



WEBINAR

Ultrasound for Accurate MSK Injections and Interventions, Part 2: The Knee

January 2023



Your Host



Oron Frenkel, M.D., M.S.

Emergency Physician & POCUS Educator
Chairman, Clarius Medical Advisory Board

Ultrasound guidance improves accuracy of knee injections

“...ultrasound-guided knee injections were more accurate across every anatomical needle injection site compared with blind injections.”

Fang WH, Chen XT, Vangsness CT Jr. Ultrasound-Guided Knee Injections Are More Accurate Than Blind Injections: A Systematic Review of Randomized Controlled Trials. *Arthrosc Sports Med Rehabil.* 2021 Jun 26;3(4):e1177-e1187. doi: 10.1016/j.asmr.2021.01.028. PMID: 34430899; PMCID: PMC8365196.

[Review](#) > [Arthrosc Sports Med Rehabil.](#) 2021 Jun 26;3(4):e1177-e1187.

doi: 10.1016/j.asmr.2021.01.028. eCollection 2021 Aug.

Ultrasound-Guided Knee Injections Are More Accurate Than Blind Injections: A Systematic Review of Randomized Controlled Trials

[William H Fang](#)¹, [Xiao T Chen](#)¹, [C Thomas Vangsness Jr](#)¹

Affiliations + expand

PMID: 34430899 PMCID: [PMC8365196](#) DOI: [10.1016/j.asmr.2021.01.028](#)

[Free PMC article](#)

Abstract

Purpose: To review the current literature to determine which injection technique and needle portal placement provide the greatest accuracy for intra-articular access to the knee.

Methods: This study followed Preferred Reporting Items and Systematic Reviews and Meta-Analyses guidelines. A comprehensive literature search was conducted in March 2020 and repeated in May 2020 using electronic databases PubMed, MEDLINE, and the Cochrane Library. Data on the accuracy of intra-articular knee injection (successful injections/total number of injections) were collected. Only Level I studies were included. Study design, demographic variables, needle sizes, and method of validating accuracy were recorded. The Jadad score was used to assess methodologic quality, and a risk-of-bias assessment was performed.

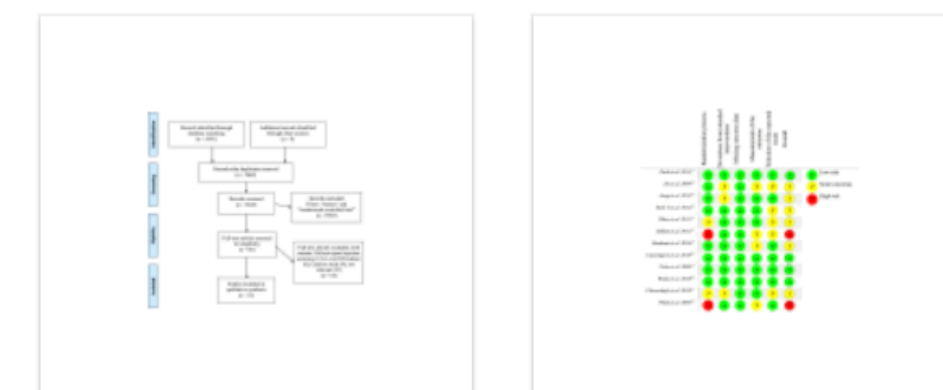
Results: A total of 12 Level I human studies (1431 patients, 1315 knees) were included in this review. Seven of the studies did a direct comparison between ultrasound-guided and blind knee injections. Ultrasound-guided injections were more accurate compared with blinded knee injections in every study. The most accurate anatomical approach was an isometric quadricep contraction method with the superolateral approach.

Conclusions: This study showed that ultrasound-guided knee injections were more accurate across every anatomical needle injection site compared with blind injections. Injections made by a blind/anatomically guided method had inconsistent accuracy rates that seemed highly dependent on the portal of entry.

Level of evidence: Level I, systematic review of Level I studies.

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Figures



Accuracy and efficacy of ultrasound-guided pes anserinus bursa injection

“The US-guided group showed significant improvement of both of VAS scores compared to the blind group at 1 week and 4 weeks after the injection ($P < .05$).”

Lee JH, Lee JU, Yoo SW. Accuracy and efficacy of ultrasound-guided pes anserinus bursa injection. J Clin Ultrasound. 2019 Feb;47(2):77-82. doi: 10.1002/jcu.22661. Epub 2018 Oct 30. PMID: 30378129.

Randomized Controlled Trial > J Clin Ultrasound. 2019 Feb;47(2):77-82.

doi: 10.1002/jcu.22661. Epub 2018 Oct 30.

Accuracy and efficacy of ultrasound-guided pes anserinus bursa injection

Jong H Lee ¹, Jae U Lee ¹, Seung W Yoo ¹

Affiliations + expand

PMID: 30378129 DOI: 10.1002/jcu.22661

Abstract

Purpose: To compare the accuracy and efficacy of ultrasound (US)-guided versus blind pes anserinus bursa (PAB) injection in patients with pes anserinus tendinobursitis (PATB).

Methods: Forty-seven patients with clinically diagnosed PATB were randomly assigned to a US-guided group or a blind group of steroid injection. In the US-guided group, the injectate was delivered under sonographic visualization. In the blind group, the conventional technique was used without any visual guidance. After the PAB injection, the injectate location was identified using US in both groups. Treatment effects were assessed using the visual analogue scale (VAS) of knee tenderness. Outcomes were measured before, 1 week and 4 weeks after the injection.

Results: Both groups showed pain relieving at 1 week and 4 weeks after the injection. The injectate in the US guided group were found to be accurately at the PAB in all subjects, whereas blind group were found to be just in 4 of 22 subjects. The US-guided group showed significant improvement of both of VAS scores compared to the blind group at 1 week and 4 weeks after the injection ($P < .05$).

Conclusion: Our results suggest that US-guided PAB injection is more accurate and effective than blind injection in patients with PATB.

Keywords: bursa injection; pes anserinus tendinobursitis; ultrasound.

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Similar articles

[Ultrasound-Guided Standard vs Dual-Target Subacromial Corticosteroid Injections for Shoulder Impingement Syndrome: A Randomized Controlled Trial.](#)

Wang JC, Chang KV, Wu WT, Han DS, Özçakar L.

Arch Phys Med Rehabil. 2019 Nov;100(11):2119-2128. doi: 10.1016/j.apmr.2019.04.016. Epub 2019 May 29.

PMID: 31150601 Clinical Trial.

[Outcomes and cost-effectiveness of ultrasound-guided injection of the trochanteric bursa.](#)

Mitchell WG, Kettwich SC, Sibbitt WL Jr, Sibbitt RR, Muruganandam M, Rolle NA, Hayward WA, Fields RA, Roldan LP, Emil NS, Fangtham M, Bankhurst AD.

Rheumatol Int. 2018 Mar;38(3):393-401. doi: 10.1007/s00296-018-3938-z. Epub 2018 Jan 20.

PMID: 29353388 Clinical Trial.

[Comparison of the therapeutic effects of intramuscular subscapularis and scapulothoracic bursa injections in patients with scapular pain: a randomized controlled trial.](#)

Chang WH, Kim YW, Choi S, Lee SC.

Ultrasound-Guided Perimeniscal Injections: Anatomical Description and Feasibility Study

“US-guided perimeniscal injections can accurately and safely deliver injectates in the perimeniscal area. In addition, our data suggest that perimeniscal corticosteroid injection provides significant symptom relief at 6 weeks in patients with meniscal pain.”

