The pesky iliopsoas muscle

Fall Conference 2023

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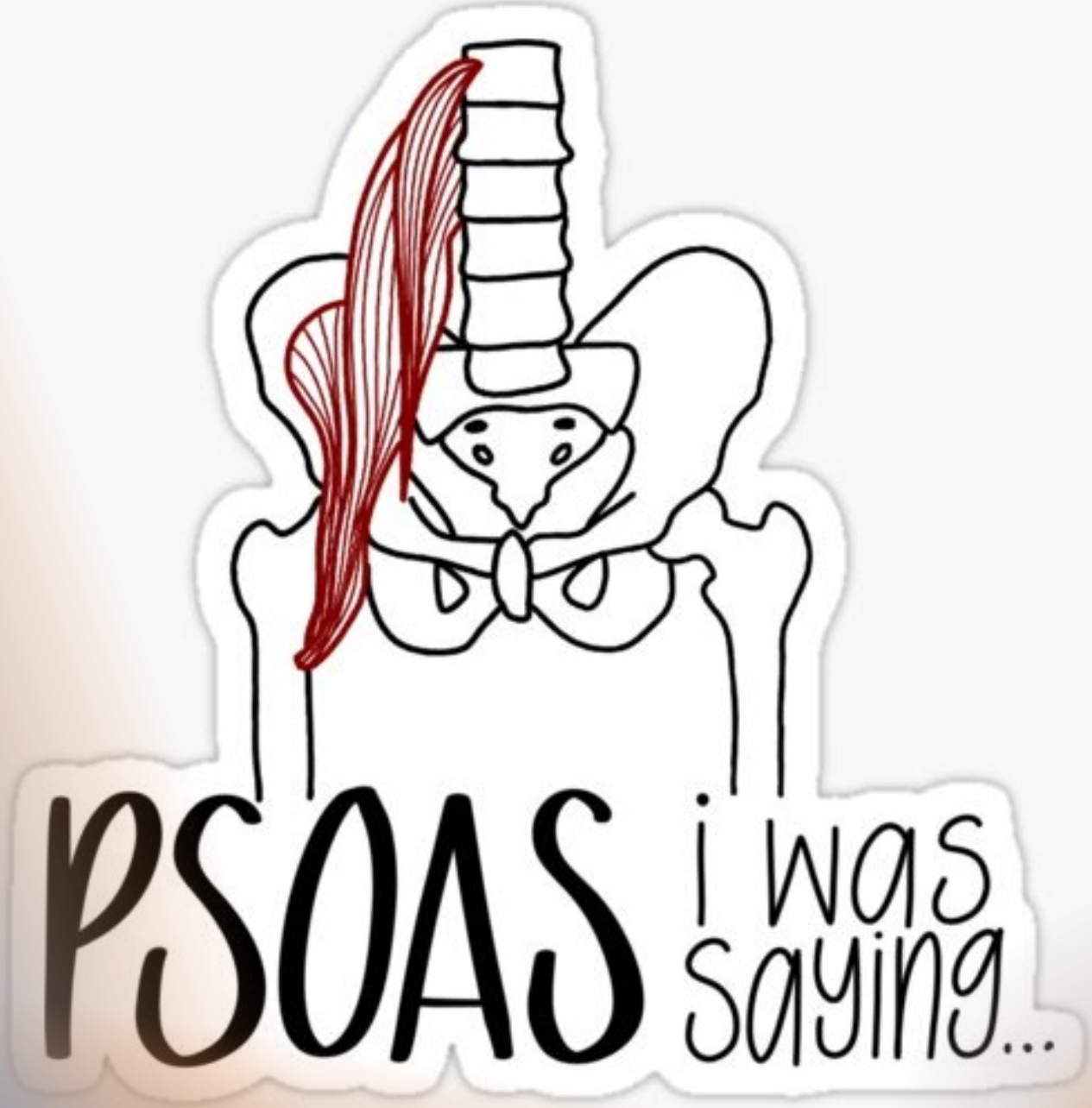
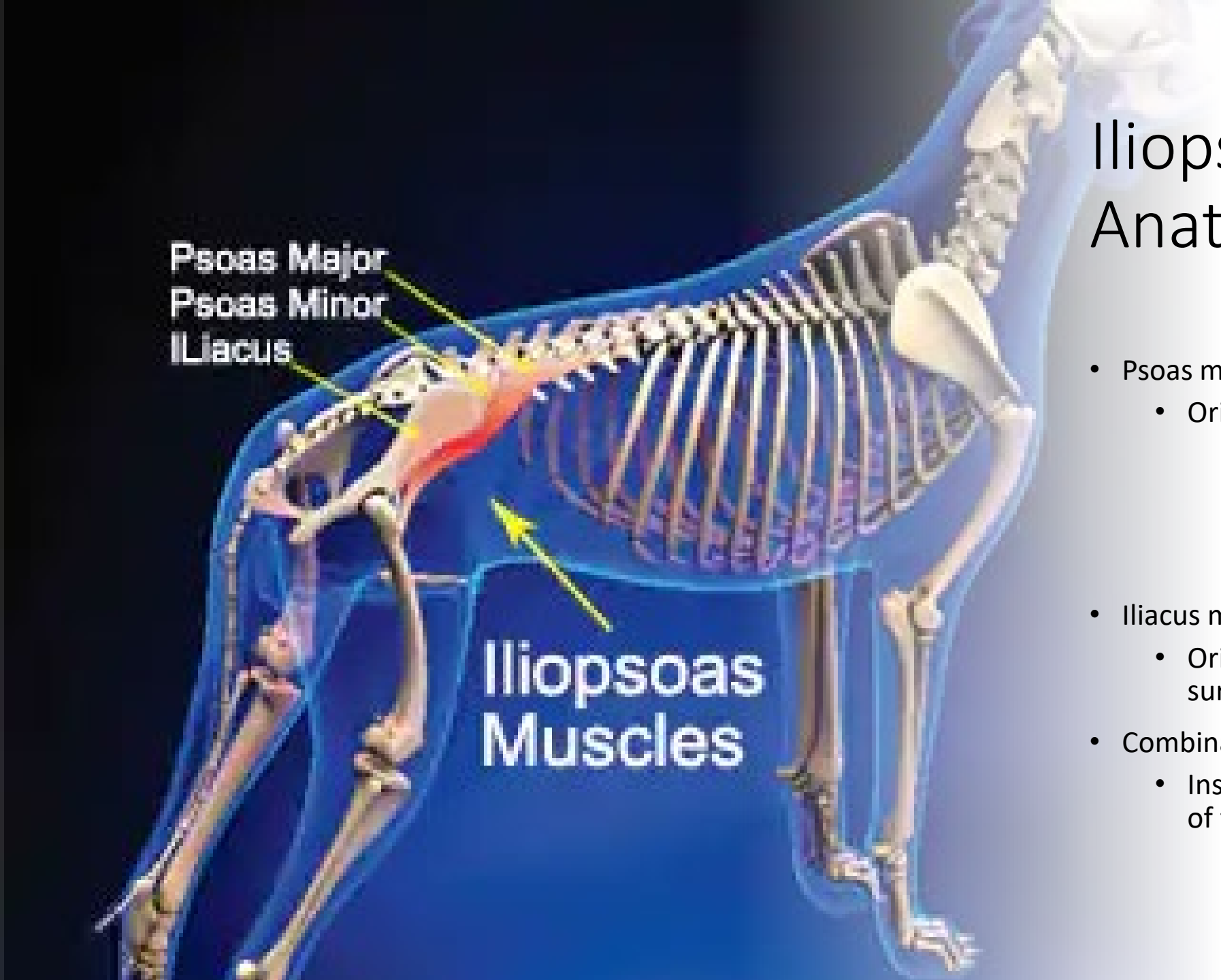


Learning objectives:

- Review iliopsoas (IP) muscle anatomy
- Describe the etiologies for IP muscle injury
- Discuss clinical presentation and relevant diagnostic testing for the IP muscle
- Describe treatment and prevention interventions



Iliopsoas Anatomy

- Psoas major
  - Originates from:
    - Transverse processes of lower spinal columns of L2 and L3
    - Vertebral bodies of L4-L7
- Iliacus muscles
  - Originates from the ventral surface of the ileum
- Combination muscle
  - Inserts on the lesser trochanter of the femur

Image credit: stemcellsafari.com

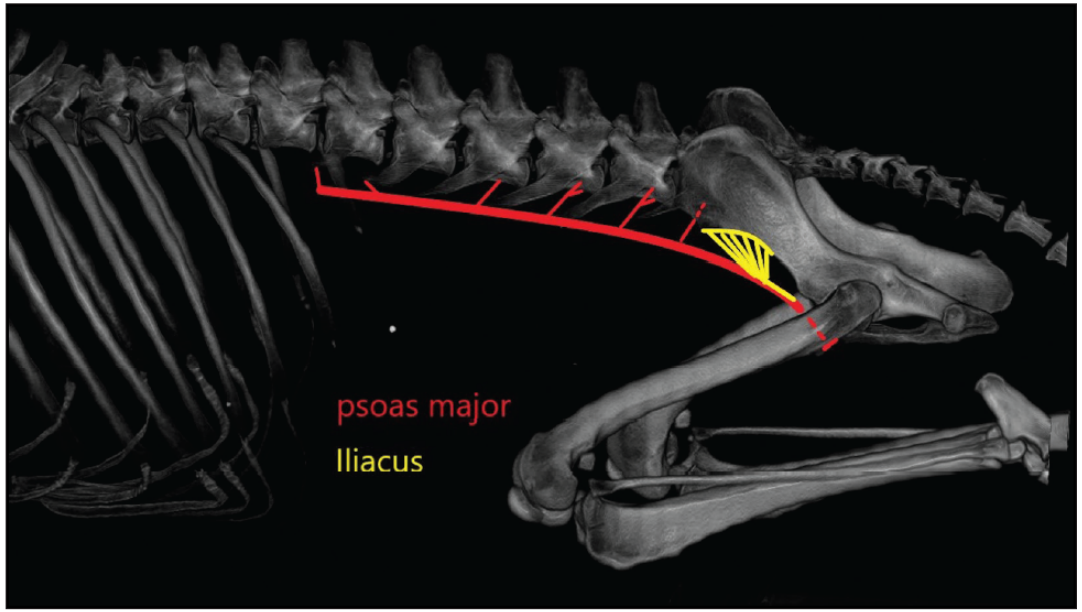


Figure 1. Sagittal reformatted computed tomographic images of the canine patient (bone algorithm) with the psoas major and iliacus muscles overlaid. The psoas major is narrow and tendinous at its origin on the transverse processes of lumbar vertebrae 2 and 3. It attaches to the ventral aspect of lumbar vertebrae 3 and 4, and the ventral and lateral surfaces of lumbar vertebrae 4 to 7. As it passes the cranioventral border of the ilium the iliacus muscle bed is received, from the ventral surface of the ilium. These combined muscles attach to the trochanter minor of the femur.

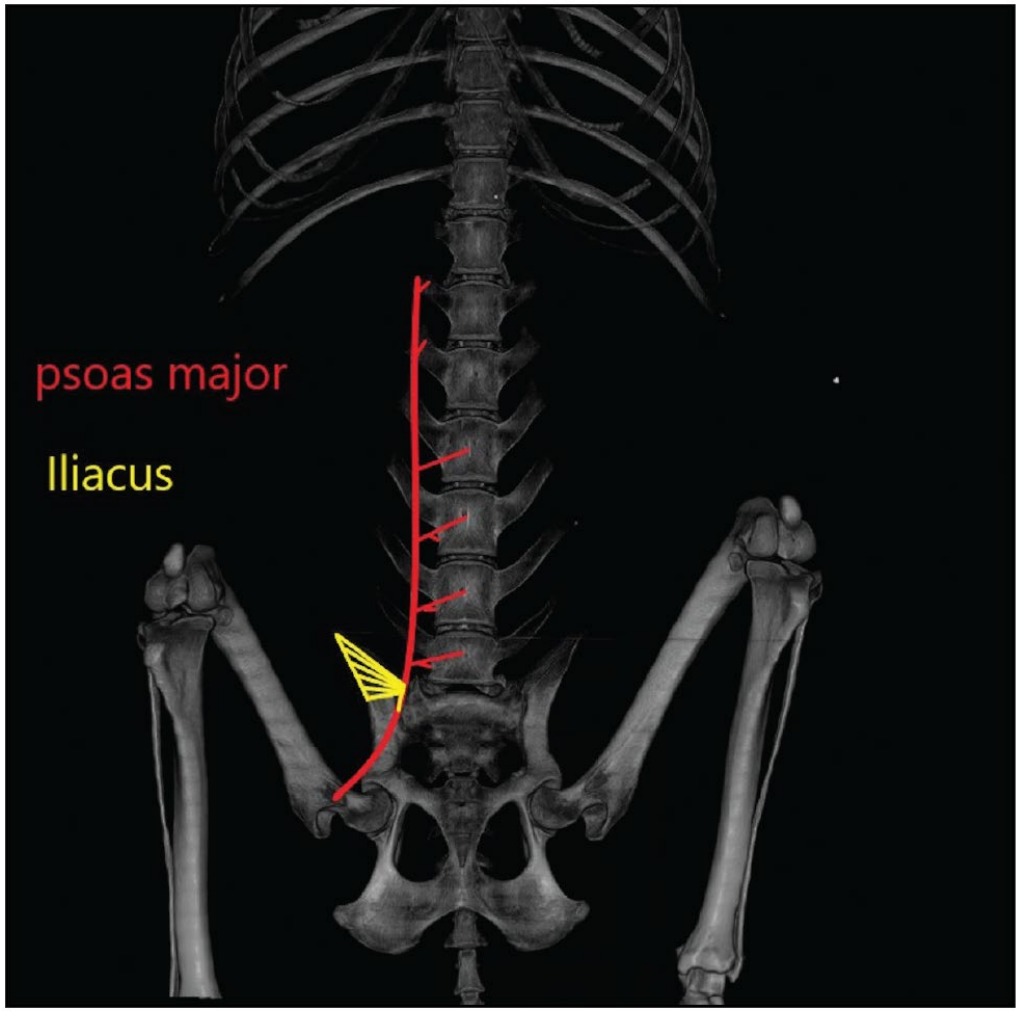
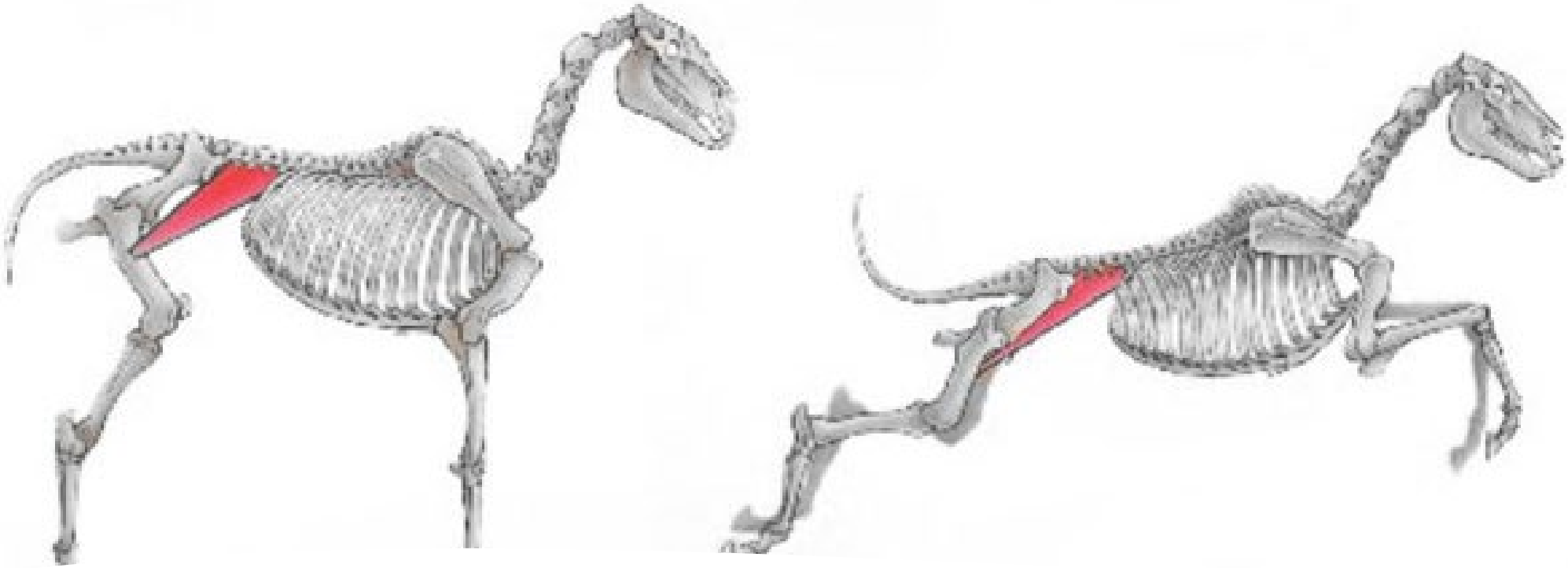


Figure 2. Coronal reformatted computed tomographic images of the canine patient (bone algorithm) with the psoas major and iliacus muscles overlaid.

