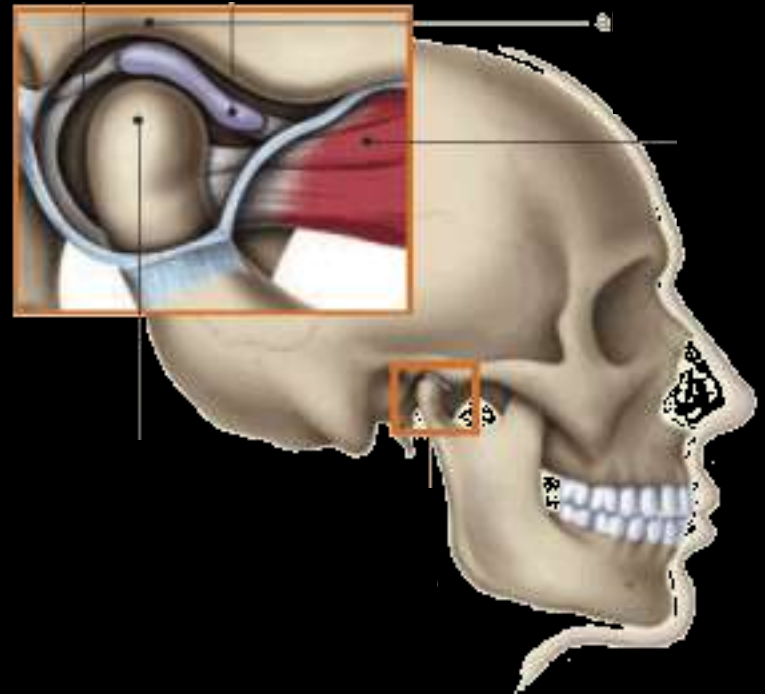


# Internal Derangement of the Temporomandibular Joint

Rosalyn Cheng

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 osteoarthritis of varying severity
- Symptoms become quiescent over a period of 6-10 years

# Etiology?

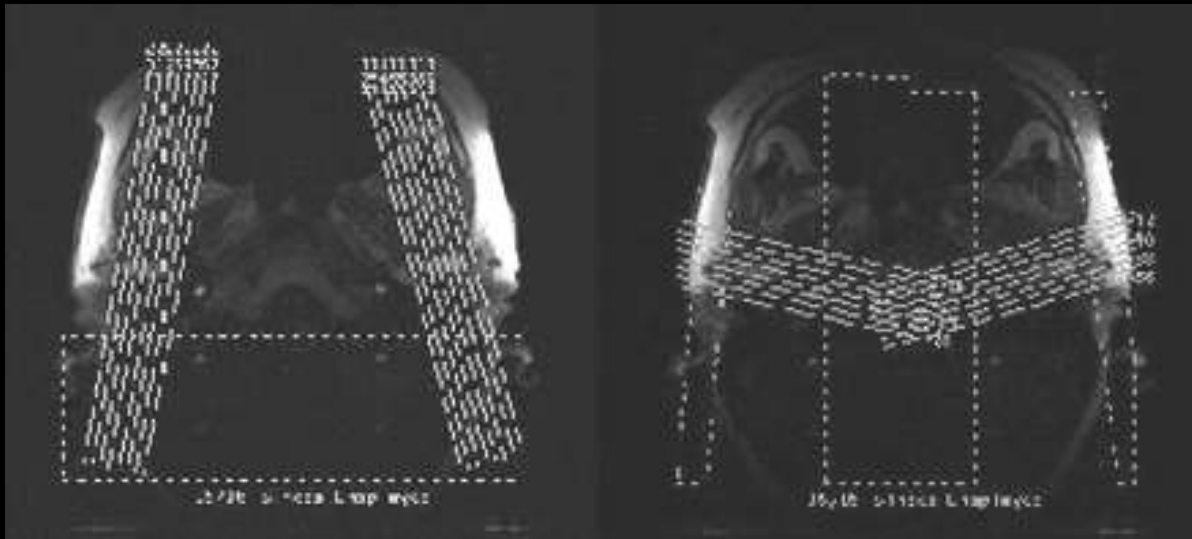
- Not understood
- Trauma
- Iatrogenic
- Ligamentous laxity
- Organic changes in the teeth, malocclusion, bruxism
- Changes in composition of synovial fluid
- Improper activity of lateral pterygoid muscle

# Imaging of the TMJ:

- Transcranial radiography
- Panorex
- SPECT using  $^{99m}\text{Tc}$  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



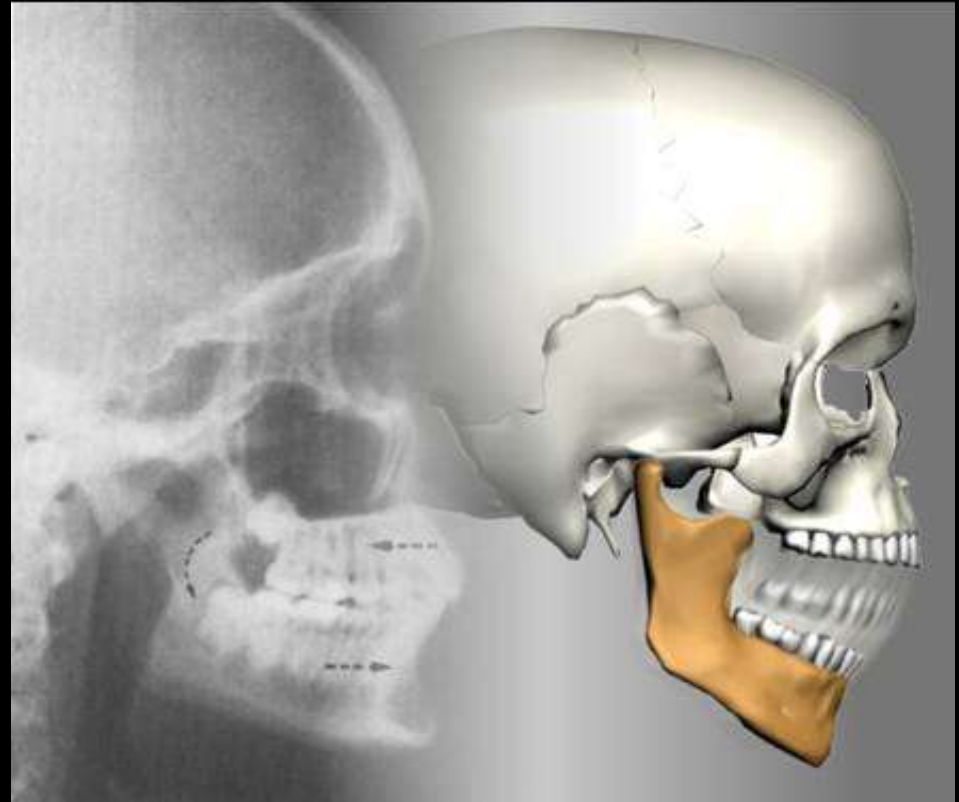


# Imaging TMJ- MRI

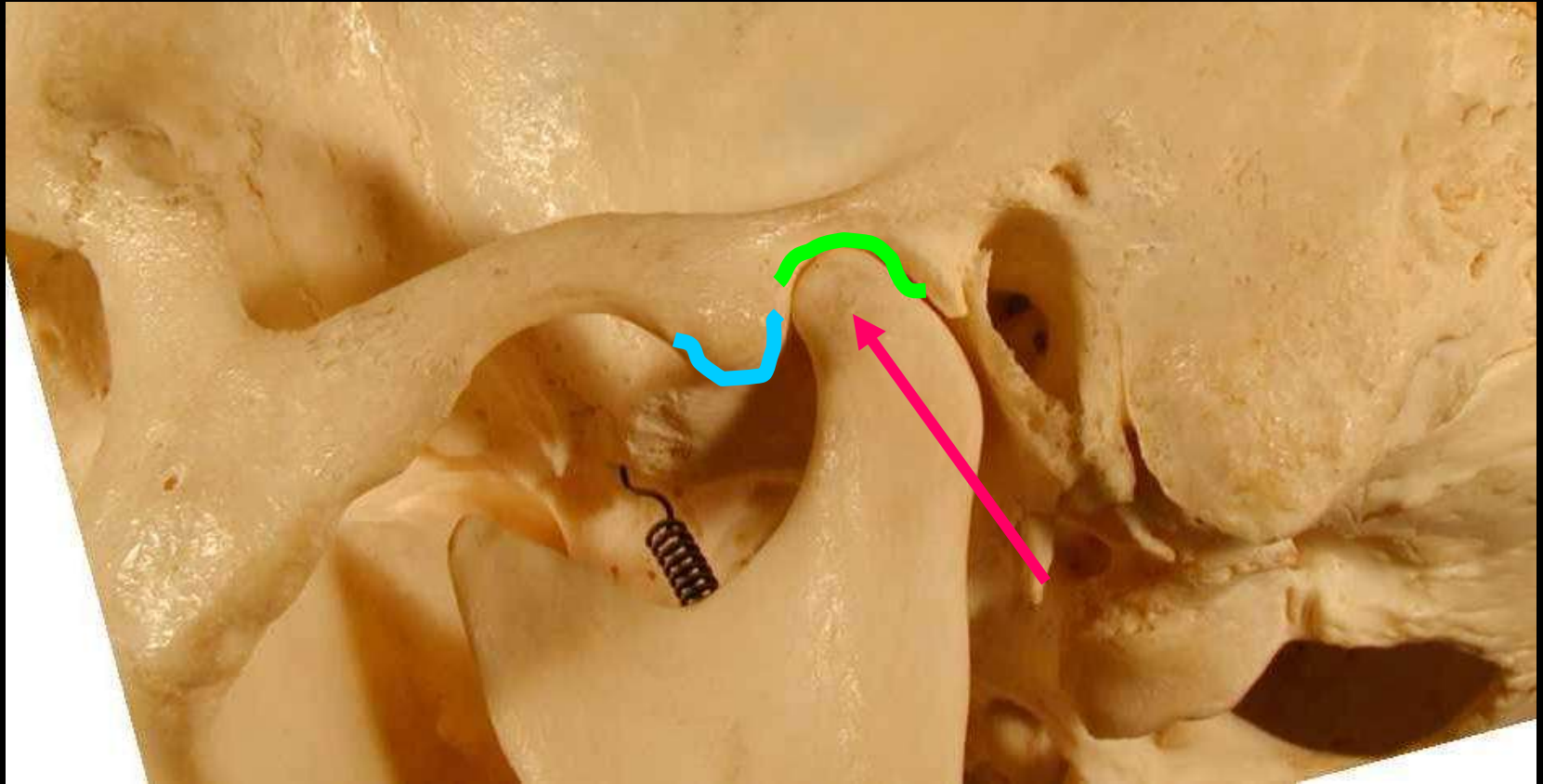
- 3 mm slice thickness with a spacing of 0.5 or 1 mm
- FOV 12-14 cm
- Matrix 256 x 192
- Small surface coils; dual
- Gradient echo- pseudodynamic; static images at progressive increments of mouth opening

# 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



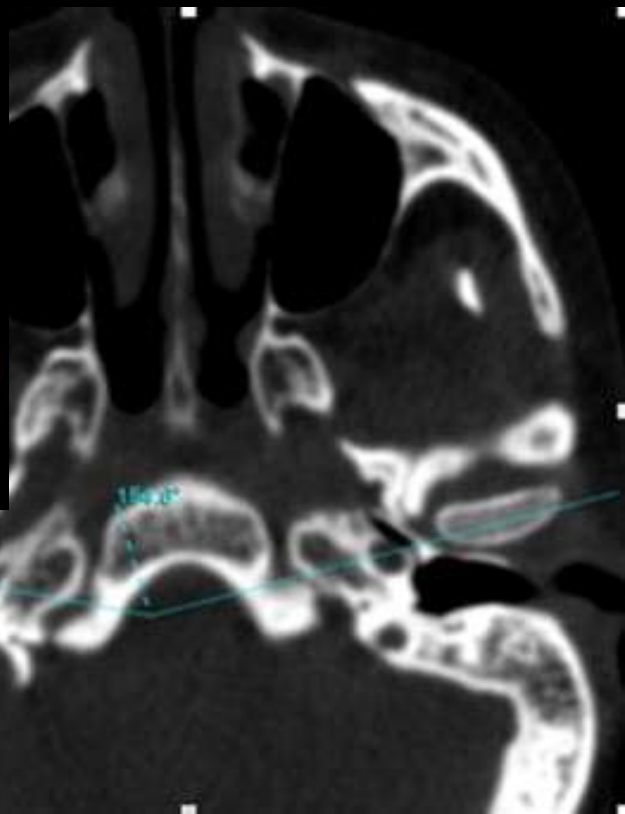
# Anatomy-Osseous components



# Mandibular component

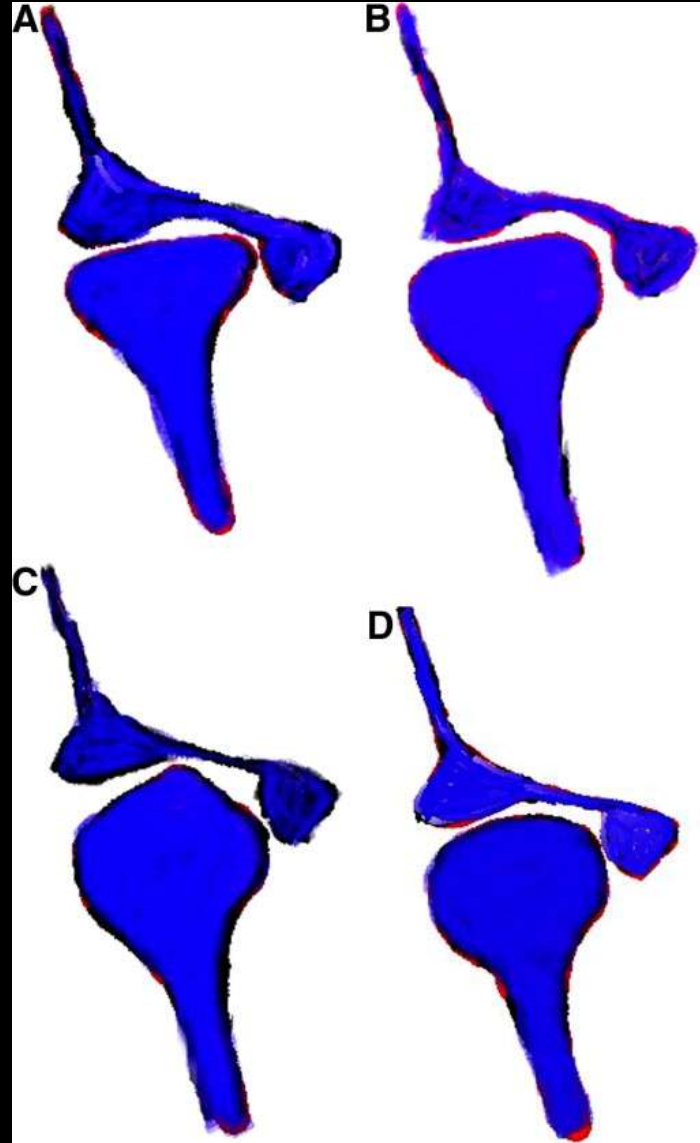
- Condylar head atop mandibular neck
- Lateral pole and medial pole





