

# Hip Injuries in Adults: Patient Evaluation Radiographic Analysis



## Treatment Options

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# Scope of Practice



## ● Comprehensive Adult Hip Specialist

- Hip Replacements
  - ▢ Minimally Invasive Anterior Hip Replacements
  - ▢ Complex Revision Hip Replacements
- Hip Preservation Surgery
  - ▢ Hip Arthroscopy for Treatment of Labral Tears (*Articular Cartilage*) of the Hip
  - ▢ Open Hip Surgery to Correct Complex Deformities of the Hip
  - ▢ Open and Arthroscopic Surgery for Repair of Tendon Injuries about the Hip
- Fracture Specialist
  - ▢ Fractures of the Hip and Proximal Femur

# Etiologies of Acute Hip Pathology

**Fractures**

**Labral Tears  
(Cartilage)**



**Aggravation  
of  
Pre-Existing  
Arthritis**

**Avascular  
Necrosis**

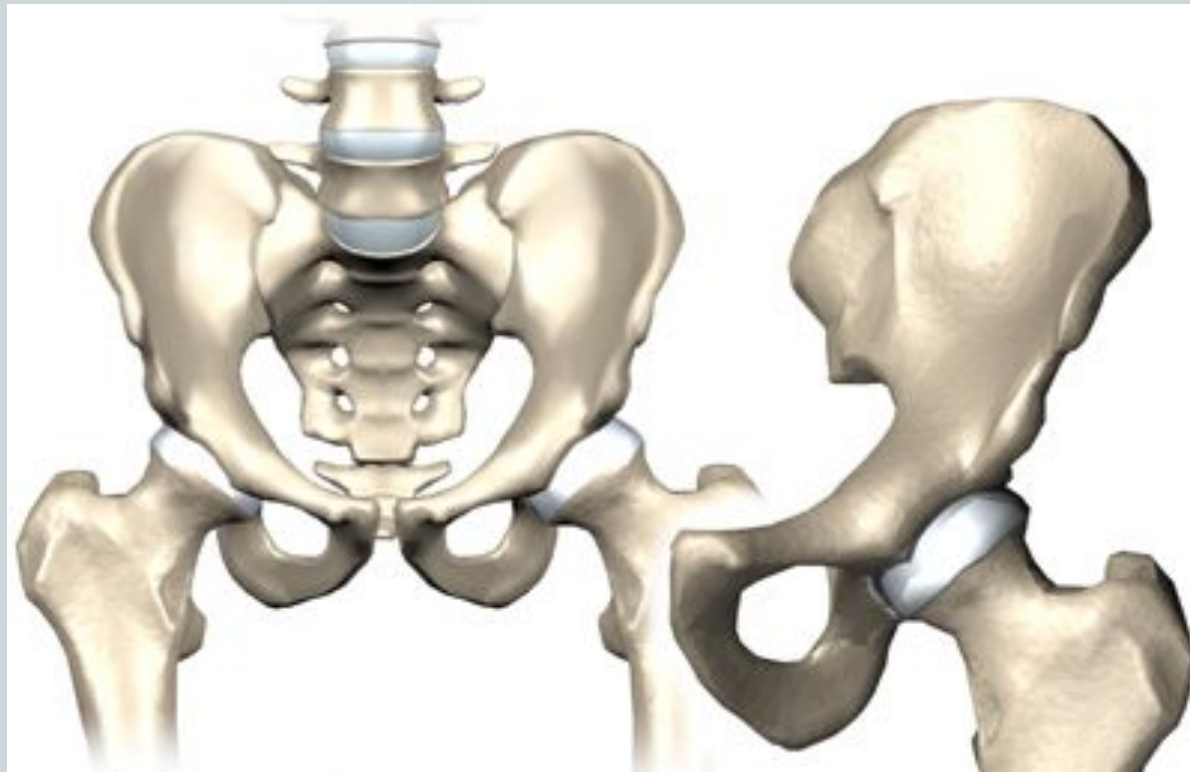
**Referred  
Pain from LS  
Spine, Knee,  
Abdomen**

**Muscular or  
Tendon  
Tears**

# Layered Approach to Evaluating the Hip



- 1. Bone





# Layered Approach to Evaluating the Hip



## ● 1. Fractures



Femoral Head



Femoral Neck



Intertrochanteric



Subtrochanteric

# Fractures

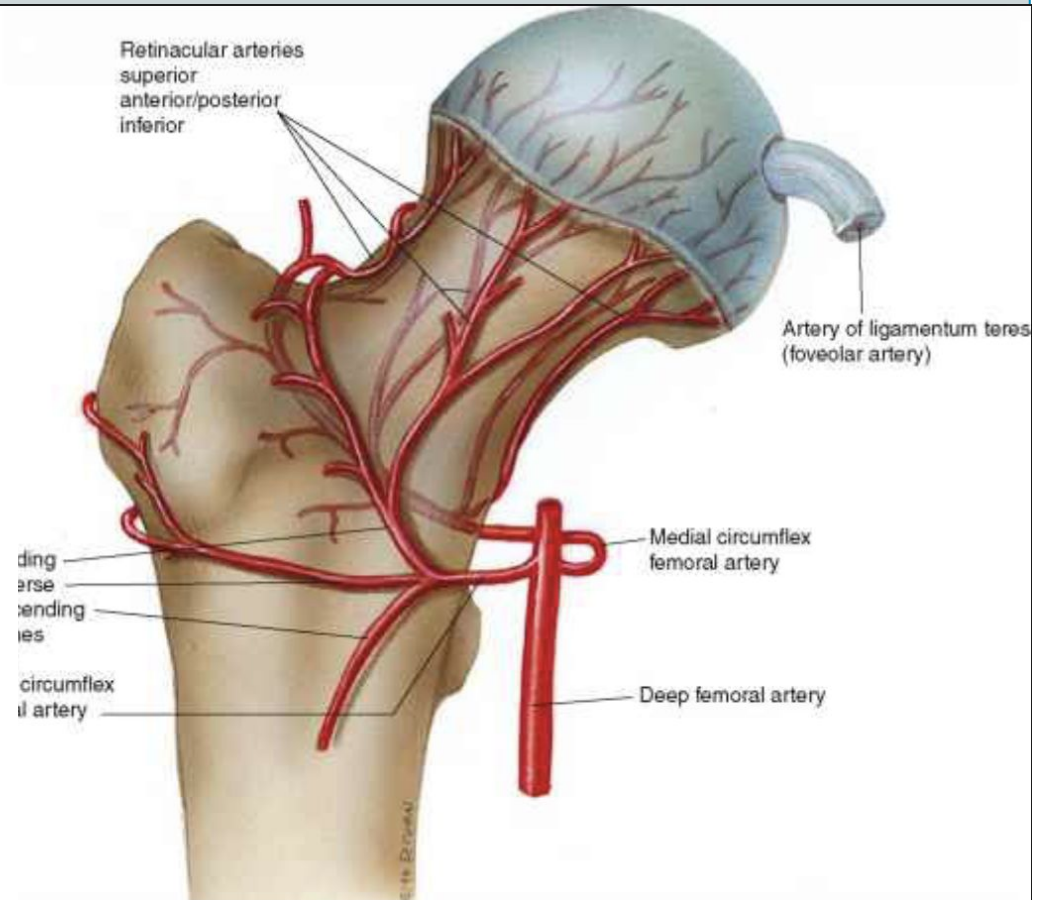


- Key Factors Determining Treatment:
  - ▢ Location
  - ▢ Patient's Age
    - For Treatment of Femoral Neck Fractures
  - ▢ Fracture Pattern
    - Technical options of fixation
- Often Urgent Surgical Treatment (fixation within 24-36 hrs)
- Rare Non-Surgical Treatment

# Blood Supply to the Hip



- Blood supply to the hip dictates treatment



# Femoral Head Fractures

- Rare fractures occurring in combination with native hip dislocations
- High energy traumatic events (*car/motorcycle accidents, falls from height*)
- Typically younger individuals
- Goal to fix fracture
- ***High rates of post-traumatic femoral head avascular necrosis – up to 40%***
  - *Traumatic interruption to the femoral head blood supply and bone dies within 3 months - 4 years after initial fixation) requiring hip arthroplasty (replacement)*

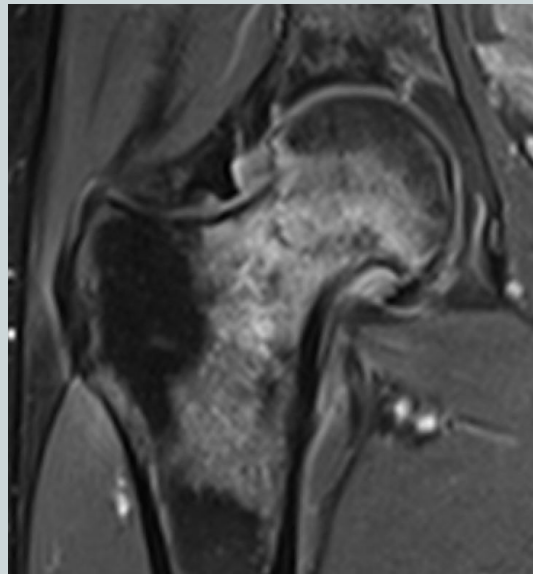




# Femoral Neck Fractures

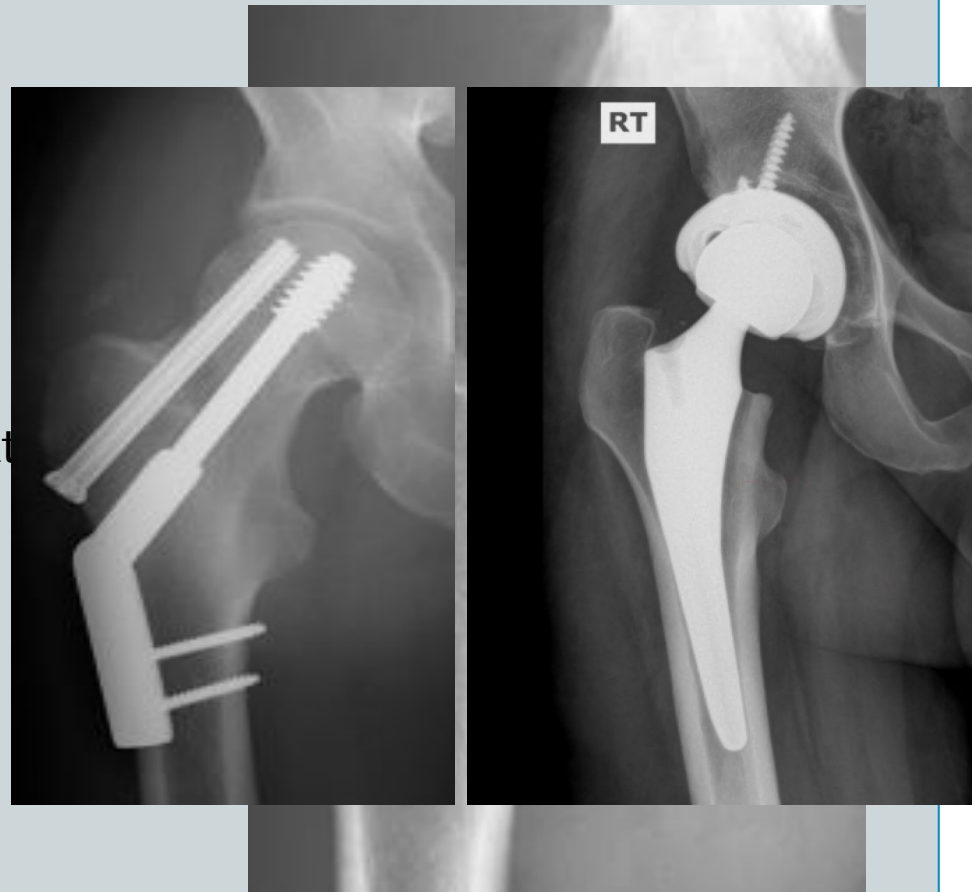


- **Treatment dictated by fracture pattern & patient's age**
- **Non-displaced fractures**
  - Can be missed on plain x-rays – require advance imaging (*MRI most sensitive*)
  - Stable fractures – fixed
  - High rate of healing, low rates of AVN (*avascular necrosis*) - 5%



# Femoral Neck Fractures

- **Treatment dictated by fracture pattern & patient's age**
- **Displaced fractures**
  - High rate of post-traumatic avascular necrosis (AVN) (as high as 40%)
  - Patient's age is important in treatment
  - Older Individuals – hip replacement (*partial/hemiarthroplasty or total hip arthroplasty*)
  - Younger Individuals – attempt fixation
    - Risks of post-traumatic AVN requiring conversion hip replacement



# Intertrochanteric & Subtrochanteric Fractures

- Fractures encased in muscular attachments with rich blood supply – fixed
  - High rates of union
  - Rare failure of fixation in poor bone quality



Intertrochanteric



Subtrochanteric

# Intertrochanteric & Subtrochanteric Fractures

- Fractures encased in muscular attachments with rich blood supply – fixed
  - High rates of union
  - Rare failure of fixation in poor bone quality
- 2 methods of fixation dependent on fracture location and pattern



Dynamic Hip  
Screw (DHS)



Cephalomedullary  
Nail



# Post-Operative Course

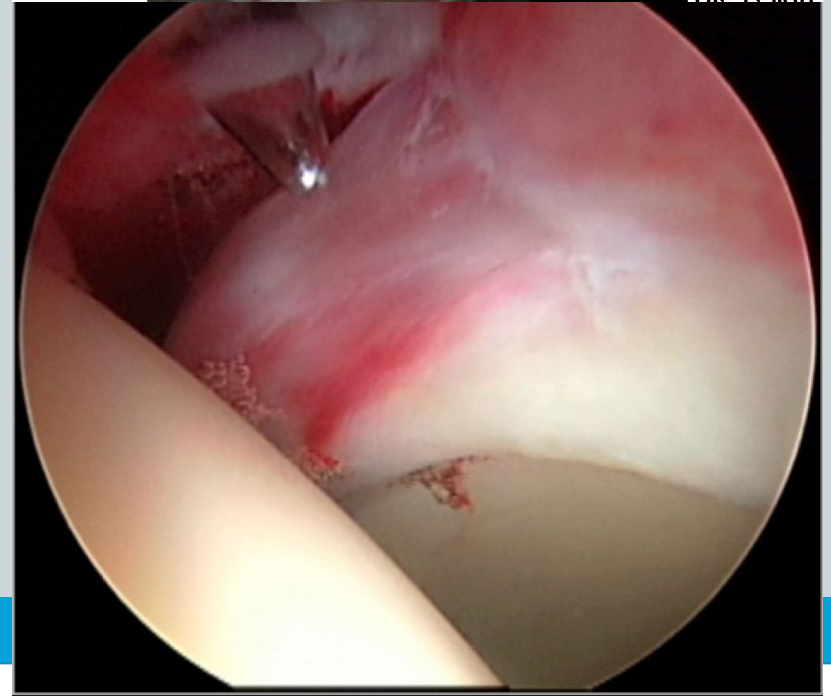
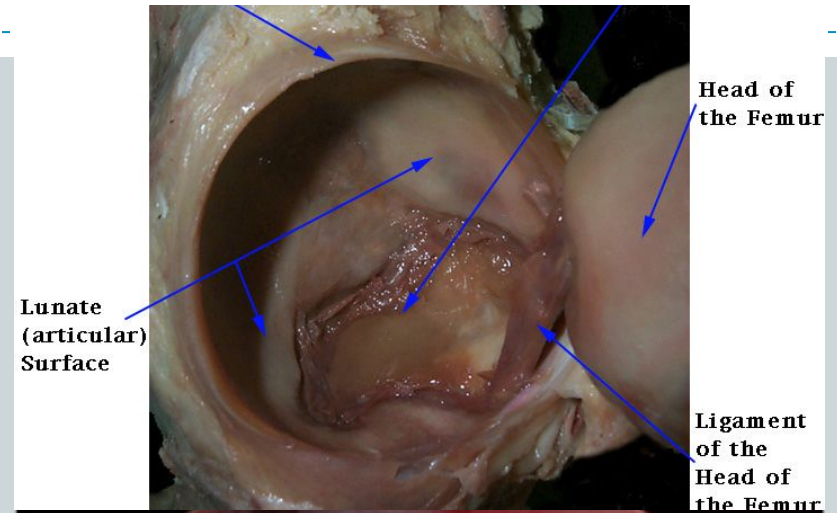


- Significant severe injuries
  - Majority of patients can be weight bearing as tolerated post-operatively
  - Need extensive therapy
  - Possible need for subsequent surgery if development of post-traumatic avascular necrosis – conversion hip replacement)
  - Maximal medical improvement typically 1 year post-op (*depending on post-operative course and complications*)

