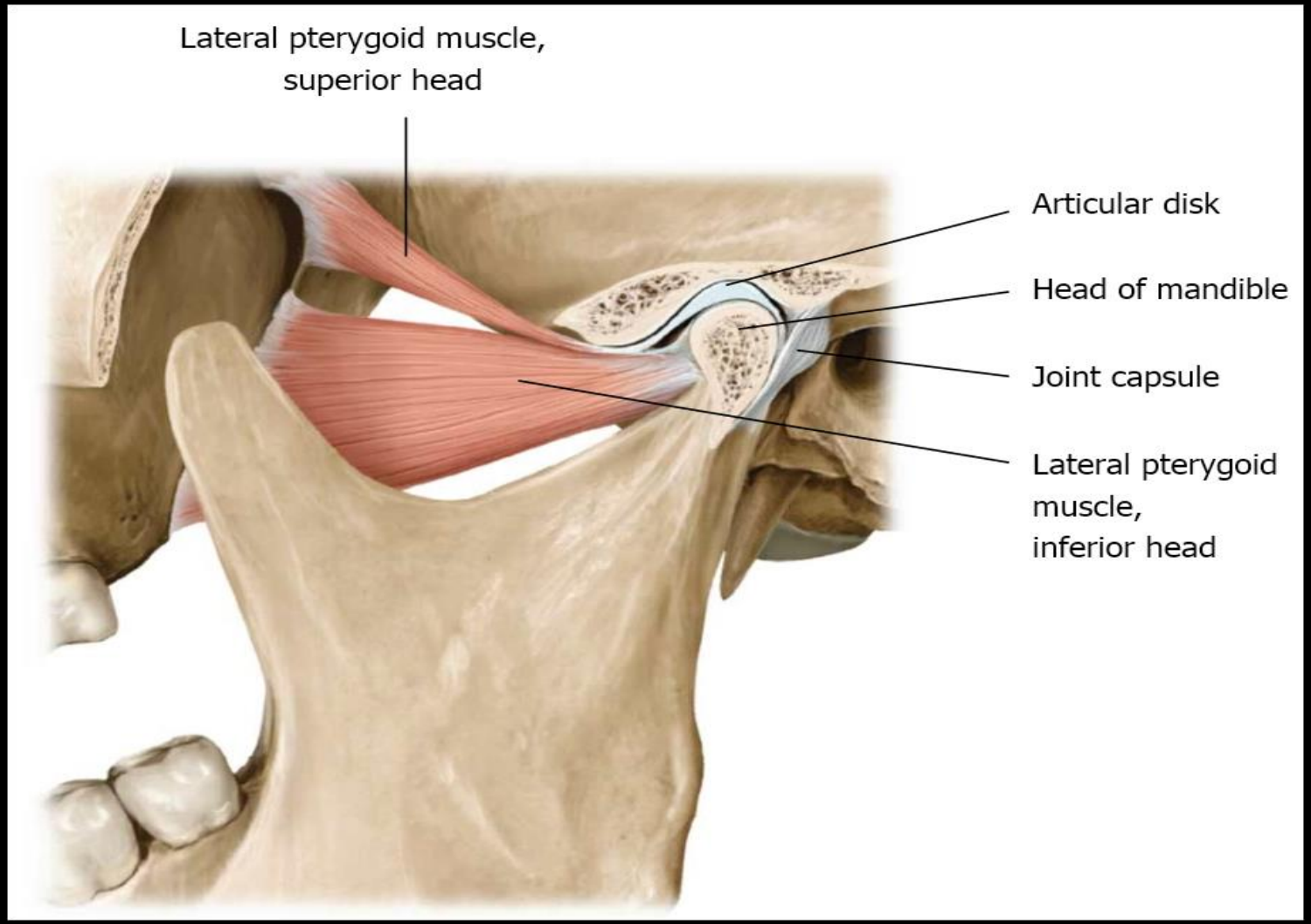
The Temporomandibular joint: Anatomy, Mechanics, Pathology

Aditya Bahel, DO

Outline

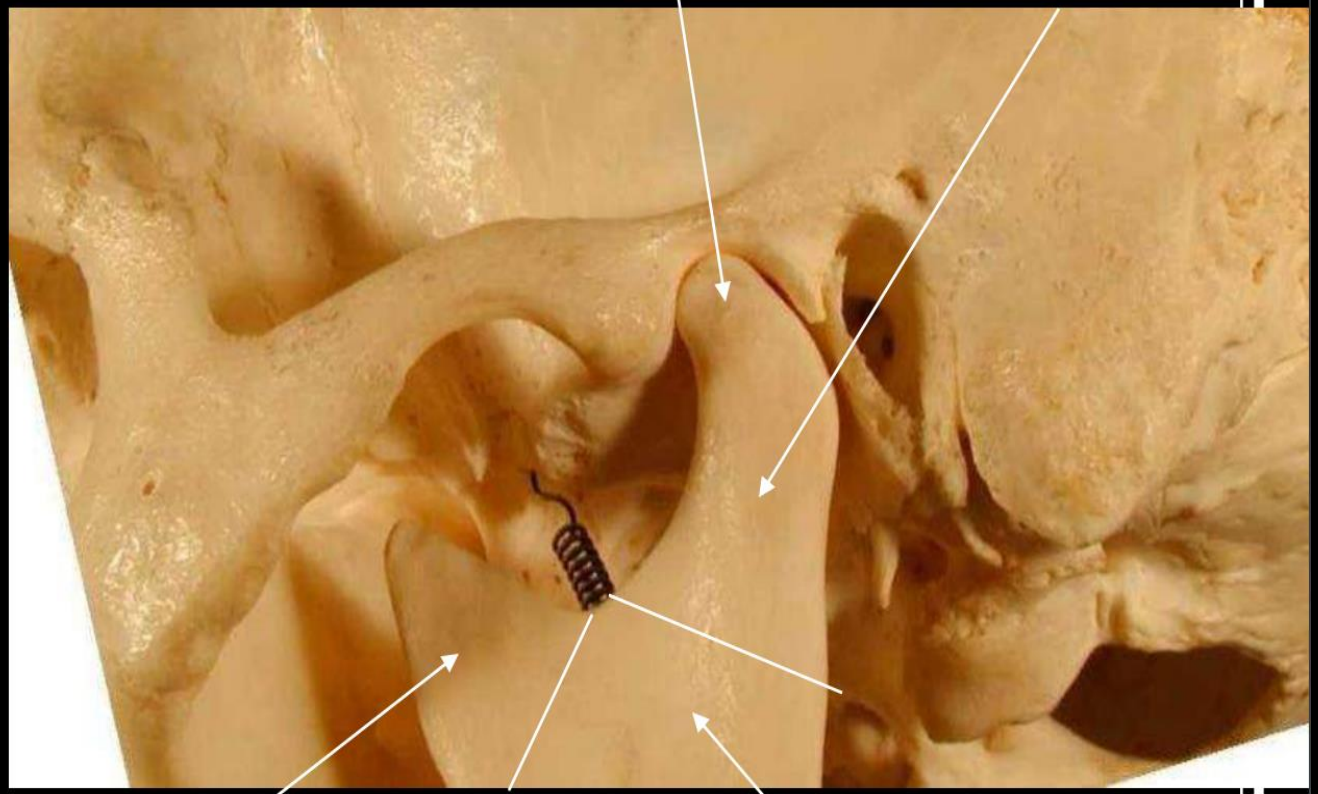
- Anatomy
- Mechanics and function
- Indications for TMJ imaging
- MR Protocols and pitfalls
- Pathology
- Treatment options