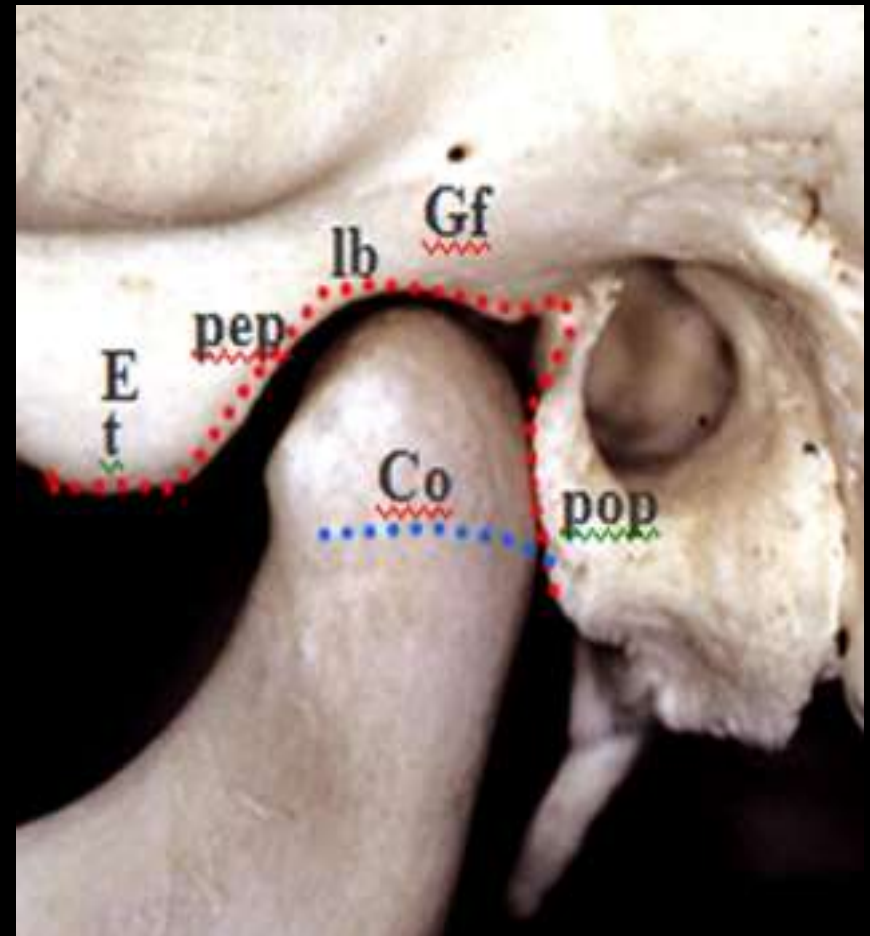
# Mandibular component

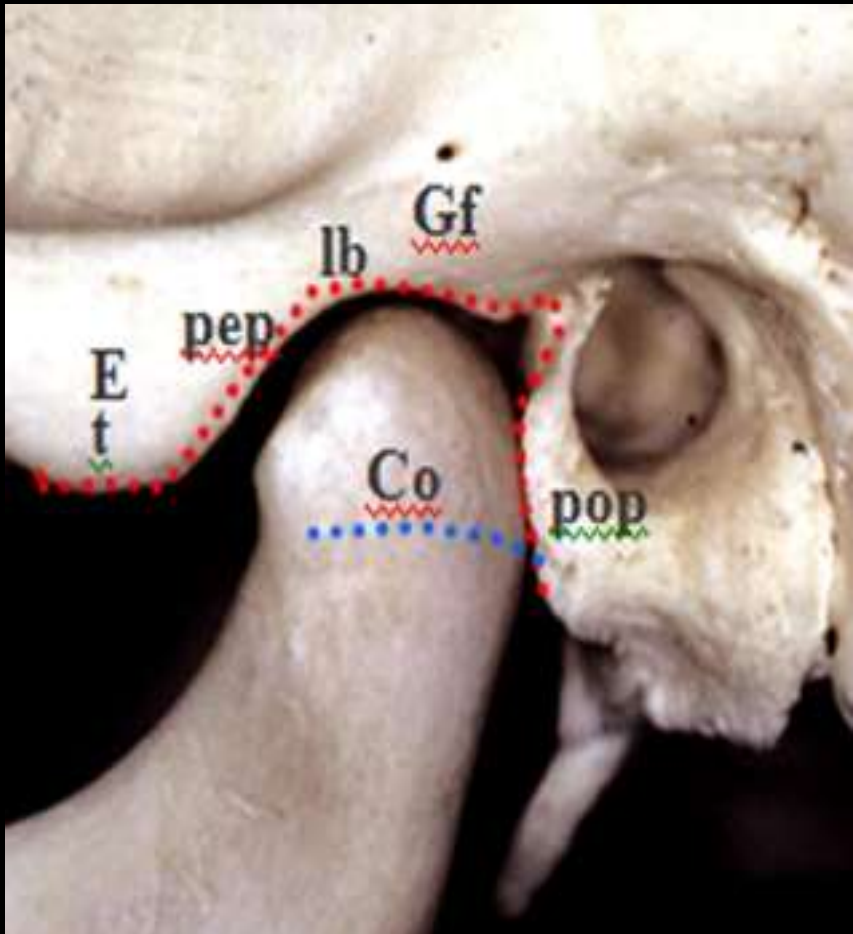
- Morphology of condyle variable



# Anatomy- Temporal bone component

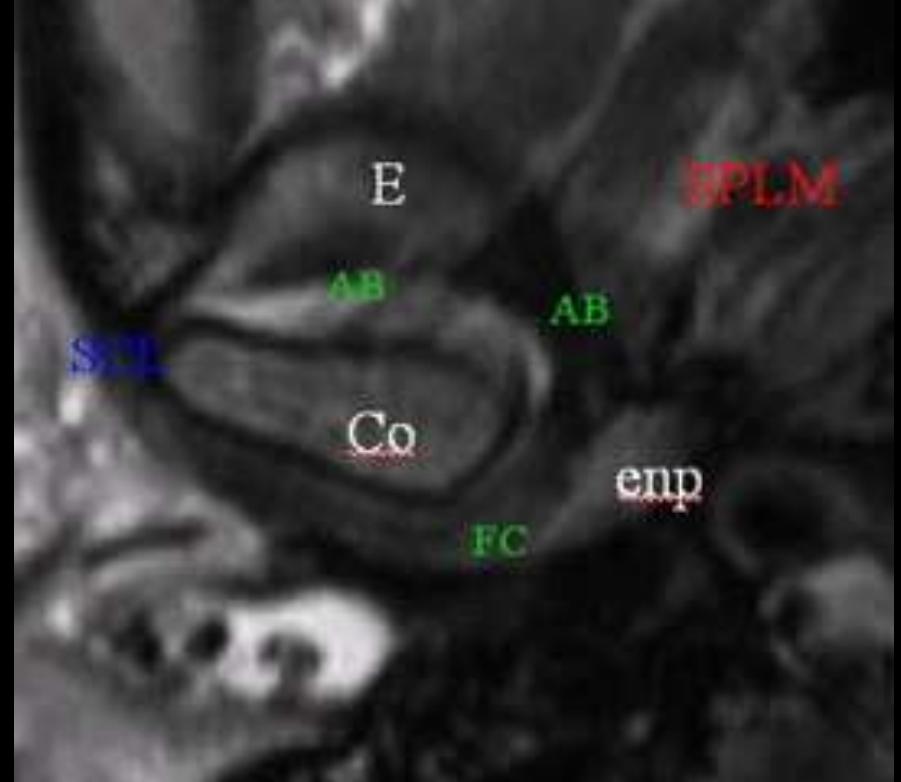
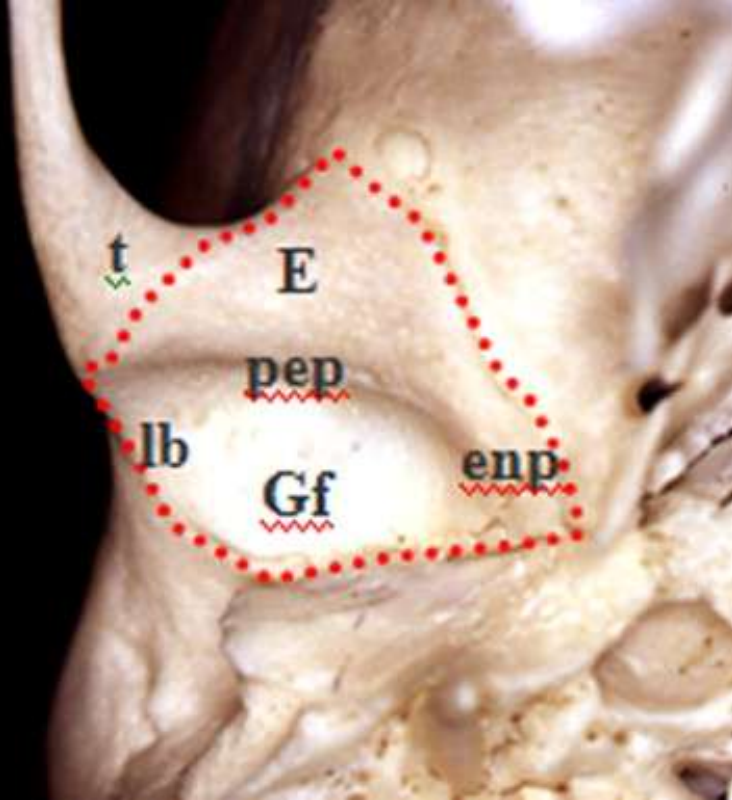
- Articular eminence
- Articular tubercle
- Preglenoid plane
- Glenoid fossa
- Postglenoid process





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



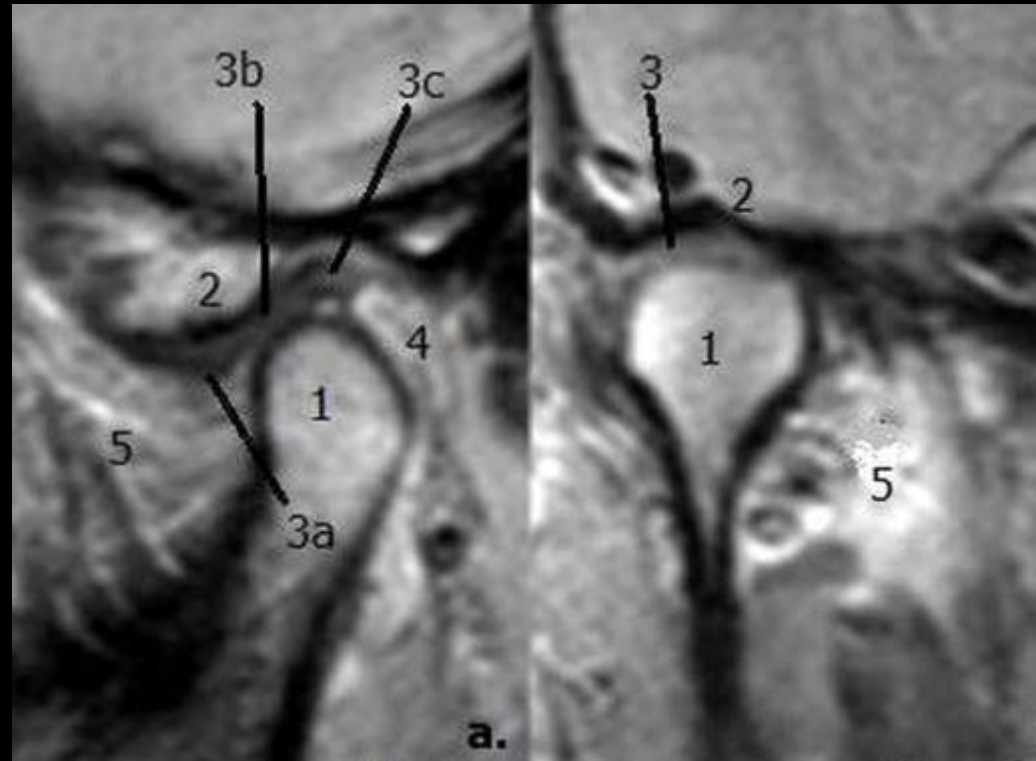


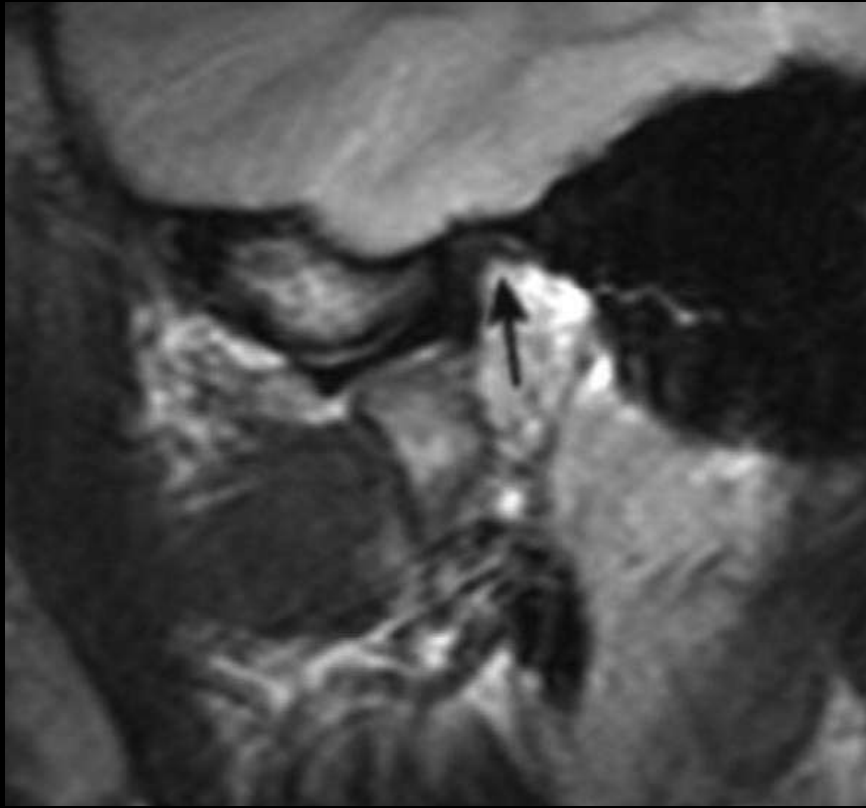
# Anatomy- Articular Disk

- Biconcave fibrocartilaginous 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

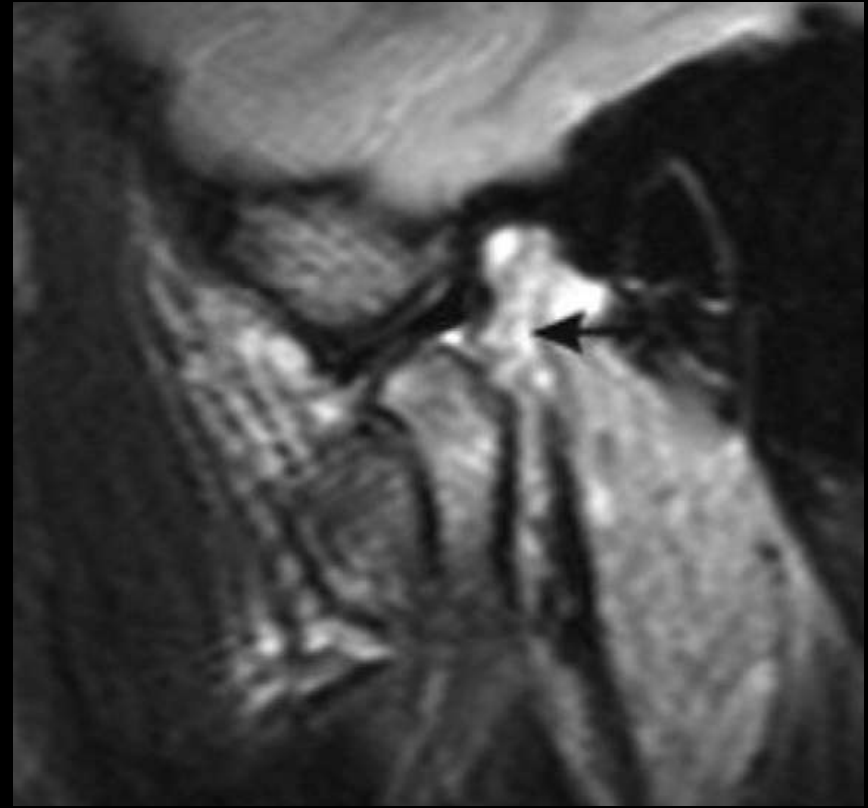
# Articular Disk

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

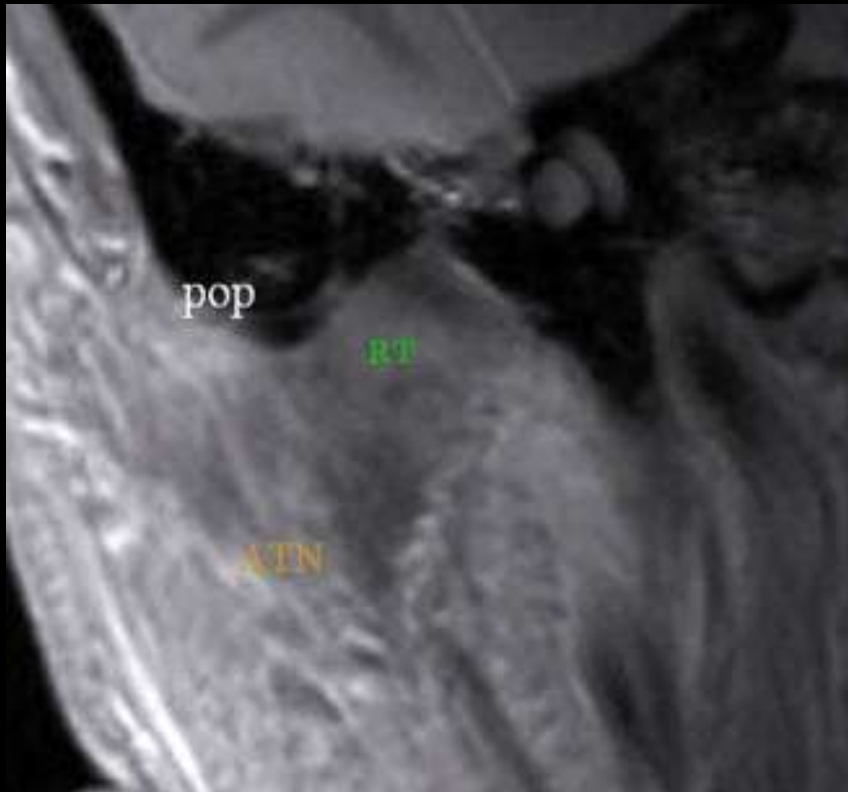




Normal superior lamina (elastic fibers)

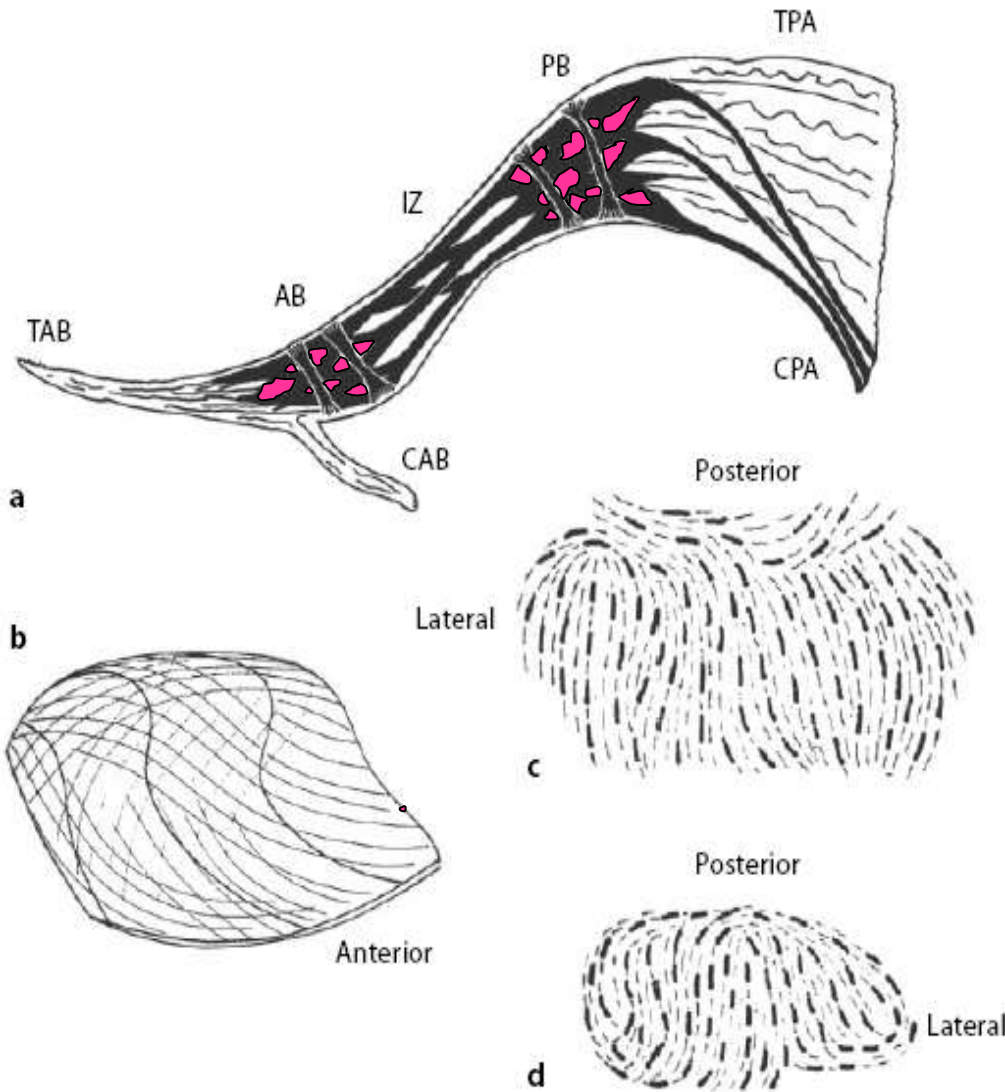


Normal inferior lamina (collagen fibers)



# Biomechanical Properties of the Disc

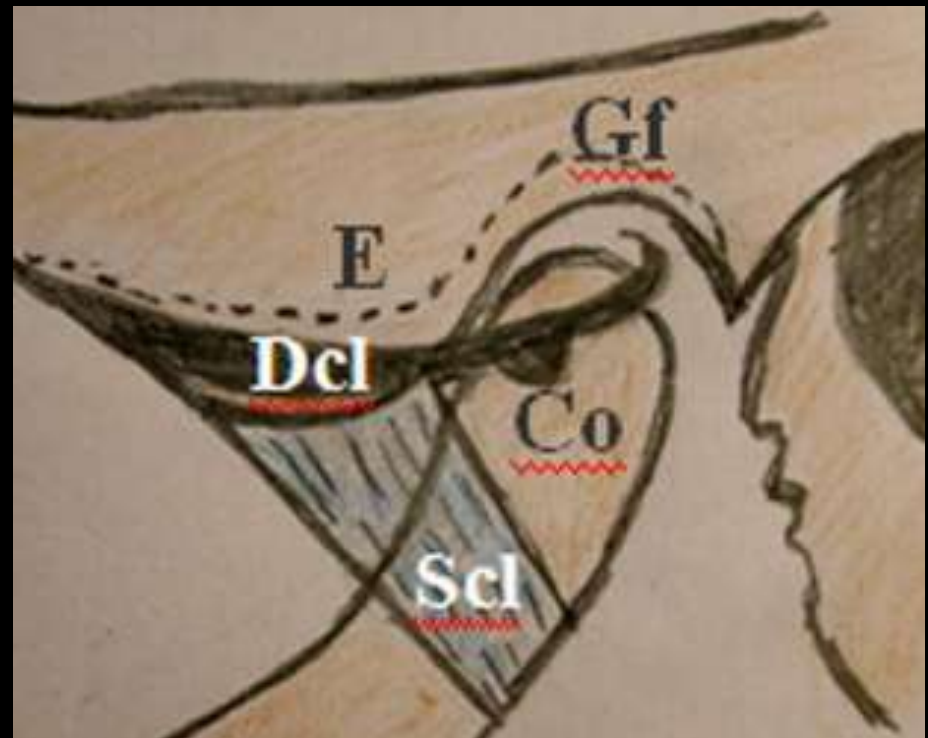
- Disc has to be able to absorb peak loads, distribute force
- Inhomogeneous distribution of collagen, elastin, proteoglycans and fluid
- Plastic deformation, local and progressively
- Adaptative response