Coll C, Coudreuse JM, Guenoun D, Bensoussan L, Viton JM, Champsaur P, Le Corroller T. Ultrasound-Guided Perimeniscal Injections: Anatomical Description and Feasibility Study. J Ultrasound Med. 2022 Jan;41(1):217-224. doi: 10.1002/jum.15700. Epub 2021 Mar 31. PMID: 33788316.

> J Ultrasound Med. 2022 Jan;41(1):217-224. doi: 10.1002/jum.15700. Epub 2021 Mar 31.

Ultrasound-Guided Perimeniscal Injections: Anatomical Description and Feasibility Study

Clemence Coll ¹, Jean-Marie Coudreuse ¹, Daphne Guenoun ^{2 3}, Laurent Bensoussan ¹, Jean-Michel Viton ¹, Pierre Champsaur ^{2 3}, Thomas Le Corroller ^{2 3}

Affiliations + expand

PMID: 33788316 DOI: 10.1002/jum.15700

Abstract

Objectives: To anatomically describe the ultrasound (US)-guided perimeniscal injection technique, and evaluate its feasibility in the treatment of meniscal pain.

Methods: This work was initially undertaken in four cadaveric specimens with US-guided medial and lateral perimeniscal injection of China ink, followed by cadaveric dissection to assess injectate distribution, and potential injury to intra-articular and peri-articular structures. Then, 35 consecutive patients who underwent US-guided perimeniscal corticosteroid injection under local anesthesia for the treatment of symptomatic medial (30/35) or lateral (5/35) degenerative meniscal tear were retrospectively evaluated. Clinical outcome was assessed using a 0-10 numerical verbal rating scale (VRS) to evaluate severity of pain before, during, and after procedure at 6 weeks follow-up.

Results: Seven of eight (87.5%) ex vivo injections were accurate. A single inaccurate medial perimeniscal injection infiltrated the tibial collateral ligament instead of the perimeniscal area. No anatomical specimen exhibited intrameniscal injection or injury to regional structures. All procedures (35/35) performed clinically were technically successful. Median VRS scores were: 7 (range, 3-9) before procedure, 5 (range, 0-10) during procedure, and 1.5 (range, 0-9) after procedure at 6 weeks follow-up (P <.0001). No complication was observed.

Conclusions: US-guided perimeniscal injections can accurately and safely deliver injectates in the perimeniscal area. In addition, our data suggest that perimeniscal corticosteroid injection provides significant symptom relief at 6 weeks in patients with meniscal pain. Further studies with long-term follow-up will be required to evaluate the role of perimeniscal injections in the nonoperative management of meniscal pathology.

Keywords: anatomy; knee; meniscus; ultrasound.

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Similar articles

[Ultrasound-Guided Meniscal Injection of Autologous Growth Factors: A Brief Report.](#)

Di Matteo B, Altomare D, Garibaldi R, La Porta A, Manca A, Kon E.

Cartilage. 2021 Dec;13(1_suppl):387S-391S. doi: 10.1177/19476035211037390. Epub 2021 Sep 13.

PMID: 34515536 [Free PMC article.](#)

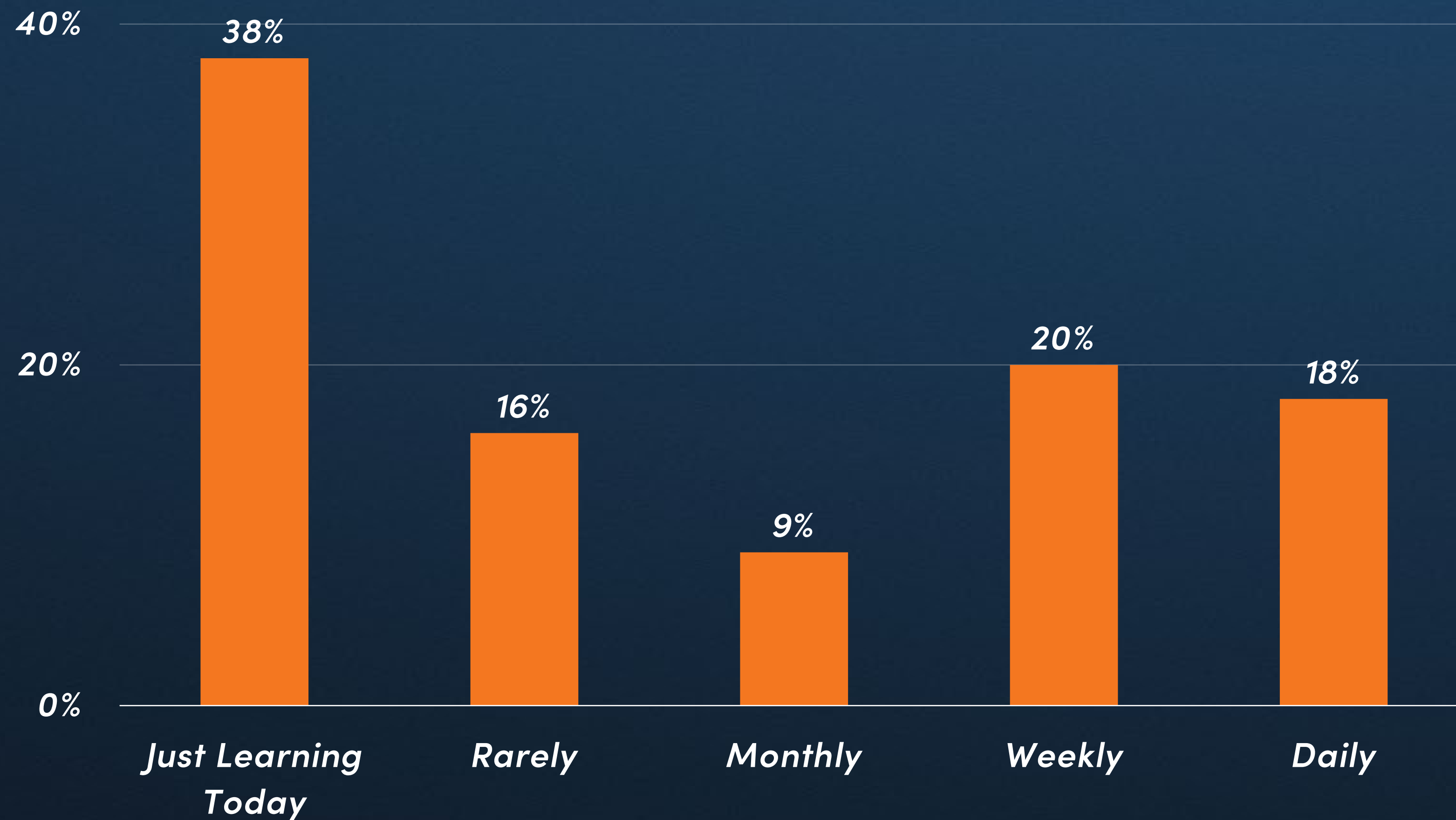
[Sonographically Guided Knee Meniscus Injections: Feasibility, Techniques, and Validation.](#)

Baria MR, Sellon JL, Lueders D, Smith J.

PM R. 2017 Oct;9(10):998-1005. doi: 10.1016/j.pmrj.2016.12.012. Epub 2017 Jan 16.

PMID: 28093371

How often do you use ultrasound to guide your injections?