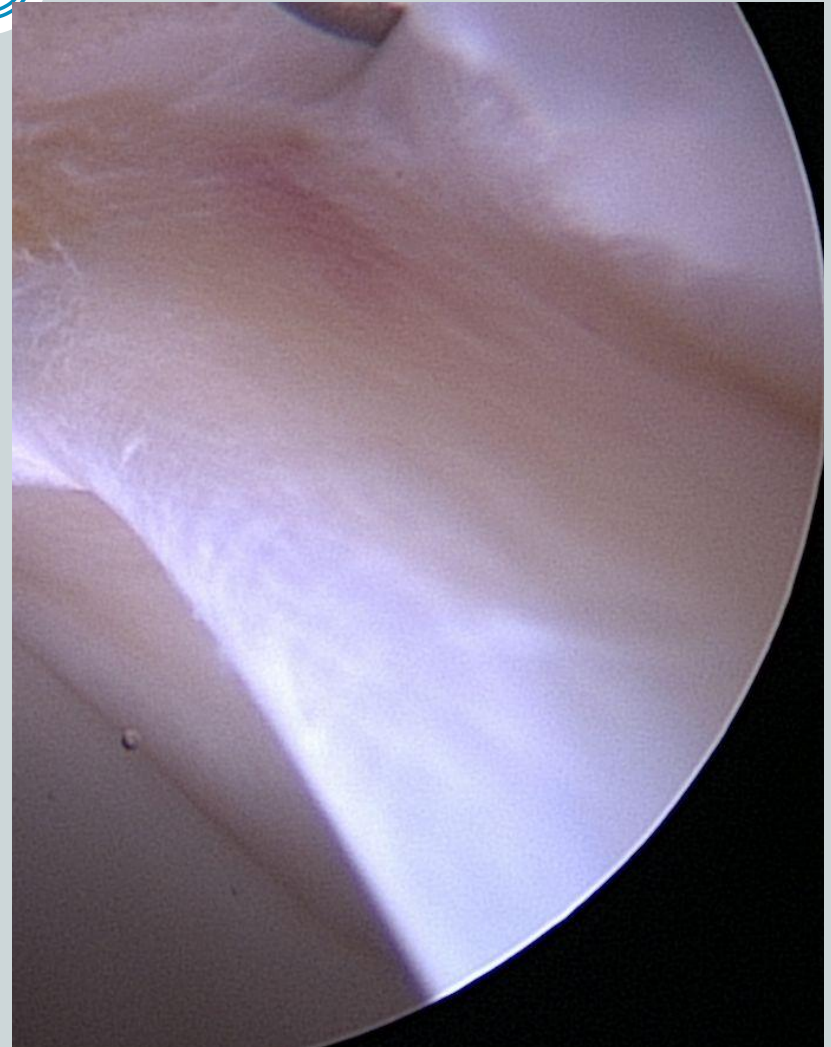
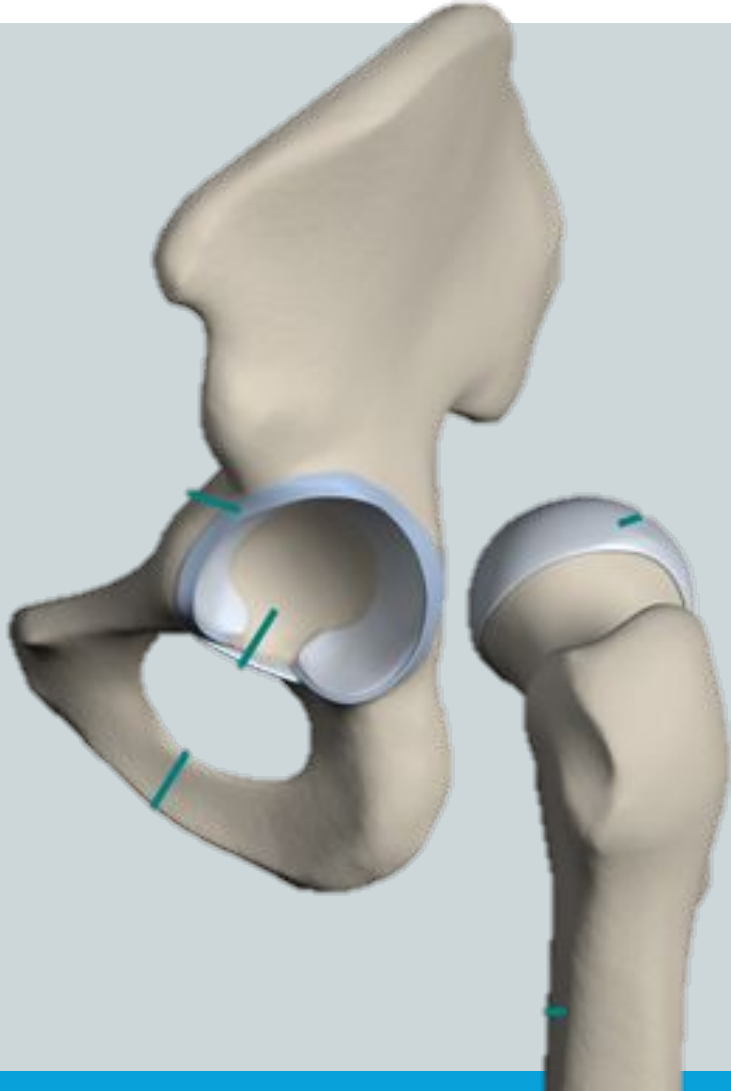
# Layered Approach to Evaluating the Hip



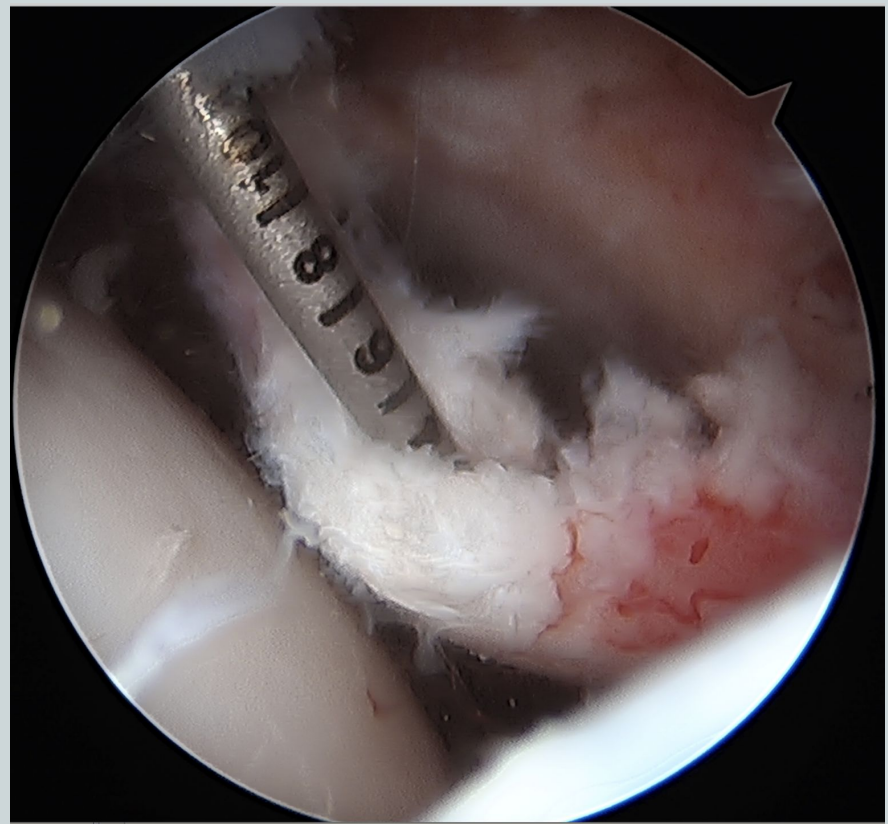
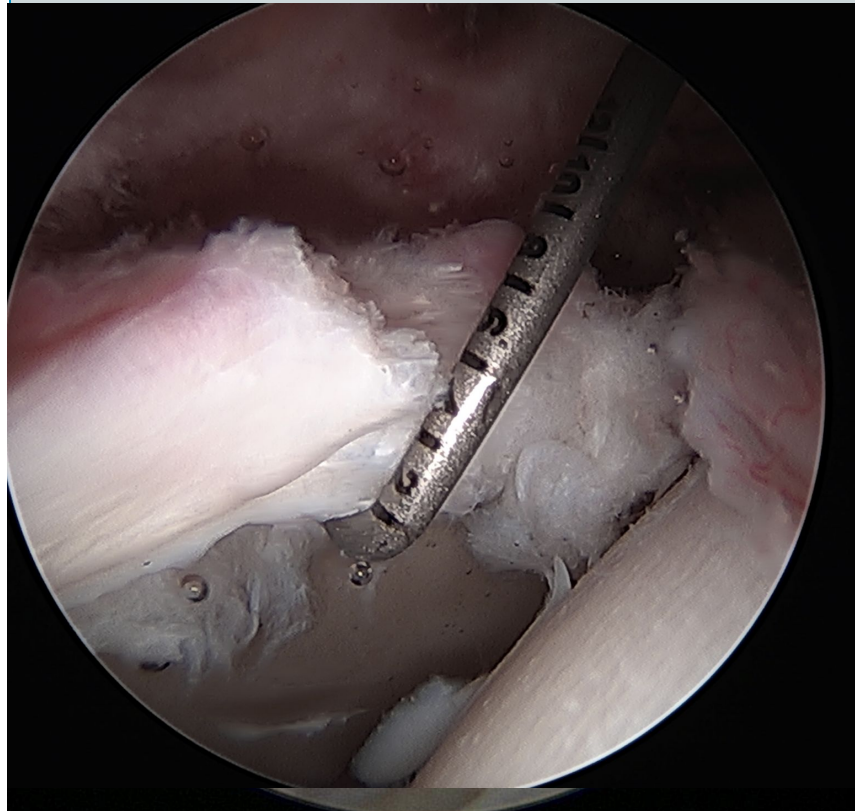
- 2. Intra-articular layer
  - **Labrum**
  - Joint Capsule
  - Ligamentous Complex
  - Ligamentum Teres



# Acetabular Labrum



# Acetabular Labral Tears



# Acetabular Labral Tears



- Traumatic
- Associated with underlying bony deformity:
  - *Femoral Acetabular Impingement Syndrome*

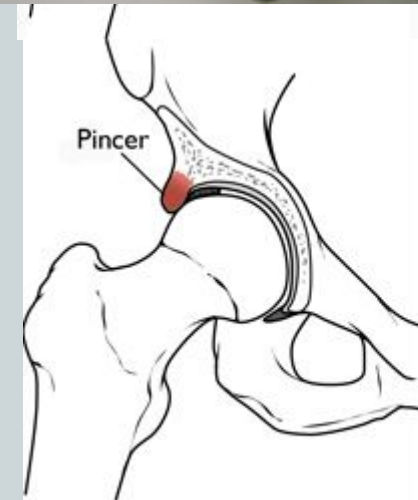




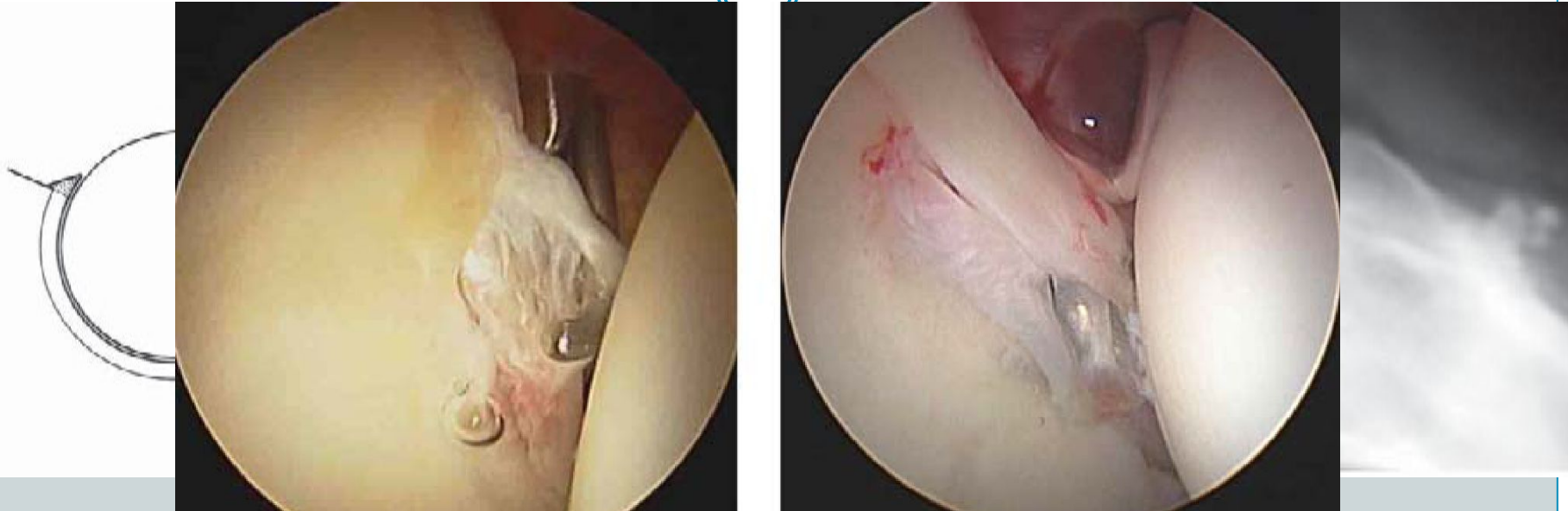
# Femoroacetabular Impingement



- Involves abnormal contact forces between femoral head-neck and acetabular rim causing osseous-labral damage.
- ***Morphological condition that predisposes hip to intra-articular pathology that becomes painful***
- Thought to be a prominent cause of osteoarthritis of the hip
  - *Ganz R, Parvizi J, Beck M, Leunig M, Notzil H, Siebenrock KA. CORR, 2008.*



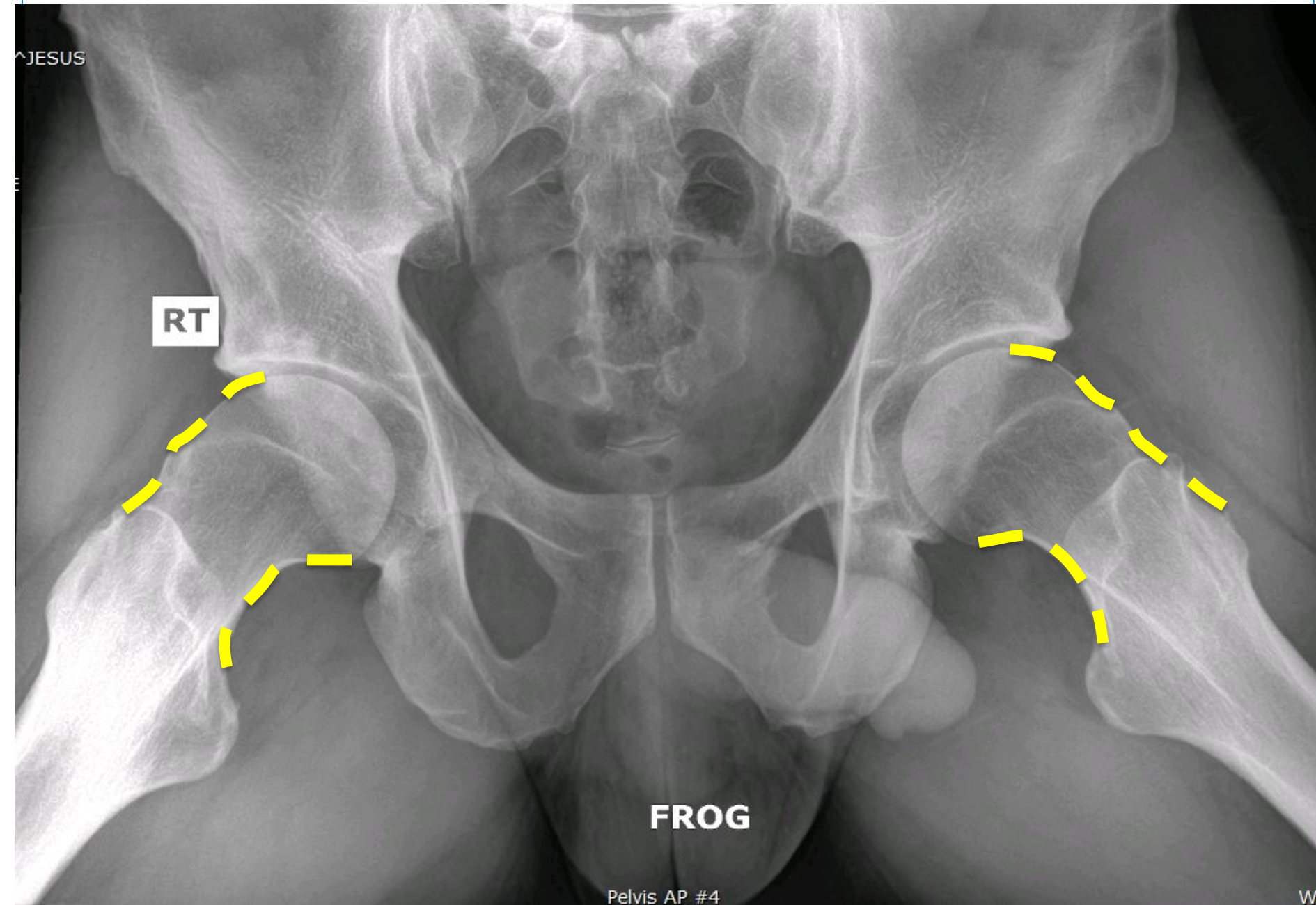
# Femoroacetabular Impingement



## **Cam Impingement**

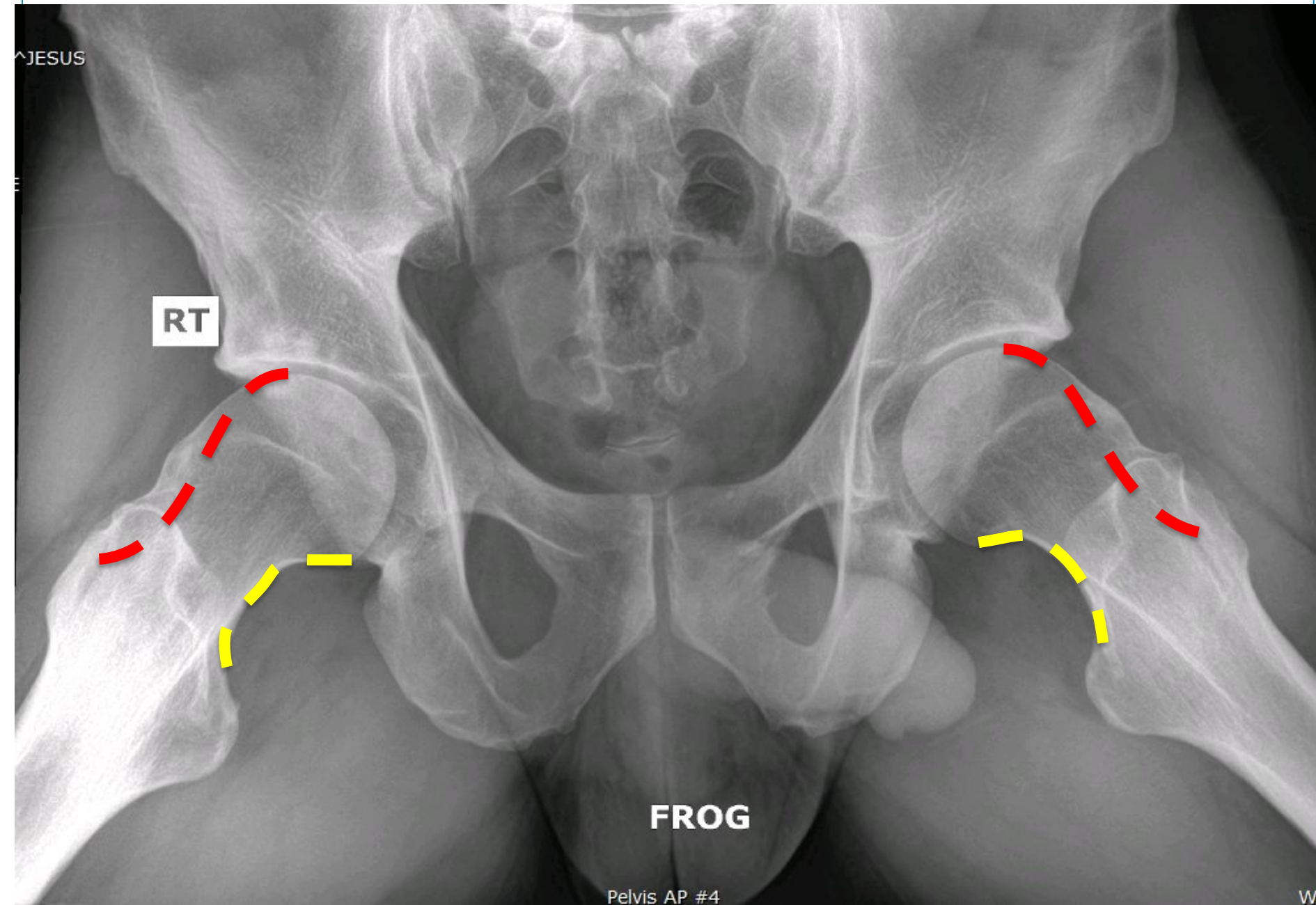
- Non-spherical femoral is jammed into the acetabulum causing chondrolabral separation