Image credit: Slater, R., Oblak, M., Wright, T., & Matsuyama, A. (2019). Preserved limb function following subtotal iliopsoas muscle and femoral nerve resection in a dog with low grade intramuscular chondrosarcoma. *Can Vet J, 60(5), 490-494.*



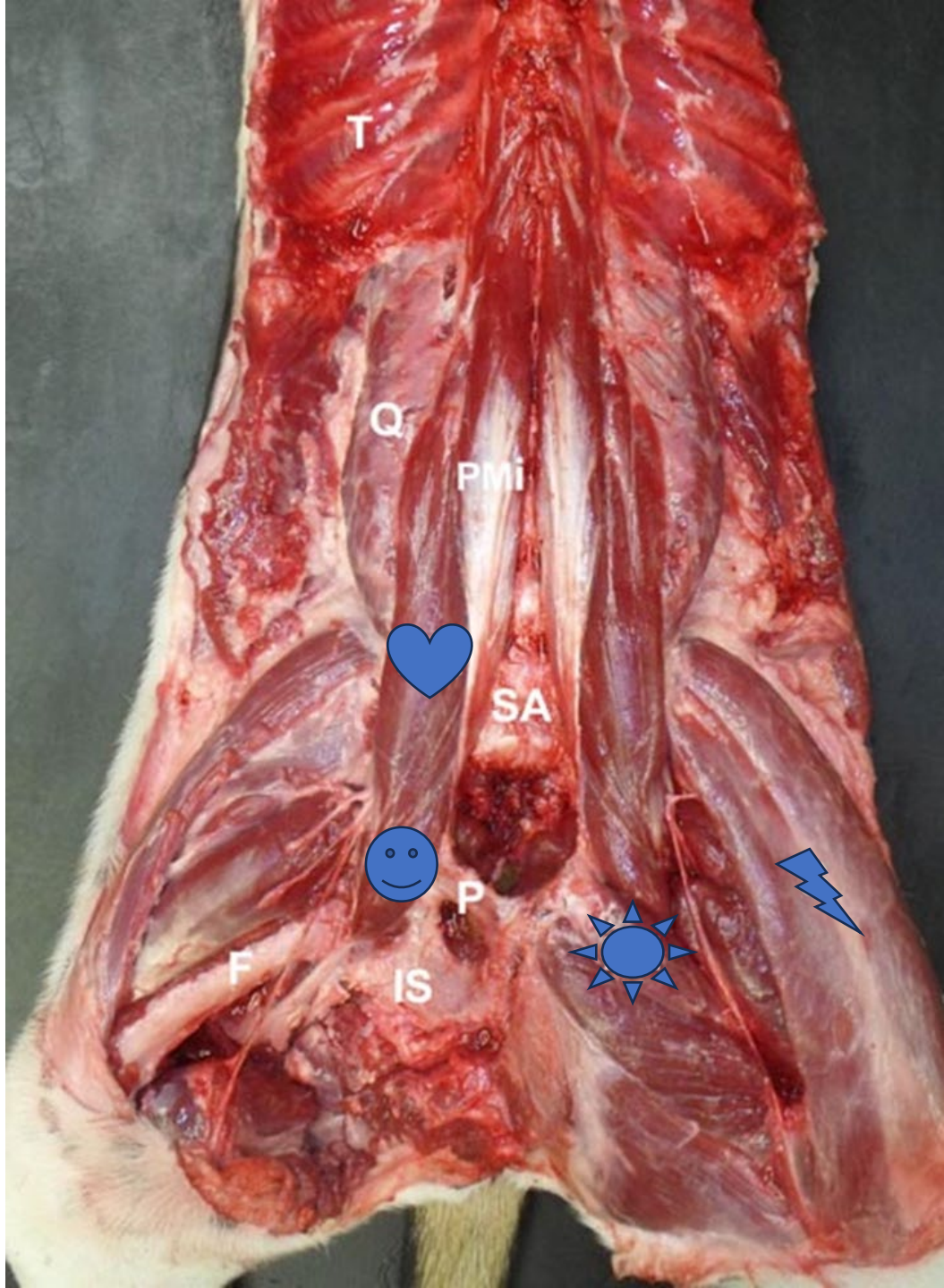
Iliopsoas Anatomy

- Strongest of all sublumbar muscles
- Core stabilizing muscle essential for:
  - Hip flexion and supination (psoas major, iliacus)
  - Lumbar vertebral column ventral flexion (psoas minor)
- Considered the “spring” of the pelvic limb

Image credit: canineworks.com.au

Question

- Which muscle is the iliopsoas?
  A. Sun
  B. Heart
  C. Smiley face
  D. Lightening strike



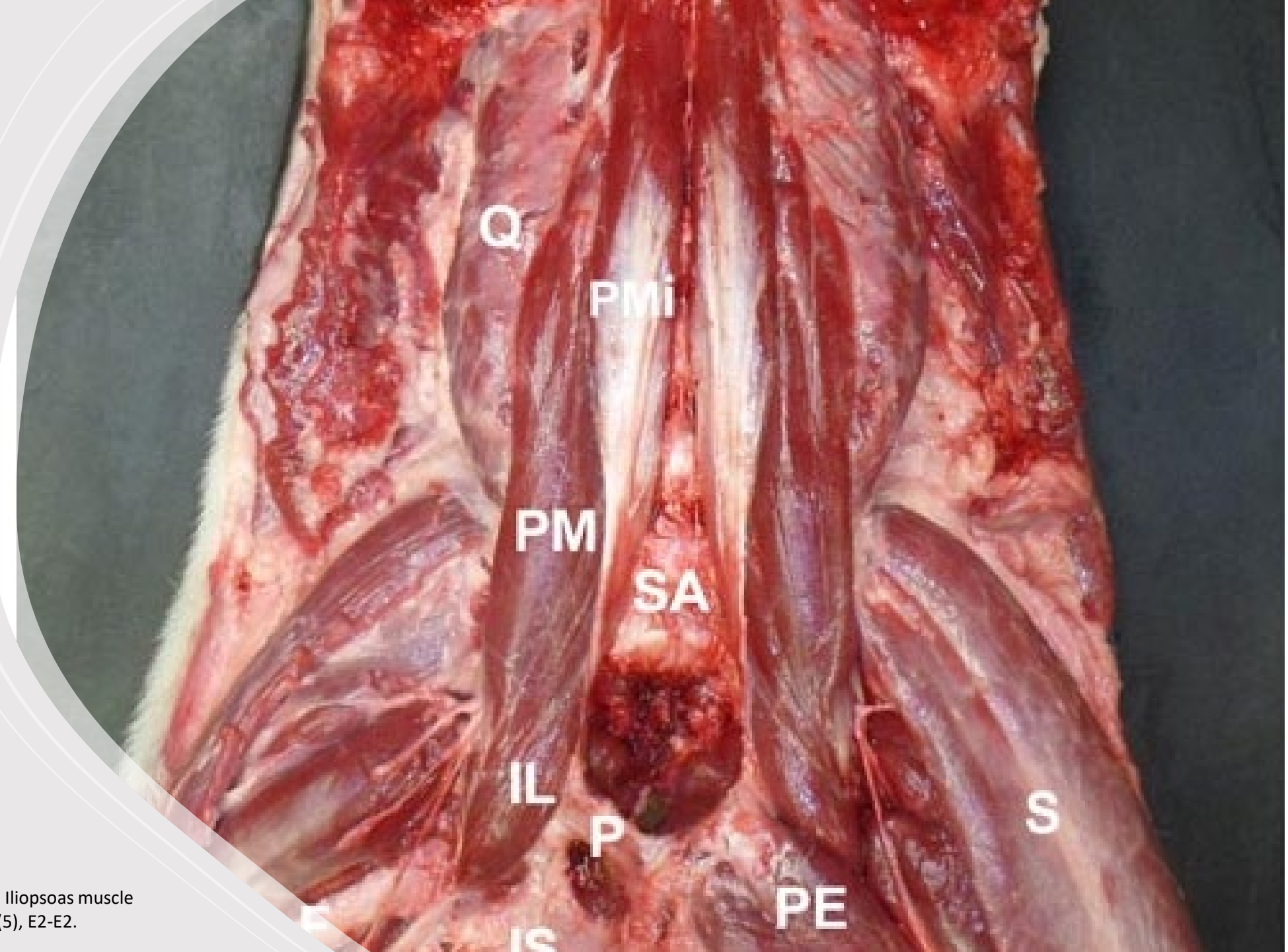
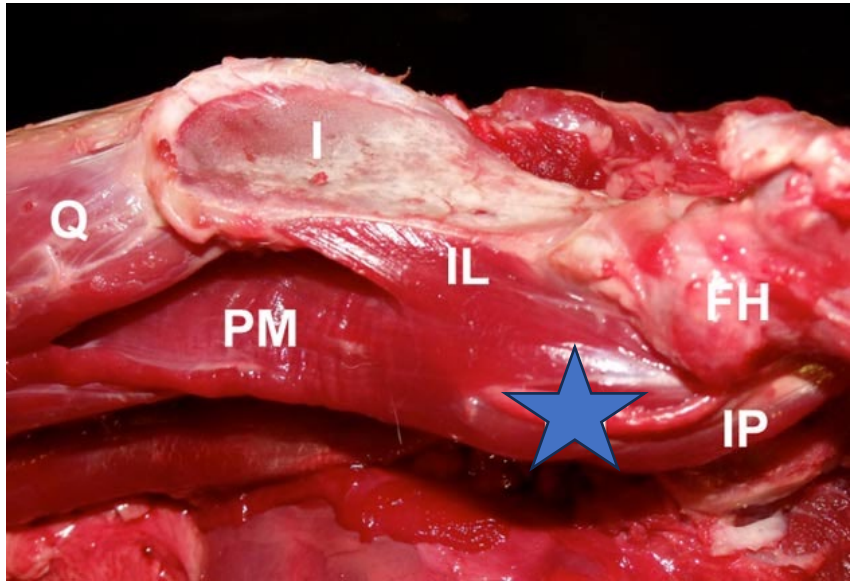
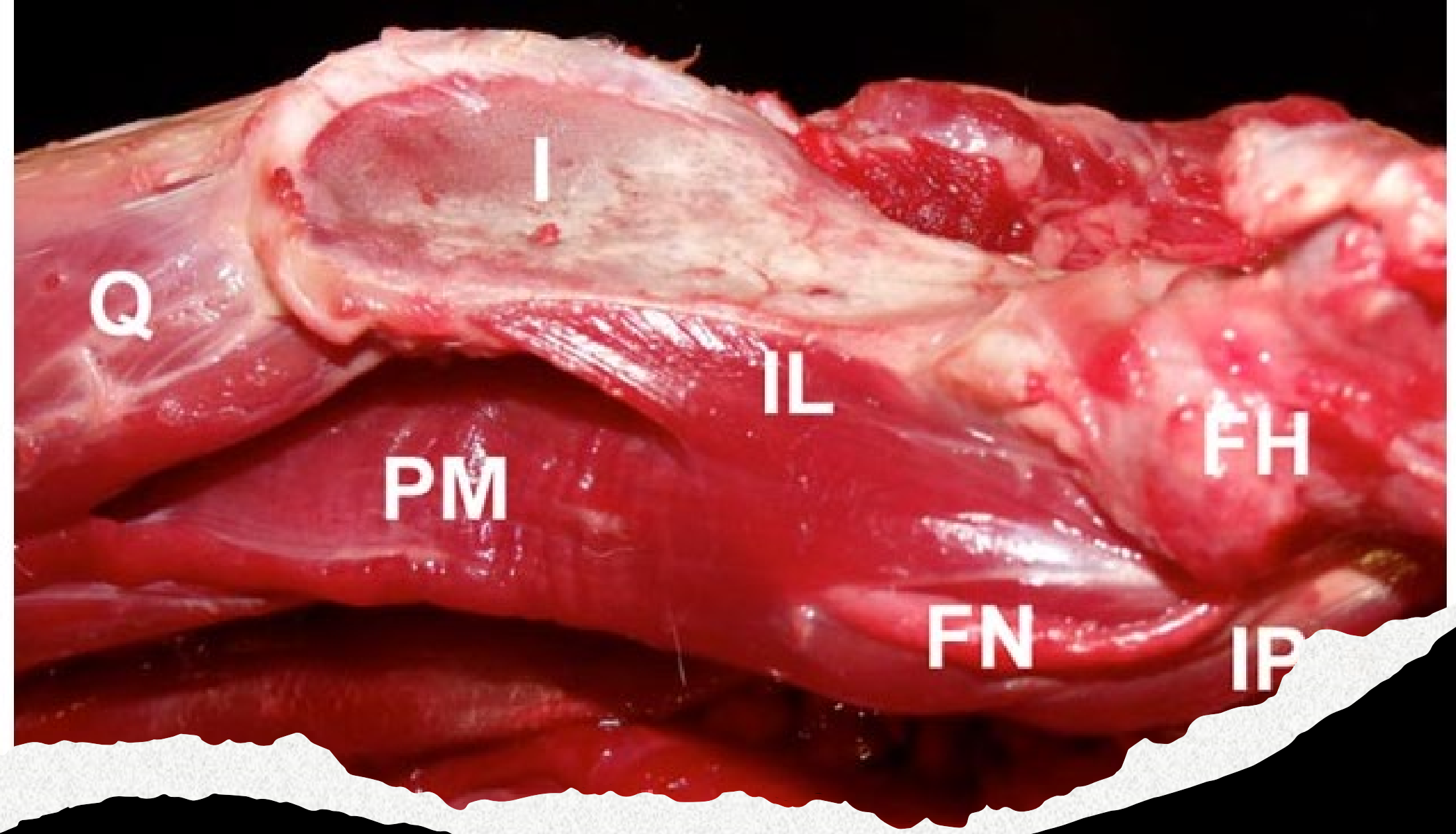


Image credit: Cabon, Q., & Bolliger, C. (2013). Iliopsoas muscle injury in dogs. *Compendium (Yardley, PA)*, *35*(5), E2-E2.

Question

- What nerve is this?
  A. Sciatic
  B. Femoral
  C. Obturator
  D. Caudal gluteal





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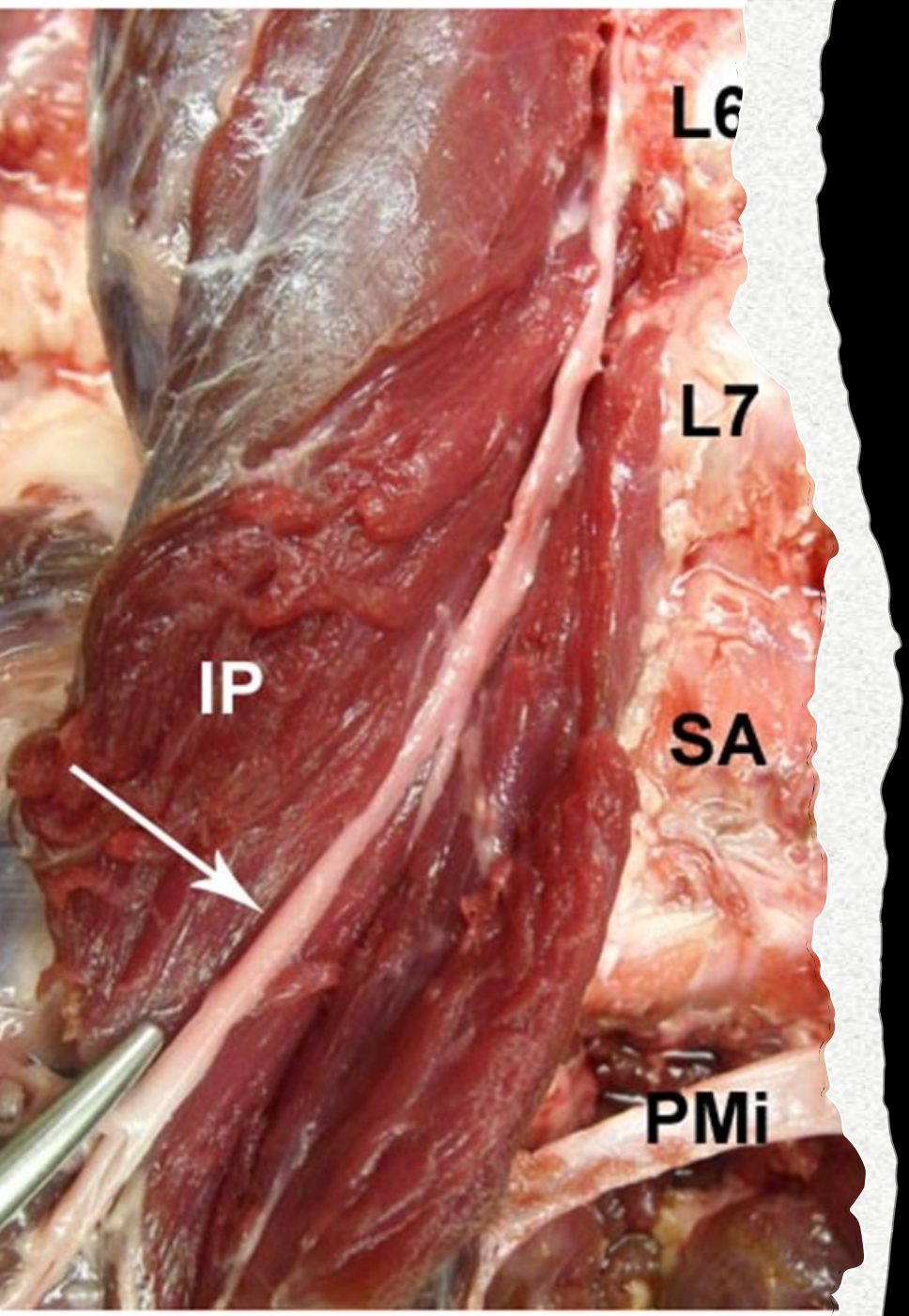


Iliopsoas Anatomy

Innervation

- Branches of lumbar nerves
- Femoral nerve
  - Arises from L4-L5 and L6
    - Embedded within the iliopsoas muscle
  - Exits the ventral surface of the muscle to branch into the saphenous nerve
    - Provides stifle innervation, sensation medially to the first and second digits
    - Innervates the sartorius and quadriceps femoris muscle

Image credit: Cabon, Q., & Bolliger, C. (2013). Iliopsoas muscle injury in dogs. *Compendium (Yardley, PA)*, *35*(5), E2-E2.

