Soft Tissue Hip Injuries: Methods of Repair and Recovery

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Dr. Kyle Kunze graduated from the University of Chicago with a Bachelor of Science in the Biological Sciences with Honors. After earning his Doctor of Medicine at Rush Medical College of Rush University in Chicago, he completed residency training in orthopedic surgery at Hospital for Special Surgery. To push his education further and pursue his interest in artificial intelligence (AI), he obtained a Professional Certification in AI for Healthcare at Massachusetts Institute of Technology.

Dr. Kunze is currently completing a Clinical Orthopedic Sports Medicine Fellowship at Midwest Orthopaedics at Rush University Medical Center. His academic record includes more than 200 publications in peer-reviewed journals and over 20 awards and honors. He has received grant funding for his research projects and has delivered grand rounds as well as national and international presentations on the use of AI to address healthcare challenges and improve patient outcomes. He will be returning to Hospital for Special Surgery in August 2026 as faculty and assistant professor of orthopedic surgery in the sports medicine department.

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Disclosures

- Dr. Kyle Kunze has a financial relationship with AllaiHealth Inc. and Arthroscopy Journal. All relevant relationships have been resolved.
- Sloane Lipkin has no relevant financial or non-financial relationships to disclose relating to the content of this activity.
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Learning Objectives

At the conclusion of this activity, participants will be able to:

1. Identify the common clinical presentations and risk factors for four common soft tissue hip injuries.
2. Describe the current evidence-based diagnostic approaches for evaluating soft tissue hip injuries.
3. Explain the pathophysiology of femoroacetabular impingement (FAI) and labral tears and how these contribute to hip pain and dysfunction.
4. Discuss non-surgical and surgical management strategies for gluteal tears, labral tears, FAI, and hamstring injuries, including expected outcomes, and rehabilitation considerations.
5. Apply key clinical decision-making principles to develop initial management plans for patients presenting with soft tissue hip injuries.

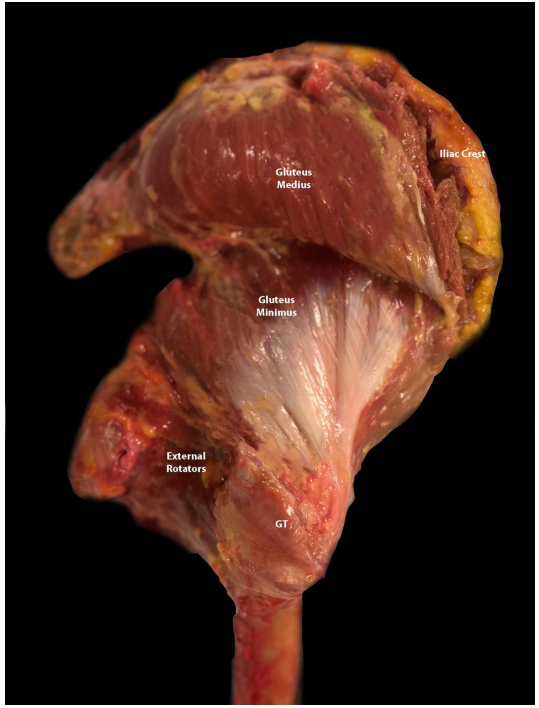
Why Are Military Hips Different?

- Repetitive load (rucks, prolonged standing/kneeling)
- High demand, nonnegotiable activity
- Young, active often with musculoskeletal injuries
- Symptoms are frequently misattributed to nonspecific “groin” or “back” pain
- Delayed diagnosis leads to chronic pain, performance decline, and lost readiness

(Ernat et al., 2019)
(Gahleitner et al., 2025)

Gluteal Tears: Anatomy

- Gluteus medius, minimus, tensor fascia lata (TFL) are the primary hip abductors
- Provide stability for pelvis during gait
- Innervation by superior gluteal nerve in both muscles, risk injury in formal posterolateral approach to hip



(Flack et al., 2012)
(Mock et al., 2017)

Gluteal Tear Risk Factors

TABLE 1

Risk Factors for Gluteal Tears

Nonmodifiable Risk Factors	Advanced age, female sex, concomitant hip osteoarthritis, GTPS syndrome (bursitis, ITB syndrome)
Modifiable Risk Factors	Sedentary lifestyle, obesity, poor biomechanics (excessive hip adduction or internal rotation), inadequate warm-up/conditioning, improper foot mechanics

GTPS, Greater Trochanteric Pain Syndrome. ITB, Iliotibial Band.

(Grimaldi et al., 2015)
(Dancy et al., 2023)

Gluteal Epidemiology

- Estimated 25% of middle-aged women and 10% of middle-aged men
- Greater compressive load for women: coxa vara, greater trochanteric offset, and greater peak forces with running
- Repetitive activities
- Positive correlation between gluteal muscle atrophy and osteoarthritis

(Fearon et al., 2012)
(Vannatta et al., 2021)

Signs and Symptoms

- Lateral hip pain, gait abnormalities, weakness
- Exacerbated by sleeping on affected side, single leg stance phase of walking
- The Trendelenburg side has a sensitivity of 73% and specificity of 77% for detecting gluteus media tears, but can be positive in GTPS due to pain related inhibition of gluteus muscle muscles. Five.
- The hip lag sign has a sensitivity of 90% and specificity of 97% for abductor injury.

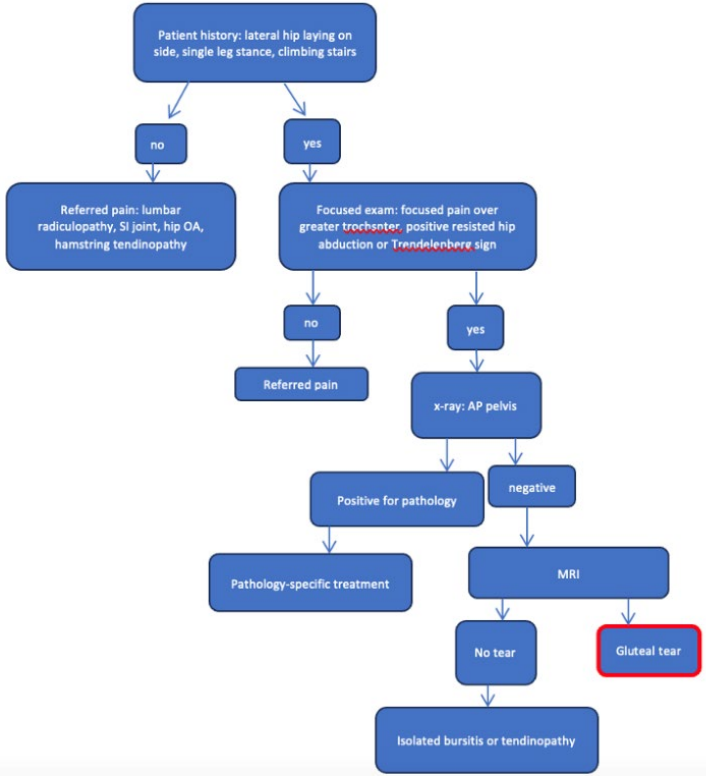
(Kaltenborn, 2014)

