Hip 201: Anatomy, Exam, Injuries & Treatments

Daniel Whiting, MD

Montana Utilization and Treatment Guidelines Medical Conference 2024

Conflict of Interest

Consultant and royalties – Ortho Development Company

Consultant – NaviSwiss

Owner – Providence Surgery Center; Big Sky Surgery Center

NRO | NORTHERN ROCKIES ORTHOPAEDICS

Outline

- Hip Anatomy
- Hip Examination
  - Physical
  - Imaging
- Injuries
- Treatments

NORTHERN ROCKIES ORTHOPAEDICS

Hip Anatomy

- Layer concept
  - 1 – osteochondral
  - 2 – inert
  - 3 – contractile
  - 4 – neuromechanical

Curr Rev Musculoskelet Med. 2012 Mar;5(1):1-8. doi: 10.1007/s12178-011-9105-8.

The layer concept: utilization in determining the pain generators, pathology and how structure determines treatment

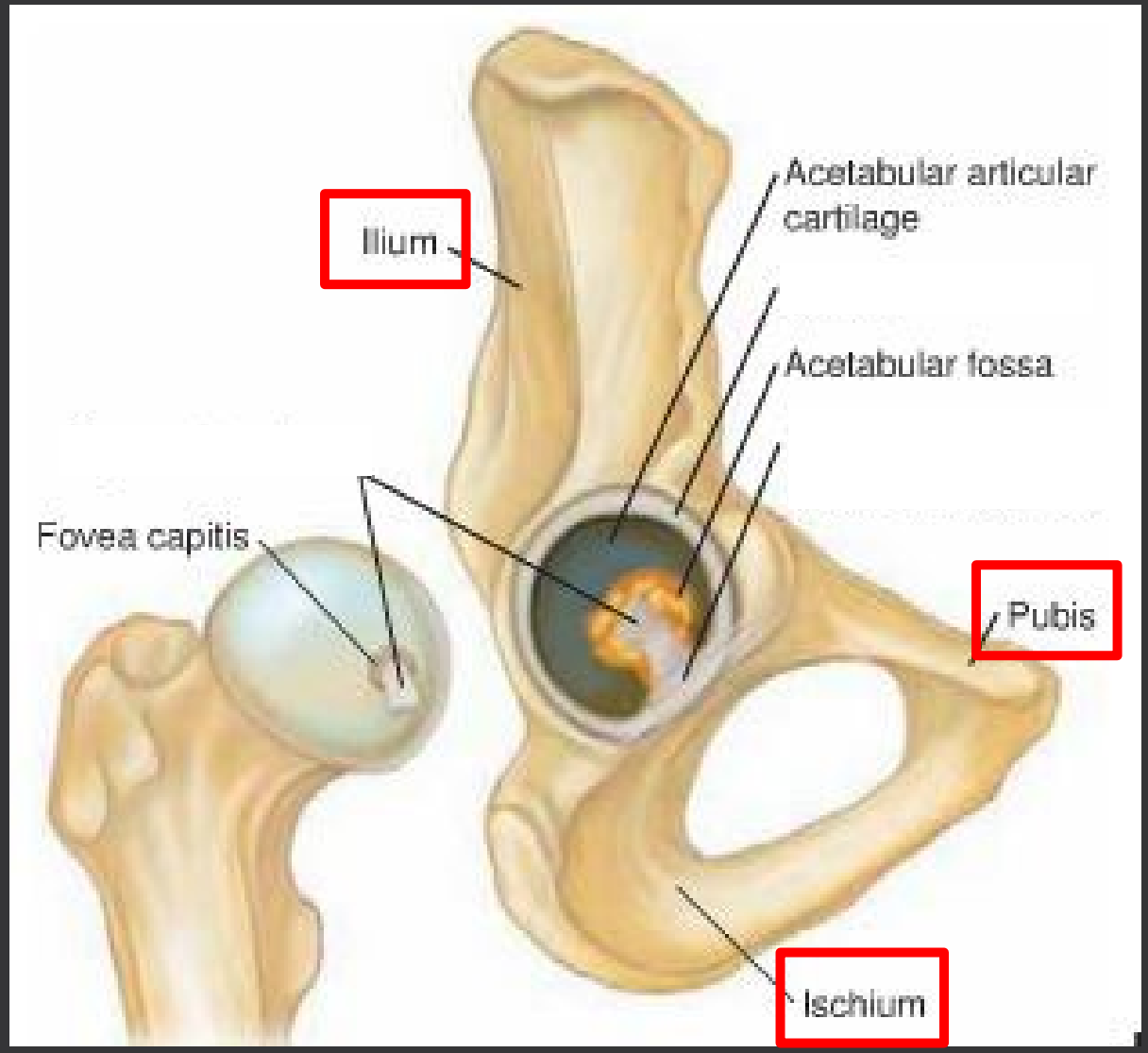
Peter Draovitch [1], Jaime Edelstein, Bryan T Kelly

Affiliations + expand

PMID: 22371303 PMCID: PMC3535125 DOI: 10.1007/s12178-011-9105-8

Hip Anatomy

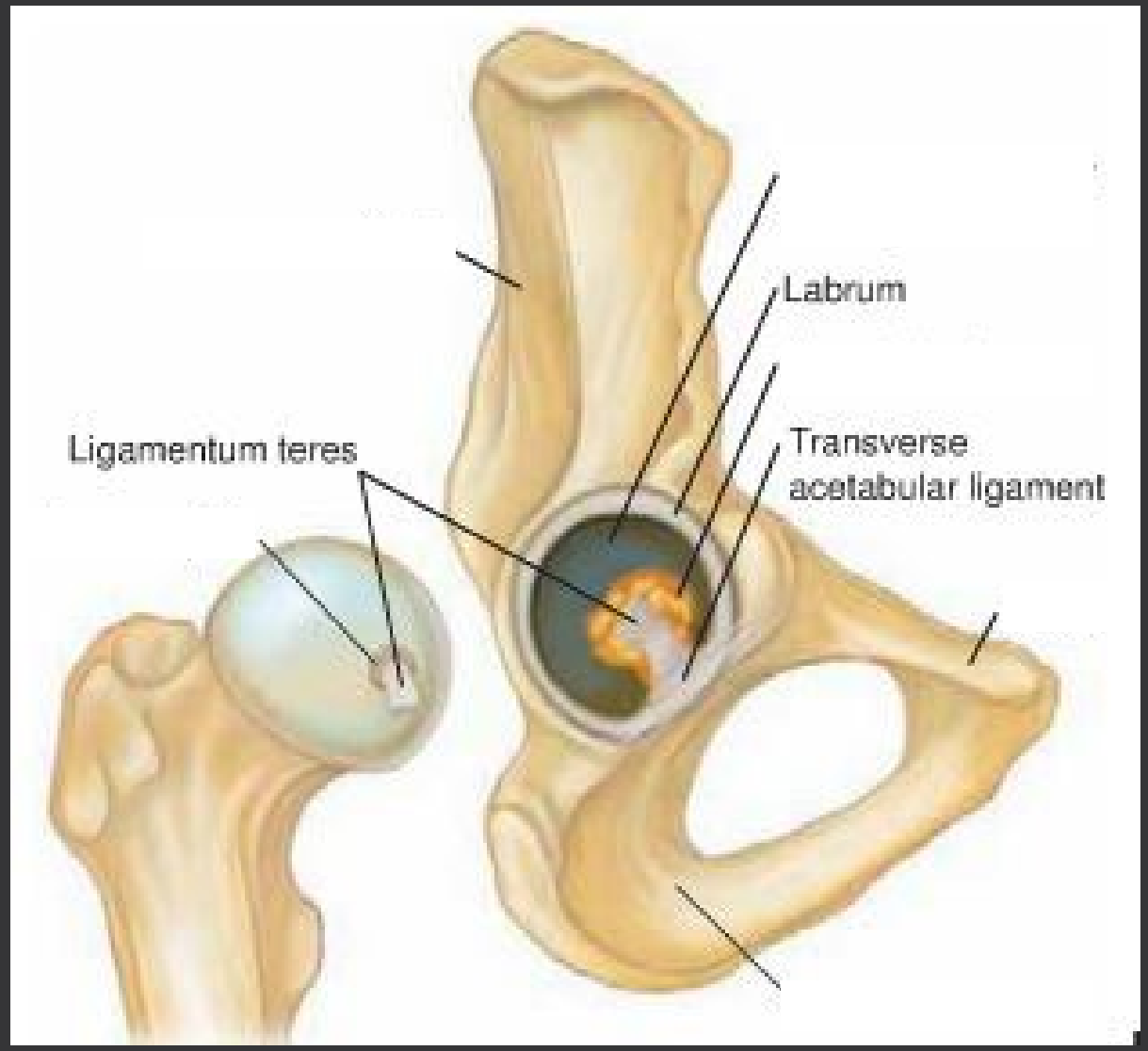
- Layer concept
  - 1 – osteochondral
    - Femoral head, acetabulum
    - Smooth motion
    - Fractures, Dysplasia, FAI, Version
  - 2 – inert
  - 3 – contractile
  - 4 – neuromechanical



Weiss S. *Operative Techniques in Orthopaedic Surgery*. Wolters-Kluwer. 2011

Hip Anatomy

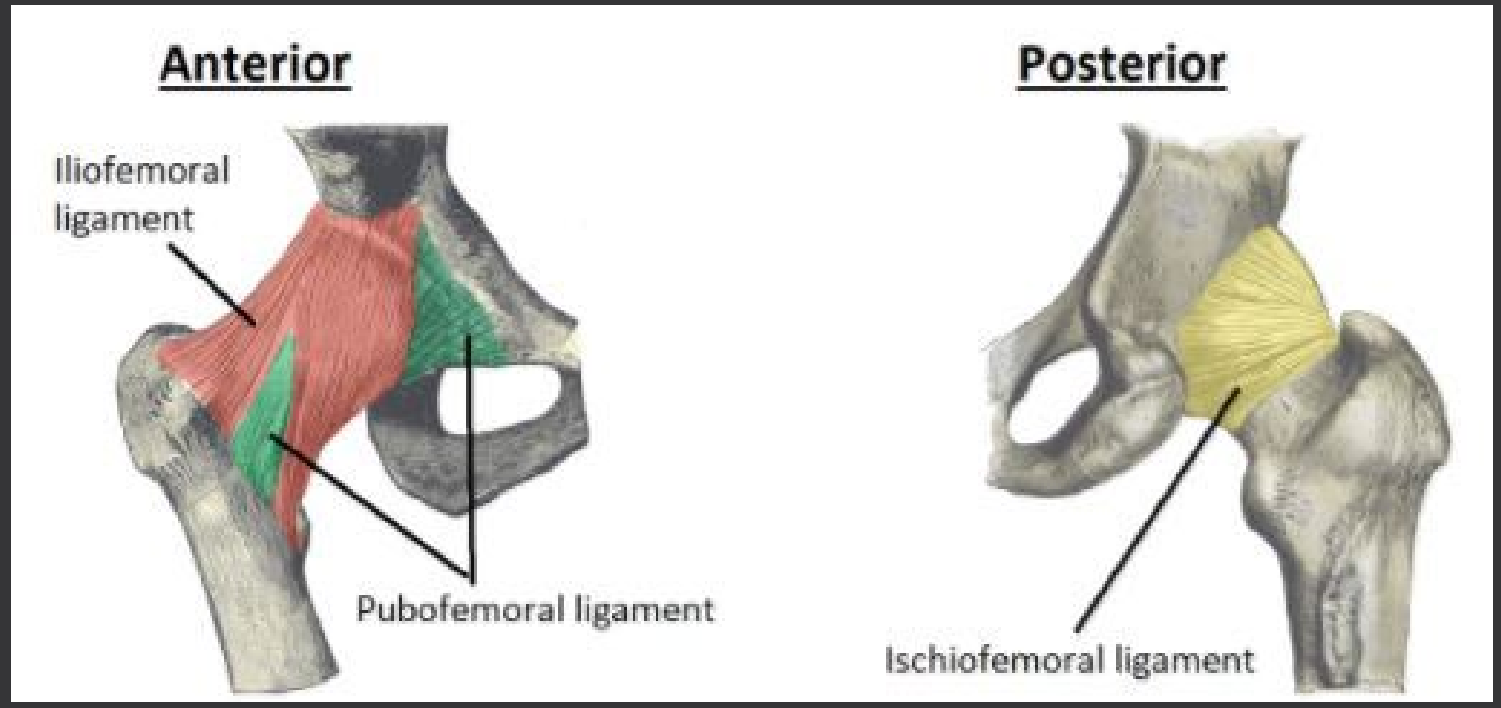
- Layer concept
  - 1 – osteochondral
  - 2 – inert
    - Capsule/ligaments, ligamentum teres, labrum
    - Static stability
    - Capsular instability, ligamentum teres tear, labral tear, adhesions
  - 3 – contractile
  - 4 – neuromechanical



Weiss S. *Operative Techniques in Orthopaedic Surgery*. Wolters-Kluwer. 2011

Hip Anatomy

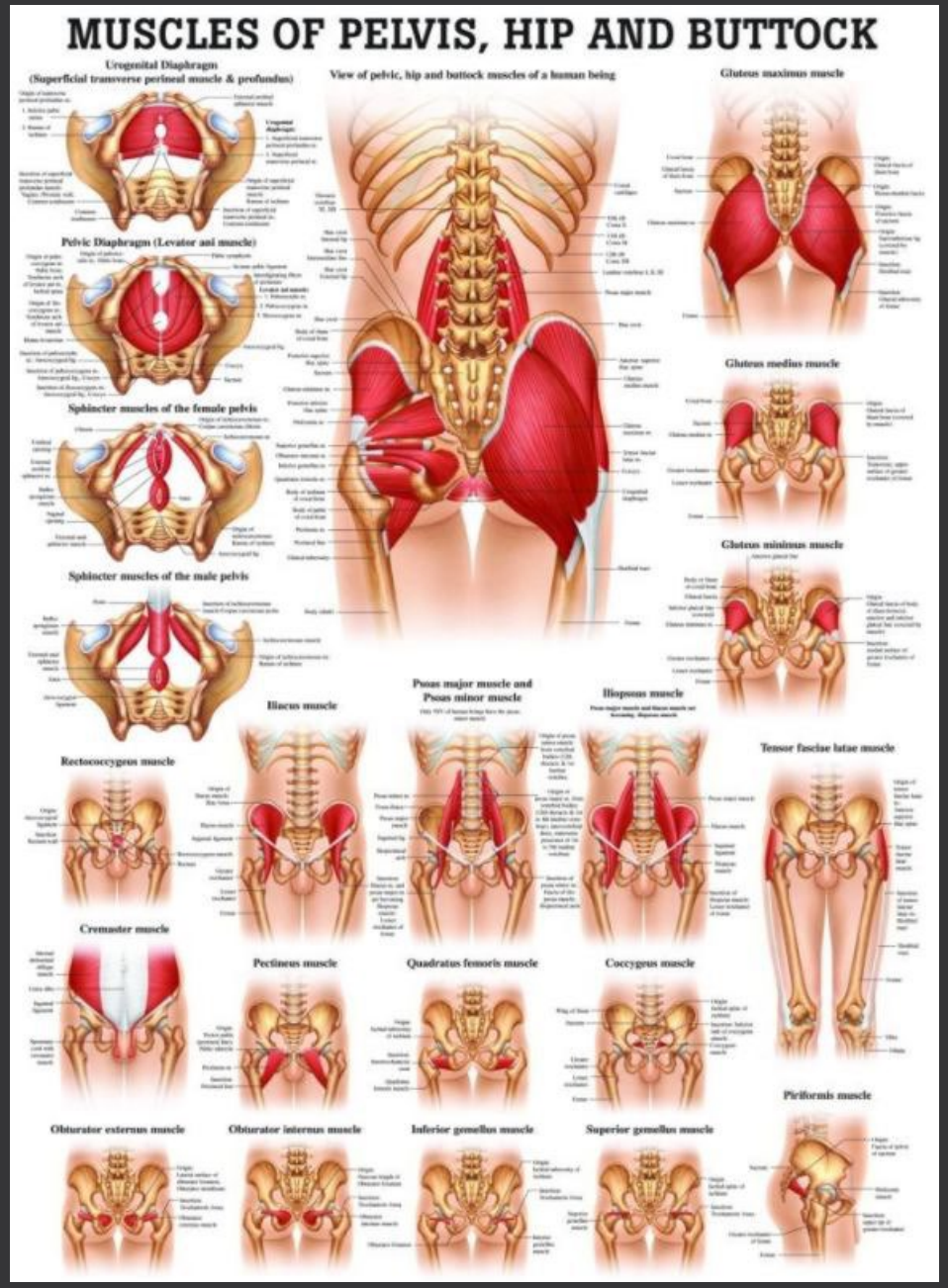
- Layer concept
  - 1 – osteochondral
  - 2 – inert
    - Capsule/ligaments, ligamentum teres, labrum
    - Static stability
    - Capsular instability, ligamentum teres tear, labral tear, adhesions
  - 3 – contractile
  - 4 – neuromechanical



http://anatomybody101.com/hip-muscles-diagram/

Hip Anatomy

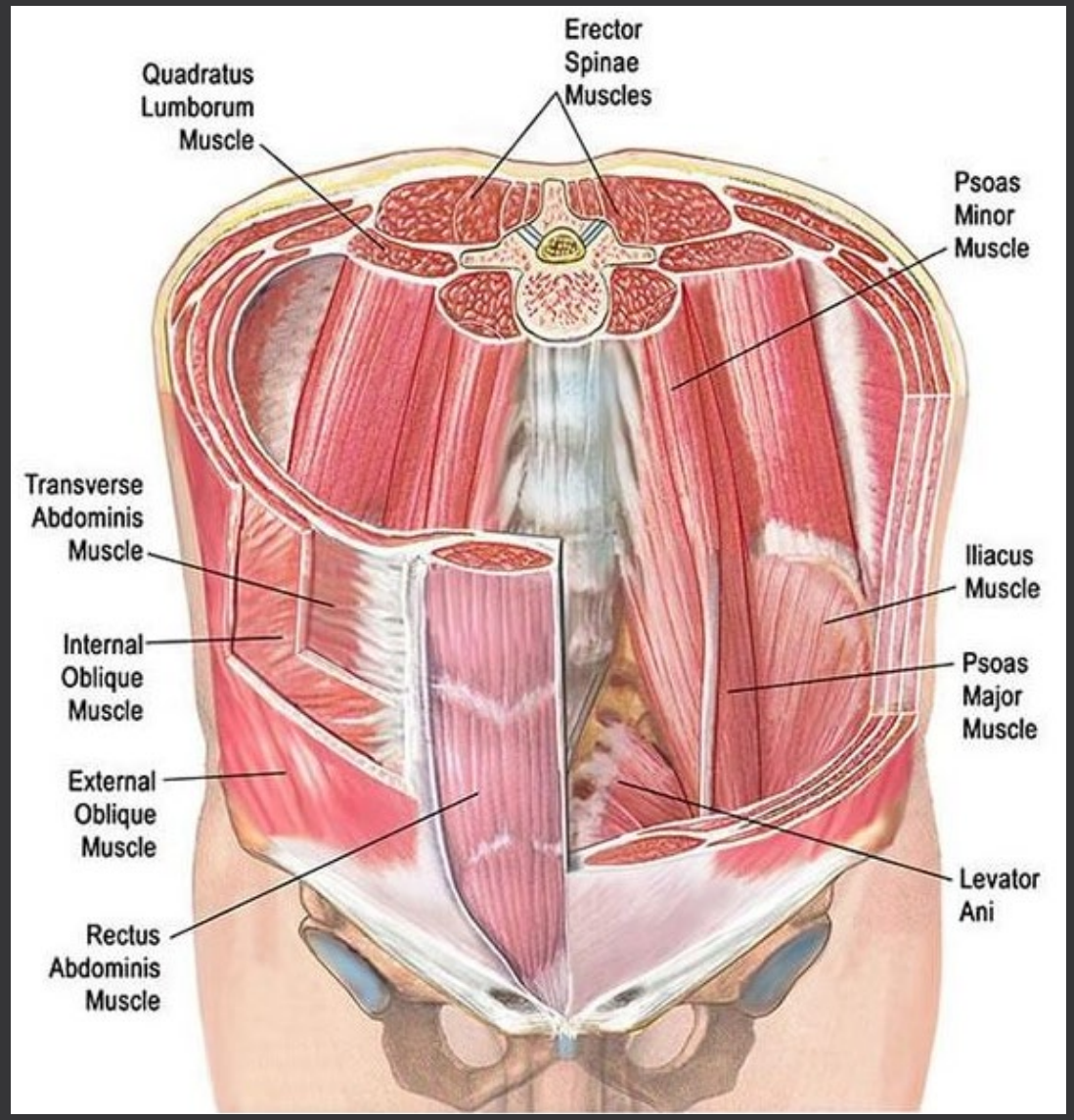
- Layer concept
  - 1 – osteochondral
  - 2 – inert
  - 3 – contractile
    - Hip muscles, lumbosacral muscles, pelvic floor
      - Dynamic stability, movement
      - Tendinopathies (hamstrings, abductors, adductors), iliopsoas tendonitis, coxa saltans, muscle strains, ruptures, contractures
  - 4 – neuromechanical



https://www.anatomywarehouse.com/muscles-of-buttock-hip-and-pelvis-anatomy-chart-a-104221