Your Host



Alan M Hirahara, MD, FRCSC

Orthopaedic Surgery | Sports Medicine

EXPERT ULTRASOUND GUIDANCE FOR ACCURATE MSK INJECTIONS

PART 2: THE KNEE

Alan M Hirahara, MD, FRCSC



SPORTS MEDICINE / SHOULDER & KNEE
ARTHROSCOPY / ULTRASOUND / ORTHOBIOLOGICS



Disclosures

- Consultant / Royalties
- Consultant
- Speaker / Stock options
- Committee member
 - CSMAS
 - Health & Safety
 - Industry
 - Development
- Arthrex Inc.
- LifeNet Health, Inc.
- Clarius Mobile Health
 - NCAA
 - Big Sky Athletic Conference
 - ASES Foundation
 - AANA



Objectives

- Tendinous, paratendinous, and bursal injections around the knee
- An intra-tendinous biologic injection into a pathological quadriceps tendon
- Easy in-plane techniques for safe patellar tendon injections
- Effective superior lateral approach to an intra-articular knee injection
- How to accurately pinpoint the pes anserine tendons to inject the bursa
- Ultrasound techniques to precisely locate the anatomical attachment point for anchor placement in an MPFL repair



WHY ULTRASOUND THE KNEE WHEN I HAVE MRI?



Ultrasound vs. MRI



**NO
ACCESS**



My Use of Biologics

In Clinic

- Diminish inflammatory processes
 - Adhesive capsulitis
 - DJD
- Treat tendonopathies and contained tears with ultrasound guidance

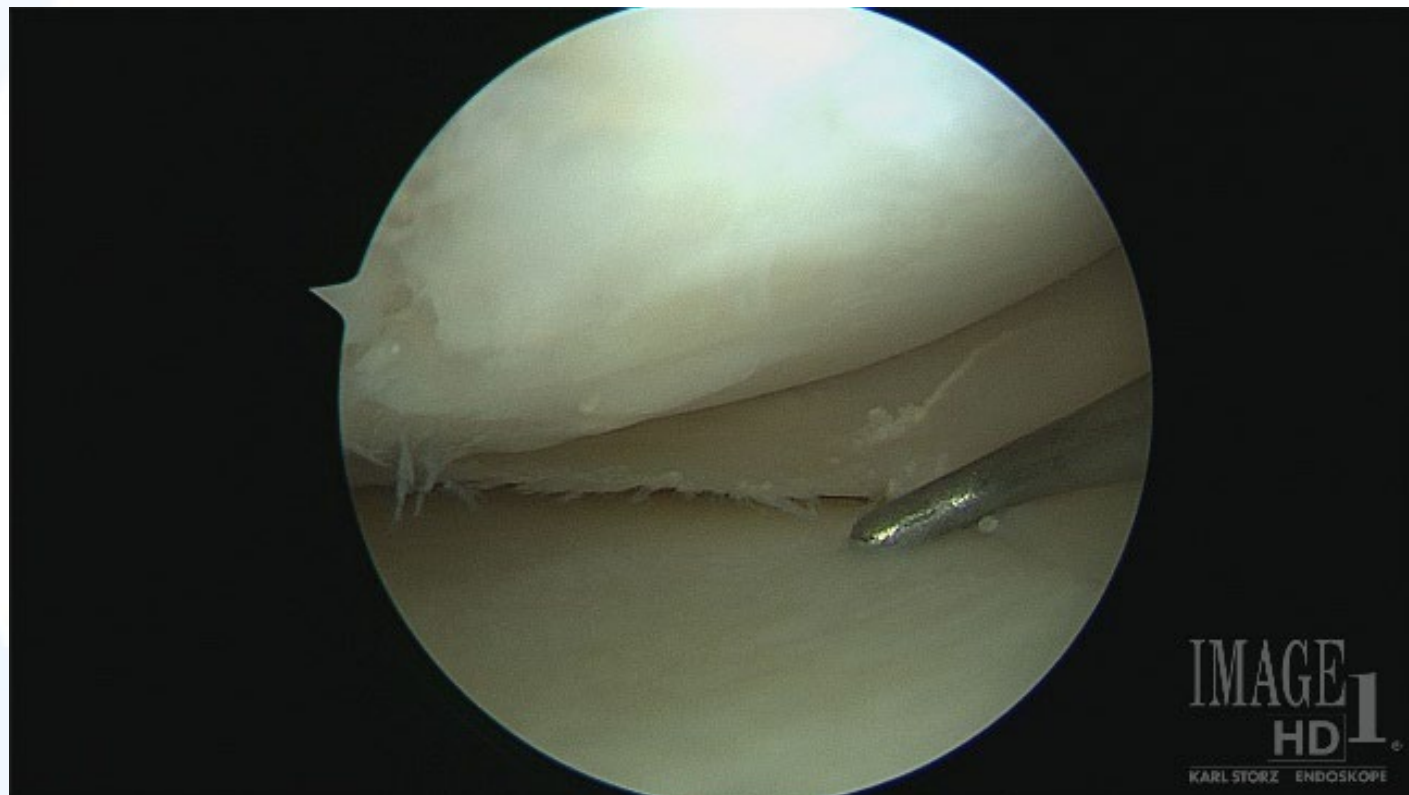
In Surgery

- Initiate the healing cascade in situ
- Promote stem cell migration to site of repair
 - Or to deliver the Stem Cells to surgical site
- Improve hemostasis
- Diminish inflammation & pain



Corticosteroid Risks

- Soften or damage cartilage
- Weaken or rupture tendons
- AVN or thinning of bone
- Increase risk of infection
- Diminish activity of immune system
- Temporary increase blood sugar
- Soft tissue (fat) atrophy
- Crystal deposition
- Steroid flare
- Hypopigmentation
- Thinning of skin or soft tissue (locally)