Magnetic Resonance Imaging (MRI) Classification

- MRI is the gold standard for diagnosis
- Goutallier-Fuchs (G-F)
  - classically for fatty infiltration of the shoulder rotator cuff muscles
  - greater grades corresponding to more fatty infiltration, increased pain, and decreased functional outcomes post-operatively.
  - G-F 1-2 generally has better post-op functional hip scores and patient satisfaction, with no correlation between postoperative outcomes and the tear size, patient's age, or a single- or double-row repair.
  - higher grade is associated with a higher rate of repair failure and thus may warrant augmentation with biologics or muscle transfer.
- Milwaukee Classification: based on tear location and extent
  - Helps with surgical planning

(Thaunat et al., 2018)
(Ebert et al., 2019)

Diagnostic Algorithm for Gluteal Tears



Nonoperative Treatment

- Activity modifications
- Anti-inflammatory medications
- Shock wave therapy
- Trochanteric bursal injections
- Orthobiologics
- Physical therapy
  - Effect specific to stage of tendinopathy
- Corticosteroid injections are best for short term improvement
- Maximally effective up to 6 weeks
  - Can degenerate tendon with successive use

(Cook et al., 2009)
(Koongsgaard et al., 2010)
(Brinks et al., 2011)

Nonoperative Treatment: Orthobiologics

- Platelet rich plasma (PRP)
  - Helps tendinous healing
  - Improves acute and chronic gluteal tendon healing up to two years
- Leukocyte-rich (LR)
  - Induces more growth factor release and tenocyte proliferation
- Leukocyte-poor
- Stem cells
- Hyaluronic acid
  - Reduces friction and inflammation of the tendon

(Kaux et al., 2015)
(Ladurner et al., 2021)
(Fitzpatrick et al., 2018)
(Begkas et al., 2020)
(Lin et al., 2022)

Operative Indications for Gluteal Repair

TABLE 3
Surgical Indications for Gluteus Medius/Minimus Repair

Overall Indications	• Clinical evidence refractory to 6 months of nonoperative management • MRI confirmation of gluteal tear, with partial/full thickness tearing
Endoscopic	• Partial thickness tearing not involving the anterior and superoposterior facets of the gluteal tendon • Concomitant intra-articular pathology
Open	• Full-thickness tears, especially involving the anterior and superoposterior gluteal tendon facets • Concomitant hip arthroplasty
Augmentation	• Full-thickness tears with extensive retraction • Presence of fatty infiltration, muscle atrophy, and muscle delamination • Failure of a primary gluteal repair

(Makridis et al., 2014)
(Morgan et al., 2024)
(Kaux et al., 2014)
(Bogunovic et al., 2015)

Operative Treatment

- High rates of improvement, low rates of reoperation
- Open repair has higher complication rates but favored for larger tears
- Retear rate for endoscopic repair is 0%, open repair is 9% per systematic review
  - Microfracture decreases retear rates and visual analog scale (VAS) scores and increased modified Harris Hip Score (mHSS), Hip Outcome Score- Activities of Daily Living (HOS-ADL), and Hip Outcome Score- Sport Scale (HOS-SS) scores
- Both open and endoscopic approaches improved function and pain, less improvement for higher GF grade

(Meghpara et al., 2021); (Okoroha et al., 2019)
(Chandrasekaran et al., 2015); (Kocaoglu et al., 2023)
(Rice et al., 2015); (Alpaugh et al., 2015)

Polling Question 1

Name one risk factor associated with hip injury in the military.

Gluteal Reconstruction

- Primary gluteal repair re-tear rates have been reported as 3.8 – 9.0%.
- Tensor fascia lata (TFL) transfer is commonly used for partial or isolated gluteus medius/minimus tears with a preserved trochanteric footprint
- Vastus lateralis advancement is considered better for larger or irreparable tears

(Longstaffe et al., 2021)
(Alpaugh et al., 2015)

Gluteal Reconstruction, continued

- In a small case series gluteus maximus transfers for gluteal tears following total hip arthroplasty (THA) improved hip abduction and resolved Trendelenburg sign.
- Gluteus maximus and TFL transfer showed significant patient-reported outcomes (PRO) improvements at a minimum of 1 year post-operatively.

(Alpaugh et al., 2015)
(Song et al., 2023)
(Fehm., 2019)
(Kohl et al., 2012)

Gluteal Repair Augmentation / Reconstruction

- Augmentation or reconstruction for chronic, retracted, irreparable tears, revisions, high grade fatty degeneration.
  - Preferred technique for high grade gluteal tears and gluteal tear revisions is open gluteus repair with acellular allograft
    - ✓ Provides immediate structural and tensile strength to the repair
    - ✓ Improves tendon-to-bone healing
    - ✓ Aids cellular infiltration and neovascularization of the native repair
    - ✓ Should be considered for:
      - massive, full thickness tears with extensive retraction
      - degenerative tears with poor tissue quality
      - revisions when tendon cannot be reduced to the footprint
      - impaired hip abduction strength