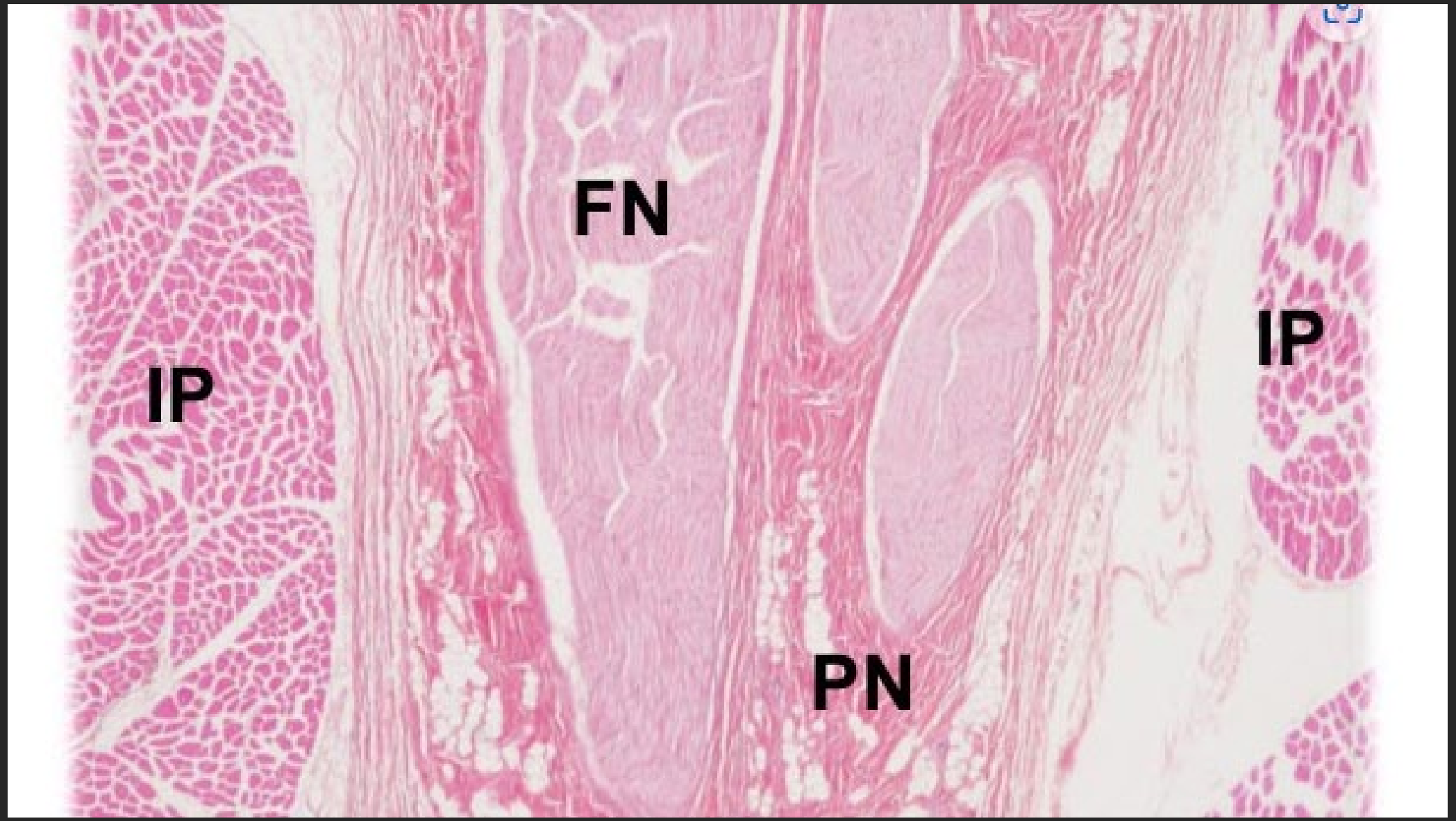


Image credit: Cabon, Q., & Bolliger, C. (2013). Iliopsoas muscle injury in dogs. *Compendium (Yardley, PA)*, *35*(5), E2-E2.

Iliopsoas Injuries

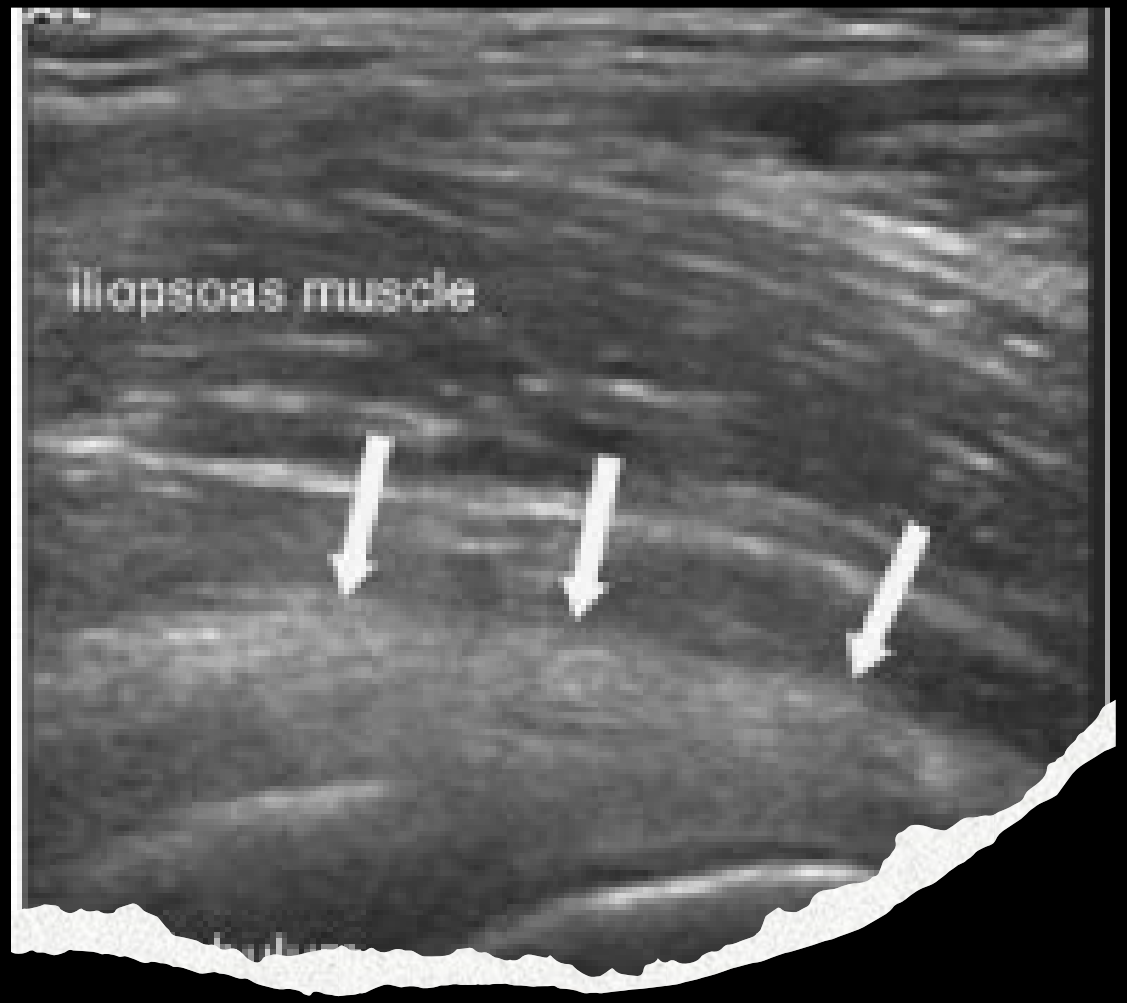
- Underdiagnosed source of pain
  - Secondary to athletic injuries
    - Stretch-induced
    - Repetitive overuse
    - Overtrained
      - Muscle fatigue
    - Unprepared athletes
      - Inadequate warm-up
    - Muscle inflexibility
  - Slipping, splay leg injury, and trauma from jumping
  - Chronic lower back or coxofemoral joint disease
    - Promotes chronic muscle strain injury, can result in contracture
  - Iatrogenic
    - Femoral head and neck ostectomy

Fig. 1 The letter A marks the head of the femur. The single white asterisk indicates the lesser trochanter. The three white asterisks annotate the iliacus m. coursing toward its origin. The two white asterisks highlight the psoas major m. tracking toward its origin.

Image credit: Gillis, C. E., Jaffe, M. H., Lee, A. M., & Seitz, M. A. (2022). Iatrogenic Iliopsoas Tendon Injury May Occur during Femoral Head and Neck Ostectomy—An Ex-Vivo Study in Dogs. VCOT Open, 5(01), e36-e40.

Iliopsoas Injuries

- Very protected muscle
  - Excessive stretch
  - Stretch while muscle is activated (eccentric contraction)
- Location:
  - Muscle tendon junction
  - Origin of the tendon
- Most likely affect by strain injury
  - Type 1: mild- myositis, bruising, intact architecture
  - Type 2: moderate- myositis and some tearing of myofascial sheath
  - Type 3: severe- tearing of the fascial sheath, muscle fiber disruption, hematoma formation



Iliopsoas Injuries

- Fry, et al completed an internet-based survey of agility dog handlers
  - 4,197 responders
  - 327 (7.8%) reported iliopsoas injury
- Risk factors for agility associated iliopsoas injury
  - Breed
  - Training methods
  - Handler association with veterinary medicine
  - Competition ground surface (unitary, loose-fill)
  - Intended use of the dog when acquired
- Take home:
  - Excessive time from competition
  - Potentially lead to retirement

Question

What breed of dog is overrepresented for iliopsoas muscle injury secondary to agility sporting events?

A. Corgi

B. Schnauzer

C. Border collie

D. Golden retriever

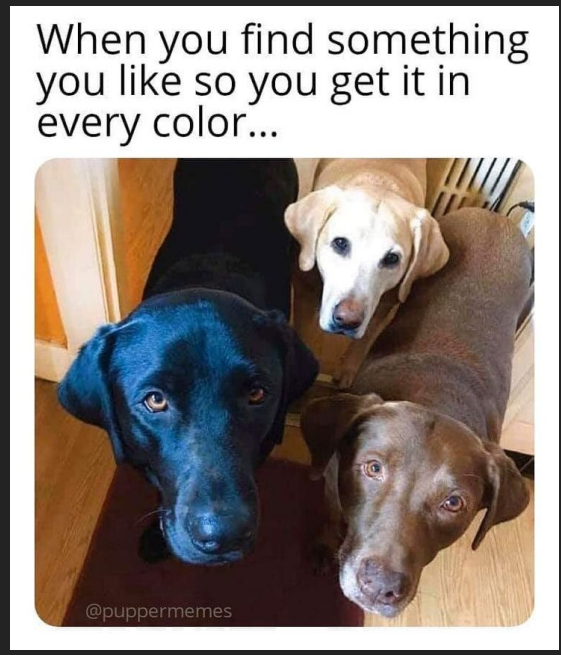


Image credit: IMG_9662-1024x683.jpg (1024×683) (pinkfox.co)

Clinical Presentation

- Variable
- Acute or chronic
- Unilateral or bilateral

Distance Examination

Abnormal, short-strided gait

Fig 2. Gait examination before (left) and after iliopsoas tenectomies (right). On admission, both pelvic limbs remained positioned under the thorax preventing ambulation (left). Extension of the hips and gait were improved after surgery (right).

Veterinary Surgery
38:946-953, 2009

Bilateral Iliopsoas Muscle Contracture and Spinous Process Impingement in a German Shepherd Dog

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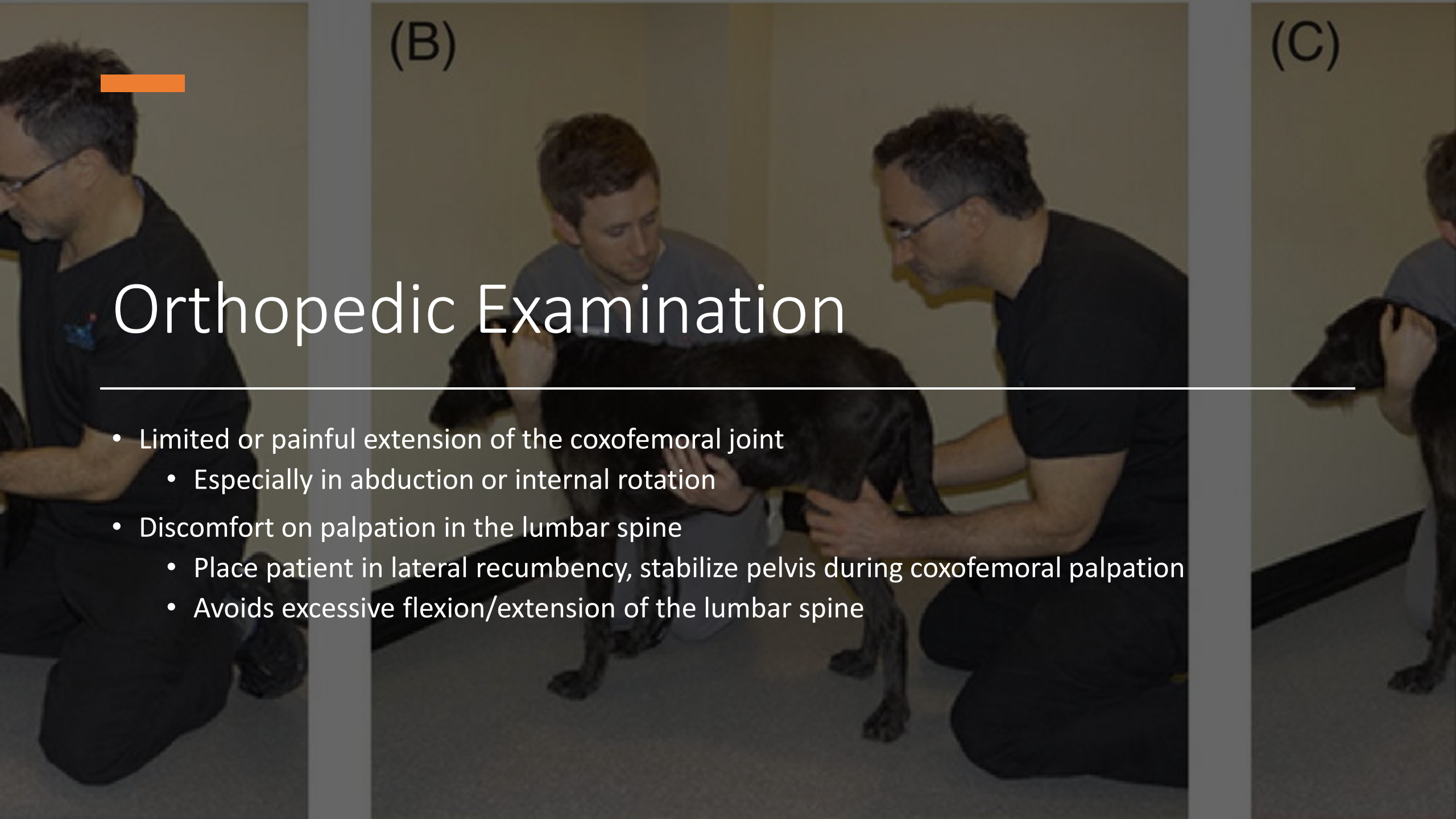