Anatomy

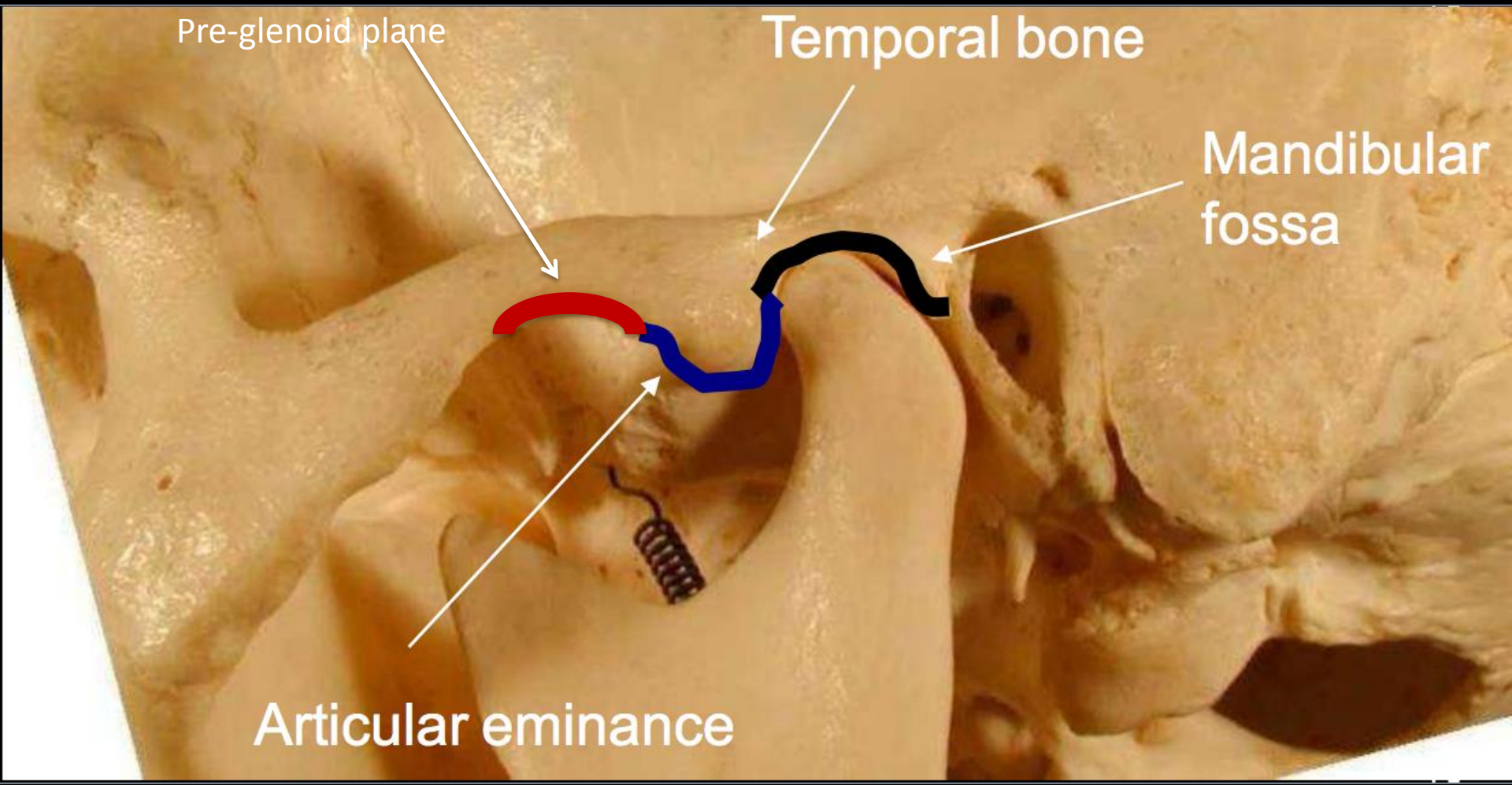


http://garciadental.com/advanced-dental-services/tmj-treatment/

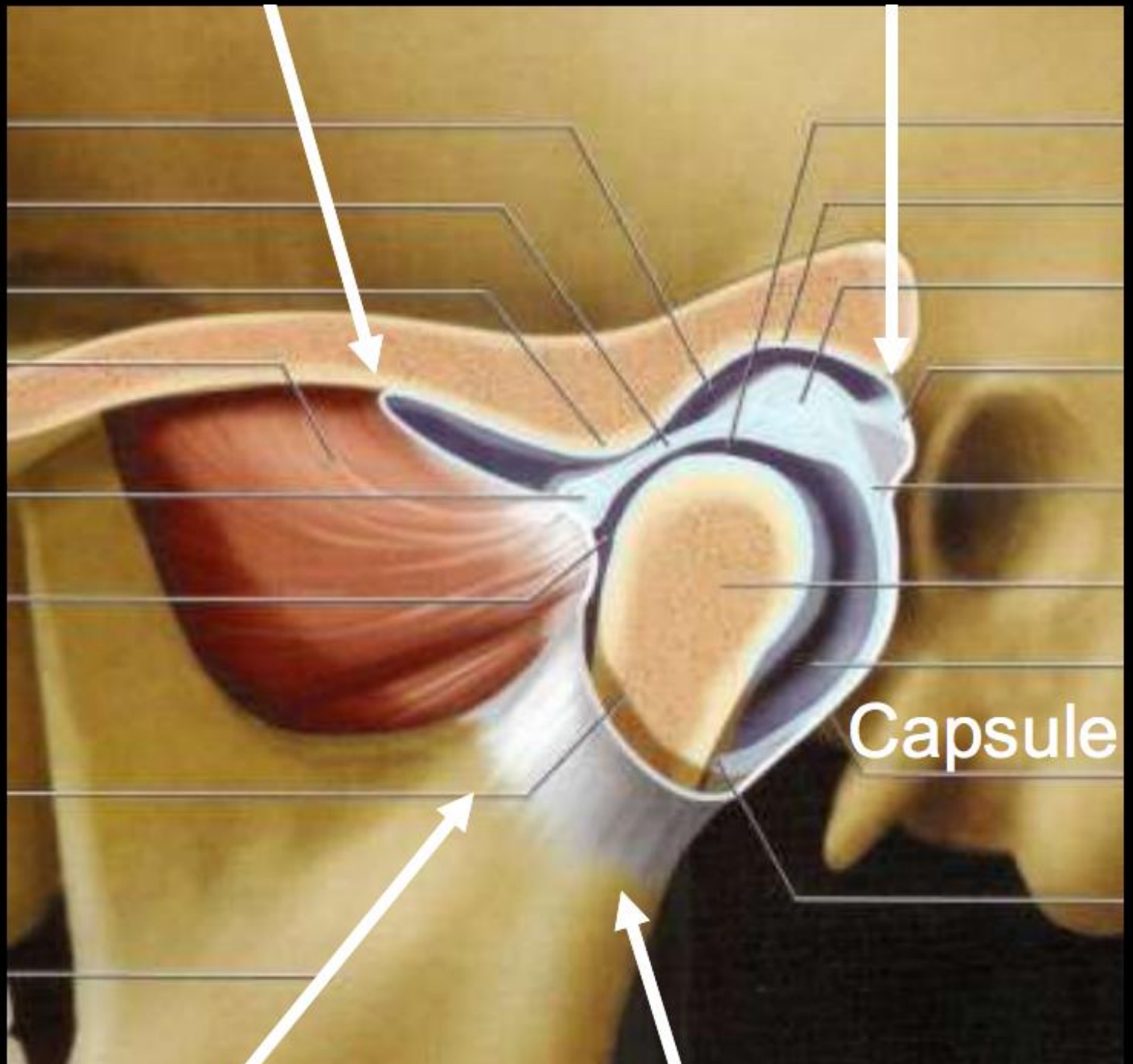
Condyle anatomy

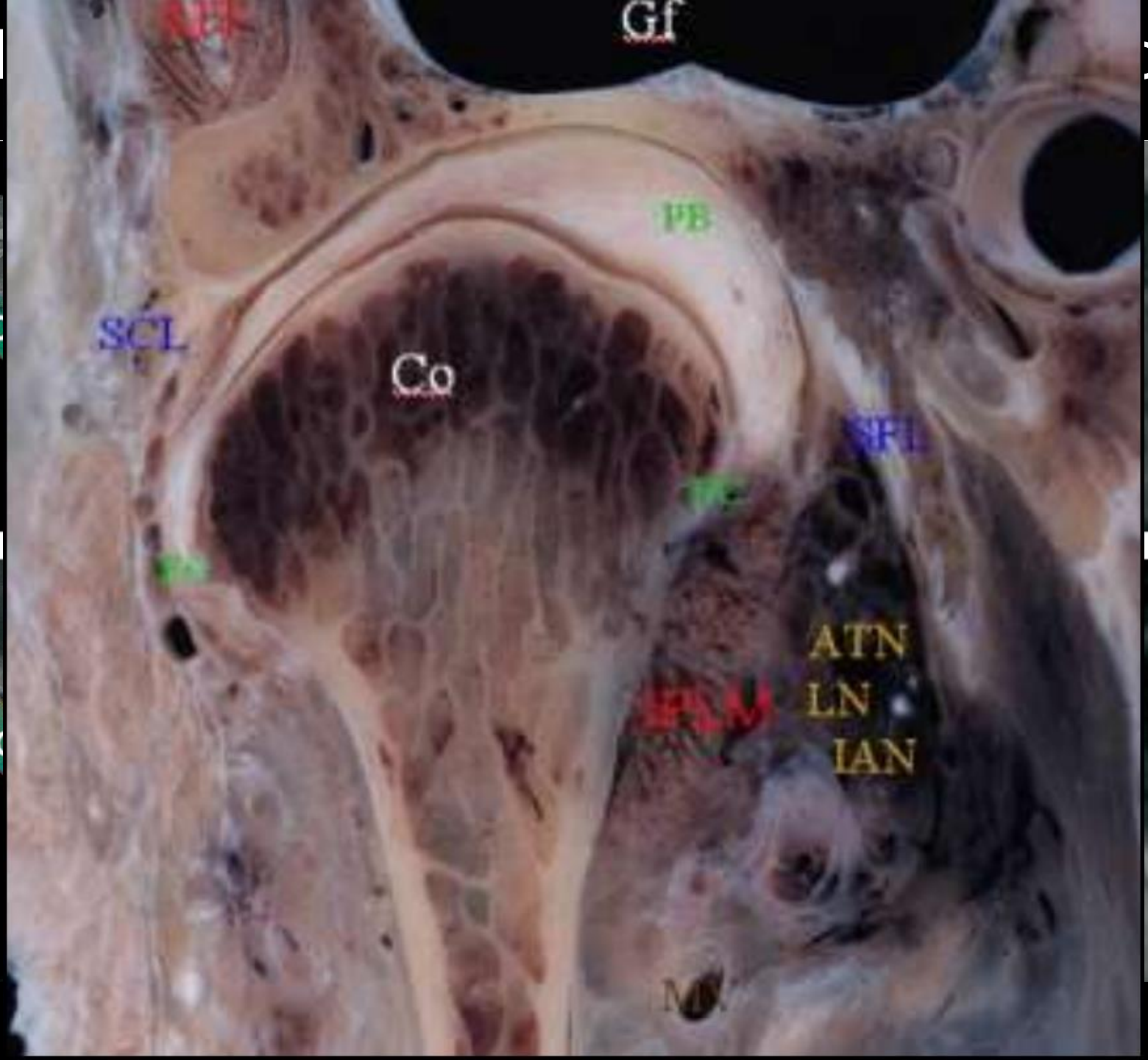


Picture courtesy of Rosalyn Cheng



Adapted from Jeff Hirata 2009, Bonepit.com


Capsule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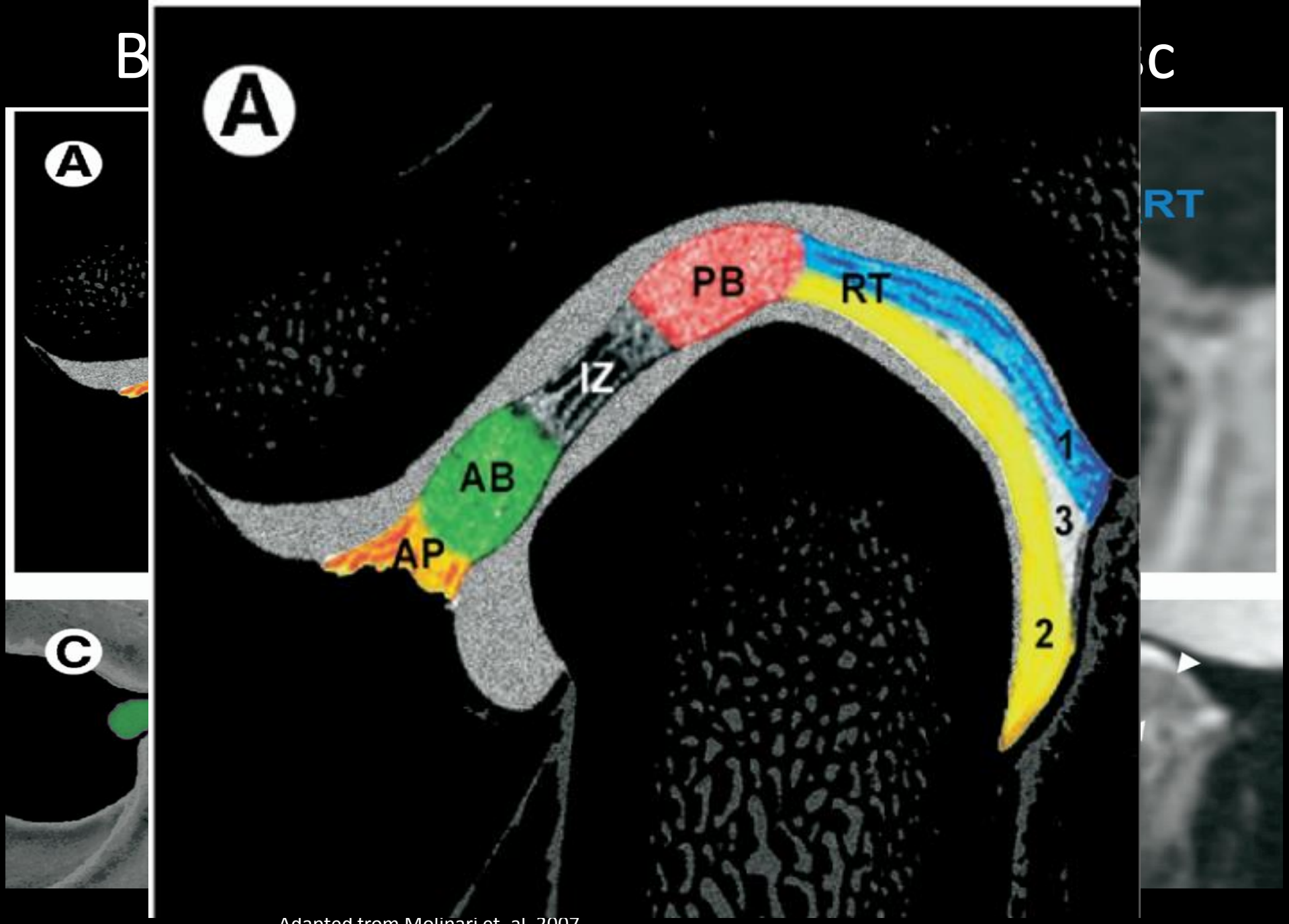
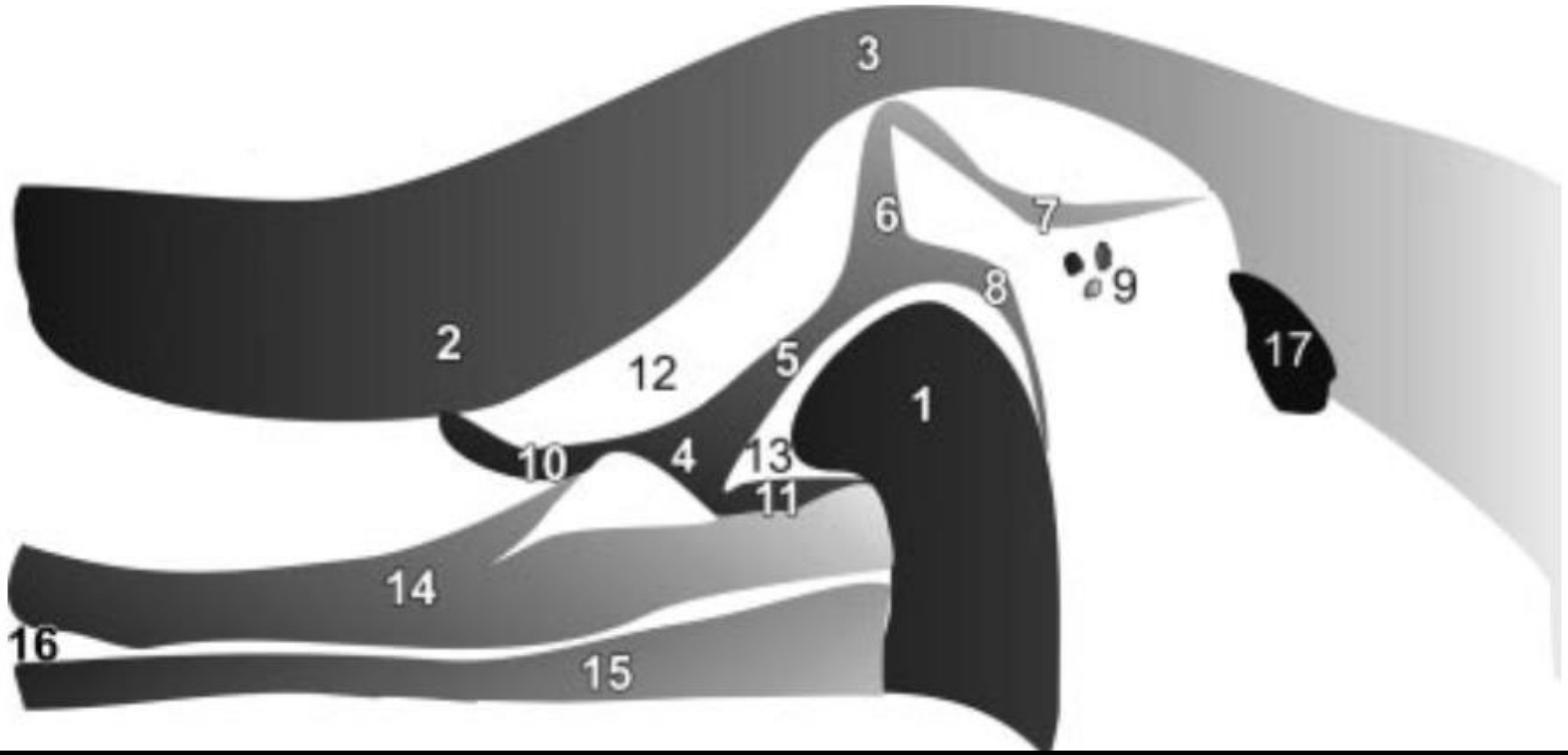
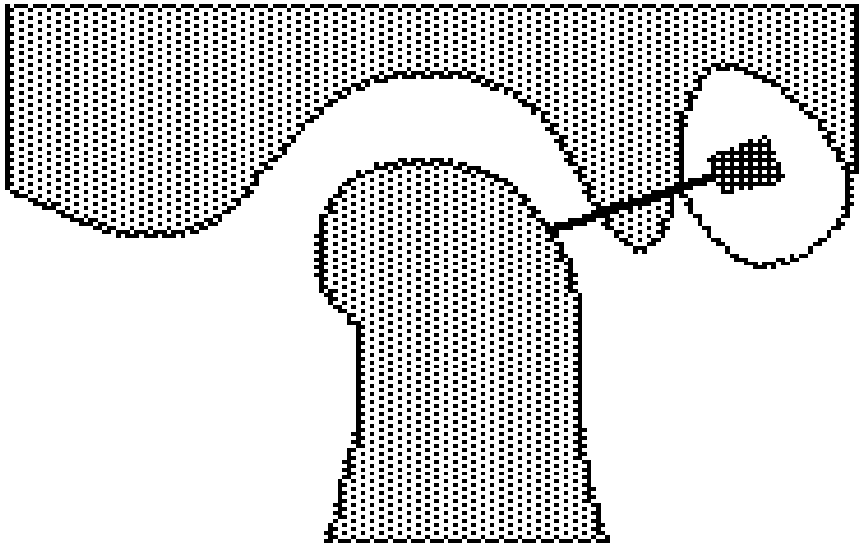


Adapted from Molinari et. al. 2007.