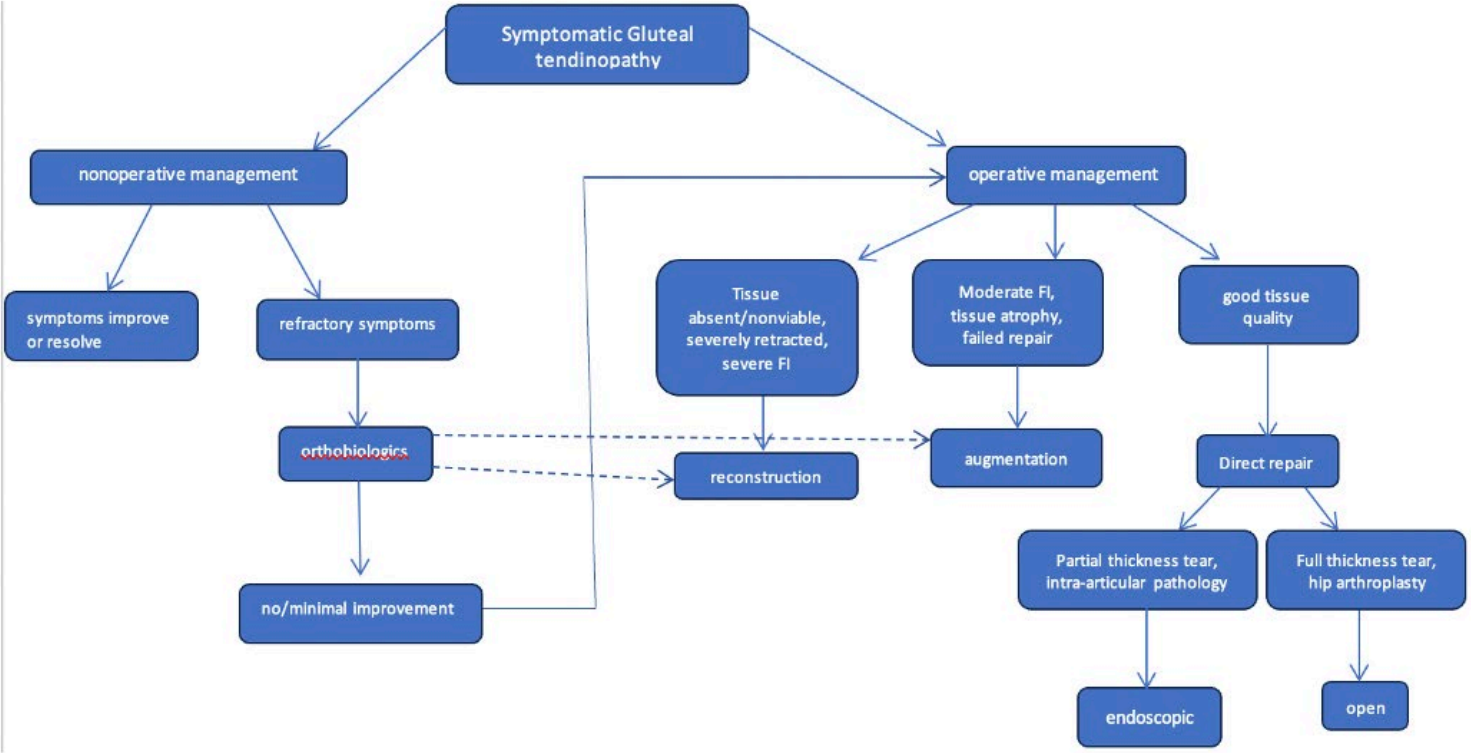
(Capurro et al., 2023)
(Laskovski et al., 2018)

Gluteal Repair Augmentation / Reconstruction, continued

- Ligament augmentation and reconstruction system (LARS), involving transosseous placement of a synthetic ligament for apposition of the native gluteus medius tendon to the greater trochanter followed by a single row of interosseous sutures with or without suture anchors, has demonstrated successful 2-year outcomes with retear rate of 5.6%.
- Achilles tendon with calcaneal bone is preferred for bone-to-bone healing for robust fixation.
  - At 24-month follow-up a gluteal tendon reconstruction with Achilles tendon and calcaneal bone block allograft improved pain and function in 6 of 7 patients.
  - After total hip arthroplasty (THA): pain relief, increased strength, and improved Trendelenberg sign and function at a minimum of 24 months post-operatively.

(Ebert et al., 2020)
(Moore et al., 2024)
(Kaux et al., 2015)

Summary of Treatment Algorithm for Gluteal Tears



Five Causes of Hip Labral Tears

- Trauma
- Femoroacetabular impingement
- Capsular laxity
- Dysplasia
- Degeneration

- Can also be associated with osteoarthritis, slipped capital femoral epiphysis, Legg-Calve-Perthes disease, repetitive pivoting movements, or repetitive hip flexion

(Kelly et al., 2005)

Signs and Symptoms of Hip Labral Tears

- Catching
- Locking
- Groin pain
- Anterior pain
- Decreased range of motion

(Kelly et al., 2005)

Hip Labral Tear Classification by Morphology

- Radial flap- tears away from the labrums free edge, common with impingement
- Radial fibrillated-fraying of splitting at the free edge
- Longitudinal peripheral- tear along attachment to socket
- Unstable-causes mechanical symptoms

(Grohl et al., 2009)

Hip Labral Tear Classification by Etiology

- **Degenerative:** Most common (48%)
- **Traumatic:** acute injury (19%)
- **Idiopathic:** (27%)
- **Congenital:** ie dysplasia (5%)

Hip Labral Tear Classification by Dysplasia

- Based on the occurrence of chondrolabral junction (CLJ) disruption, capsulolabral recess (CLR) disruption, and labral displacement
- **Grade 1:** Blistering/partial delamination with minimal fraying
- **Grade 2:** Disruption at the (CLJ)
- **Grade 3:** Unstable tear with disruption at CLJ & capsulolabral recess (CLR) (no displacement)
- **Grade 4:** Most severe; unstable tear with CLJ/CLR disruption and labral displacement
- * Grades 1 and 2: labral tears without instability

(Yoon et al., 2020)

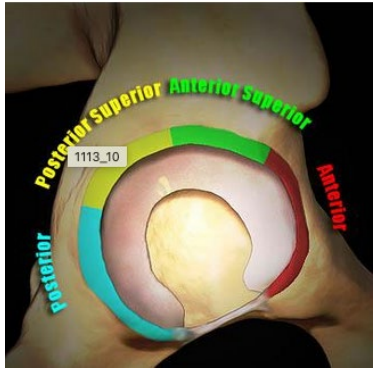
Goal of Treating a Torn Labrum

- Reduce pain by eliminating the unstable flap
- Maintain function and stability of the hip joint
- Decrease premature arthrosis

(Kelly et al., 2005)

Hip Labrum Anatomy

- Acetabular labrum is triangular fibro-cartilage, covers 70% of labral head
  - Joint stability
  - Fluid pressurization/suction seal
  - Load distribution
- Incomplete inferiorly, attaches to transverse acetabular ligament
- Increases articular surface
- Posterior labrum is thicker than anterior labrum
  - Anterior injuries are more common



