

# **Back To Chiropractic Continuing Education Seminars**

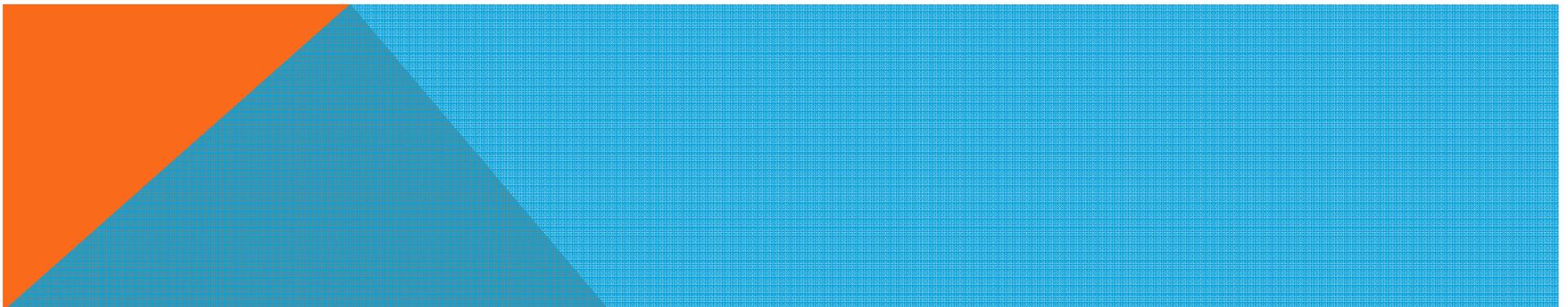
## **MRI ~ 6 Hours**

**Welcome:**

**This course is approved for 6 Hours of MRI for the Chiropractic Board of Examiners for the state of California and is also accepted in Colorado, Iowa, Michigan, Oregon and Washington.**

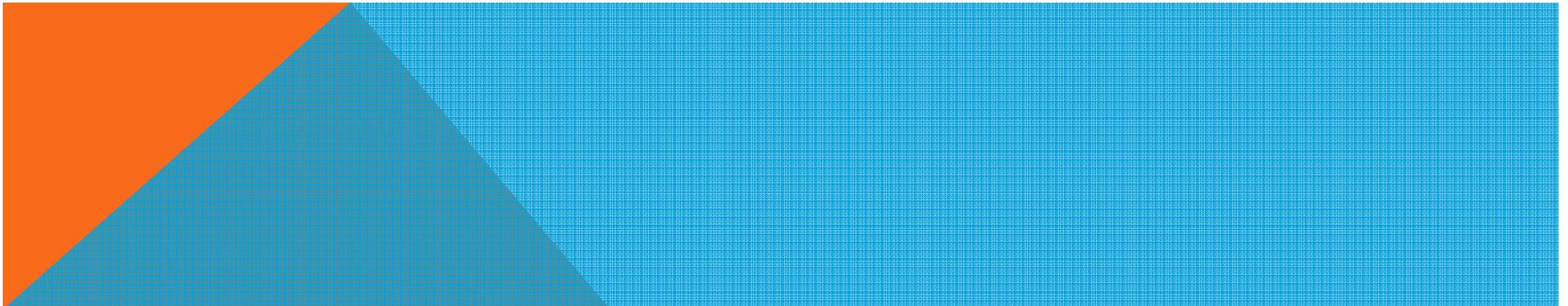
**This course does **NOT** count towards your Radiography Supervisor and Operator Permit renewal. Course must be completed before your permit expires.**

**There is no time element to this course, take it at your leisure. If you read slow or fast or if you read it all at once or a little at a time it does not matter.**



## **How it works:**

- 1. Helpful Hint: Print exam only and read through notes on computer screen and answer as you read.**
- 2. Printing notes will use a ton of printer ink, so not advised.**
- 3. Read thru course materials.**
- 4. Take exam; e-mail letter answers in a NUMBERED vertical column to [marcusstrutzdc@gmail.com](mailto:marcusstrutzdc@gmail.com).**
- 5. If you pass exam (70%), I will email you a certificate, within 24 hrs, if you do not pass, you must repeat the exam. If you do not pass the second time then you must retake and pay again.**
- 6. If you are taking the course for DC license renewal you must complete the course by the end of your birthday month for it to count towards renewing your license. I strongly advise to take it well before the end of your birthday month so you can send in your renewal form early.**
- 7. Upon passing, your Certificate will be e-mailed to you for your records.**
- 8. DO NOT send the state board this certificate.**
- 9. I will retain a record of all your CE courses. If you get audited and lost your records, I have a copy.**



**The Board of Chiropractic Examiners requires that you complete all of your required CE hours BEFORE you submit your chiropractic license renewal form and fee.**

**NOTE: It is solely your responsibility to complete the course by then, no refunds will be given for lack of completion.**

**Enjoy,**

**Marcus Strutz DC**

**CE Provider**

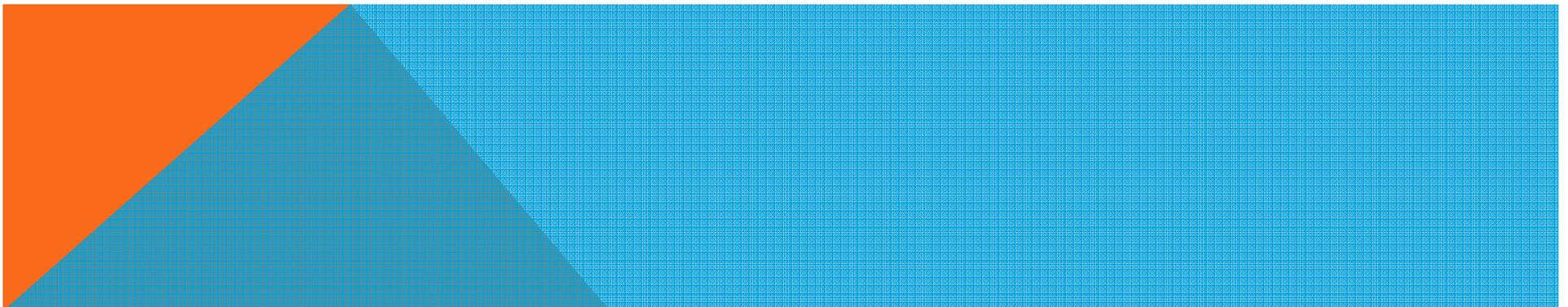
**Back To Chiropractic CE Seminars**

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[jcradiology.com](http://jcradiology.com)

**SPINAL MRI: WHERE DO I  
START?**



Thank You For Providing Many  
of the Images in This  
Presentation!

- Sunnyvale Imaging Center
    - 568 South Mathilda Ave.
    - Sunnyvale, CA 94086
    - 408.738.0232
- 

# References

- *Musculoskeletal MRI*, Helms et. Al., Saunders, 2001, Phil PA
- *Magnetic Resonance Imaging in Ortopaedics and Sports Medicine*, D Stoller, Lippincott, Williams and Wilkins, 2007, Baltimore, MD.
- *Skeletal Imaging Atlas of the Spine and Extremities* Taylor Hughes Resnick, Saunders Elsevier , 2010, Maryland Heights, MO.
- *Diagnostic Imaging Orthopedics*, Stoller et. Al., Amirys, 2004, Salt Lake City, UT

# How does MR work?

- Hydrogen ions (most prevalent in body) all spin creating a magnetic moment but do so randomly cancelling each other out
- When the body is near a strong magnetic field the H<sup>+</sup> align with the magnetic field of the magnet
- The H<sup>+</sup> are excited by adding energy in the form of a radio frequency (RF) using a surface coil
- The protons realign by “precessing” in unison
- Their changing magnetic moment causes an electric current in the surface coil that is transferred back to the computer creating the image

# Field Strength

- Magnetic strength measured in Tesla
- 0.3-0.5: low field strength
- 0.5-1.0: intermediate field strength
- 1.5-3.0: high field strength
- Above 4.0 eyes can't see difference and creates too much heat in patient
- The higher the Tesla the prettier the image
- Small extremities should be obtained on high field magnets

# MR Contra-indications

- Brain aneurysm clips
- Intra-ocular foreign bodies esp. metal
- Subcutaneous metal or shrapnel
- Pacemakers and some heart valves
- Neurotransmitters
- Cochlear implants
- Tattoos????
- Early pregnancy?

# MR Terms

- High (bright) signal-white
- Intermediate signal-light gray
- Low signal-dark gray
- Signal void-black (air is a signal void on ALL imaging sequences)
- Hypo intense-darker than adjacent tissue
- Hyper intense-brighter than adjacent tissue
- Iso intense-same

# MR Sequences

- T<sub>1</sub>
- T<sub>2</sub>
- PD
- Fat Suppressed
  - STIR
  - FS PD FSE

# T1

- Fat- white
- Water-black
- Good anatomical detail

# T2

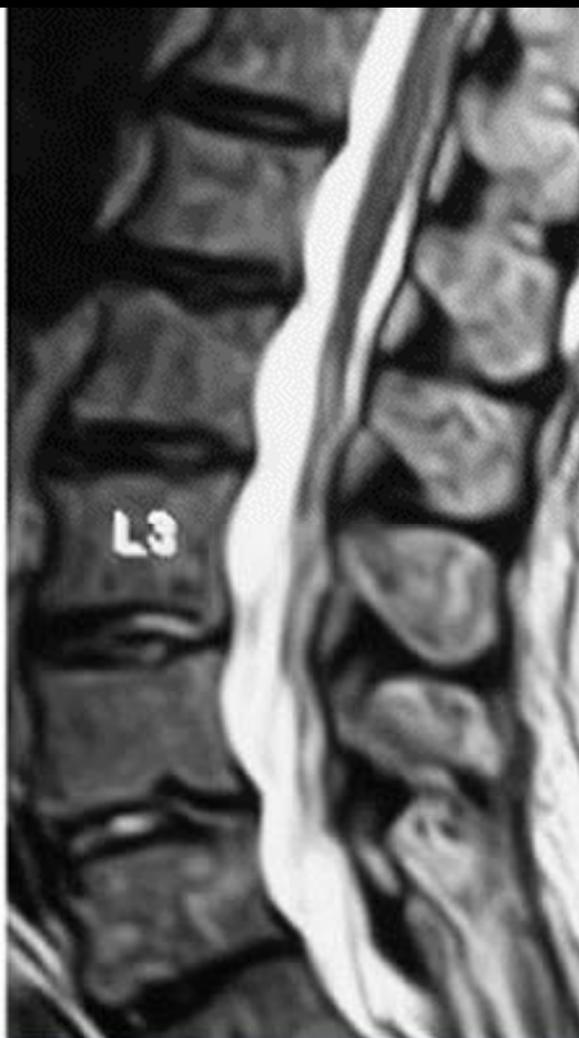
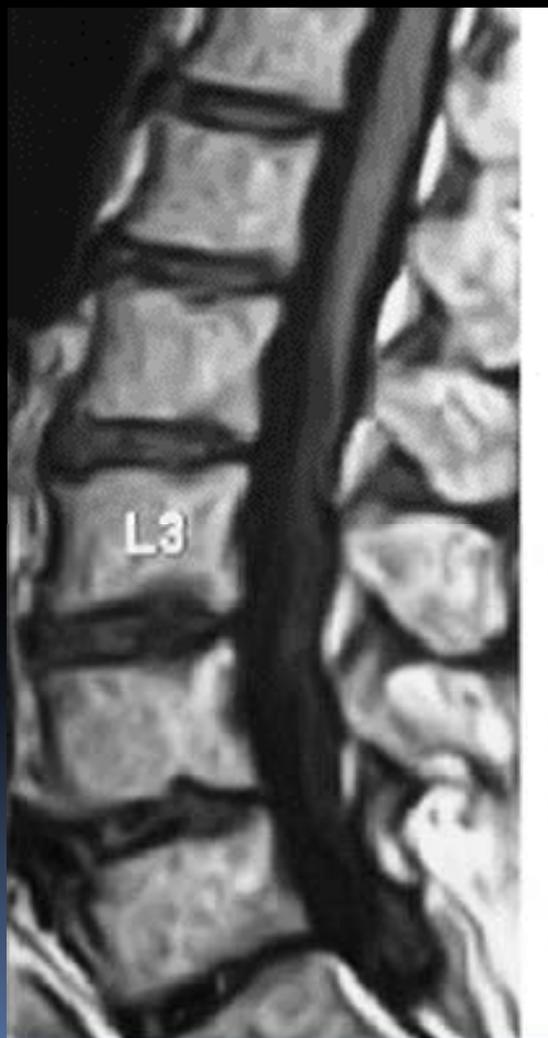
- Fat- dark gray
- Water-white
- Gives physiologic information especially edema (bone or soft tissue)

# T1 from T2

- Locate the CSF
- If black, it is T<sub>1</sub>
- If white, it is T<sub>2</sub>, STIR, or FS PD FSE
- If gray, it is likely PD

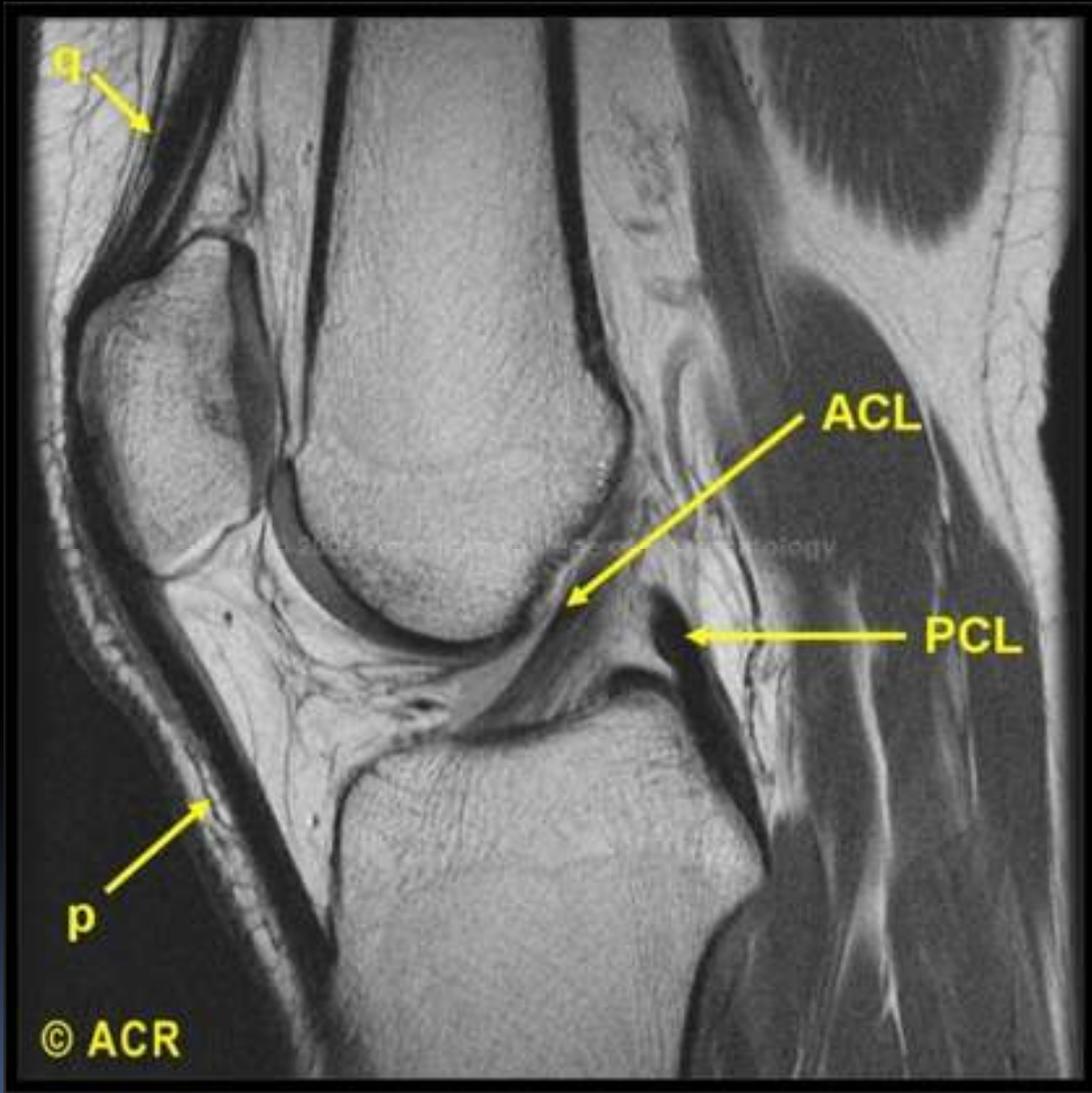
T1

T2



# Proton Density (PD)

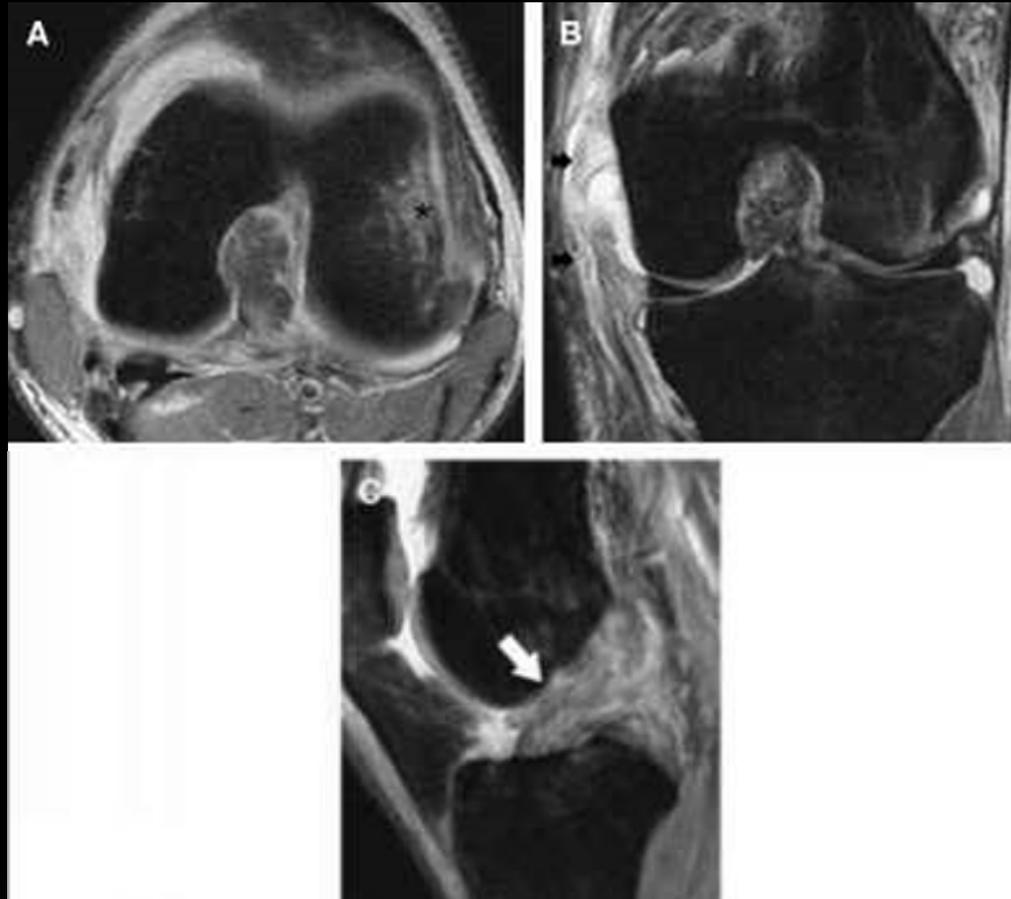
- Fat- light gray
- Water-medium gray
- Good for cartilage evaluation
- Not very common





# Fat Suppressed Proton Density Fast Spin Echo (FS PD FSE)

- Fat- black
- Water-bright
- Good for bone marrow edema, synovial fluid, tendons, ligaments, and cartilage evaluation



- A: bone bruise
- B: MCL tear
- C: ACL tear

# Short T1 Inversion Recovery (STIR)

- Fat- black
- Water-bright
- Takes longer to do than FS PD FSE
- Good for bone marrow edema, synovial fluid, tendons, ligaments, and cartilage evaluation

# STIR

- Anything bright is fluid
- Great for evaluation of tumor (especially metastasis), fracture and bone bruising

The bright areas in the vertebrae represent tumor

8



W 952 : L 476



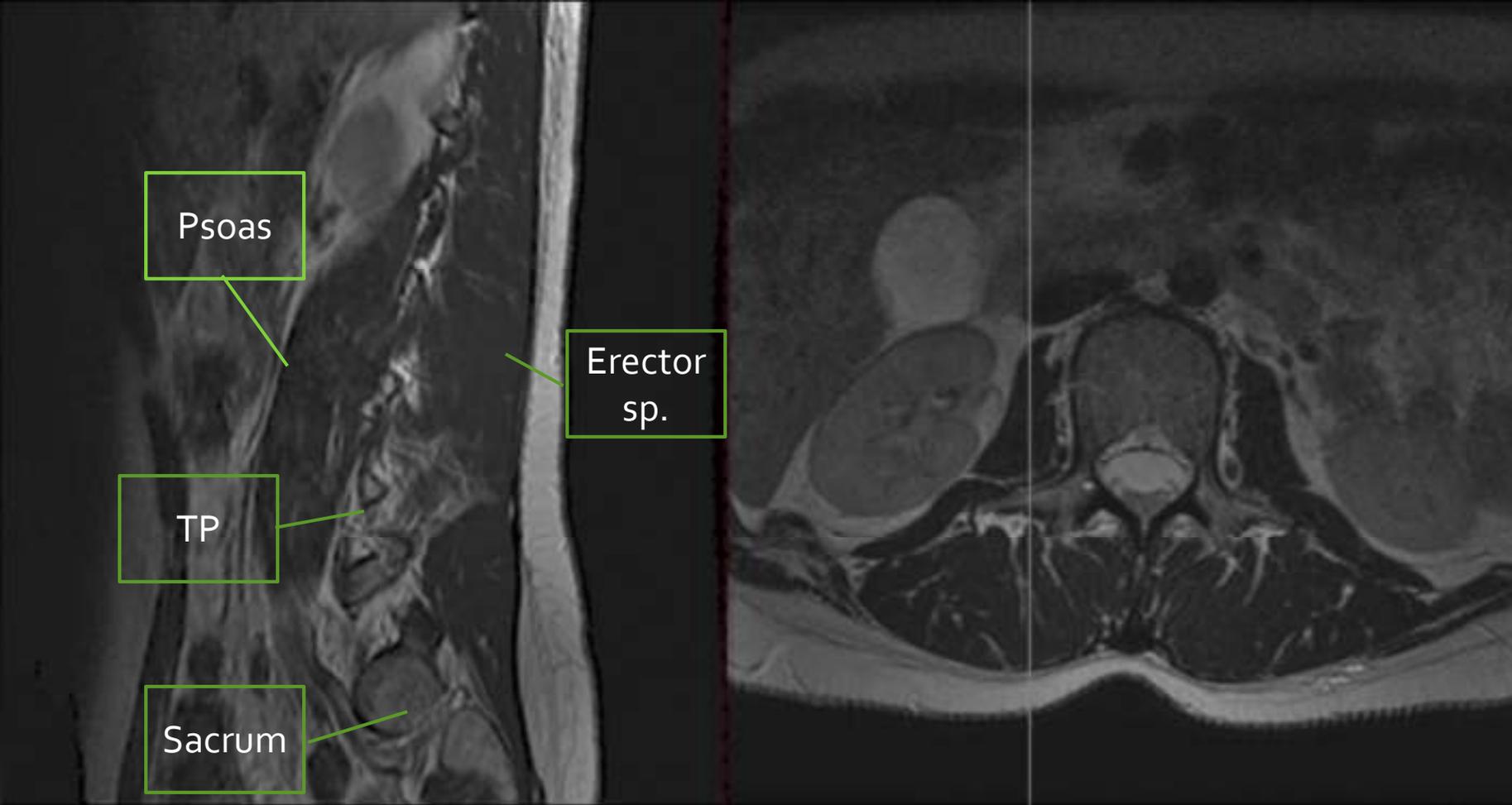
# Normal Lumbar Anatomy

T<sub>1</sub>



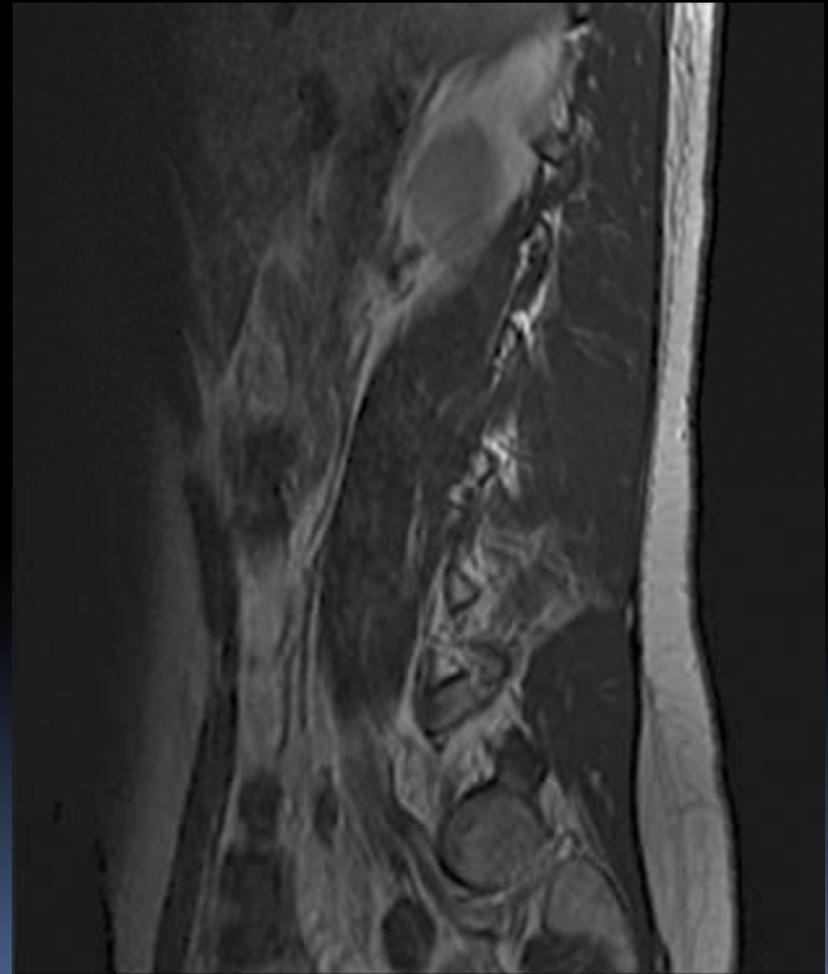
T<sub>2</sub>

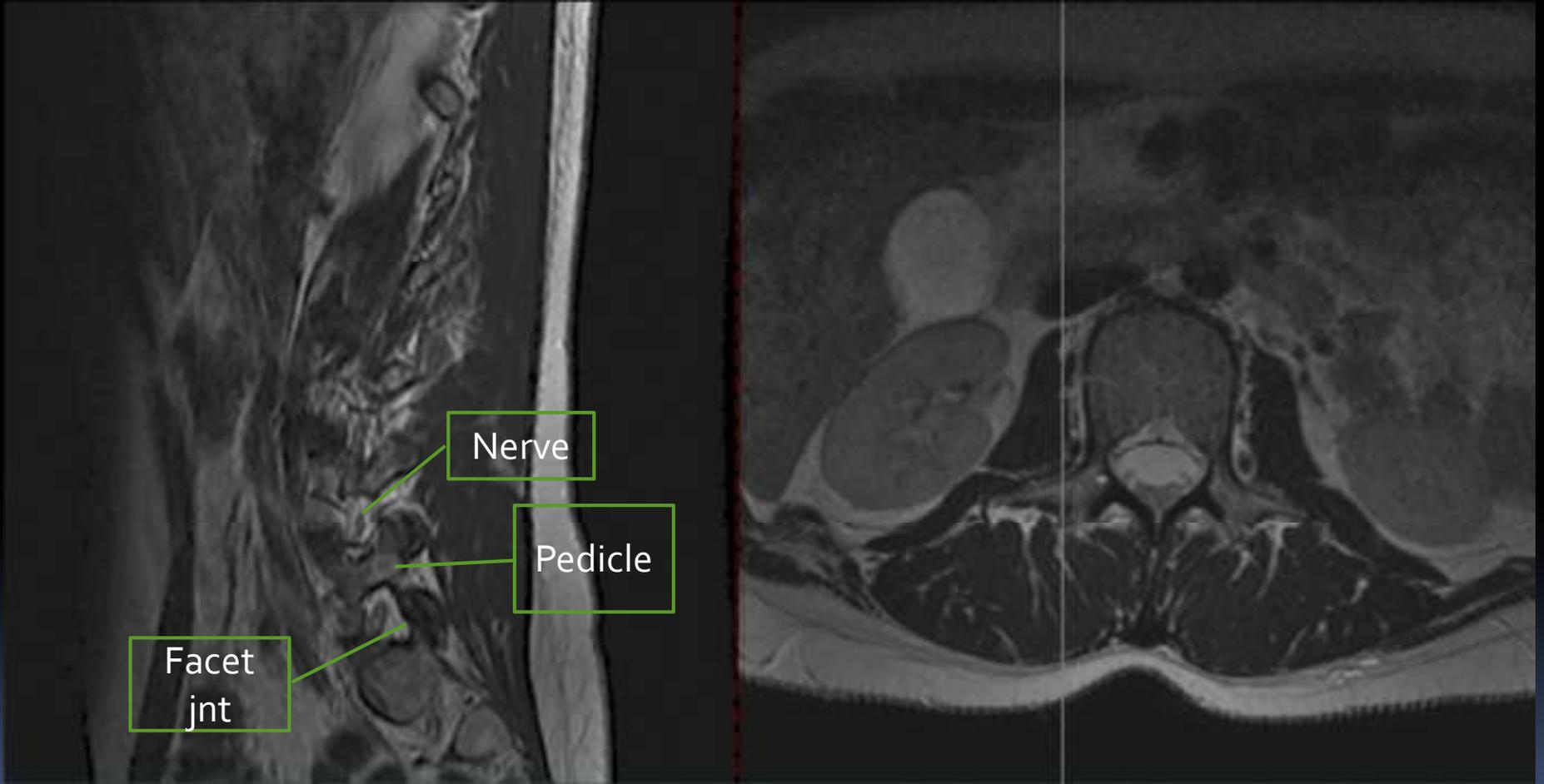




# Find

- TP
- Erector spinae
- Psoas
- Sacrum

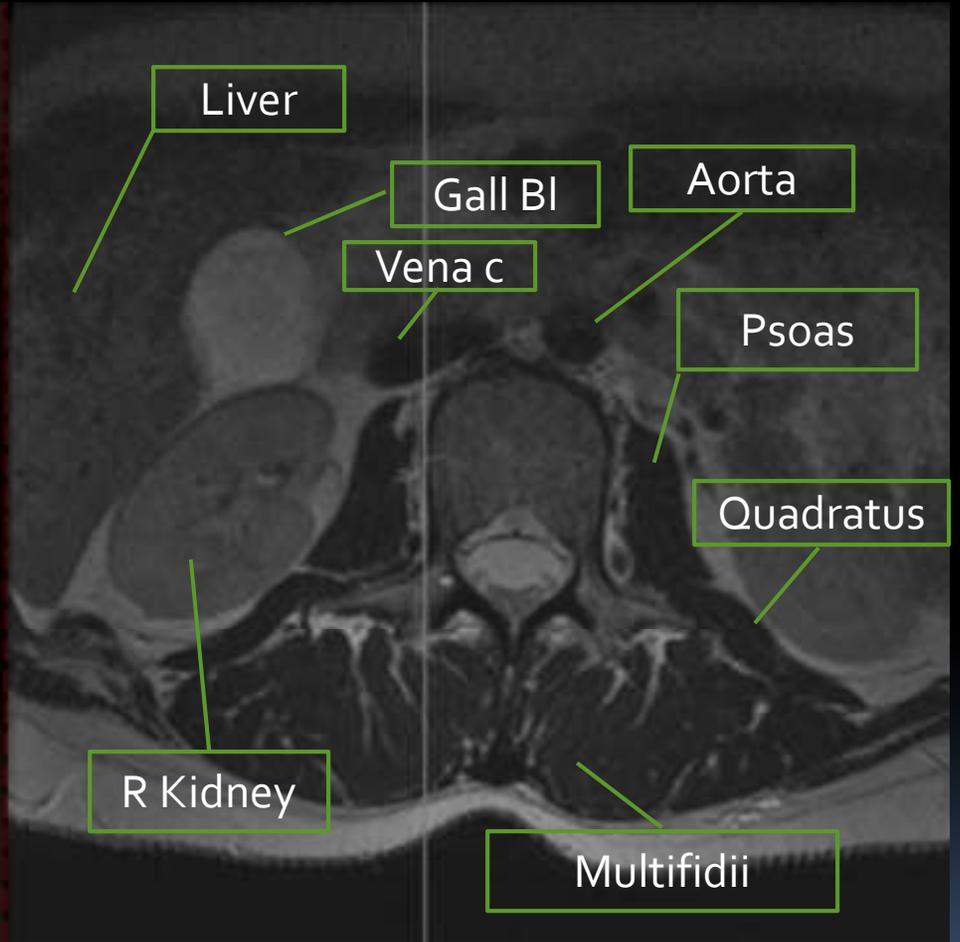
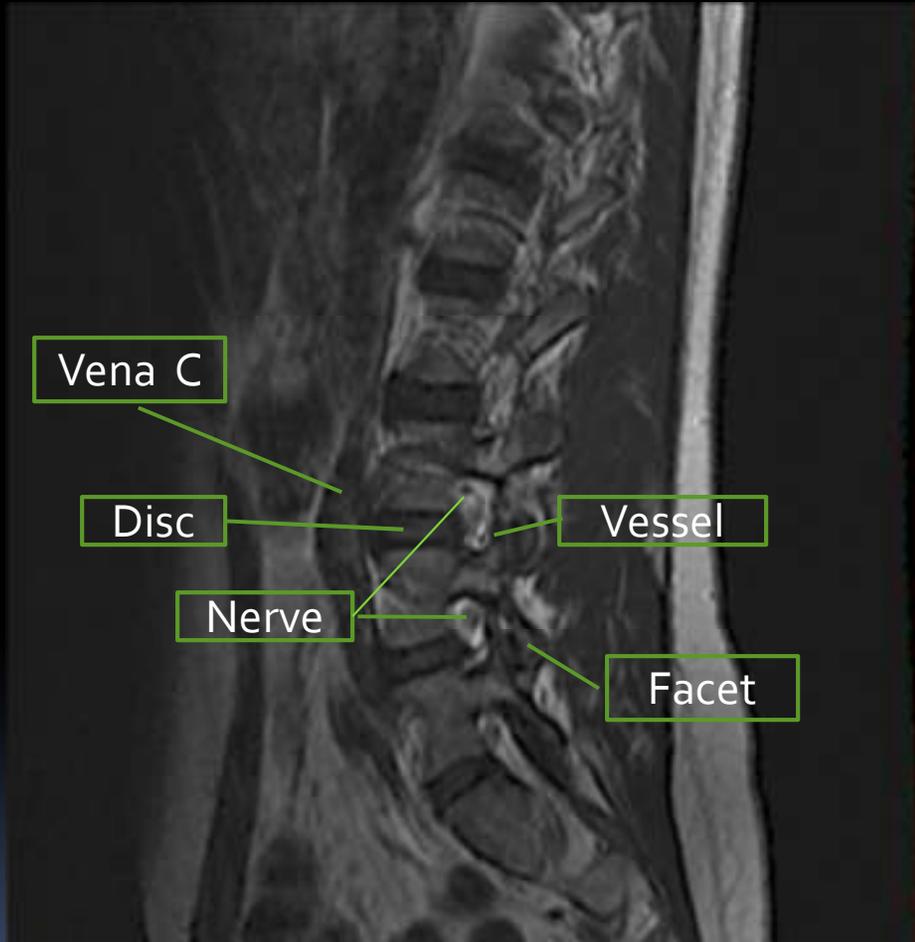


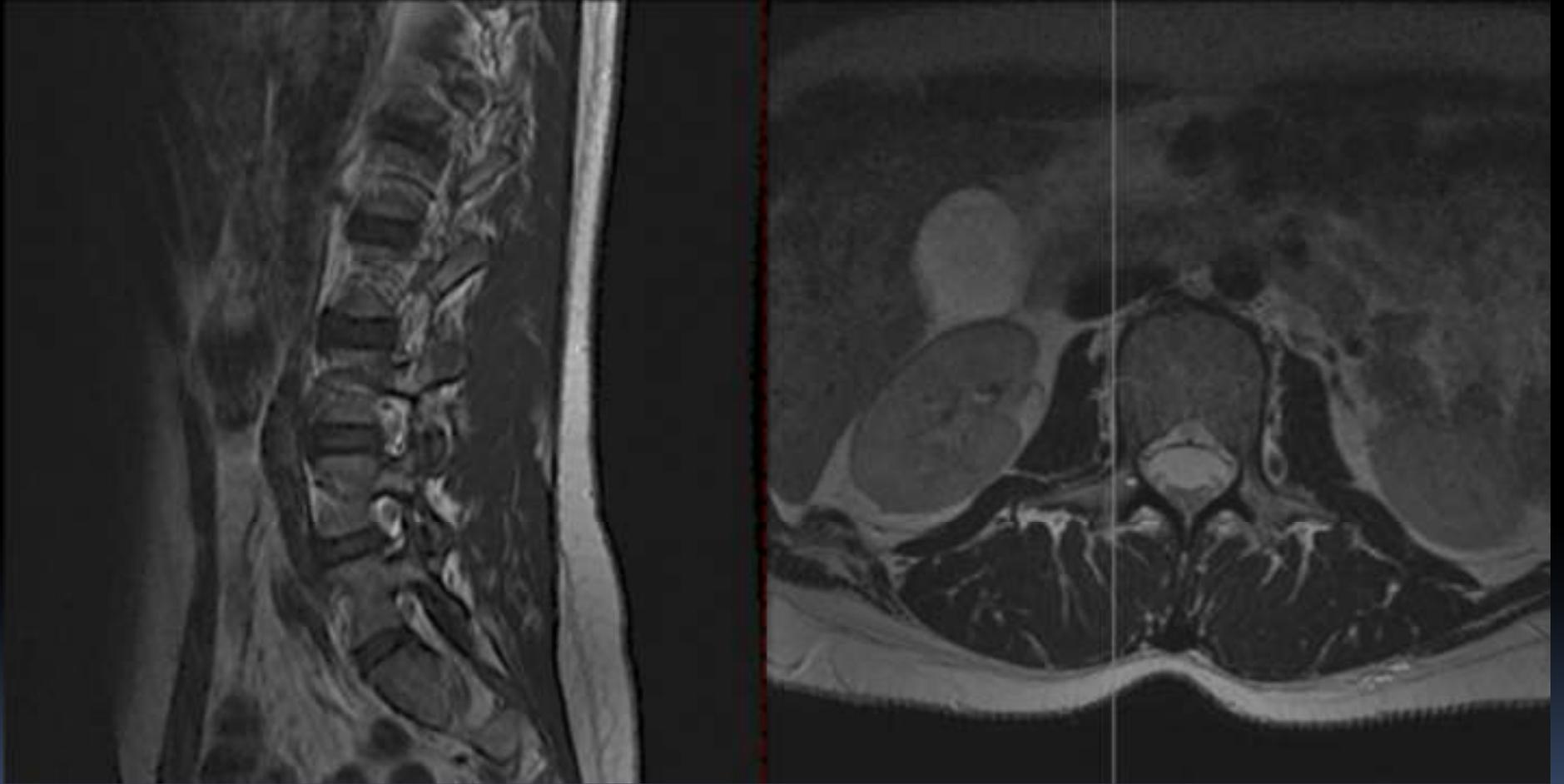


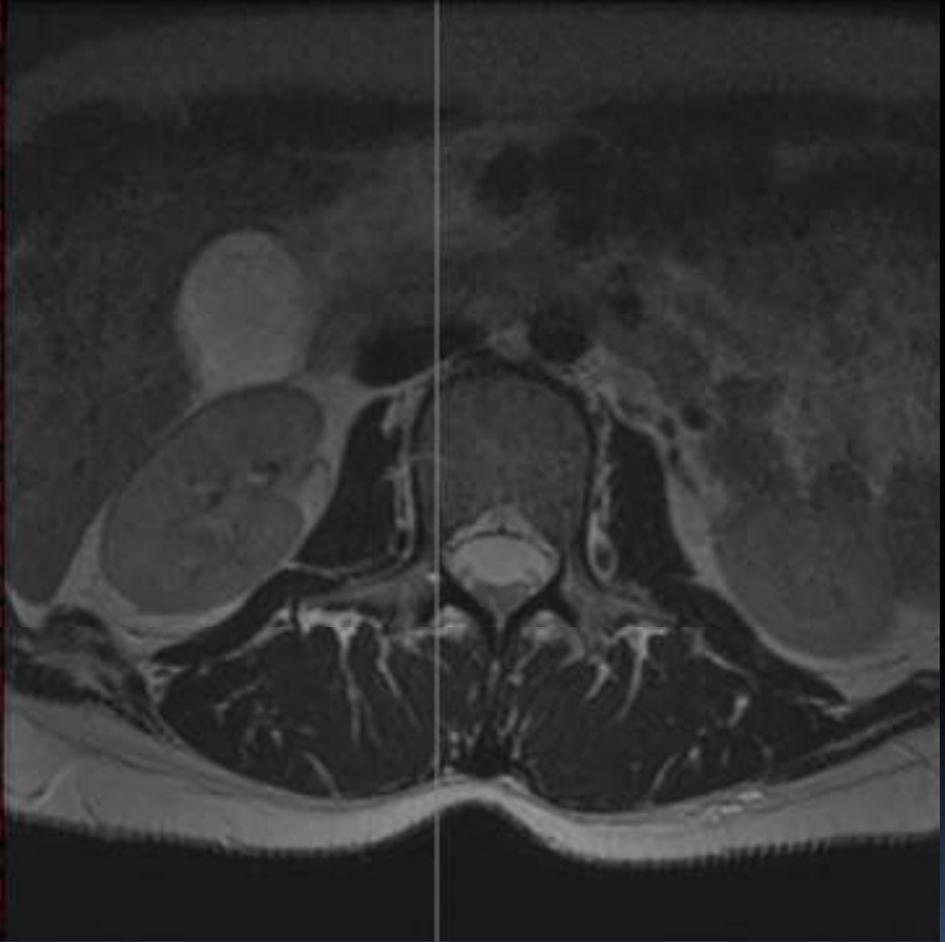
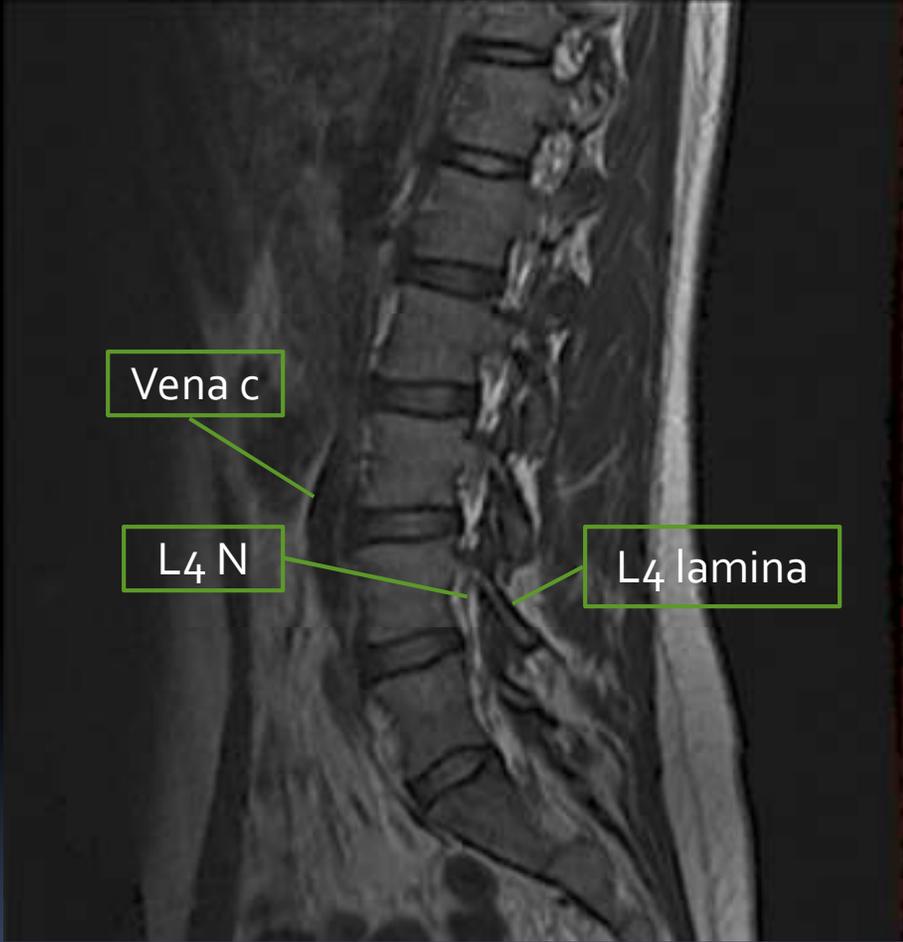
# Find

- Pedicle
- Nerve
- Facet joint









# Find

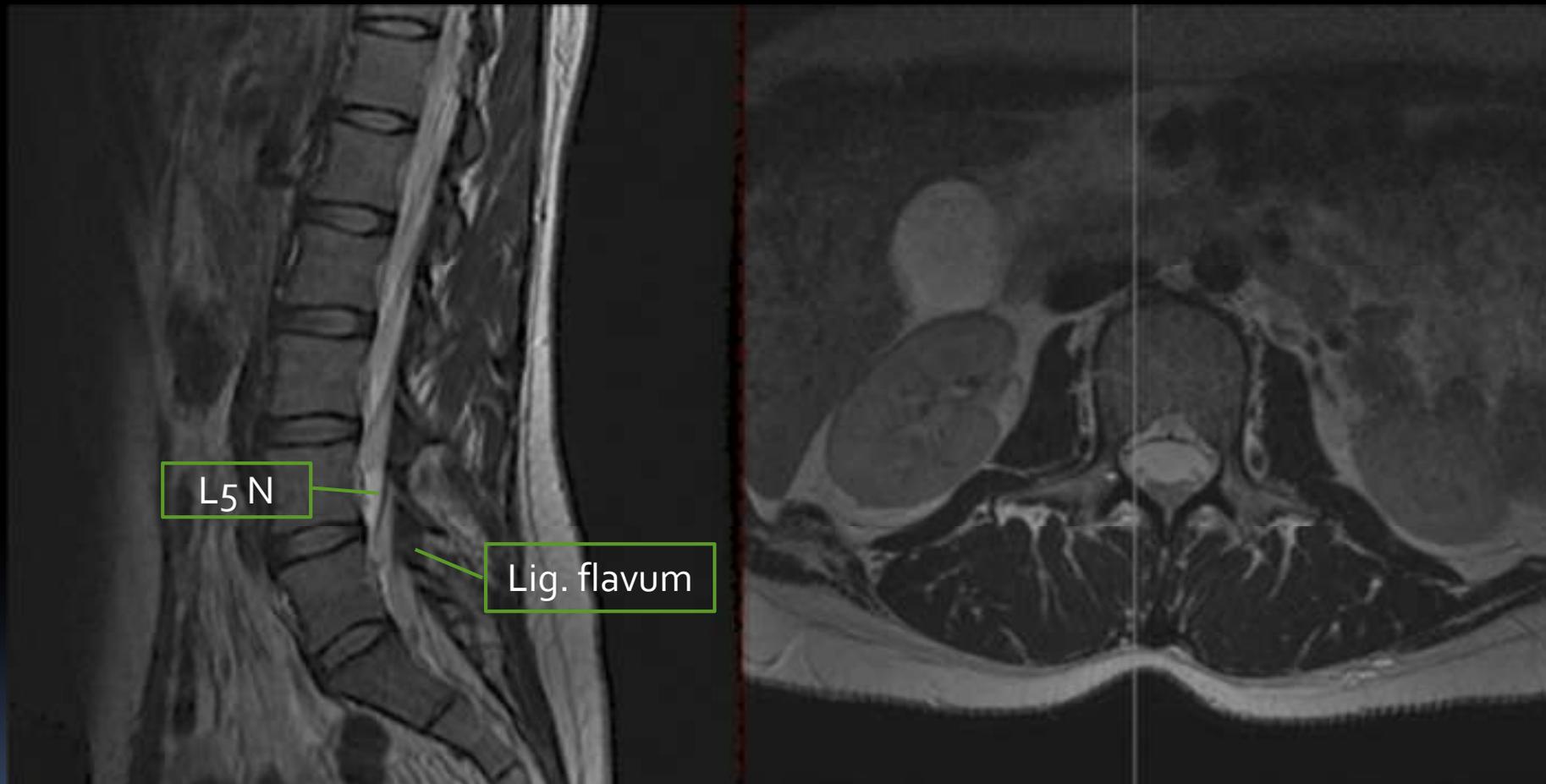
- Spinal nerve
- Lamina
- IVC



# Find

- Liver
- GB
- IVC
- Aorta
- Psoas
- Quadratus
- Multifidi
- Kidney

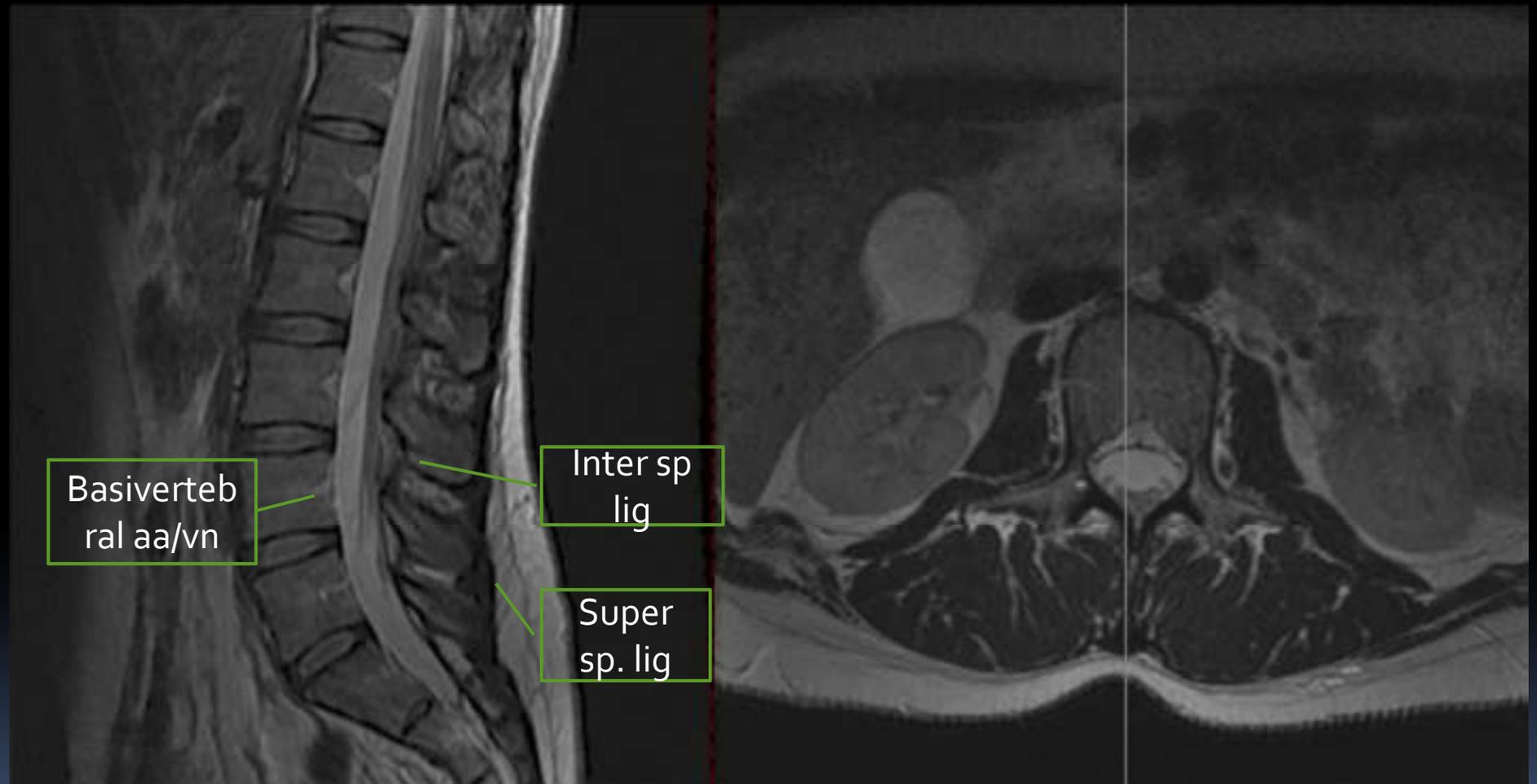




# Find

- L4 sup end plate
- L5 nerve
- L4 lamina





Basivertebral aa/vn

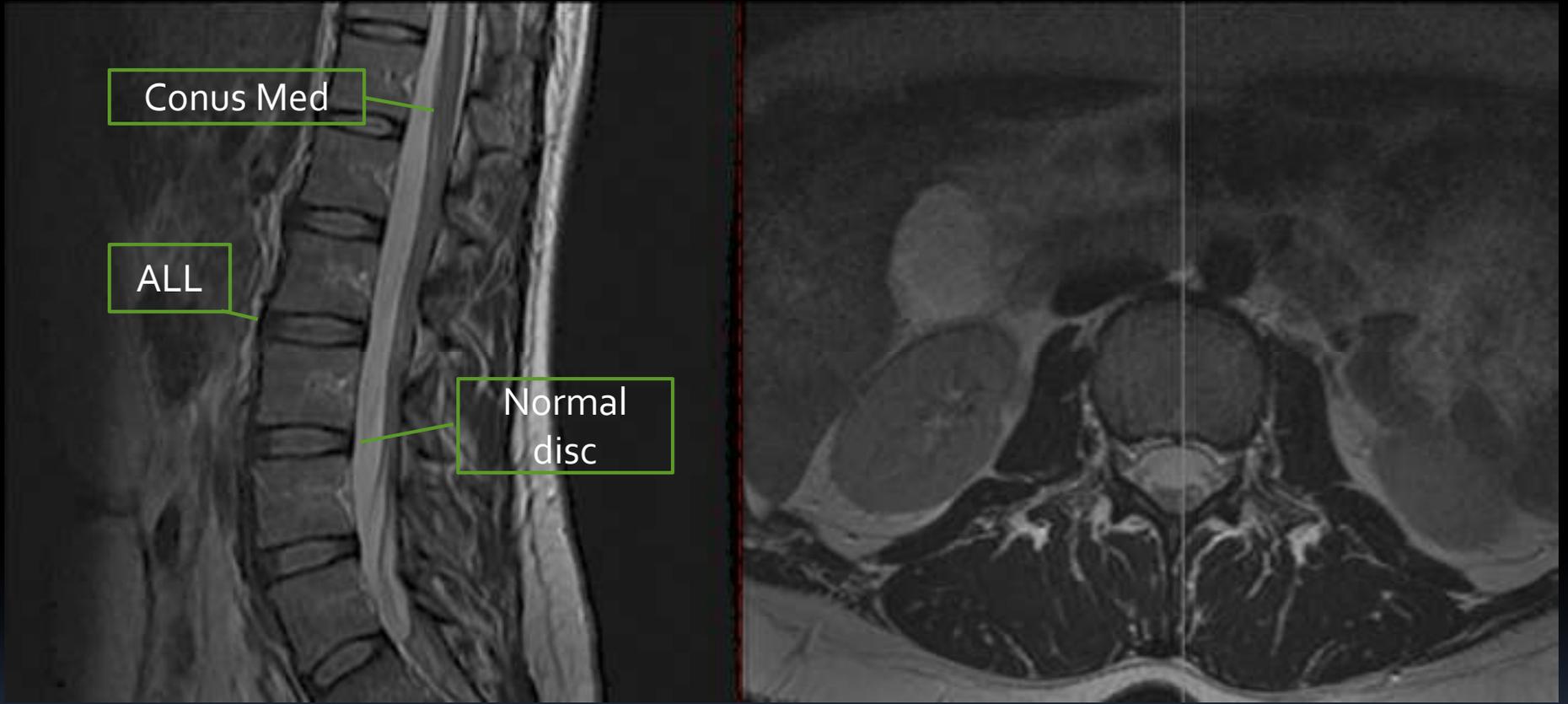
Inter sp lig

Super sp. lig

# Find

- Basivertebral a/v
- S<sub>1</sub> N
- SP
- Superspinous lig
- Interspinous lig

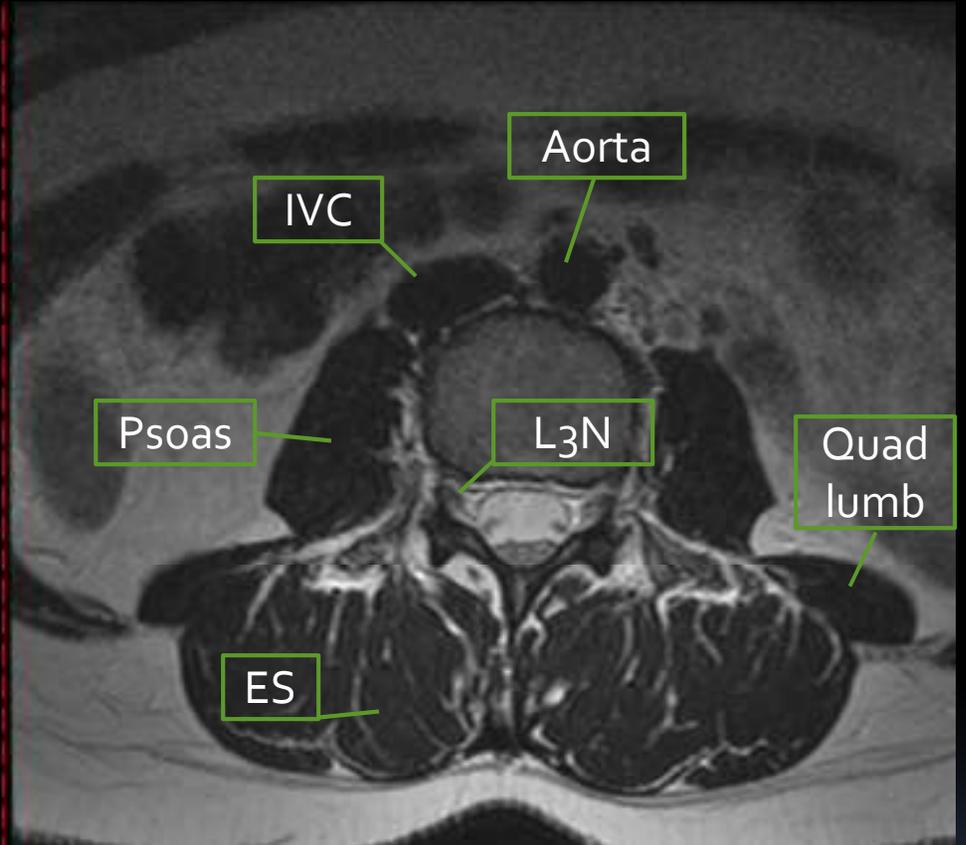




# Find

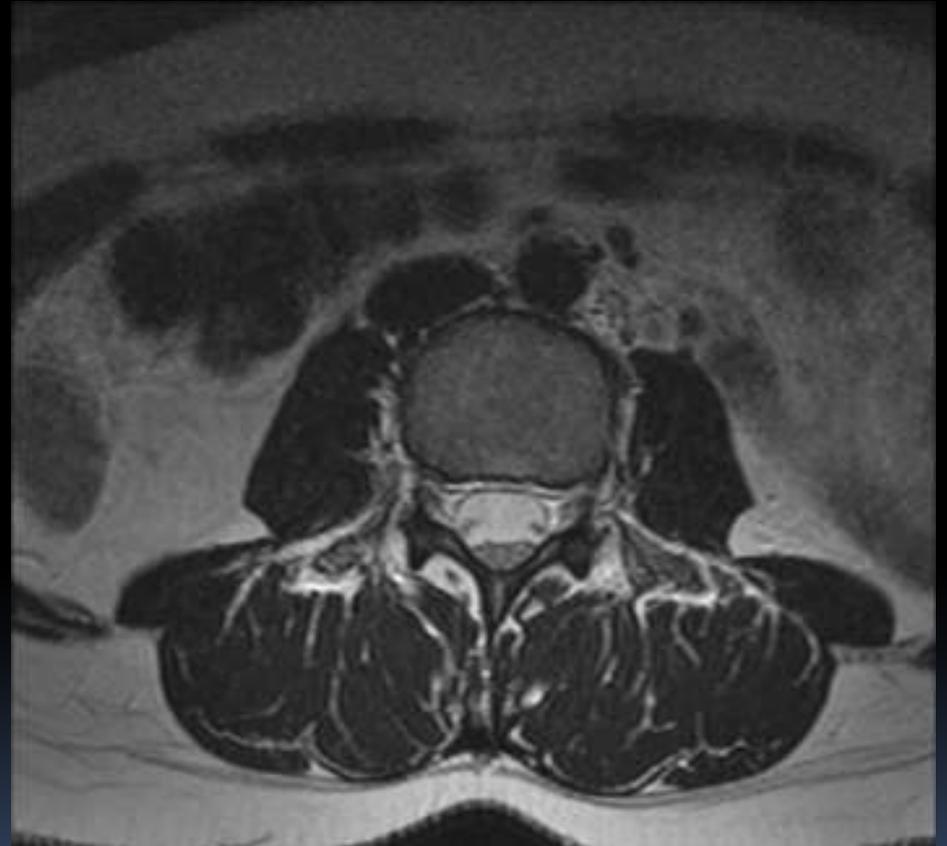
- Conus
- Basivertebral a/v
- L<sub>5</sub> N
- ALL
- Nucleus p