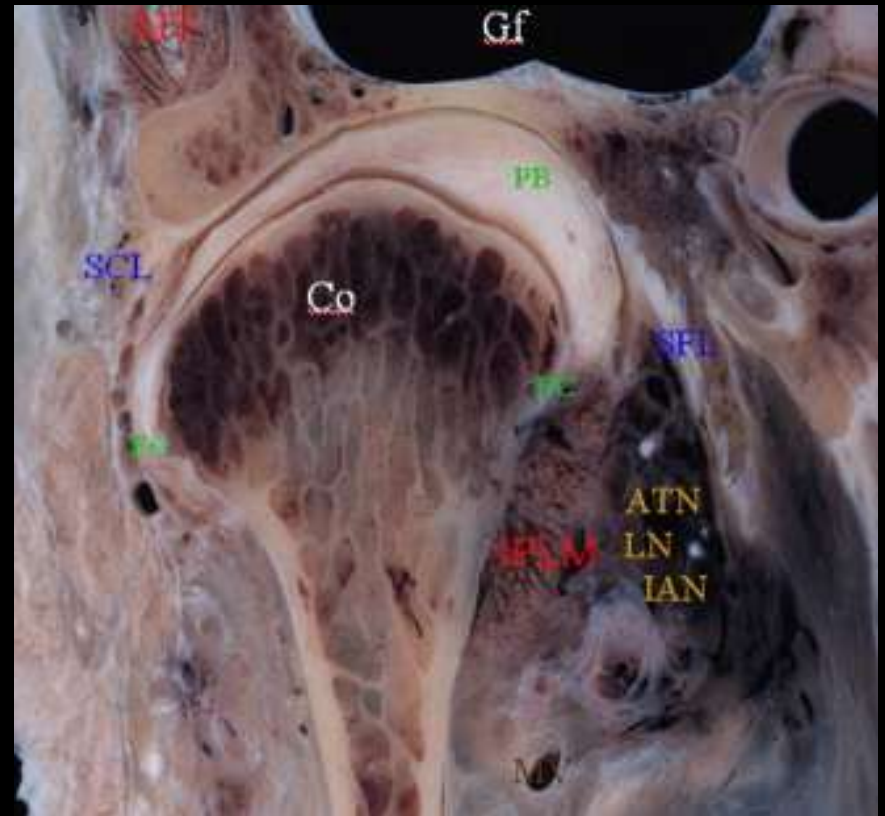
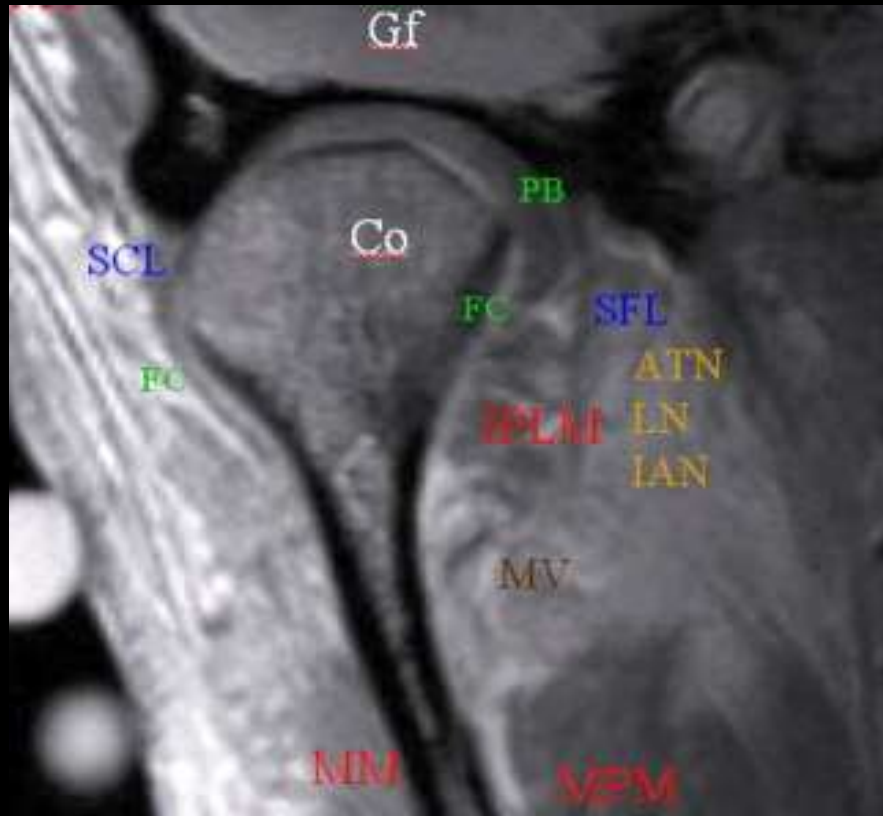
# Collateral Ligaments

Strong lateral ligament

- 2 layers:
  - 1) superficial
    - fan-shaped
    - oblique course
    - taut in protraction
  - 2) deep
    - narrow
    - anteroposterior course
    - taut in retraction





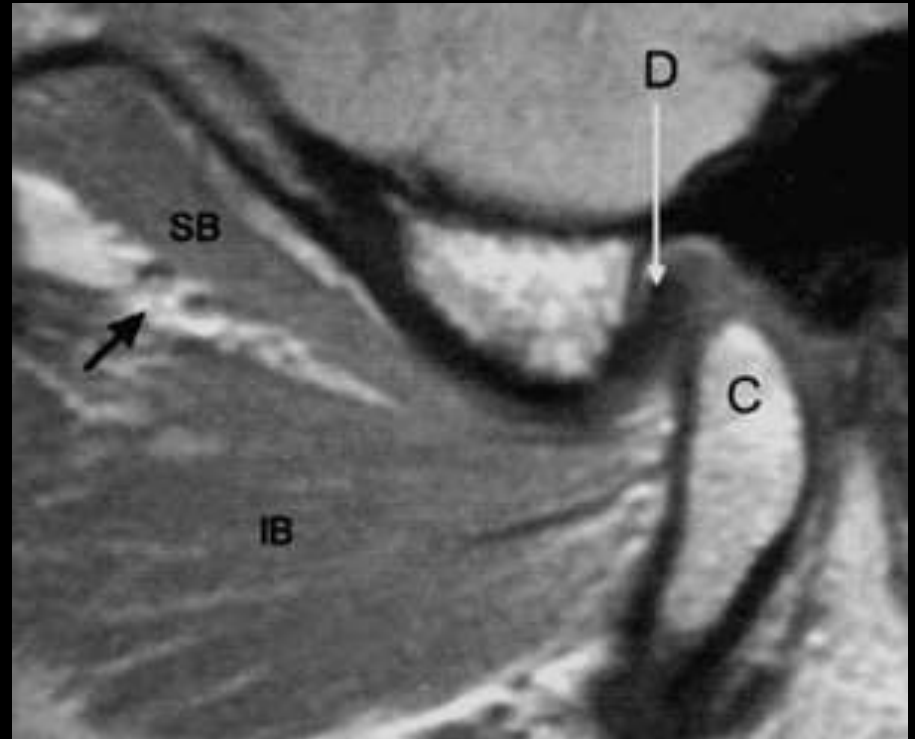
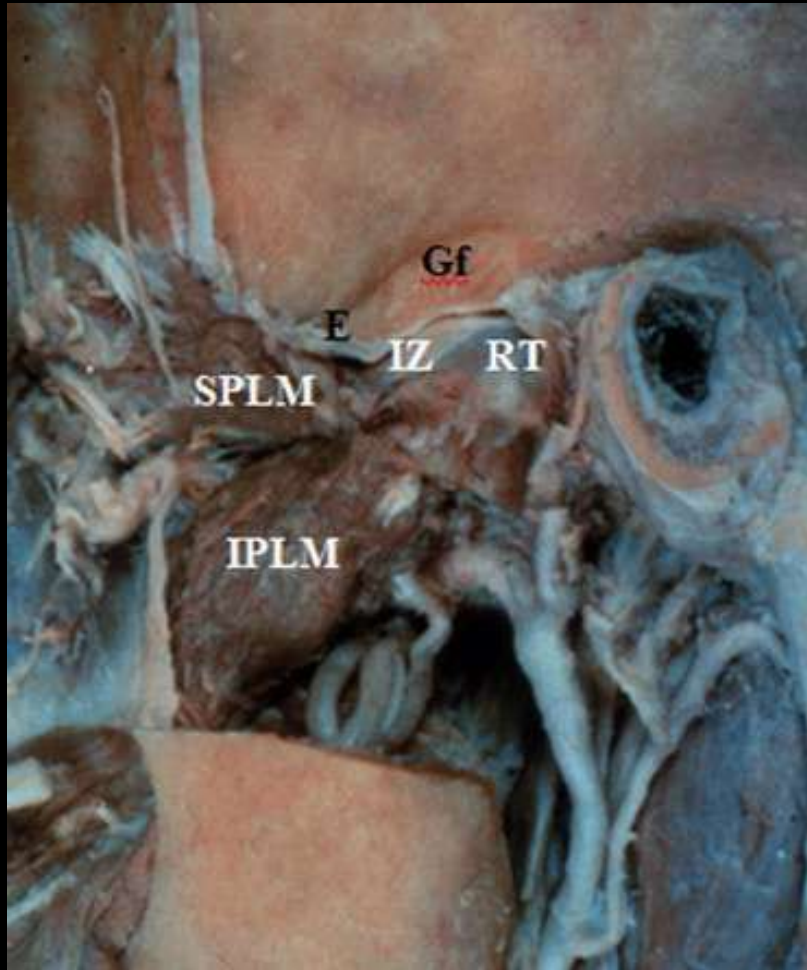


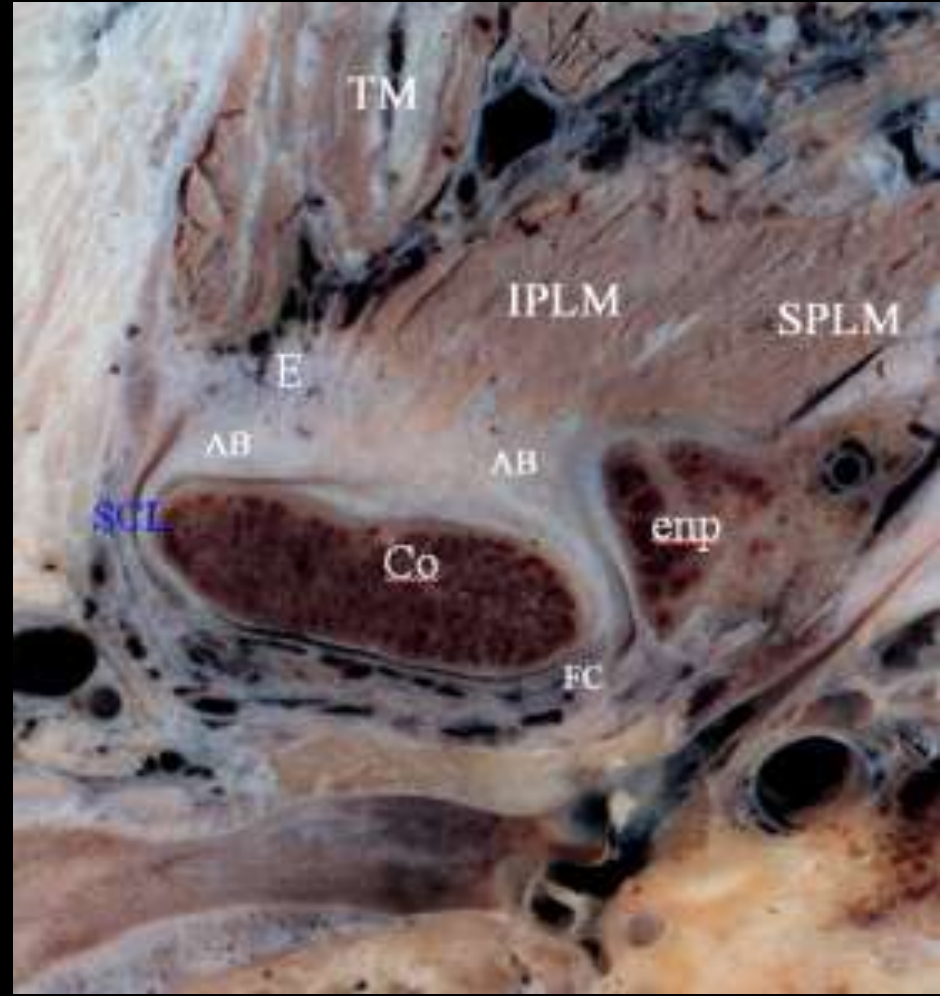
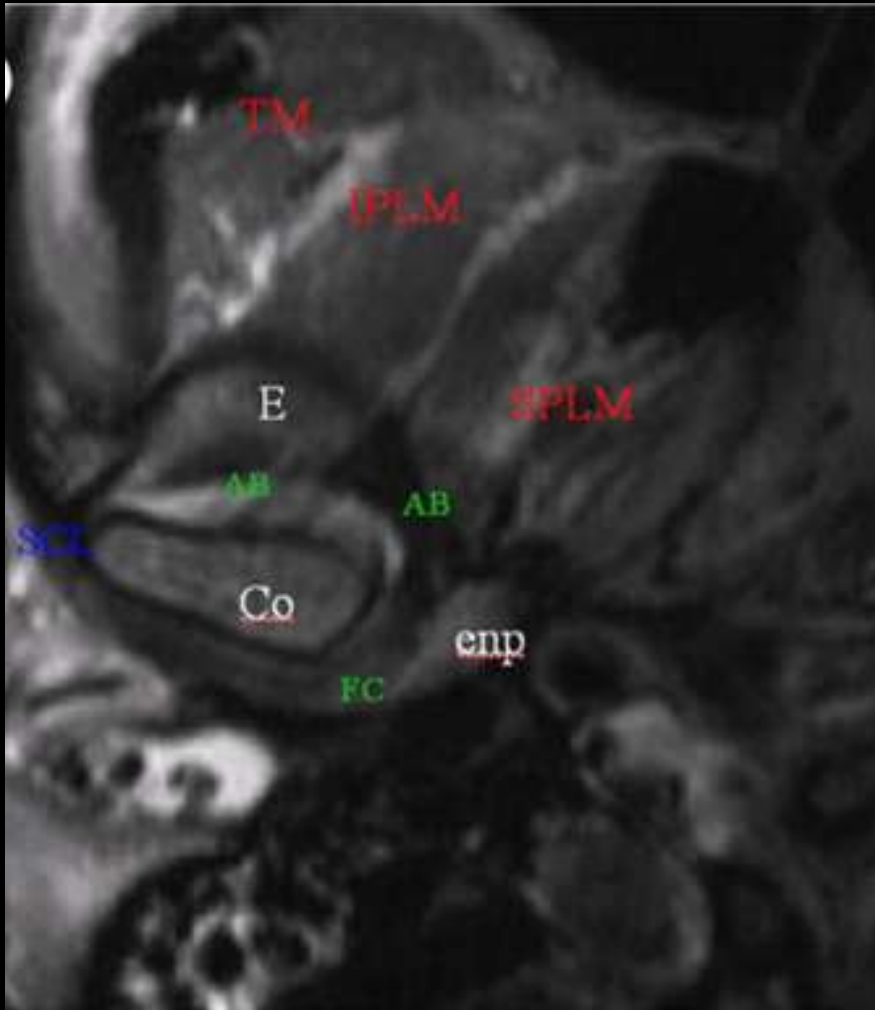
# Muscles

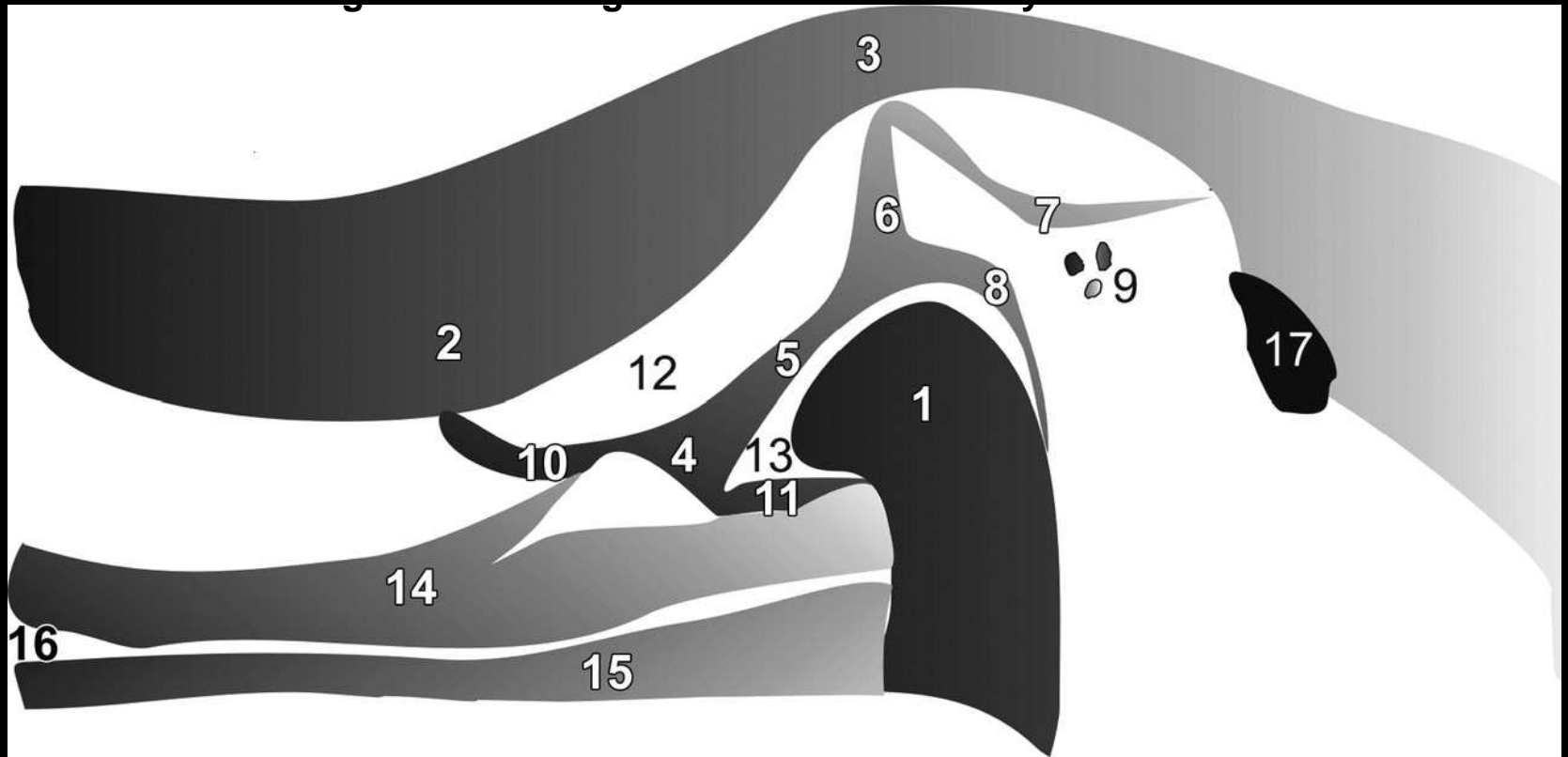
- Muscles of mastication:
  - Abductors (jaw opener)
    - Lateral pterygoid
  - Adductors (jaw closers)
    - Temporalis, masseter, and medial pterygoid

# 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

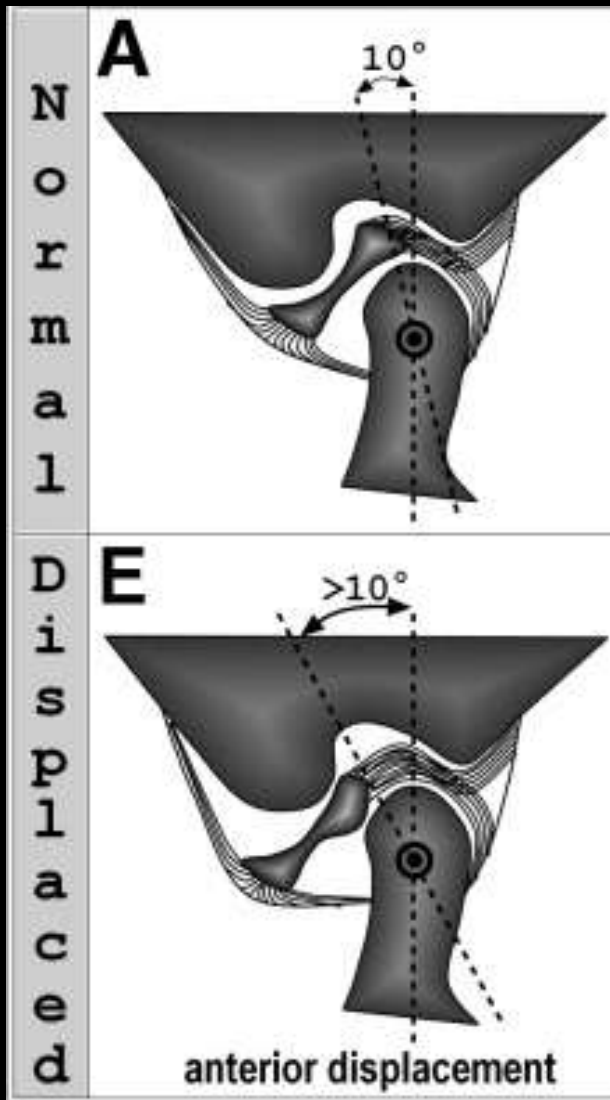






# What is normal?





Closed

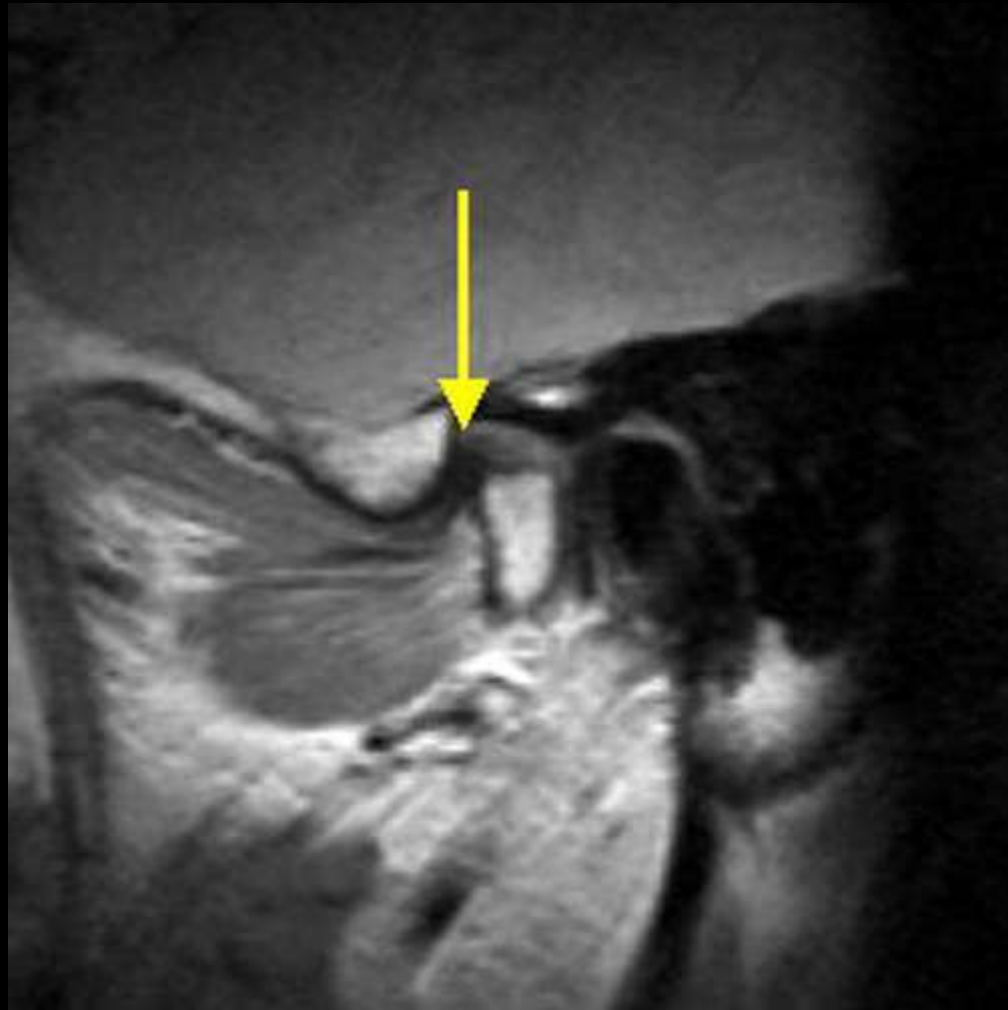


Open

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.