# Femoral Acetabular Impingement (FAI)

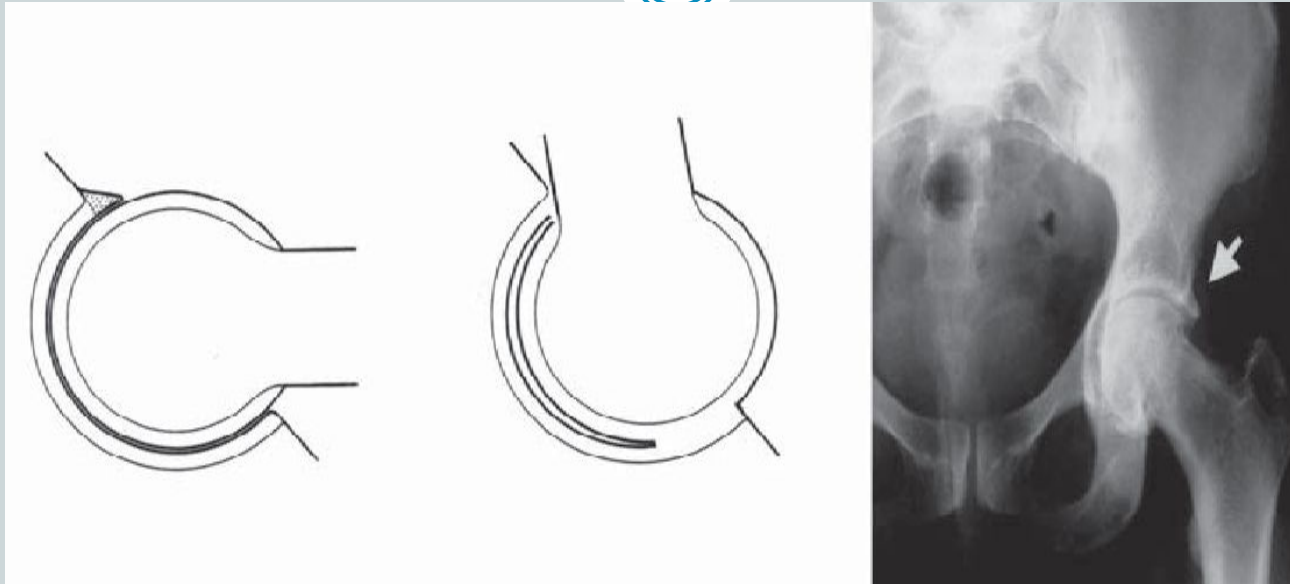




# Femoral Acetabular Impingement (FAI)



# Femoroacetabular Impingement



## **Pincer Impingement**

- Abnormal contact of acetabular rim and femoral neck as a result of over-coverage of the femoral head (*excessively deep hip socket*)—causing labral damage
- With persistent forceful levering of the head against anterosuperior labrum can develop contrecoup chondral injury in posteroinferior acetabulum.

# Incidence of Labral Tears



Incidence of labral pathology is very high *even in asymptomatic individuals as demonstrated in MRI studies:*

- *Briggs, et al. British Journal of Sports Medicine, 2016.*
  - *101 asymptomatic individuals no history of hip surgery or injuries (ages 11-19)*
    - ▢ *89% incidence of labral pathology in athletic individuals > 16 years*
    - ▢ *56% incidence of labral pathology in athletic individuals <16 years*
- *Register, et al. American Journal of Sports Medicine, 2012.*
  - *45 asymptomatic individuals, avg age 37.8 yrs*
    - ▢ *69% of hips*
- *Lee et al. Bone & Joint Journal, 2015.*
  - *70 asymptomatic adults avg age 26 years*
    - ▢ *38.6% incidence of labral tears*

# Diagnosis of Acetabular Labral Tears



## ● History

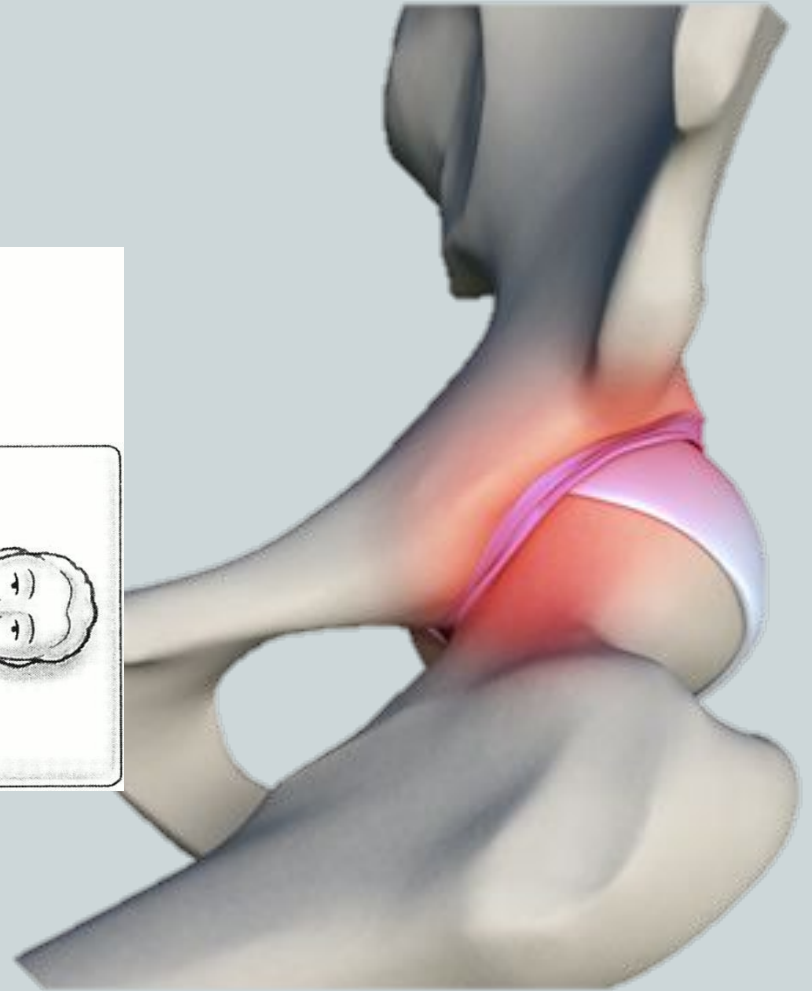
- Level of Pain
  - Sitting
  - Standing
  - Stairs
- Location of Pain
- Aggravating Factors
  - Rotational movements of hip
    - Getting in/out of car
    - Putting on shoes
    - Stairs – *need to hold onto handrail*

# Key Exam Findings in Patient's with Acetabular Labral Tear



- **Provocative Maneuver**

- Anterior Impingement Testing

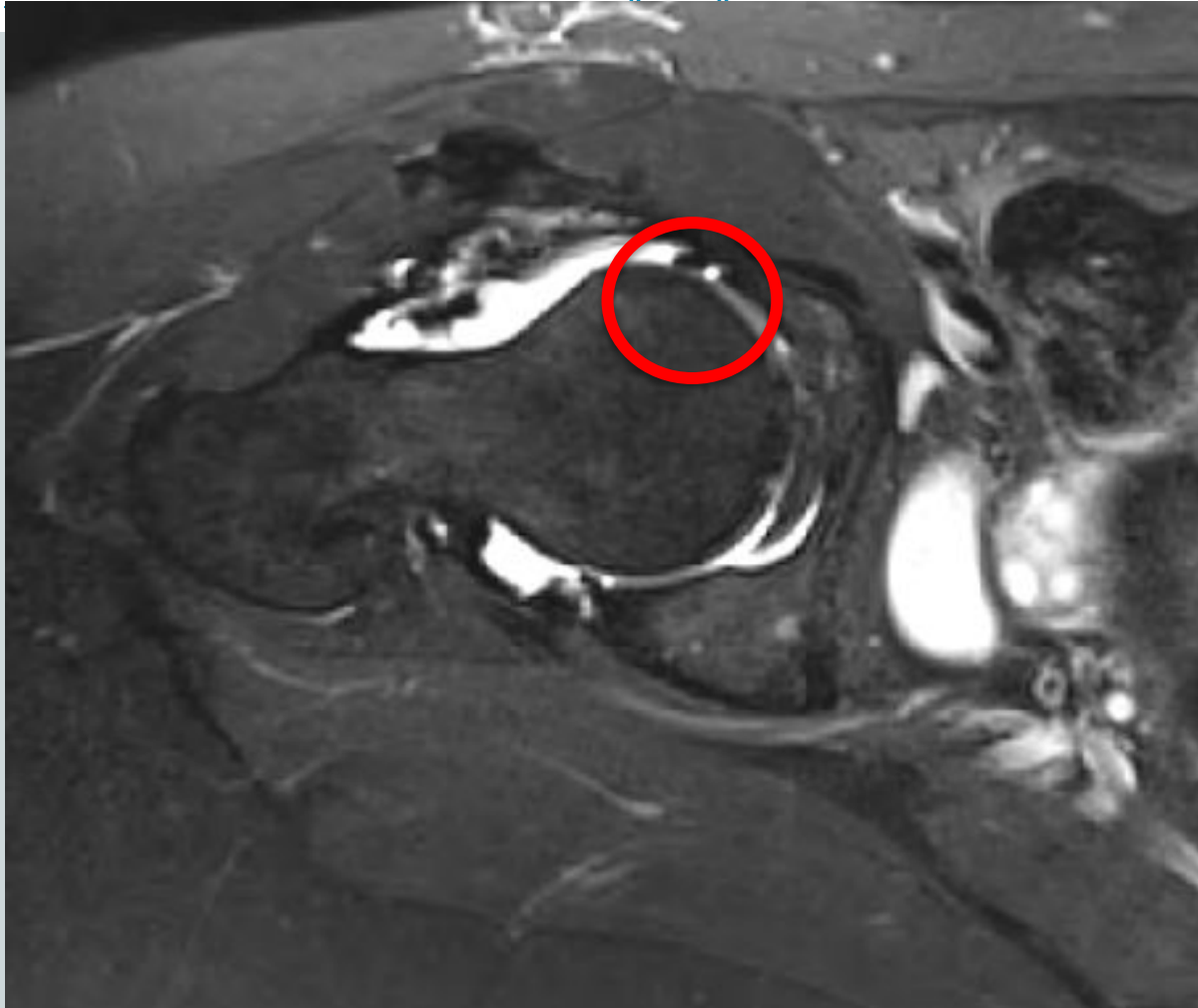


# Imaging





# Imaging – MR Arthrogram



*Antero-superior labral tear*

# Imaging – MR Arthrogram



- MRI arthrogram – sensitivity 76-91%, specificity 71% for detection of labral tears
  - Versus <30% sensitivity for non-contrast 1.5T MRI scans

Coronal Sequence

Sagittal Sequence



# Diagnostic-Therapeutic Hip Injection



- ***Solidifies diagnosis and location of pain – aka “money-shot”***
- 4 ml of 0.5% Bupivocaine (intermediate duration local anesthetic - onset 5-10 mins, lasts 4-8 hours)
- 80mg (1 ml) of Depomedrol (Long-acting cortisone)



LUT: /1 W

# Labral Tears and FAI Treatment Options



## 1. Nonsurgical Treatment

- I. Activity modification
- II. NSAIDs
- III. PT focusing on gluteal, tensor fascia latae, and core muscle strengthening
- IV. Intra-articular corticosteroid injections

### ● *Emara et al. Journal Orthopaedic Surgery, 2011.*

- 37 pts with FAI treated with activity modification and PT.
- At 2 year f/u, 11% of pts crossed over to surgical intervention, and an additional 16% had recurrent symptoms but didn't pursue surgery.
- The 89% of pts who pursued non-surgical treatment had improvement in their Harris hip score from 72 □ 91 at 2 year f/u.

# FAI - Treatment Options

## 2. Surgical Options

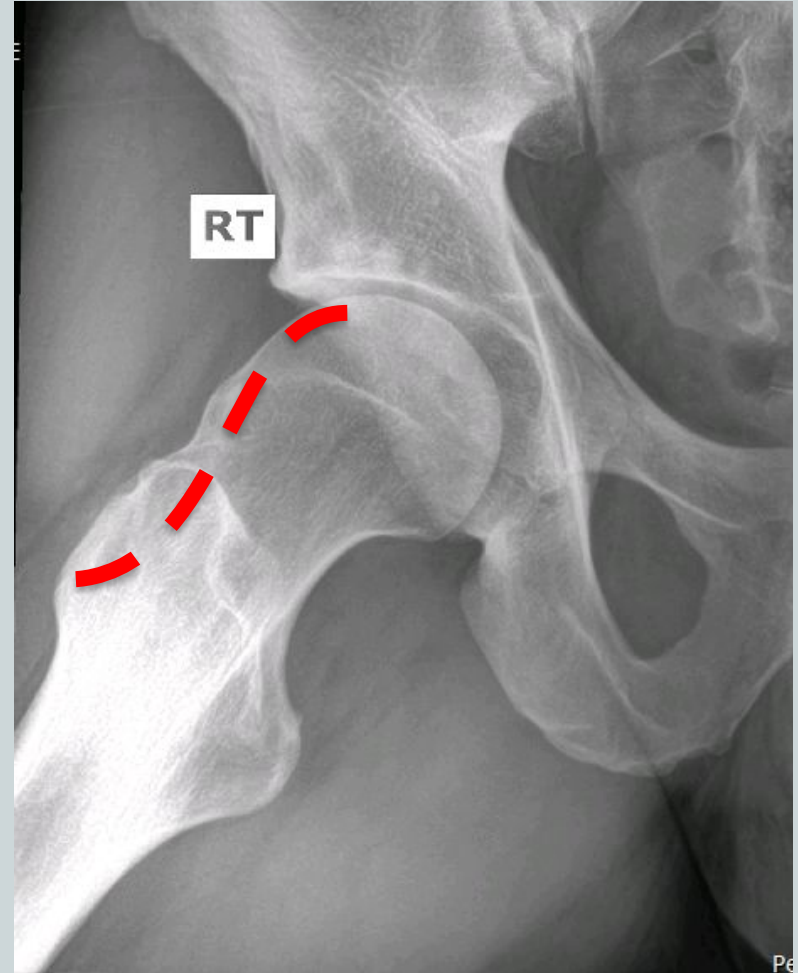
II. Hip Arthroscopy

III. Surgical Dislocation

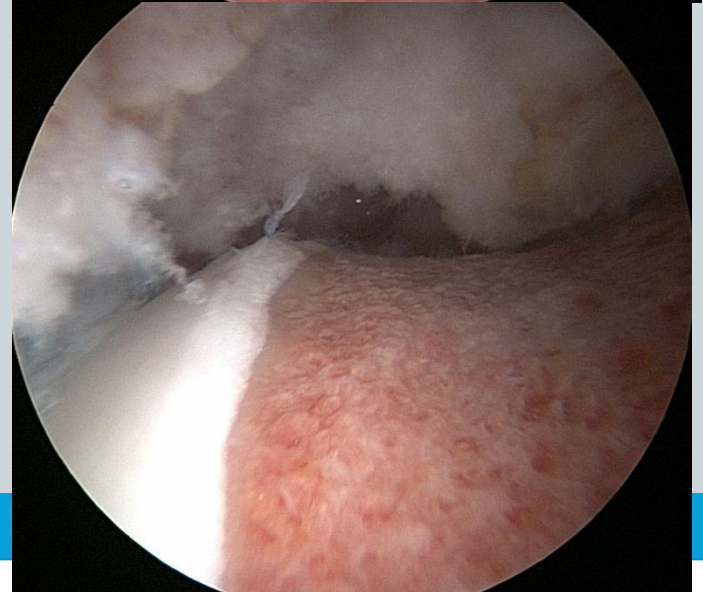
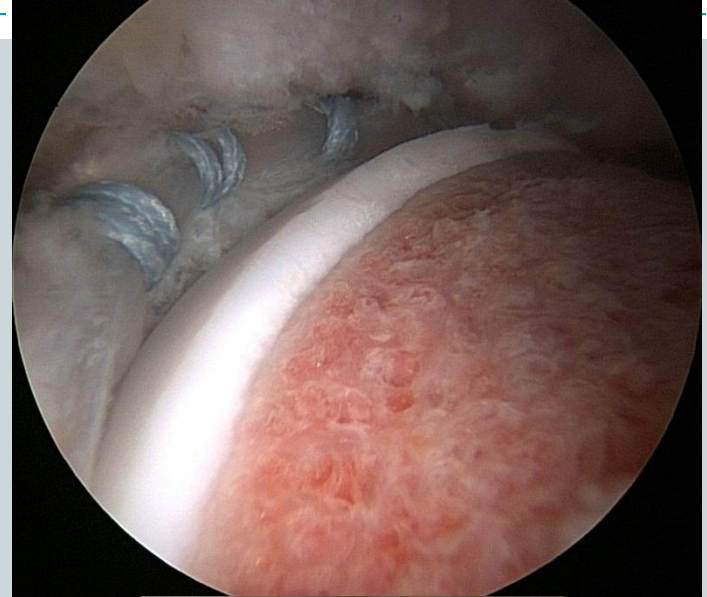
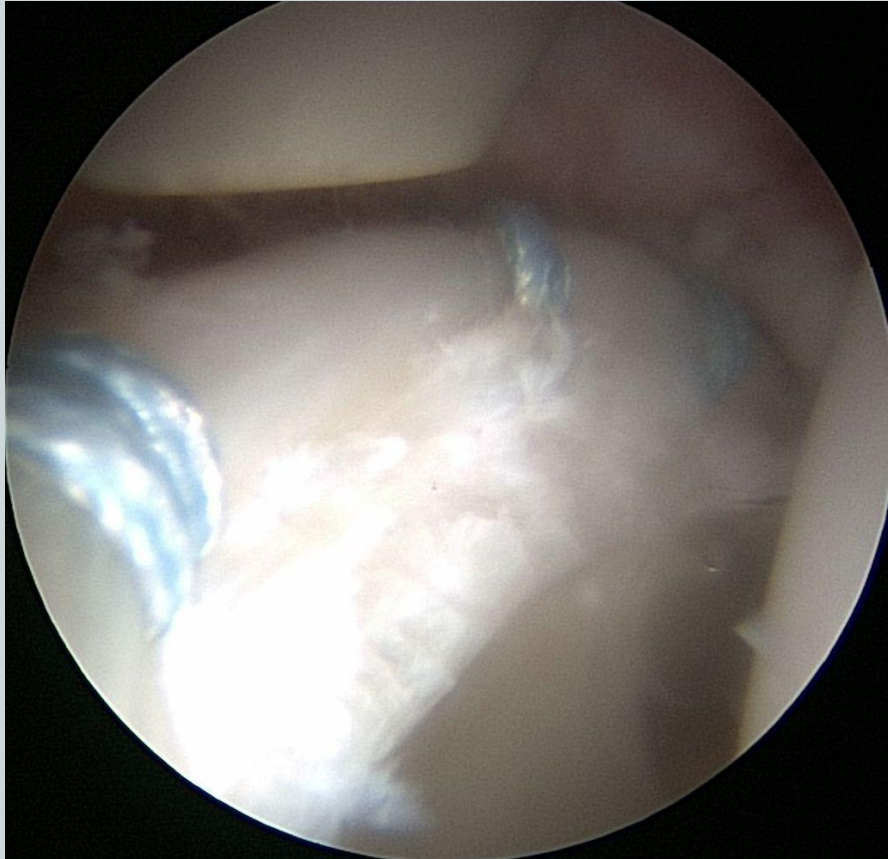
● **Depends on complexity of deformity and associated intra-articular pathology**