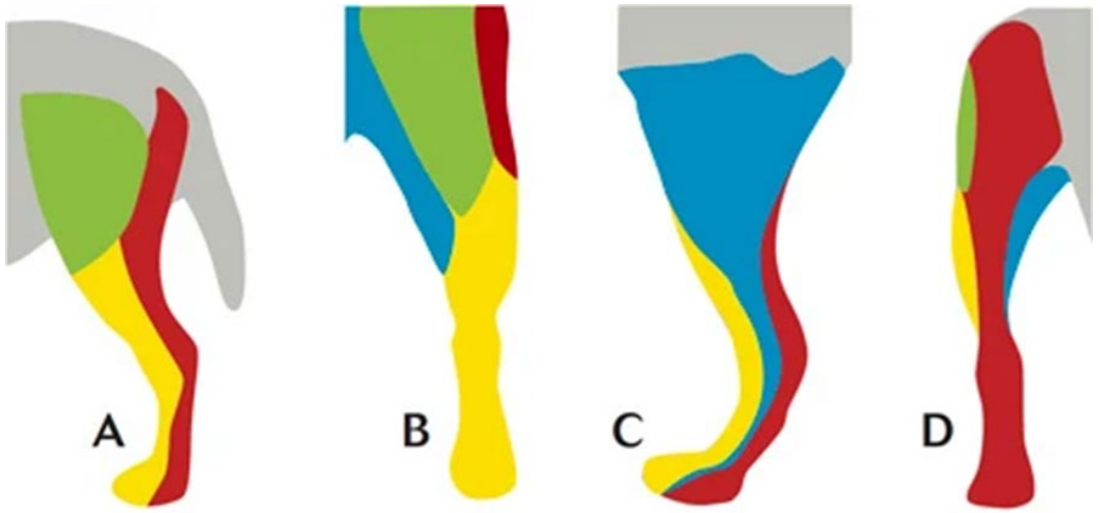
Orthopedic Examination

- Limited or painful extension of the coxofemoral joint
  - Especially in abduction or internal rotation
- Discomfort on palpation in the lumbar spine
  - Place patient in lateral recumbency, stabilize pelvis during coxofemoral palpation
  - Avoids excessive flexion/extension of the lumbar spine

Myofascial Examination

- Direct muscle palpation
  - Discomfort or pain
  - Careful not to over interpret
    - Light on direct palpation pressure
    - Commonly tender area for most dogs!
- Evaluate:
  - Muscle belly
  - Insertion point (lesser trochanter)
    - Hip extension, internal rotation of femur may accentuate pain
- Palpate joint supporting muscles
  - Concurrent pectineus muscle strains are common (25%)

Question

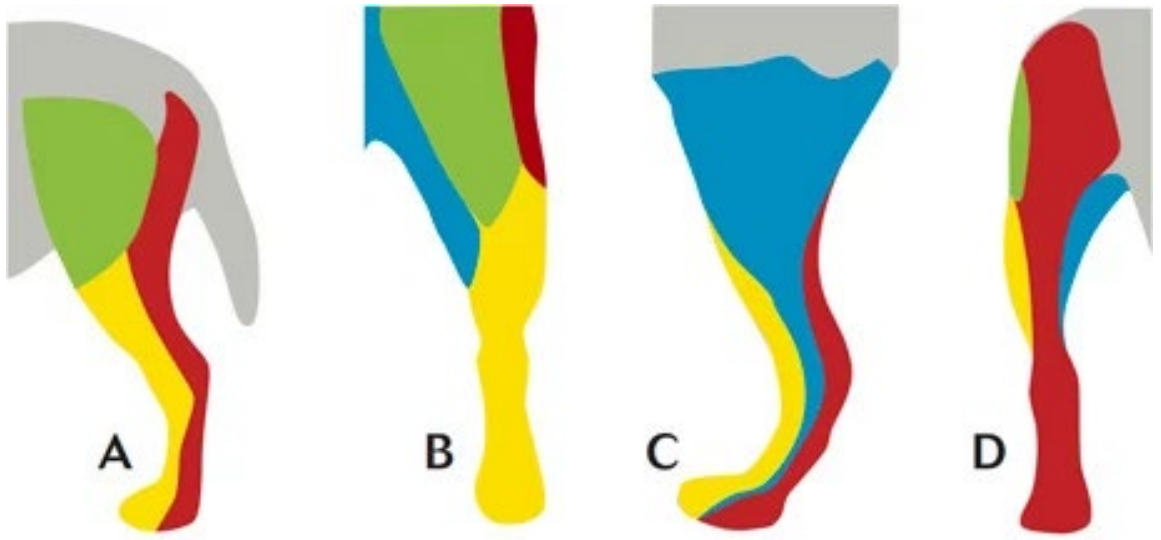


The femoral nerve innervation to the back leg is represented by what color?

1. Red
2. Blue
3. Green
4. Yellow

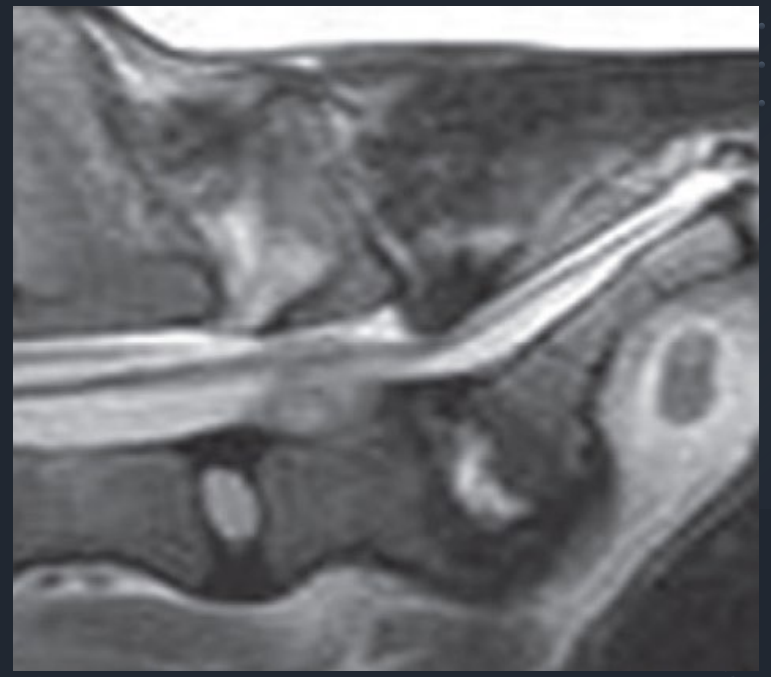
Neurological Examination

- Femoral nerve (blue = innervation)
  - Close anatomic relationship!
  - Reduced patellar reflexes
  - Decreased conscious proprioception
  - Hindlimb weakness
  - Quadriceps femoris m. atrophy
  - Loss of cutaneous nociception medially (rare)



Excellent Hips

Severe Hip Dysplasia

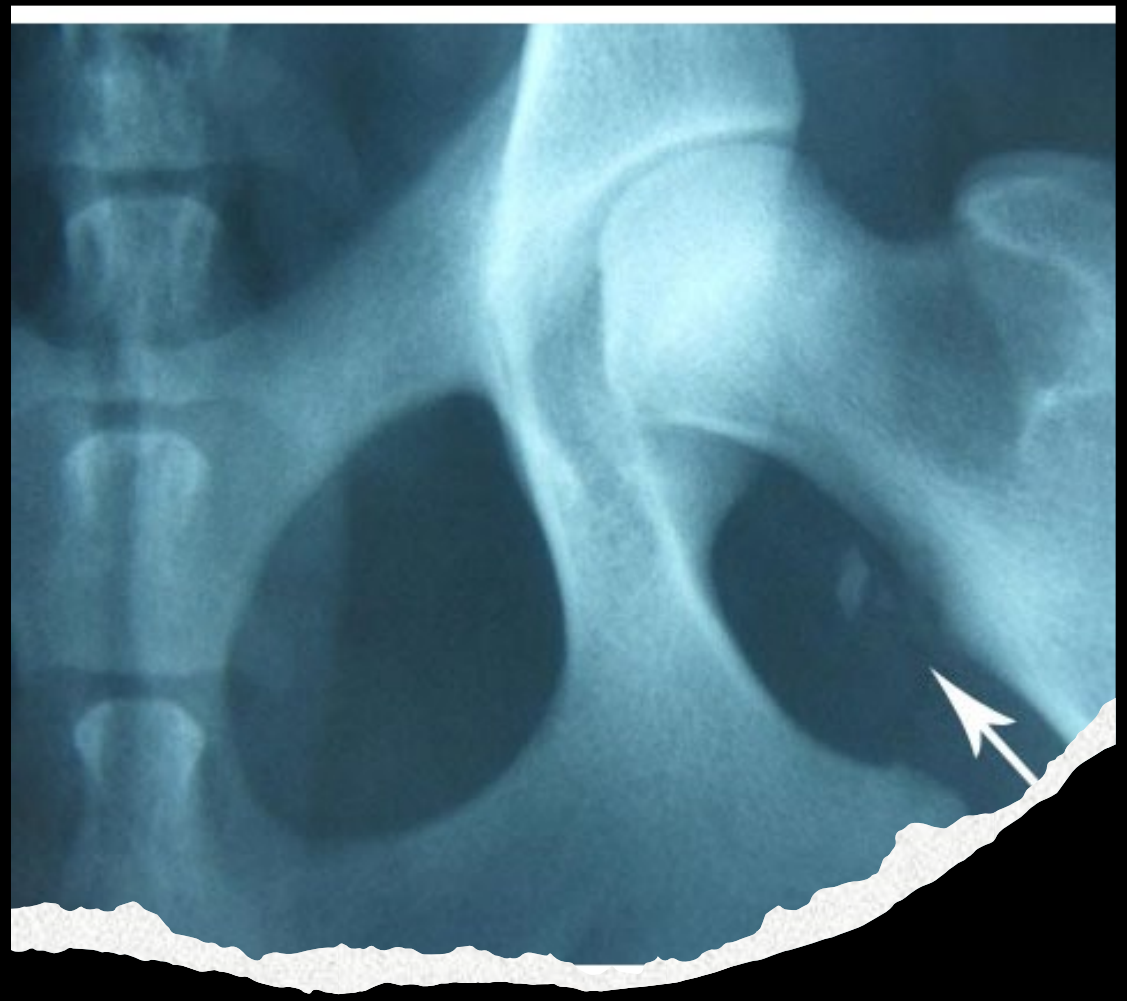


Diagnostic Imaging: Radiographs

- Evaluate orthopedic abnormalities
  - Lumbar spine
  - Coxofemoral joints

Image credit: https://www.vettimes.co.uk/article/canine-lumbosacral-disease/ https://ofa.org/diseases/hip-dysplasia/

Dystrophic calcification does not mean active disease!



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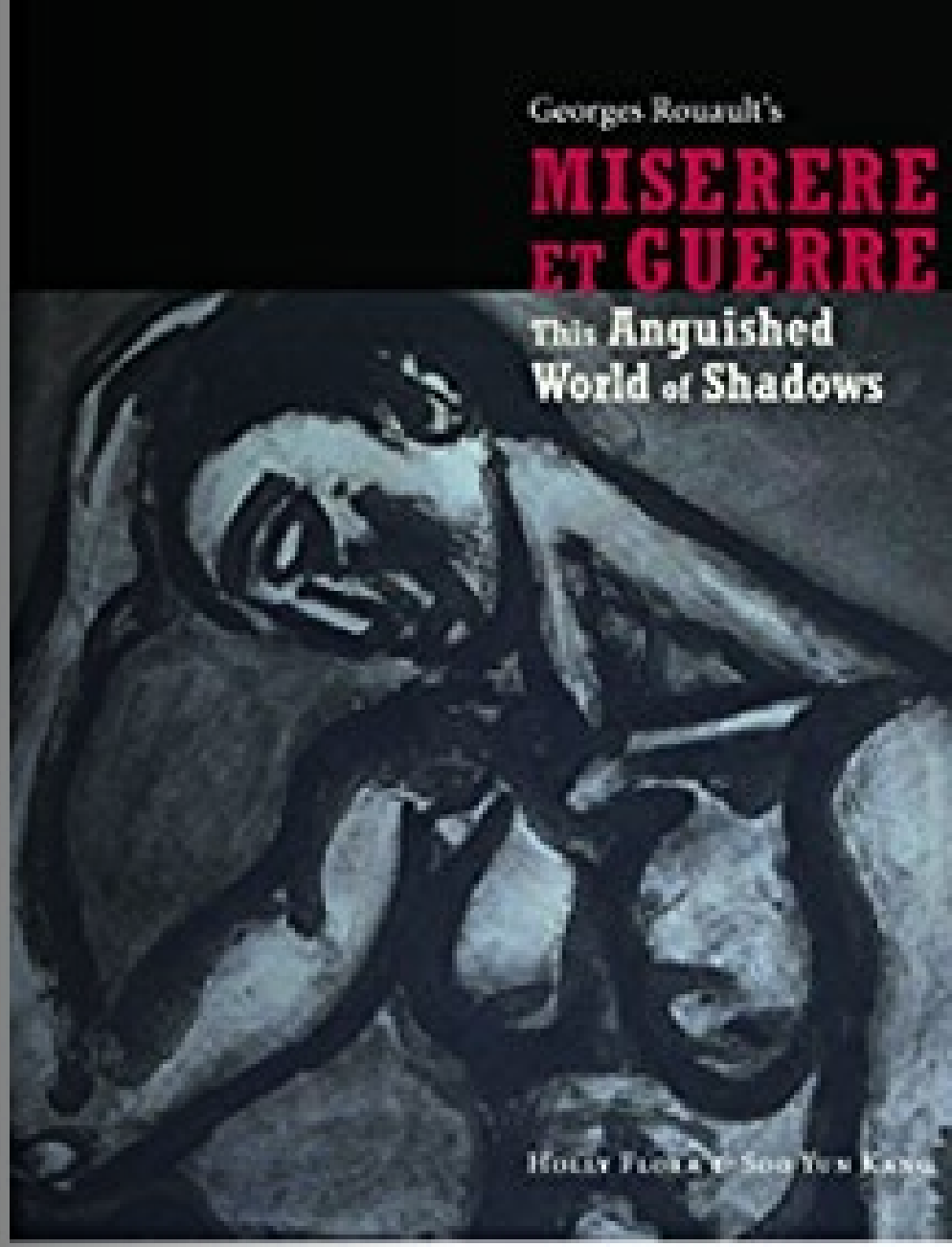
https://www.cliniciansbrief.com/article/top-5-muscle-tendon-injuries-lame-patients

Diagnostic Imaging: Ultrasound

- Superior, modality to evaluate ST
  - Muscle, tendon, ligament
  - +/- Joint abnormalities



