Internal Derangement of the Temporomandibular Joint

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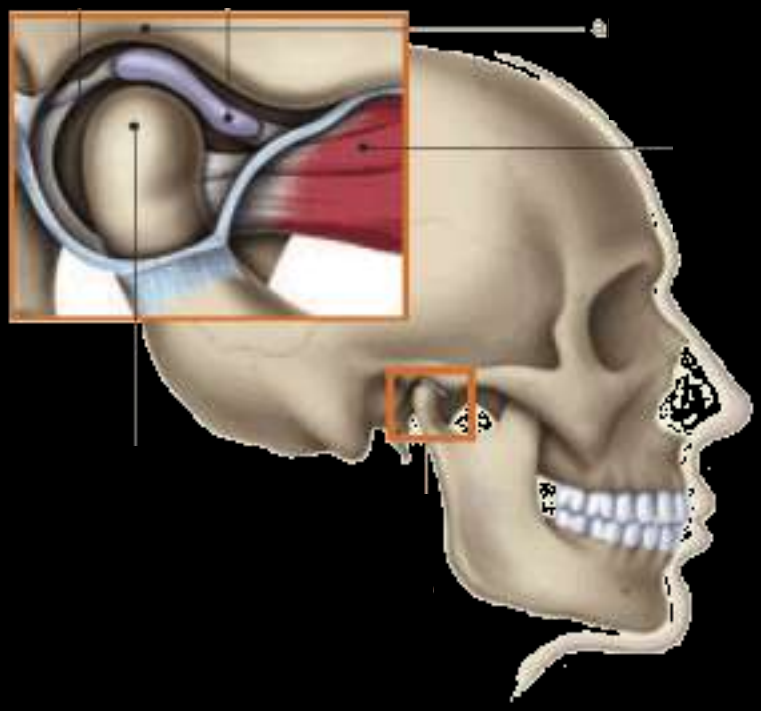
April 3, 2008



Objectives

- Clinical significance
- Imaging using MRI
- Normal anatomy of the temporomandibular joint
- MRI findings of TMJ internal derangement
- Review examples

20-30% of population

Internal derangement and clinical significance

- Most frequent disorder of the TMJ
- Abnormal positional and functional relationship between the articular disk and its articulating surfaces
- F:M= 3-5:1
- Fourth decade
- Bilateral abnormalities 60-70%

Internal derangement and clinical significance

- Disk position can be abnormal in up to 33% of asymptomatic individuals
- 82% of patients presenting with pain and functional disturbance have displaced disks on MRI
- Progressive disorder eventually resulting in ankylosis and osteoarthrosis of varying severity
- Symptoms become quiescent over a period of 6-10 years

Etiology?

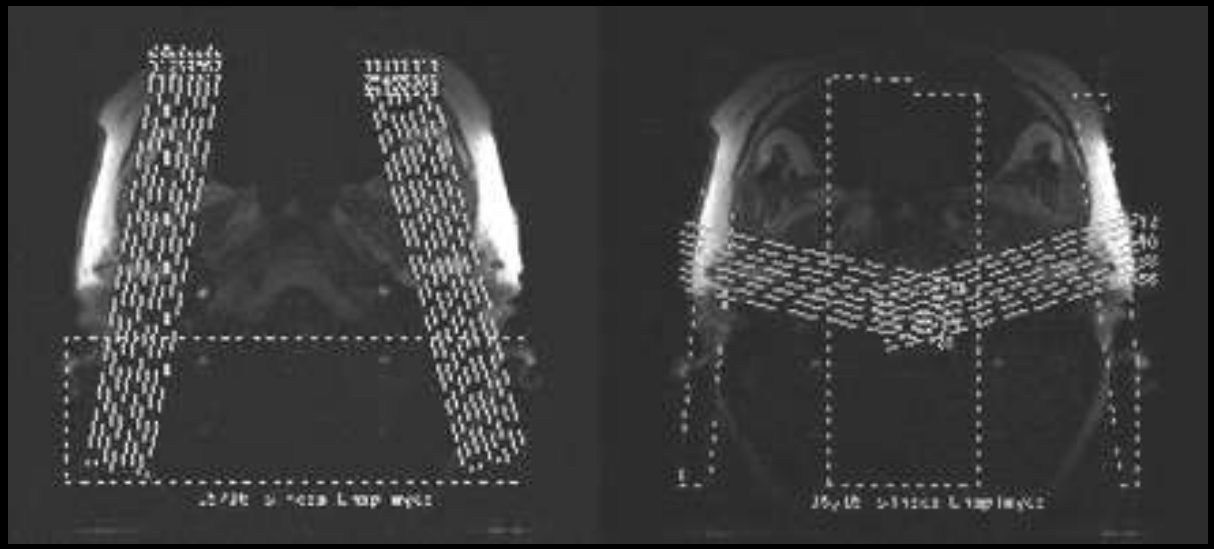
- Not understood
- Trauma
- Iatrogenic
- Ligamentous laxity
- Organic changes in the teeth, malocclusion, bruxism
- Changes in composition of synovial fluid
- Improper activity of lateral pterygoid muscle

Imaging of the TMJ:

- Transcranial radiography
- Panorex
- SPECT using 99mTc MDP/HMDP
- Ultrasound
- CT
- Arthrography
- MRI

Imaging TMJ- MRI

- T1 spin echo coronal or axial localizer
- PD or T1 and T2 sagittal and coronal in closed- and open-mouth positions



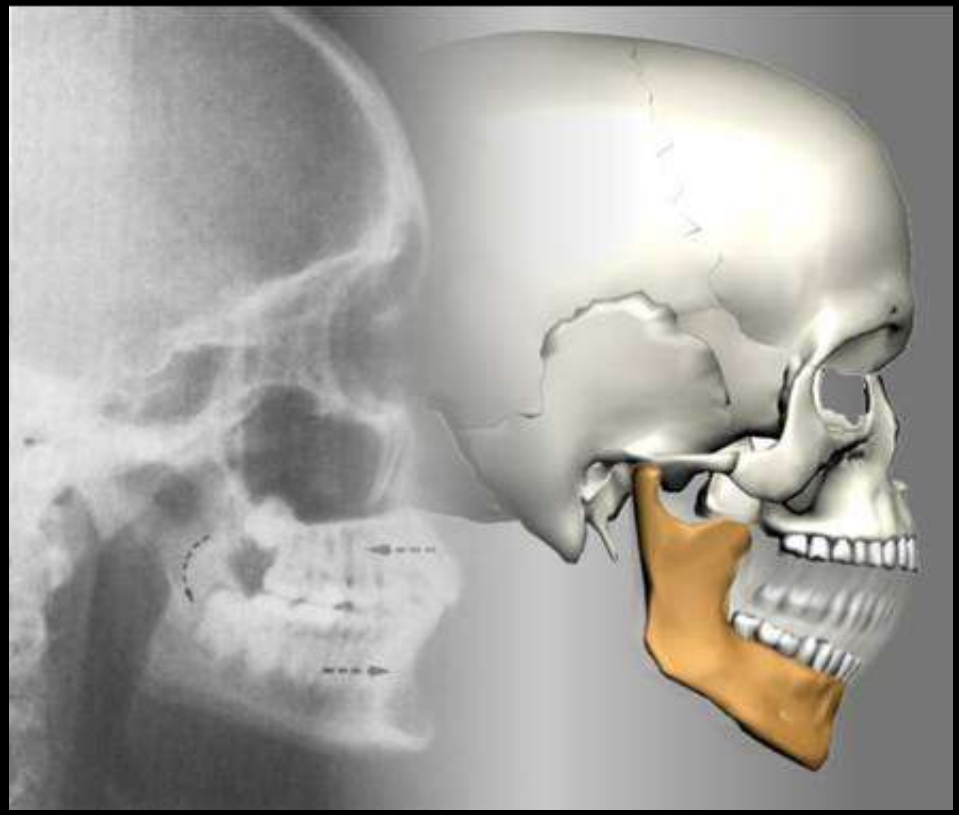
Sommer, O. J. et al. Radiographics 2003;23:14

Imaging TMJ- MRI

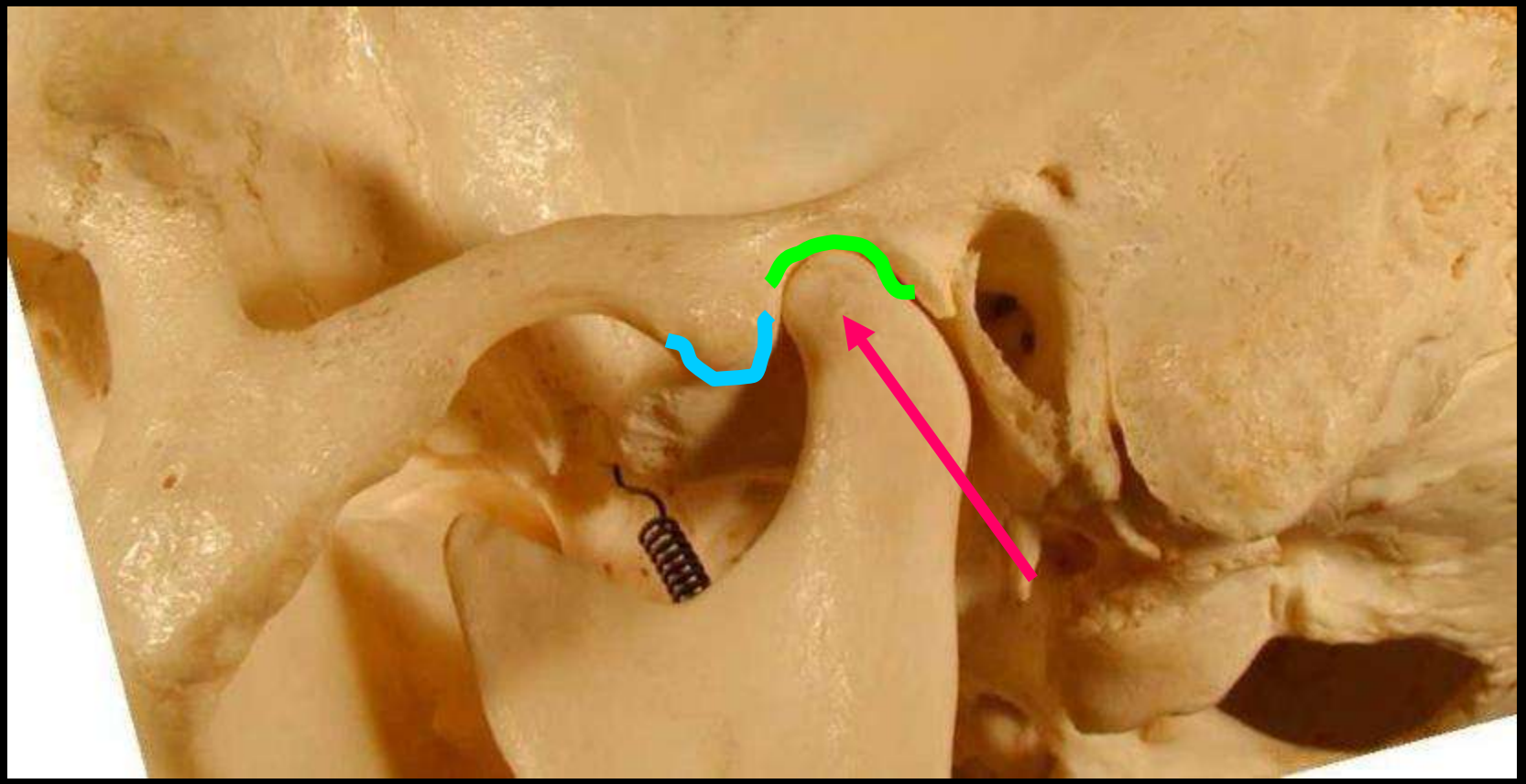
- 3 mm slice thickness with a spacing of 0.5 or 1 mm
- FOV 12-14 cm
- Matrix 256 x 192
- Small surface coils; dual
- Gradient echo- pseudodynamic; static images at progressive increments of mouth opening

Temporomandibular joint

- Craniomandibular articulation
- Ginglymoarthrodial joint
- Joint surfaces covered by fibrocartilage instead of hyaline cartilage
- Synovial membrane lines parts of the joint not covered by fibrocartilage



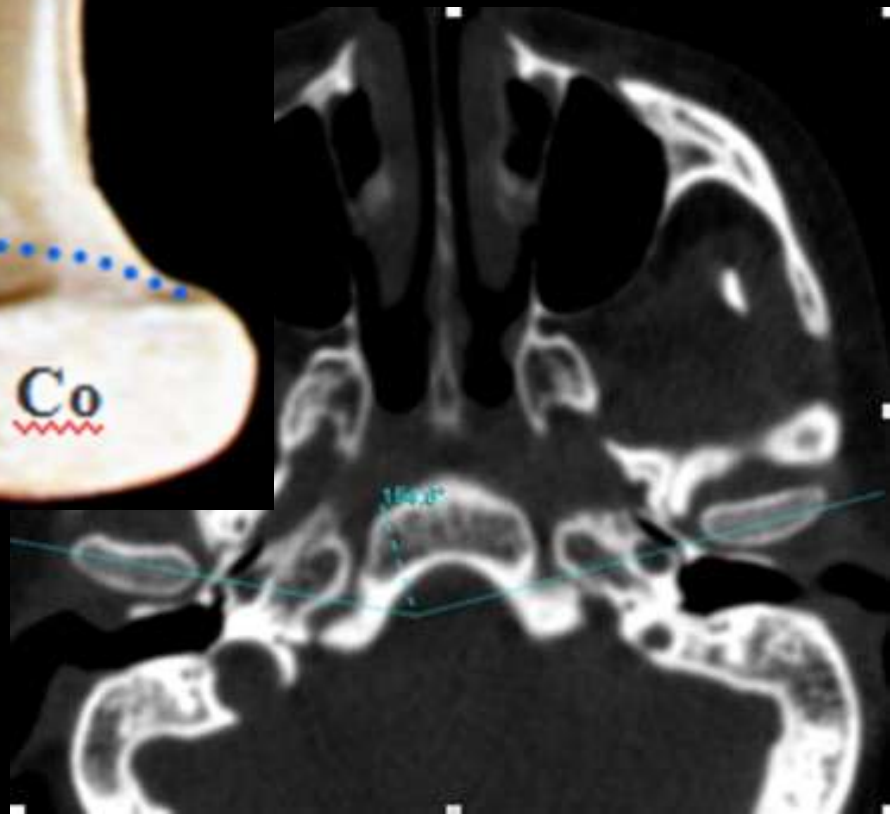
Anatomy-Osseous components



Mandibular component

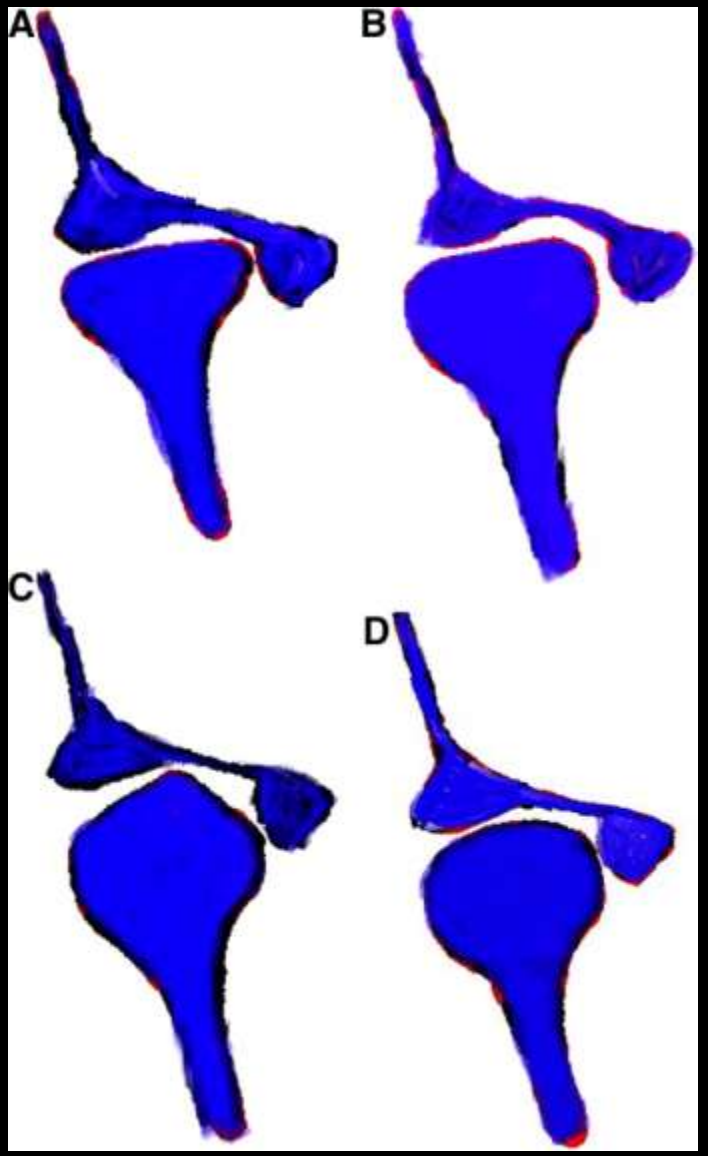
- Condylar head atop mandibular neck
- Lateral pole and medial pole