(Marketing, R. D. S, 2013)

Hip Labrum Biomechanics

- Great circumferential strains of posterior labrum with hip flexion in adduction or neutral abduction-adduction
- Greatest strains anteriorly were in flexion with adduction
- Greatest strains anterolaterally were in full extension
- External rotation had greater strains than neutral rotation and internal rotation
- Greatest strains laterally were at 90° of flexion with abduction, and external or neutral rotation

Anatomy and Physiology of Anterior- Superior Hip Labral Tears

- Most common because anterior labrum is thinner
- Impingement, twisting
- Groin pain
- Association with impingement FAI

Anatomy and Physiology of Superior-Lateral Hip Labral Tears

- Superior labrum is thicker
- Injury from maximum load in 90 degrees of flexion with abduction(greatest lateral strain), FAI, trauma

Anatomy and Physiology of Circumferential Hip Labral Tears

- More complex, difficult to diagnose
- Possible increased rotational laxity in extension

Polling Question 2

What is the most common cause of hip labral tears?

A) traumatic

B) degenerative

C) idiopathic

D) congenital

Diagnosis and Treatment

Curr Rev Musculoskelet Med. 2009 Jun;2(2):105-17. doi: 10.1007/s12178-009-9052-9. Epub 2009 Apr 7.

A comprehensive review of hip labral tears

Megan M Groh [1], Joseph Herrera

- Diagnosis:
  - Clinical: positive anterior hip impingement test (most consistent)
  - MRI is unreliable
  - Magnetic resonance angiography (MRA) is most reliable
  - Arthroscopy is the gold standard
- Treatment:
  - Conservative: rest, Nonsteroidal anti-Inflammatory drugs (NSAIDs), physical therapy (PT)
  - Surgical treatment when refractory to conservative measures

Labral Repair

- Goals
  - Eliminate unstable labral flaps
  - Restore function-especially suction seal for hip stability
- Supine or lateral positioning
- Distraction to best arthroscopically visualize the joint
- Suture anchors around the acetabular rim to reattach the labral tissue to bone
- Tissue preservation > debridement for best joint suction seal and fluid pressurization

Hip Labral Repair

- 5-year outcomes of hip arthroscopy for cam or pincer-type femoroacetabular impingement (FAI) and associated labral tears in a defined patient population.
- 49 patients (50 hips, average age 49)
- Hip arthroscopy delayed THA

(Gahleitner et al., 2025)

Two-year Post-labral Repair of Young Athletes

- 50 patients with a mean age of 17.8 years
- Athletes returned to sport at a rate of 92%
- Mean follow-up of 34 months, the mean mHHS, HOS ADL, and HOS Sport
- Median preinjury and postoperative Tegner levels were 8 and 7, respectively.
- Labral takedown and reattachment was associated with lower HOS ADL and HOS Sport scores
- Arthroscopic labral repair with chondrolabral preservation, which reflected less severe chondrolabral pathology, performed better than labral repair with takedown and reattachment

(Mohan et al., 2017)

Repair vs Debridement for Hip Labral Tear

- Systematic review
- 5 of 8 included studies reported that acetabular labral repair (ALR) resulted in superior outcomes with statistically significant differences when compared to acetabular labral debridement (ALD).
- Rate of osteoarthritis progression was significantly improved with ALR relative to ALD
- No statistically significant differences in the rate of total complications, the rate of total revisions, and the rate of conversion to total hip arthroplasty between these two procedures
- Supports the results of several previous biomechanical studies, which demonstrated that ALR restores the suction seal of the normal labrum, reduces femoral head translation, and reduces acetabular contact stress.

(Hurley et al., 2021)

Repair vs Debridement for Hip Labral Tear, continued

- Retrospective cohort study; 99 hip (48.5%) labral repair, and 105hips (51.5%) underwent debridement
- Labral repairs had a lower rate of conversion to total hip arthroplasty (THA)
  - 28 total (13.7%) of the 204 patients underwent conversion to THA within 10 years
    - ✓ labral repair: 5
    - ✓ labral debridement: 23
- No difference in patient reported outcomes or satisfaction
- Age and Tönnis grade were associated with increased risk of conversion to THA

(Kucharik et al., 2022)

Failed Arthroscopy/ Persistent Labral Injuries

- Inadequate osteochondroplasty causing residual impingement, hip dysplasia, progression of osteoarthritis, recurrent labral injury, or insufficient capsular closure.
- Clinical and radiologic assessments help indicate if revision hip arthroscopy is warranted
- Recurring pain post-periacetabular osteotomy (PAO) or labral reconstruction, there should be a systematic approach to determine the root cause to direct treatment.
  - If significant arthritic changes are absent, revision hip arthroscopy should be considered
- For sufficient tissue quality, re-repair is an option
- For degenerative tissue, labral reconstruction should be considered.
- Dr. Nho described a series of 8 patients undergoing hip arthroscopy for failed labral reconstruction and found that capsulolabral adhesions, and residual impingement were the most common findings.

(Perry et al., 2022)

Hip Labrum Reconstruction

- Systematic review of 4 studies
- Durable results at 5 years years post-op
- Three studies performed segmental labral reconstructions; one study used circumferential technique.
- Varying grafts including hamstring autograft/allograft, ligamentum teres autograft, iliotibial band autograft, and tensor fascia lata autograft
- Modified Harris Hip Score (mHHS)
- After labral reconstruction, rates of revision arthroscopy ranged from 4.8% to 13.3% and conversion to total hip arthroplasty (THA) ranged from 1.6% to 27%.