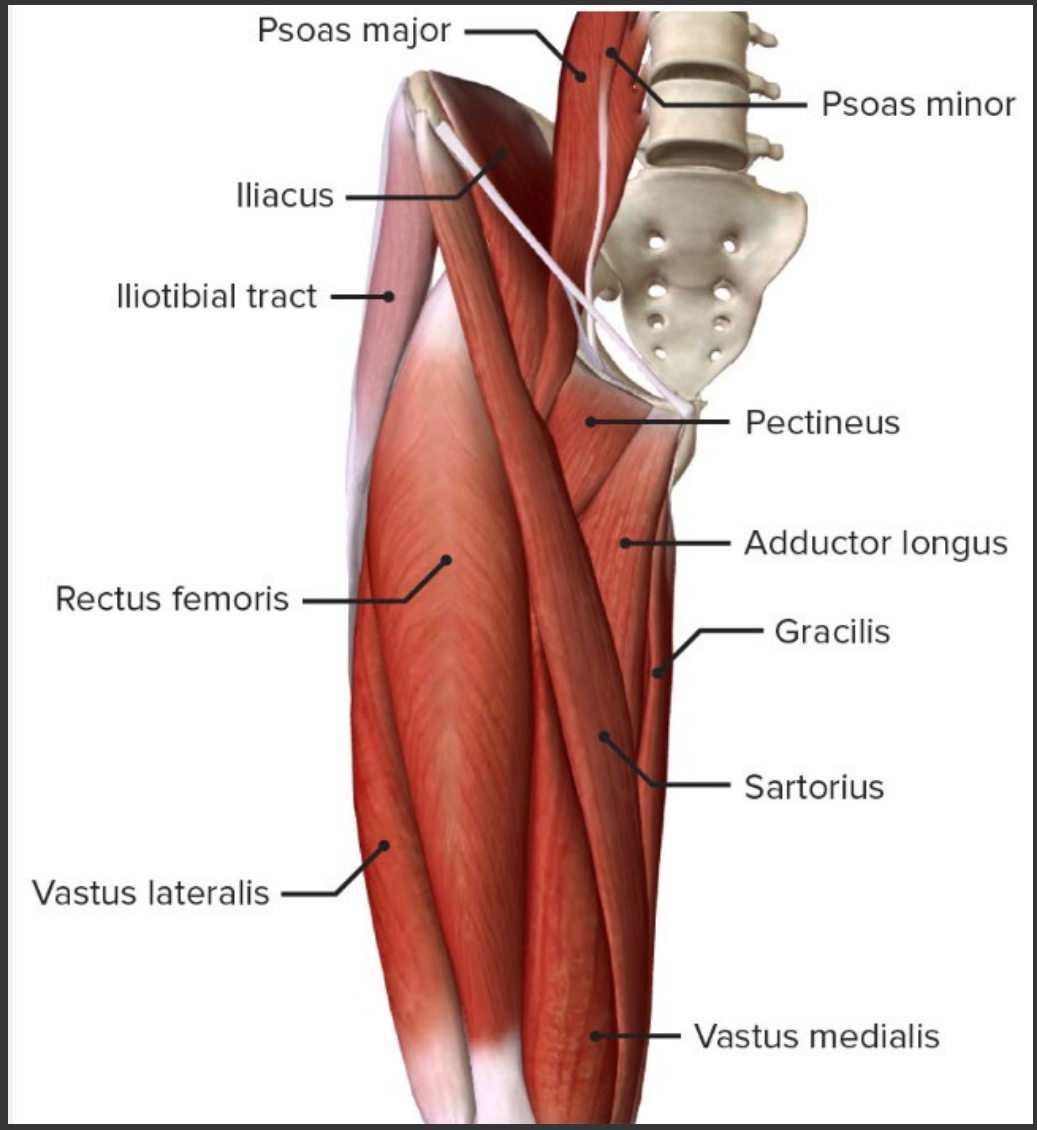
Hip Anatomy

- Layer concept
  - 1 – osteochondral
  - 2 – inert
  - 3 – contractile
    - Anterior
    - Lateral
    - Posterior
    - Pelvic floor
  - 4 – neuromechanical



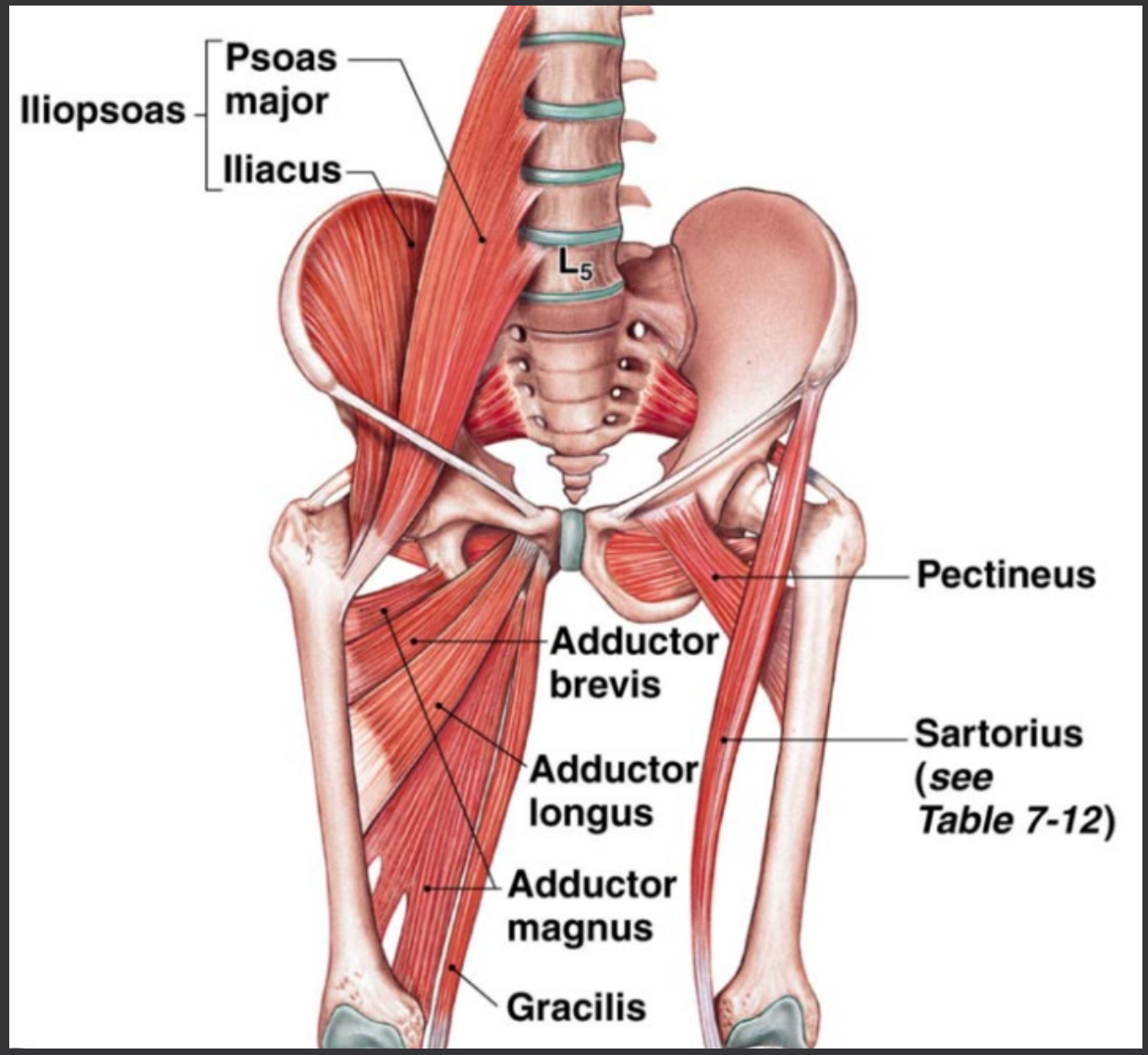
Hip Anatomy

- Layer concept
  - 1 – osteochondral
  - 2 – inert
  - 3 – contractile
    - Anterior
    - Lateral
    - Posterior
    - Pelvic floor
  - 4 – neuromechanical



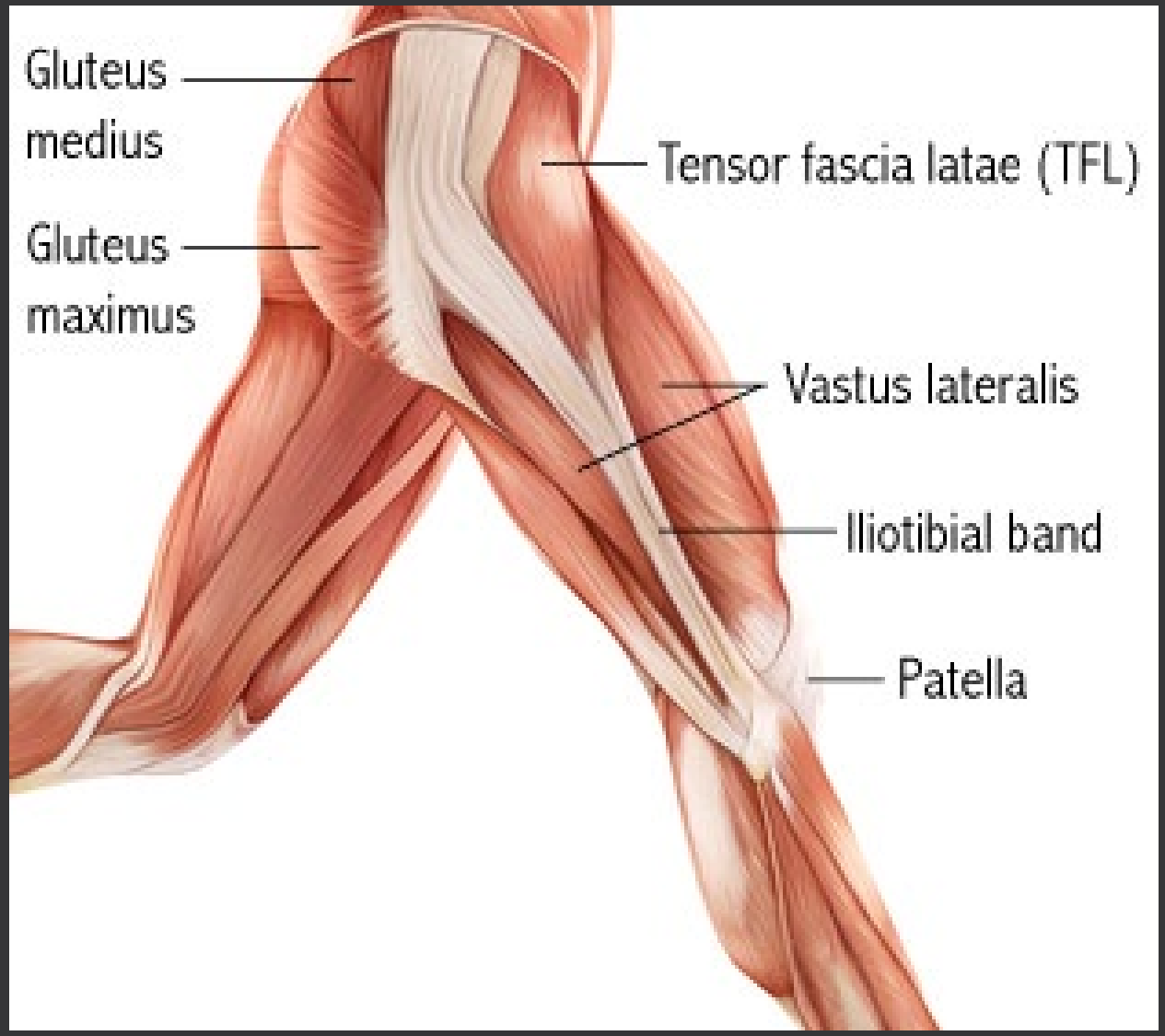
Hip Anatomy

- Layer concept
  - 1 – osteochondral
  - 2 – inert
  - 3 – contractile
    - Anterior
    - Lateral
    - Posterior
    - Pelvic floor
  - 4 – neuromechanical



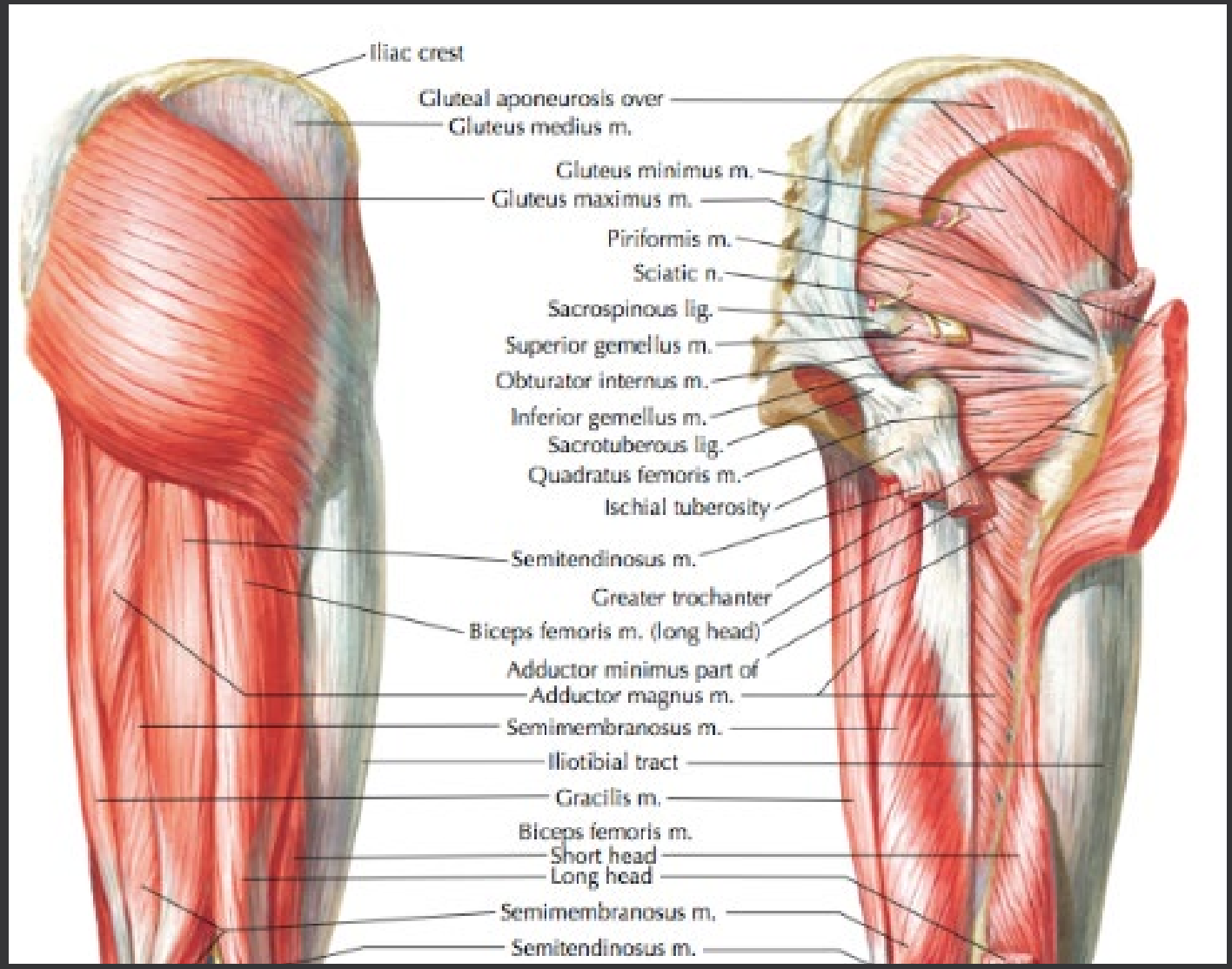
Hip Anatomy

- Layer concept
  - 1 – osteochondral
  - 2 – inert
  - 3 – contractile
    - Anterior
    - Lateral
    - Posterior
    - Pelvic floor
  - 4 – neuromechanical



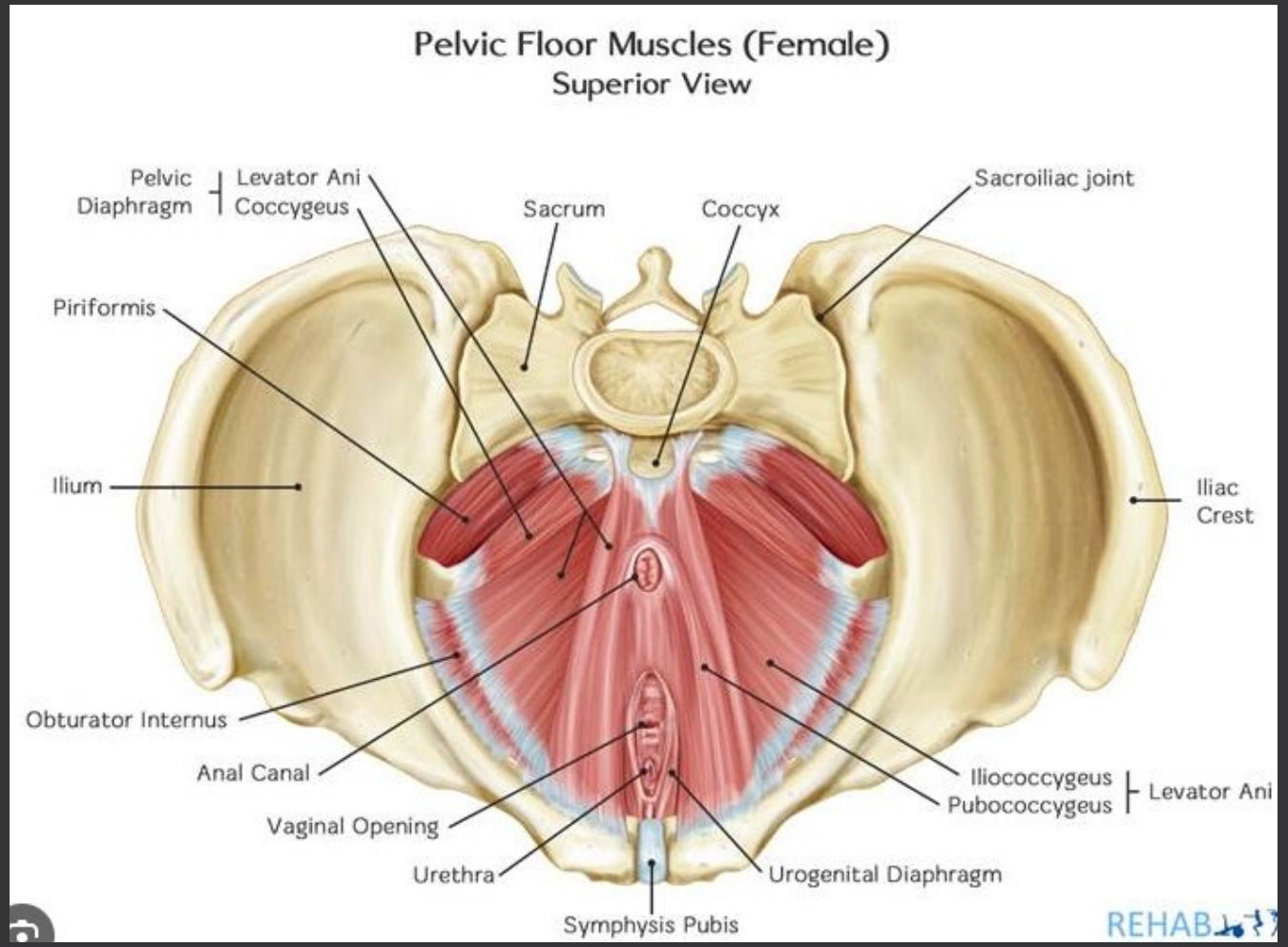
Hip Anatomy

- Layer concept
  - 1 – osteochondral
  - 2 – inert
  - 3 – contractile
    - Anterior
    - Lateral
    - Posterior
    - Pelvic floor
  - 4 – neuromechanical