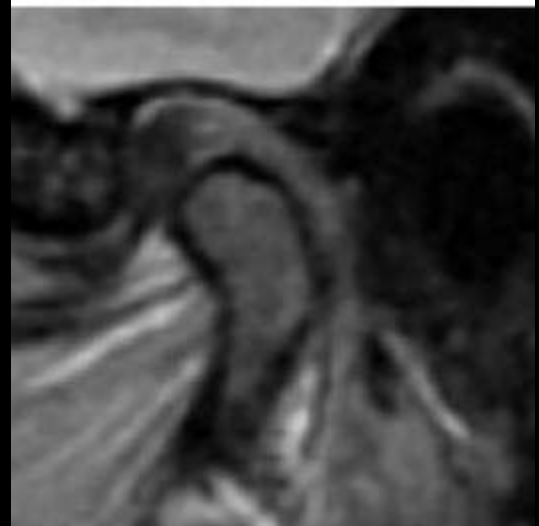
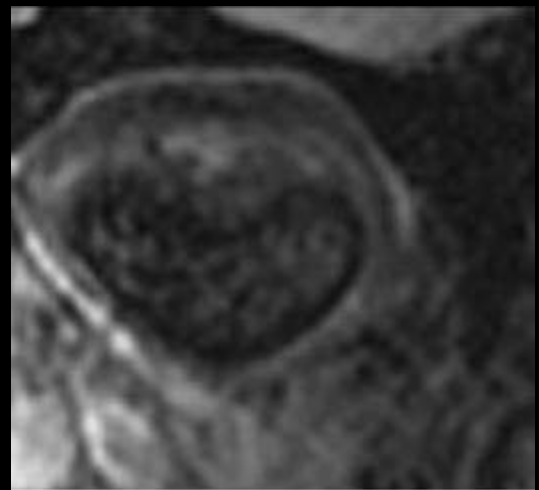
Coronal view

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lateral displacement

medial displacement



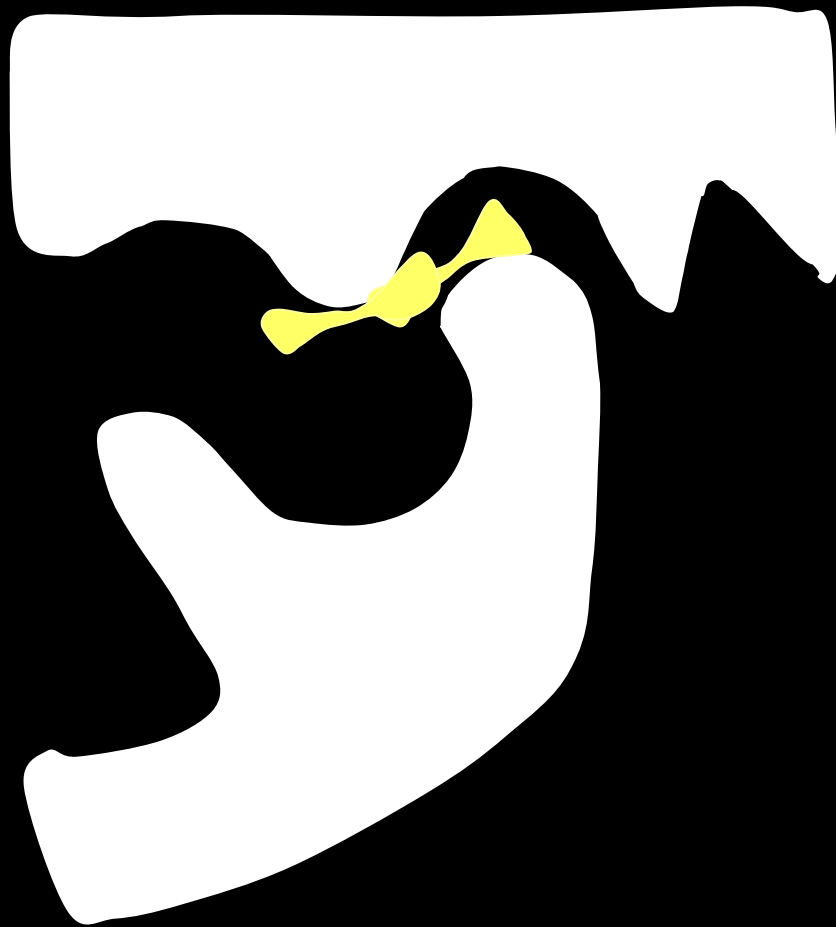
# Normal TMJ motion

- 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

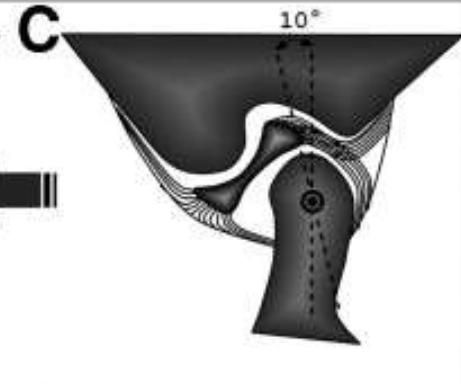
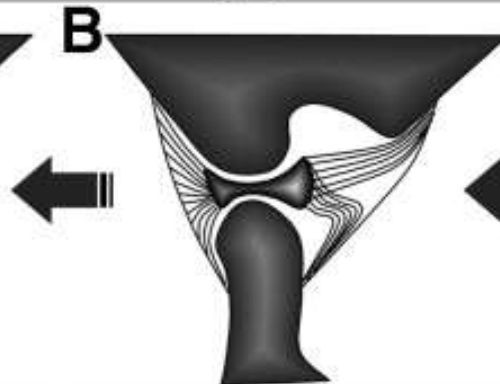
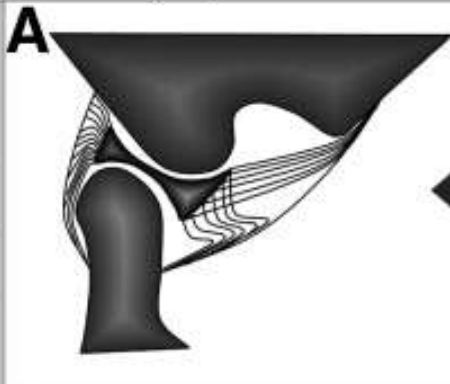
- Anterior displacement with reduction during opening
- Anterior displacement without reduction during opening
- Anterior displacement with perforation of the disk
- Stuck disk, adhesions

Fully open mouth

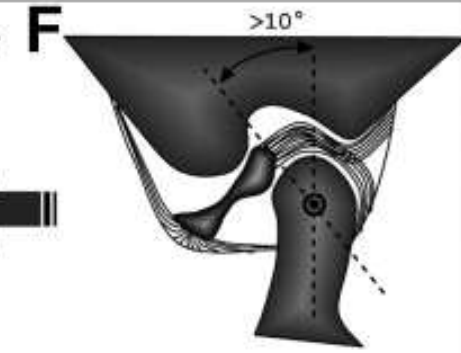
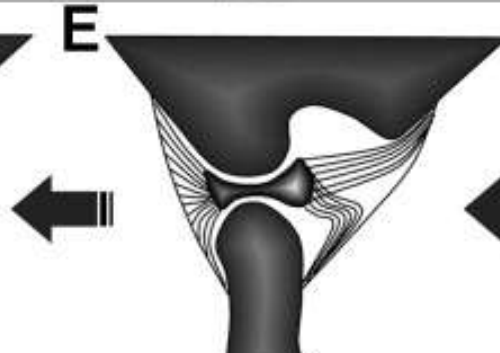
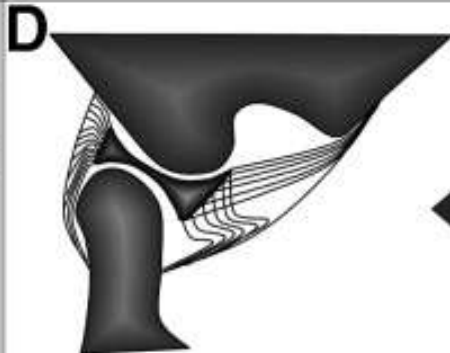
Partially open mouth

Closed mouth

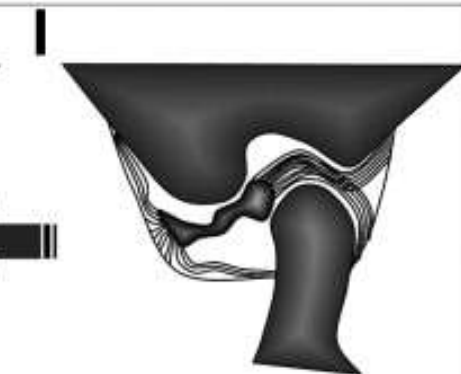
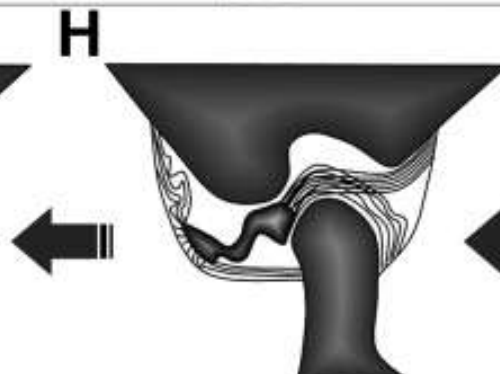
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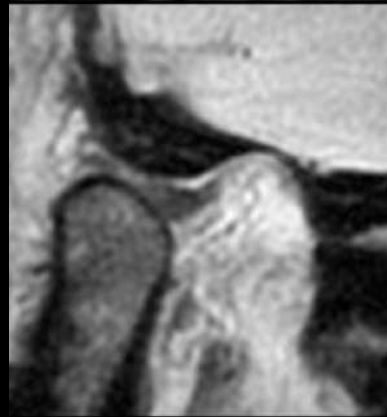
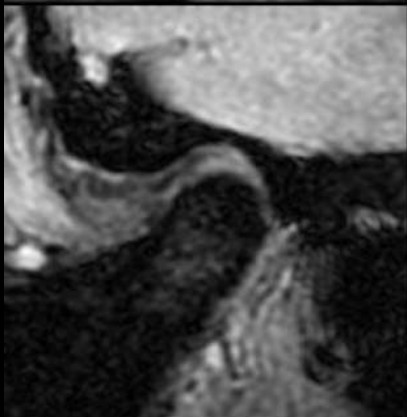
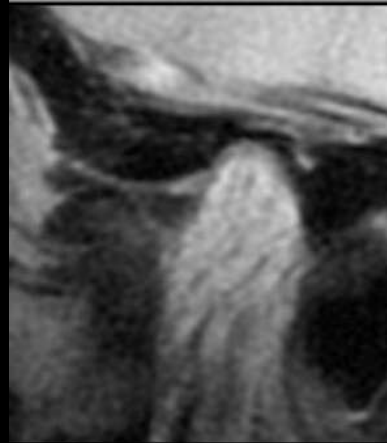
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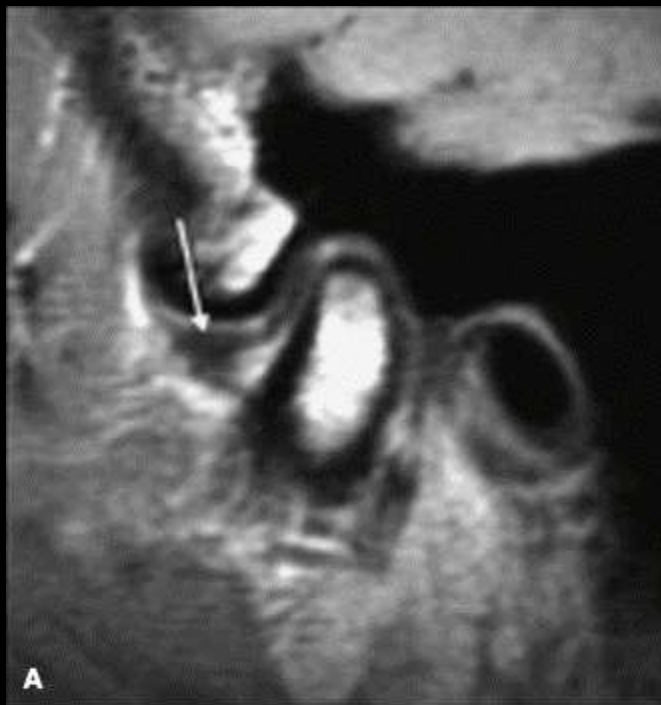






Closed

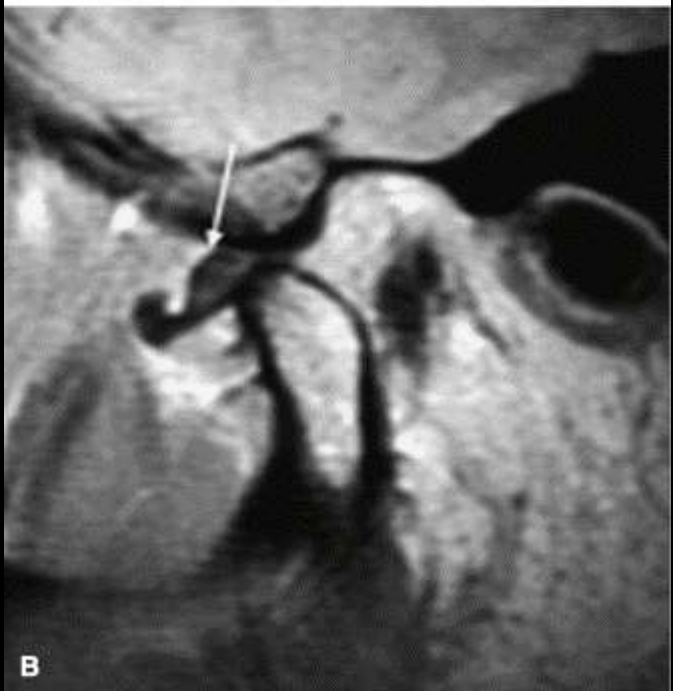
Open



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

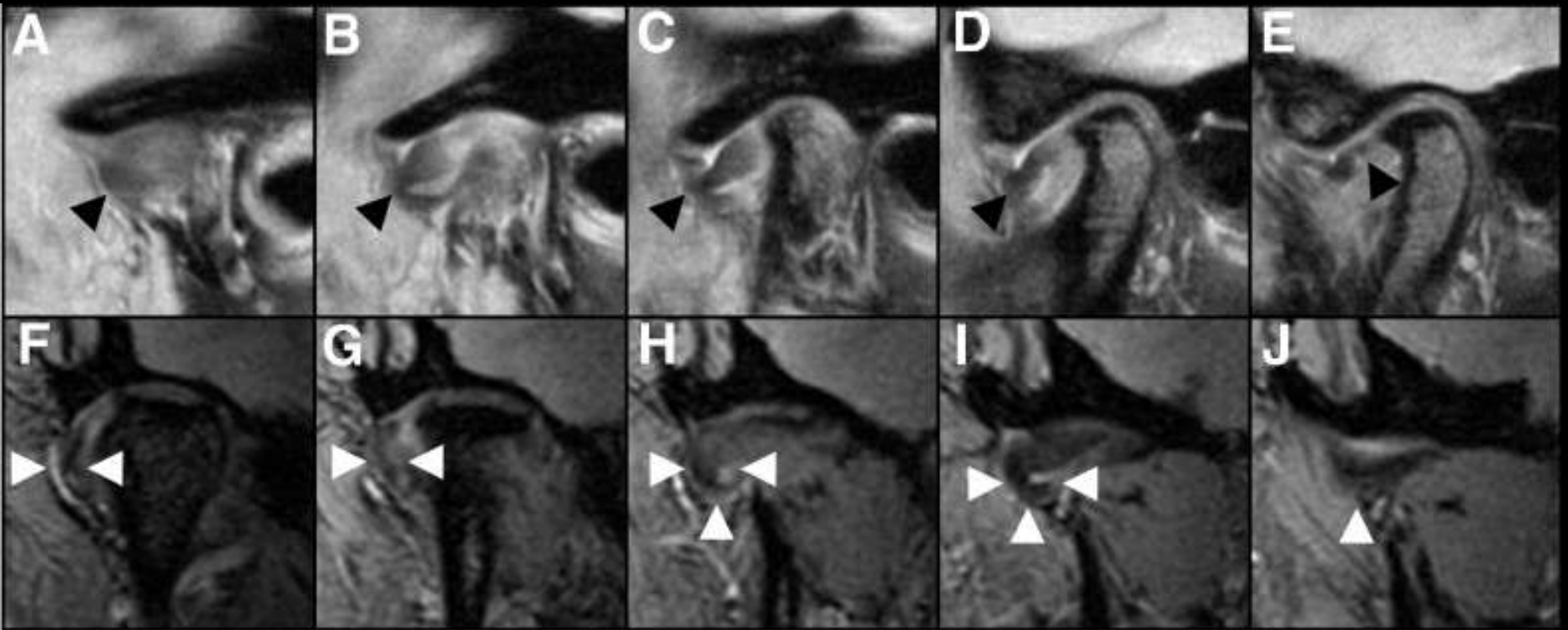


A



B

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

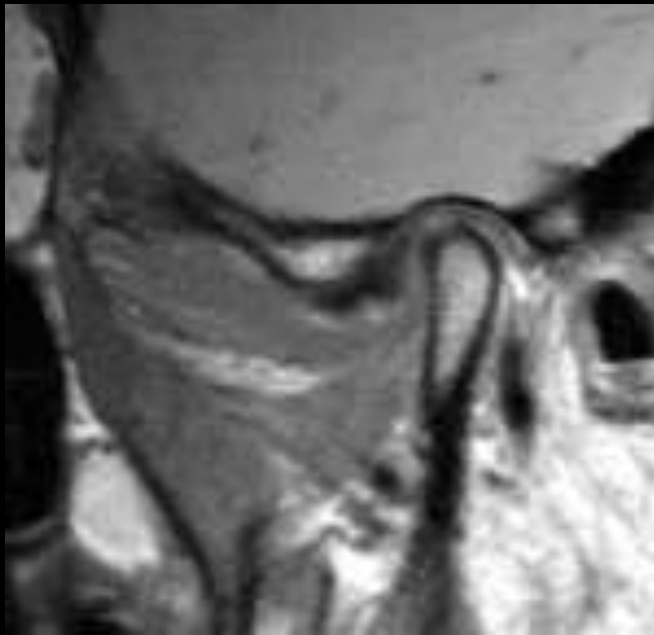
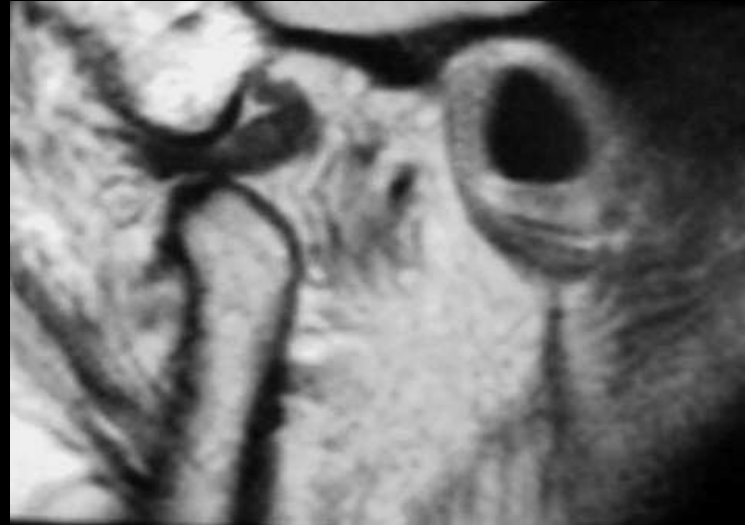
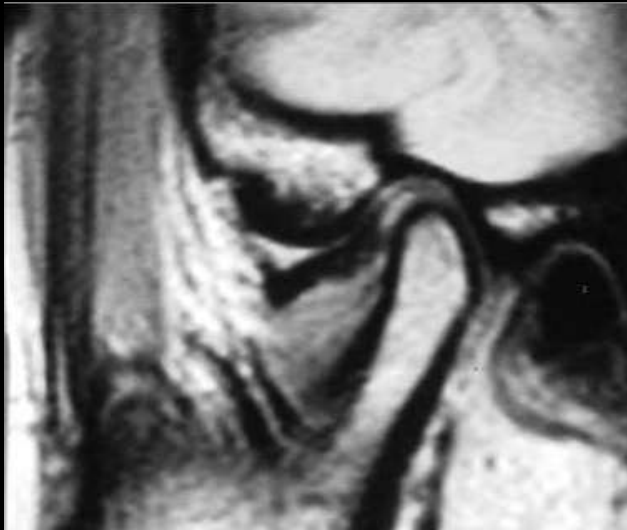