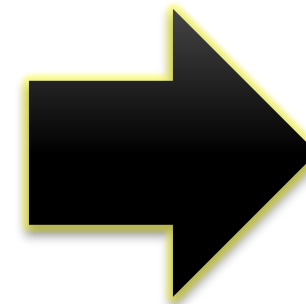
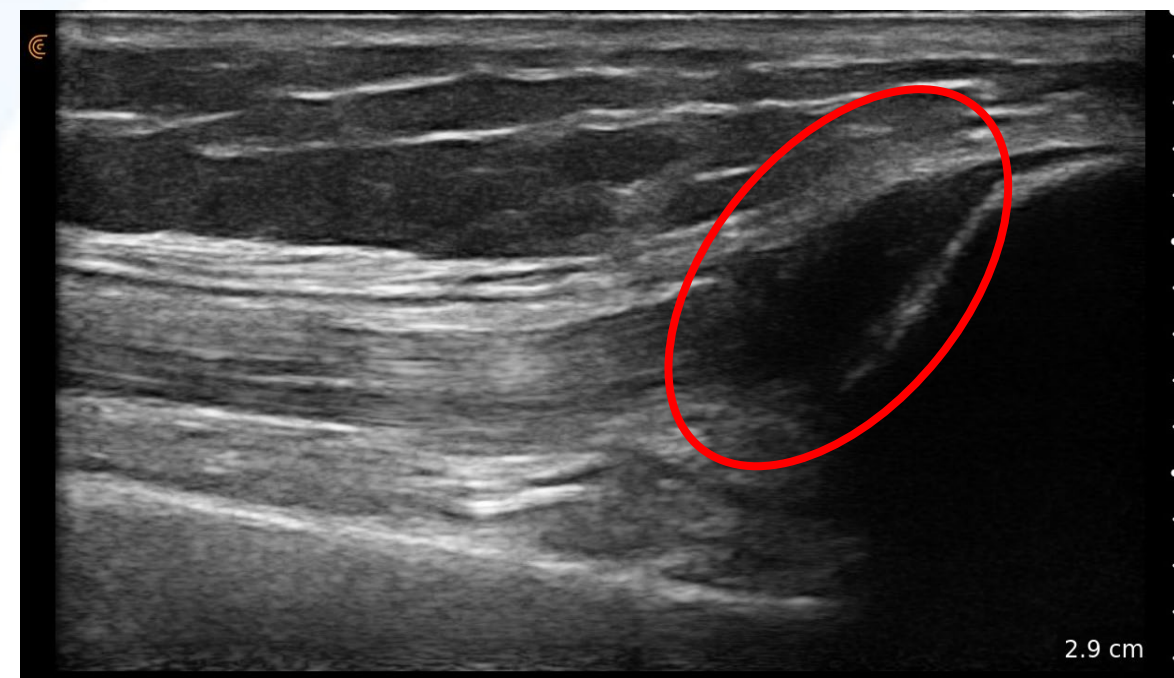
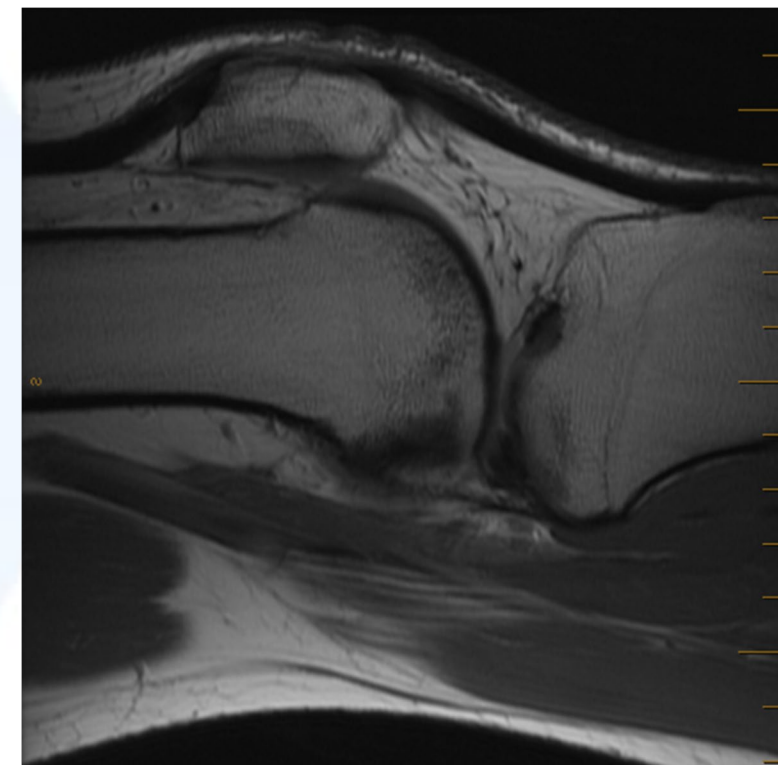
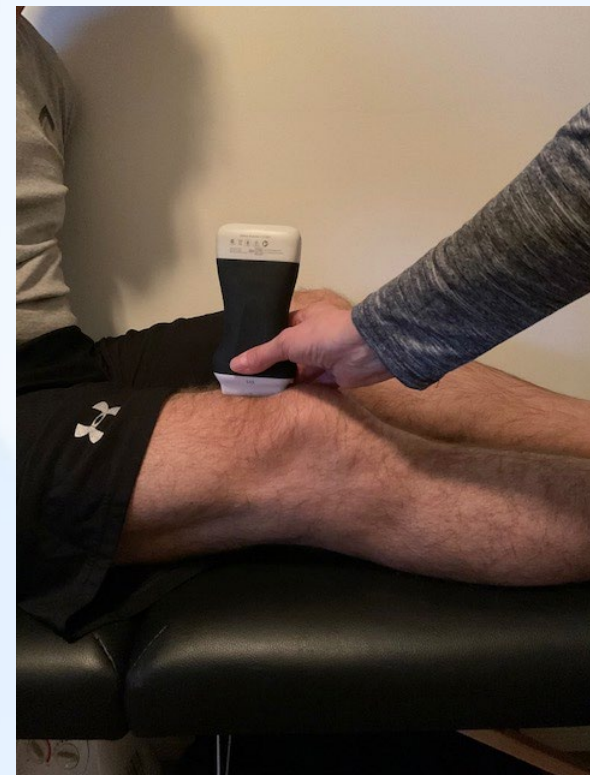
Negative Effect of Pre-operative Cortisone Injections on RCR Outcome & **Increased Risk of Revision**

- Agarwalla et al, Arthroscopy, 2019
- Desai et al, Arthroscopy, 2019
- Forsythe, JBJS-Am, 2019
- Lee et al, KSSTA, 2015
- Maman et al, AJSM, 2015
- Traven et al, Arthroscopy, 2019
- Weber et al, Arthroscopy, 2019
- Werner et al, AANA Abstract, 2018

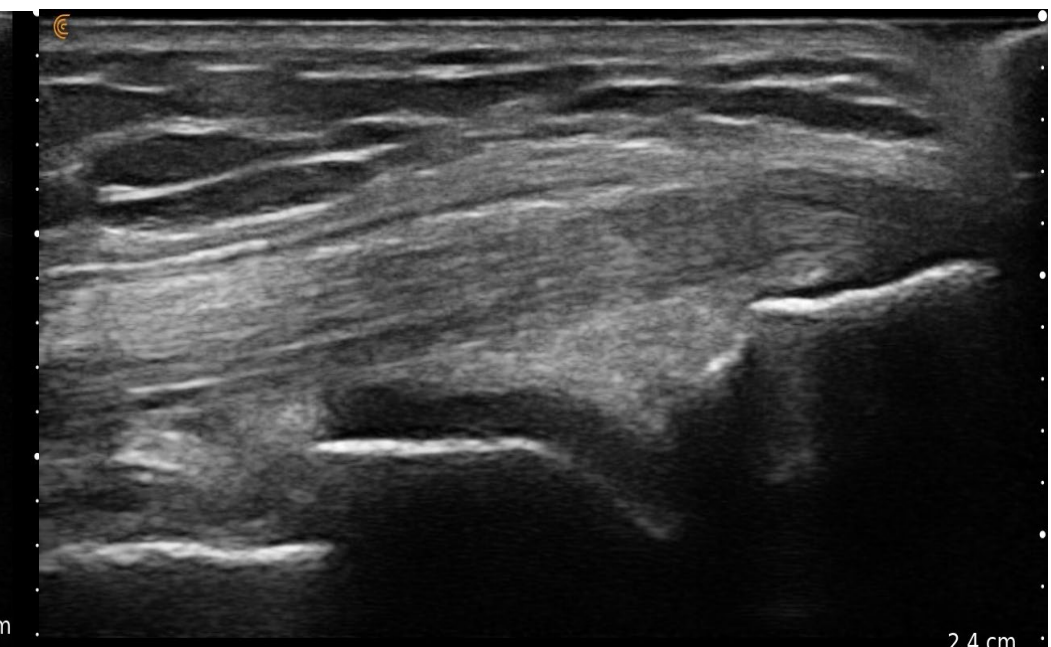
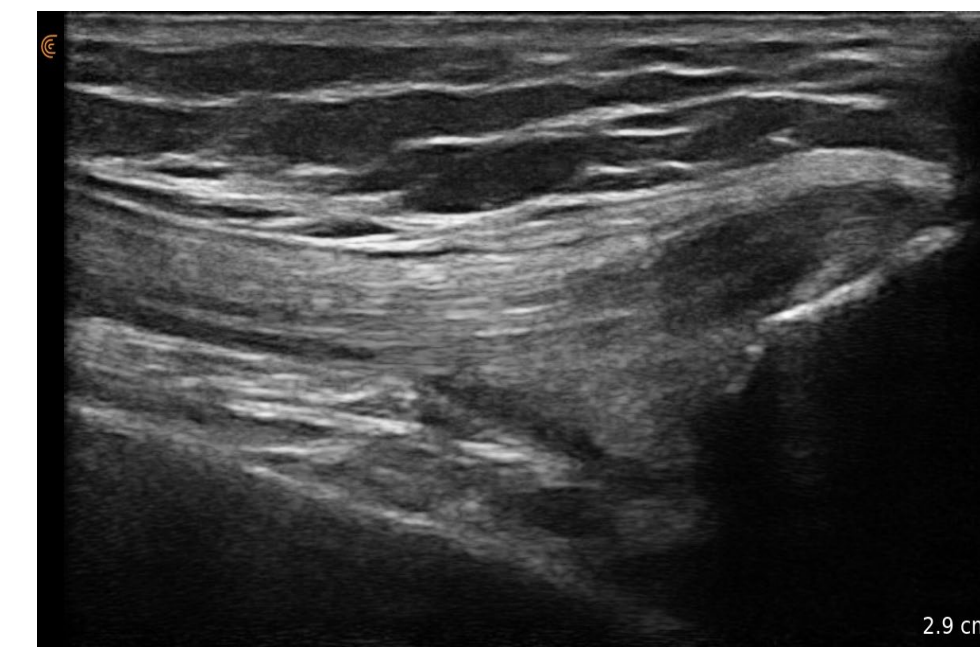


