

TMD DIAGNOSIS USING VARIOUS RADIOGRAPHIC TECHNIQUES

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ABSTRACT

Temporomandibular disorders are a complex set of conditions which is manifested by pain in the temporomandibular joint and its surrounding muscles. Restriction in jaw movements is also another characteristic finding of this disorder. Temporomandibular joint is complex in nature and hence the treatment of the disorders associated with the joint solely depends on the accurate diagnosis of the problem. This review article briefly discusses about the various clinical and radiographic techniques involved in the diagnosis of TMD and the validity and assessment of diagnostic tests used for TMD.

KEYWORDS: Temporomandibular disorders, Diagnosis, TMD, Temporomandubular Joint, Radiographic techniques.

INTRODUCTION

TMD refers to Temporomandibular disorders which are a complex set of conditions that cause pain in the jaw joint, surrounding muscles and also restriction in jaw movements. This term TMD was proposed by Bell. This term does not merely suggest problems that are isolated with the joints but includes all disturbances associated with the function of the masticatory system.

History

Dr. James Costen an Otolaryngologist was the first to suggest that changes in the dental conditions were responsible for various ear symptoms. He observed this in 1930's.^[1]

Etiology of TMD

- 1) Dynamic functional relationships between occlusion and temporomandibular disorders.
- 2) Effects of occlusal factors on orthopedic stability.
- 3) Effects of acute changes in the occlusal condition and temporomandibular disorders.
- 4) Activities of the masticatory system.
- 5) Occlusal contacts and muscle hyperactivity.
- 6) Trauma.
- 7) Emotional stress.
- 8) Deep pain input.
- 9) Parafunctional activities.

Signs and Symptoms

The signs and symptoms of TMD develop based on the following formula:

$$\text{Normal function} + \text{Event} > \text{Physiologic tolerance} \\ = \text{TMD symptoms}^{[2]}$$

The signs and symptoms are as follows:

- 1) Pain
- 2) Dysfunction
- 3) Protective co-contraction (muscle splinting)
- 4) Local muscle soreness (non inflammatory myalgia)
- 5) Myospasm (tonic contraction myalgia)
- 6) Regional myalgic disorders like myofascial pain (trigger point myalgia)
- 7) Chronic systemic myalgic disorders (fibromyalgia)
- 8) Functional disorders of TMJ and its symptoms inclusive of pain and clicking sounds.
- 9) Functional disorders of the dentition
- 10) Tooth mobility
- 11) Pulpitis
- 12) Tooth wear
- 13) Headache, Tention type headache, migraines^[3]
- 14) Otologic symptoms.^[4]

Diagnosis

“The most important thing that you can do for your patient is to make the correct diagnosis. It is the foundation for success.”

The following steps involved in the diagnostic process include:

- 1) Recording a complete case history with appropriate chief complaint
- 2) Followed by clinical examination. This includes examination of all the cranial nerves, palpation of the muscles of mastication and cervical muscles, temporomandibular joint examination, intra-oral examination and radiographic examination.

Some of the other methods include:-

- 1) Articulated casts
- 2) Electromyography
- 3) Ultra sound
- 4) Diagnostic nerve block
- 5) Jaw tracking device
- 6) Vibration analysis device
- 7) Thermography^[5]

Imaging of TMJ

Provides two information:

- 1) Morphological characteristics of the bony components of the joint.
- 2) Certain functional relationships between the condyle and the fossa.

Radiographic Techniques

- 1) Transcranial view
- 2) Transpharyngeal view
- 3) Panoramic view
- 4) Lateral tomography
- 5) Anteroposteriortransmaxillary projections
- 6) Ultra sound
- 7) Bone scanning
- 8) Arthrography
- 9) Cone beam tomographic scan (CBCT)^[6]
- 10) Computed tomography (CT)
- 11) Magnetic resonance imaging (MRI)

Transcranial View

Technique

The X-ray film cassette is positioned against the facial skin surface against the side of interest parallel to the sagittal plane. The X-ray tube is positioned at an angle of 25° downward to the TMJ.