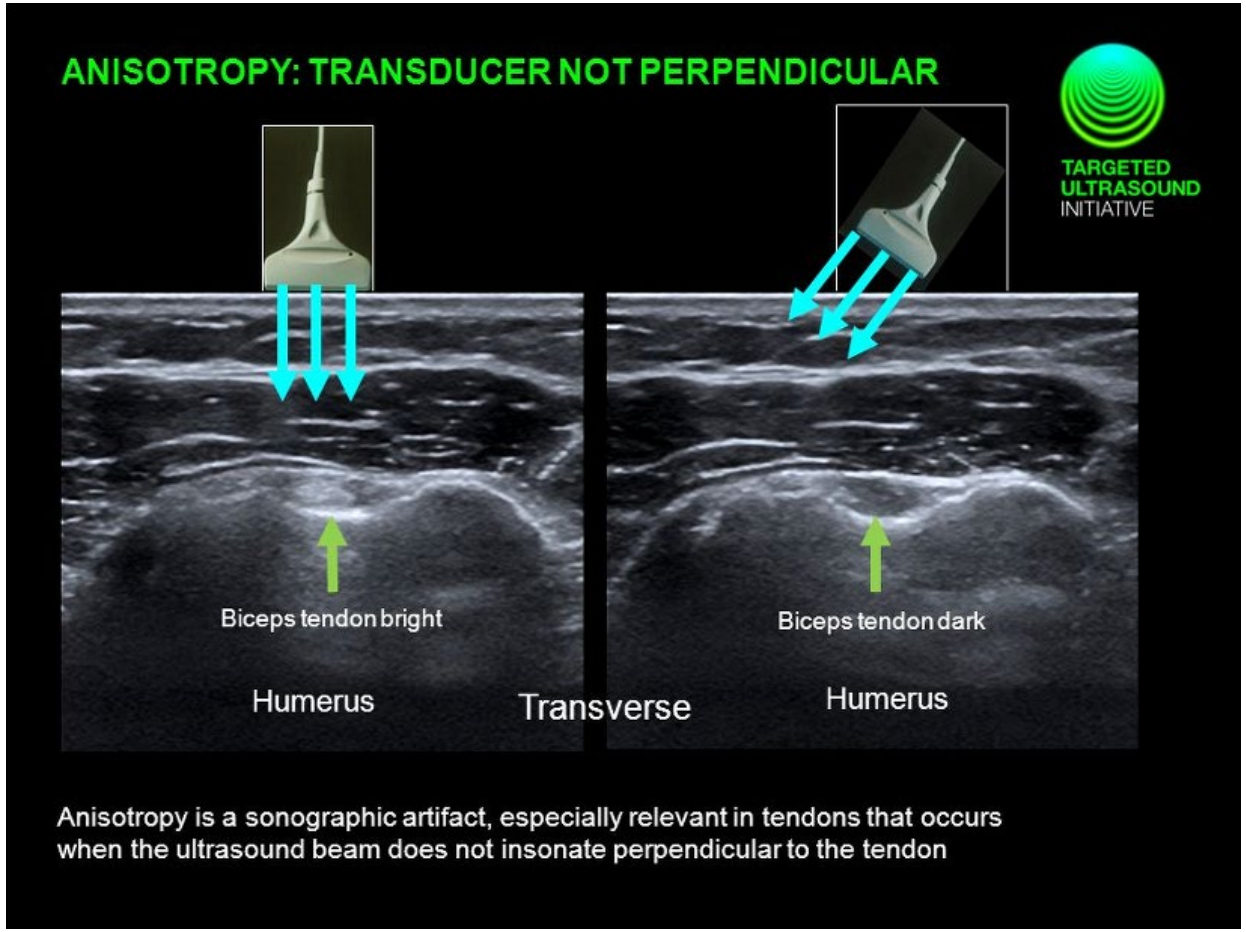
Diagnostic Imaging: Ultrasound

- Equipment
  - 8-15 MHz
  - High resolution, linear transducer
  - Small to medium length footprint to maintain good contact
  - Curvilinear or sector transducers may produce artifact from curved probe surface

Diagnostic Imaging: Ultrasound

- Clip hair, isopropyl alcohol, coupling gel
- Ultrasound beam should be **perpendicular** to area of interest
- Fibers of tendons and ligaments will become hypoechoic when the angle of the tendon is no longer perpendicular producing off-axis artifact

Image Credit: https://www.pinterest.com/pin/479070479098361546/

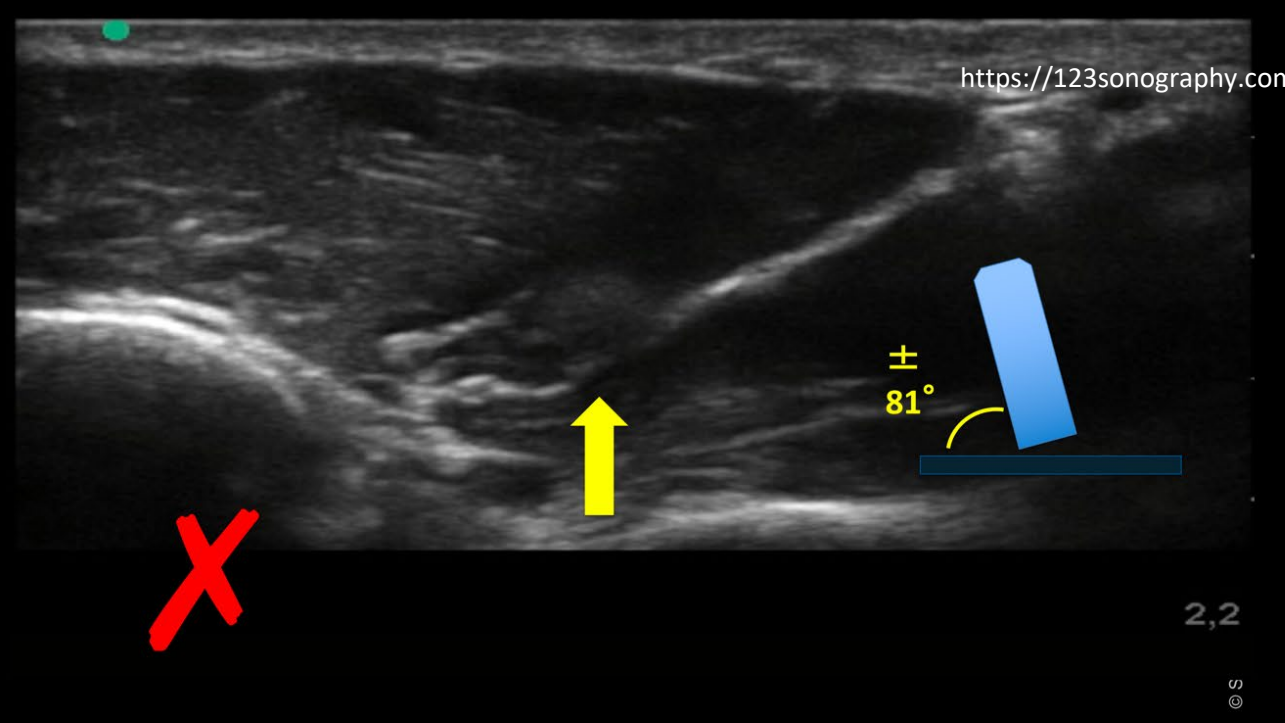


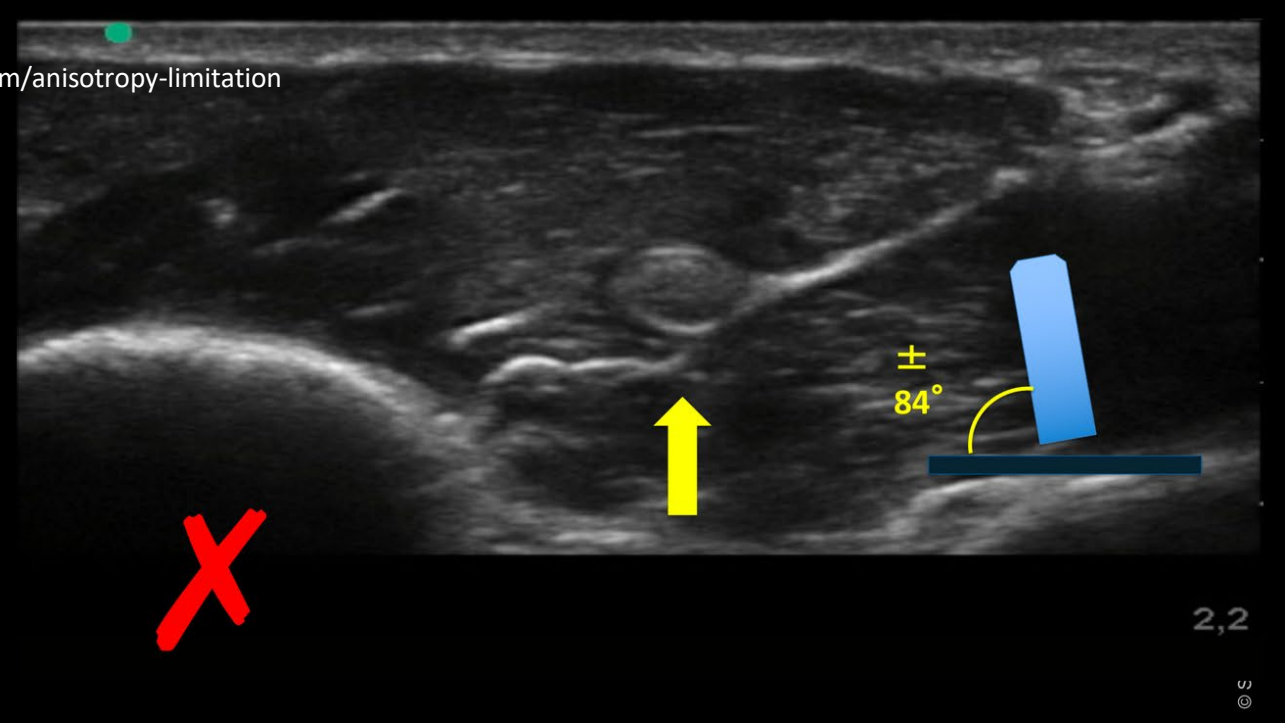
Diagnostic Imaging: Ultrasound

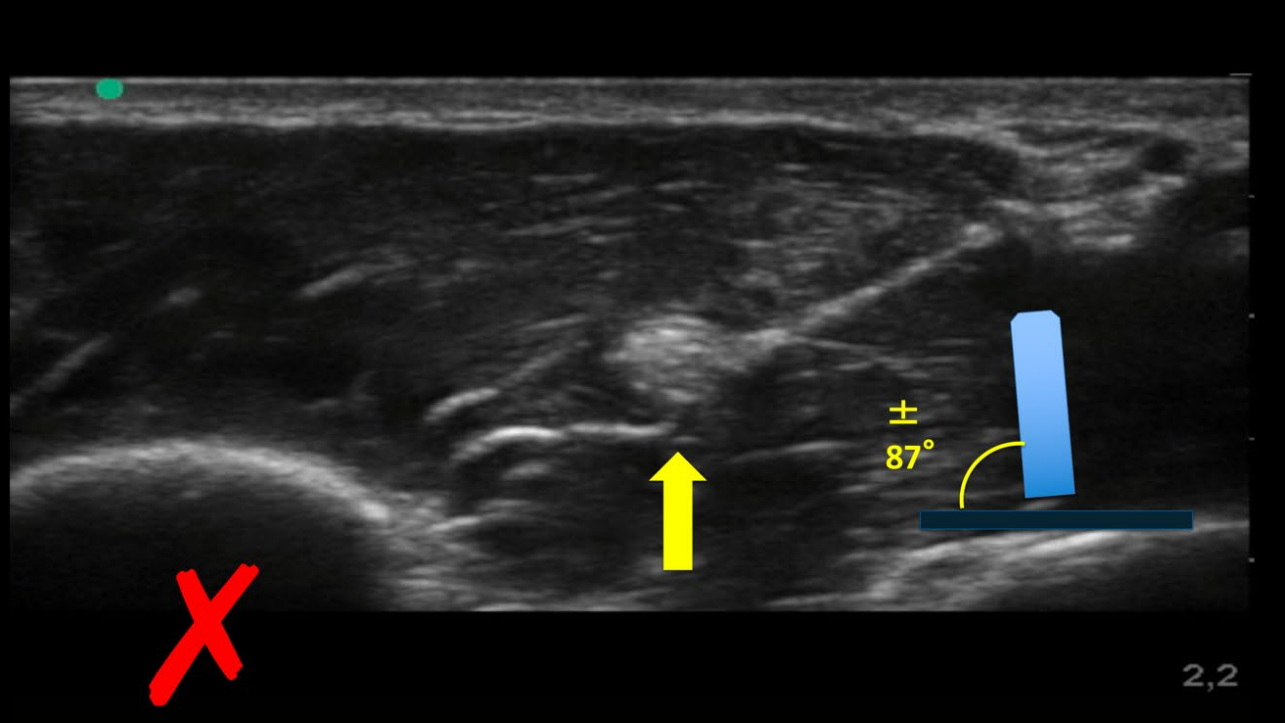
- Most common pitfall: Anisotropy
  - Property of tissue to differentially conduct/reflect sound waves back to the transducer based on the angle of incidence of the sound waves
- Refers to darkening, loss of resolution when the approach of the sound waves is less than perpendicular
  - Angle of incidence greater than 0 degrees
- Keep the direction of the beam as close to perpendicular as possible!

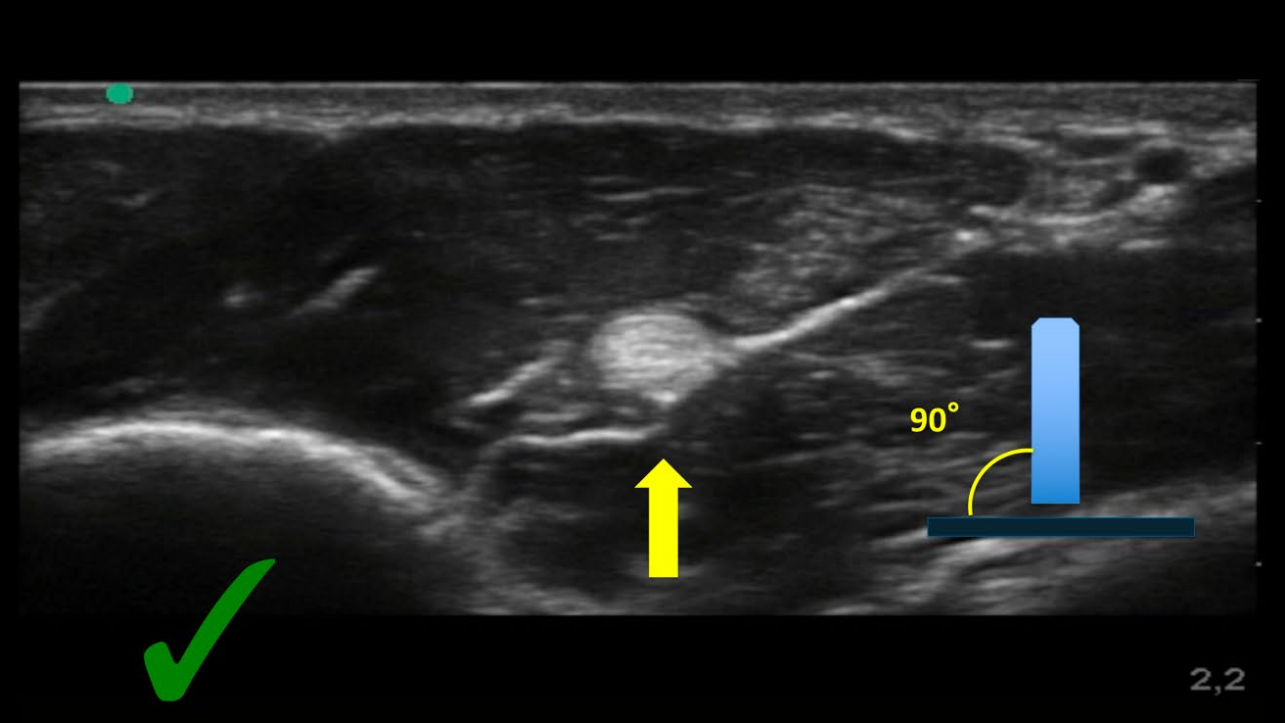
Image Credit: https://duckduckgo.com/?q=anisotropy+ultrasound&iar=images&iax=images&ia=images&iai=https%3A%2F%2Ft1.daumcdn.net%2Fcfile%2Ftistory%2F99B61A3C5AD618B930

https://123sonography.com/anisotropy-limitation









Diagnostic Imaging: Ultrasound

- Bone
  - Hyperechoic, smooth surface, distal acoustic shadow
- Muscle
  - Longitudinal
    - Hyperechoic surface (epimysium, fascial tissue)
    - Mostly hypoechoic with longitudinal hyperechoic, fine striations (connective tissue b/w muscle fascicles)
  - Transverse
    - Multifocal, pinpoint hyperechogenicities
    - Starry night appearance
      - Bright connective tissue b/w dark muscle fibers
- Tendon/Ligament
  - Fine, thin structure with hyperechoic parallel fibers
  - Tendons can be followed to MTJ
    - Varying lengths
    - Some have small amount of hypoechoic fluid superficial to them and within tendon sheath

Table 1. Musculoskeletal ultrasound echogenicity spectrum

Anechoic	Black	Fluid	Blood vessels or swelling/inflammation
		Hyaline Cartilage	At end of long bones, surrounded by bright white periosteum
		Fat	Hazy streaks below skin
Hypoechoic	Grayscale	Muscle	Fasciculated/ speckled hypoechoic with hyperechoic striations, encased by bright fascia
		Tendon	Linear striated hyperechoic at ends of muscle inserting into bone (fibrillated in long-axis)
		Nerve	Hyperechoic "starry night" appearance
		Ligament	Linear Striated hyperechoic surrounding ends of bones at joints
		Cartilage	Articular cartilage at end of bones includes anechoic periosteum
		Fascia	Bright white, surrounding muscles
Hyperechoic	White	Bone	Bright white line with acoustic shadow at bottom of image