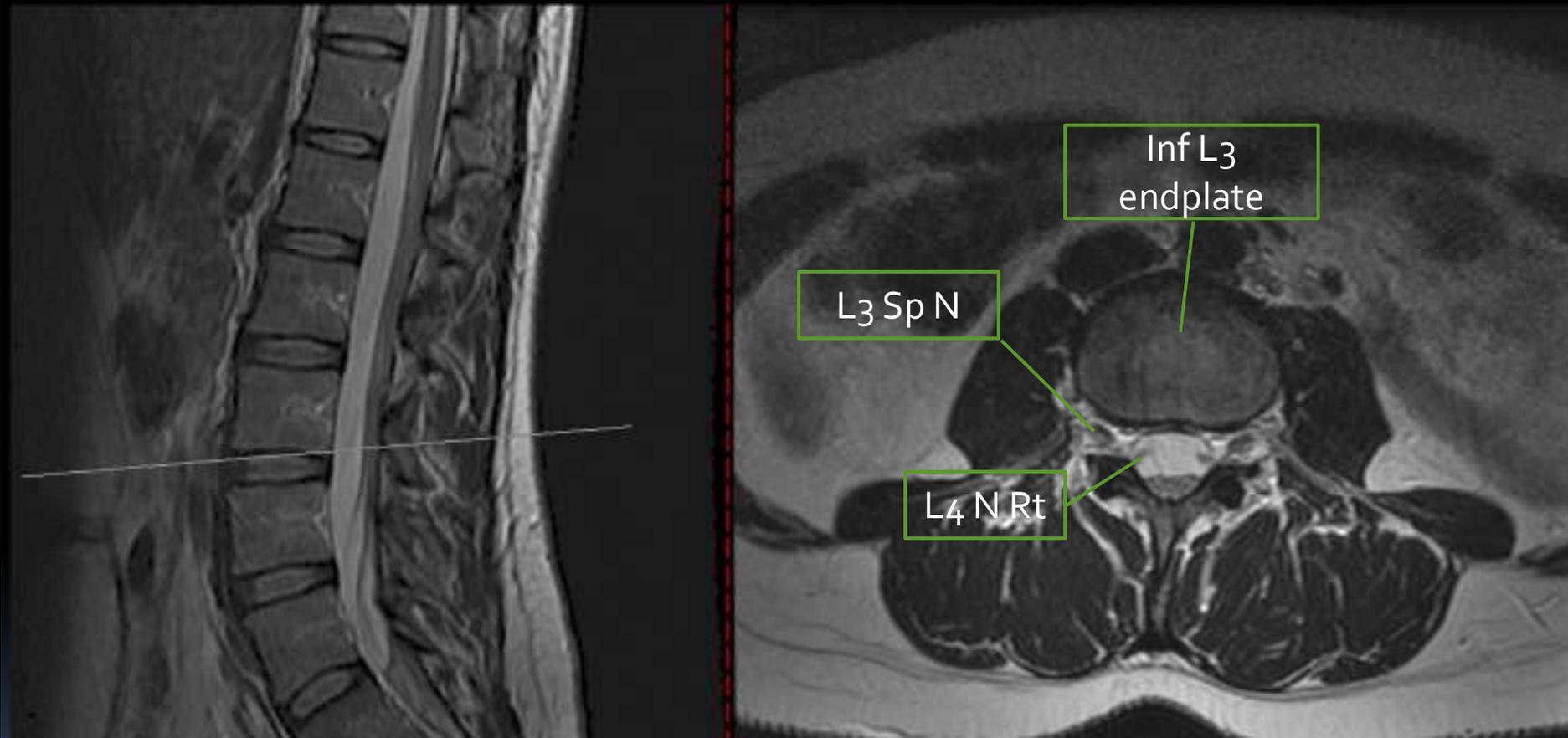




# Find

- Psoas
- IVC
- Aorta
- Erector sp.
- Exiting spinal N

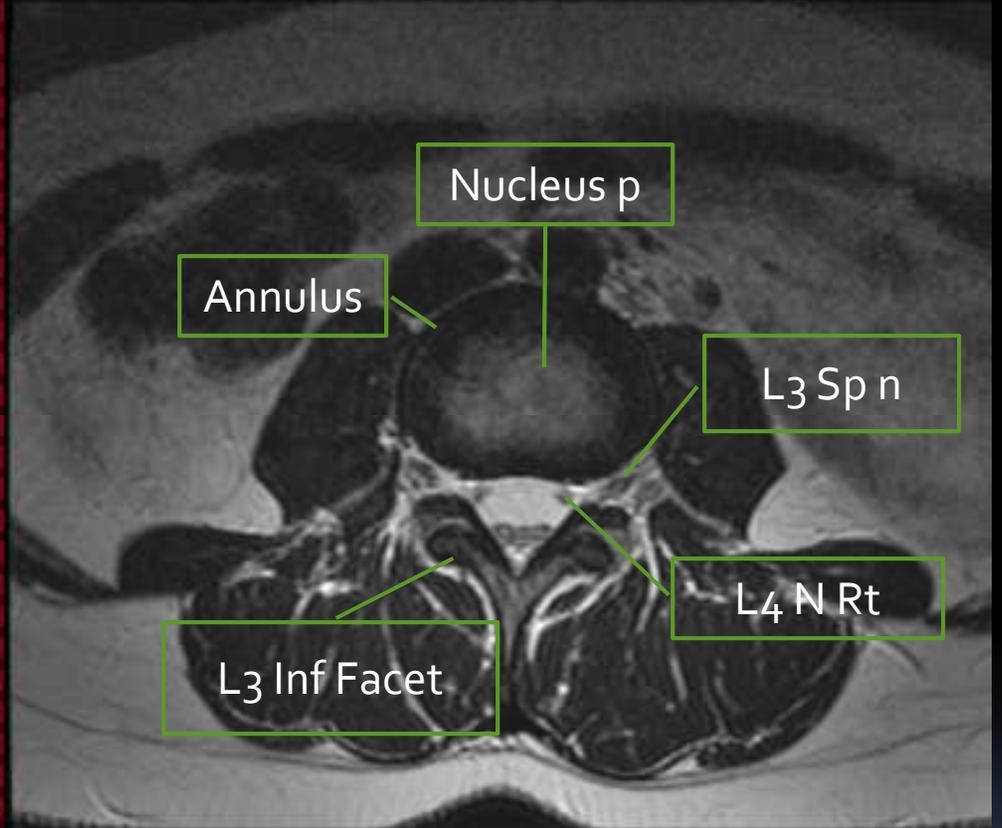
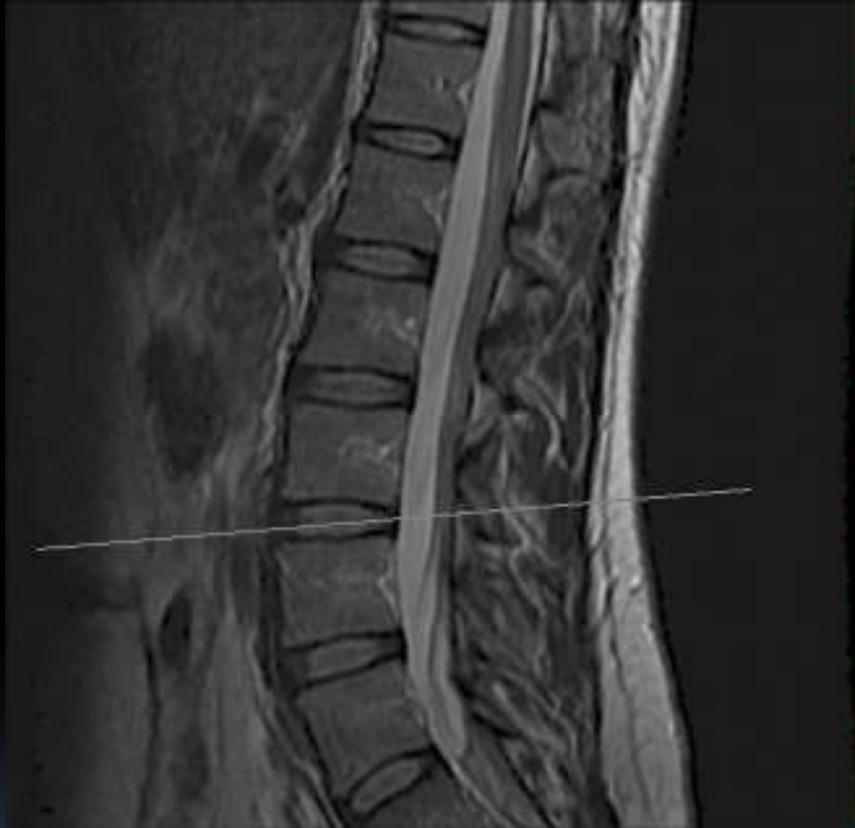




Inf L3  
endplate

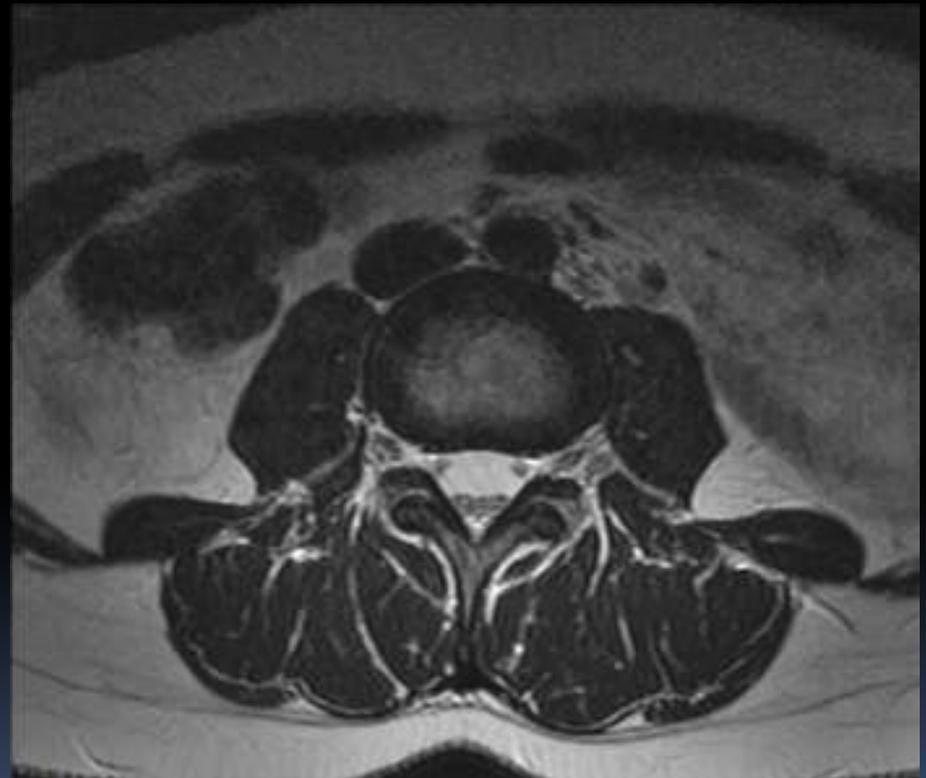
L3 Sp N

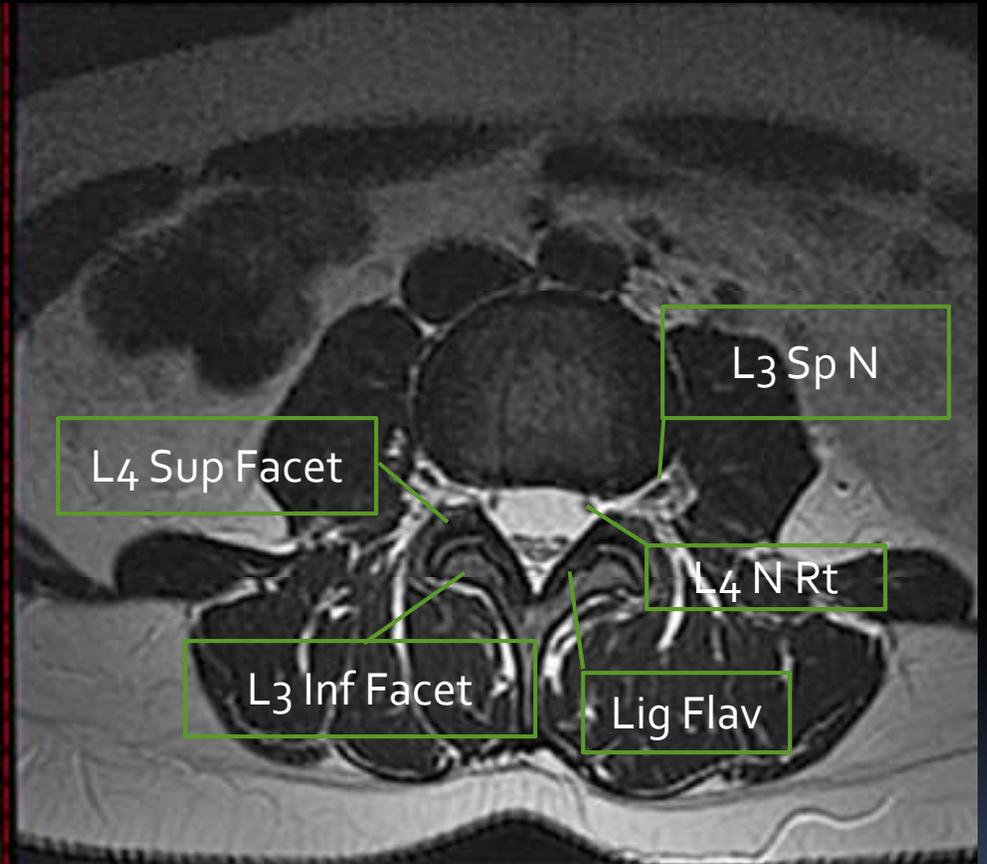
L4 N Rt



# Find

- Annulus
- Nucleus p
- Exiting sp N
- Nerve root
- Superior facet
- Floating N roots

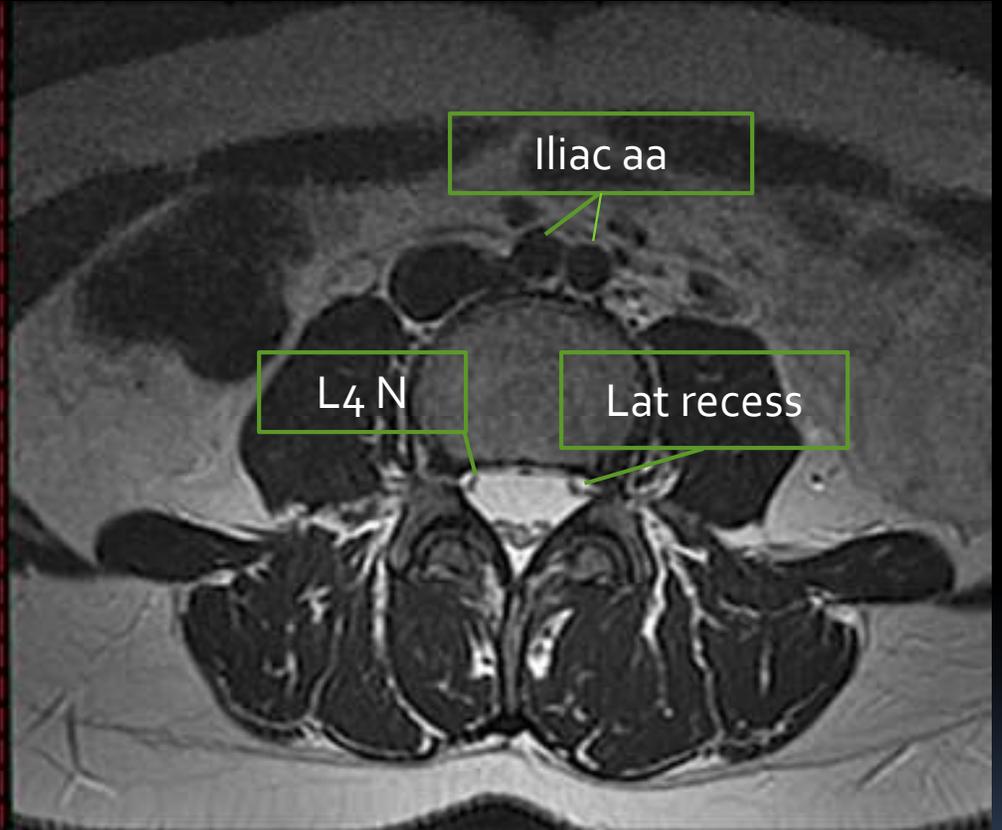




# Find

- Exiting sp N
- N root
- Lig flavum

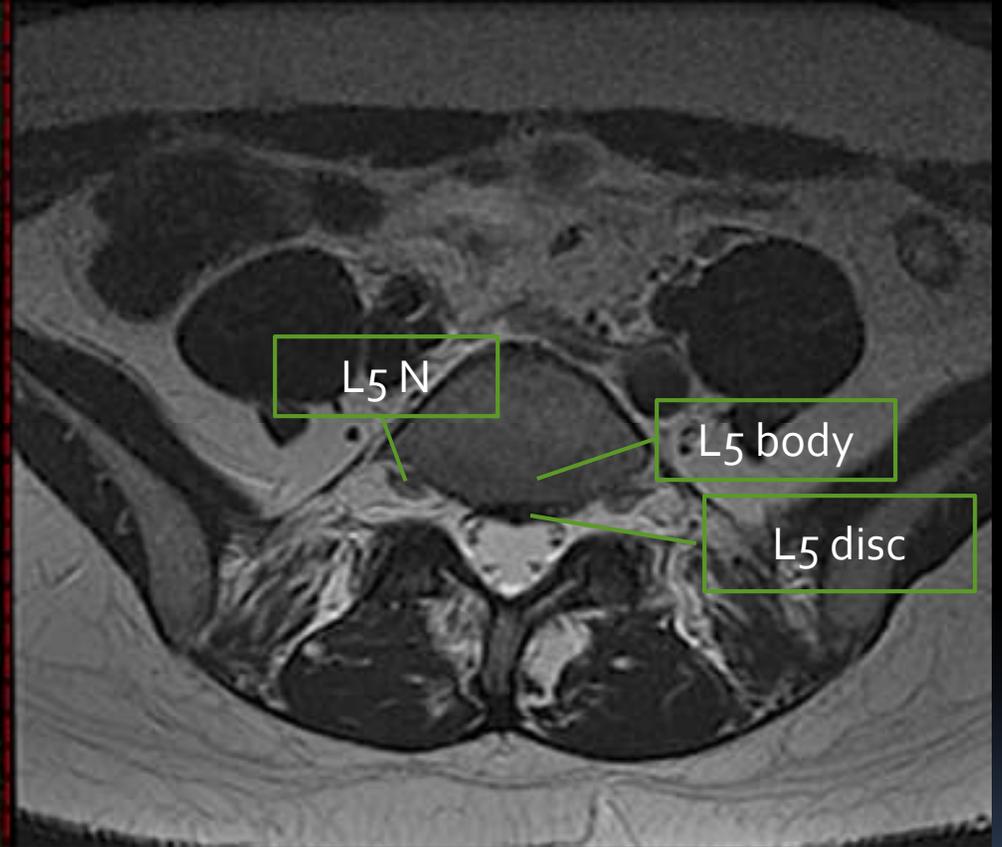




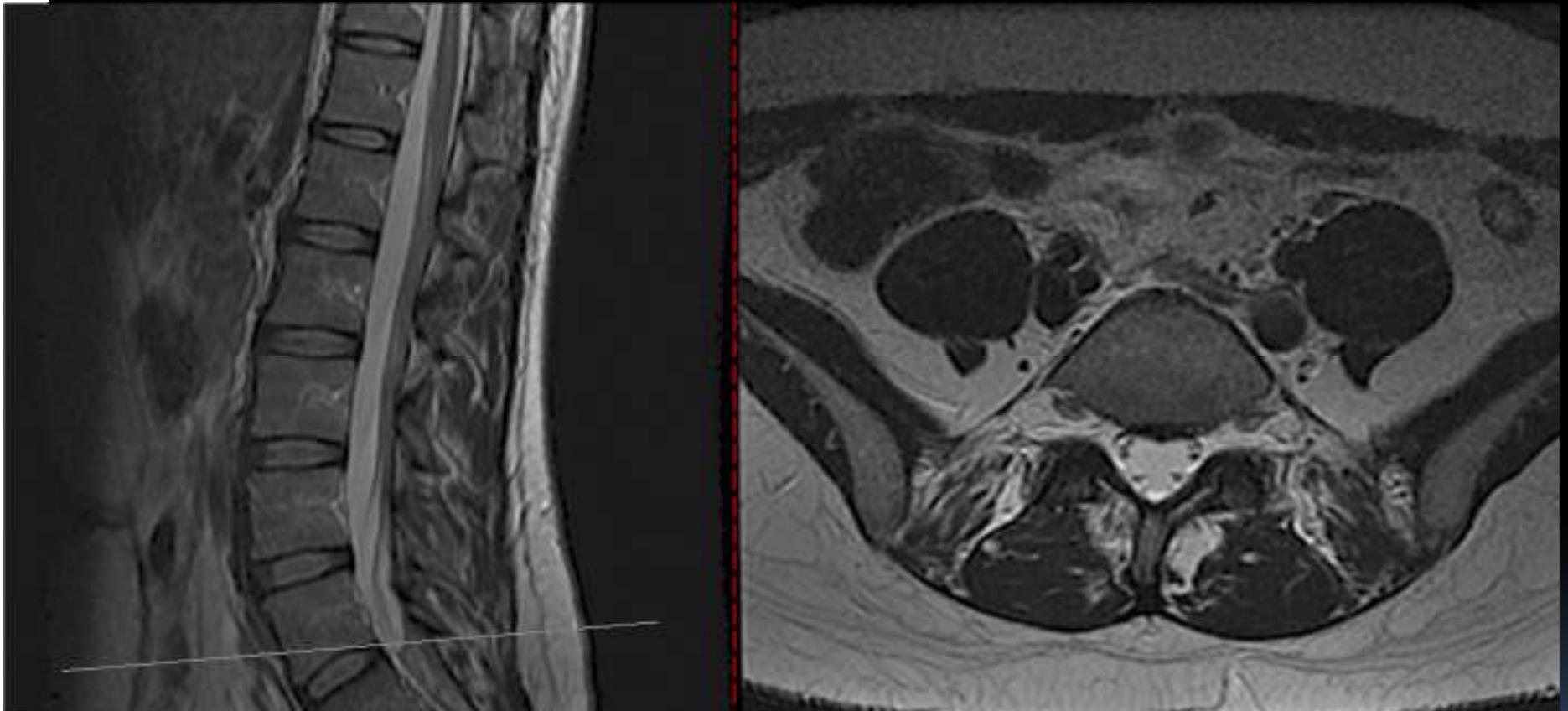
# Find

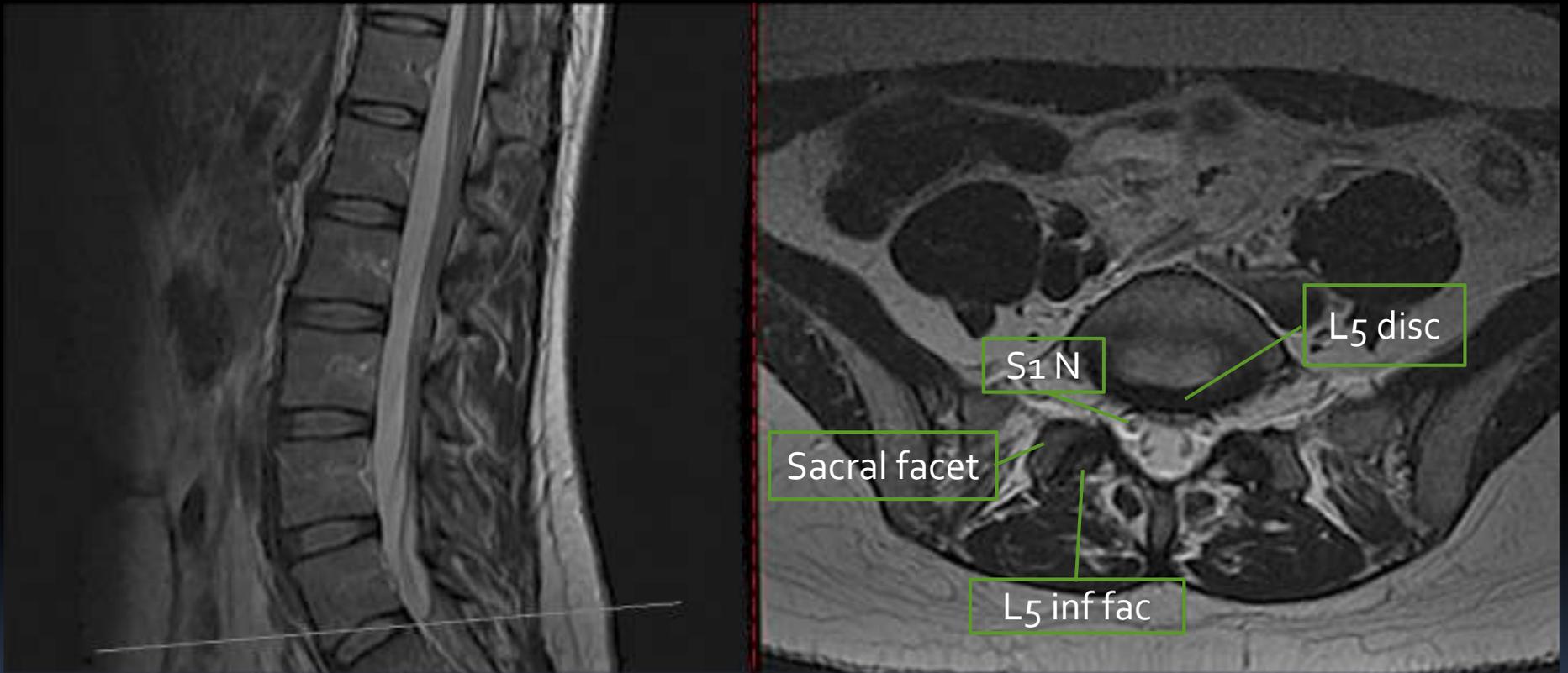
- Lateral recess
- Nerve
- Inferior facet
- Iliac aa
- Lig flavum



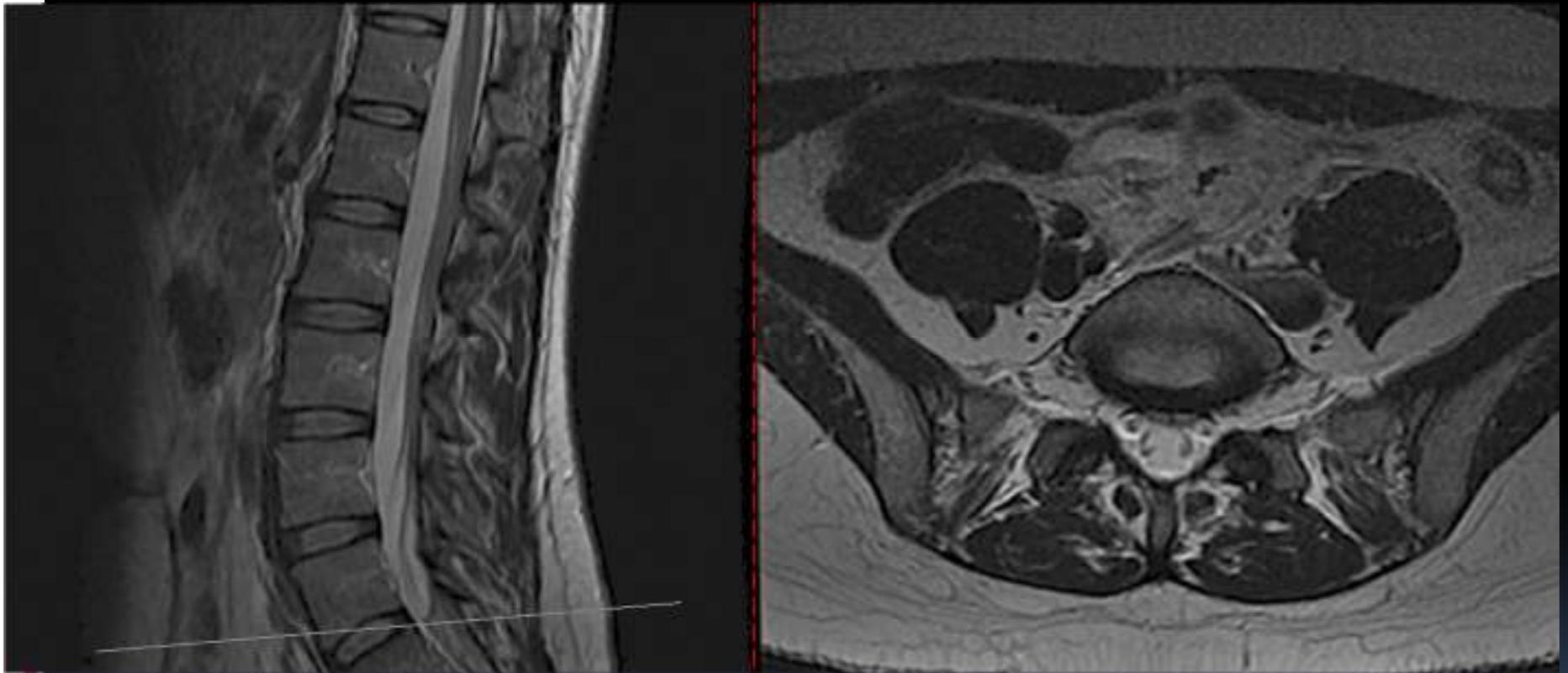


Find????





Find????



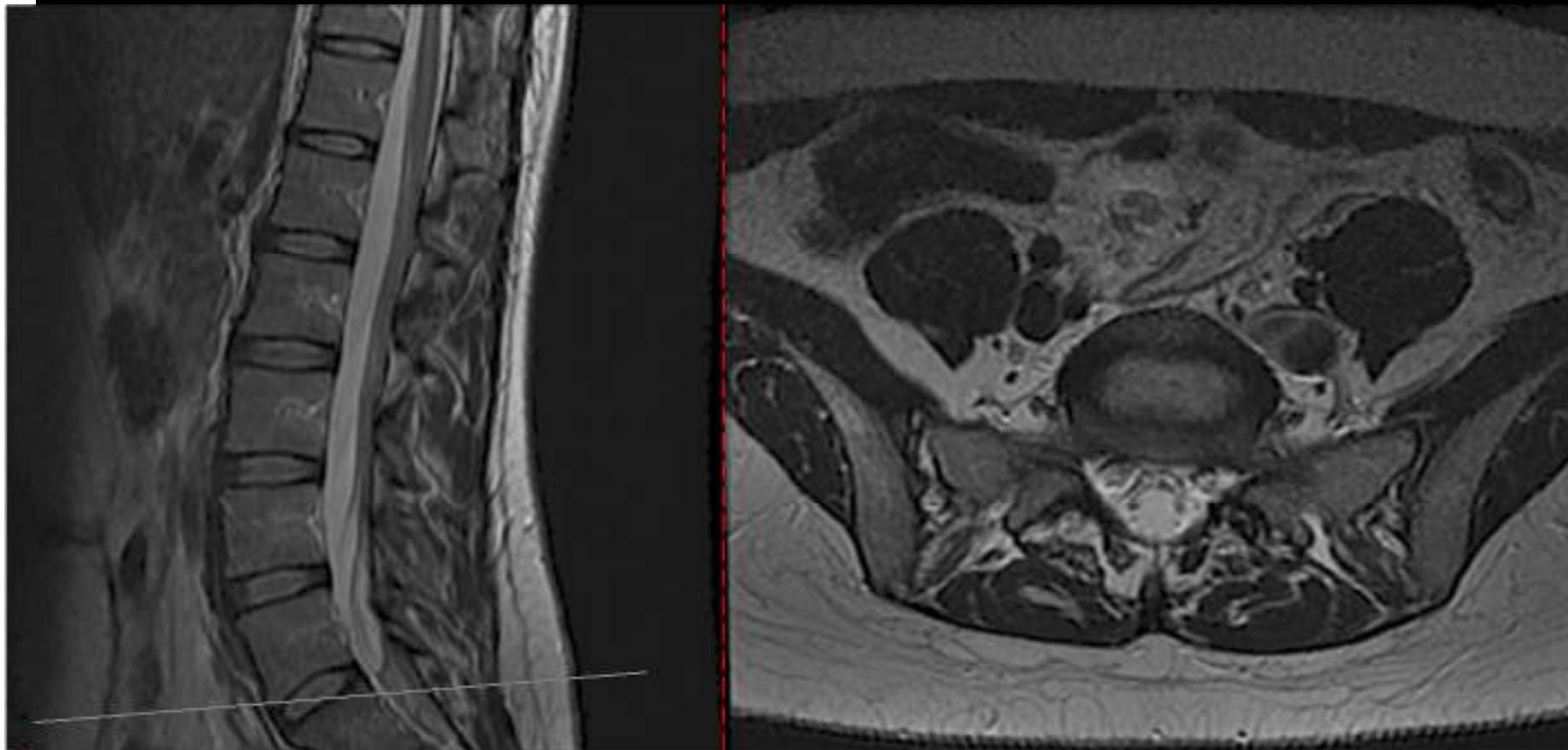


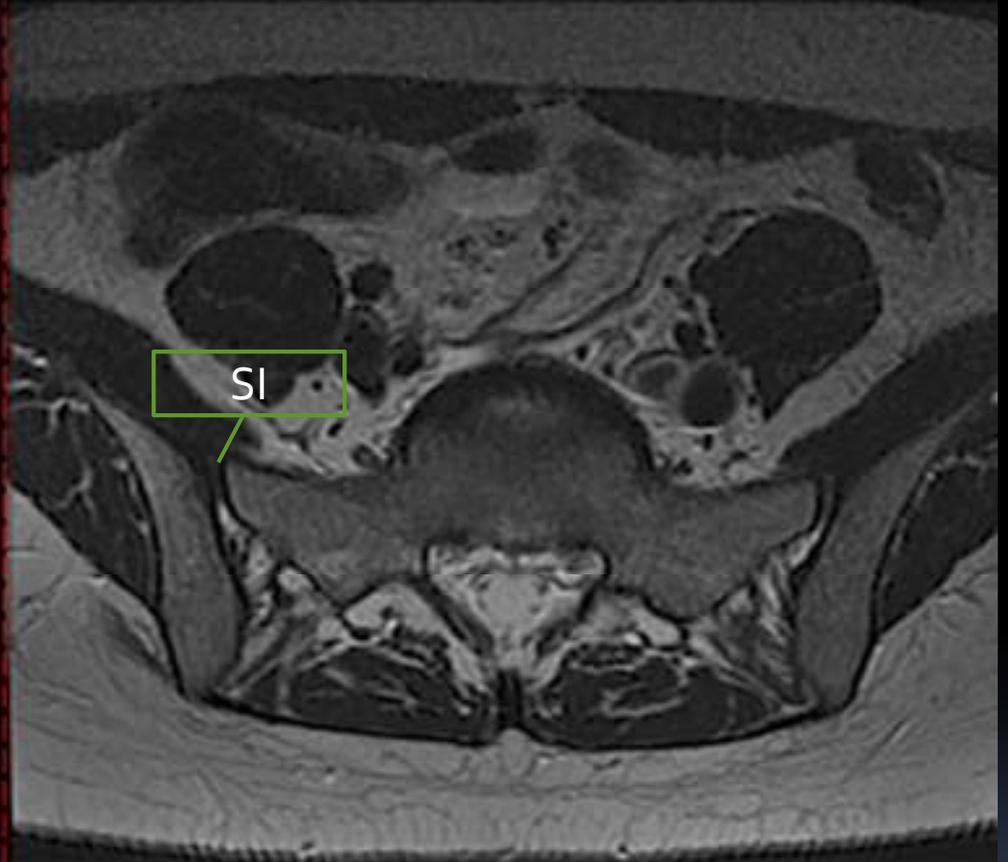
Glut Med

Lat recess

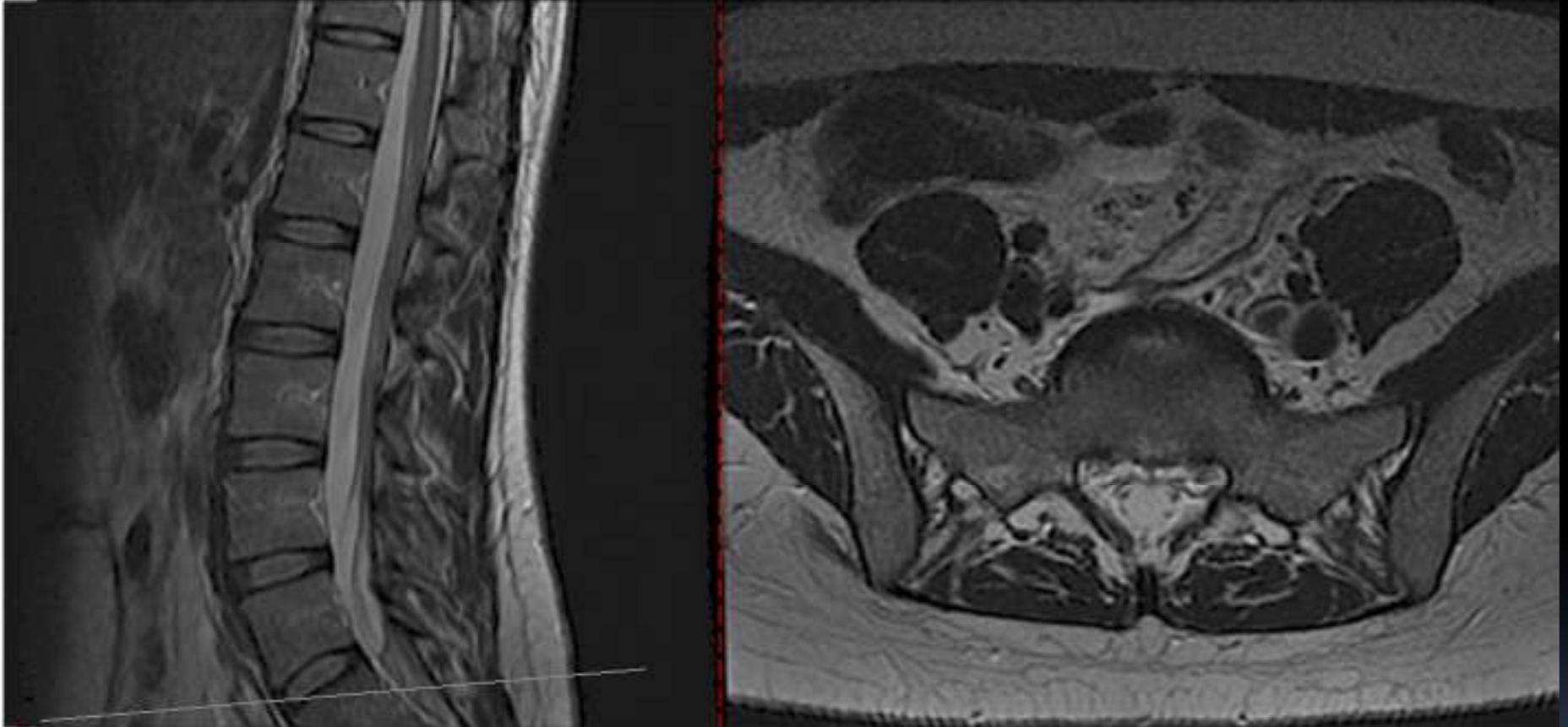
S1 N

Find????



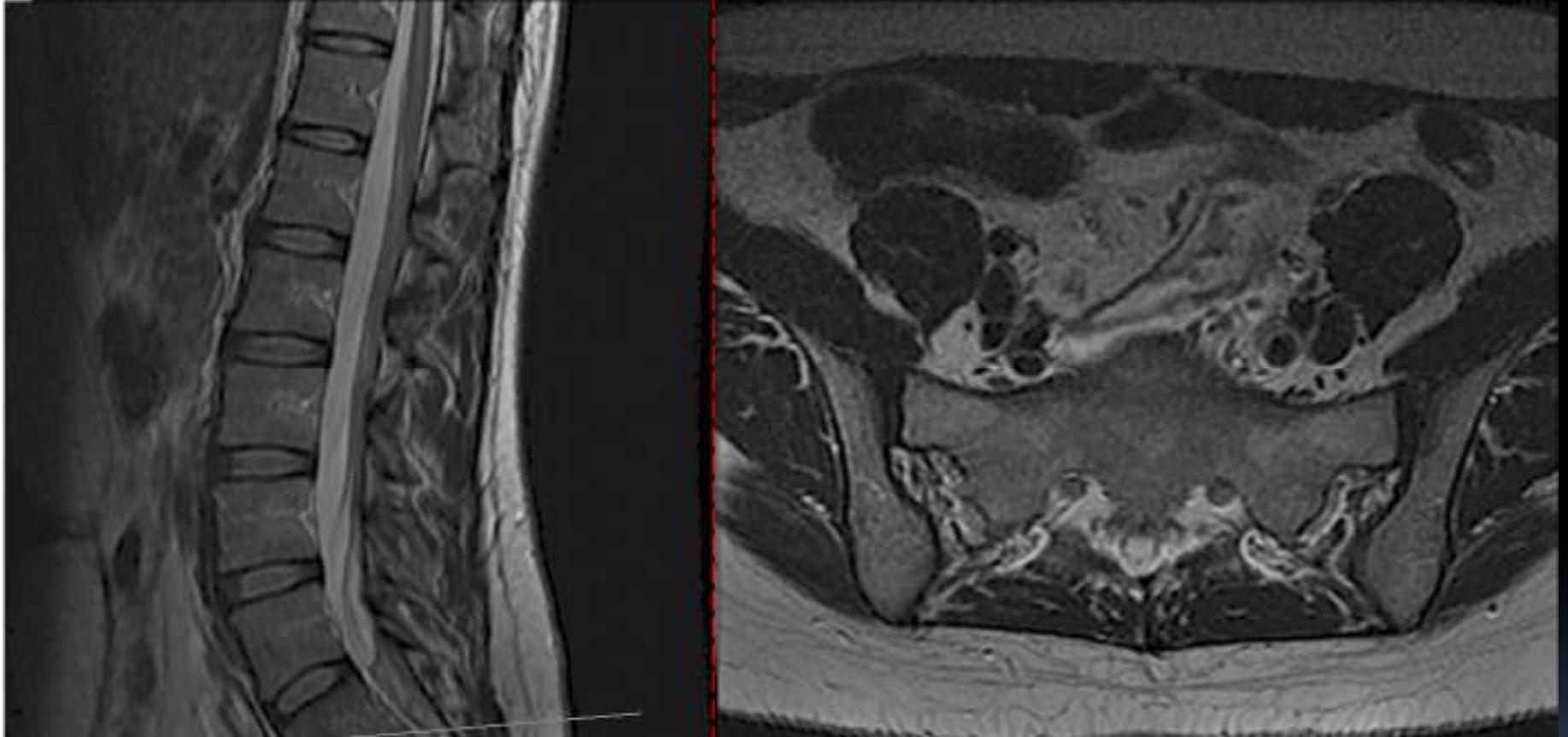


Find????





Find????





# Lumbar MRI Search Pattern

- What follows is my search pattern
  - Examples of some of the things I'm looking for are provided as well
- 

# Lumbar Spine: Sagittal

- Alignment
  - Overall curve
  - ADI
  - Anterolisthesis
  - Retrolisthesis

# L4 anterolisthesis



# Lumbar Spine: Sagittal

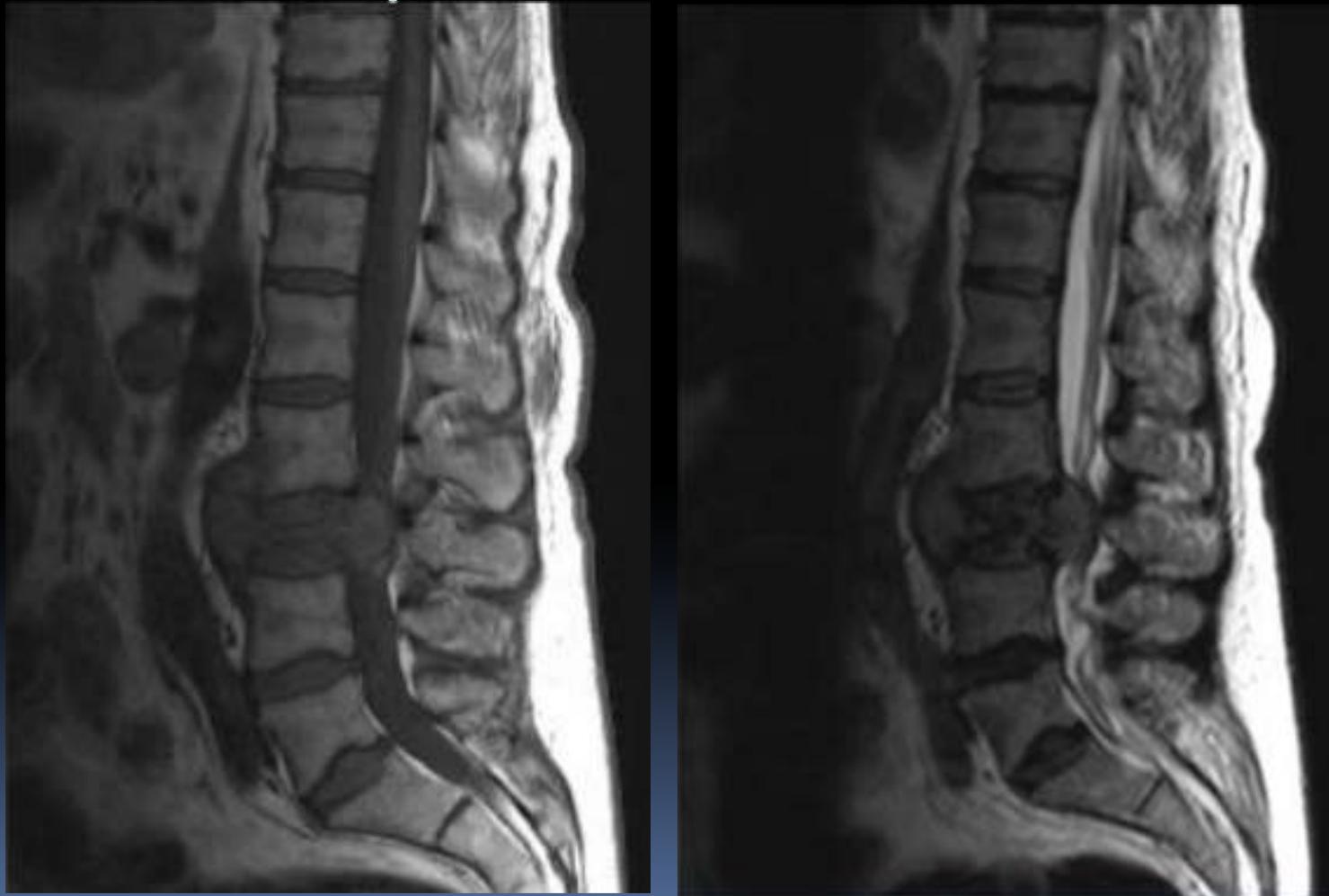
- Vertebral bodies/Sacrum
  - Overall signal
  - Shape
  - Cortex
  - Anterior osteophytes

# Hemangioma

- Typically decreased signal T<sub>1</sub> and increased signal T<sub>2</sub>
- VERY common
- Rarely of any significance



# Mets: Abnormal signal/shape and end-plate destruction



# Anterior bulge/osteophyte



# Lumbar Spine: Sagittal

- Posterior arch
  - Overall signal
  - Shape
  - IVF

Active pars defects: bright marrow on T2



# Lumbar Spine: Sagittal

- Discs/End-plate
  - End-plate signal
  - Height
  - Signal
  - Contour
  - Posterior spurs
  - Schmorl's nodes



# Modic Changes

- Indicate progressive changes of degenerative disc disease as it affects the end-plate
- Not always seen but helpful when present

# Endplate Changes

- Modic Type I
  - Decreased T<sub>1</sub>
  - Increased T<sub>2</sub>
  - Sign of acute degeneration
  - Invariably associated with PAINFUL DISCS
    - Spine 2003; 28: 715-20
    - Radiology 2001; 218: 420-7
    - Eur Spine J 1998; 7: 363-8
    - J Spine Discord 2000; 15: 438-43

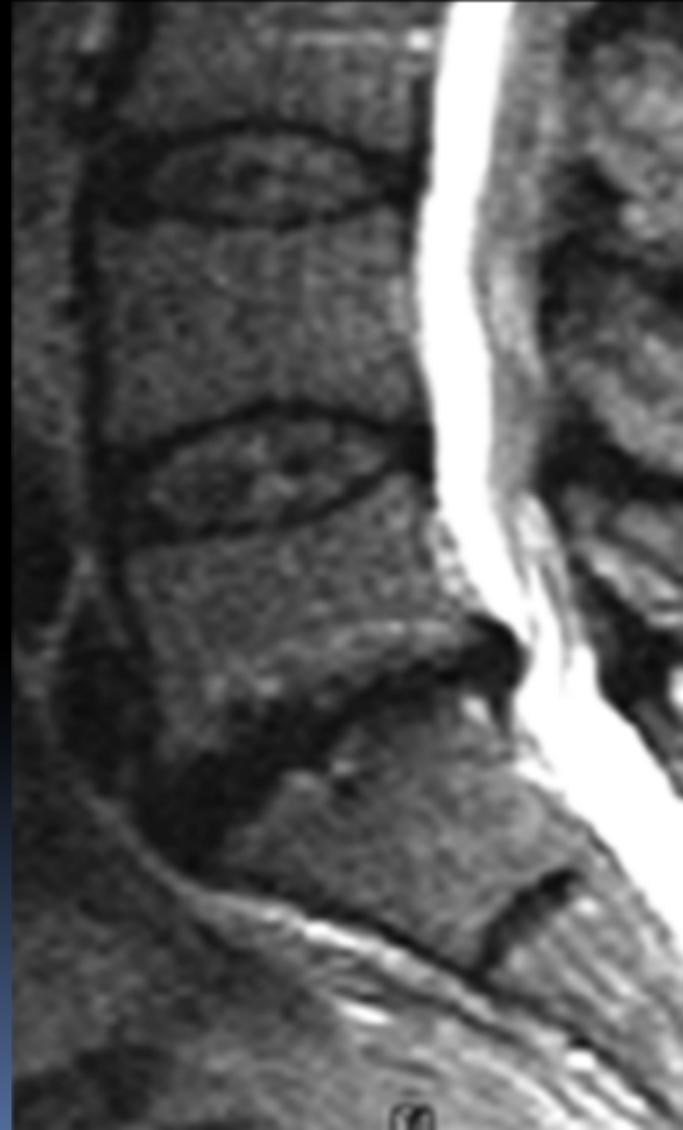
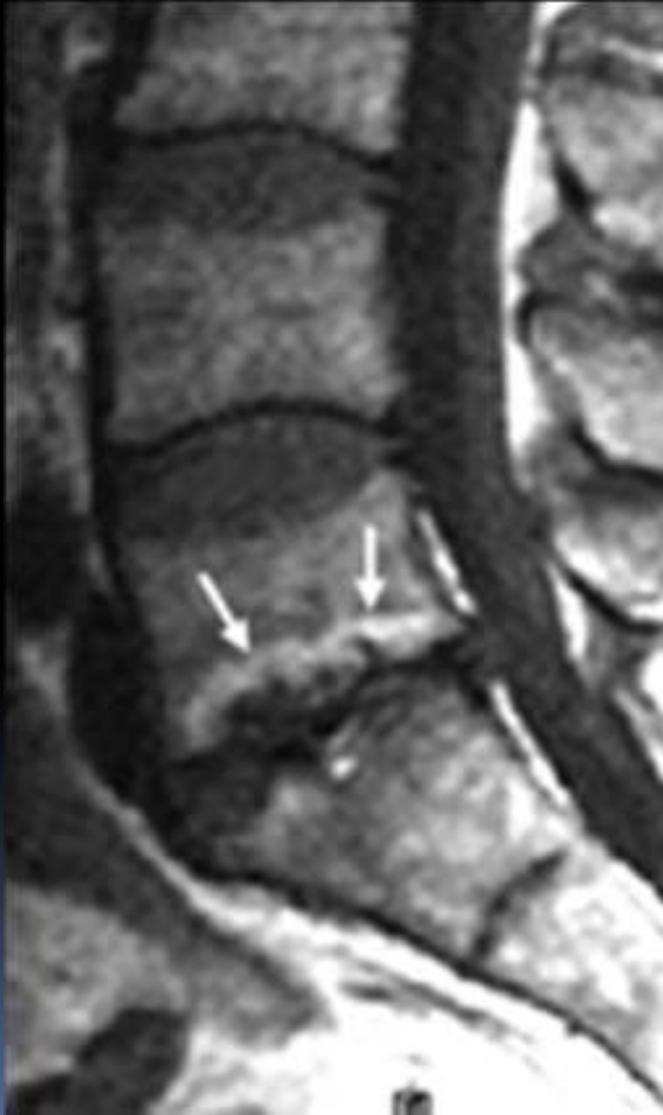
# Modic Type I



# Endplate Changes

- Modic Type II
  - Increased T<sub>1</sub>
  - Isointense T<sub>2</sub>
  - Represents the endplate changing but is not yet visible on X-ray.
  - IT IS INVOLVED WITH CHANGE IN THE NUTRITION TO THE DISC.