Tomas, Xavier, et al. “MR Imaging of Temporomandibular Joint Dysfunction: A Pictorial Review.” Radiographics 26.3 (2006): 765-781.

TMJ Arthrography



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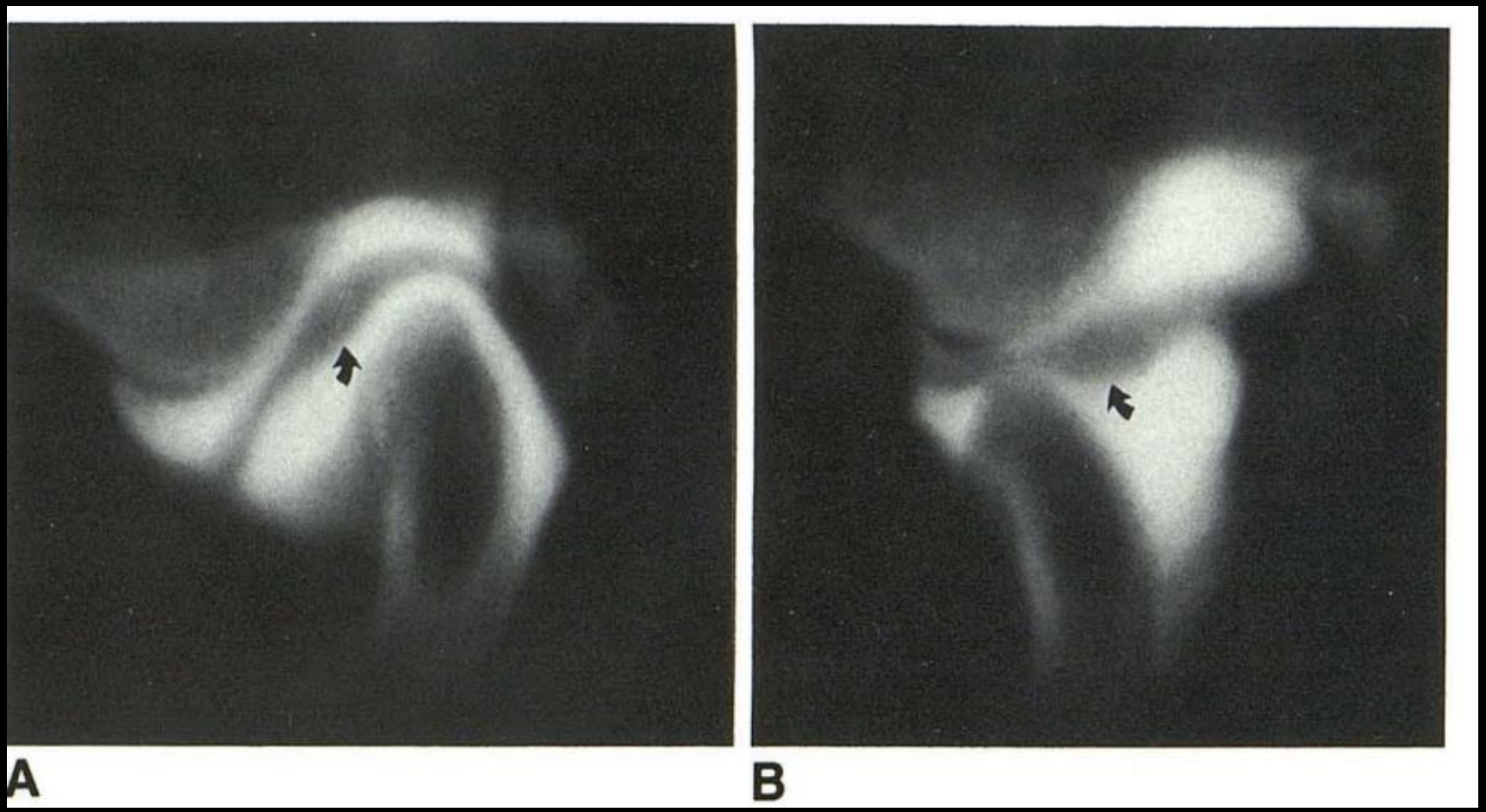


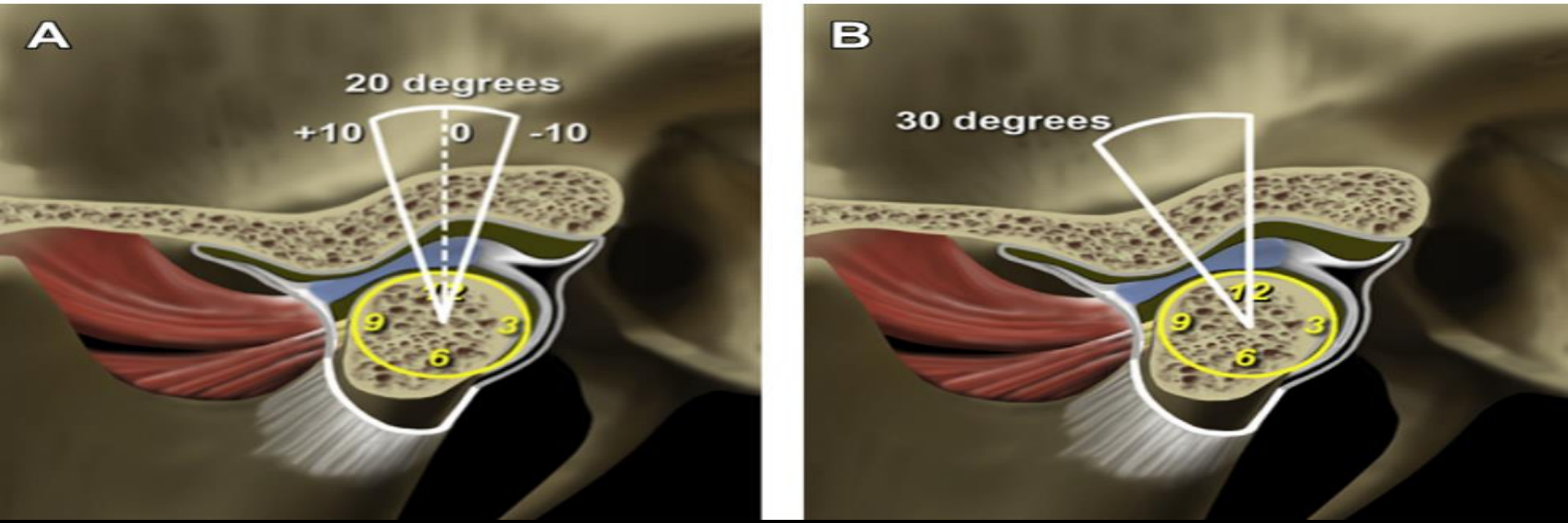
Schellhas et al. AJNR 1988

Mechanics of the TMJ

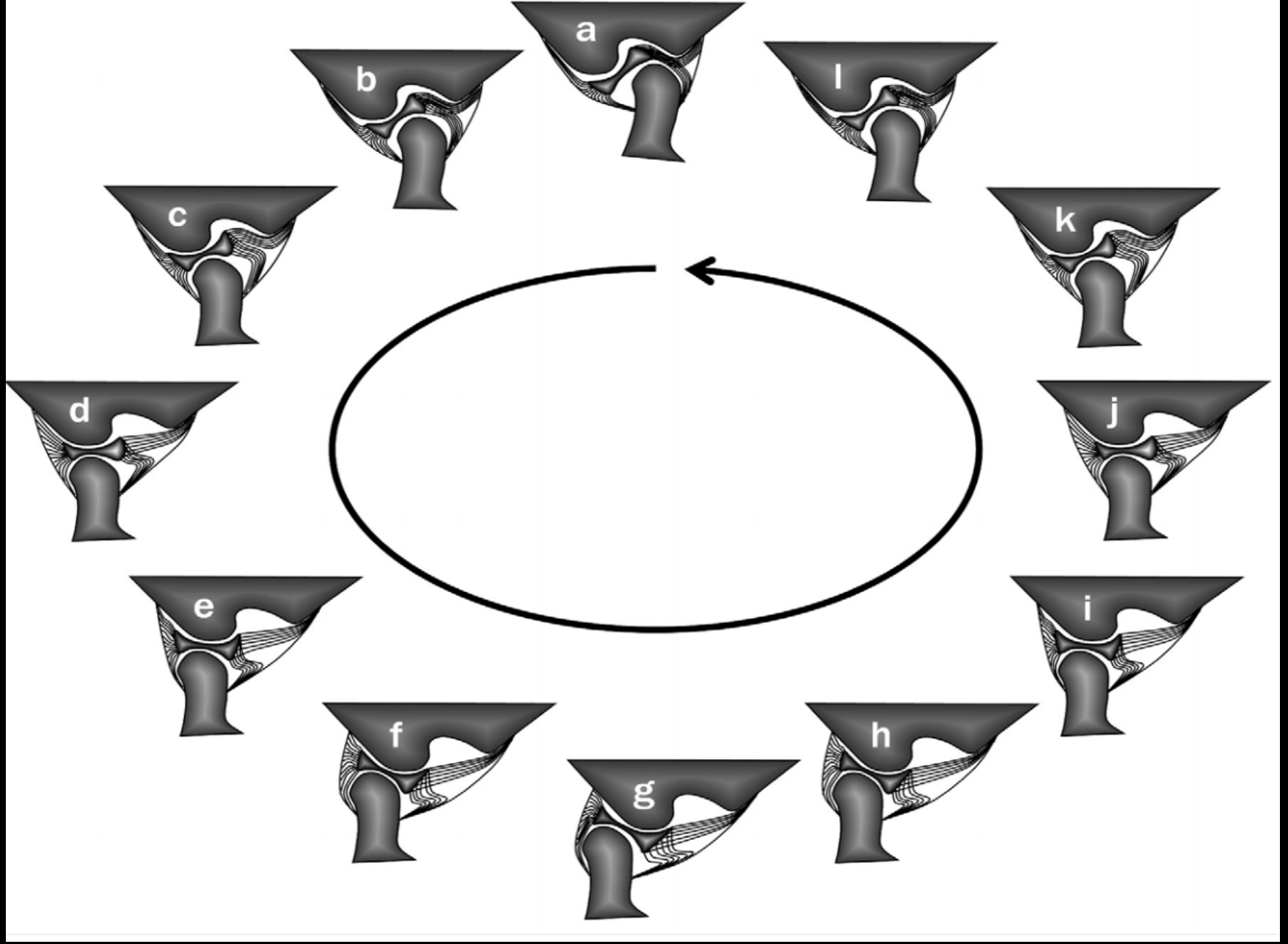
- The TMJ is a hinge and glide articulation but side to side motion is also allowed
- Temporalis, medial pterygoid, and masseter muscles facilitate jaw closure
- Lateral pterygoid contributes to jaw opening
  - Superior and Inferior muscle bellies

Assessing position of the disc

- In the closed mouth position, the junction of the posterior band and bilaminar zone should lie immediately above the condylar head at the 12:00 position
- Should fall within 10 degrees of the vertical
  - Some reports indicate that 30 degrees should be used
  - Helms indicates that the position of the intermediate zone should be the determining factor of an anteriorly displaced disc



Adapted from Aiken et. al. 2012.