Cp
Co



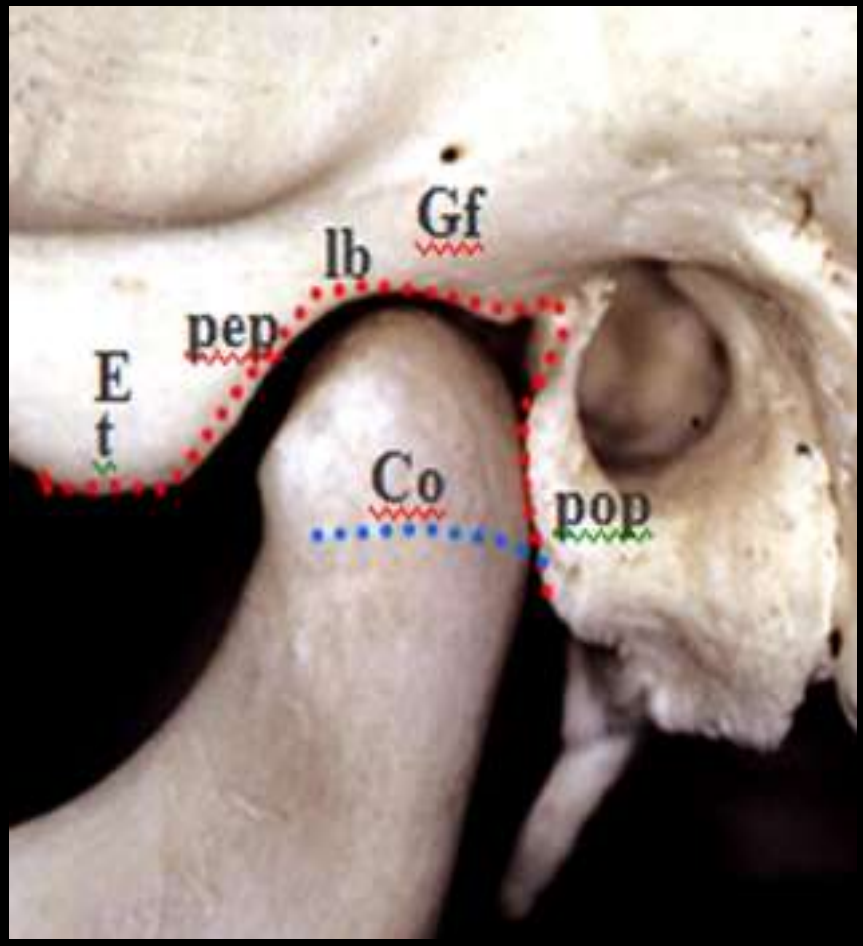
Mandibular component

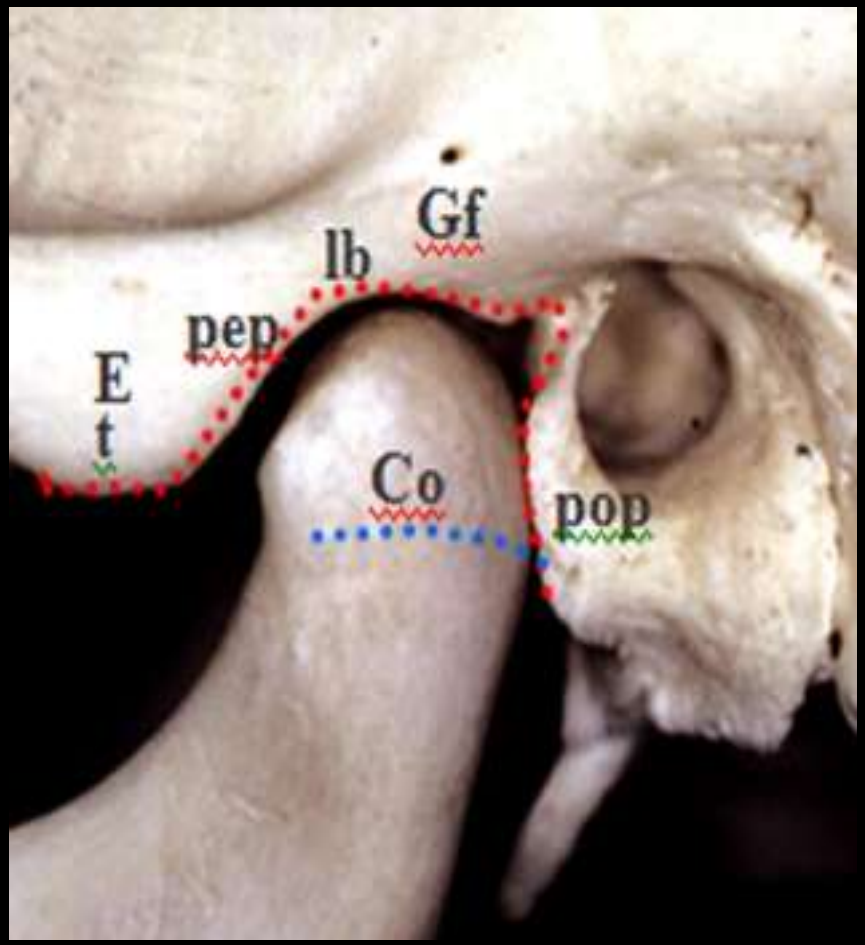
- Morphology of condyle variable



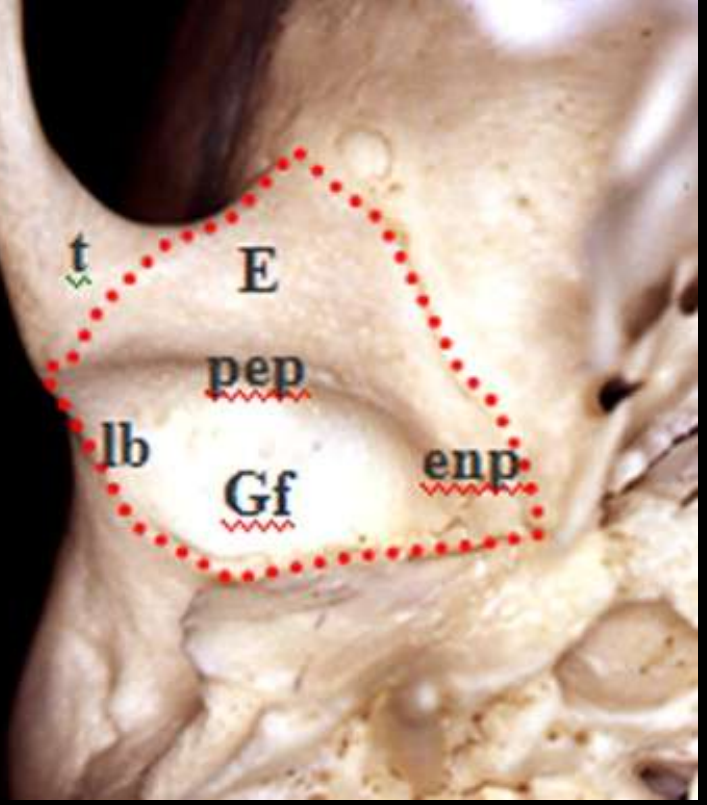
Anatomy- Temporal bone component

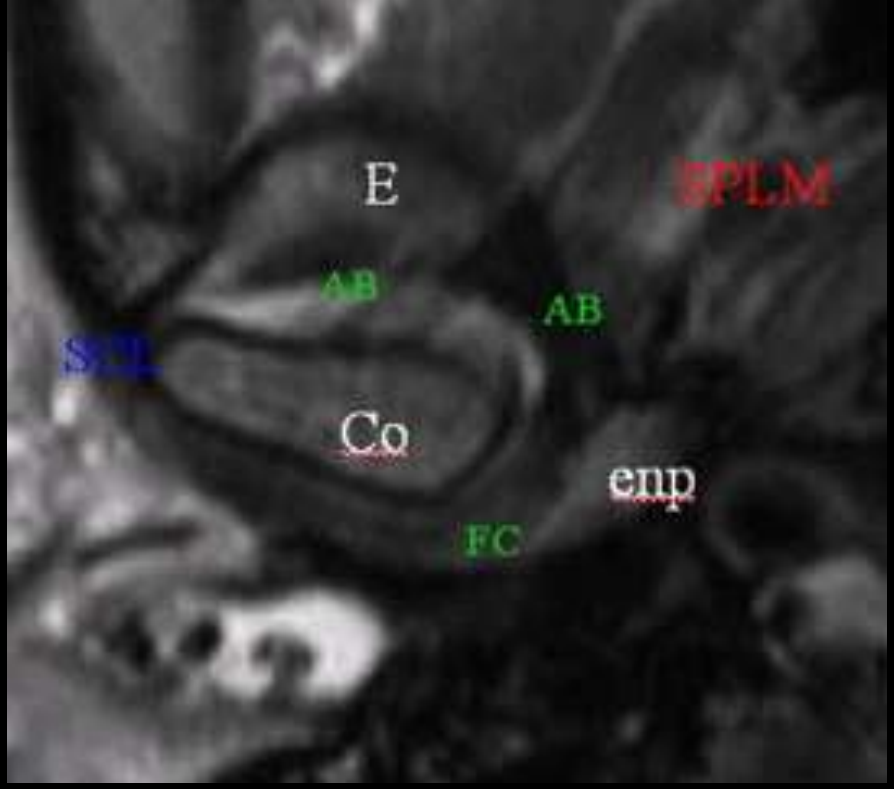
- Articular eminence
- Articular tubercle
- Preglenoid plane
- Glenoid fossa
- Postglenoid process





Alomar X, et al. Sem Ultrasound, CT, MRI. 2007; 28(3):170-183.





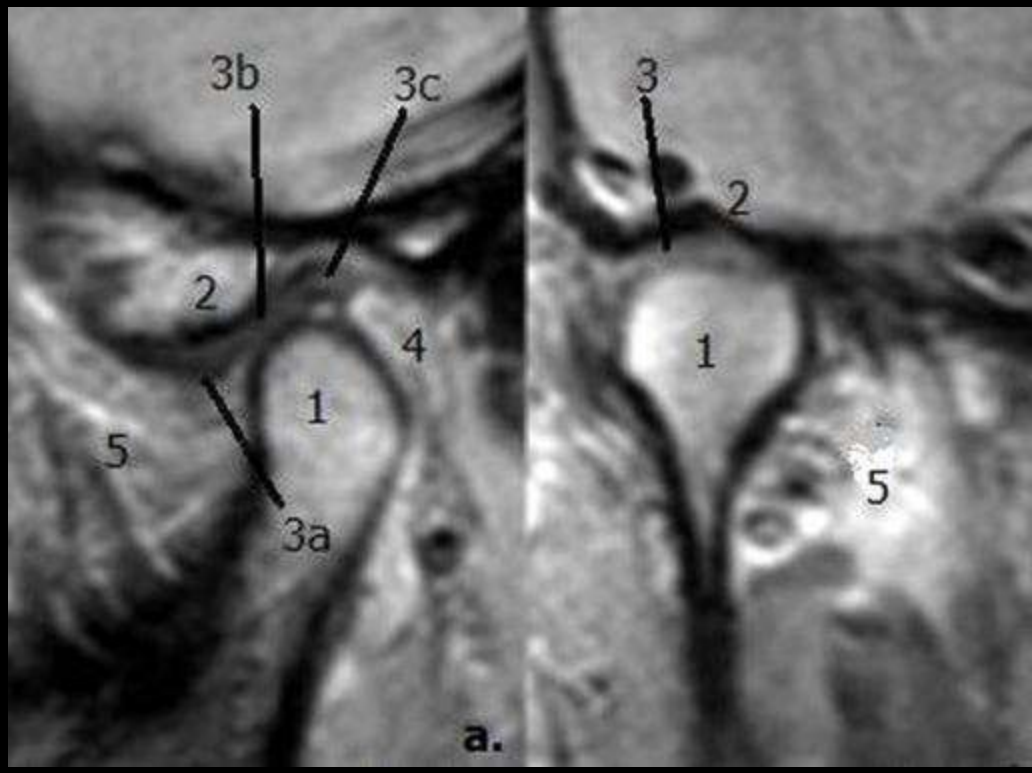
Aloma X, et al. Sem Ultrasound, CT, MRI. 2007; 28(3):170-183.

Anatomy- Articular Disk

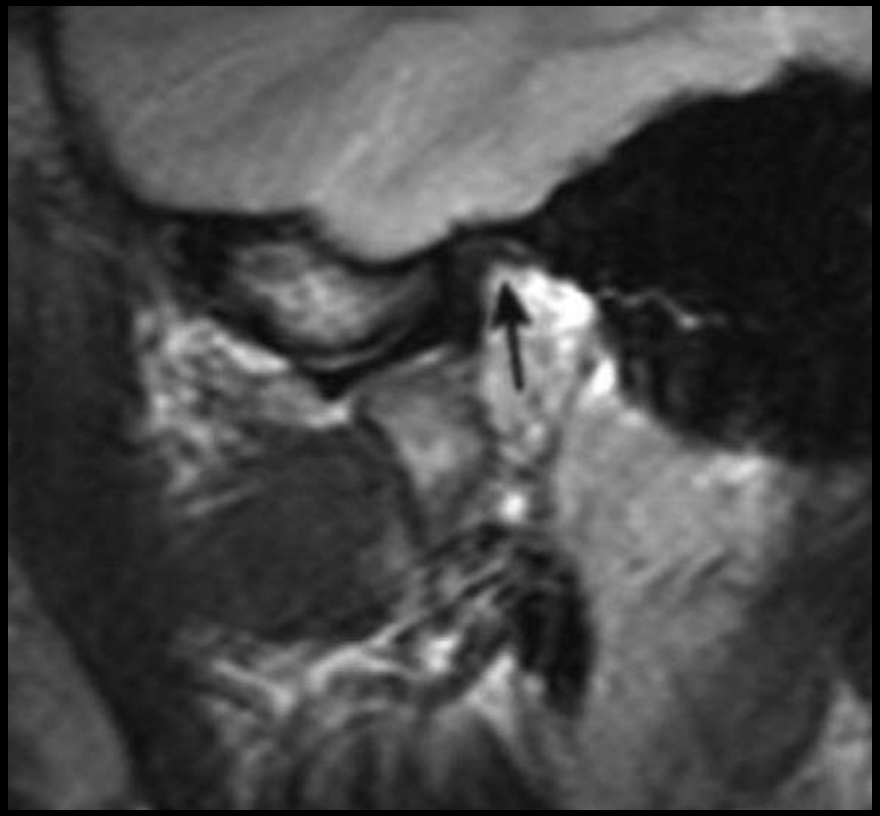
- Biconcave fibrocartilagous disc
- Divides joint into larger upper and smaller lower compartments
- Firmly attached to articular capsule circumferentially except for medially and laterally where it is attached to medial and lateral poles of condyle by collateral condylodiskal ligaments

Articular Disk

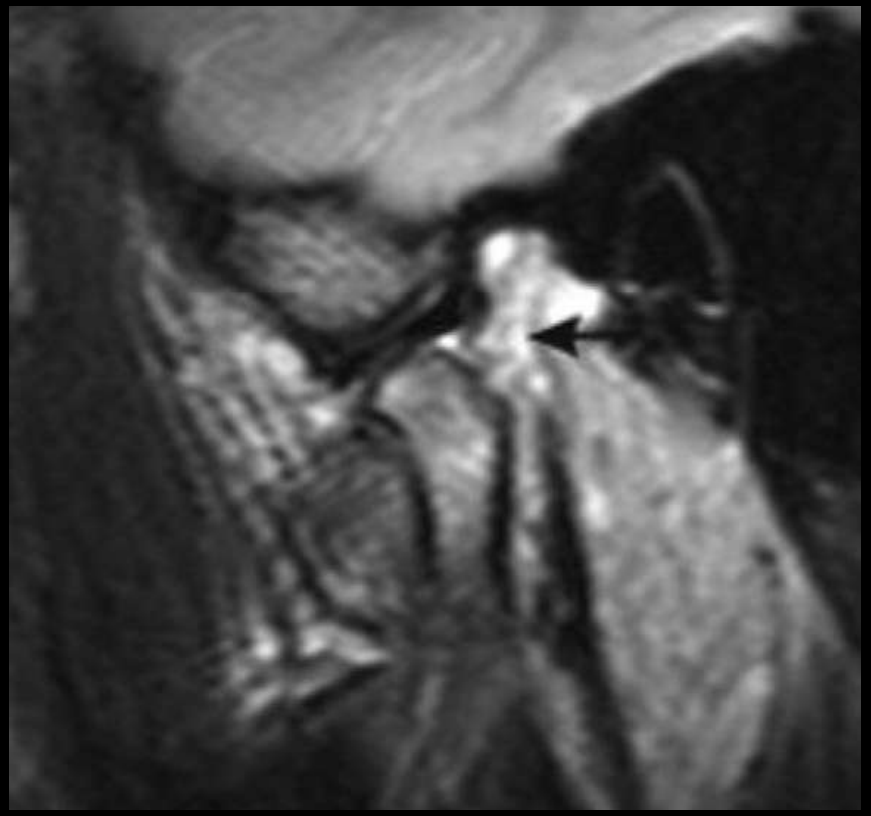
- Anterior band
- Intermediate band
- Posterior band
- Retrodiskal tissue (bilaminar zone)
  - 2 laminae
  - Neurovascular structures



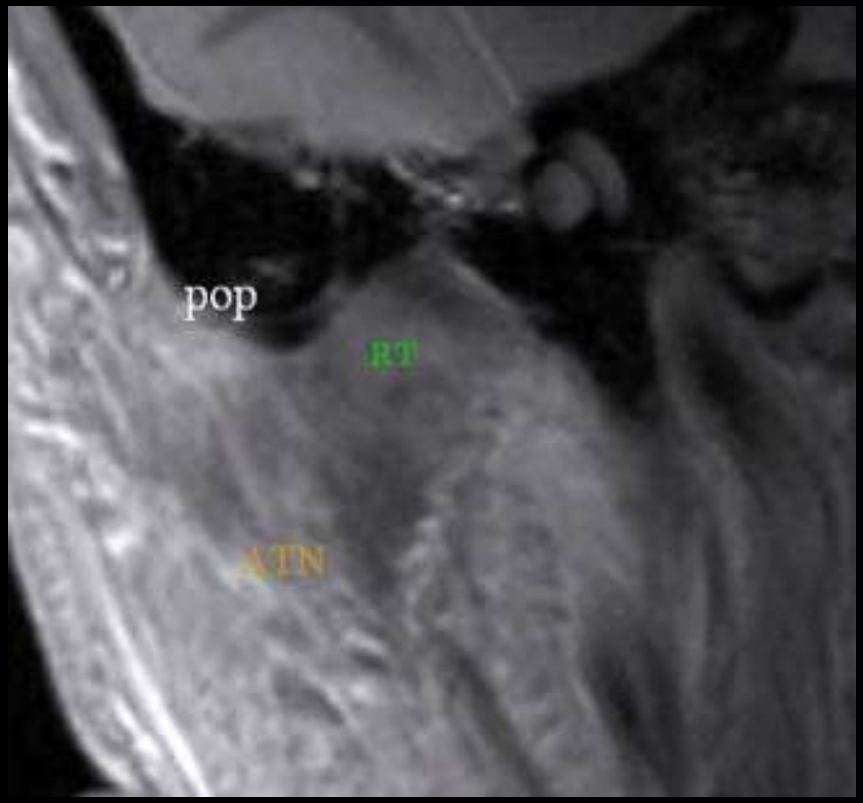
Sommer, O. J. et al. Radiographics 2003;23:14



Normal superior lamina (elastic fibers)



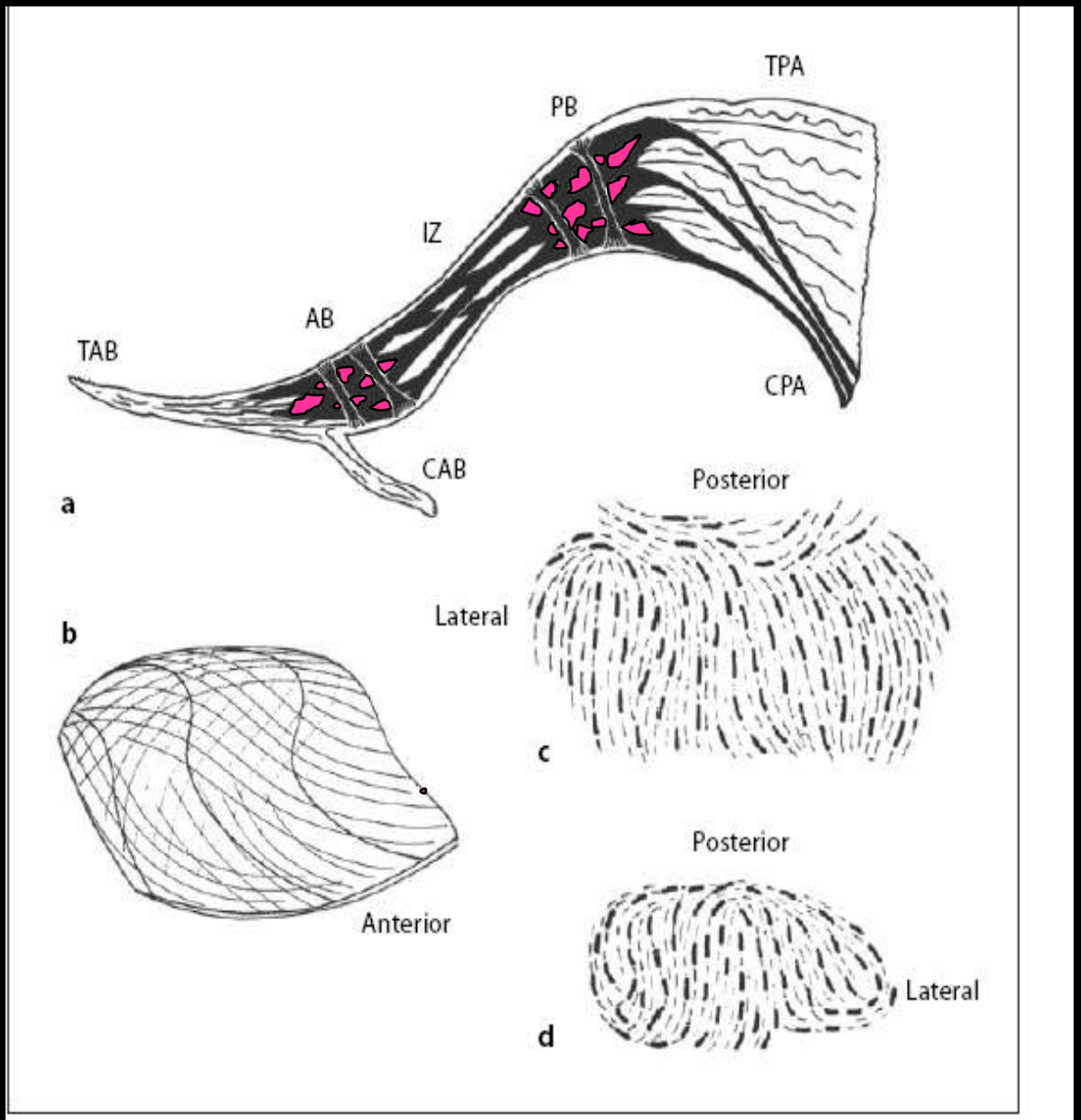
Normal inferior lamina (collagen fibers)



Alomar X et al. Sem Ultrasound, CT, MRI. 2007; 28(3):170-183.

Biomechanical Properties of the Disc

- Disc has to be able to absorb peak loads, distribute force
- Inhomogeneous distribution of collagen, elastin ,proteoglycans and fluid
- Plastic deformation, local and progressively
- Adaptative response



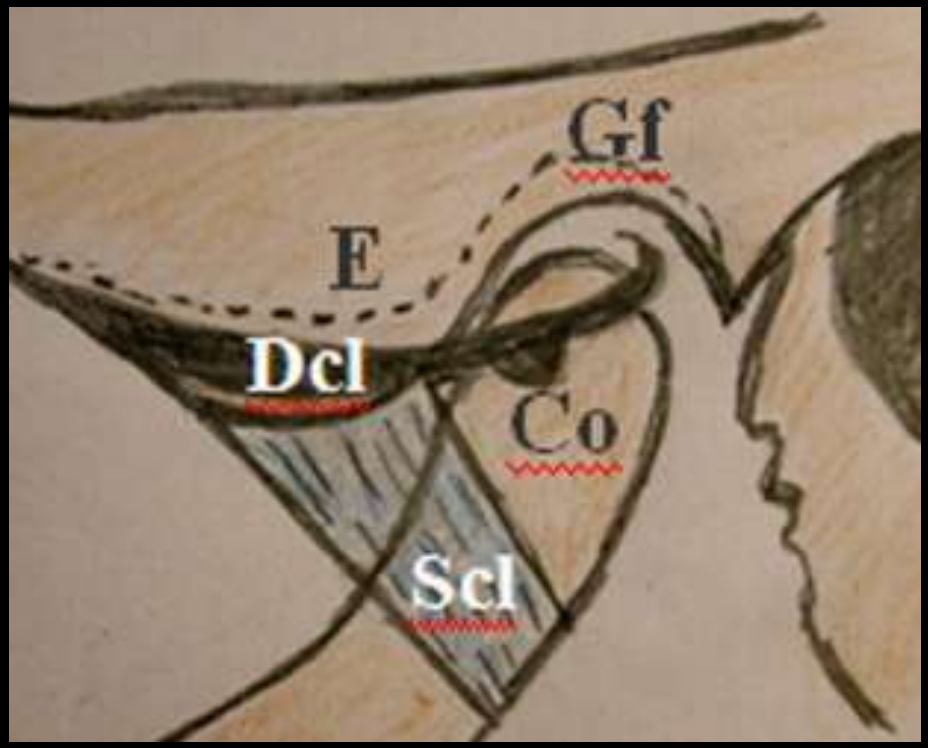
Scapino, et al. Cell Tissues Organs 2006; 182: 201-225