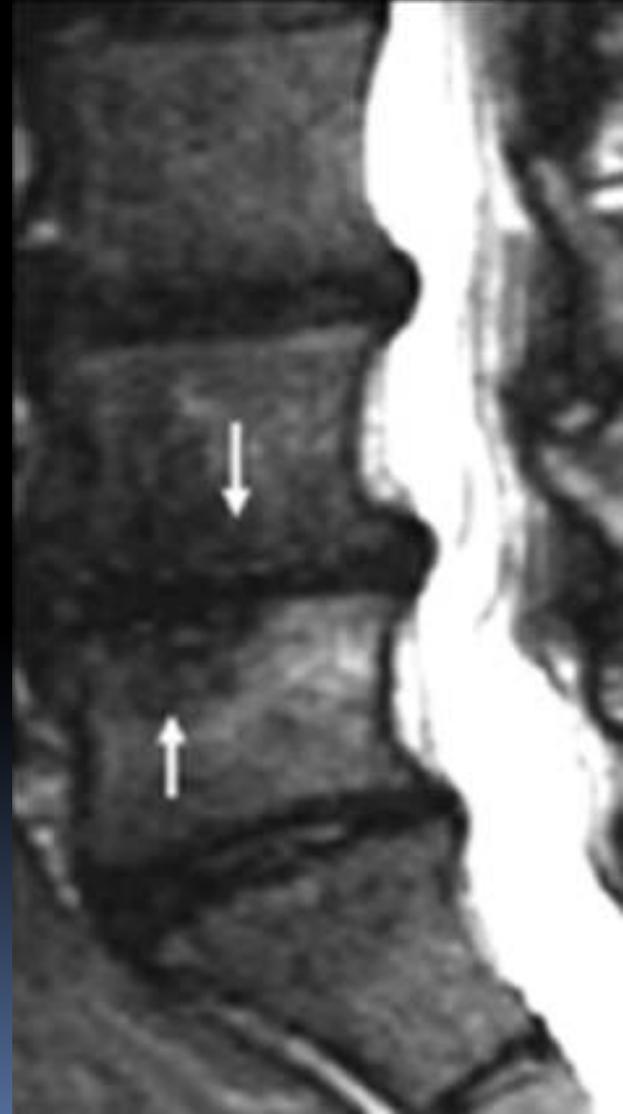
# Modic Type II



# Endplate Changes

- Modic Type III
  - Decreased T<sub>1</sub>
  - Decreased T<sub>2</sub>
  - Sclerosis visible on X-ray
  - No active marrow
  - End-stage endplate change

# Modic Type III



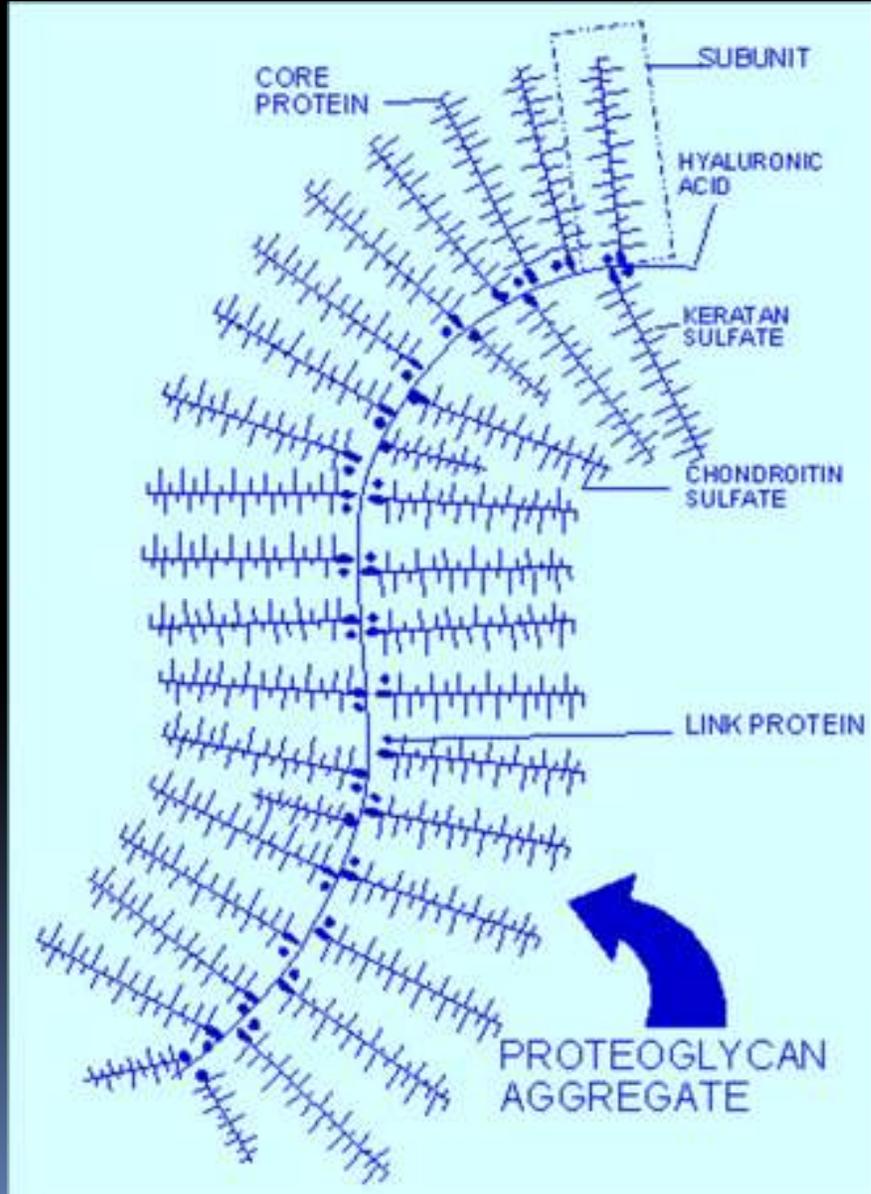
# DJD Facts

- Scientific studies suggest that spondylosis deformans is the consequence of normal aging, whereas intervertebral osteochondrosis (AKA deteriorated disc), results from a clearly pathologic process with (or without) symptoms.
  - J Bone Jnt Surg 1962; 44: 243-68
  - Acta Ortop Scan 1985; 56: 496-99
  - Cin Orthop Rl Res 1987; 224: 97-104
  - Spine 2004; 4(6suppl): 167s-72s

# Disc

- Intervertebral osteochondrosis
  - Loss of disc height
  - Vacuum phenomenon
  - Disc calcification
  - Posterior spur/osteocartilagenous ridge

# PG/GAG: The Water Binders



# Importance of Water in Cartilage

- Although the tensile strength of the collagen is that of steel wire, it cannot support compressive load since it would fold or crumble. It is the hydrostatic pressure of water bound to proteoglycans, retained and restrained by the collagen meshwork, that gives cartilage its resilience and load bearing properties.
  - Sem In Arth & Rheum 1984; 14(2): 110

# GAGs and DDD

- In cadaveric spines, decreased T<sub>2</sub> signal in degenerated discs was closely associated with glucoseaminoglycan (GAG) concentration rather than absolute water content.
  - New Orleans Ortho Rsrch Soc; 1994

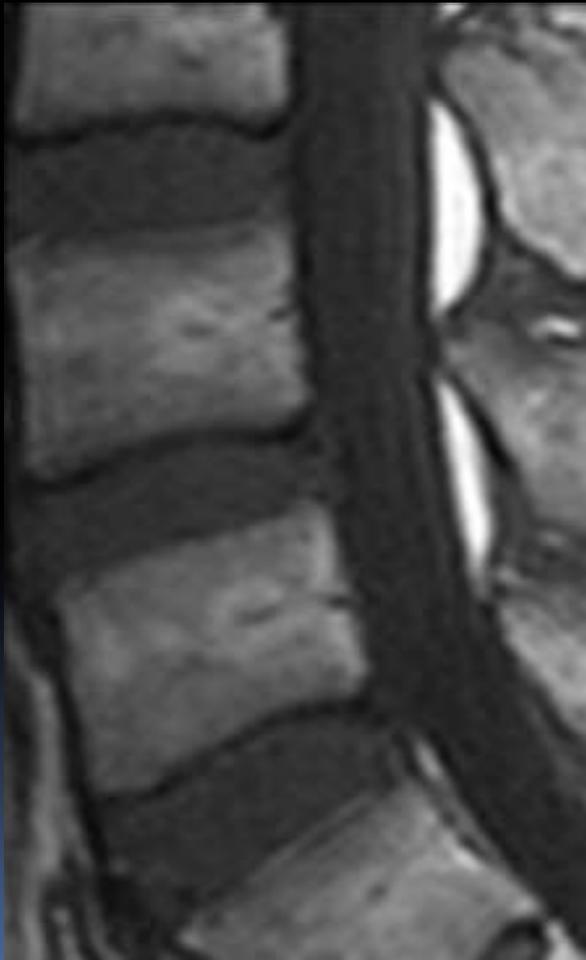
# PGs and DDD

- The degenerated PG has a higher keratin sulfate to chondroitin sulfate ratio reducing the tensile strength and the disc becomes progressively more fibrous and disorganized.
  - Rehabil 1977; 16: 22-9
  - Orthop Clin N Am 1971; 2: 59-70
  - Arth Rheum 1981; 24: 12-21

# Disc Bulge

- Physiologic
  - 1-3mm
  - Due to compressive forces during course of a day
- Degenerative
  - Not a herniation
  - Can contribute to stenosis
  - Due to lack of water binding from decreased glucosaminoglycans (GAGs)

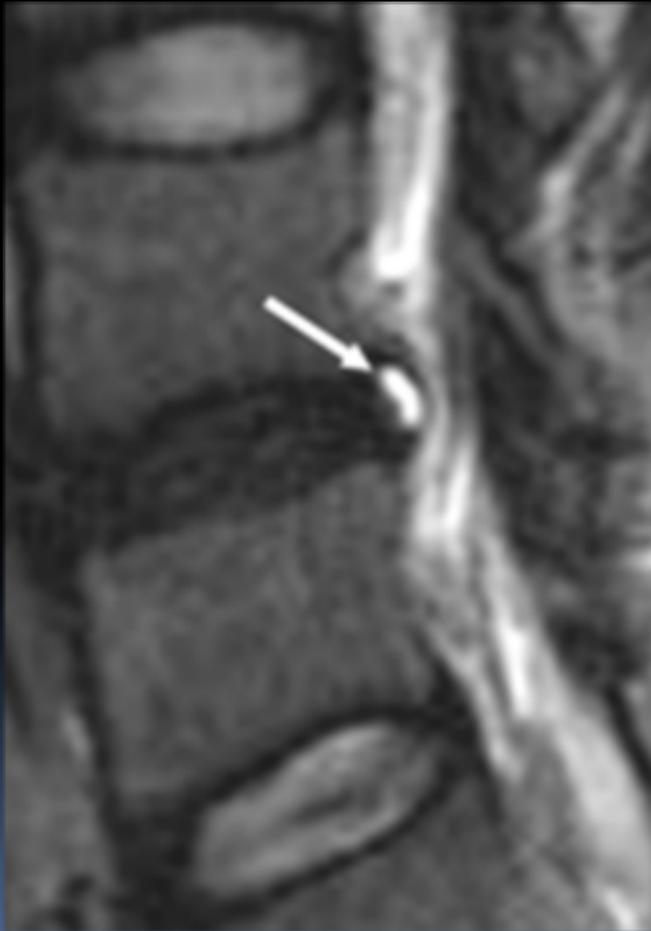
# Disc Bulge and Dessiccation: loss of signal on T2



# Annular Tears

- Typically on periphery of disc
- Contributes to DDD
- When in a disc herniation signifies it is recent

Annular Tear: localized bright signal in disc on T2



# Significance of Annular Tears

- Simply an incision of the annulus can produce morphologic and functional changes in the adjacent nerves, such as increased capillaries and reduced nerve conduction velocities.
  - Spine 1996; 21: 2539-43

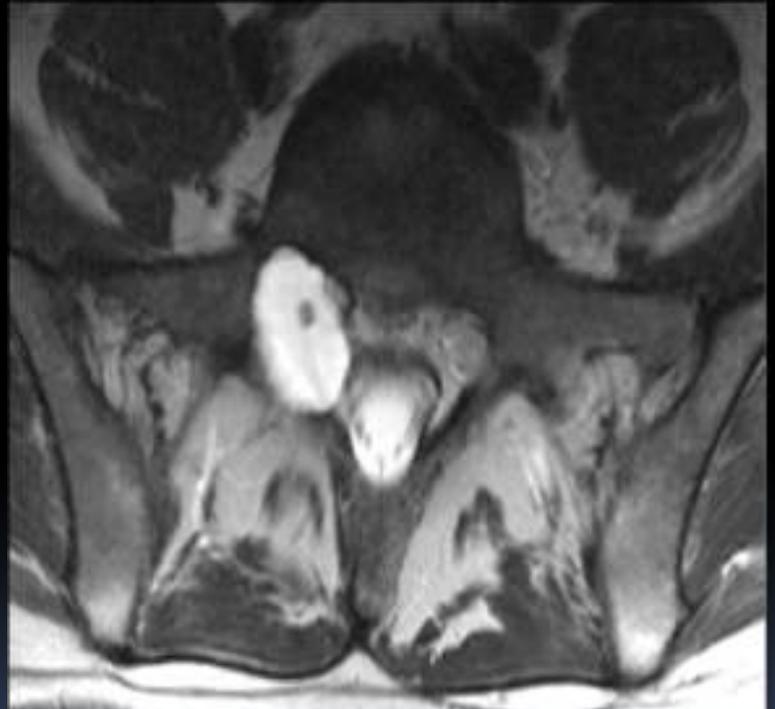
# Lumbar Spine: Sagittal

- Spinal canal
  - End of cord
  - Contour
  - Signal

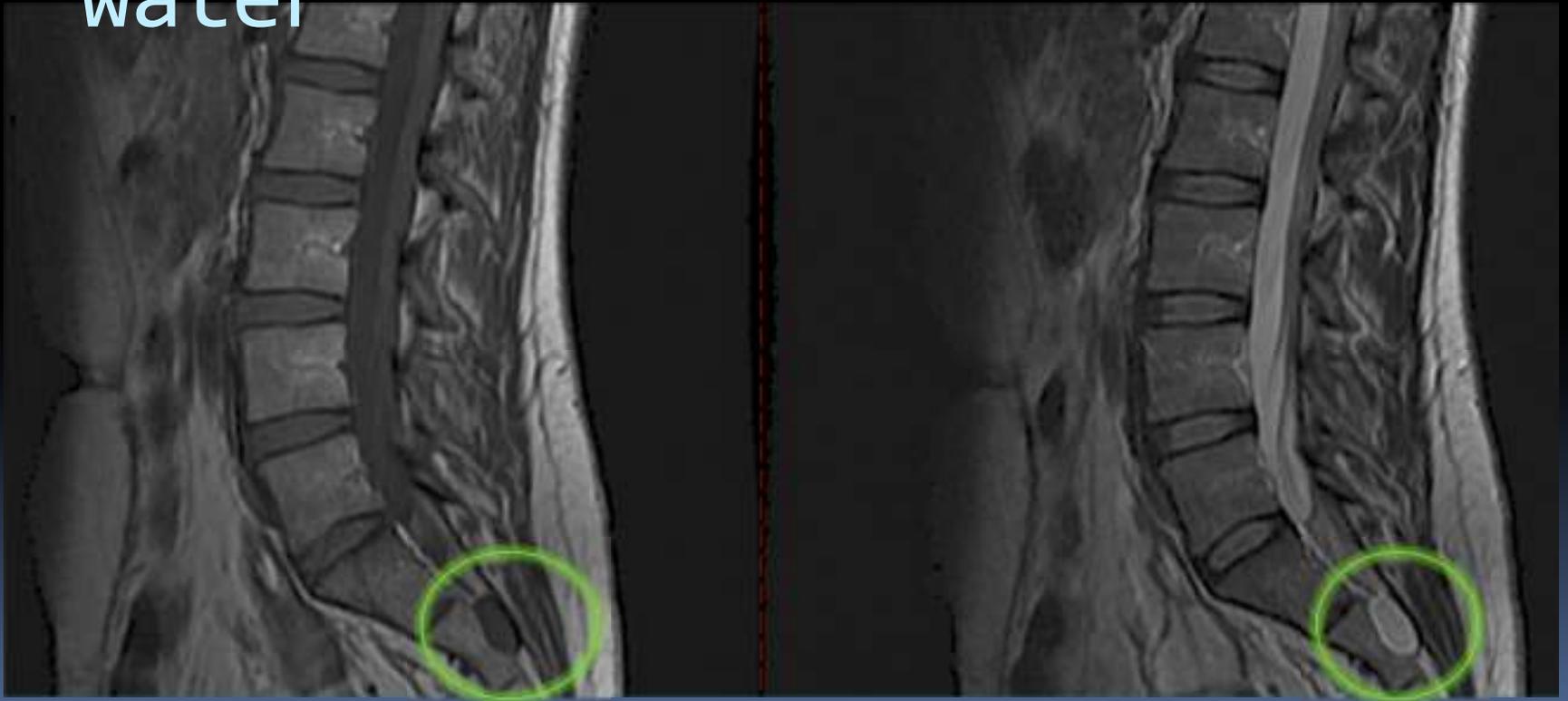
# Tarlov Cysts

- Benign out-pouchings of dura through sacral foramina or against the sacrum
- Almost ALWAYS asymptomatic

# Tarlov Cyst



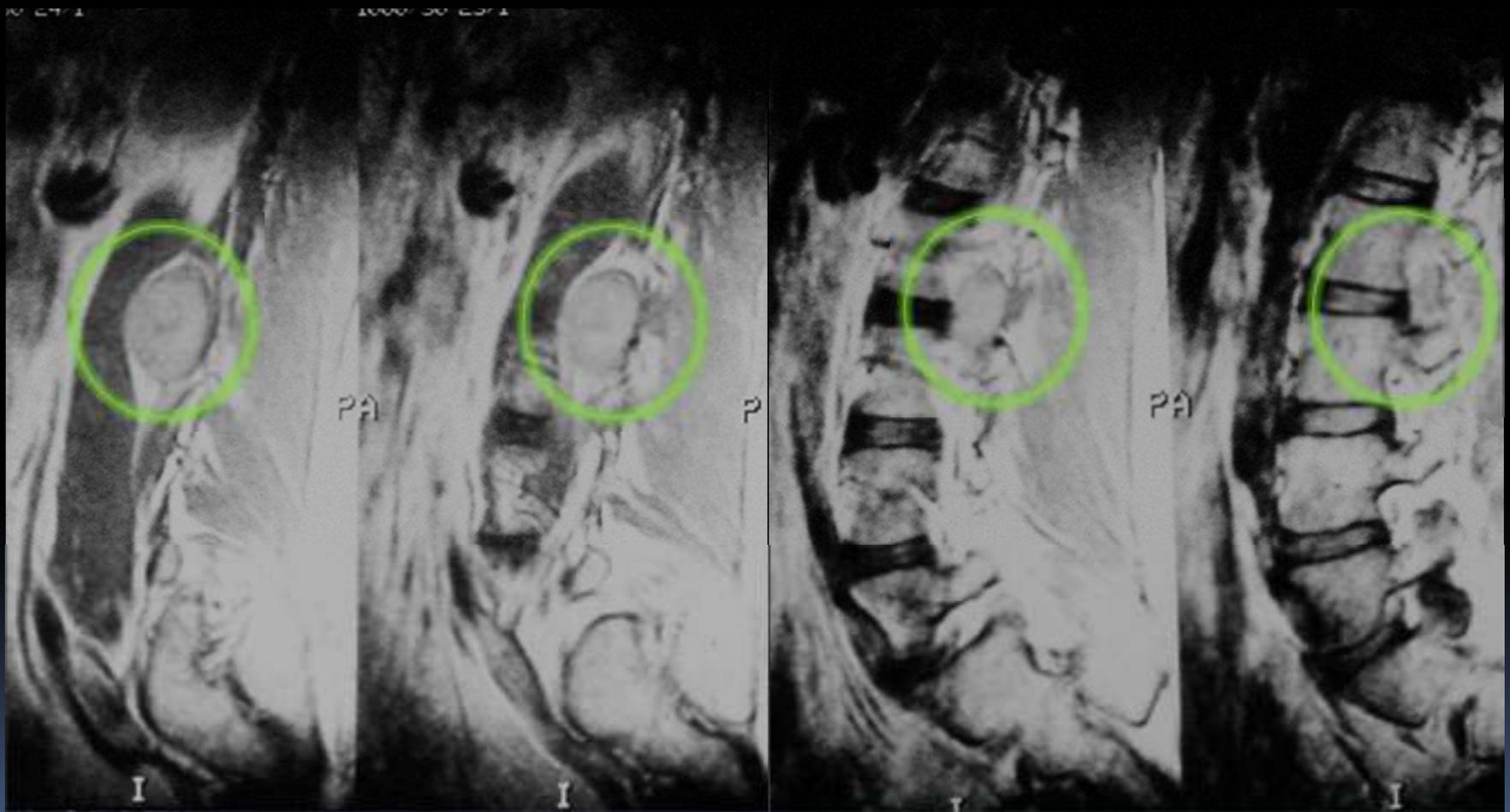
Arachnoid (Tarlov)  
cysts/Sacral meningoceles  
(rarely symptomatic): follow  
water

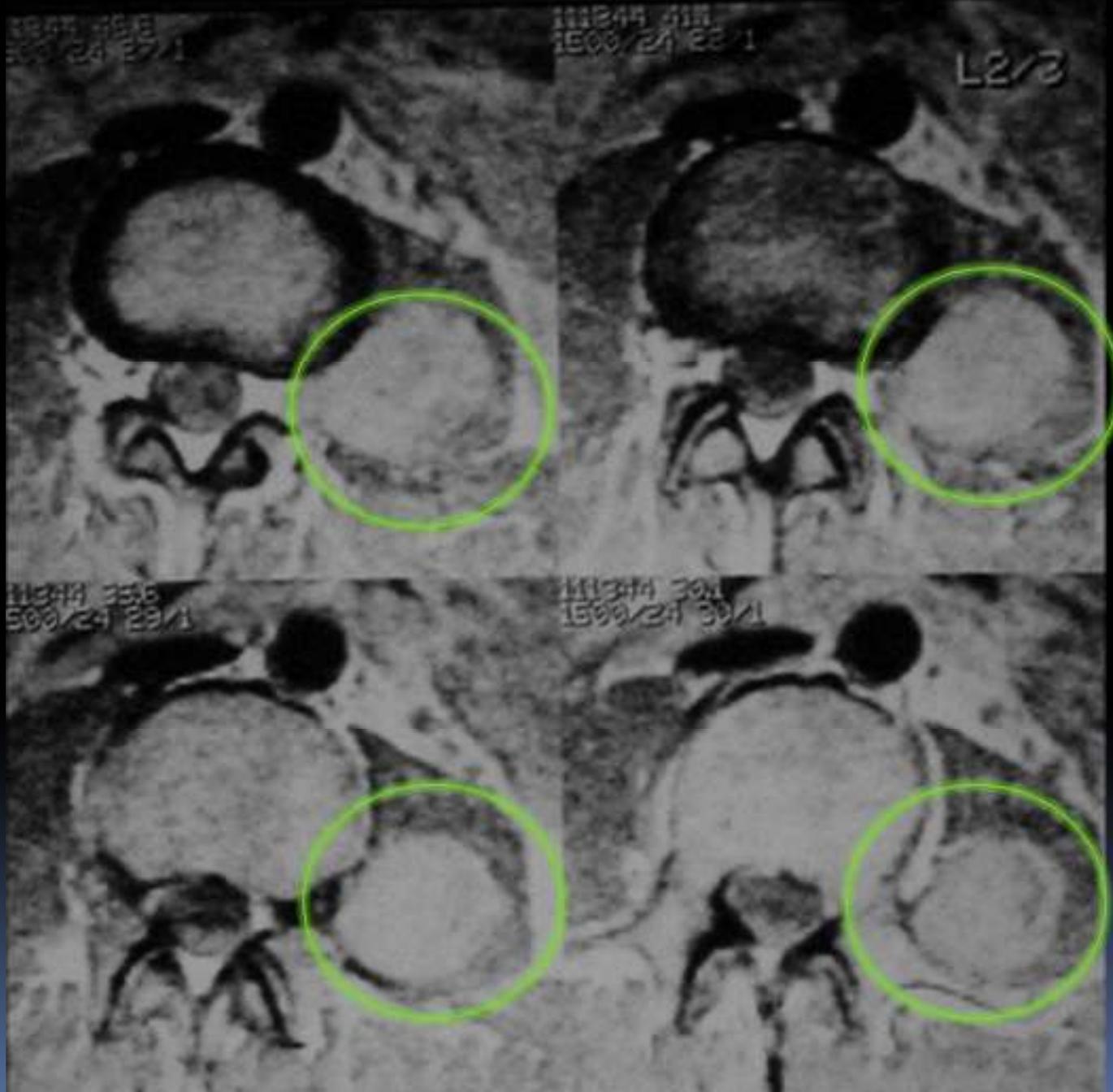


# Lumbar Spine: Sagittal

- Soft Tissues
  - Abdominal aorta
  - Pelvic cavity
  - Paravertebral muscles

# Neurofibroma





# Lumbar Spine: Transaxial

- Vertebral body
  - Signal
  - Shape

# Pedicle/body destruction



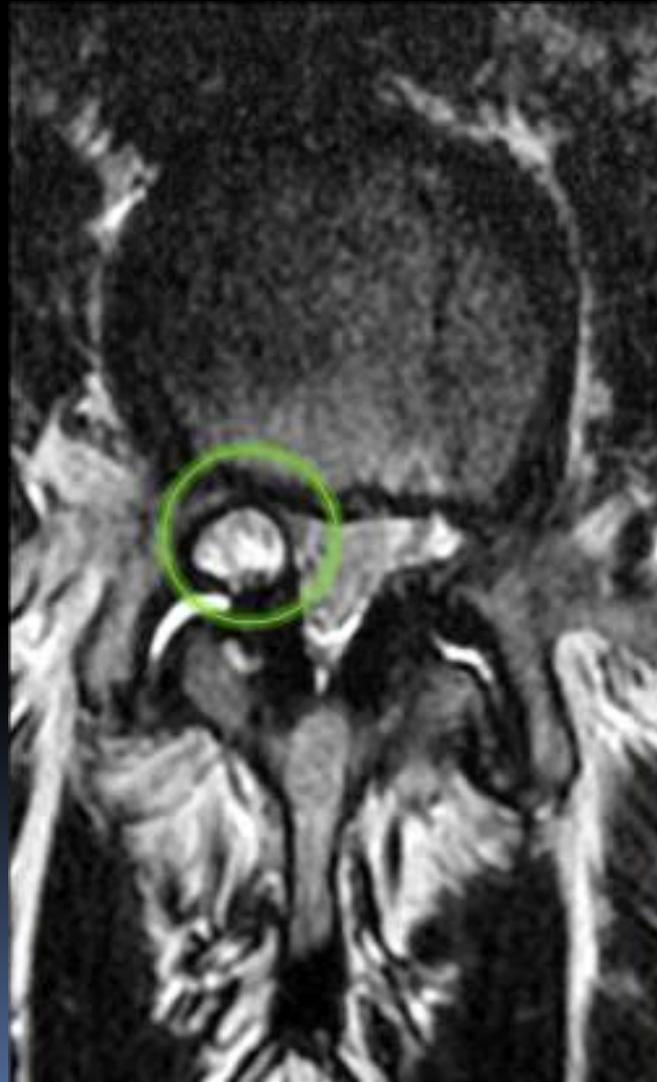
# Lumbar Spine: Transaxial

- Posterior arch
  - Signal
  - Shape
  - Articular facets

# Synovial Cyst

- Due to increased hydrostatic pressure from facet OA
- Acts like a disc herniation
- Usually found incidentally on a patient sent in with a clinical suspicion of disc herniation

# Synovial Cyst



# Lumbar Spine: Transaxial

- Disc contour
  - Neural compression

# Signs of Disc Herniation: Need 3 of 5 (consistent to same N level)

- Primarily leg pain
- Leg pain confined to dermatome
- Neural stretch tests recreate or exacerbate the leg pain
- At least 2 of 4 neurologic findings consistent with dermatome
  - Muscle weakness
  - Decreased reflex
  - Abnormal pinwheel
  - Atrophy
- MR or CT correlating to dermatome

# Disc Displacement

- PROTRUSION

- Present if the width of the base is wider than the length of the posterior extension
- Contained

# Disc Displacement

- **EXTRUSION**

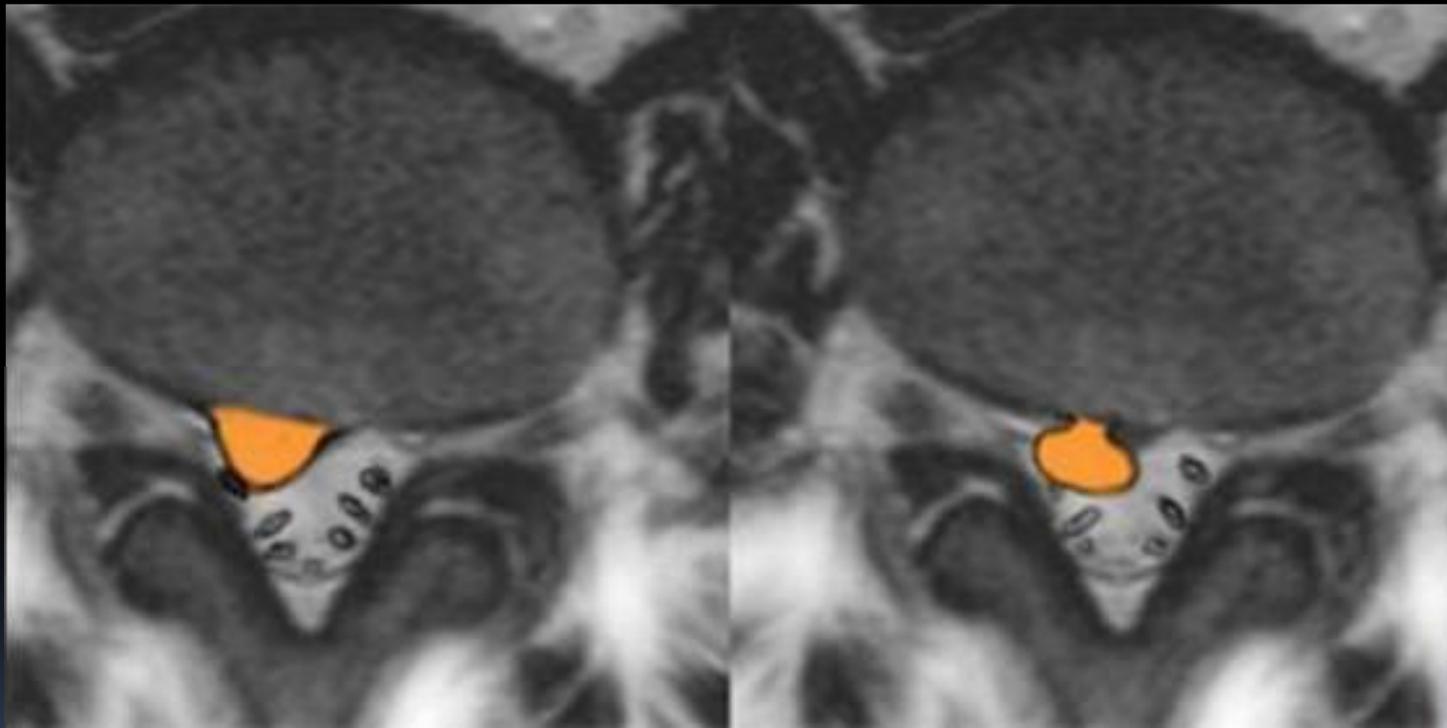
- Present if the width of the base is narrower than the length of the posterior extension
- Contained

# Disc Displacement

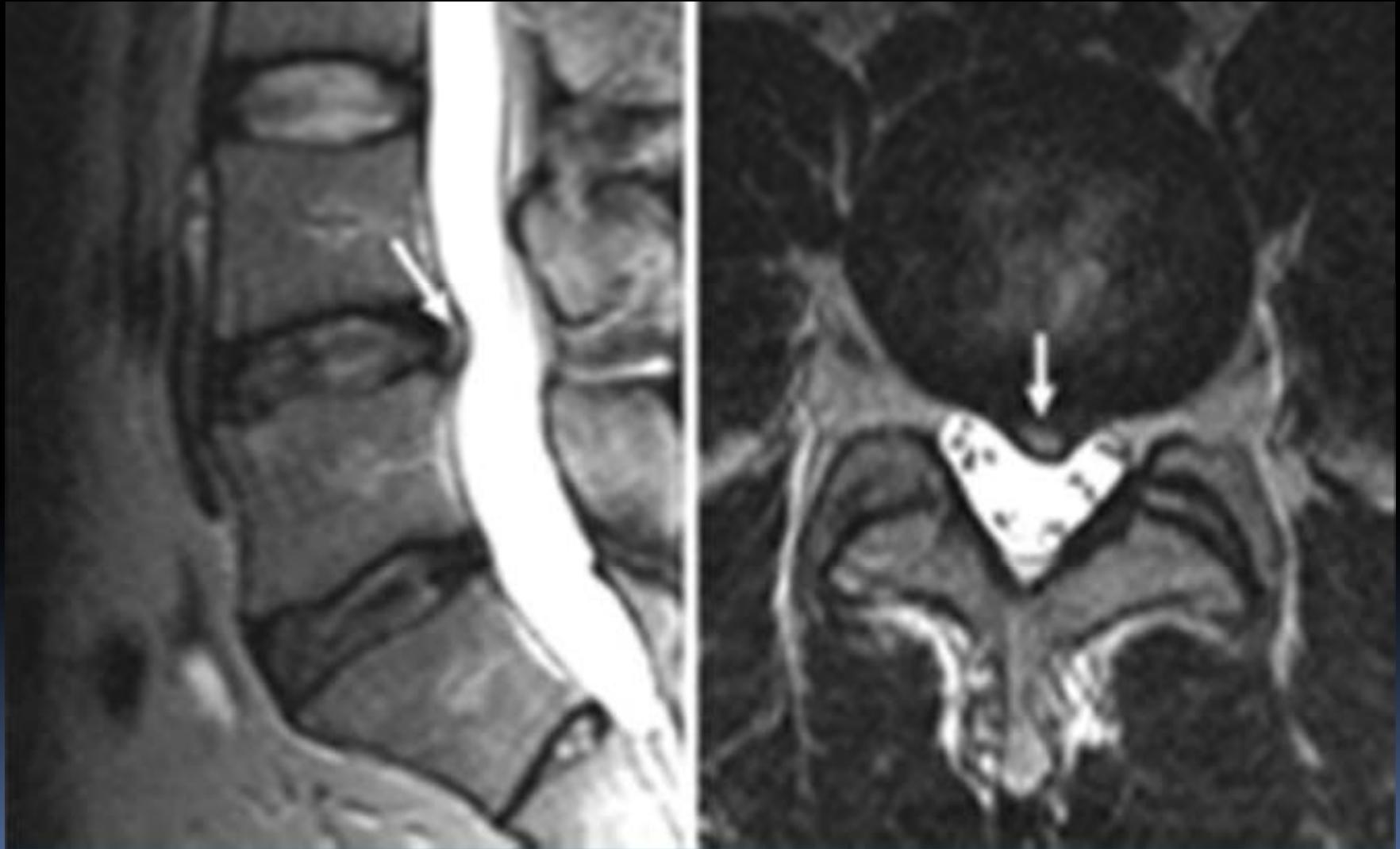
- **SEQUESTRATION**

- Present if the displaced disc material has lost completely any continuity with the parent disc. The sequestered disc may migrate
- Can result in a free fragment

# Protrusion vs. Extrusion



# Disc Protrusion



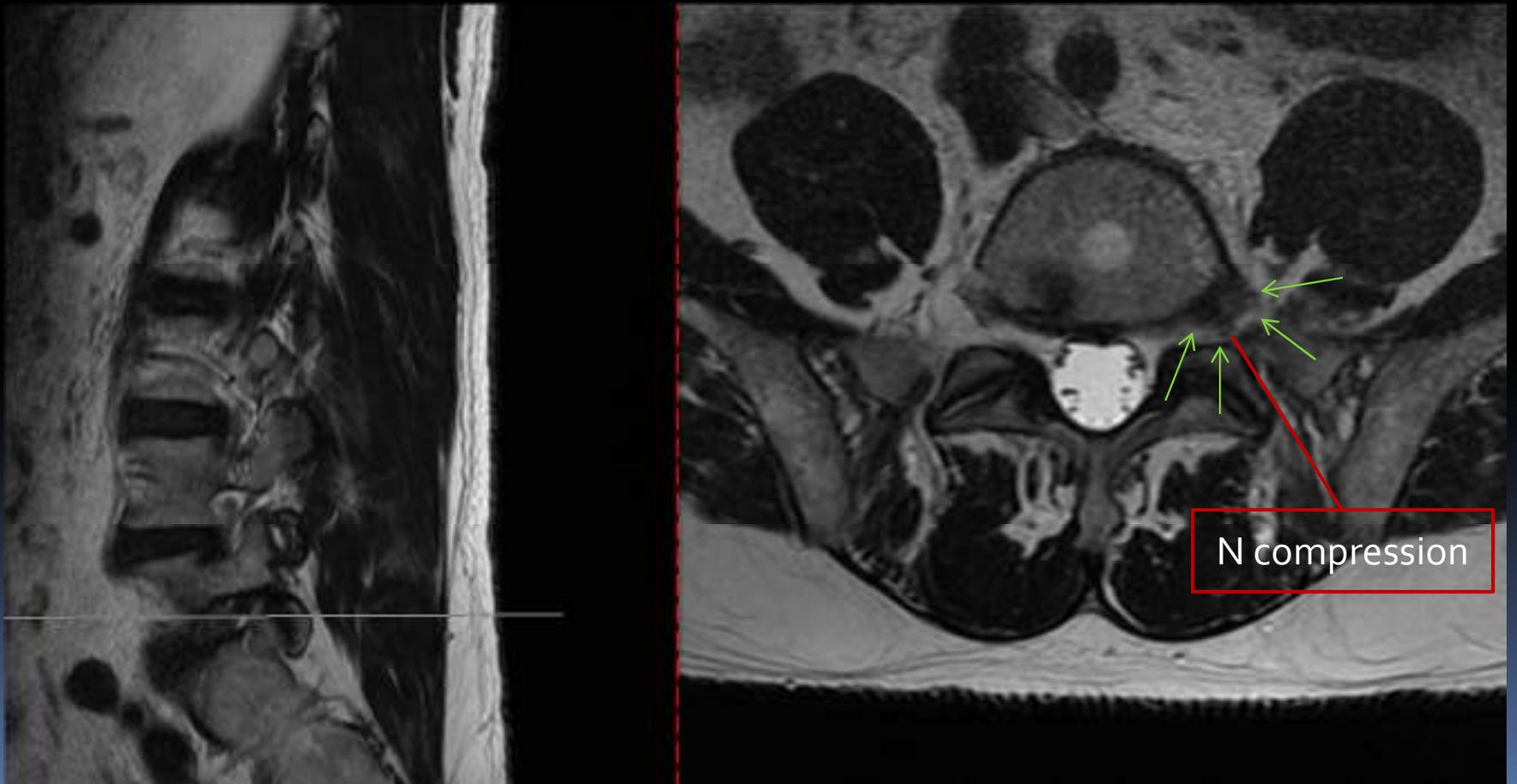
# Disc Extrusion



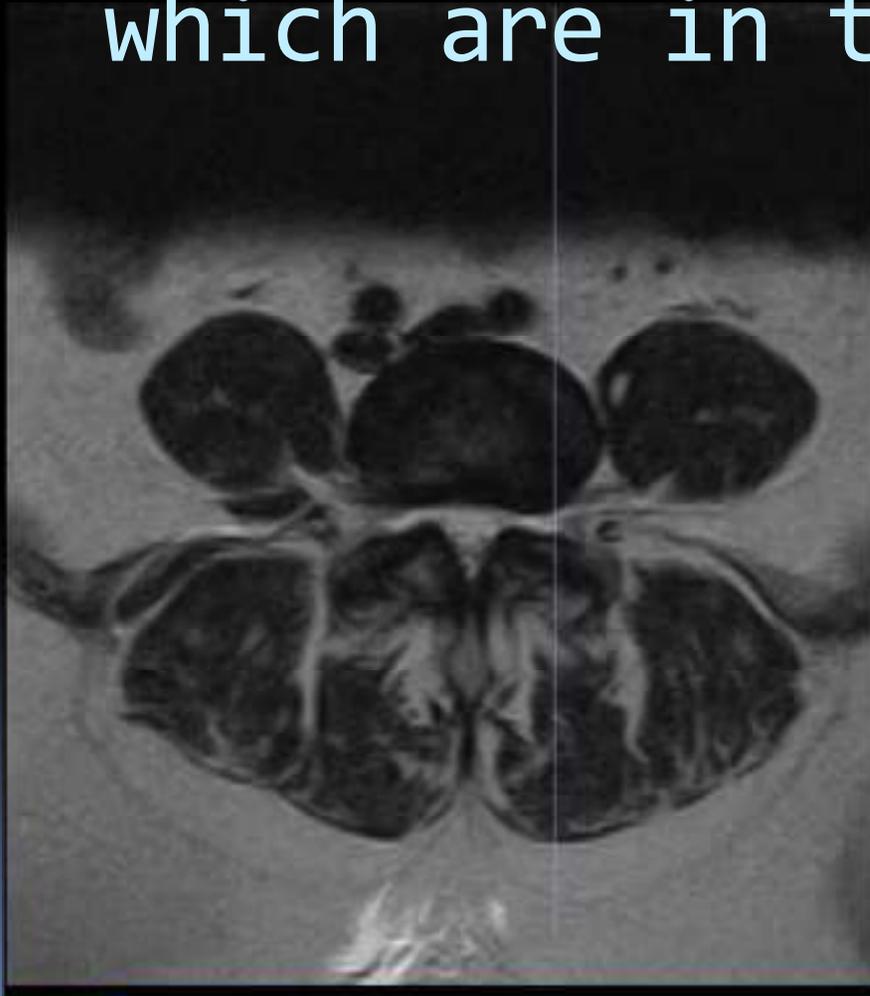
# Disc Sequestration



Foraminal protrusion: Often compress the N fascicles which are in the inf. IVF



Foraminal bulge: Can compress the N fascicles which are in the inf. IVF



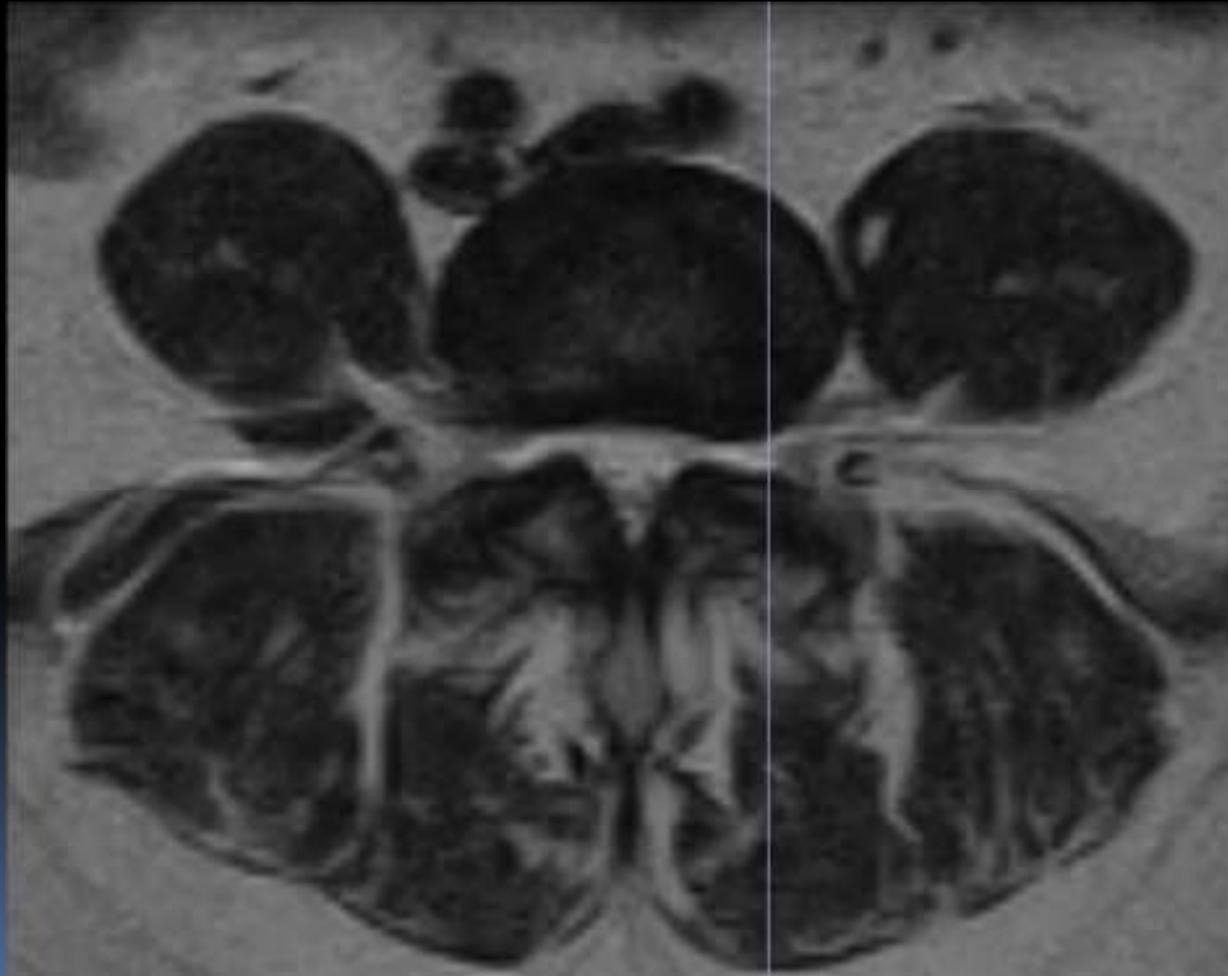
# Lumbar Spine: Transaxial

- Canal
  - Size
  - Signal
  - Nerve compression
- Ligamentum flavum
- Lateral recess

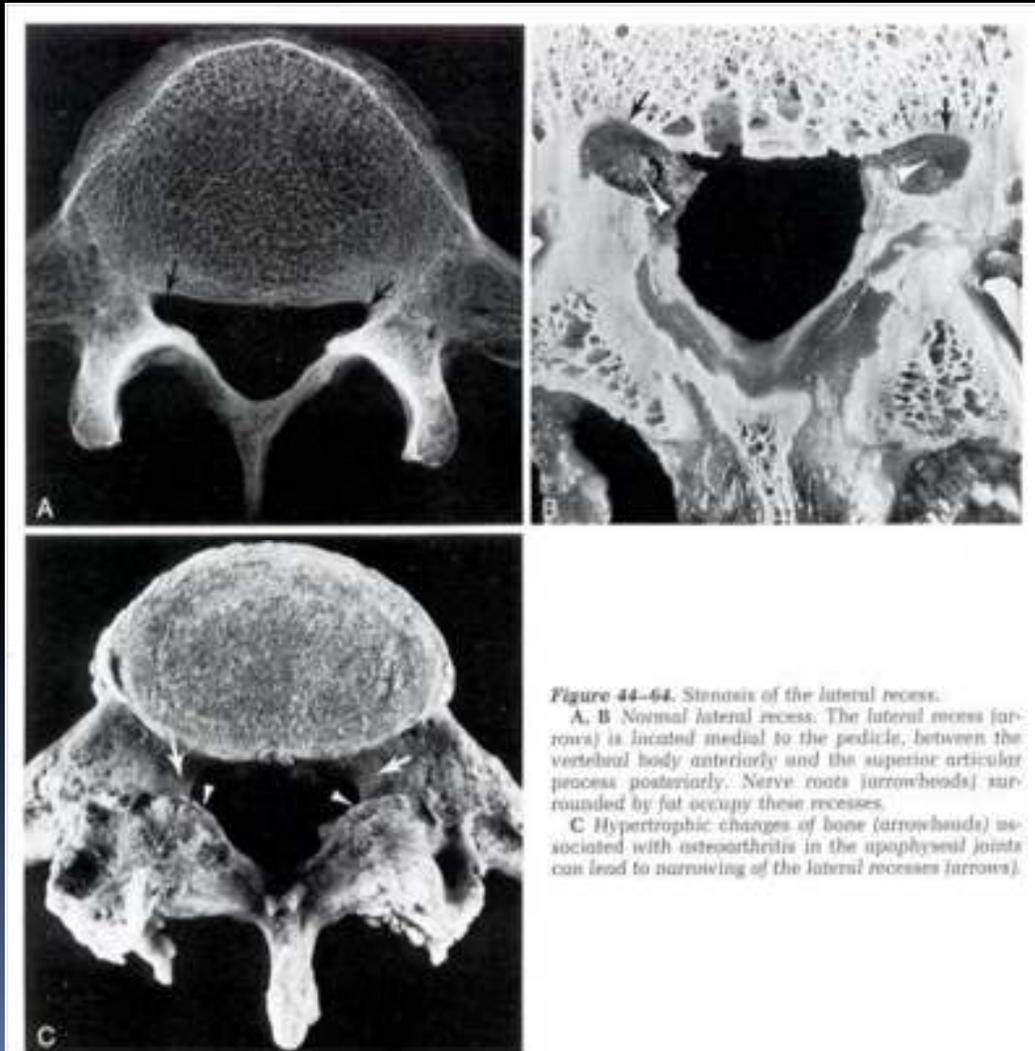
# Signs of Degenerative Spondylolisthesis in Lumbar Spine

- Primarily scleratogenous leg pain (one or both legs)
- Comes and goes
- Often reduced by leaning forward or sitting down
- No neurologic findings
- Very common
- 4 F's: fat, female (I didn't come up with this ladies), forty, L<sub>4</sub>

# Central Stenosis



# Lateral Recess Stenosis

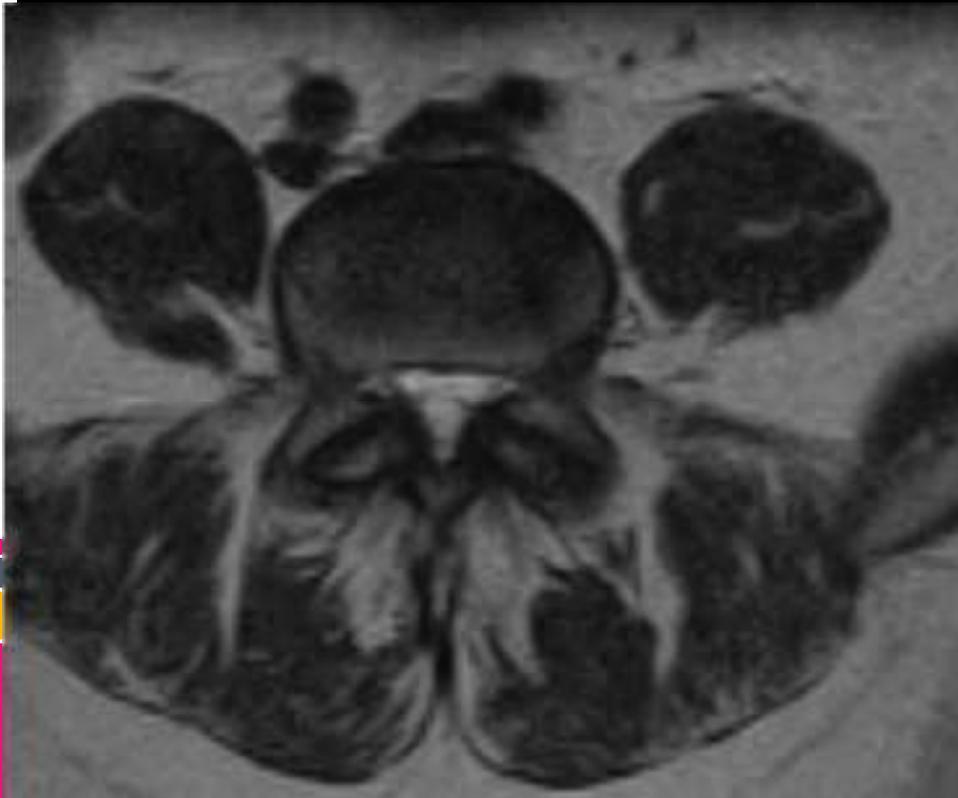


*Figure 44-64. Stenosis of the lateral recess.*

*A, B Normal lateral recess. The lateral recess (arrows) is located medial to the pedicle, between the vertebral body anteriorly and the superior articular process posteriorly. Nerve roots (arrowheads) surrounded by fat occupy these recesses.*

*C Hypertrophic changes of bone (arrowheads) associated with osteoarthritis in the apophyseal joints can lead to narrowing of the lateral recesses (arrows).*

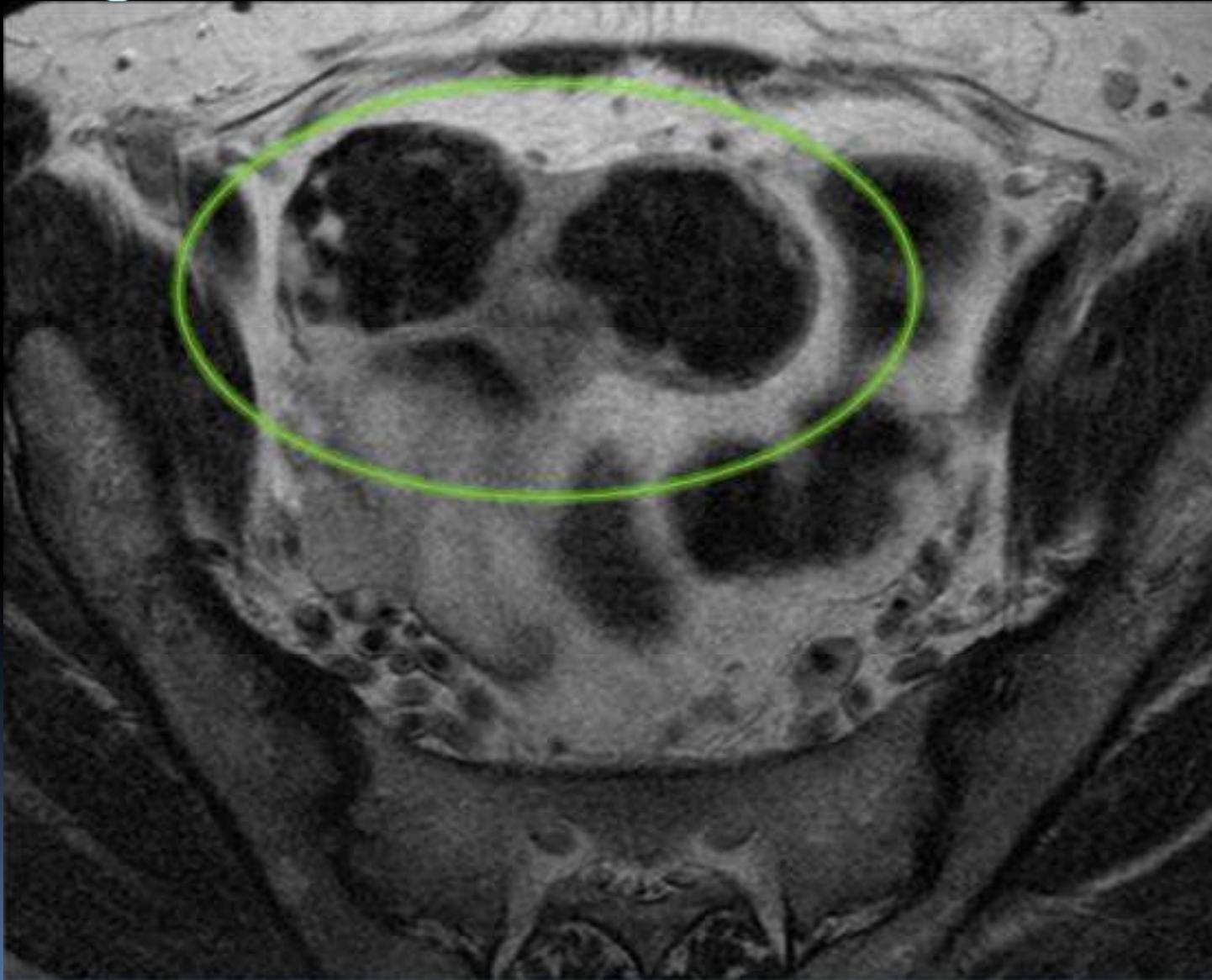
# Lateral Recess Stenosis



# Lumbar Spine: Transaxial

- Soft Tissues
  - Aorta
  - Kidneys
  - Paravertebral muscles
  - Pelvic cavity

# Large uterine fibroids

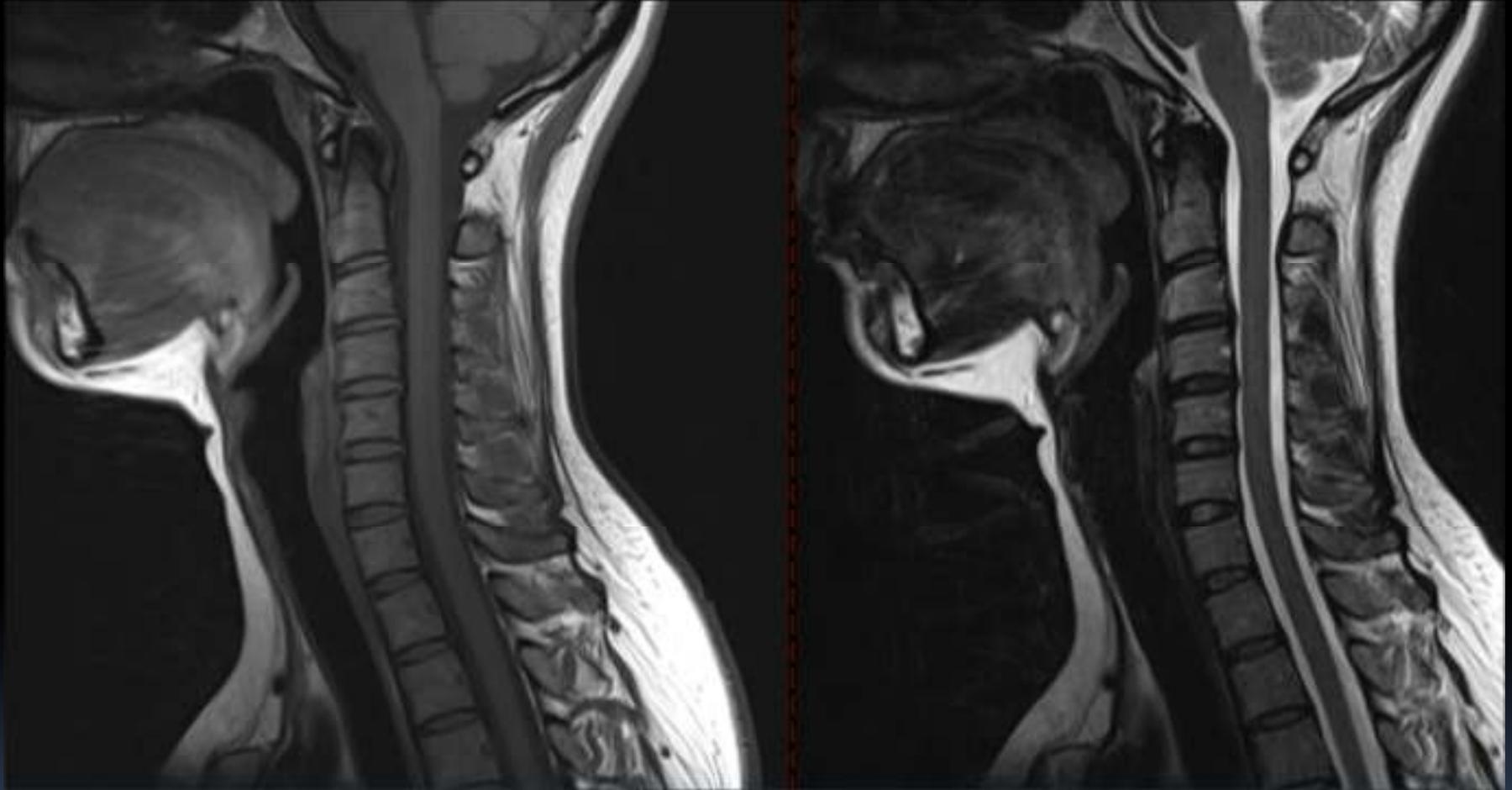


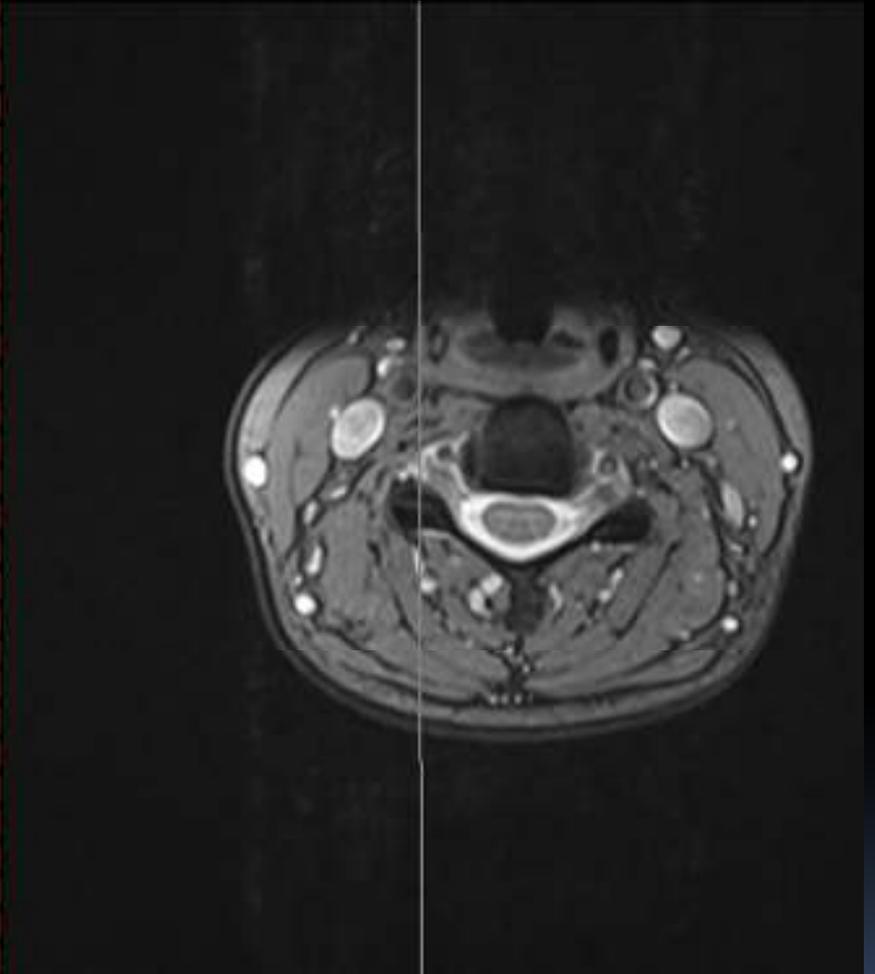
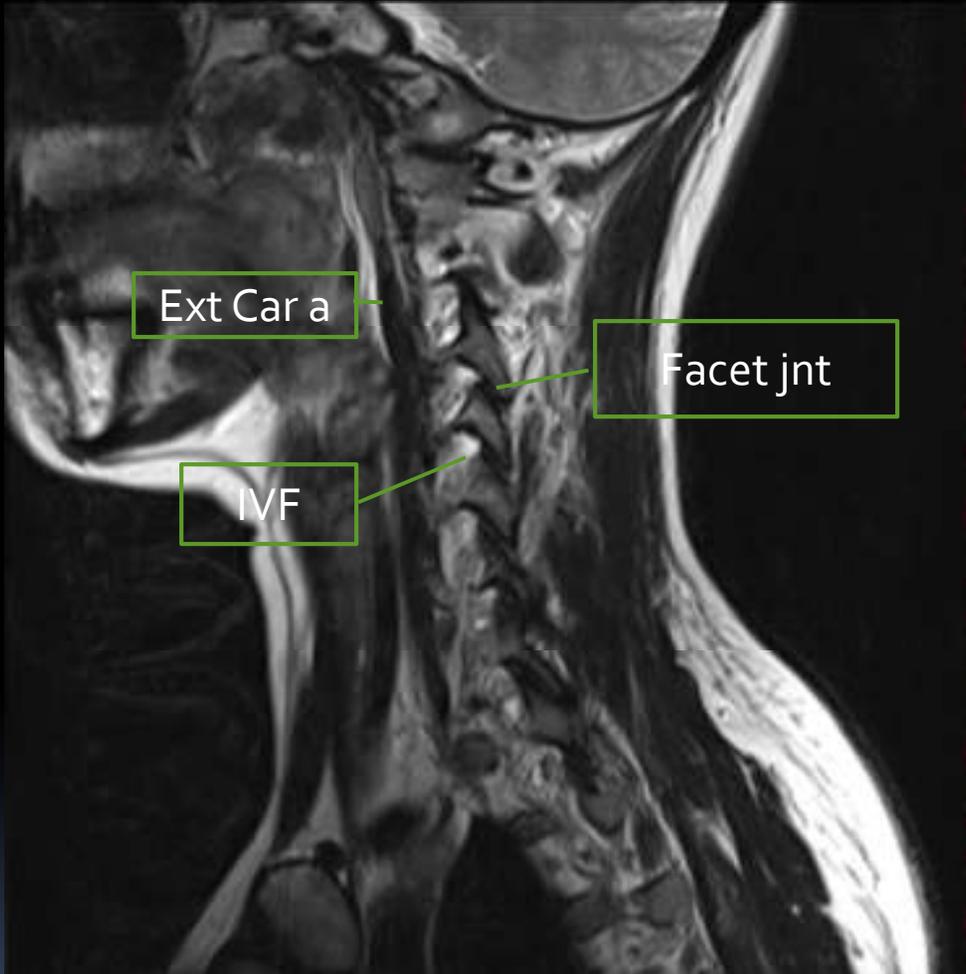