Quadriceps – Poor Technique

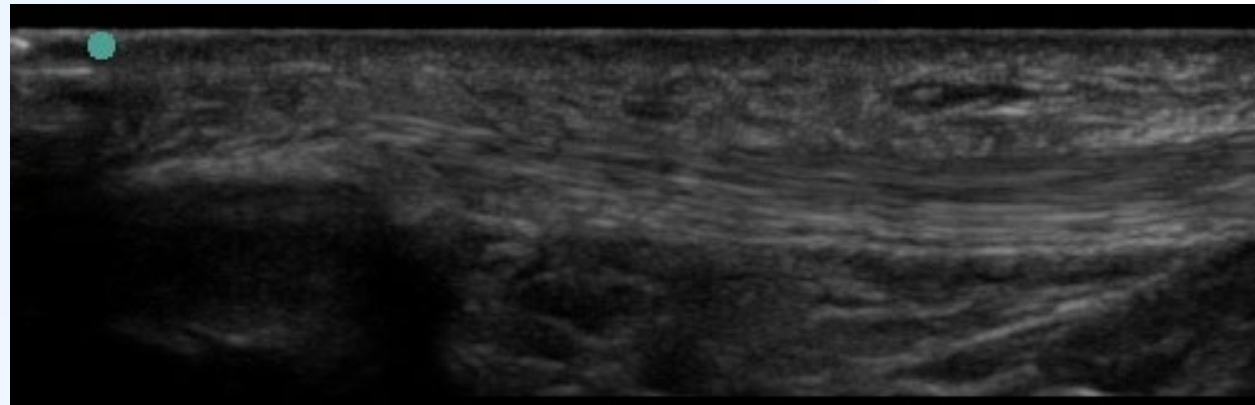
Quad tear?