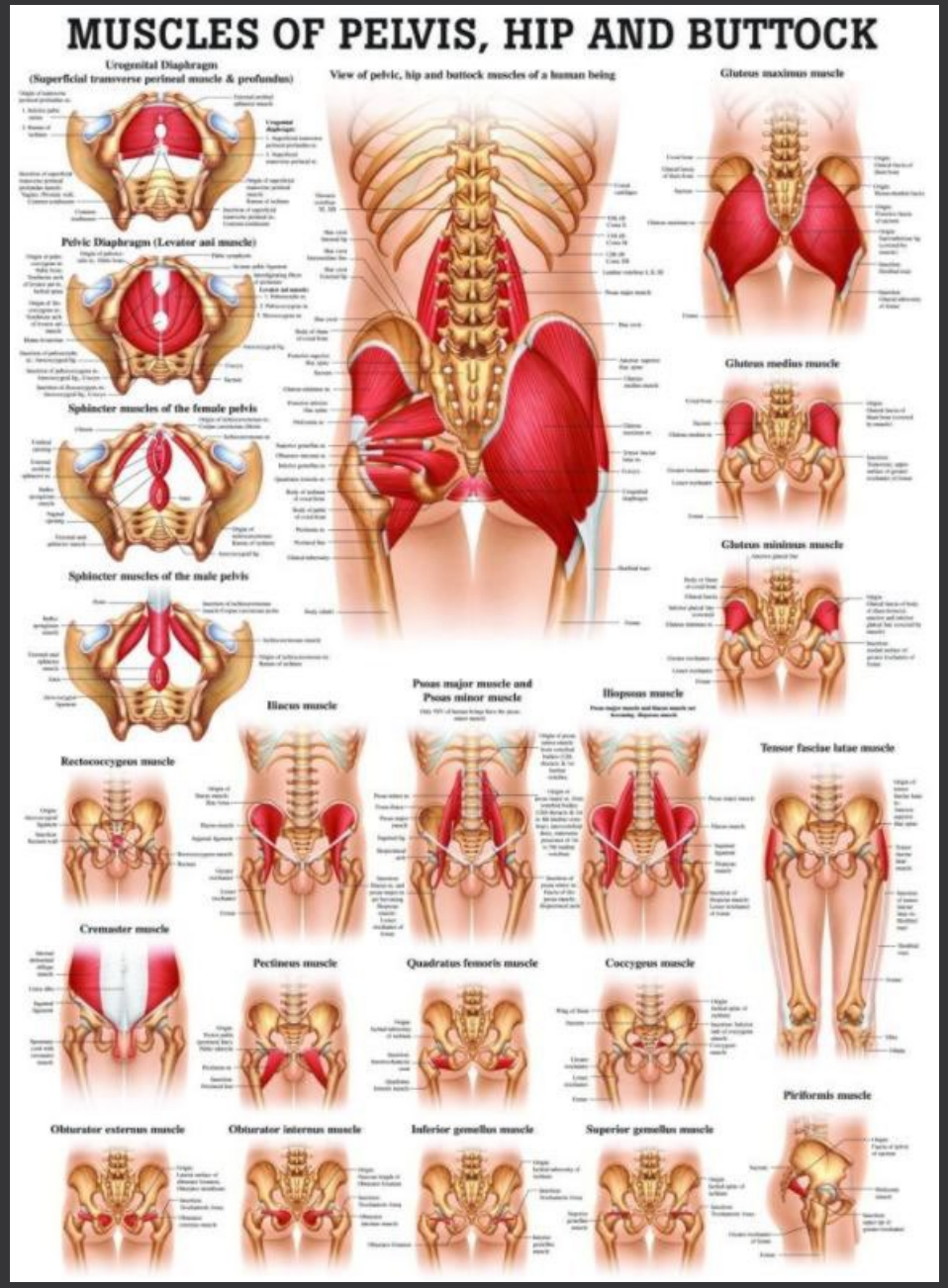
Hip Anatomy

- Layer concept
  - 1 – osteochondral
  - 2 – inert
  - 3 – contractile
    - Anterior
    - Lateral
    - Posterior
    - Pelvic floor
  - 4 – neuromechanical



Hip Anatomy

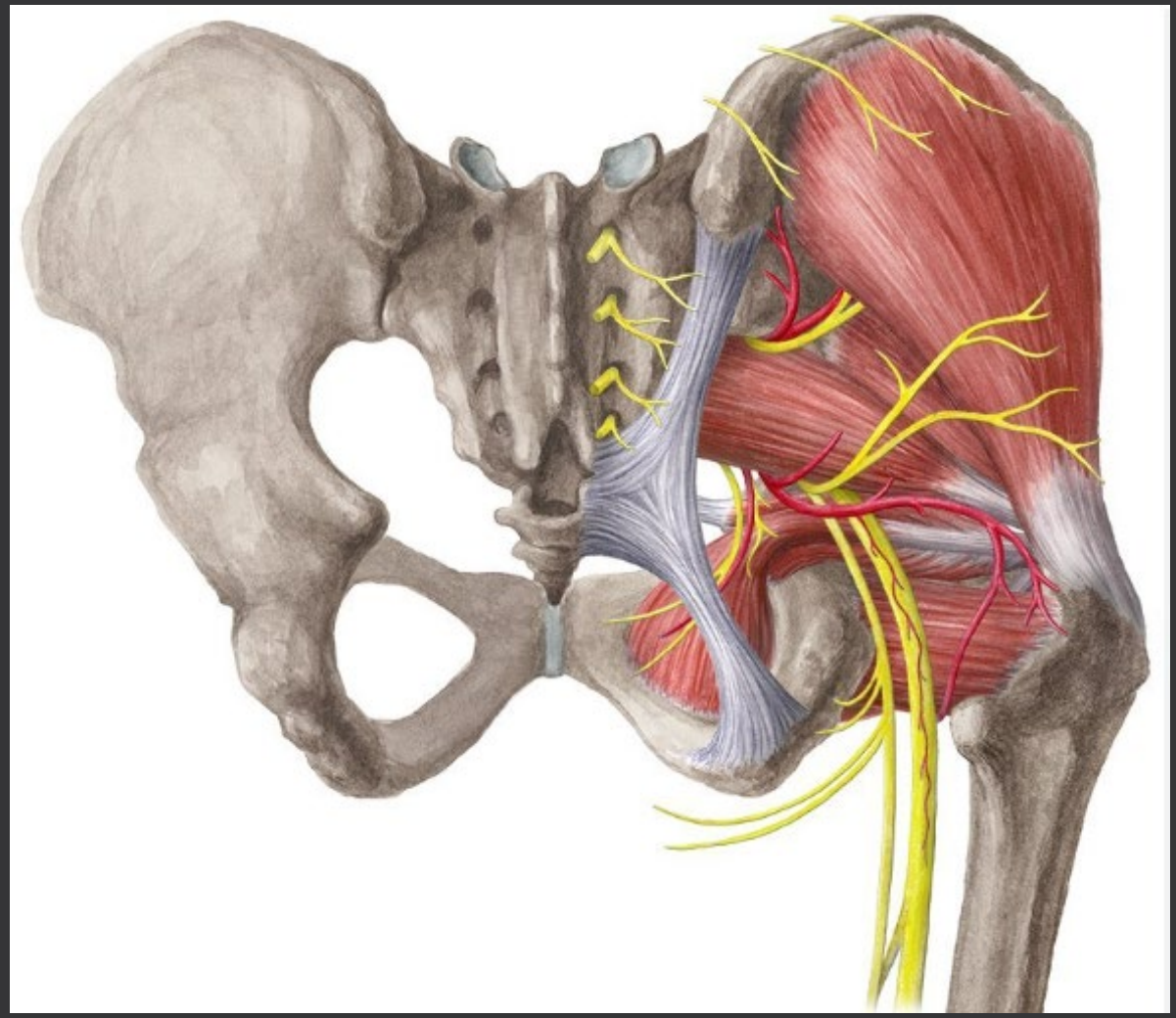
- Layer concept
  - 1 – osteochondral
  - 2 – inert
  - 3 – contractile
    - Hip muscles, lumbosacral muscles, pelvic floor
      - Dynamic stability, movement
      - Tendinopathies (hamstrings, abductors, adductors), iliopsoas tendonitis, coxa saltans, muscle strains, ruptures, contractures
  - 4 – neuromechanical



https://www.anatomywarehouse.com/muscles-of-buttock-hip-and-pelvis-anatomy-chart-a-104221

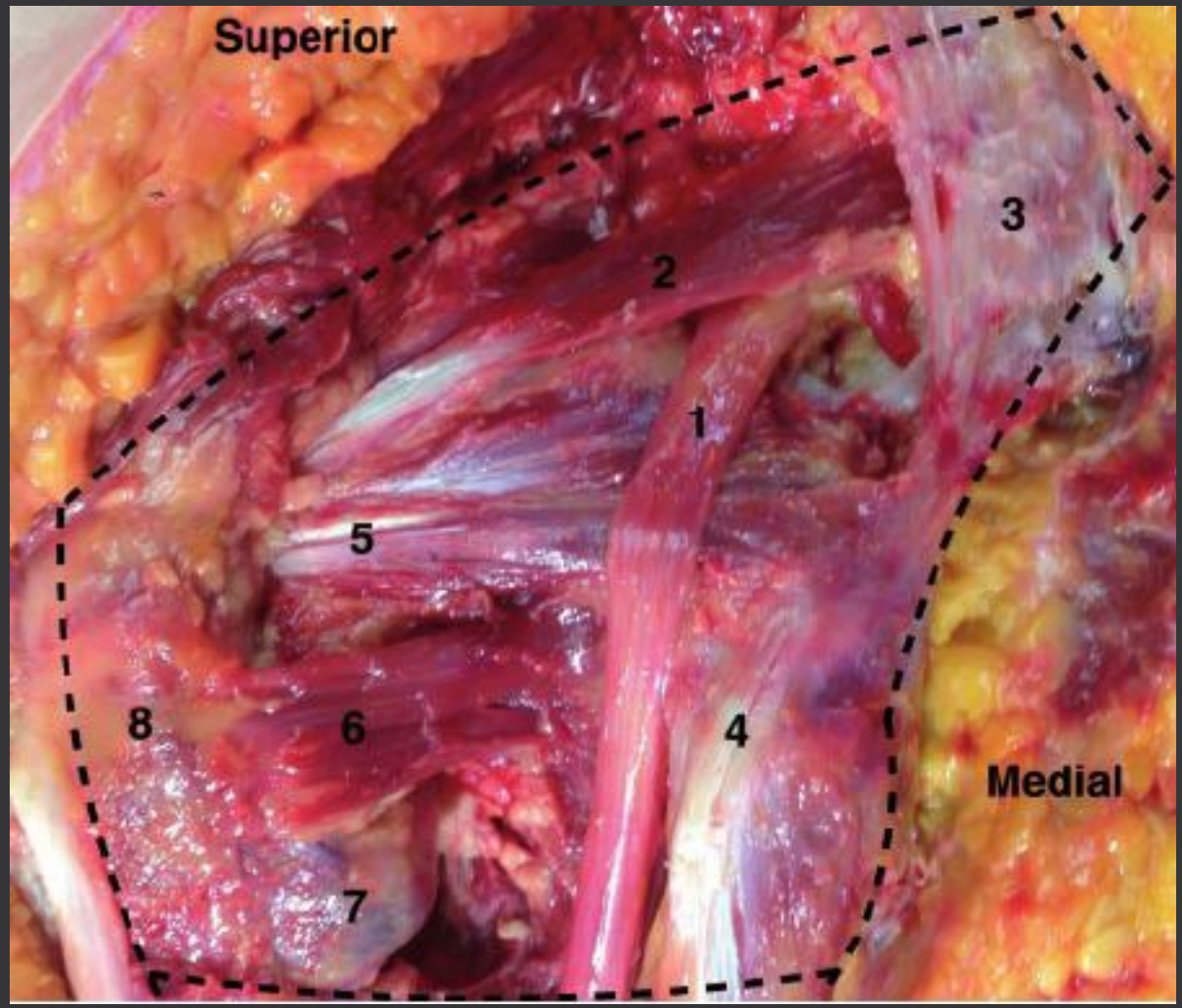
Hip Anatomy

- Layer concept
  - 1 – osteochondral
  - 2 – inert
  - 3 – contractile
  - 4 – neuromechanical
    - Sciatic, pudendal, gluteal, obturator nerves, vascular structures, mechanoreceptors
    - Communication, timing, sequence of muscle firing
    - Extraspinal sciatic entrapment, pudendal entrapment, pain syndromes, neuromuscular dysfunction



Hip Anatomy

- Layer concept
  - 1 – osteochondral
  - 2 – inert
  - 3 – contractile
  - 4 – neuromechanical
    - Sciatic, pudendal, gluteal, obturator nerves, vascular structures, mechanoreceptors
    - Communication, timing, sequence of muscle firing
    - Extraspinal sciatic entrapment, pudendal entrapment, pain syndromes, neuromuscular dysfunction



Martin H. Deep Gluteal Syndrome. *J Hip Preservation Surg.* Vol. 2, No. 2, 99-107

Hip Examination

- Antalgic gait
- Internal rotation
- External rotation
- Flexion
- + FADDIR
- + Stinchfield/resisted hip flexion

Shoulder Examination

- Internal rotation at 0 and 90
- External rotation at 0 and 90
- Forward Flexion/Extension
- Abduction
- Spurling maneuver
- Thoracic outlet
- Deltoid/biceps/triceps/EPL/FDP/hand
- Neer/Hawkin/Jobe/Jerk
- Anterior instability tests
- Posterior instability tests
- Scapular winging
- Internal impingement
- Belly press
- Lift off test
- Biceps impingement/groove TTP
- Hornblower
- O'Brien
- Crank
- Speed
- Yergason
- Cross-body adduction
- AC joint TTP

“My hip hurts”

“My hip hurts”

“My hip hurts”

“My hip hurts”

“My hip hurts”

“My hip hurts”

“My hip hurts”

“My hip hurts”

“My hip hurts”

“My hip hurts”

“My hip hurts”

“My hip hurts”

“My hip hurts”

Hip Examination

- Antalgic gait
- Internal rotation
- External rotation
- Flexion
- + FADDIR
- + Stinchfield/resisted hip flexion

International Hip Outcome Tool (IHOT12)

eform v 3.1

Patient Name: **Side:** Left

Patient ID: Right

Date of review: (complete either the date of review or the follow up period below)

Follow up period: Pre Op OR _____ Weeks / Months / Years (add the delay and circle one)

Simply place a vertical line at the position on the line below that corresponds accurately with your perception of your answer to the question. Please ensure that your line crosses the horizontal line, inside the shaded area.

1. Overall, how much pain do you have in your hip/groin?

Extreme pain — No pain at all

2. How difficult is it for you to get up and down off the floor/ground?

Extremely difficult — Not difficult at all

3. How difficult is it for you to walk long distances?

Extremely difficult — Not difficult at all

4. How much trouble do you have with grinding, catching or clicking in your hip?

Severe trouble — No trouble at all

5. How much trouble do you have pushing, pulling, lifting or carrying heavy objects?

Severe trouble — No trouble at all

6. How concerned are you about cutting/changing directions during your sport or recreational activities?

Extremely concerned — Not concerned at all

7. How much pain do you experience in your hip after activity?

Extreme pain — No pain at all

International Hip Outcome Tool (IHOT12)

8. How concerned are you about picking up or carrying children because of your hip?

Extremely concerned — Not concerned at all

9. How much trouble do you have with sexual activity because of your hip?

This is not relevant to me

Severe trouble — No trouble at all

10. How much of the time are you aware of the disability in your hip?

Constantly aware — Not aware at all

11. How concerned are you about your ability to maintain your desired fitness level?

Extremely concerned — Not concerned at all

12. How much of a distraction is your hip problem?

Extreme distraction — No distraction at all

Hip Examination

- Standing/Gait
- Seated
- Supine
- Lateral
- Prone

- Hal Martin hip exam Youtube

https://www.youtube.com/watch?v=IhvVoKGyl8E

STANDING		RIGHT	LEFT
GAIT			
	Long Stride Test		
	Foot Progression Angle		
	Heel Strike / Symptoms with Gait Cycle		
SL STAND			
DL – SL STAND (HOP TEST)			
LUMBAR MOTION			

SEATED	RIGHT	LEFT	SEATED	RIGHT	LEFT
HIP IR			SEATED PIRIFORMIS		
HIP ER			MMT Hip Flexion		
PASSIVE SLR			MMT Hip IR		
SLUMP TEST			MMT Hip ER		
RESISTED HS 30 DEG			MYOTOMES / DERMA		
RESISTED HS 90 DEG			DISTAL PULSES		

SUPINE	*RIGHT*	*LEFT*	SUPINE	*RIGHT*	*LEFT*	LATERAL	*RIGHT*	*LEFT*
LEG LENGTH			SIT UP TEST			MMT GLUTE MAX		
LOG ROLL			RESISTED ADD			MMT G MED		
DISTRACTION			RESISTED ADD (90)			MMT G MIN		
HIP FLEX ROM			P – ADDUCTOR			APPREH		
THOMAS TEST			P – GROIN AREA			POST RIM		
DIRI (ant rim)			LFCN / TINEL'S			ACTIVE PIRIFORMIS		
DEEP FLEXION						HIP / SPINE		
DEXRIT (post rim)						IFI TEST		
FADDIR						DIRI		
FABER – groin						OBERS – G MAX		
FABER – lateral hip			LATERAL			OBERS - TFL		
FABER – SI joint			P – SI JOINT					
APPREH			P – GT FACET					
FAN TEST			P – MED ISCHIUM					
MMT HIP FLEX (N)			P – HS ISCHIUM					
MMT HIP FLEX (ER)			P – LAT ISCHIUM					
			P – PIRIFORMIS					
PASSIVE SLR			P –QFS					
ACTIVE PIRIFORMIS								