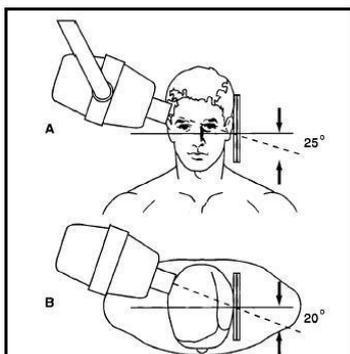


Figure 1: (image courtesy: diagnostic imaging of the temporomandibular joint, c. Grace petrikowski). A.

The x-ray tube is positioned 25° to the line perpendicular to the film cassette. B. The central ray is anteriorly 20° centered over the tmj of interest.

Indications

- 1) MPDS
- 2) Internal derangement
- 3) Range of movement in joints

The following landmarks that can be viewed are the Lateral aspects of - Glenoid fossa, Articular eminence, Joint space, Condylar head.

Disadvantage

Superimposition of the ipsilateral petrous ridge.

Transpharyngeal view

Technique

The X-ray cassette is positioned parallel to the sagittal plane on the side of interest against the patient's head. The X-ray tube is positioned at an angle of 5 to 10 degrees cranially and 10 degrees posteriorly.

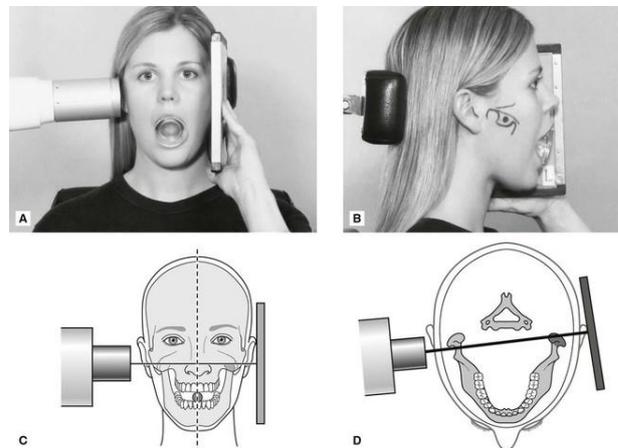


Figure 2: (Image Courtesy: Pocketdentistry.org).

A. Positioning for left transpharyngeal- Patient holding the X-ray cassette against the left TMJ, the mouth is open and the X-ray beam is aimed across the pharynx. B. The side of the face with various anatomical structures- the zygomatic arch, condyle, sigmoid notch and coronoid process- drawn on to clarify the centering point of the X-ray beam which is marked. C. Diagram of the positioning from the front showing the film parallel to the mid-sagittal plane and the X-ray beam aimed across the pharynx. D. Diagram of the positioning from above, showing the X-ray beam aimed slightly posteriorly across the pharynx.

Indications

- 1) MPDS
- 2) Osteoarthritis / Rheumatoid arthritis
- 3) Pathologies of the condyle head, joint space such as cyst / tumor
- 4) Fractured condyle head and neck
- 5) Lateral view of the condylar head and neck, articular surface.

Panoramic View

Technique

The X-ray beam moves and rotates following a fixed orbit with continuous exposure of a rotating film.



Figure 3: (Image Courtesy: Rodrigo Costa Monero, Anatomic and radiograph study of the persistence of Foramen of Huschke).

An orthopantomogram with a skull placed in position.

Indications

- 1) MPDS
- 2) Diseases within joint
- 3) Pathologies associated with the condylar head
- 4) Fractures of the condylar head and neck
- 5) Condylar hyperplasia and hypoplasia (hemifacialmicrosomia)

The following pathologies can be viewed:

- 1) Gross osseous changes
- 2) Extensive erosions or growth
- 3) Eagle's Syndrome^[7]
- 4) Fractures

Disadvantage

Relationship between condyle and fossa is not possible because X-ray beams pass obliquely through the TMJ.

Lateral Projection

Lateral image shows condyle in the centre position. Medial shift shows retruded condyle. Open view shows the translation of the condyle.

Transorbital/ Zimmers View

Technique

Ask the patient to bend their head 10° downwards such that the canthomeatal line is horizontal. The X-ray

cassette is placed behind the head of the patient. The X-ray tube is placed in front of the patient's head and the central ray is directed to the joint of interest at an angle of 20 degrees to the cassette at right angles.