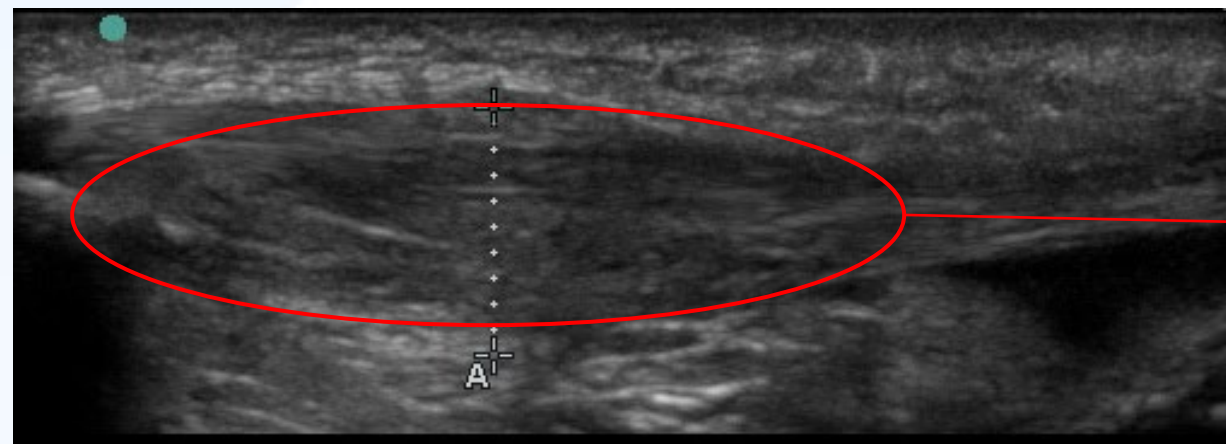
NO!!! - ANISOTROPY



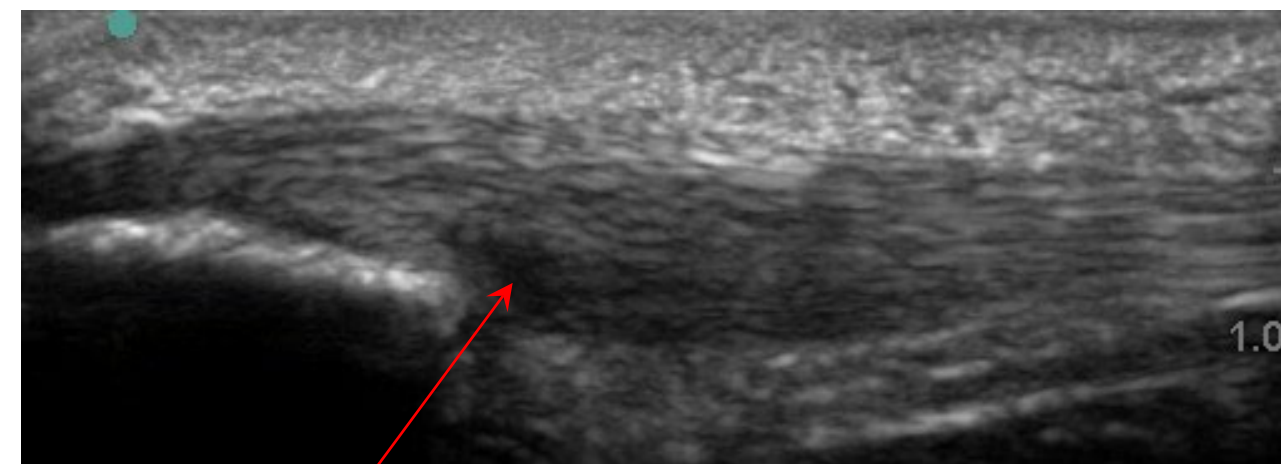
Spectrum of Patellar Tendon Pathology