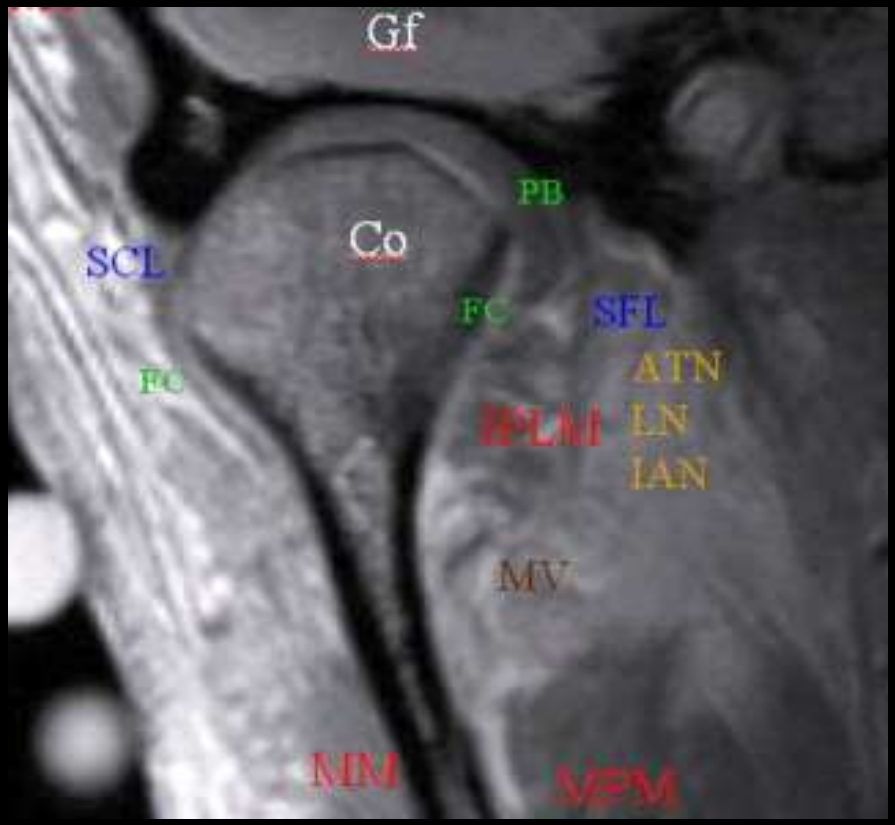
Collateral Ligaments

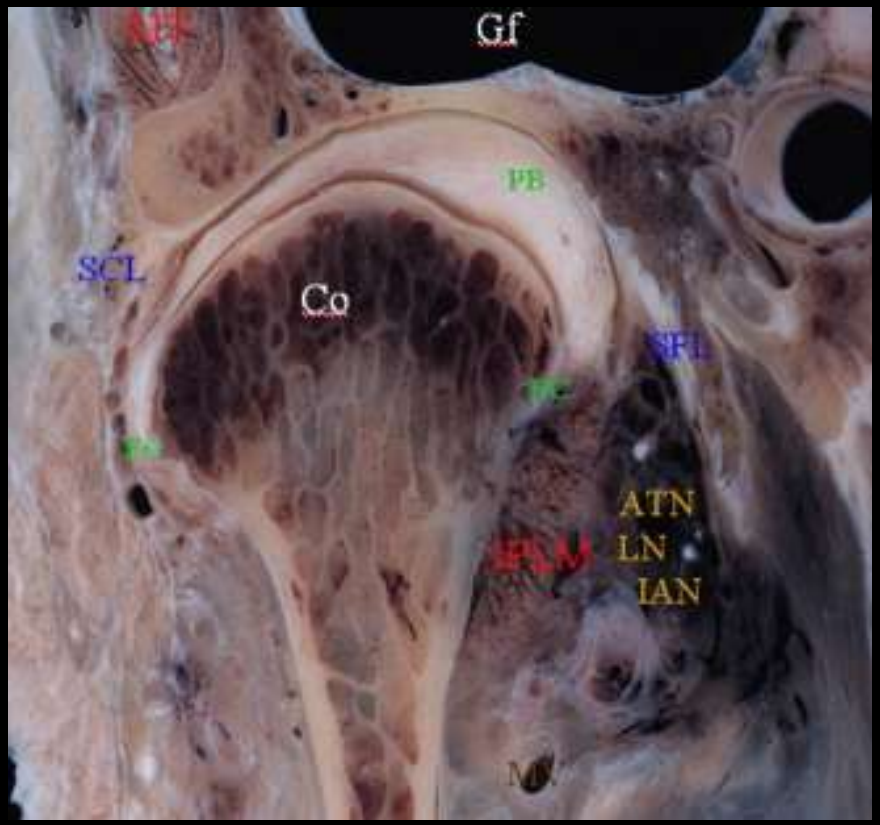
Strong lateral ligament

- 2 layers:
  1) superficial
     -fan-shaped
     -oblique course
     -taut in protraction

  2) deep
     -narrow
     -anteroposterior course
     -taut in retraction







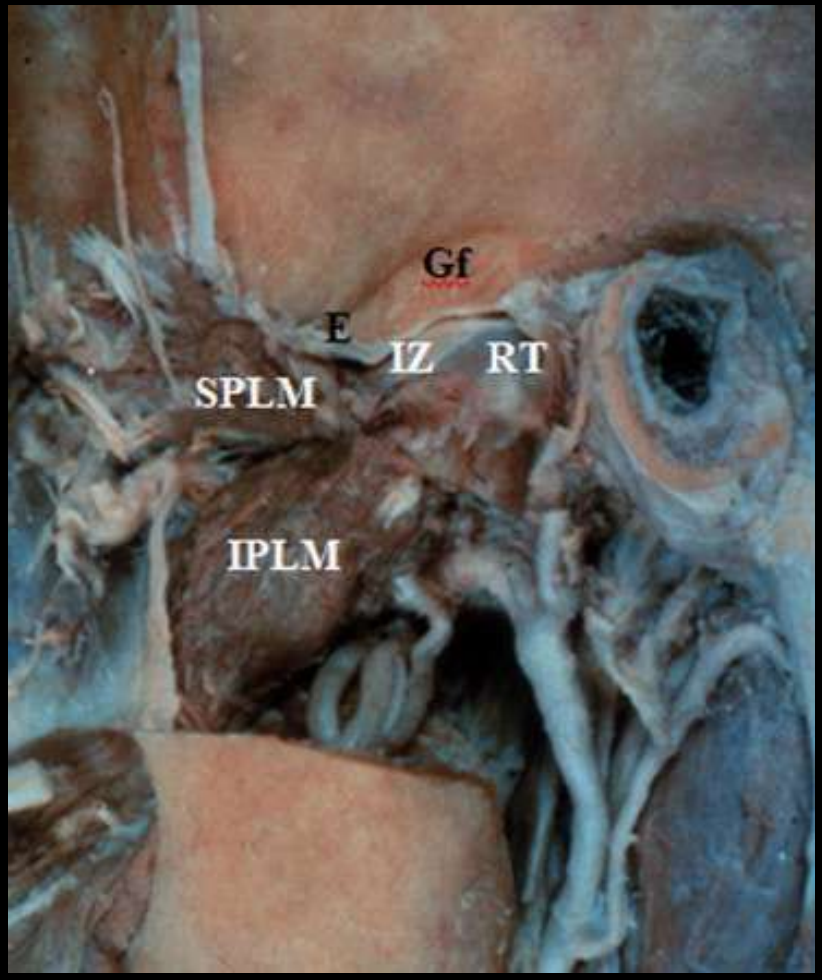
Alomar X, et al. Sem Ultrasound, CT, MRI. 2007; 28(3):170-183.

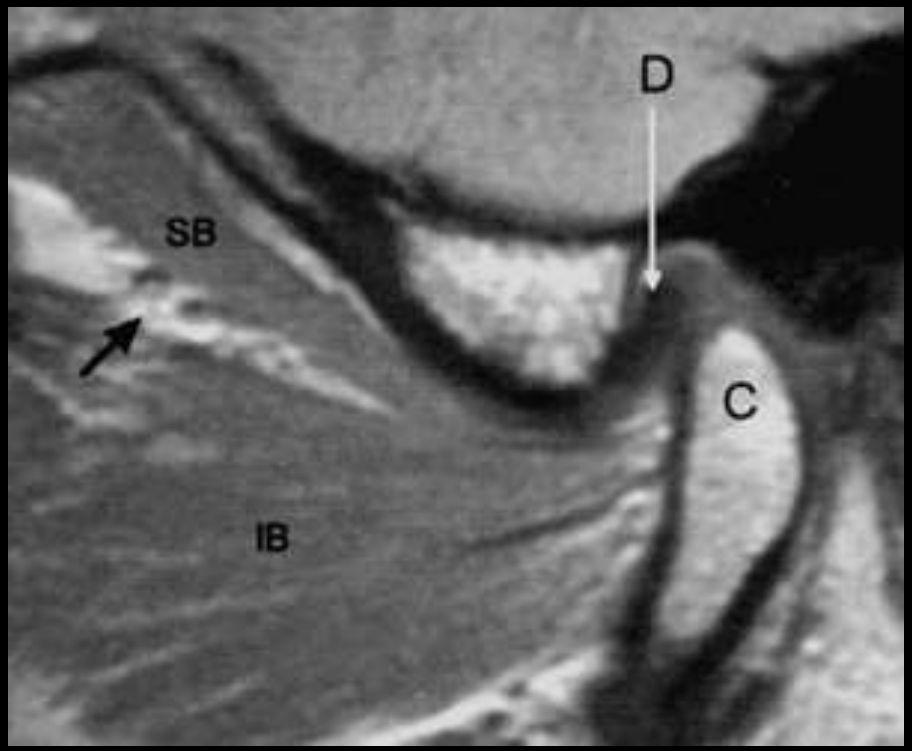
Muscles

- Muscles of mastication:
  - Abductors (jaw opener)
    - Lateral pterygoid
  - Adductors (jaw closers)
    - Temporalis, masseter, and medial pterygoid

Lateral pterygoid

- Superior belly:
  - Pass through joint capsule connecting with anterior band of disk
  - Responsible for proper disk movement in coordination with movement of lower jaw especially during **closing and ipsilateral movements**
- Inferior belly:
  - Pulls condyles forward during **opening**
  - Alternate contracting allows **contralateral** movement





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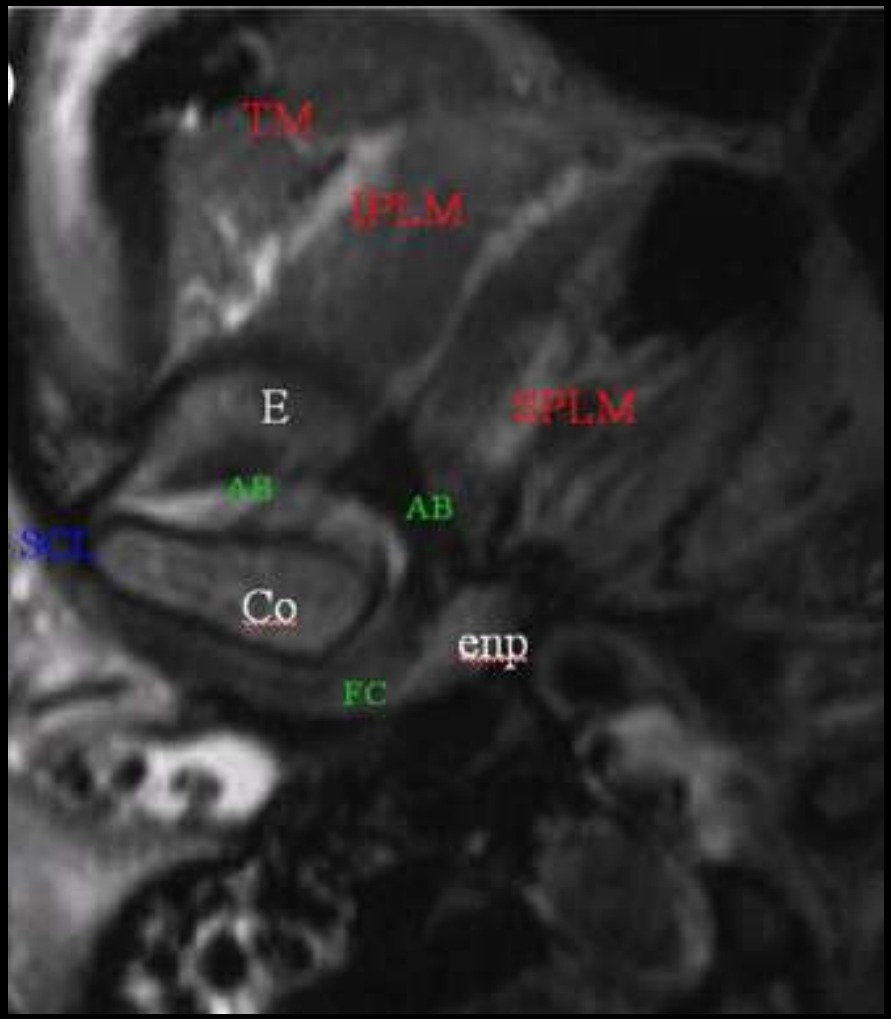

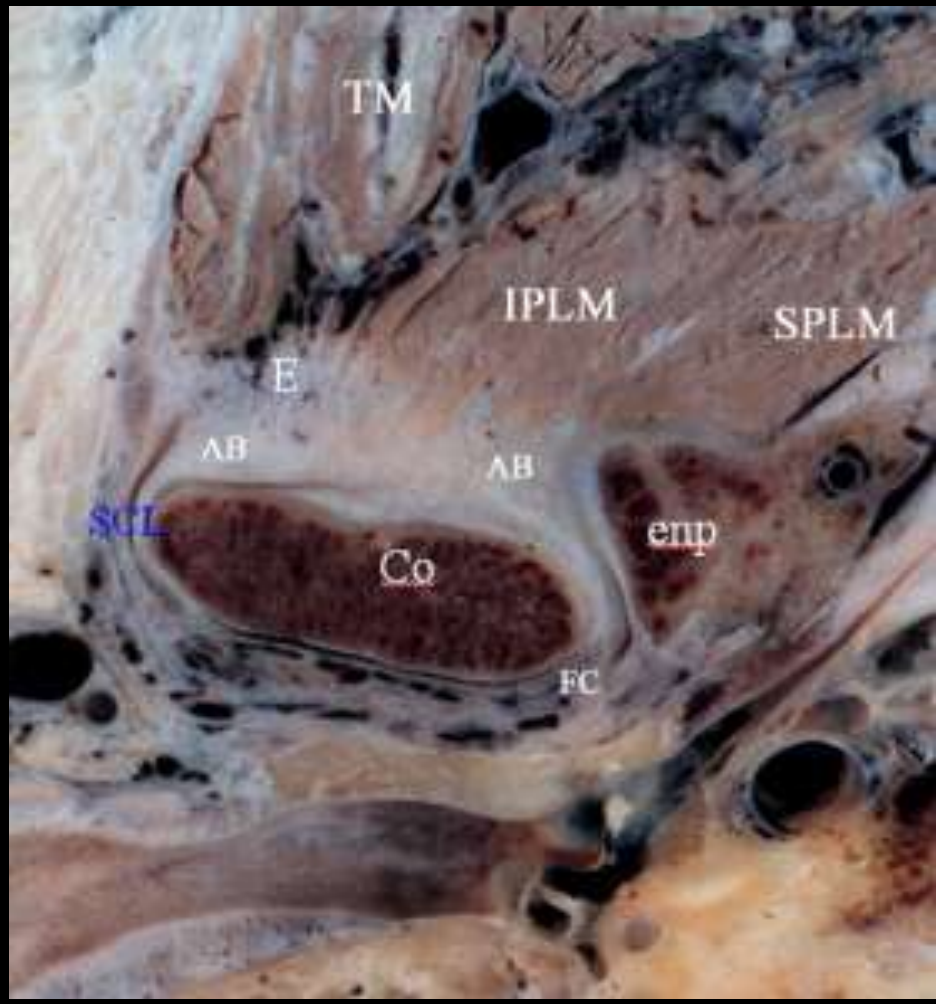

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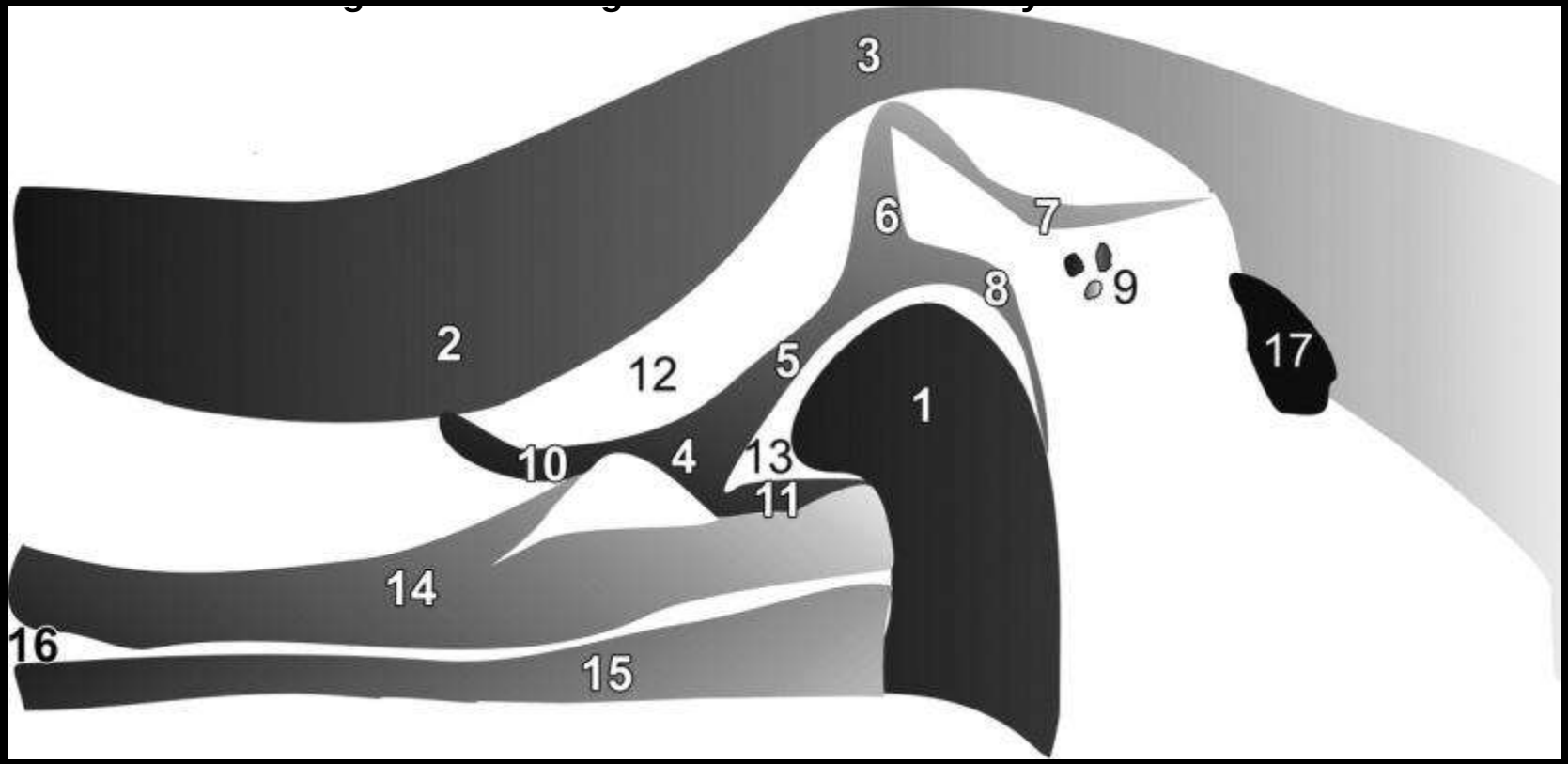
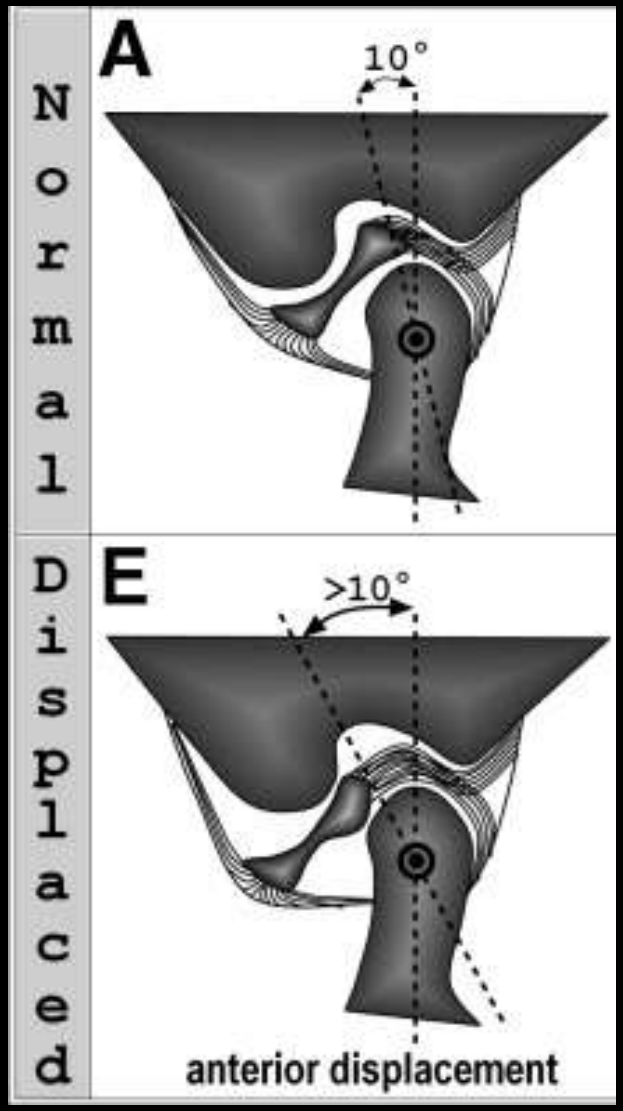
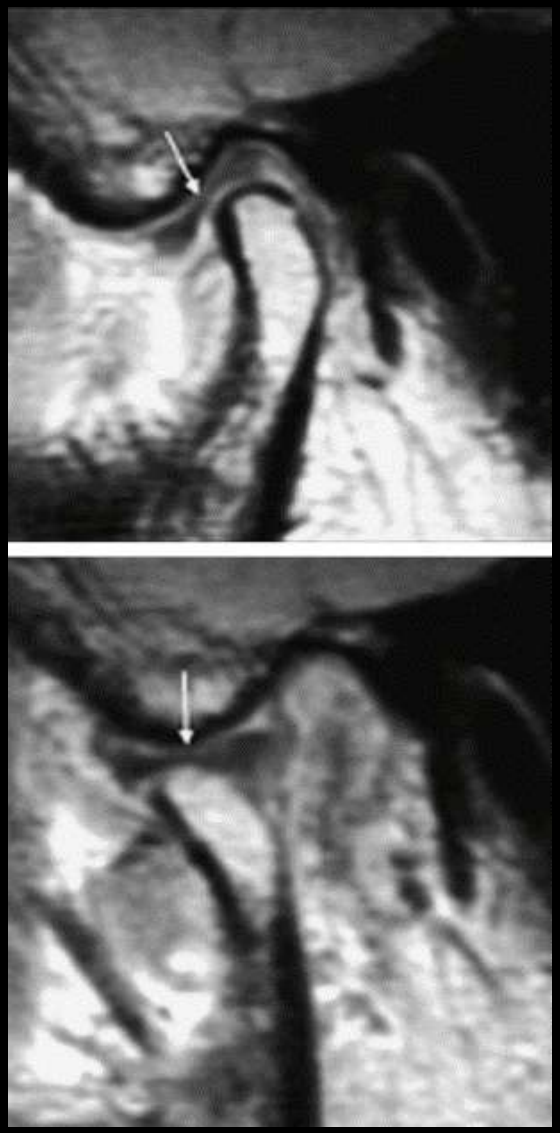


Tomas, X. et al. Radiographics 2006;26:765-781

What is normal?