a
b
l
c
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d
j
e
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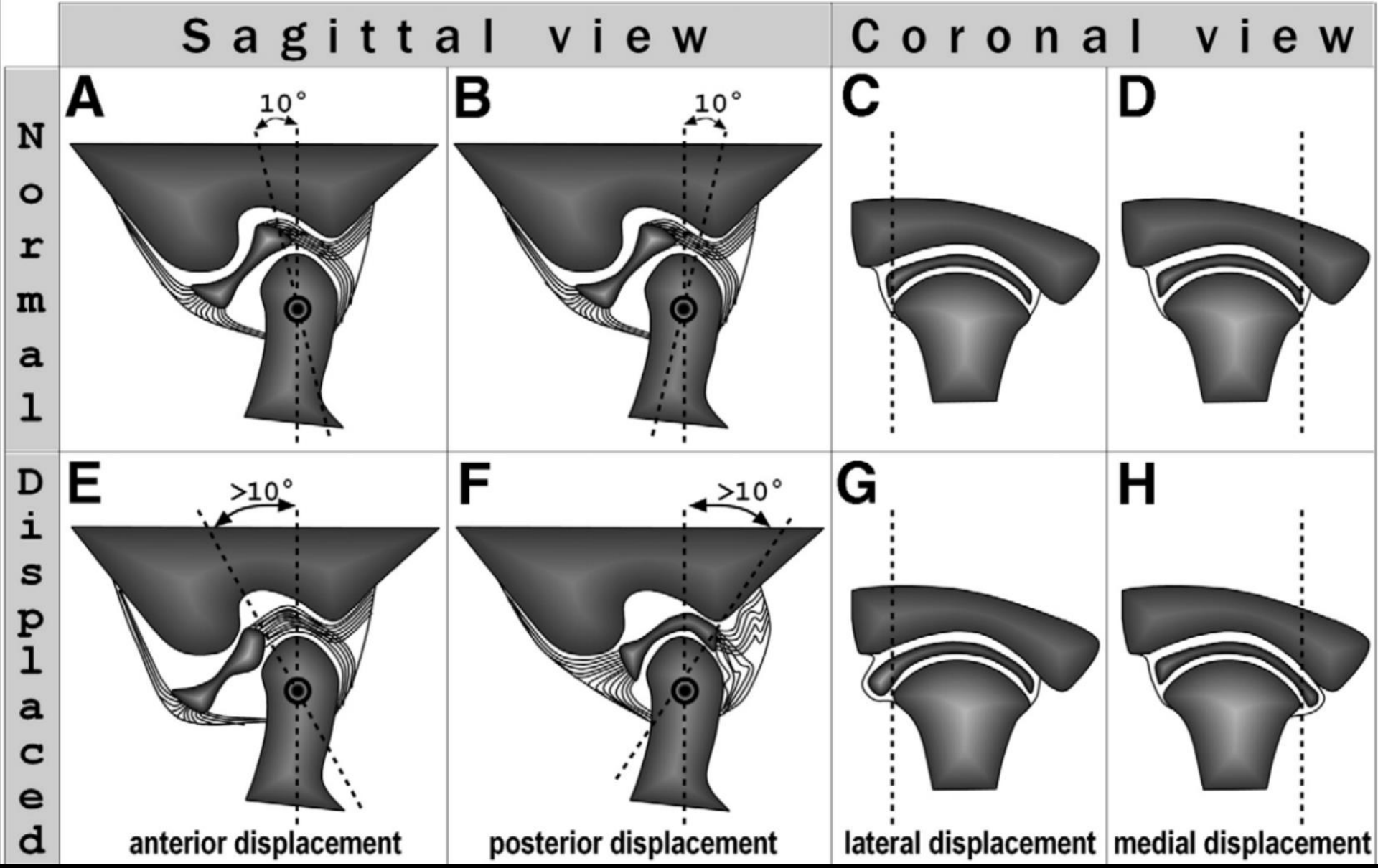
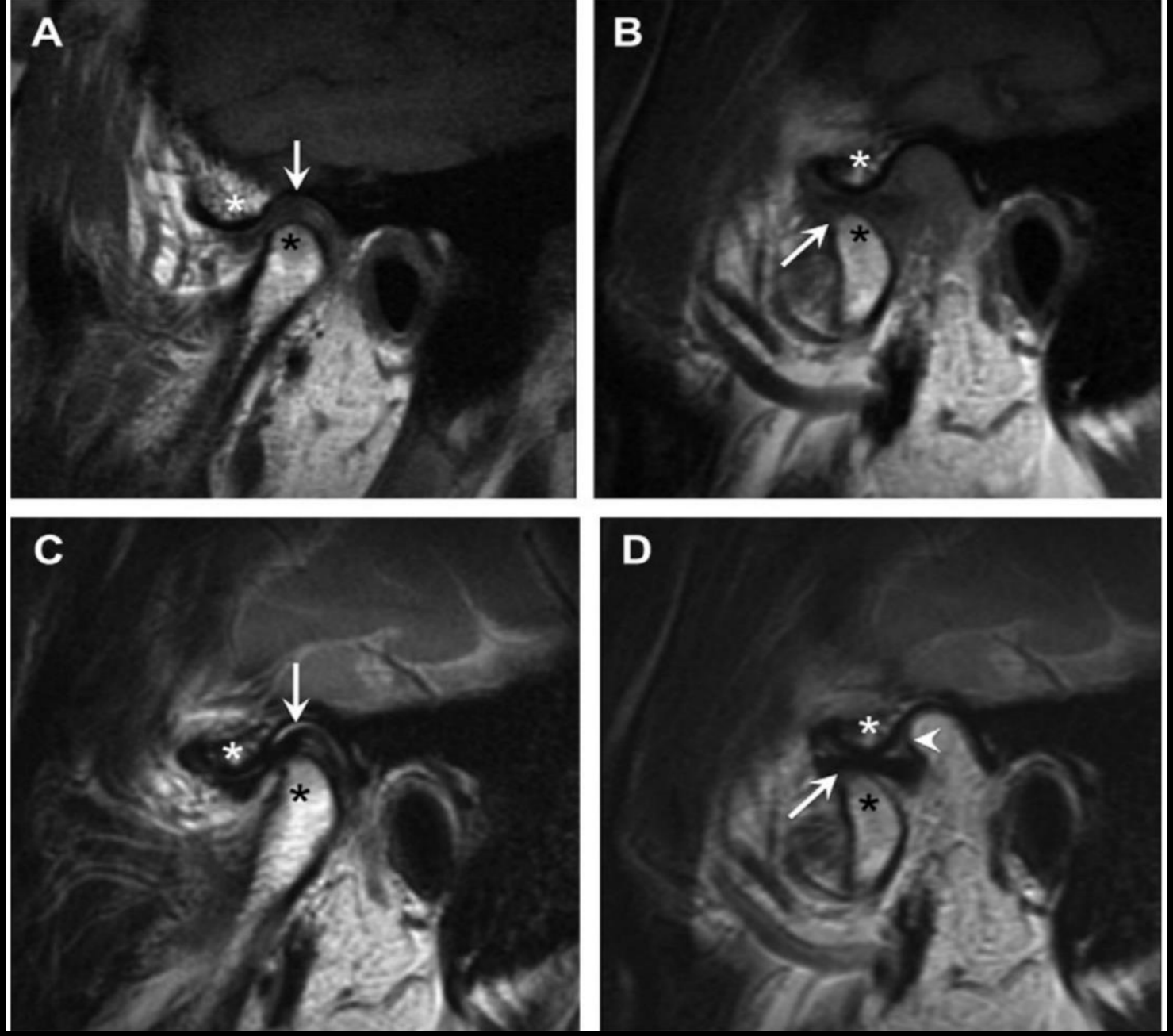
h
g


Sagittal view
Coronal view
Normal
Displaced
A
10°
B
10°
C
D
E
>10°
F
>10°
G
H
anterior displacement
posterior displacement
lateral displacement
medial displacement



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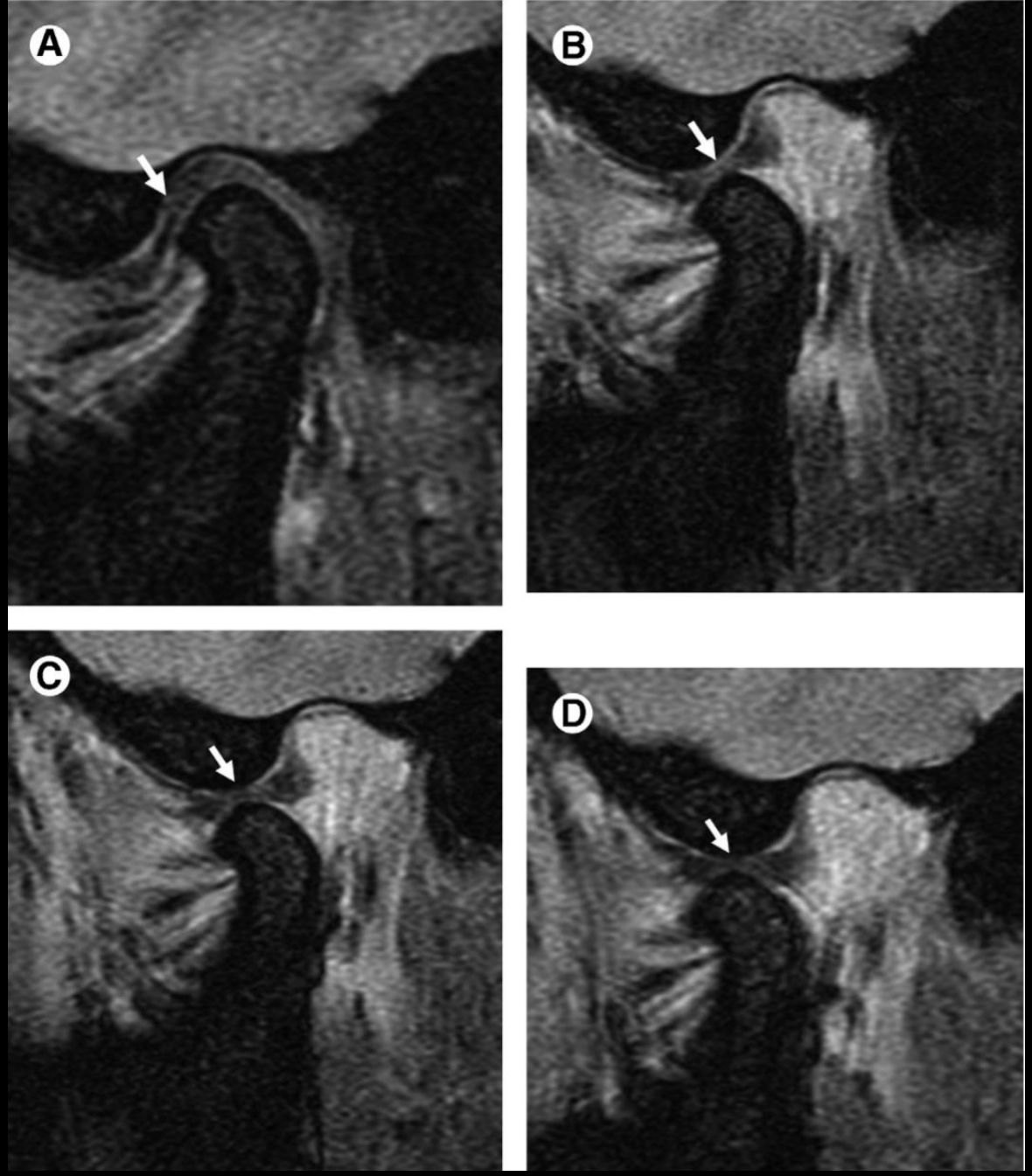
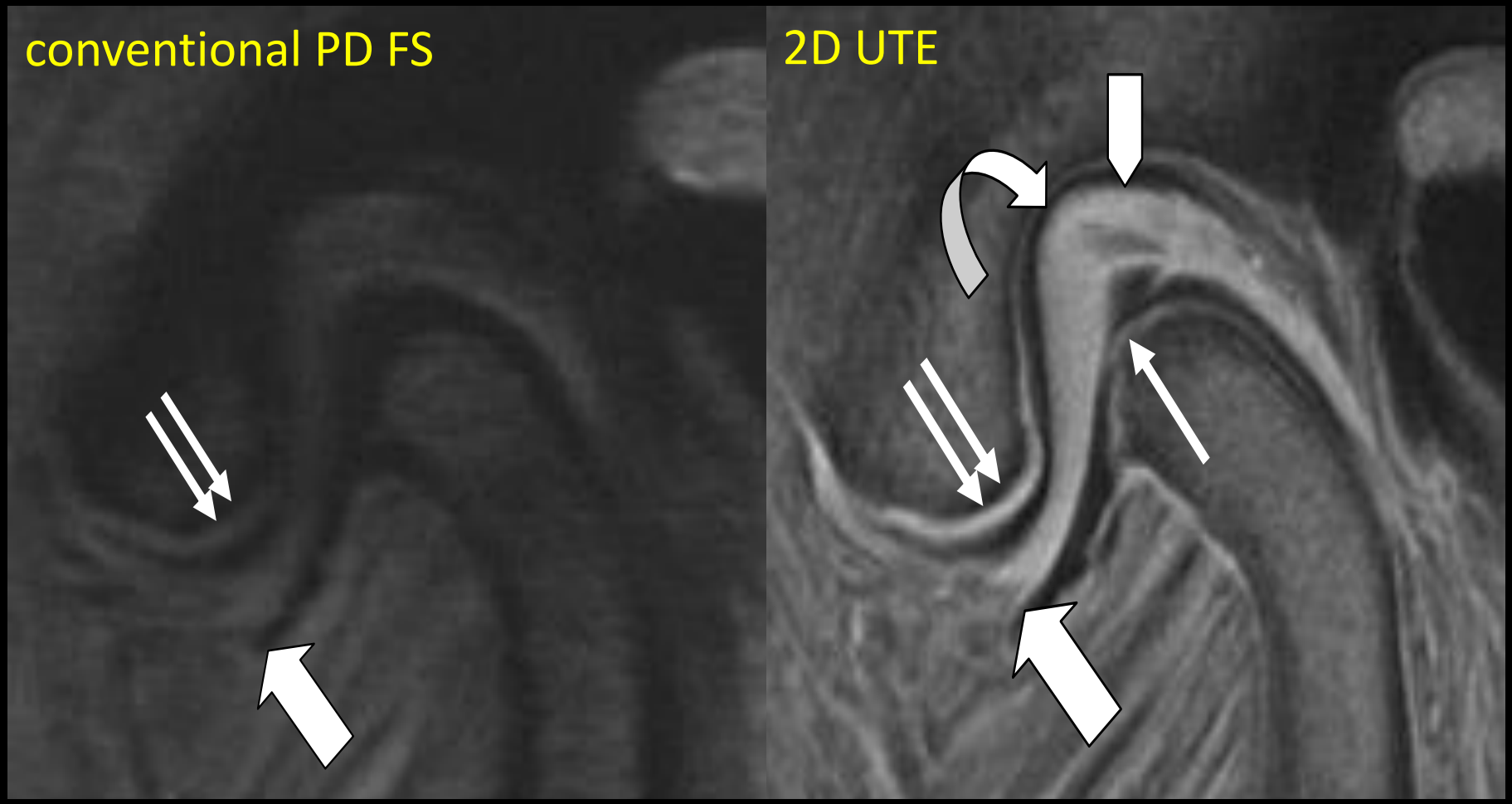


Vilanova et al. Seminars in Ultrasound CT and MRI 2007.

Translational Imaging TMJ

Non-invasive Tissue Characterization

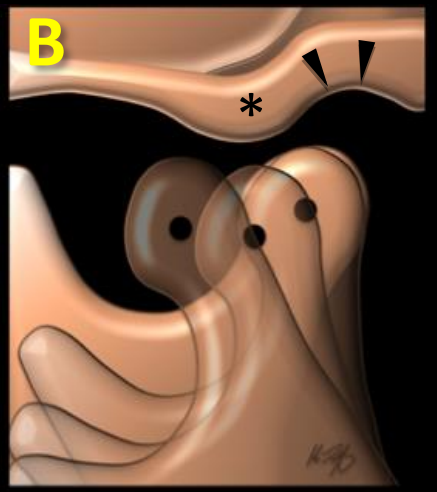


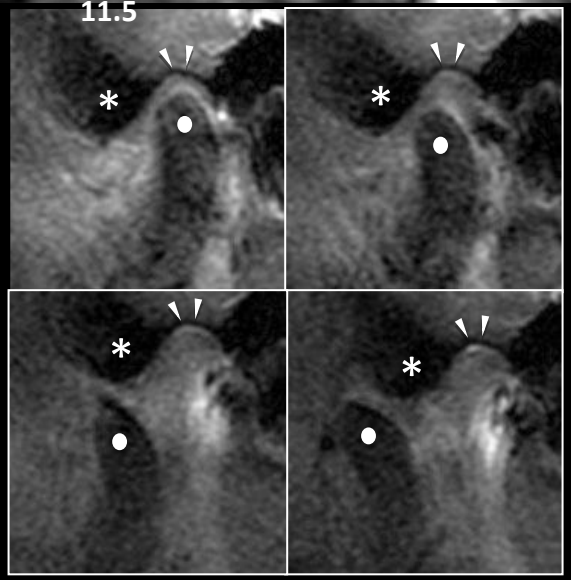
C. Chung, MD

Translational Imaging TMJ

Dynamic Imaging Phenotype

Low-resolution dynamic acquisition (A) and illustration (B) showing the normal motion of the **condyle (dot)** during the full range of open and closing with rotation and translation of the condyle.





