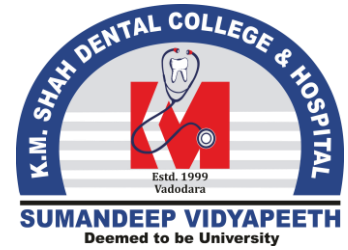
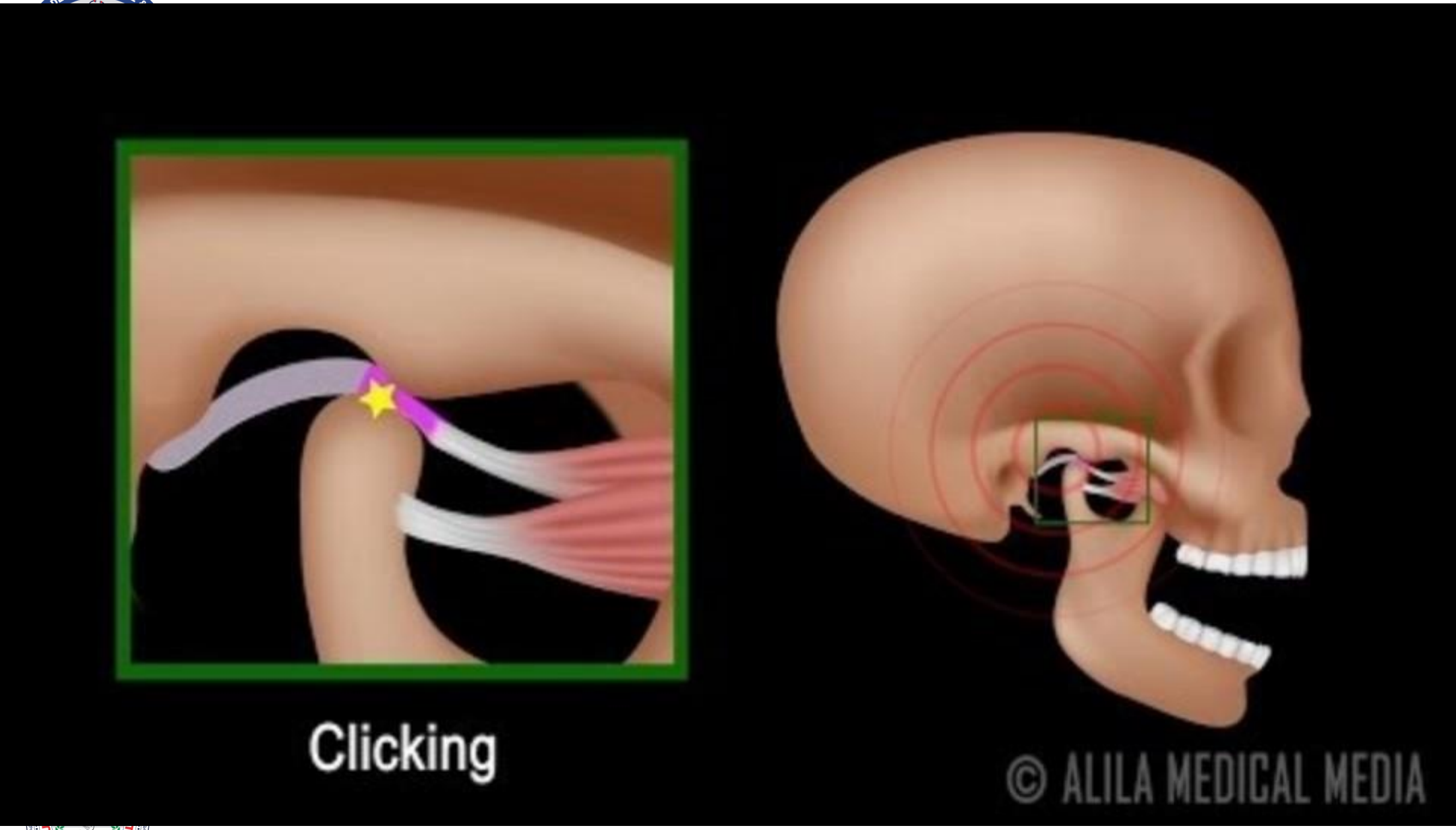


BDS Year 4 Regular & Casual batch
Academic Year 2023-2024
Subject: Oral Medicine and Radiology
Topic: TMJ IMAGING

Dr. Deepa J Patil
Professor
Dept. of Oral Medicine and Radiology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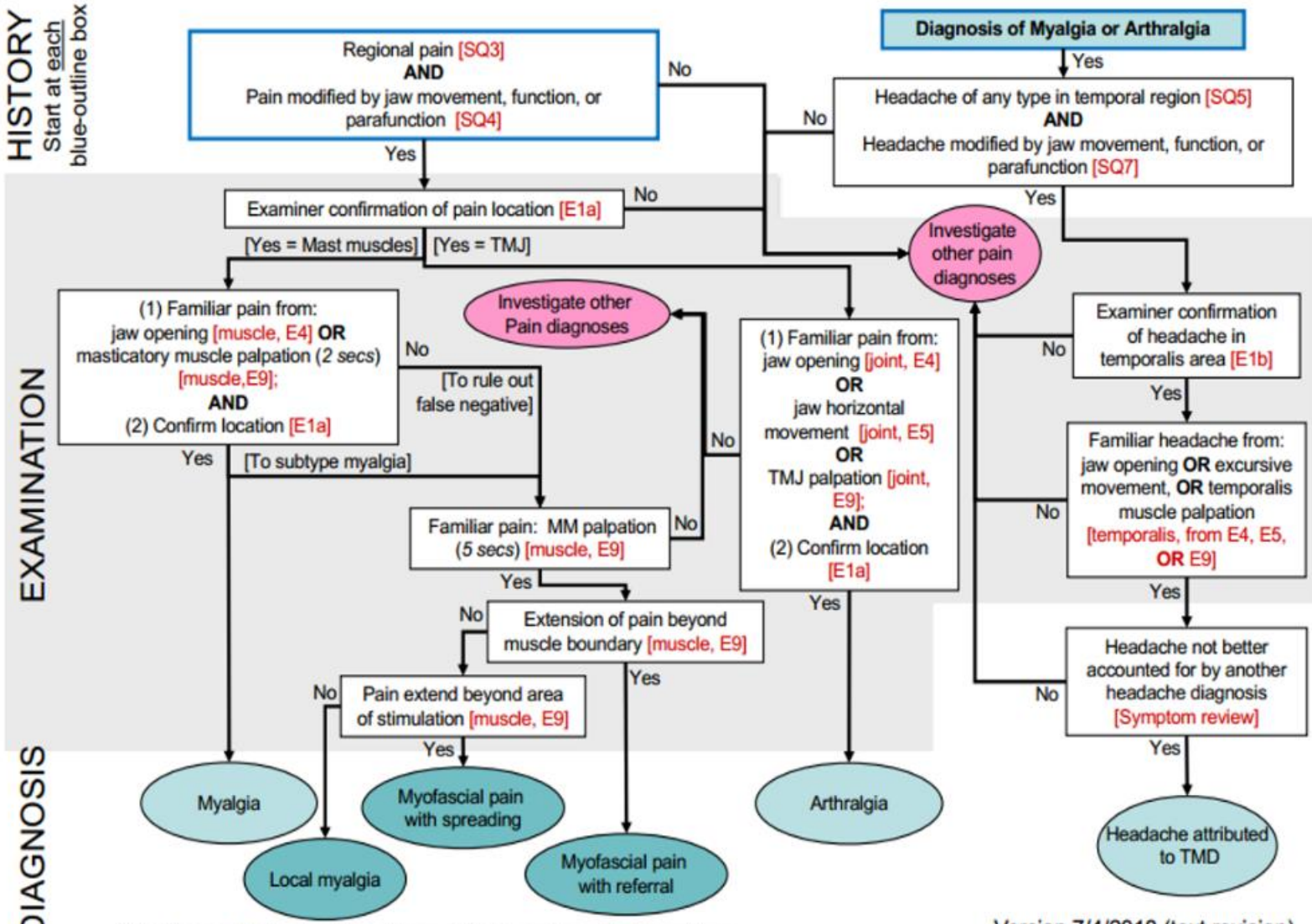
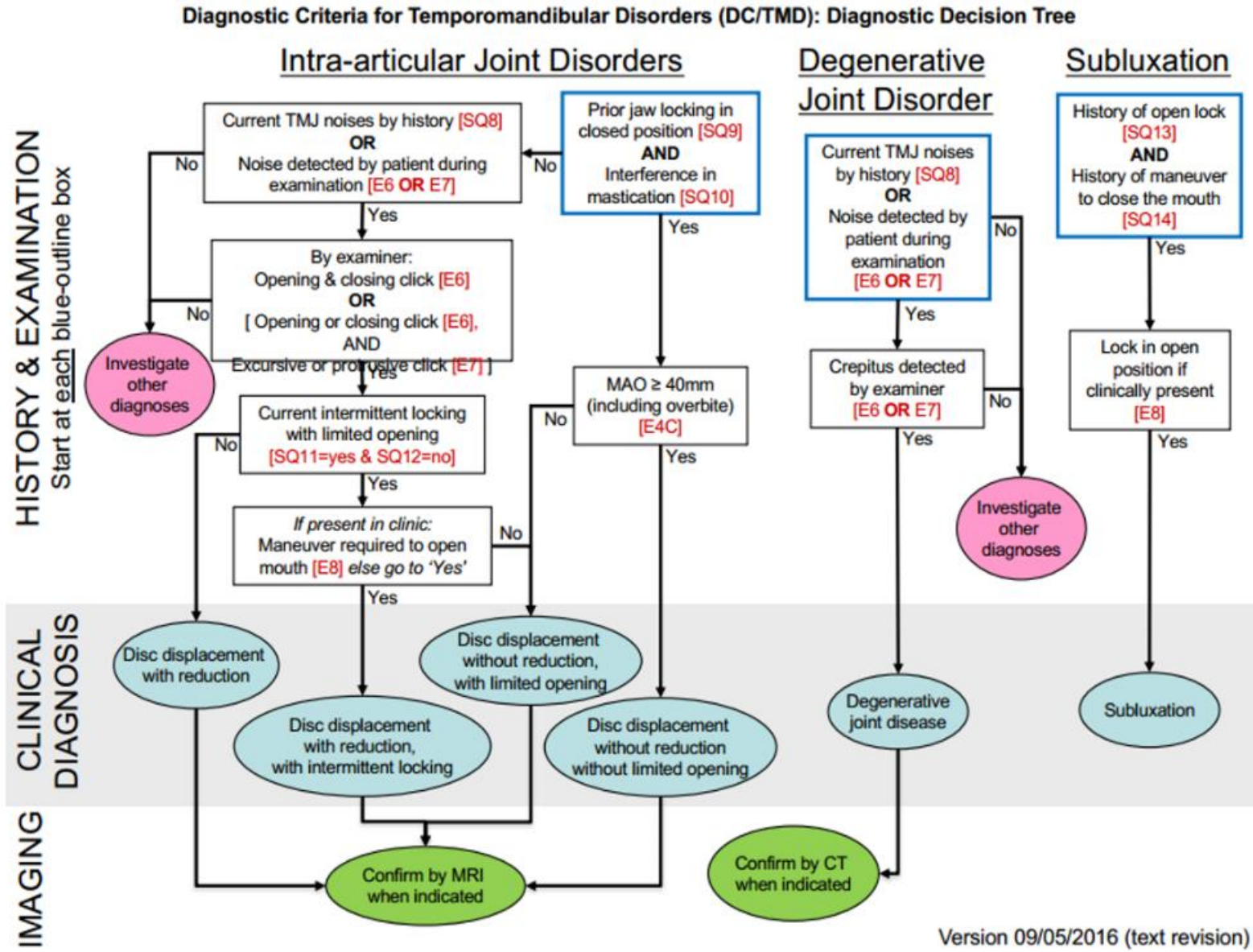
Diagnostic Criteria for Temporomandibular Disorders (DC/TMD): Diagnostic Decision Tree

Pain-Related TMD and Headache



Note: 2 secs palpation is sufficient for myalgia; 5-secs is required for subtypes

Version 7/4/2018 (text revision)

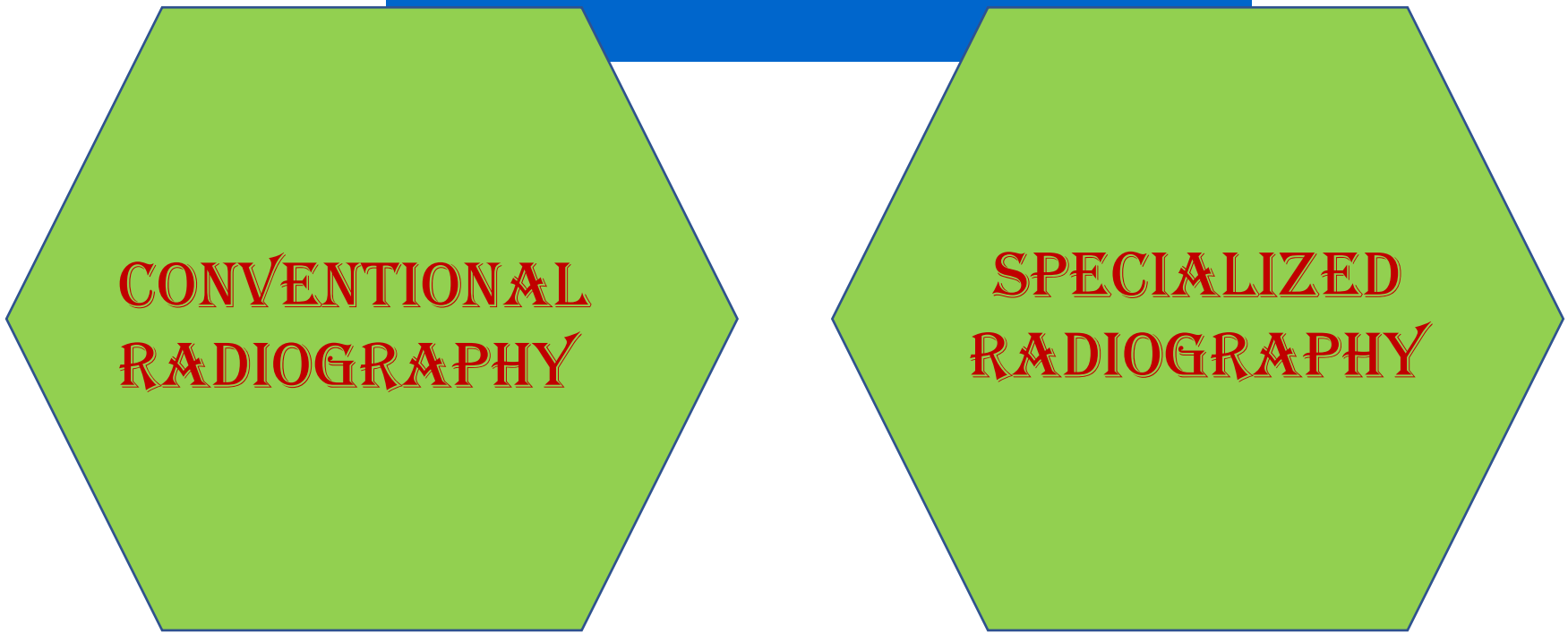


Introduction

- Disorders of TMJ are abnormalities that interfere with normal form and function of the joint.