○ Complex deformities of residual childhood hip diseases require open surgeries

# Hip Preservation Surgery for Femoral Acetabular Impingement (FAI)

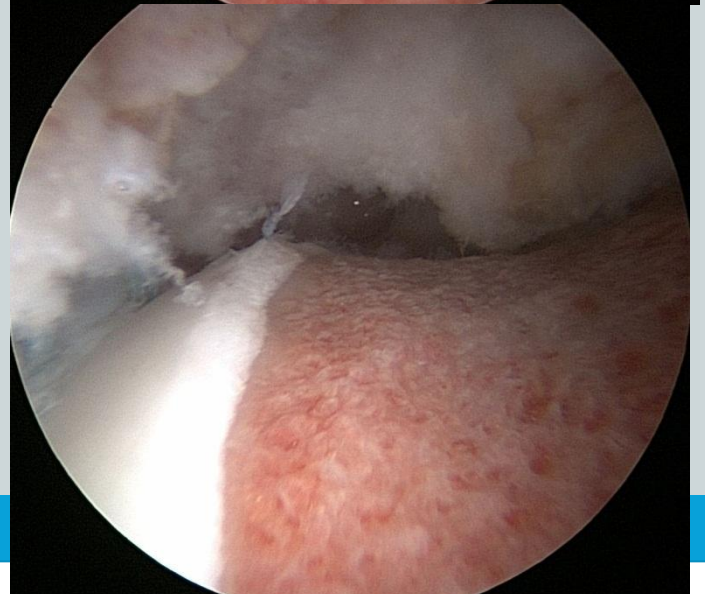
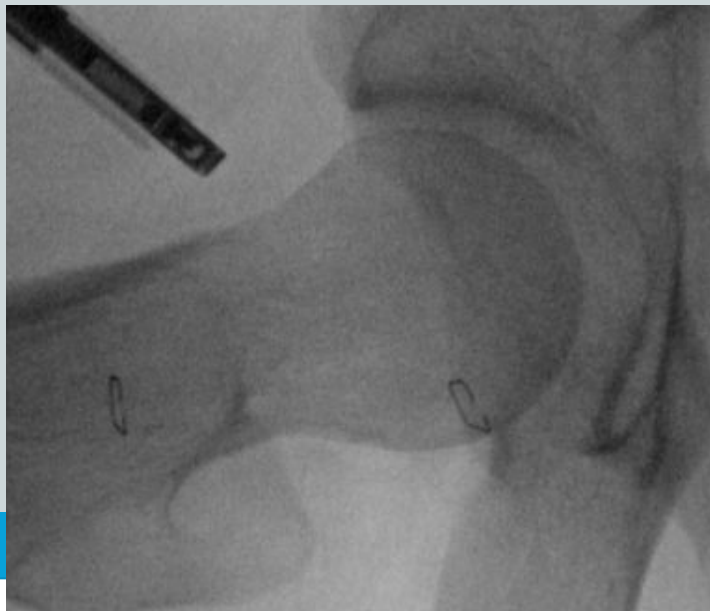
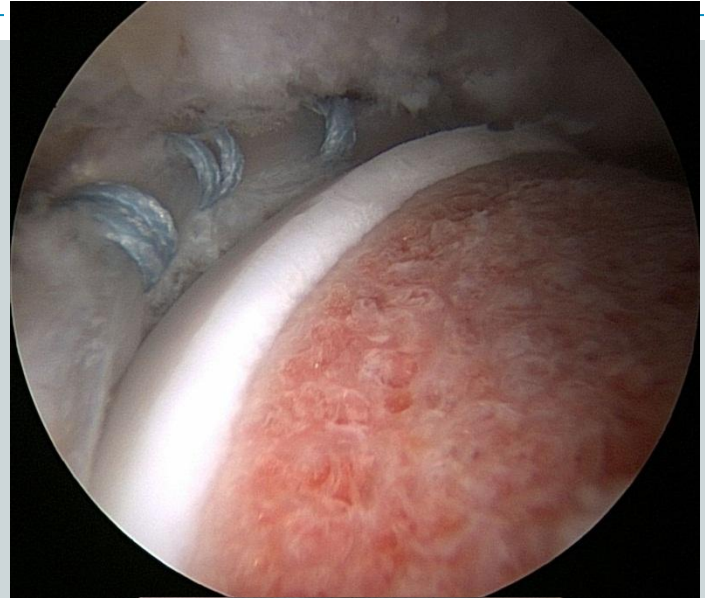


# Hip Preservation Surgery for Femoral Acetabular Impingement (FAI)

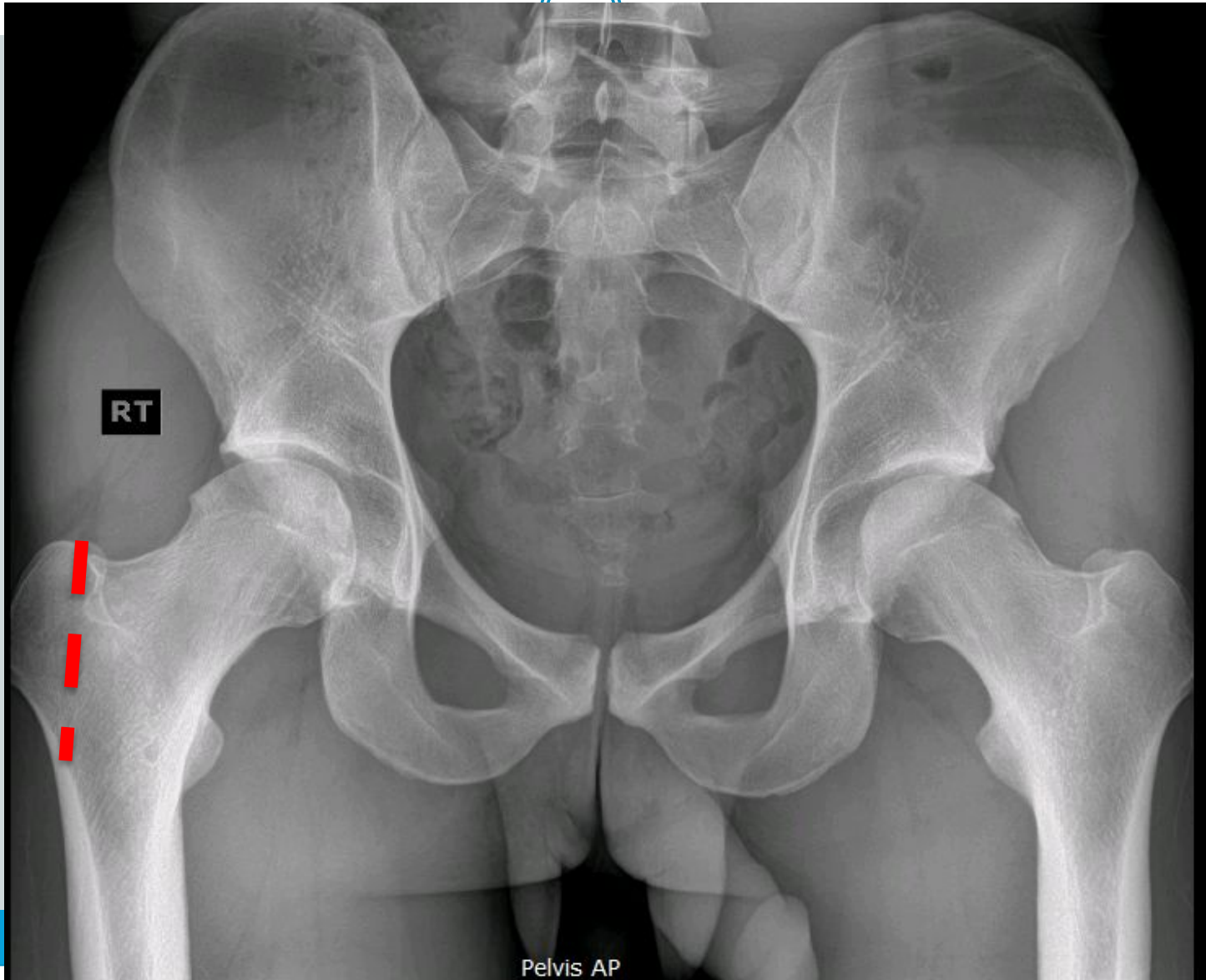




# Hip Preservation Surgery for Femoral Acetabular Impingement (FAI)



# Surgical Dislocation of the Hip for Complex Intra-articular Deformities



# Surgical Dislocation of the Hip for Complex Intra-articular Deformities





# Surgical Dislocation of the Hip for Complex Intra-articular Deformities



# Hip Arthroscopy versus Surgical Dislocation

## Hip Arthroscopy

- Advantages
  - Theoretically less invasive procedure
  - No risk of hardware irritation
  - No risk of injury to MFCA
  - Faster recovery

- **Excellent to good outcomes after arthroscopy for FAI 56-100%.**

- Larson et al, CORR, 2011.
- Byrd & Jones, AJSM, 2011.
- Nho et al, AJSM, 2011.
- Philippon et al, AJSM, 2010.
- Fabricant et al, CORR, 2012.
- Ilizaliturri et al, JBJS Br, 2007.



# Failures of FAI Surgery

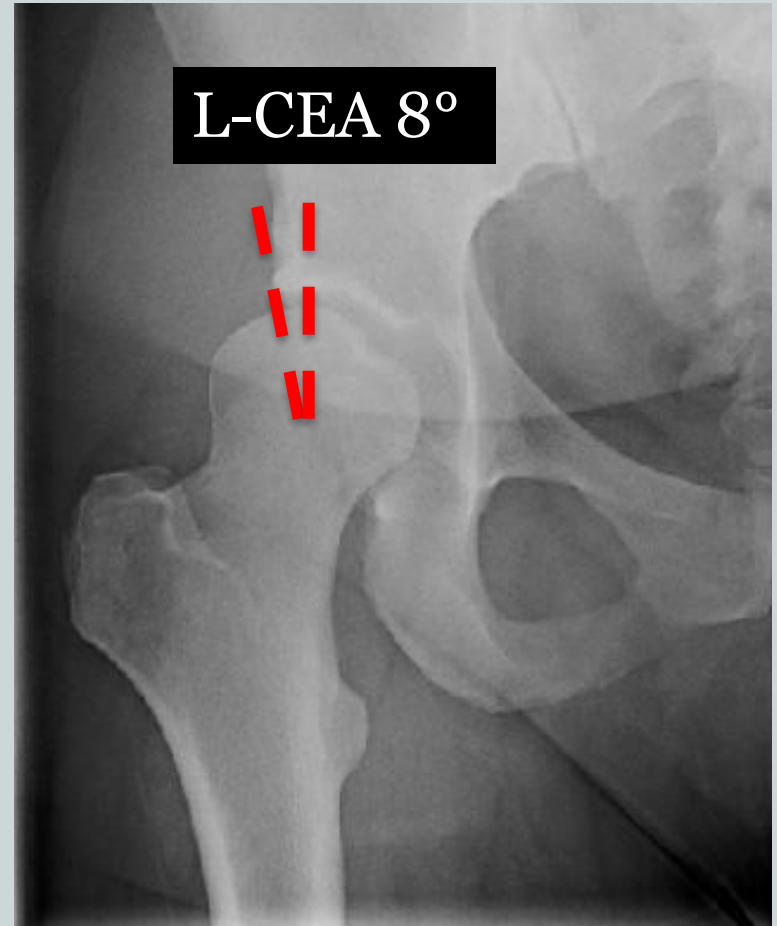


- 1. Pre-existing degenerative changes/early arthritis
  - Tonnis Grade  $\geq 2$  (*Any joint space narrowing*)
- 2. Dysplasia
- 3. Insufficient osteochondroplasty

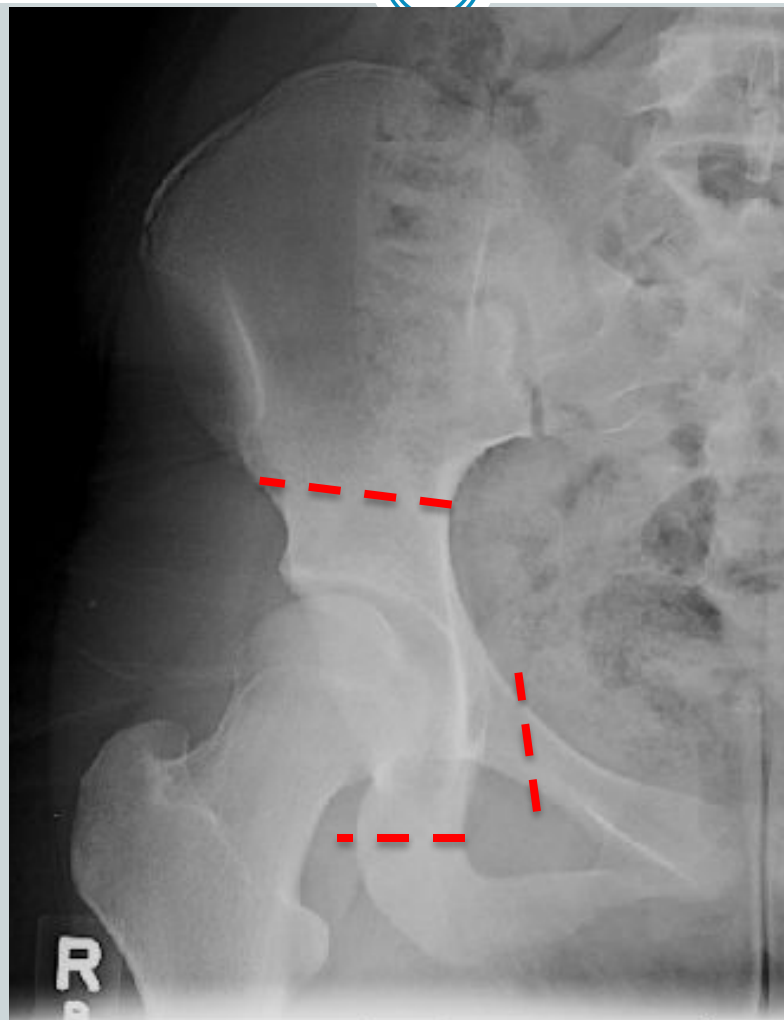
***Why do hip arthroscopy procedures fail?*** Bogunovic L, Clohisy et al. CORR, Aug 2013.

***Causes and risk factors for revision hip preservation surgery.*** Ricciardi BF, Kelly BT, Ranawat AS, Sink EL, et al. *Am J Sports Medicine*, Nov 2017.

# Hip Dysplasia



# Periacetabular Osteotomy



# Periacetabular Osteotomy

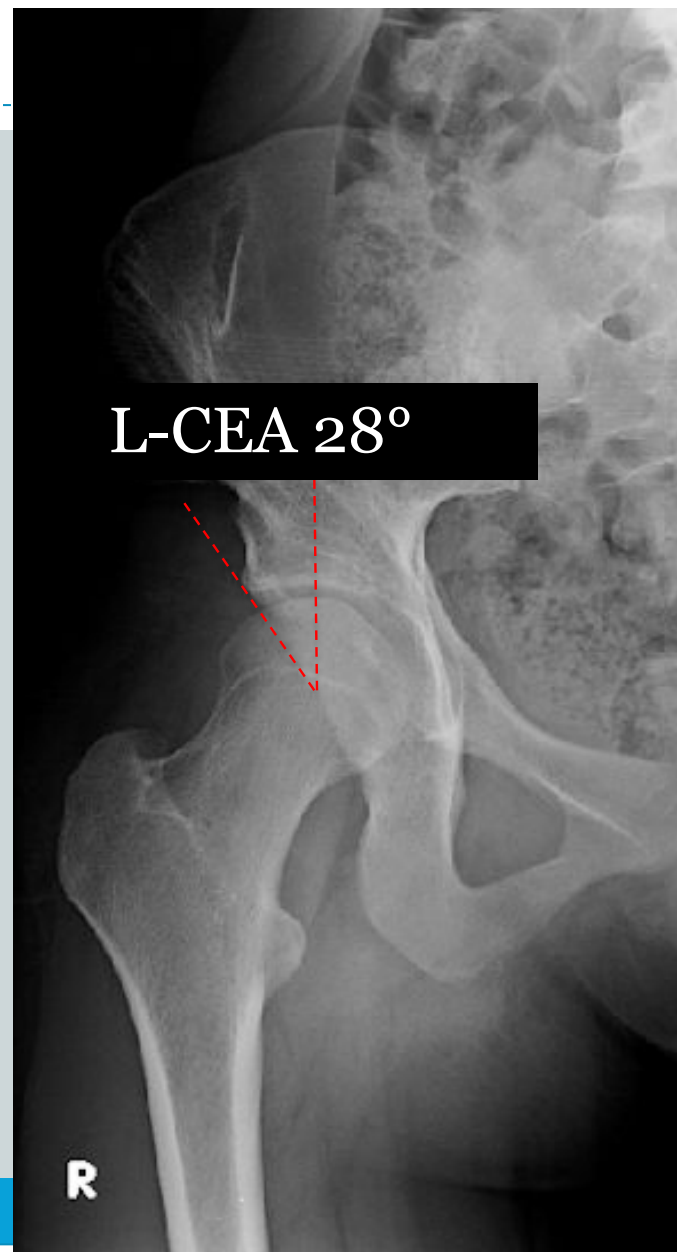
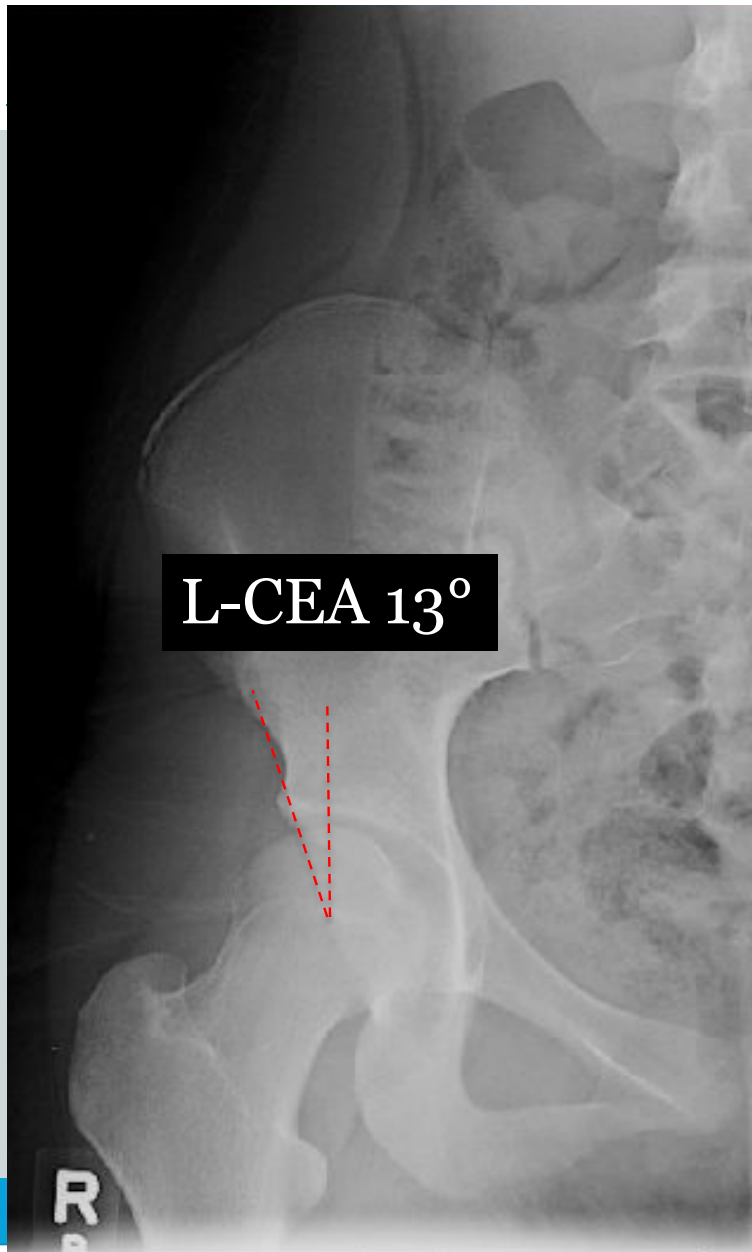