**Anterolateral displacement**

# Secondary signs

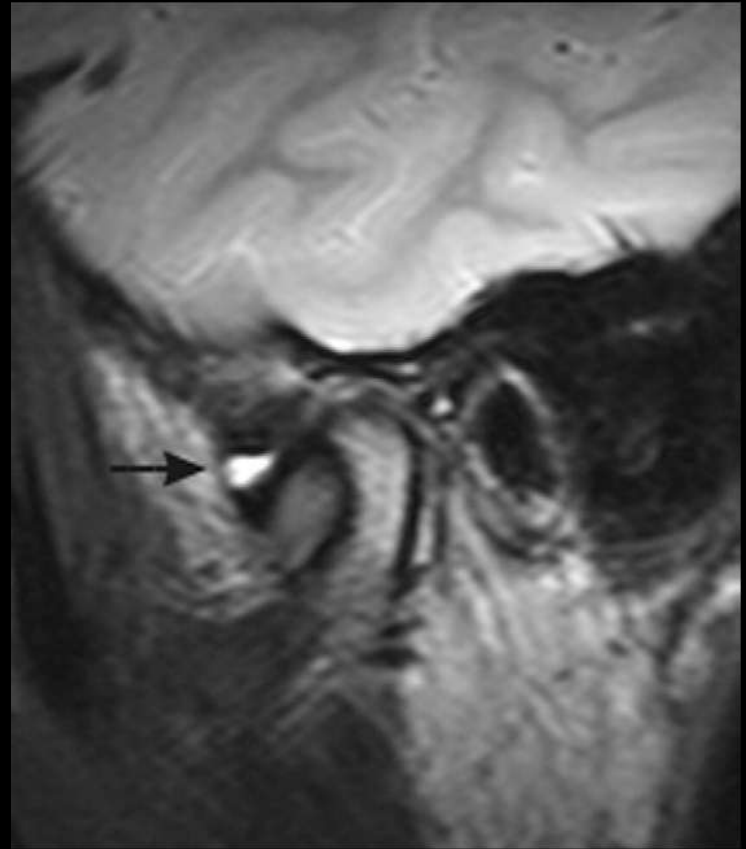
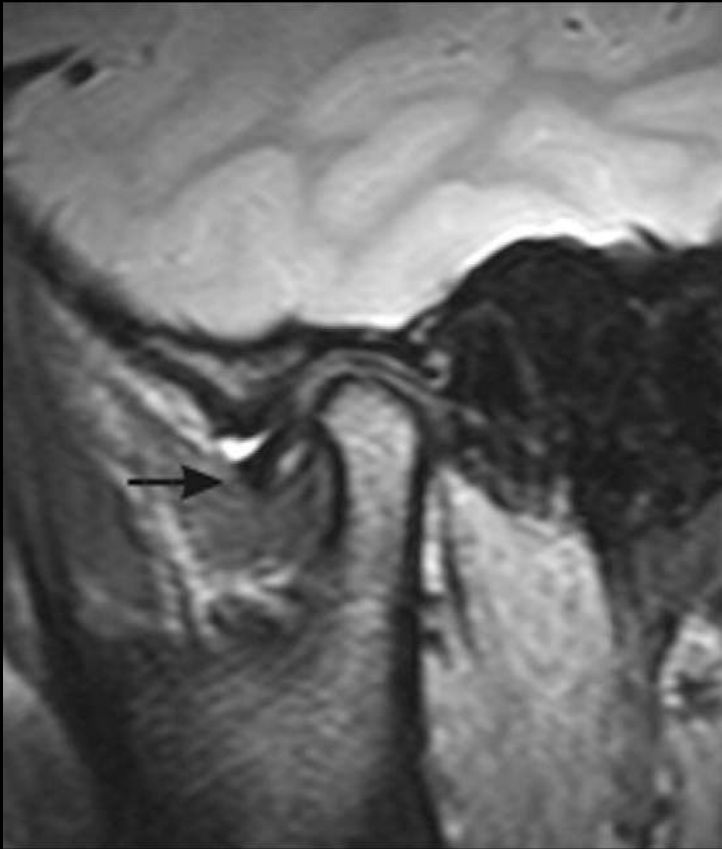
- Morphology of disc- biconvex, rounded, irregular or flat usually indicates more advanced disease
- Presence of joint effusion
- Rupture of retrodiscal ligaments
- Decreased signal intensity of the disc
- Increased T2 SI of retrodiscal tissue- due to higher degree of vascular supply
- Lateral pterygoid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

# Abnormal morphology

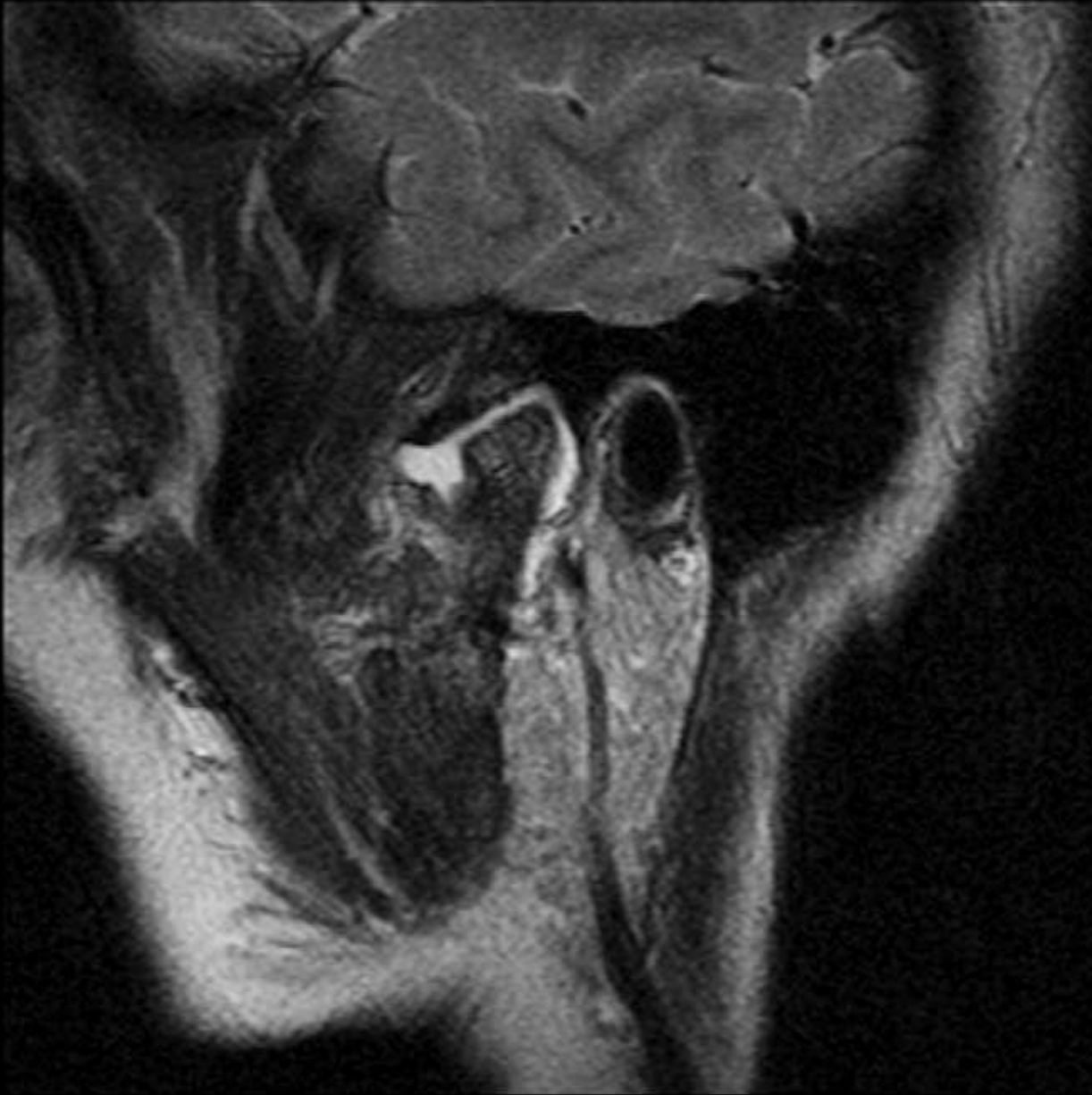


# Joint Effusions

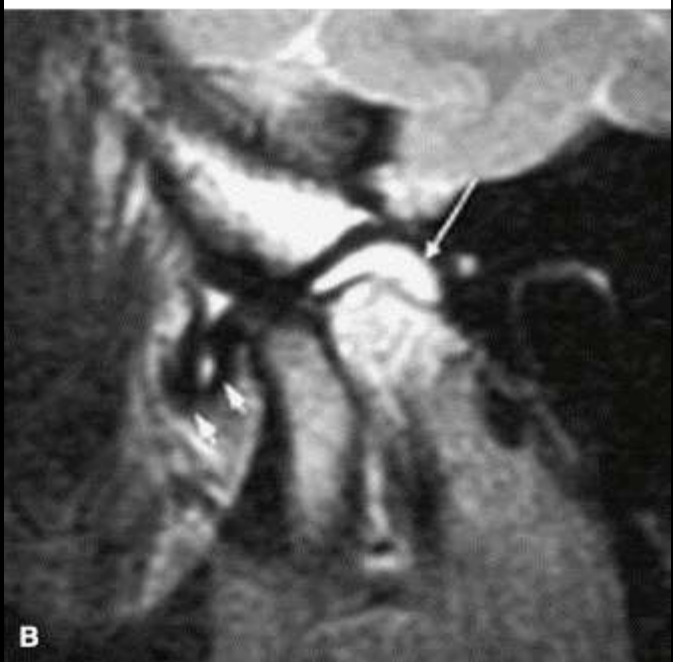
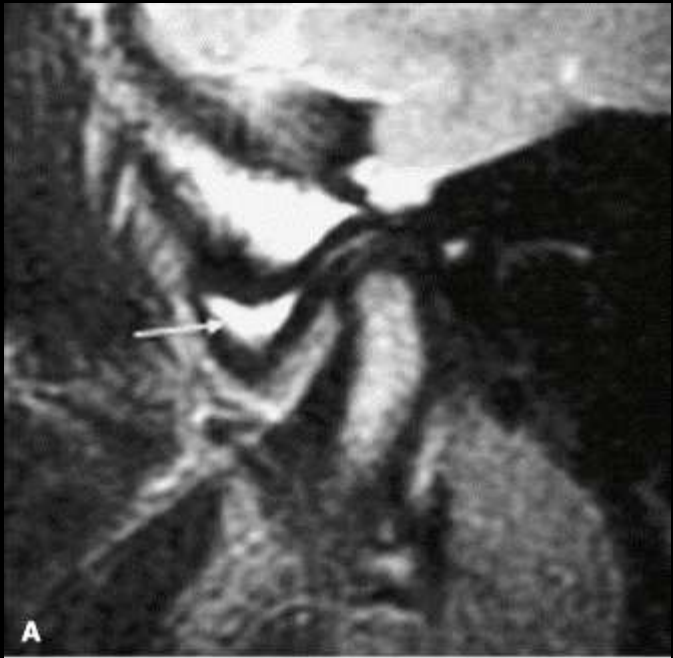
- Significantly more prevalent in painful vs. nonpainful joints
- Large joint effusions seen only in symptomatic patients
- Presence of joint effusion unusual sign in asymptomatic individuals
- Generally seen surrounding anterior band







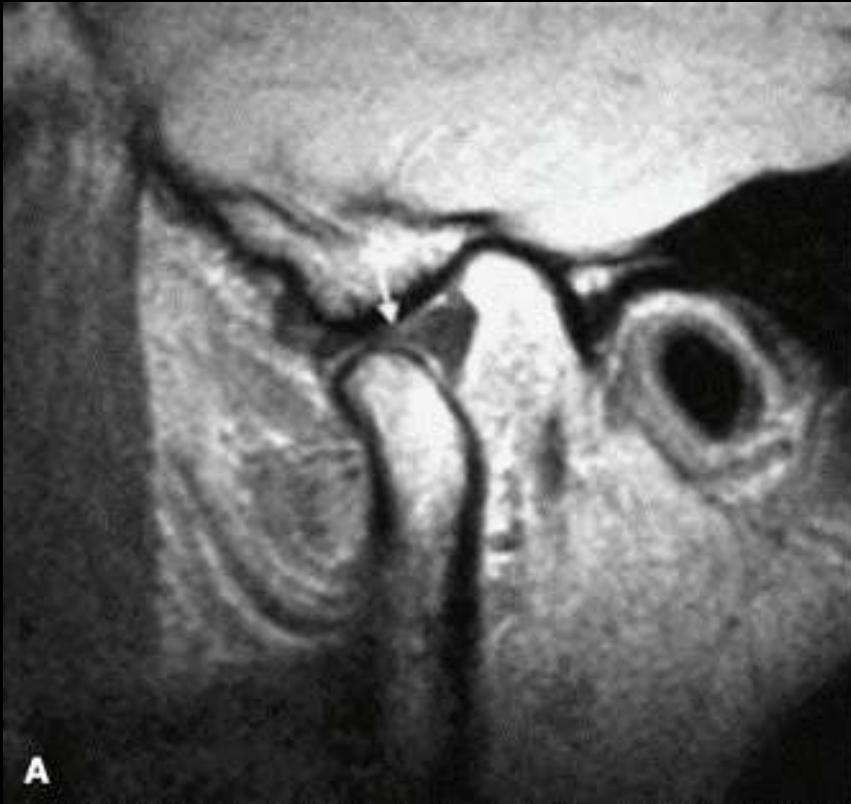
Tomas X, et al. Semin Ultrasound CT MRI 2007; 28:205-212.



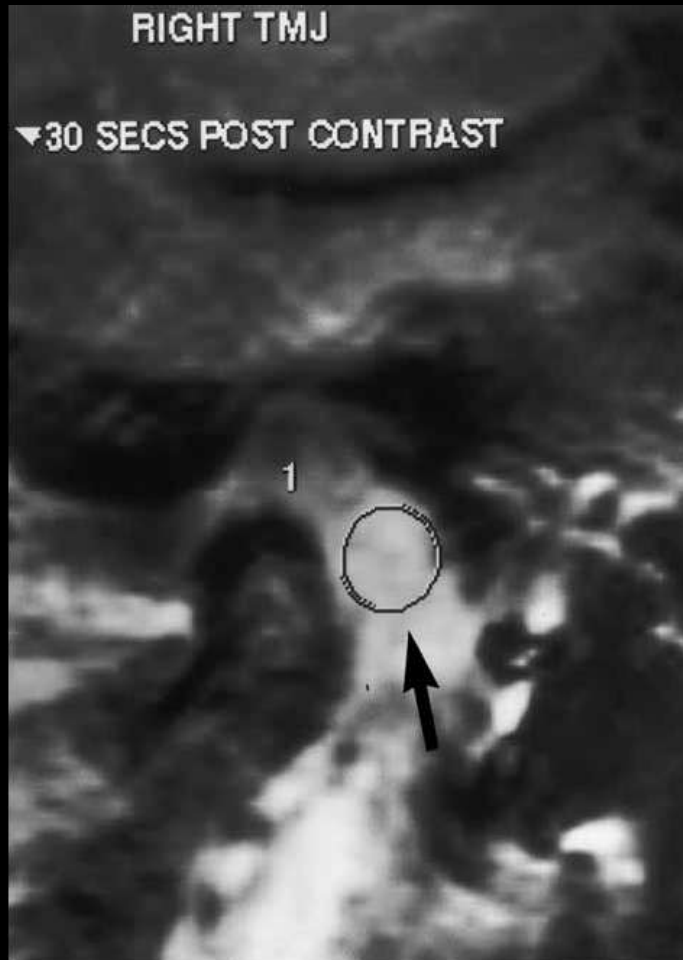
Sano et al. Current problems in Diagnostic Radiology 33(1); 2004 16-24.

