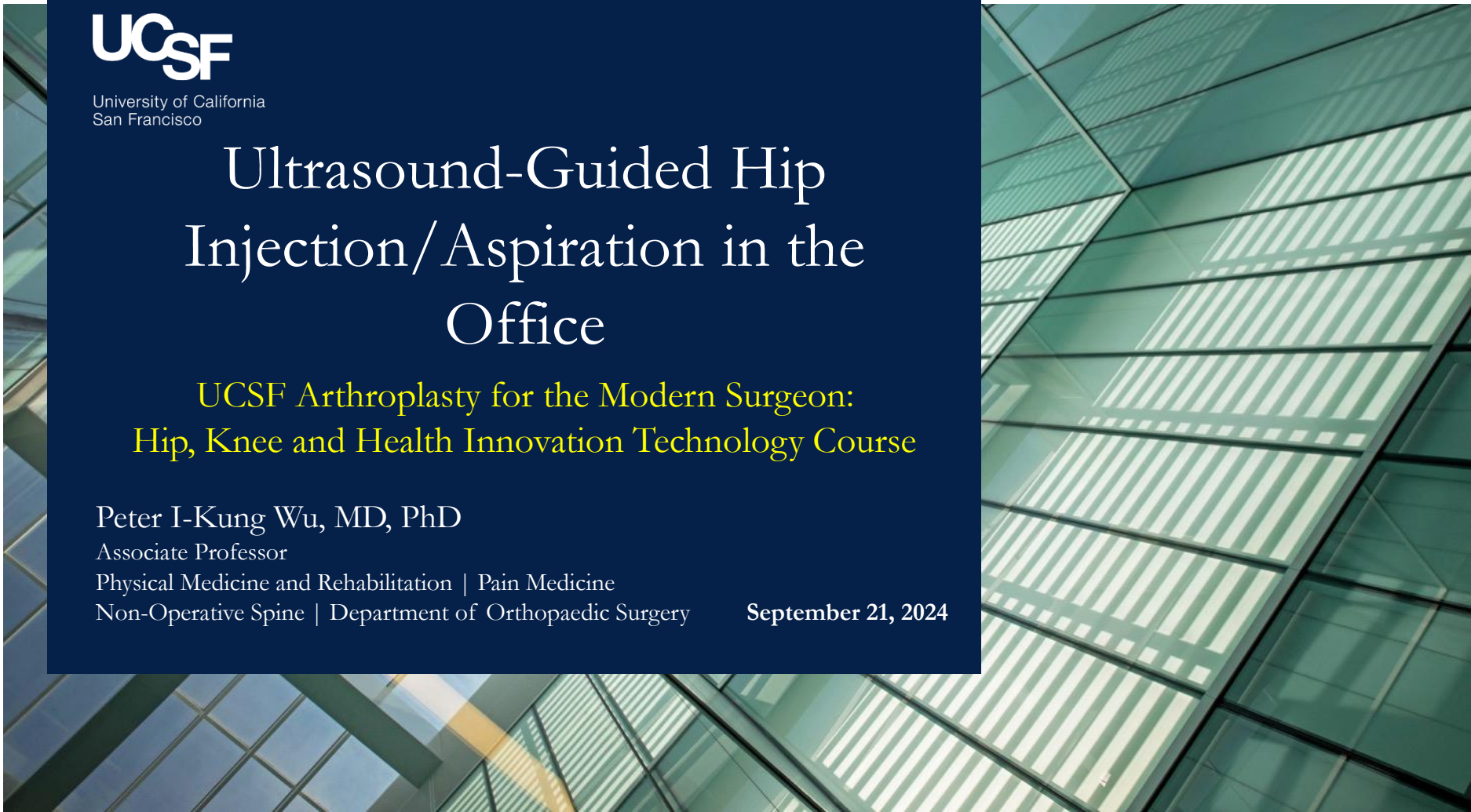


University of California
San Francisco

Ultrasound-Guided Hip Injection/Aspiration in the Office

UCSF Arthroplasty for the Modern Surgeon: Hip, Knee and Health Innovation Technology Course

Peter I-Kung Wu, MD, PhD
Associate Professor
Physical Medicine and Rehabilitation | Pain Medicine
Non-Operative Spine | Department of Orthopaedic Surgery

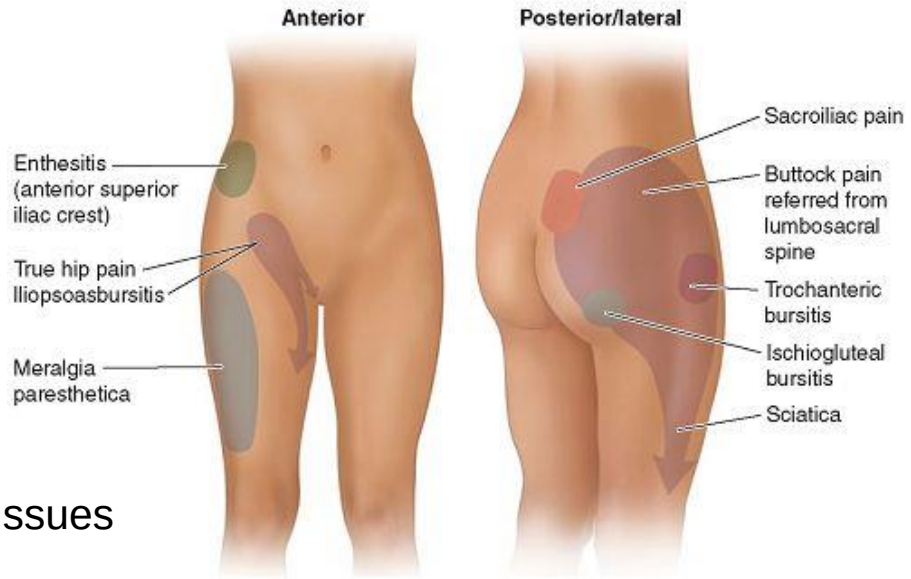
September 21, 2024

Objectives

- Indications, Medications, Preparation for US-guided hip procedures
- Considerations and Methods for US-guided hip interventions
- Evidence for key interventions

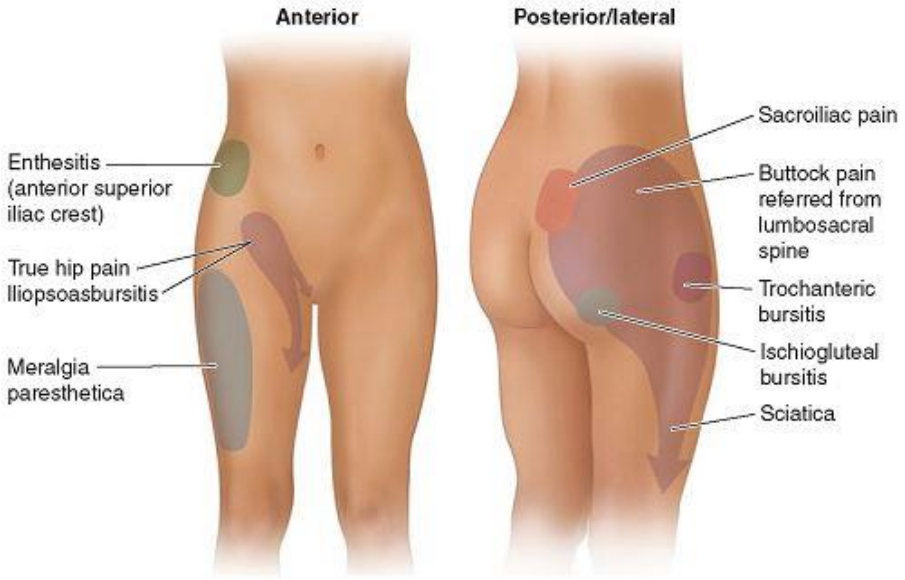
Indications

- Percutaneous musculoskeletal intervention serves to:
  - Identify pain generators
  - Manage hip pain
  - Bridge to surgery
- Ultrasound guidance offers:
  - Low cost and portability
  - Lack of ionizing radiation
  - Real-time visualization of soft and bony tissues
  - Dynamic testing



Indications

- Common indications for ultrasound-guided injections
  - lack of surface anatomic landmarks
  - aberrant or deeper anatomy
  - proximity to neurovascular structures
  - bleeding diathesis
  - need to avoid radiation exposure
  - failure of a non-guided procedure
  - diagnostic injection



Medications

- **Steroids**
- **Orthobiologics**

https://orthoinfo.aaos.org/en/treatment/orthobiologics-faq/

Medications – Steroids

- **Steroids**
  - **Corticosteroids**
    - analog of cortisol, a glucocorticoid class of steroid hormones that control metabolism and inflammation (i.e., reduce levels of phospholipase A2)
      - **Triamcinolone** acetonide and **methylprednisolone** acetate
  - **Treatment:** treat inflammation or pain of hip structures, such as synovium, bursa, tendon sheath, and spinal and peripheral nerves

Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199.
MacMahon et al. Radiology 2009;252(3):647–661.
Vane J, Botting R. FASEB J. 1987 Aug;1(2):89-96.

Medications – Steroids

- **Steroids**
  - effect is gradual
  - symptom relief may not begin until 3–14 days
  - therapeutic benefit can last a few weeks to several months depending on the condition

Potential Adverse Effects of Steroids
Rare complications
Septic arthritis
Tendon rupture
Chondrotoxicity
Cutaneous atrophy and depigmentation
Avascular necrosis
Nerve injury
Relatively common transient adverse effects
Corticosteroid flare
Facial flushing
Transient headache
Nausea and vomiting
Stomach upset
Hyperglycemia
Hypertension
Palpitations

Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199.
Cole et al. J Am Acad Orthop Surg 2005;13(1):37–46.

Medications – Orthobiologics

- **Platelet-Rich Plasma (PRP)**
  - platelets are known for their role in coagulation, but are essential in activating tissue healing by releasing growth factors
  - platelet concentration above physiologic concentration in whole blood, at least 5x, or 1 x 10^6/μL, achieved by centrifugation of the patient's own blood
  - **Treatment:**
    - promote healing at the site of injury, in relatively low-vascularity structures such as tendon
    - provide longer-term relief

Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199.
Lee et al. AJR Am J Roentgenol 2011;196(3):628–636

Medications – Orthobiologics

- **Viscosupplementation**
  - **Hyaluronic acid (HA)**
    - high molecular-weight viscoelastic glycosaminoglycan present in cartilage and synovial fluid
    - serves as lubricant and regulator of cellular activities in normal joints
  - **Treatment:**
    - provide anti-inflammatory, analgesic, and chondroprotective effects

AAOS Clinical Practice Guideline Summary

American Academy of Orthopaedic Surgeons Clinical Practice Guideline Summary Management of Osteoarthritis of the Hip

Intra-articular Hyaluronic Acid

Intra-articular hyaluronic acid should not be considered for treatment of symptomatic OA of the hip because it does not improve function or reduce pain better than placebo.

Strength of recommendation: Strong. ★★★★

Journal of Orthopaedics

Viscosupplementation for hip osteoarthritis: Does systematic review of patient-reported outcome measures support use?☆

Alexander J. Acuña, Linsen T. Samuel, Stacy H. Jeong, Ahmed K. Emara, Atul F. Kamath*

Department of Orthopaedic Surgery, Cleveland Clinic Foundation, Cleveland, OH, USA

Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199. | Bowman et al. Clin Transl Med 2018;7(1):6.
Hannon CP, et al. J Am Acad Orthop Surg. 2024 Jun 6. | Sabha M, et al. Osteoarthr Cartil Open. 2021 Dec 25;4(1):100232.
Acuña et al. J Orthop. 2020 Mar 25;21:137-149.

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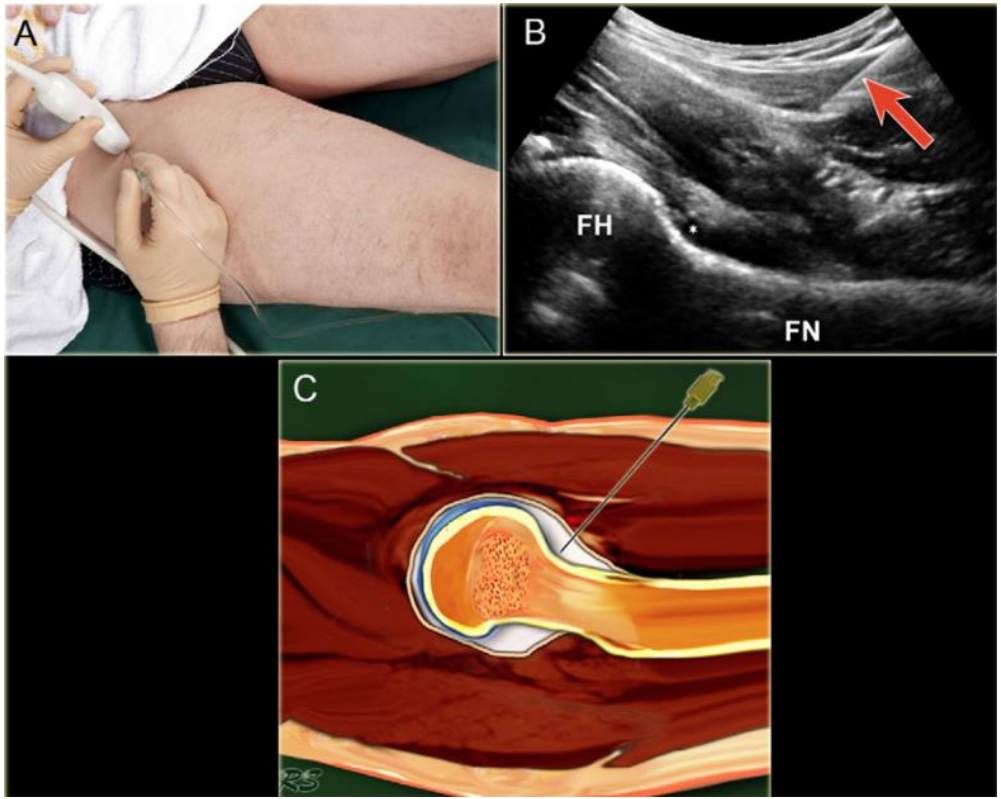
Ultrasound Guided Injections



Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199.
https://radiologyassistant.nl/musculoskeletal/us-guided-injection-of-joints

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Preparation

- **Ultrasound Transducer Selection**

Curvilinear
~2.5-5 MHz

Linear
~5-12 MHz

Linear “Hockey Stick”
~10-18 MHz

Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199.
Malanga and Mautner. Atlas of Ultrasound Guided Musculoskeletal Injections. New York: McGraw-Hill Education.2014
Baloch et al. Int J Surg. 2018 Jun;54(Pt B):333-340

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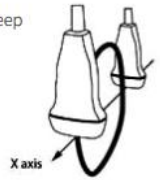
Preparation

Consensus statement

Recommended musculoskeletal and sports ultrasound terminology: a Delphi-based consensus statement

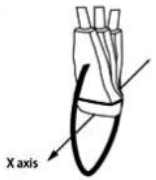
- **Ultrasound Transducer Manipulation**

Sweep



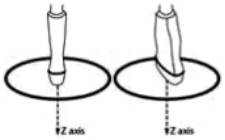
Motion in the short axis of the probe across the body with a consistent angle of insonation at 90° to the target

Fan

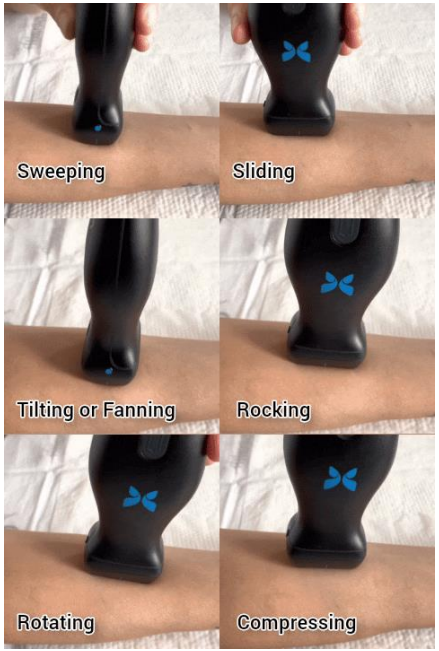


Motion in the short axis of the probe along a fixed point on the body while changing the angle of insonation away from 90°

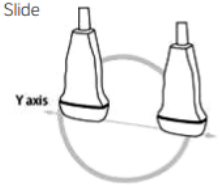
Rotation



Movement around the compression axis in a clockwise or counter-clockwise direction

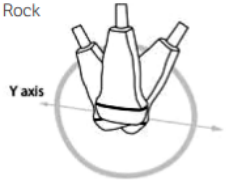


Slide



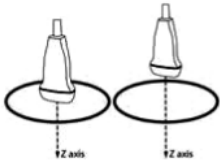
Motion in the long axis of the probe across the body with a consistent angle of insonation at 90° to the target

Rock



Motion in the long axis of the probe along a fixed point on the body while changing the angle of insonation away from 90°

Pressure/compression



Pressure on the probe into the body, compression of the body by applying force on the probe toward the patient's body

Hall MM, et al. 2022 Oct;41(10):2395-2412. | Bahner DP, et al. J Ultrasound Med. 2016 Jan;35(1):183-8.
https://sinaiem.org/foam/ultrasound-guided-peripheral-intravenous-line/

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Preparation

Arthritis Care & Research
Vol. 72, No. 8, August 2020, pp 1177–1184
DOI 10.1002/acr.24005
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AMERICAN COLLEGE of RHEUMATOLOGY
Empowering Rheumatology Professionals

Musculoskeletal Ultrasound Scanning Protocol Consensus Statements on Scanning Conventions and Documentation in the US

- **Transducer Placement**
  - Long axis (longitudinal)
  - Short axis (transverse)

Long axis

Short axis

- **Image Presentation**
  - 2020 ACR: the radiologic anatomic position is used as a reference with palms facing forward: hence the left side of the ultrasound monitor screen is cranial, anterior, medial, ulnar, or tibial
  - 2017 EULAR: Left side of image is left side from the perspective of sonographer: Left image = right side of body (supine), left side of body (prone)

Hall MM, et al. 2022 Oct;41(10):2395-2412. | Möller I, et al. Ann Rheum Dis. 2017 Dec;76(12):1974-1979.
Torralba KD, et al. 2020 Aug;72(8):1177-1184. | Malanga and Mautner. New York: McGraw-Hill Education.2014.

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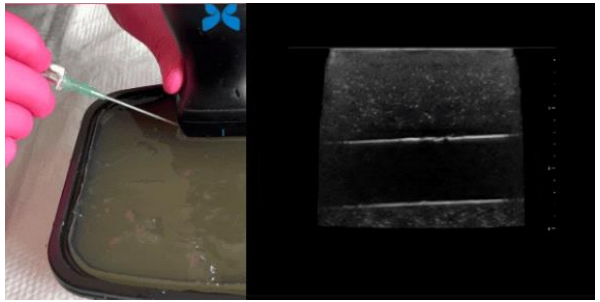
Preparation

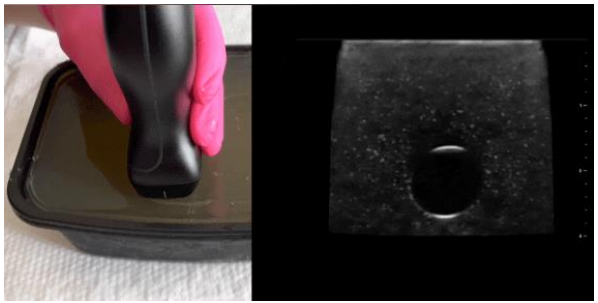
- **Needle Placement**
  - In plane

In plane



  - Out of plane

Out of plane



Malanga and Mautner. Atlas of Ultrasound Guided Musculoskeletal Injections. New York: McGraw-Hill Education.2014
https://sinaiem.org/foam/ultrasound-guided-peripheral-intravenous-line/

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Preparation

- **Supplies**

Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199.
Baloch et al. Int J Surg. 2018 Jun;54(Pt B):333-340

Considerations

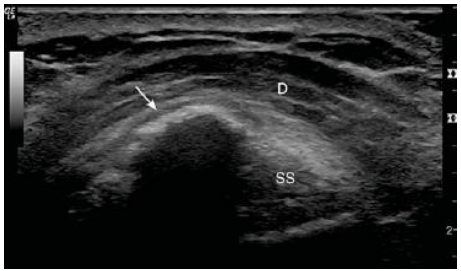
- **Echogenicity**

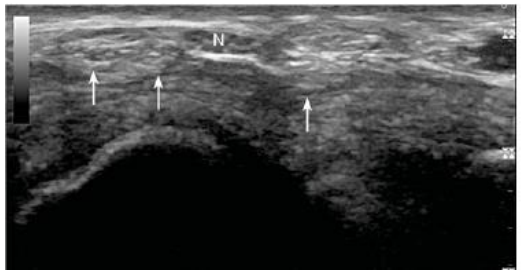
Anechoic	Black	Fluid	Blood vessels or swelling/inflammation
		Hyaline Cartilage	At end of long bones, surrounded by bright white periosteum
	Grayscale	Fat	Hazy streaks below skin
Hypoechoic		Muscle	Fasciculated/ speckled hypoechoic with hyperechoic striations, encased by bright fascia
		Tendon	Linear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

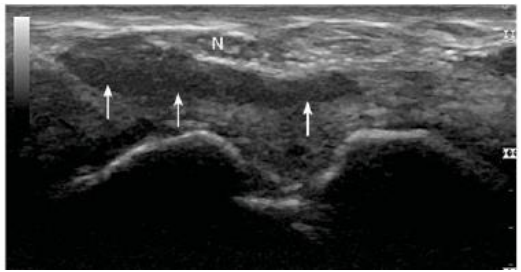
Page P, et al. Int J Sports Phys Ther. 2023 Feb 2;18(1):1-10.

Considerations

- **Artifacts**
  - Acoustic Shadowing: hyperechoic tissue causes tissue deeper to it to appear dark
  - Anisotropy: the property of certain tissues to have echogenicity that varies depending on the angle of the US beam







Malanga and Mautner. Atlas of Ultrasound Guided Musculoskeletal Injections. New York: McGraw-Hill Education.2014.

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Considerations

- **Risks and Contraindications**

Injection Complications
Procedural Risks
Pain
Infection
Bleeding
Nerve injury
Allergic reaction to the administered therapeutic agent
Contraindications
Active infection
Infectious symptoms / signs within the past 1-2 weeks
Antibiotic therapy within the past 1-2 weeks
Anticoagulation
Anaphylactic reactions to therapeutic agent

Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199.
Baloch et al. Int J Surg. 2018 Jun;54(Pt B):333-340

Considerations

- **Expectations**

Instructions and Expectations
Corticosteroid
Immediate pain relief due to anesthetic medication Corticosteroid effect is gradual - symptom relief may not begin for 3–14d Therapeutic benefit can last a few weeks to several months Corticosteroids do not correct or heal the underlying insult
Activity Recommendations
Avoid exertion of affected limb for the remainder of the day Keep injection site clean and dry and do not submerge in water for 24-48h

Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199.

Considerations

- **Expectations**

Instructions and Expectations
PRP
Avoid the use of nonsteroidal anti-inflammatory drugs and corticosteroids for 2 weeks before and 2 weeks after the injection
Activity Recommendations – Strict Return to Activity Protocol
Immobilization for the first 24–72 hours Early range of motion as allowed by pain Resume physical therapy in 1-2 weeks Gradual increase in activity at 4-6 weeks Activity, as tolerated, at 2 months

Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199.

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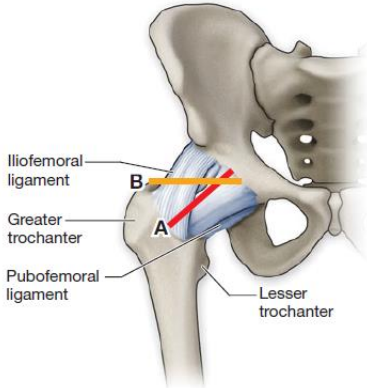
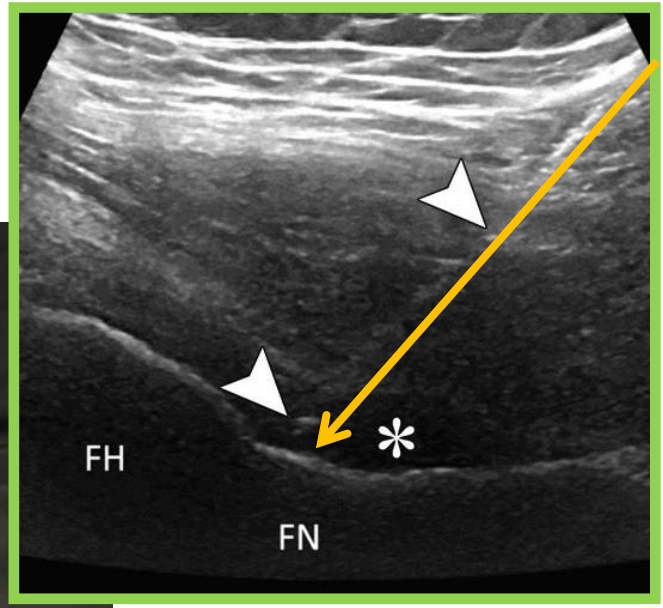
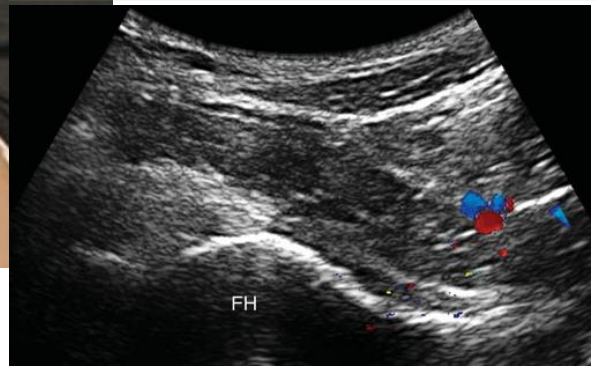
Methods – Anterior Hip

- **Hip Joint**







Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199.
Malanga and Mautner. Atlas of Ultrasound Guided Musculoskeletal Injections. New York: McGraw-Hill Education.2014.

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Evidence – Anterior Hip

- **Hip Joint - Efficacy**
  - **Steroid:**
    - Intra-articular hip joint corticosteroid injections have been shown to reduce pain for up to 3 months
    - Pain relief from steroid (methylprednisolone) injection has been found to correlate with the severity of hip OA on XR (ρ = 0.24 -0.26, p<0.001)

AAOS Clinical Practice Guideline Summary

American Academy of Orthopaedic Surgeons Clinical Practice Guideline Summary Management of Osteoarthritis of the Hip

Intra-articular Corticosteroid Injection

Intra-articular corticosteroids could be considered to improve function and reduce pain in the short term for patients with symptomatic OA of the hip.

Strength of recommendation: Moderate. ★★★☆ (downgraded)

Lambert RG, et al. 2007 Jul;56(7):2278-87. | Waseem et al. Hip Int. 2002 Oct - Dec;12(4):378-382.
Deshmukh et al. Skeletal Radiol. 2011 Nov;40(11):1449-54.
Hannon CP, et al. J Am Acad Orthop Surg. 2024 Jun 6. | Kolasinski SL, et al. Arthritis Care Res (Hoboken). 2020 Feb;72(2):149-162.