# Right PAO





# 1 Year After PAO



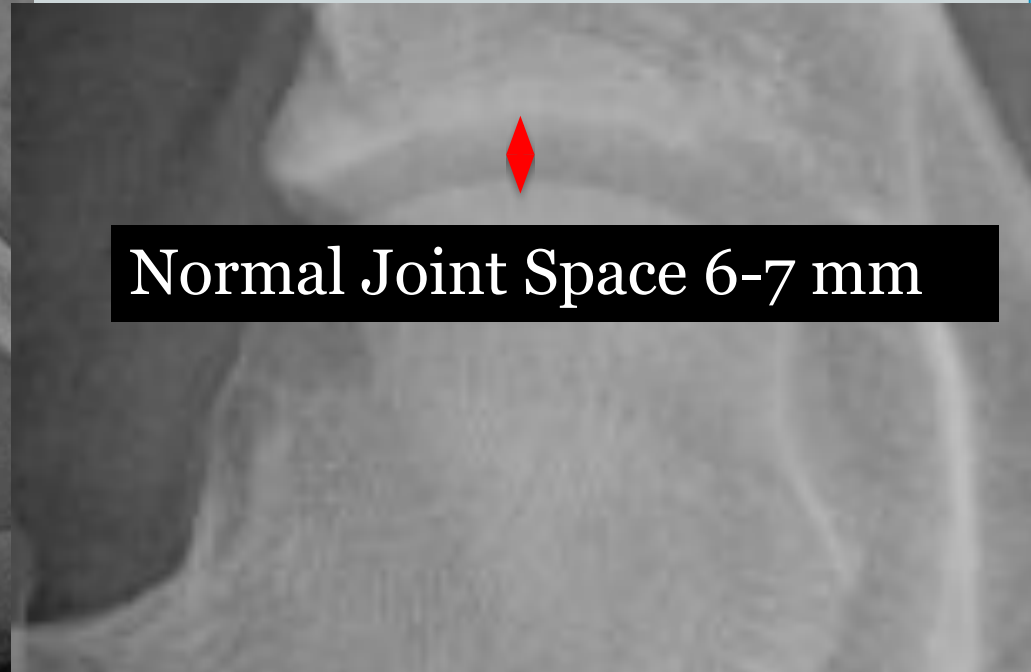
# Return To Sport Following PAO



Bogunovic L, Hunt D, Prather H, Schoenecker PL, Clohisy JC. ***Activity Tolerance After PAO***. AJSM, 2014.

- 71% patients, 39 hips in 36 active patients (*UCLA preoperative activity score  $\geq 7$* ), able to return to pre-surgical or higher activity level after PAO at 33 month mean (*18-59 months*) follow-up
  - Overall no significant change in UCLA score (preop  $\square$  postop)
- 97% satisfaction postoperatively
- 4 patients (11%) still had activity limiting hip pain
- Sport participation varied from recreational to collegiate-level athletes

# Hip Arthritis



**Normal Joint Space 6-7 mm**

# Hip Arthritis

## Tire Tread Depths Influence Wet Road and Wintertime Traction

### NEW

Replacement  
Not Necessary

Deep grooves allow water to flow easily from between your tires and the road to resist hydroplaning. Block edges and tread siping bite into snow to promote wintertime traction.

Tire tread depths typically begin with 9/32" to 12/32"

### WEARING

Replacement  
Upcoming

Dry road responsiveness is enhanced as treads wear, but traction on very wet roads and in deep snow is reduced.

Make sure your tires' tread depths are sufficient for road and weather conditions.

### WORN OUT

Replacement  
Recommended  
Immediately

Low tread depth restricts water, slush and snow from escaping from between tread and road. This will promote hydroplaning and reduce traction on wet and wintry roads.

Minimum tread depth recommended for vehicles likely to encounter listed condition:

Snow - 5/32"  
Rain - 4/32"  
Dry - 2/32"

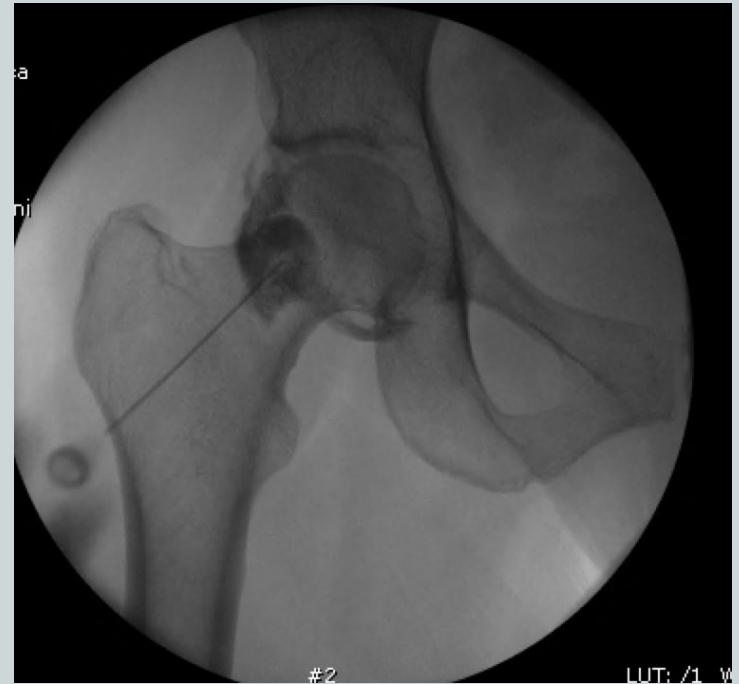
Tread depth under 2/32" may violate applicable law.



# Treatment Options for Hip Arthritis



- Nonsurgical Treatment
  - Activity modification
  - NSAIDs
  - Physical Therapy
  - Intra-articular corticosteroid injections
- Surgical
  - Hip Arthroplasty (Hip Replacement)



# Total Hip Arthroplasty

Femoral Neck Angle Wizard  
More Wizards...

**Tritanium Cup**

stryker Hip Systems Tritanium Cup

Alignment: To Wizard

Cup Size	Socket Size
58	36
60	40
	44

**SecurFit Advanced Hip Stem**

stryker Hip Systems Secur-Fit™ Advanced Hip Stem

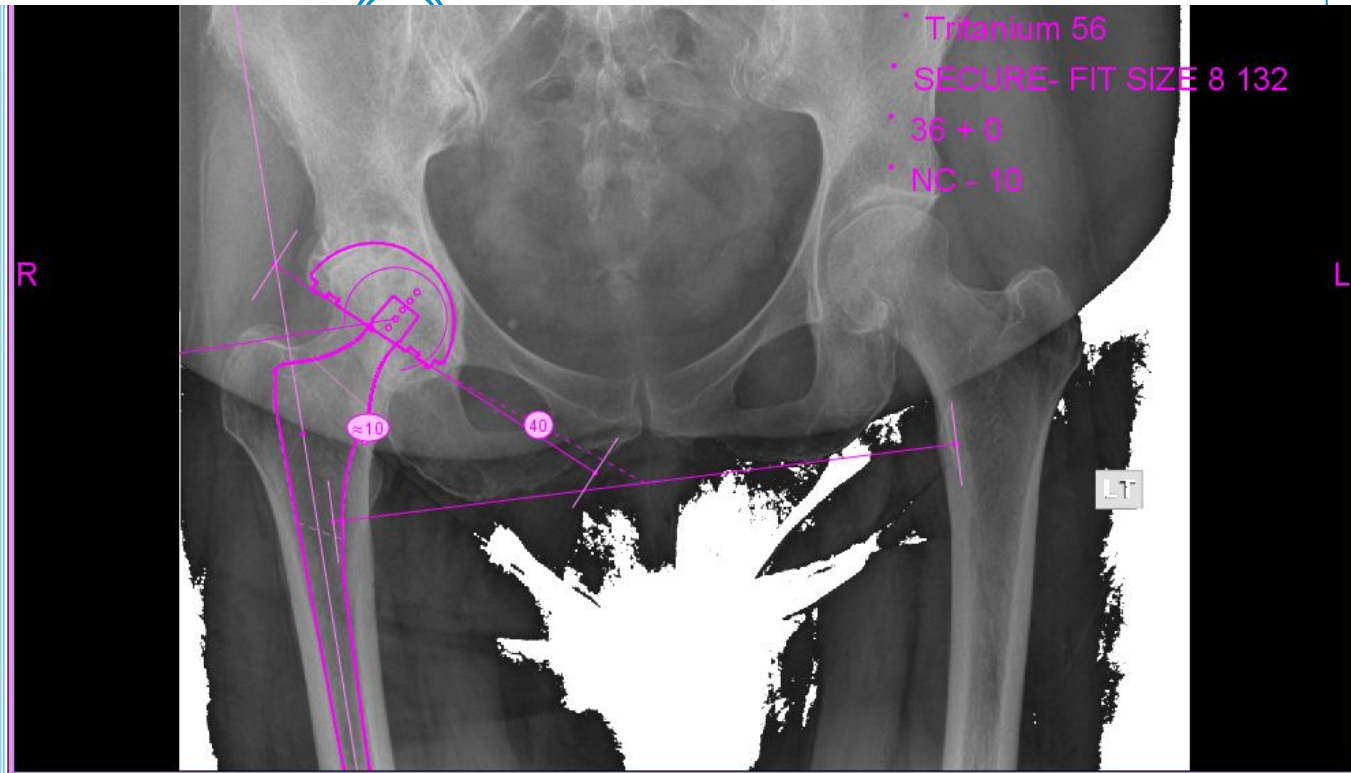
Alignment: To Wizard

Size	Head Diameter
6	36
7	40
8	44
Head Length	
-3 CoCr V40	
0 CoCr V40	
3 CoCr V40	

Type
129
132

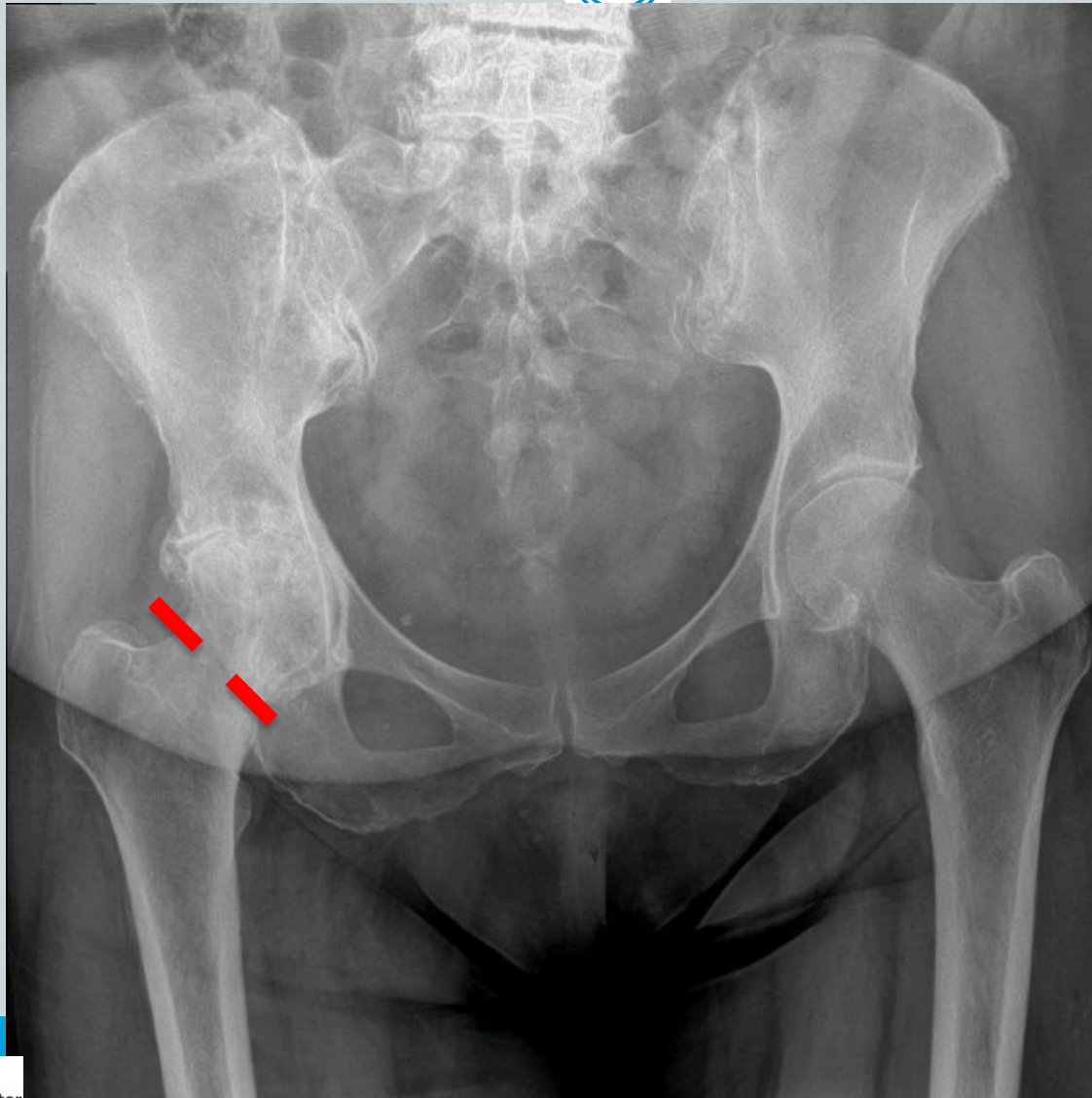
**Messages**

Pre-operative Right leg shorter by: 8 mm  
Planned Right leg lengthening: 2.5 mm  
Predicted Right leg discrepancy: 5.5 mm