PRONE	*RIGHT*	*LEFT*	*NORM VALUES*
ELYS			Fist between heel and gluteals
CRAIGS TEST	Retro / Normal / Ante	Retro / Normal / Ante	Version
HIP ROM IR / ER			8-10 Deg Males 14 - 20 Deg Females
PRONE PROP / PA'S			
SPRING TEST			
Gluteal Timing			

Hip Examination

- Standing/Gait
- Seated
- Supine
- Lateral
- Prone

STANDING		RIGHT	LEFT
GAIT			
	Long Stride Test		
	Foot Progression Angle		
	Heel Strike / Symptoms with Gait Cycle		
SL STAND			
DL – SL STAND (HOP TEST)			
LUMBAR MOTION			

- Hal Martin hip exam Youtube

https://www.youtube.com/watch?v=IhvVoKGyl8E

Hip Examination

- Standing/Gait
- Seated
- Supine
- Lateral
- Prone

SEATED	RIGHT	LEFT	SEATED	RIGHT	LEFT
HIP IR			SEATED PIRIFORMIS		
HIP ER			MMT Hip Flexion		
PASSIVE SLR			MMT Hip IR		
SLUMP TEST			MMT Hip ER		
RESISTED HS 30 DEG			MYOTOMES / DERMA		
RESISTED HS 90 DEG			DISTAL PULSES		

- Hal Martin hip exam Youtube

https://www.youtube.com/watch?v=IhvVoKGyl8E

Hip Examination

- Standing/Gait
- Seated
- Supine
- Lateral
- Prone

SUPINE	*RIGHT*	*LEFT*	SUPINE	*RIGHT*	*LEFT*
LEG LENGTH			SIT UP TEST		
LOG ROLL			RESISTED ADD		
DISTRACTION			RESISTED ADD (90)		
HIP FLEX ROM			P – ADDUCTOR		
THOMAS TEST			P – GROIN AREA		
DIRI (ant rim)			LFCN / TINEL'S		
DEEP FLEXION					
DEXRIT (post rim)					
FADDIR					
FABER – groin					
FABER – lateral hip			LATERAL		
FABER – SI joint			P – SI JOINT		
APPREH			P – GT FACET		
FAN TEST			P – MED ISCHIUM		
MMT HIP FLEX (N)			P – HS ISCHIUM		
MMT HIP FLEX (ER)			P – LAT ISCHIUM		
			P – PIRIFORMIS		
PASSIVE SLR			P –QFS		
ACTIVE PIRIFORMIS					

- Hal Martin hip exam Youtube

https://www.youtube.com/watch?v=IhvVoKGyl8E

Hip Examination

- Standing/Gait
- Seated
- Supine
- Lateral
- Prone

SUPINE	*RIGHT*	*LEFT*	LATERAL	*RIGHT*	*LEFT*
SIT UP TEST			MMT GLUTE MAX		
RESISTED ADD			MMT G MED		
RESISTED ADD (90)			MMT G MIN		
P – ADDUCTOR			APPREH		
P – GROIN AREA			POST RIM		
LFCN / TINEL'S			ACTIVE PIRIFORMIS		
			HIP / SPINE		
			IFI TEST		
			DIRI		
			OBERS – G MAX		
LATERAL			OBERS - TFL		
P – SI JOINT					
P – GT FACET					
P – MED ISCHIUM					
P – HS ISCHIUM					
P – LAT ISCHIUM					
P – PIRIFORMIS					
P –QFS					

- Hal Martin hip exam Youtube

https://www.youtube.com/watch?v=IhvVoKGyl8E

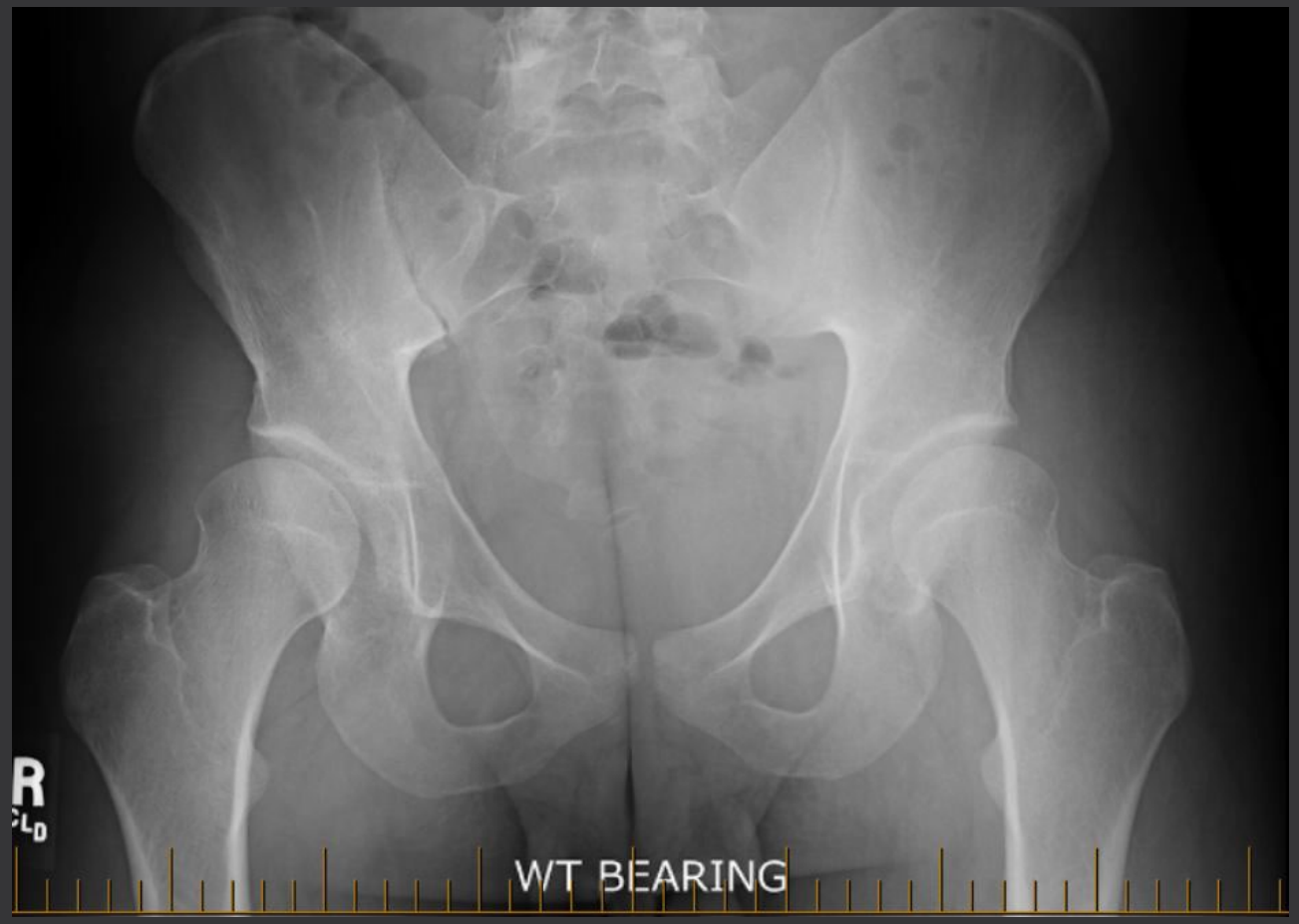
Hip Examination

- Standing/Gait
- Seated
- Supine
- Lateral
- Prone

PRONE	*RIGHT*	*LEFT*	*NORM VALUES*
ELYS			Fist between heel and gluteals
CRAIGS TEST	Retro / Normal / Ante	Retro / Normal / Ante	Version
HIP ROM IR / ER			8-10 Deg Males 14 - 20 Deg Females
PRONE PROP / PA'S			
SPRING TEST			
Gluteal Timing			

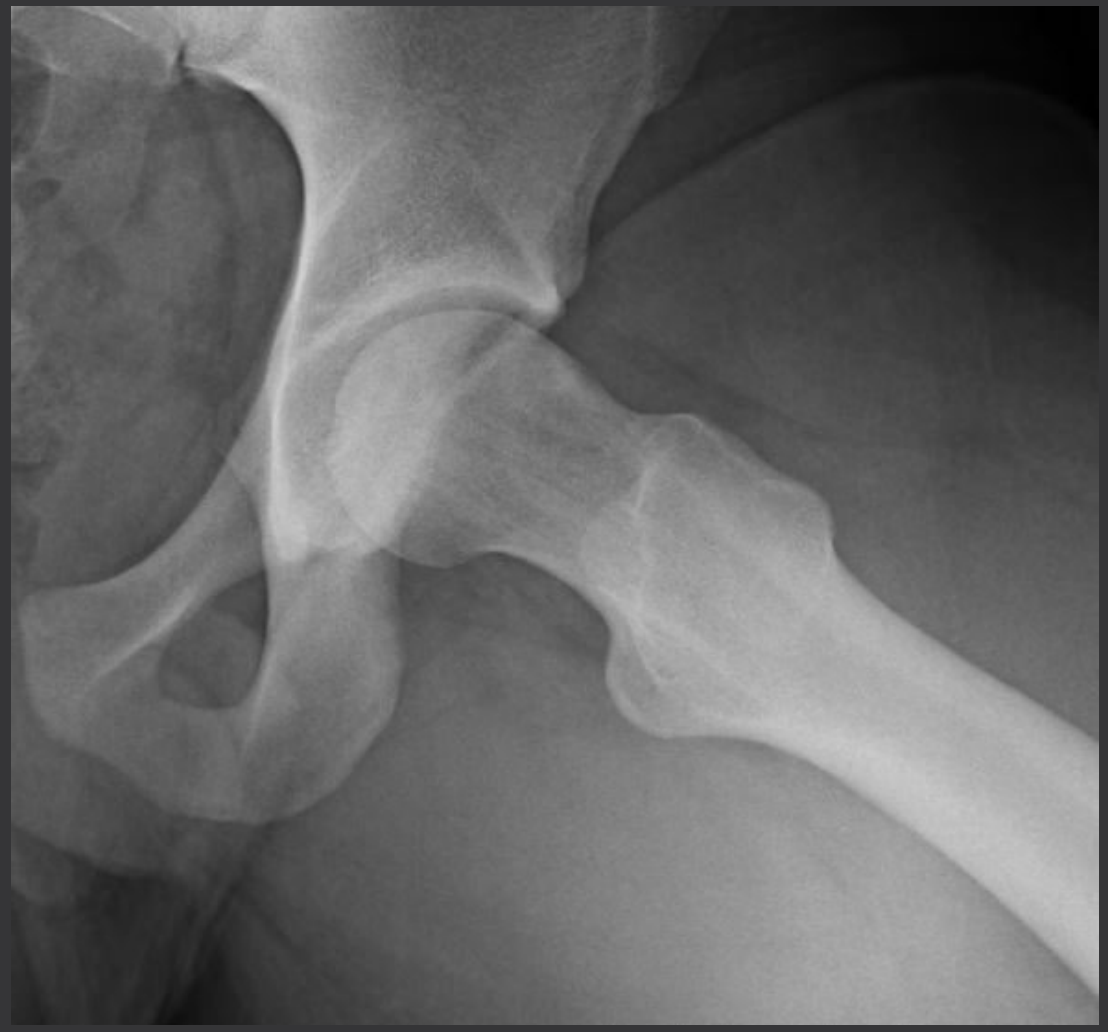
- Hal Martin hip exam Youtube

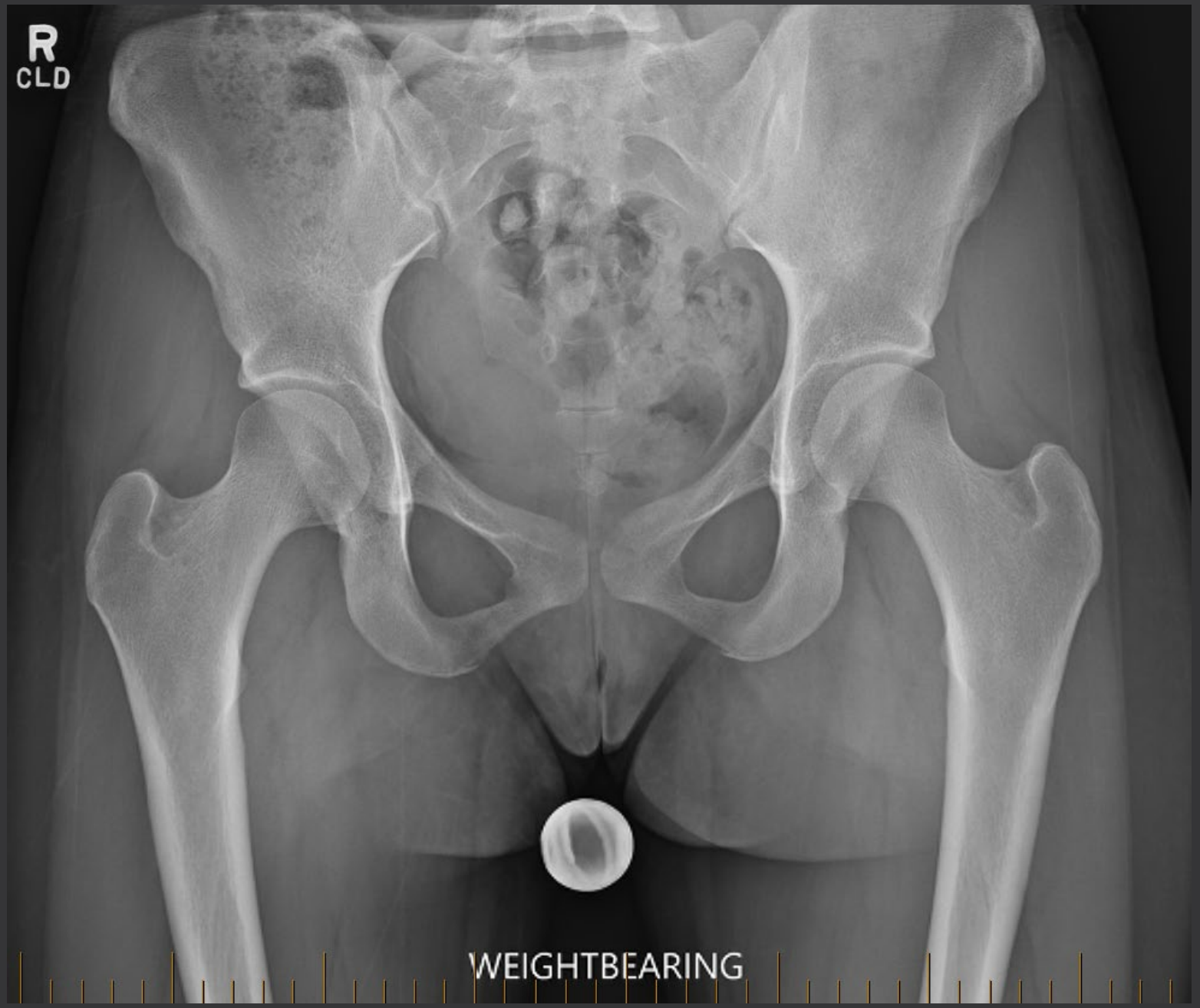
https://www.youtube.com/watch?v=IhvVoKGyl8E

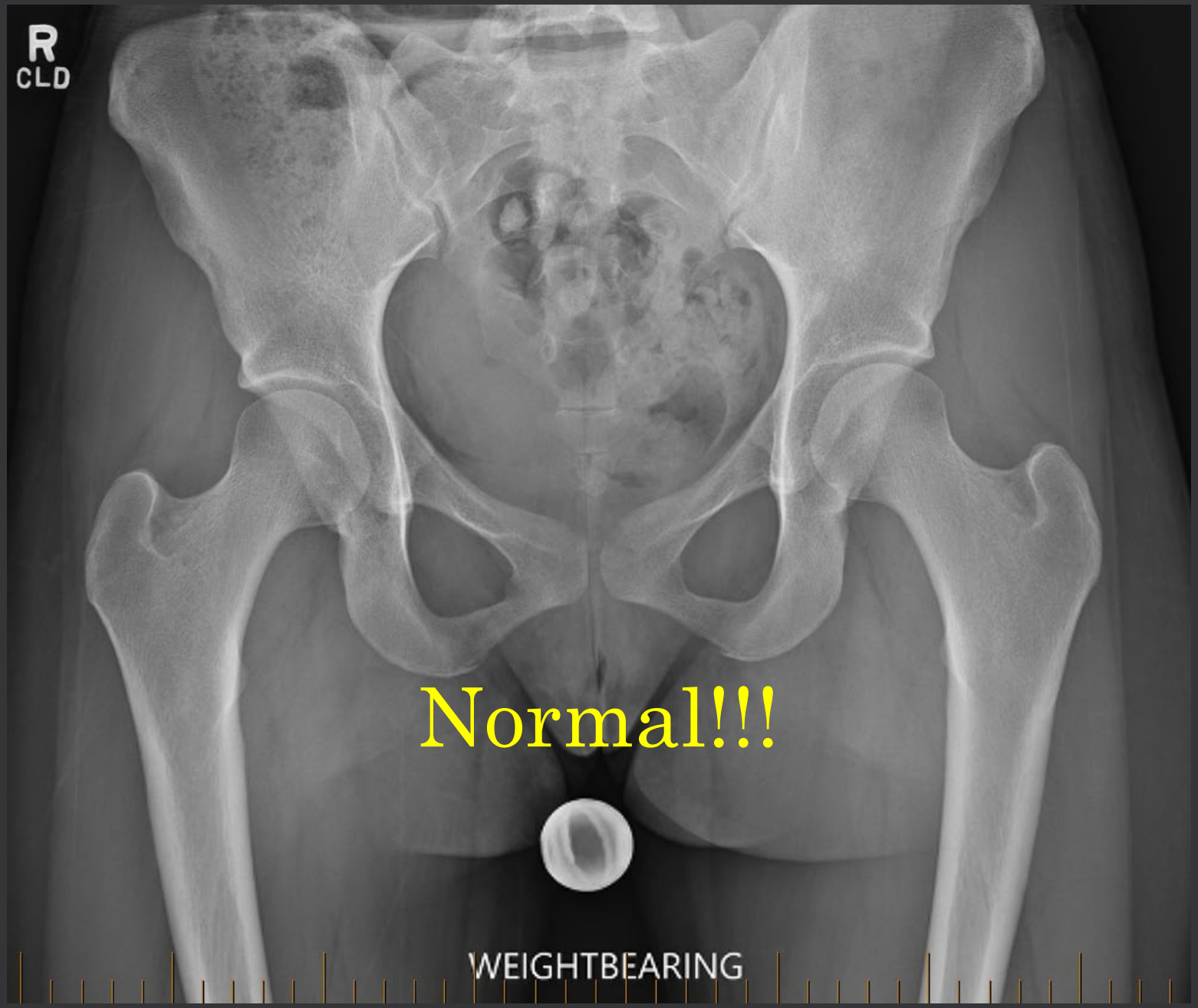


Dysplasia

Femoroacetabular impingement (FAI)