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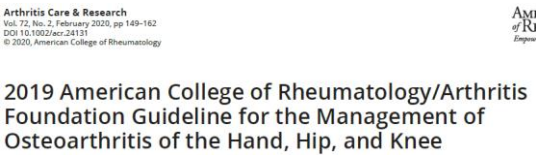
Evidence – Anterior Hip

- **Hip Joint - Evidence**
  - **Risk of Infection:** Insufficient evidence to conclude that an intra-articular steroid injection administered prior to total hip arthroplasty increases the rate of infection
  - **Steroids:** Steroid reduces chondrocyte viability in concentration-dependent manner
  - **Anesthetics:** Local anesthetics can be cytotoxic to chondrocytes, lidocaine / bupivacaine > mepivacaine/ ropivacaine, which is also dependent on concentration and duration of exposure

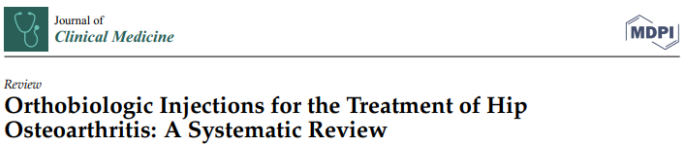
Pereira et al. Bone Joint J. 2016 Aug;98-B(8):1027-35. Grishko et al. J Bone Joint Surg Am. 2010 Mar;92(3):609-18 Euppayo et al. In Vitro Cell Dev Biol Anim. 2016 Aug;52(7):723-35. Busse et al. Bone Joint Res. 2019 Mar 2;8(2):41-48. Jacob et al. Cartilage. 2019 Jul;10(3):364-369. Sabatini FM, et e. Arthroplast Today. 2023 Oct 25;24:101242. | Kreuz et al. Knee Surg Sports Traumatol Arthrosc. 2018 Mar;26(3):819-830.

Evidence – Anterior Hip

- **Hip Joint - Efficacy**
  - **PRP:**



    - 2019 ACR/AF guidelines recommended against the use of platelet-rich plasma to treat hip OA due to concern regarding the heterogeneity and lack of standardization



    - 2022 systematic review of the use of orthobiologics for treating hip OA
    - 6 RCTs, all on PRP
    - safety and overall promising results for improvement in function and pain for potentially 6 mos
    - treatment success being inversely proportional to the severity of OA

Moussa et al. Exp Cell Res. 2017 Mar 1;352(1):146-156.
Kolasinski SL, et al. Arthritis Care Res (Hoboken). 2020 Feb;72(2):149-162.
Zaffagnini M, et al. J Clin Med. 2022 Nov 10;11(22):6663.

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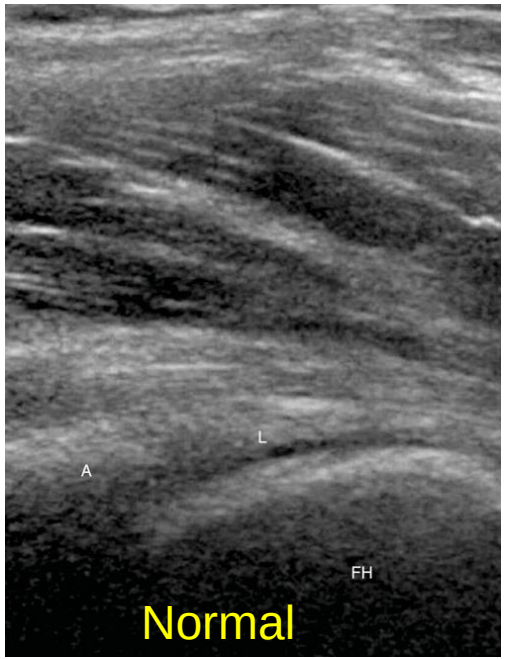
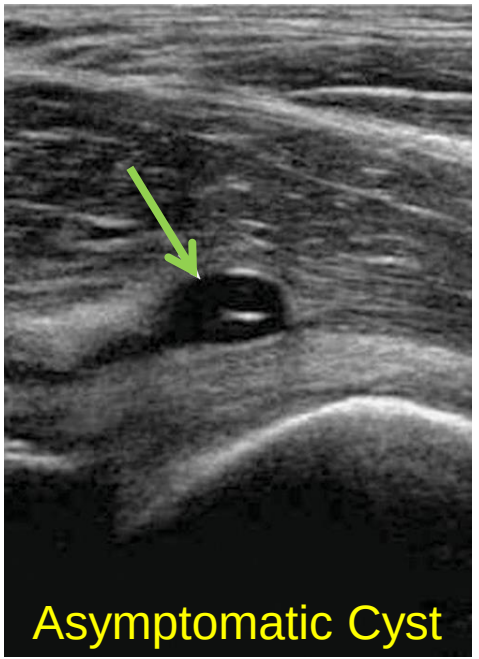
Methods – Anterior Hip

- **Paralabral Cyst Aspiration**





Malanga and Mautner. Atlas of Ultrasound Guided Musculoskeletal Injections. New York: McGraw-Hill Education.2014

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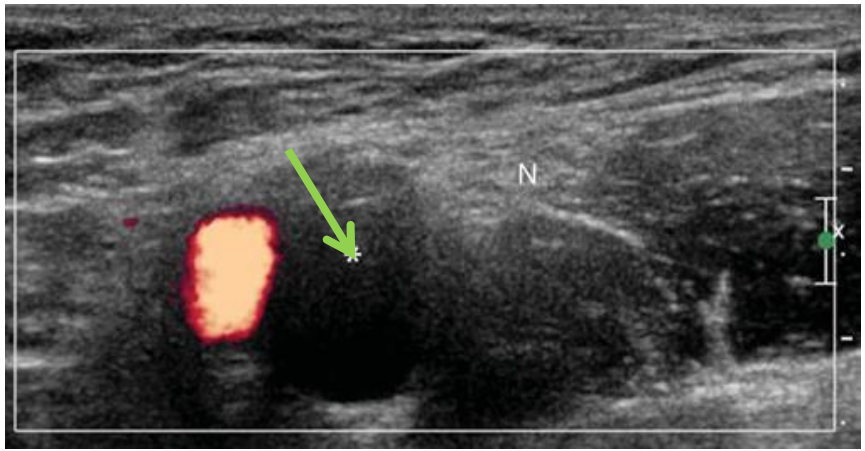
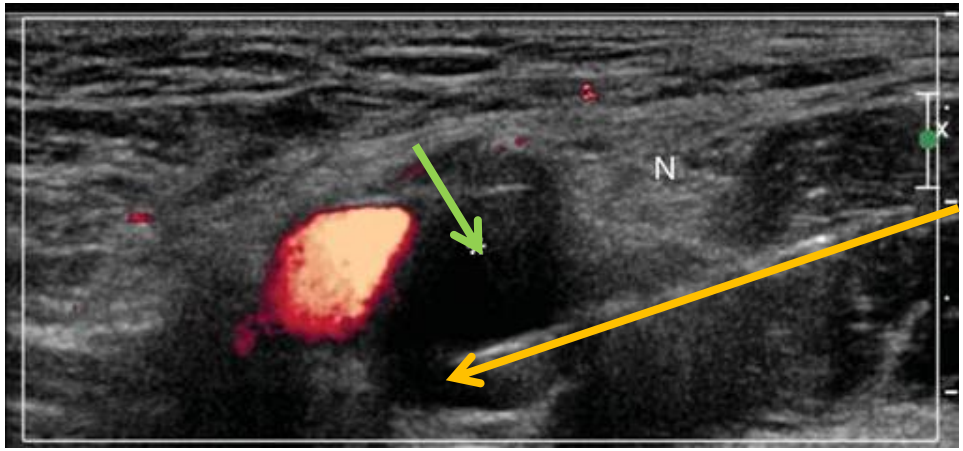
Methods – Anterior Hip

- **Paralabral Cyst Aspiration**





Malanga and Mautner. Atlas of Ultrasound Guided Musculoskeletal Injections. New York: McGraw-Hill Education.2014

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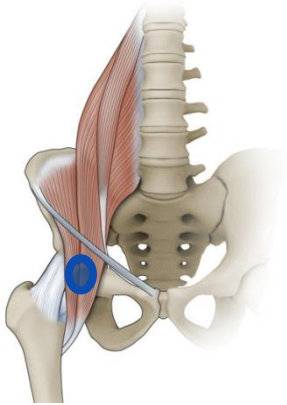
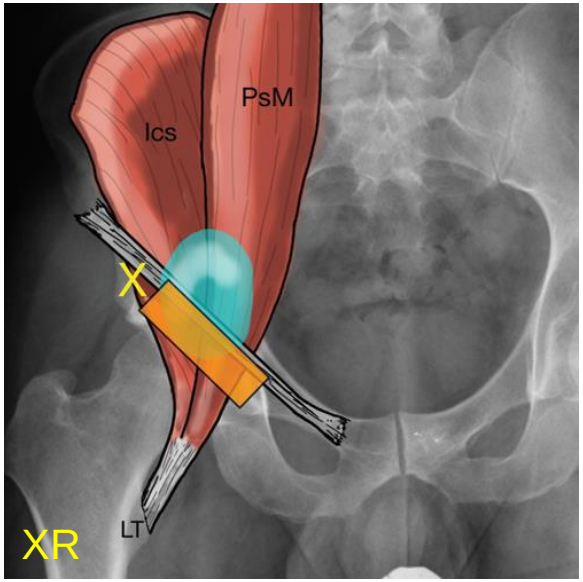
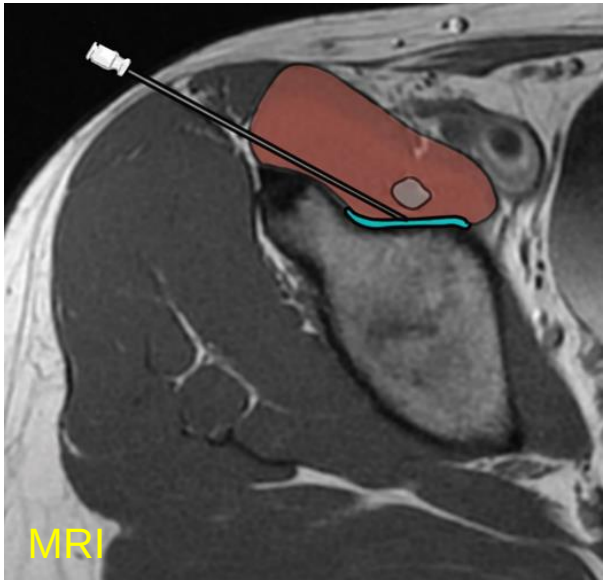
Methods – Anterior Hip

- **Iliopsoas**







Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199.
Blankenbaker et al. Skeletal Radiol 2006;35(8):565–571.

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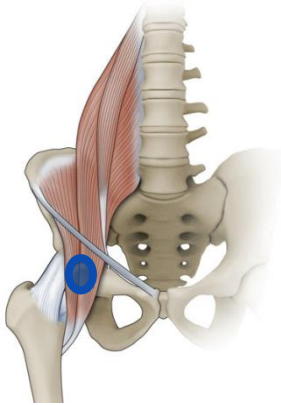
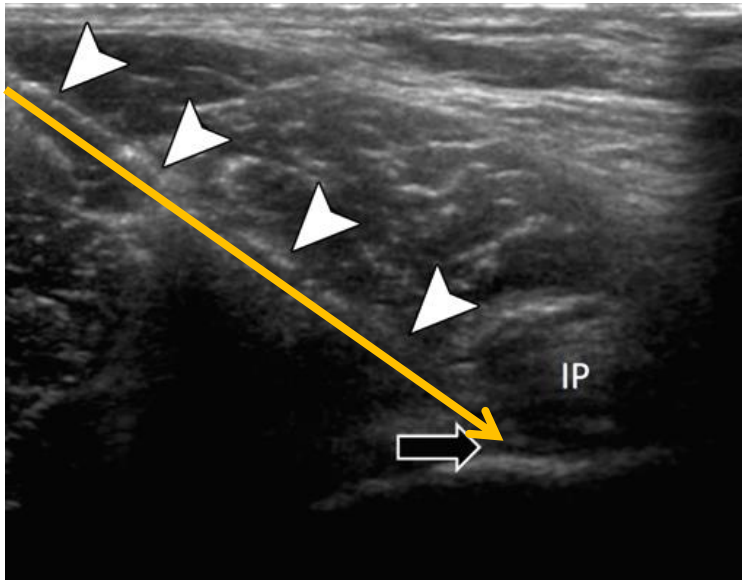
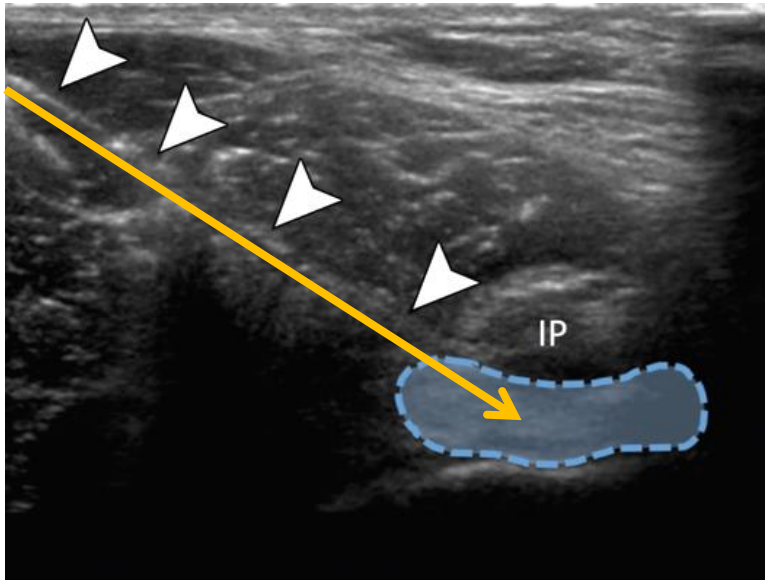
Methods – Anterior Hip

- **Iliopsoas**







Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199.
Blankenbaker DG, et al. Skeletal Radiol 2006;35(8):565–571. | Weintraub MT, et al. J Arthroplasty. 2023 Jul;38(7 Suppl 2):S426-S430.