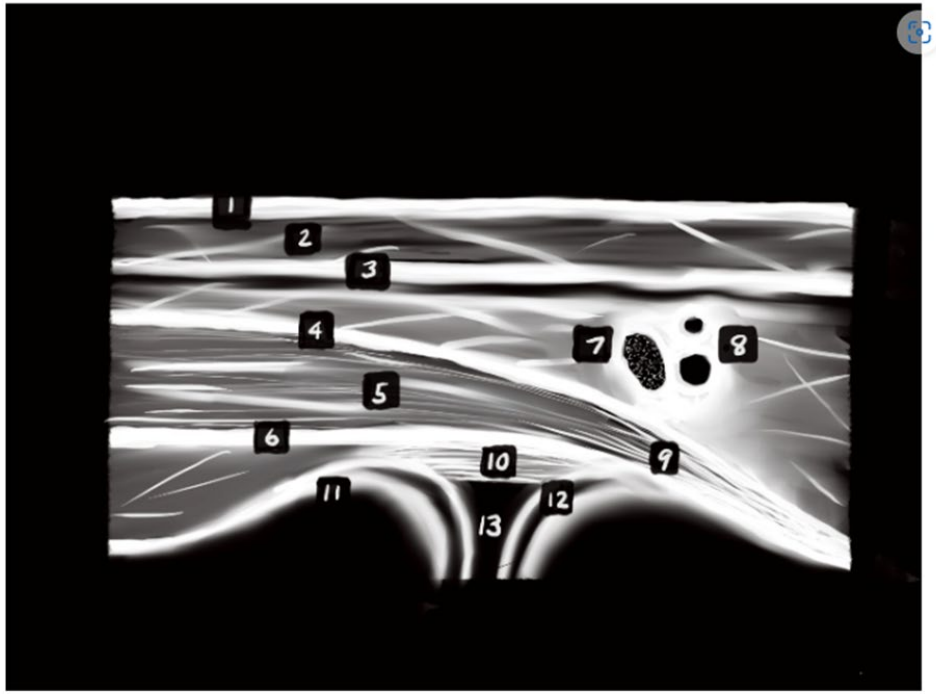
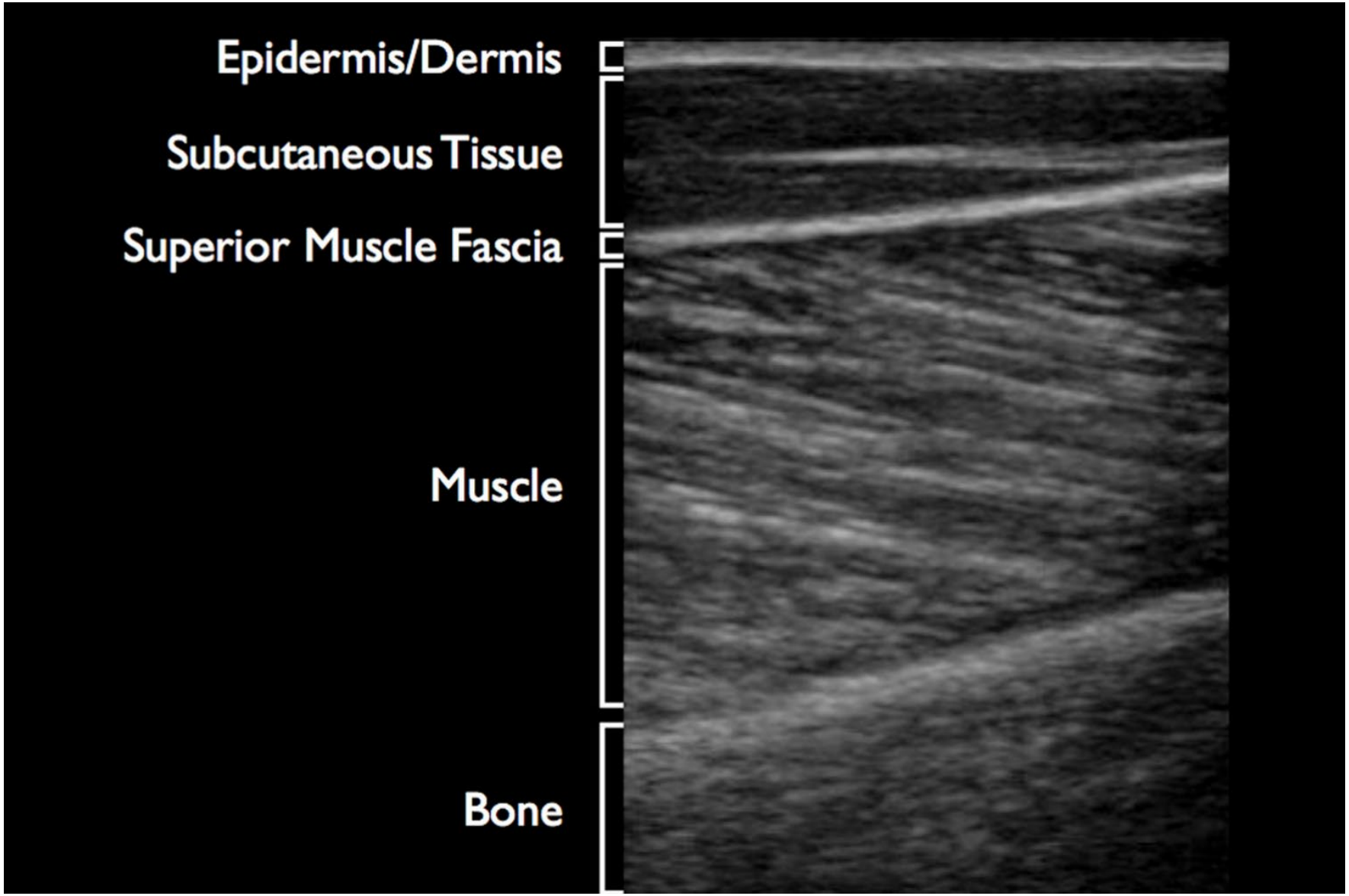


Figure 1. Schematic representation of echogenicity of various structures with musculoskeletal ultrasound.

1. Skin
2. Subcutaneous fat
3. Superficial fascia
4. Deep muscular fascia
5. Muscle
6. Deep muscular fascia
7. Nerve
8. Vein (smaller) and Artery
9. Tendon
10. Ligament
11. Bone
12. Hyaline cartilage
13. Articular cartilage / joint space

Image credit: Page, P., Manske, R. C., Voight, M., & Wolfe, C. (2023). MSK Ultrasound - An IJSPT Perspective. Int J Sports Phys Ther, 18(1), 1-10. doi:10.26603/001c.68184



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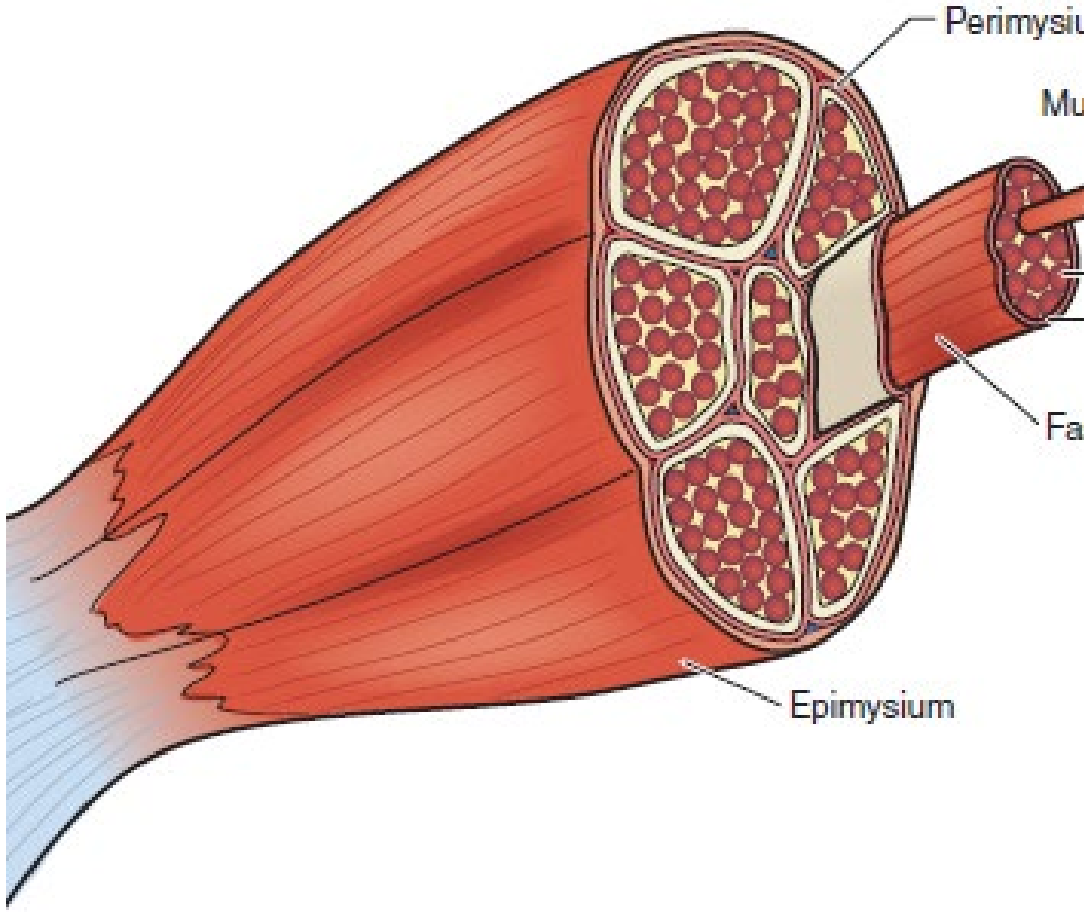
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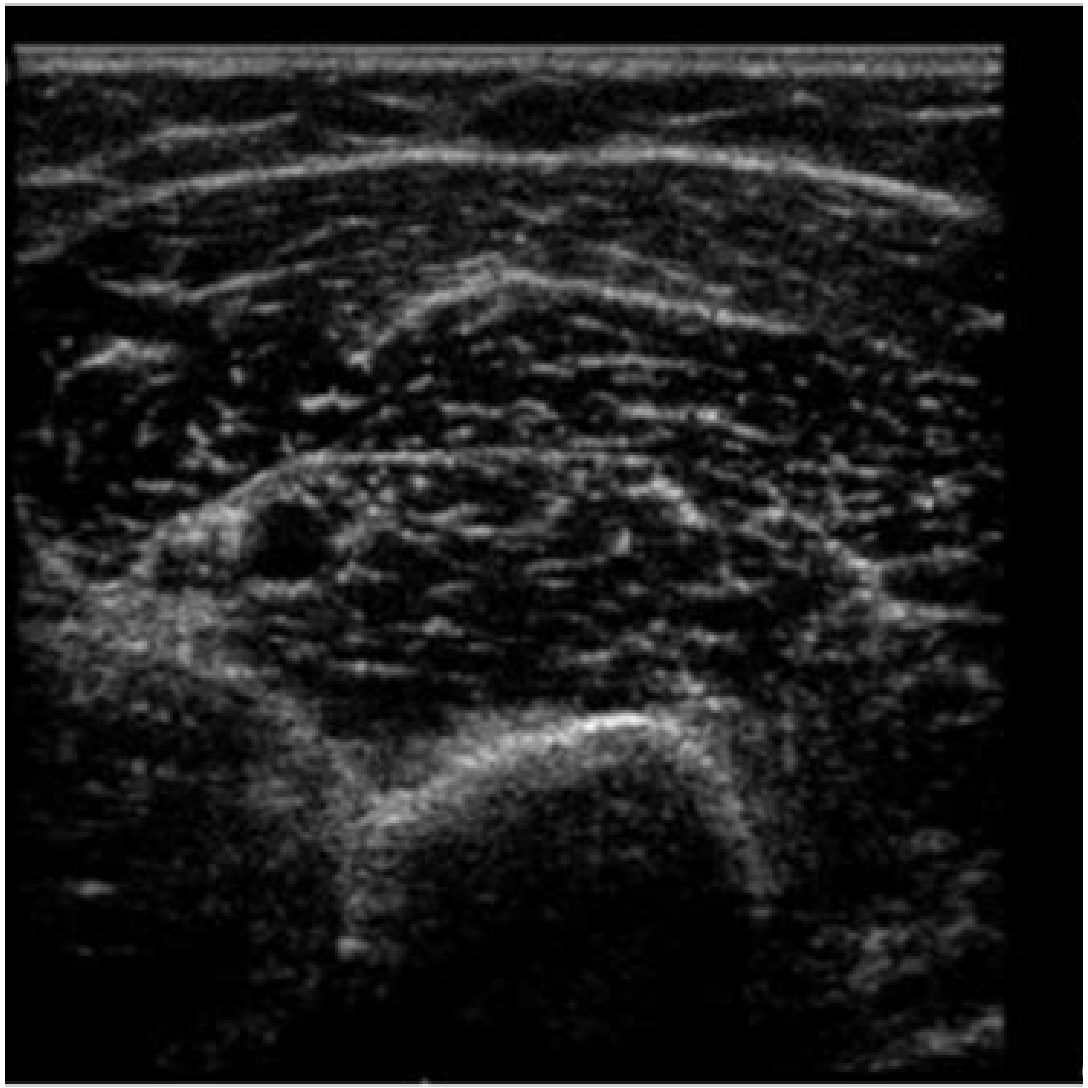
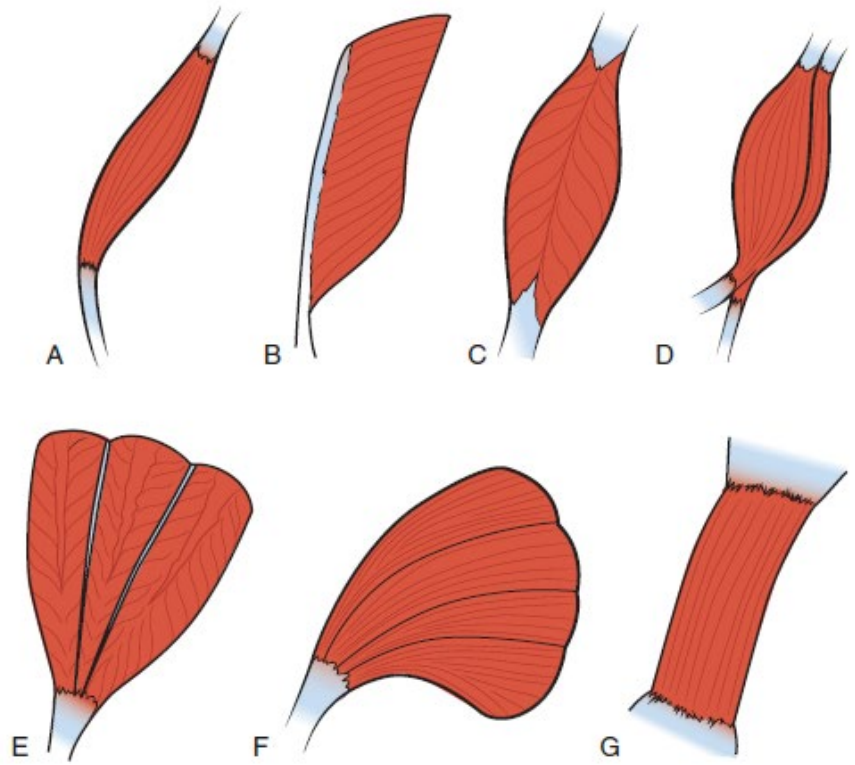
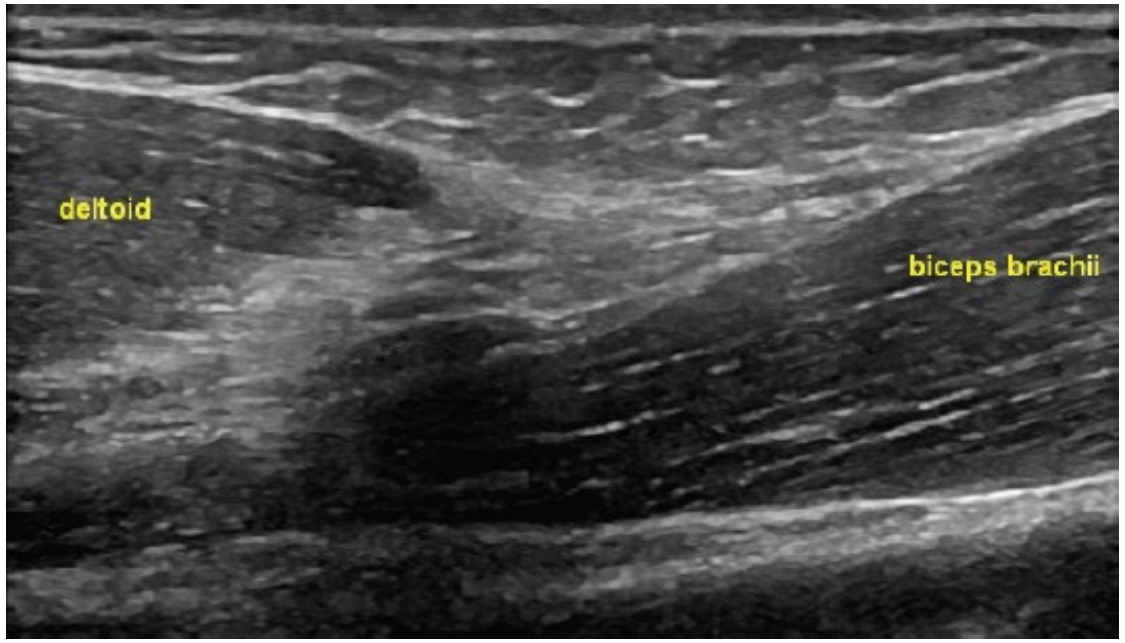