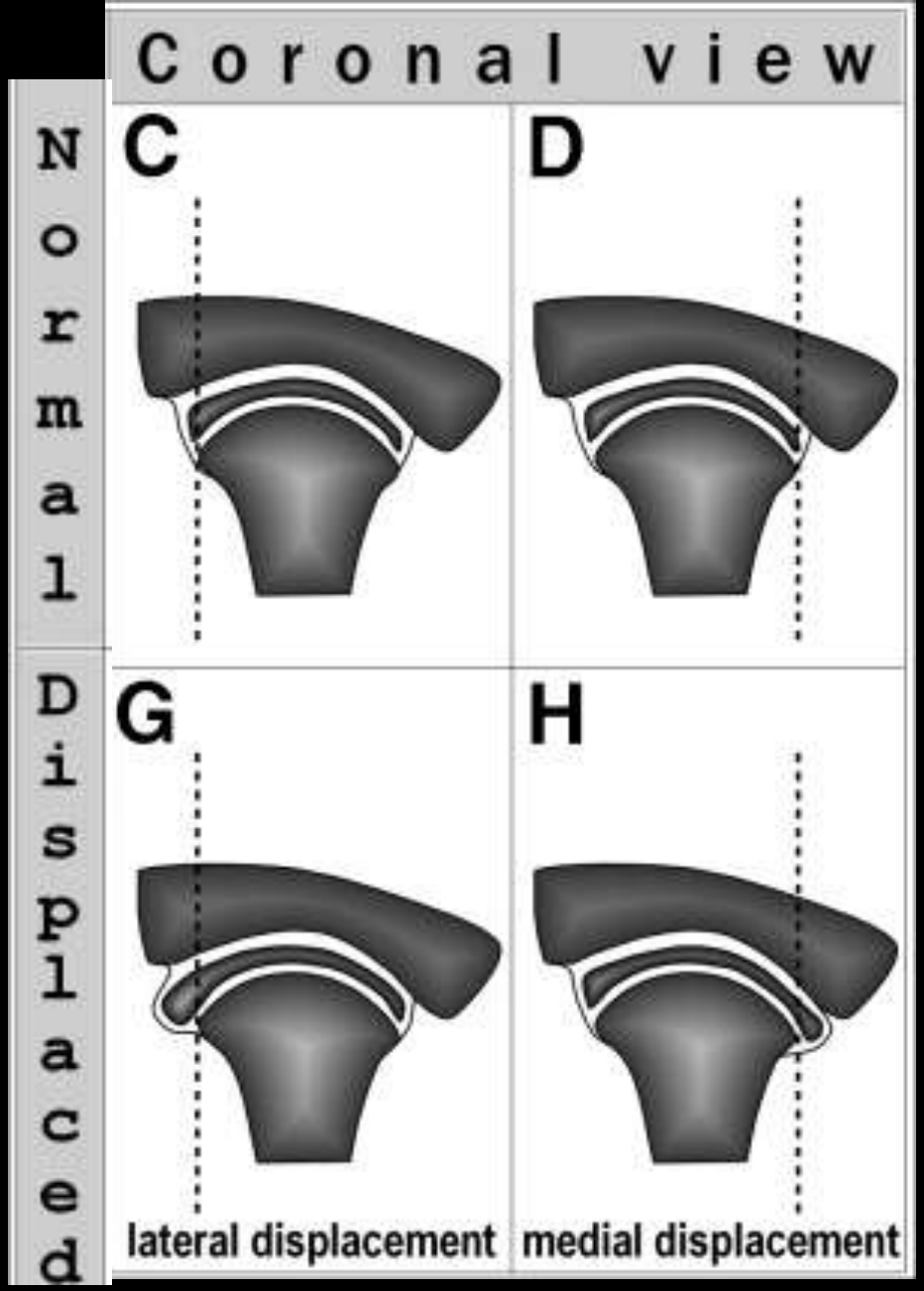
Closed

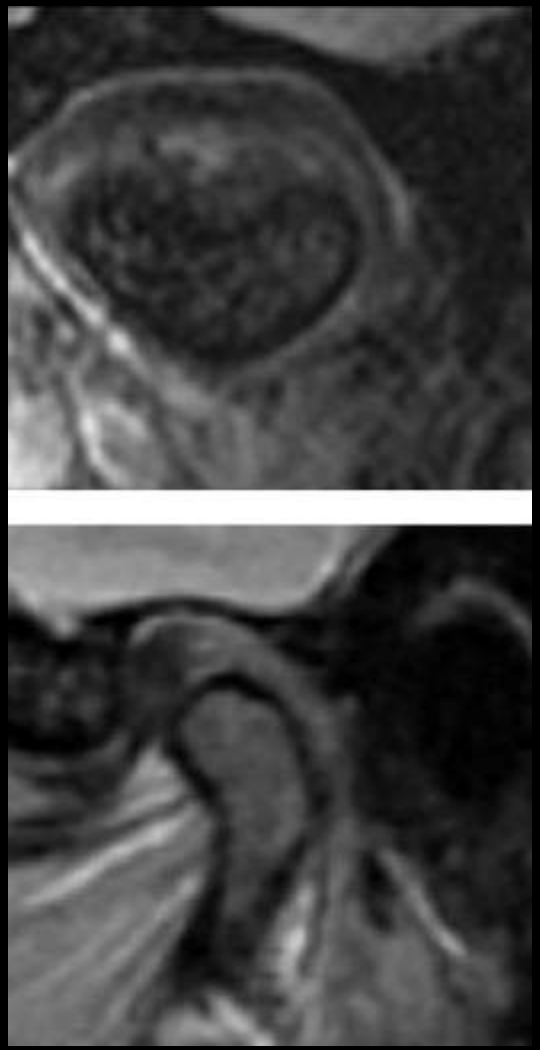
Open

Molinari et al. Sem Ultrasound, CT, and MRI. 2007; 28(3):192-204.

Sano et al. Current problems in Diagnostic Radiology 33(1); 2004 16-24.

Sommer, OJ et al. Radiographics 2003;23:14





Molinari et al. Sem Ultrasound, CT, and MRI. 2007; 28(3):192-204.

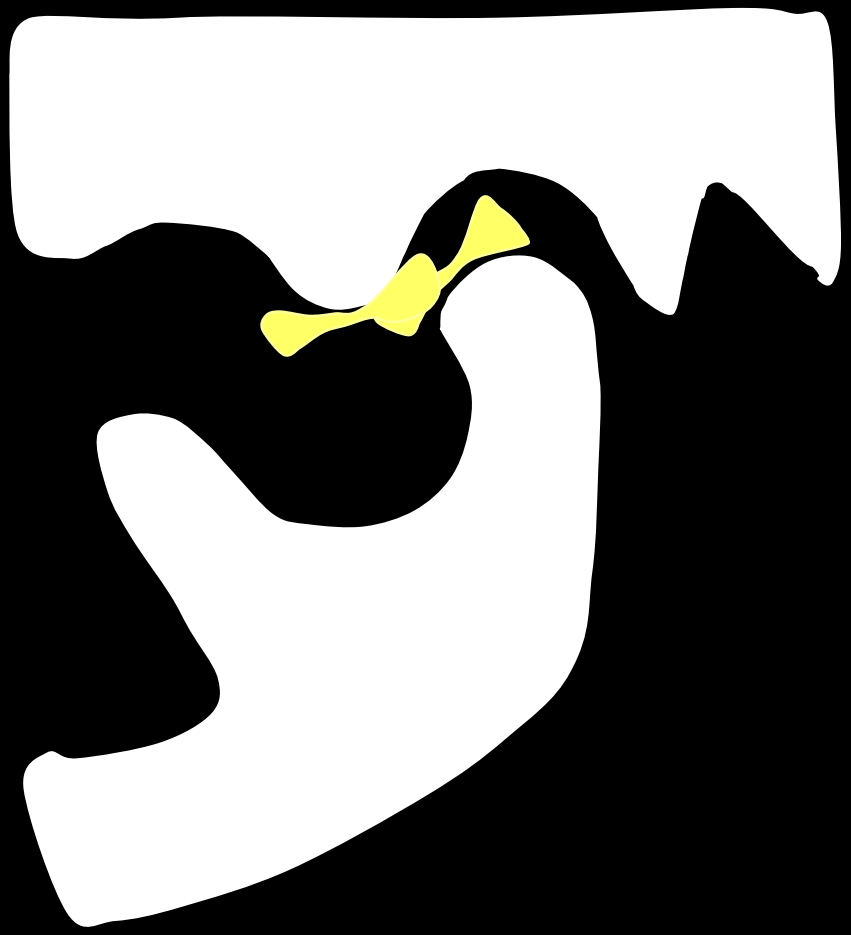
Normal TMJ motion

- Opening-two different motions:

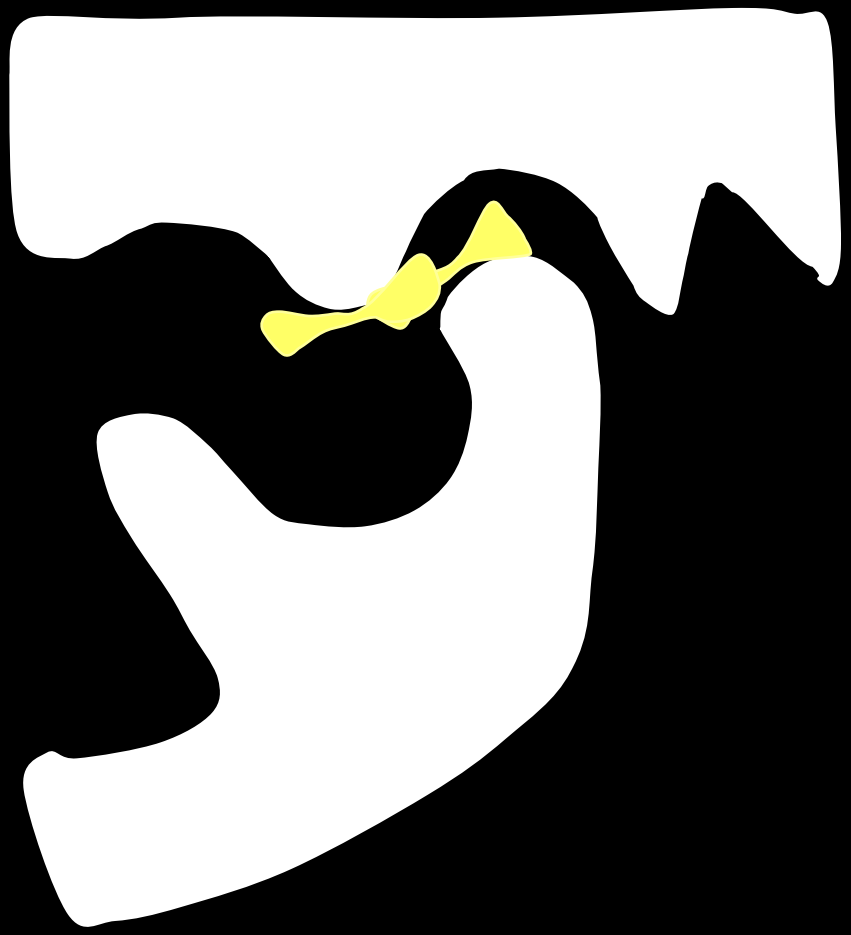
  1) Rotation around a horizontal axis through the condylar heads

  2) Translation

  condyle and meniscus move together anteriorly beneath the articular eminence; intermediate zone of the meniscus becomes the articulating surface between the condyle and the articular eminence



Protraction



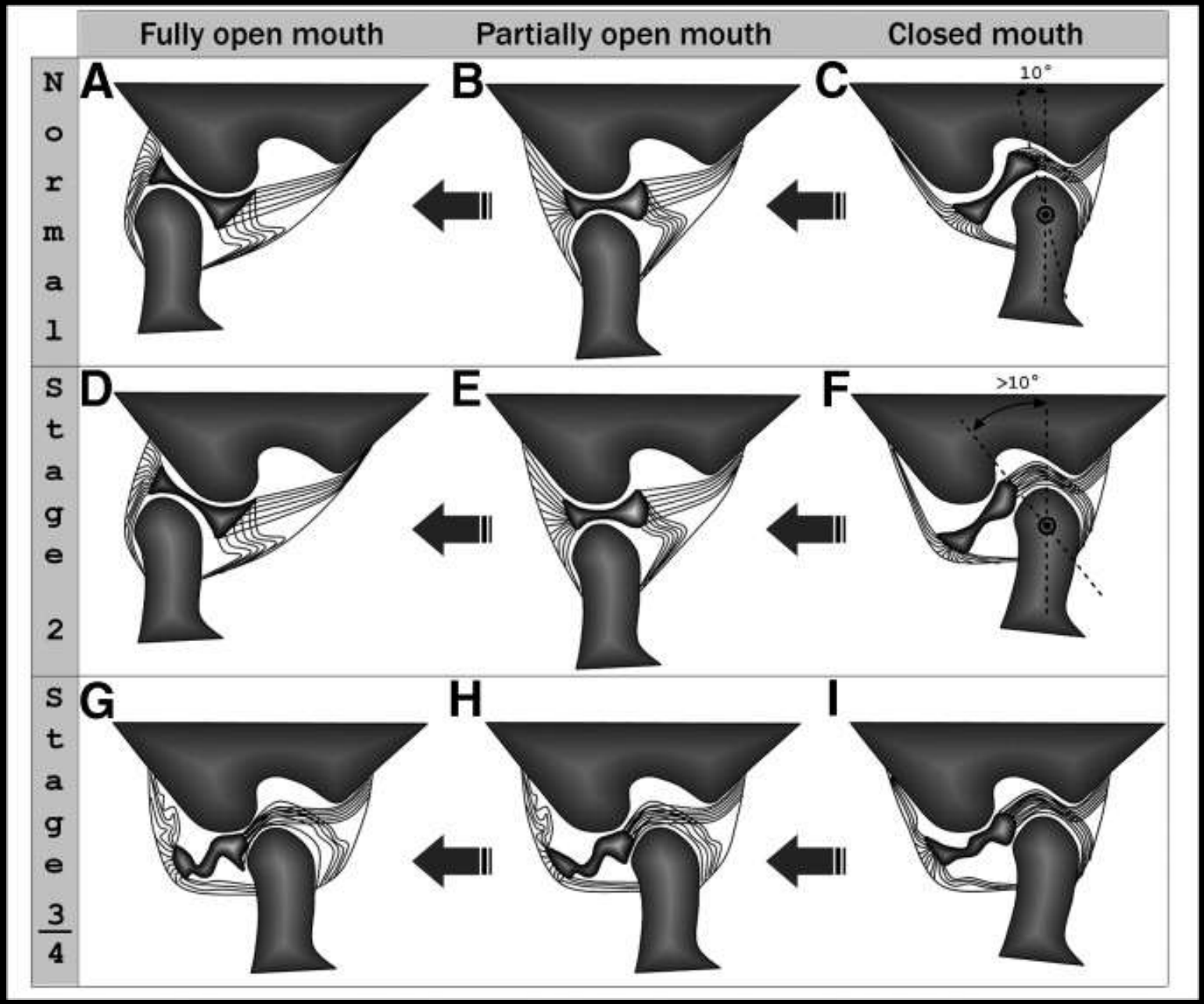
Retraction

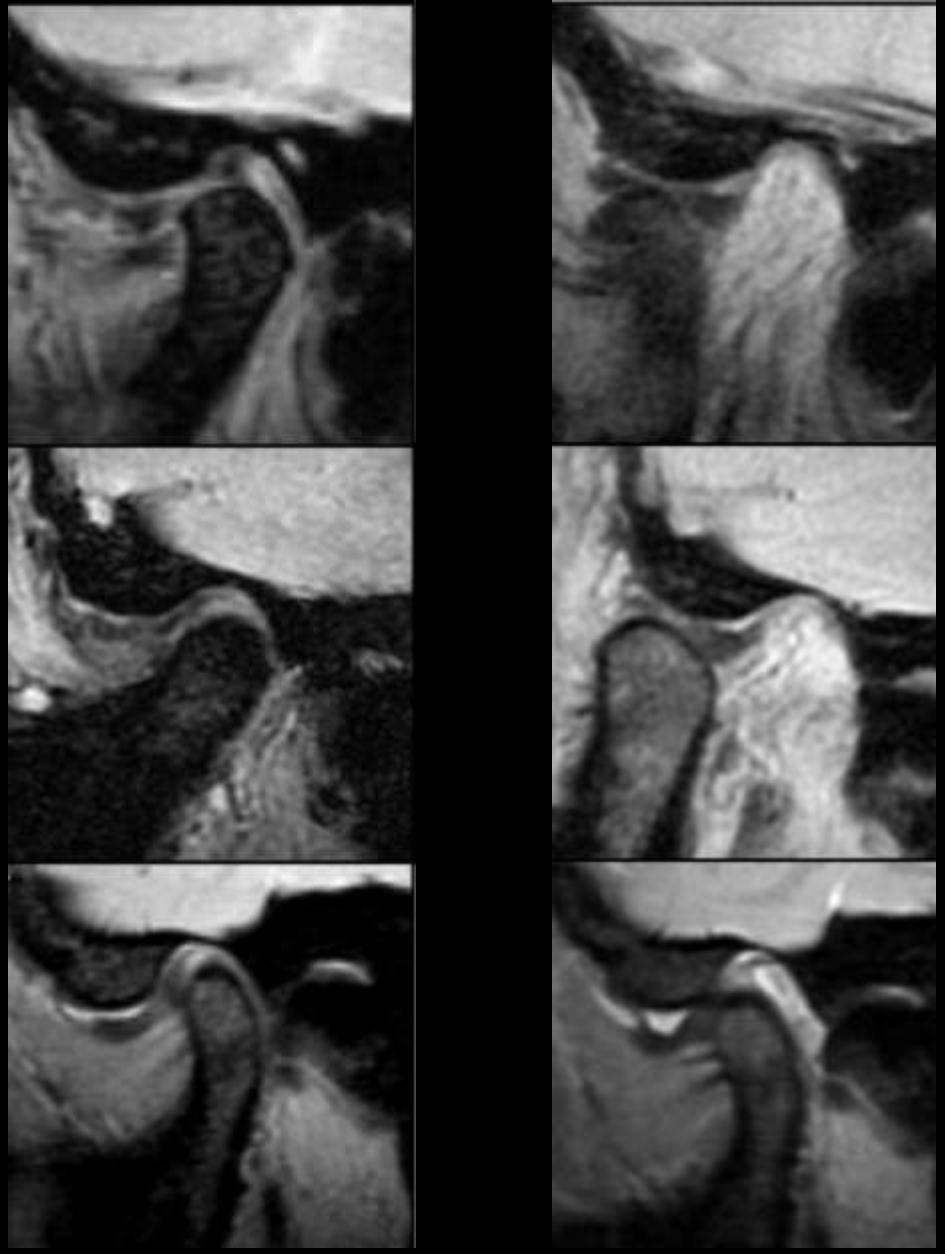
Classifications of Internal Derangement- Direction

- Direction of displacement (ant, med, lat, posterior, anteromedial, anterolateral)
- Multidirectional displacements more frequent than unidirectional ones
- Posterior displacement rare
- Oblique orientation of lateral pterygoid muscle and angulation of condyle direct most meniscal displacements in anteromedial path

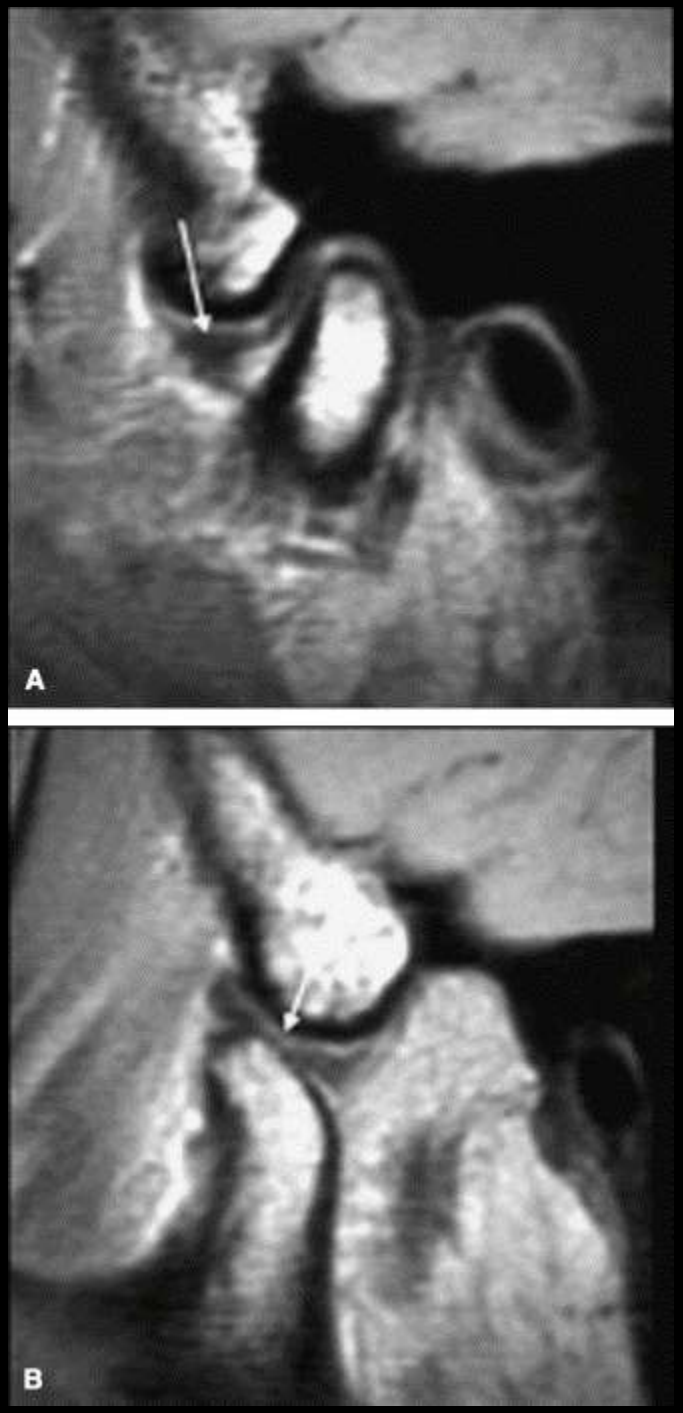
Classification –Direction plus altered motion