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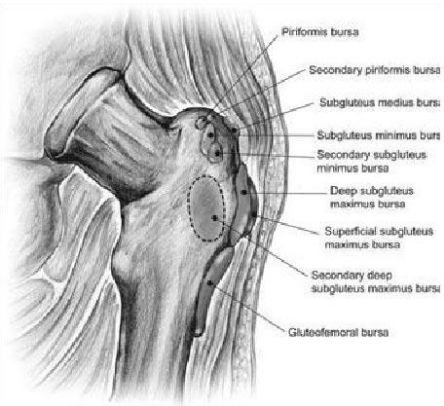
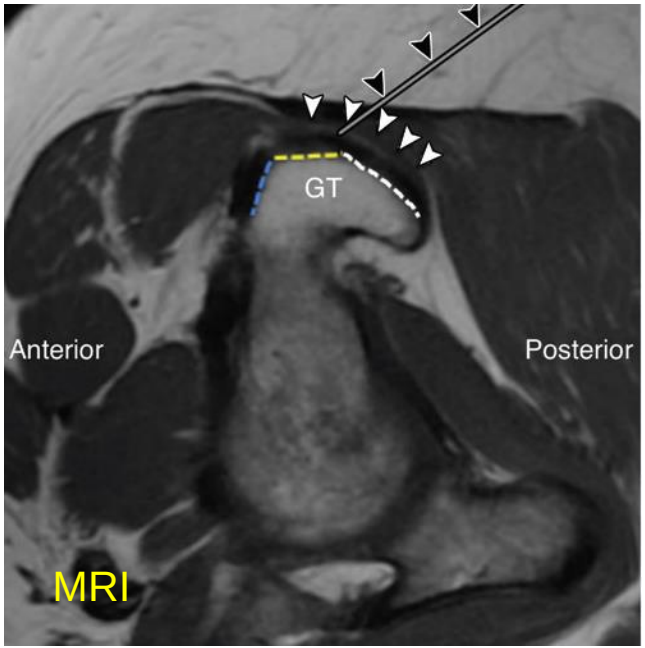
Methods – Lateral Hip

- **Greater Trochanter**





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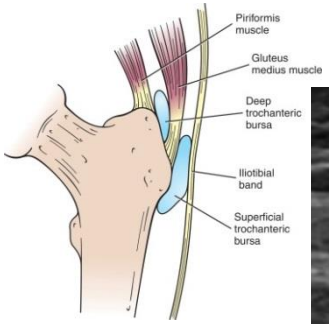
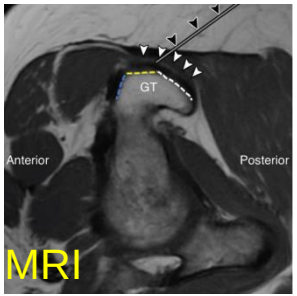
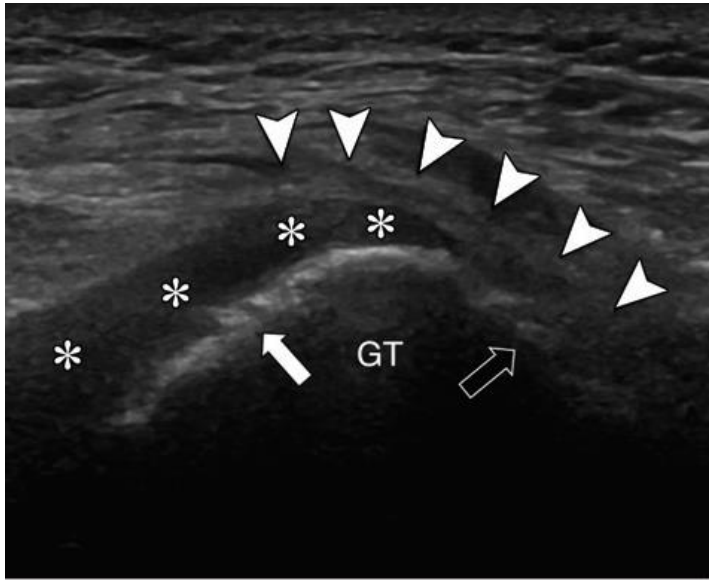
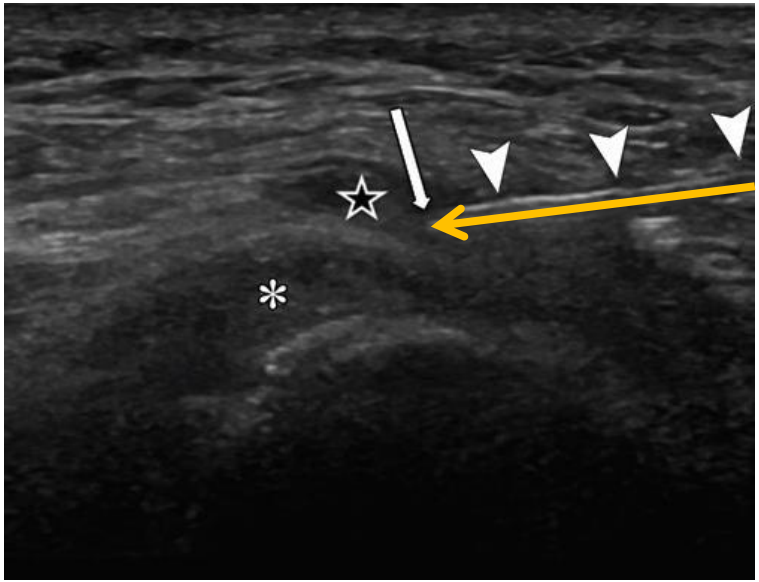
Methods – Lateral Hip

- **Greater Trochanter**









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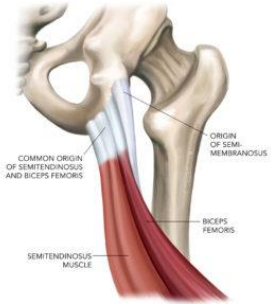
Evidence – Lateral Hip

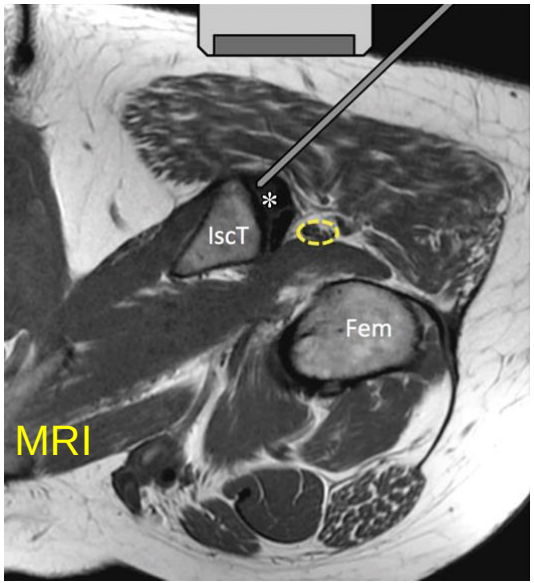
- **Greater Trochanter - Efficacy**
  - **Steroid**
    - Steroid injection vs. usual care for greater trochanteric pain provides greater recovery (55% vs. 34 % of patients), and greater pain reduction by 1.18 on VAS at rest and 1.3 with activity at 3 months. No significant differences at 12 months.
  - **PRP:**
    - Leukocyte-rich PRP injection provides greater improvement in pain and function for gluteal tendinopathy than single injection of corticosteroid, sustained at 2 y, compared to maximal effect from corticosteroid at 6 wks, dissipating by 24 wks

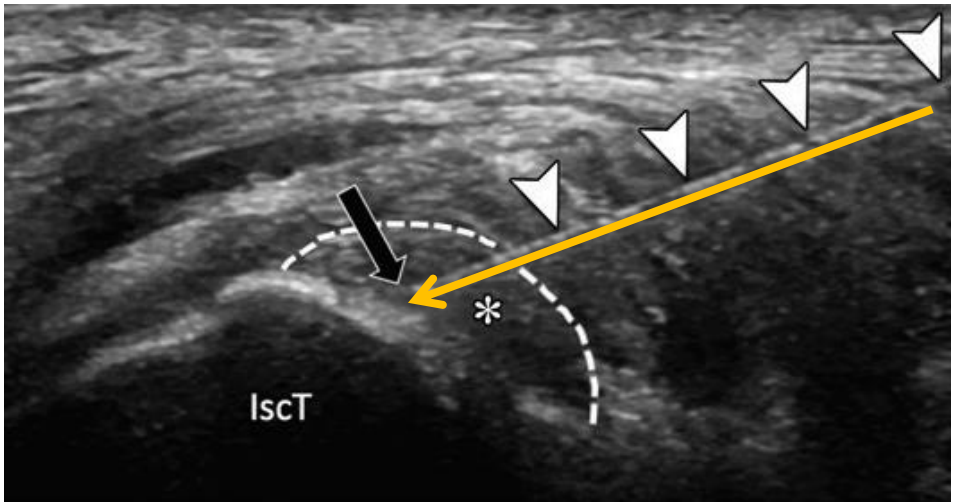
Brinks et al. Ann Fam Med. 2011 May-Jun;9(3):226-34. Nissen et al. Clin Rheumatol. 2019 Mar;38(3):647-655
Fitzpatrick J, et al. Am J Sports Med. 2018 Mar;46(4):933-939. | Fitzpatrick J, et al. Am J Sports Med. 2019 Apr;47(5):1130-1137.

Methods – Posterior Hip

- **Ischial Tuberosity/ Proximal Hamstring Tendon**







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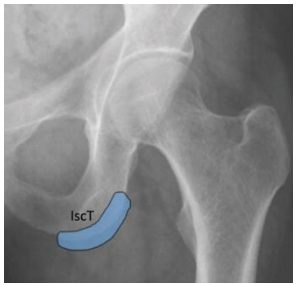
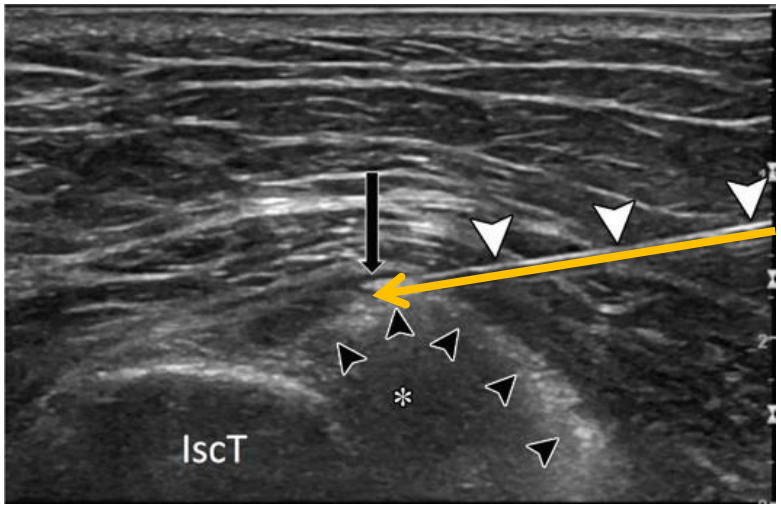
Methods – Posterior Hip

- **Ischial Tuberosity/ Proximal Hamstring Tendon**





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Evidence – Posterior Hip

- **Proximal Hamstring Tendinopathy - Efficacy**
  - **Steroid**
    - Low level evidence: a retrospective study of 65 patients with hamstring tendinopathy who received ultrasound-guided proximal hamstring injections, demonstrated pain relief can be sustained up to 6 months
  - **PRP:**
    - Clinical trials investigating PRP as an alternative treatment option for chronic refractory proximal hamstring tendinopathy demonstrate mixed results, and are mostly low level evidence

Zissen MH, et al. AJR Am J Roentgenol. 2010 Oct;195(4):993-8.
McInnis KC, et al. PM&R. 2020 Oct;12(10):1045-1054.

ICD-10 Code		US Guided Injection	CPT Code
Anterior Hip	**ICD-10**	**Injection**	**CPT**
Hip arthritis Labral tear of hip joint Paralabral cyst of hip Osteophyte of hip Femoroacetabular impingement	**M16.10** **S73.199A** **M24.859** **M25.759** **M25.859**	**Hip joint**	**20611** (injection of medication or drainage of fluid from a major joint or bursa using ultrasound guidance)
Iliopsoas bursitis	**M70.70**	**Iliopsoas bursa**	**20611**
Snapping hip syndrome	**M24.859**	**Iliopsoas tendon**	**76942** (use of ultrasound guidance for needle placement, such as for a biopsy, aspiration, injection, or localization device) plus **20550** (tendon sheath or ligament) or **20552** (trigger point injections into 1 or 2 muscles)
Lateral Hip			
Greater trochanteric pain syndrome Greater trochanteric bursitis	**M25.559** **M70.60**	**Greater trochanter bursa**	**20611**
Tendinopathy of gluteal region	**M67.959**	**Gluteal tendon**	**76942** plus **20551** (tendon origin or insertion)
Posterior Hip			
Hamstring tendonitis Ischial bursitis	**M76.899** **M70.70**	**Hamstring tendon** **Ischial bursa**	**76942** plus **20551** **20611**

Thank you

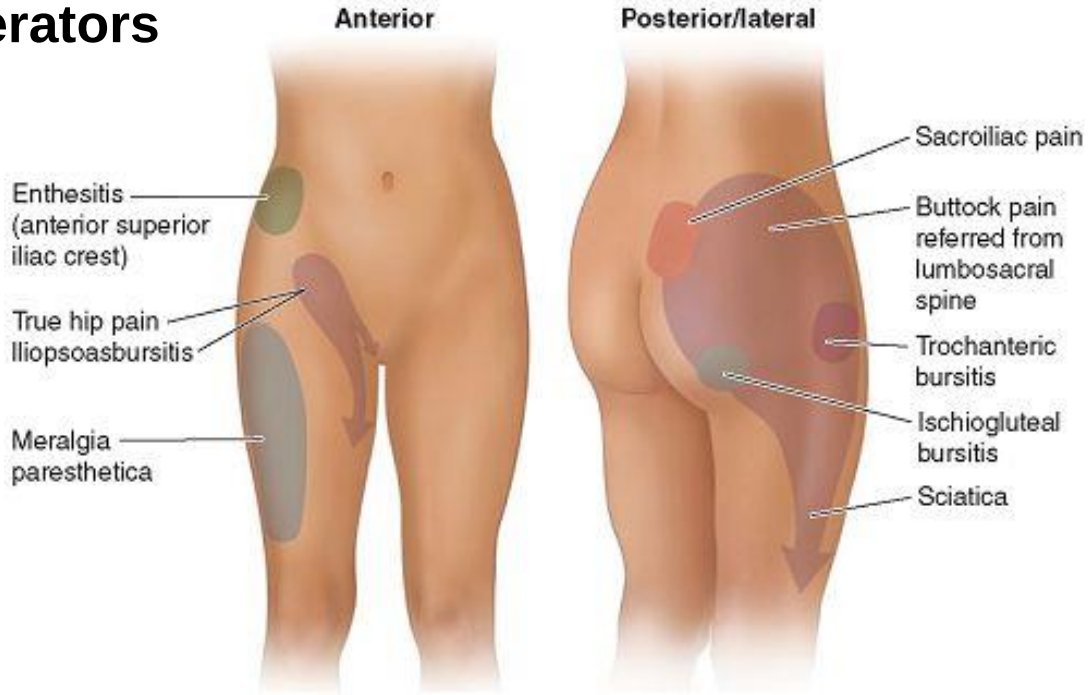
- Questions

Summary

- Preparation and Considerations for US-guided hip procedures
- Methods for Key US-guided hip injections
- Evidence for key interventions