(Curley et al., 2023)

Femoroacetabular Impingement (FAI)

- Increased incidence due to better diagnostic and clinical detection
- Between 2011 and 2018 there was an 85% increase in hip arthroscopies in a US insurance database

(Perry et al., 2022)

Femoroacetabular Impingement (FAI), continued

- Premature contact between the proximal femur and acetabulum
- Loss of femoral head-neck concavity associated with cam morphology during hip flexion and internal rotation.
- Contributing factors:
  - femoral neck-shaft angle
  - acetabular anteversion angle
  - acetabular inclination angle
  - acetabular depth

(Cannon et al., 2023)

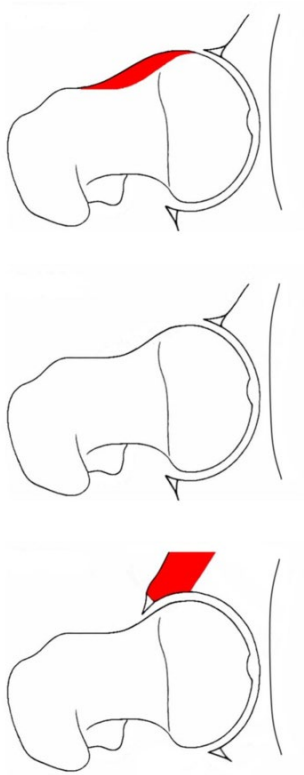
FAI Types Based on Morphology

- **Cam:** Extra bone on the femoral head/neck (alpha angle > 42-55°)
- **Pincer:** Over-coverage by the acetabulum
- **Combined:** Both Cam and Pincer
- **Supine Impingement:** Overgrowth of the anterior inferior iliac spine (AIS)

(Cannon et al., 2023)

Cam and Pincer Deformities

- Cam deformity (top)
- Normal (middle)
- Pincer deformity (bottom)



(Thomas et al., 2013)

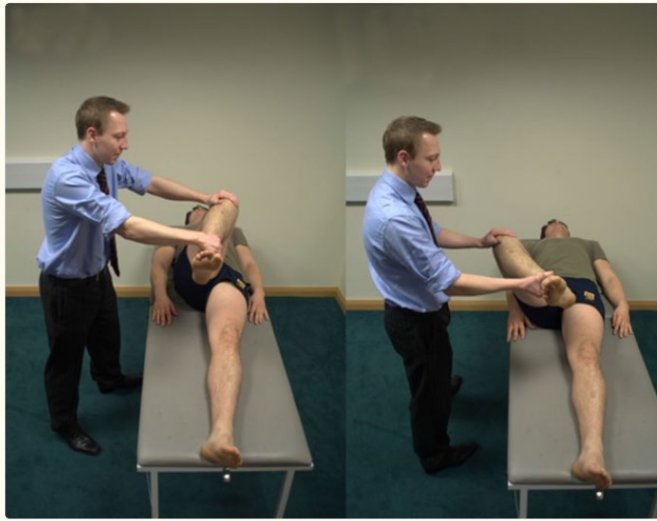
FAI: Presentation

- Active adults age 25-50
- Antalgic or Trendelenberg-gait
- Discomfort after activity
- Anterior hip pain
- Groin pain
  - Anterior impingement with pain after hip flexion, associated with either cam or pincer deformities
  - Sprinting, kicking, hill climbing, prolonged sitting in low chairs can exacerbate pain
- Referred pain to the anterior thigh, symphysis pubis, or the ipsilateral testicle in men.
- Posterior impingement with pain in the buttock or sacroiliac region associated with pincer deformity.
  - Exacerbated with hyperextension- fast-walking, or walking downhill
  - Posterior hip pain during intercourse is also a frequent complaint in women.

(Thomas et al., 2013)

FAI: Examination

- FADIR: flexion, adduction, and internal rotation
- FABER: flexion, abduction, and external rotation.
- Positive test induces pain
  - 90% of patients with FAI have a positive test
  - Predictive of labral pathology



(Thomas et al., 2013)

Polling Question 3

What is the most common area for hip labral tears?

A) supero-posterior

B) supero medial

C) supero lateral

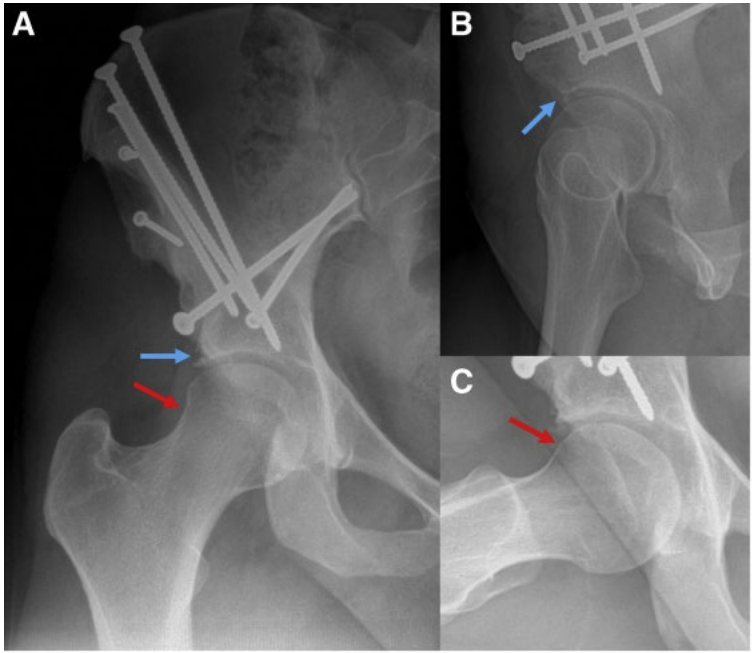
D) antero-superior

Diagnostic Imaging

- Anteroposterior pelvis x-ray with a cross-table lateral or Dunn view radiographic evidence can be subtle or appear normal.
- MRI arthrogram (MRA) with intra-articular contrast is the Gold standard.
- CT if complex bony deformity

(Thomas et al., 2013)
(Perry et al., 2022)

Diagnostic Imaging, continued



A: Standing anteroposterior
B: False Profile
C: Dunn

(Perry et al., 2022)

Nonoperative vs Operative treatment

- Nonoperative treatment is first-line
  - Activity modification, NSAIDS
- Operative management when refractory to nonoperative modalities

(Thomas et al., 2013)

Femoroacetabular Impingement

- Retrospective study of consecutive active-duty patients receiving mini-open arthroscopic-assisted surgery for FAI between 2007 and 2011
- 1 year minimum of follow-up
- 24% had cam and pincer lesions
  - femoral neck osteochondroplasty and acetabular rim trimming.
- (76%) had isolated cam lesions
  - femoral neck osteochondroplasty

(Ernat et al., 2019)

Active Duty after FAIS

- 78% of service members could return to duty at follow-up of 2.8 years post-surgery for FAI!
  - 25% returned to duty with restriction
  - More likely medically discharged in Marines vs Army
    - ✓ 22% medically discharged
- More likely to receive permanent activity restrictions after labral repair and acetabular chondroplasty performed in conjunction with femoral neck compared to femoral neck osteochondroplasty alone.
  - Suggestive of degenerative or traumatic pathology, in conjunction with femoral neck deformity
- Previous studies show correlation of poor outcomes of FAI surgery and joint space narrowing of 2 mm or less
  - Not found in this study, likely due to small sample size of patients with a joint space of 2 mm or less