# Cervical Spine

T1

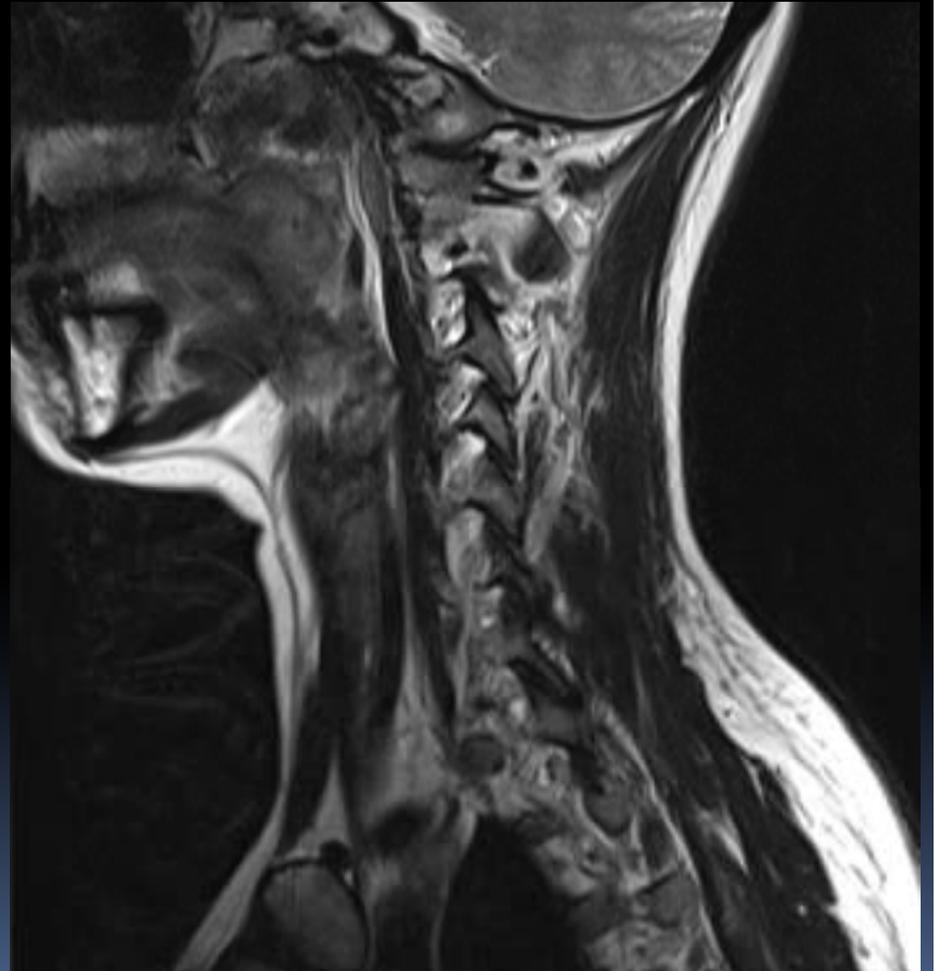
T2

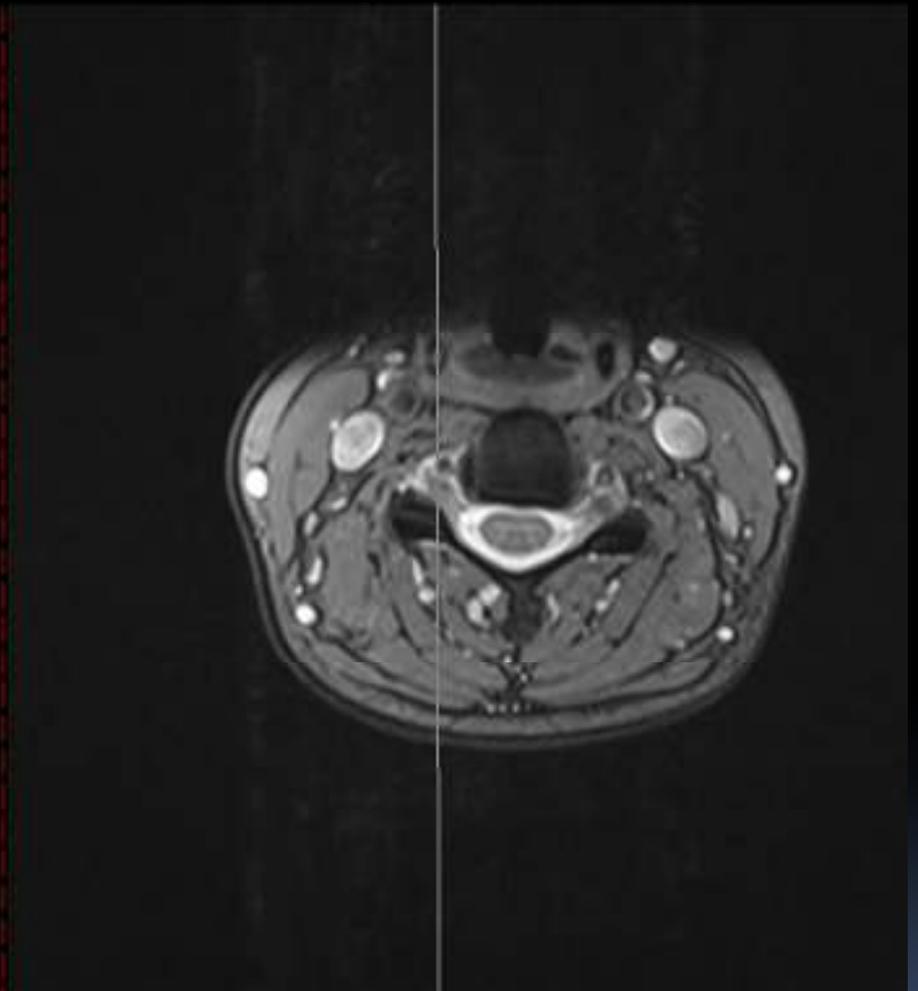
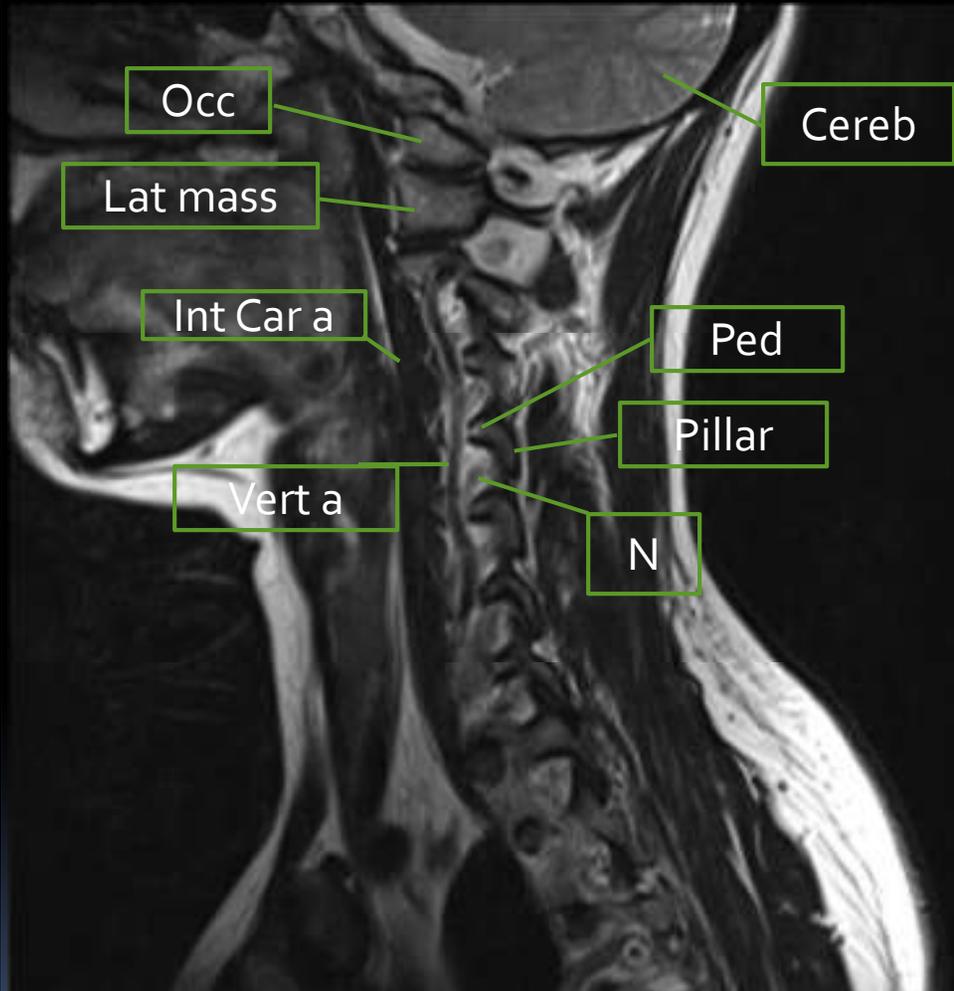




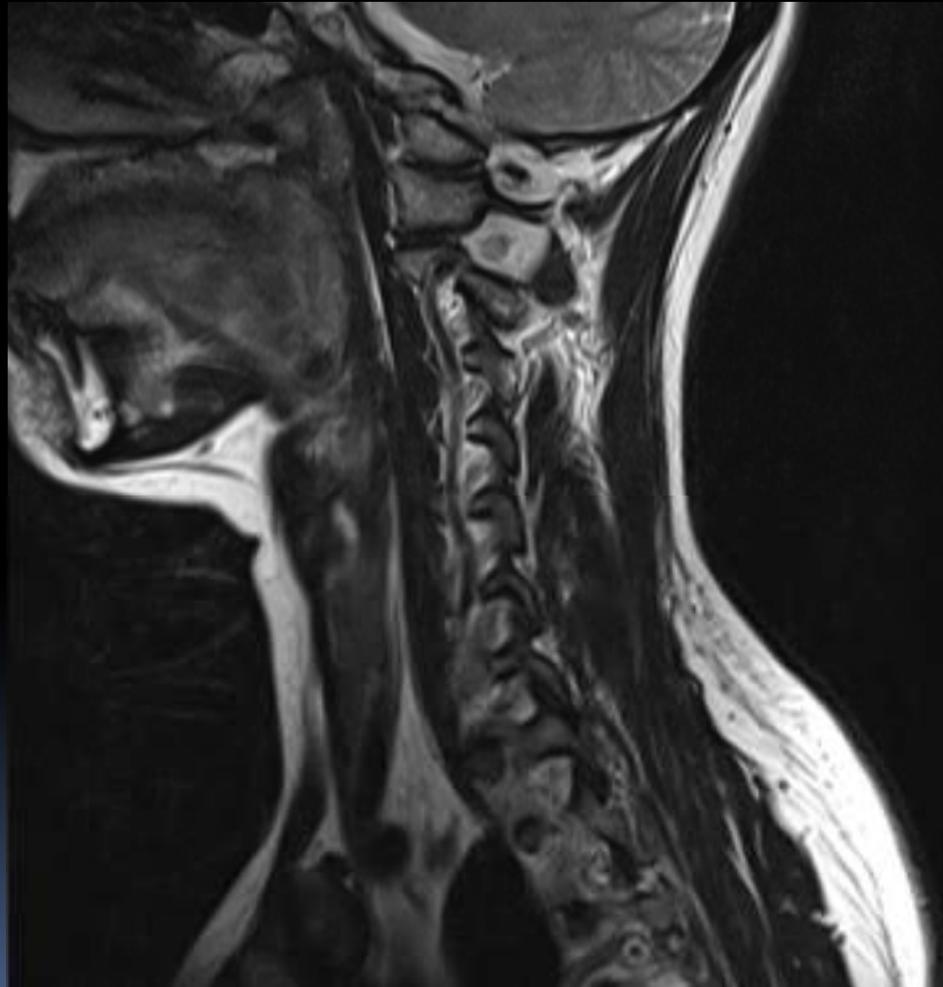
# Find

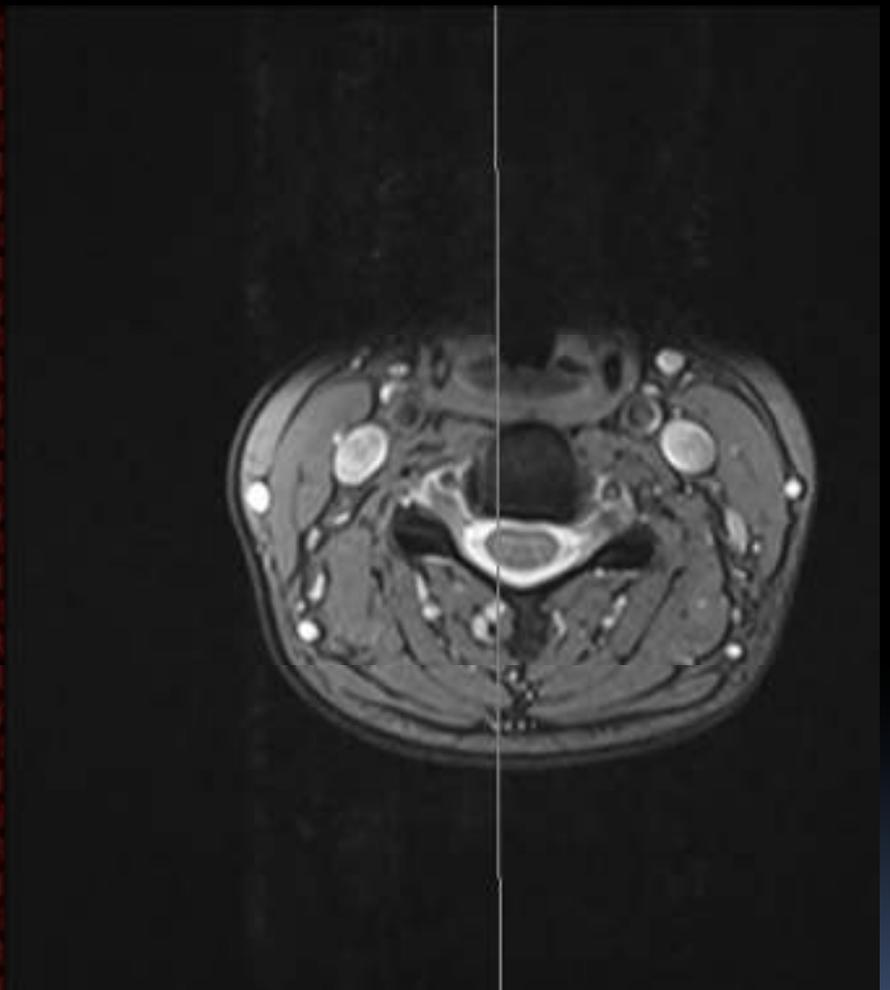
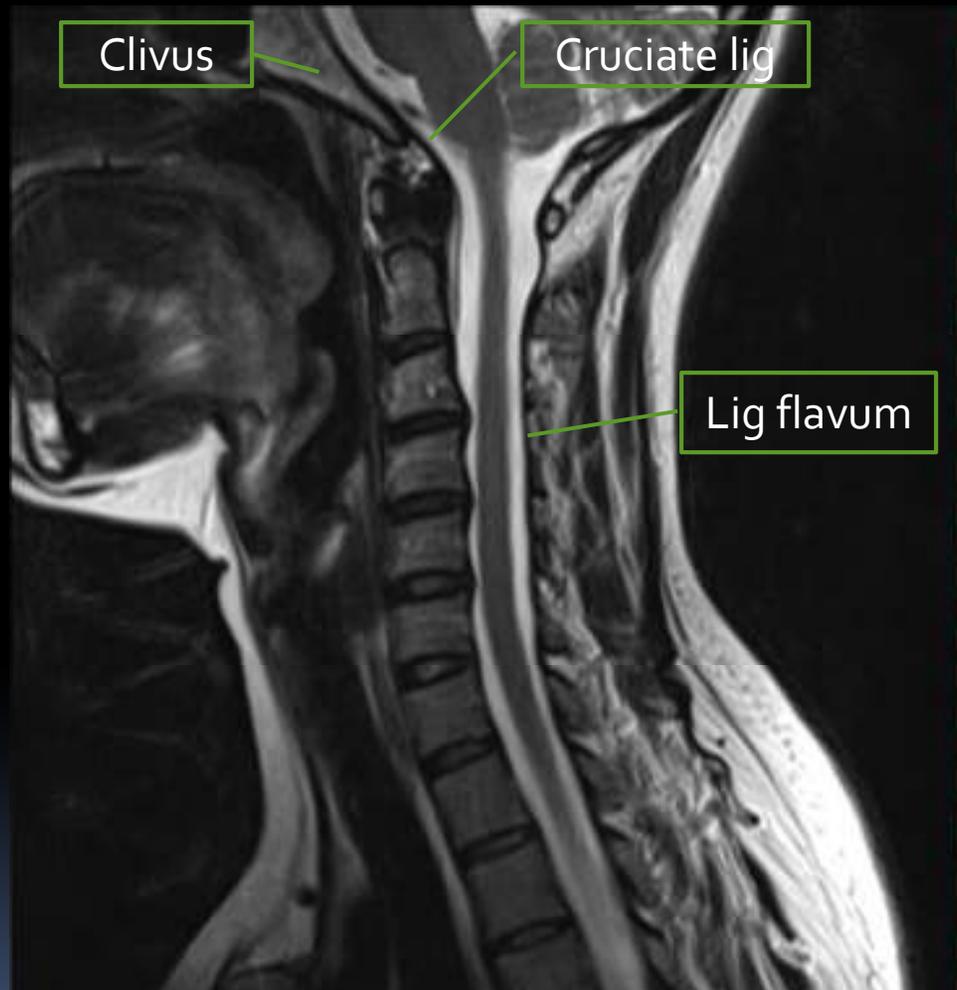
- Ext carottid
- Facet joint
- IVF





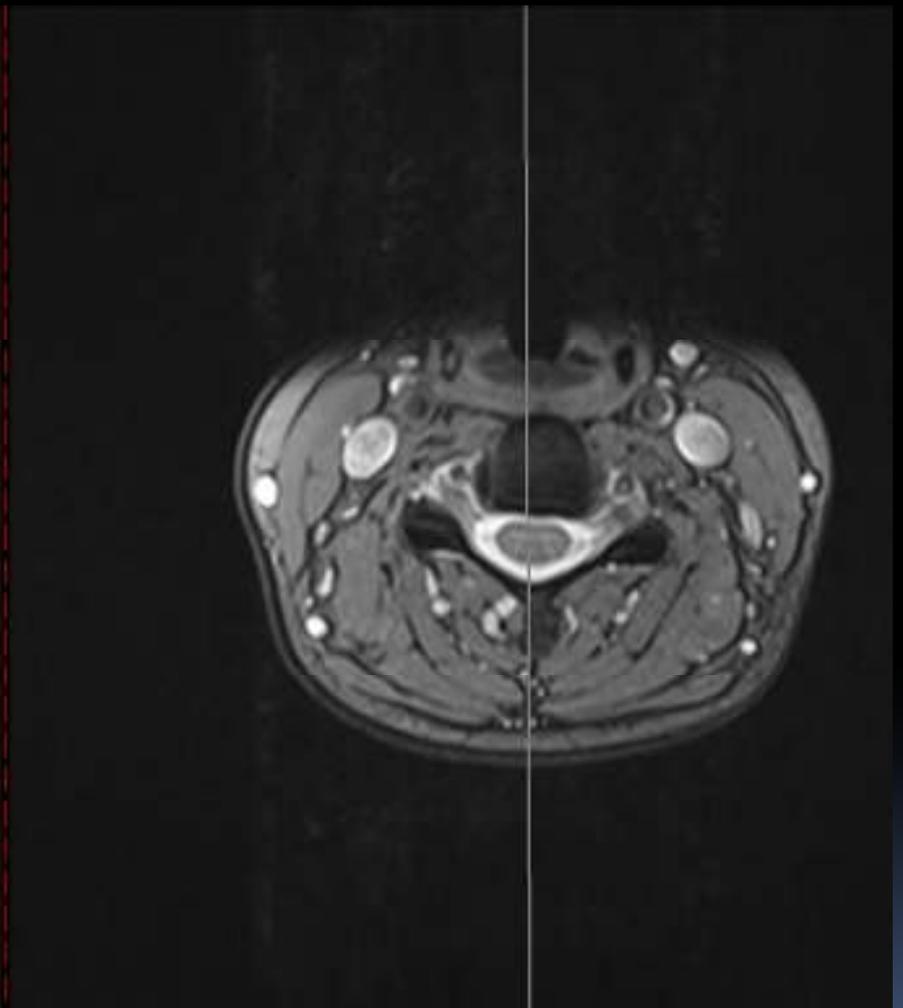
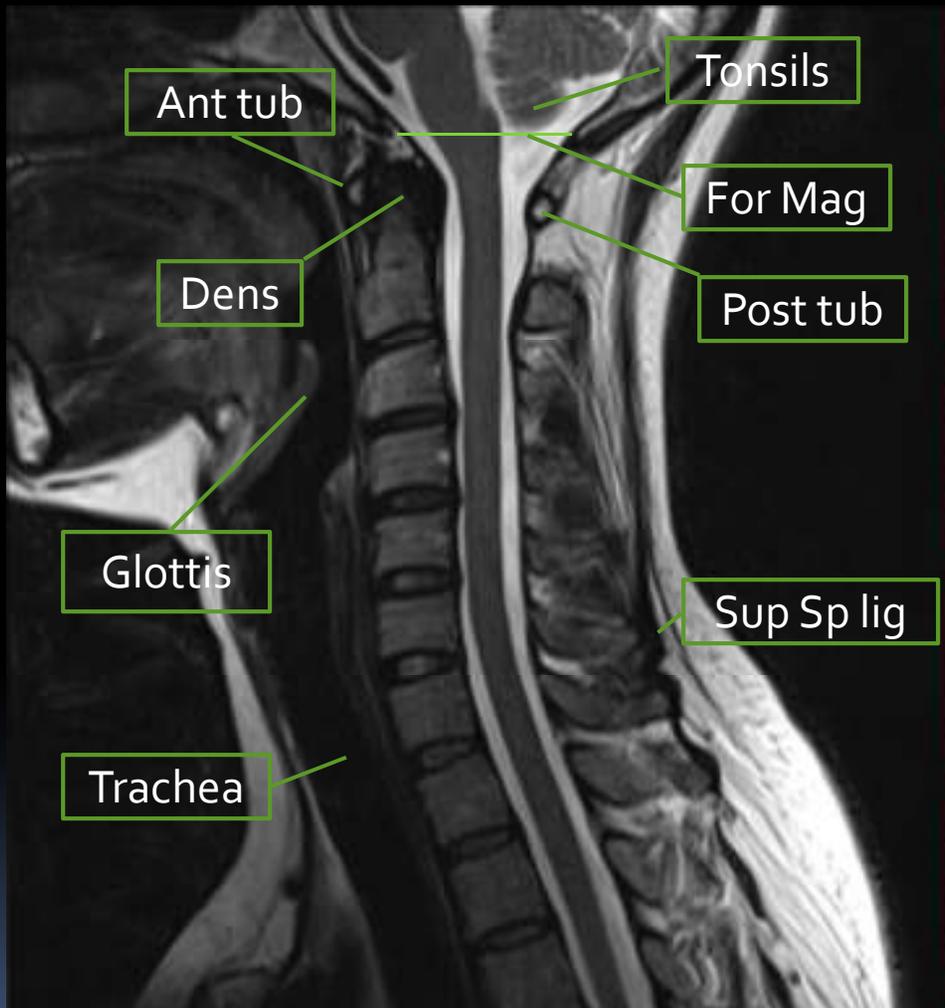
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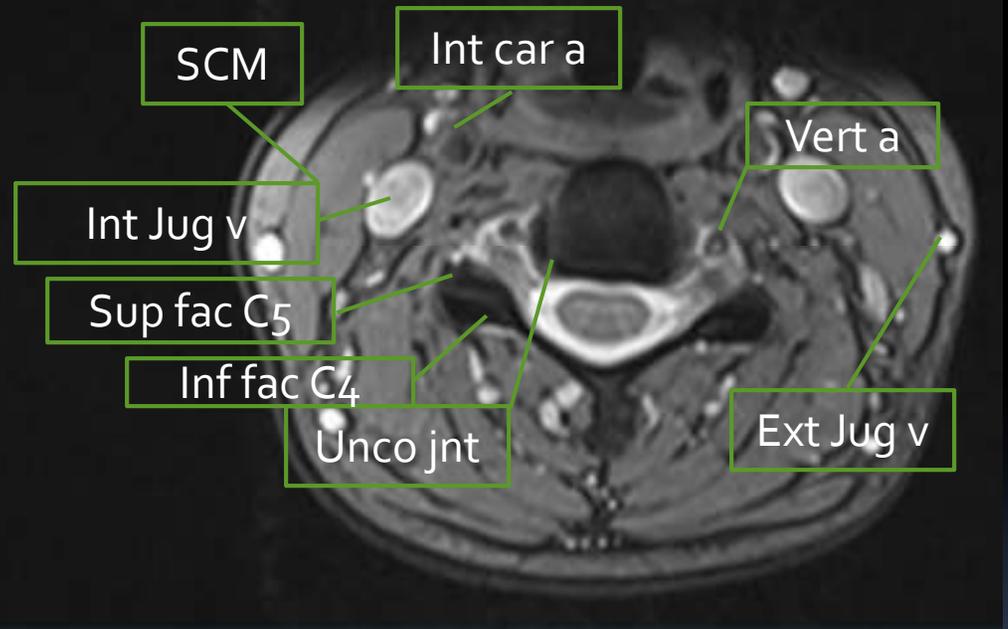
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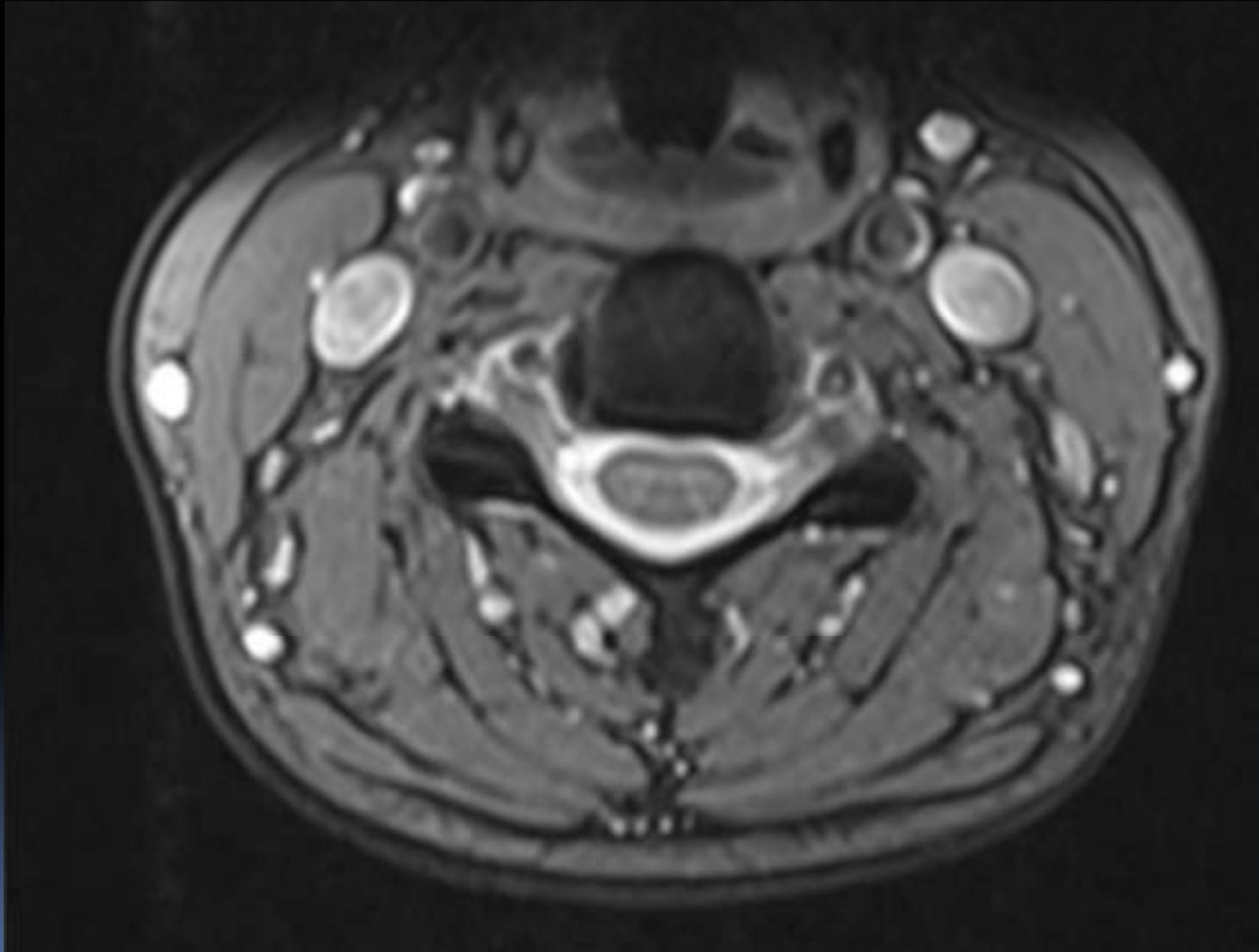


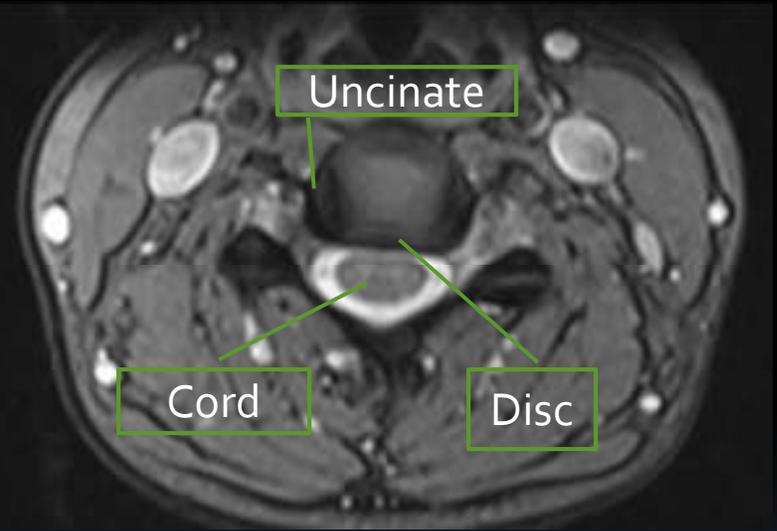
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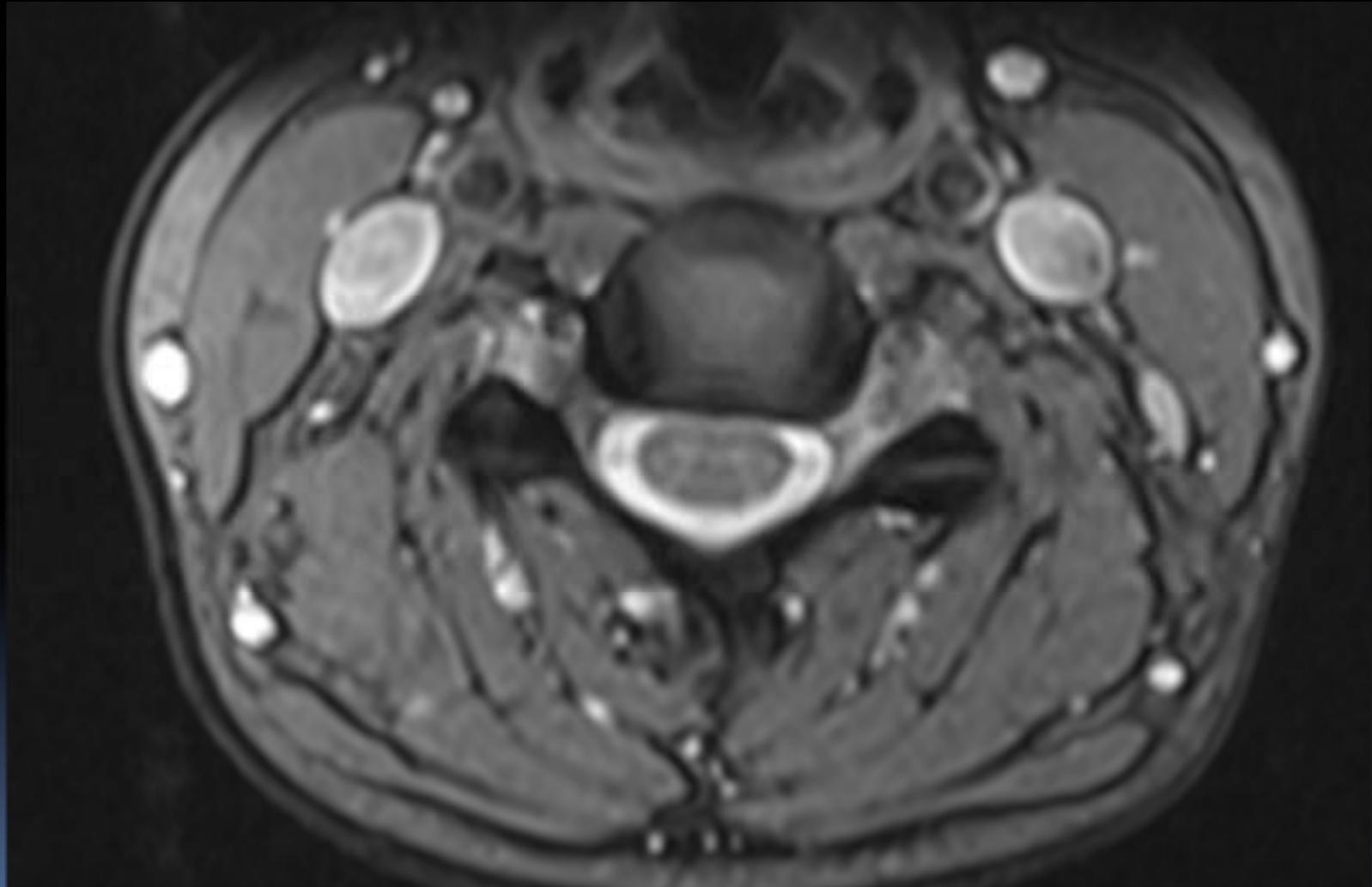


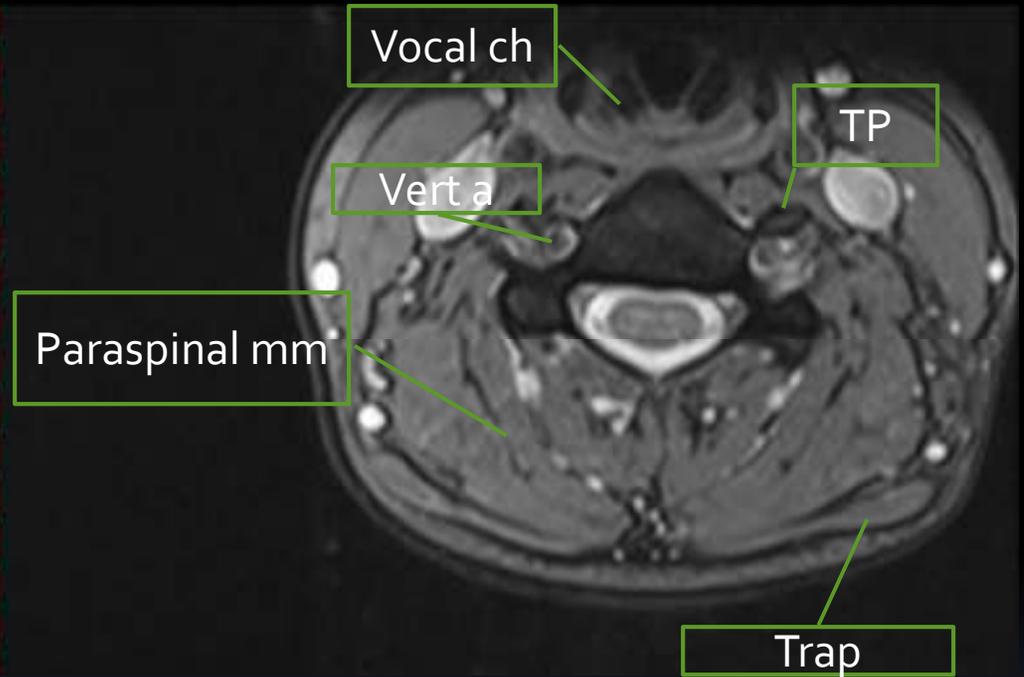
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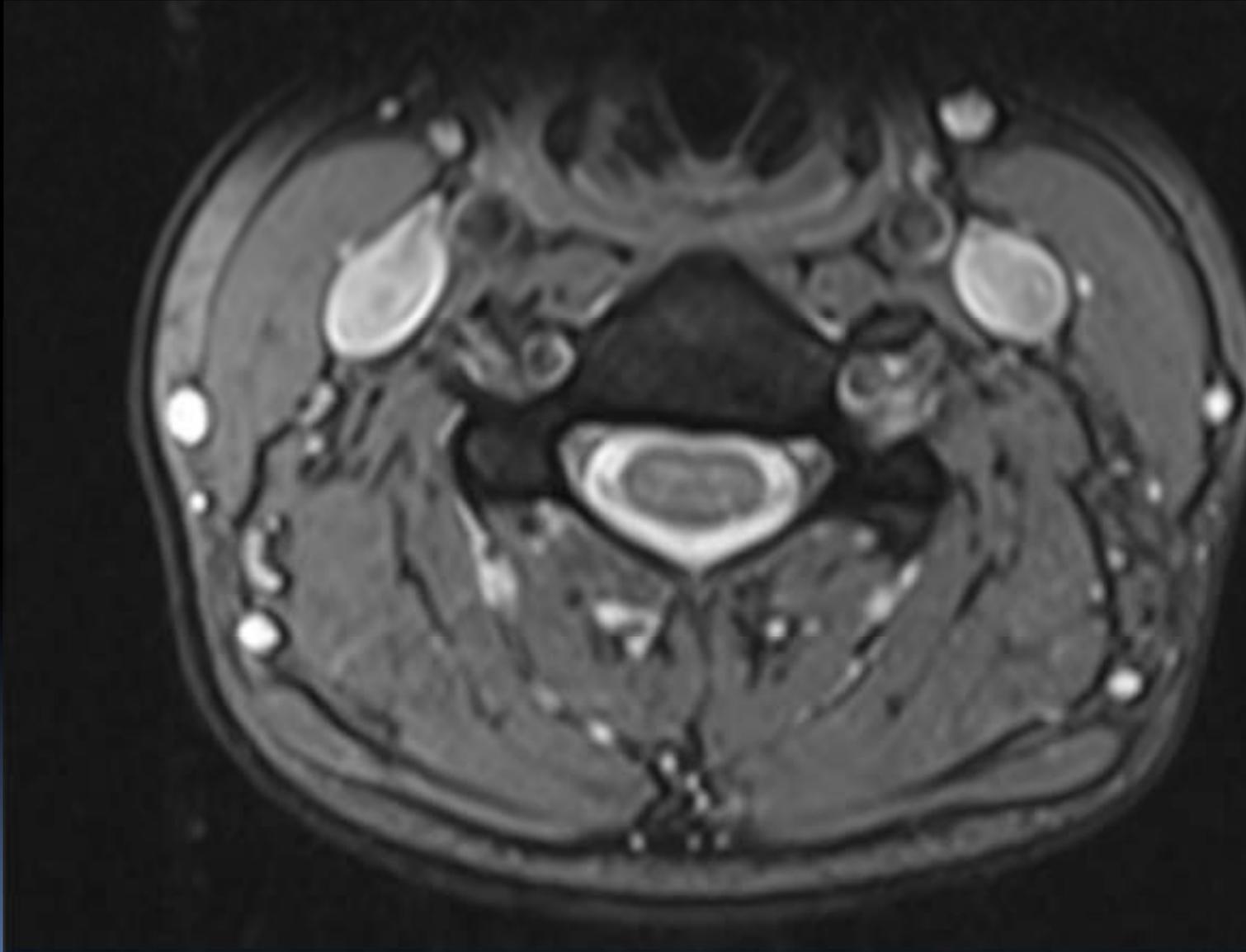


Find????





Find????





# Cervical Spine

- Sagittal
  - Transaxial
- 

# Cervical Spine: Sagittal

- Alignment
  - Overall curve
  - ADI
  - Anterolisthesis
  - Retrolisthesis
  - Basilar invagination

# RA: Stair stepping



# Cervical Spine: Sagittal

- Vertebral bodies
  - Overall signal
  - Shape
  - Cortex
  - Anterior osteophytes

Mets: Bright signal in bone  
on T2



# Mets: Abnormal signal and shape



# Cervical Spine: Sagittal

- Posterior arch
  - Overall signal
  - Shape

Mets: Abnormal signal,  
shape, size



# Cervical Spine: Sagittal

- Discs
  - Height
  - Signal
  - Contour
  - Posterior spurs

Decreased ht, herniation,  
annular tear, cord  
compression



# Cervical Spine: Sagittal

- Spinal canal
  - Cord thickness
  - Cord signal
  - Ligamentum flavum
  - Brain stem

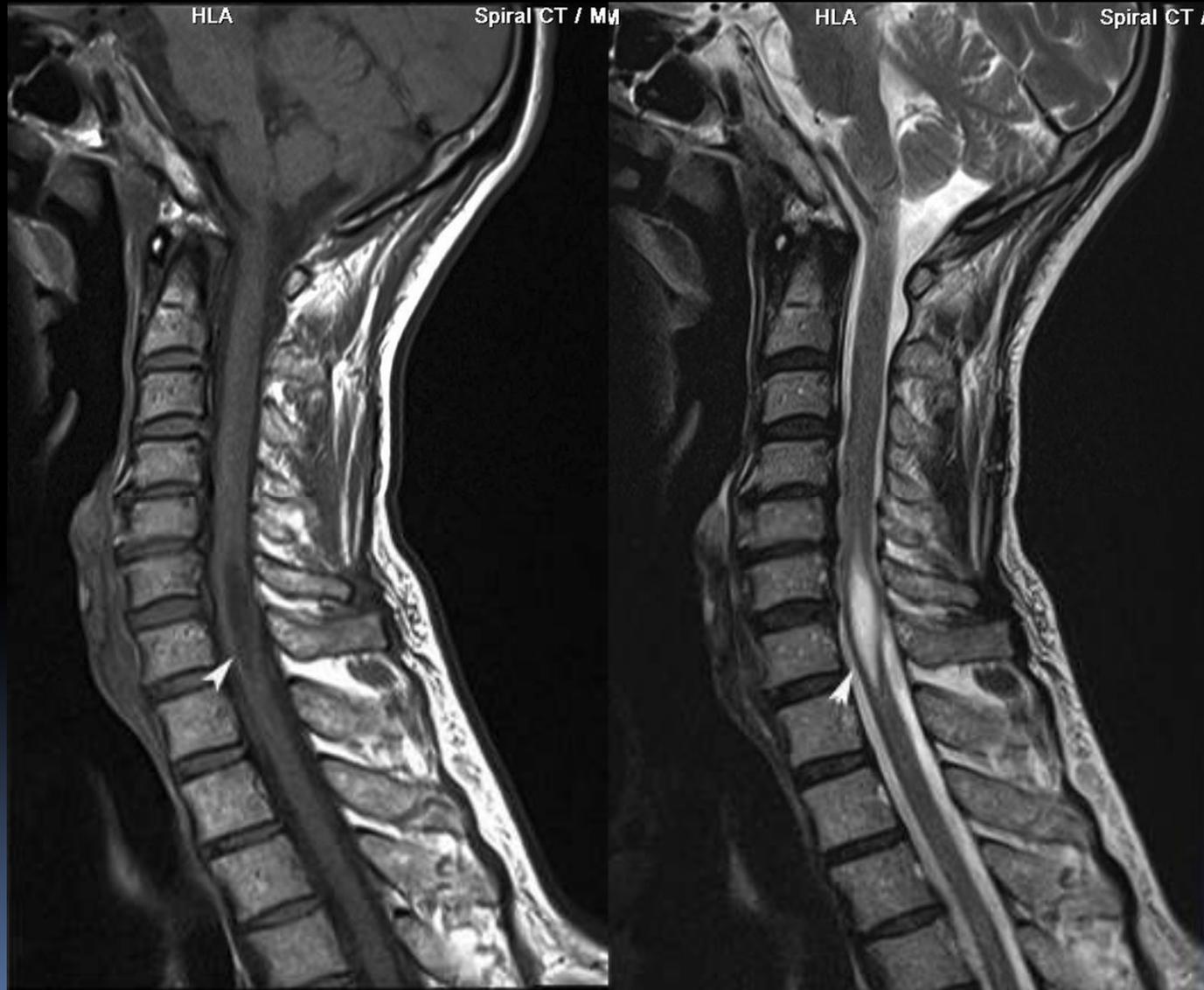
# Arnold-Chiari Malformation

- Type I: 1-4 mm. Usually asymptomatic
- Type II: 5 mm or more. Usually symptomatic at some point
- Both may cause syrinx formation (usually Type II)
- Both may be associated with upper cervical anomalies

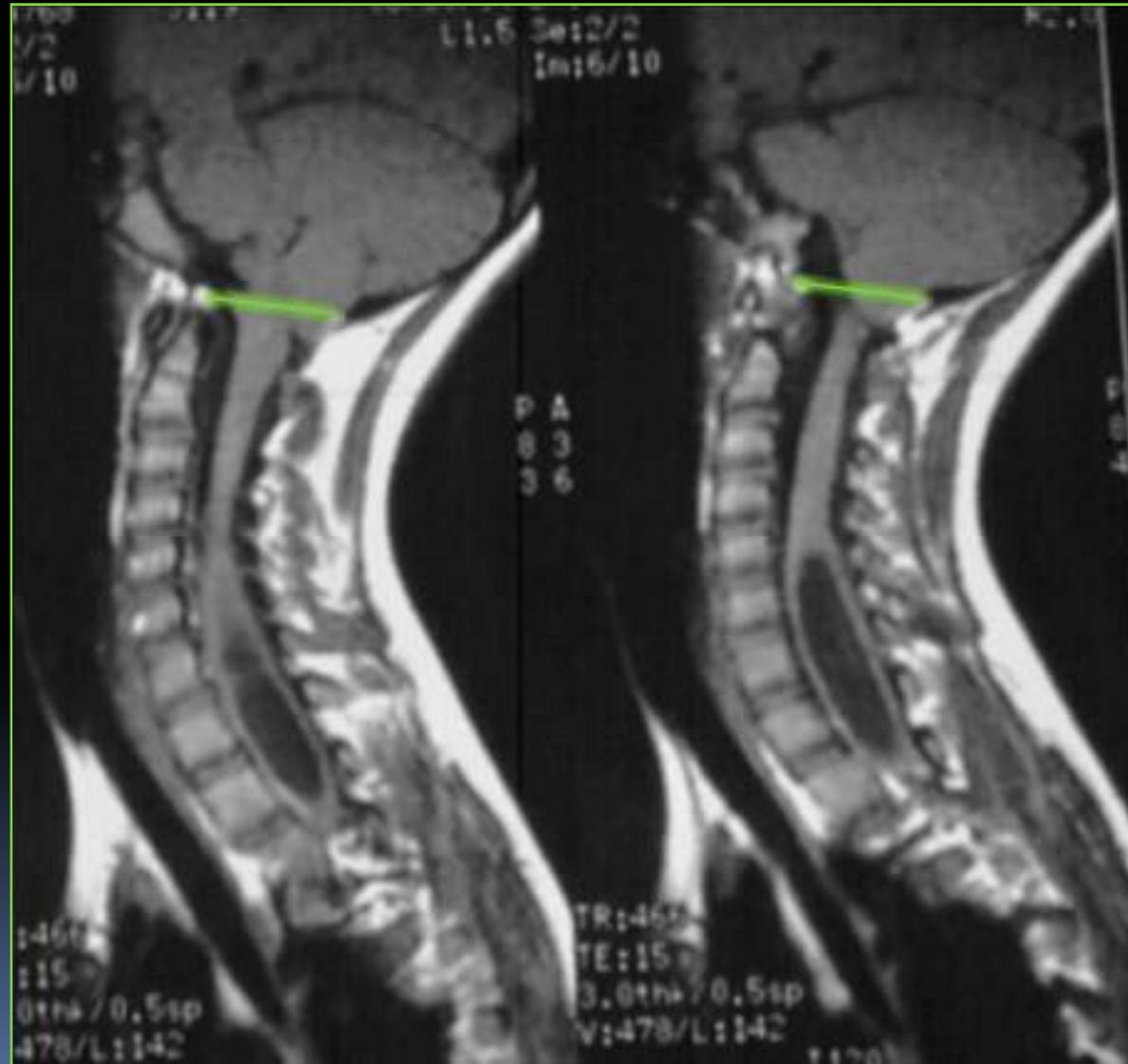
# Syrinx/Syringomyelia

- CSF filled cavity within the parenchyma of the spinal cord
- Causes:
  - Arnold-Chiari
  - Cord tumor
  - Cord trauma
  - Idiopathic
  - Left sided thoracic scoliosis

# Syrinx: follows water



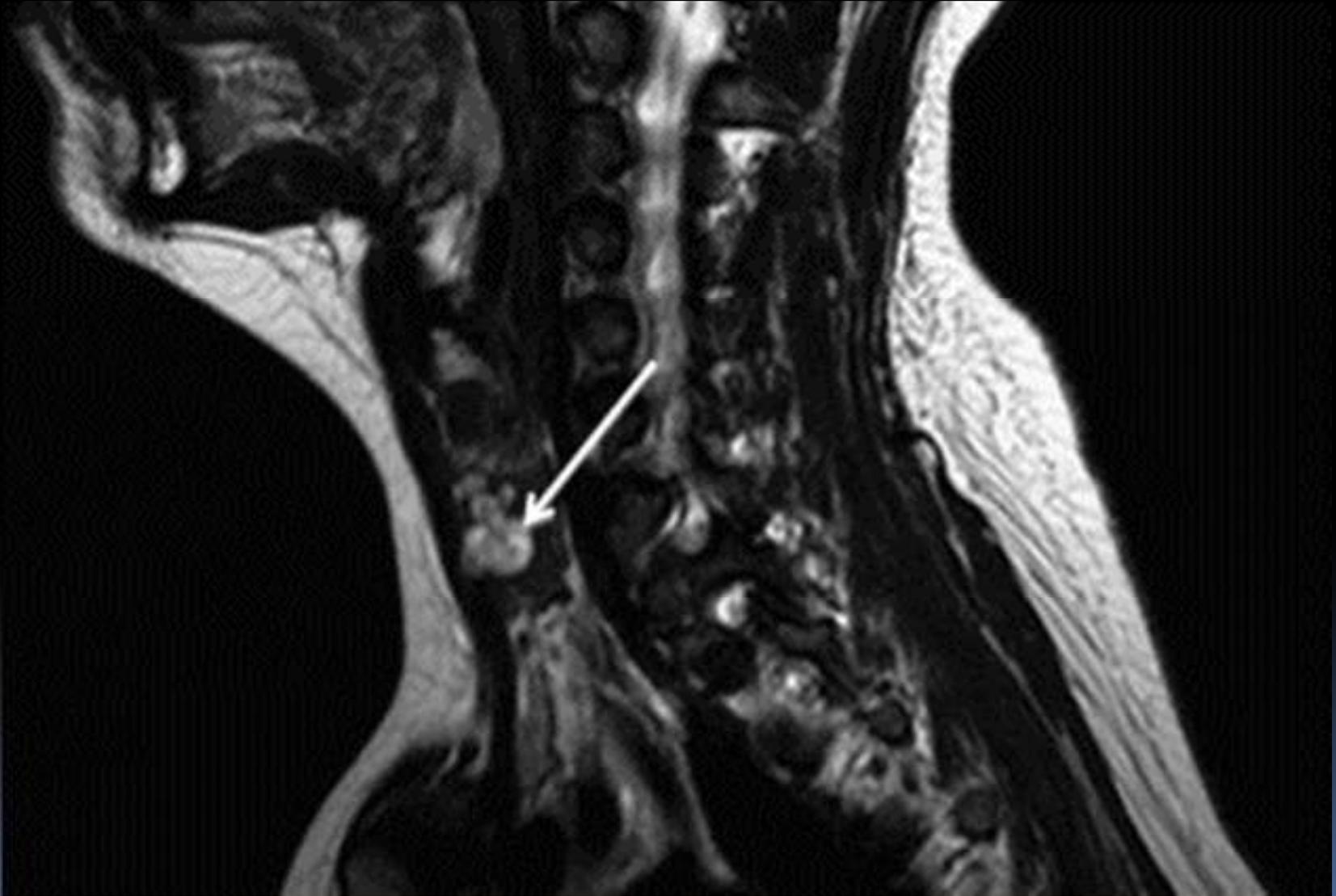
# Type 2 Chiari with syrinx



# Cervical Spine: Sagittal

- Soft Tissues
  - Soft tissue space
  - Thyroid
  - Paravertebral muscles
  - Vertebral artery

# Parathyroid adenoma



# Cervical Spine: Transaxial

- Vertebral body
  - Signal
  - Shape

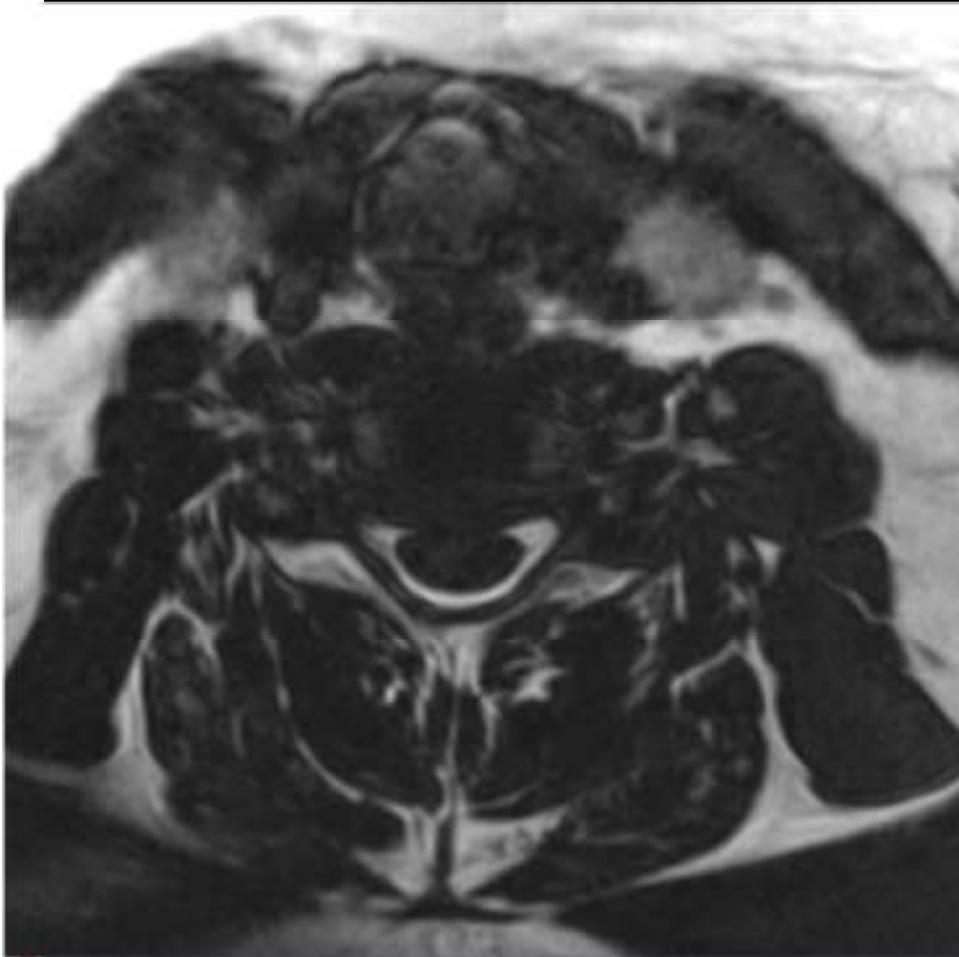
# Cervical Spine: Transaxial

- Posterior arch
  - Signal
  - Shape
  - Articular facets
  - Uncovertebral joints
    - Neural foramen