Indications – Hip Pain

- **Pain Generators**



http://hippainrelief.org/wp-content/uploads/2013/08/causes-of-hip-pain-both-sides.jpg

Medications

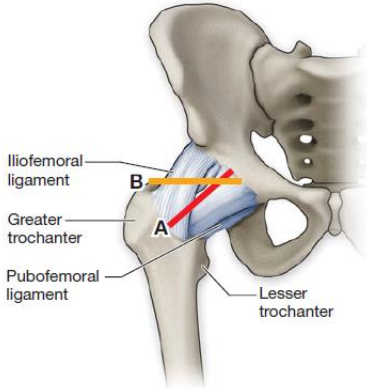
- **Viscosupplementation**
  - **Hyaluronic acid (HA)**
    - different preparations of locally injectable HA differ in molecular weight

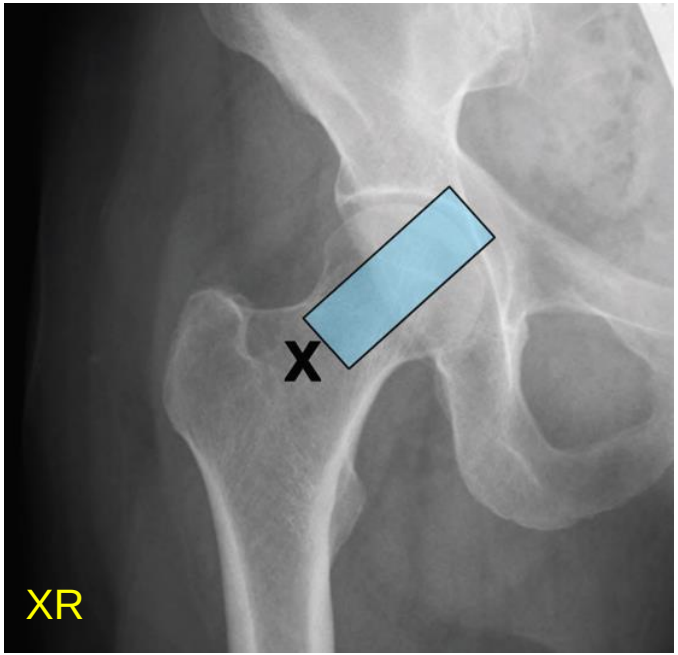
Potential Adverse Effects of Viscosupplementation
High-molecular-weight, cross-linked HA
Acute transient worsening, or flaring, of joint pain in the form of a pseudoseptic reaction after injection

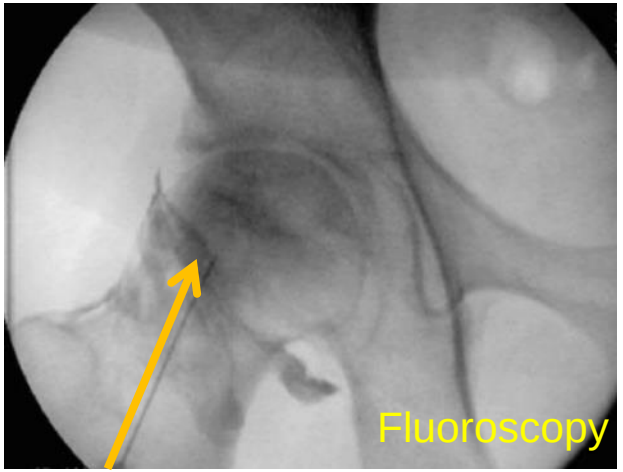
Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199.
Bowman et al. Clin Transl Med 2018;7(1):6.

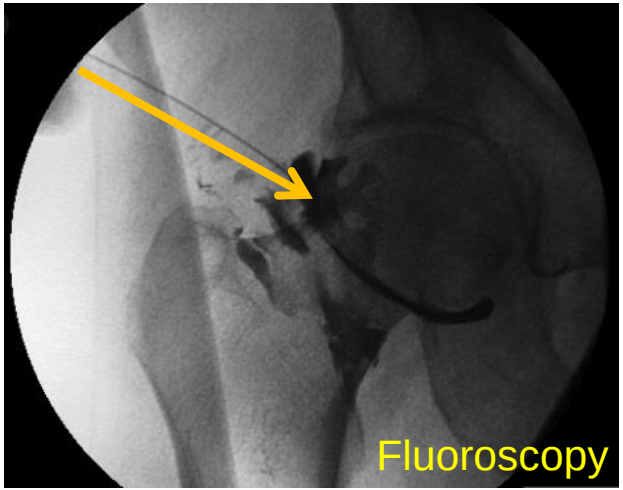
Methods

- **Hip Joint**









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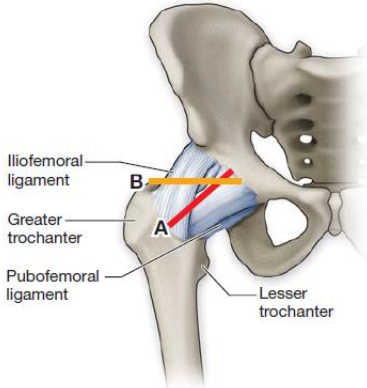
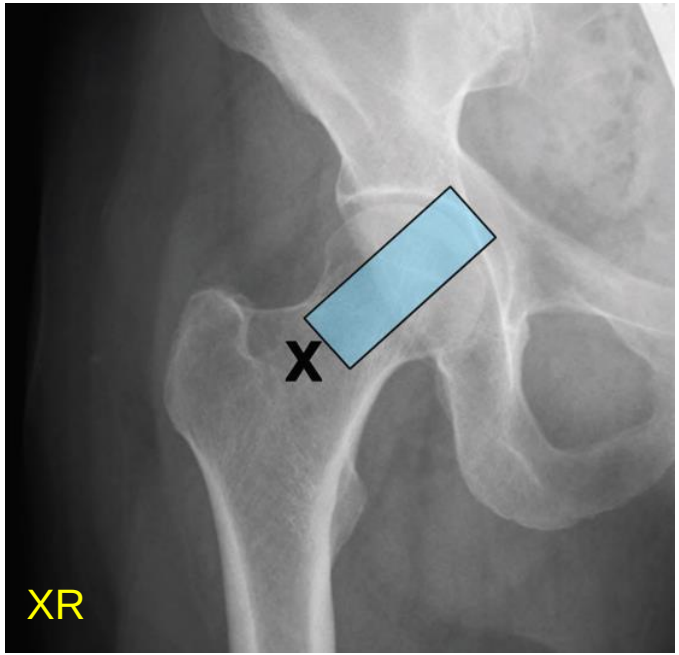
Methods – Anterior Hip

- **Hip Joint**





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Anterior Hip

- **Hip Joint - Evidence**
  - **Risk of Infection:** Insufficient evidence to conclude that an intra-articular steroid injection administered prior to total hip arthroplasty increases the rate of infection
  - **Steroids:** Steroid reduces chondrocyte viability in concentration-dependent manner
  - **Anesthetics:** Local anesthetics can be cytotoxic to chondrocytes, lidocaine / bupivacaine > mepivacaine/ ropivacaine, which is also dependent on concentration and duration of exposure
  - **Hyaluronic acid:** hyaluronic acid is not cytotoxic to chondrocytes, but may not provide protective effects either
  - **PRP:** PRP may be chondroprotective and stimulate cartilage regeneration

Pereira et al. Bone Joint J. 2016 Aug;98-B(8):1027-35. Grishko et al. J Bone Joint Surg Am. 2010 Mar;92(3):609-18 Euppayo et al. In Vitro Cell Dev Biol Anim. 2016 Aug;52(7):723-35. Busse et al. Bone Joint Res. 2019 Mar 2;8(2):41-48. Jacob et al. Cartilage. 2019 Jul;10(3):364-369 Kreuz et al. Knee Surg Sports Traumatol Arthrosc. 2018 Mar;26(3):819-830. Moussa et al. Exp Cell Res. 2017 Mar 1;352(1):146-156.

Evidence – Anterior Hip

- **Hip Joint - Efficacy**
  - **Steroid:**
    - Intra-articular hip joint steroid injection provides significant pain reduction from a mean pre-injection pain score of 6.4 +/- 0.77 to a mean post-injection pain score of 2.6 +/- 2.7 at 2 weeks, and 2.7 +/- 2.5 at 12 weeks
    - Pain relief from steroid (methylprednisolone) injection has been found to correlate with the severity of hip OA on XR (ρ = 0.24 -0.26, p<0.001)

AAOS Clinical Practice Guideline Summary

American Academy of Orthopaedic Surgeons Clinical Practice Guideline Summary Management of Osteoarthritis of the Hip

Intra-articular Corticosteroid Injection

Intra-articular corticosteroids could be considered to improve function and reduce pain in the short term for patients with symptomatic OA of the hip.

Strength of recommendation: Moderate. ★★★☆ (downgraded)

Waseem et al. Hip Int. 2002 Oct - Dec;12(4):378-382. | Deshmukh et al. Skeletal Radiol. 2011 Nov;40(11):1449-54.
Hannon CP, et al. J Am Acad Orthop Surg. 2024 Jun 6. | Kolasinski SL, et al. Arthritis Care Res (Hoboken). 2020 Feb;72(2):149-162.

Anterior Hip

- **Hip Joint - Efficacy**
  - **Viscosupplementation:**
    - a 2020 systematic review of literature over the last 20 years on patient reported outcomes after HA intra-articular injection for hip OA demonstrated that HA can achieve satisfactory improvement in pain and function
    - a 2018 systematic review and meta-analysis of 8 RCTs found little difference in efficacy between HA and placebo, PRP, and methylprednisolone
  - **PRP:**
    - a 2018 meta-analysis of 4 RCTs comparing the efficacy of intra-articular injection of HA vs. PRP for treating hip OA found PRP provided significantly greater reduction of pain at 2 months compared to HA; however, both provided the same functional outcomes at 6 and 12 months

Leite et al. Arch Phys Med Rehabil. 2018 Mar;99(3):574-583.e1 Acuña et al. J Orthop. 2020 Mar 25;21:137-149.
Ye et al. Int J Surg. 2018 May;53:279-287. Dallari et al. Am J Sports Med. 2016 Mar;44(3):664-71.
Di Sante et al. Med Ultrason. 2016 Dec 5;18(4):463-468

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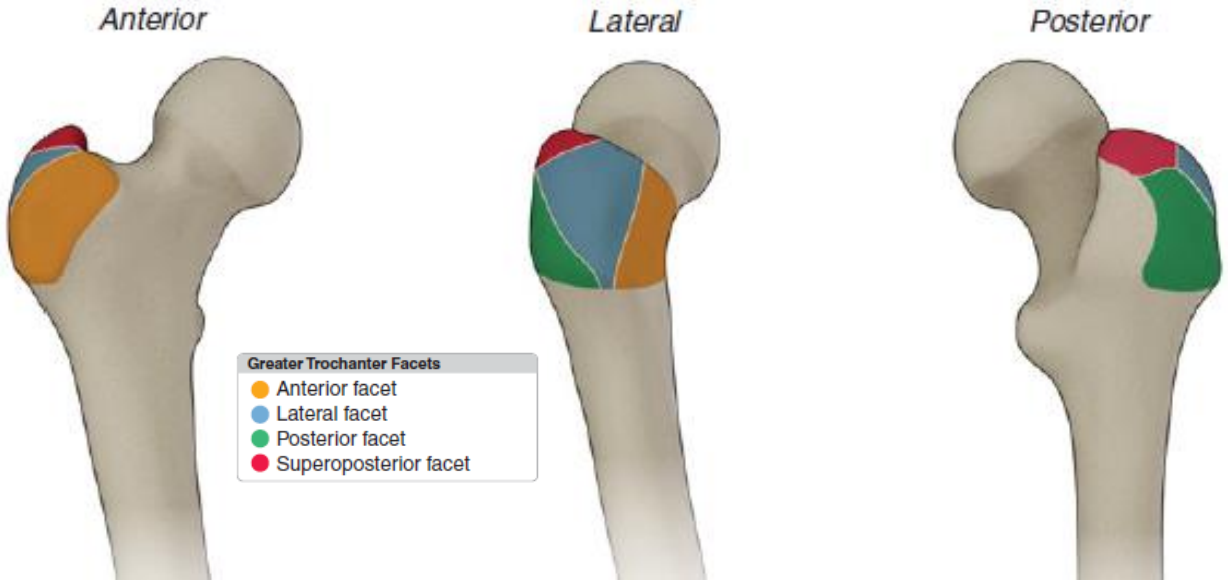
Lateral Hip