Slide adapted with permission from C. Chung, MD

Statum, Carl UCSD MSK Imaging Research Lab

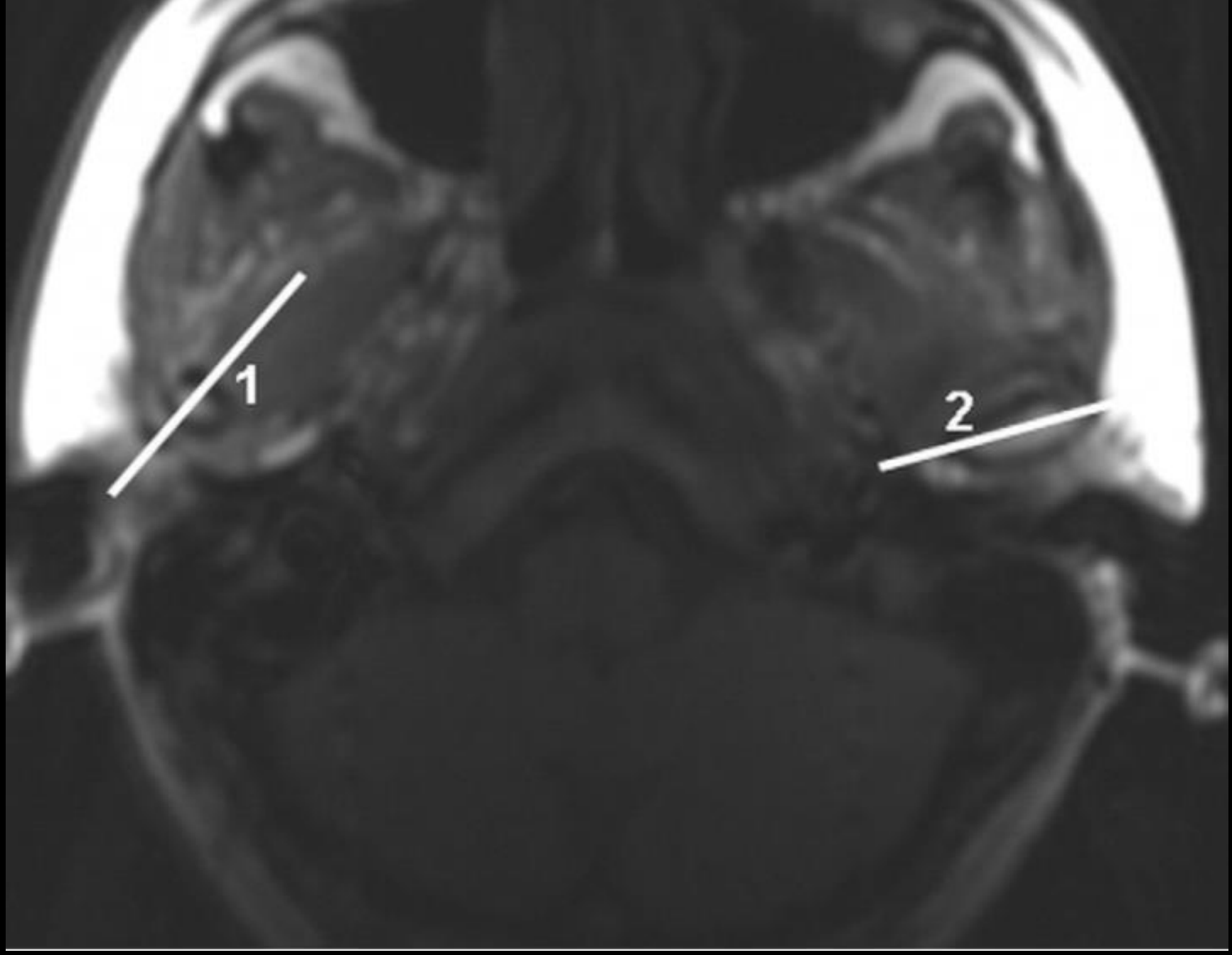
Indications for TMJ Imaging

- Up to 30 % of the population experiences pain related to TMJ and up to 7% seek treatment
- Highest prevalence is in women between ages of 20-40
  - Women represent 80% of patients with TMJ disorders
- Pain
- Clicking
- Catching
- Restriction of motion

MR imaging and protocols

- Dual surface coils are used
- Standard axial and coronal T1
- Oblique sagittal images are the mainstay of TMJ imaging and provide the most diagnostic information with the articulation
- Contrast is not needed for evaluation of internal derangement

Vilanova et al. Seminars in Ultrasound CT and MRI 2007.



Vilanova et al. Seminars in Ultrasound CT and MRI 2007.

Table 1
TMJ protocol: without contrast

#	Sequence	Plane	Comment
1	T1: TR 500, TE min, 3 mm, 0.5 skip	COR	Closed mouth
2	T1: TR 500, TE min, 2 mm, 0 skip	AX	Closed mouth
3	T2 & PD, TR 3500, TE min & 85	Left SAG OBL	Closed mouth
4	T2 & PD, TR 3500, TE min & 85	Right SAG OBL	Closed mouth
5	T2 & PD, TR 3500, TE min & 85	LEFT SAG OBL	Open mouth
6	T2 & PD, TR 3500, TE min & 85	Right SAG OBL	Open mouth
7	T2, TR 1180, TE 64, cine	Left SAG OBL	Dynamic
8	T2, TR 1180, TE 64, cine	Right SAG OBL	Dynamic

Checklist

1. Position of the disc
2. Morphology and signal of the disc
3. Condylar Translation
4. Masticator space
5. Joint Effusion
6. Osteoarthritis

Internal Derangement

- Refers to abnormal relationship of the disc with respect to the joint
- Patient's present with jaw pain on biting and mouth opening, clicking with TMJ motion and decreased mouth opening

Wilkes staging criteria for IDJ of the TMJ

I. Early stage

Clinical: no significant mechanical symptoms, other than reciprocal clicking

Radiologic: slight anterior displacement, but good anatomic contour of disc

Surgical: normal anatomic form and slight anterior displacement

II. Early/intermediate stage

Clinical: occasional joint tenderness and temporal headaches, increase in intensity of clicking sounds, and beginning transient subluxations or joint locking

Radiologic: slight anterior displacement and thickening of posterior edge of disc

Surgical: anterior displacement, early anatomic deformity (slight thickening of posterior edge)

Wilkes CM. Arch Otolaryngol. Head Neck Surg 1989.

III. Intermediate stage

Clinical: multiple episodes of pain, joint tenderness, temporal headaches, major mechanical symptoms—sustained locking, restriction of motion, and pain with function

Radiologic: anterior displacement with significant anatomic deformity (moderate to marked thickening of posterior edge)

Surgical: marked anatomic deformity with displacement, variable adhesions (anterior, lateral, and posterior recesses)

IV. Intermediate/late stage

Clinical: chronic episodic pain, headaches, restriction of motion, undulating course

Radiologic: increase in severity over intermediate stage with early to

moderate degenerative remodeling of the mandibular condyle and glenoid fossa

Surgical: degenerative remodeling changes of both bearing surfaces, osteophytic projections, multiple adhesions, but no perforation of disc or attachment

V. Late stage

Clinical: crepitus grinding symptoms, chronic episodic pain, restriction of motion

Radiologic: anterior displacement, disc perforation with gross anatomic deformity of disc, severe degenerative arthritic changes

Surgical: perforation of posterior disc attachments, erosions of bearing surfaces with sclerosis and flattening of the condyle, osteophytic projections, subcortical cysts

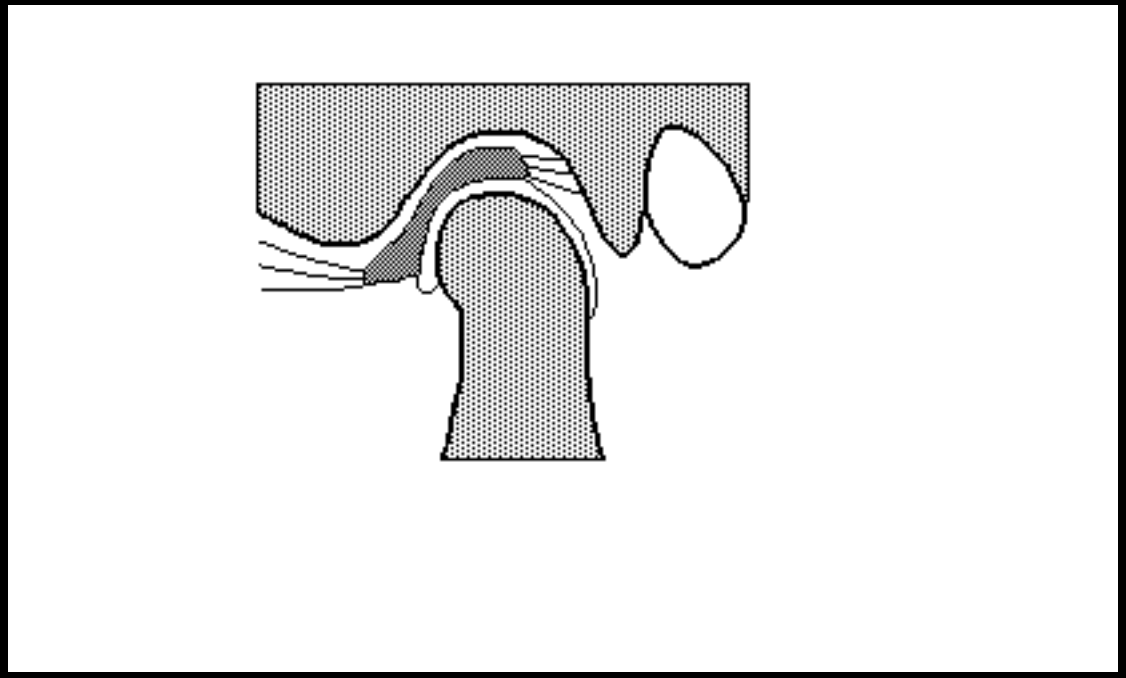
To simplify

- Anterior displacement with recapture on mouth opening
- Anterior displacement without recapture
- Chronic anterior disc displacement with abnormal disc morphology and features of the degenerative joint disease.

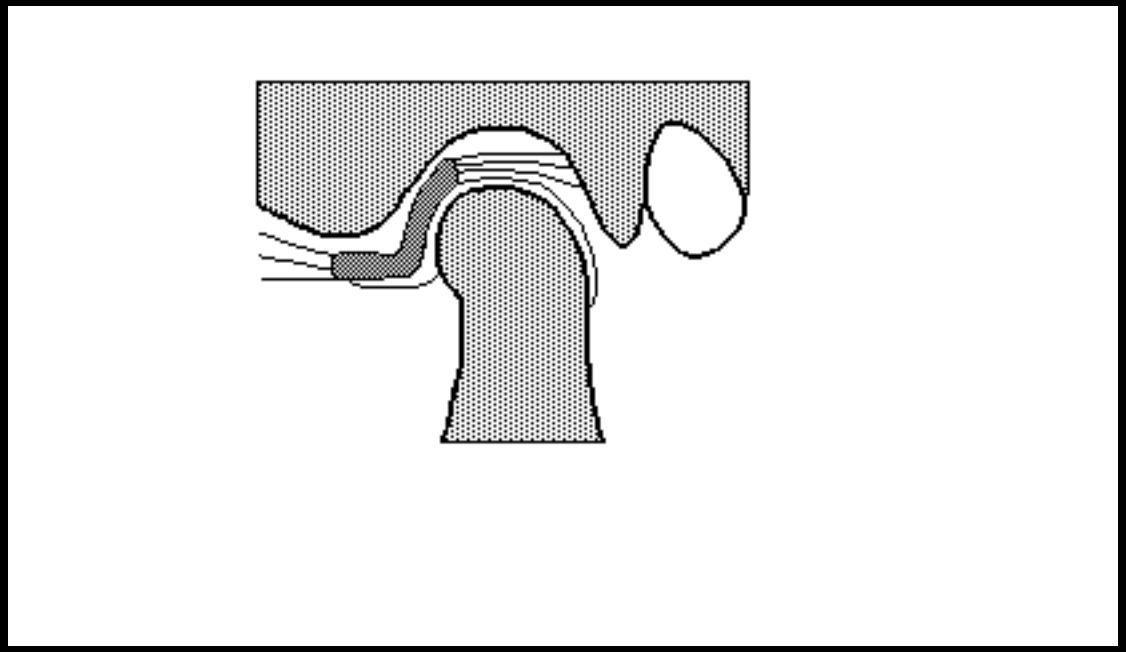
Which direction does the disc go?