# 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



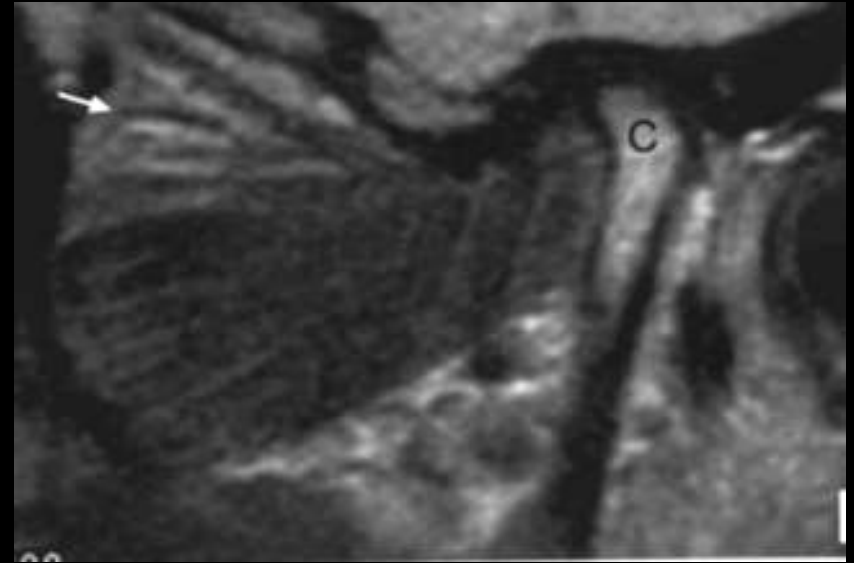
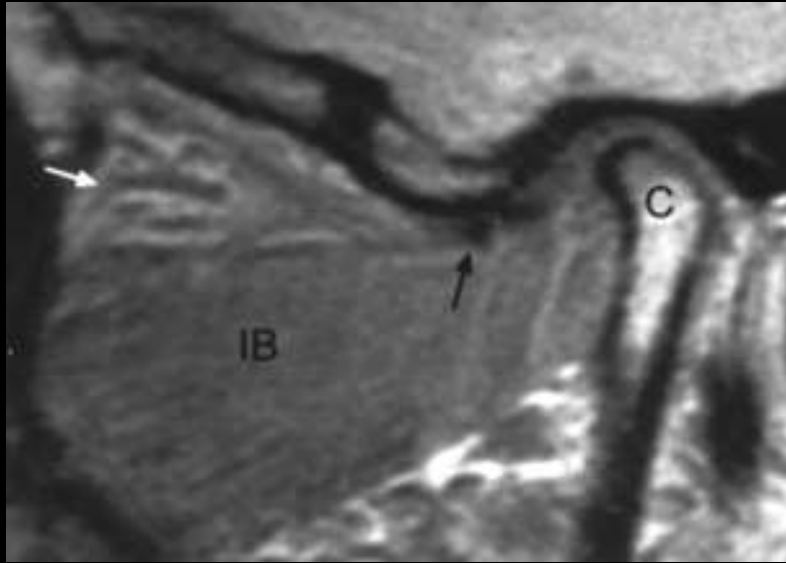
Sano et al. Current problems in  
Diagnostic Radiology 200; 33(1):  
16-24



Abnormal  
enhancement of  
RT



Normal side



# Osteoarthritis

- 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 asymptomatic

# Osteoarthritis

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





# Treatment of Internal Derangement

- 1<sup>st</sup> 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



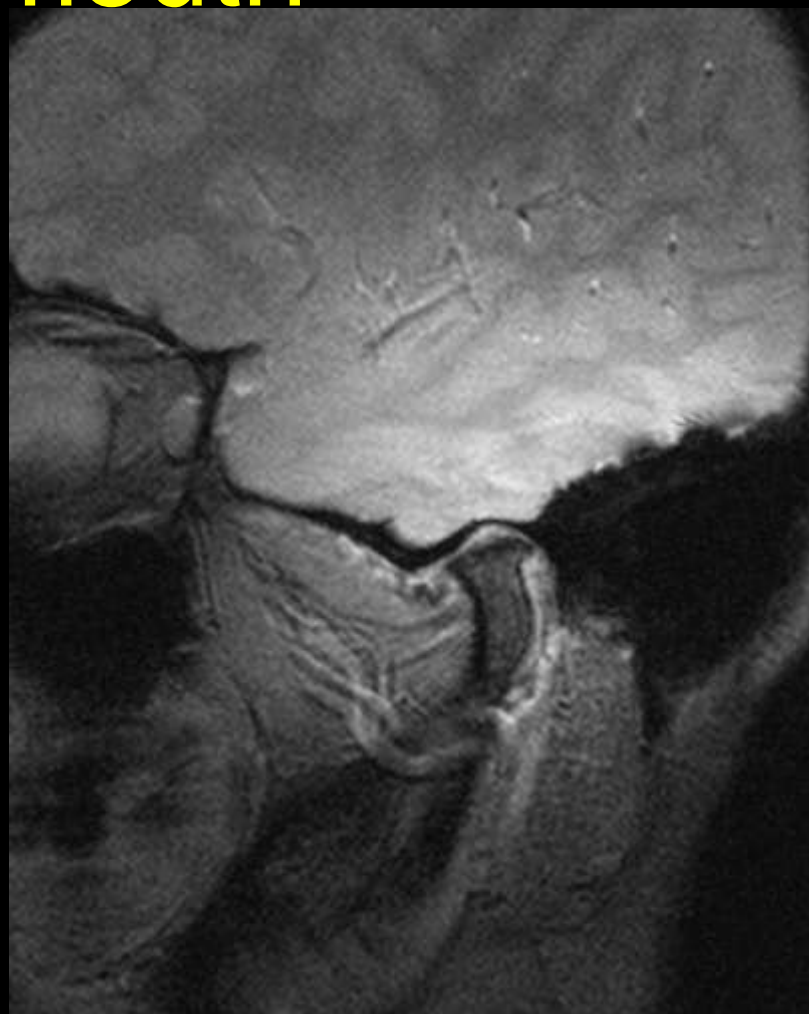
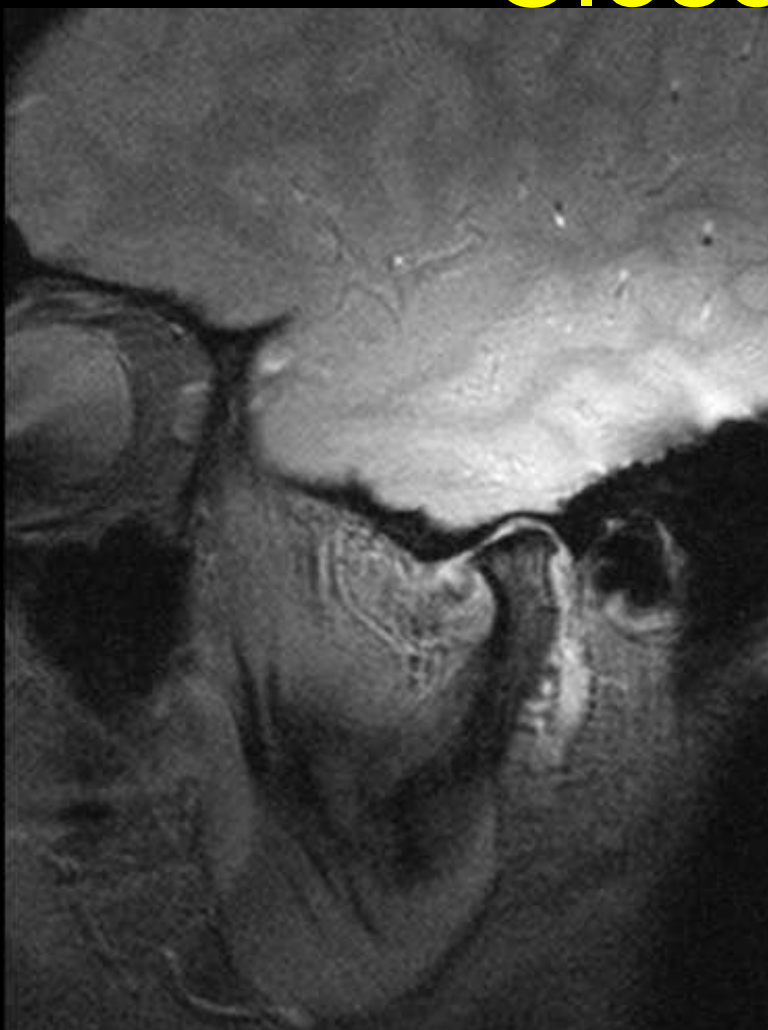
# Postoperative

- Failed implants resulting from foreign body reaction- bone erosions similar to septic arthritis and RA
- Clinical findings and MRI appearances correlate poorly

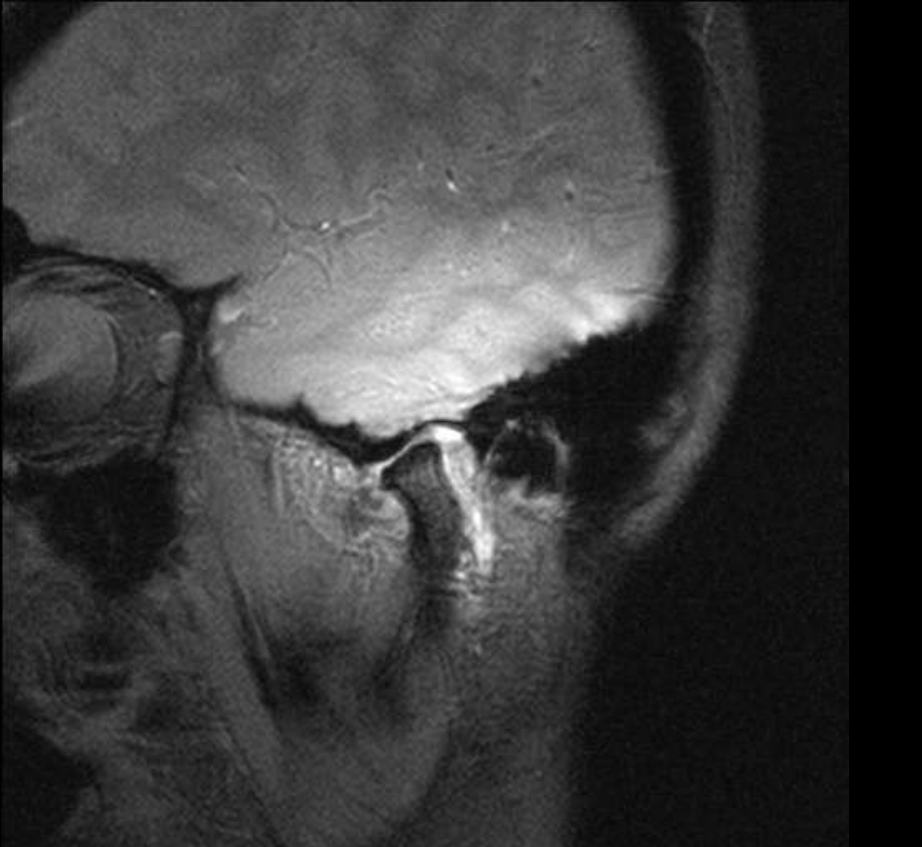
# Case review:

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

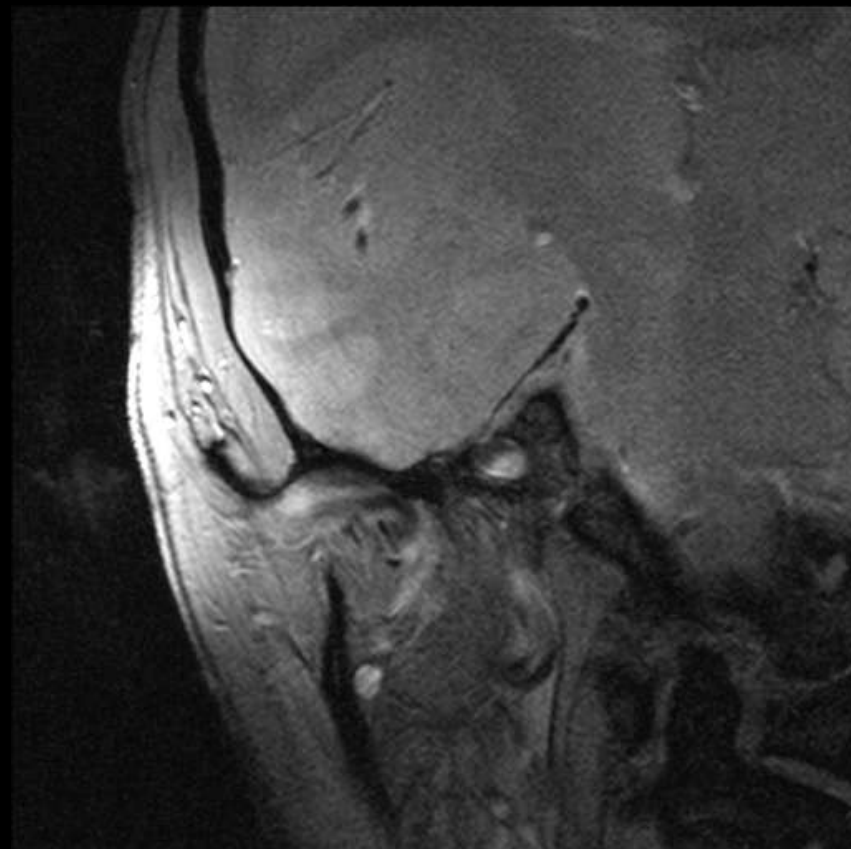
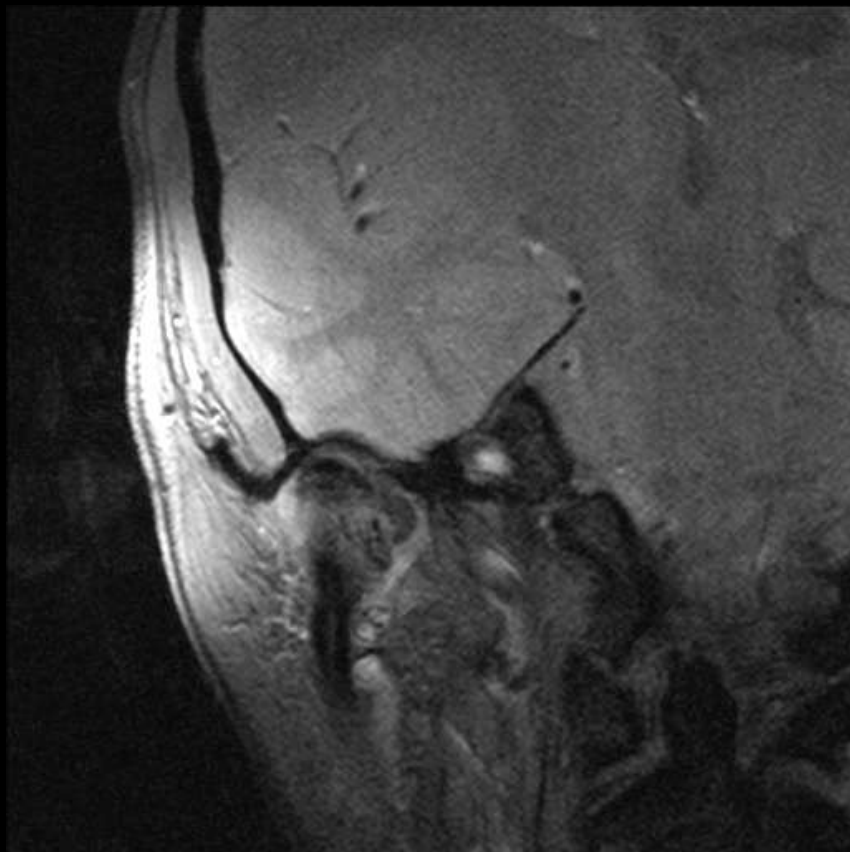
# Closed mouth



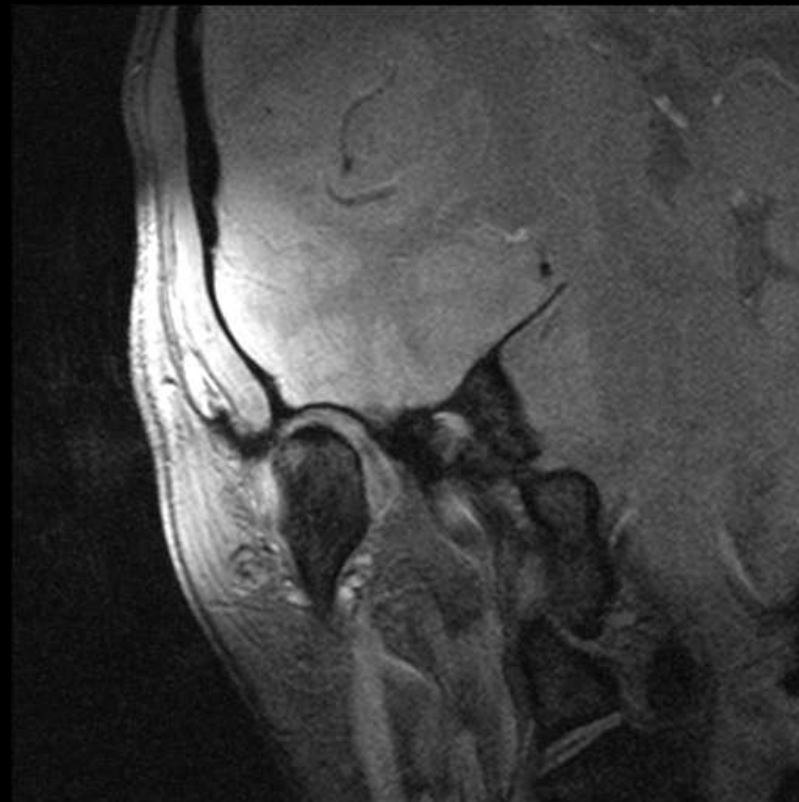
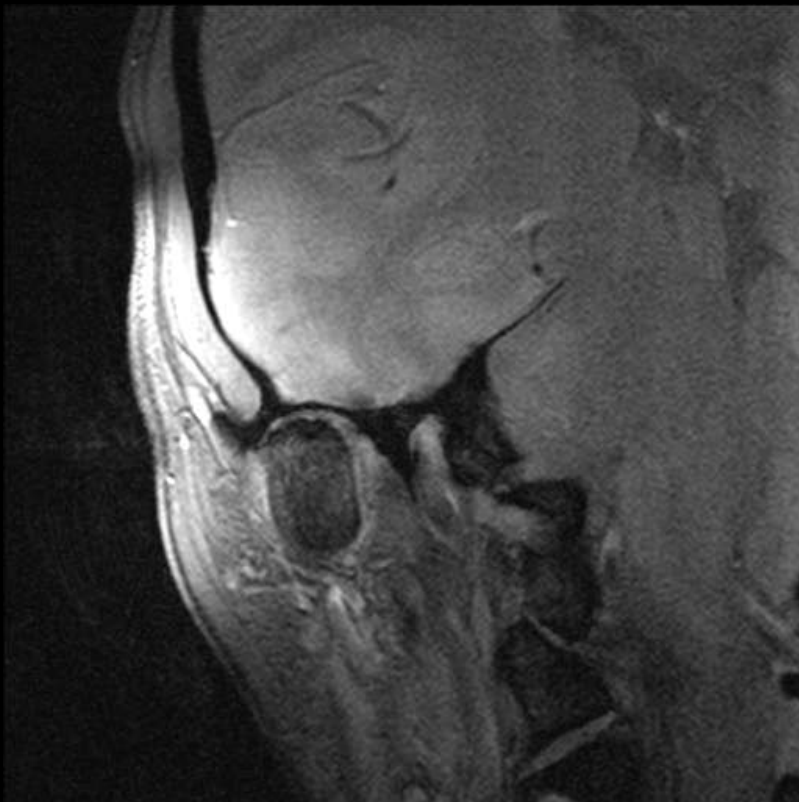
# Open mouth