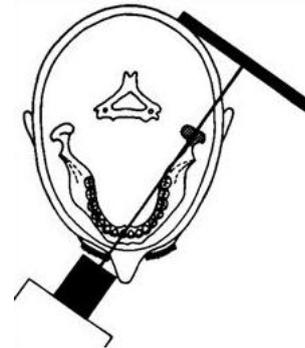


Figure 4: (Image Courtesy: Diagnostic Imaging of the Temporomandibular joint, C. Grace Petrikowski).

The X-ray tube is directed perpendicular to the cassette through the orbital surface. The cassette is placed behind the head of the patient.

Indications

- 1) Trauma or fracture cases.
- 2) Anterior view of TMJ.
- 3) Medial displacement of fractured condyle.
- 4) Fractured neck of condyle.

Anteroposterior transmaxillary projection

Indications

Fractures involving the condyle.

Ultrasonography

It is an alternative method in imaging of TMJ.

Advantages

- 1) Non-invasive and inexpensive (compared to MRI).
- 2) Disc displacement and joint effusion.

Disadvantages

- 1) Scarce accessibility of medial parts of TMJ.
- 2) Need for trained operators.

Figure 1. Sonograms of a normal TMJ. **A.** Closed mouth. The mandible condylar head (large arrow) and the temporal glenoid fossa (upper short arrow) are shown as hyperechoic curved lines. The disk (opposed short arrows) is shown between both over the mandible condyle. **B.** Open mouth. At maximal opening, the disk (arrows), shown as a hyperechoic line surrounded by a hypoechoic area, is seen over the mandible condylar head. **C.** Normal disk position (arrows) in a split image: closed mouth (left) and open mouth (right).

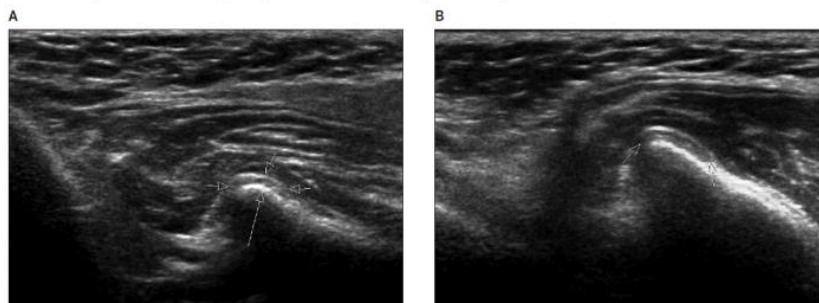


Figure 5: (Image Courtesy: The American Institute of Ultrasound in Medicine).

Bone Scan

Sensitive technique used to identify bone and joint pathologies through an IV injection of radio nuclear technetium methylene diphosphonate.

Indications

To rule out tumors, condylar hypoplasia and internal derangement.

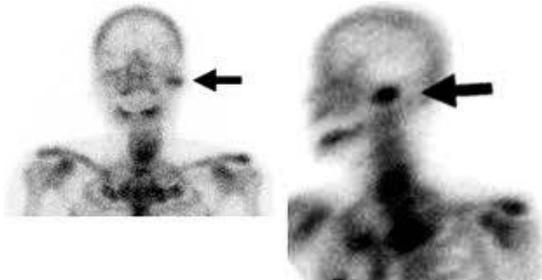


Figure 6: (Image Courtesy: Dr. Jong-Ki Huh, Synovial chondromatosis of the temporomandibular joint with condylar extension).

Bone scan showing synovial chondromatosis of the temporomandibular joint (indicated with black arrow).

Arthrography^[8]**Indications**

When patient reports with pain and dysfunction (longstanding) and provides a history of persistent locking of jaw.

Contraindications

- 1) Infections involving periauricular region.
- 2) Patients who are allergic to contrast media.
- 3) Patients with bleeding disorders.
- 4) Patients under anticoagulant therapy.

Used for

- 1) Analysis of position and function of disc
- 2) Analysis of joint dynamics.
- 3) Analysis of disc displacement – anterior or anteromedially.

Therapeutic

- 1) Delineate loose bodies in joint spaces.
- 2) Diagnostic aspiration of joint fluids.
- 3) Intra-articular injection of steroids.