- Always always anterior
- Less common
  - Anterolateral
  - Anteromedial
  - Medial
  - Lateral
  - Posterior (rare)

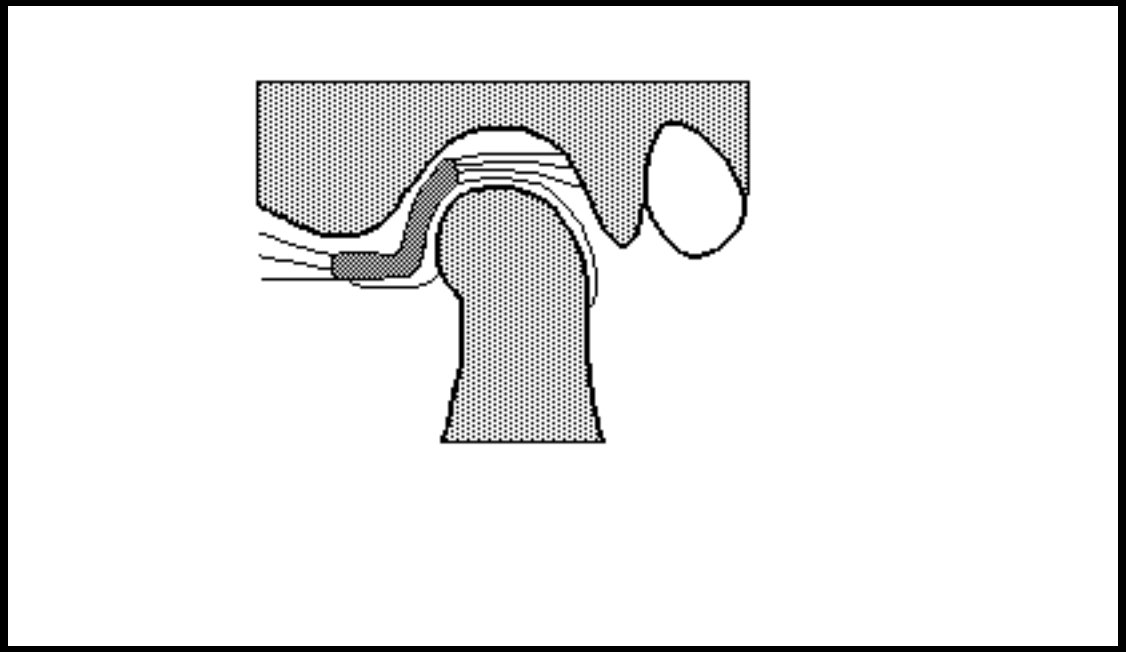
Normal Motion of the Disc



Anterior displacement with recapture



Anterior Displacement without recapture



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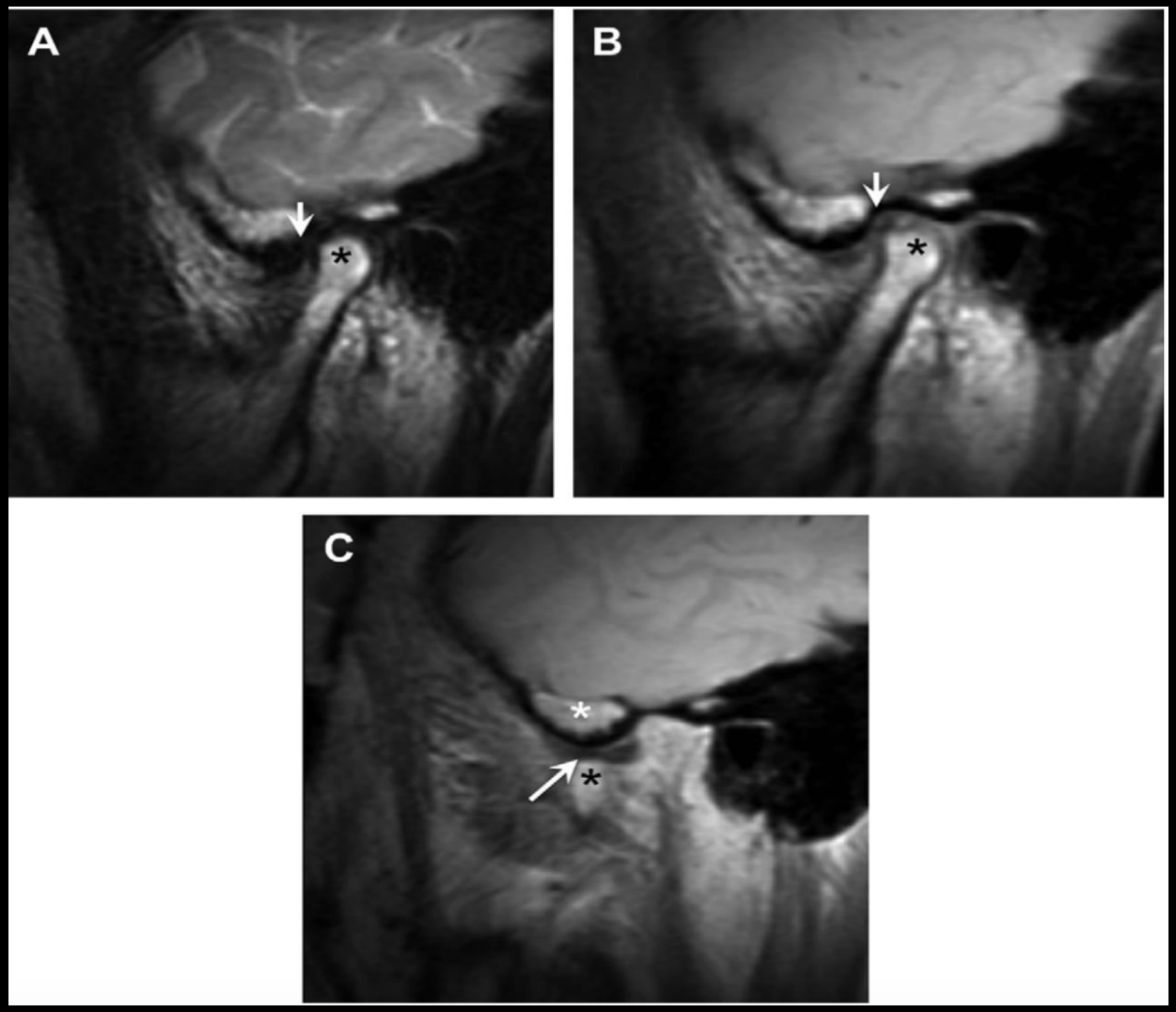
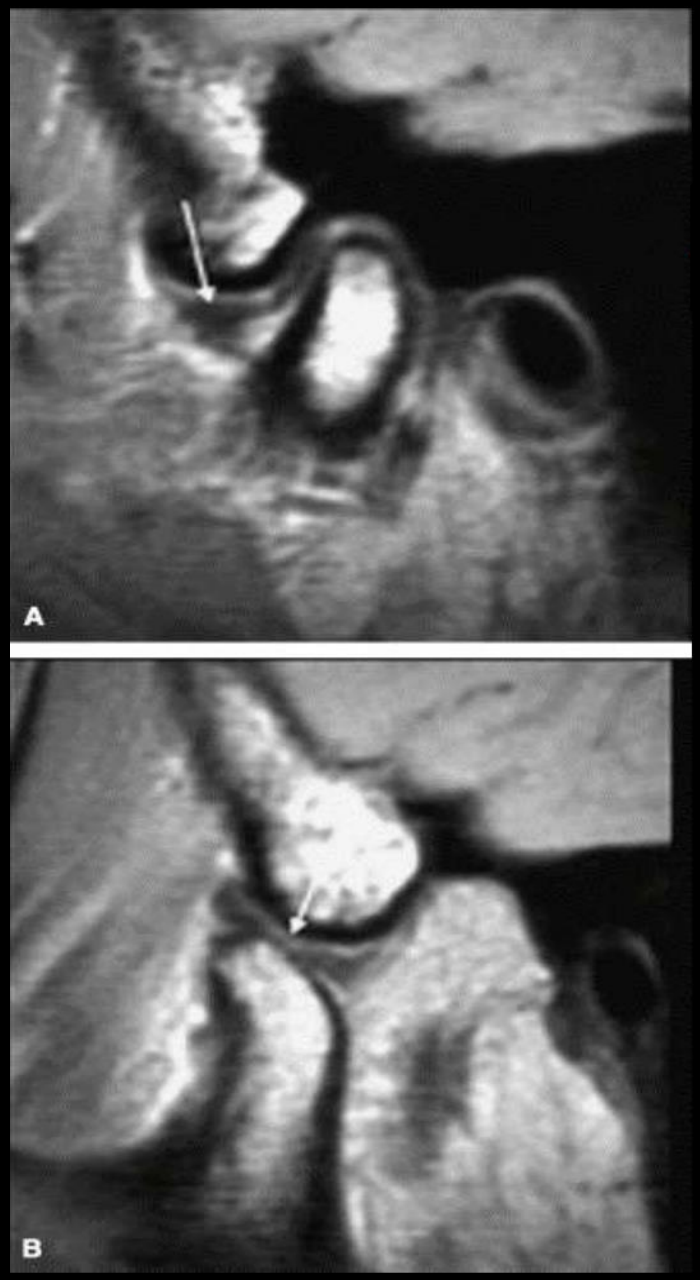


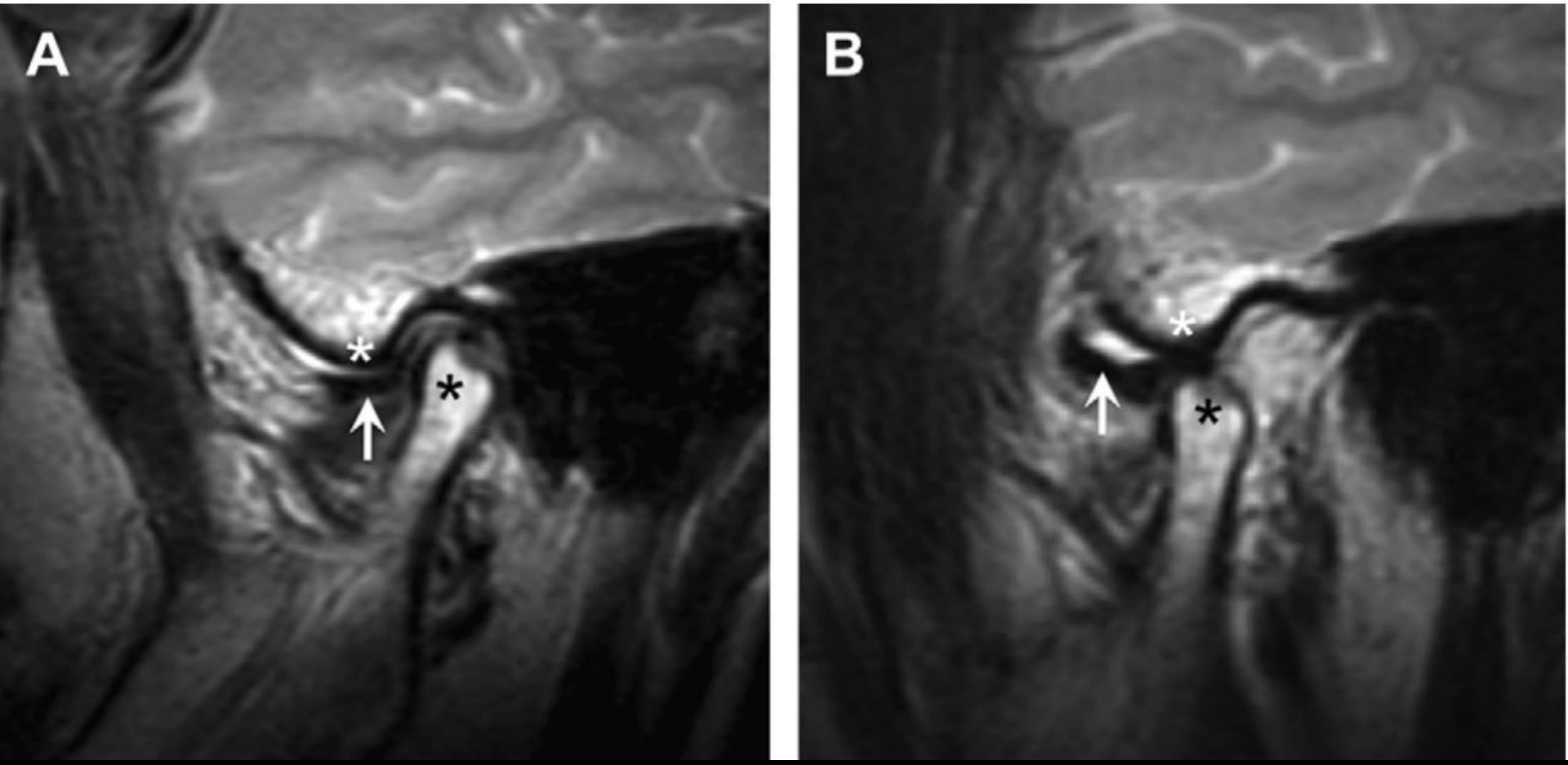
Adapted from Aiken et. al. 2012.