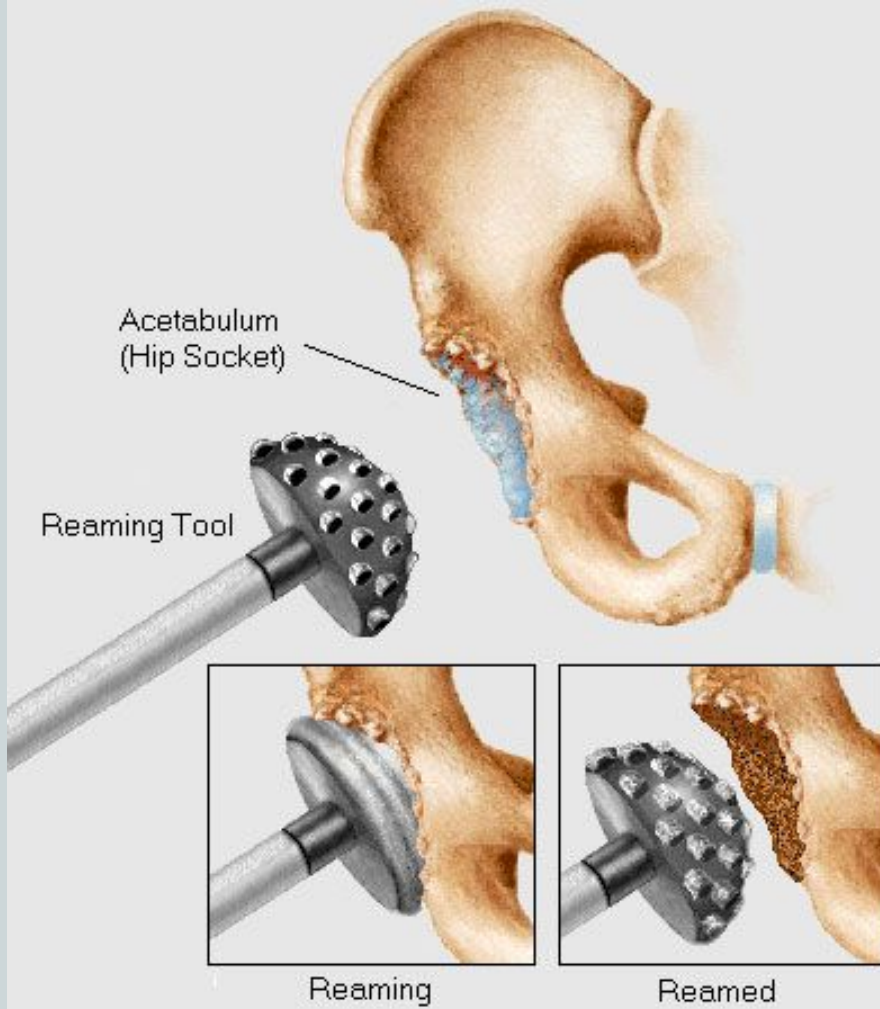




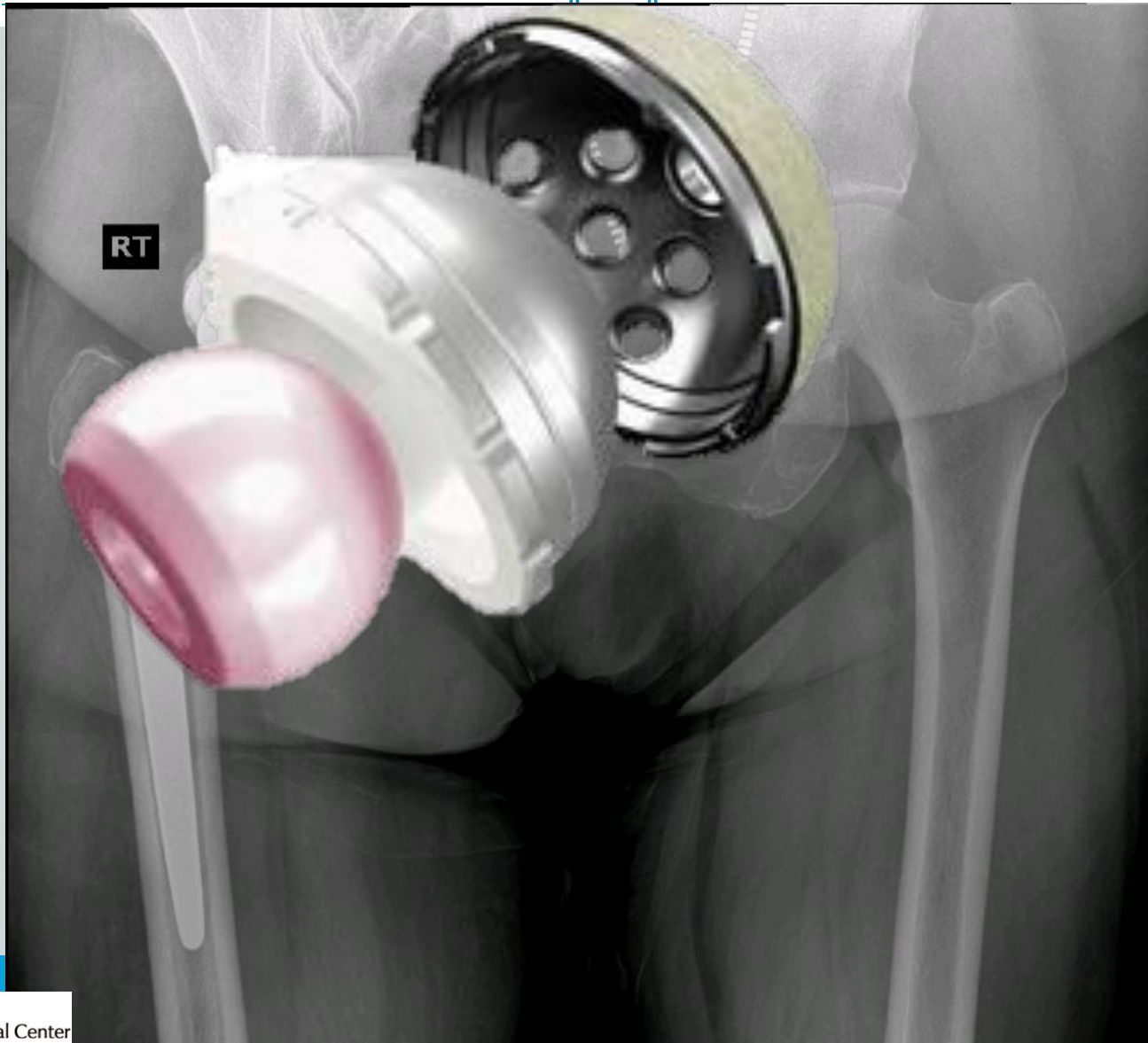
# Total Hip Arthroplasty



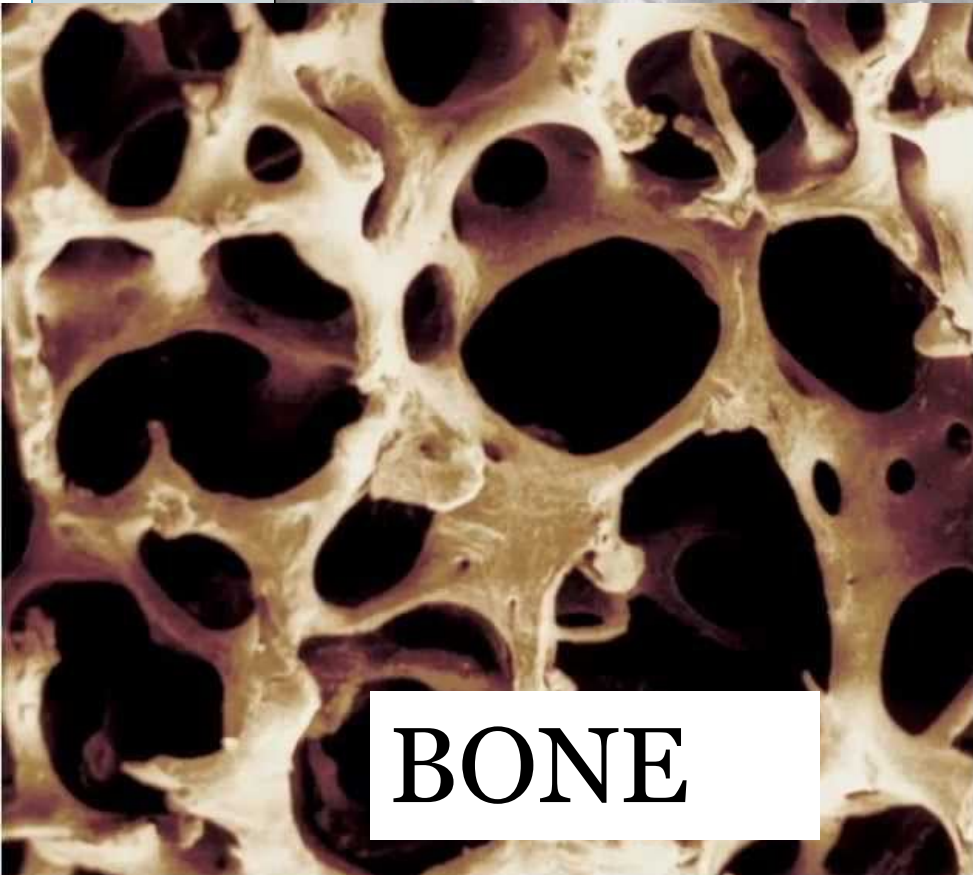
# Total Hip Arthroplasty



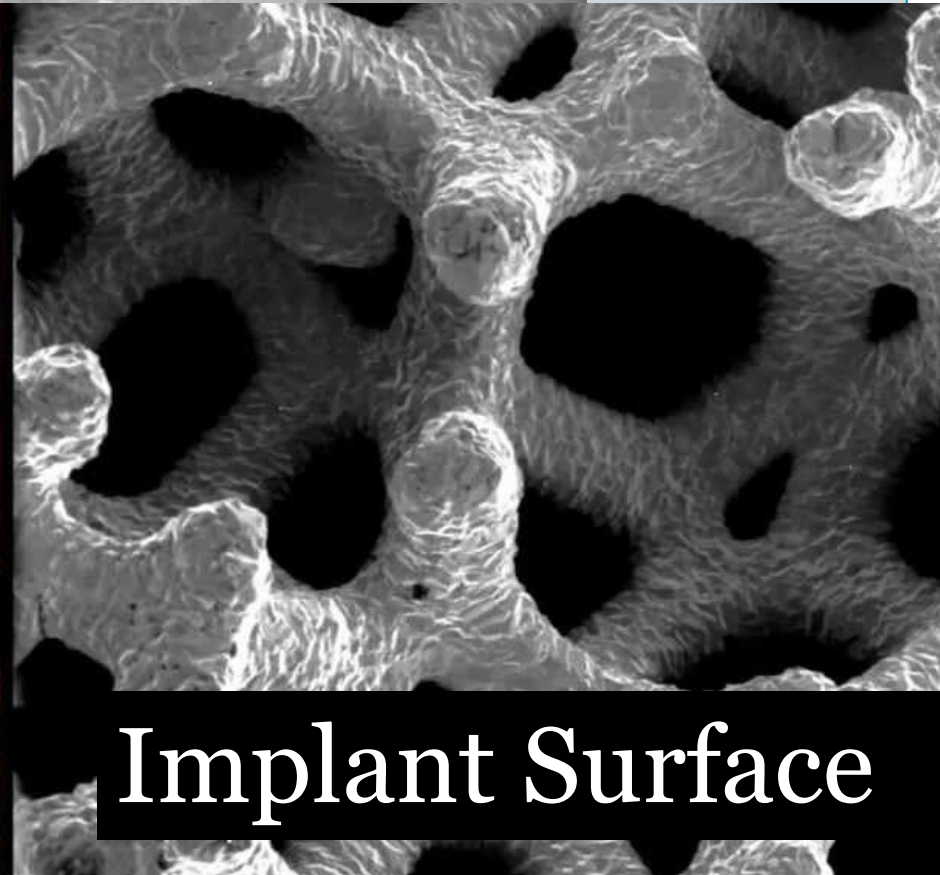
# Total Hip Arthroplasty



# Total Hip Arthroplasty



**BONE**



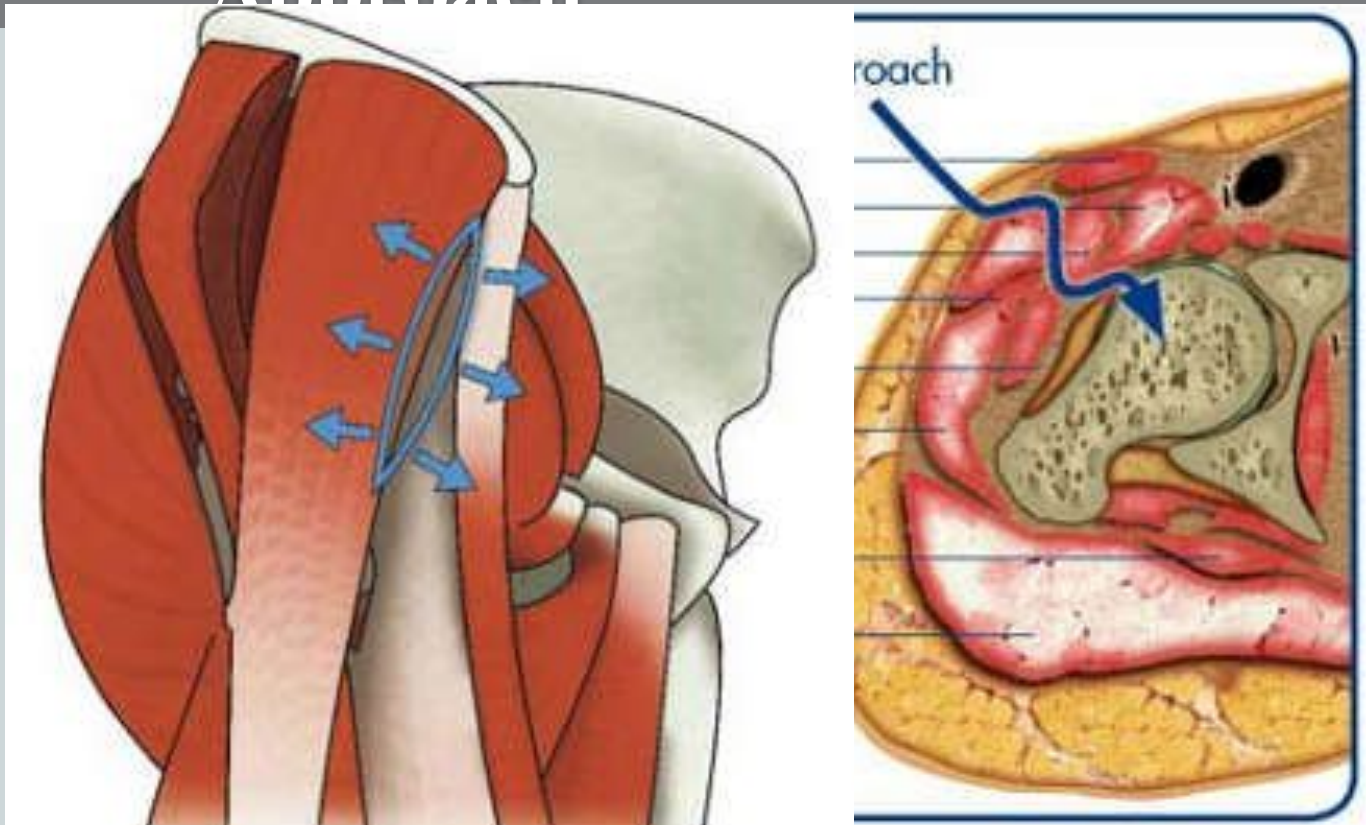
**Implant Surface**



# Minimally Invasive Total Hip Arthroplasty

## *Surgical Approach*

### Direct Anterior Approach

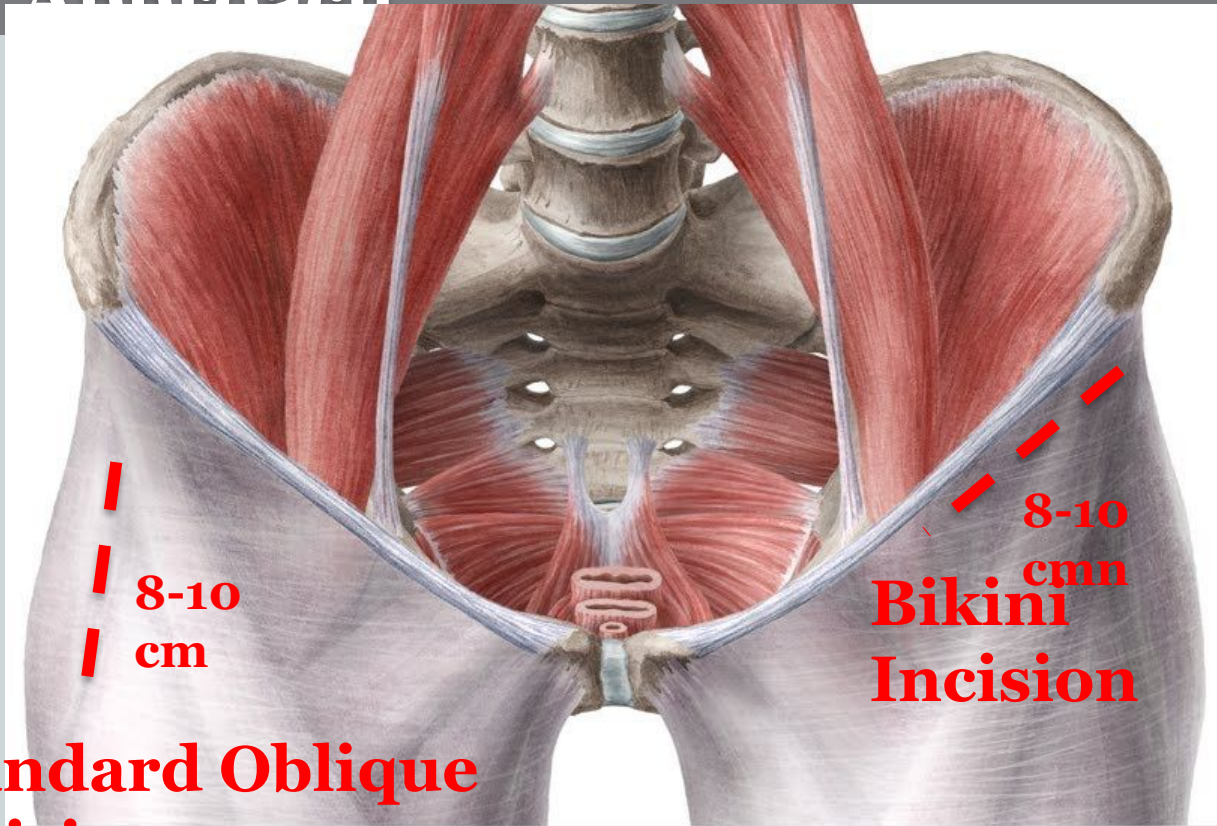




# Minimally Invasive Total Hip Arthroplasty *Surgical Approach*



## Direct Anterior Approach



Standard Oblique  
Incision  
8-10  
cm

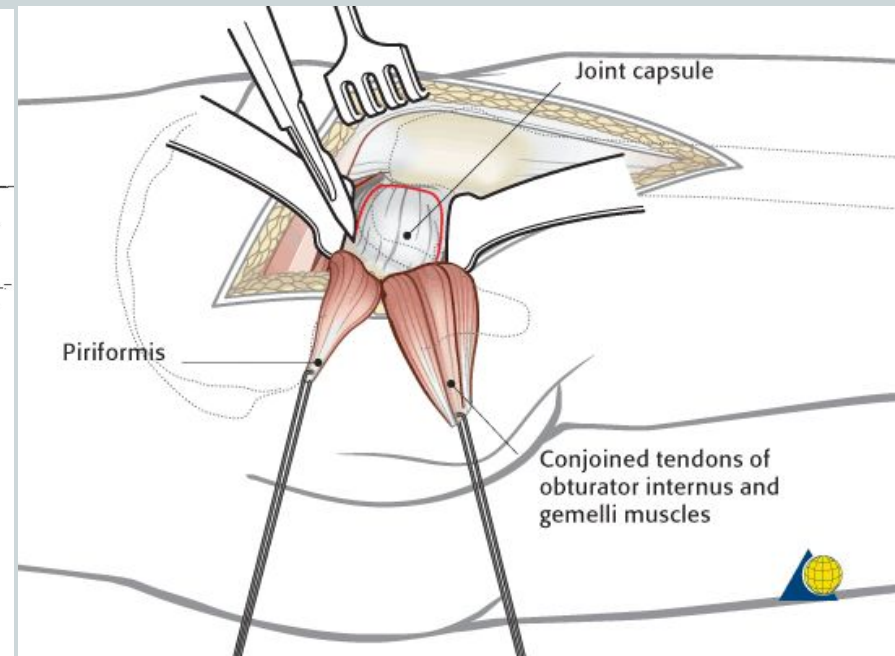
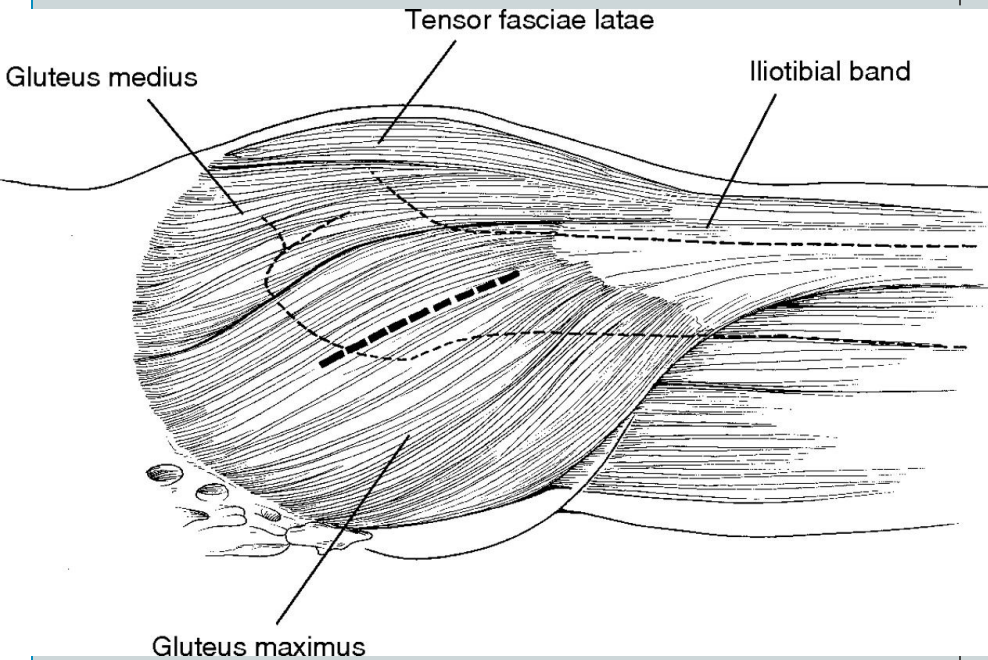
Bikini  
Incision  
8-10  
cm

Standard Oblique  
Incision

# Minimally Invasive Total Hip Arthroplasty *Surgical Approach*



## Posterior Approach



# Minimally Invasive Total Hip Arthroplasty

## *Surgical Approach*



### Direct Anterior Approach

- Better functional outcome scores in early post-operative period
- Better early pain scores
- Earlier independent ambulation
- Results level at between 6 weeks – 6 months

Parvizi J, et al. *Total Hip Arthroplasty Performed Through Direct Anterior Approach Provides Superior Early Outcome: Results of a Randomized, Prospective Study*. Orthopaedics Clinical North America. July, 2016.