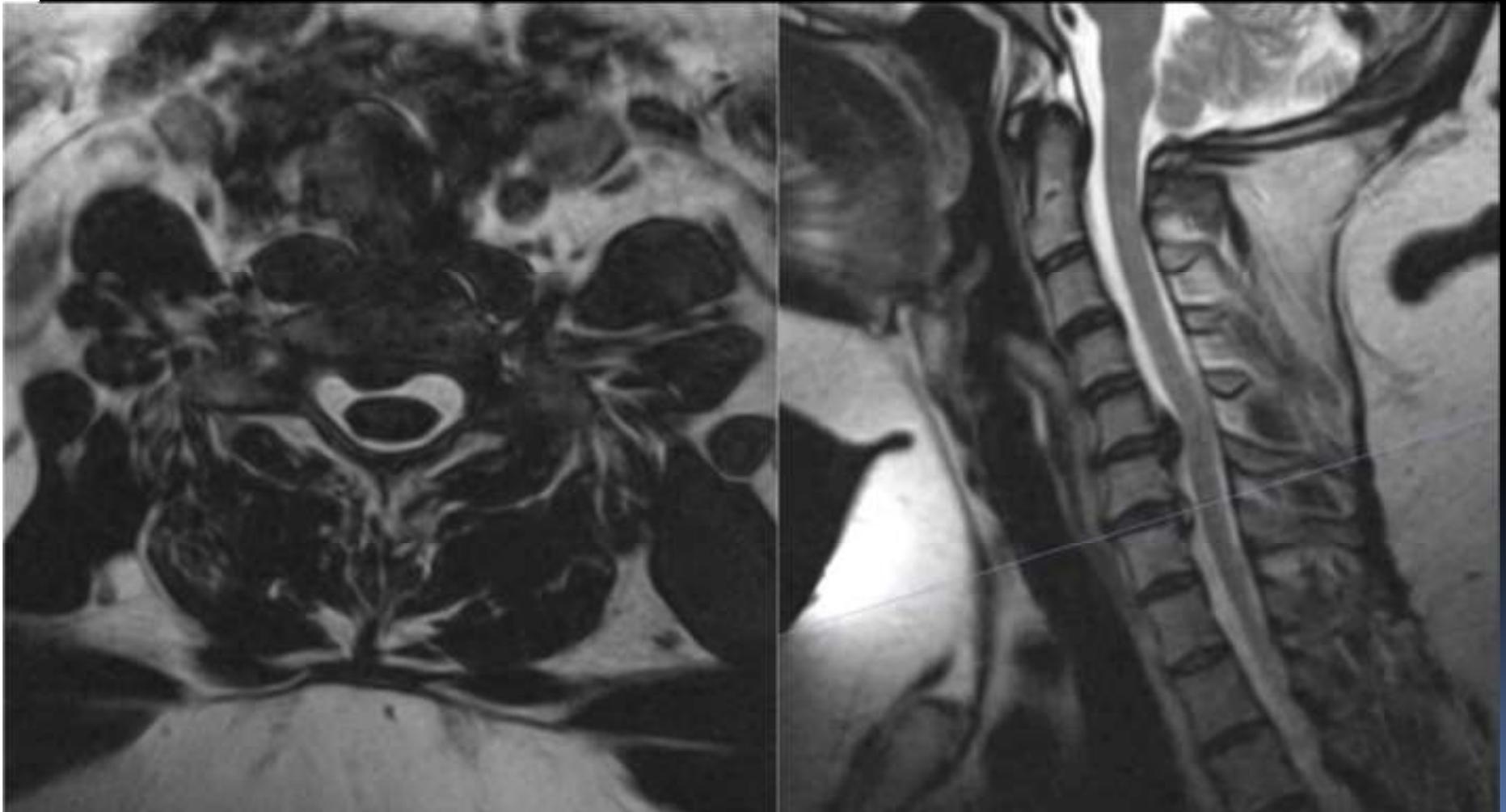
# Cervical Spine: Tansaxial

- Disc contour
  - Neural compression

# Extrusion with neural compression



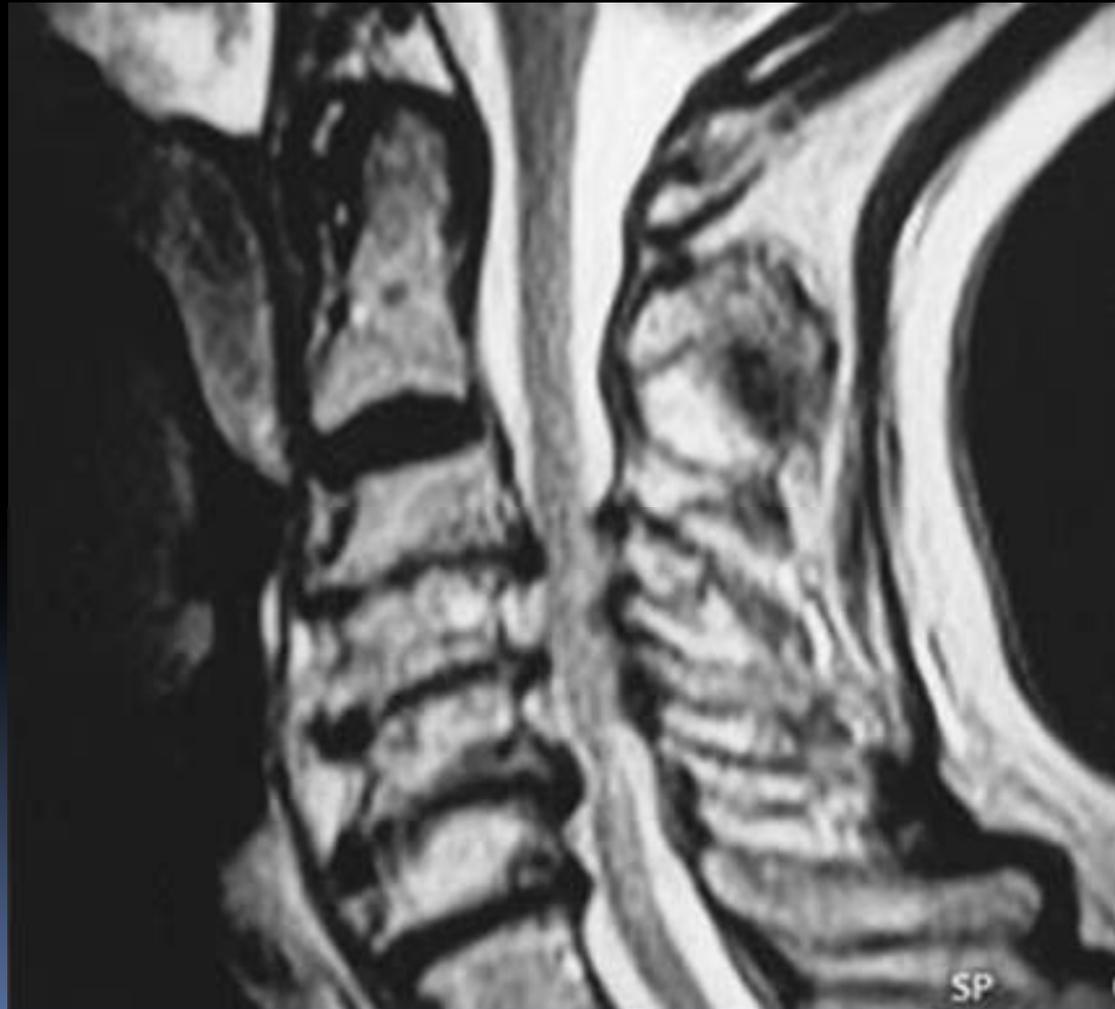
# Protrusion without neural compression



# Cervical Spine: Transaxial

- Canal
  - Cord
    - Size
    - Signal
    - Compression
  - Ligamentum flavum

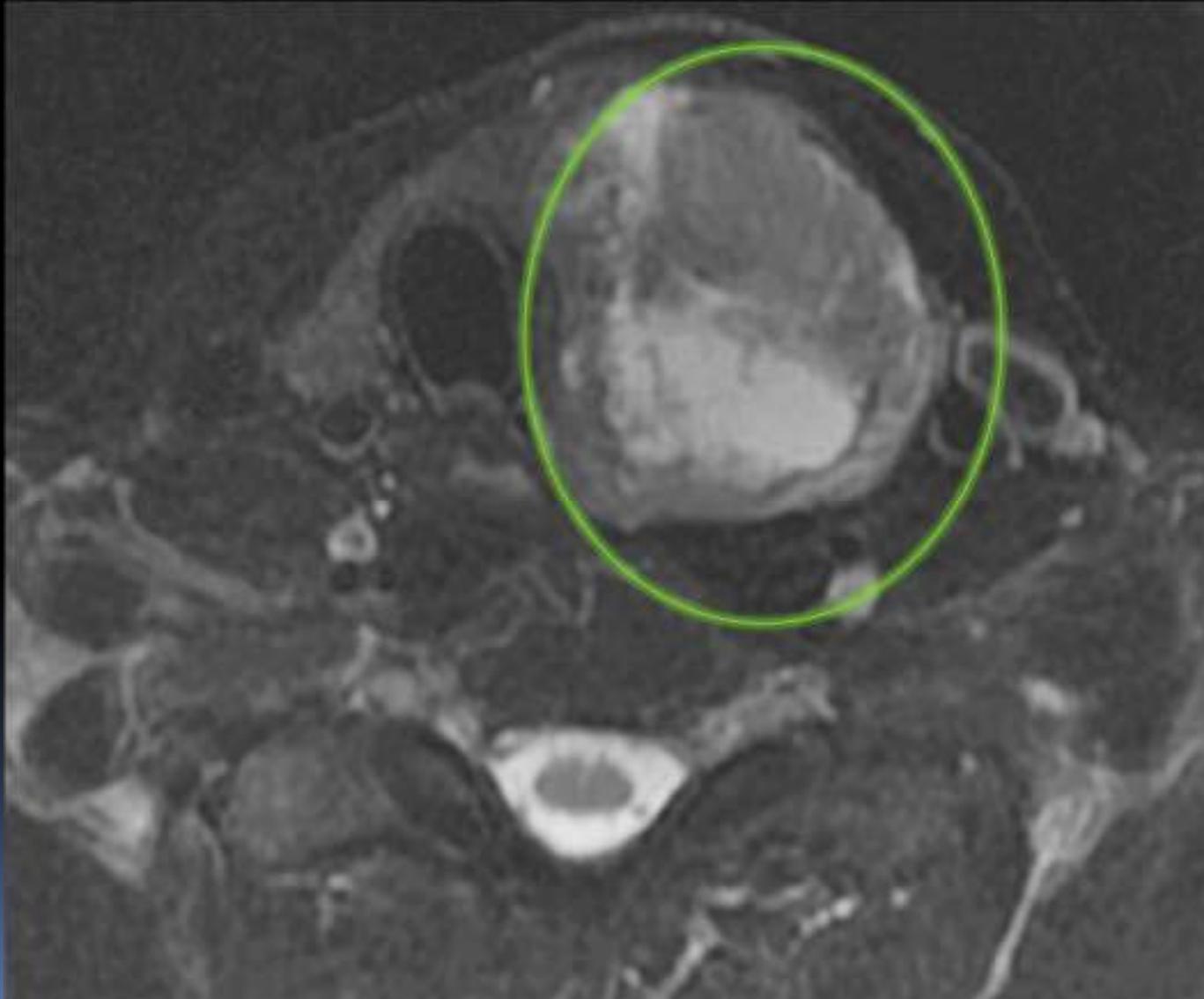
Cord compression, post  
sours/bulge, buckling of lig  
flavum



# Cervical Spine: Transaxial

- Soft Tissues
  - Soft tissue space
  - Thyroid
  - Paravertebral muscles
  - Vertebral artery

# Thyroid carcinoma





JC Carter DC, DACBR  
4480-H S Cobb Dr #325  
Smyrna, GA 30080  
770-984-5395  
[jcradiology.com](http://jcradiology.com)



**SHOULDER AND KNEE MRI:  
WHERE DO I START?**



Thank You For Providing Many  
of the Images in This  
Presentation!

- Sunnyvale Imaging Center
    - 568 South Mathilda Ave.
    - Sunnyvale, CA 94086
    - 408.738.0232
- 

# References

- *Diagnostic Imaging Orthopedics, Stoller et. Al., Amirys, 2004, Salt Lake City, UT*
- *Musculoskeletal MRI, Helms et. Al., Saunders, 2001, Phil PA*
- *Magnetic Resonance Imaging in Ortopaedics and Sports Medicine, D Stoller, Lippincott, Williams and Wilkins, 2007, Baltimore, MD.*
- *Skeletal Imaging Atlas of the Spine and Extremities Taylor Hughes Resnick, Saunders Elsevier , 2010, Maryland Heights, MO.*

# MR Terms

- High (bright) signal-white
- Intermediate signal-light gray
- Low signal-dark gray
- Signal void-black (air is a signal void on ALL imaging sequences)
- Hypo intense-darker than adjacent tissue
- Hyper intense-brighter than adjacent tissue
- Iso intense-same

# MR Sequences

- T<sub>1</sub>
- T<sub>2</sub>
- PD
- Fat Suppressed
  - STIR
  - FS PD FSE

# T1

- Fat- white
- Water-black
- Good anatomical detail

# T2

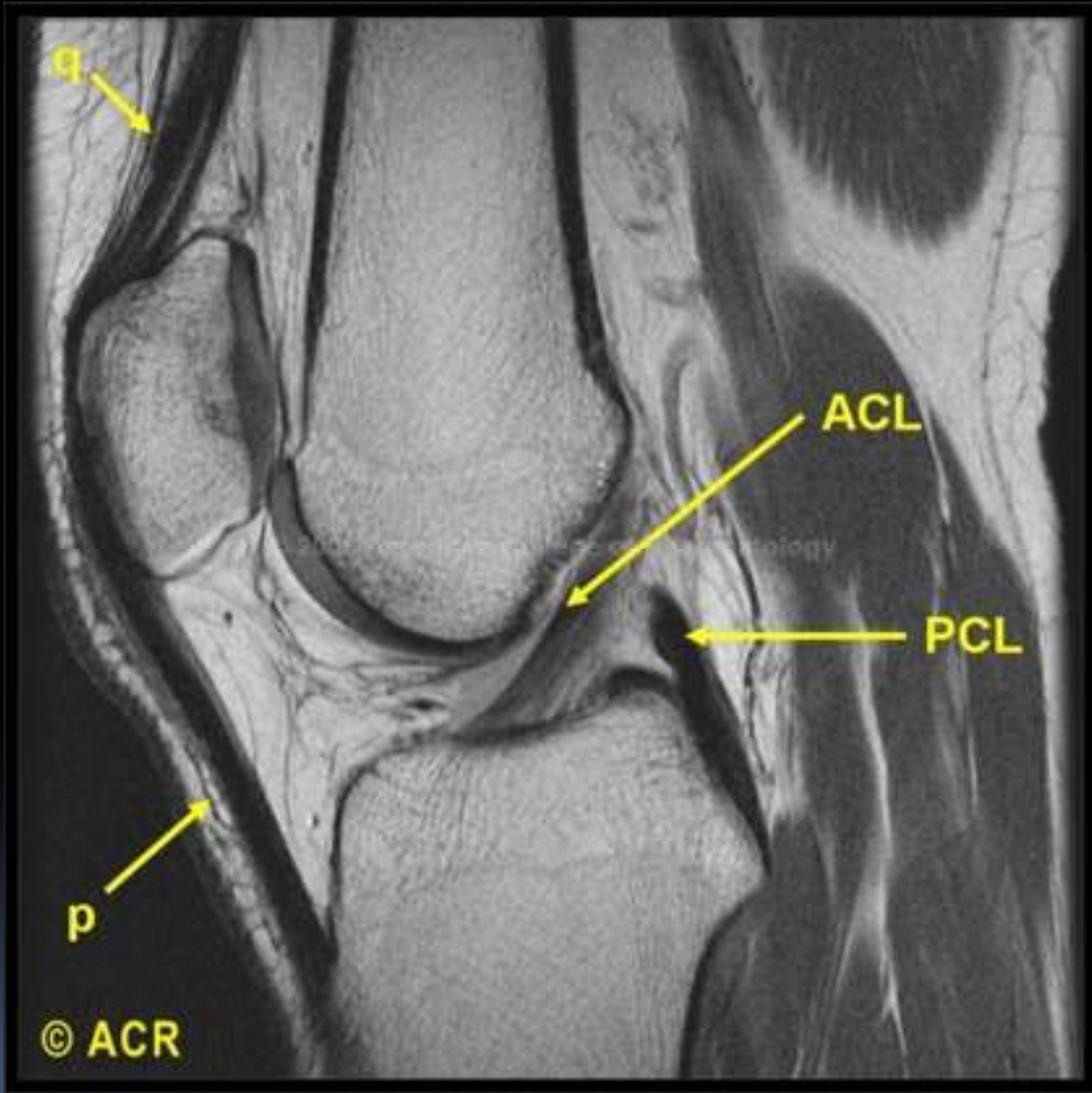
- Fat- dark gray
- Water-white
- Gives physiologic information especially edema (bone or soft tissue)

# T1 from T2

- Locate the synovial fluid
- If black, it is T<sub>1</sub>
- If white, it is T<sub>2</sub>, STIR, or FS PD FSE
- If gray, it is likely PD

# Proton Density (PD)

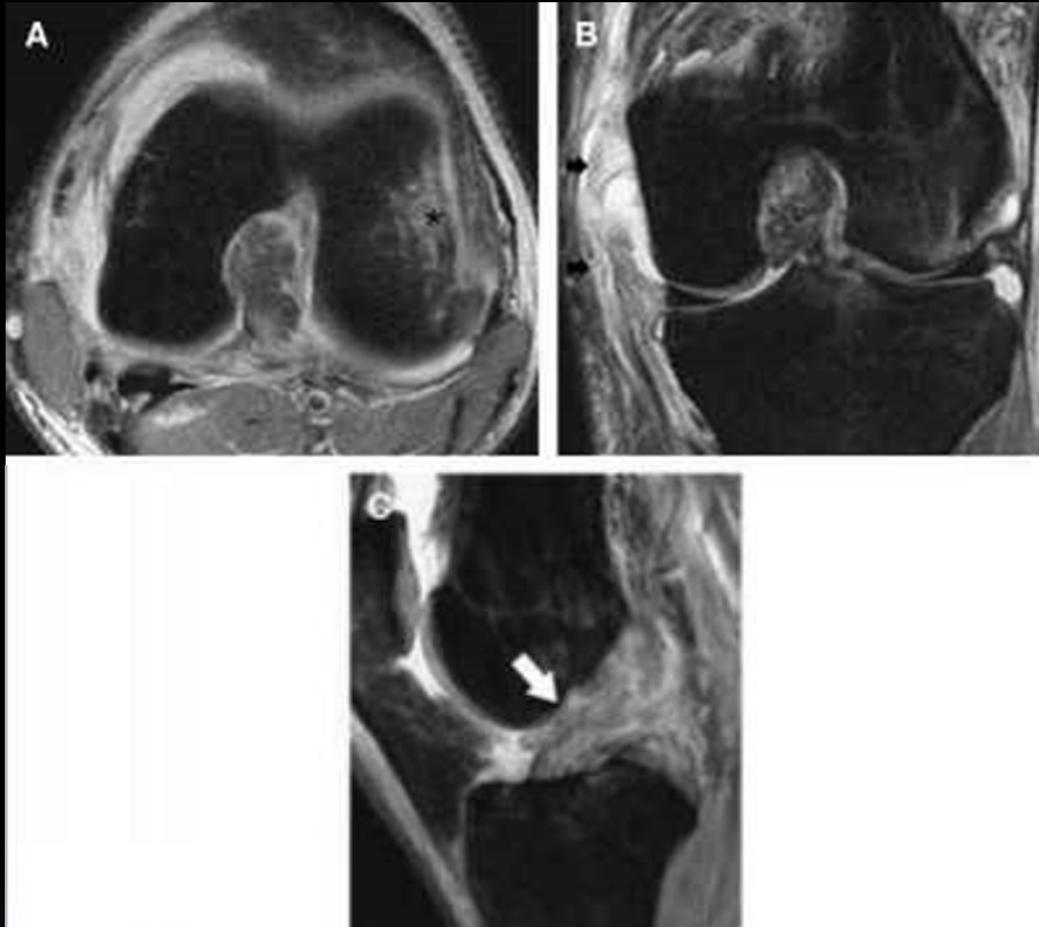
- Fat- light gray
- Water-medium gray
- Good for cartilage evaluation
- Not very common





# Fat Suppressed Proton Density Fast Spin Echo (FS PD FSE)

- Fat- black
- Water-bright
- Good for bone marrow edema, synovial fluid, tendons, ligaments, and cartilage evaluation



- A: bone bruise
- B: MCL tear
- C: ACL tear

# Short T1 Inversion Recovery (STIR)

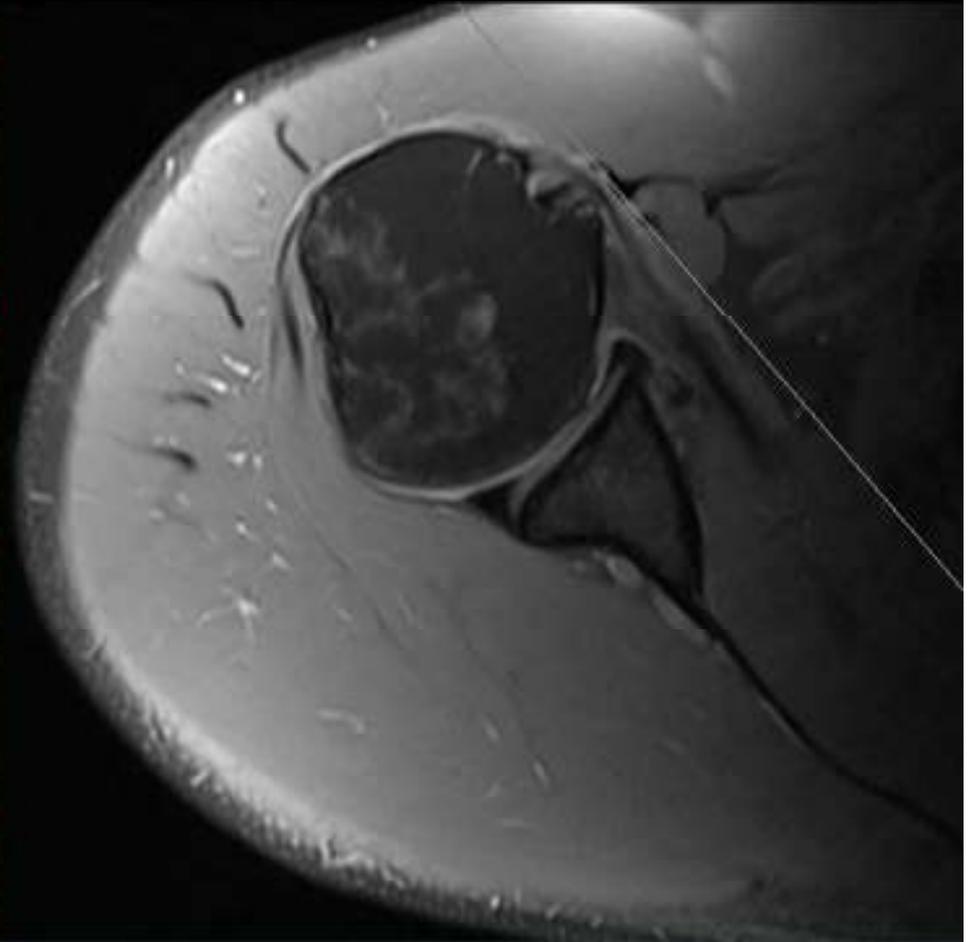
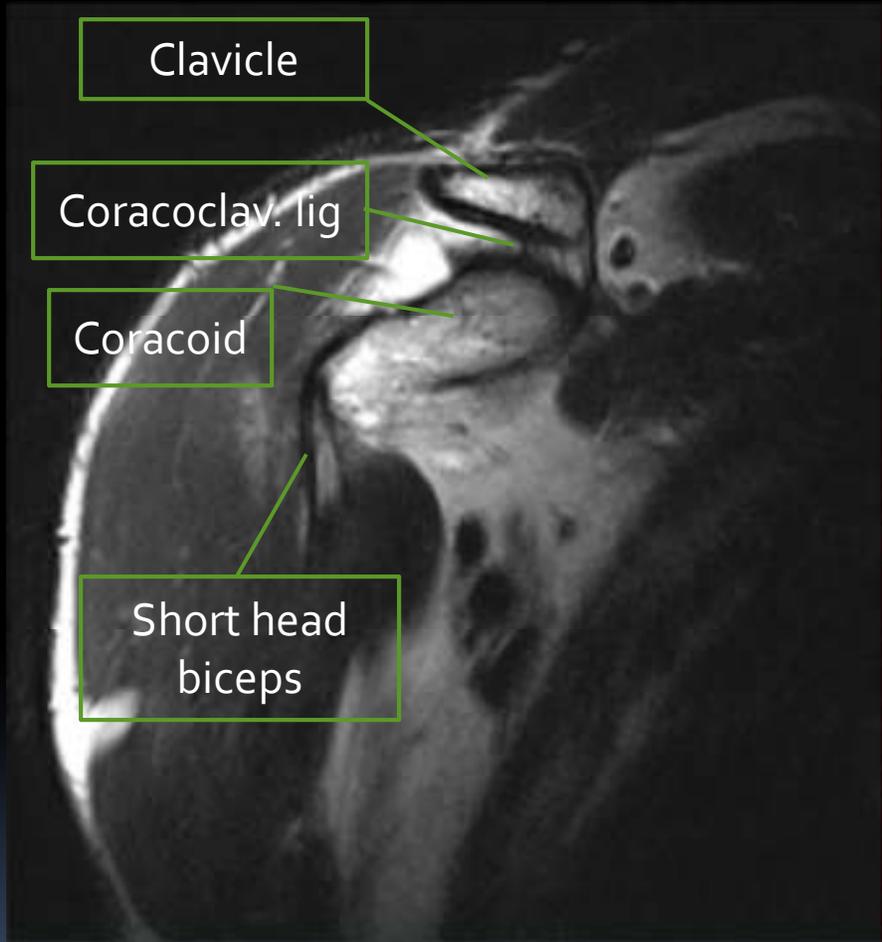
- Fat- black
- Water-bright
- Takes longer to do than FS PD FSE
- Good for bone marrow edema, synovial fluid, tendons, ligaments, and cartilage evaluation

# STIR

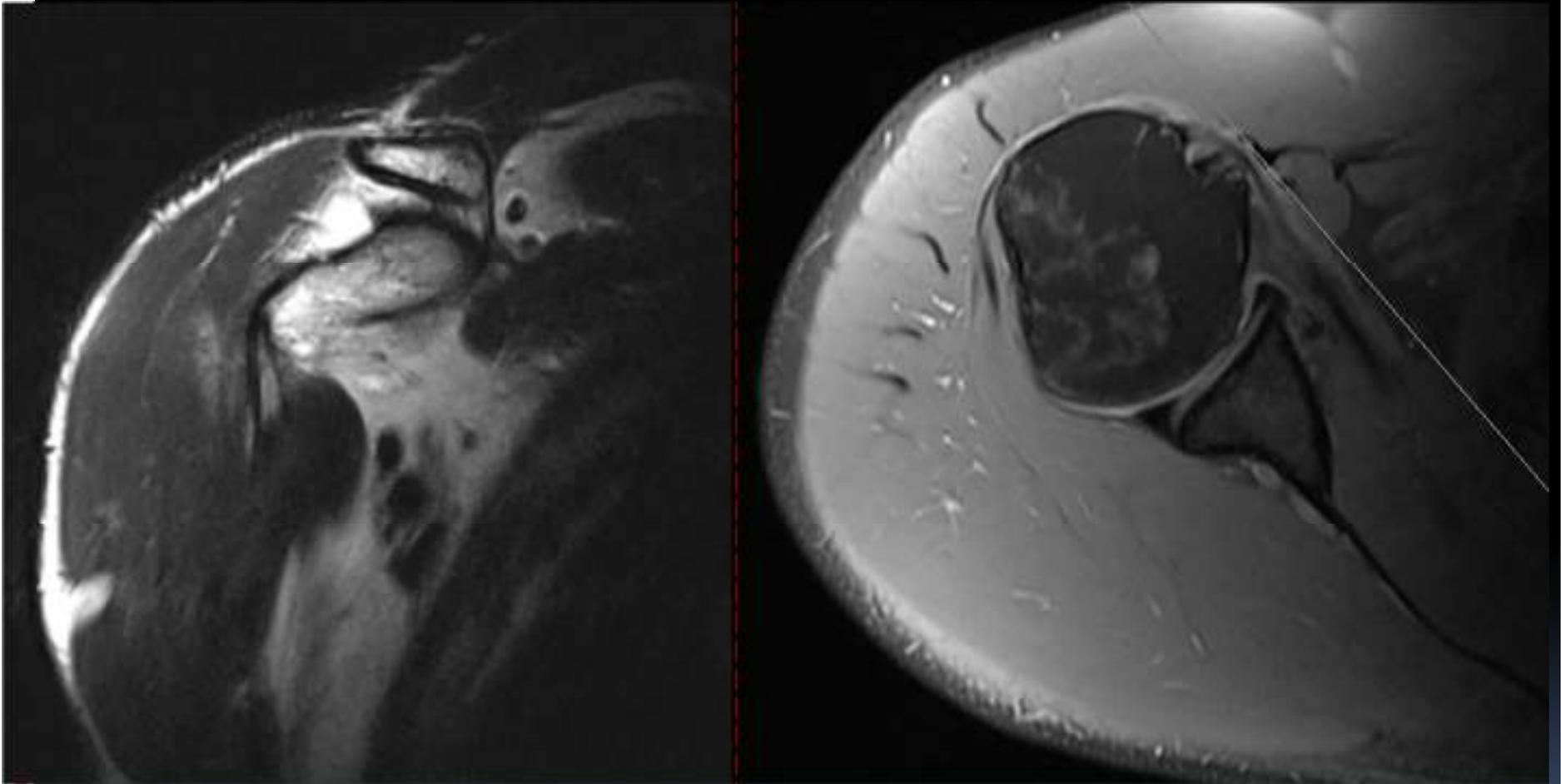
- Anything bright is fluid
- Great for evaluation of tumor (especially metastasis), fracture and bone bruising

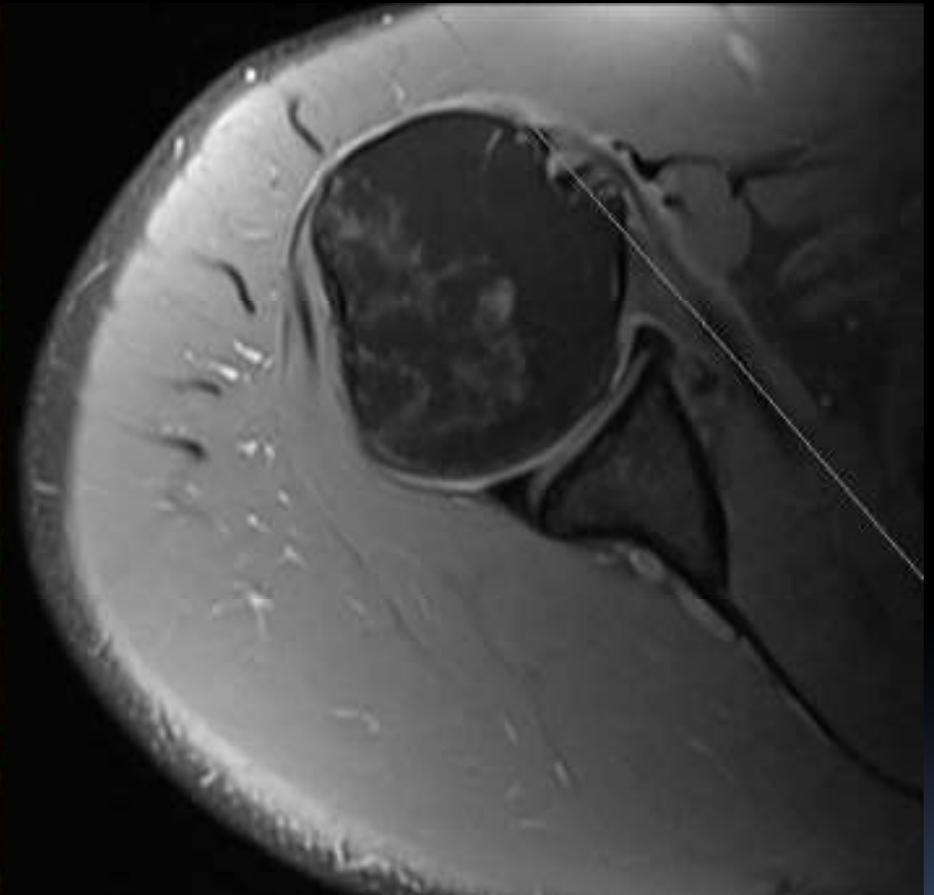
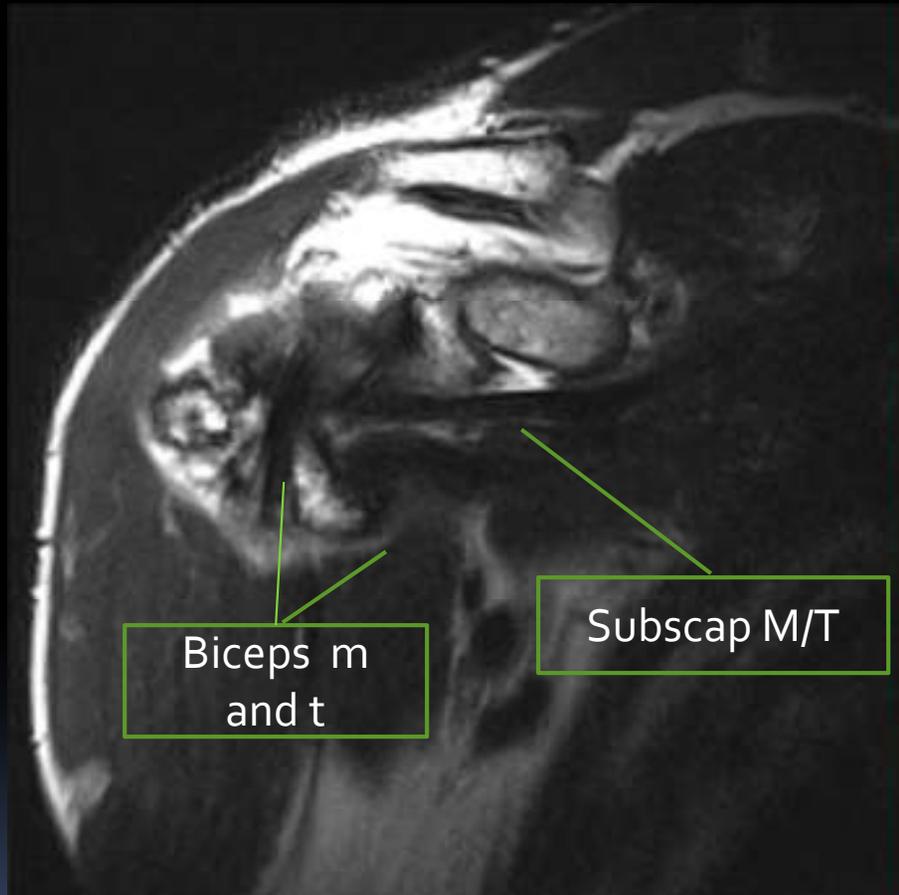
# Normal Shoulder Anatomy

- Don't get too frustrated, it takes a long time to learn

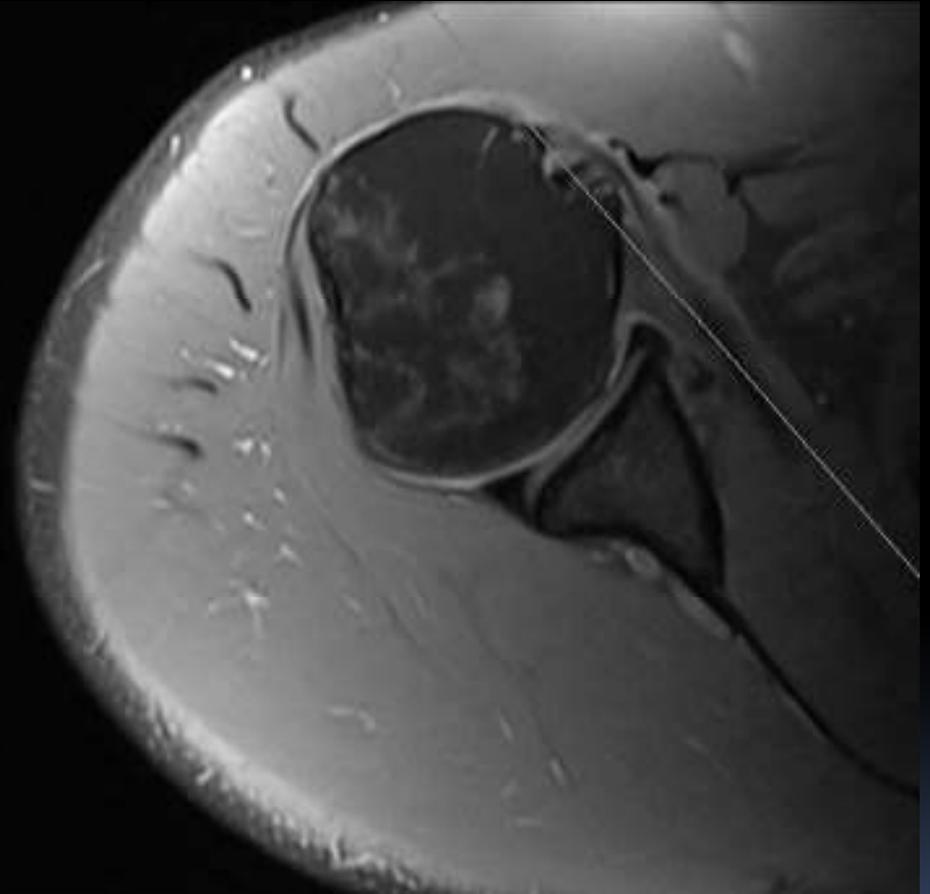
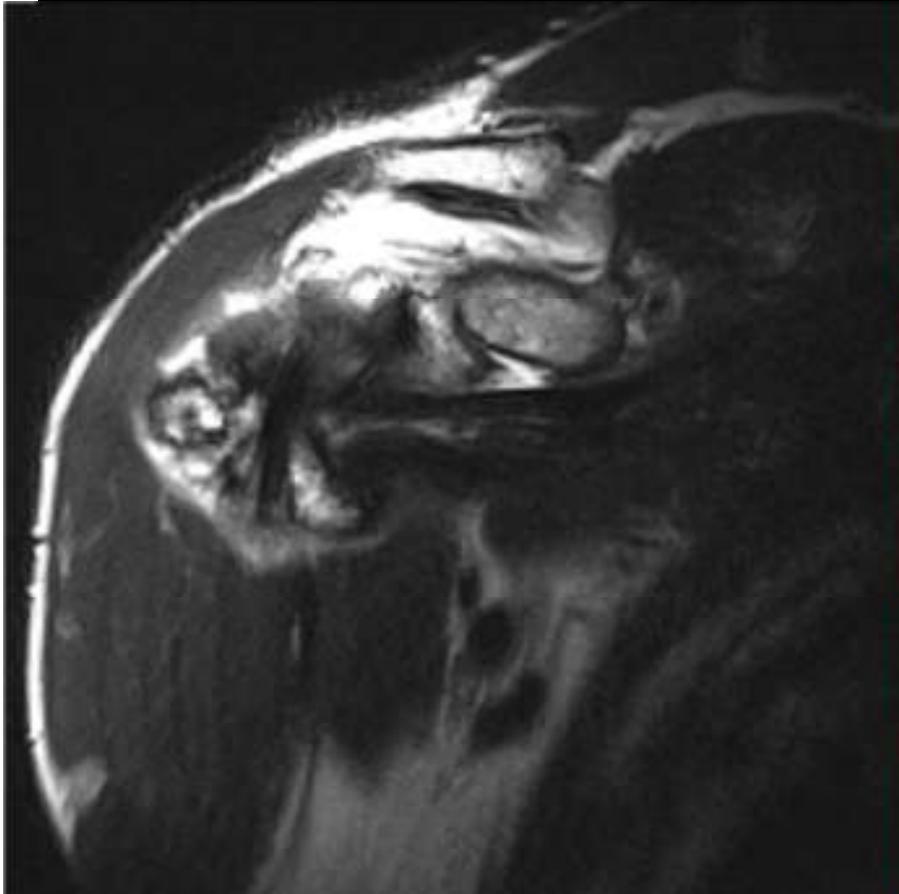


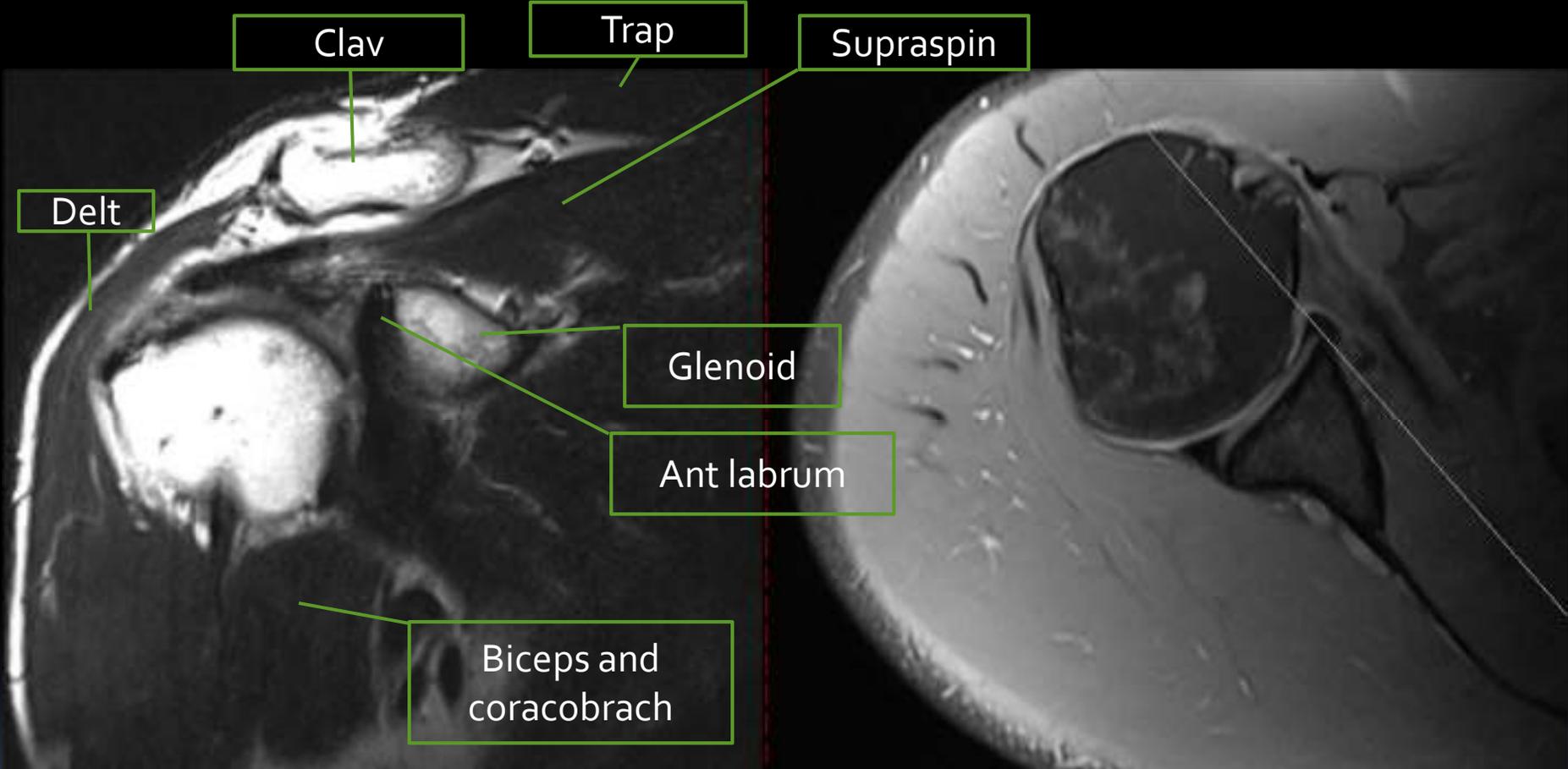
Find????



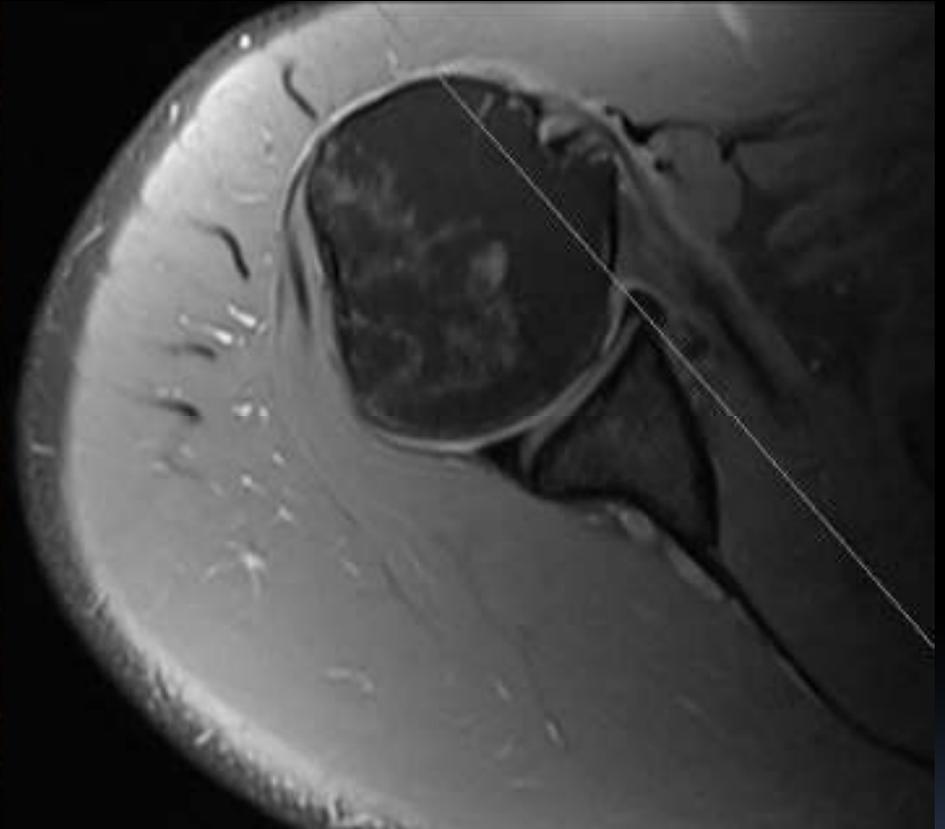
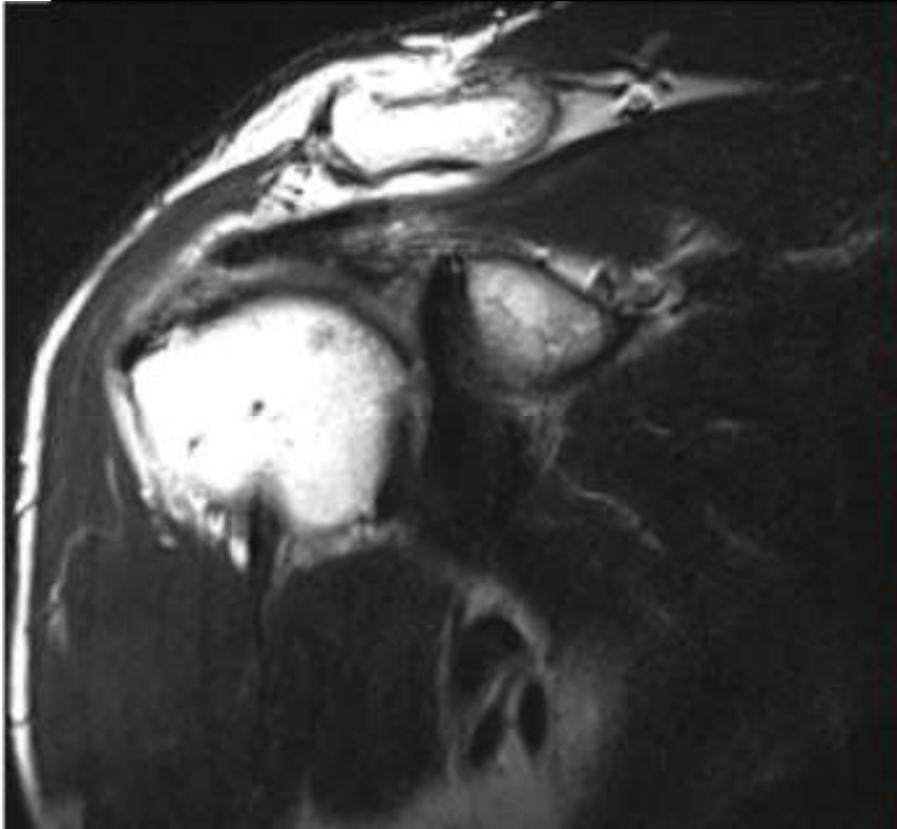


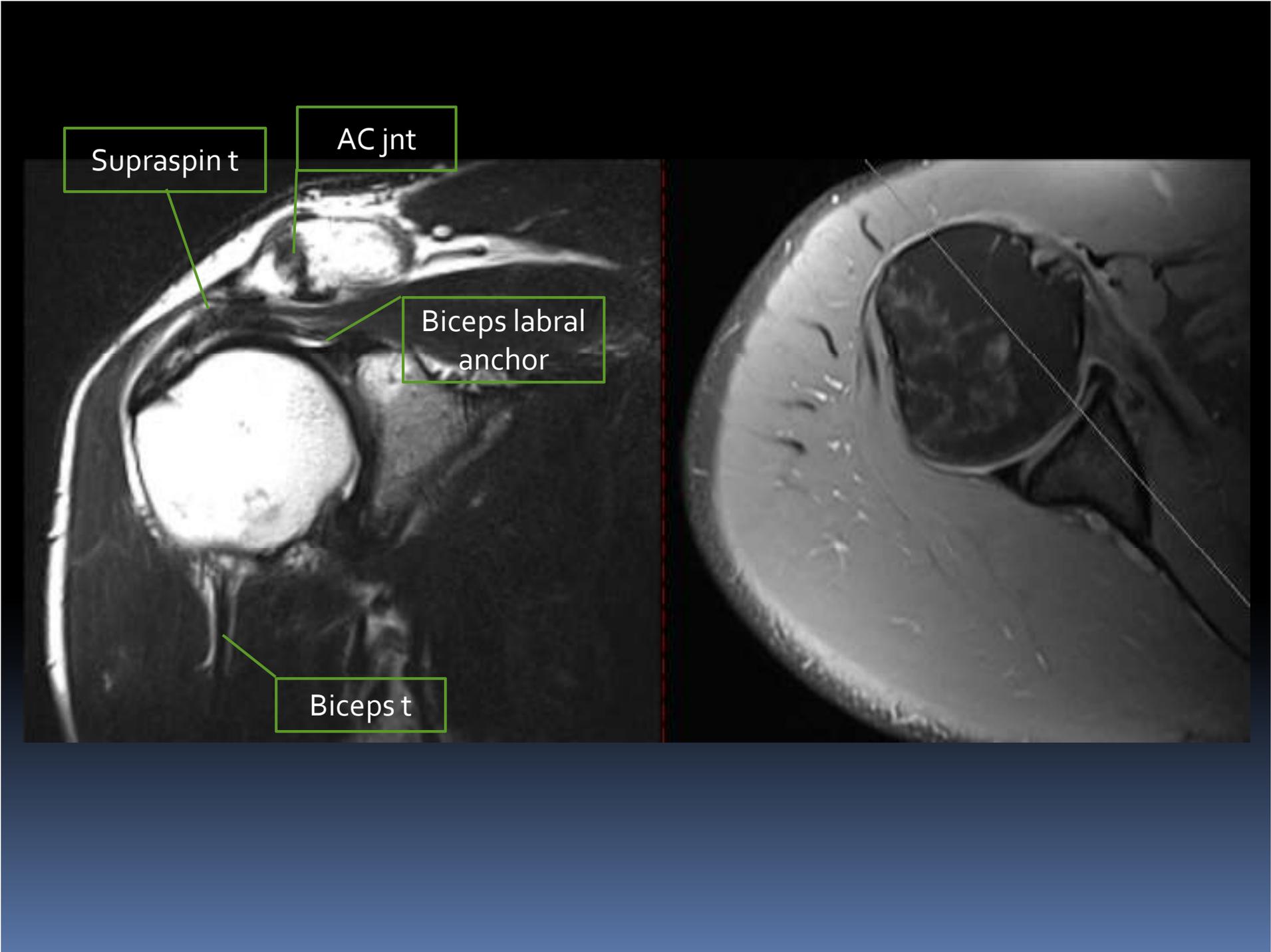
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Find????