- Unique anatomical configuration and complex relations in temporomandibular joint (TMJ) ask for special imaging techniques in radiological evaluation of the (TMJ).

IMAGING OF TMJ



Conventional Radiography

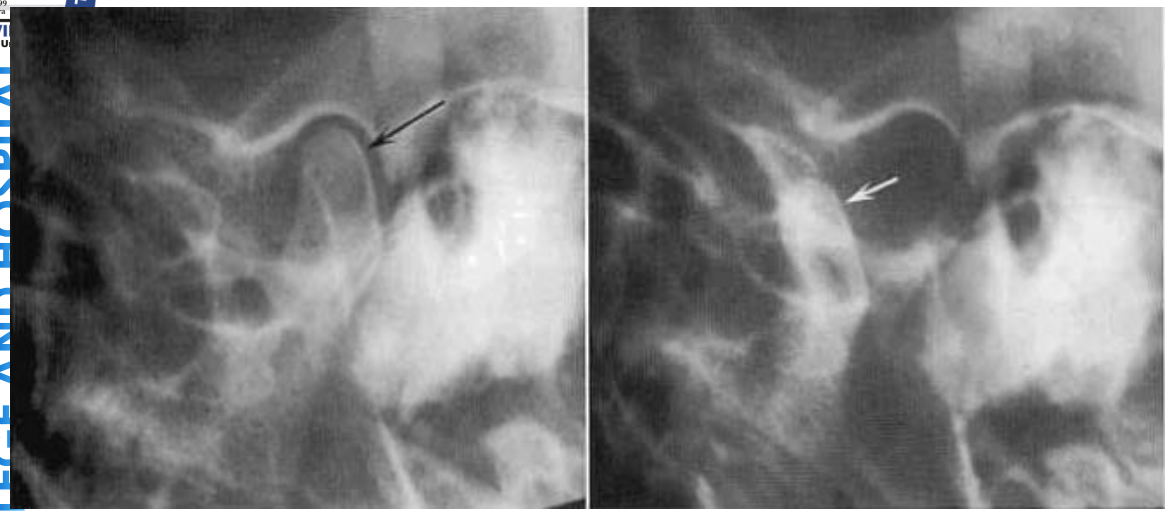
- Transcranial view
- Transorbital view
- Transpharyngeal view
- Revese Town's view
- Submentovertex view
- Orthopantomogram
- Conventional Tomography

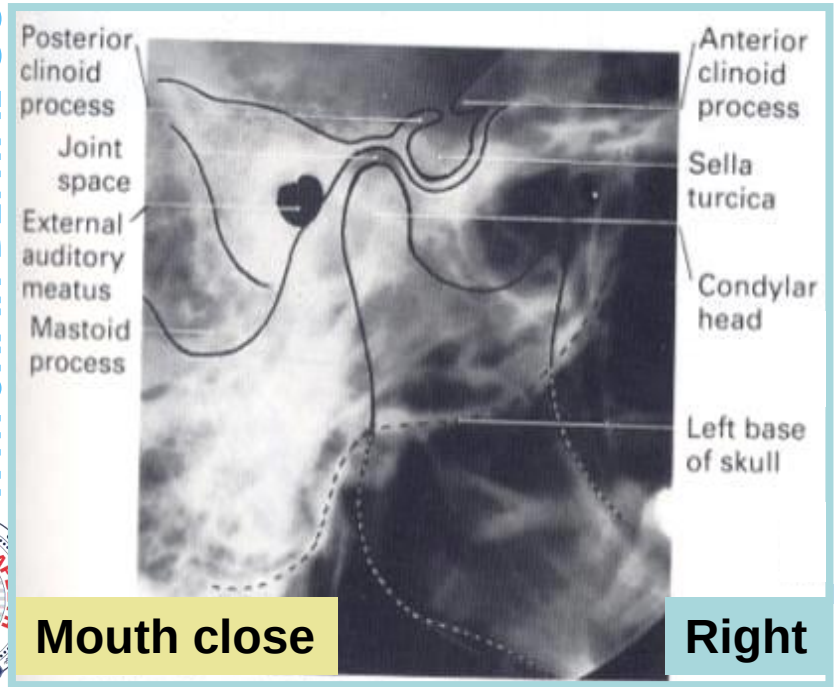
Specialized Radiogrpahy

- Computed Tomography
- Cone Beam Computed Tomography
- Magnetic Resonance Imaging
- Arthrography
- Bone Scintigraphy
- Ultrasonography

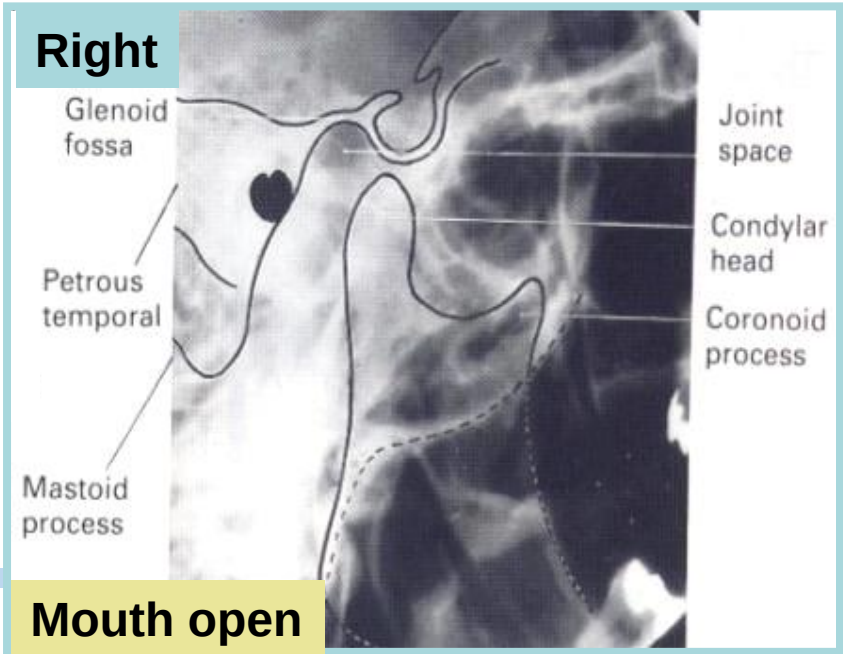
TRANSCRANIAL VIEW

INDICATION	AREA OF JOINT SEEN
Internal derangement Displaced condylar fractures Range of motion (open views).	Lateral aspect of Glenoid fossa Articular eminence Joint space Condylar head





Mouth close **Right**



Mouth open

Technique

- This view is taken with patients mouth in three positions
  - Open Mouth
  - Rest Position
  - Closed Mouth

- **Film Position: Cassette is placed flat against patient's ear and centered over the TM joint of interest parallel to saggital plane**
- **Position of Patient: Saggital plane is vertical**
- **Central Ray: Point of entry is different according to technique used**

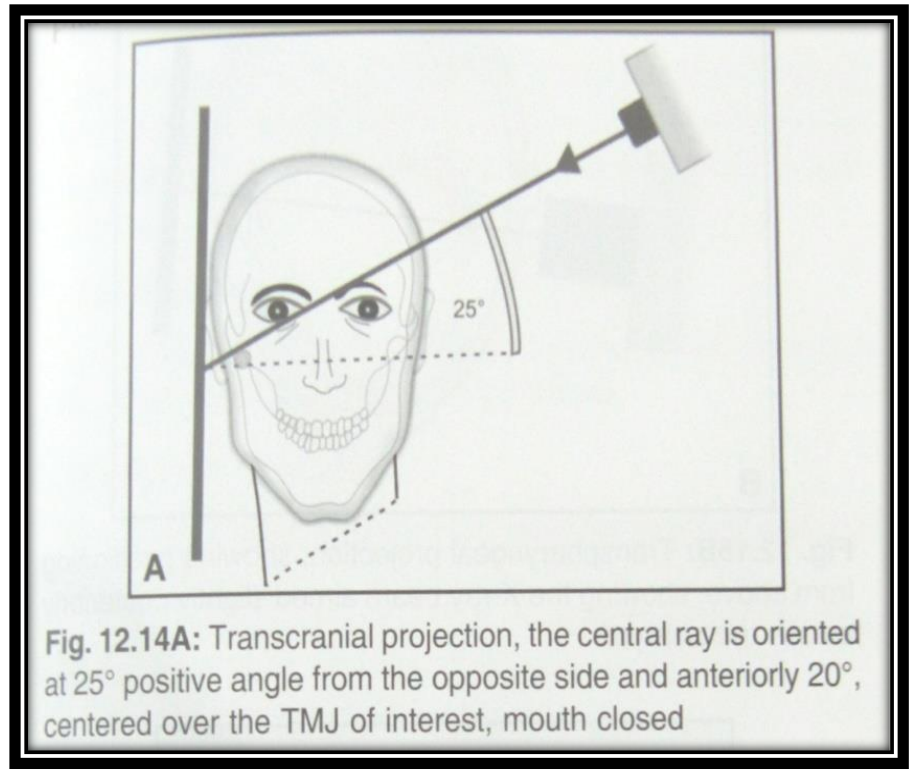


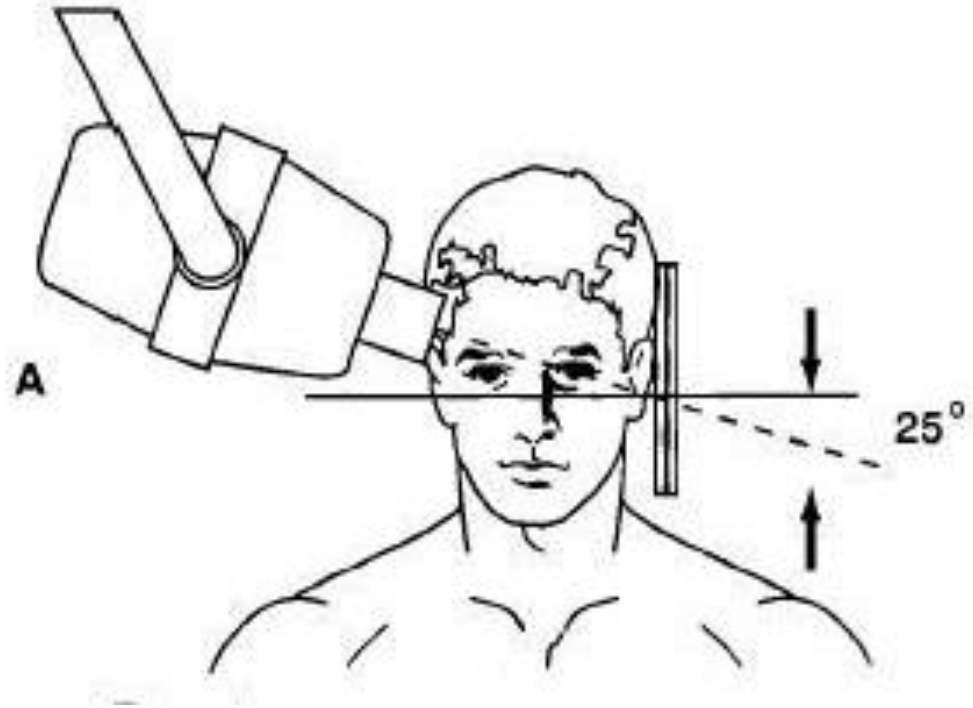
Fig. 12.14A: Transcranial projection, the central ray is oriented at 25° positive angle from the opposite side and anteriorly 20°, centered over the TMJ of interest, mouth closed

POST AURICULAR OR LINDBLOM TECHNIQUE

GILL'S APPROACH

GREWCOCK APPROACH

- In all the techniques central ray is directed caudally at an angle of +20 to +25 degree



TRANSPHARYNGEAL VIEW / Infracranial / McQueen Dell

INDICATION	AREA OF JOINT SEEN
Osteoarthritis & rheumatoid arthritis	Lateral view Condylar head & neck
Pathology-condylar head-cyst & tumor	Articular surface
Fracture of neck & condyle	

Structures Shown

Medial surface of the condylar head and neck usually taken in open mouth position

- **Film placement: Cassette is placed flat against patient's ear and centered to a point ½" anterior to the external auditory meatus over the TM joint of interest parallel to sagittal plane**

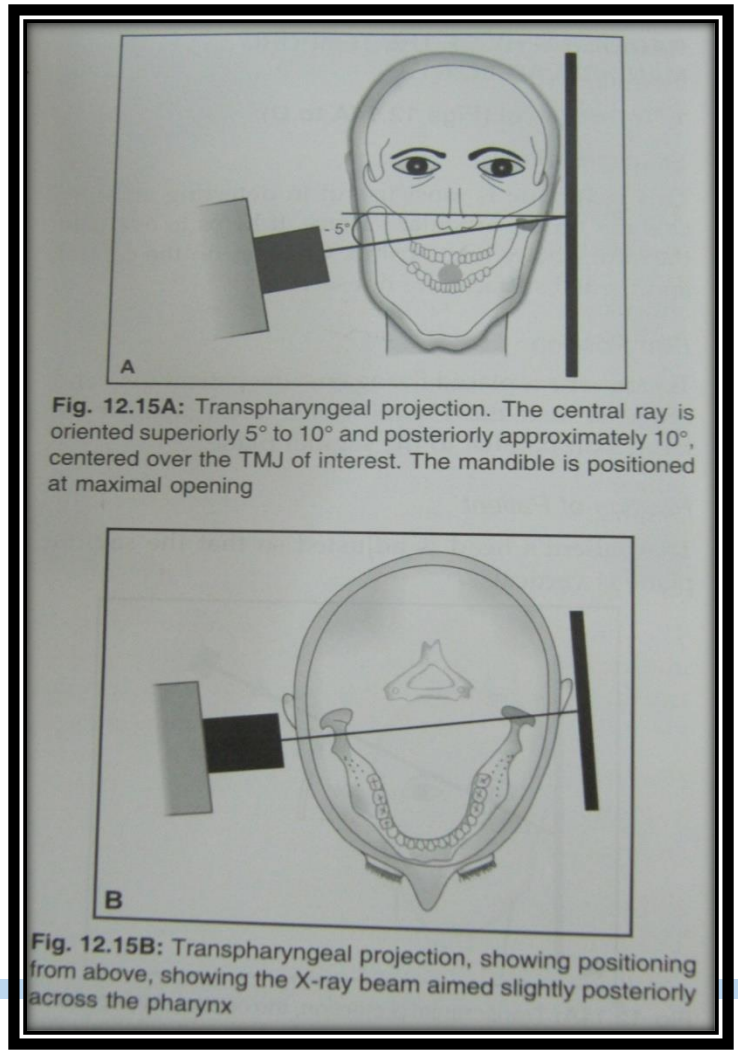


Fig. 12.15A: Transpharyngeal projection. The central ray is oriented superiorly 5° to 10° and posteriorly approximately 10°, centered over the TMJ of interest. The mandible is positioned at maximal opening

Fig. 12.15B: Transpharyngeal projection, showing positioning from above, showing the X-ray beam aimed slightly posteriorly across the pharynx

- **Position of Patient:**
  - **Saggital plane is vertical and parallel to the film.**
  - **Patient is asked to slowly inhale through the nose during exposure, so as to ensure filling of the nasopharynx with air.**
  - **Patient is asked to open his mouth so that condyles move away from base of the skull and the mandibular notch of opposite side is enlarged**

Central Ray:

It is directed from opposite side cranially at an angle of - 5 to -10 degree posteriorly

Directed through the mandibular notch.