R
CLD
WEIGHTBEARING


R
CLD
Normal!!!
WEIGHTBEARING

Hip Imaging

- Standing AP pelvis
- False profile view
- Modified Dunn view

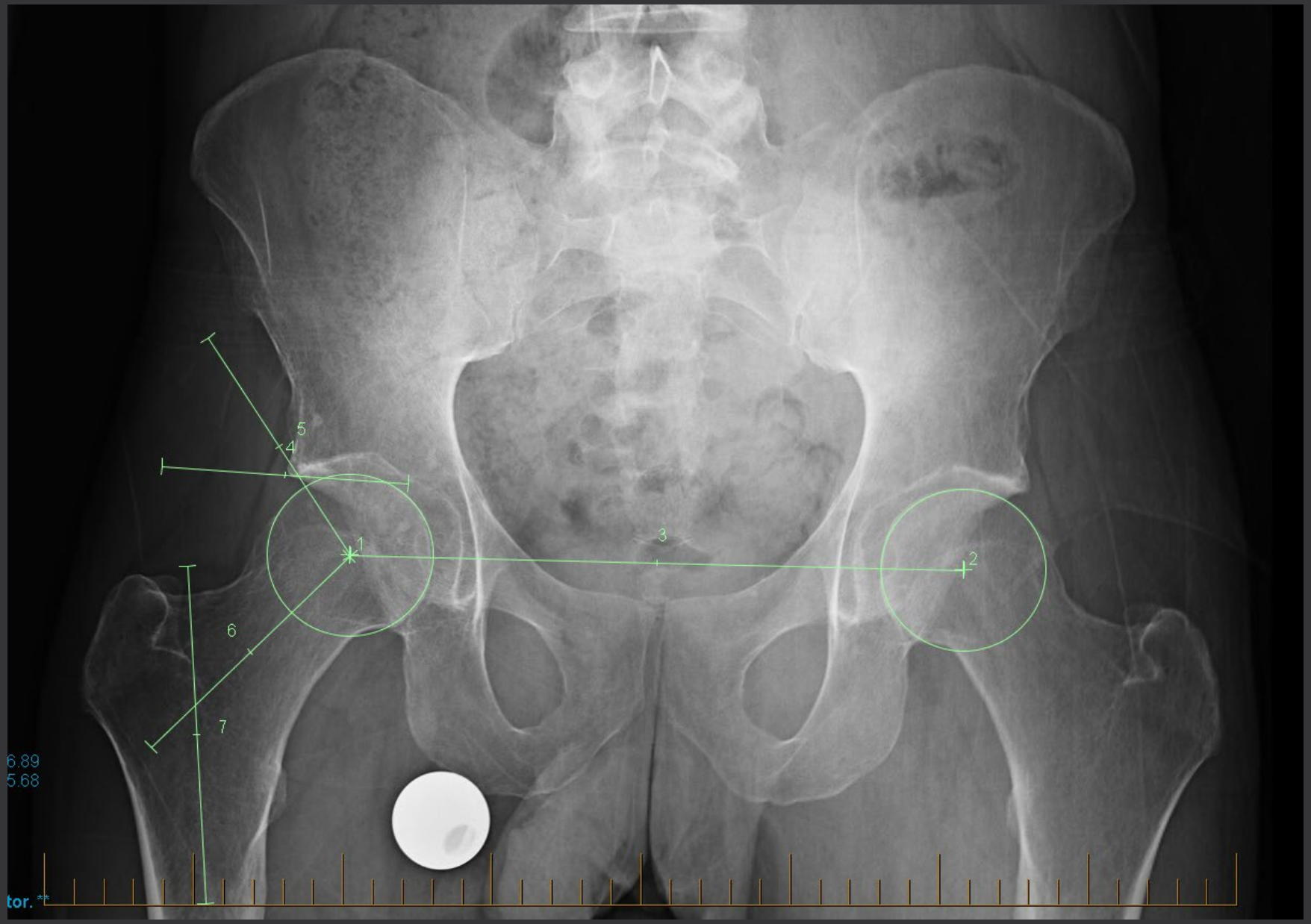
- CT
- MRI

Hip Imaging

- Standing AP pelvis
- False profile view
- Modified Dunn view

- CT
- MRI

- Clohisy JBJS 2008 Nov 1; 90(Suppl 4):47-66

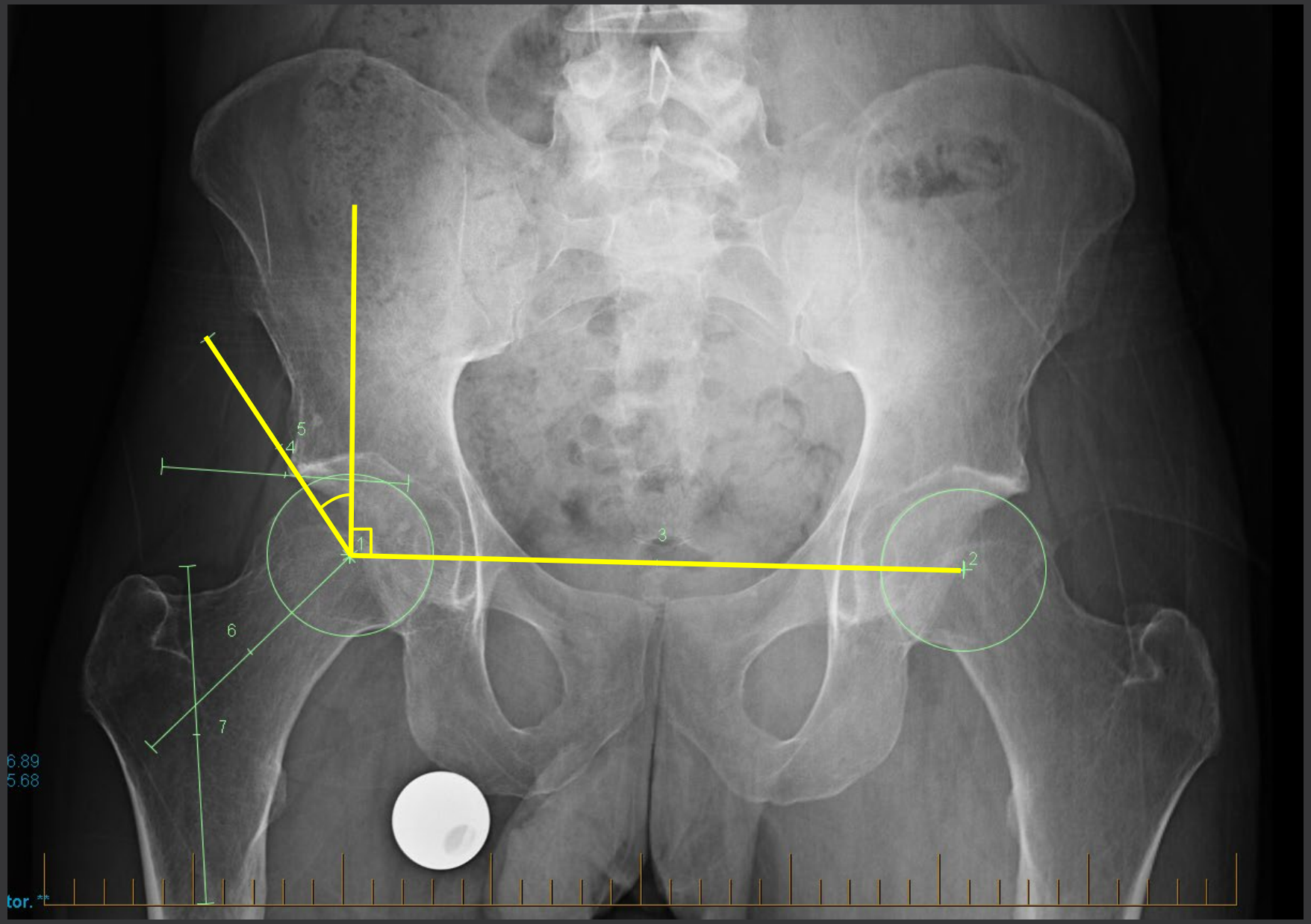


Hip Imaging

- Standing AP pelvis
- False profile view
- Modified Dunn view

- CT
- MRI

- Clohisy JBJS 2008 Nov 1; 90(Suppl 4):47-66

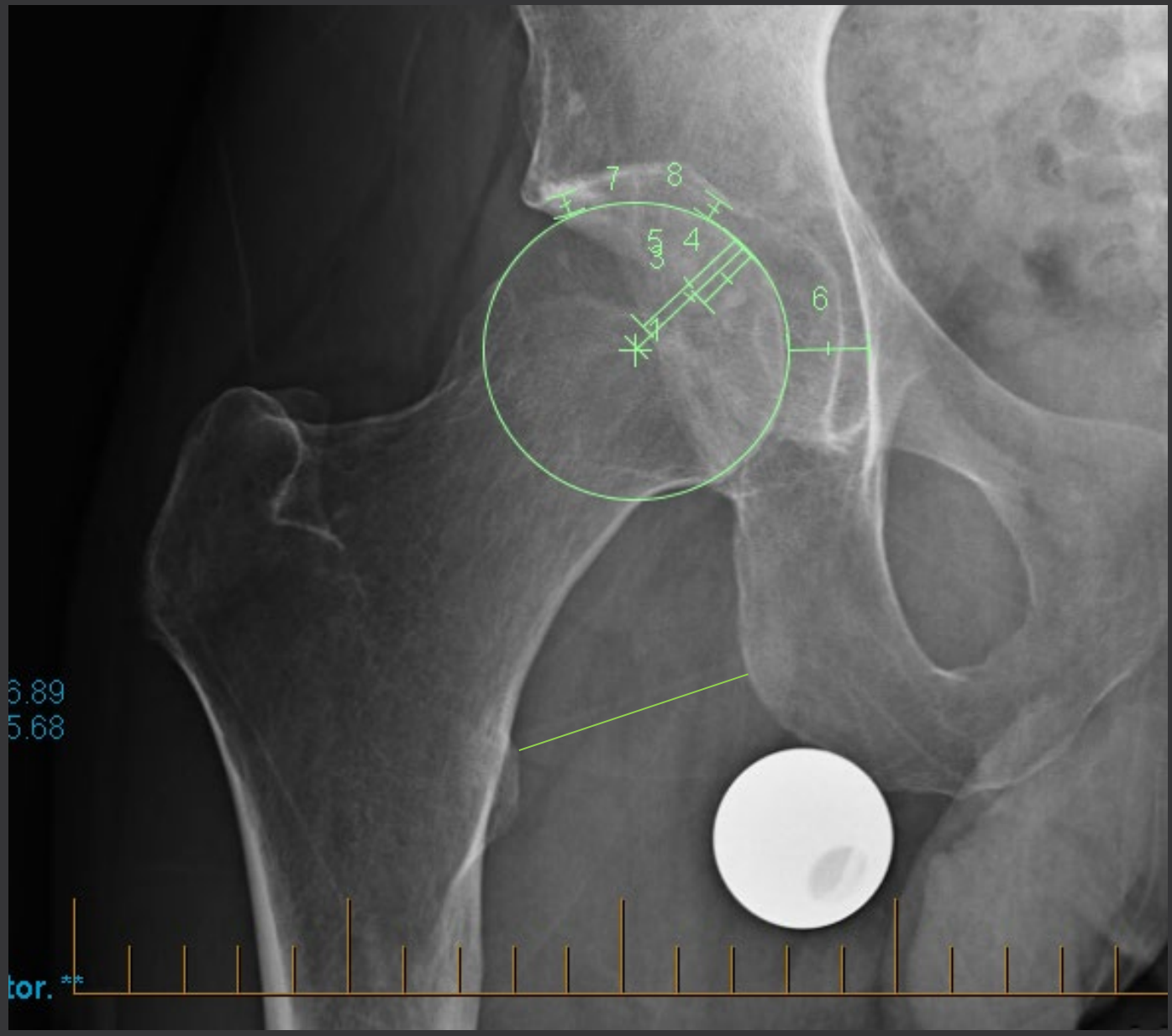


Hip Imaging

- Standing AP pelvis
- False profile view
- Modified Dunn view

- CT
- MRI

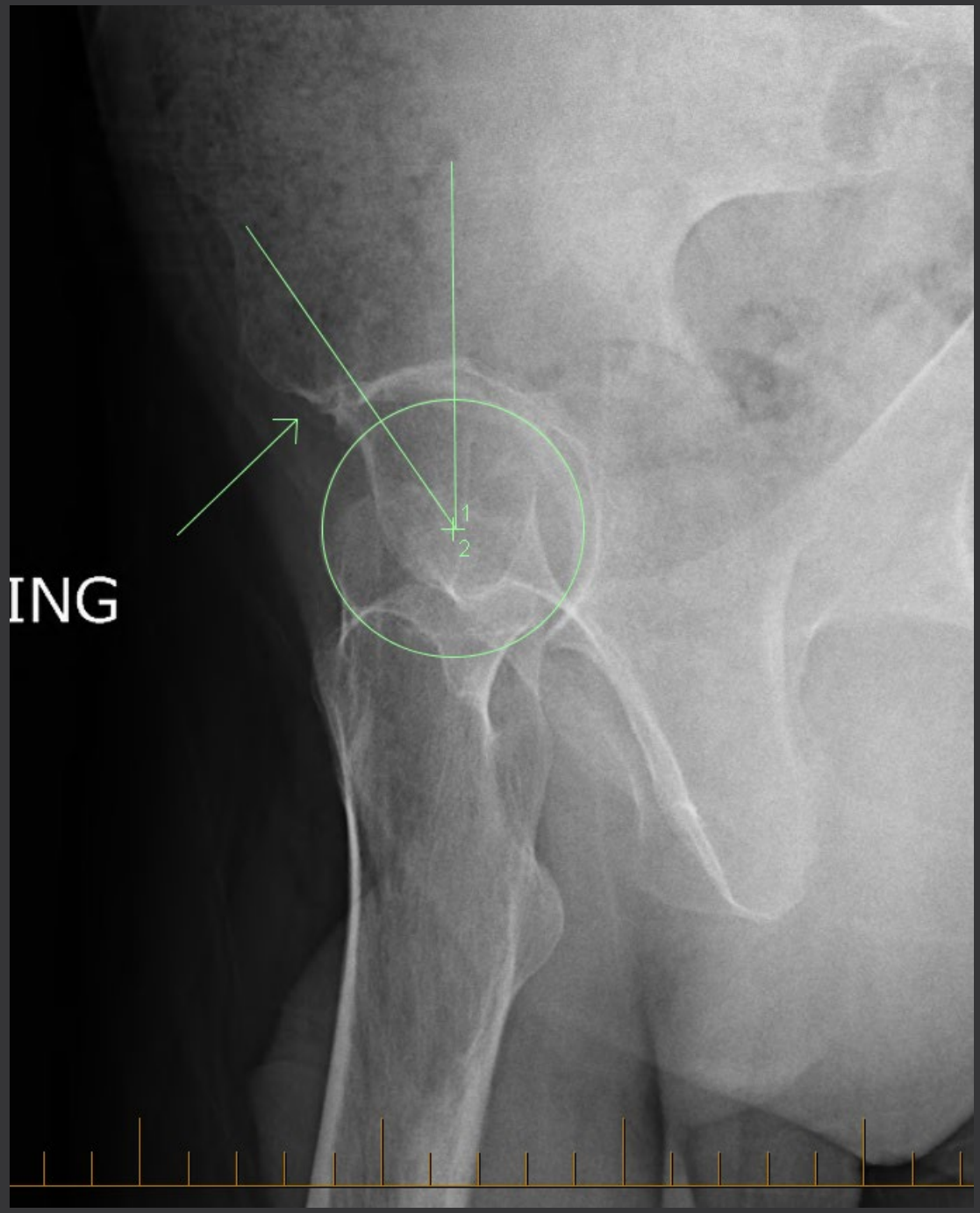
- Siebenrock CORR 2012 Dec; 470(12):3355-60