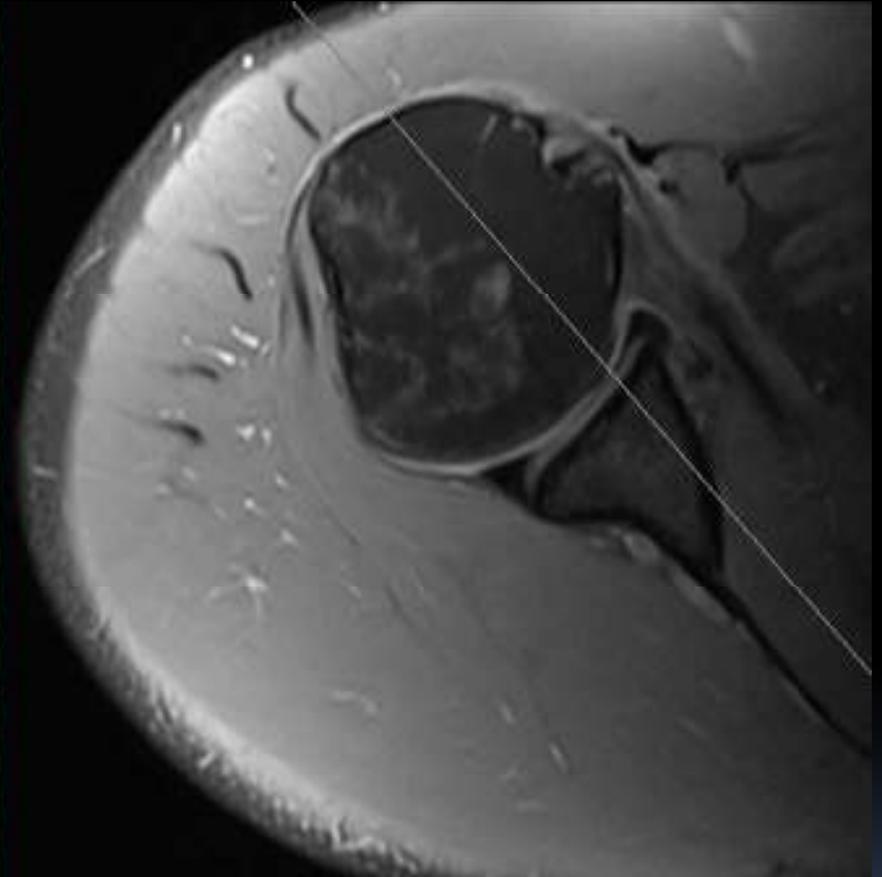
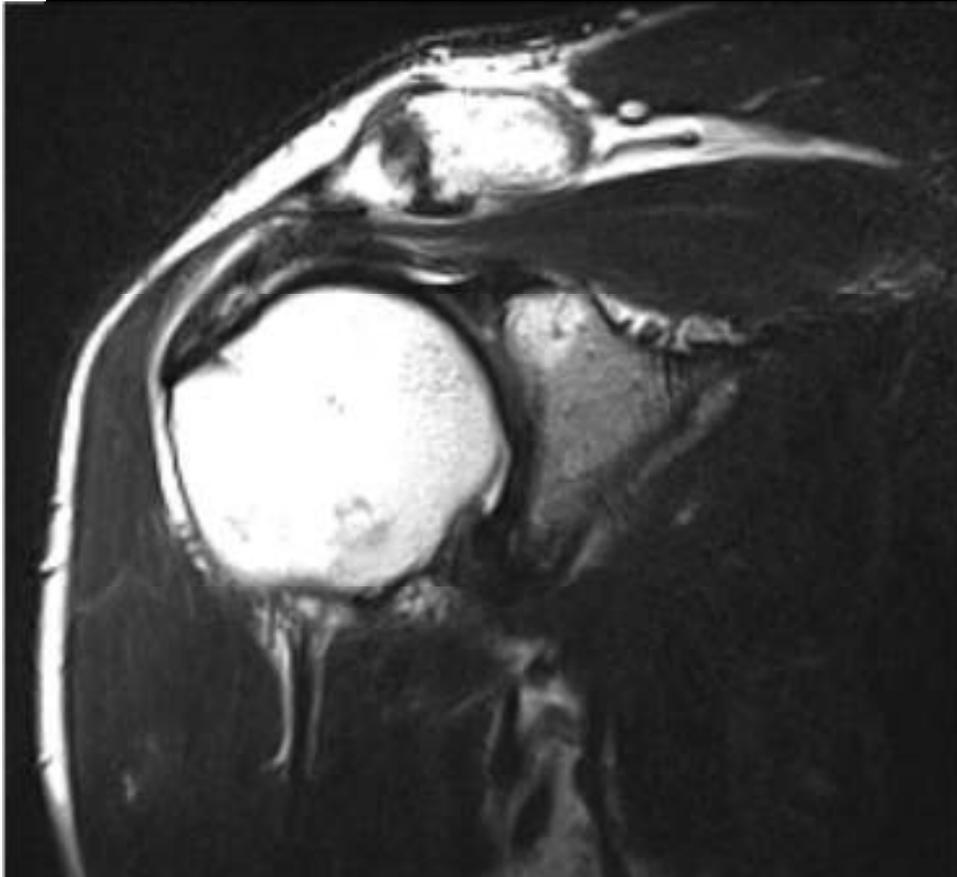
Supraspin t

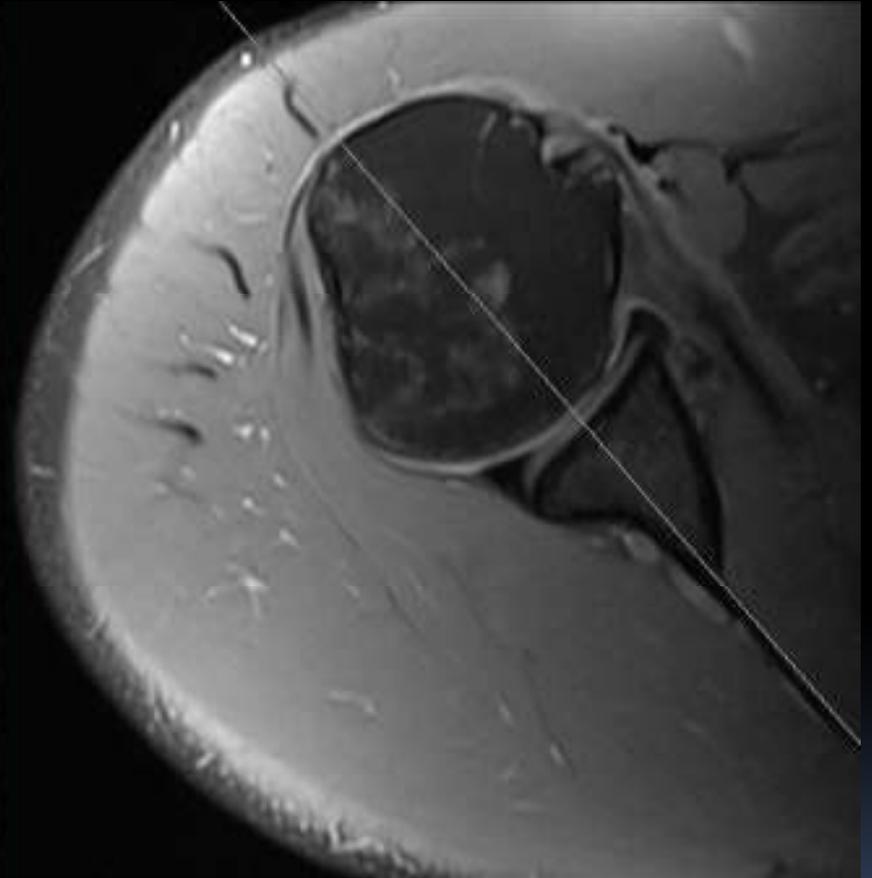
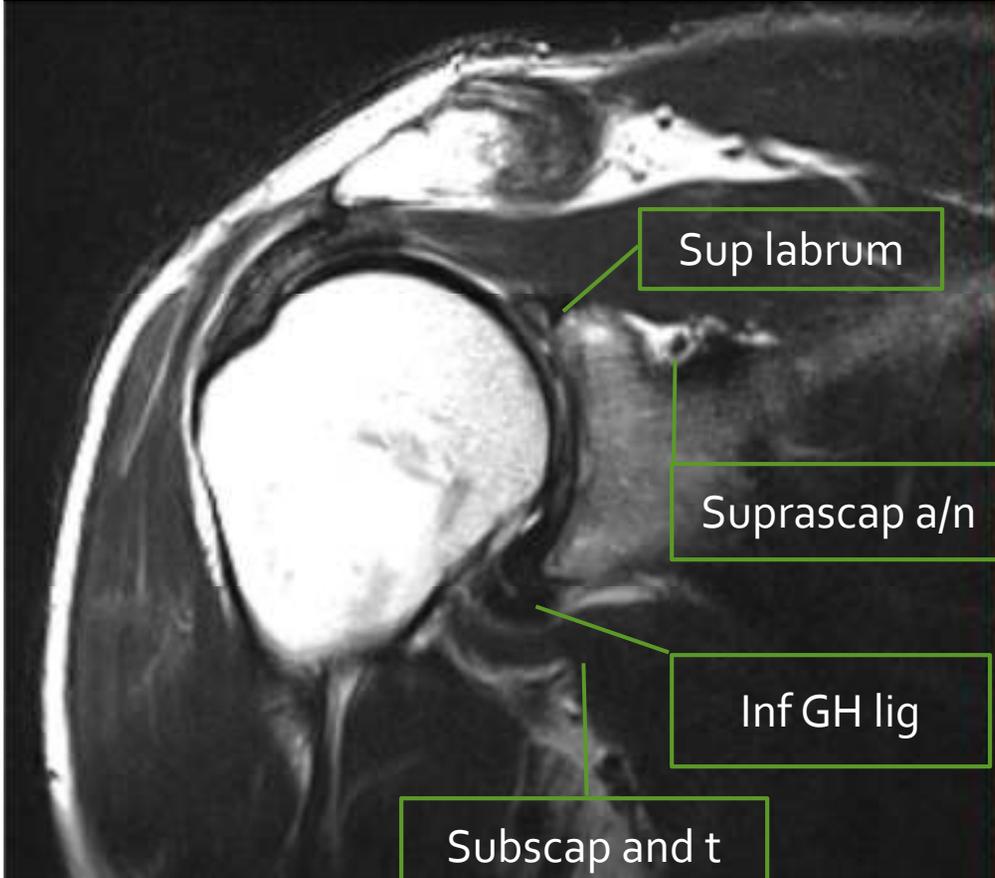
AC jnt

Biceps labral anchor

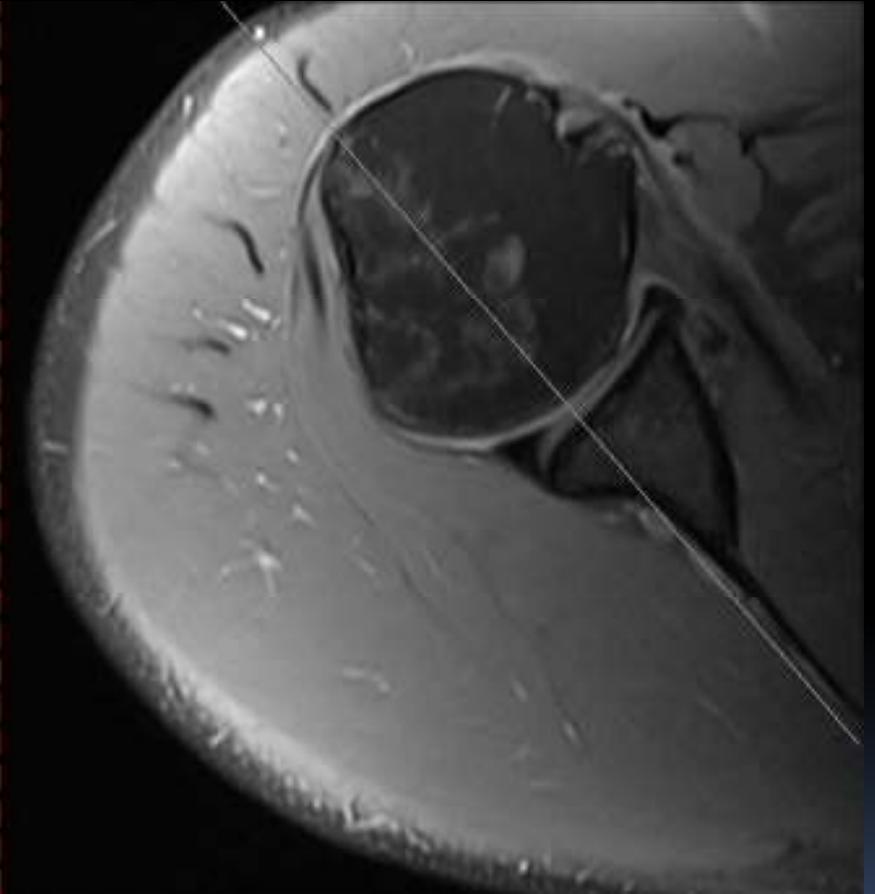
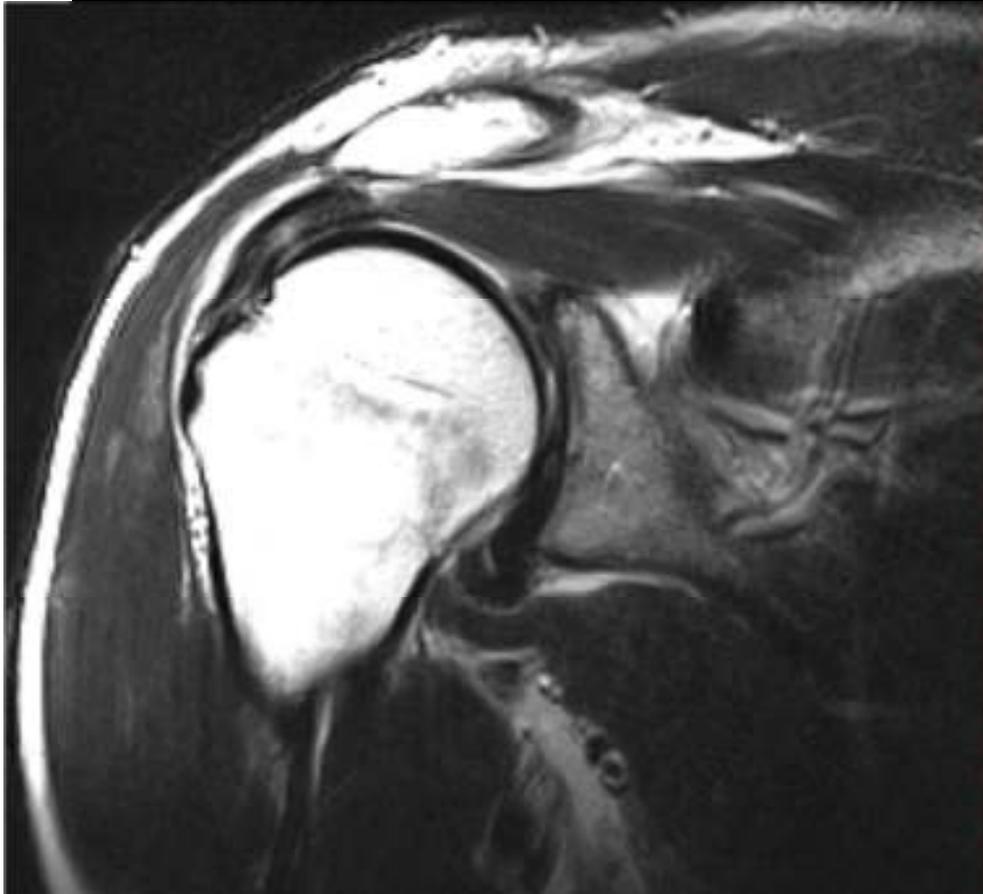
Biceps t

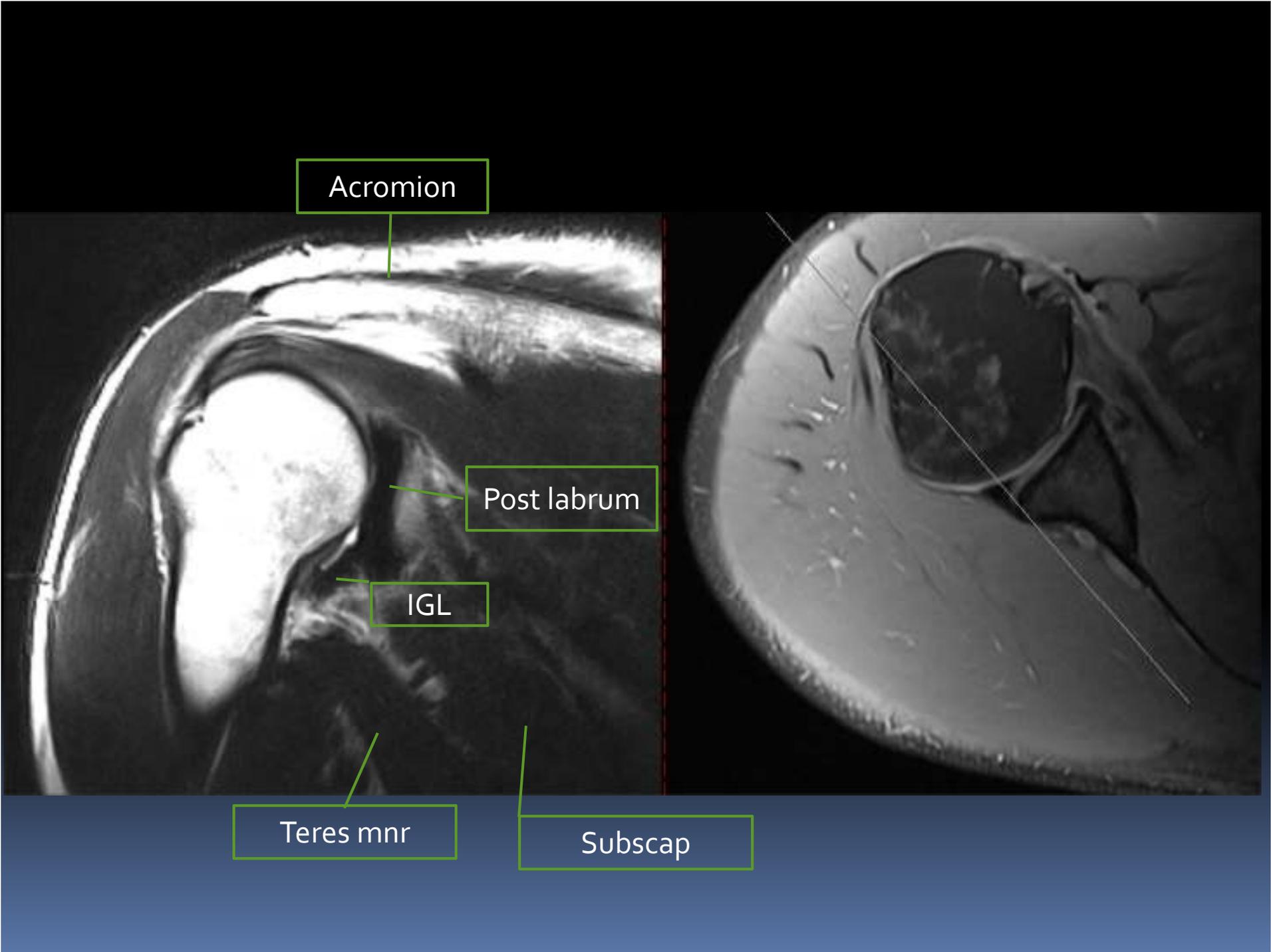
Find????





Find????





Acromion

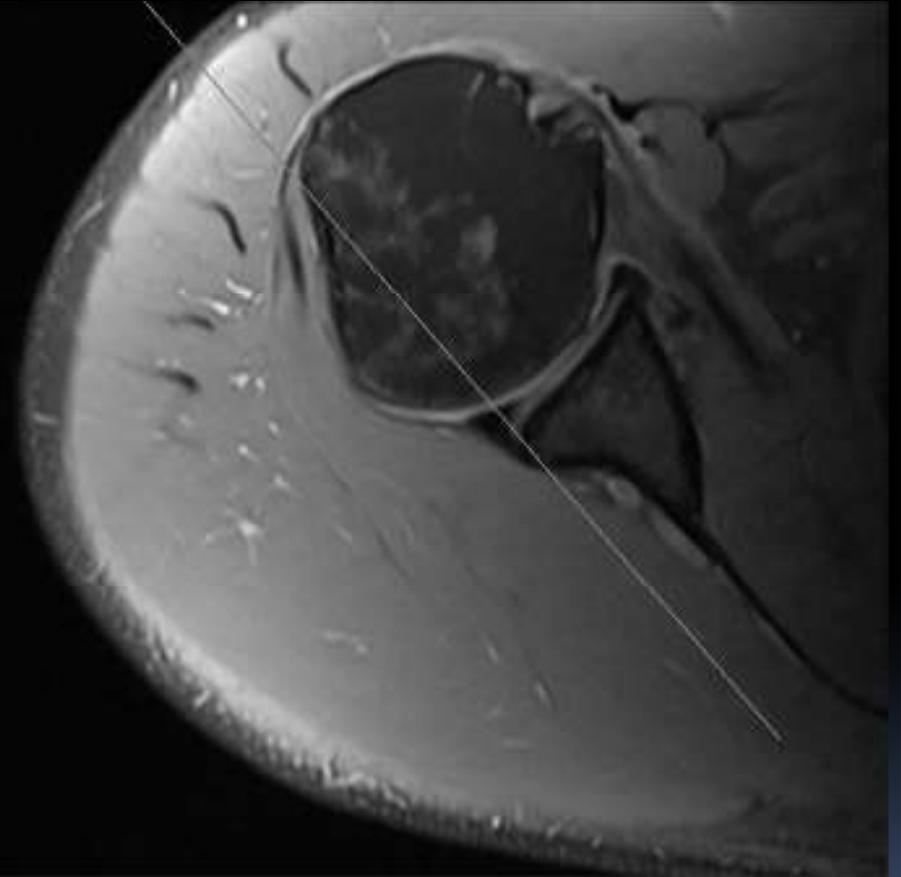
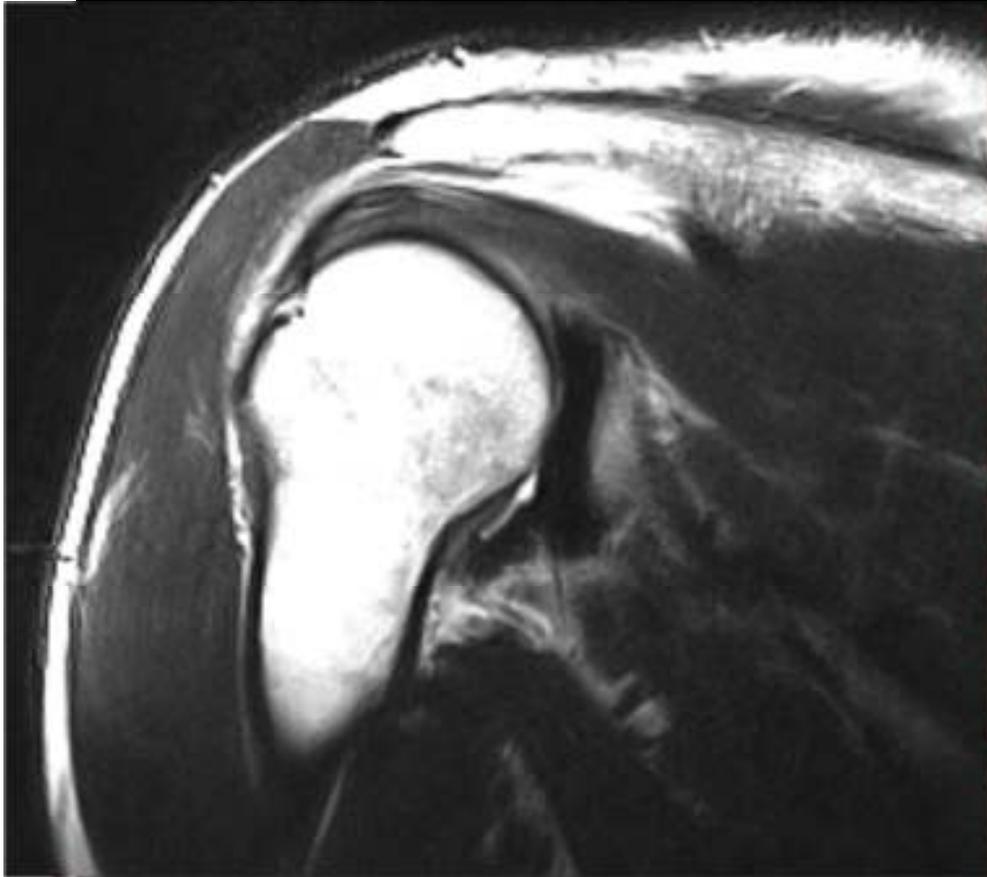
Post labrum

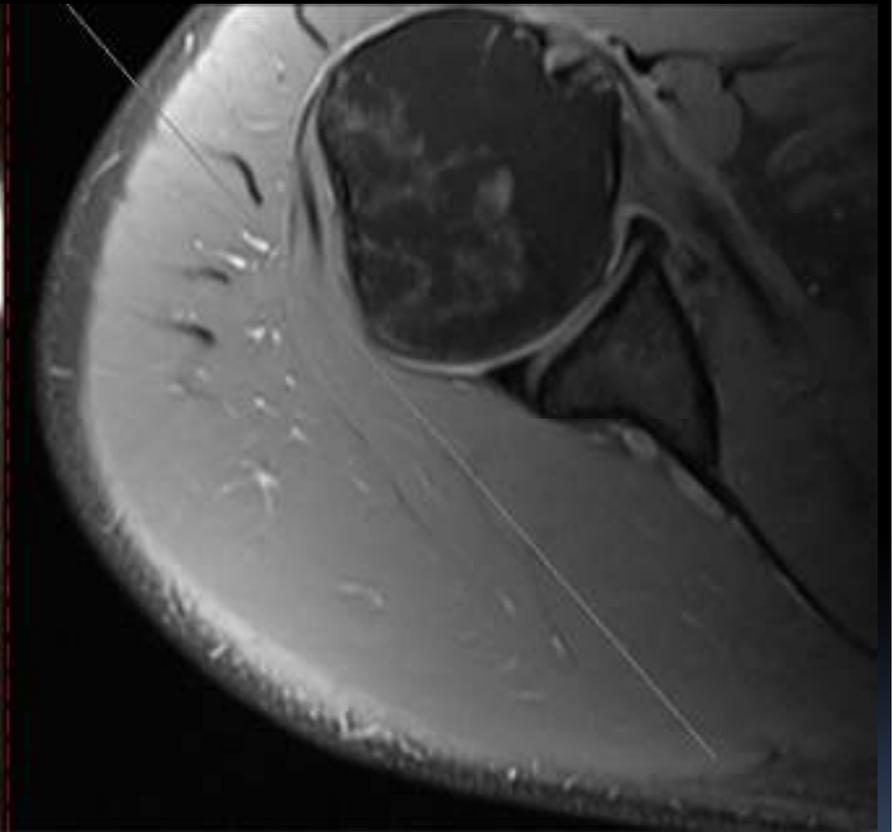
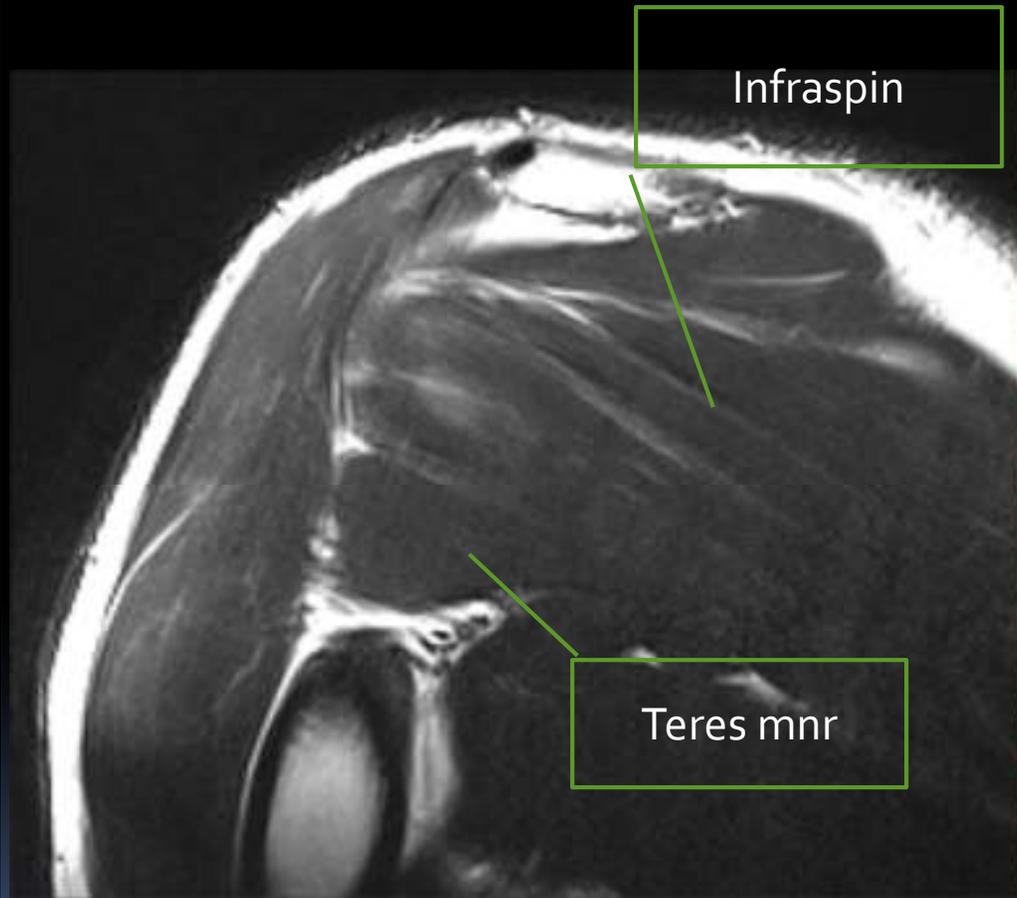
IGL

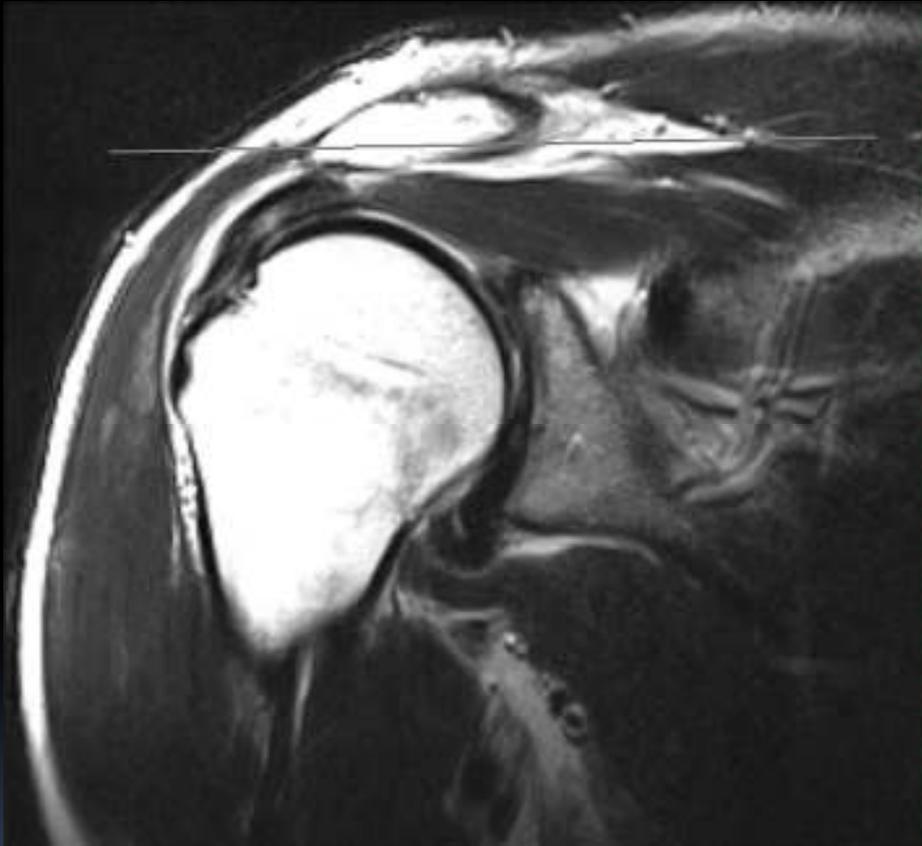
Teres mnr

Subscap

Find????

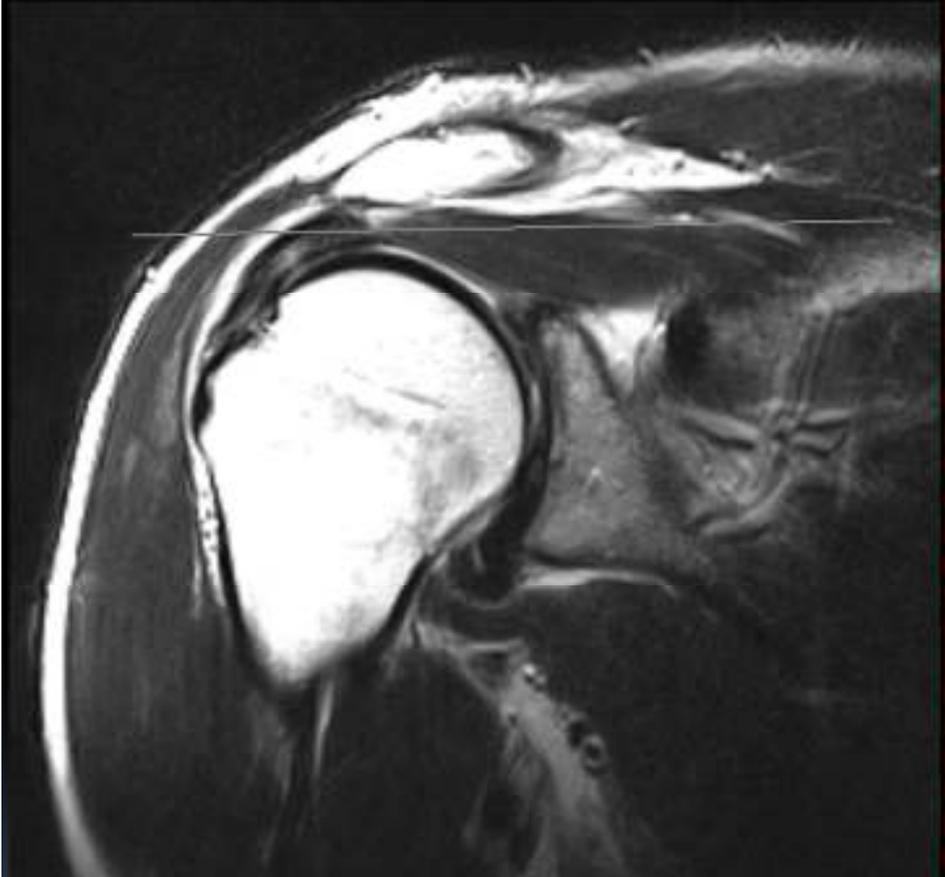




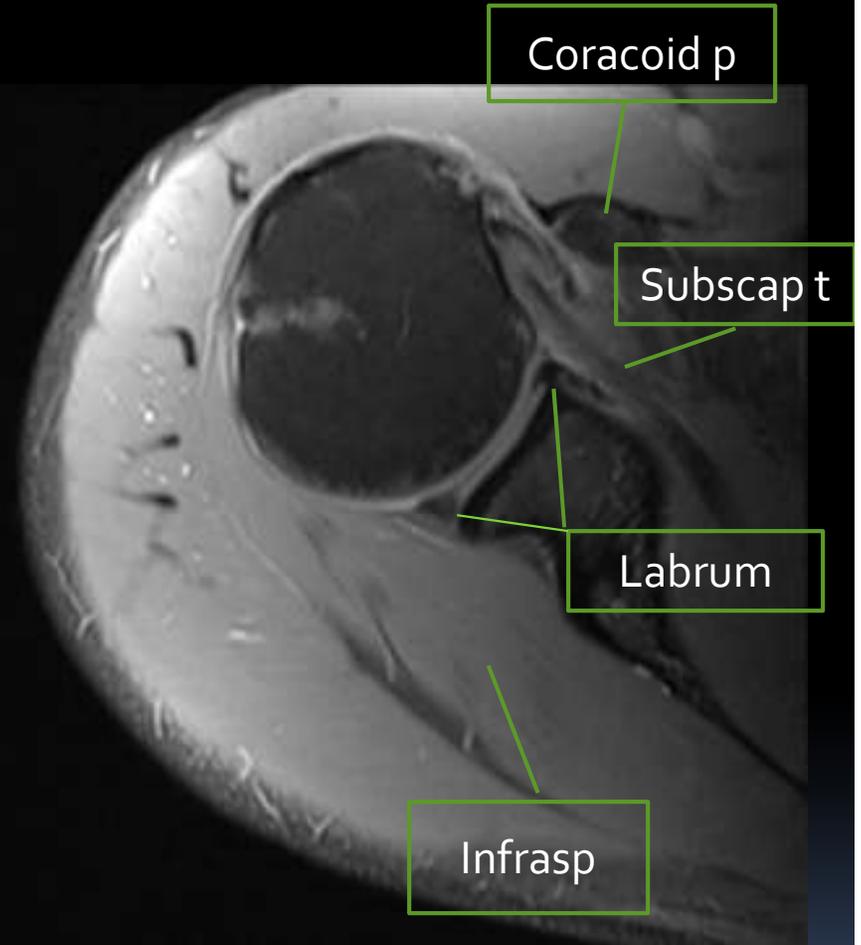
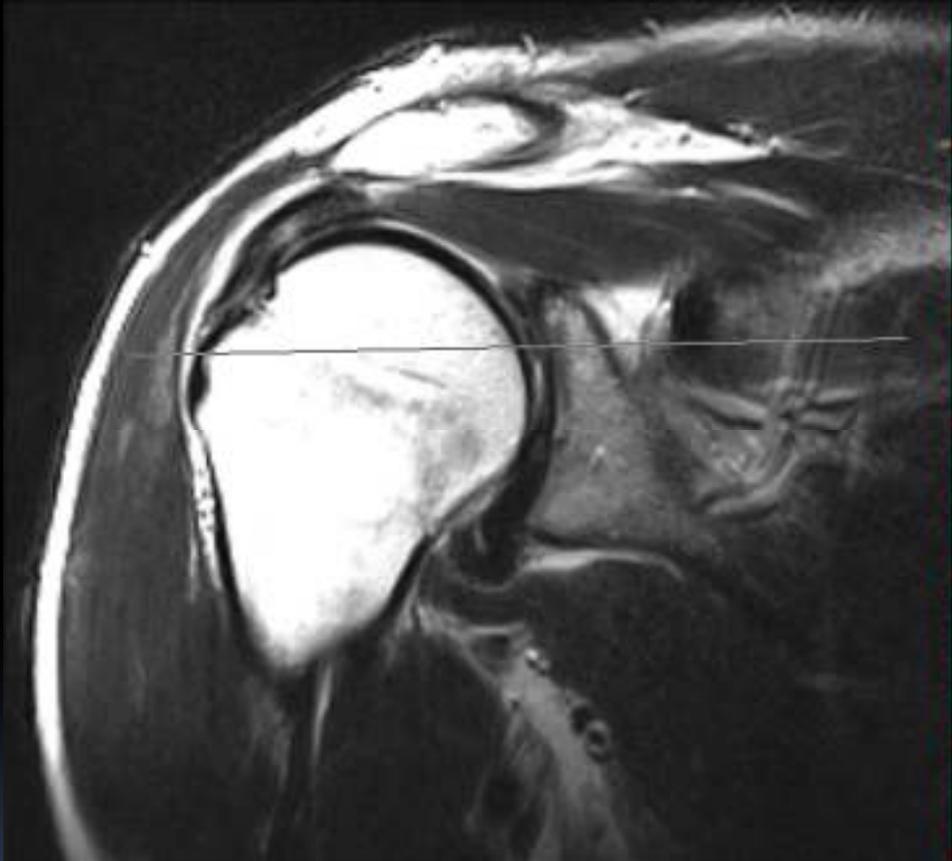


Clav

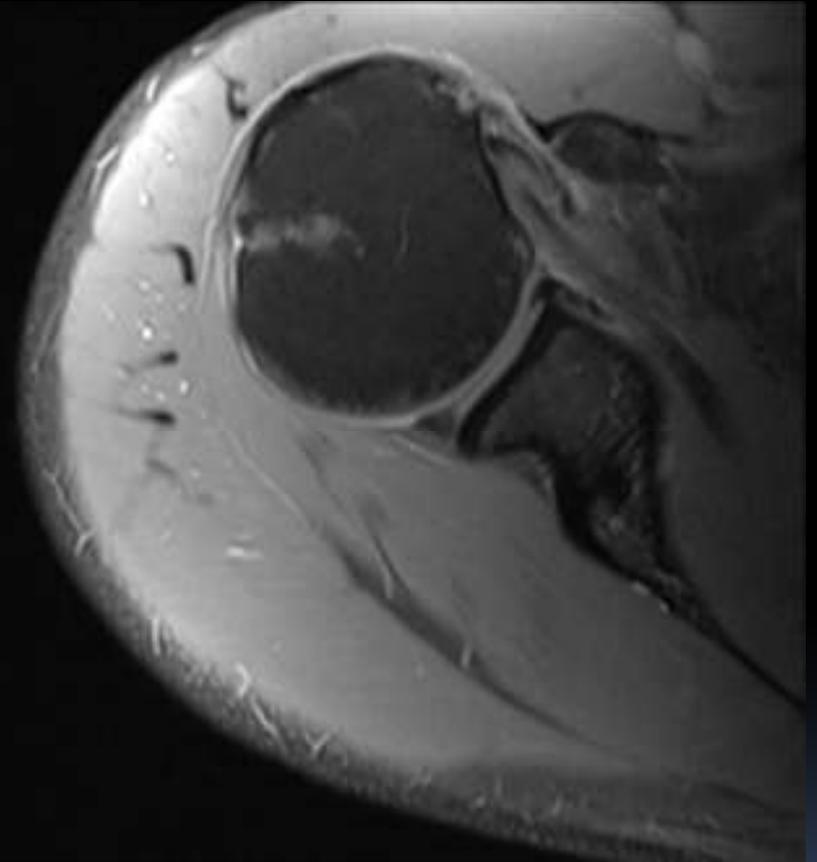
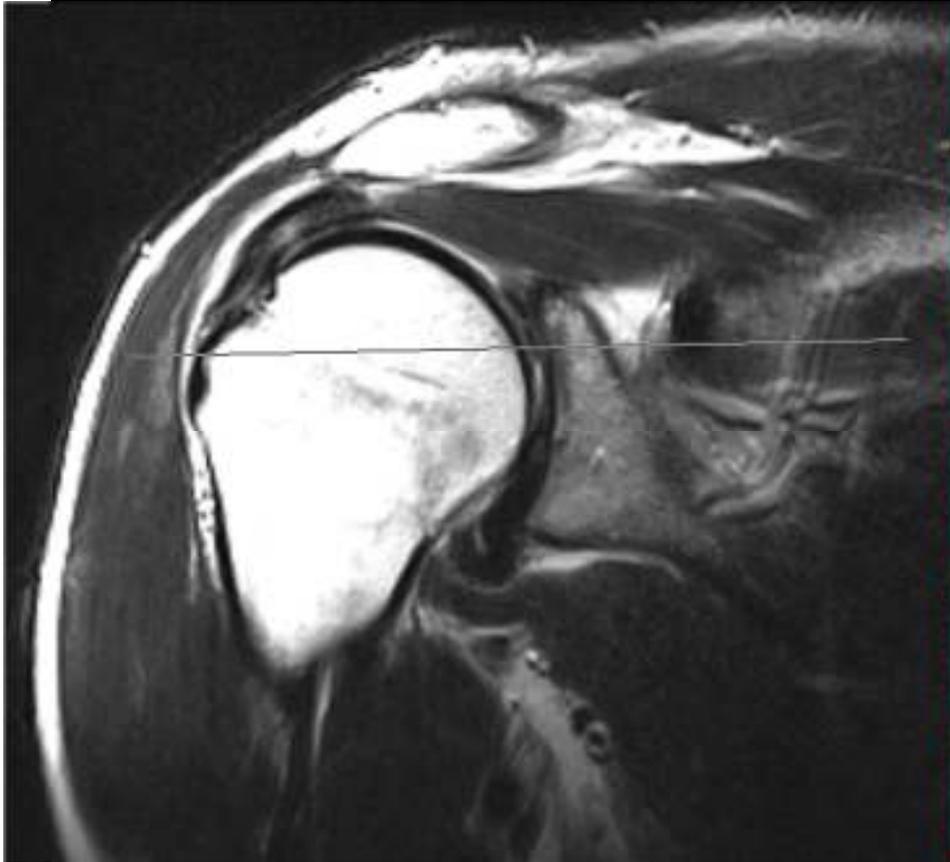
Acromion

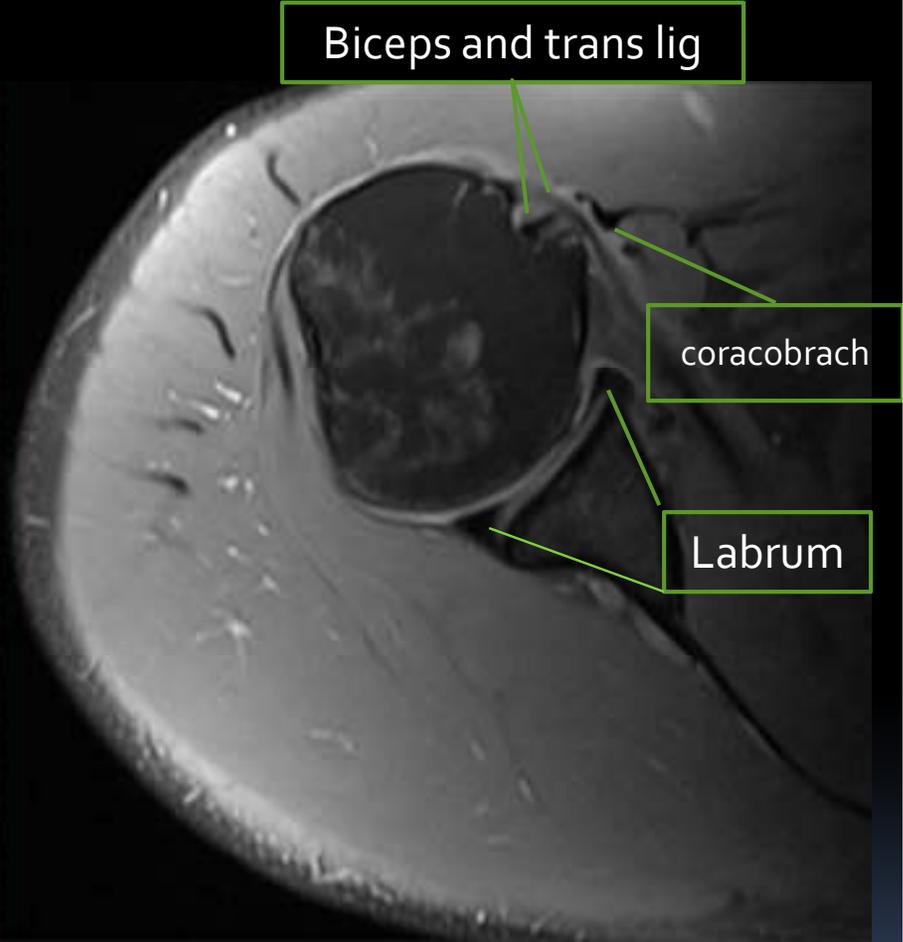
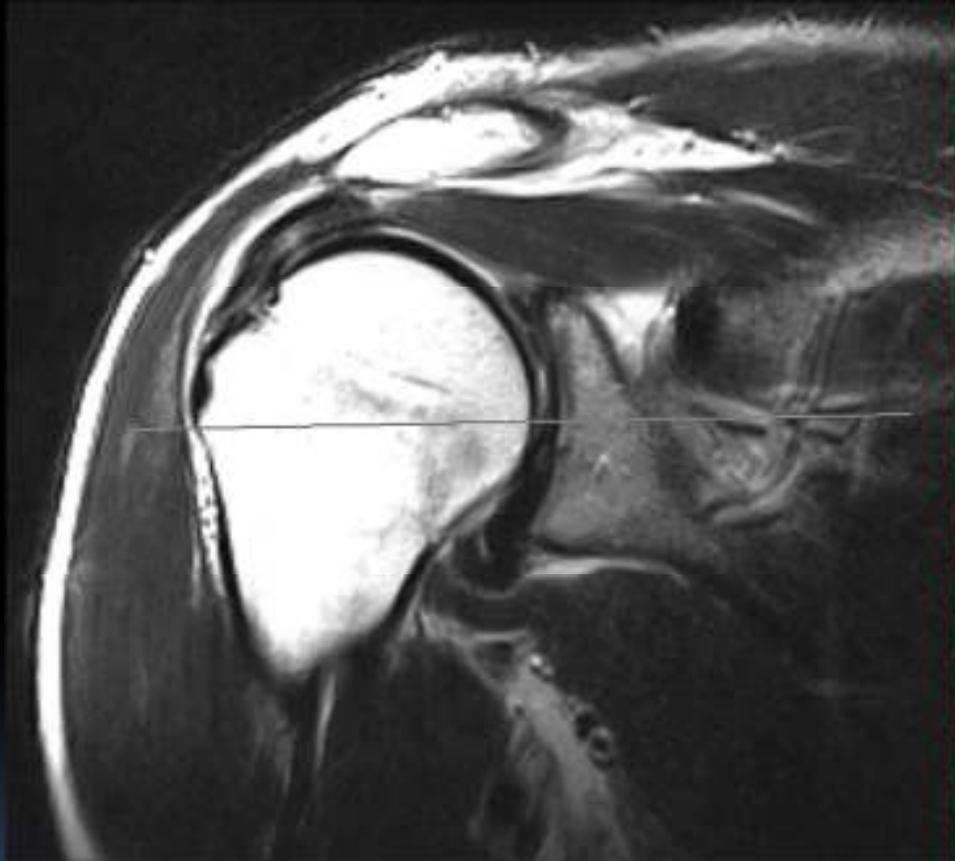


Suprasp and  
central t

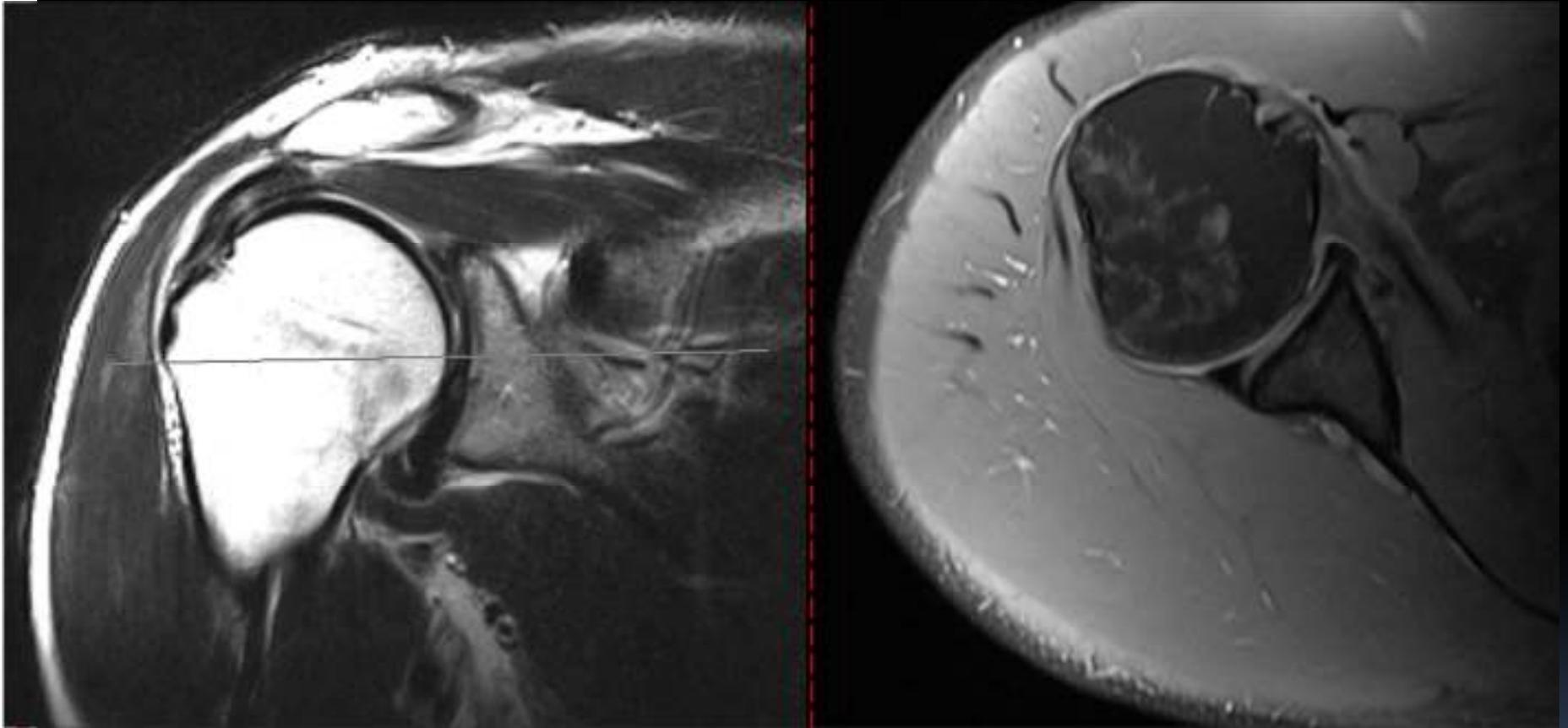


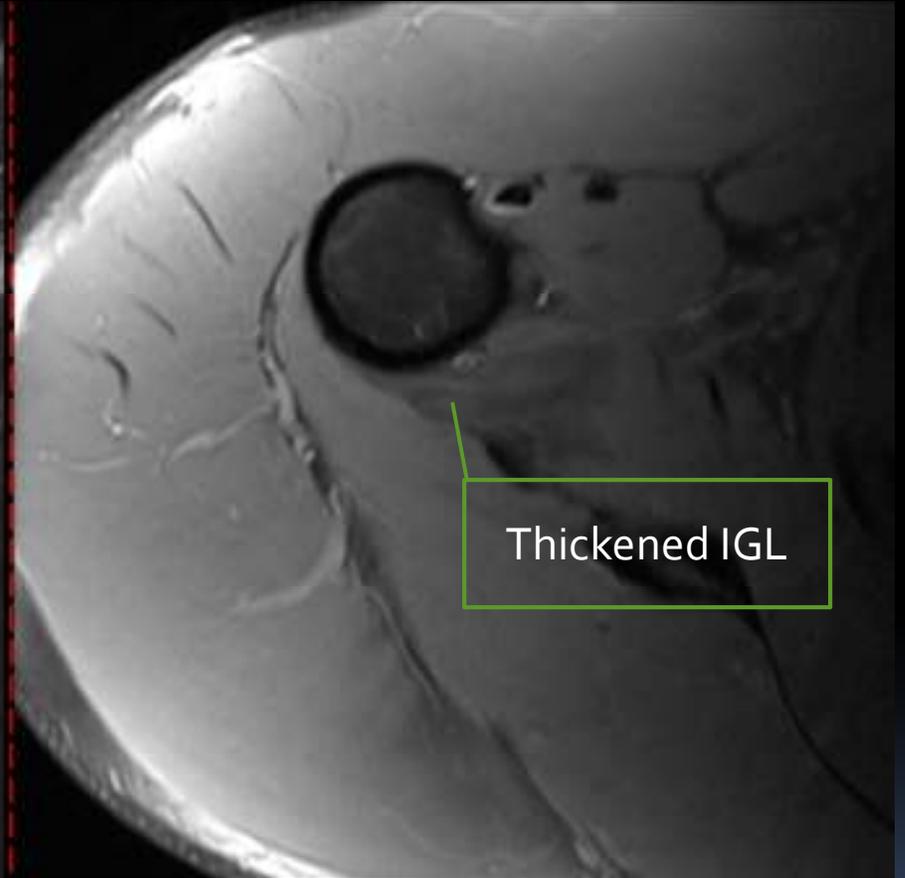
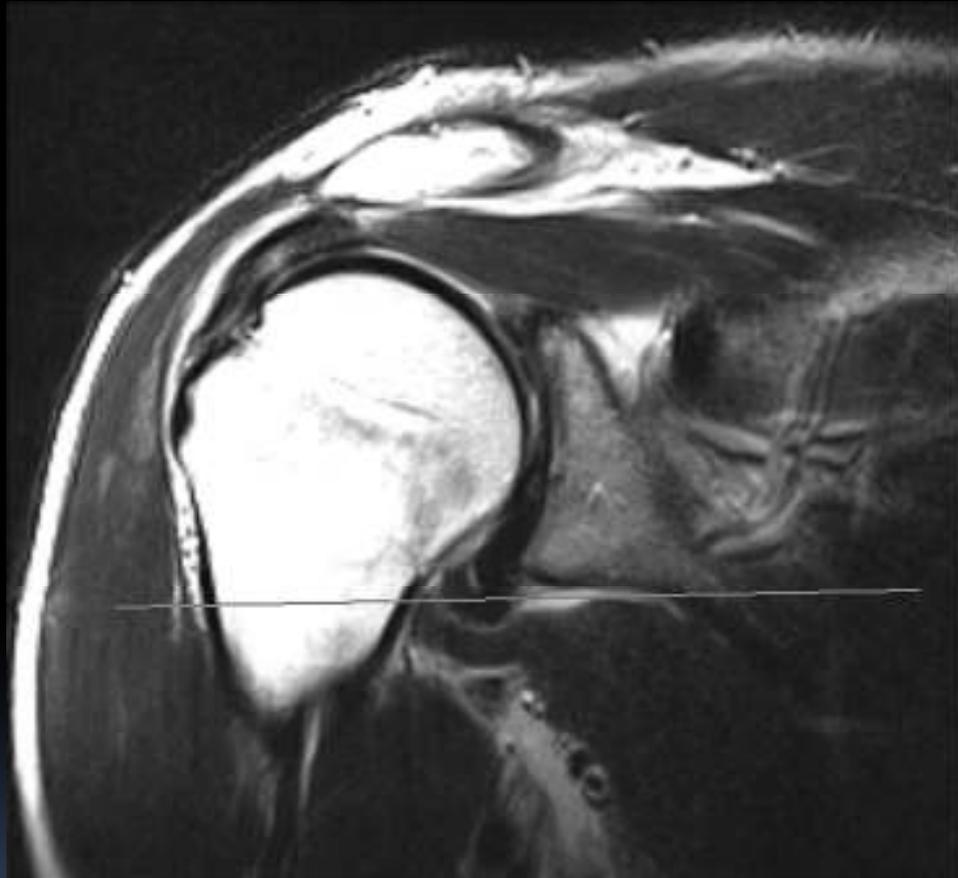
Find???