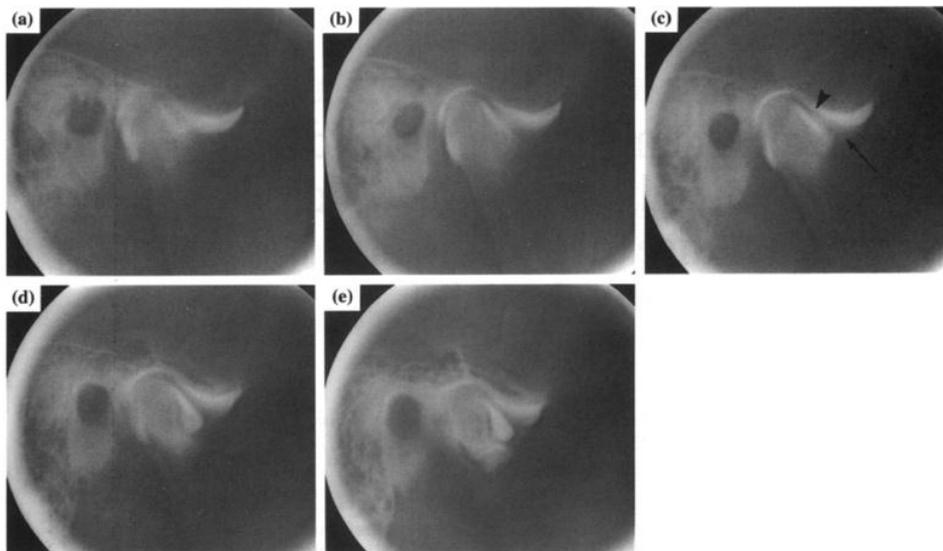


Figure 7: (Image Courtesy: Takehito Sasaki, Arthrotomographic sign of a 'double line' as an indicator of disc folding and sideways disc displacement in the temporomandibular joint).

Sagittal dual-space arthrotomograms of the left TMJ in the closed position, (a) to (e) correspond to arthrograms from the medial to lateral side of the condyle at 2mm intervals. A plate like-disc (arrow) has been displaced anteriorly. The arrowheads show the posterior band of the disc.

Cone Beam Technology**Indications**

- 1) Evaluation of fractures.
- 2) Degenerative changes.

- 3) Erosions.
- 4) Infections.
- 5) Congenital anomalies.

Advantages

Produces sub-millimeter spatial resolution images of high quality along with short scanning times (10-70 seconds).

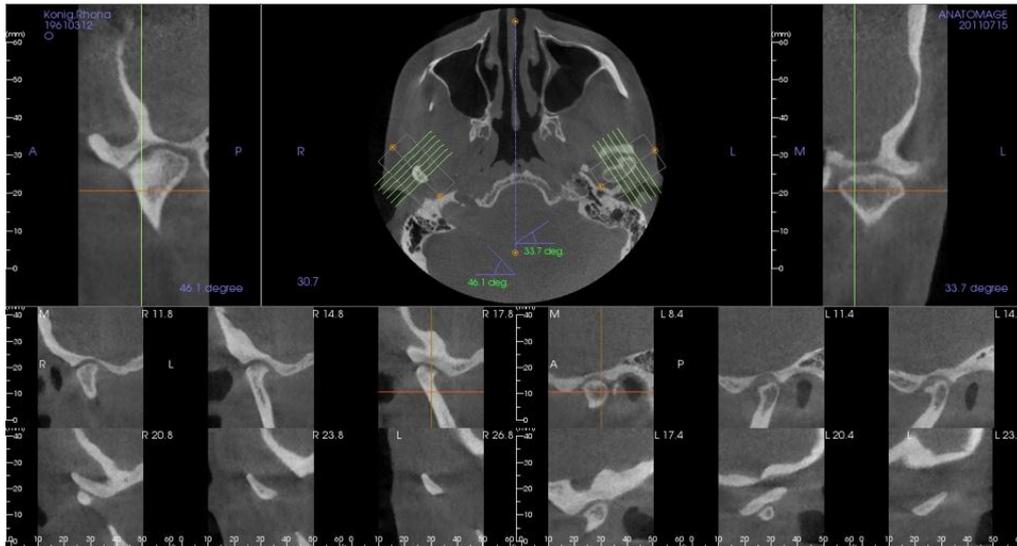


Figure 8: (Image Courtesy: Dr. Ronald W. König, Houston).

TMJ 3D scan showing degeneration in the joints from right to left TMJ.