- **Greater Trochanter**



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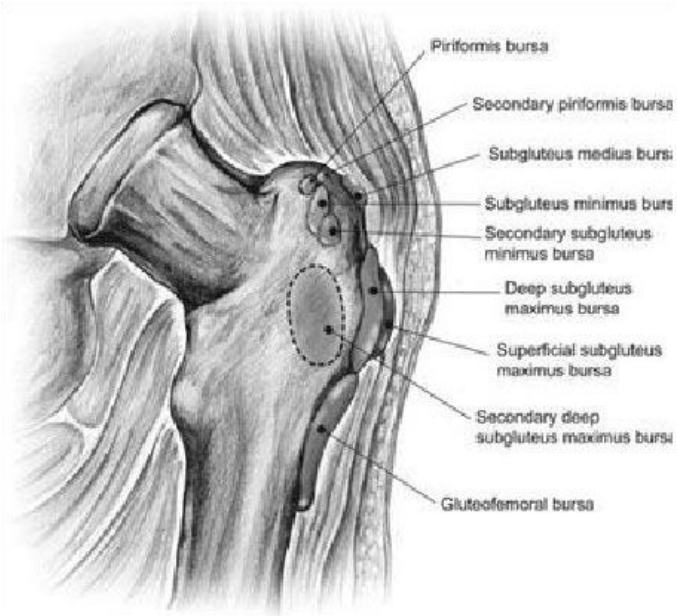
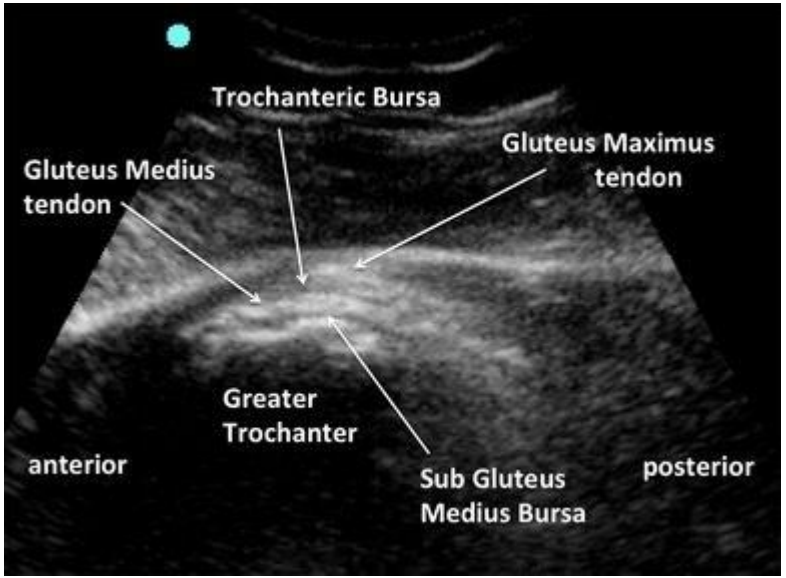
Methods – Lateral Hip

- **Greater Trochanter**





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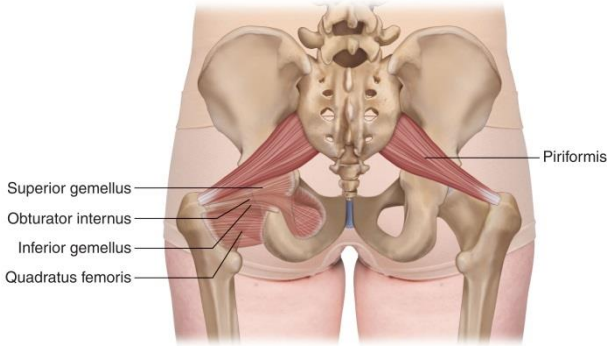
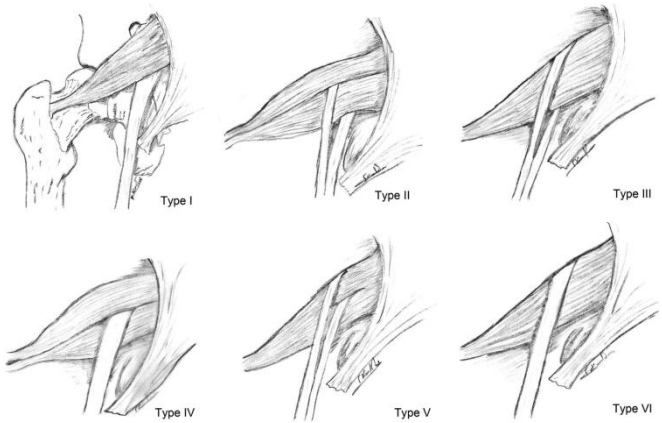
Posterior Hip

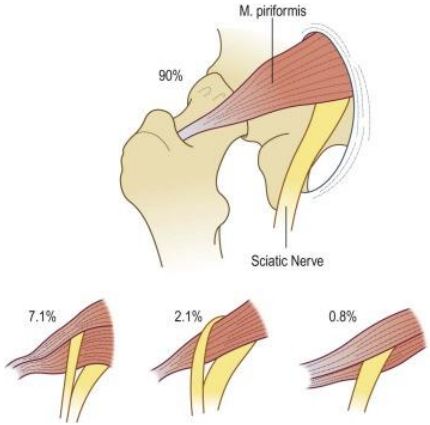
- **Piriformis**



Beaton and Anson Classification System

Type	Description
I	Undivided sciatic nerve exits below muscle
II	Common peroneal division exits through muscle and tibial division exits below muscle
III	Common peroneal division exits above muscle and tibial division exits below muscle
IV	Undivided sciatic nerve exits through muscle
V	Common peroneal division exits above muscle and tibial division exits through muscle
VI	Undivided sciatic nerve exits above muscle





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Al-Al-Shaikh et al. Diagn Interv Imaging. 2015;96(1):37–43. Natsis et al. Surg Radiol Anat (2014) 36:273–280
Beaton and Anson. Anatomical Record. 1937;70:1–5. Beaton and Anson. J Bone Jt Surg. 1938;20:686–688.

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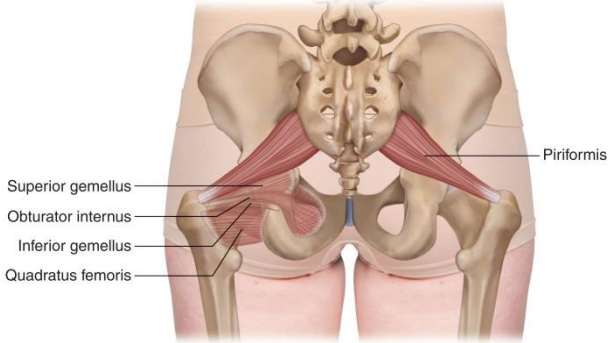
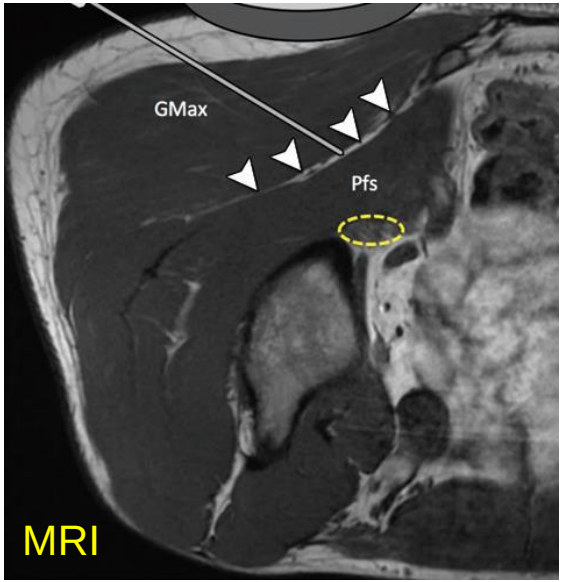
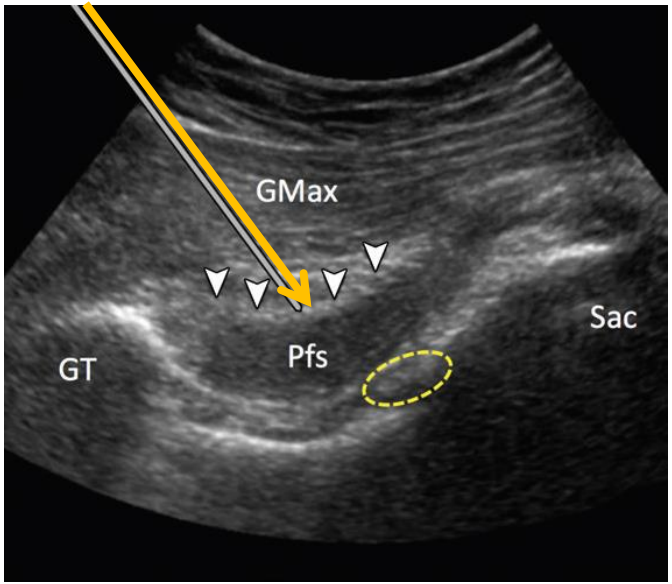
Posterior Hip

- **Piriformis**







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Ro et al. J Clin Imaging Sci 2018;8:6.
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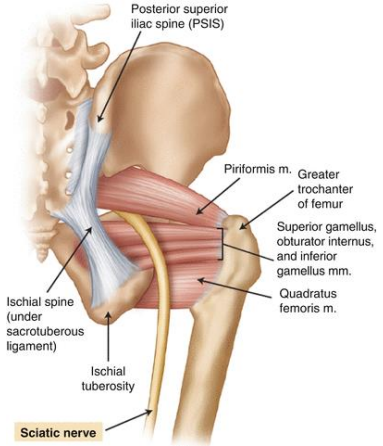
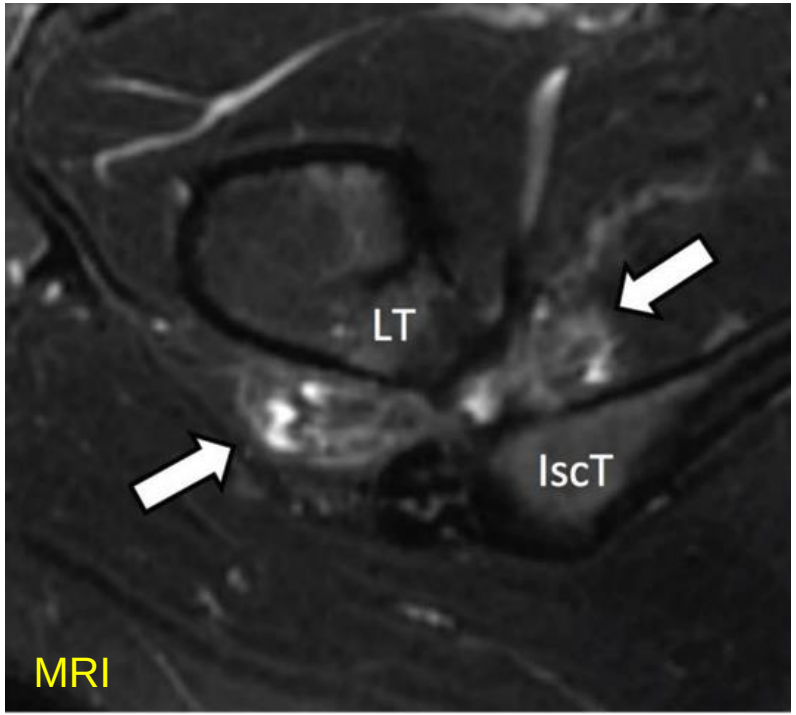
Posterior Hip

- **Quadratus Femoris**





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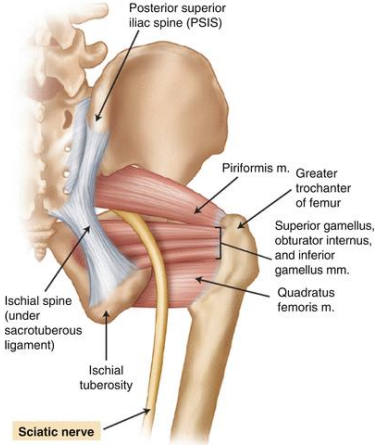
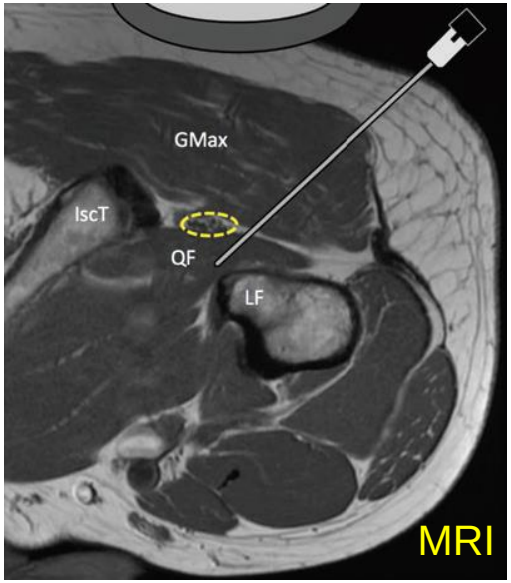
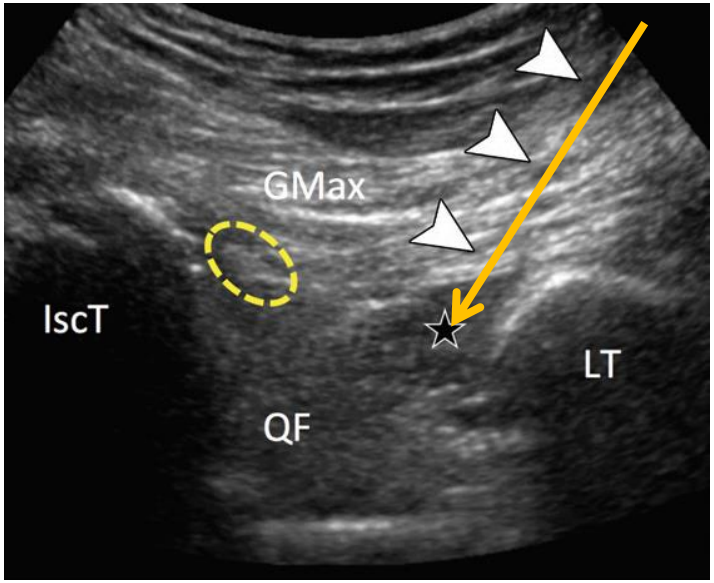
Posterior Hip