Anterior Displacement with recapture



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

Anterior displacement WITHOUT recapture

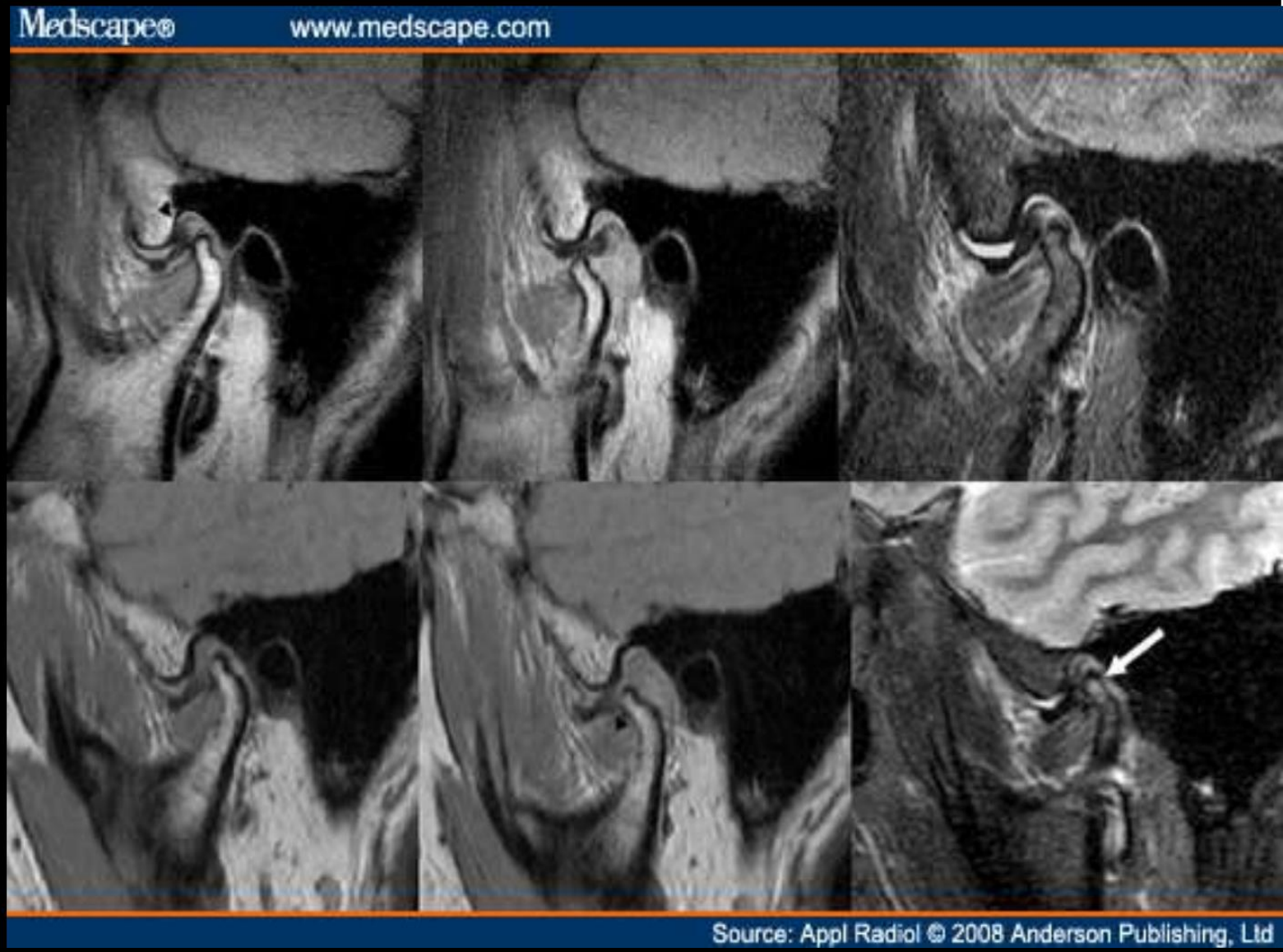


Adapted from Molinari et. al. 2007.

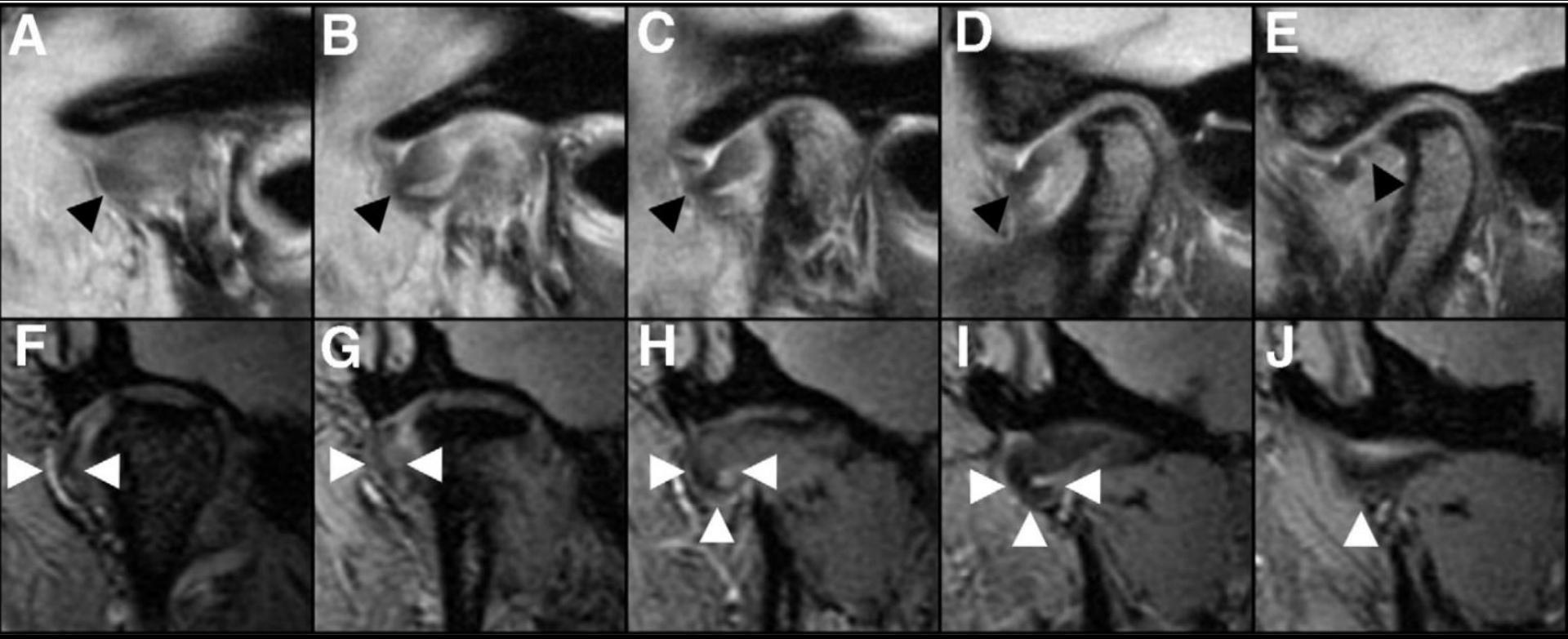
Progression of TMJ disease

Recapture

No Recapture

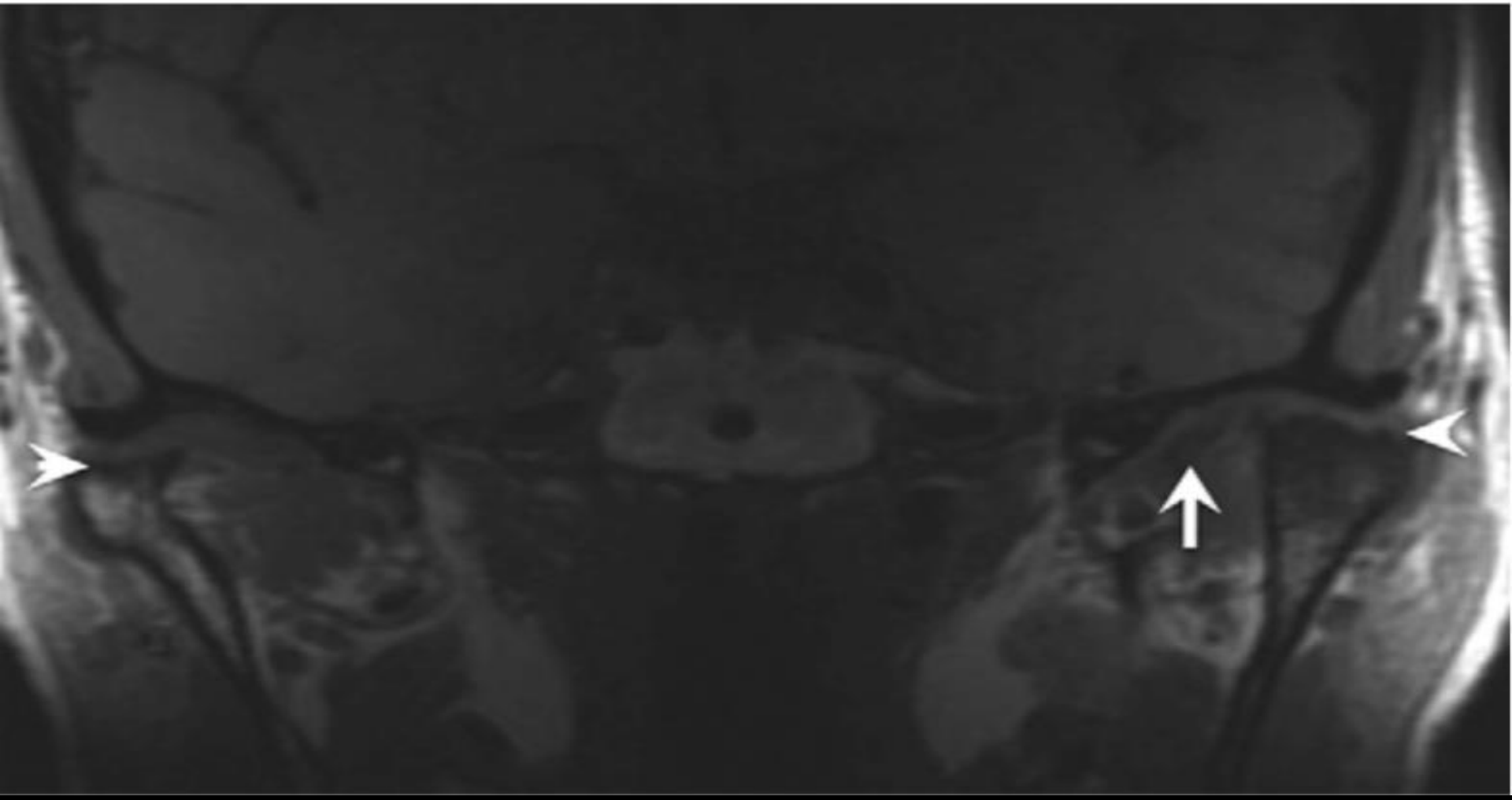


Anterolateral Displacement



Adapted from Molinari et. al. 2007.

Medial Displacement

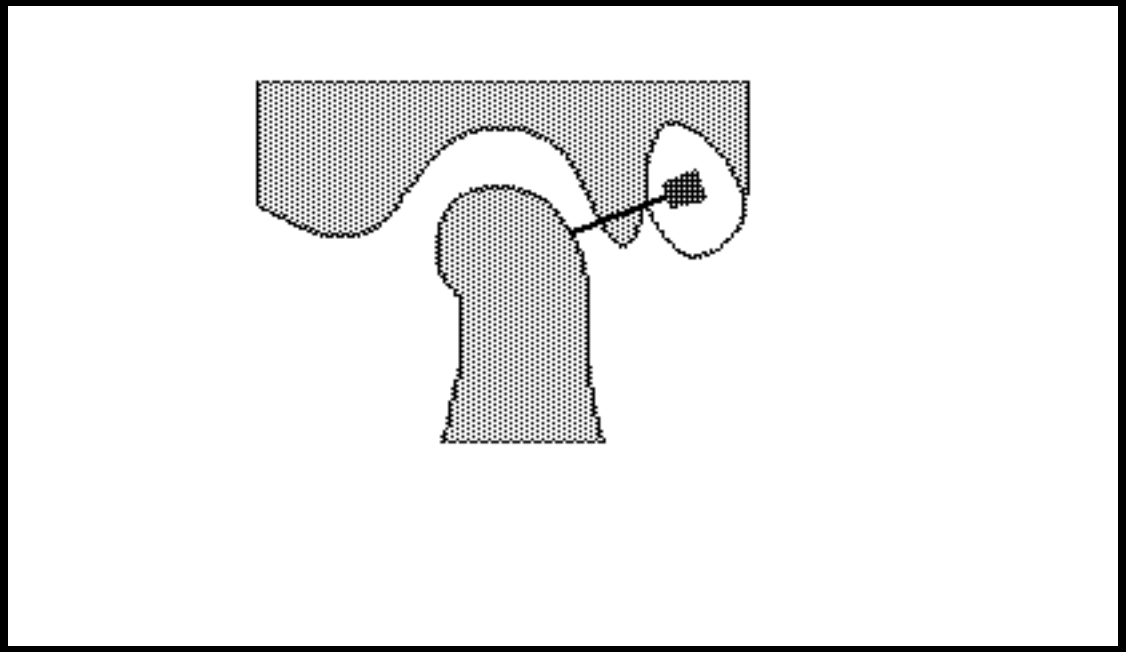


Adapted from Aiken et. al. 2012.

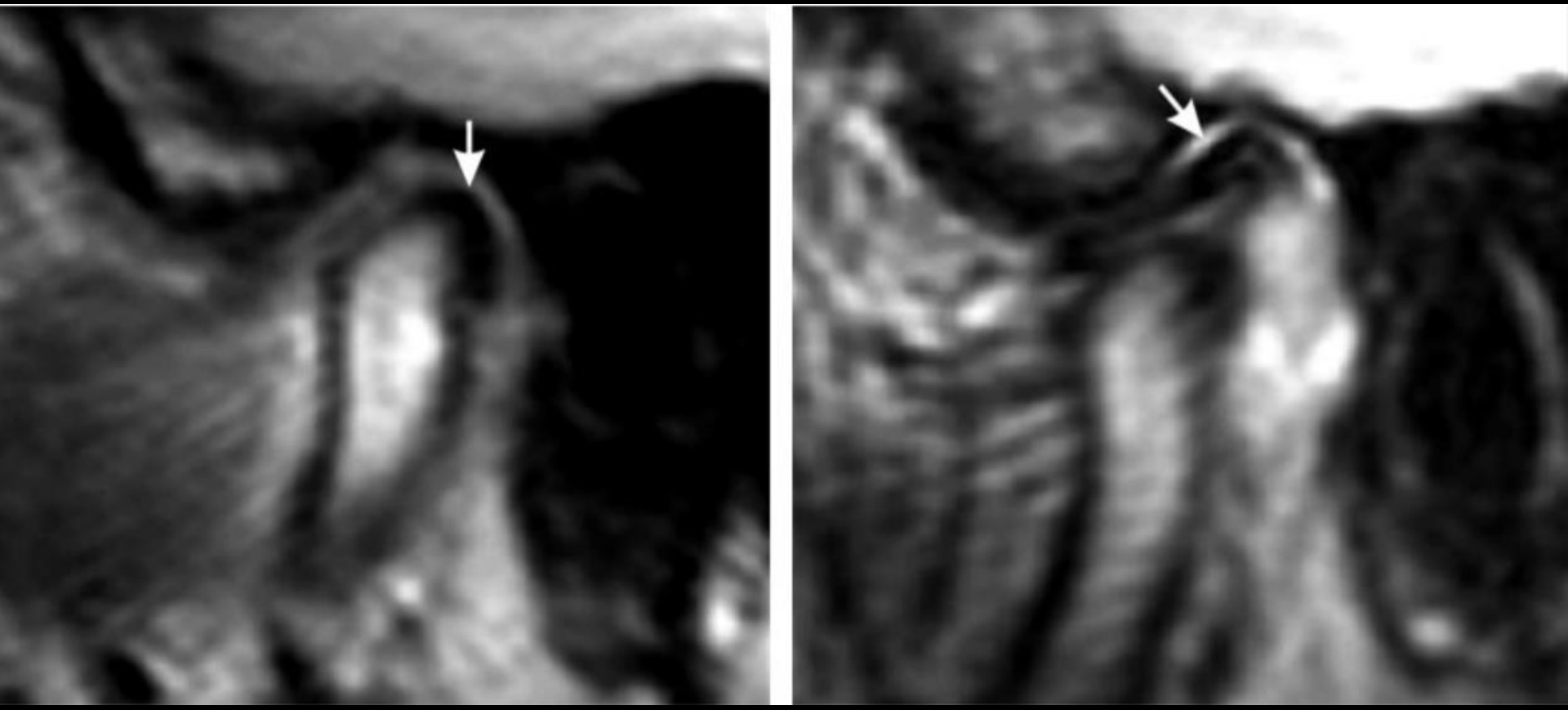
Disc Morphology

Tomas, Xavier, et al. “MR Imaging of Temporomandibular Joint Dysfunction: A Pictorial Review.” Radiographics 26.3 (2006): 765-781.