- Anterior displacement with reduction during opening
- Anterior displacement without reduction during opening
- Anterior displacement with perforation of the disk
- Stuck disk, adhesions


Fully open mouth
Partially open mouth
Closed mouth
Normal
Stage 2
Stage 3/4
A
B
C
10°
D
E
F
>10°
G
H
I



Closed Open



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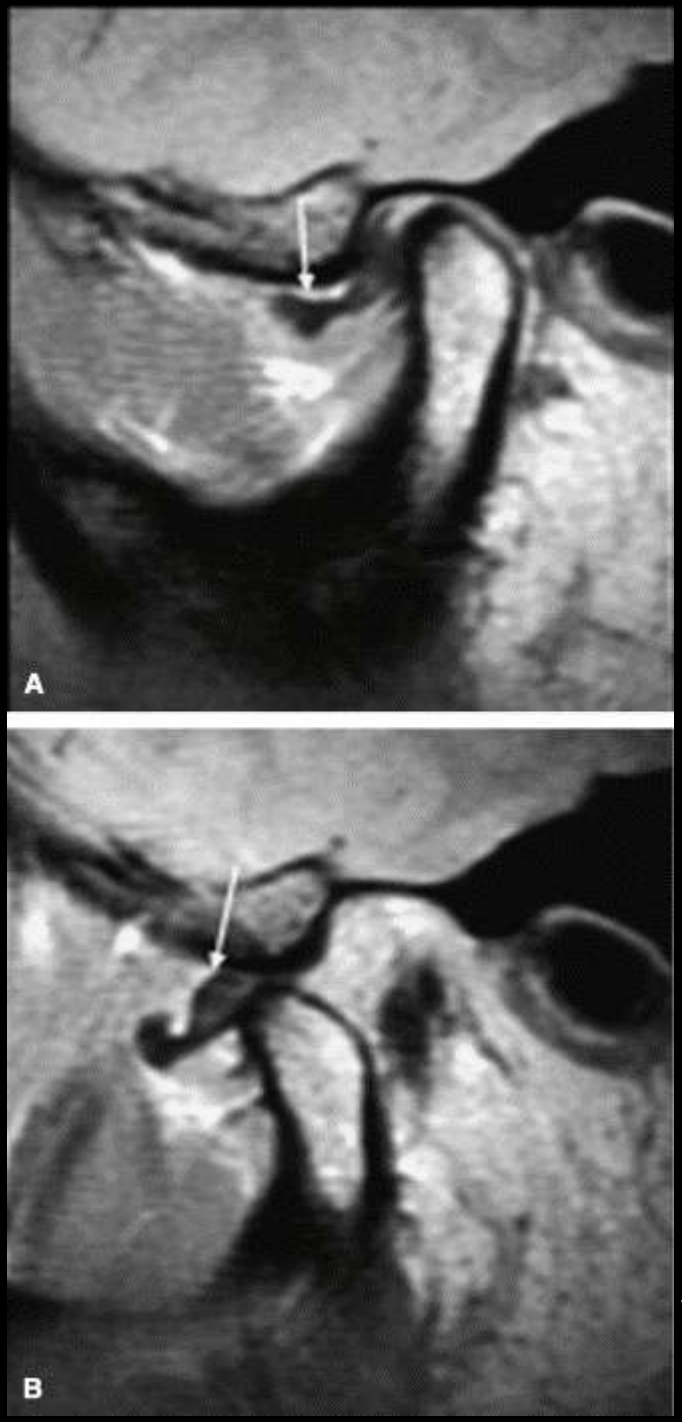

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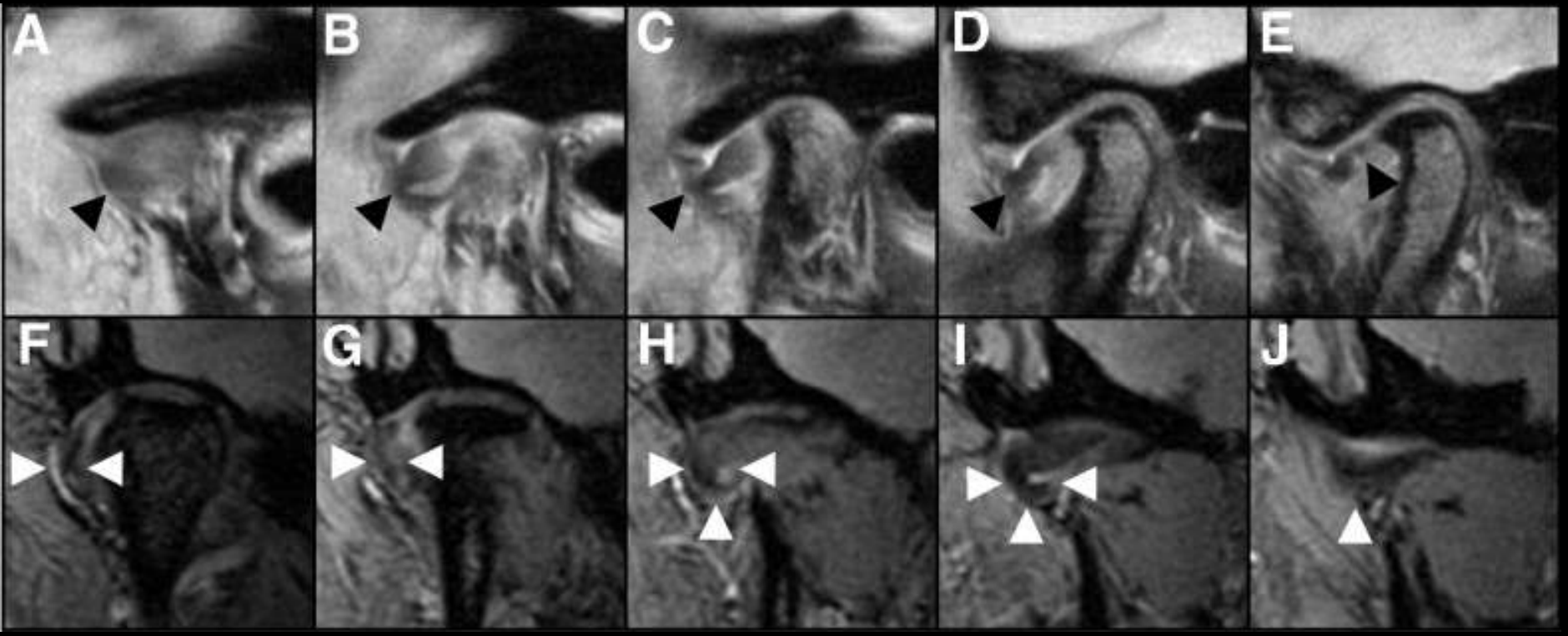
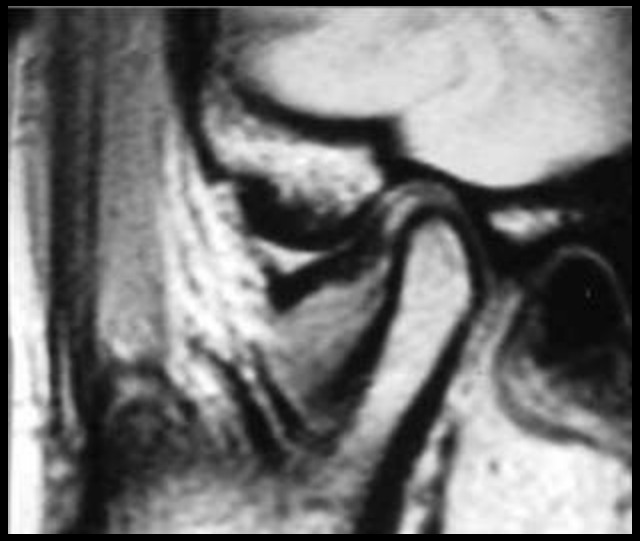


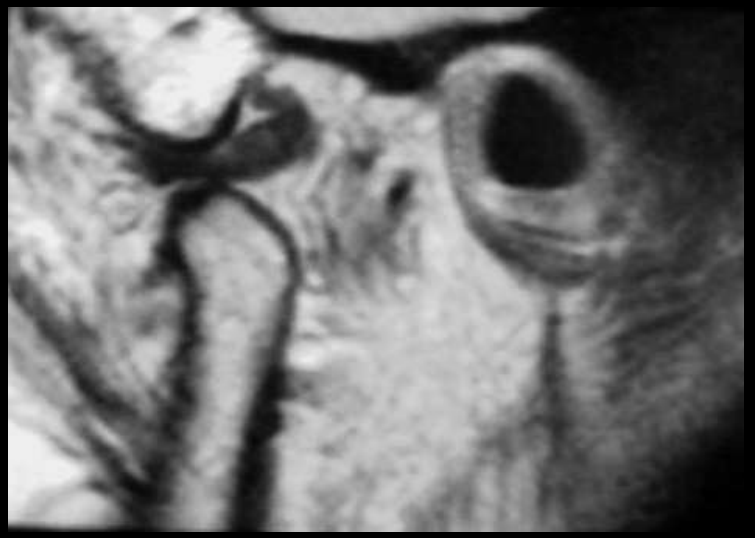
Anterolateral displacement

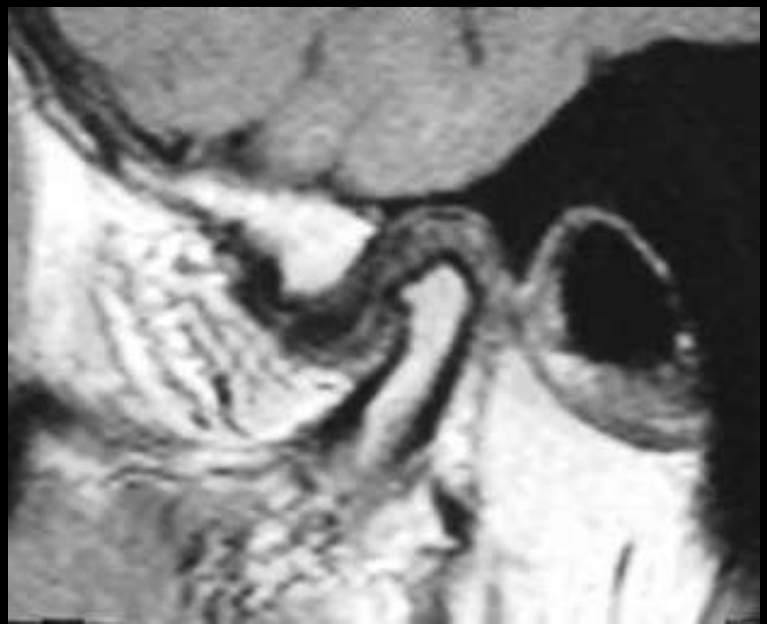
Secondary signs

- Morphology of disc- biconvex, rounded, irregular or flat usually indicates more advanced disease
- Presence of joint effusion
- Rupture of retrodiscal ligaments
- Decreased signal intensity of the disc
- Increased T2 SI of retrodiscal tissue- due to higher degree of vascular supply
- Lateral pterygoid muscle: hypertrophy, atrophy or contracture

Abnormal morphology

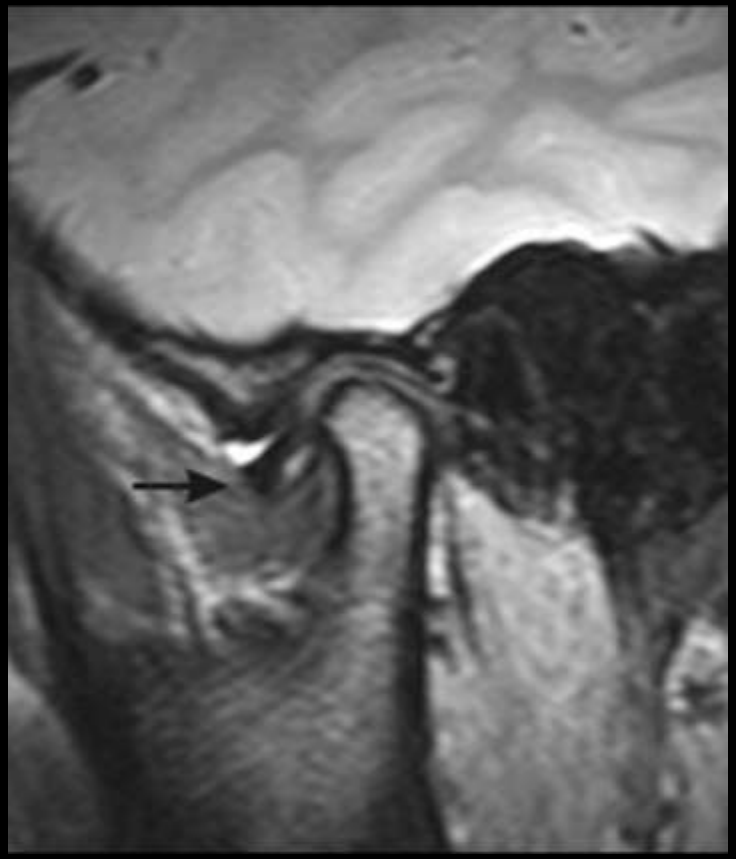


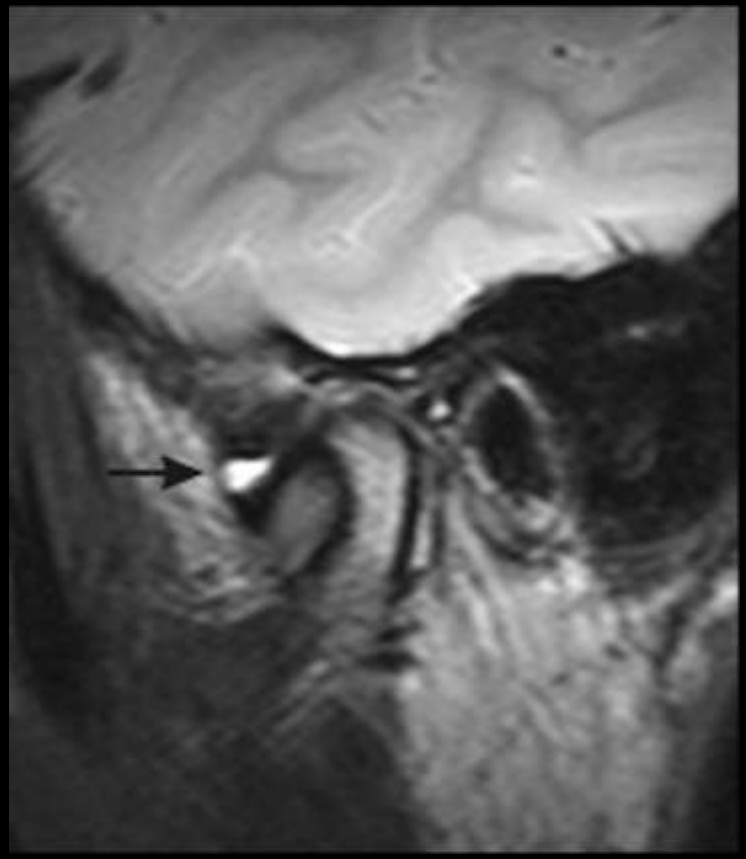




Joint Effusions

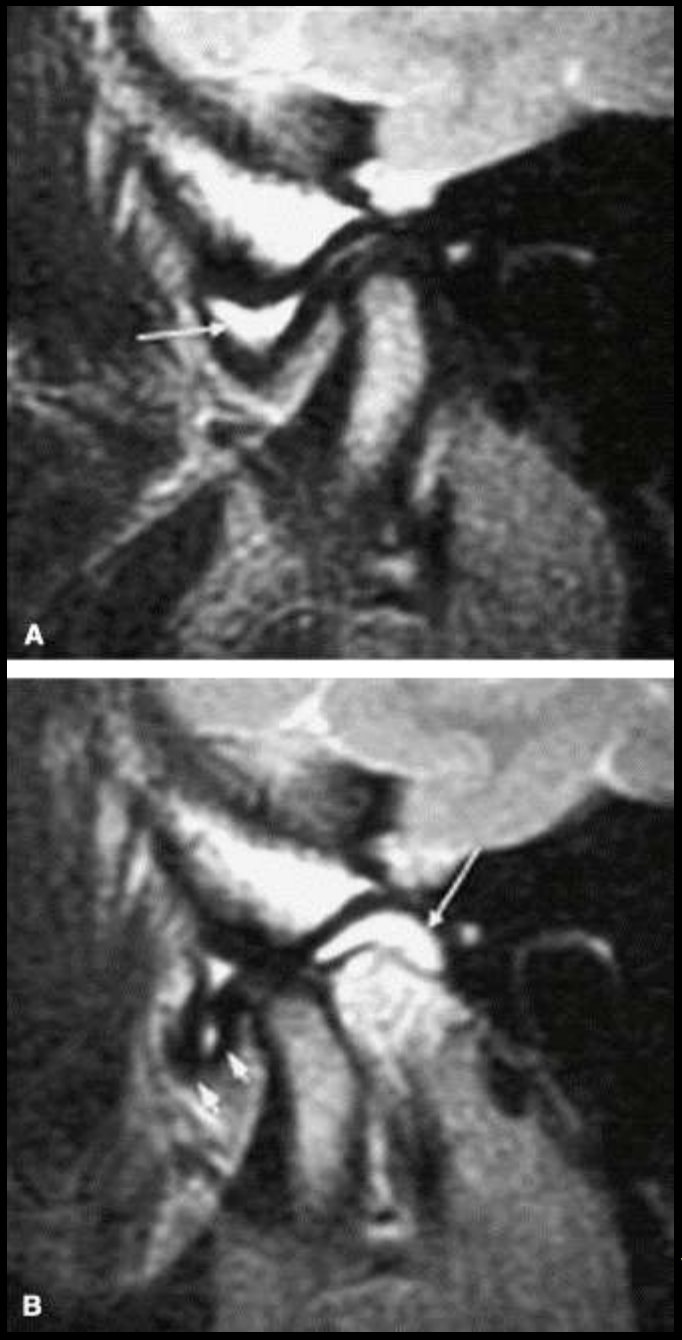
- Significantly more prevalent in painful vs. nonpainful joints
- Large joint effusions seen only in symptomatic patients
- Presence of joint effusion unusual sign in asymptomatic individuals
- Generally seen surrounding anterior band





Tomas X, et al. Semin Ultrasound CT MRI 2007; 28:205-212.

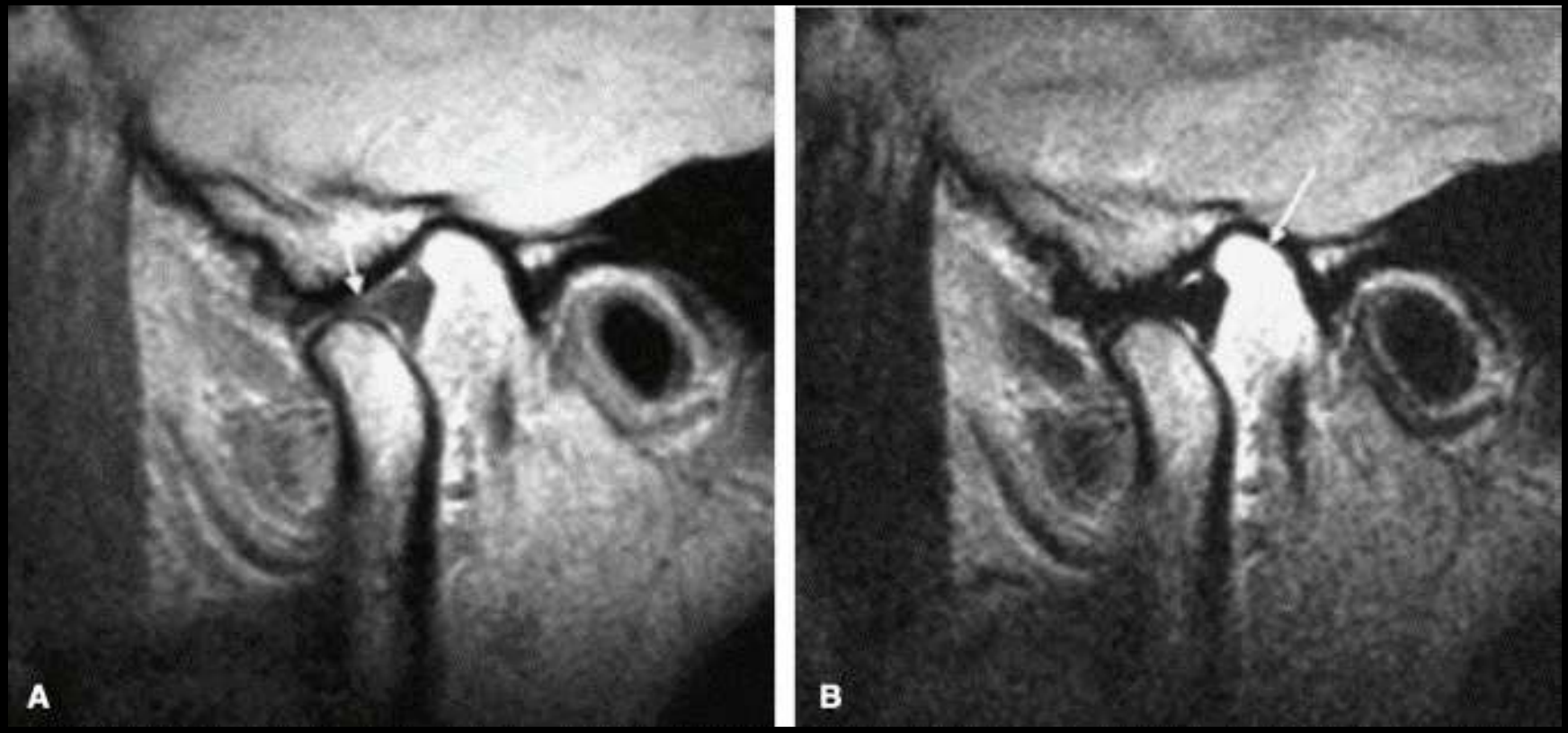
Tomas X, et al. Semin Ultrasound CT MRI 2007; 28:205-212.