Hip Imaging

- Standing AP pelvis
- False profile view
- Modified Dunn view

- CT
- MRI



Hip Imaging

- Standing AP pelvis
- False profile view
- Modified Dunn view

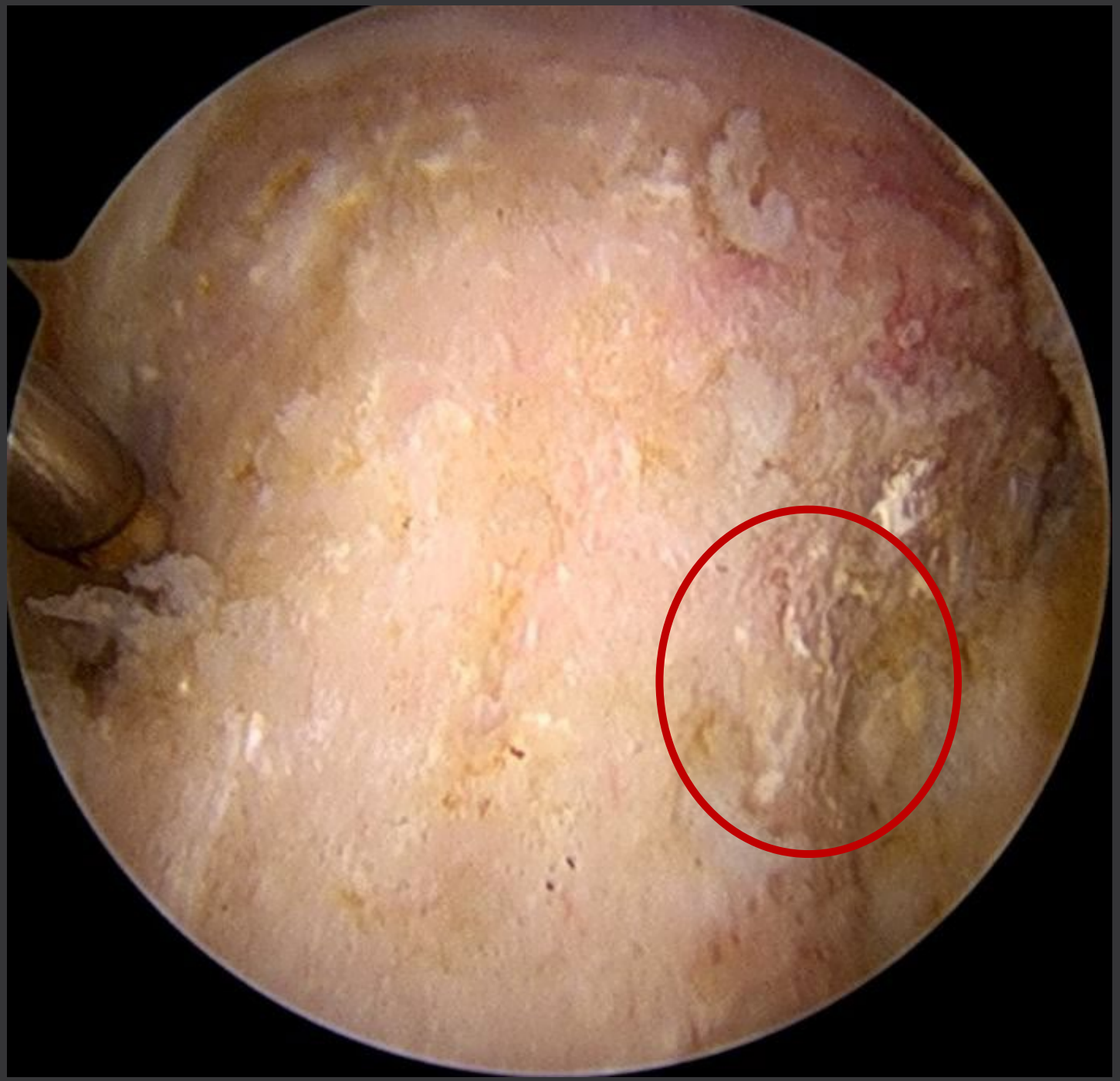
- CT
- MRI

Hip Imaging

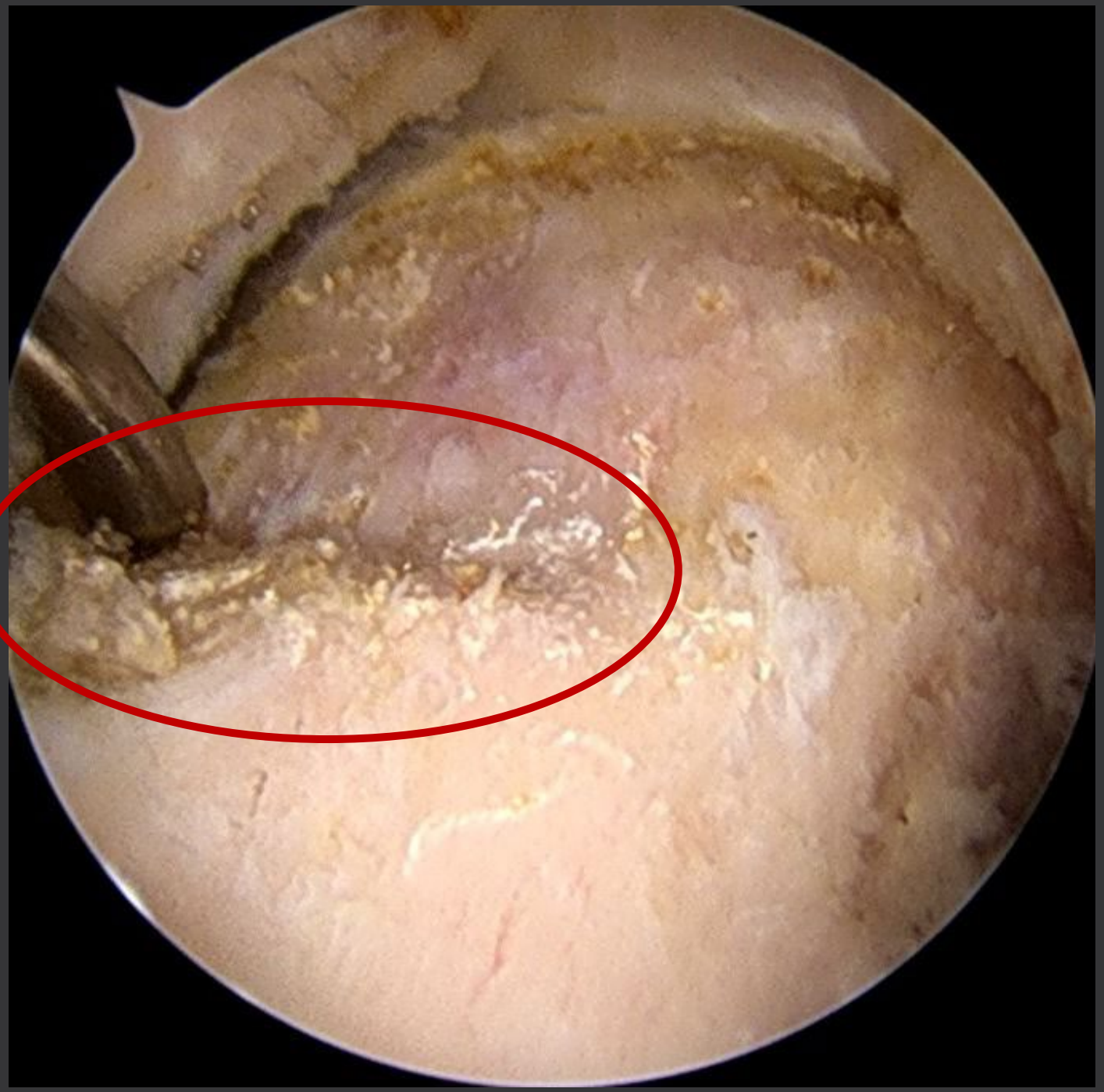
- Standing AP pelvis
- False profile view
- Modified Dunn view

- CT
  - Fractures – acetabular, pelvic, occult
  - Femoroacetabular impingement (FAI)
- MRI

Hip Imaging



Hip Imaging

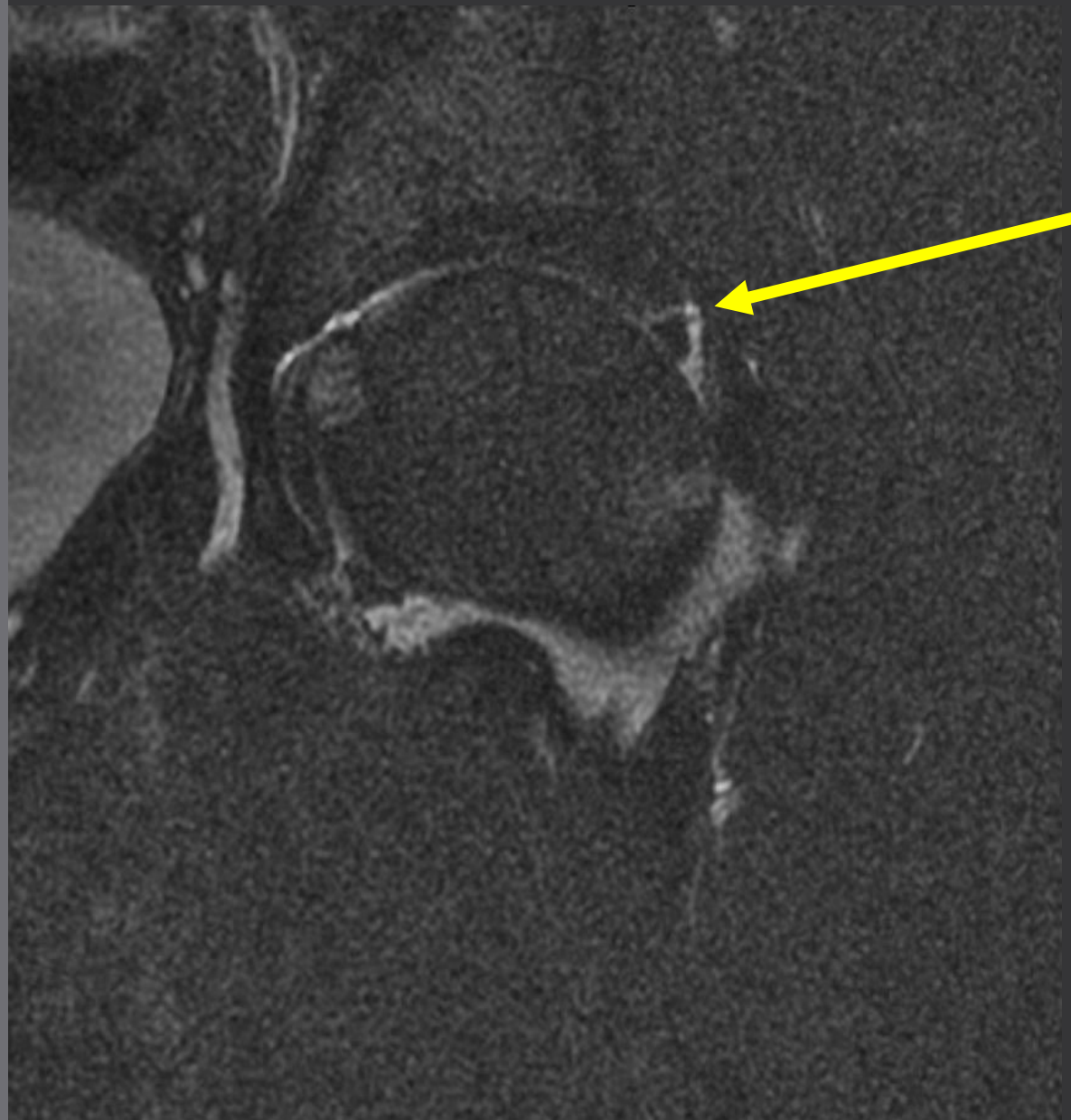


Hip Imaging

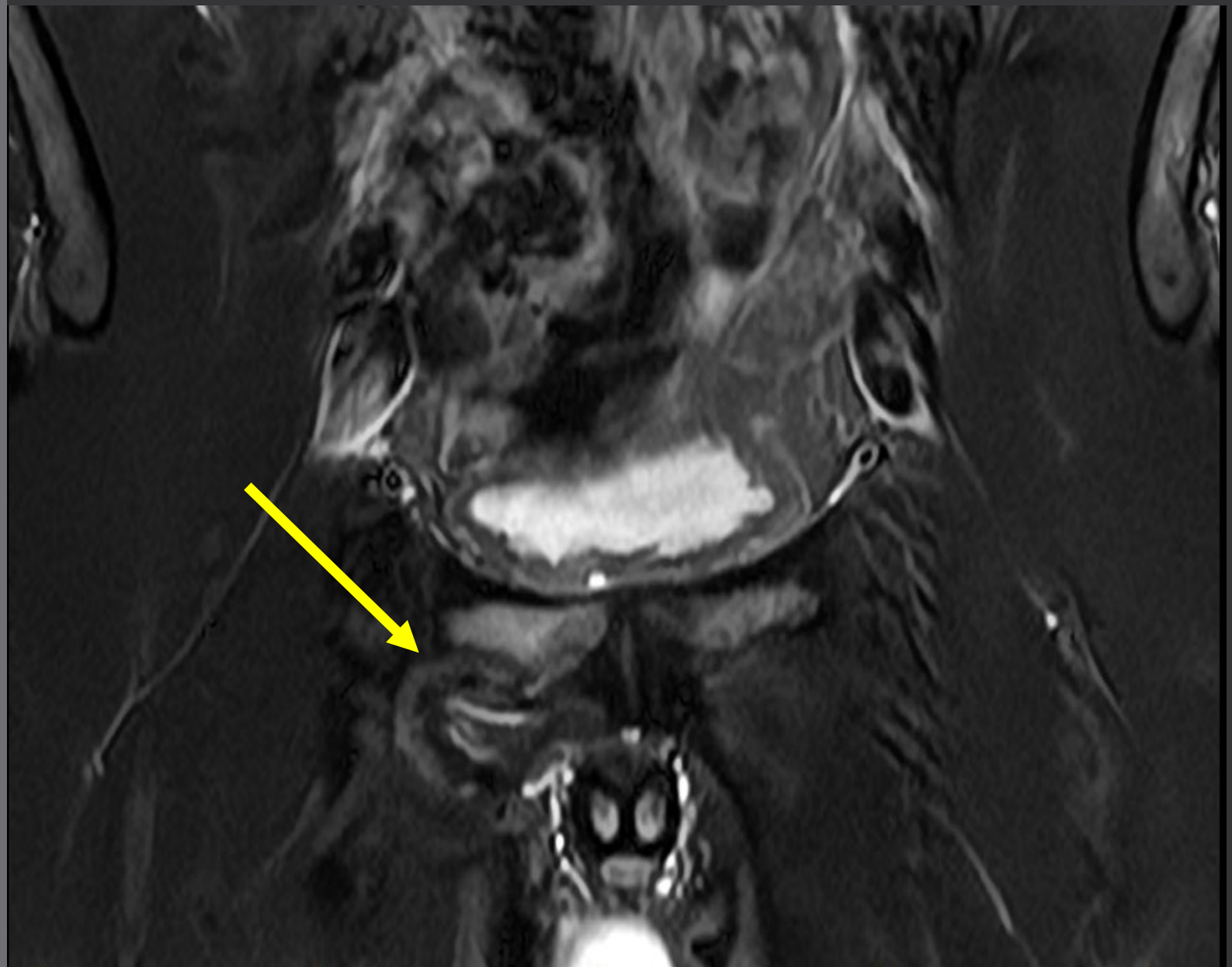
- Standing AP pelvis
- False profile view
- Modified Dunn view

- CT
- MRI
  - Labral tear
  - Cartilage assessment
  - Tendinopathies
  - Ischiofemoral impingement (IFI)
  - Piriformis
  - Stress fracture
  - Post-arthroscopy pain