Diagnostic Imaging: Ultrasound

- Consider arrangement of skeletal muscles
- Pennate (B, C, E)
  - Many fibers per unit arranged in uni-, bi-, multi-penate
- Parallel (A, D)
  - Fibers run parallel, if bulges in middle = fusiform
- Convergent (F)
  - Fibers converge at insertion
- Quadrilateral (G)
  - Fibers in parallel and oriented in the longitudinal axis as the tendon

Image Credit: https://radiologykey.com/imaging-muscle/



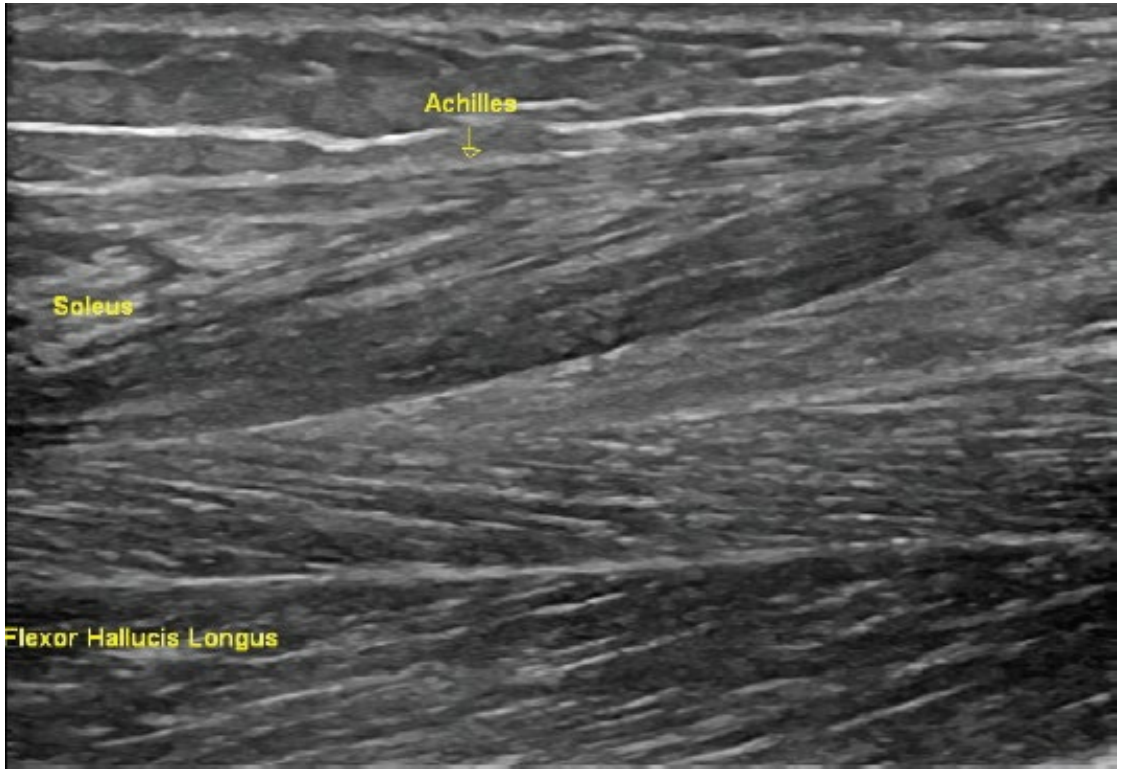
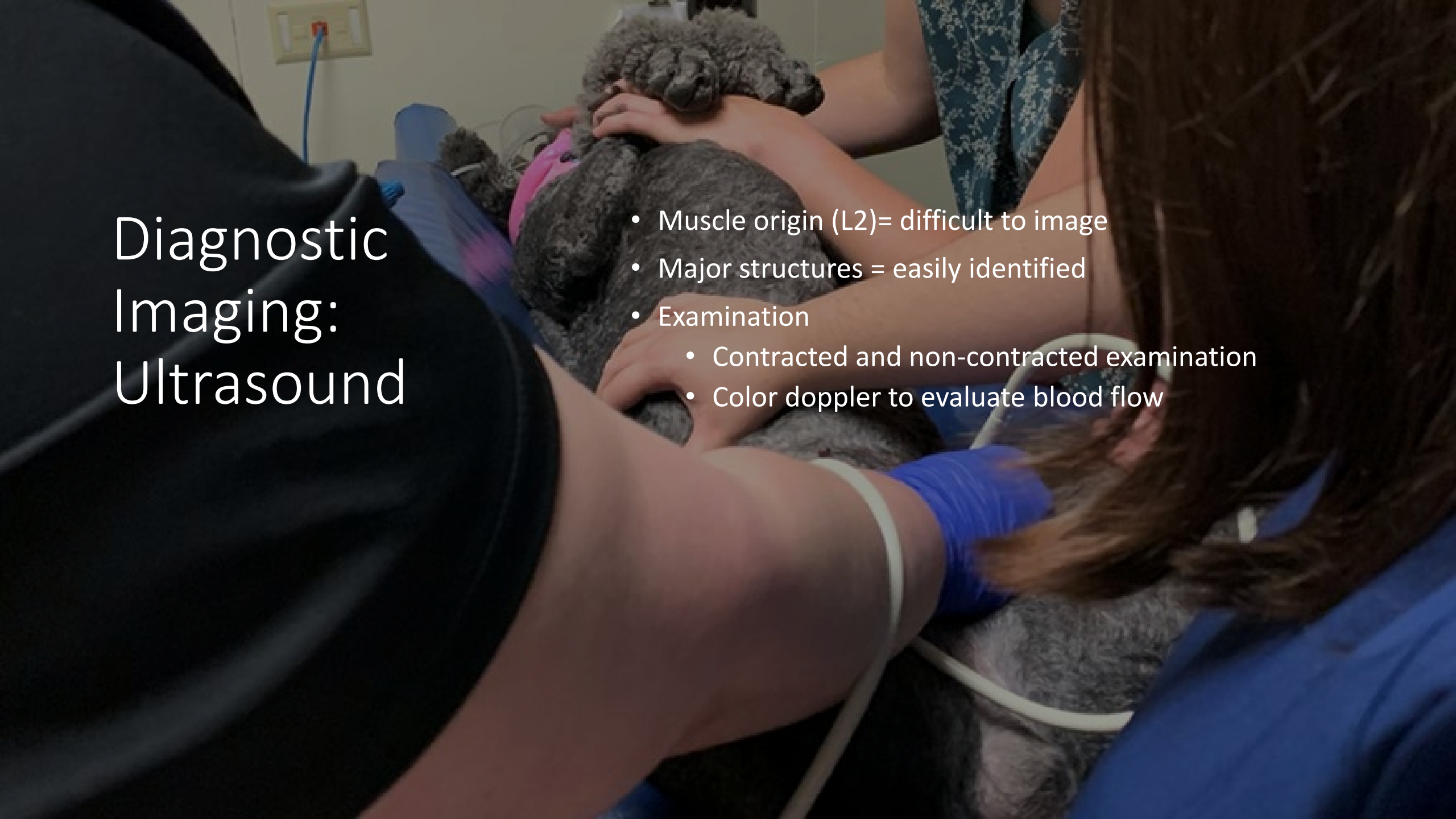


Image Credit: https://radiologykey.com/imaging-muscle/

Diagnostic Imaging: Ultrasound

- Scan in both short and long axis
- Review anatomy!!
  - Know tendons of origin and insertion
- Short axis good to ID muscle
- Followed to level of MTJ
  - Easiest in long axis


IN MY DAY
I HAD ONE TOY AND
IT WAS A STICK



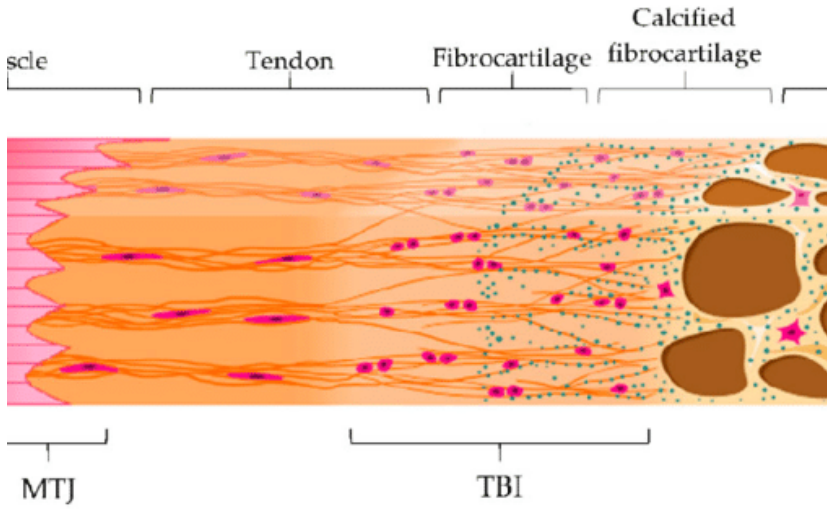
Diagnostic Imaging: Ultrasound

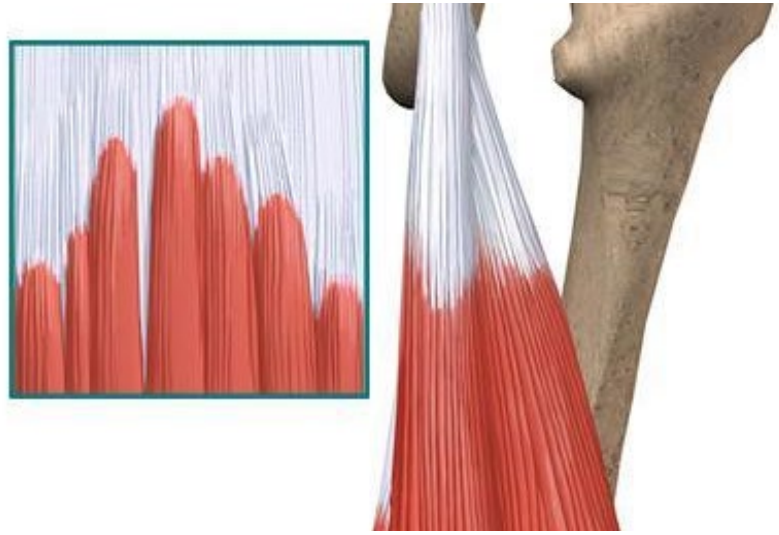
- Muscle origin (L2)= difficult to image
- Major structures = easily identified
- Examination
  - Contracted and non-contracted examination
  - Color doppler to evaluate blood flow

Question

- Where is the most common site of iliopsoas muscle injury?
    1. Muscle origin (L2-L4)
    2. Muscle belly
    3. Myotendinous junction
    4. Muscle insertion (lesser trochanter)

Image Credit: https://taylorveterinary.com/acupuncture/



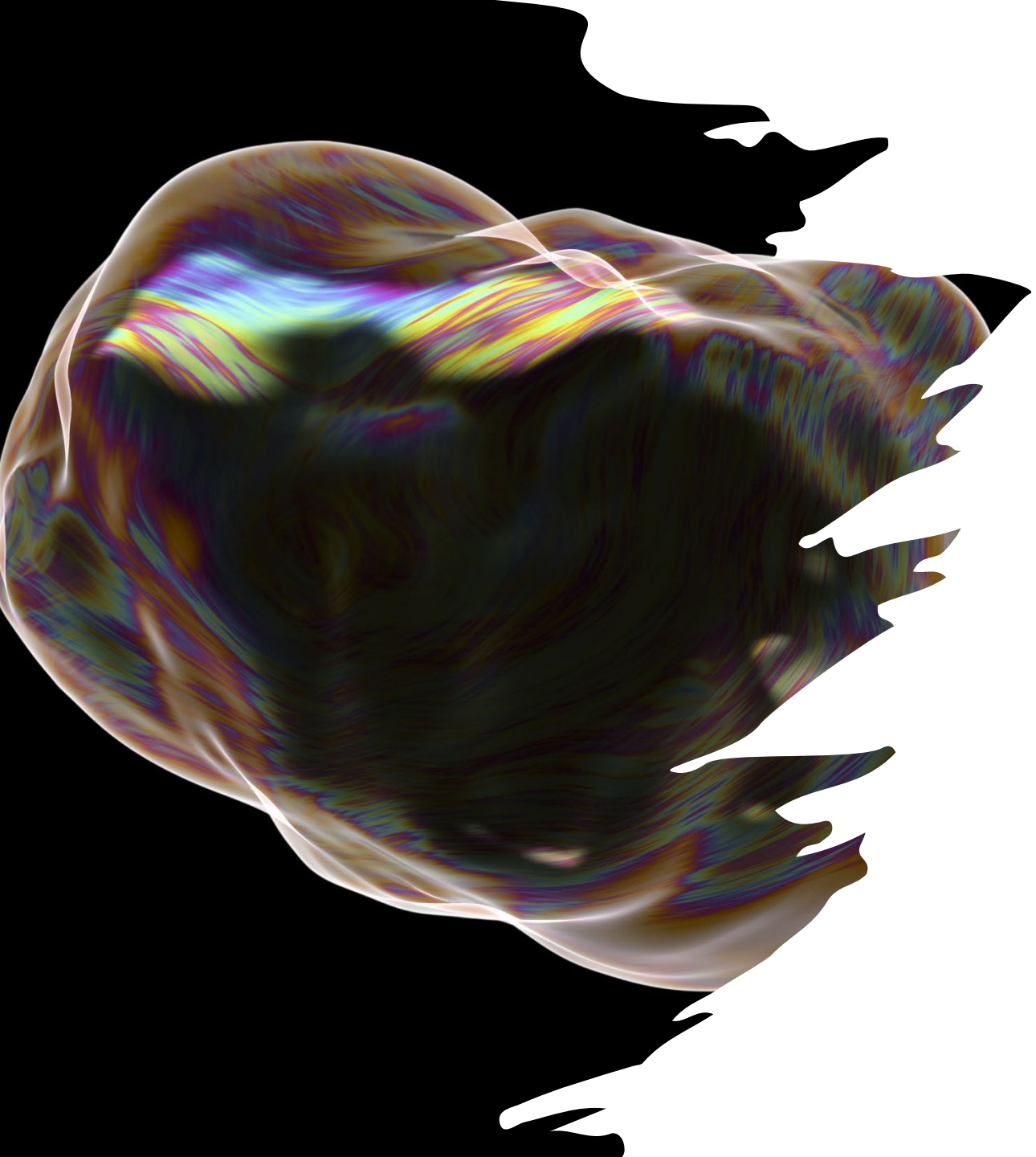


Diagnostic Imaging: Ultrasound

- Areas of injury:
  - Musculotendinous junction
  - Distal to insertion point on the lesser trochanter
- Coxofemoral joint, if diseased:
  - Increased joint fluid
  - Joint capsule thickening
  - Bony irregularities

https://www.flickr.com/photos/48762090@N08/5617396452

https://www.researchgate.net/figure/Schematic-representation-of-the-myotendinous-junction-MTJ-and-the-tendon-to-bone_fig3_348398429



Diagnostic Imaging: Ultrasound

Notable changes:

- Thickened, hypoechoic tendon
- Disruption of muscle fibrillar structure
- Irregular muscle boundaries
- Increased echodensity (inflammation)
- Hypo- or an-echoic lesions within the muscle
- If avulsed, a mineralized fragment of the lesser trochanter with tendon retraction may be seen

Diagnostic imaging: Ultrasound

- 73 performance dogs
  - 62.8% of the dogs had both acute and chronic changes
  - Low-grade strains at insertion = most common injury (80.8%)
  - Acute injury
    - Tendon fiber disruption (71.2%)
    - Indistinct hypoechoic lesions (91.8%)
  - Chronic injury
    - Hyperechoic changes (84.9%)

Evaluation of Iliopsoas Strain with Findings from Diagnostic Musculoskeletal Ultrasound in Agility Performance Canines – 73 Cases