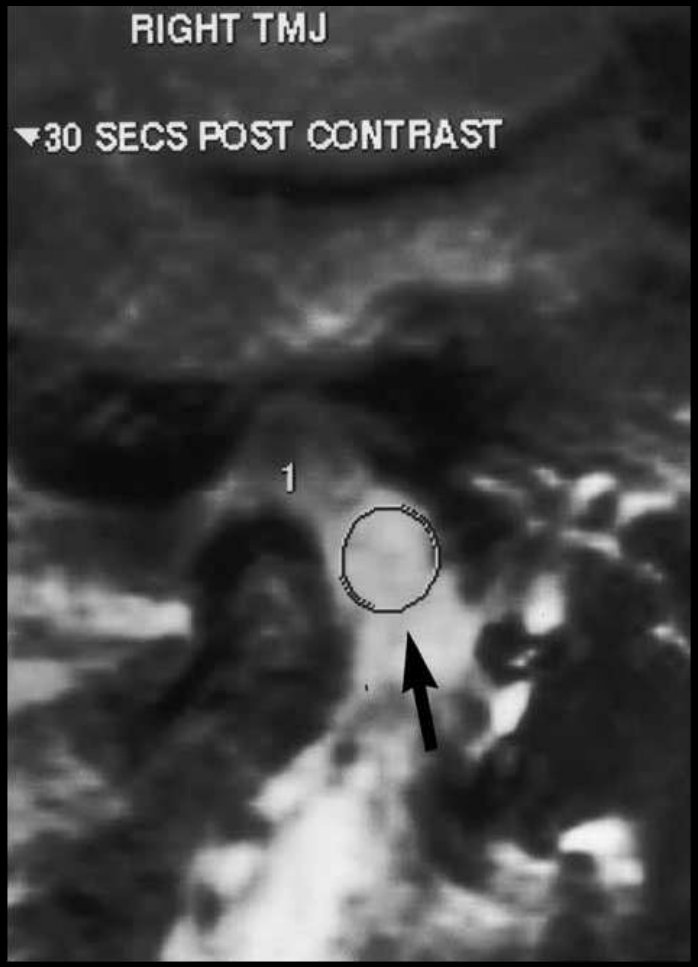
Sano et al. Current problems in Diagnostic Radiology 33(1); 2004 16-24.

Changes in retrodiskal tissue

- TMJs with pain and dysfunction have higher signal intensity in retrodiskal tissue than those without
- Indicates higher degree of vascularity in RDT in painful vs nonpainful



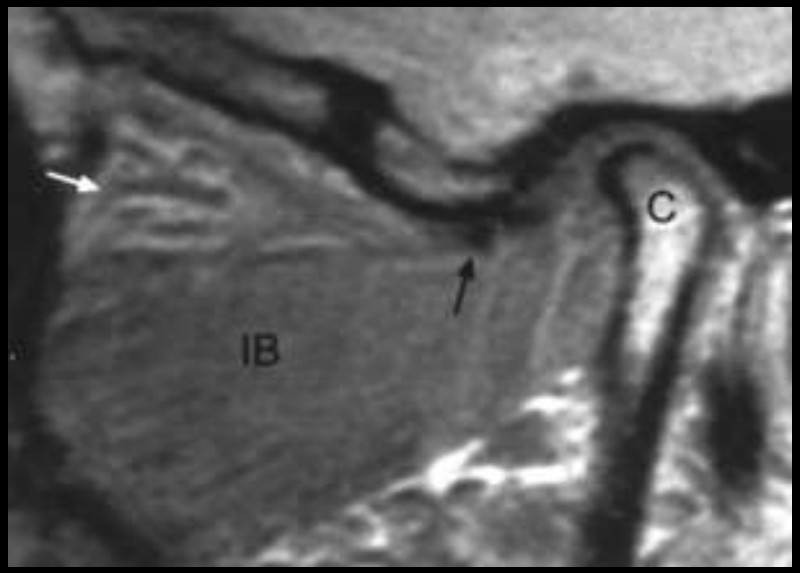
Sano et al. Current problems in Diagnostic Radiology 200; 33(1): 16-24

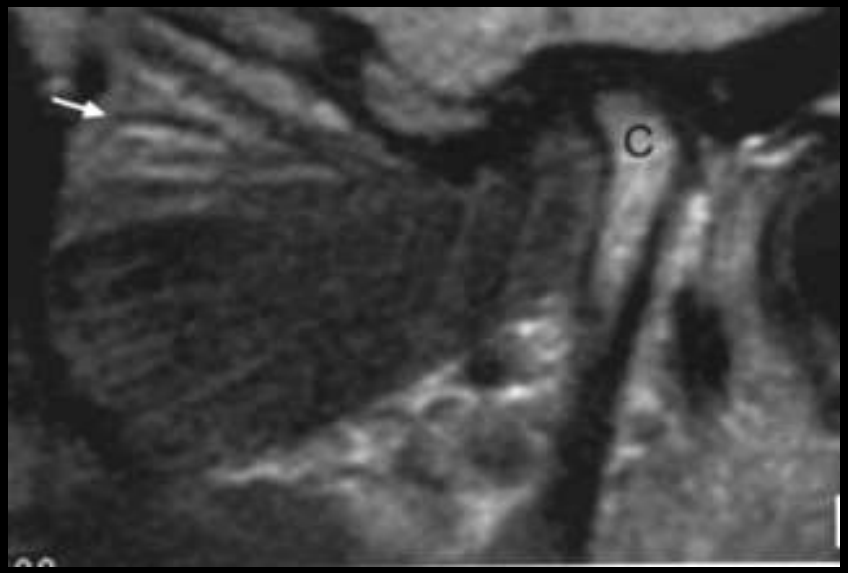


Abnormal enhancement of RT

Normal side

Tomas X, et al. Semin Ultrasound CT MRI 2007; 28:205-212.





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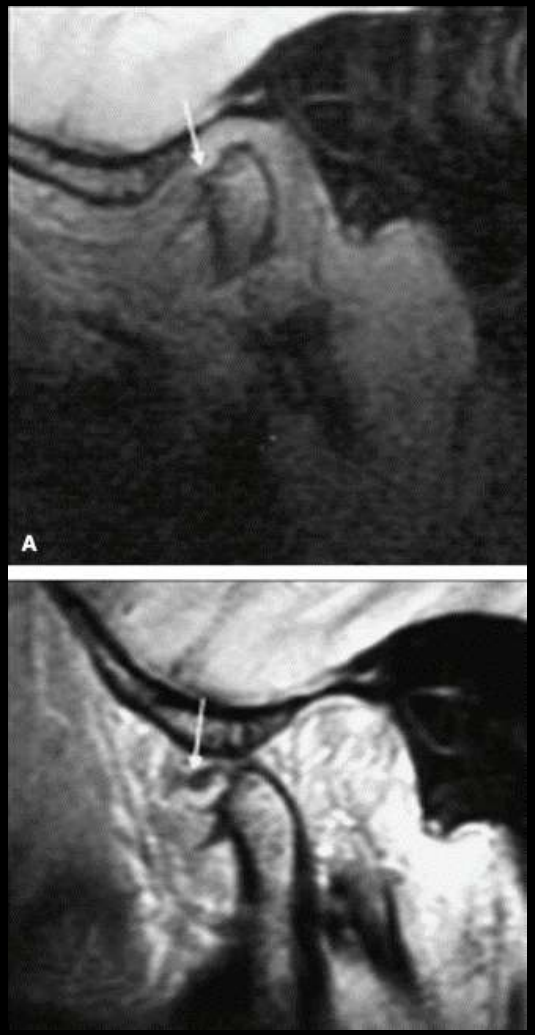
Osteoarthrosis

- Second most common abnormality of TMJ
- 20% of patients with internal derangement have OA at time of initial presentation
- Rare in joints with normal disk position
- OA in large proportion of older individuals completely asx

Osteoarthrosis

- Flattening, irregularity of articular surfaces, subchondral decreased signal, subchondral cystic change, osteophytosis, erosions



Sano et al. Current problems in Diagnostic Radiology 2004; 33(1):16-24.

Treatment of Internal Derangement

- 1st line: conservative and reversible approaches
- NSAIDS, muscle relaxants
- splints, home care procedures
- cognitive-behavioral information program

Treatment of Internal Derangement

- Surgery:
- Diskal plication with repositioning
- Arthroscopy with lysis of adhesions
- Diskectomy and alloplastic disc implant or autograft

Postoperative

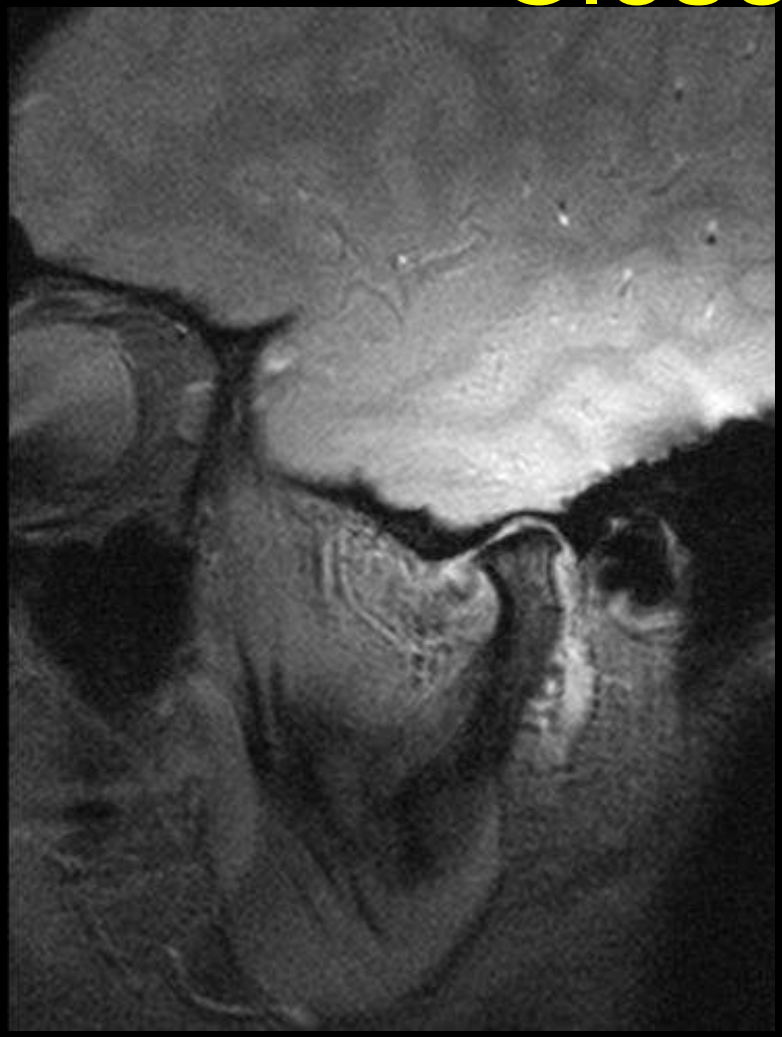
- Failed implants resulting from foreign body reaction- bone erosions similar to septic arthritis and RA

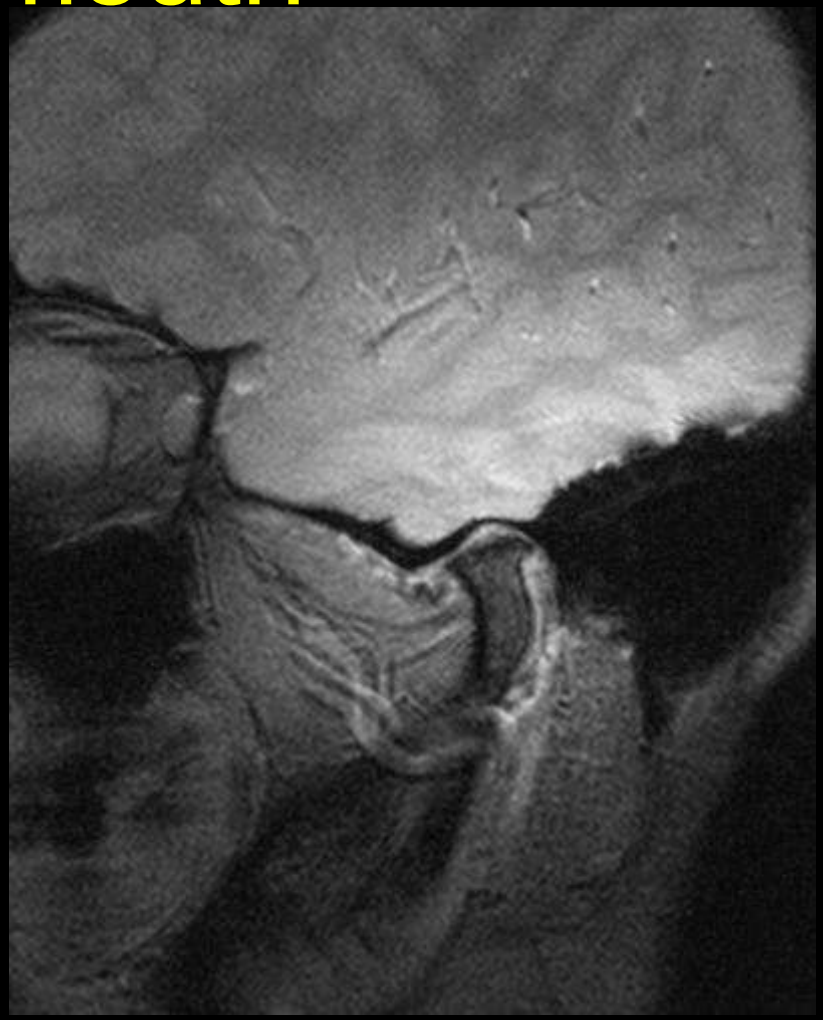
- Clinical findings and MRI appearances correlate poorly

Case review:

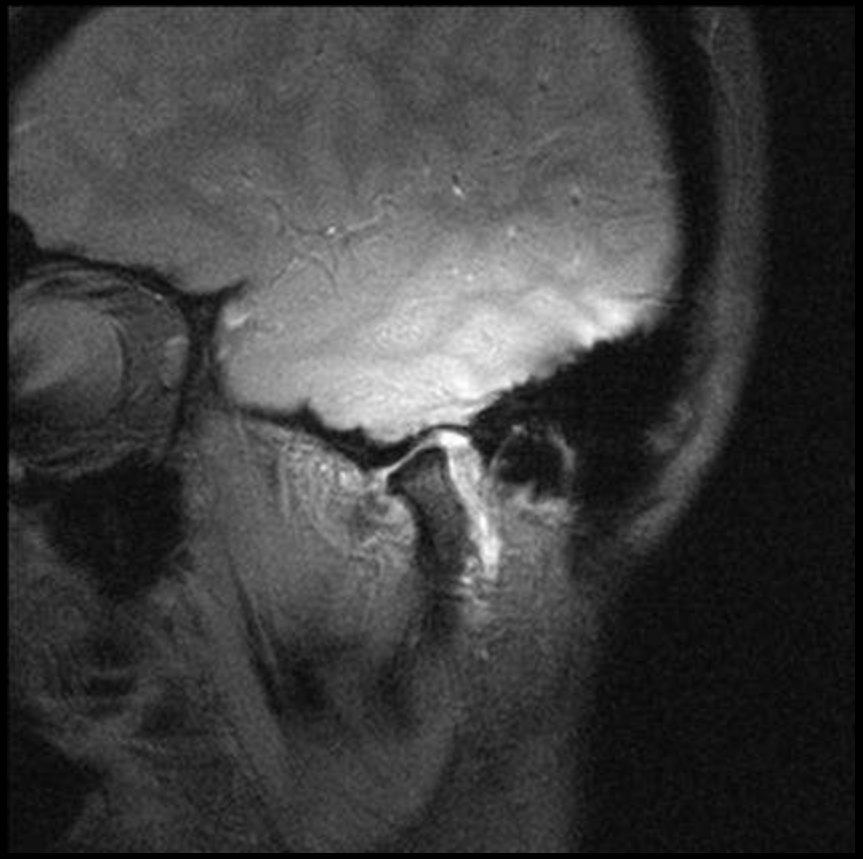
- **P**osition and mobility
- **O**A changes
- **E**ffusion
- **M**orphology
- **S**ignal intensity (disk and retrodiskal tissue)