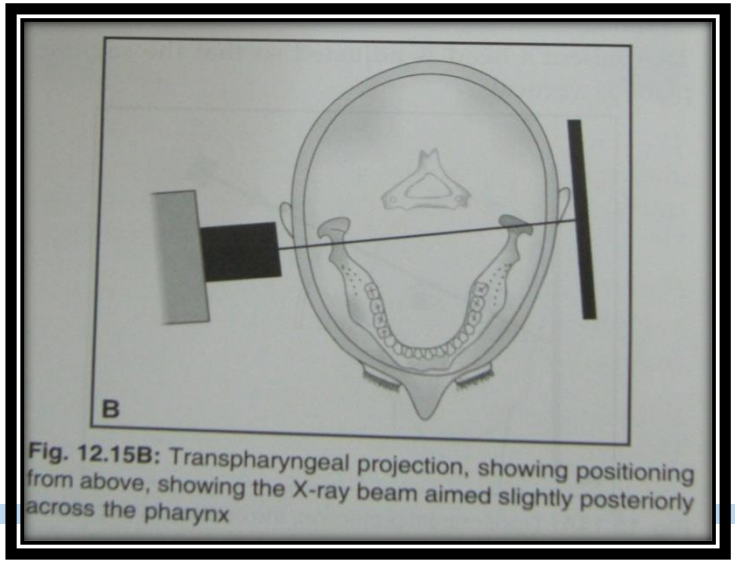


Fig. 12.15B: Transpharyngeal projection, showing positioning from above, showing the X-ray beam aimed slightly posteriorly across the pharynx

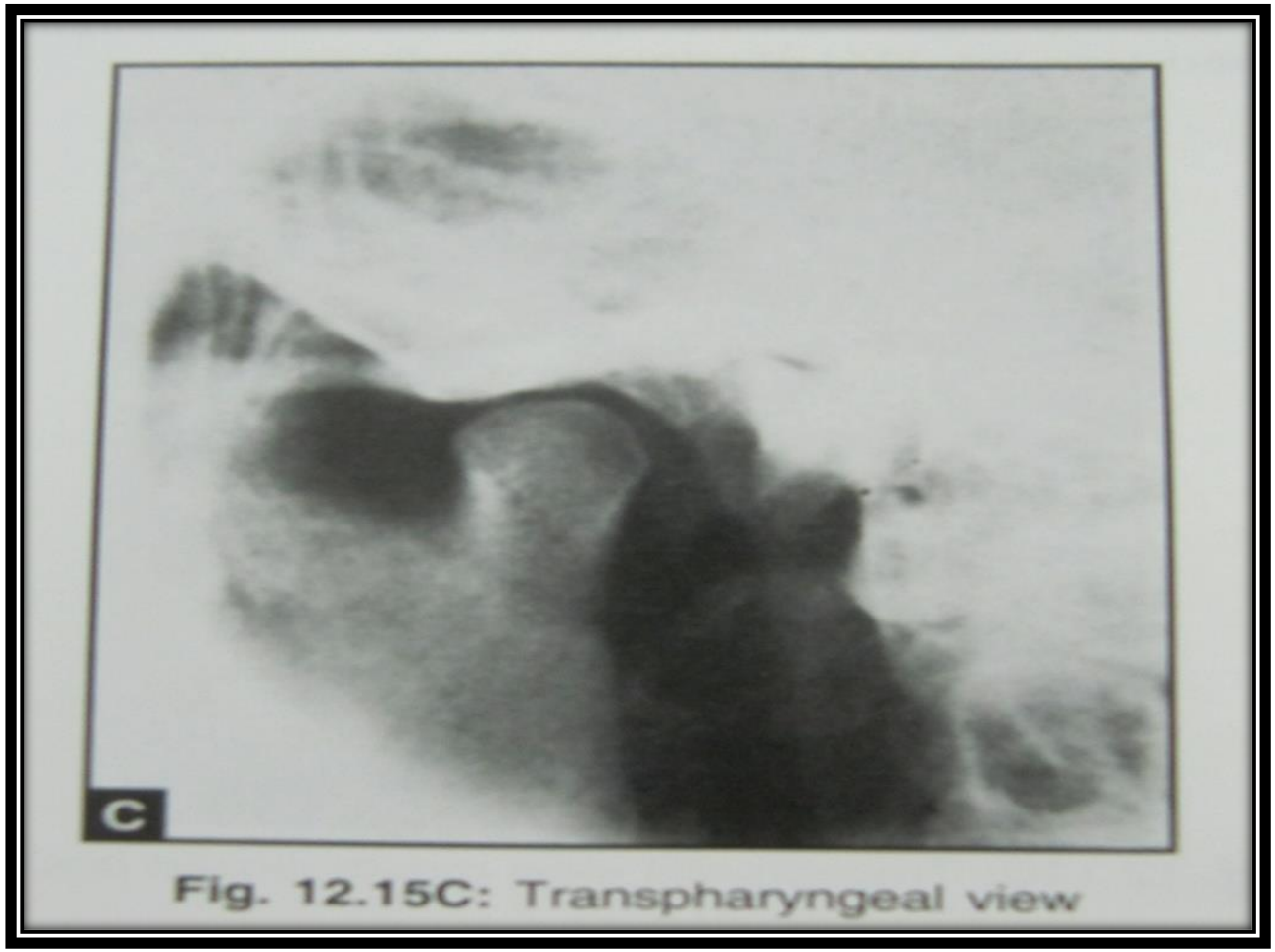
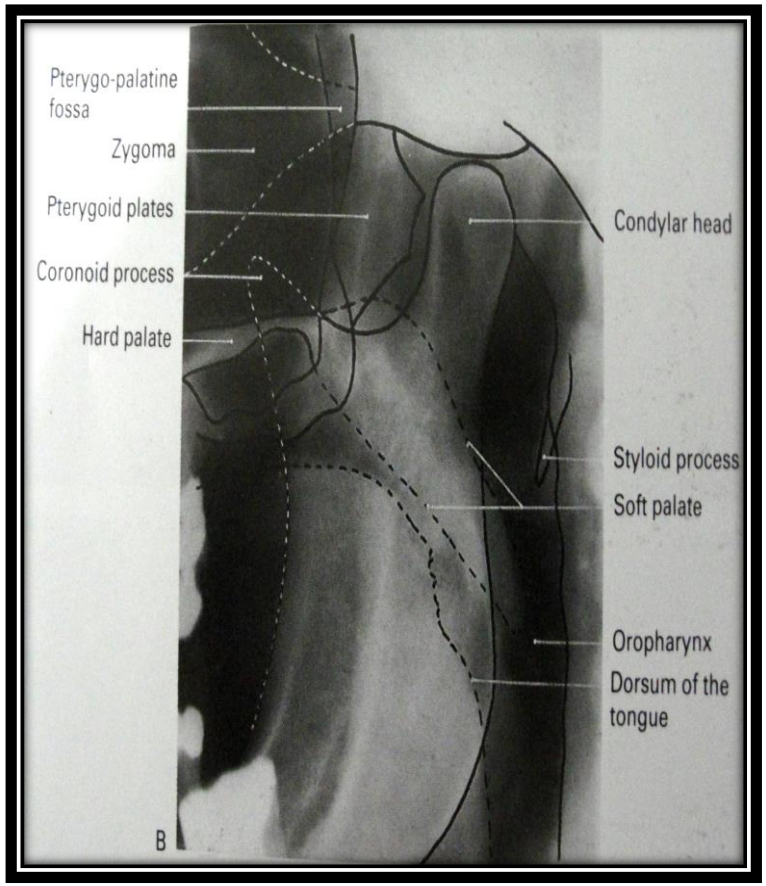
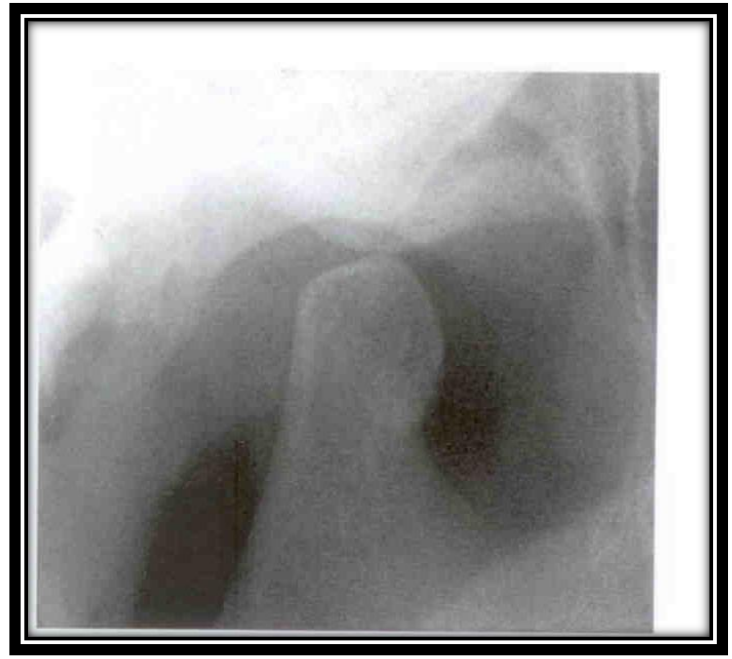


Fig. 12.15C: Transpharyngeal view





superimposed over the glenoid fossa

Parma Modification

- The lead lined open ended cone is removed and the tube head is brought close to skin surface.
- Producing magnification of the tube side structures.
- Thereby reducing superimposition.

Trans orbital or Zimmer Projection

- **Structures Shown:**
  - Anterior view of TMJ
  - Medial displacement of fractured condyle
  - Fracture of neck of condyle

- **Film Position:**

  Behind patient's head at an angle of 45 degree to the saggital plane

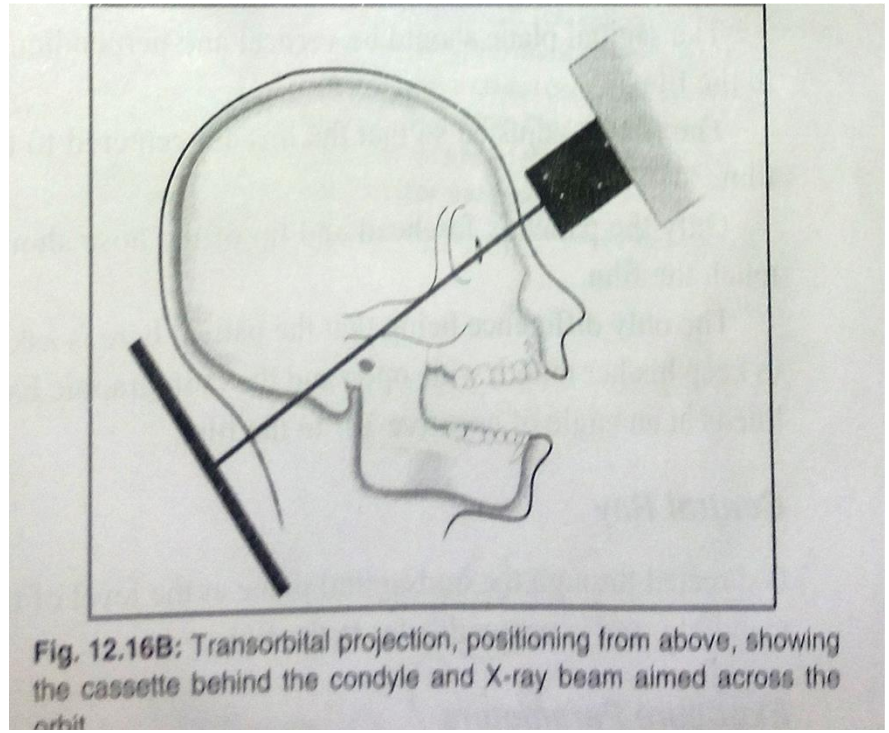


Fig. 12.16B: Transorbital projection, positioning from above, showing the cassette behind the condyle and X-ray beam aimed across the orbit

- **Position of the Patient**
  - **Vertical to sagittal plane and**
  - **Canthomeatal line should be 10 degree to the horizontal with head tipped downwards and mouth wide open**

- Directed at an angle of +20 degree to strike the cassette at right angle
- Point of entry

Pupil of same eye

Medial Canthus of same eye

Medial Canthus of opposite eye

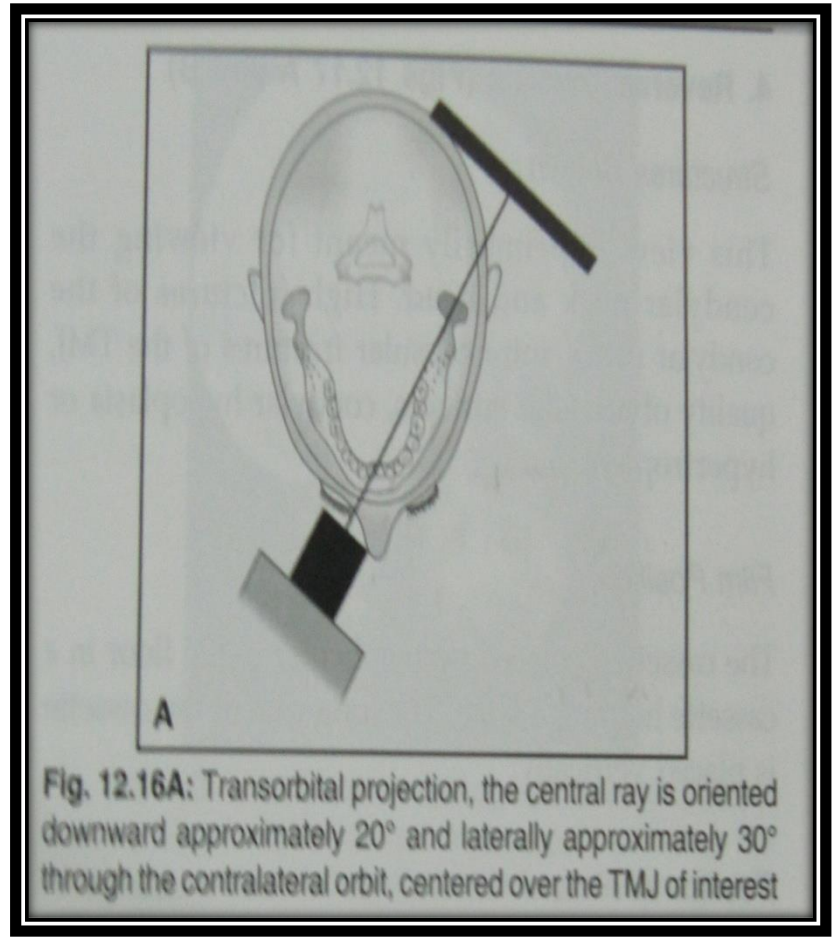
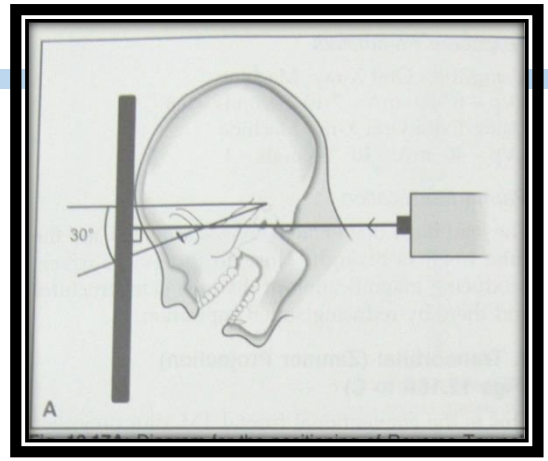