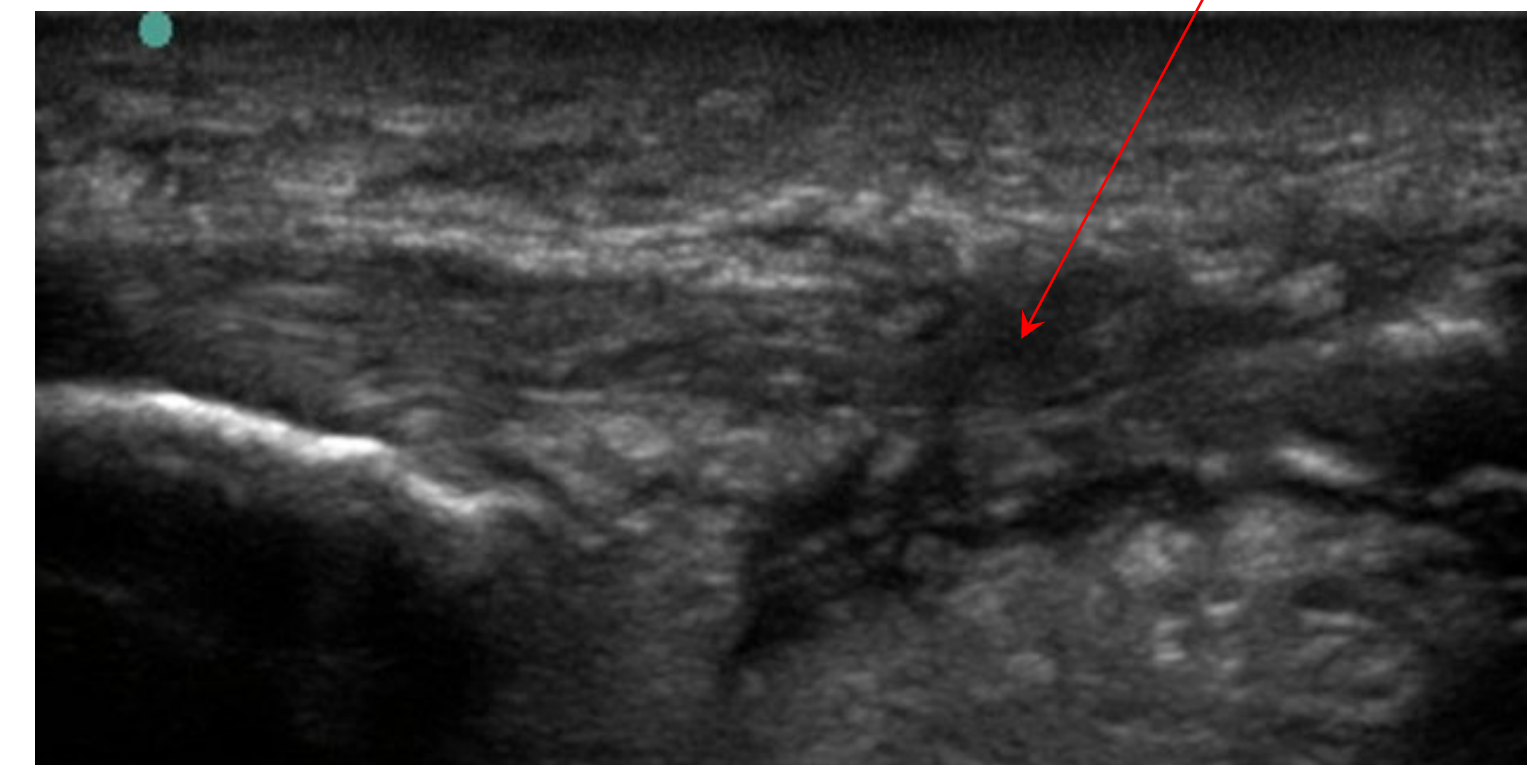
Normal



Fusiform Swelling

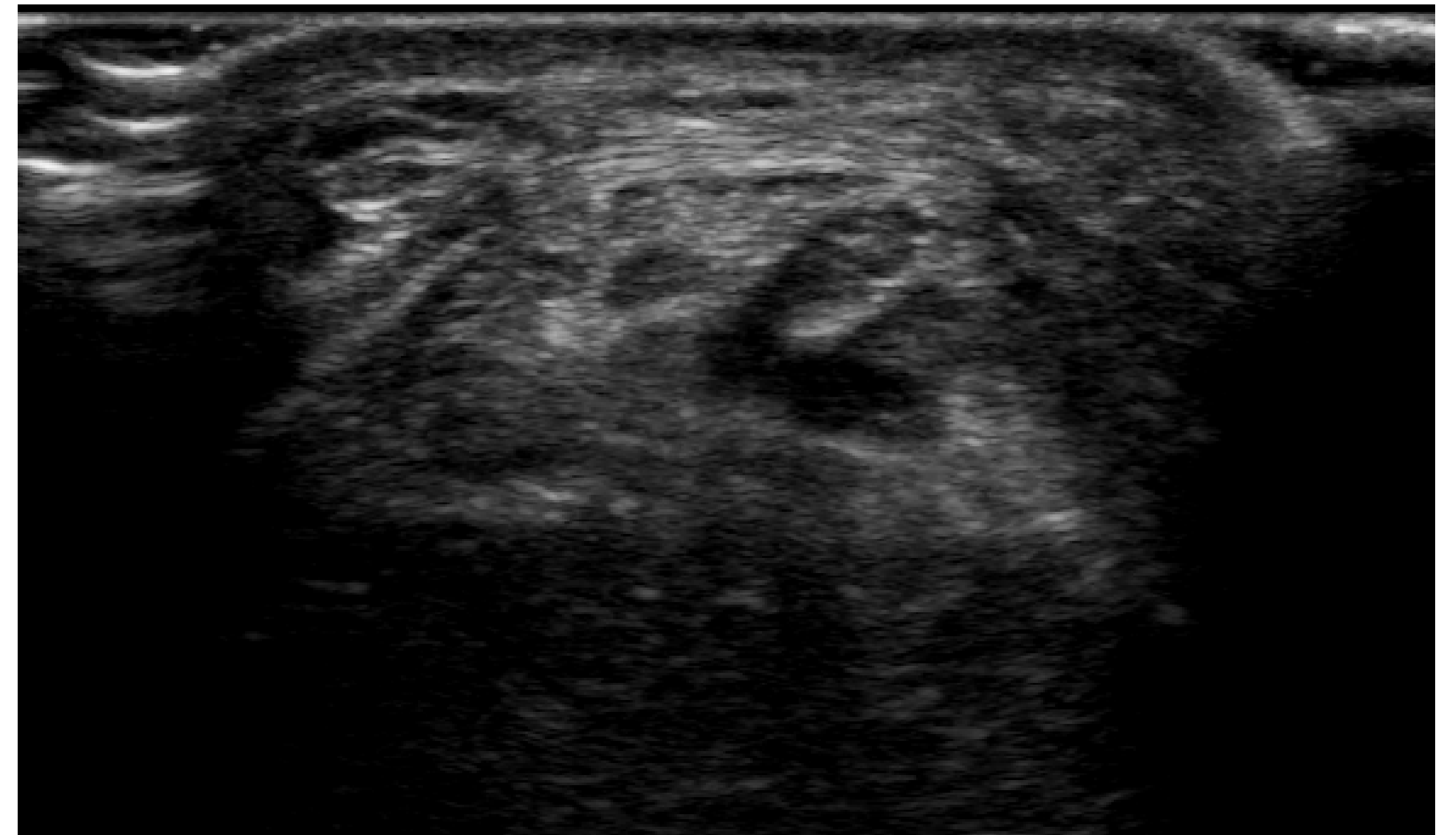
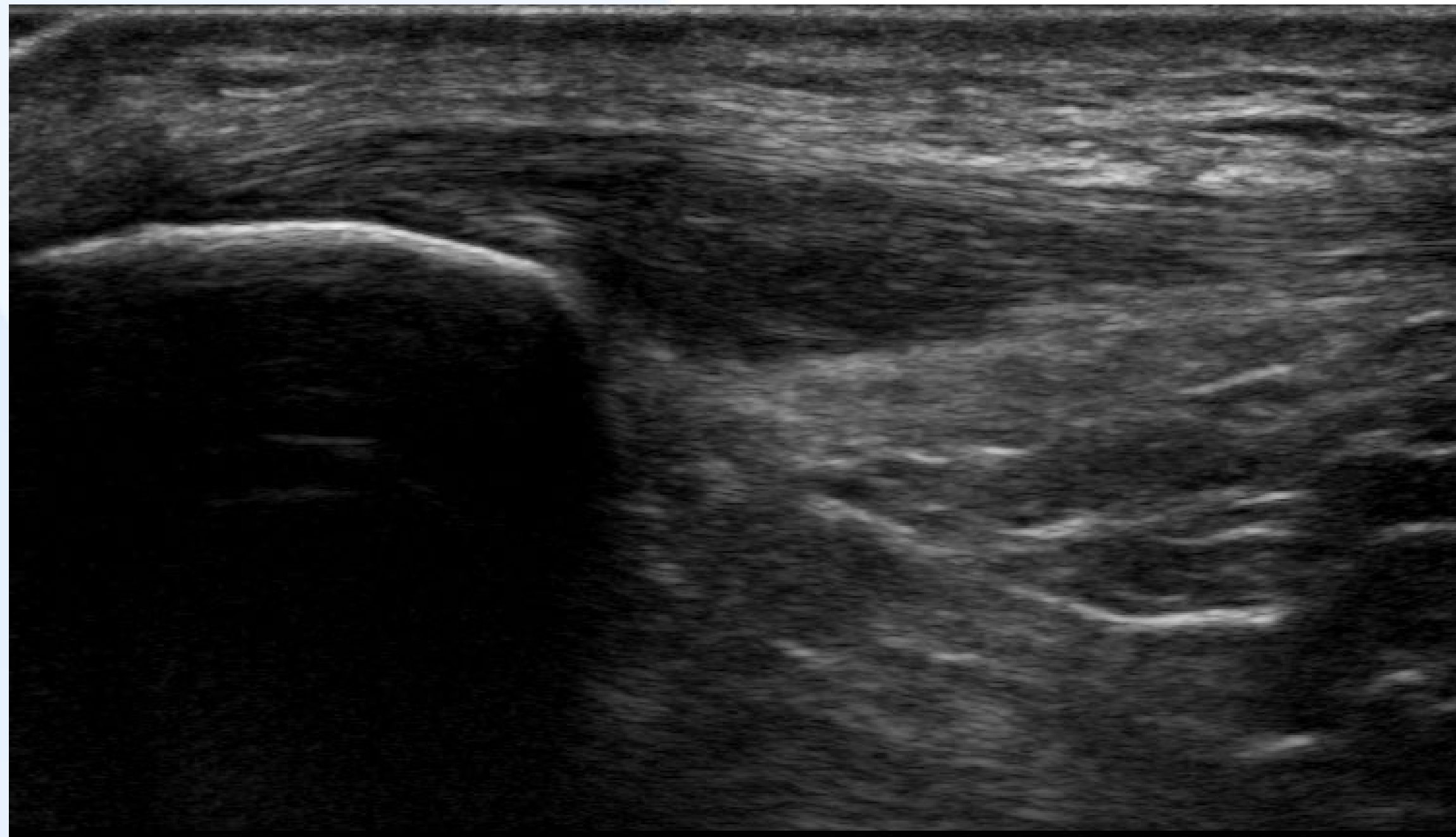