(Ernat, 2019)

Hamstring Tears

- Hamstring muscles include the semimembranosus, semitendinosus, and biceps femoris (BF) short and long heads
  - Deceleration of the lower limb during running and kicking movements while these muscles are at high strain and stretch.
- Hamstring injuries are among the most common in active populations, often occurring with forceful eccentric contraction and sprinting
  - Hip extended with knee flexed
- Most hamstring strain injuries are “sprint-type,” occurring during high-speed running.
  - Most commonly affect proximal long head of the biceps femoris at the musculotendinous junction and/or intramuscular belly.
- “Stretch-type” hamstring injuries
  - end-range hip flexion and knee extension,
  - Commonly involve proximal semimembranosus tendon.

(Larson et al., 2024)

Hamstring anatomy

- Hamstrings are biarticular muscles spanning both the hip and knee joints.
- Proximal attachment: ischial tuberosity
  - Site where biceps femoris longhead (BFLH) and semitendinosus conjoin.
  - BFLH also attach at the sacrotuberous ligament, connection to the sacroiliac joint (SIJ)
    - ✓ Thus BFLH is influenced by pelvic and SIJ stability
- Distally attachment:
  - the biceps femoris shorthead inserts on the lateral fibula head, fibres blending with the lateral collateral ligament, iliotibial band and fascia
  - semimembranosus and semitendinosus attach to the medial tibia, merging with the medial collateral ligament, meniscus and pes anserine.

(Bramah et al., 2024)

Hamstring Tears: Epidemiology & Mechanism

- Hamstrings extend the hip and flex the knee
- Aid rotational and translational stability at the knee.
- Contribute to stability of sacroiliac (SI) joint and pelvis
- Most prevention focuses on eccentric strength exercise to help withstand strain

(Bramah et al., 2024)

Kinematics Increasing Hamstring Strain

- Forward trunk lean increases hamstring length and thus causes greater strain
- Overstriding- foot contacting the ground in front of the center of mass
- Anterior pelvic tilt
- Trunk lateral flexion and rotation
- Lumbar extension

(Bramah et al., 2024)

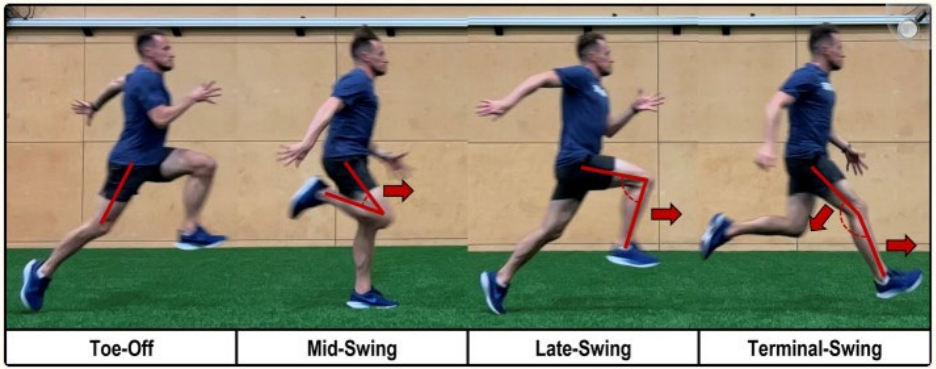
Kinematic and Hamstring Strain Injuries

Parameter	Proposed Biomechanical Link to Hamstring Strain Injury	Biomechanical Evidence
Lumbo-Pelvic Control	Reduced control proposed to influence load transference to hamstrings due to anatomical connections between pelvis & hamstrings.	Prospective cohort studies: 1 study: ↑ GMed EMG [57] 1 study: ↓ GMax, Oblique & Erector spinae EMG [56] 1 Modelling study: Trunk muscles reduce BFLH stretch [35]
Anterior Pelvic Tilt	APT causes a rotation of the ischial tuberosity in the posterior and superior direction, lengthening the proximal hamstrings and increasing tissue strain.	1 prospective & 1 retrospective study: ↑ APT in injured individuals [54, 68] 1 prospective study: N.S.D APT injured v controls [55]
Forward Trunk Lean	Increases hamstring tissue lengths during stance. May also lead to compensatory kinematics & kinetics including, APT, overstride & ↑ hip extensor moments.	1 case study & 1 2D video analysis suggest ↑ trunk lean in subsequently injured individuals [98, 99] 1 modelling study: ↑ trunk lean ↑ hamstring length [94]
Trunk Lateral Flexion	Alters lever arms of trunk musculature resulting in reduced trunk muscle ability to stabilise the pelvis for force transfer.	Prospective cohort studies: 2 studies: ↑ Trunk Side Flexion [54, 55] 1 Modelling study: Trunk muscles reduce BFLH stretch [35]
Maximal Hip Flexion Angle	Possible performance v injury paradox. Greater MHF ↑ the distance for the lower limb to unfold during swing, generating ↑ angular accelerations of the lower limb & ↑ vGRF application. However, may ↑ hamstring tissue lengths, peak force & negative work.	Retrospective studies with conflicting findings: 1 report of ↑ MHF in HSI [68] 2 report ↓ in HSI [88, 89]
Back-Side Mechanics	Increases hip flexor lengths with subsequent impact on APT & contralateral hamstring stretch.	Theoretical evidence from 1 modelling study [35] 2 studies with inconsistent outcome measures (kick-back & inter-thigh angle asymmetries) report N.S.D [78, 83]
Overstride	Increases peak braking leading to ↑ hamstring requirements to reaccelerate the CoM Increases hip extensor moments during stance & tissue lengths at initial contact.	Conflicting findings & inconsistent reporting of parameters. 2 retrospective studies: 1 reporting ↑ HF angle at contact [68], 1 reporting N.S.D [89]
Lumbar Extension	Repeated extension may lead to nerve root irritation & altered motor neurone function. Possible influence via kinematic coupling with APT.	No supporting evidence: anecdotal theory.

(Bramah et al., 2024)

Lower Limb Kinematics Across Sprint Cycle

- Swing phase, rapid flexion and extension of the hip generates large angular accelerations.
- Muscles forces are 10x body weight at peak swing.