Fig. 12.16A: Transorbital projection, the central ray is oriented downward approximately 20° and laterally approximately 30° through the contralateral orbit, centered over the TMJ of interest

Reverse towne's

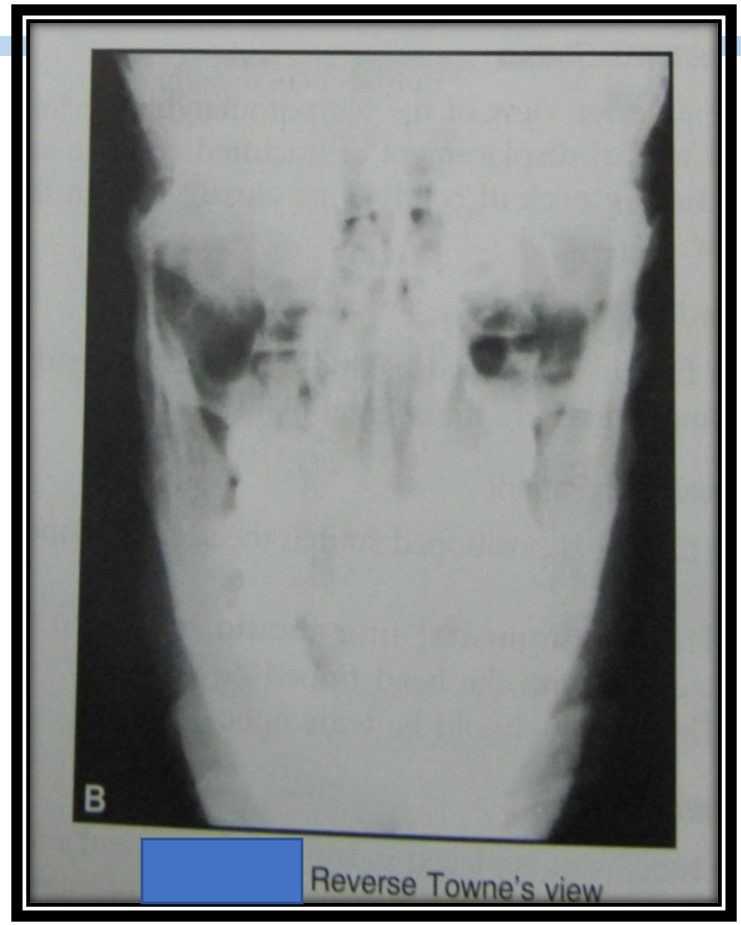
INDICATION	AREAS OF JOINT SEEN
Articular surface of condyles and disease within joint	Posterior view of both condylar head and neck
Fracture of condylar head & neck, intracapsular fracture	
Condylar hypo/hyperplasia	

- Cassette is placed perpendicular to the floor
- Long axis of cassette is placed vertically

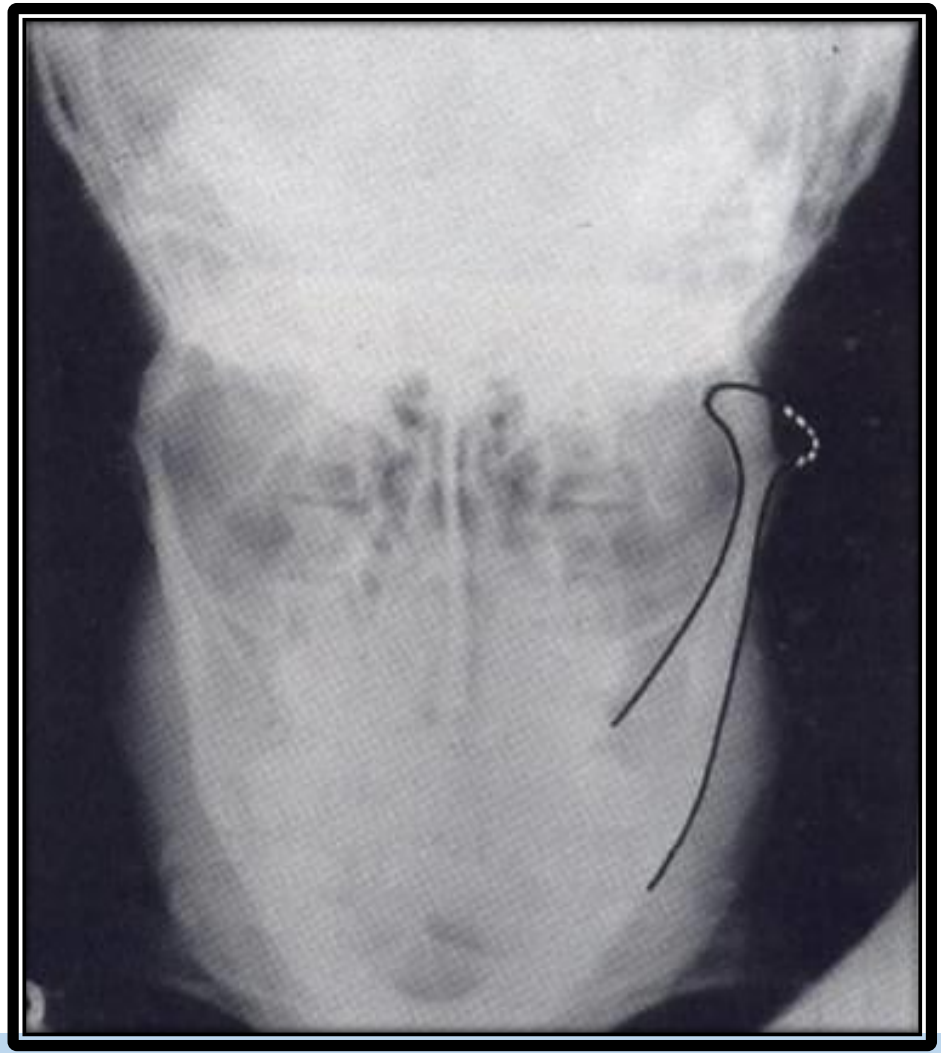


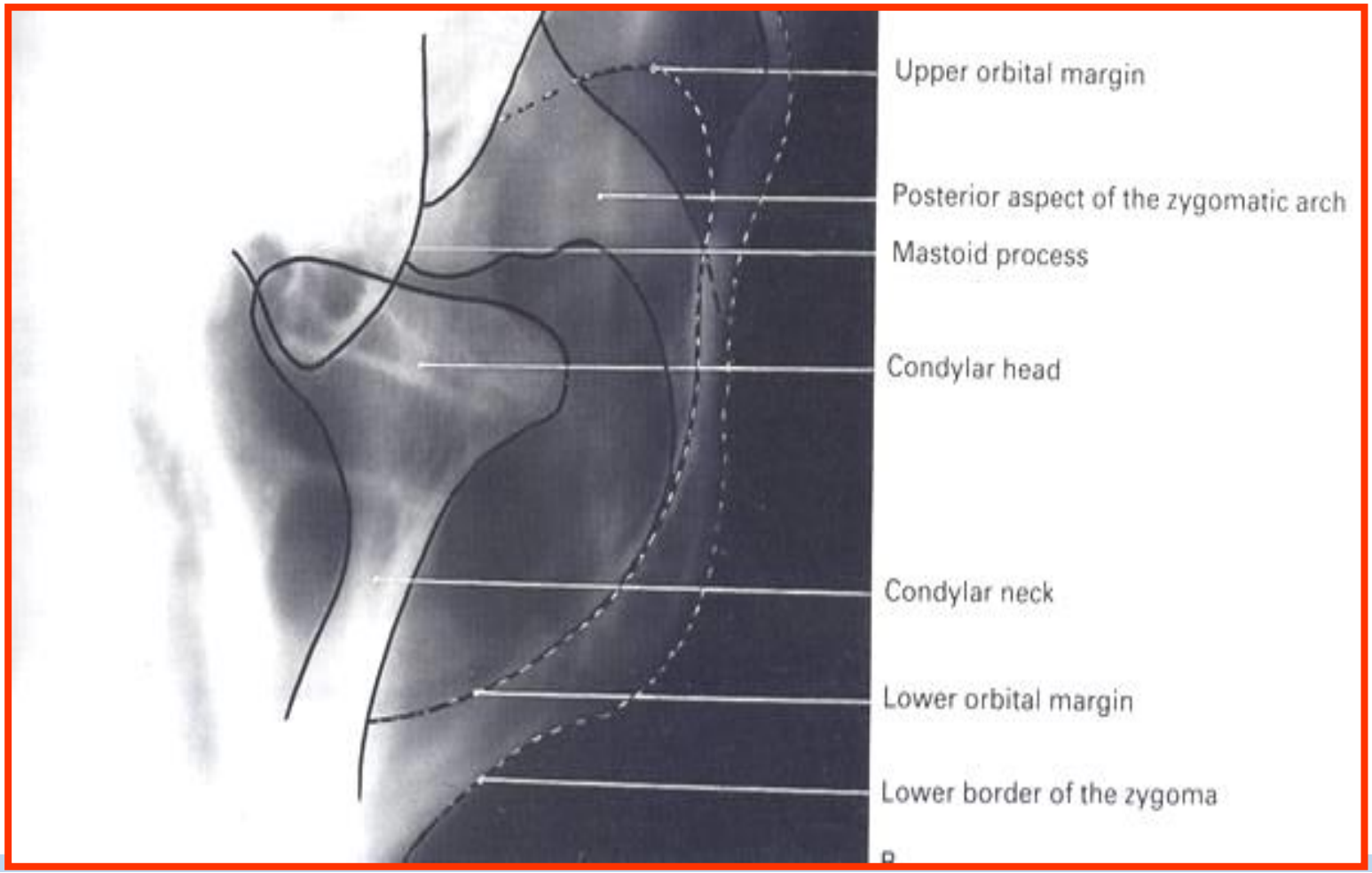
- Position of Patient
- Saggital plane should be perpendicular and vertical to the film
- Lips are centered to the film
- Patient's forehead and nose should touch the film
- Wide open mouth with radiographic baseline at an angle of -30 degree to the film

- Central ray
- Directed through the mid saggital plane at the level of mandible, and is perpendicular to the film



Reverse Towne's view

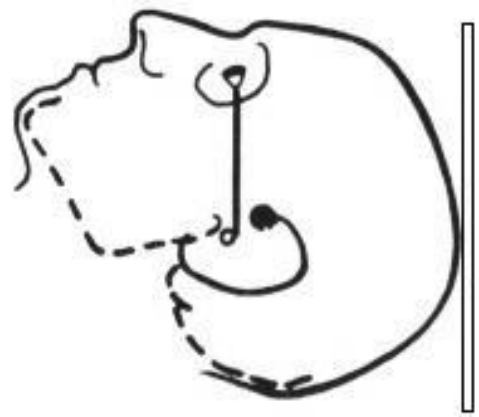




Submentovertex View

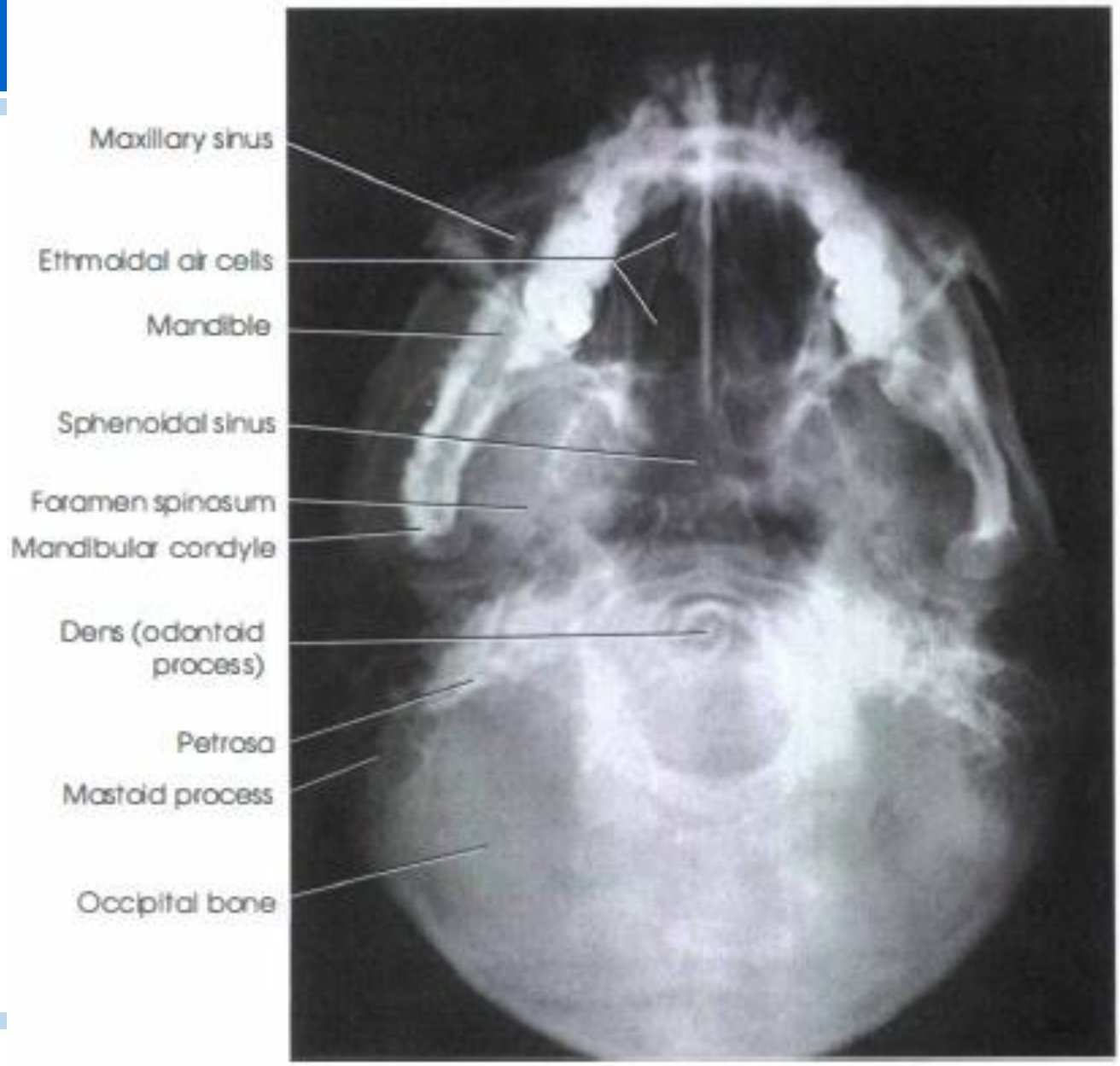
INDICATION	AREA OF JOINT SEEN
Destructive / expansile lesions affacting the palate, pterygoid region or base of the skull	Axial inclination of the mandibular condyles