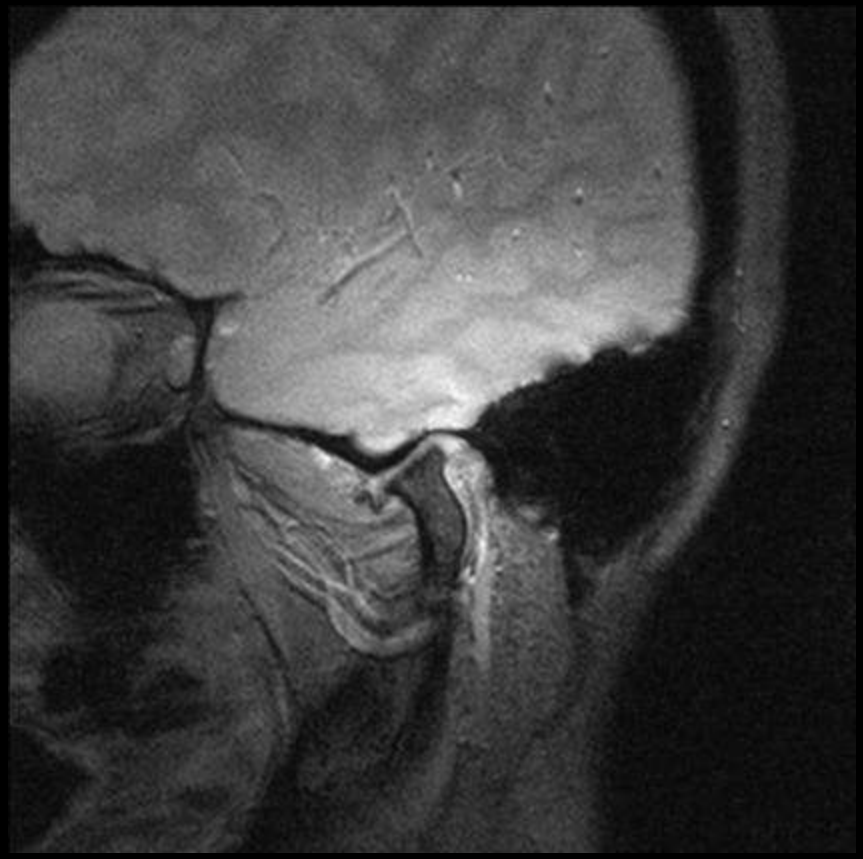
Closed mouth



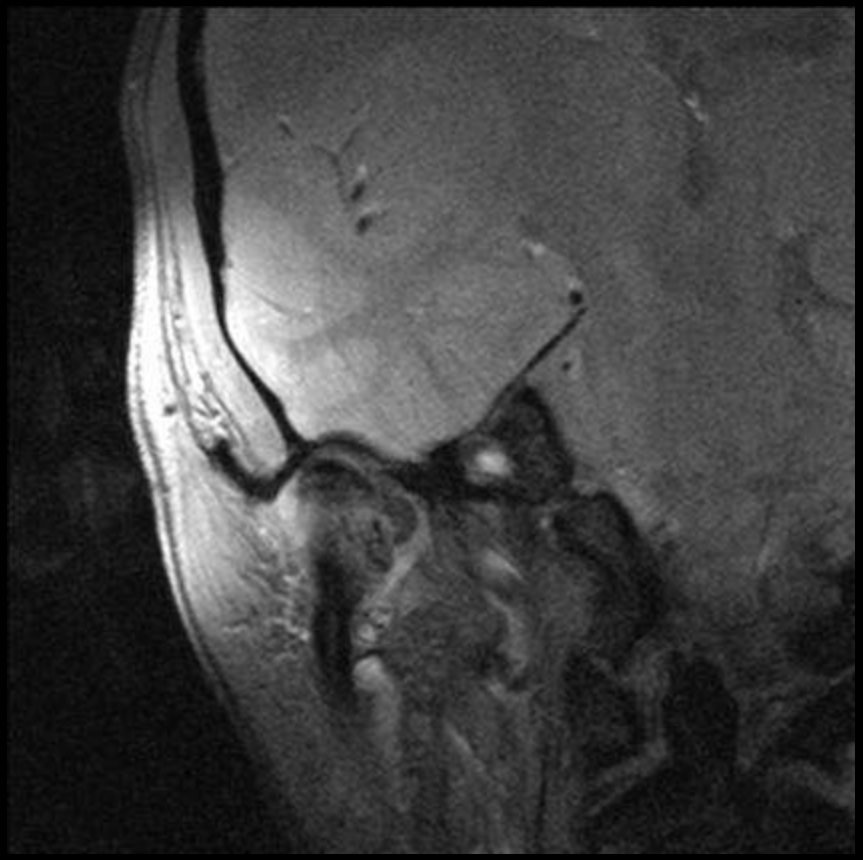


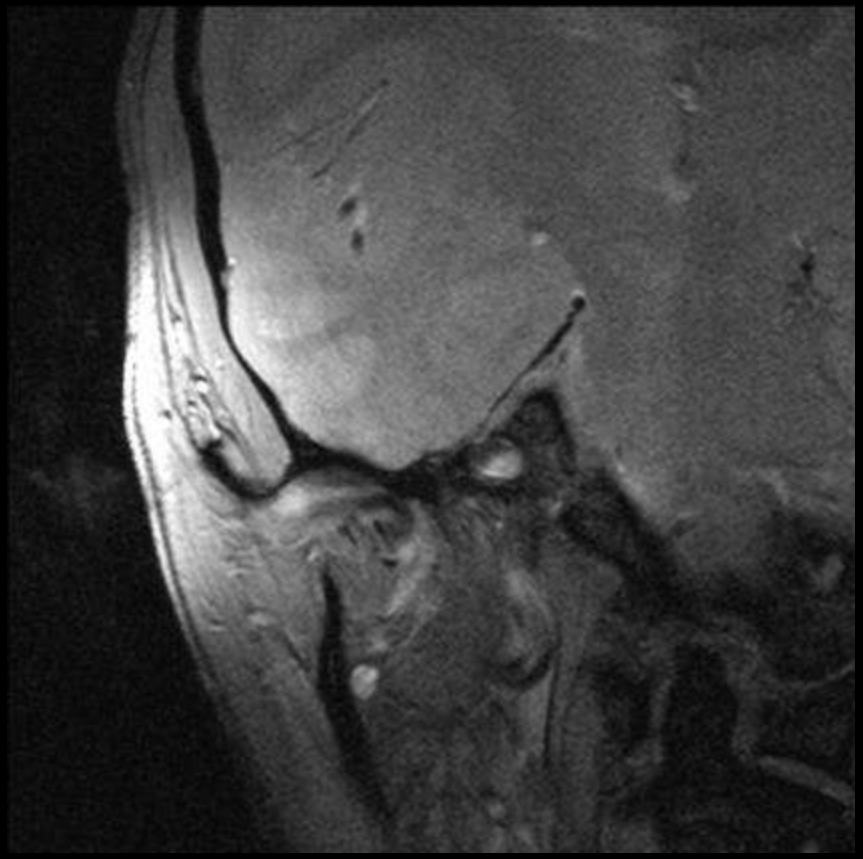
Open mouth



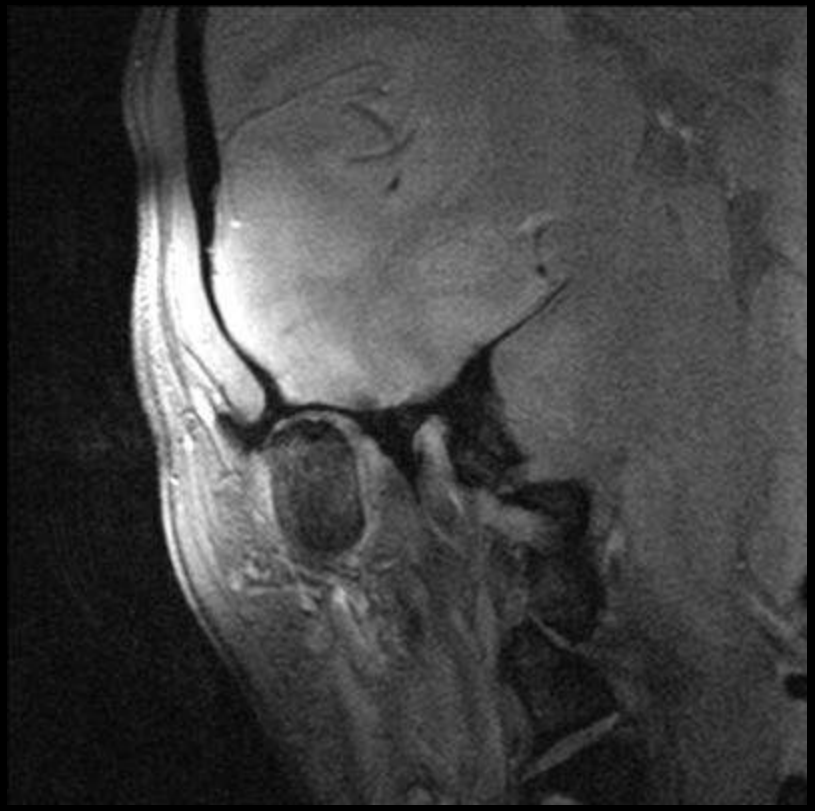


Closed mouth Coronal

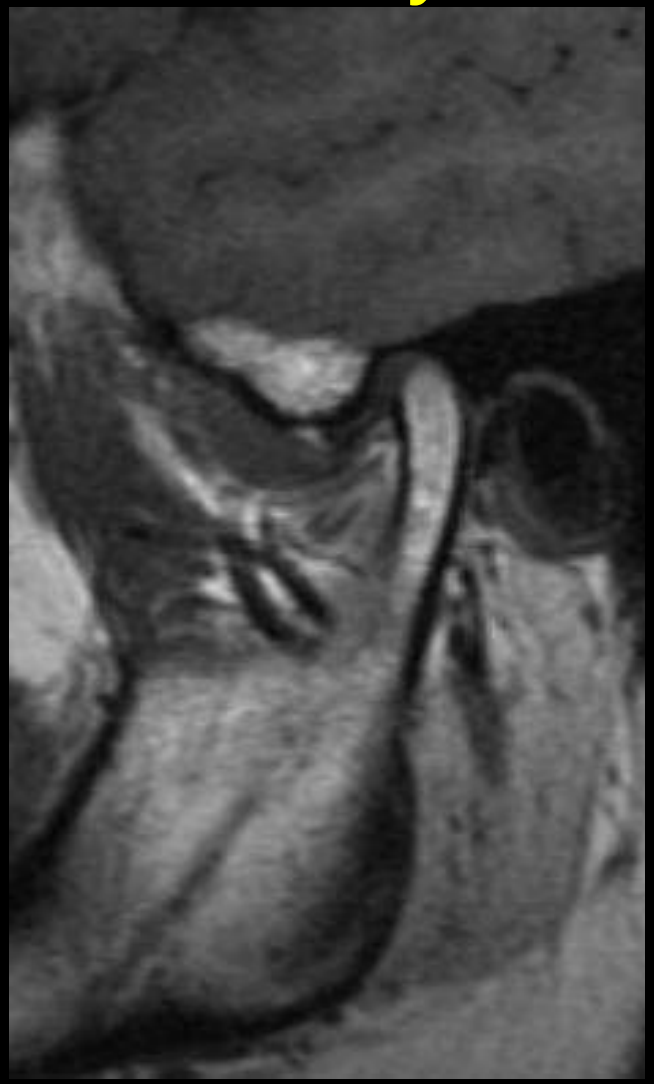




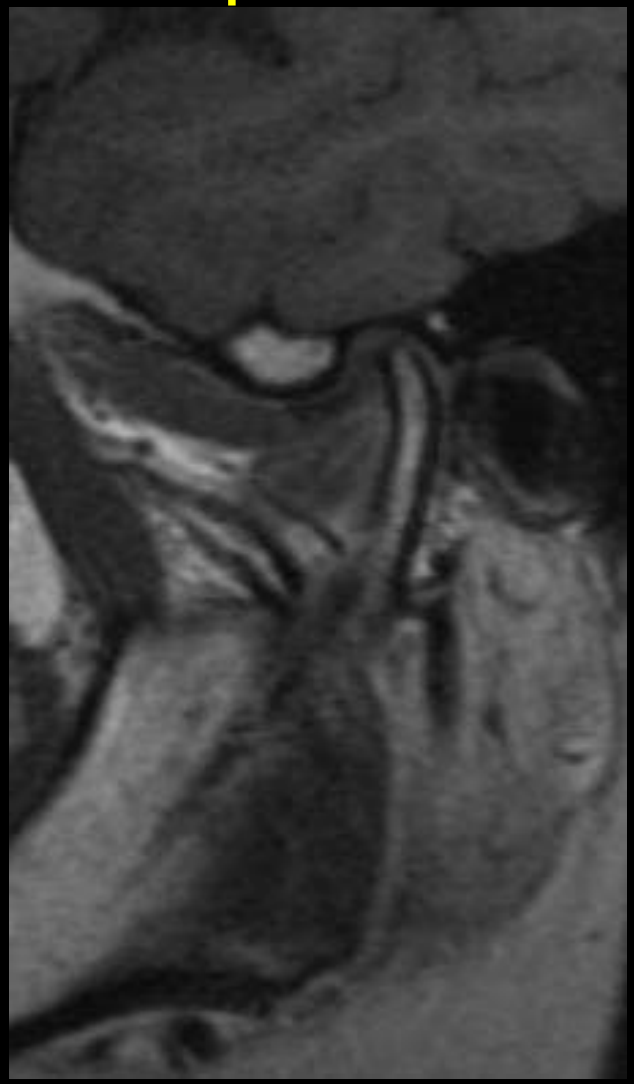
Closed mouth Coronal



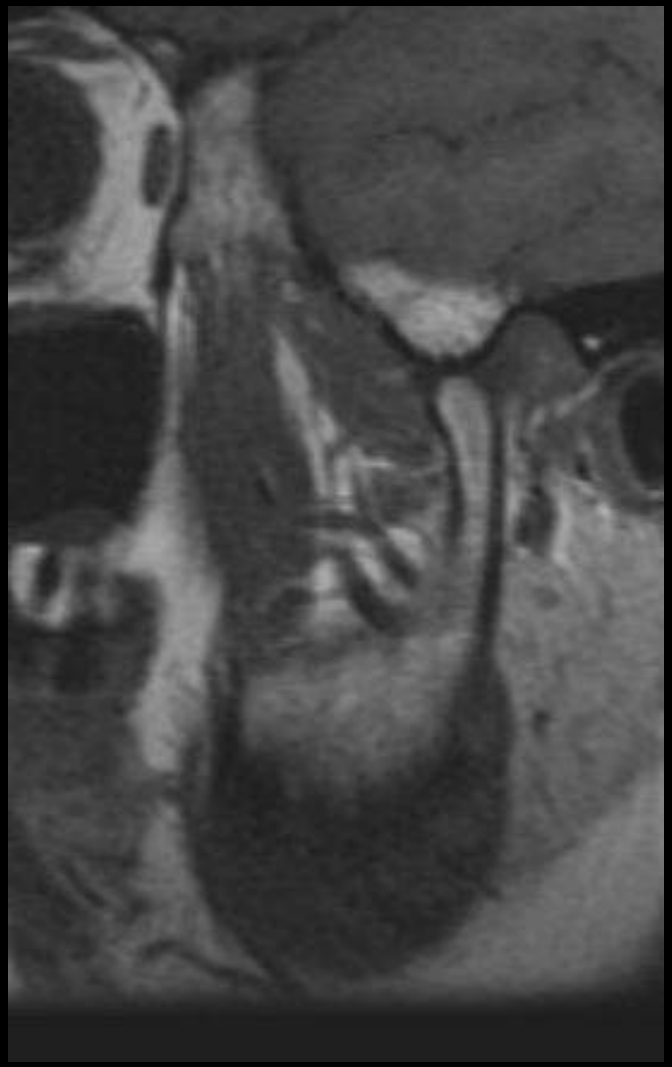
27 y.o with left TMJ pain



Right Closed

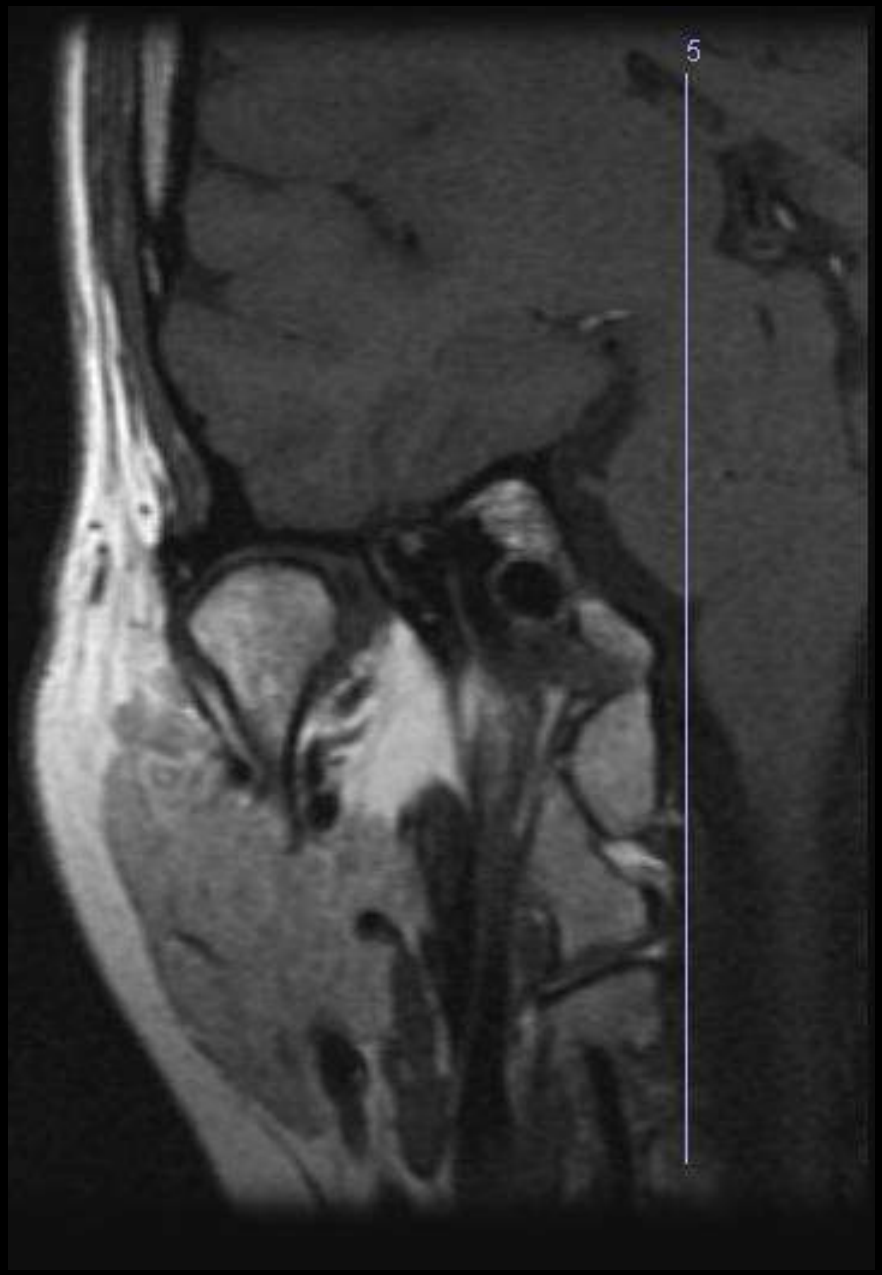


Left Closed

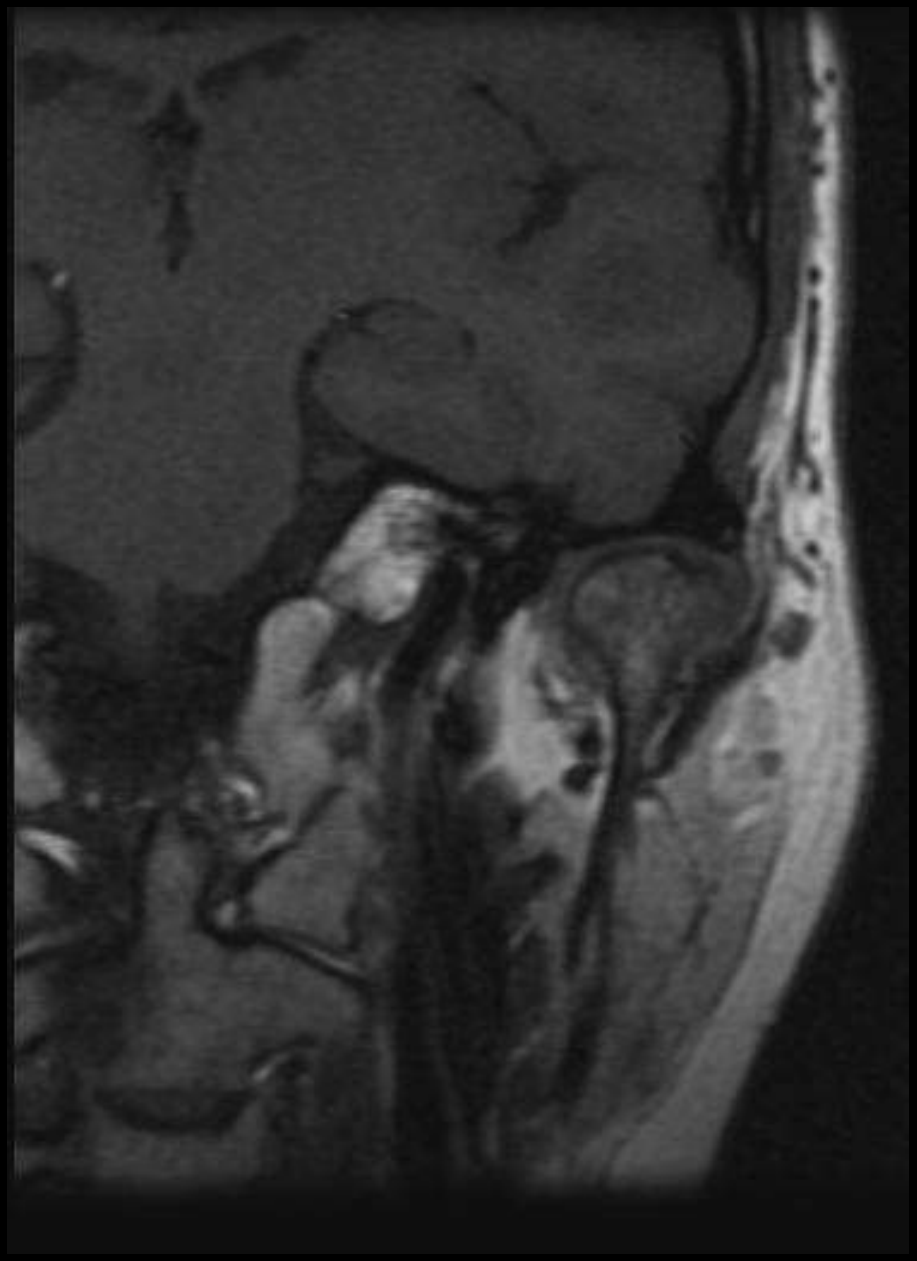


Right Open

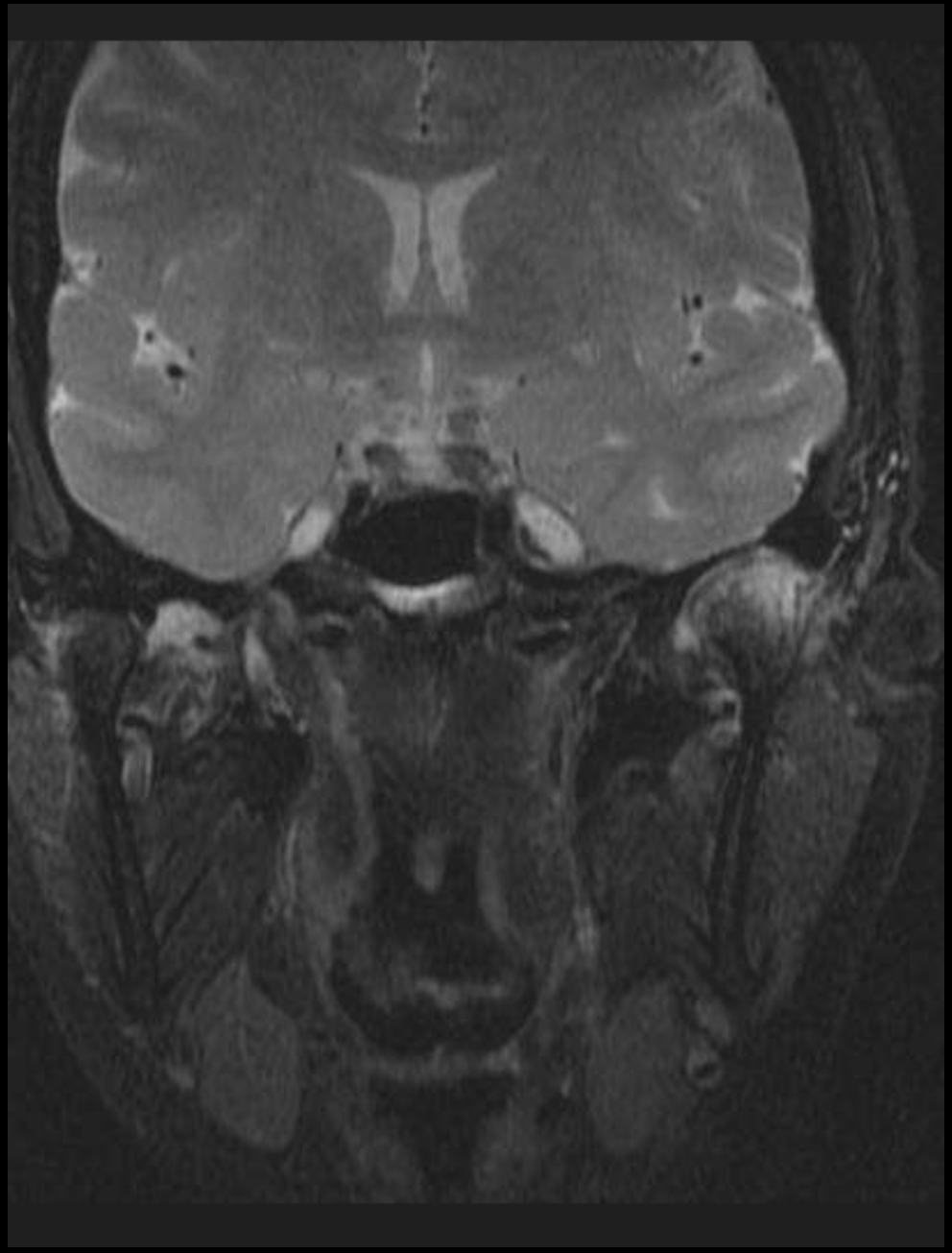
Left Open

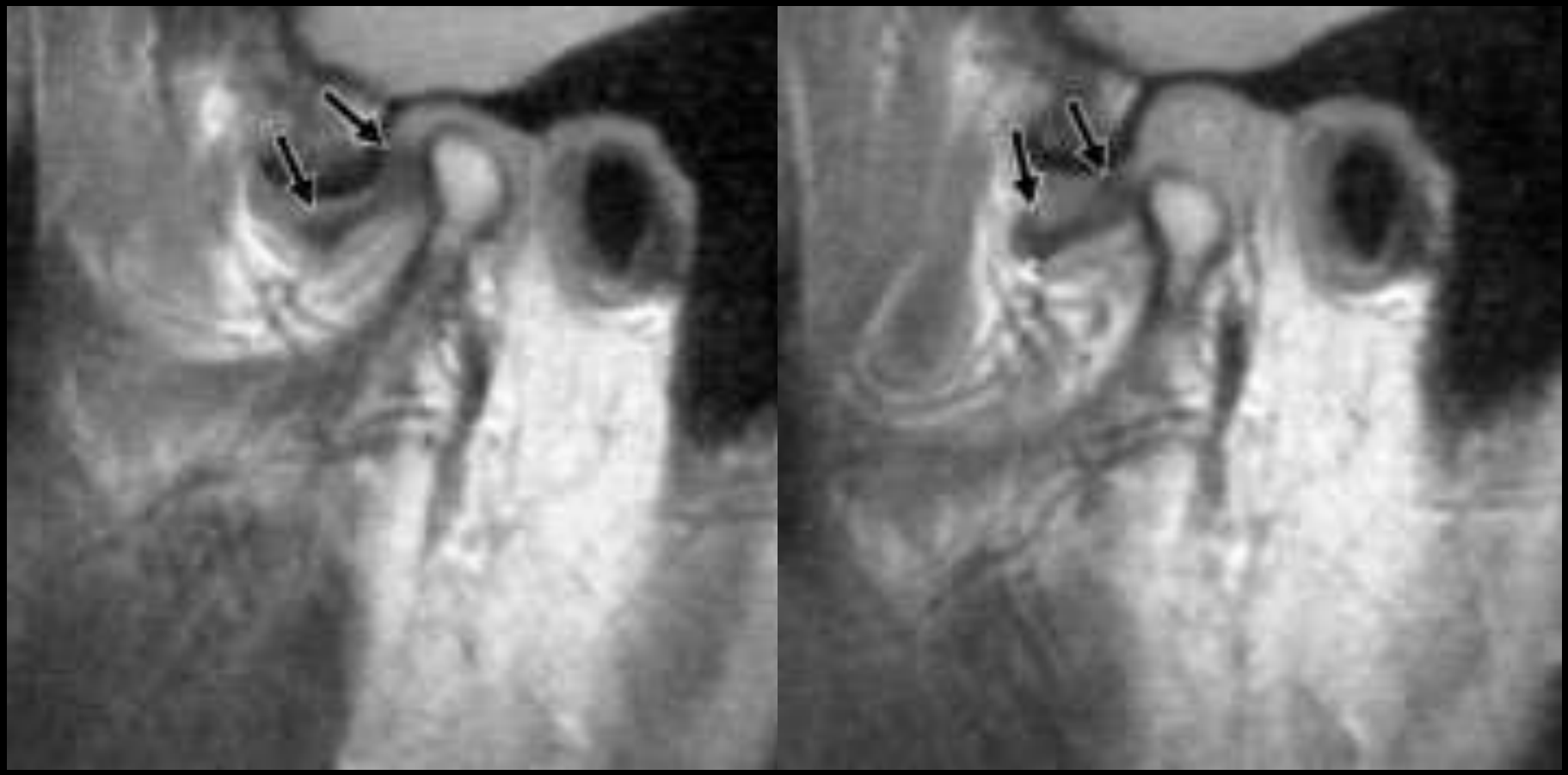


Right Closed

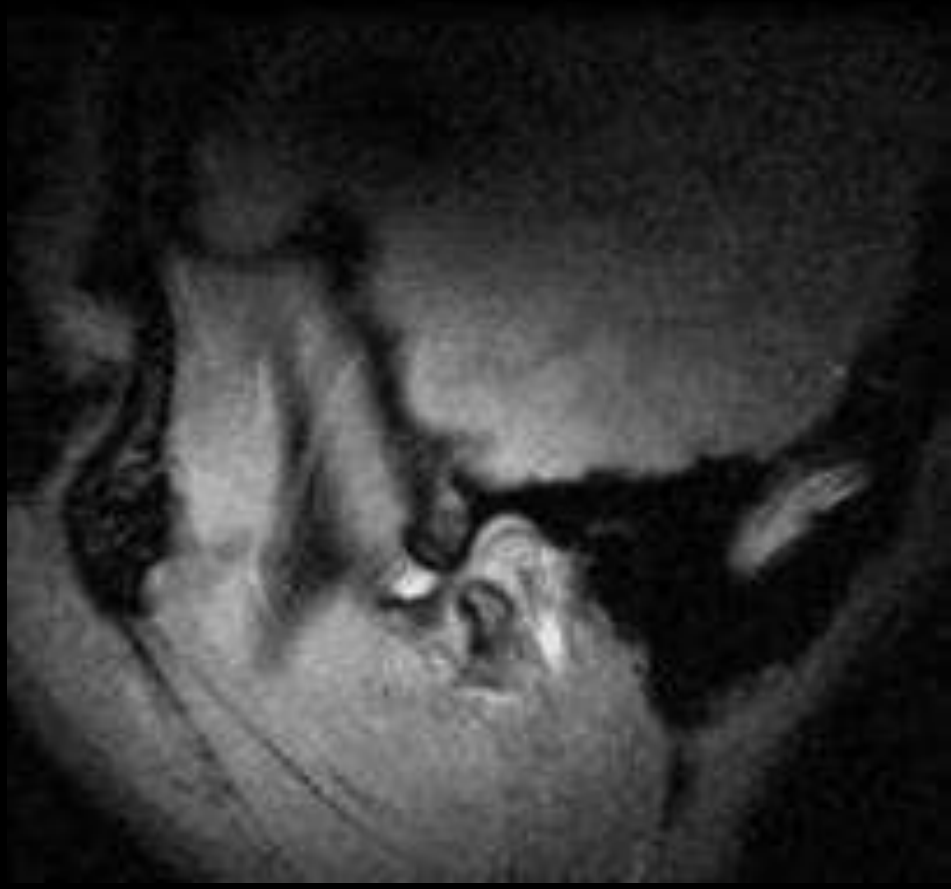


Left Closed



CLOSED LOCK

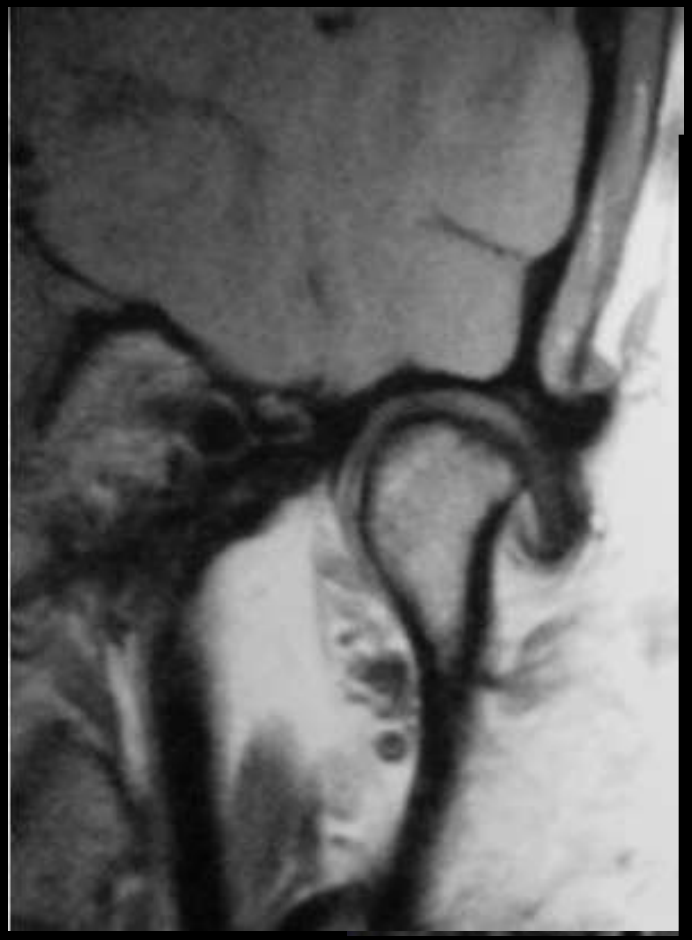


Anterior disc displacement
without reduction

Posterior band rupture

Normal

Tomas, X. et al. Radiographics 2006;26:765-781

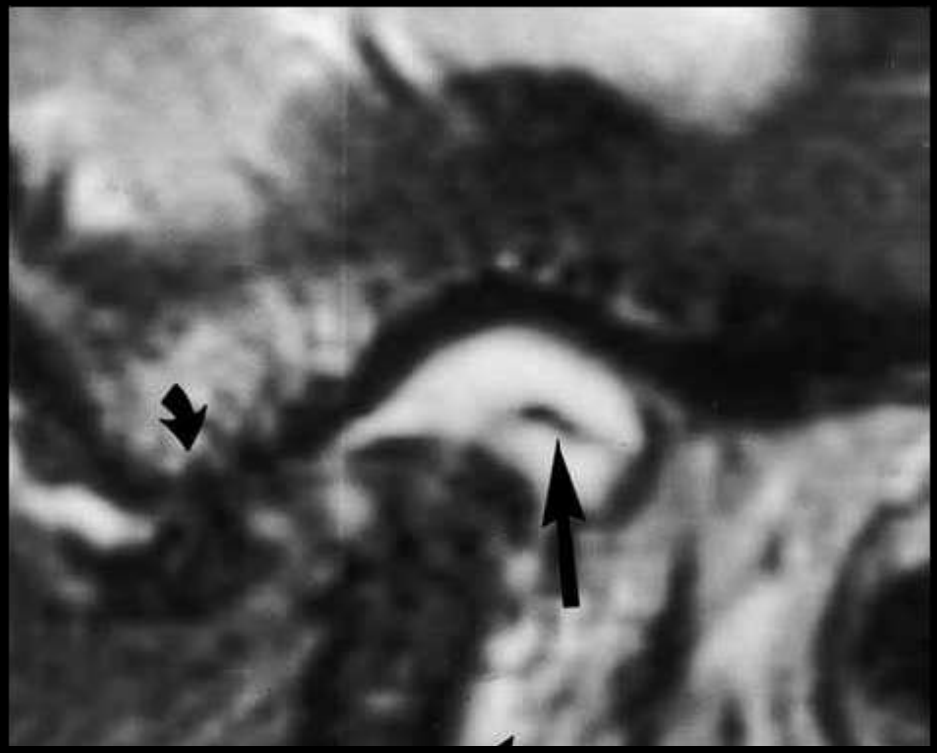


Lateral displacement

Styles C, Whyte A. Brit J of Oral and Maxillofacial Surgery (2002) 40:220-228.