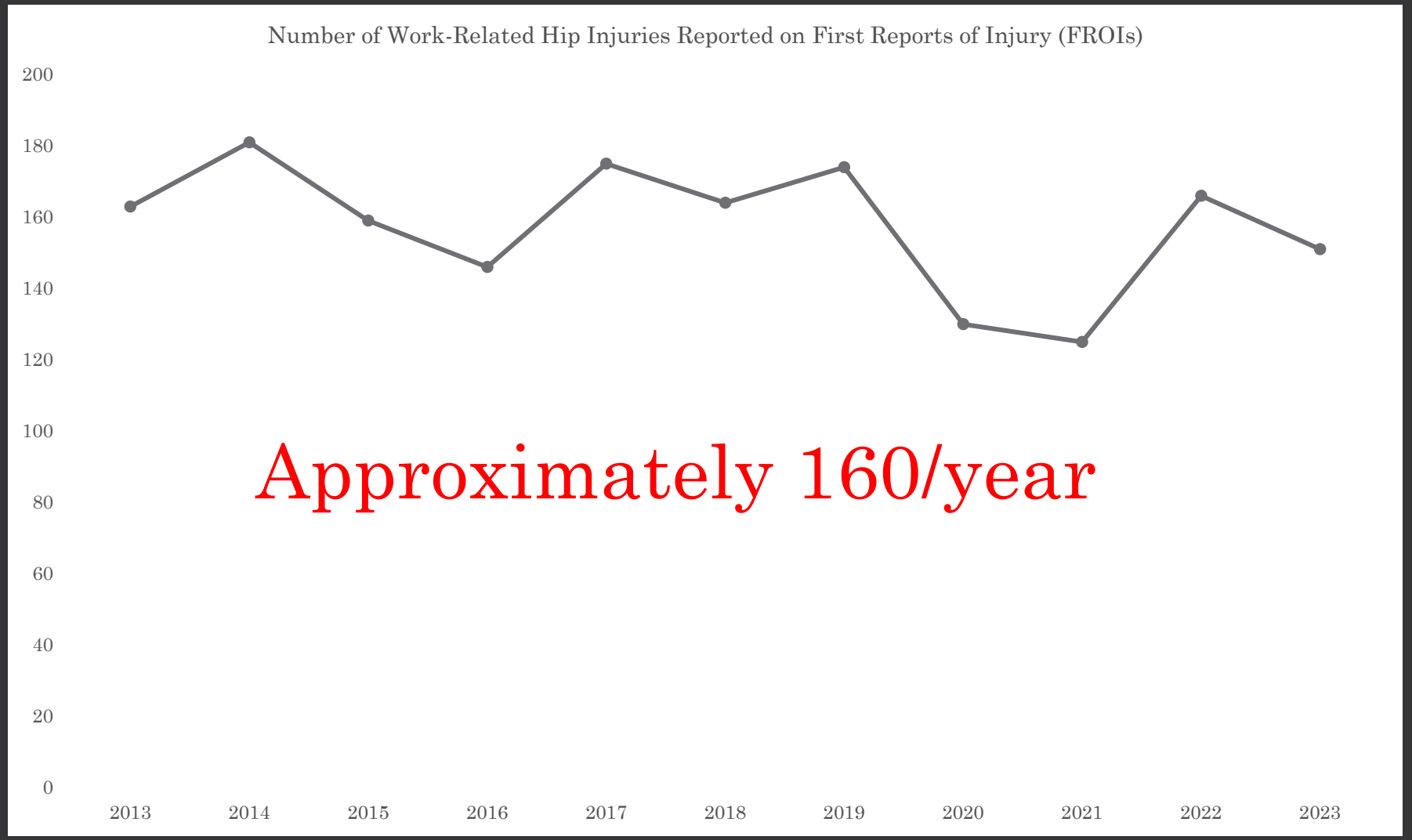
Hip Imaging



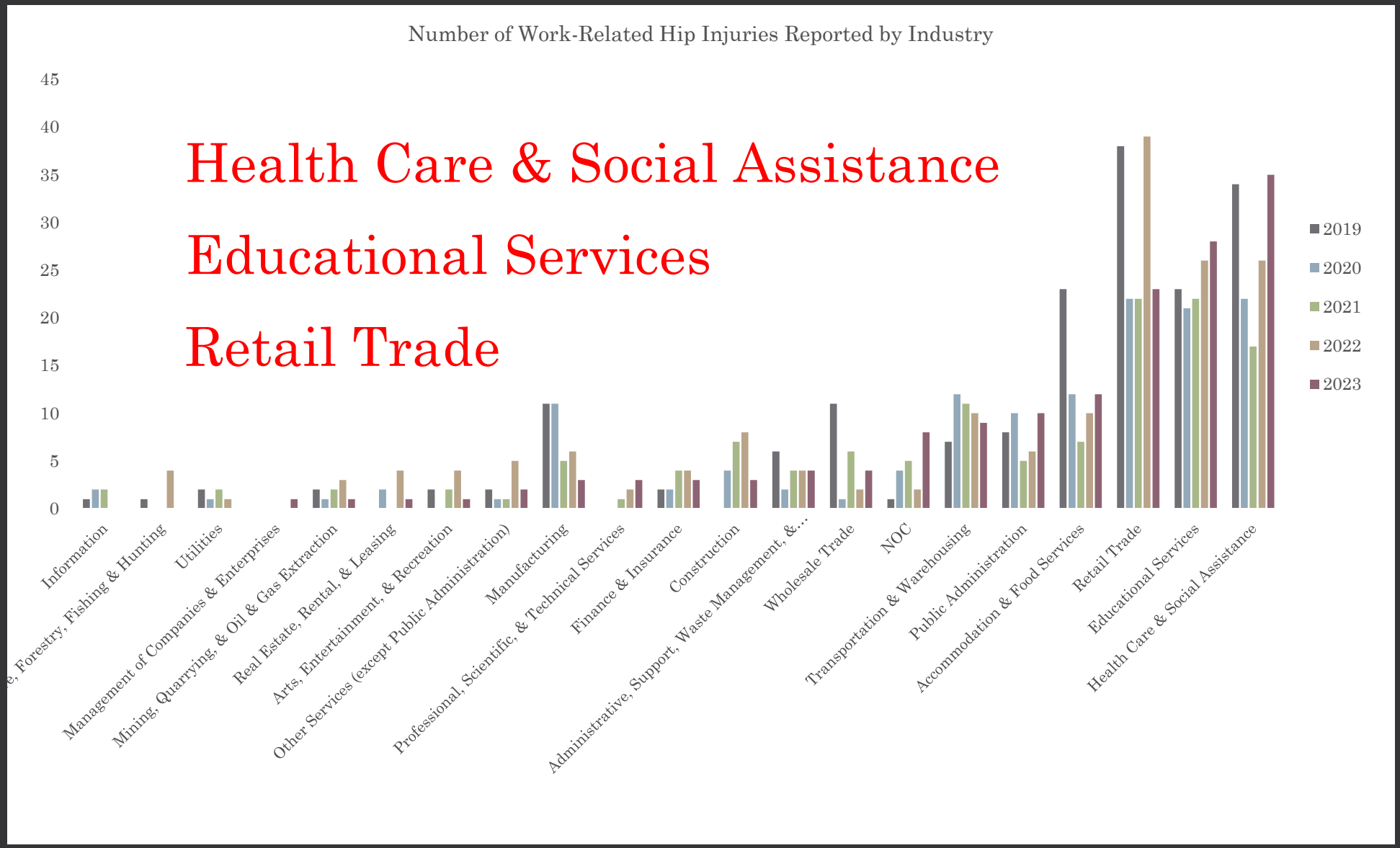
Hip Imaging



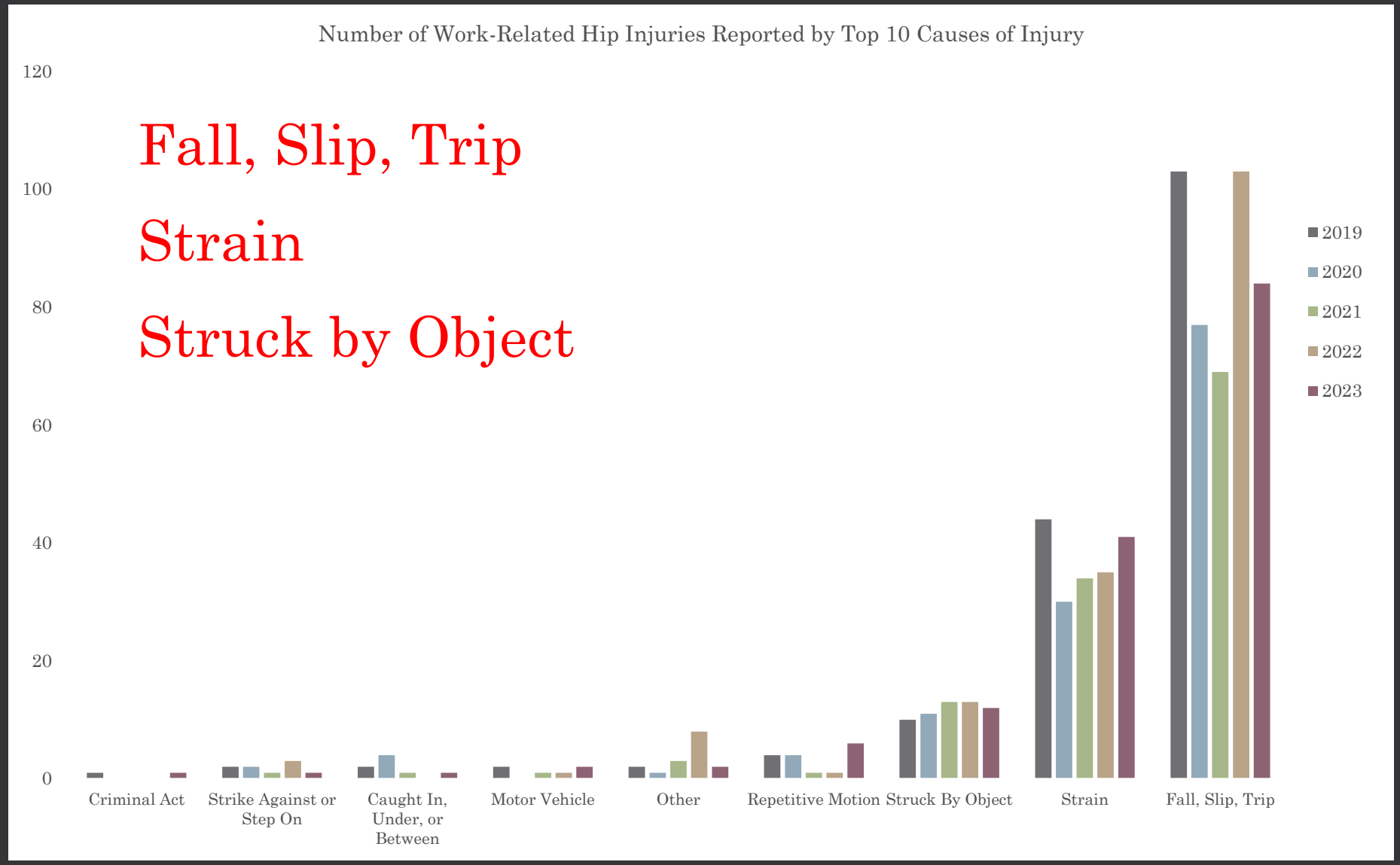
Work-related Injuries



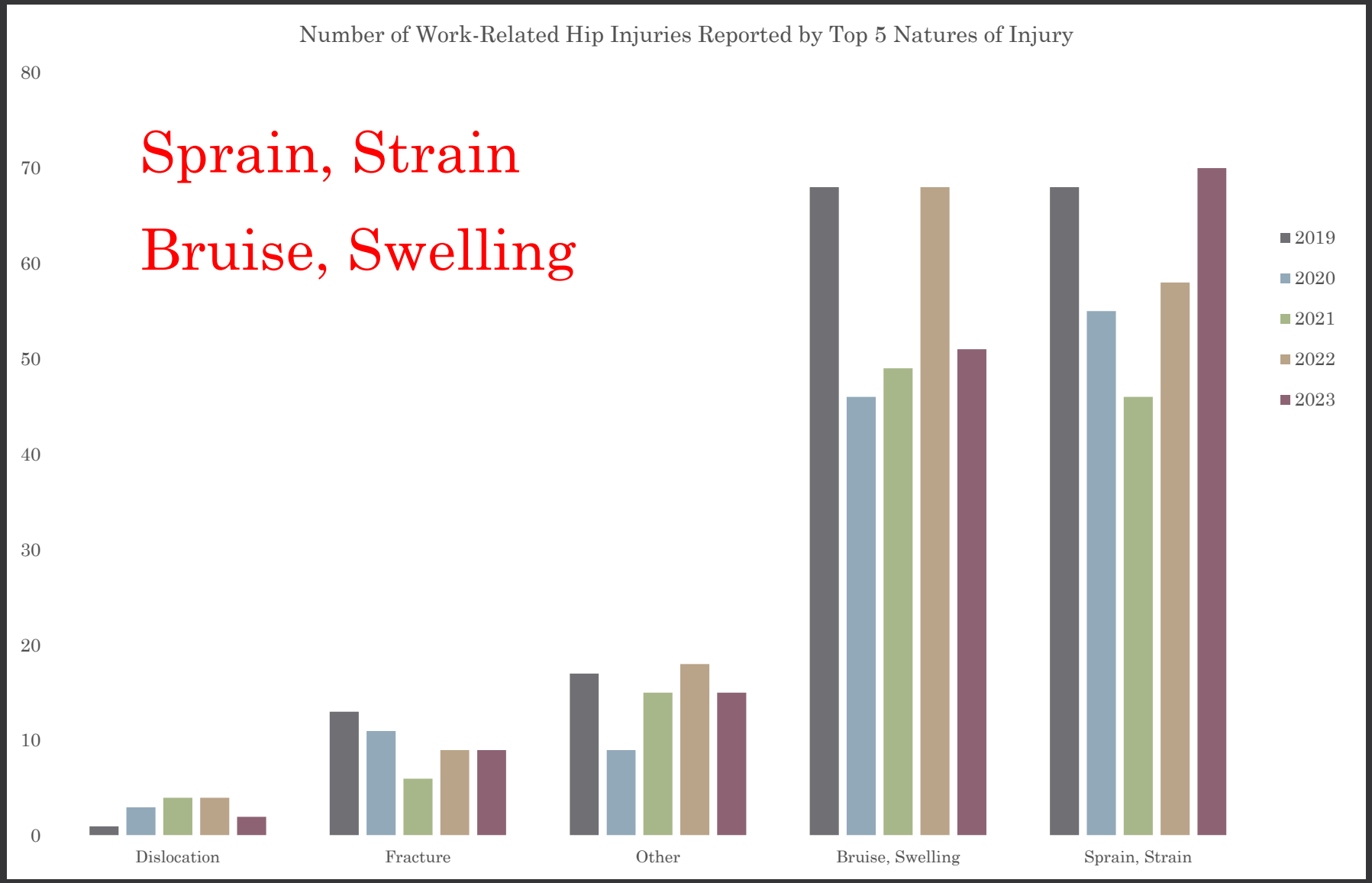
Work-related Injuries



Work-related Injuries



Work-related Injuries



- DJD
- FAI
- Abductor tendinopathy
- Ischiofemoral impingement
- Hamstring tendinopathy
- Lumbar etiology
- Stress fracture
- SI joint
- Intra-pelvic
- Pudendal neuralgia
- Meralgia paresthetica
- Trochanteric bursitis
- TFL contracture
- Dysplasia
- Instability
- Iliopsoas tendonitis
- Piriformis syndrome
- Deep gluteal syndrome
- Core muscle injury
- Ligamentum teres tear
- Trochanteric impingement
- Femoral version
- Coxa saltans
- Osteitis pubis
- Adductor strain
- Rectus femoris tendonitis

Osteochondral Layer

- DJD
- FAI
- Abductor tendinopathy
- Ischiofemoral impingement
- Hamstring tendinopathy
- Lumbar etiology
- Stress fracture
- SI joint
- Intra-pelvic
- Pudendal neuralgia
- Meralgia paresthetica
- Trochanteric bursitis
- TFL contracture
- Dysplasia
- Instability
- Iliopsoas tendonitis
- Piriformis syndrome
- Deep gluteal syndrome
- Core muscle injury
- Ligamentum teres tear
- Trochanteric impingement
- Femoral version
- Coxa saltans
- Osteitis pubis
- Adductor strain
- Rectus femoris tendonitis

Inert Layer

- DJD
- FAI – labral tear
- Abductor tendinopathy
- Ischiofemoral impingement
- Hamstring tendinopathy
- Lumbar etiology
- Stress fracture
- SI joint
- Intra-pelvic
- Pudendal neuralgia
- Meralgia paresthetica
- Trochanteric bursitis
- TFL contracture
- Dysplasia
- Instability
- Iliopsoas tendonitis
- Piriformis syndrome
- Deep gluteal syndrome
- Core muscle injury
- Ligamentum teres tear
- Trochanteric impingement
- Femoral version
- Coxa saltans
- Osteitis pubis
- Adductor strain
- Rectus femoris tendonitis

Contractile Layer

- DJD
- FAI
- Abductor tendinopathy
- Ischiofemoral impingement
- Hamstring tendinopathy
- Lumbar etiology
- Stress fracture
- SI joint
- Intra-pelvic
- Pudendal neuralgia
- Meralgia paresthetica
- Trochanteric bursitis
- TFL contracture
- Dysplasia
- Instability
- Iliopsoas tendonitis
- Piriformis syndrome
- Deep gluteal syndrome
- Core muscle injury
- Ligamentum teres tear
- Trochanteric impingement
- Femoral version
- Coxa saltans
- Osteitis pubis
- Adductor strain
- Rectus femoris tendonitis

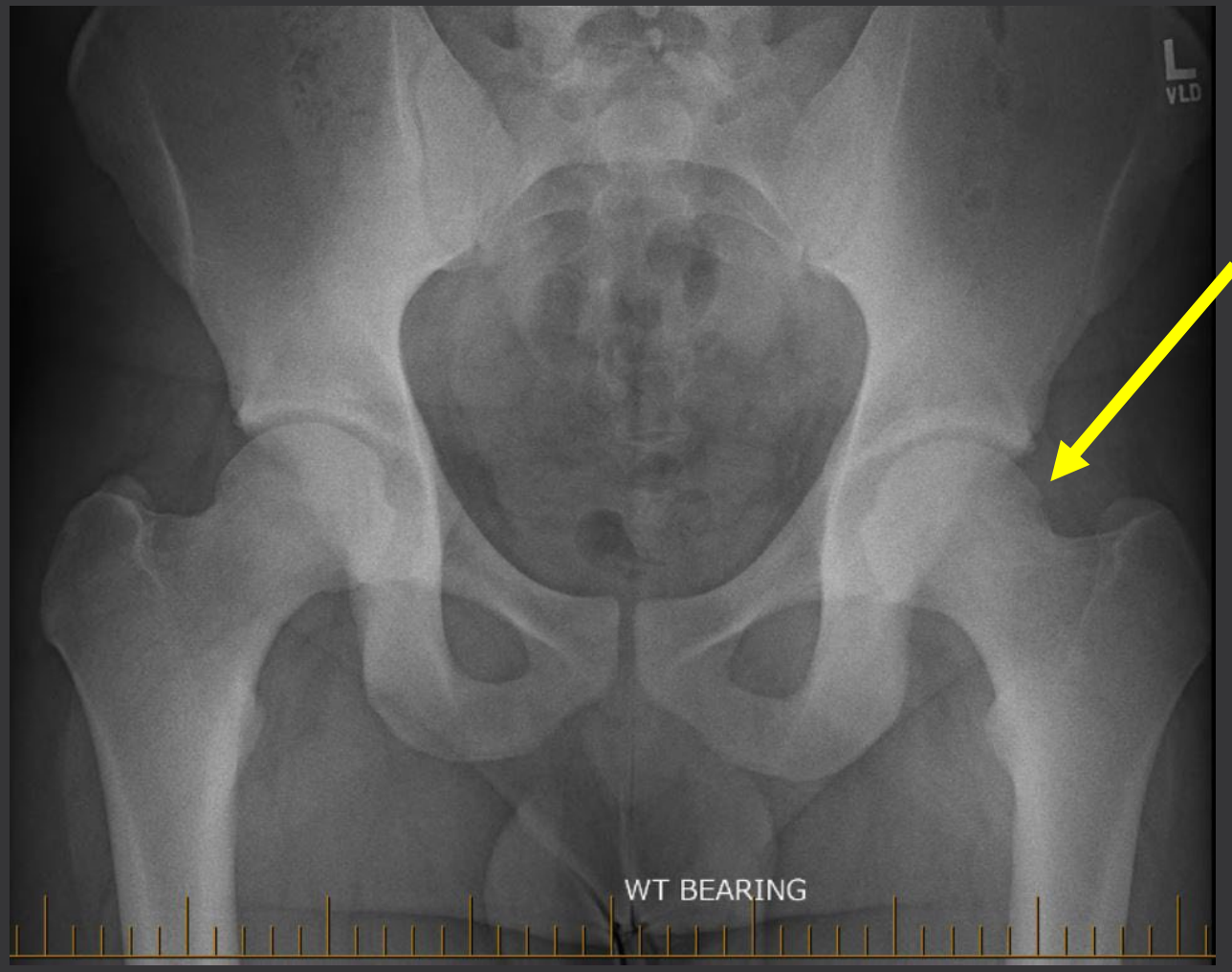
Neuromechanical Layer

- DJD
- FAI
- Abductor tendinopathy
- Ischiofemoral impingement
- Hamstring tendinopathy
- Lumbar etiology
- Stress fracture
- SI joint
- Intra-pelvic
- Pudendal neuralgia
- Meralgia paresthetica
- Trochanteric bursitis
- TFL contracture
- Dysplasia
- Instability
- Iliopsoas tendonitis
- Piriformis syndrome
- Deep gluteal syndrome
- Core muscle injury
- Ligamentum teres tear
- Trochanteric impingement
- Femoral version
- Coxa saltans
- Osteitis pubis
- Adductor strain
- Rectus femoris tendonitis

Femoroacetabular Impingement

- Anterior groin
- Prolonged sitting
- Physical activity
- Flexion activities
- Limp
- “groin pulls”

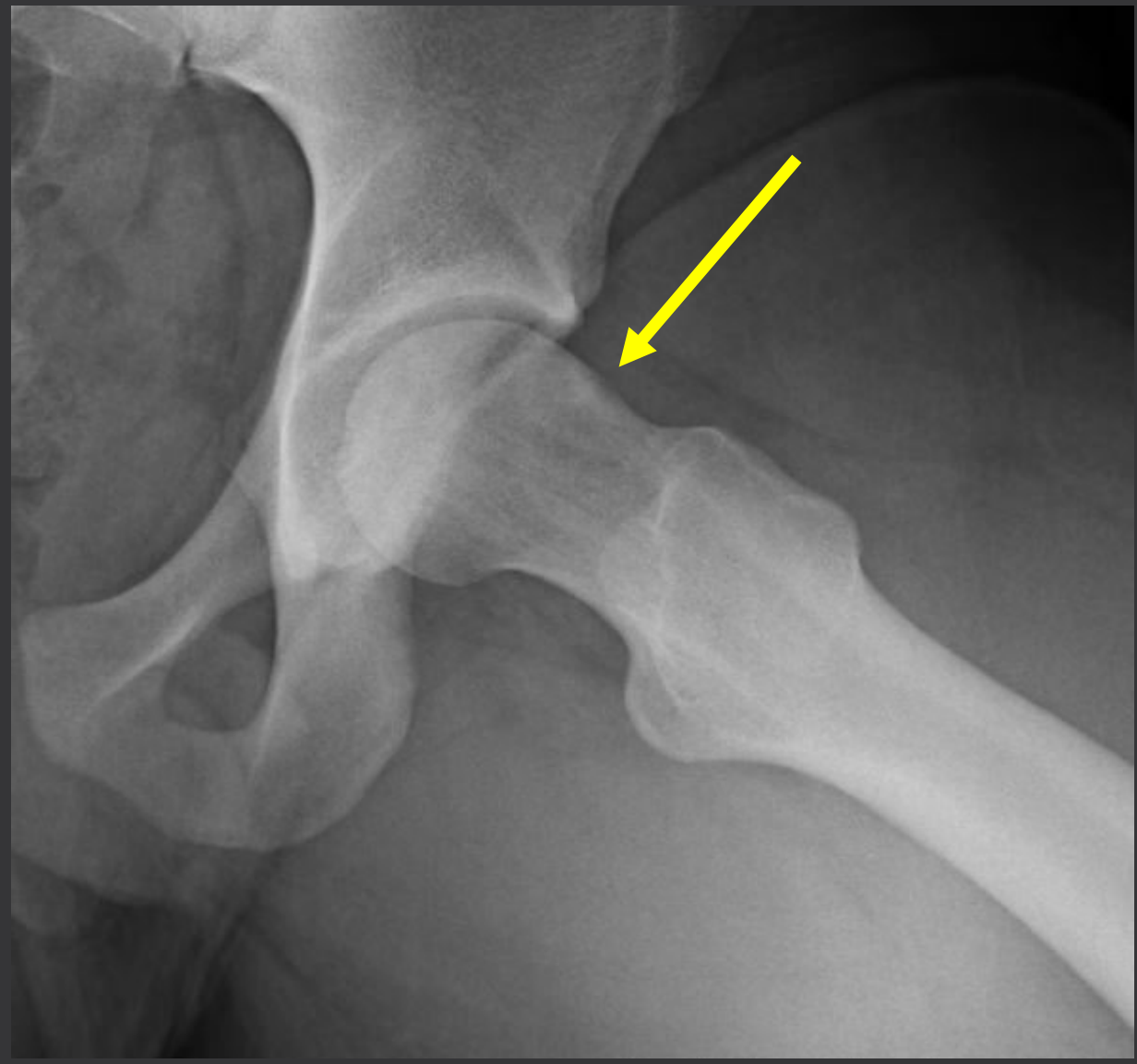
- PT
- NSAIDs
- Massage



Femoroacetabular Impingement

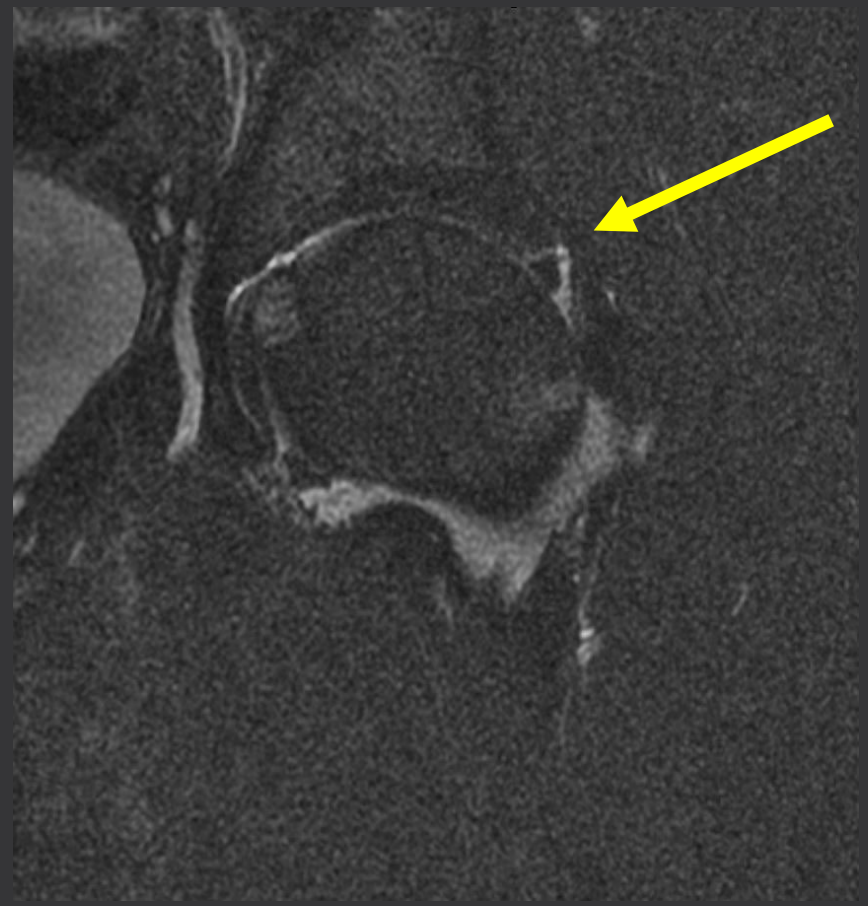
- Anterior groin
- Prolonged sitting
- Physical activity
- Flexion activities
- Limp
- “groin pulls”