- **Film placement:**
  - **Perpendicular to the floor**



- **Patient position:**
  - **Head centered on the cassette**
  - **Pt's head and neck tipped back as far as possible**
  - **Midsagittal palne perpendicular to plane of film**
  - **Vertex touches the film**

- **Central Ray:**
  - **Perpendicular to the film**
  - **Enters through sagittal plane b/w the angles of mandible and coronal plane 3/4th inches ant to the ext auditory meatus**



Dental Panoramic Radiography

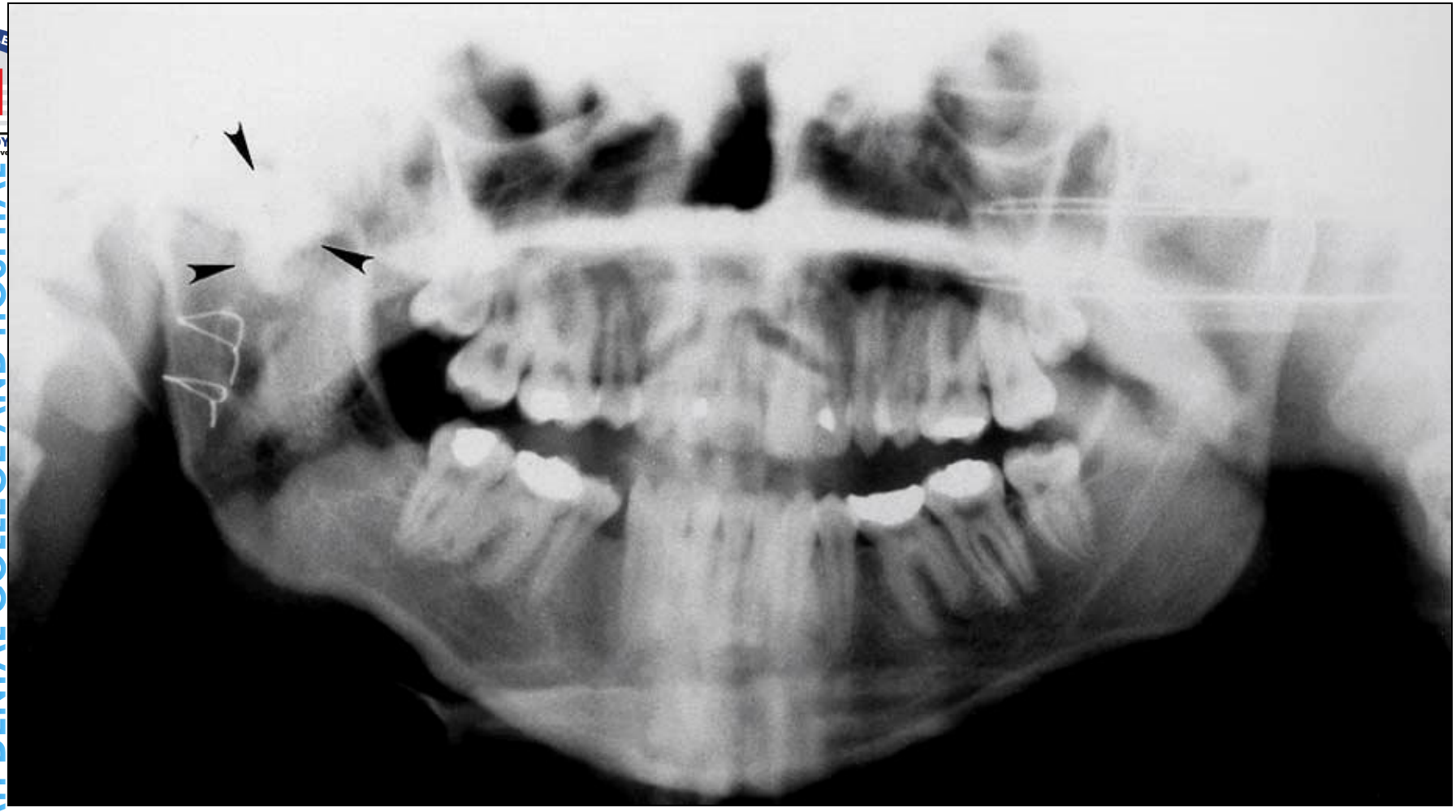
MAIN INDICATIONS:

- TMJ pain dysfunction syndrome.
- To investigate disease within joint.
- To investigate pathological condition affecting condylar head.
- Fracture of condylar head or neck.
- Primary diagnostic technique of TMJ (fractures, cysts, tumors, inflammation, aplasya, hypoplasia, hyperplasia and degenerative changes).

DIAGNOSTIC INFORMATION:

- It gives information of shape of condylar heads and condition of articular surfaces from lateral aspect.
- Direct comparison of both condylar heads.

Mandibular condylar hypoplasia: The left condyle is smaller and altered in shape in comparison with the right.



Osseous ankylosis (arrowheads) between coronoid process and zygomatic arch. Metallic sutures are from a previous trauma-related operation.

Panoramic TMJ Programmes

- **Diagnostic Information:**
  - **The shape of the condylar heads and the condition of the articular surfaces from the lateral aspect.**
  - **The range of movement of the condyles when the mouth is open**
  - **A direct comparison of both condylar heads.**

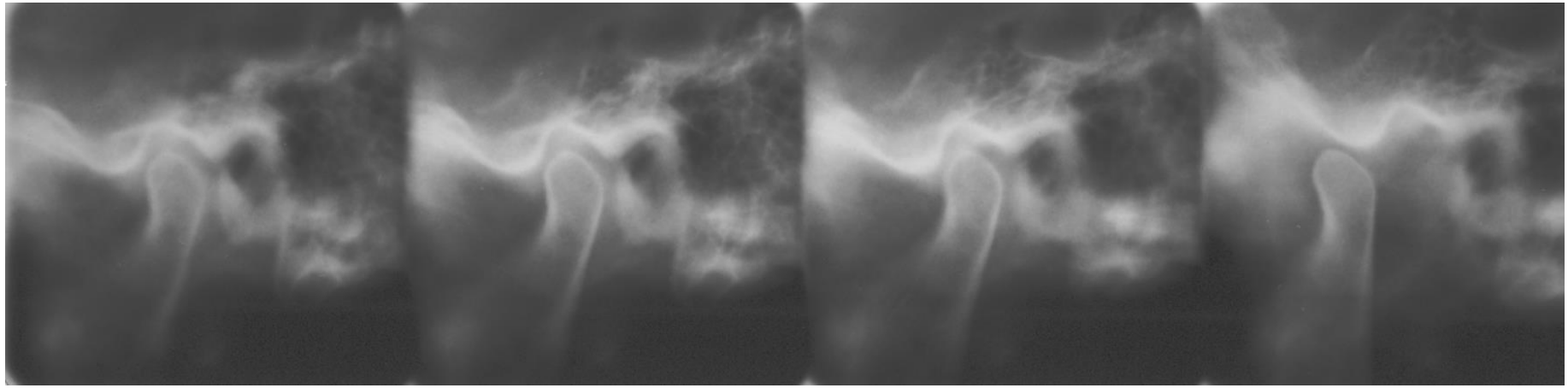
SUMANDEEP VIDYAPEETH
Deemed to be University

SUMANDEEP VIDYAPEETH
K M SHAH DENTAL COLLEGE AND HOSPITAL

Conventional Tomography

- Tomography is a technique that produces multiple thin image slices, permitting visualization of the osseous structures essentially free of superimpositions of overlapping structures.

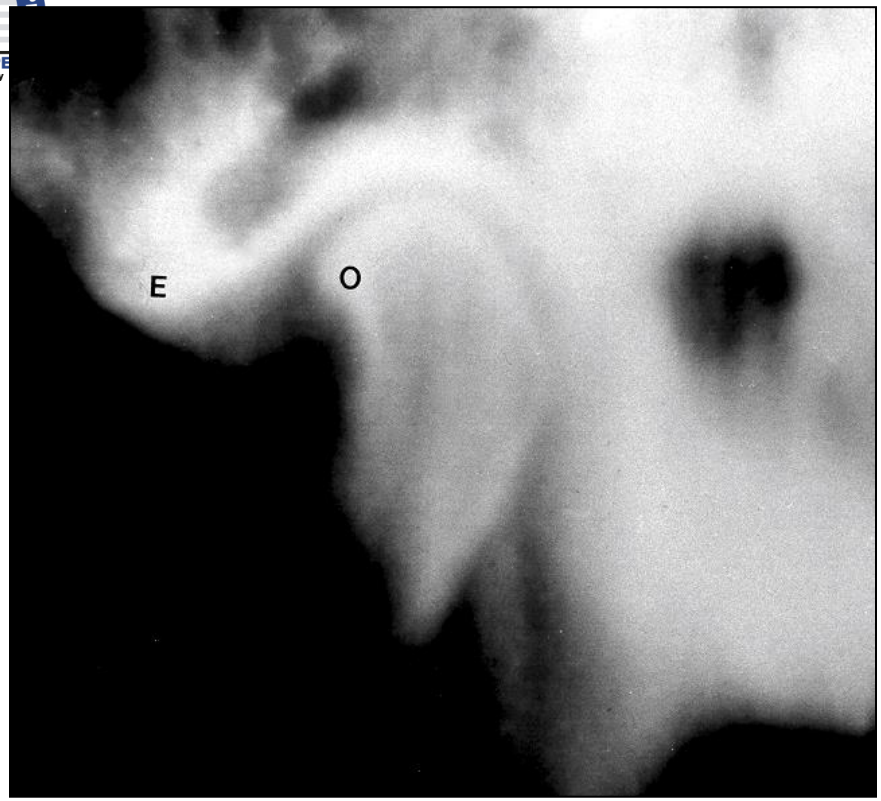
TMJ - Tomograms



Indications:

- Full assessment of the whole joint to determine the presence and site of any bone disease and abnormality.
- To investigate the condyle and articular fossa when the patient is unable to open the mouth.
- Assessment of fractures of the articular fossa and intracapsular fractures.

- **Diagnostic Information:**
  - The size of joint space
  - The position of the head of condyle within the fossa
  - The shape of the head of the condyle and condition of the articular surface including the medial and lateral aspects
  - Shape and condition of the articualr fossa and eminence
  - Information of all aspects of the joints
  - The position and orientation of fracture fragments



TMJ osteoarthrosis

Conventional tomogram: Joint “space” is thinned because of loss of articular cartilage. Anterior osteophyte is composed of dense cortical bone and articular eminence (E) is eburnated.

Computed Tomography

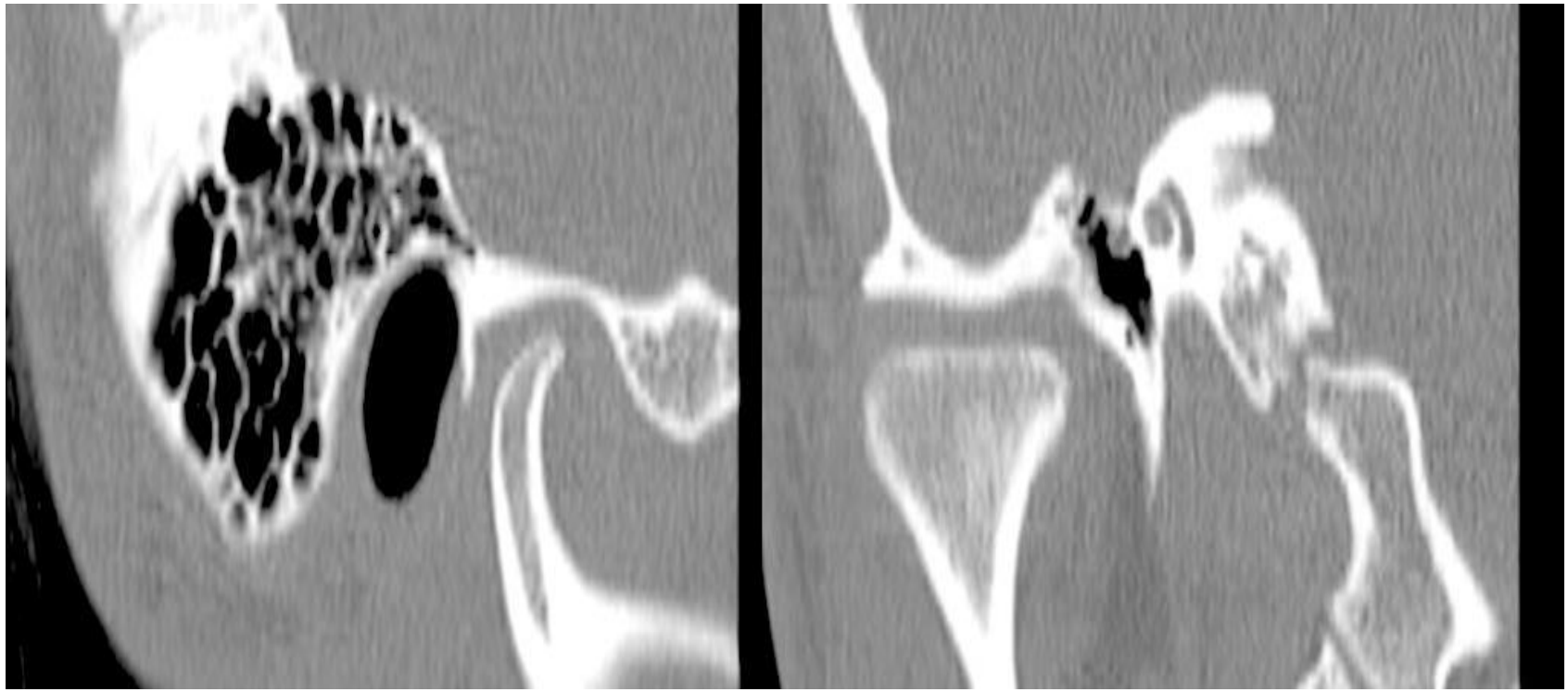
- **Indications:**
  - **Evaluation of trauma and tumors**
  - **Presence and extent of ankylosis of TMJ**
  - **Degree of bone involvement in some arthritides**
  - **Imaging of complex fractures**
  - **Heterotrophic bone growth**
  - **Perforation of alloplastic grafts into cranial fossa**

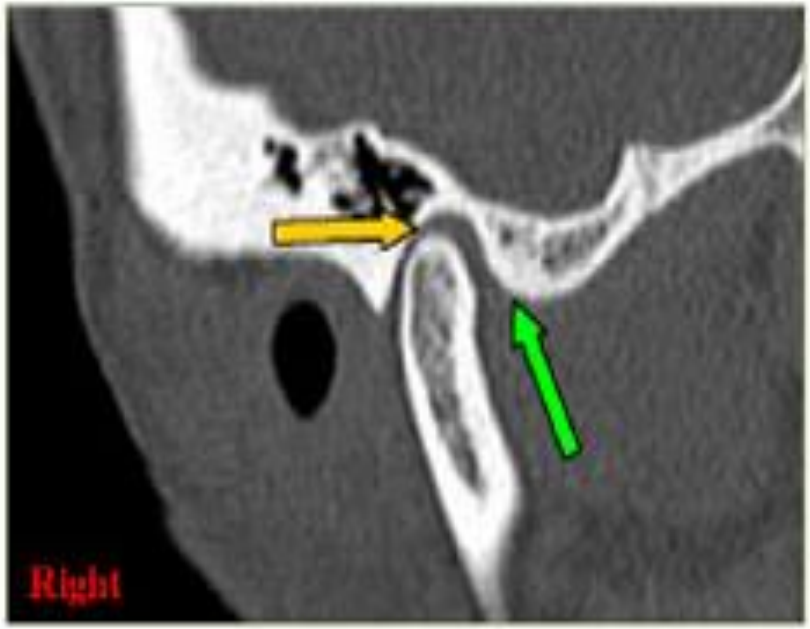
has several advantages over conventional radiography:

- There is no superimposition of structures outside the area of interest
- Contrast resolution is improved so that tissues with small differences in density can be distinguished
- Three-dimensional images can be constructed.
- CT permits the imaging of thin slices of tissues in a wide variety of planes, and provide axial, coronal and sagittal plane

Normal

Flattening





Healthy jaw joint with good cartilage thickness over the condylar head (yellow arrow), and a smooth articular eminence (green arrow).