Arthrography



Stuck Disc



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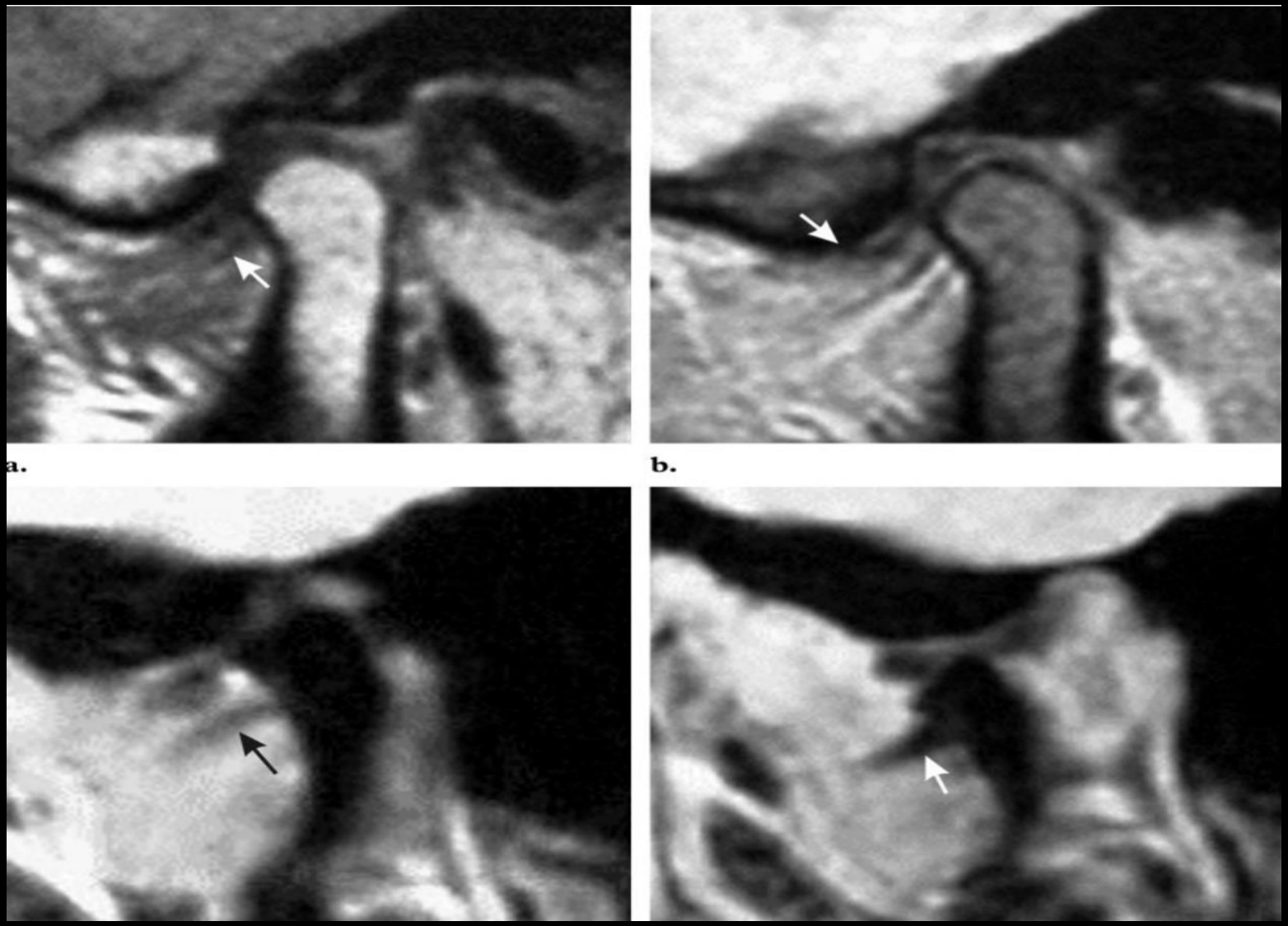
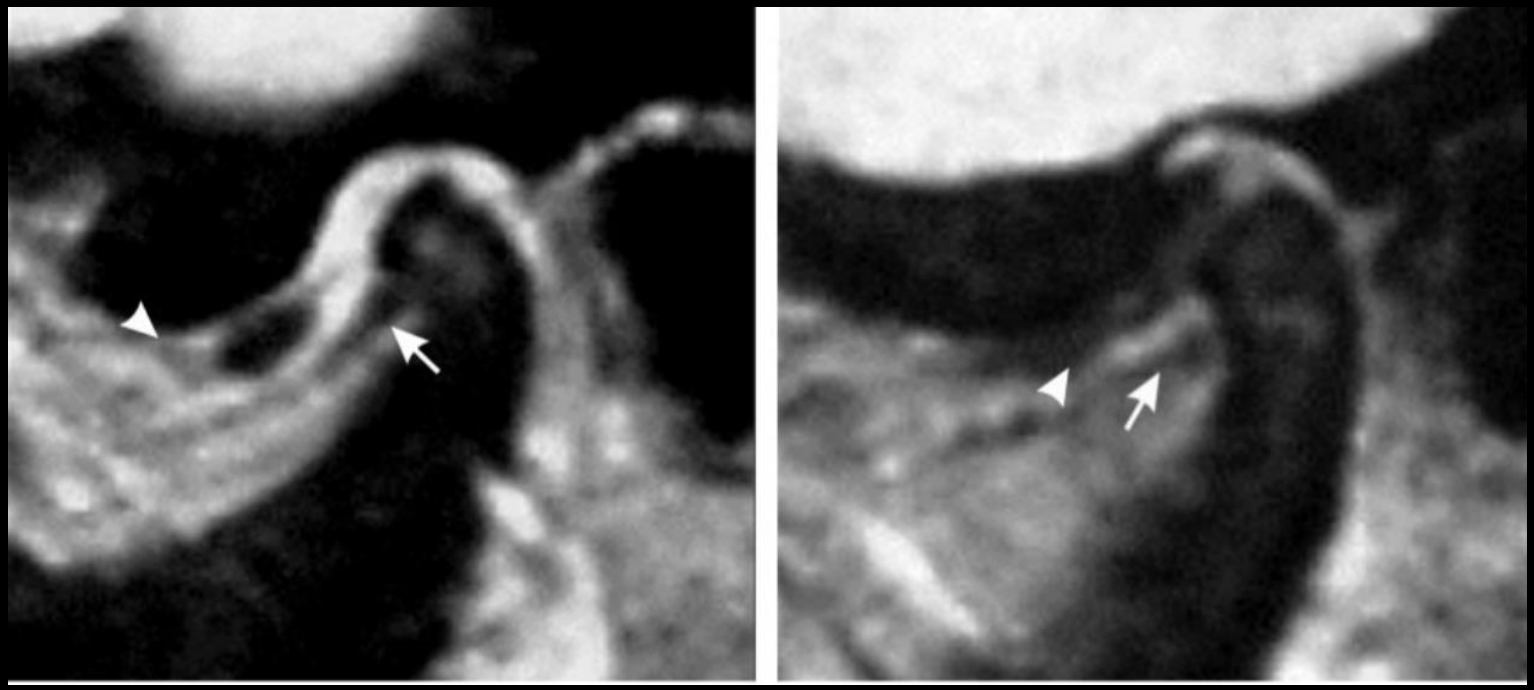
The Lateral Pterygoid Muscle



The Lateral Pterygoid Muscle

Patients with LPM muscle dysfunction proven by TMJ have been shown to have thick tendons on MR



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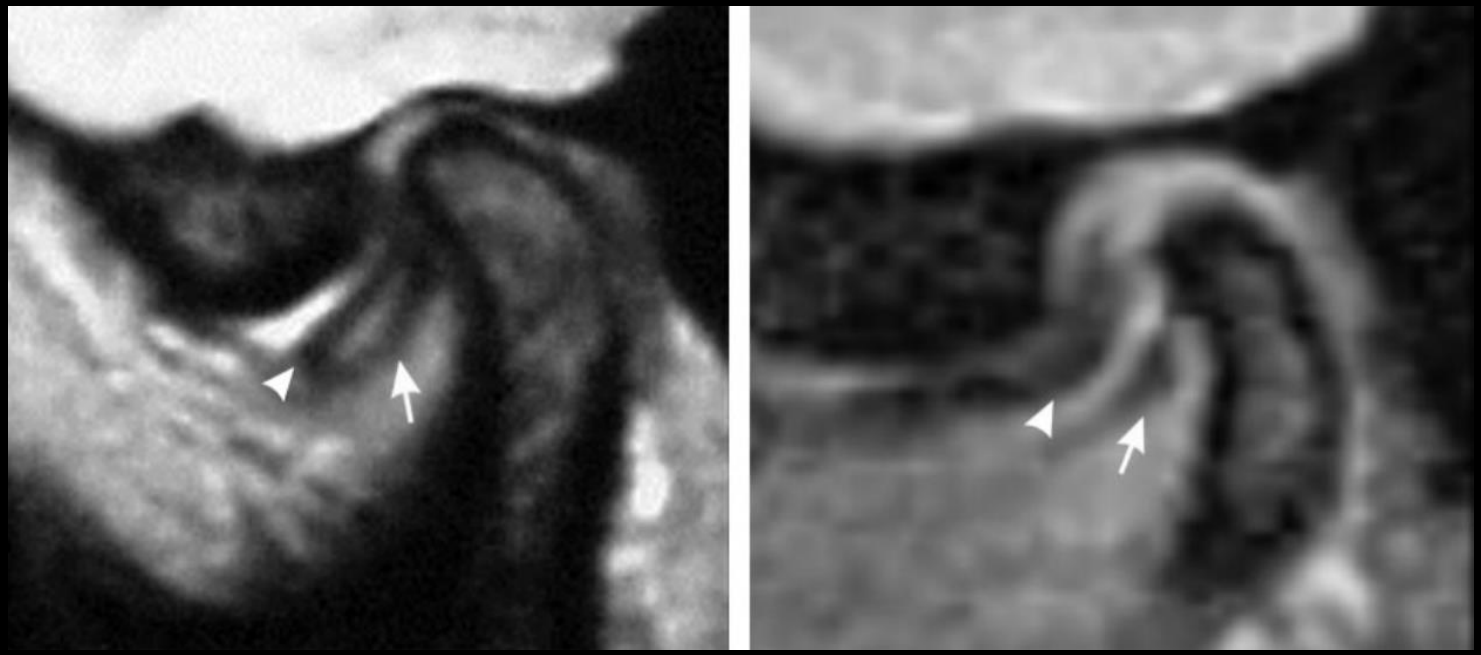

Tomas, Xavier, et al. “MR Imaging of Temporomandibular Joint Dysfunction: A Pictorial Review.” Radiographics 26.3 (2006): 765-781.

Treatment

- First and most common line of therapy is conservative
  - Soft diet
  - Rest
  - Heat
  - NSAIDS
  - Muscle Relaxants
  - Splints
  - Physical Therapy

Treatment

- Surgical Intervention is reserved for patients with refractory pain
  - Disc Plication
  - Repositioning
  - Discectomy
    - Temporalis muscle, auricular cartilage, fat, dermis, or silastic is used.
- Exact surgical procedure is controversial

Adapted from Aiken et. al. 2012.

Summary

- Anatomy
- Mechanics and function
- Indications for TMJ imaging
- MR Protocols and pitfalls
- Pathology
- Treatment options

IF you want to read more on this topic-this article is the probably the best…

MR Imaging of the Temporomandibular Joint

Ashley Aiken, MD[a,*], Gary Bouloux, MD, DDS[b,c,d], Patricia Hudgins, MD[a]

KEYWORDS

• TMJ • Temporomandibular joint • Internal derangement • Articular disc • Osteoarthritis • MRI • Synovial joint • Anterior displacement

KEY POINTS

- Internal derangement of the temporomandibular joint (TMJ) is very common.
- MR imaging is the preferred study for evaluating the TMJ.
- Key TMJ features to evaluate include disc position, disc morphology, condylar translation, presence of a joint effusion, and superimposed osteoarthritis.
- Disc position can be classified as normal, anteriorly displaced with recapture, and anteriorly displaced without recapture.
- MR imaging is also useful to exclude other diagnoses that may mimic internal derangement, including infection and inflammatory arthritis.

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