Computed Tomographic Scan^[9]

Indications

- 1) Ankylosis and its extent
- 2) Neoplasms involving bone
- 3) Complex fractures
- 4) Heterotrophic bone growth

Advantages

Produces three dimensional shape and internal structures of the osseous components.

Disadvantage

Not used for diagnosis of the disc.

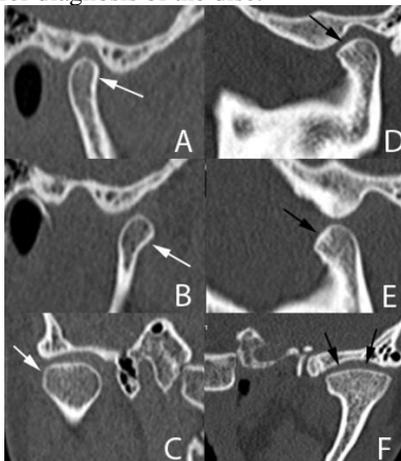


Figure 9: (Image Courtesy: Freire JSL, Barbosa JMN, Evaluation of bone changes in the temporomandibular joint using cone beam CT. Dentomaxillofacial Radiology. 2012;41:24-9).

A. CT Sagittal reconstructions mouth shut. B. Sagittal open mouth C. Coronal on the right D. Sagittal closed mouth reconstructions E. Sagittal open mouth F. Left

coronal. White arrows indicate the cortical bone covering the entire condylar process. Black arrows indicate planning.

Magnetic Resonance Imaging^[10]

Gold standard diagnostic method used in TMD diagnosis which uses magnetic field and radiofrequency pulses, tissues with greater water content emit a higher signal. Provides oblique sagittal and coronal sections in T1 and T2.

Indications

- 1) When patient reports with clicking sounds, pain and locking symptoms.
- 2) Internal derangement.
- 3) Disc displacements with or without reduction.
- 4) Pathologies associated with the joint and joint space.

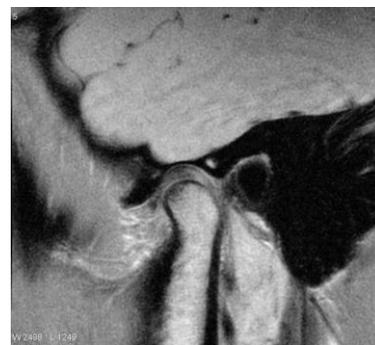


Figure 10: (Image Courtesy: Radiopaedia.org).

A normal temporomandibular joint under MRI. The disc and joint space are clearly visible under the MRI whereas it is not possible with a CT scan.

Validity of diagnostic tests used for TMD⁽¹¹⁾

Category	Use	Comment
Predictive Tests	To identify individuals at risk/not at risk of developing a specific disease.	Only useful if techniques exist for preventing the development or transmission of the condition.
Screening Tests	To identify individuals who have/ do not have a disease or category of disease.	Screening tests cannot replace the patient history and physical examination.
Discriminatory Tests	For differential diagnosis.	Of little use if the result does not influence treatment or outcome.
Monitoring Tests	To describe changes in the disease process and/ or effects of therapy.	Variable measured should closely reflect the change in the underlying pathology or primary symptom.

Assessment of the efficacy of a diagnostic test

Parameter	Description
Measurement Validity	The accuracy of a measurement technique when compared with a known standard
Measurement Reliability	The variability of the measurements over time and in different environments
Diagnostic Validity	The ability to separate those with the disease from those without the disease
Sensitivity	Ability to identify patients in a patient population
Specificity	Ability to identify non-patients in an asymptomatic population
Positive predictive value	Ability of a diagnostic technique to identify a patient correctly, given that the test is positive
Negative predictive value	Ability of a diagnostic technique to identify a non-patient correctly, given that the test is negative

CONCLUSION

- 1) TMJ being a complex joint may lead to multiple diagnosis.
- 2) Although a positive diagnosis can be made only through the co relation of the medical history and clinical examination.
- 3) A radiographic or TMJ imaging should only supplement the clinical diagnosis so as to justify.
- 4) No screening test, no matter how sensitive and specific will replace this examination.
- 5) The use of new tests will therefore increase the health care costs.
- 6) Hence diagnosis should be correct to provide the apt treatment for the patients.

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