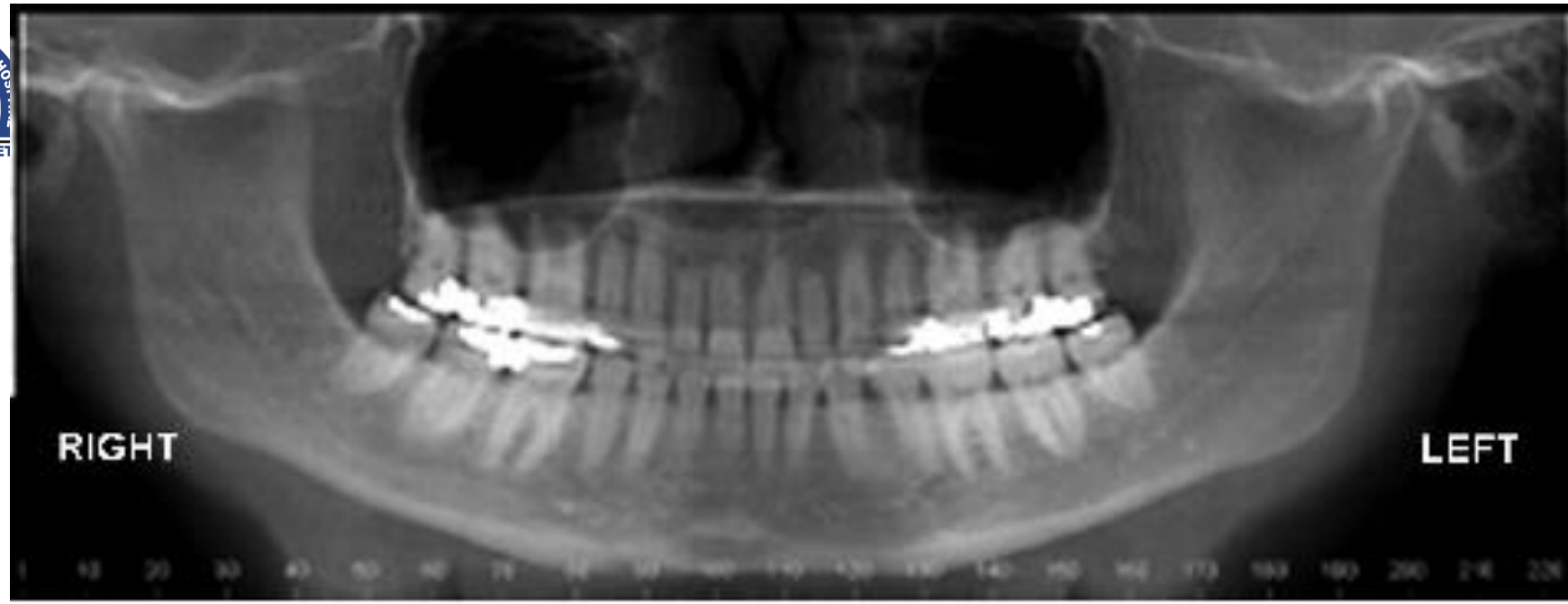
Arthritic jaw joint with loss of cartilage and erosion of bone over the condylar head (yellow arrow), and thickening and flattening of articular eminence (green arrow).

Evidence

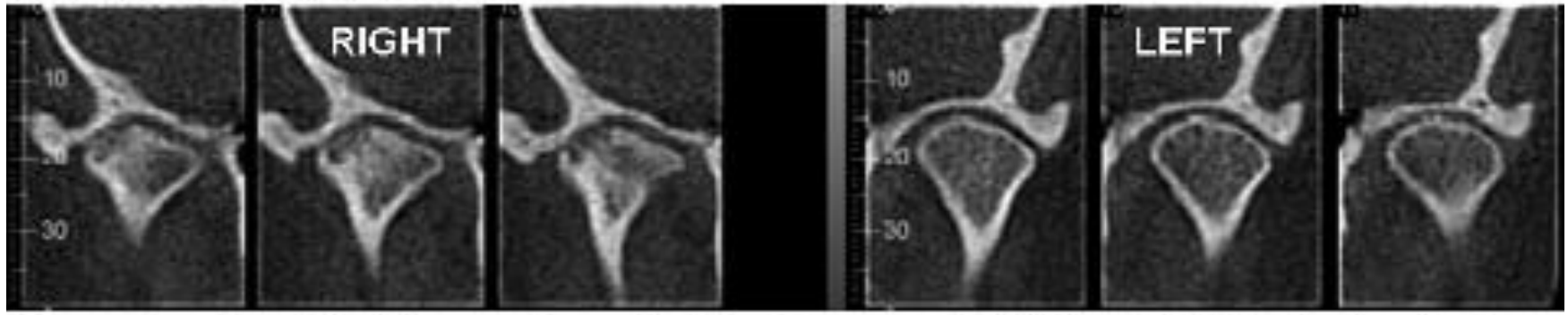
Authors	Sinha VP, Pradhan H, Gupta H et al
Title	Efficacy of plain radiographs, CT scan, MRI and ultra sonography in temporomandibular joint Disorders. Grade: +++
Aim	To compare four imaging modalities of TMJ viz. plain radiographs, CT scan, MRI and ultrasound.
Results	there was no statistically significant diff erence in effi cacy of transpharyngeal view, CT scan or MRI in interpreting hard tissue. Ultrasound was of no value in interpreting hard tissue. MRI was found to be superior to CT scan or transpharyngeal view, in diagnosing DJD
Interpretation	MRI was most specific and sensitive for interpretation of soft tissue and inflammatory conditions in the joint, whereas CT examination produced excellent image for osseous morphology and pathology. Plain X-rays are useful for destructive bony changes and sonography is a good in aid in diagnosing disc derangement and is very economical.

Cone Beam Computed Tomography

- CBCT is increasingly being used to image the bony elements of the TMJ.
- As with conventional tomography, sectional images of all aspects of joints are produced.
- In addition, using appropriate software, 3D images can be created.



Reformatted 'panoramic' image from CBCT showing right side condyle differences in shape compared to normal left



Cropped reformatted images from the front (para-sagittal) from CBCT clearly showing defects in surface of right condyle (cyst) = ACTIVE OSTEOARTHTITIS

Advantage:

- One CBCT scan only delivers between 3-20 percent of the radiation dose of a conventional CT scan.
- Furthermore, the dose from a single CBCT scan may be the equivalent of as few as four film-based panoramic radiographs and may be less than the effective dose of a 19-film full mouth intraoral film series.

Disadvantage:

- CBCT is not suitable for patients unable to remain motionless for the duration of the scan.

- **Diagnostic Information:**
  - **The shape of condyles and the condition of articualr surfaces.**
  - **The condition of glenoid fossae and eminences.**
  - **The nature of any disease affecting the condylar heads.**

Evidence

Authors	Honey OB, Scarfe WC, Allan G et al
Title	Accuracy of CBCT imaging of the TMJ: comparisions with panoramic radiology and linear tomography Grade: +++
Aim	To compare the diagnosic accuracy of observers viewing images made with CBCT, panoramic radiography and linear tomography.
Results	The task was to detect cortical erosions affecting the mandibular condylar head. Intraobserver reliability was moderate. The diagnostic accuracy of CBCT was significantly greater than all other modalities.
Interpretation	CBCT images provide superior reliability and greater accuracy than linear tomography and TMJ panoramic projection in the detection of condylar cortical erosion.

Magnetic Resonance Imaging

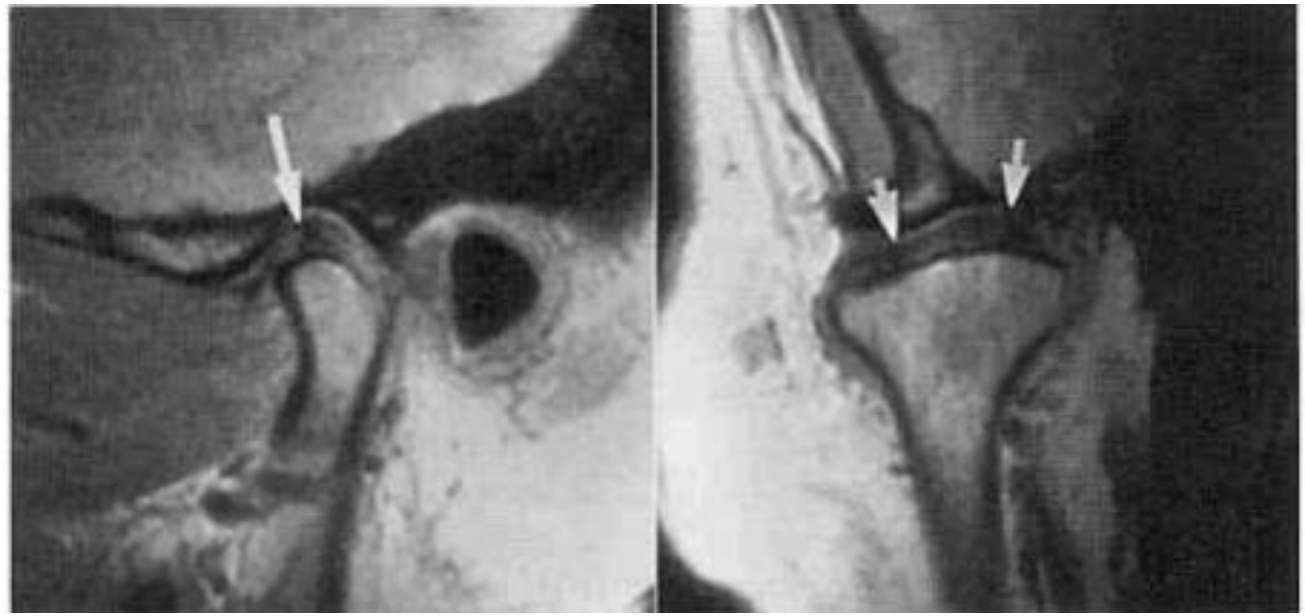
- Uses a magnetic field and radiofrequency pulses rather than ionizing radiation to produce multiple digital image slices.
- Used for imaging of articular disk.
- Allows construction of images in sagittal and coronal planes without repositioning the pt
- Images are aquired in open and close mouth position

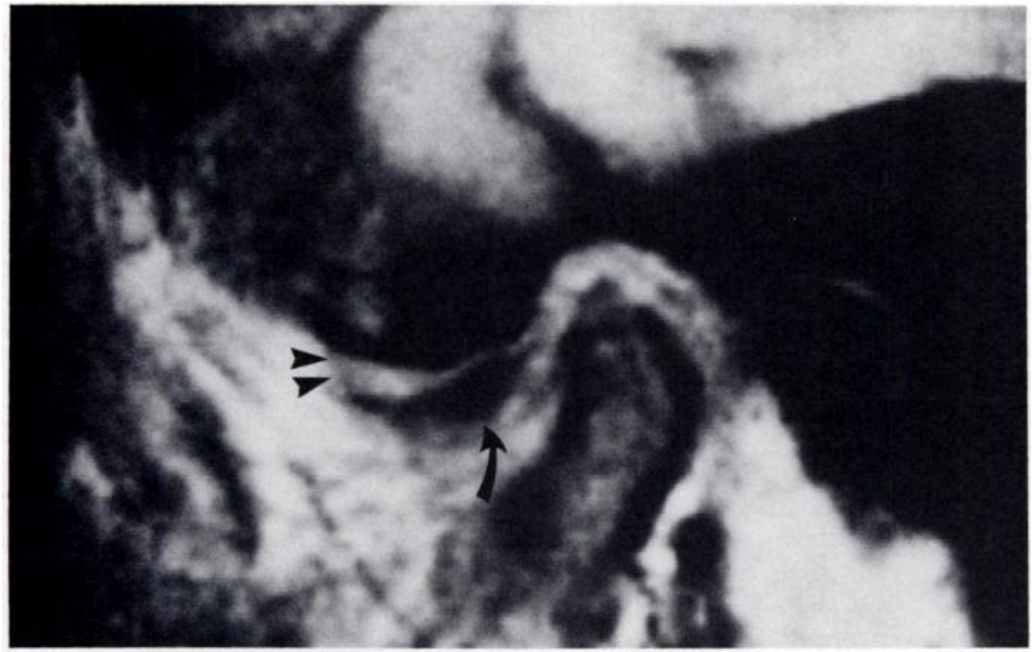
- Surface coils are used to improve resolution.