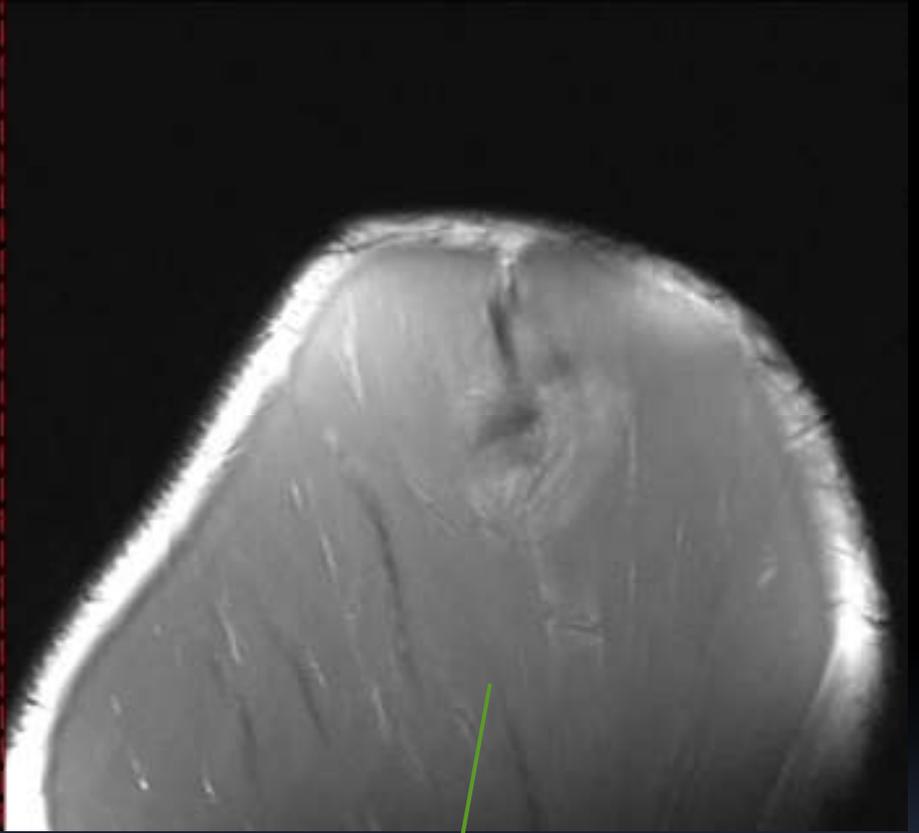
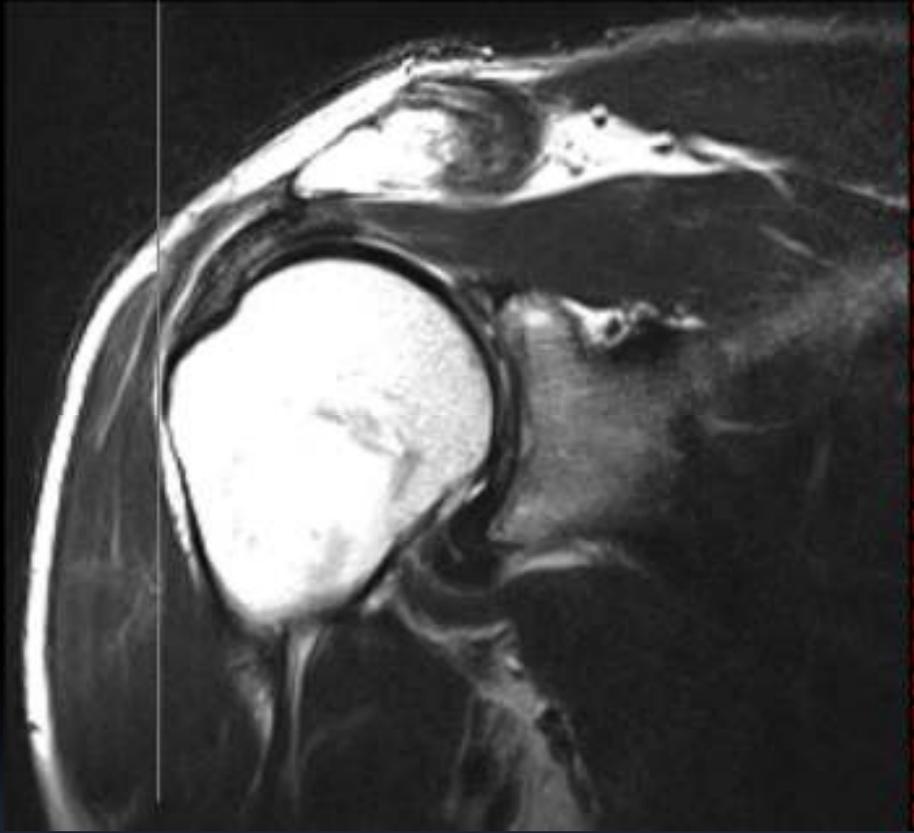


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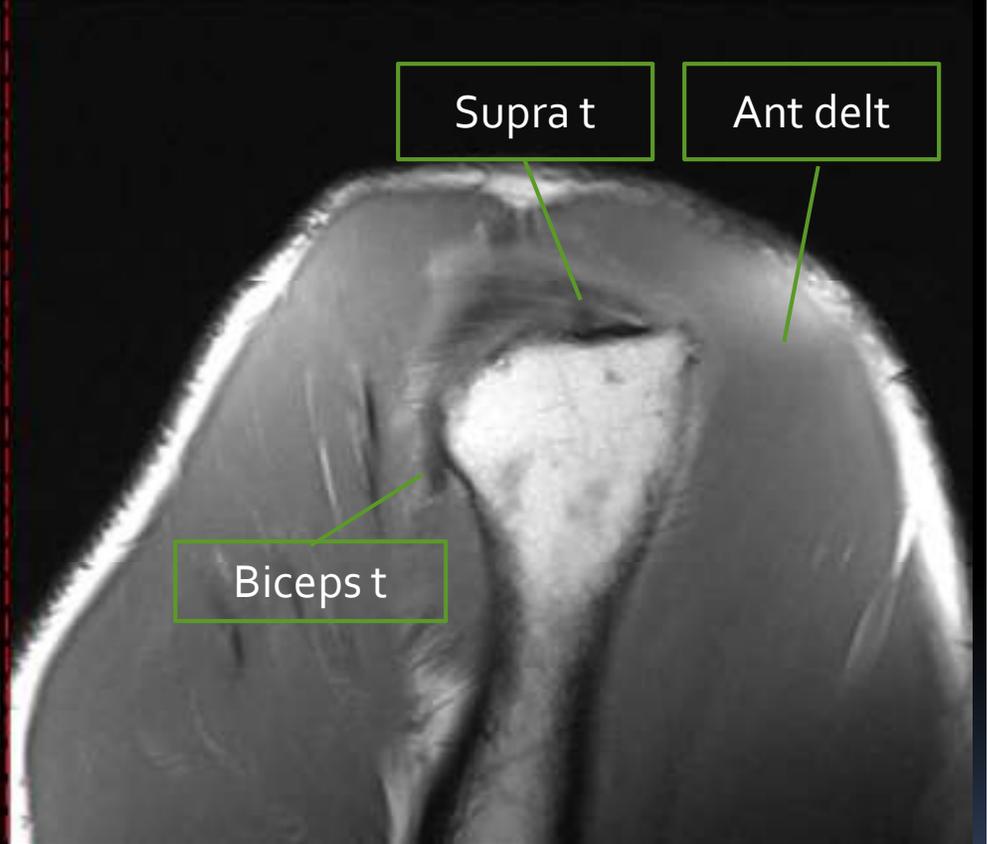
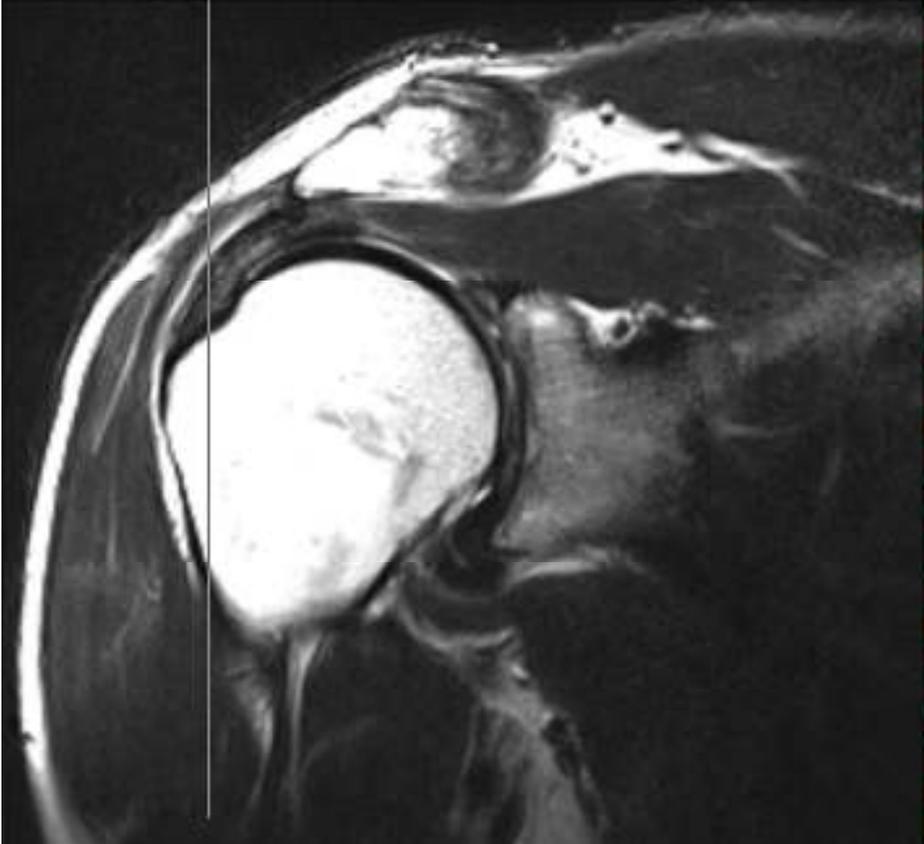


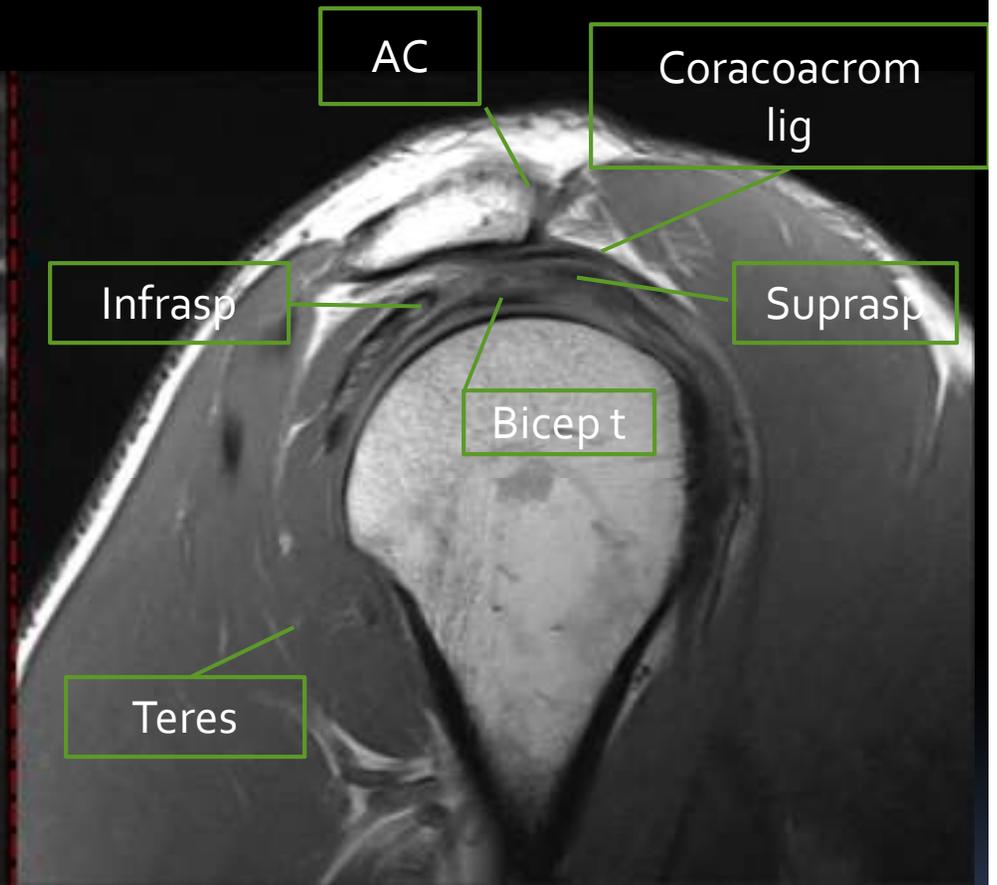
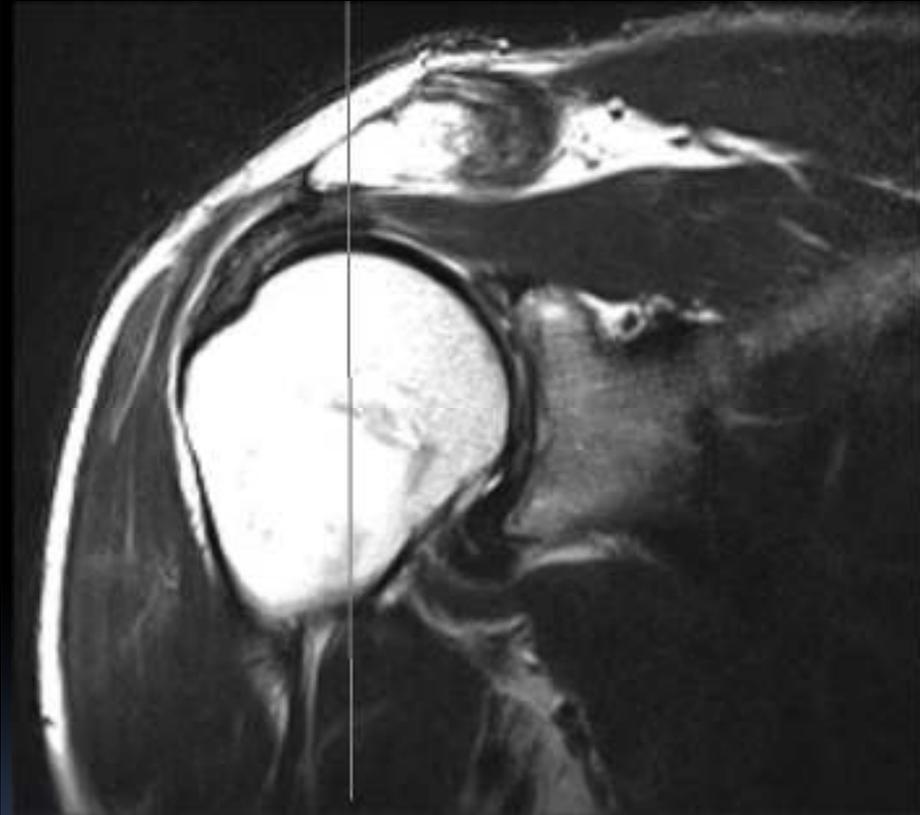


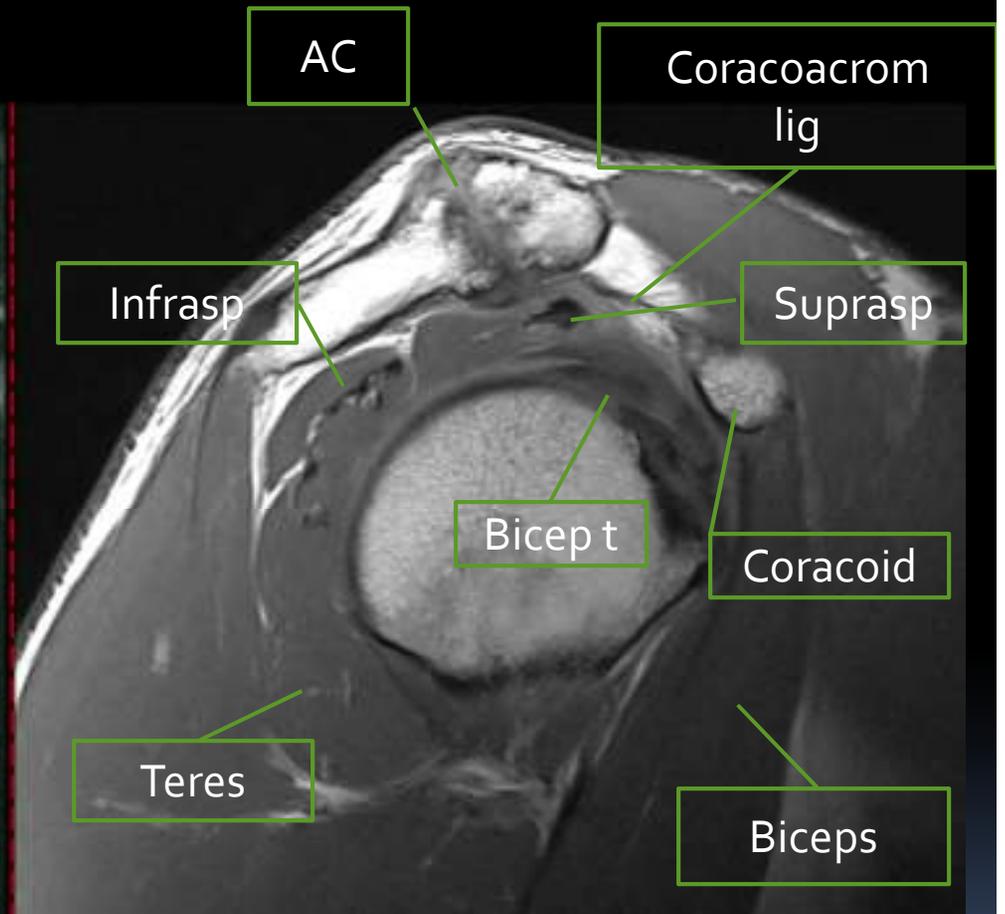
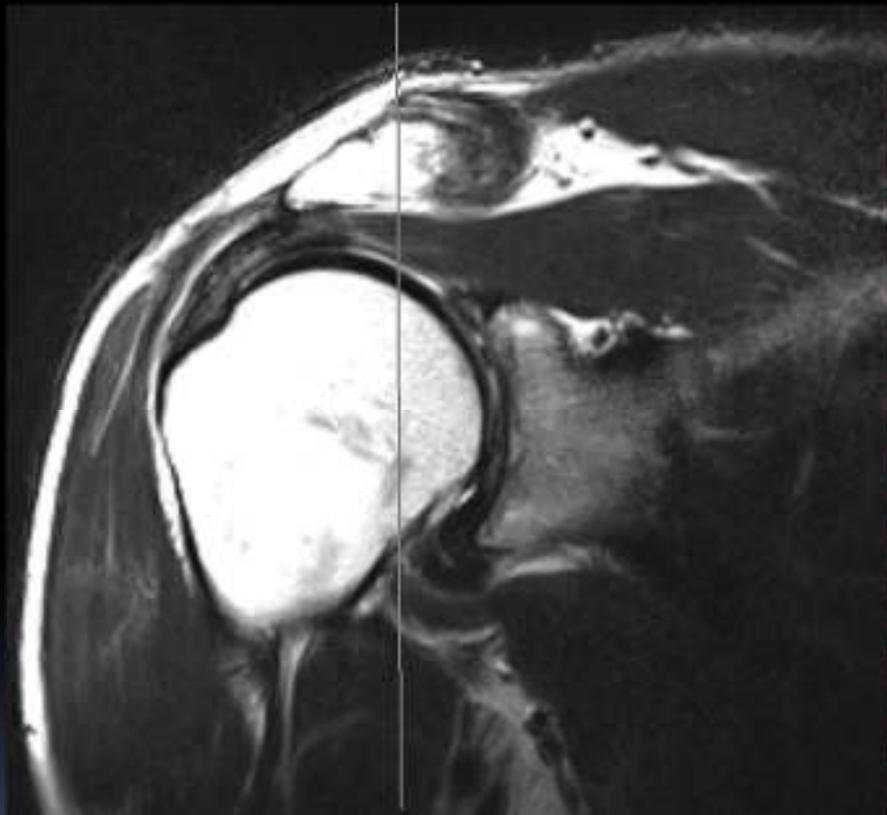
Thickened IGL

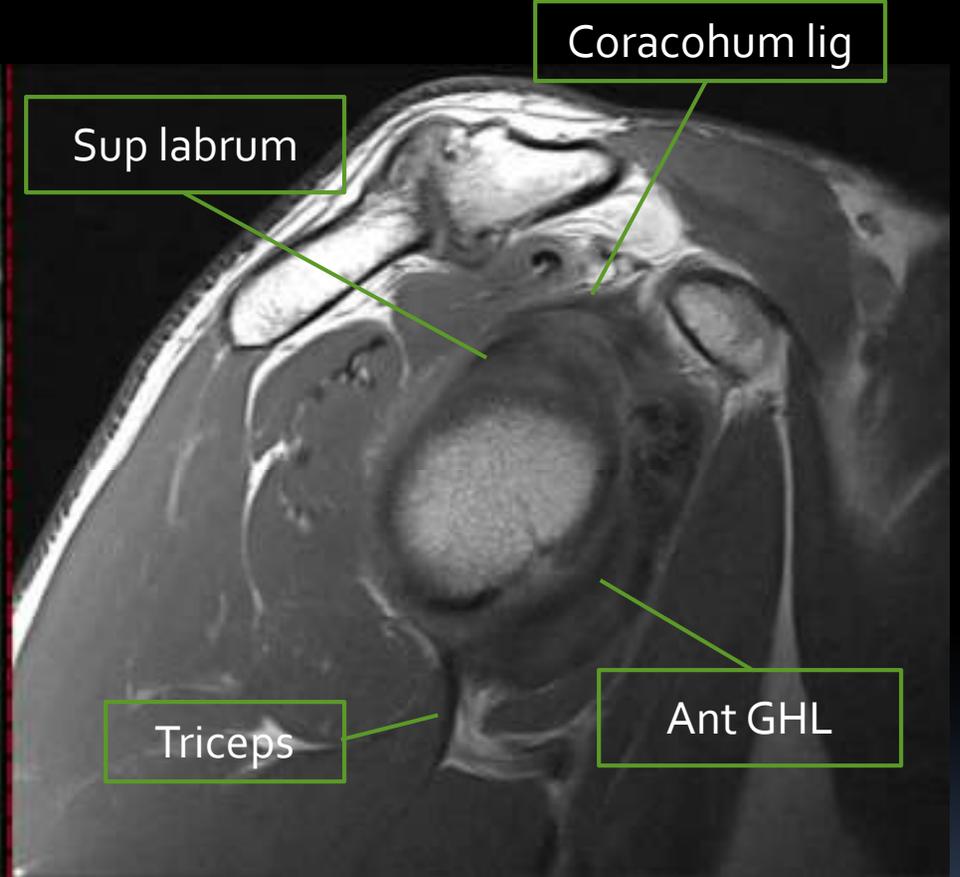
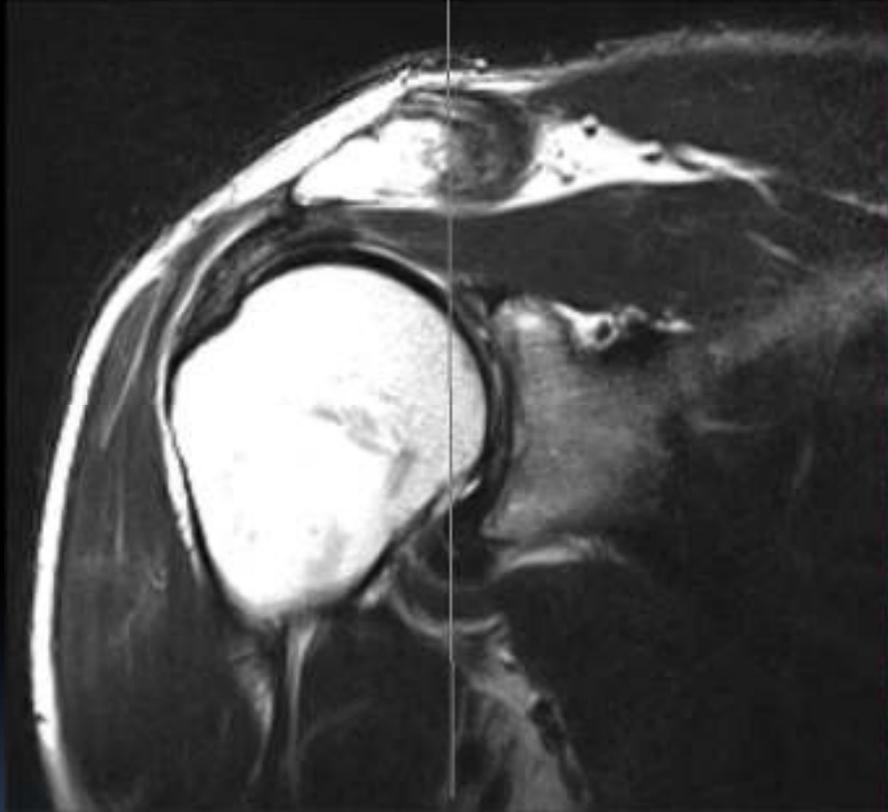


Delt







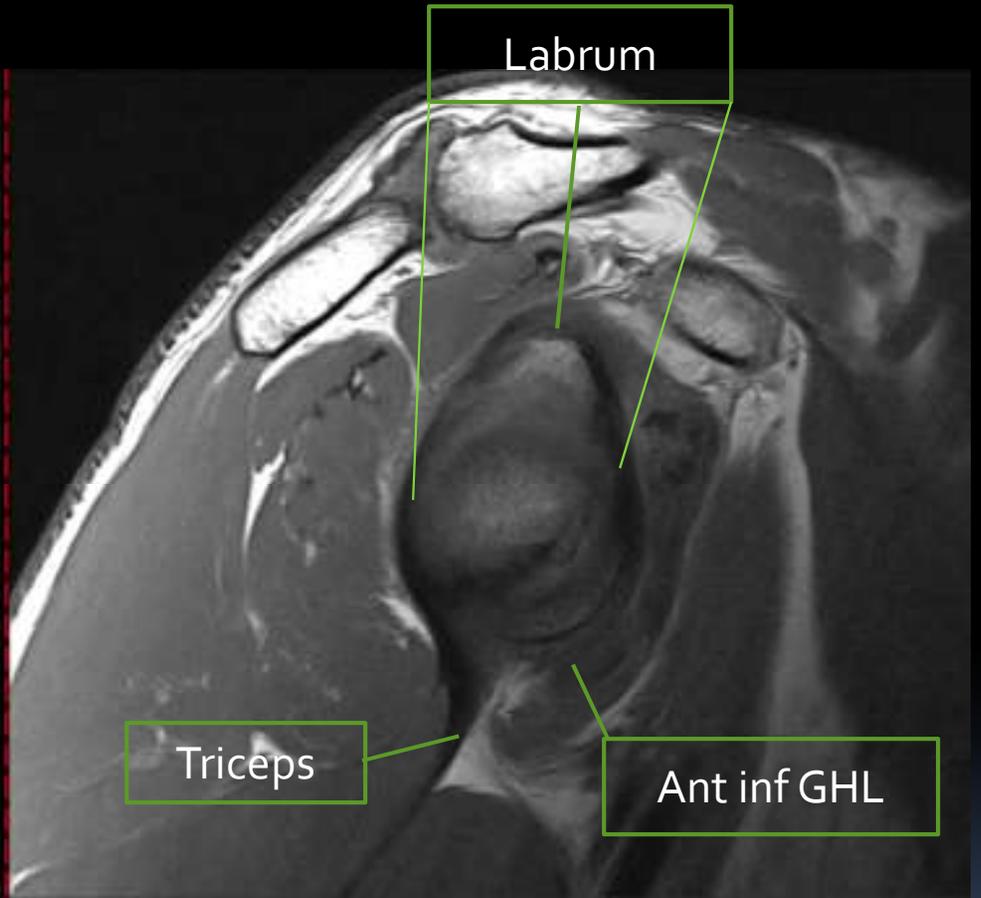
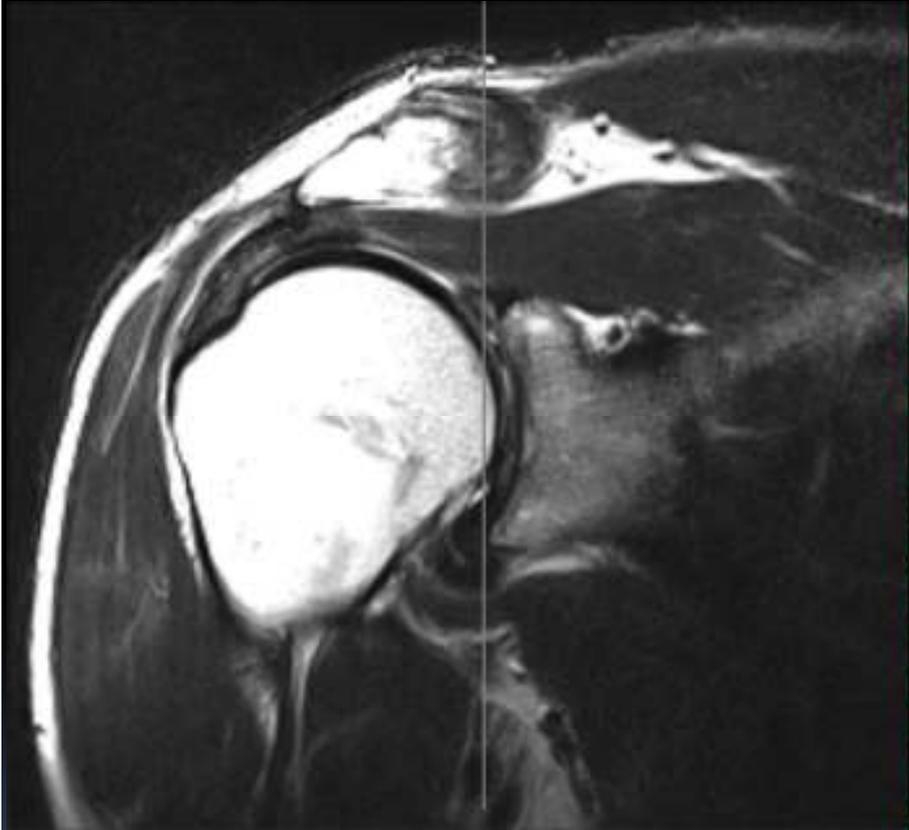


Sup labrum

Coracohum lig

Triceps

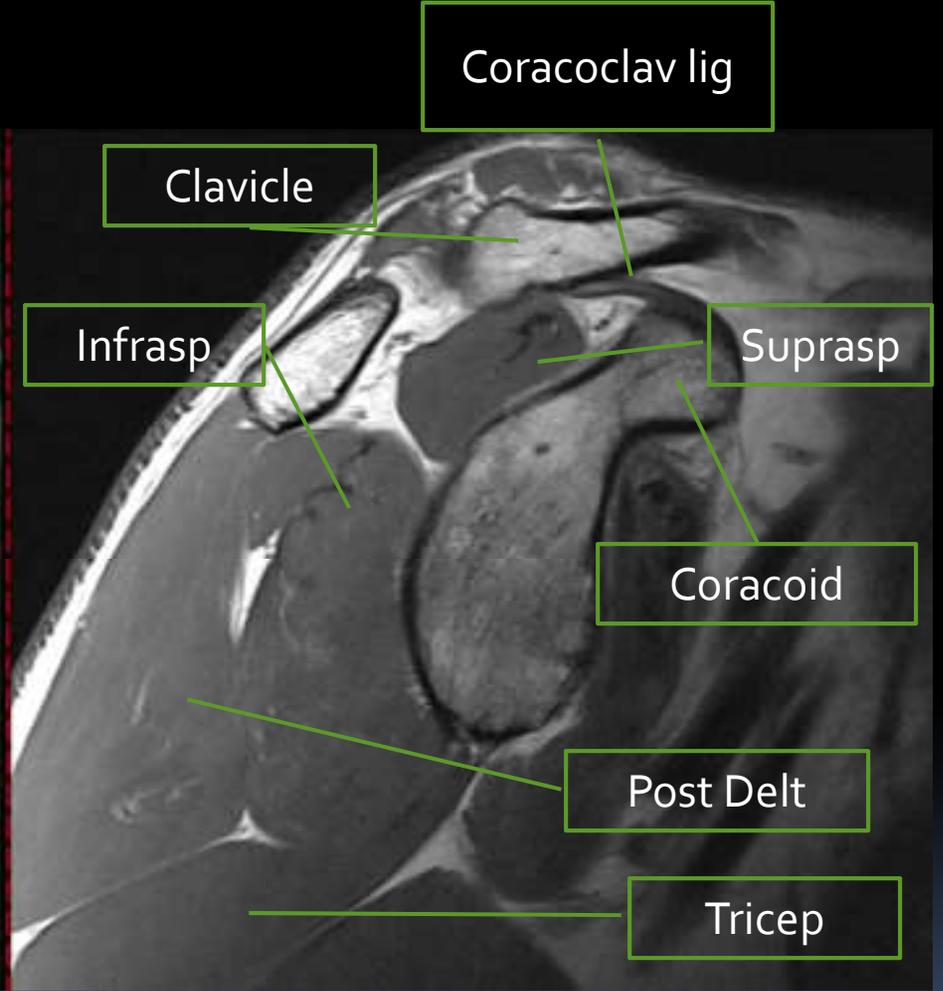
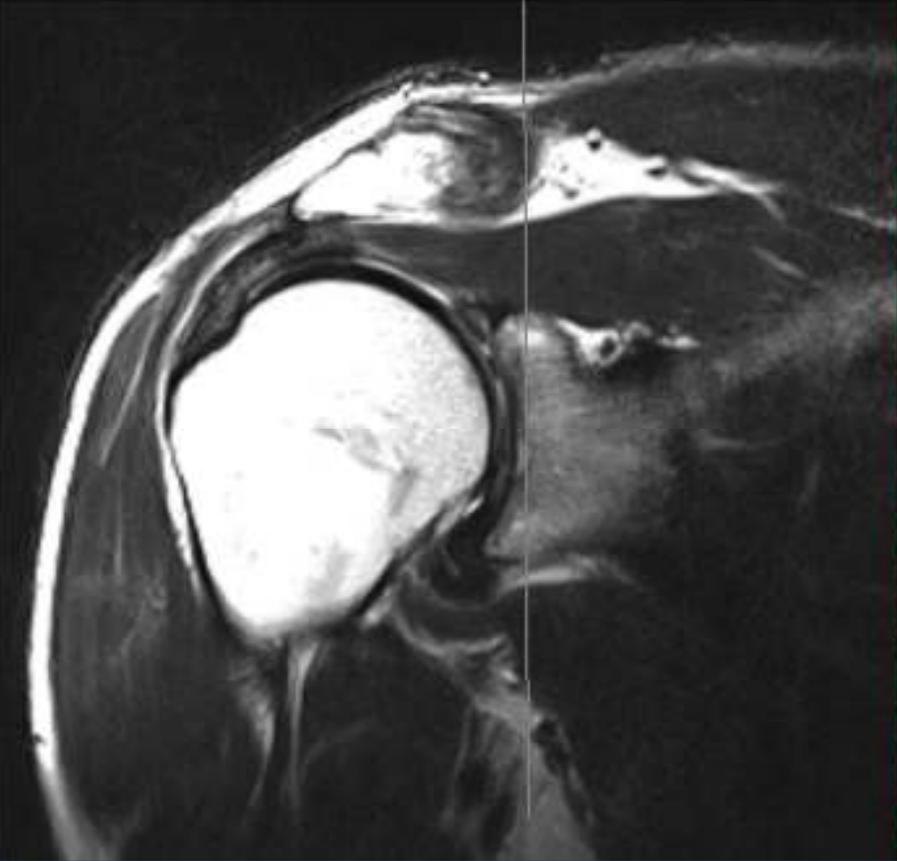
Ant GHL

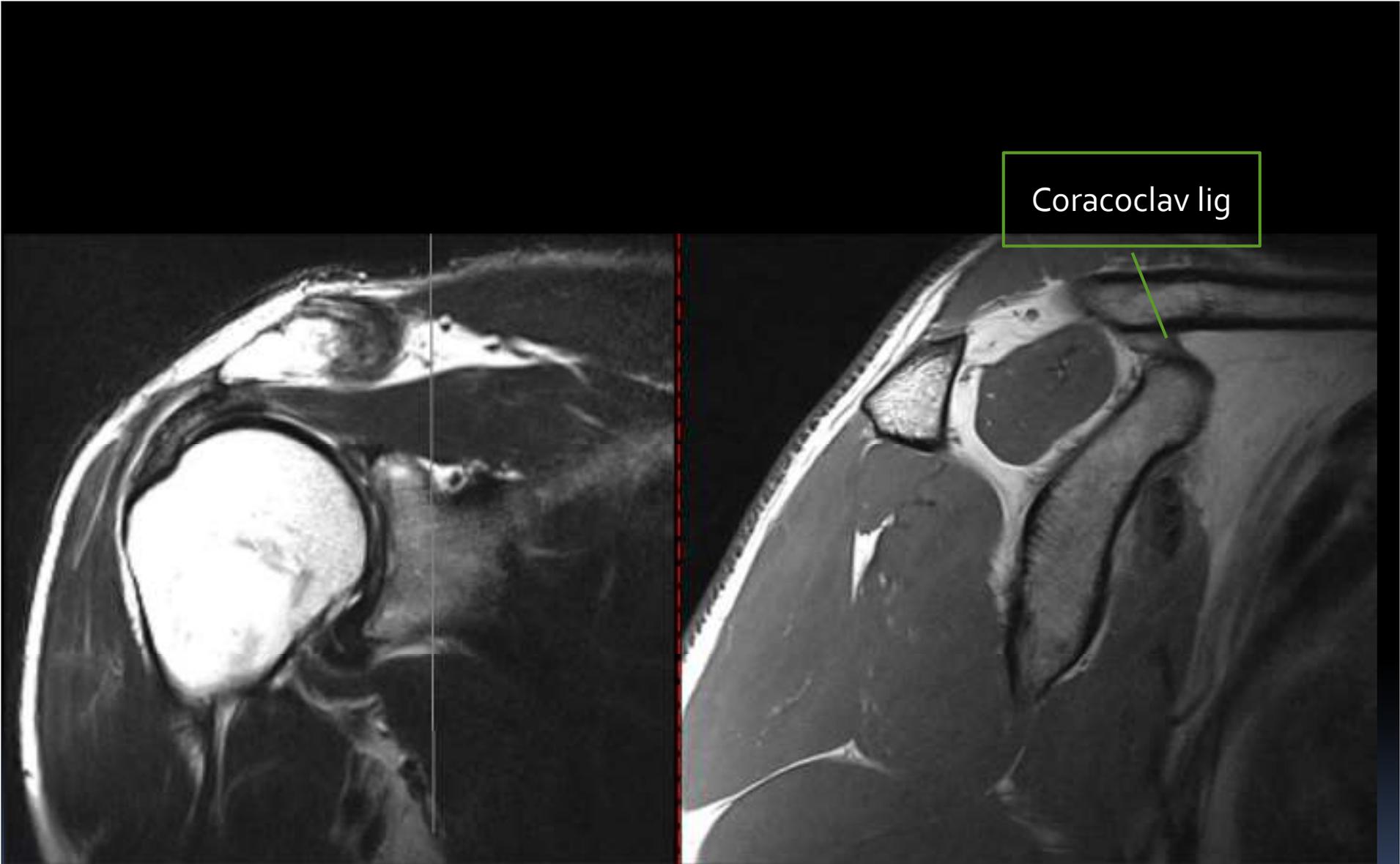


Labrum

Triceps

Ant inf GHL





Coracoclav lig



# Shoulder Search Pattern

# Coronal Oblique

- Overall signal
- Supraspinatus and infraspinatus
- AC joint
- Acromion
- GH joint
- Sup and inf labrum
- IGL

# Sagittal Oblique

- Supraspin, infraspin, teres, subscap
- Rotator interval
- Biceps
- Glenohumeral ligs

# Axial

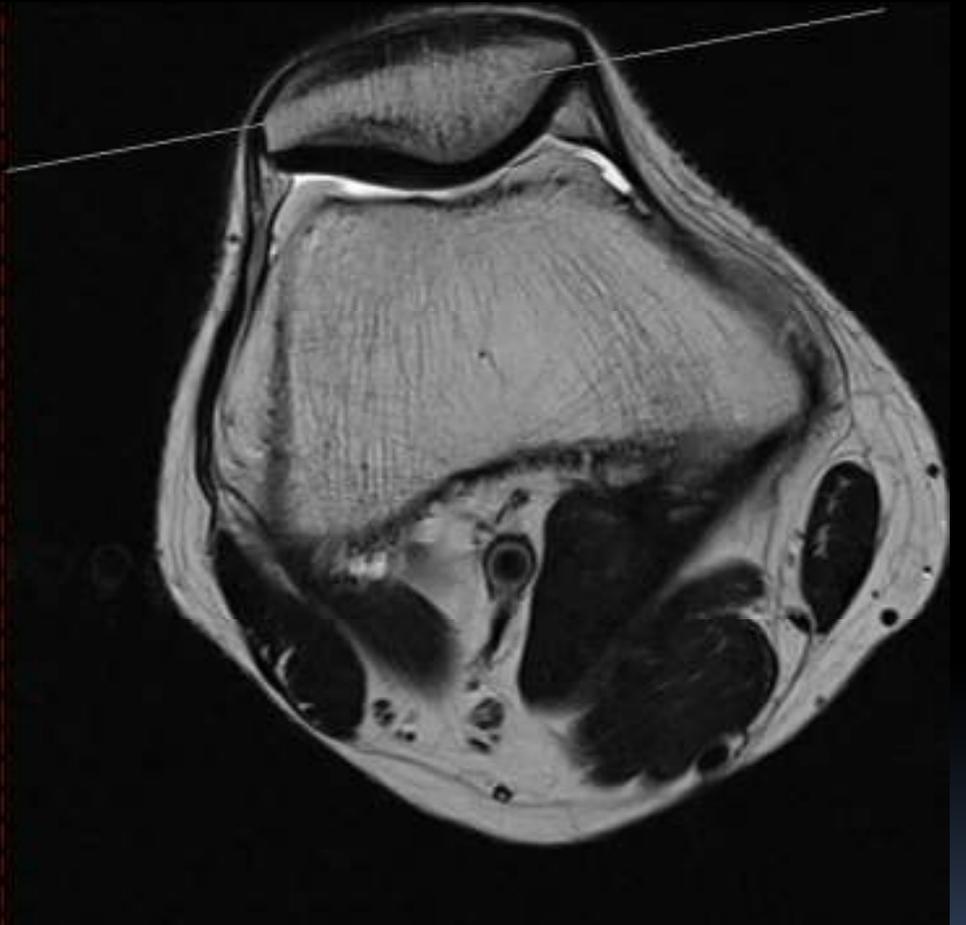
- Long head biceps
- Subscap
- Ant and post labrum
- Glenohumeral lig

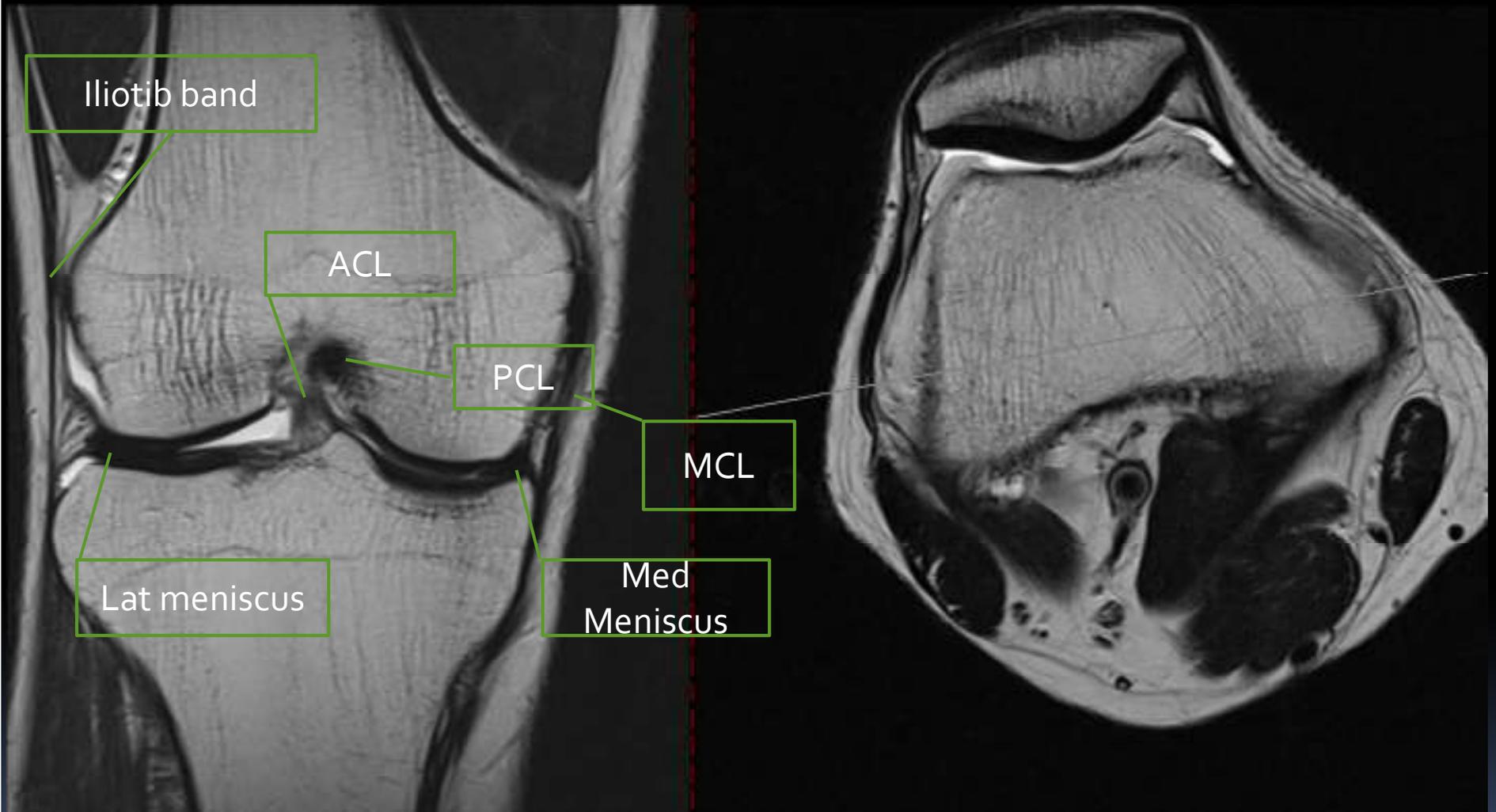
# Normal Knee Anatomy

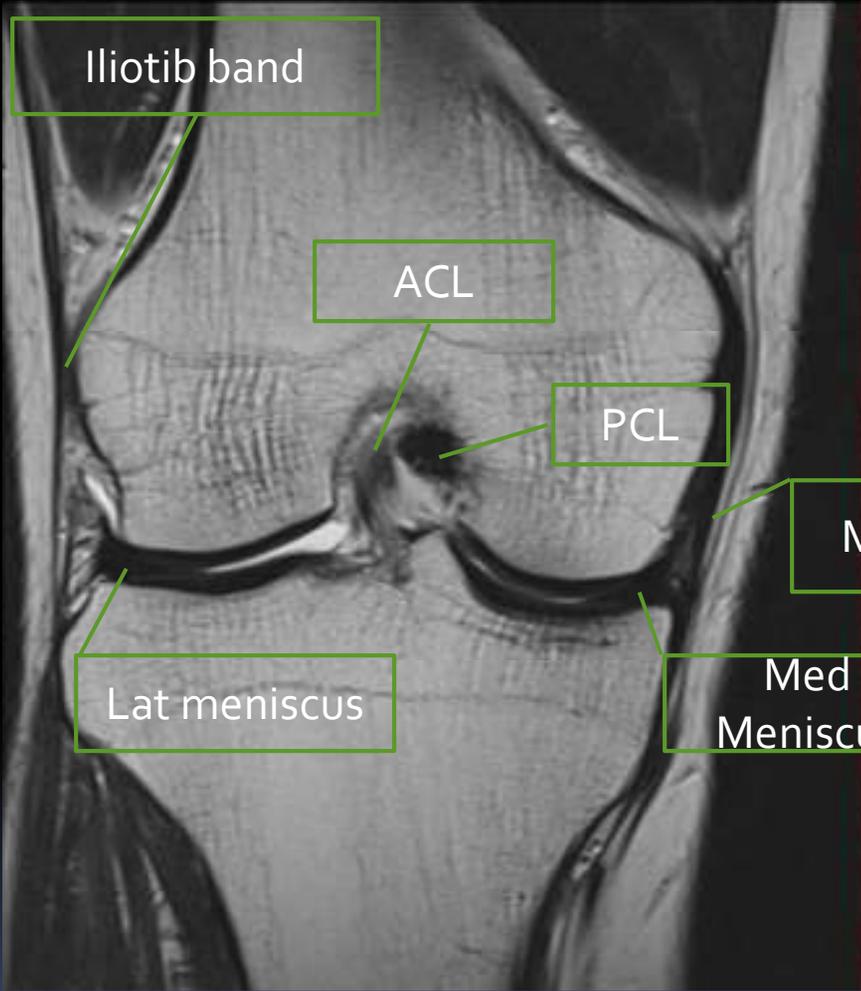
- Don't get too frustrated, it takes a long time to learn

Quad t

Patellar t







Iliotib band

ACL

PCL

MCL

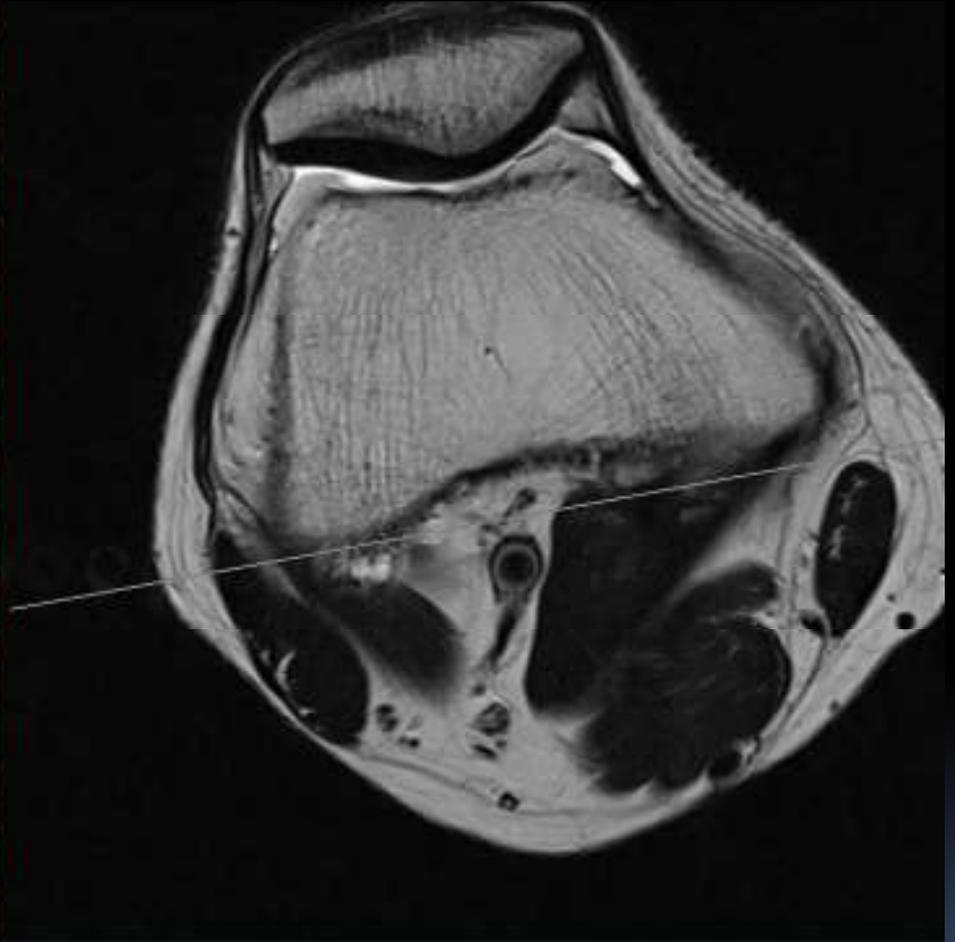
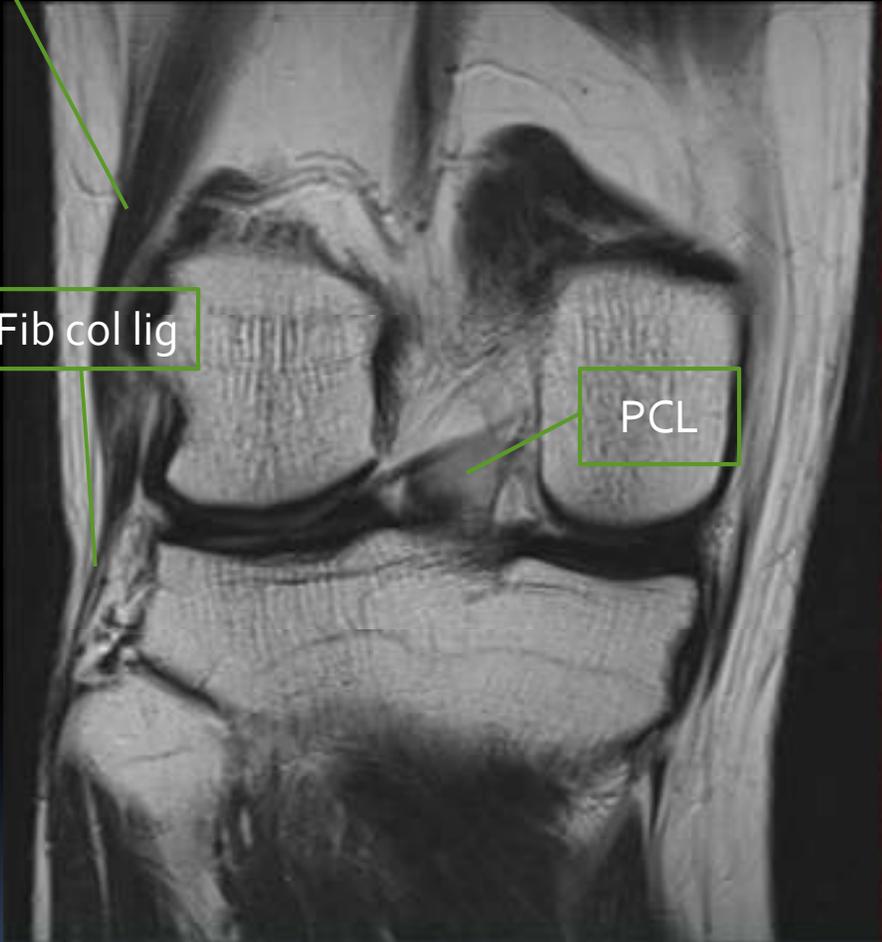
Lat meniscus

Med  
Meniscus

Bicep fem

Fib col lig

PCL



Vastus lat

Biceps

Femur

Fib col lig

Lat  
gast

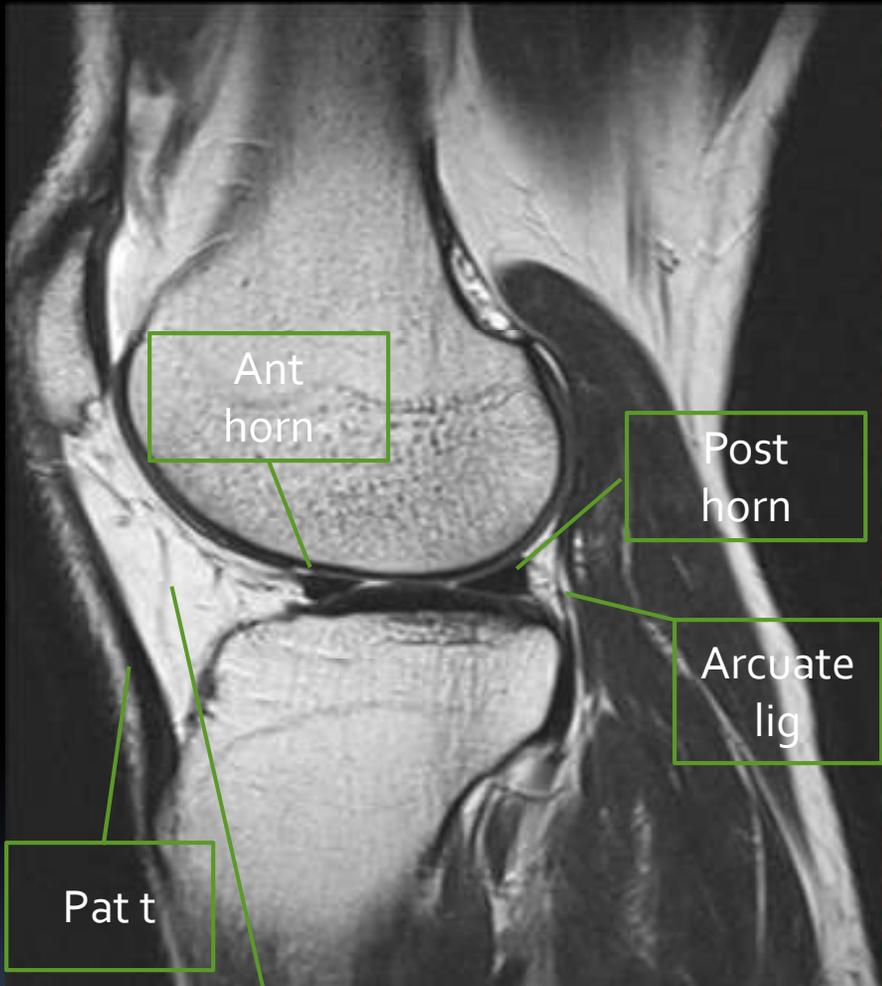
Tib ant





Body of lat men





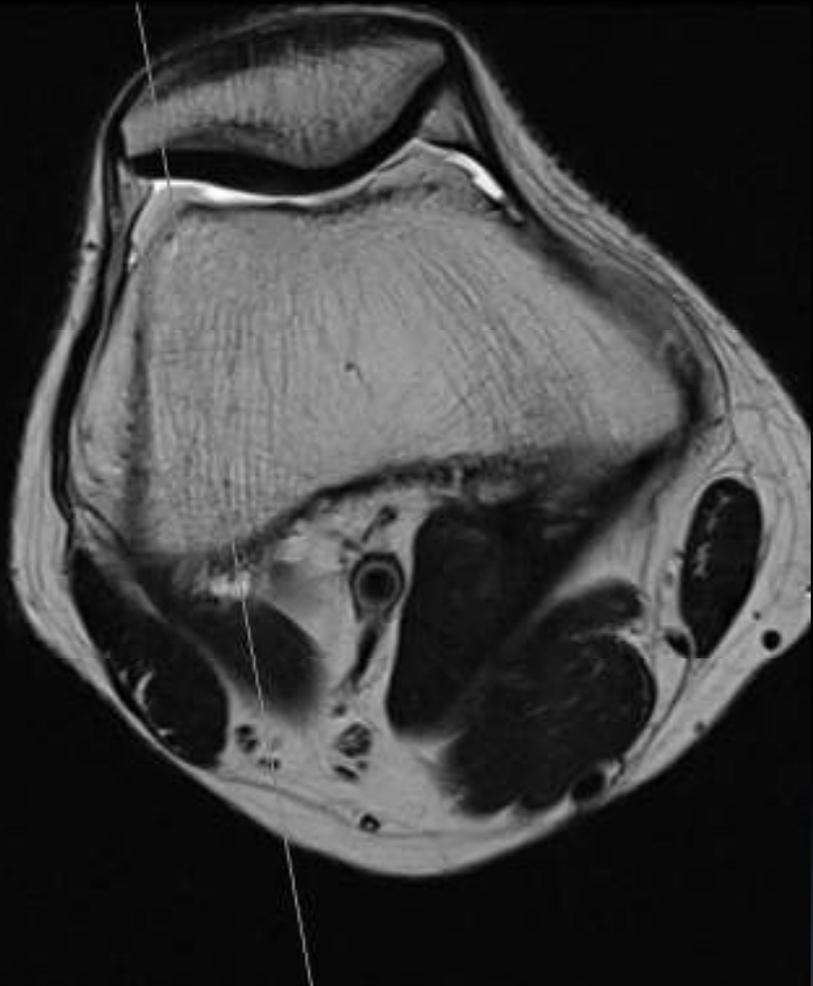
Ant  
horn

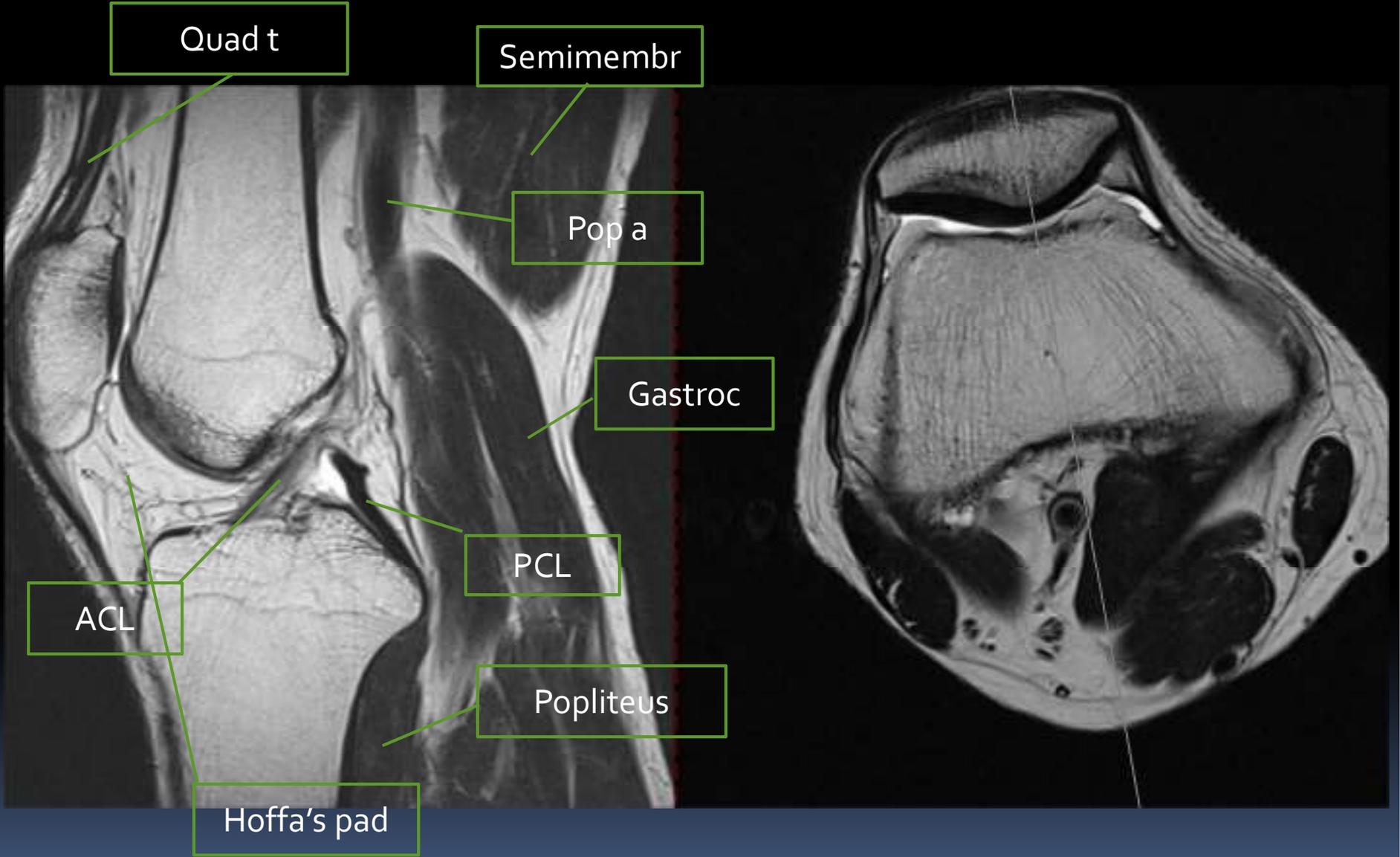
Post  
horn

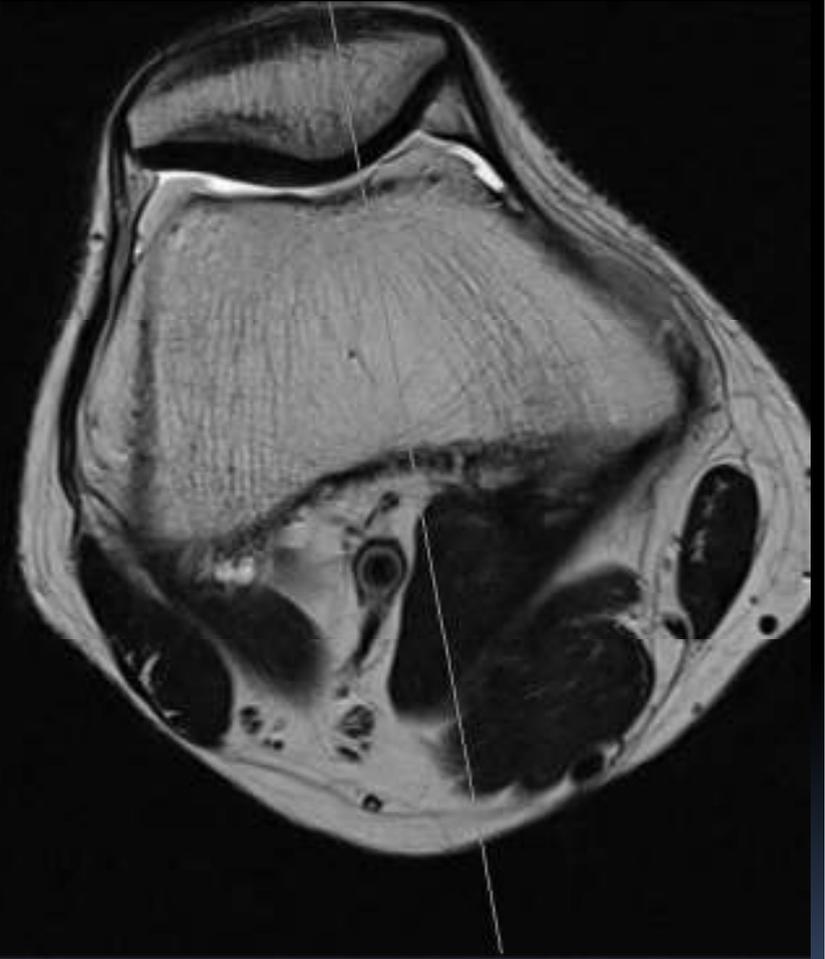
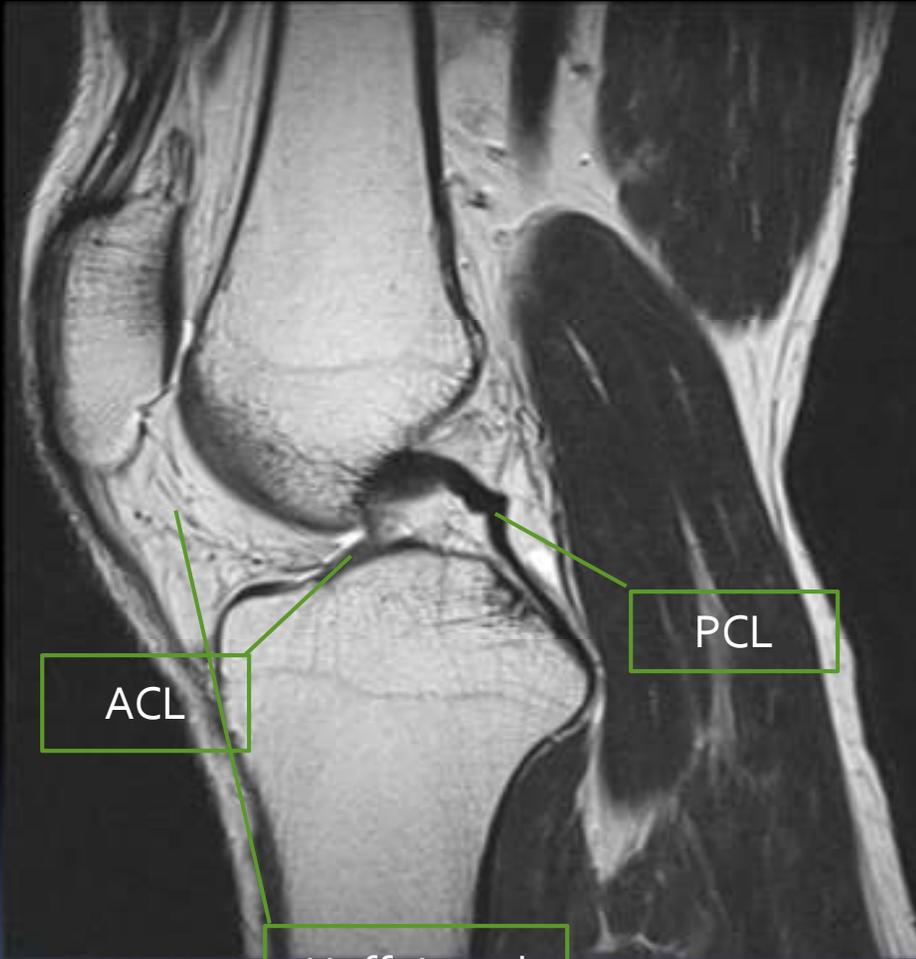
Arcuate  
lig