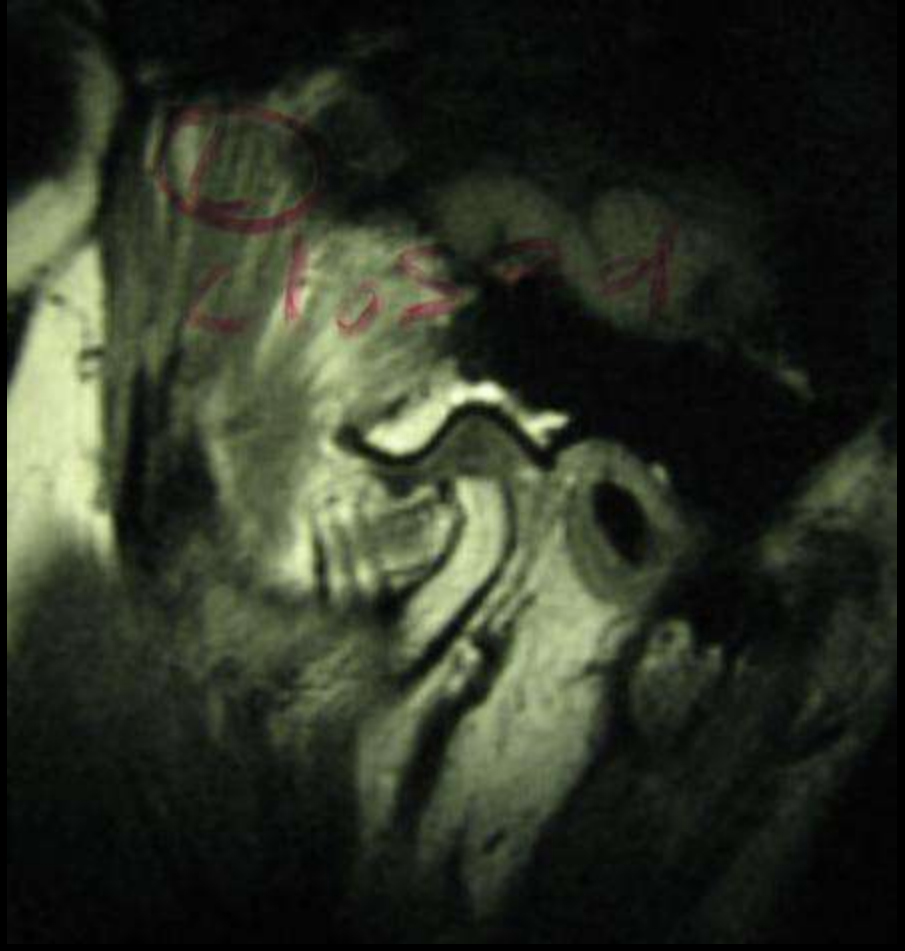
Posterior displacement

Tomas, X. et al. Radiographics 2006;26:765-781.



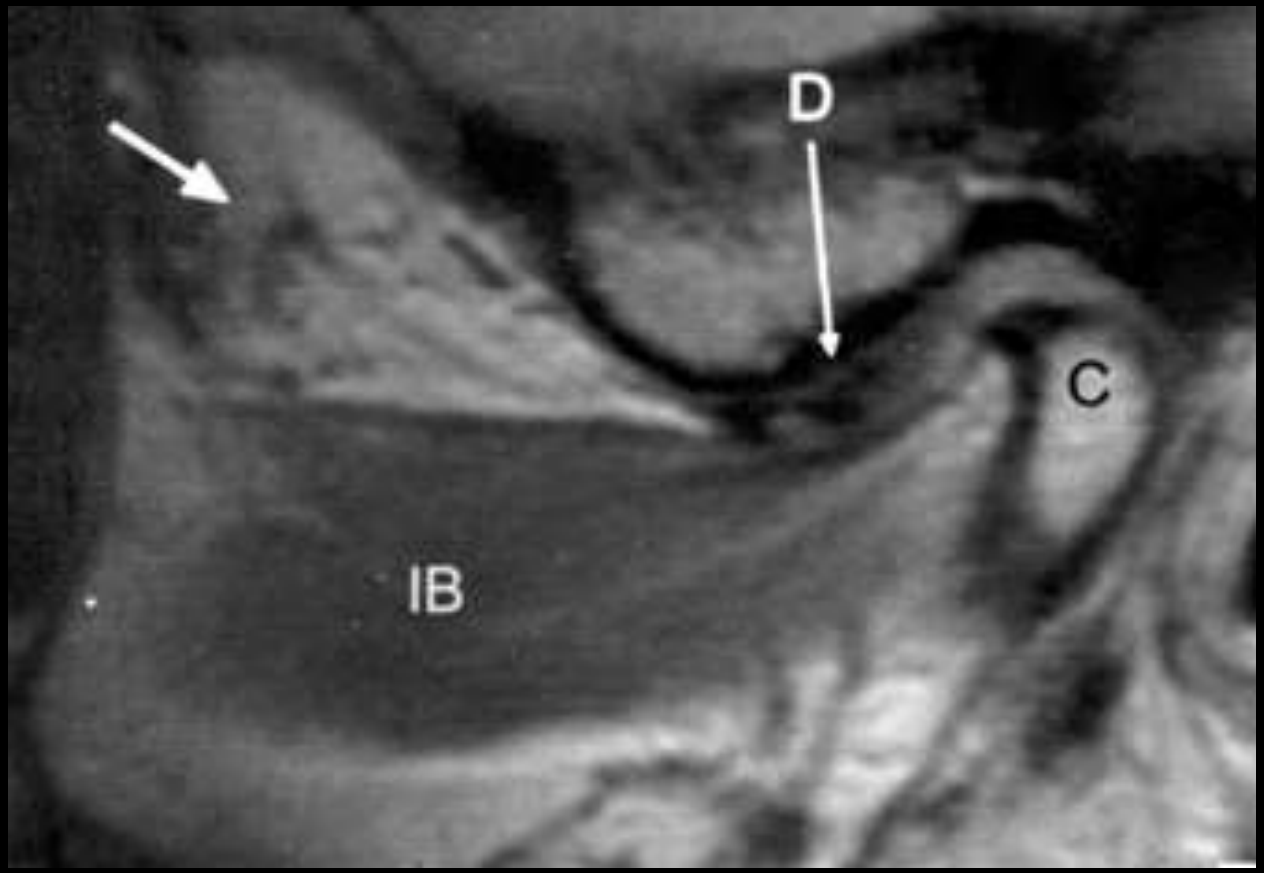
Anterior dislocation without recapture and perforation posterior attachment

Styles C, et al. Brit J of Oral and Maxillofacial Surgery. 2002; 40:220-228.



Stuck disk

35 y.o. F pain on jaw movement; difficult with mouth opening x past two years



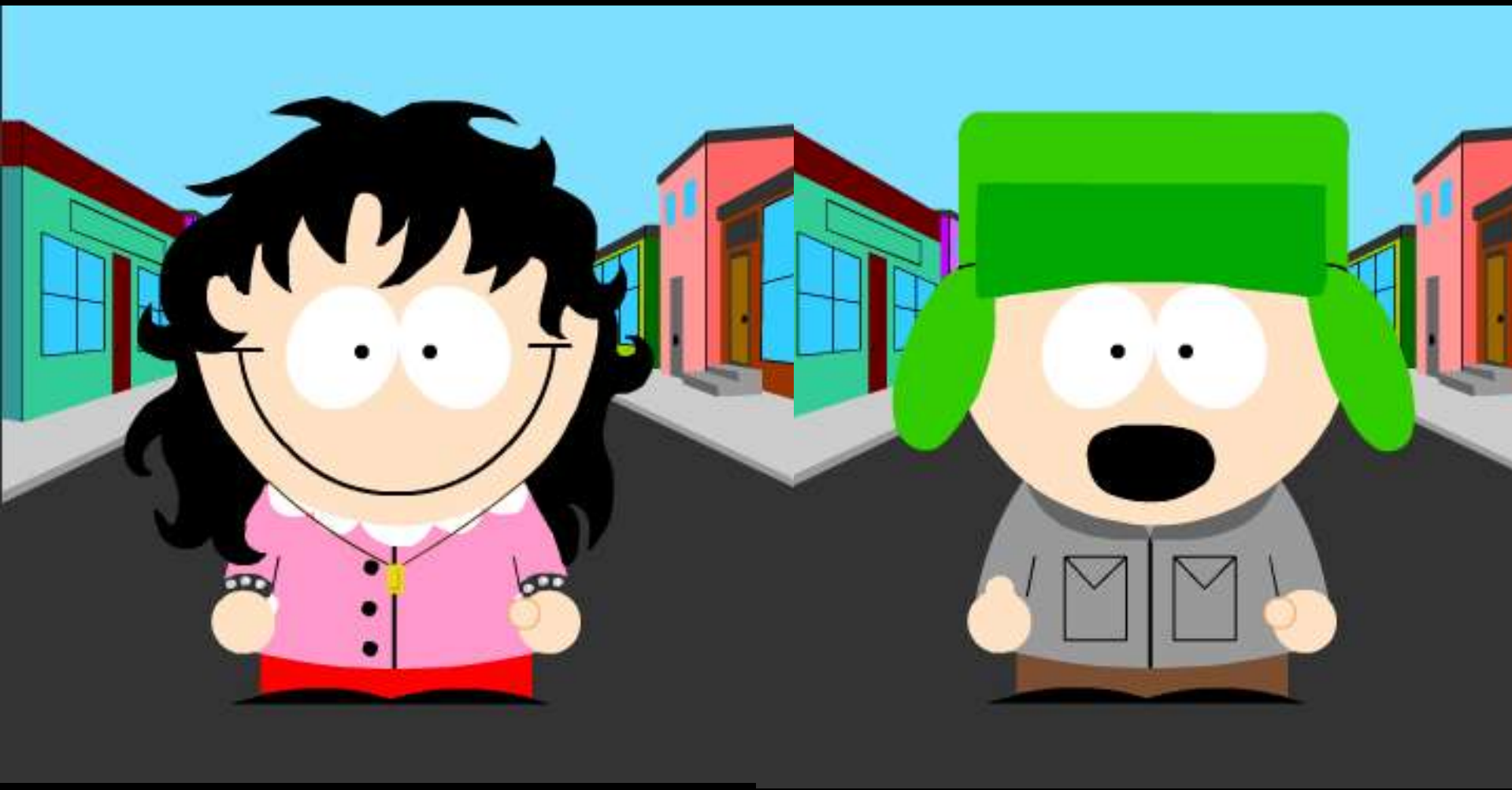
Anterior dislocation without reduction upon opening

http://www.herkules.oulu

Summary

- Internal derangement most common abnormality affecting the TMJ
- MRI modality of choice
- Symptomatology may not correlate with imaging findings
- Frequently sequential progression:
  - ADDWR
  - ADDWOR
  - Perforation
  - Stuck
- POEMS: (position and mobility, OA, effusion, morphology, signal intensity)

The End



Thanks to Christine and Tudor!

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