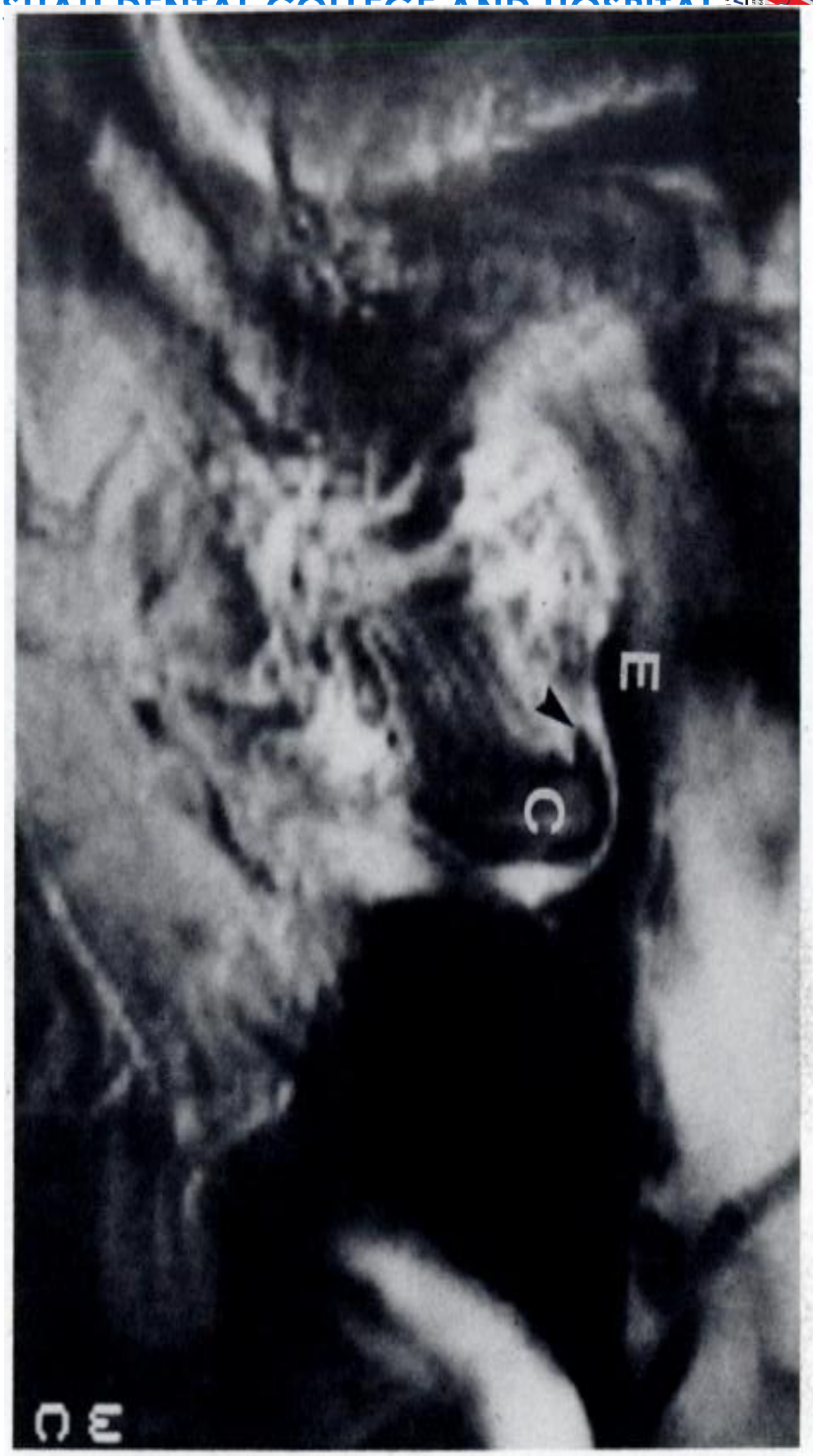
- Examinations are usually performed with use of:
  - T1 weighted
  - Proton weighted
  - T2 weighted

  Pulse sequences.

- T1-weighted images – osseous & discal tissues
- T2-weighted images - inflammation and joint effusion
- Motion MRI studies - during opening and closing the patient open in a series of stepped distances and using rapid image acquisition. ("fast scan ")



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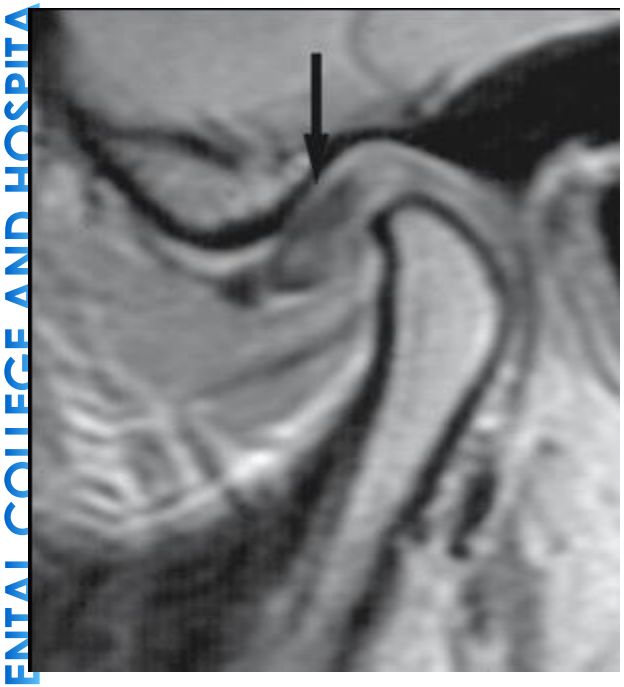
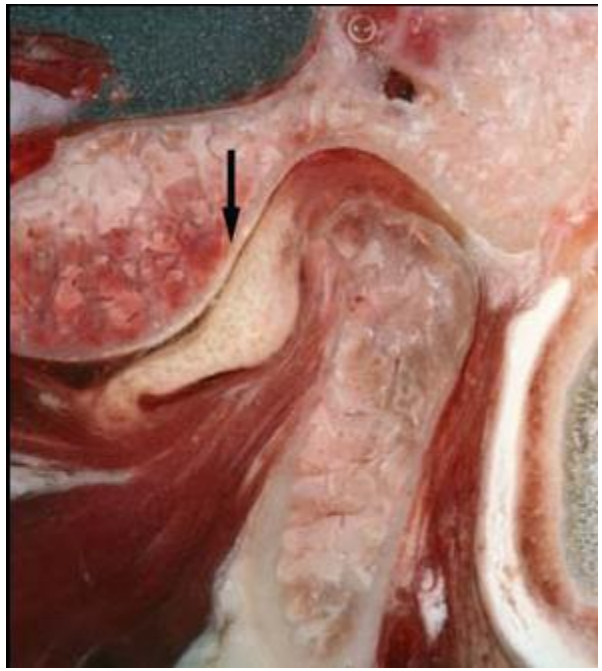
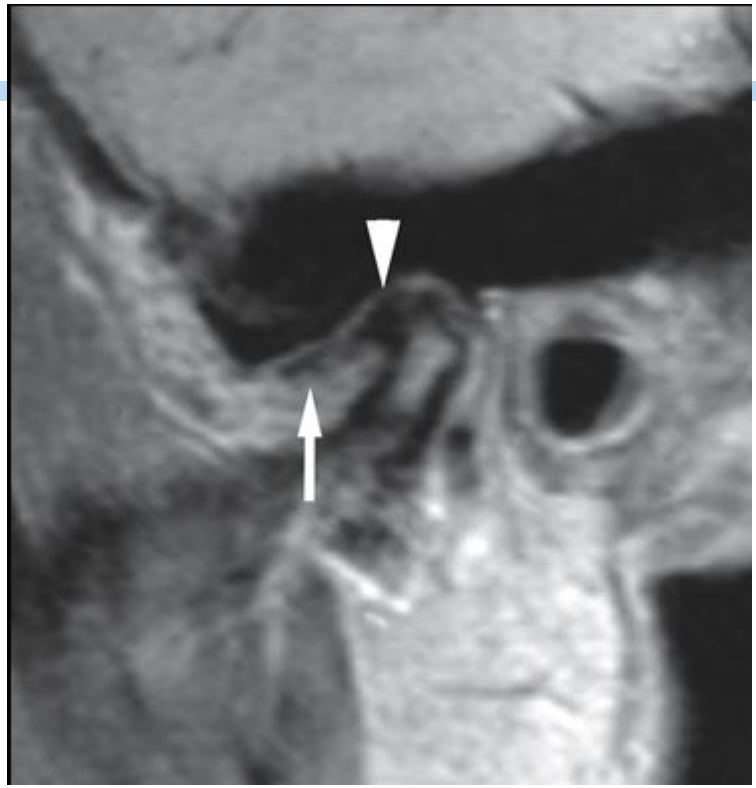


medial section



Autopsy

Open-mouth MRI



anteriorly displaced and deformed, degenerated disc and irregular cortical outline

Evidence

Authors	Limchaichana N, Petersson A, Rohlin M
Title	The efficacy of magnetic resonance imaging in the diagnosis of degenerative and inflammatory temporomandibular joint disorders: a systematic literature review. Grade ++++
Aim	To evaluate the evidence for the efficacy of magnetic resonanceimaging (MRI) in the diagnosis of disk position and configuration, diskperforation, joint effusion, and osseous and bone marrow changes in TMJ
Results	The literature search yielded 494 titles, of which 22 were relevant. No publication had high level of evidence, and 12 had moderate and 10 low levels of evidance. The evidence grade for diagnostic efficacy expressed as sensitivity, specificity and predictive values was insufficient.
Interpretation	Insufficient evidence emphasizes the need for high quality studies on the diagnostic efficacy of MRI, incorporating accepted methodologic criteria.

Arthrography

- Arthrography involves injection of a radiopaque contrast material into the joint spaces.

- The space occupied by the disc can then be visualised lying between the layers of contrast material.

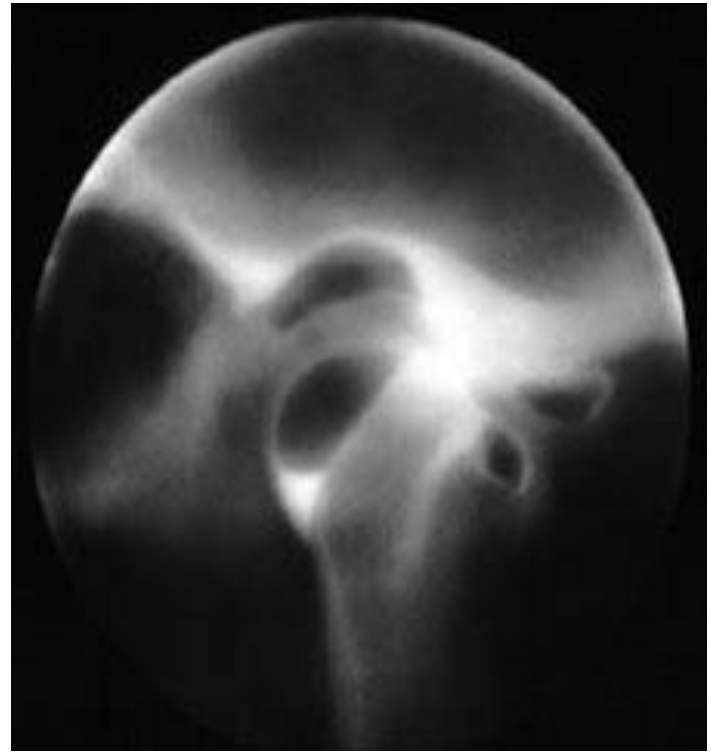
TYPES OF ARTHROGRAPHY

1. SINGLE CONTRAST ARTHROGRAPHY
2. DOUBLE CONTRAST RADIOGRAPHY

Variations of the Arthrographic technique

- One of the more commonly used approaches involves injection of contrast material into the lower joint spaces, referred to as lower joint space or single — contrast arthrography.
- Perforations of the disc or posterior attachment are demonstrated by contrast material simultaneously flowing into the upper joint space as the lower space is injected.

- Another variation of the technique involves injecting contrast material into both the spaces and viewing the more central portions of the joint with tomography. Because contrast material is in both the joint spaces, the outline of the disc is profiled, showing its configuration and position.



- The outline of the disc can often be enhanced by using double-contrast arthrography. This technique involves injecting a small amount of air along with a small amount of contrast material into both joint spaces, producing a thin coat around the periphery of both joint spaces that highlights the disc and the joint spaces.

Indications

- Position and function of disk - pain and dysfunction - long standing
- History of locking - persistent
- Perforations of the disk and retrodiscal tissue.
- Joint dynamics
- Disc displacement - ant / anteromedial

ADVANTAGES

- Arthrography provides information regarding the soft tissue components, specifically the shape and position of the articular disc.
- It has been demonstrated that with the addition of tomography, the diagnosis of abnormalities in the position and shape of the disc is accurate.
- Fluoroscopic observation of the injection may reveal the presence of adhesions, perforations and discontinuities in the capsule and provides a dynamic study of disc movements, also any abnormal accumulation of joint fluid may be evident.

- Synovial fluid sampling (arthocentesis) and lavage of the joint can accompany the procedure of arthrography.

- Arthrography assures a correct pre-operative diagnosis of loose bodies (joint mice)

CONTRAINDICATIONS

- Acute joint infection
- Allergy to iodine or to the contrast medium

LIMITATIONS

- Direct medial or lateral displacements are difficult to interpret with arthrography.
- Cannot be used when the disc is severely de-formed.

COMPLICATIONS

- Joint sepsis
- Allergic reaction to the iodinated contrast medium and haemarthrosis.
- Pain during and after the procedure
- Extravasation of the contrast medium, disc perforation and transient facial paralysis

Contrast Media

- Water soluble – eg Sinografin, Renografin
- Oil Soluble – Ethiodol
- Iodine-based contrast media are usually classified as

1. Ionic Eg Diatrizoate, Isopaque
2. Non-ionic. Eg Iopamidol, Iohexol

BONE SCINTIGRAPHY

- Sensitive technique
- Bone and joint pathology
- Intravenous injection of tracer dose of radionuclide-technetium methylene diphosphonate.
- Planar and tomographic images are obtained in all planes.
- Indication-to rule out tumors, condylar hypoplasia, Internal derangement

Procedure

- 99mTc is bound to methyle disphosphonate (MDP).
- Dose – 20-30 mCi
- Injected IV
- First phase – Flow phase – first 60 to 90 sec – radionuclide angiography
- Second phase – blood pool phase
- Third phase – scintigraphy phase – 2-3 hrs after injection
- MDP deposition in bone depends upon osteoclastic activity and blood flow

Advantages of bone scintigraphy :

- Bone changes are demonstrated before they are depicted by radiographic examination up to 6 to 12 months earlier in neoplastic involvement.
- Up to 2 weeks earlier in bone infection.

Disadvantage

- Lack of specificity.
- Radionuclide imaging is a highly sensitive technique for evaluating the TMJ but is not specific; arthritis, tumor, inflammation, and trauma can give rise to similar appearances.

Evidence

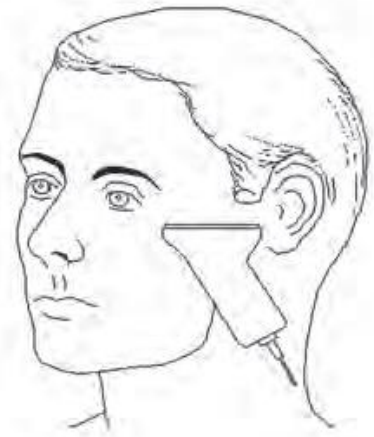
Authors	Saridin CP, Pieter GHM, Dirk TB et al.
Title	Bone scintigraphy as a diagnostic method in unilateral hyperactivity of the mandibular condyles: a review and meta-analysis of the literature. Grade: ++++
Aim	To compare the diagnostic accuracy of planner and SPECT bone scans
Results	The pooled sensitivity of planner bone scan was 0.71, which was significantly lower than that of bone SPECT technique which was 0.90. the pooled specificity of SPECT scan was 0.95, which did not significantly differ from that of planner scan.
Interpretation	Bone scans are best performed using SPECT, conducting a quantitative analysis by calculating the percentile differences between the left and right condylar regions.