(Bramah et al., 2024)

Signs and Symptoms

- Sudden onset posterolateral pain, ecchymosis, weakness

Diagnosis and Classification

- MRI is the gold standard for diagnosis
- Pain with clinical tests i.e., straight leg raise, bent knee test

(Allahabadi et al., 2024)

Hamstring Injury (HSI) Grading

- Grade I - microscopic tearing with minor swelling and discomfort and little to no loss of strength
- Grade II - gross partial tear with clear weakness
  - Grade I and II HSIs can be treated nonoperatively with a 3-phase protocol.
- Grade III - complete rupture with total loss of function.
  - often traumatic injuries
  - open or endoscopic repair; goal of returning to sport ~4 to 6 months postoperatively

(Larson et al., 2024)

Management Strategies: Conservative vs Surgery

- Treatment is dictated by tear location, severity, and chronicity.
- Nonoperative treatment: activity modification and physical therapy and possibly platelet-rich plasma injections
- Operative treatment: including endoscopic or open approaches
  - 2-tendon injuries with >2 cm of retraction
  - 3-tendon injuries
  - nonoperative treatment of 6 months does not improve injury

(Allahabadi et al., 2024)

Open vs Endoscopic Proximal Hamstring Repair

- 35 patients providing ≥ 5 year post-op data
  - 65.7% female; mean age, 52.3 ± 8.4; BMI, 26.3 ± 5.2
  - mean follow-up of 69.0 months
  - Mean duration from symptom onset to surgery: 37.9 weeks
- Confirmed tears on MRI
  - 11 partial-thickness tears
    - ✓ lesion to the conjoint tendon or the semimembranosus tendon.
  - 24 full-thickness tears
    - ✓ amount of tendon retraction from the ischial tuberosity was measured
  - 23 patients (65.7%) having chronic preoperative symptoms

(Fenn et al., 2023)

Patient Categories

- Patients grouped by:
  - procedure type (open vs endoscopic)
    - ✓ 23 patients had open repair; 12 patients had an endoscopic repair.
  - chronicity (acute vs chronic); chronic defined as as ≥4 weeks of pain
  - tear size (partial vs complete)
    - ✓ full-thickness tears categorized by <3 cm or >3 cm of retraction on MRI.

(Fenn et al., 2023)

Surgical Management Indications

General Indications for Surgical Management of Proximal Hamstring Injuries [12]

Overall indications	• 3-Tendon, complete, proximal avulsions • Partial avulsions of ≥2 tendons and >2 cm of retraction in young/active patients • Partial avulsions refractory to 6 months of conservative treatment
Open approach	• Complete tears with 3-tendon avulsion • Two hamstring tendons tears retracted >5 cm • Refractory chronic insertional tendinosis
Endoscopic approach	• Partial avulsion injuries • High-demand patient with full-thickness with ~2 to 5 cm of retraction • Chronic tendinopathy with partial- or full-thickness tear after failure of conservative management • Tendon remains under the gluteus maximus

(Fenn et al., 2023)

Patient Reported Outcomes (PROs)

Open and Endoscopic 5-year PROs

Measure	Open	Endoscopic
HOS-ADL	86.9 ± 11.4	84.4 ± 16.1
HOS-SS	80.8 ± 19.7	80.2 ± 23.3
iHOT-12	84.9 ± 16.1	84.8 ± 15.5
PROMIS-PF	50.7 ± 12.8	48.7 ± 8.2
PROMIS–Pain	51.2 ± 7.4	49.6 ± 8.5

(Fenn et al., 2023)

Open Postoperative Complications

- Overall the open approach has more complications
  - all patients who had a complication had retraction >2 cm
  - 7 (30.4%) reported postoperative complications and 1 person had a revision at 50.1 months postoperatively 2 patients had persistent neuropathy (1 posterior thigh, 1 posterior calf pain)
    - ✓ At 5-year post-op, 1 patient's neuropathy resolved, 1 had no significant change.
  - 1 patient had persistent numbness around the incision
  - 1 patient had both superficial cellulitis and prolonged sitting pain
    - ✓ No significant change in sitting pain at 5 years post-op
  - 1 patient had a deep surgical wound infection
  - 2 patients had superficial cellulitis and persistent numbness around the incision
    - ✓ 5 years post-op 2/3 patients with incisional numbness noted improvement

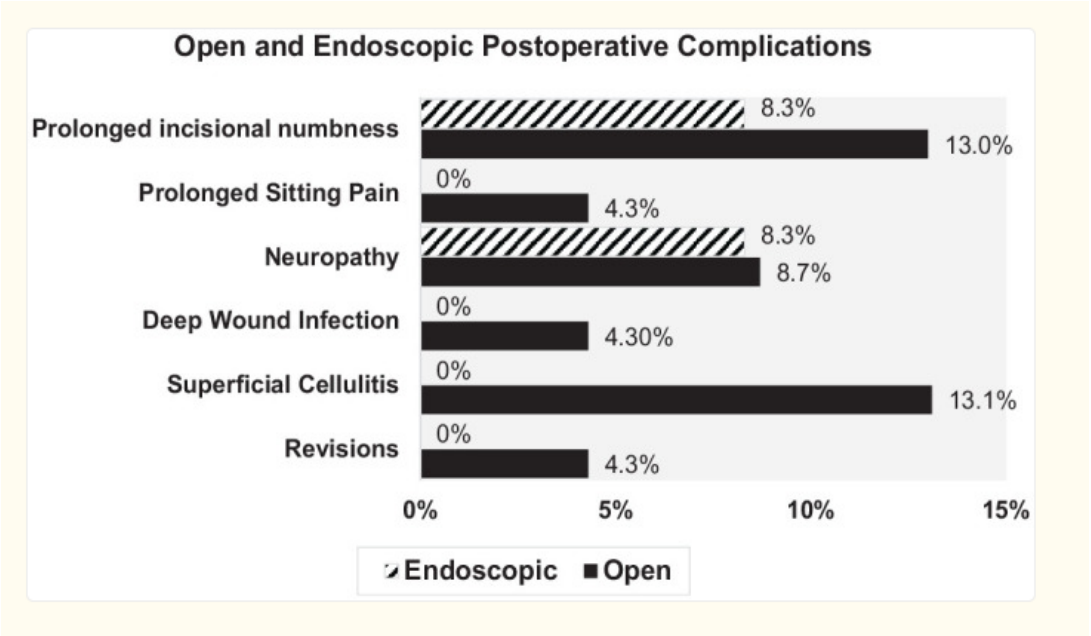
(Fenn et al., 2023)

