) [10]. TMJ is mostly involved in the patients with multiple maxillofacial fractures. However, in most cases neither conventional dental radiography nor the medical CT alone can suffice all the encountered diagnostic challenges [11, 12]. CBCT provides the adequate information which enables us to meet the patient needs regarding the nature, extent and its relative location of important anatomic structures [13]. There is also a disadvantage or shortcoming with CBCT in the aspect that there is a limited capability to visualize the internal soft tissue and low contrast resolution and [14]. Though CBCT has been largely adopted as a dental office-based imaging technique currently, but still the role of CBCT in TMJ disc disorders is questionable.

### MRI

Magnetic resonance imaging (MRI) has replaced Computed tomography (CT) and arthrography which was considered as the primary diagnostic imaging tools used in the evaluation of the temporomandibular joint (TMJ) disorders.<sup>15</sup> MRI evaluation of TMJ disk provides a distinct advantage over arthrography. Abnormalities related to intra-articular areas are readily visible on MRI images [15,

16]. MRI is unique in the sense that there is no associated risk of ionizing x-ray. It is preferably appropriate for the assessment of the variations of the disk. The most frequently ones that are used in TMJ images are T1-weighted image, T2-weighted image and Proton-density (PD) image [17, 18].

### Ultrasonography

Ultrasonography of TMJ is a readily available, non-invasive and relatively cheap dynamic “real time” investigation, and mostly featuring the soft joint tissues. This investigation serves both for the diagnosis as well as the differential diagnosis. Also, helps in the comparison of the therapeutic results for the treatment of internal joint defects. In 2000, TMJ sonography was first reported [19, 20]. It uses the presently available equipment types of USG with 7.5-12 MHz frequency of scanning transducer. It also reveals the ligament adhesion. During the examination it is possible to directly observe the joint disk move when the mouth is opening and closing [21].

### Radionuclide Imaging

Radionuclide imaging provides the only mean for assessing the physiological changes those are directly the result of biochemical alterations. It is based on the radiotracer method, which postulates that the radioactive atoms or molecules in an organism behave in an identical manner as that of their stable counterparts as they are chemically indistinguishable. Scintigraphy also helps in diagnosing and discovering the early changes in the TMJ. Temporomandibular joint is ideal for Single Proton Emission Computed Tomography (SPECT), because TMJ is a small joint which is situated close to the base of the skull, and therefore is ideal for the evaluation by Single Proton Emission Computed Tomography. Many literature and studies state that the radionuclide examination is significantly relevant only as a screening method [22, 23].

### CONCLUSION

The radiologists very frequently face great challenges to determine the diagnostic pathways and to plan an effective treatment based on the proper therapeutic strategy. The imaging of TMJ should be performed on the basis of individual case, and should depend upon clinical signs and symptoms. For the evaluation of internal derangement of the joint and disk position, MRI is the diagnostic study of choice. If there is suspicion of bony involvement, CT scan should be done for the evaluation of TMJ and there should be judicial consideration because of radiation risk. In order to accurately recognize and manage various TMJ pathologies, it is very crucial to understand the biomechanics, TMJ anatomy and the imaging manifestations of disease [24, 25].

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