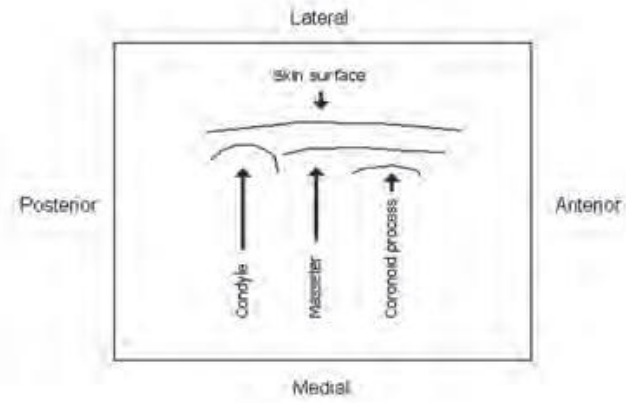
Ultrasonography

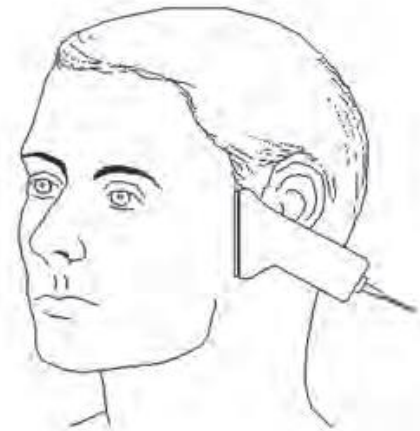
Principle:

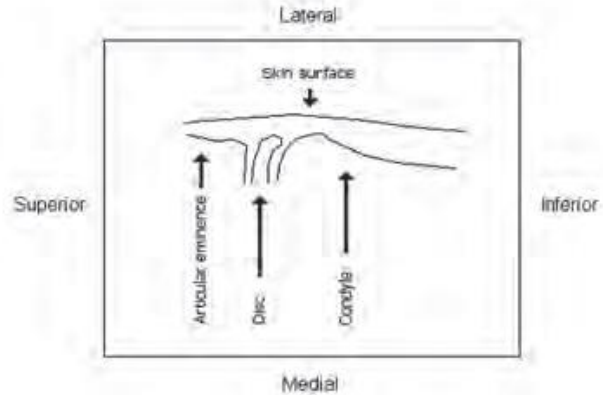
- Ultrasonic sound waves emitted by a device (transducer), travel through the tissue against which they are aimed, and are partly reflected on transiting through dissimilar anatomical structures. The reflected sound waves are then read by the same emitting device, and translated into images

- Condyle – hyperechoic
- Connective tissue i.e. the joint capsule and the retrodiscal tissue, and muscular tissue - isoechoic
- Sup and Inf joint space – Isoechoic
- Disk – Iso to hypoechoic









- Noninvasive and inexpensive
- Disc displacement and joint effusion

Limitations

- Scarce accessibility of the medial part of the TMJ structures
- Need for trained and calibrated operators

Evidence

Authors	Saridin CP, Pieter GHM, Dirk TB et al.
Title	Use of ultrasonography for the diagnosis of temporomandibular joint disorders: A review Grade: +++
Aim	To evaluate the reliability of ultrasonography in the diagnosis of temporomandibular joint (TMJ) disorders.
Results	Ultrasonography sensitivity ranged from 13-100% for the evaluation of disc displacement (DD), from 70.6-83.9% for the evaluation of joint effusion (JE), and from 70-94% for the evaluation of condylar erosion (CE). Specificity ranged from 62-100% for the evaluation of DD, from 73.7-100% for the evaluation of JE, and from 20-100% for the evaluation of CE. Accuracy ranged from 51.5-100% for the evaluation of DD, from 72.2-95% for the evaluation of JE, and from 67-94% for the evaluation of CE.
Interpretation	Ultrasonography is a noninvasive and inexpensive diagnostic procedure that can be suggested for the evaluation of TMJ disorders, with particular accuracy in the detection of disc displacement and joint effusion. Limitations are especially related to the scarce accessibility of the medial part of the TMJ structures, and the need for trained and calibrated operators.

TMJ Arthroscopy

- **TMJ Arthroscopy is a technique for direct visual inspection of internal joint structures, including biopsy and other surgical procedures performed under visual control which comprises use of an Arthroscope.**
- **Arthroscopy was first described by Takagi in 1939**
- **Ohnishi in 1975 ,published first report on TMJ arthroscopy**

INDICATIONS

- Internal derangement
- Osteoarthritis
- Arthritides
- Pseudotumors
- Post-traumatic complaints
- To perform biopsy

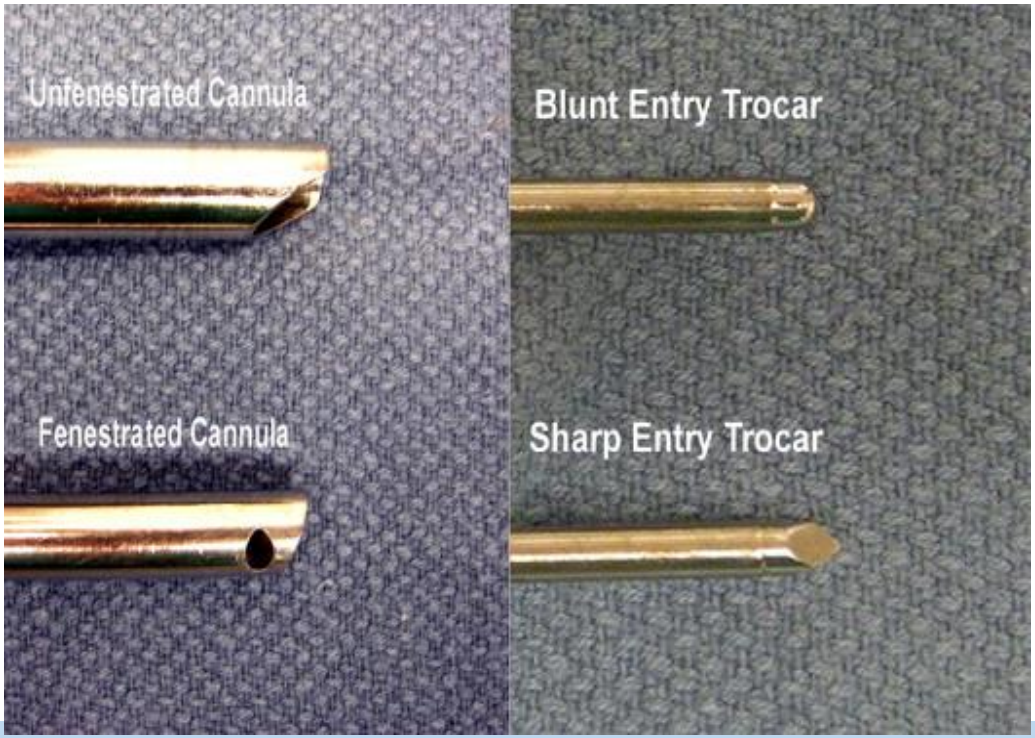
CONTRAINDICATIONS

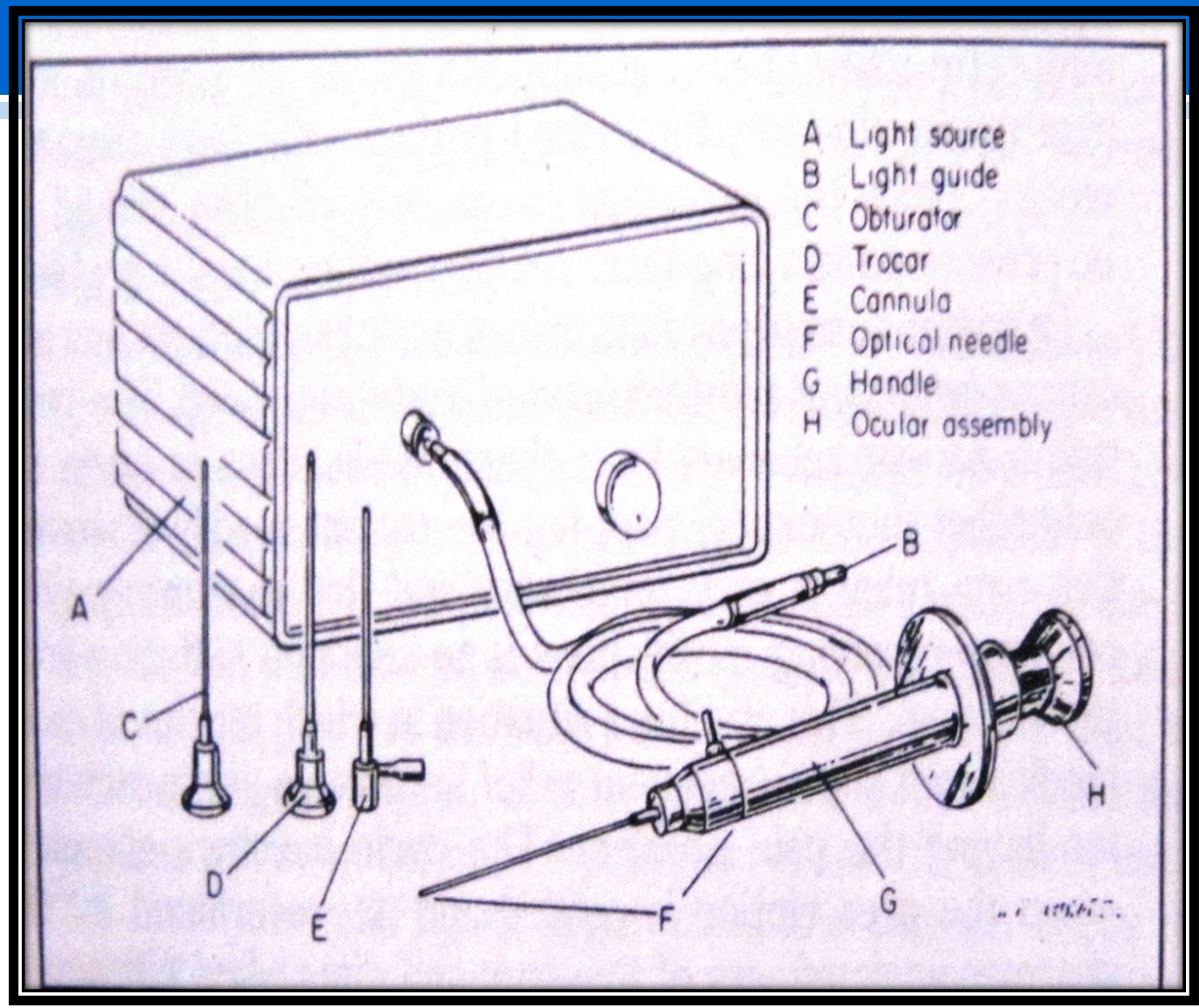
- Bony ankylosis
- Advanced resorption of the glenoid fossa
- Infection in the joint area
- Malignant tumors
- Increased risk for hemorrhage
- Increased risk for infection
- Fibrous ankylosis

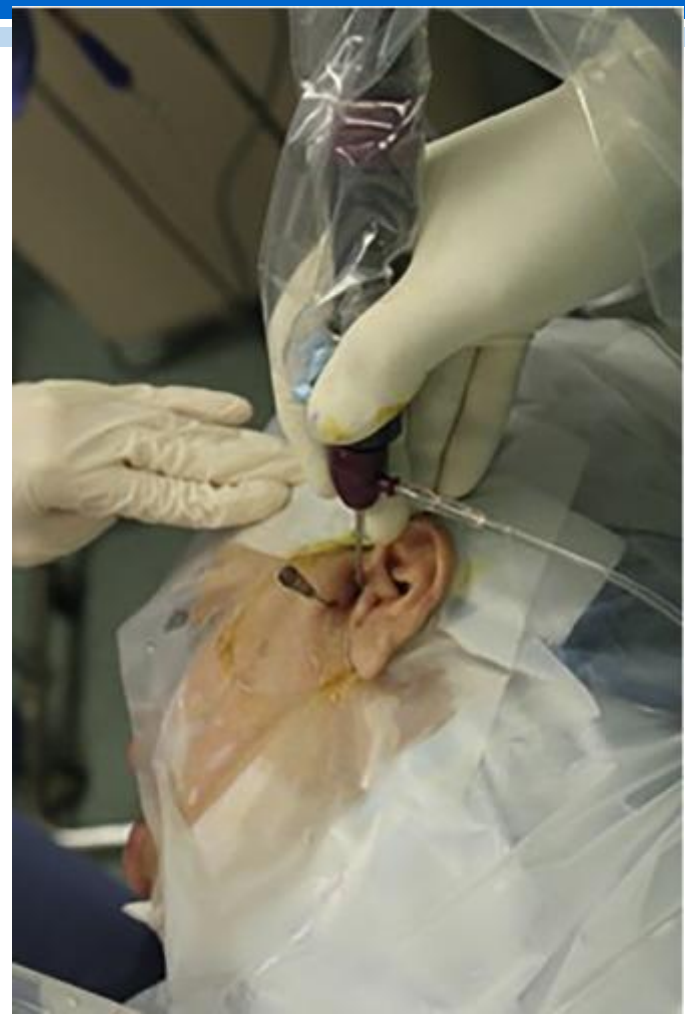
ARTHROSCOPY EQUIPMENT

- **General:** suction, Lactated Ringer's IV bag for irrigation, marking pen
- **Specific**
  - TMJ instrument set
    - 30-degree arthroscope
    - 0 , 70 ,120 degree

- Trocars – sharp & blunt
- Canullas
- Fluid infusion system







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- Karjodkar F. textbook of dental and maxillofacial radiology. 1st edition. 2005. Jaypee brothers.
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1. Which is NOT identified in a panoramic projection?

a. Large osteophytes.

b. Extensive erosions.

c. Tumors or fractures.

d. Mild osseous changes.

2. Medial surface of the condylar head and neck is seen in which view

a. Transcranial

b. Trans pharyngeal

c. Transorbital

d. Towne's view

3.Which is NOT a viable characteristic of cone-beam computed tomography (CBCT)?

a. Decreased radiation dosage.

b. Excellent images of osseous structures.

c. Excellent images of surrounding soft tissues.

d. Data can be reformatted to improve frontal images of the TMJ

4. Which imaging technique provides an ideal view of osseous TMJ structures?

a. Transcranial.

b. Submentovertex.

c. Cone-beam computed tomography (CBCT).

d. Magnetic resonance imaging (MRI).

5. Which imaging technique best visualizes the soft tissues of the TMJ?

a. CT.

b. MRI.

c. Panoramic.

d. Arthrography

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Thank You