Endoscopic Postoperative Complications

- 2 (16.7%) patients reported postoperative complications
  - 1 patient had persistent neuropathy (posterior thigh/calf pain)
  - 1 patient had persistent incisional numbness.
    - ✓ 5 years post-op, both patient's numbness had improved

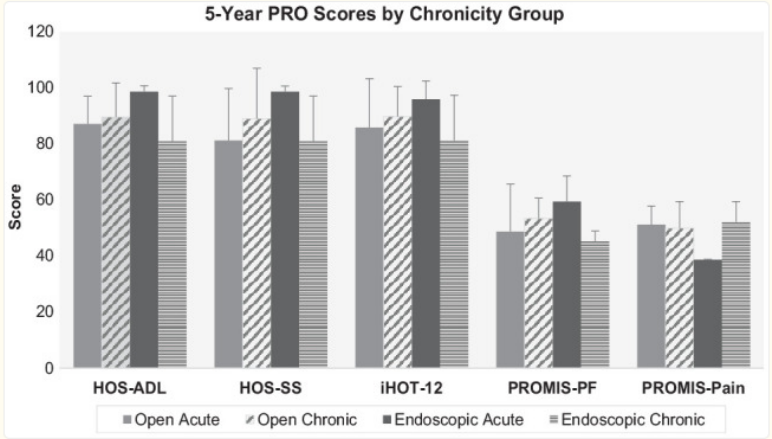
(Fenn et al., 2023)

Open vs Endoscopic Postoperative Complications



(Fenn et al., 2023)

5-Year PRO Scores by Chronicity Group



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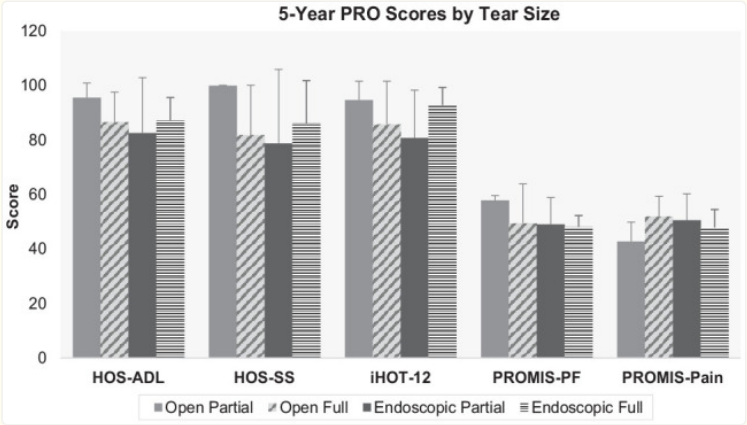
Open and endoscopic 5-year patient-reported outcomes (PROs) stratified by chronicity group (acute vs chronic). Error bars indicate standard deviations. HOS-ADL, Hip Outcome Score Activities of Daily Living subscale; HOS-SS, Hip Outcome Score Sports-Specific subscale; iHOT-12, 12-Item International Hip Outcome Tool; PROMIS, Patient-Reported Outcomes Measurement Information System for Physical Function (PF) and Pain subscales.

(Fenn et al., 2023)

5-Year PRO Scores by Tear Size



Open in a new tab

Open and endoscopic 5-year patient-reported outcomes (PROs) stratified by tear size (partial vs full). Error bars indicate SDs. HOS-ADL, Hip Outcome Score Activities of Daily Living subscale; HOS-SS, Hip Outcome Score Sports-Specific subscale; iHOT-12, 12-Item International Hip Outcome Tool; PROMIS, Patient-Reported Outcomes Measurement Information System for Physical Function (PF) and Pain subscales.

(Fenn et al., 2023)

Rehab Therapy

- Endoscopic repair: formal therapy began 4 weeks postoperatively
- Open repair: formal therapy began 6 weeks postoperatively
- Phase 1 rehabilitation (weeks 0-6): protection of the repaired tendons and avoiding hip flexion and knee extension (hamstring stretch),
  - hinged kneed brace locked at 45° with axillary crutches for up to 8 weeks.
- Phase 2 rehabilitation (weeks 7-12): goal is gait normalization and lower extremity control
  - knee brace was gradually unlocked to 30° of flexion and then to 0°
  - gradual progression off crutches with weightbearing as tolerated.
- Phase 3 rehabilitation (weeks 13-16): goal of good control and limited pain with sport-/work-specific movement and continued advancing in hamstring strengthening.
- Phase 4 rehabilitation (weeks 16-24): goal of return to sport/work with good control and no pain

(Fenn et al., 2023)

Positive Outcomes are Consistent Long-term

- Favorable outcomes achieved at short-term follow-up remain durable to a minimum of 5 years postoperatively
- Consistent across different proximal hamstring injuries and procedures

(Fenn et al., 2023)

Proximal Hamstring Repair vs Reconstruction

- Retrospective cross-sectional study used a large nationwide insurance claims database with deidentified data (PearlDiver).
  - 2,813 patients (54.2% female) were included from 2015 to 2022
    - ✓ 2,656 repair
    - ✓ 157 reconstruction
- Minimum 2-year follow-up

(Wang et al., 2025)

Proximal Hamstring Repair vs Reconstruction, continued

- Repair patients had a lower 2-year reoperation rates and infection
- Repair and reconstruction had similar rates of sciatic nerve injury and venous thromboembolism
- No significant differences in rates of postoperative hospitalization or emergency department (ED) visits

(Wang et al., 2025)

Key Takeaways

- Hip pain is multifactorial — gluteal tears, proximal hamstring tears, femoroacetabular impingement (FAI), and labral pathology frequently coexist and should be considered together rather than in isolation.
- Persistent or activity-limiting pain is not benign — delayed diagnosis can lead to tendon degeneration, labral progression, altered biomechanics, and worse functional outcomes.
- MRI is central for diagnosis and surgical planning, particularly for distinguishing tendinopathy from partial or full-thickness tears and identifying concomitant intra-articular pathology.
- Conservative management is first-line but not indefinite — failure to improve after structured therapy should prompt reassessment and referral.
- Early recognition and appropriate referral improve outcomes, particularly before fatty degeneration, muscle atrophy, or irreversible chondrolabral damage develops.

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