# Closed mouth Coronal

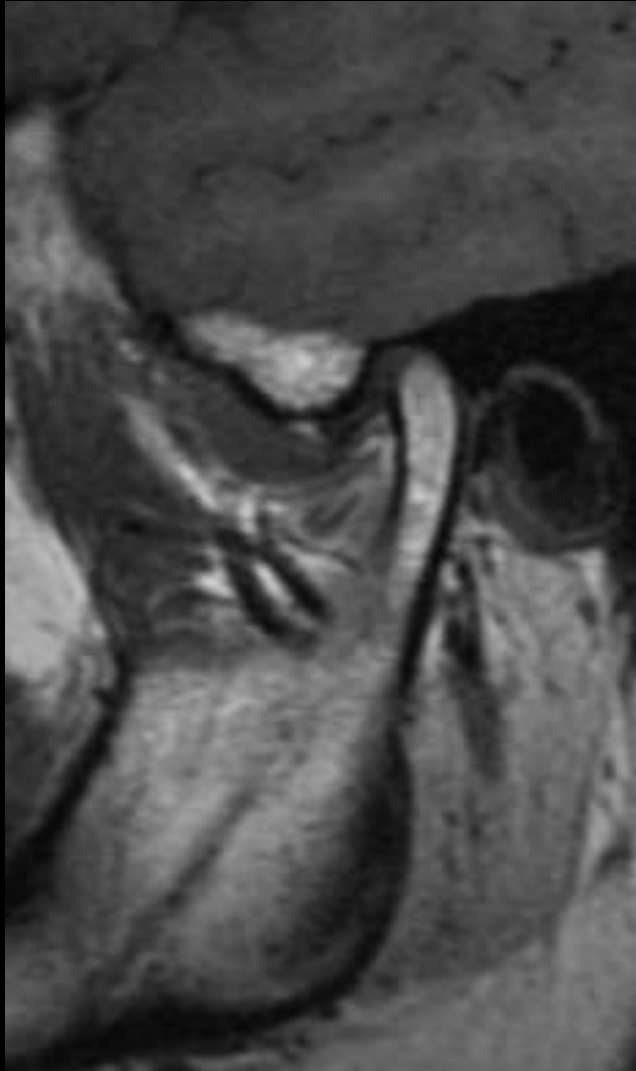


# Closed mouth Coronal

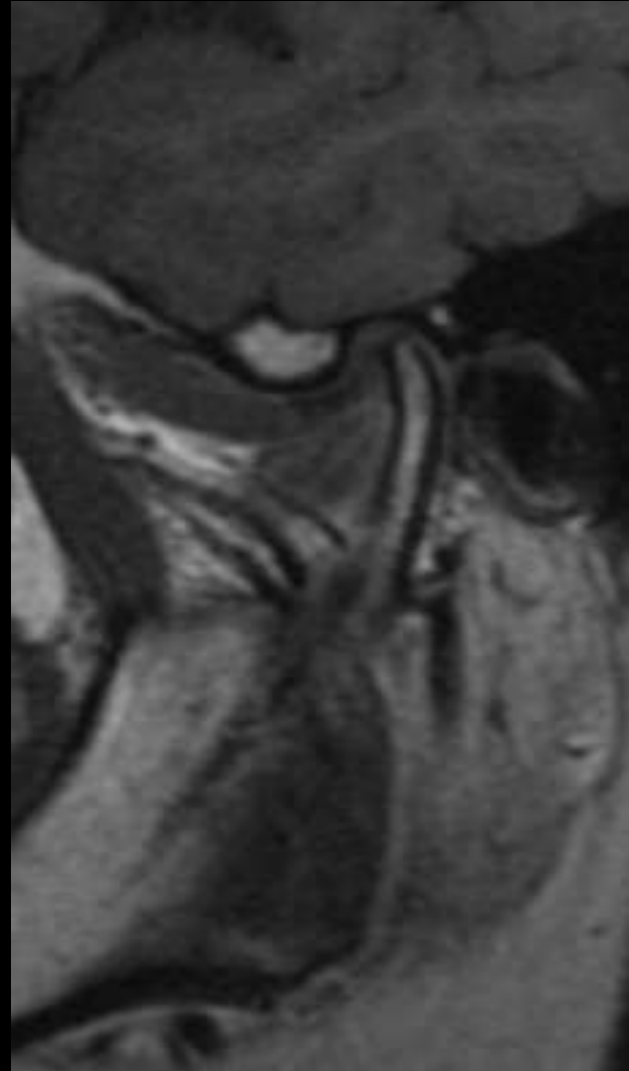




# 27 y.o with left TMJ pain



Right Closed



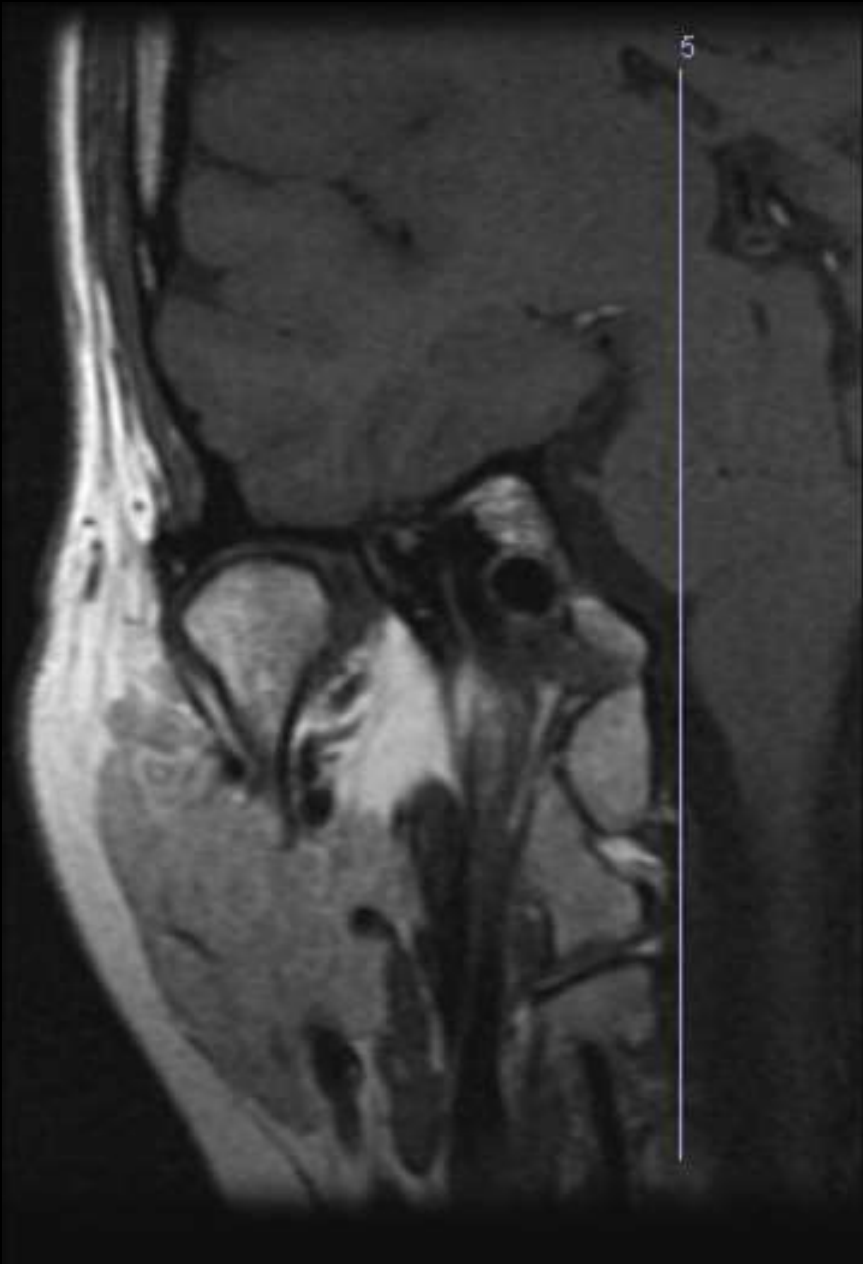
Left Closed



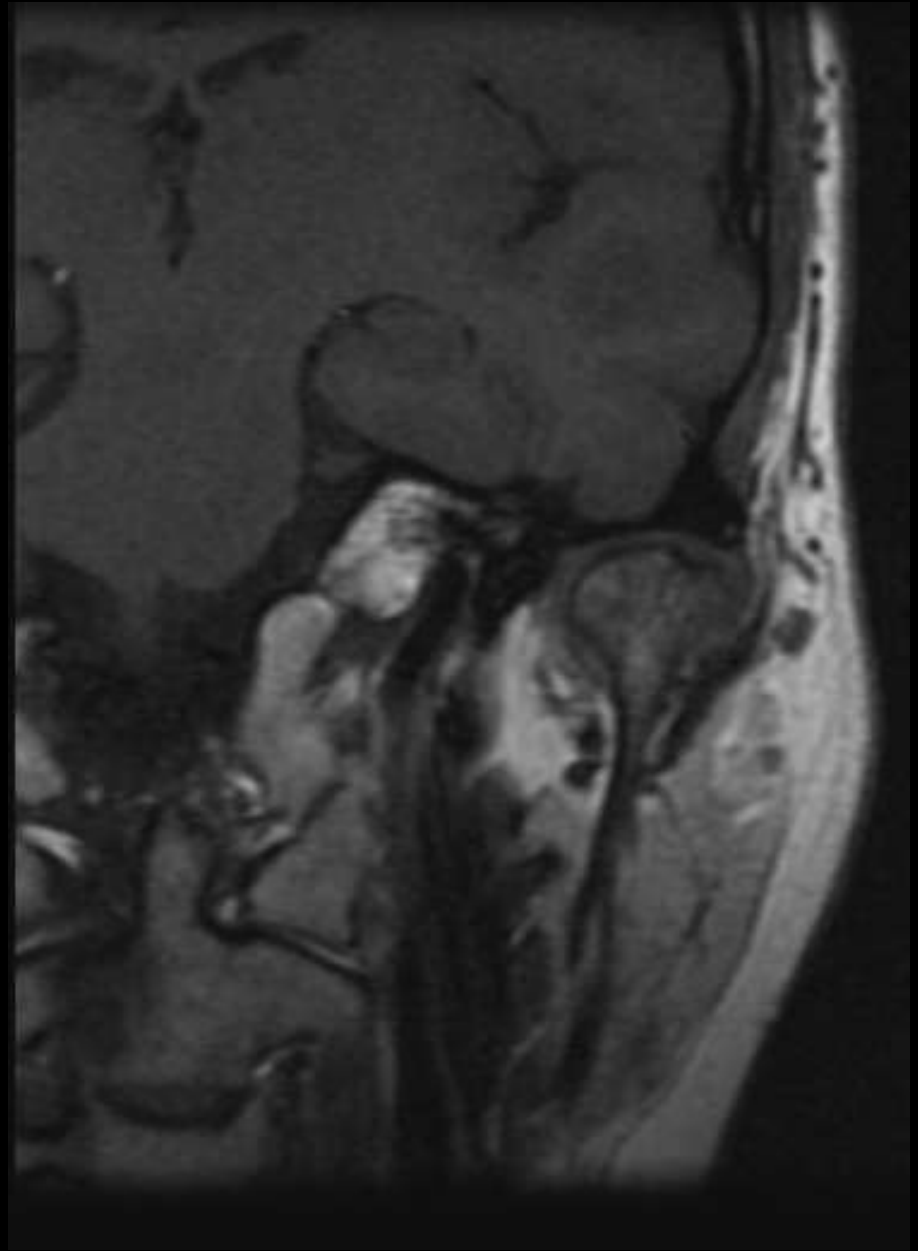
Right Open



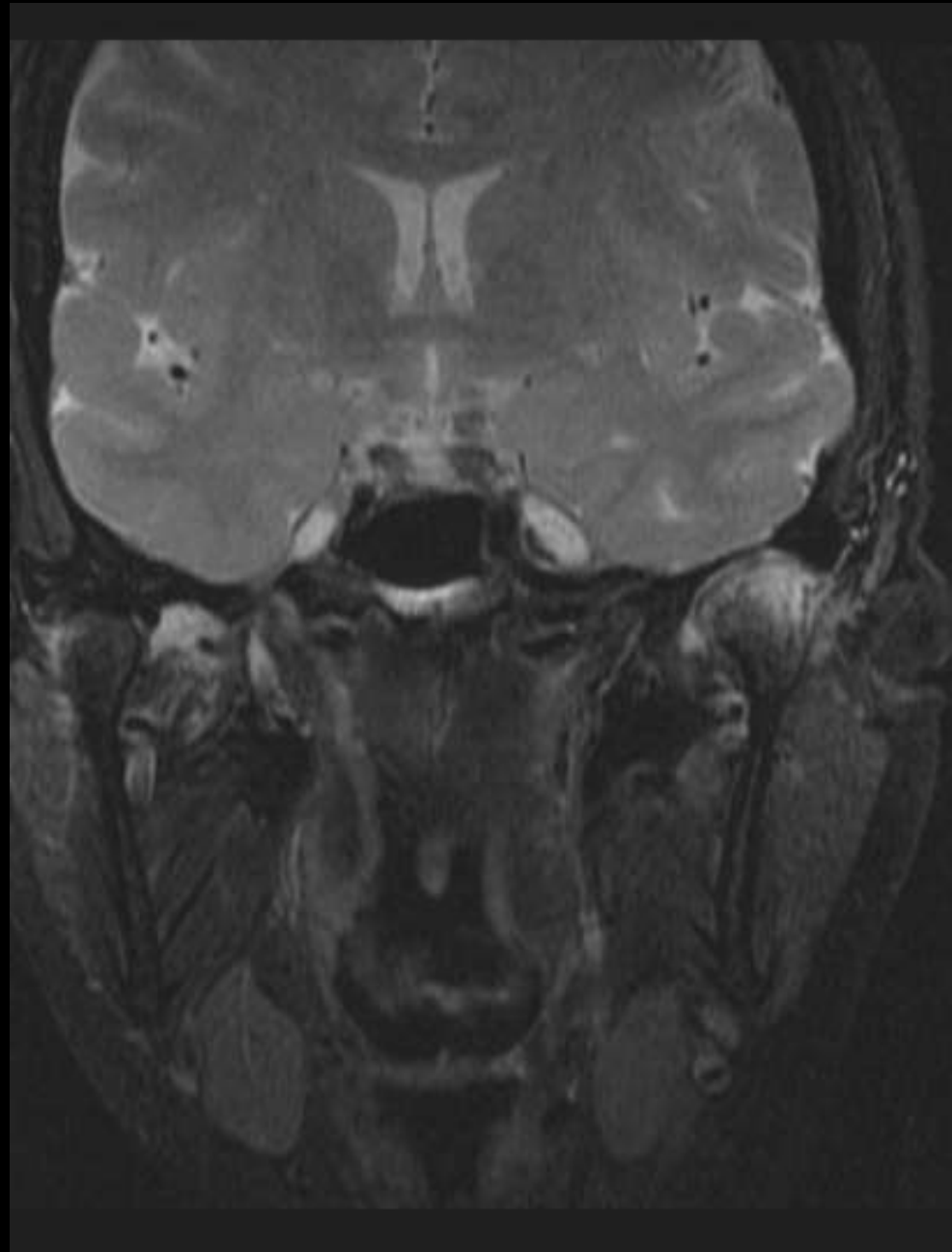
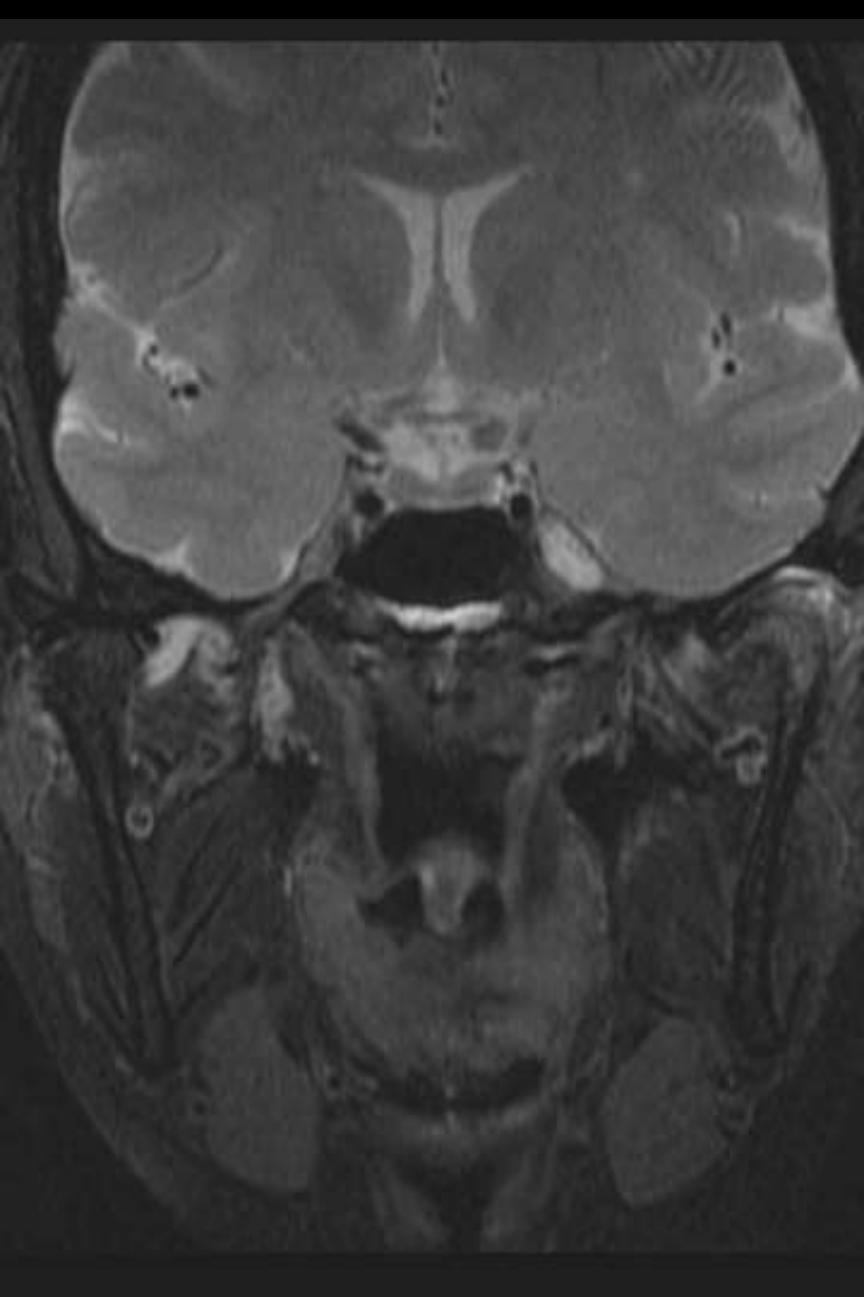
Left Open



Right Closed

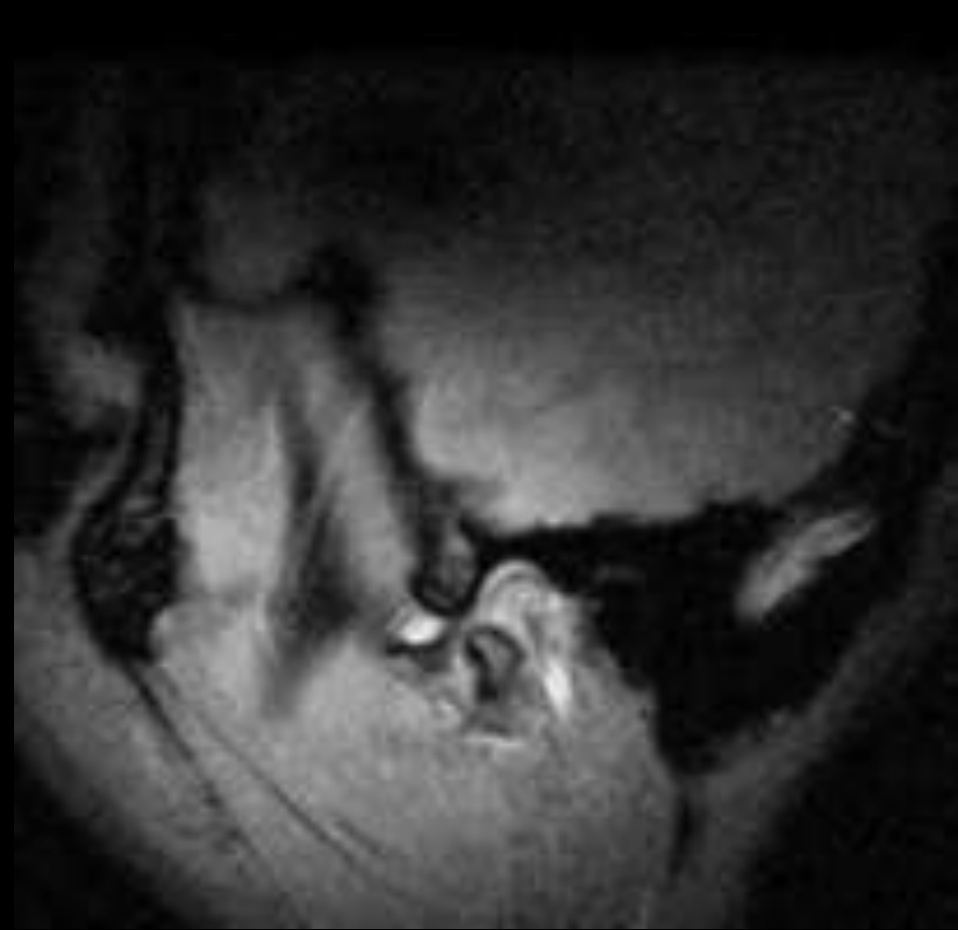
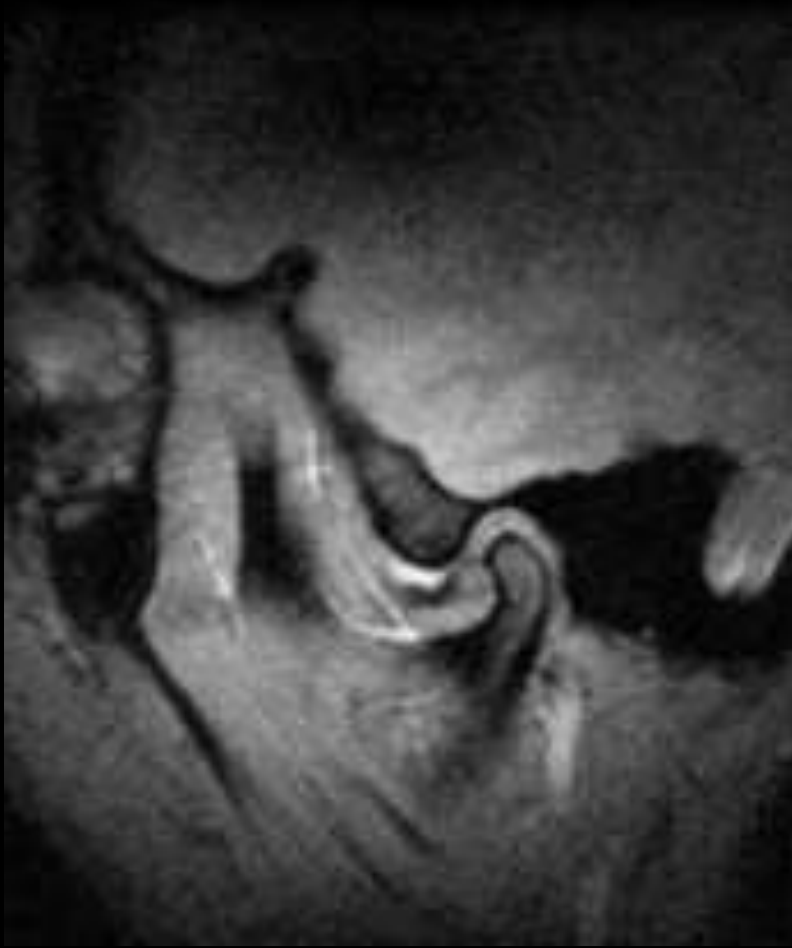