- PT
- NSAIDs
- Massage



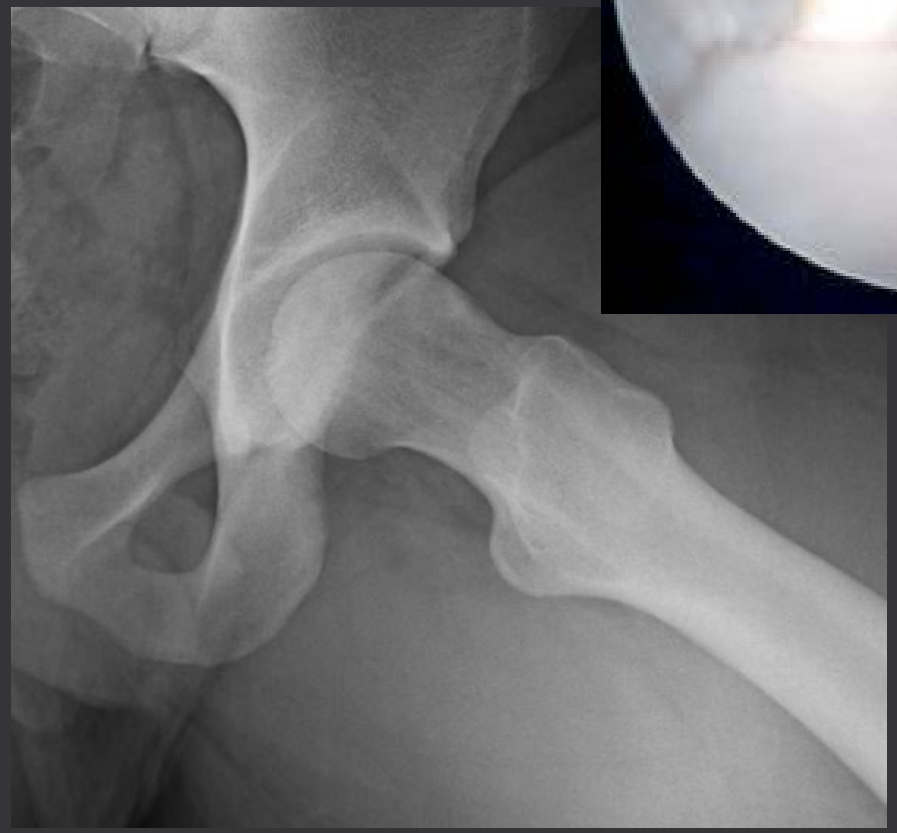
Femoroacetabular Impingement

- Slouched in chair
- Decreased/asymmetric ROM
- Deep flexion
- FADDIR, DIRI
- FABER anterior
- Gluteal/hip flexor weakness



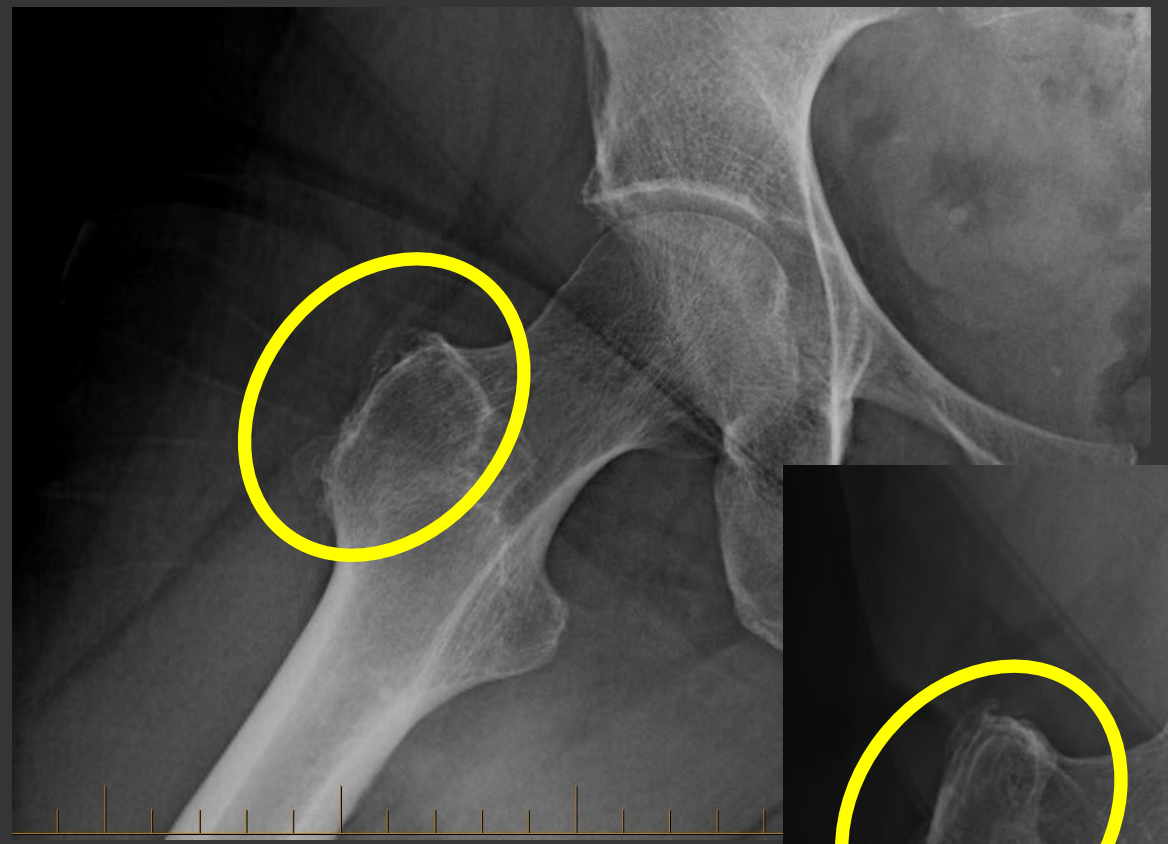
- NSAIDs
- PT – deficiencies, contractures
- Injections – PRP, CSI
- Hip arthroscopy

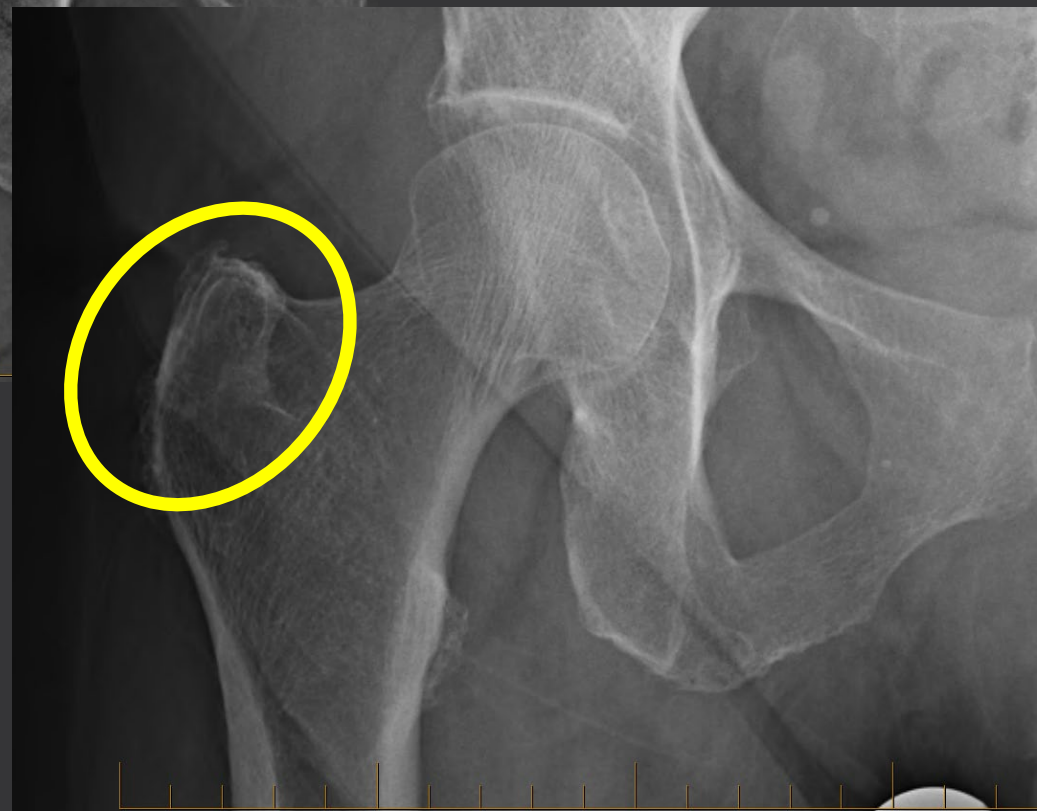
Femoroacetabular Impingement



Abdcutor/Gluteal Tendinopathy

- Lateral pain
- Lying on side
- Start up
- Prolonged walking
- Limp
- “chronic bursitis”



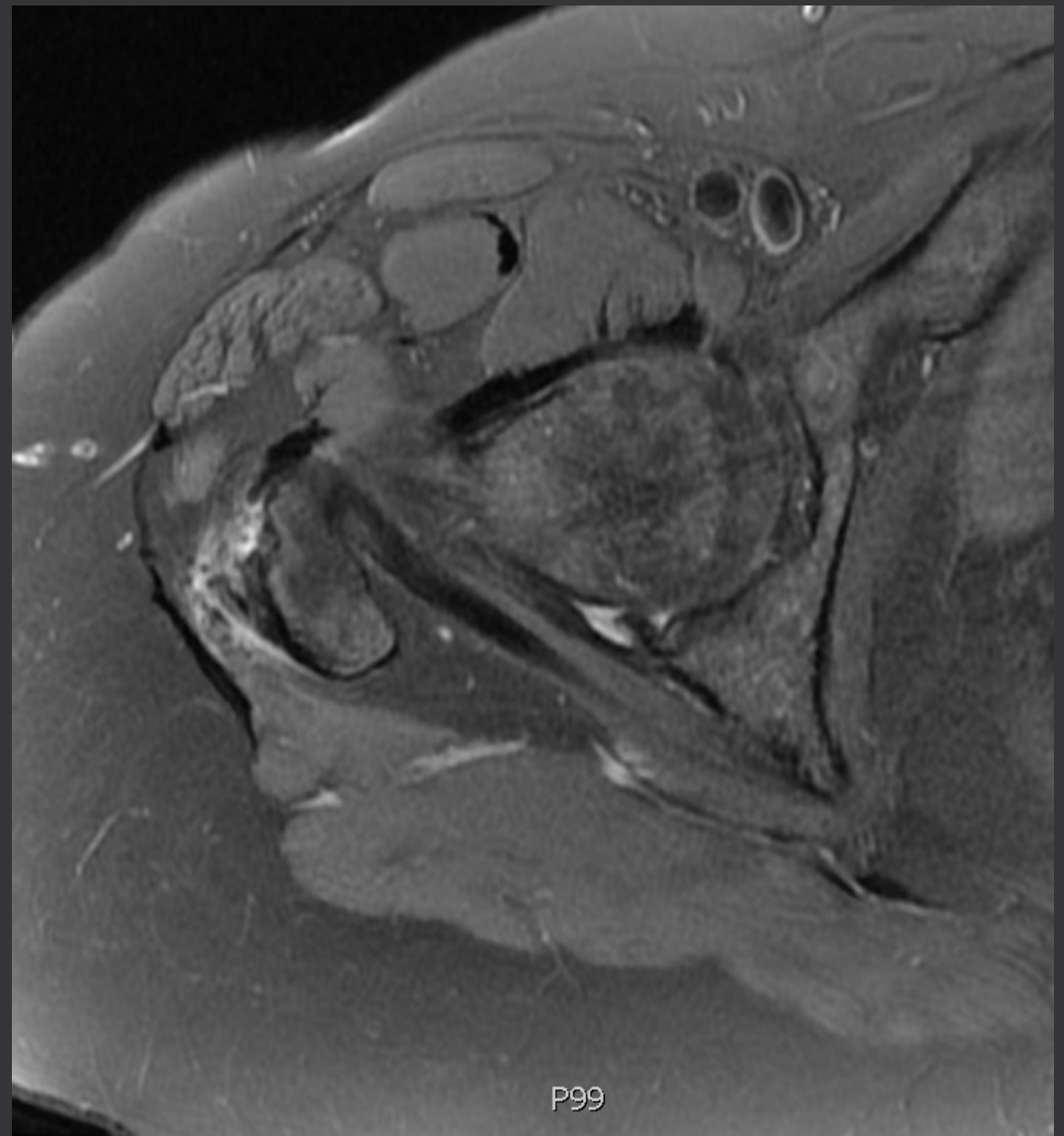


- PT
- NSAIDs
- Bursa injections

Abdcutor/Gluteal Tendinopathy

- Trendelenburg gait
- Single leg stance unsteadiness
- TTP greater trochanter (anterior, lateral, posterior facets)
- Gluteal weakness/pain with resisted testing
- + lag sign

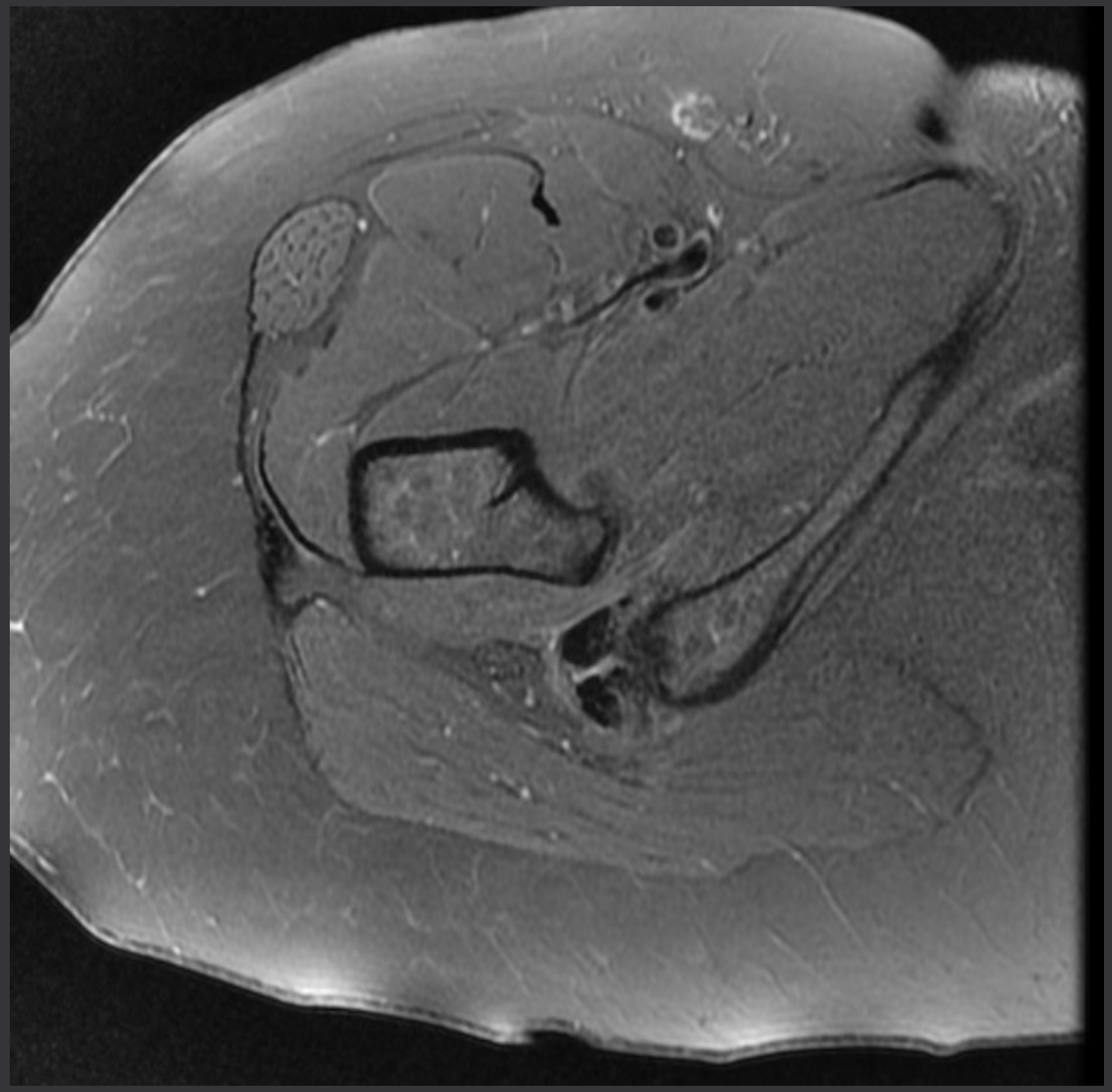
- PT - eccentric strengthening
- NSAIDs
- Injections – PRP, CSI
- Open/arthroscopic repair



Hamstring Tendinopathy

- Buttock pain
- Radiating to medial groin
- Walking
- Prolonged sitting
- Shifting in chair
- +/- sciatica

- Spine evaluation
- Hip evaluation
- PT
- Piriformis syndrome



Hamstring Tendinopathy

- Short stride
- Pain with heel strike
- Pain with resisted HS testing 30/90, seated/prone
- TTP lateral ischial tuberosity, proximal HS tendons

- MRI
- PT - eccentric strengthening
- NSAIDs
- Sheath CSI
- Tendon PRP injections
- Open/arthroscopic repair

PRP in Tendinopathy

- Iliopsoas
- Adductor
- Gluteal
  - Better mHHS at 12, 24, 52, and 104 weeks
  - Statistically and clinically significant
  - Crossover from steroids to PRP improved
  - PRP improvements maintained at two years
- Hamstring
- Quadriceps
- Patellar tendon

Randomized Controlled Trial > Am J Sports Med. 2019 Apr;47(5):1130-1137.
doi: 10.1177/0363546519826969. Epub 2019 Mar 6.

Leucocyte-Rich Platelet-Rich Plasma Treatment of Gluteus Medius and Minimus Tendinopathy: A Double-Blind Randomized Controlled Trial With 2-Year Follow-up

Jane Fitzpatrick [1 2 3], Max K Bulsara [4], John O'Donnell [5], Ming Hao Zheng [6 7]

PRP in Tendinopathy

- Acute
- Acute on chronic
- Chronic

Muscles Ligaments Tendons J. 2016 Jul-Sep; 6(3): 410–419.
Published online 2016 Dec 21. doi: 10.11138/mltj/2016.6.3.410
PMCID: PMC5193533
PMID: 28066748

The use of platelet-rich plasma to augment conservative and surgical treatment of hip and pelvic disorders

Matthew J. Kraeutler,[1] Tigran Garabekyan,[2] and Omer Mei-Dan[3]

- Recruits healing cells for healthier tissue repair
  - More organized tissue
  - Higher quality collagen
  - Increased early angiogenesis
  - Earlier return to activity

Thank You

Questions?