- **Quadratus Femoris**







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ICD-10 Codes		CPT
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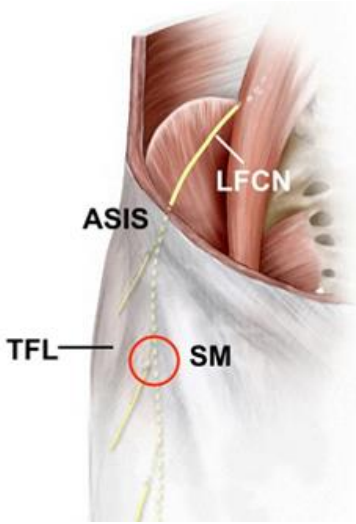
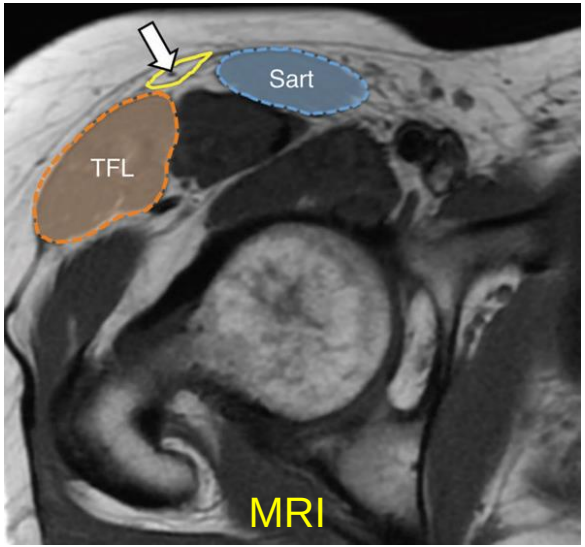
Labral tear of hip joint	**S73.199A**	
Paralabral cyst of hip	**M24.859**	
Osteophyte of hip	**M25.759**	
Femoroacetabular impingement	**M25.859**	
Iliopsoas bursitis	**M70.70**	**20611**
Snapping hip syndrome	**M24.859**	**76942** (use of ultrasound guidance for needle placement, such as for a biopsy, aspiration, injection, or localization device) plus **20550** (tendon sheath or ligament) or **20552** (trigger point injections into 1 or 2 muscles)
Lateral Hip		
Greater trochanteric pain syndrome	**M25.559**	**20611**
Greater trochanteric bursitis	**M70.60**	
Tendinopathy of gluteal region	**M67.959**	**76942** plus **20551** (tendon origin or insertion)
Posterior Hip		
Hamstring tendonitis	**M76.899**	**76942** plus **20551**
Ischial bursitis	**M70.70**	**20611**

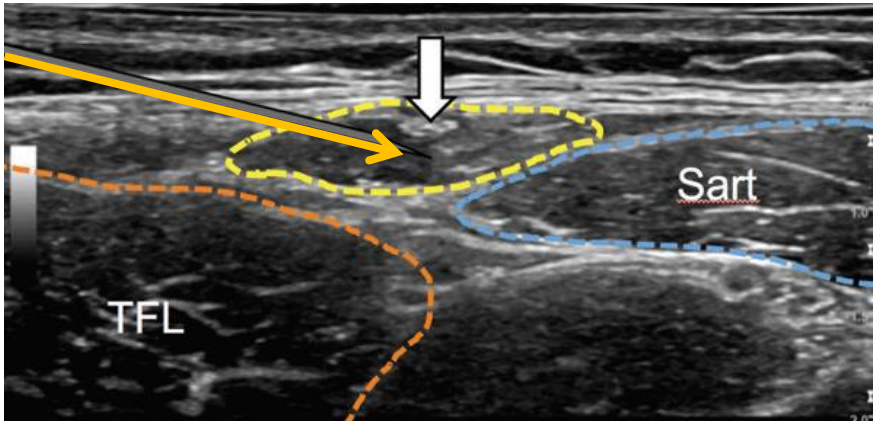
- Ischial bursitis: **M70.70**

Nerve Block

- **Lateral Femoral Cutaneous Nerve**







Blaichman et al. Radiographics. 2020 Jan-Feb;40(1):181-199.
Petchprapa et al. RadioGraphics 2010;30(4):983–1000.
Malanga and Mautner. Atlas of Ultrasound Guided Musculoskeletal Injections. New York: McGraw-Hill Education,2014

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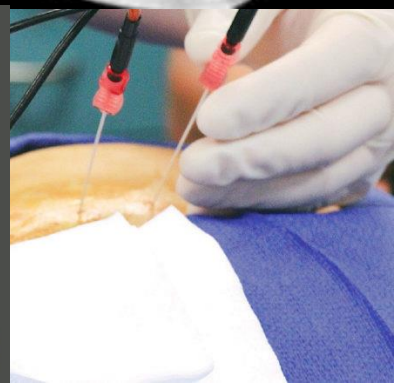
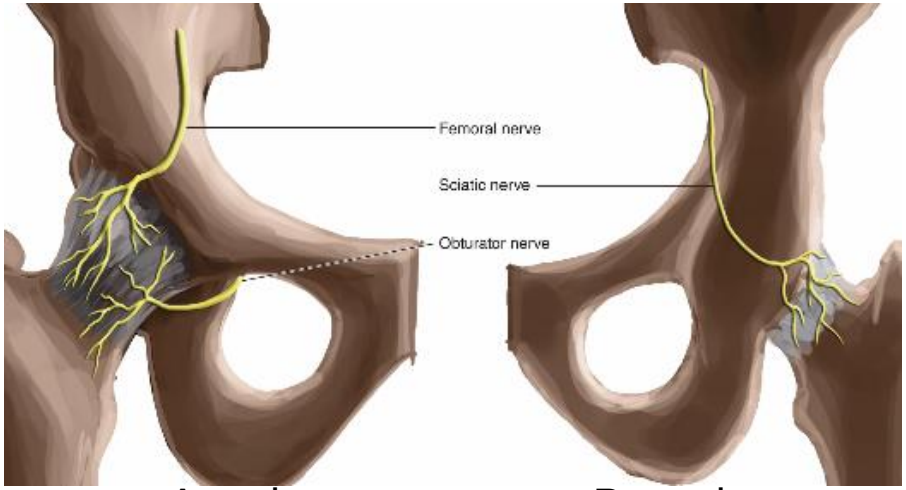
Hip Denervation

- Increased literature on percutaneous radiofrequency ablation of sensory nerves to address hip pain
- Osteoarthritis has been the most frequent indication for denervation procedures
- Questions remain regarding anatomical targets, technical aspects, selection criteria, and evidence for effectiveness



Hip Denervation

- Direct articular branches from nerves around the hip joint represent the primary innervation of the hip



Anterior Posterior

Kumar et al. Curr Pain Headache Rep. 2019 May 1;23(6):38.
Hilton J. Lectures. Royal College of Surgeons of England, 1860, 1861, and 1862.
Short et al. Reg Anesth Pain Med. 2018;43(2): 186–92.

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Hip Denervation

J Bone Joint Surg Am. 1949 Oct;31A(4):805-14.

Early effects of partial sensory denervation of the hip for relief of pain in chronic arthritis.

OBLETZ BE, LOCKIE LM, et al.

PMID: 18142922

Obletz et al. J Bone Joint Surg. 1949;31:805–13.

Hip Denervation

Innervation of the quadrants in the anterior capsule				
	Superolateral	Superomedial	Inferolateral	Inferomedial
Femoral high nerves	++++	+++	+++	++
Femoral low nerves	+	+	++	+
Obturator high nerves			+	+++
Obturator low nerves			++	++
Accessory obturator nerve		++		+++
Innervation of the quadrants in the posterior capsule				
Nerve to quadratus femoris	Medial, Superior, and Inferior			
Sciatic nerve	? Lateral, Medial(unclear)			
Superior gluteal nerve	Lateral			
Inferior gluteal nerve	Inferior (unclear)			

"+" refers to the presence of nerves in relation to the quadrant of the capsule. The number of "+" simply refers to the predominance of the nerve supply

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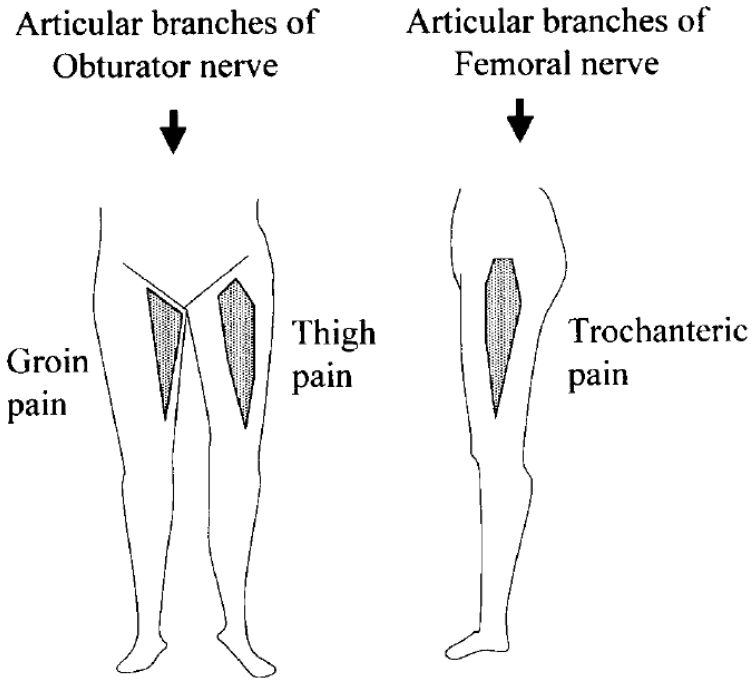
Hip Denervation



Kumar et al. Curr Pain Headache Rep. 2019 May 1;23(6):38.
Kawaguchi et al. Reg Anesth Pain Med. 2001 Nov-Dec;26(6):576-81.

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Hip Denervation

Cases	Age/ Sex	Disease	Pain	Treatments	VAS Scores Before	VAS Scores After	Outcome	Duration of Effectiveness (mo)	Operation
1	62/F	Osteoarthritis	rt-groin	O	6.5	1.8	Effective	6	Rejected
2	74/F	Osteoarthritis	rt-groin	O	6.2	2.2	Effective	3	Rejected
			rt-trochanteric	F	6.2	2.5	Effective	3	
3	71/F	Osteoarthritis	bil-groin	O	7.2	3.5	Effective	2	Rejected
4	85/F	Osteoarthritis	bil-groin	O	6.5	4.5	Ineffective		Rejected
5	74/M	Osteoarthritis	lt-groin	O	6.5	1.5	Effective	6	High risk (AAA)
6	77/F	Osteoarthritis	lt-groin	O	7.2	1.5	Effective	3	Rejected
			lt-trochanteric	F	7.6	2	Effective	3	
7	64/F	Osteoarthritis	rt-groin	O	7.5	3.1	Effective	5	Rejected
8	55/F	Osteoarthritis	rt-groin	O	7.2	3.5	Effective	1	High risk (heart disease)
9	42/F	Congenital dislocation	rt-groin, thigh	O	7.2	0.5	Effective	11	Postoperative
10	26/M	Dislocation and fracture	lt-groin	O	8.2	1.3	Effective	8	Postoperative
11	26/F	Congenital dislocation	lt-groin	O	6.5	3.8	Ineffective		Postoperative
			lt-trochanteric	F	4.5	4	Ineffective		
12	87/F	Osteoarthritis	rt-groin	O	6.5	3.2	Effective	4	Postoperative
			rt-trochanteric	F	5.7	2.3	Effective	6	
13	57/F	Metastasis	lt-groin	O	7.8	2.5	Effective	1	Not indicated
			lt-trochanteric	F	7.8	2.5	Effective	1	
14	70/M	Metastasis	lt-groin	O	7.1	6	Ineffective		Not indicated

Kawaguchi et al. Reg Anesth Pain Med. 2001 Nov-Dec;26(6):576-81.

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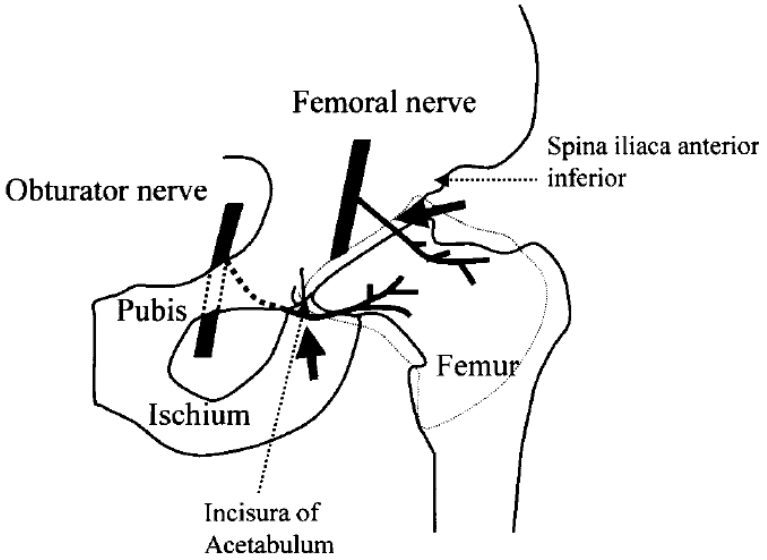
Hip Denervation