### Mini Posterior Approach

- No difference in mean length of stay with performed with rapid recovery protocol

Malek IA, et al. *A comparison between the direct anterior and posterior approaches for total hip arthroplasty: the role of an “Enhanced Recovery” pathway*. JBJS. June, 2016

Poehling-Monaghan KL, et al. *Direct anterior versus miniposterior THA with the same advanced perioperative protocols – surprising early clinical results*. Clinical Orthopaedics and Related Research. February, 2015.

# Left Hip Arthritis

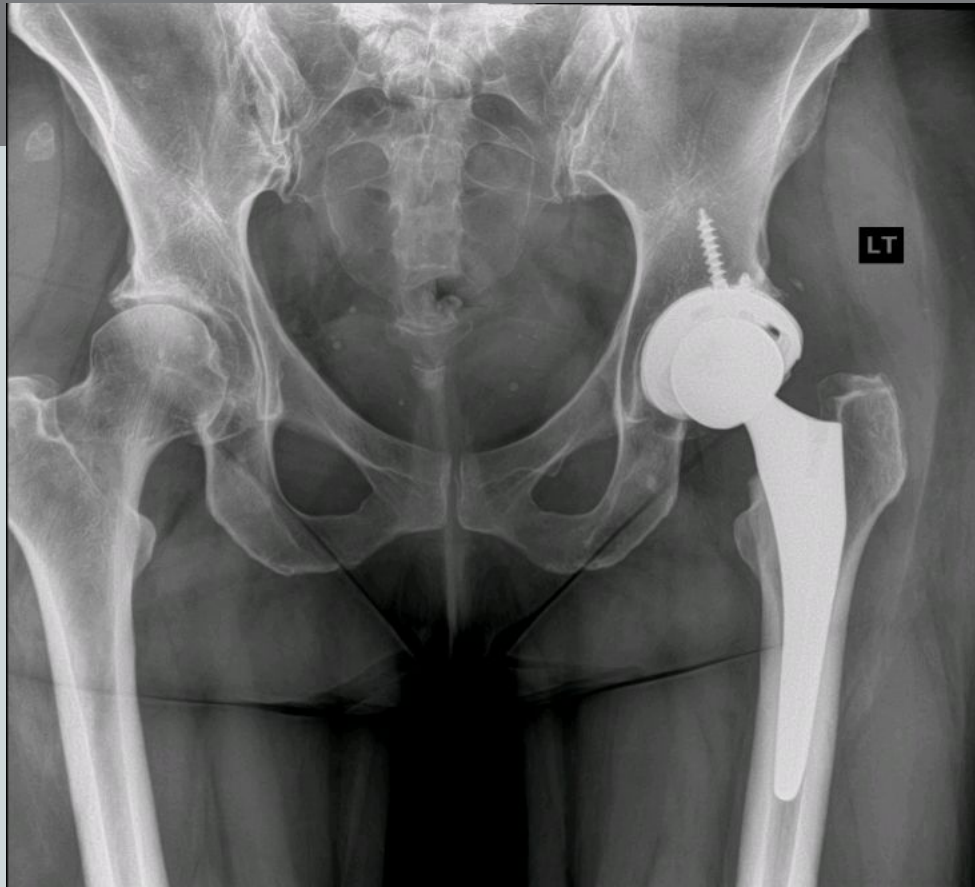


- 51 year old female presented for 2<sup>nd</sup> opinion of progressively increasing left hip pain.
- Persistent symptoms despite PT, intra-articular cortisone injection, oral NSAIDs





# Left Anterior Total Hip Arthroplasty





# THA Longevity



- 30 year survival of THA:  
73%
- Technology has  
dramatically changed...



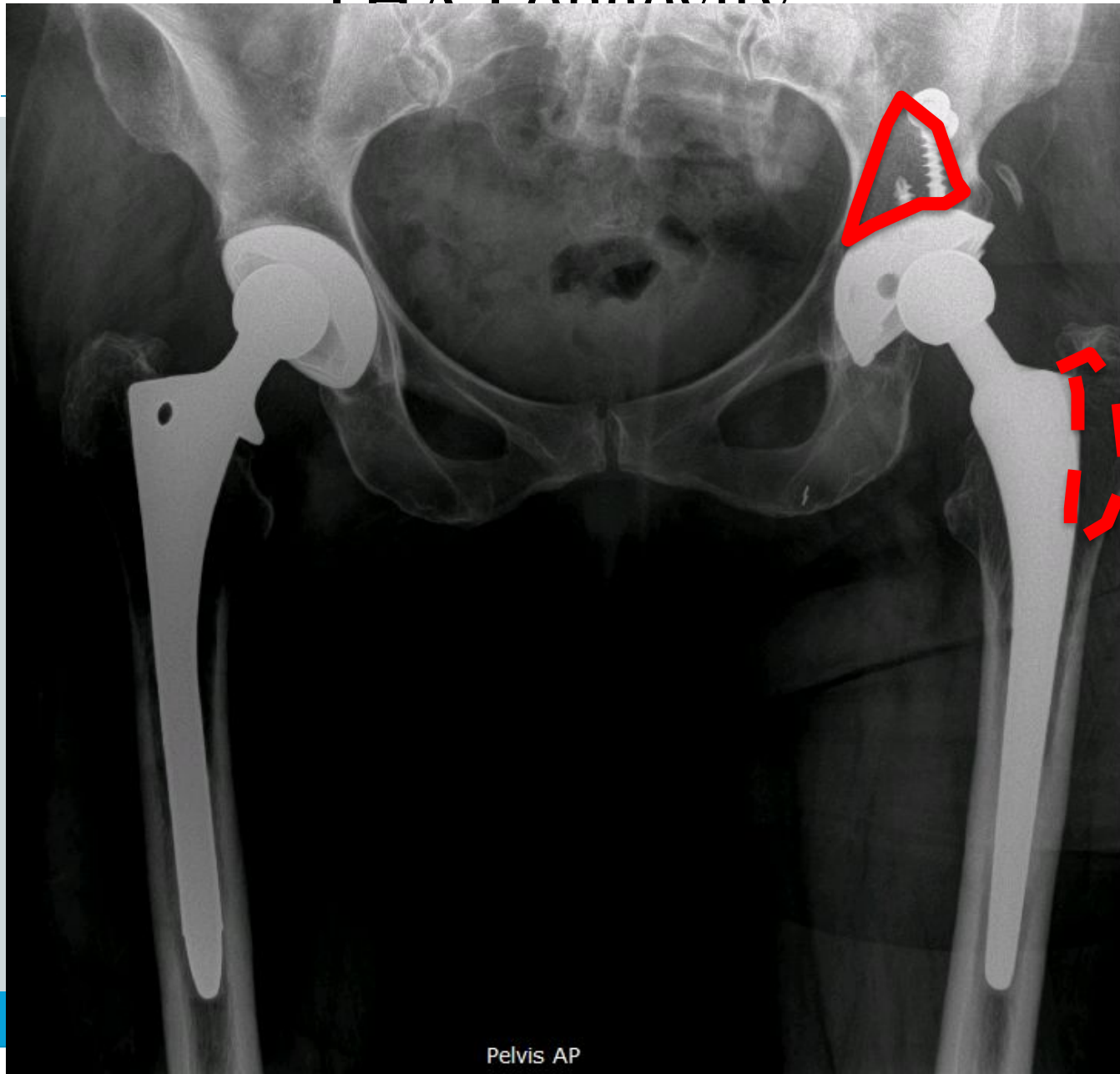
Mullins M, et al. Thirty-Year Results of a Prospective Study of Charnley Total Hip Arthroplasty. *J of Arthroplasty* 2007

# THA Longevity

- Press-fit acetabular and femoral components
- Polyethylene manufacturing process has been entirely changed



# THA Longevity



Pelvis AP

# THA Longevity



- Modern THA in active patients younger than 50 years

- 100% survivorship @10-14 years

- Babovic N, Trousdale RT. *Total hip arthroplasty using highly cross-linked polyethylene in patients younger than 50 years with minimum 10-year follow-up.* J of Arthroplasty, 2013.
- Garvin KL, et al. *Low wear rates seen in THAs with highly crosslinked polyethylene at 9-14 years in patients younger than 50 years old.* CORR, 2015.
- Stambough JB, et al. *Long-Term Results of Total Hip Arthroplasty with 28mm cobalt-chromium femoral heads on highly cross-linked polyethylene in patients 50 years and less.* J of Arthroplasty, 2015.

# Hip Resurfacing



Chicago Marathon.com



Orbea.com





# Hip Resurfacing



# Hip Resurfacing



# Hip Resurfacing

- 96-100% Survival at 10-14 years
  - Higher percentage of patients are able to return to running after hip resurfacing than traditional THA (94% vs. 74%)
- Matharu et al. *The outcome of the Birmingham Hip Resurfacing in patients aged <50 years up to 14 years postop.* JBJS, 2013.
  - Murray et al. *The ten-year survival of the Birmingham hip resurfacing: an independent series.* JBJS Br, 2012.
  - Glyn-Jones et al. *Risk factors for inflammatory pseudotumour formation following hip resurfacing.* JBJS-Br, 2009
  - Barrack, R, et al. *Do young, active patients perceive advantages after surface replacement compared to cementless THA?* CORR, 2013.



# Hip Avascular Necrosis

- Avascular Necrosis of Femoral Head – *interruption of the blood supply to the subchondral surface of the femoral head*
  - Risk factors:
    - ▢ Chronic steroid use
    - ▢ Excessive alcohol use
    - ▢ Caisson's disease – *diving history*
    - ▢ **Idiopathic**



# Hip Avascular Necrosis

- Treatment depends on integrity of the articular surface of the femoral head



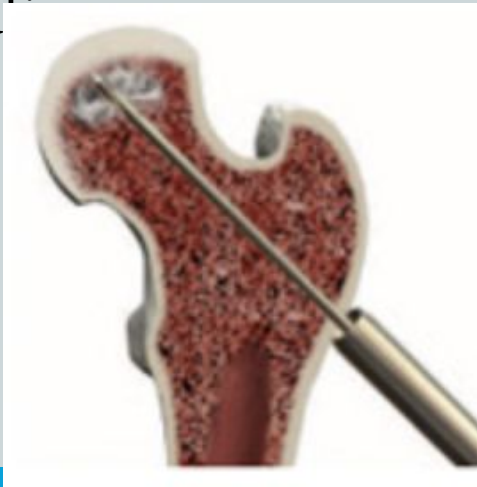


# Hip Avascular Necrosis



## Pre-Collapse

- Off-label use of osteoporotic medications
- Femoral head core-decompression with autologous bone-marrow aspiration



## Collapse of Articular Surface

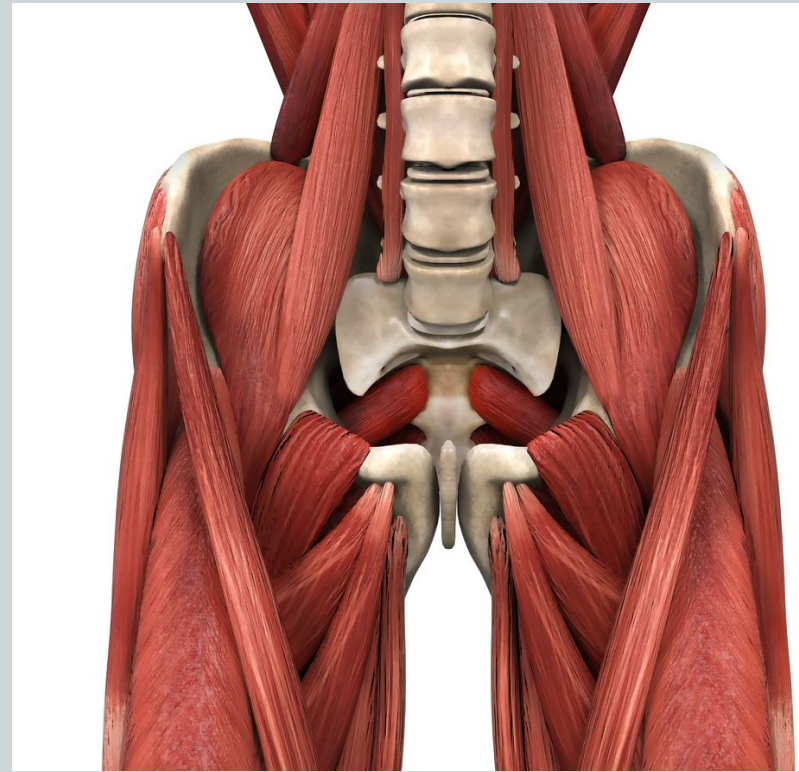
- Hip Replacement



# Layered Approach to Evaluating the Hip

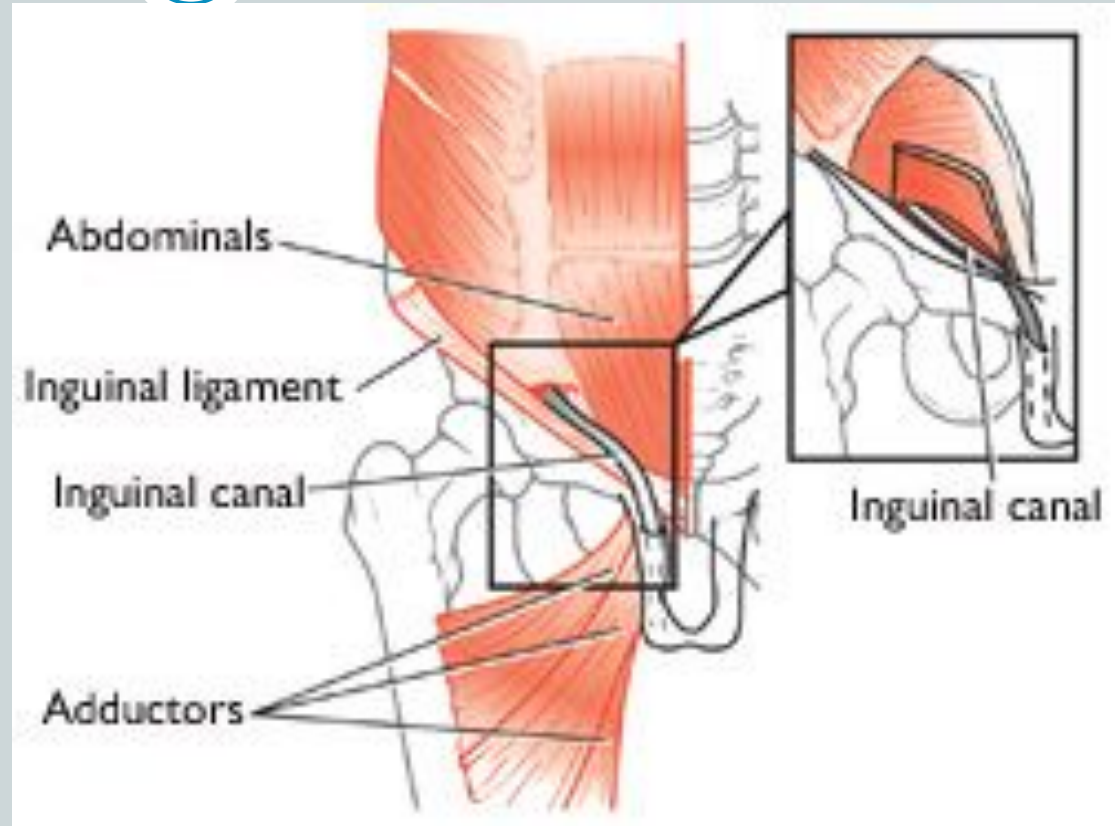
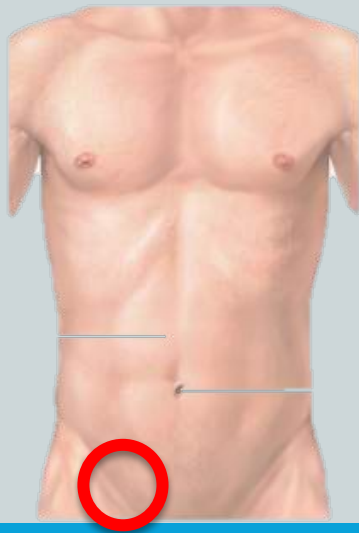


- 3. Muscular Layer – comprises all the muscles around the hemipelvis, including lumbosacral and pelvic floor musculature that provides dynamic stability and muscular balance to the hip, pelvis, and trunk.



# Hernias

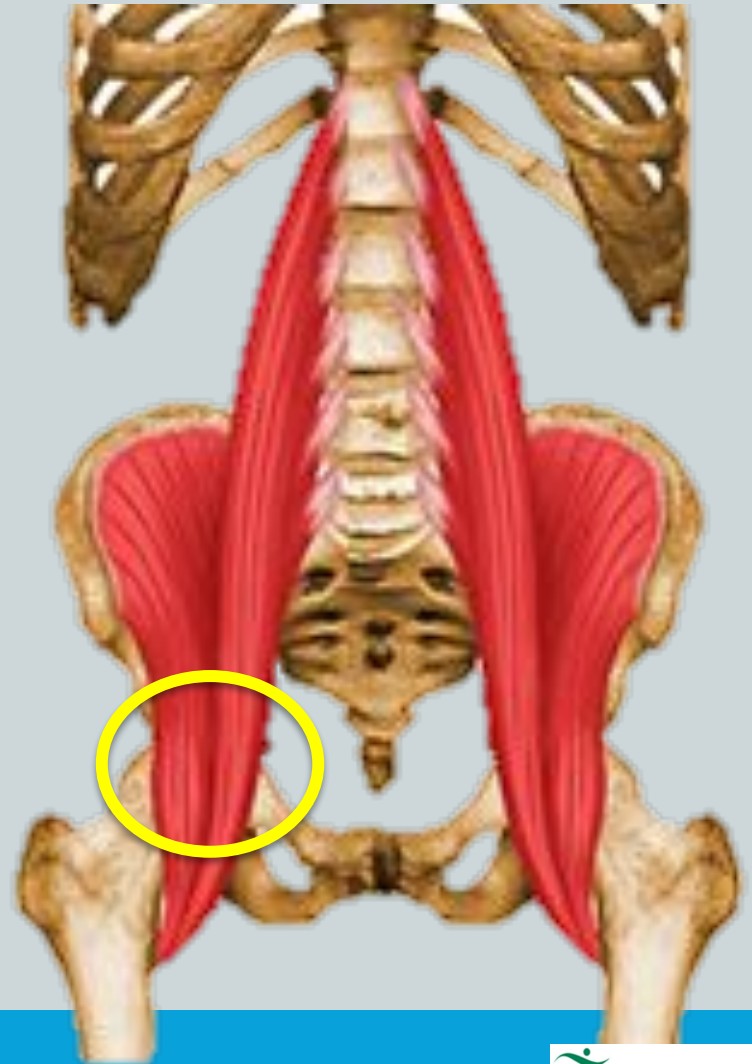
- Inguinal Hernias
- Sports Hernias
  - External/Internal Oblique insertion onto conjoint tendon



Gilmore OJ. Gilmore's groin. Sportsmed Soft Tissue Trauma 1992.  
Hackney RG. The sports hernia: a cause of chronic groin pain. Br J Sports Med 1993.