Pat t

Hoffa's pad



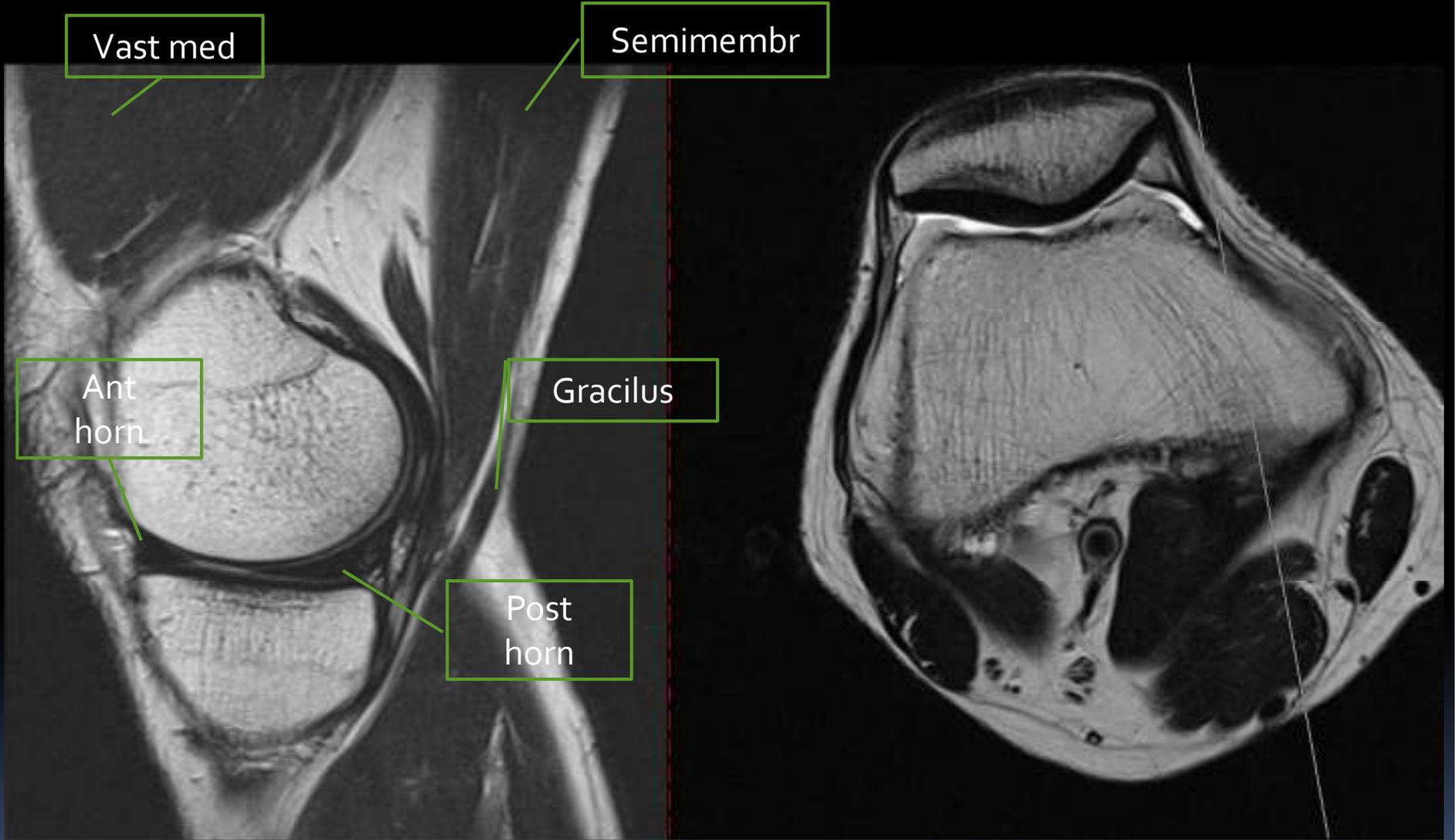




ACL

PCL

Hoffa's pad



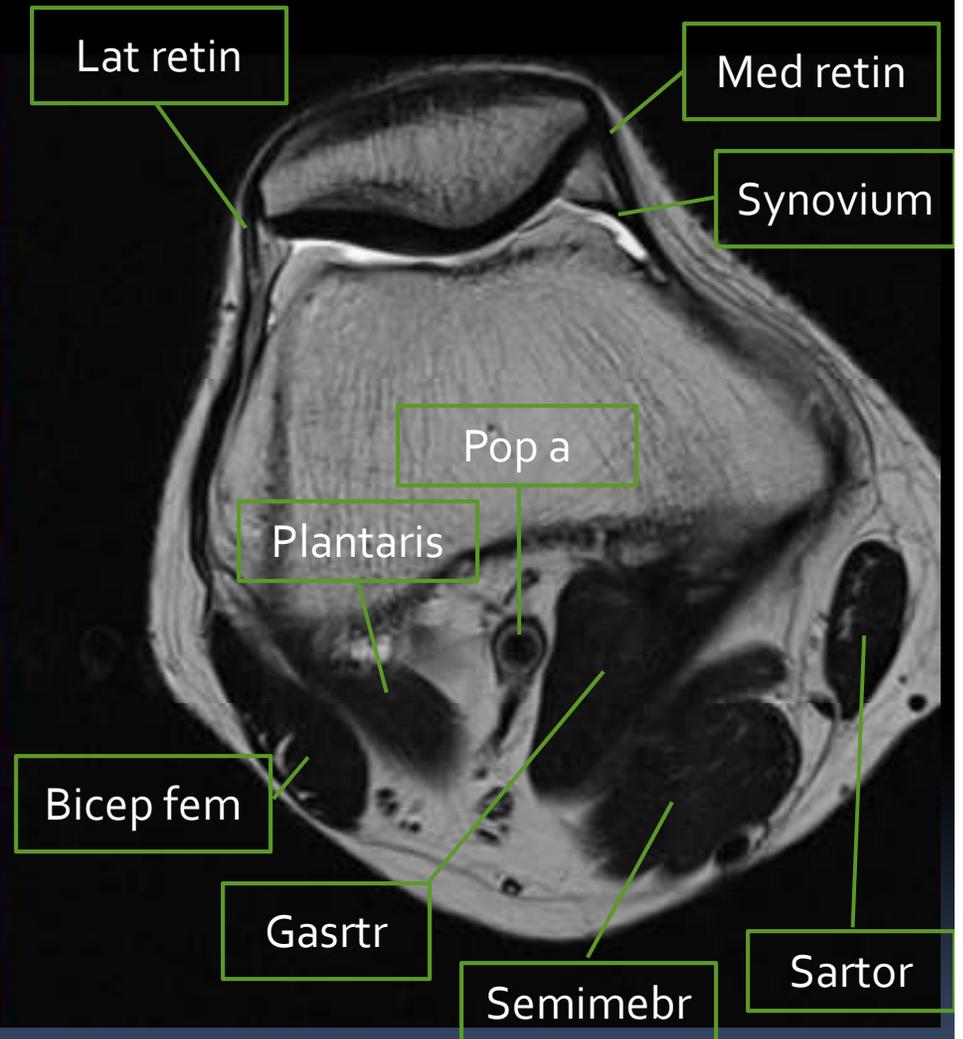
Vast med

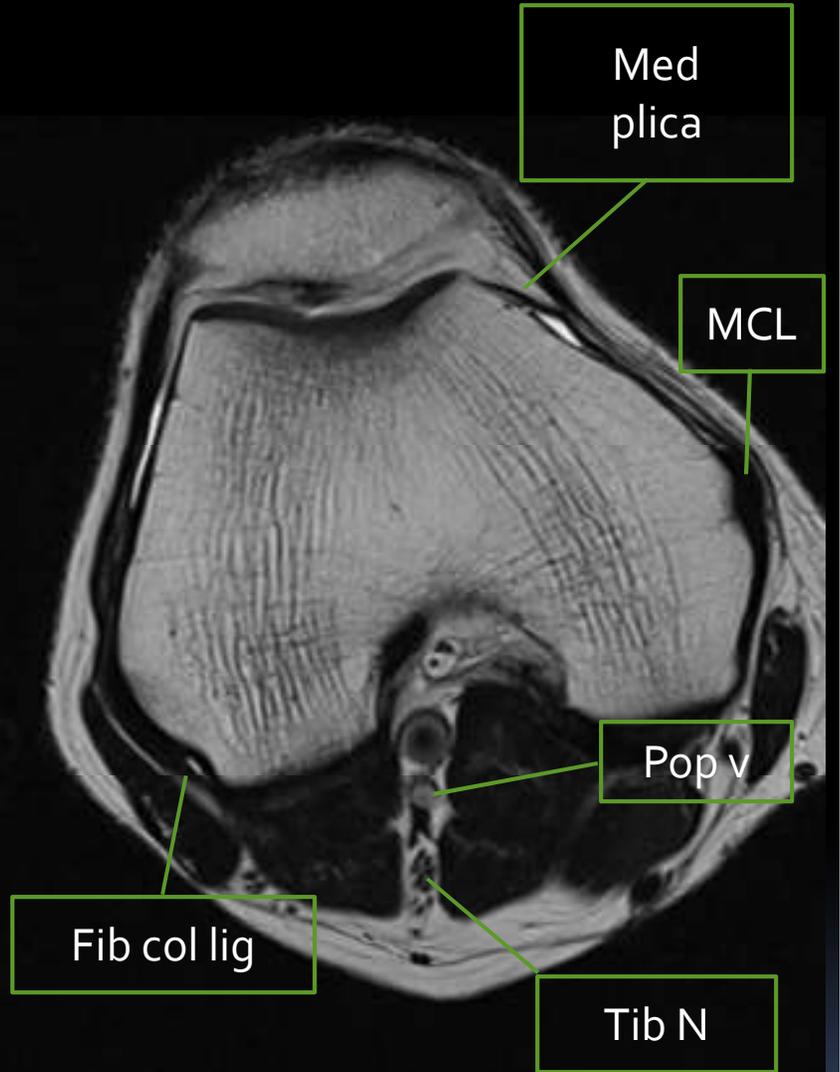
Semimembr

Ant  
horn

Gracilus

Post  
horn





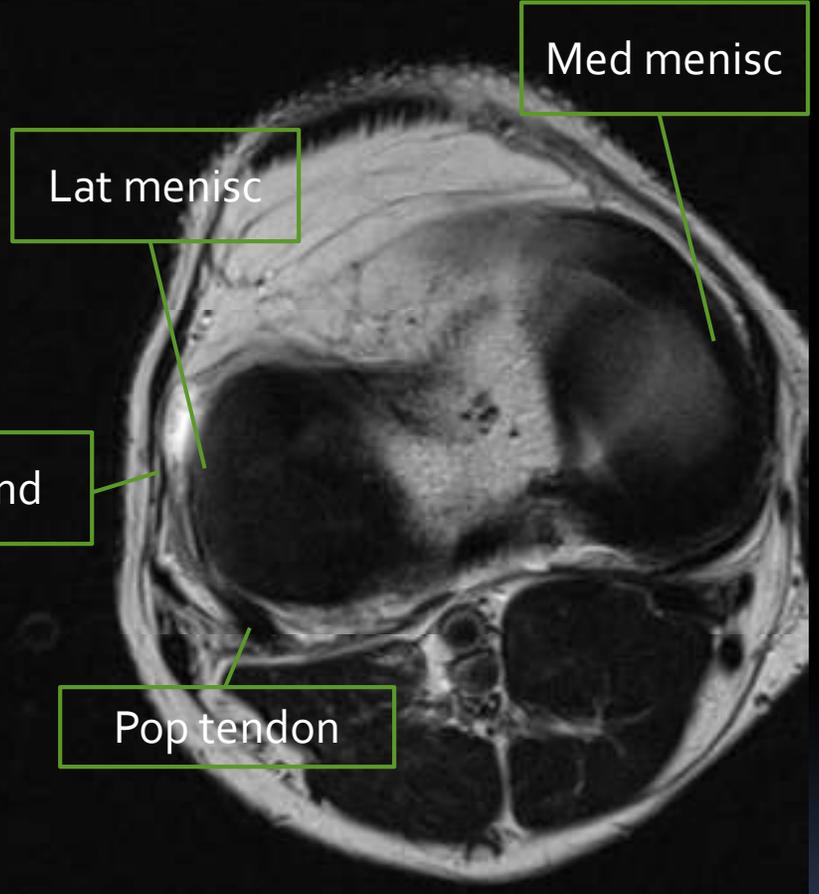
Med plica

MCL

Pop v

Fib col lig

Tib N





# Knee Checklist

# Coronal Checklist

- Overall signal
- MCL
- LCL
- Meniscii
- Articular cartilage
- ACL
- PCL
- Iliotibial band

# Sagittal Checklist

- Overall signal
- Meniscii
- Articular cartilage
- ACL
- PCL
- Patellar and quad tendons
- Suprapatellar pouch



# Axial Checklist

- Overall signal
- Patellofemoral joint
- ACL/PCL
- Collateral ligs
- Meniscii
- Iliotibial band
- Joint effusion?



# Shoulder Search Pattern

# Coronal Oblique

- Overall signal
- Supraspinatus and infraspinatus
- AC joint
- Acromion
- GH joint
- Sup and inf labrum
- IGL



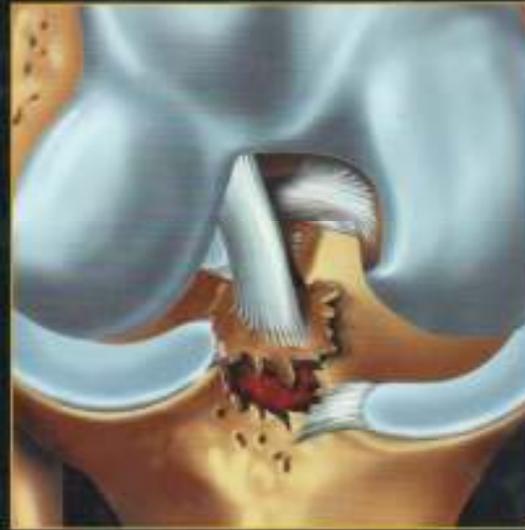
# Rotator Cuff Tears

- Chronic repetitive stress
- Pain with or without motion
- Pain with movement or isometric contraction of the involved muscle group



# Types of Rotator Cuff Tears

# DIAGNOSTIC IMAGING



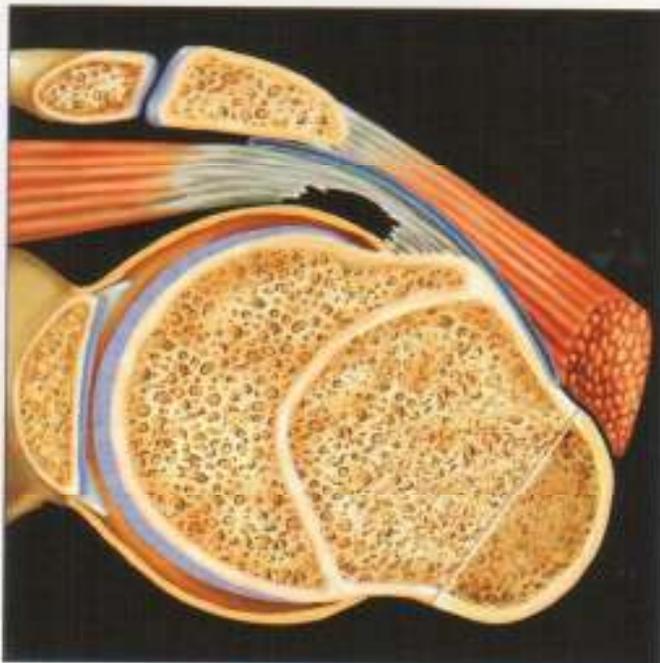
# ORTHOPAEDICS

Stoller • Tirman  
Bredella  
Beltran • Branstetter • Blease



A Must

## ROTATOR CUFF PARTIAL THICKNESS TEAR

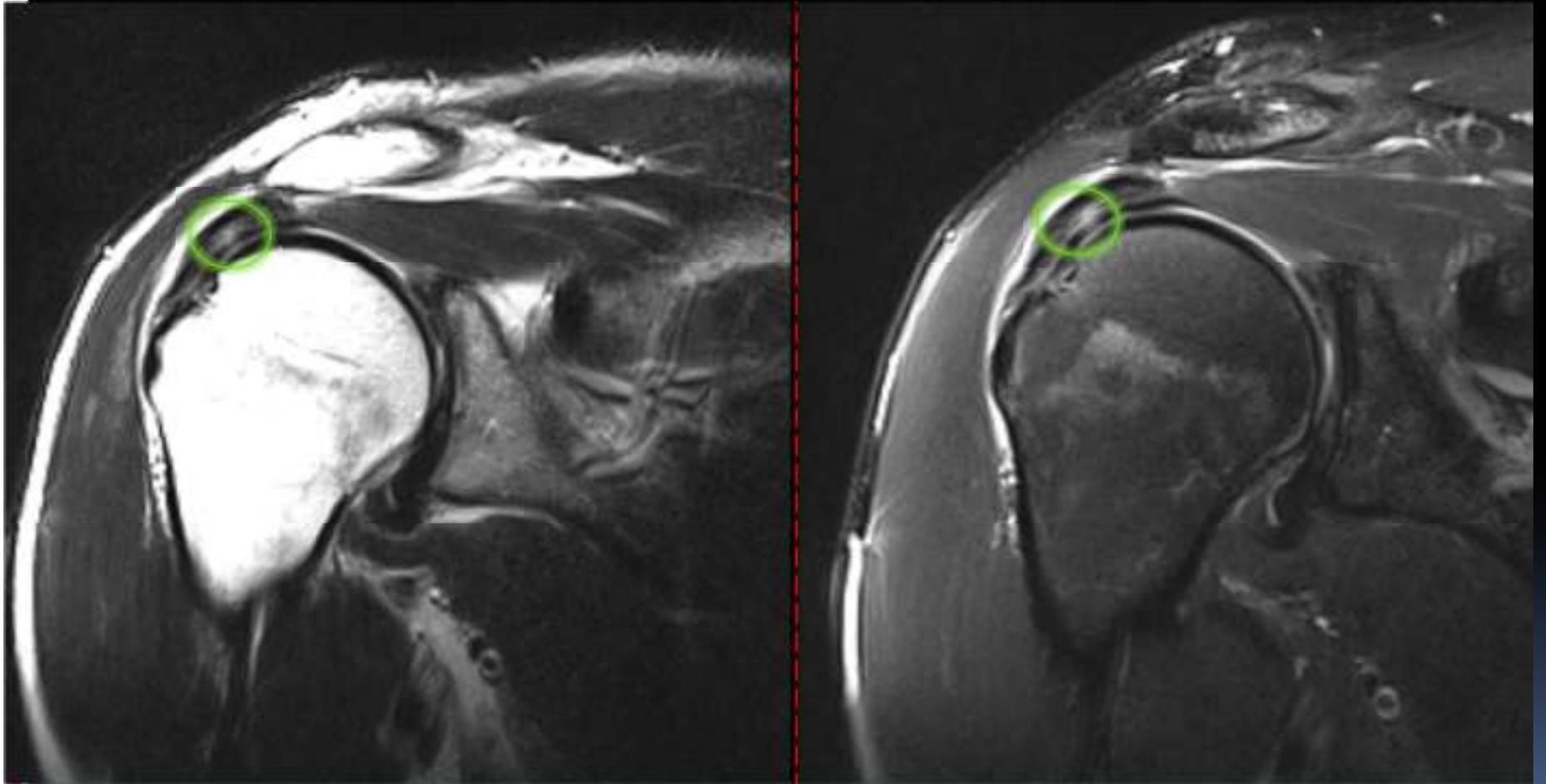


*Coronal graphic shows a partial undersurface tear of the supraspinatus tendon involving the critical zone.*

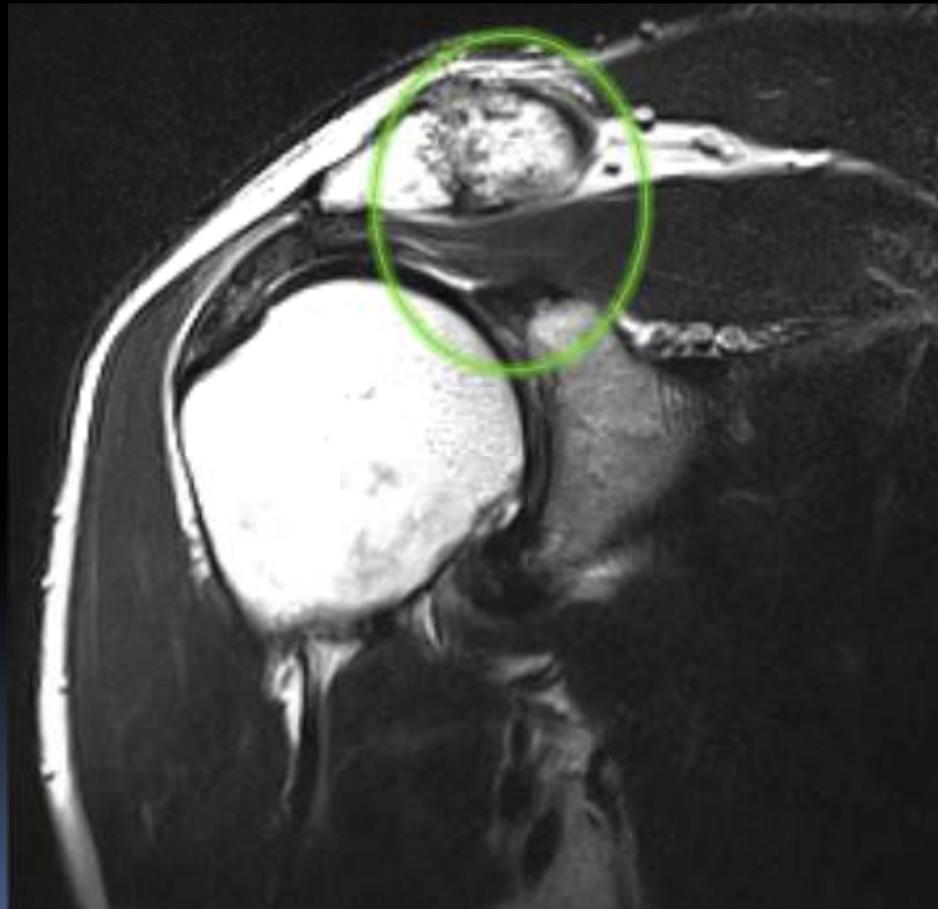


*Coronal FS PD FSE MR shows an articular surface partial tear (arrow) of the supraspinatus involving the critical zone.*

# Rotator cuff tear



# AC OA with compression of supraspinatus



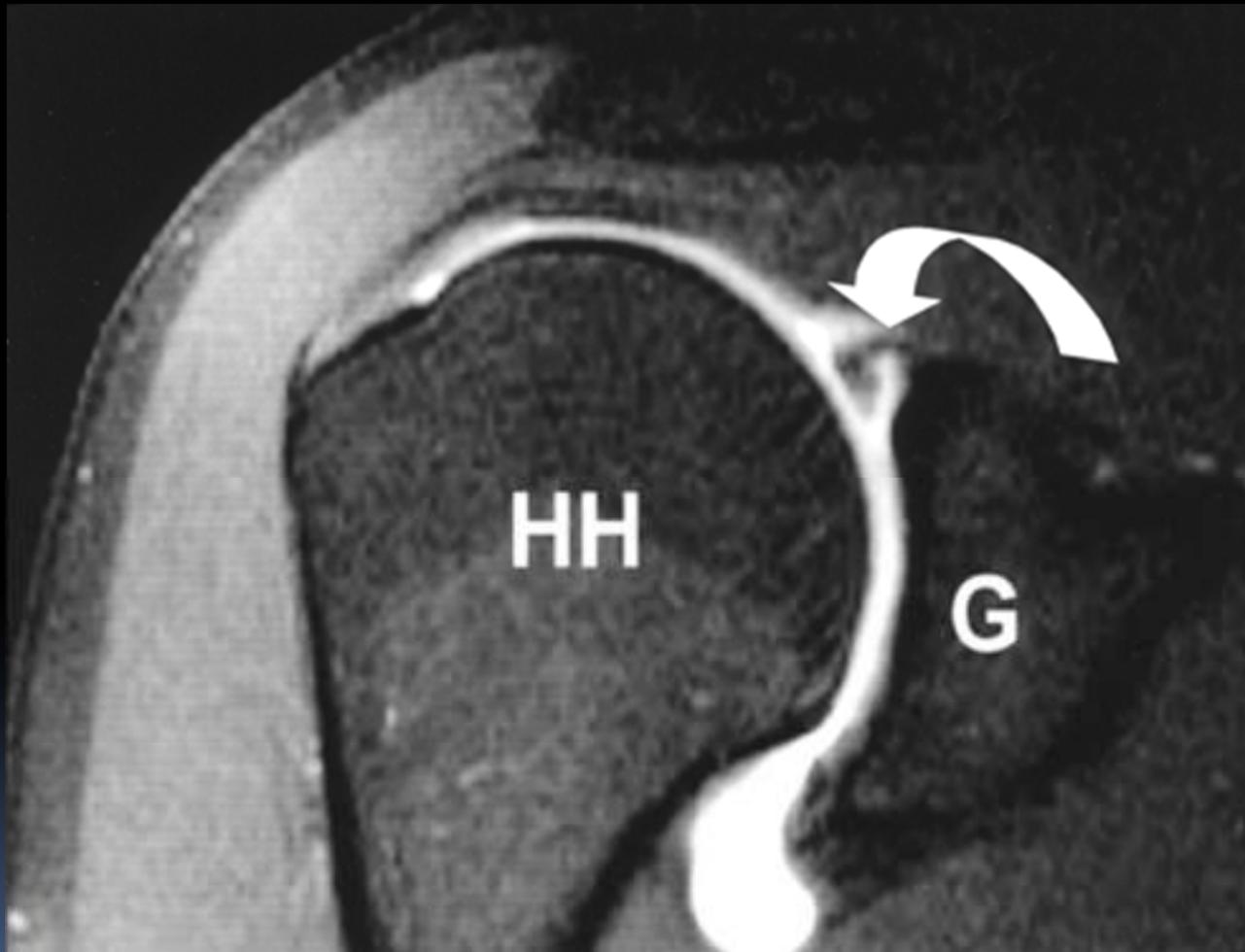
# SLAP Lesions

- Superior labral anterior to posterior lesion
- Popping, clicking, or catching in the shoulder.
- Pain when you move your arm over your head or throw a ball.
- A feeling of weakness or instability in the shoulder.
- Aching pain. People often have a hard time describing or pointing to exactly where the pain is
- Causes:
  - Fall on your outstretched arm.
  - Fall on your shoulder.
  - Brace yourself with your outstretched arm in a car accident.
  - Lift heavy objects repeatedly or too suddenly.
  - **Do a lot of overhead activities, such as throwing a baseball.**

# SLAP Tears

- Superior labral anterior to posterior tears
- Best on sagittal obliques with increased signal in the superior labrum
- Very common and cause instability

# Superior labral tear

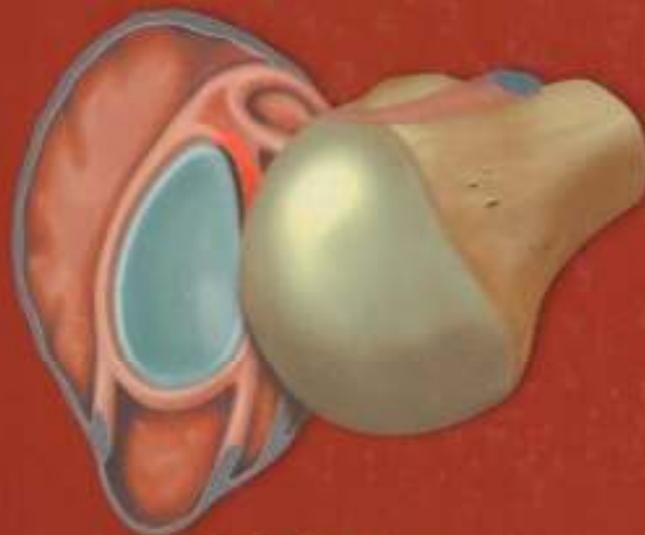


3<sup>rd</sup>  
EDITION

VOLUME TWO • UPPER EXTREMITY

# MAGNETIC RESONANCE IMAGING IN ORTHOPAEDICS AND SPORTS MEDICINE

DAVID W. STOLLER



Salvador Beltran

Arthur E. Li • Miriam A. Bredella • Hollis G. Potter • Zehava S. Rosenberg  
Jenny T. Bencardino • Jean-Luc Drapé • Simon Blease • Thomas E. Schubert • Hubert Lejay



Wolters Kluwer  
Health

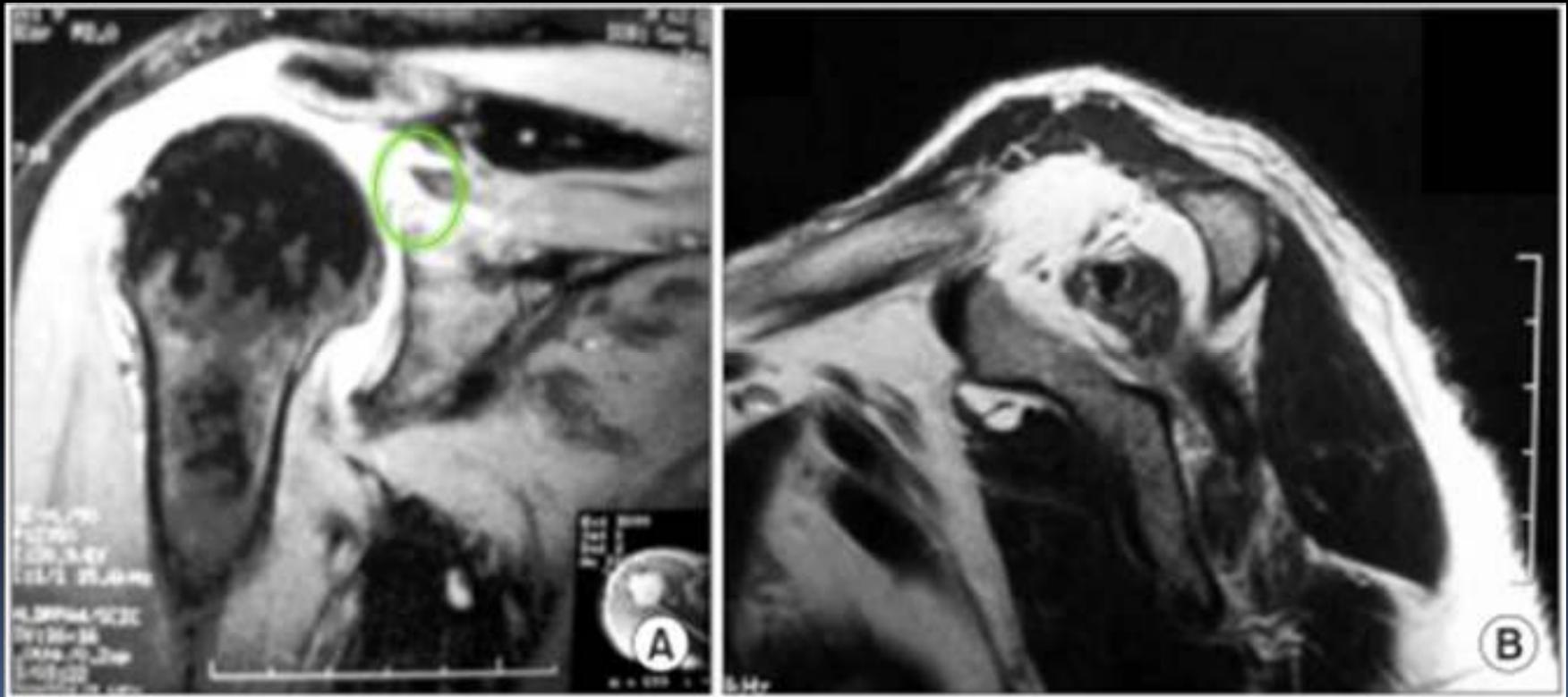
Lippincott  
Williams & Wilkins

In my opinion, the  
**ABSOLUTE BEST**  
book on  
extremity MR

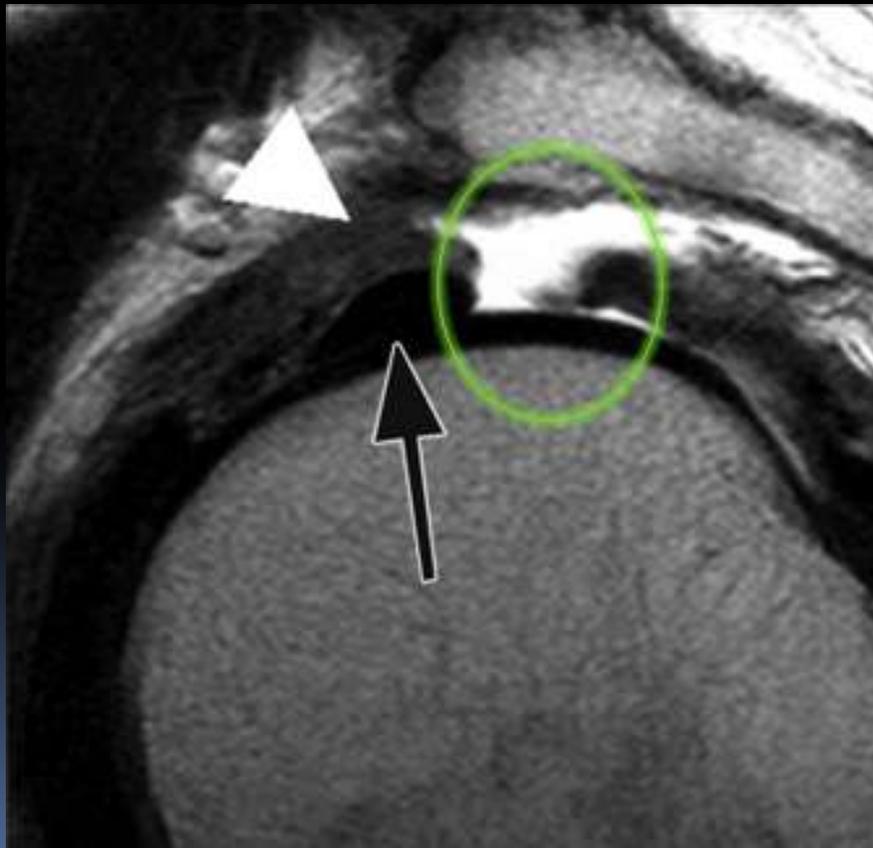
# Sagittal Oblique

- Supraspin, infraspin, teres, subscap
- Rotator interval
- Biceps
- Glenohumeral lig

Tear with retraction:  
supraspinatus stops before  
humeral head



Cuff and glenohumeral lig  
tear: harder to see on  
sagittal but visible



# Axial

- Long head biceps
- Subscap
- Ant and post labrum
- Glenohumeral lig

Biceps dislocation ( not common) and transverse ligament tear: best seen on transaxial



# Anterior Labral Tear

- Pain, usually with overhead activities
- Catching, locking, popping, or grinding
- Occasional night pain or pain with daily activities
- A sense of instability in the shoulder
- Decreased range of motion
- Loss of strength
- Causes:
  - Falling on an outstretched arm
  - A direct blow to the shoulder
  - A sudden pull, such as when trying to lift a heavy object
  - A violent overhead reach, such as when trying to stop a fall or slide

Anterior labral tear: seen on transaxials, equator (half way down glenoid), and cause instability



# Posterior Labral Tears

- Clicking or popping
- Sharp pain when torn labrum is pinched or displaced
- Sense of instability or apprehension with activity
- Causes:
  - Usually trauma

Posterior labral tear: not as common as anterior or SLAP tears, best seen transaxial, equator, cause instability





# Knee Checklist

# Coronal Checklist

- Overall signal
- MCL
- LCL
- Meniscii
- Articular cartilage
- ACL
- PCL
- Iliotibial band

Osteochondral defect: helmet shaped defect along the articular surface of femur



# MCL Tears

- Pain at the sides of your knee. If there is an MCL injury, the pain is on the inside of the knee
- Swelling over the site of the injury.
- Instability — the feeling that your knee is giving way.
- Increased movement with valgus stress

MCL Tear: interruption in fibers with adjacent increased signal, best on coronal images



LCL and Semimembranosus  
Tear: best seen on post  
aspect of coronal images



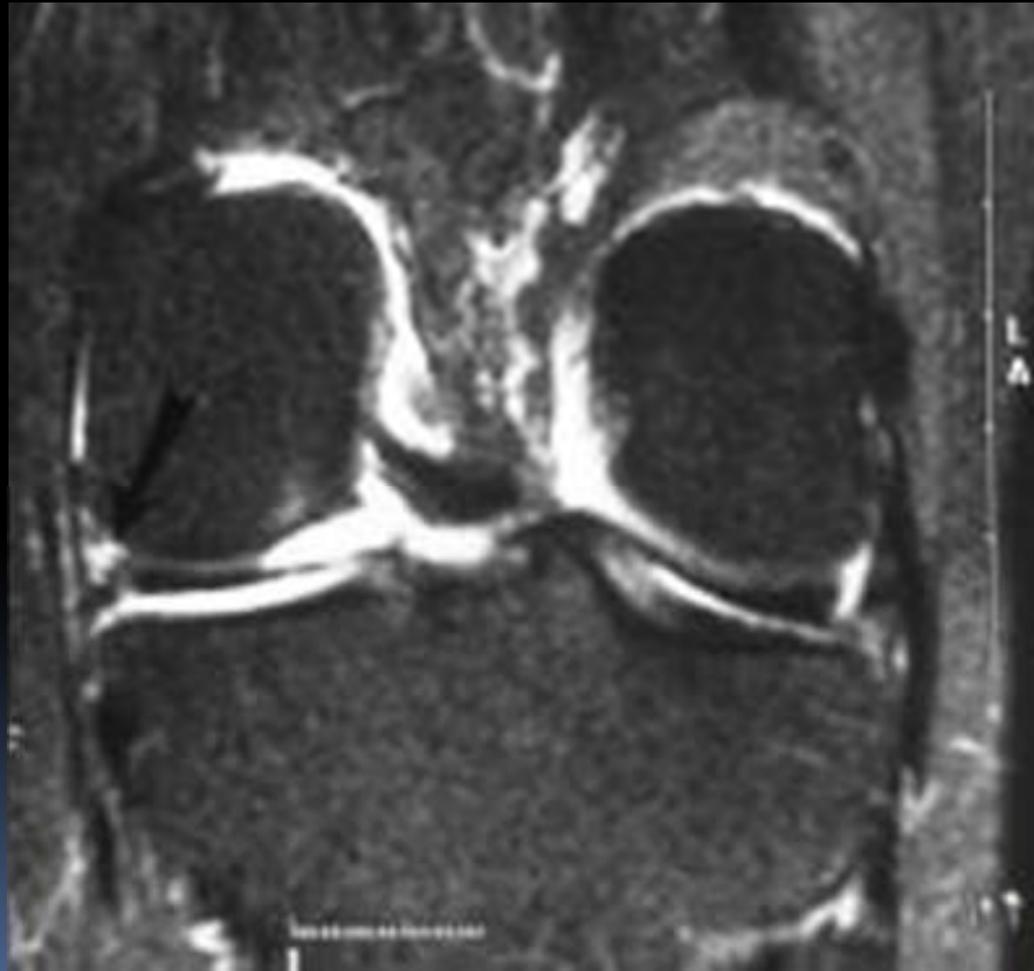
# Meniscal Tears

- Pain
- Stiffness and swelling
- Catching or locking of your knee
- The sensation of your knee "giving way"
- You are not able to move your knee through its full range of motion
- Causes:
  - Sudden meniscal tears often happen during sports. Players may squat and twist the knee, causing a tear. Direct contact, like a tackle, is sometimes involved.
  - Older people are more likely to have degenerative meniscal tears. Cartilage weakens and wears thin over time. Aged, worn tissue is more prone to tears. Just an awkward twist when getting up from a chair may be enough to cause a tear, if the menisci have weakened with age.

# Medial Meniscus Vertical Tear



# Lateral Meniscus Tear



# ACL Tears

- On coronal do not see adjacent to lateral femoral condyle
- Should see continuous fibers (even if small) on the sagittal images
- On sagittal look for bone bruising on anterior femur and posterior tibia

# ACL Tears

- Pain with swelling
- Loss of full range of motion
- Tenderness along the joint line
- Discomfort while walking with a feeling your knee will “give out”
- Causes
  - Changing direction rapidly
    - Stopping suddenly
    - Slowing down while running
    - Landing from a jump incorrectly
    - Direct contact or collision, such as a football tackle (least common)

ACL Tear: no ACL adjacent to lateral condyle



# ACL tear: interruption in fibers

11



W 1617 : L 831

# Bone Bruise Pattern In ACL Tears



# ACL Tear



# Sagittal Checklist

- Overall signal
- Meniscii
- Articular cartilage
- ACL
- PCL
- Patellar and quad tendons
- Suprapatellar pouch



# Meniscal Patterns/Grades

# Grade I Meniscus

- Increased signal in central meniscus
- Indicates degeneration
- Not a true tear



# Grade II Meniscus

- Linear increased signal which does not extend to meniscal surface
- That area of meniscus predisposed to tear



# Grade III Meniscus

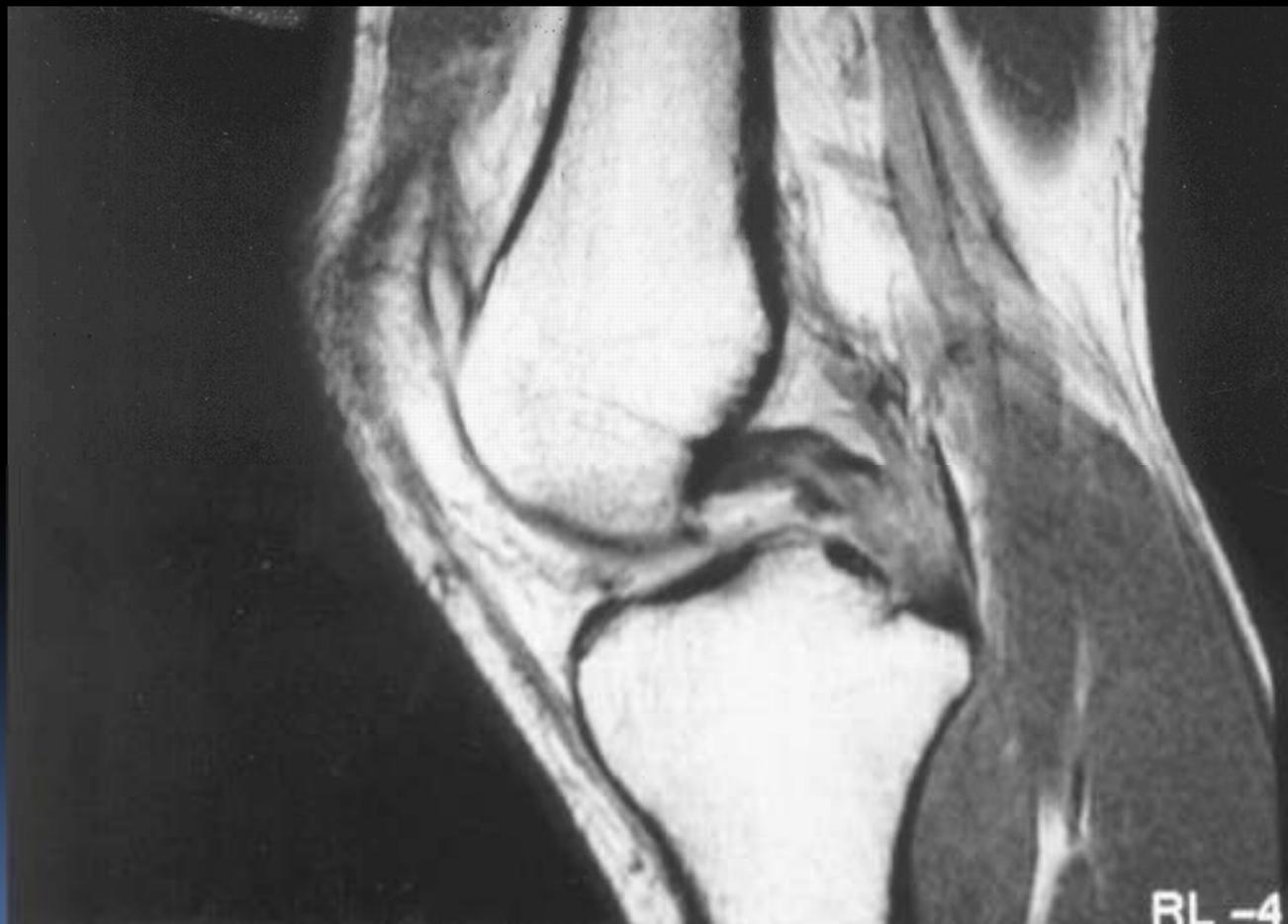
- Linear increased signal which **does** extend to meniscal surface
- A true tear



# PCL Tears

- Pain with swelling that occurs steadily and quickly after the injury
- Swelling that makes the knee stiff and may cause a limp
- Difficulty walking
- The knee feels unstable, like it may "give out"
- Causes:
  - A direct blow to the front of the knee (such as a bent knee hitting a dashboard in a car crash, or a fall onto a bent knee in sports)
  - Pulling or stretching the ligament (such as in a twisting or hyperextension injury)
  - Simple misstep

# PCL Tear



# Patellar Tendon Tear (Jumper's Knee)

- Pain, tenderness, swelling, warmth, or redness over the patellar tendon, most often at the lower pole of the patella (kneecap) or at the tibial tubercle (bump on the upper part of the lower leg)
- Pain and loss of strength (occasionally) with forcefully straightening the knee (especially when jumping or when rising from a seated or squatting position) or bending the knee completely (squatting or kneeling)
- Crepitation (a crackling sound) when the tendon is moved or touched
- Causes:
  - Sports that require sudden, explosive quadriceps contraction (jumping, quick starts, or kicking)
  - Running sports, especially running down hills
  - Poor physical conditioning (strength and flexibility, such as with weak quadriceps or tight hamstrings)
  - Flat feet

# Patellar Tendon Tear



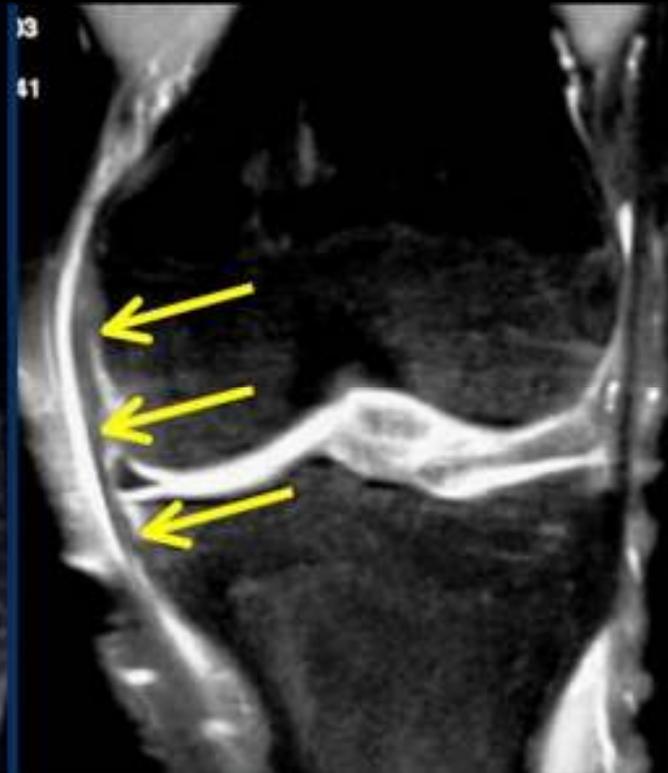
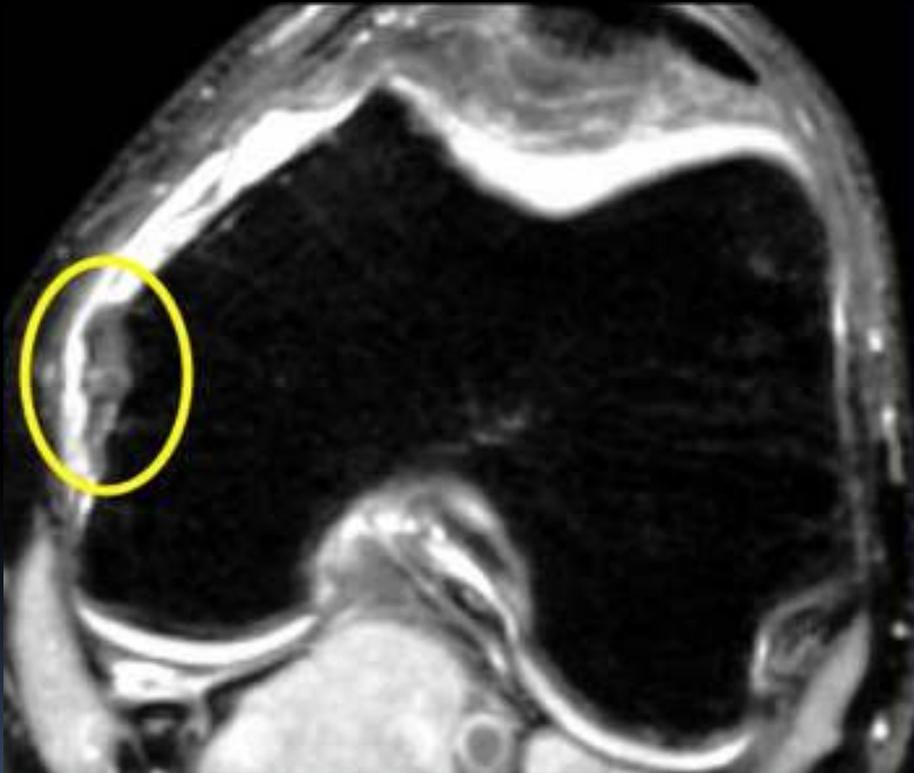
# Axial Checklist

- Overall signal
- Patellofemoral joint
- ACL/PCL
- Collateral ligs
- Meniscii
- Iliotibial band
- Joint effusion?

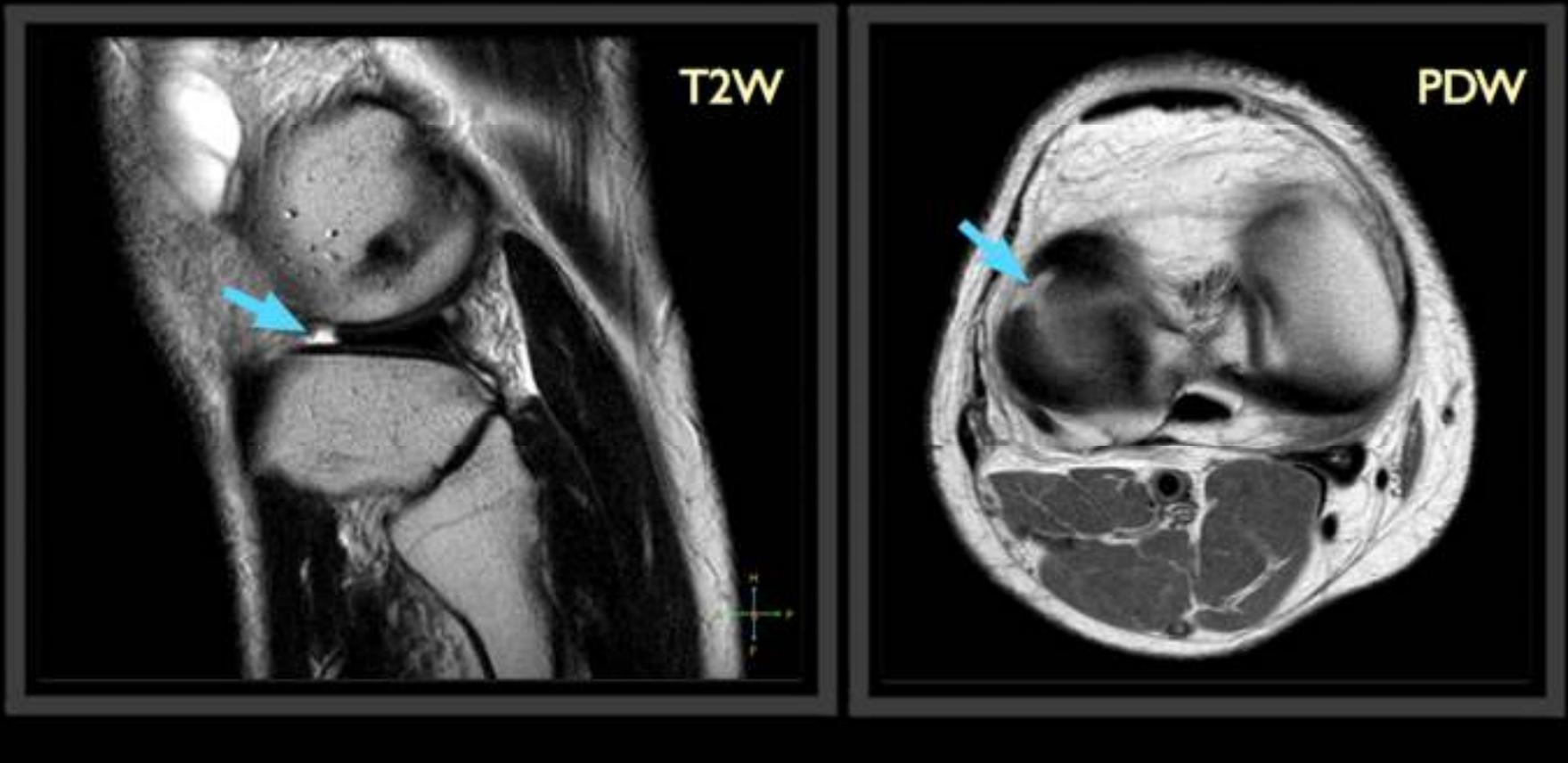
# Bone Bruises From Patellar Dislocation



# MCL Tear



## Full Thickness Radial Tears of the Anterior Horn of Right Knee (blue arrow)



# The End



# CONFUSION

Sometimes to stop the idiots, you have to confuse the smart ones.