- **Sensory Inputs Responsible for Hip Pain**



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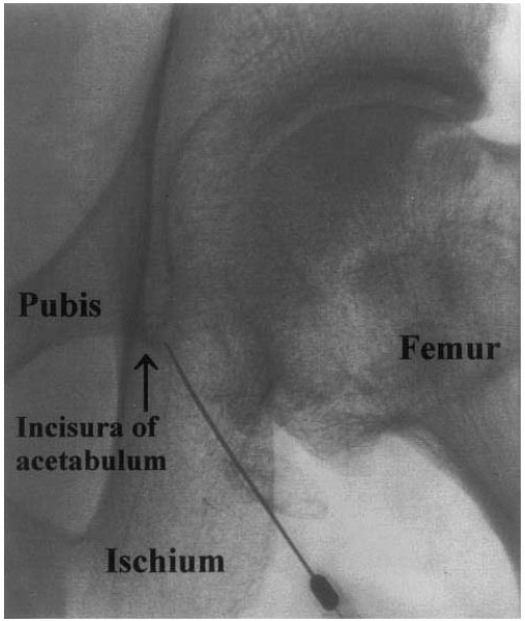
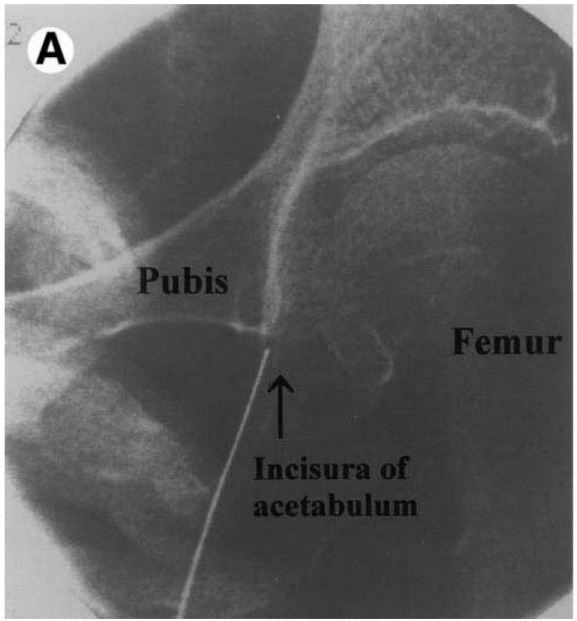
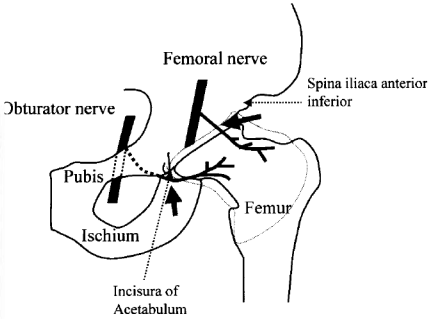
Hip Denervation – Obturator Branches







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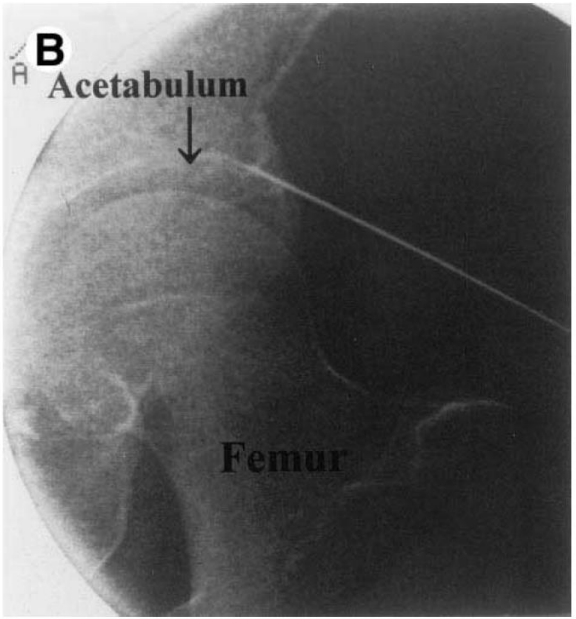
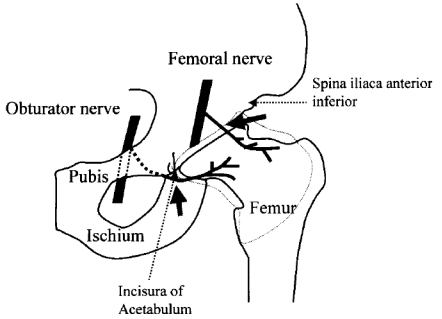
Hip Denervation – Femoral Branches





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Hip Denervation

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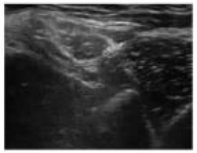
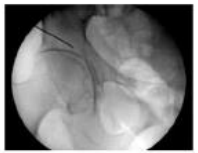
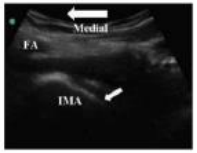
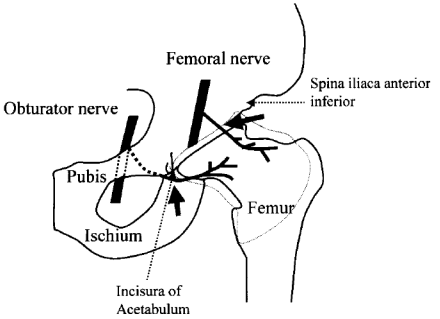
Hip Denervation

Nerve	Anatomy Target	Ultrasound	Fluoroscopy
Femoral nerve 			
Accessory obturator nerve 			
Obturator nerve 			



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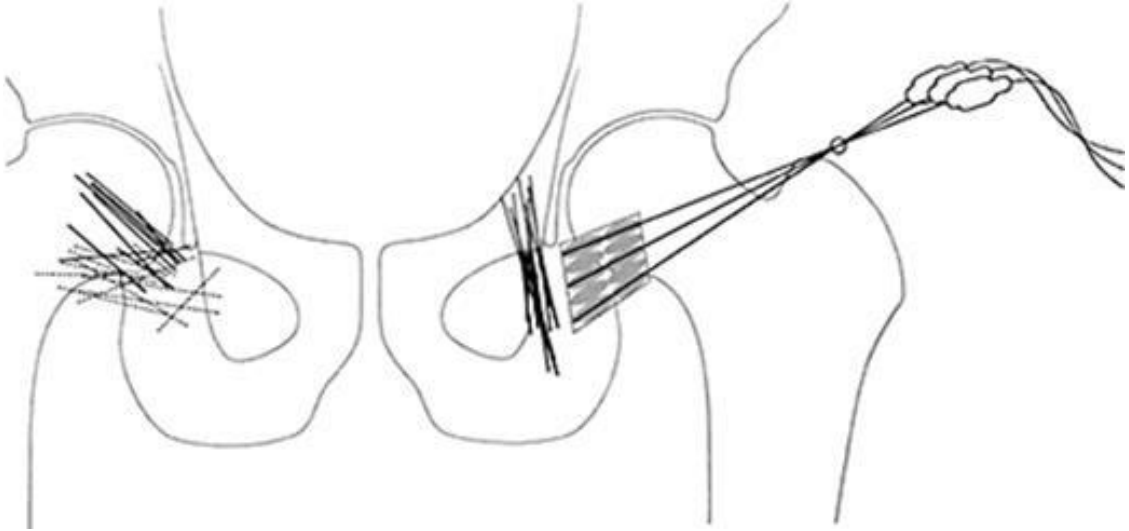
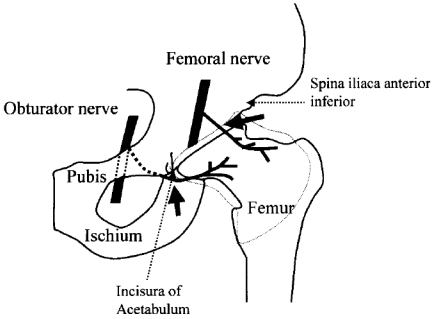
Hip Denervation





Locher et al. Pain Med. 2008 Apr;9(3):291-8.

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Hip Denervation

Author/year	Sample Size	Nerve	Imaging	Follow up	Outcome on Pain
Kawaguchi/2001	14	ON and FN	Fluoroscopy	11 months	60% reduction in pain score
Rivera/2012	18	ON and FN	Fluoroscopy	6 months	33% reduction in pain scores
Chye/2015	15	ON and FN	Fluoroscopy	3 months	60% reduction in pain score
Okada/1993	15	ON and FN	Fluoroscopy	12 months	Pain relief in 14/15 patients
Kapural/2018	23	ON and FN	Fluoro + ultrasound	6 months	>80% reduction in pain scores
Tinnirello/2018	14	ON and FN	Fluoroscopy	12 months	>50% improvement in 9/14 pts at 12 mo

Kumar et al. Curr Pain Headache Rep. 2019 May 1;23(6):38.

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Hip Denervation

- **Limitations**
  - Multiple nerve supply from small branches
    - Obturator
    - Branches of femoral nerve
    - Accessory femoral and accessory obturator nerves if present
    - Nerve supplying quadratus femoris
    - Superior gluteal nerve
    - Direct branches from the sciatic nerve
  - Difficulties of parallel-to-nerve placement of electrodes
  - Adverse Effects:
    - loss of sensation in the cutaneous distribution of the FN and ON
    - Hematoma
    - Potential motor dysfunction of muscle innervated by the femoral and obturator nerves.

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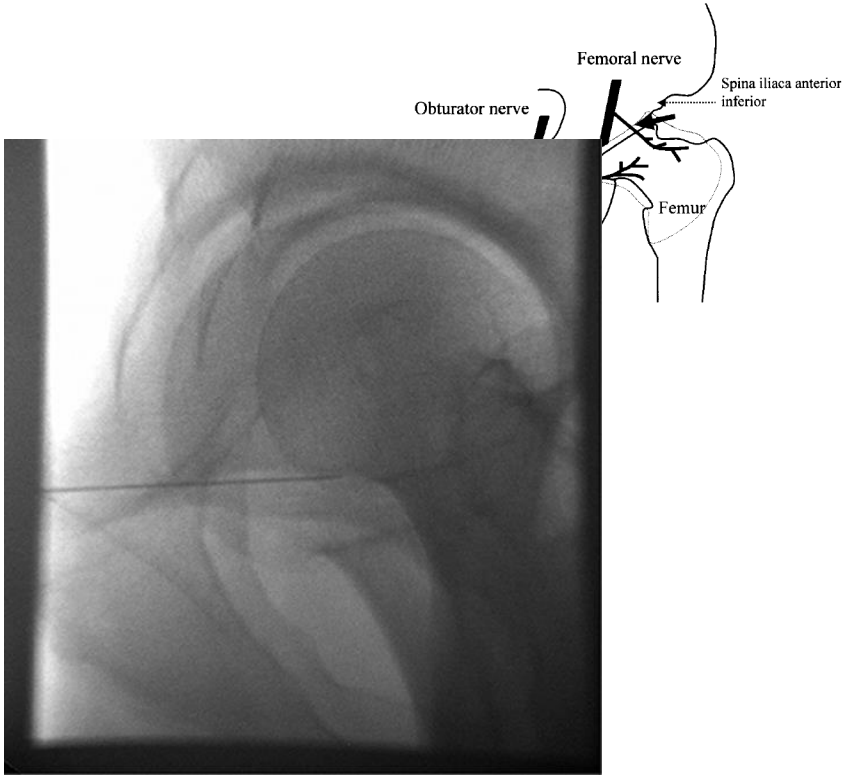
Summary

- Therapeutic agents
- Relevant anatomy and indications for interventions
- Ultrasound guided injections
- Evidence for key procedures
- Hip Denervation

Hip Denervation



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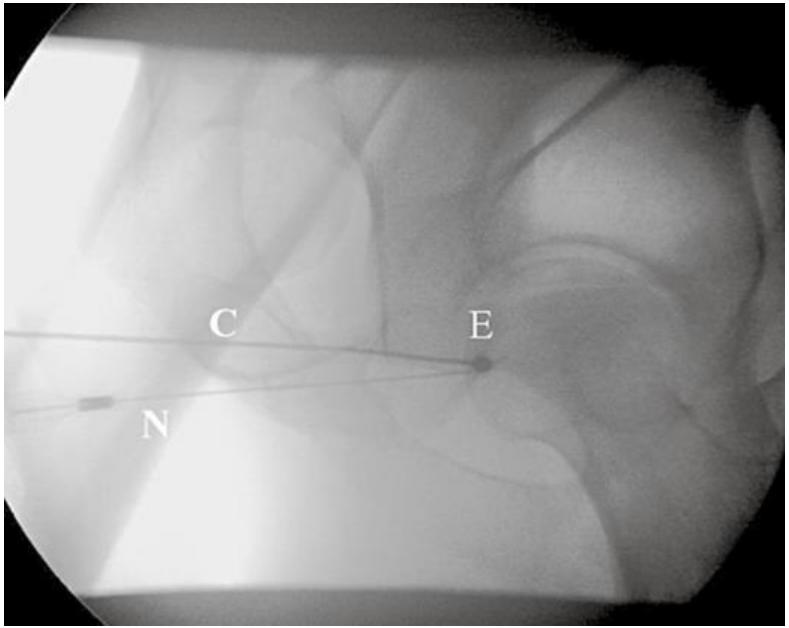
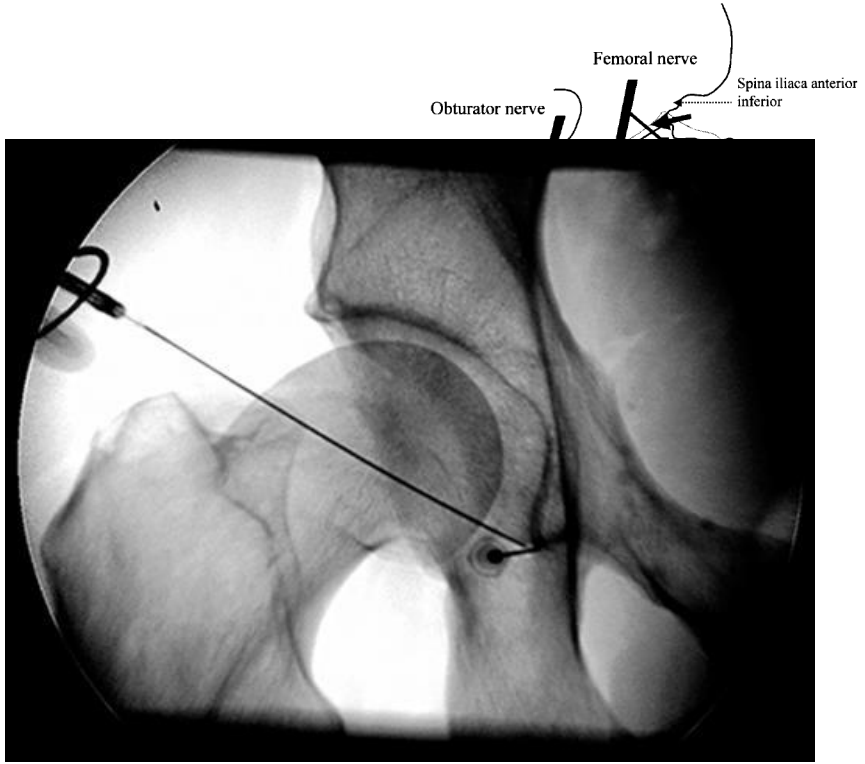
Hip Denervation





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