# Iliopsoas Tendonitis

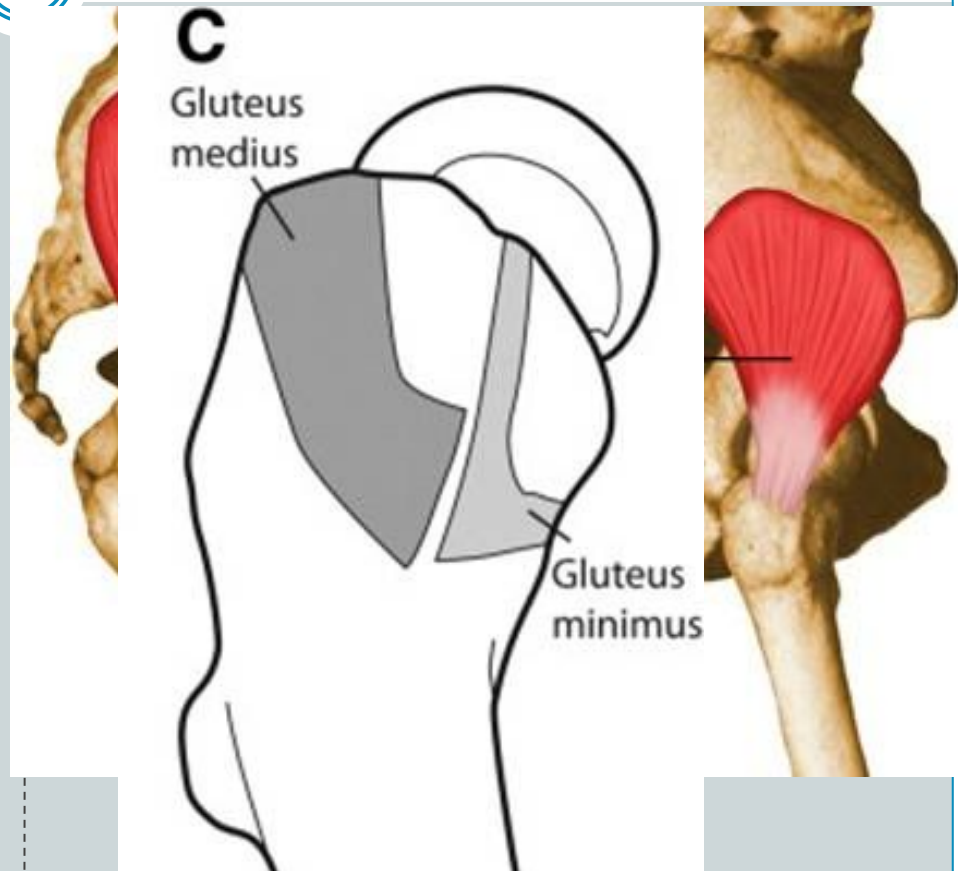
- Tenderness over anterior aspect of hip
- Pain with resistance against with straight hip flexion
- Describe snapping/catching symptoms in anterior aspect of hip



# Gluteal Tendon Tears

Overuse tendonitis, tears, or avulsion injuries

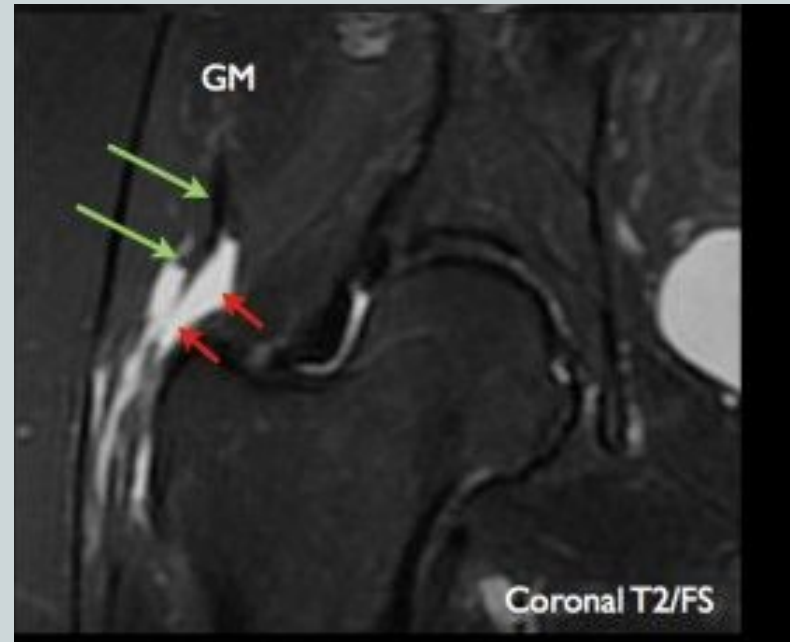
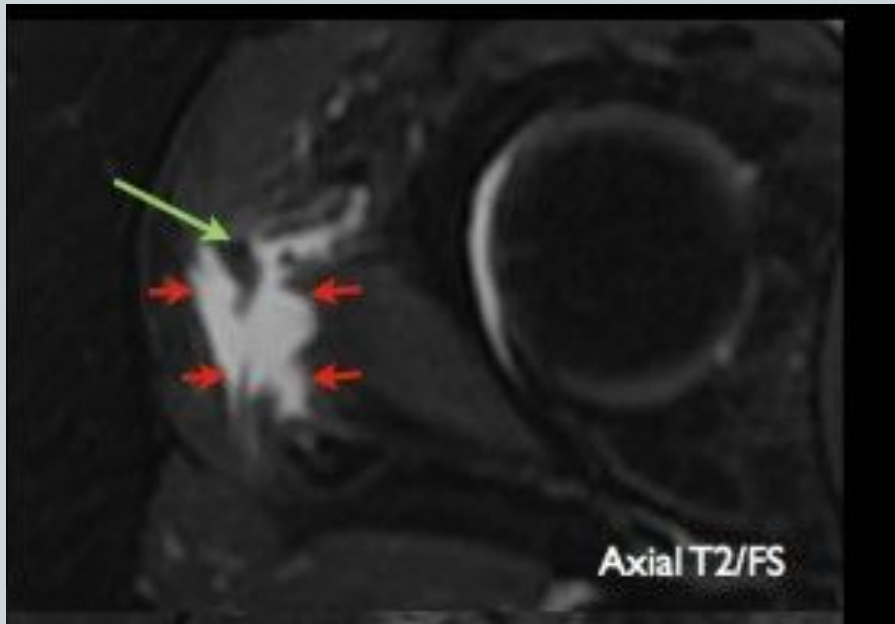
- Hip Abductors  
(*Gluteal Minimus/Medius*)
- *Presents as lateral hip pain*



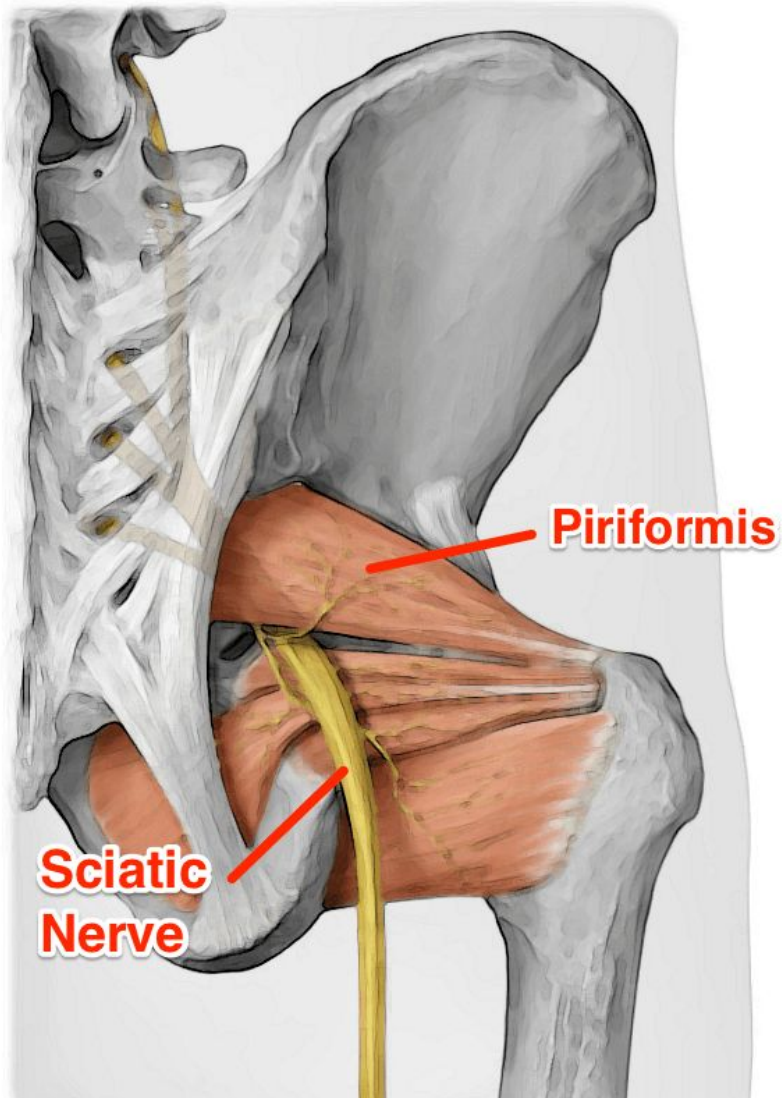
**“Rotator Cuff of the Hip”**



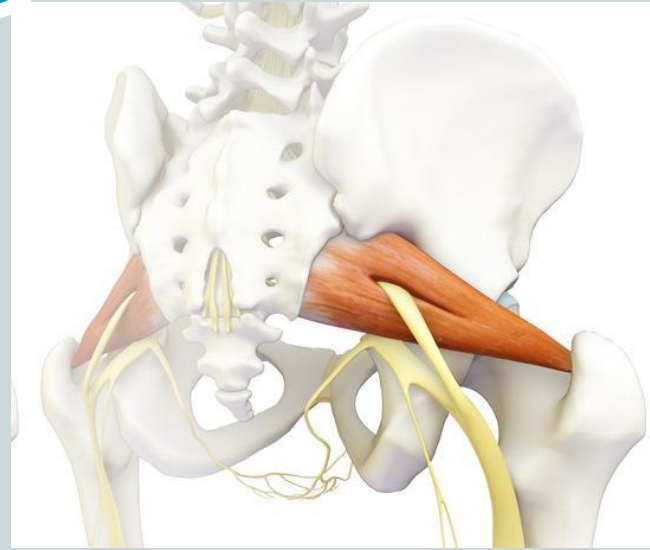
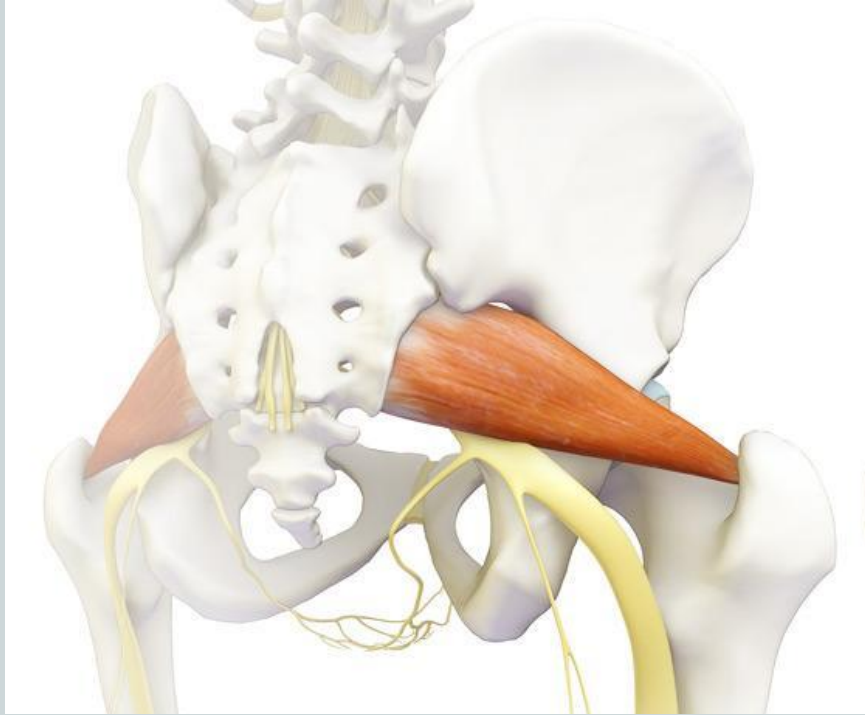
# Gluteal Tendon Tears



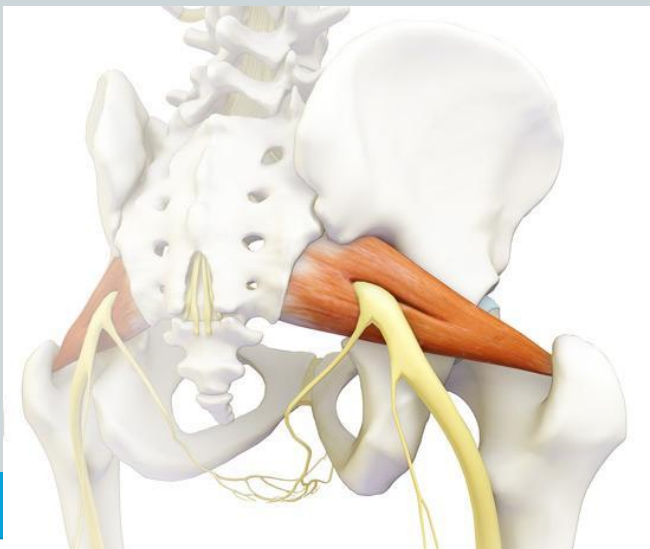
# Piriformis Syndrome



# Piriformis Syndrome



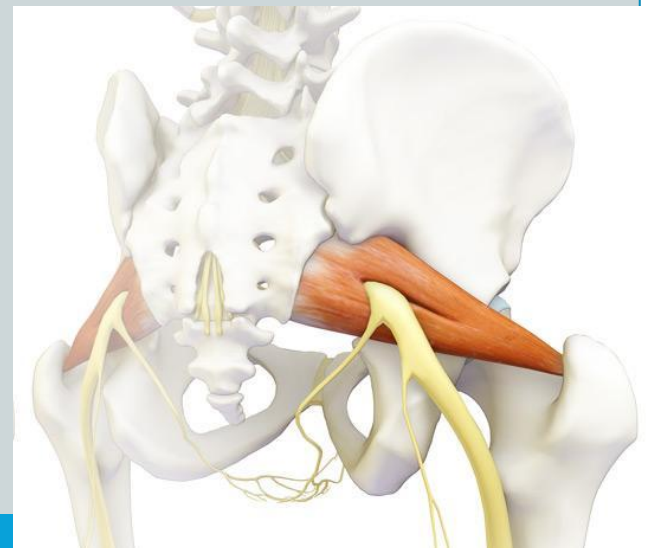
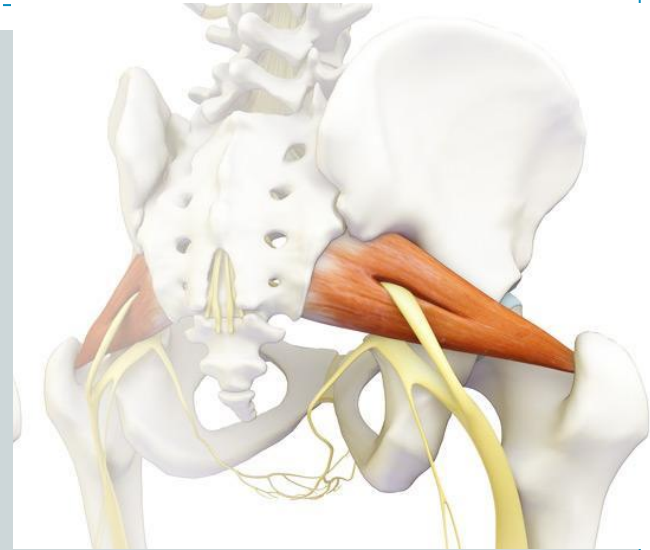
11%



0.2  
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# Piriformis Syndrome

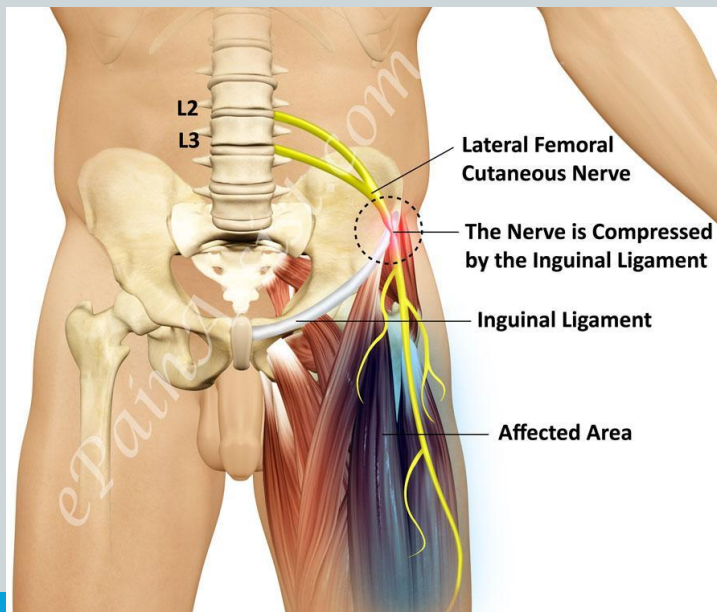
- Sciatica-type radicular symptoms - *very difficult to differentiate from lumbar etiology*
- Very specific symptoms of focal radicular symptoms with prolonged sitting with associated distal paresthesias



# Layered Approach to Evaluating the Hip



- 4. Neural Layer
  - Thoracolumbosacral plexus
  - Peripheral nerves in lumbopelvic tissue and lower extremity





# Making the Right Diagnosis



- Precise History
- Proper Clinical Exam
- Imaging
- Diagnostic Injections

# Key Points



- Hip Mechanics and the evaluation of the patient with hip pain is very complicated
- Making the right diagnosis depends on a detailed history, physical, and proper imaging
- Patient selection is key to avoid failures