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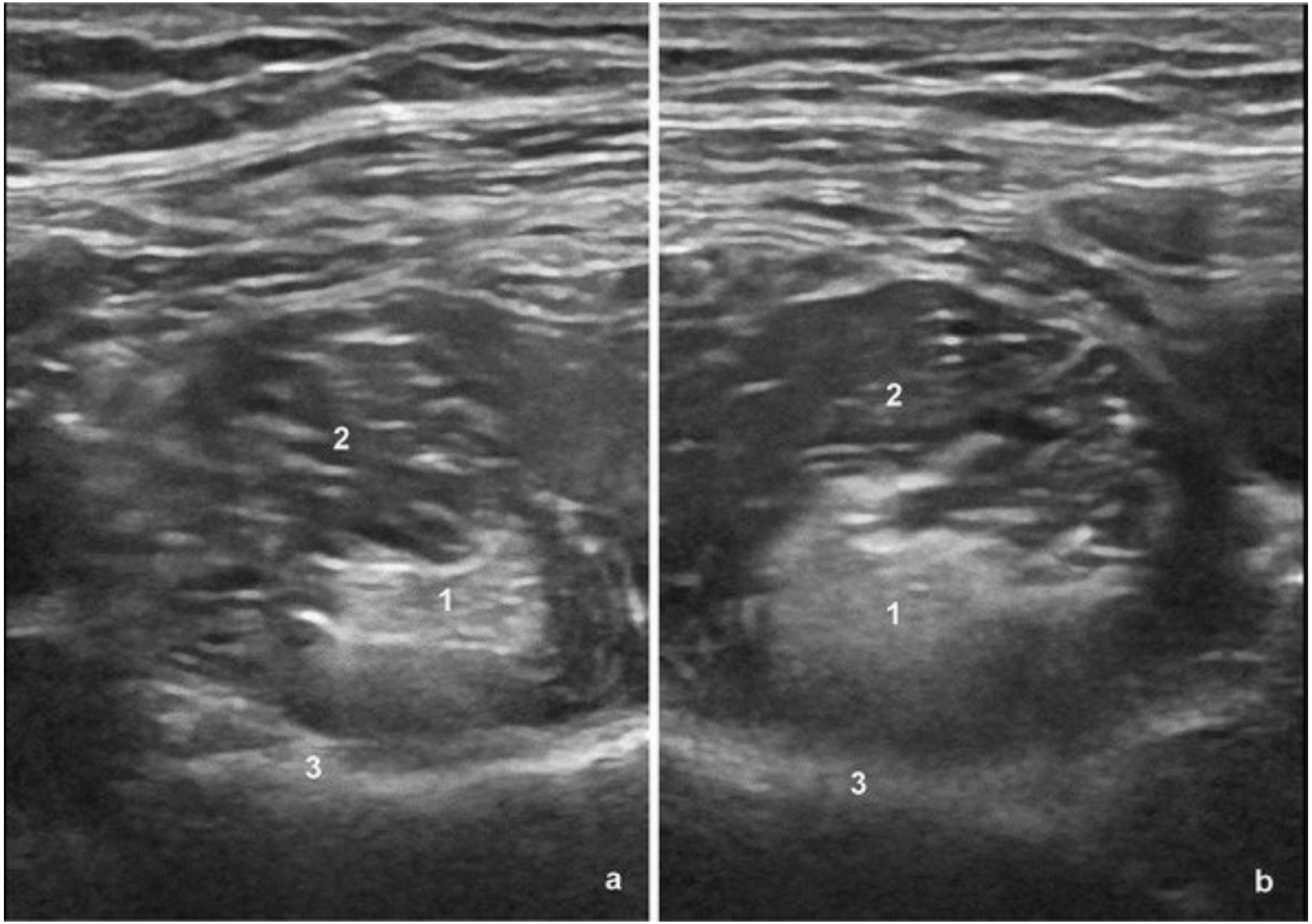


Image credit: https://www.researchgate.net/figure/Transverse-ultrasound-image-of-a-normal-and-homogeneous-iliopsoas-tendon-with-normal_fig1_324958171

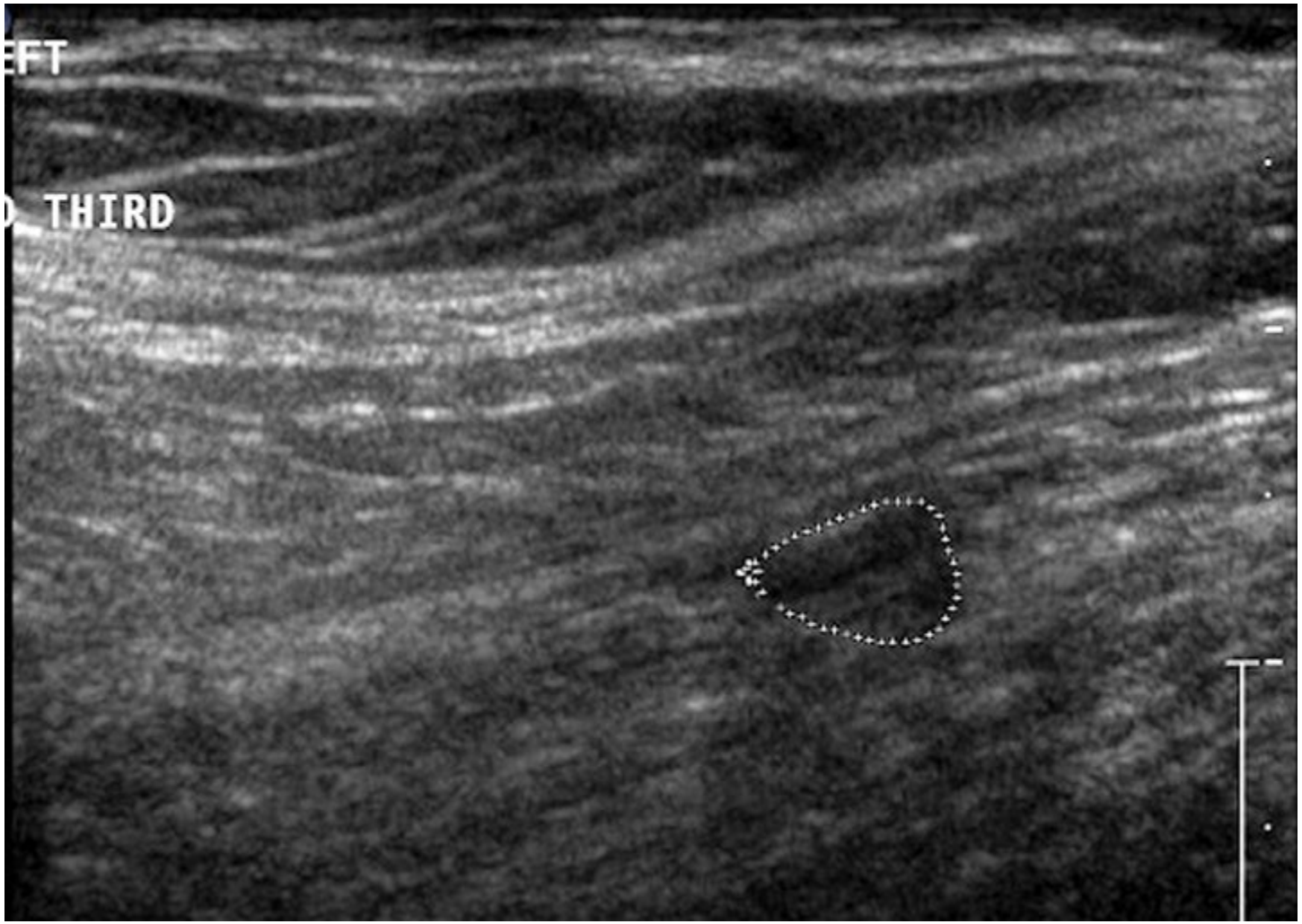


Image Credit: https://www.cliniciansbrief.com/article/top-5-muscle-tendon-injuries-lame-patients

Diagnostic Imaging: CT

- CT
  - Muscular inflammation and edema = hypoattenuating lesions
  - Variable contrast enhancement related to severity, extent, etiology and duration
  - Superior for Ca++ muscle deposition

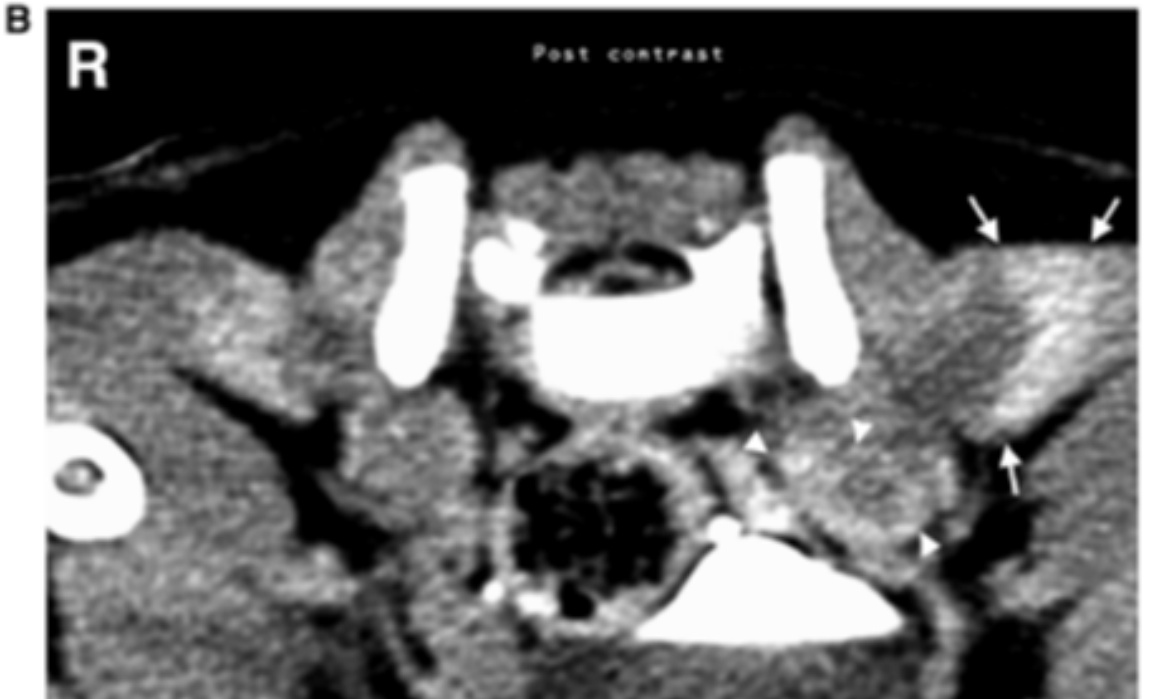
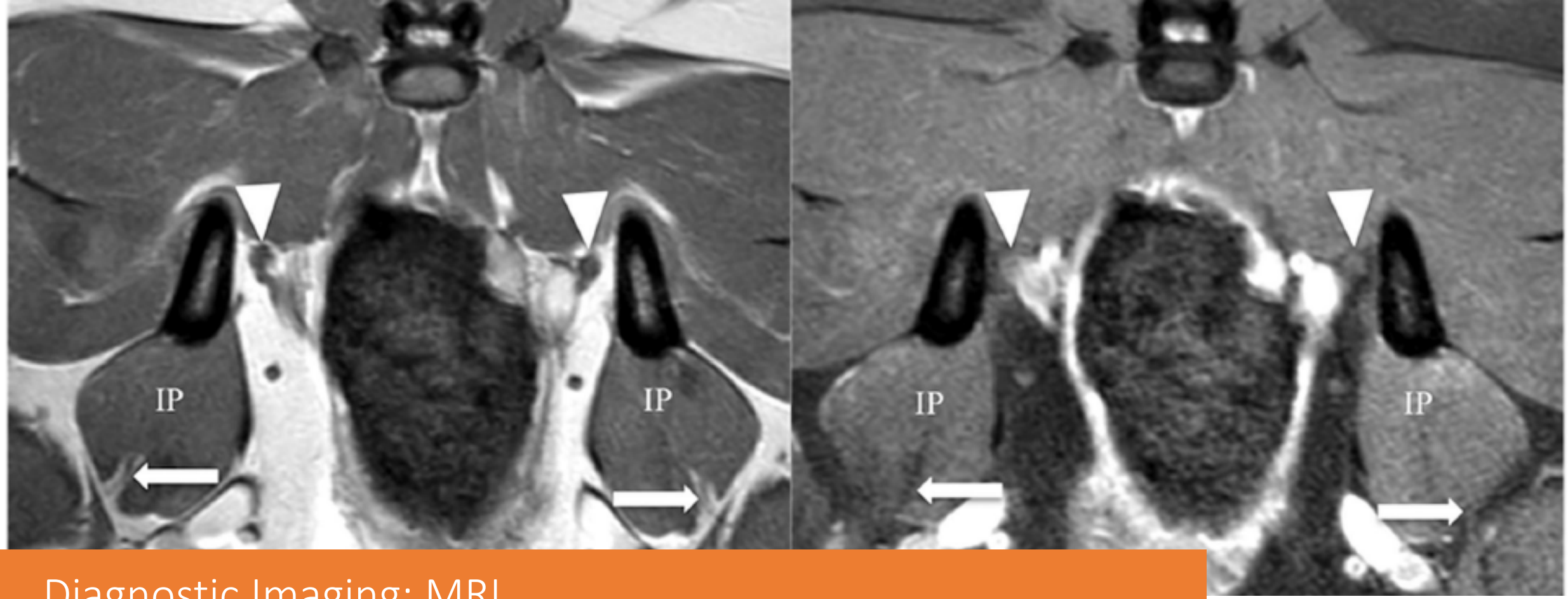


Image credit: Rossmeisl Jr, J. H., Rohleder, J. J., Hancock, R., & Lanz, O. I. (2004). Computed tomographic features of suspected traumatic injury to the iliopsoas and pelvic limb musculature of a dog. Veterinary Radiology & Ultrasound, 45(5), 388-392.



Diagnostic Imaging: MRI

Image credit: Sievert, C., Richter, H., Gascho, D., Kircher, P. R., & Carrera, I. (2017). 3 Tesla magnetic resonance imaging study of the normal canine femoral and sciatic nerves. Veterinary Radiology & Ultrasound, 58(5), 598-606.

Treatment strategies

- It DEPENDS…
- Primary lesion?
  - Acute or chronic?
- Secondary lesion?
  - Acute or chronic?
  - Spinal dysfunction?
  - Coxofemoral disease?

Pain Control

- NSAIDS
- Gabapentin
- Amantadine
- Acetaminophen
- Opioids

Physical Modalities

- Active rest
- Cryotherapy
- Superficial heat
- Stretching
    - Active hip stretching
        - Petting the pet's stomach while they are in dorsal recumbency
        - Dancer pose (front feet elevated, head/nose pointing up)
            - Straighten the back and stretch the core

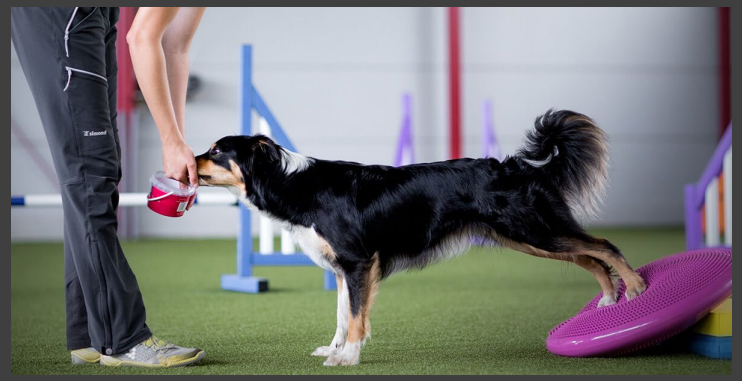
Physical Modalities

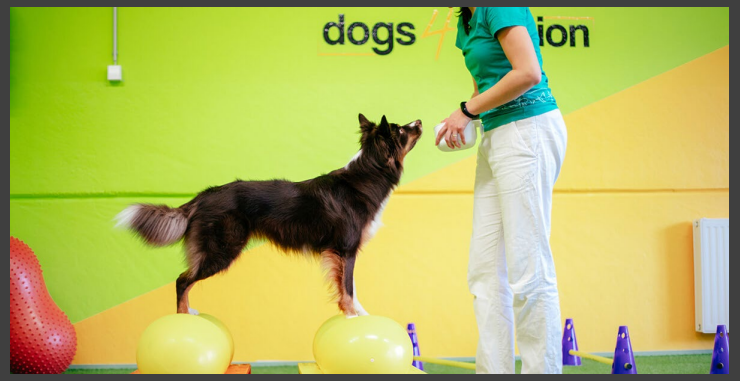
- Massage
- Shockwave
- Acupuncture
- Photobiomodulation
- Platelet rich plasma injections

Preventative Strategies

- Basic, advanced core work
  - Controlled walks (up, down hill)
  - Backwards walking
  - Sit to stands
  - Bird dogs
  - Figure 8s (+/- on a hill)
  - Crawling

https://canineworks.com.au/health-articles/2017/8/22/strengthen-your-dogs-core-muscles





Adducted Stand- PL Focus: Advanced

Targets: The intrinsic core muscles, specifically the **psoas** by adducting the rear legs and narrowing the base of support. The back muscles, shoulder stabilizers and pelvic stabilizers

HOW I'M SUPPOSED TO SIT

HOW I SIT

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ANY
QUESTIONS ?