Left Closed





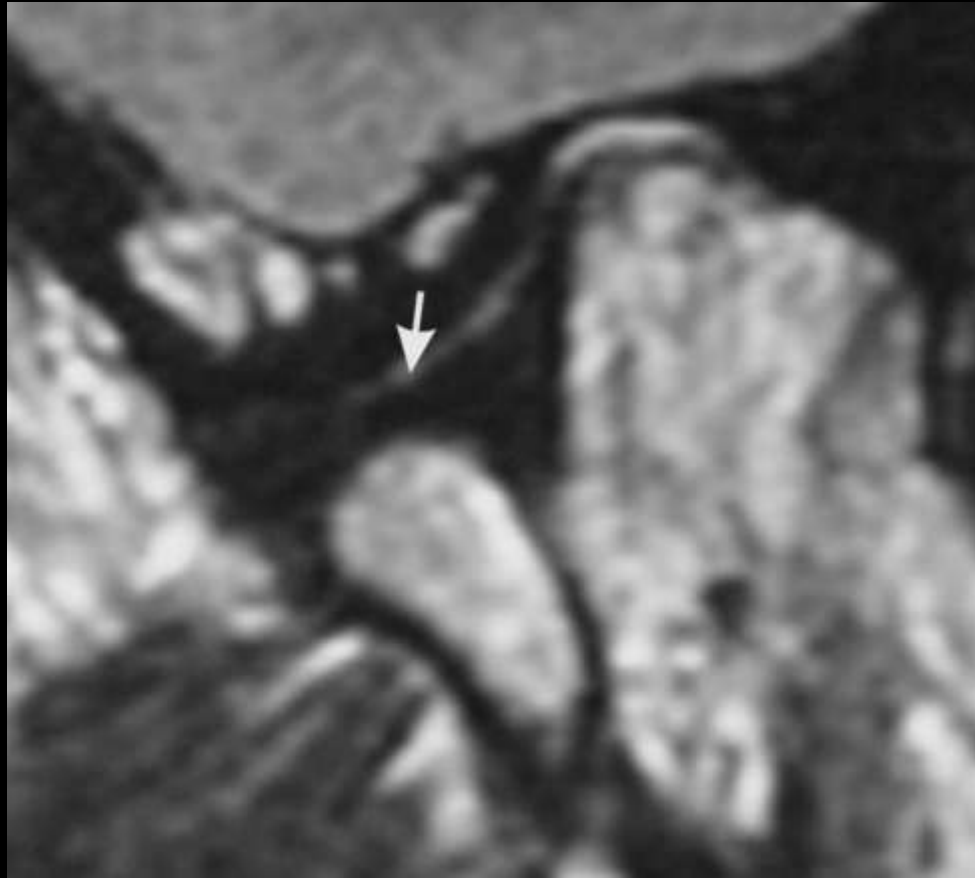
CLOSED LOCK



**Anterior disc displacement  
without reduction**

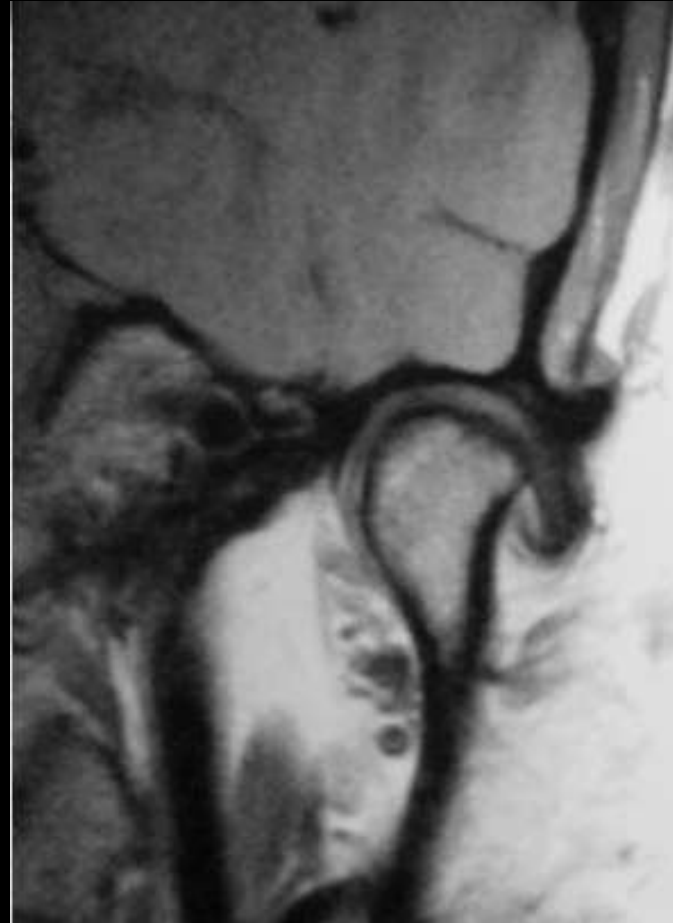


Posterior band rupture



**Normal**

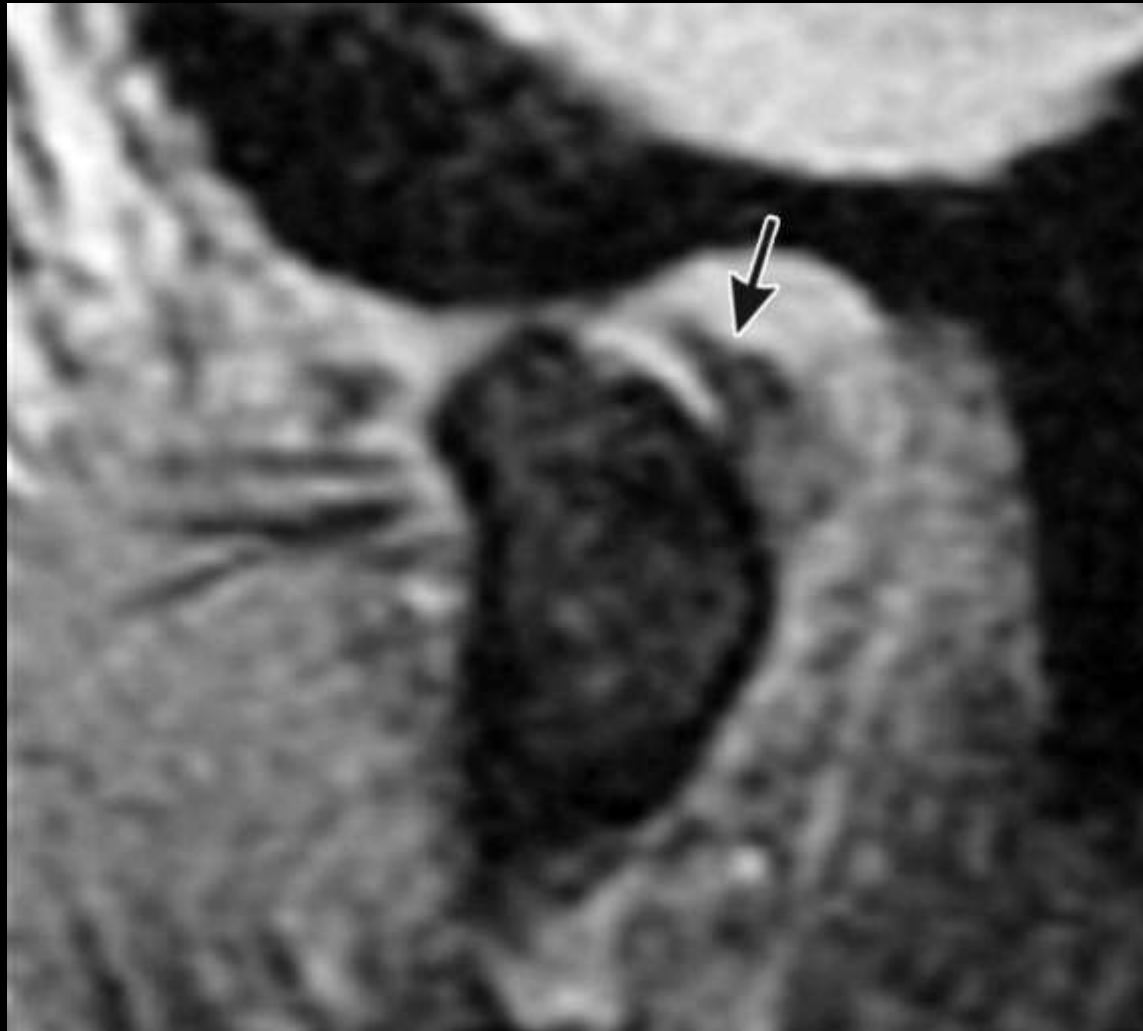




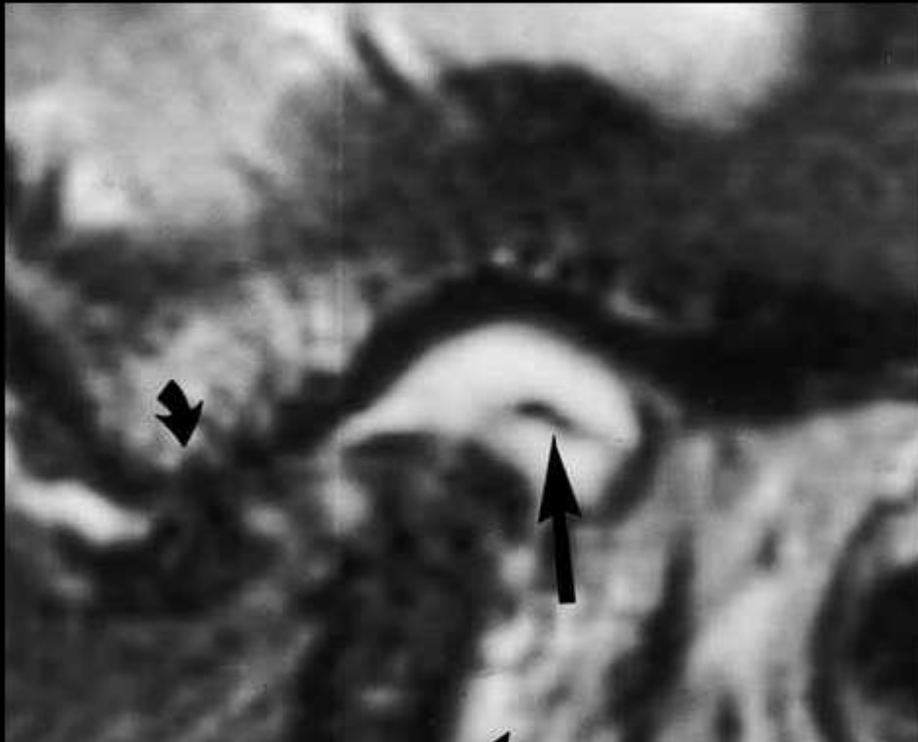
Lateral displacement



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

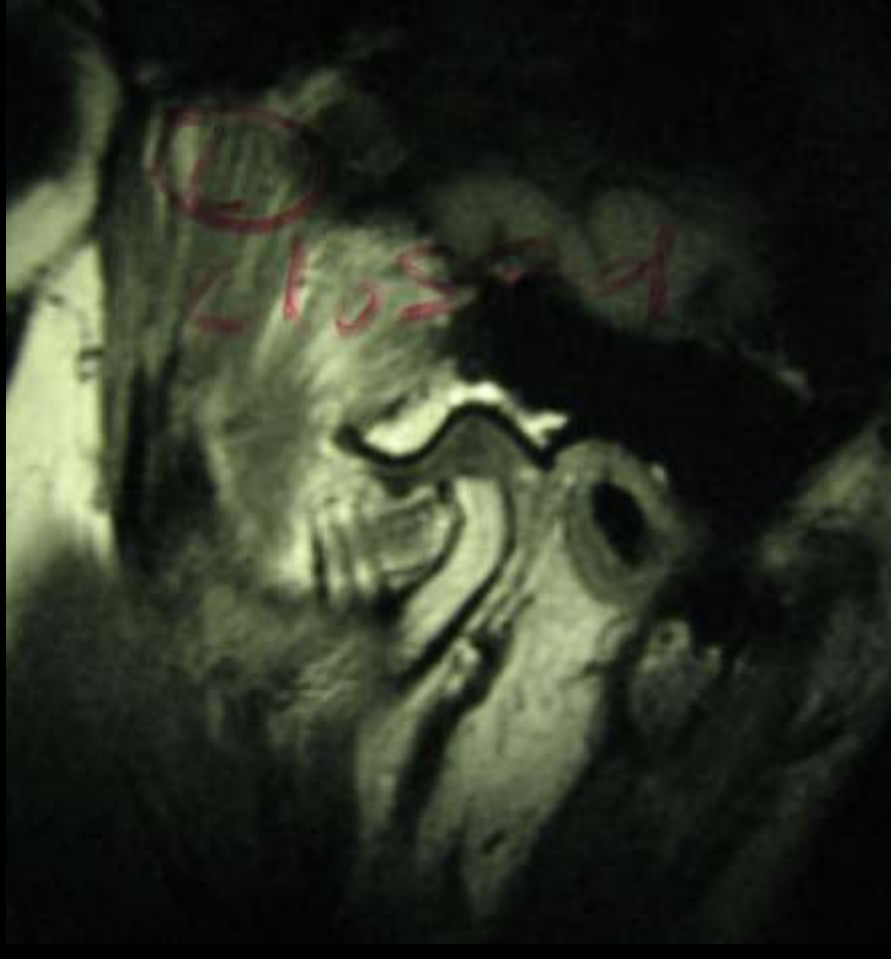


## Posterior displacement



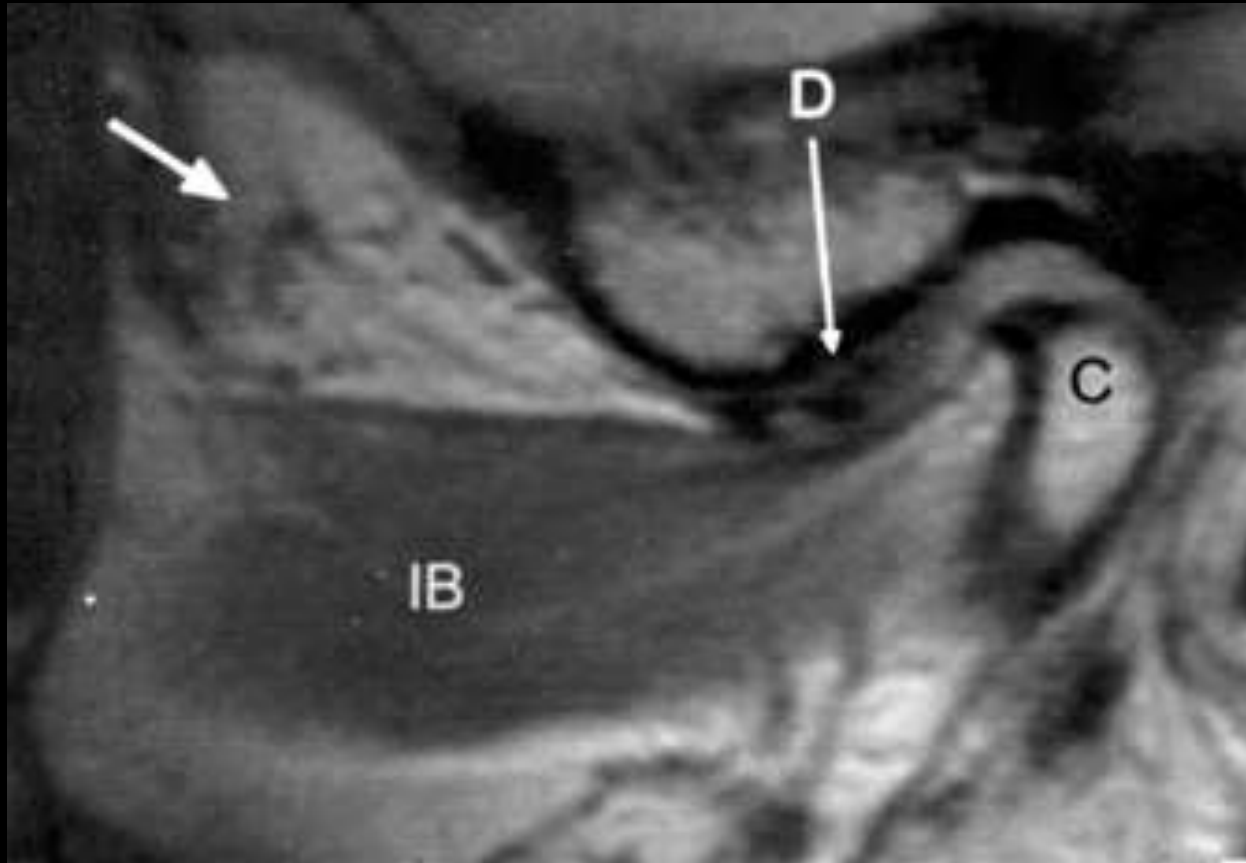
Anterior dislocation without recapture and perforation posterior attachment

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

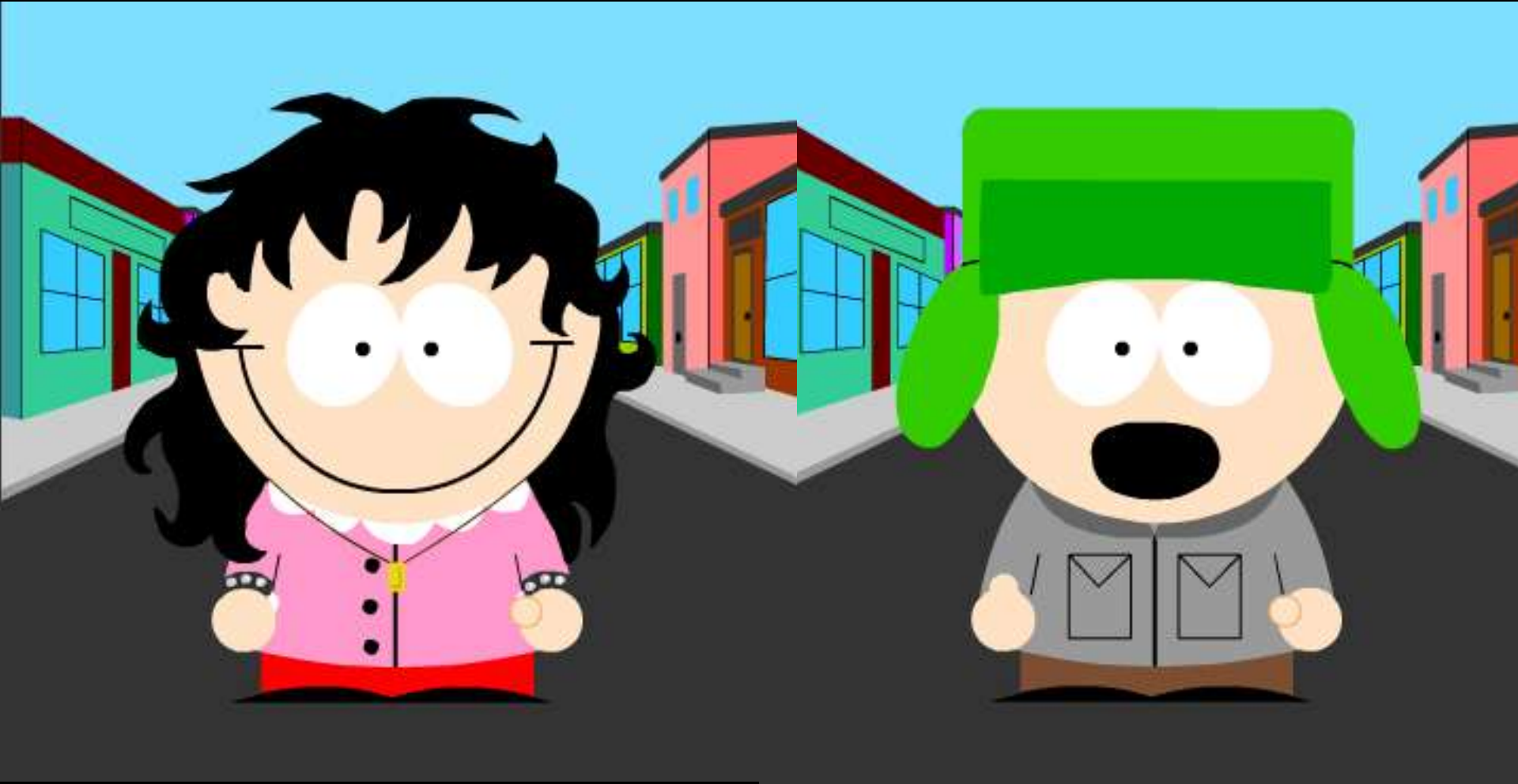


Anterior dislocation without reduction upon opening

# 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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