Partial Tear



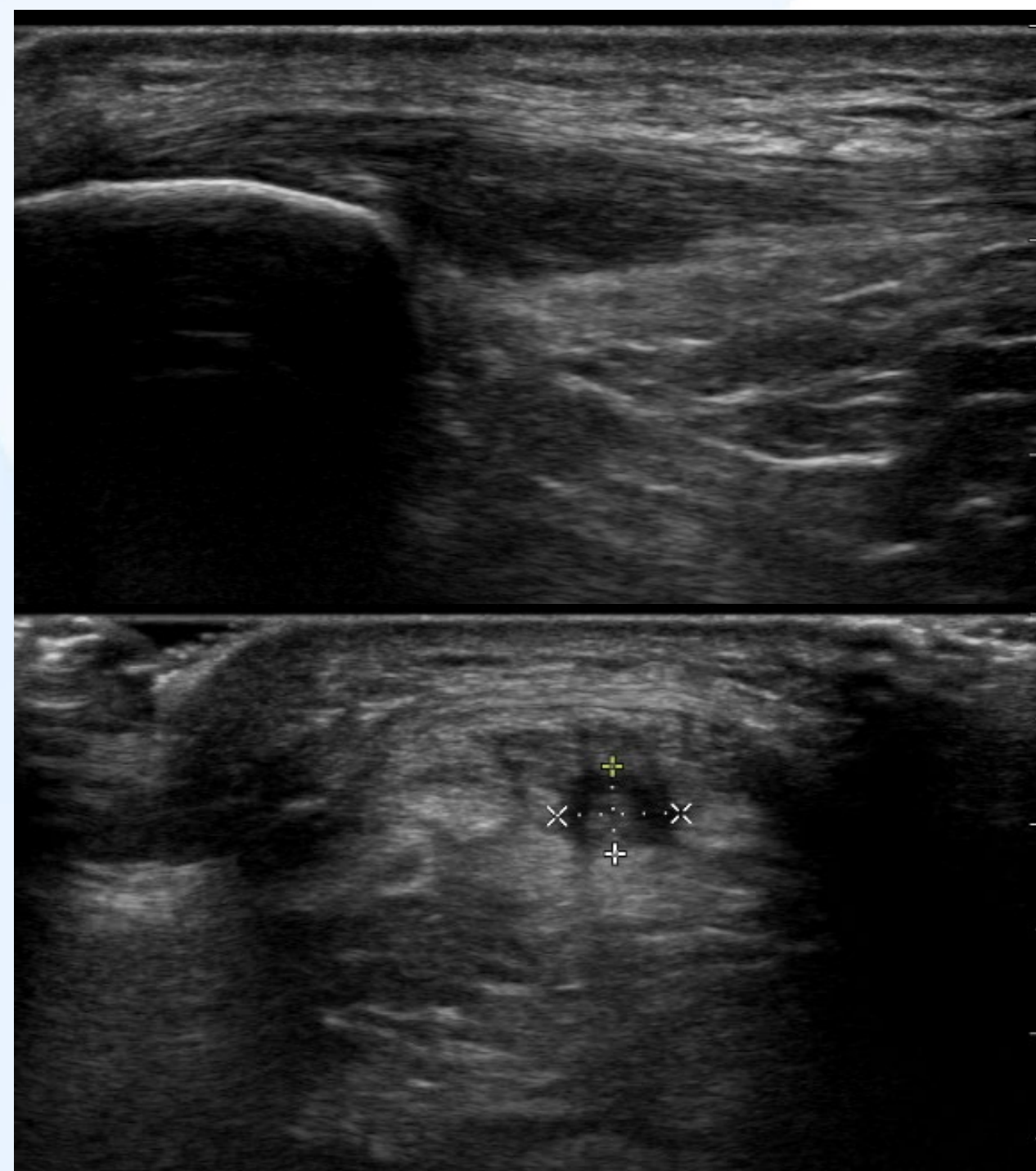
Rupture

Patellar Tendon BMC

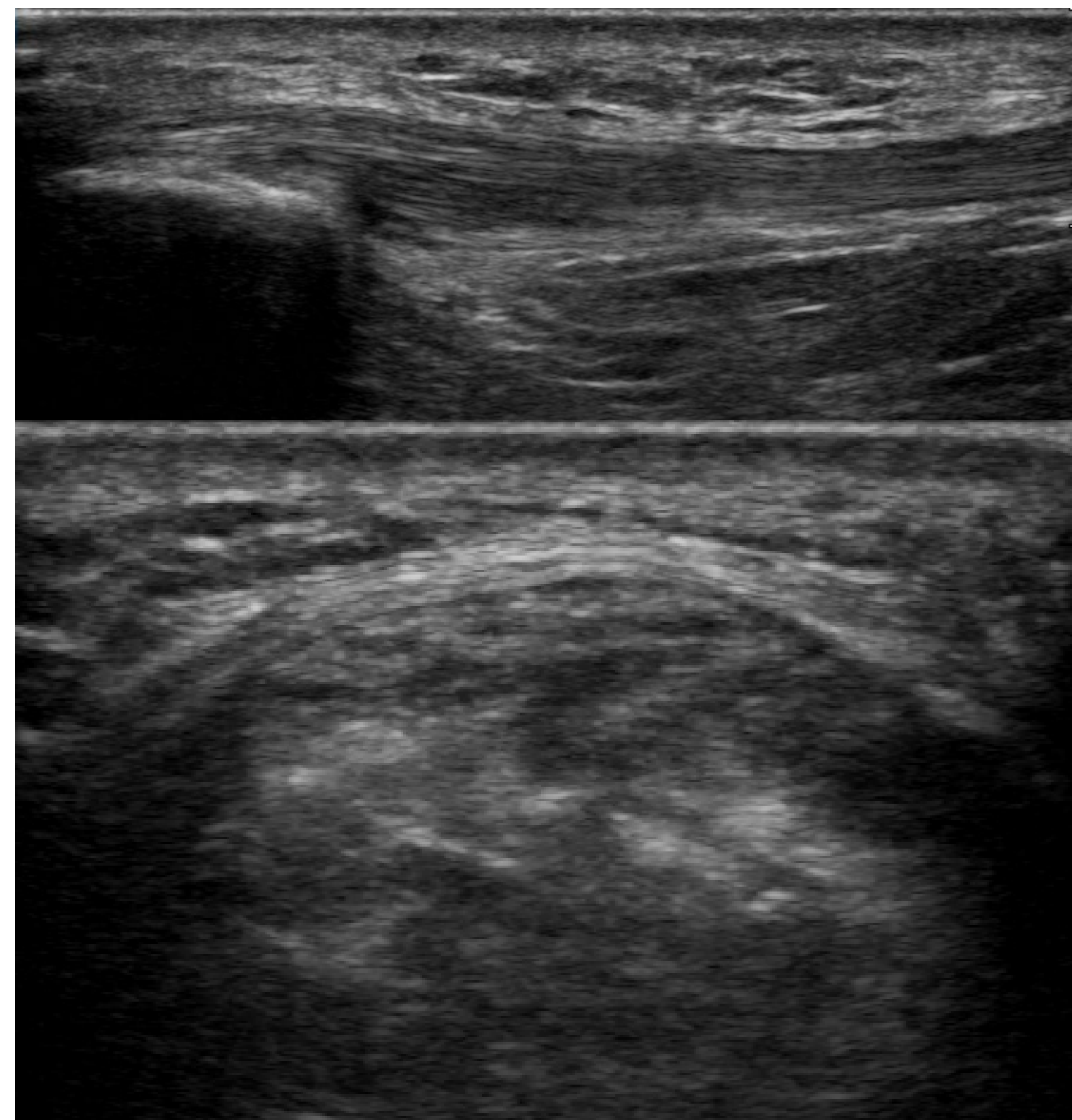


Patellar Tendon BMC

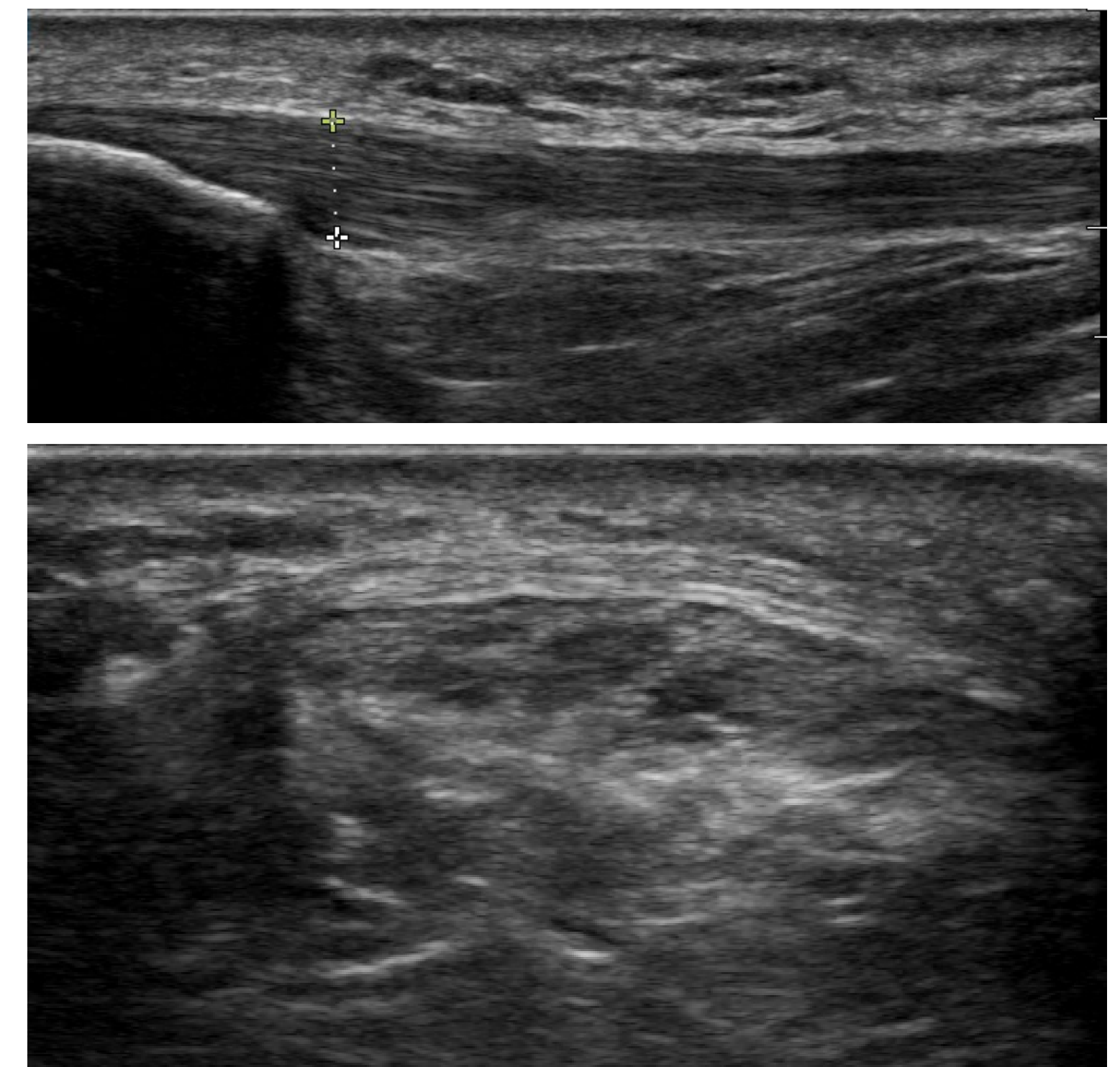
Pre-injection

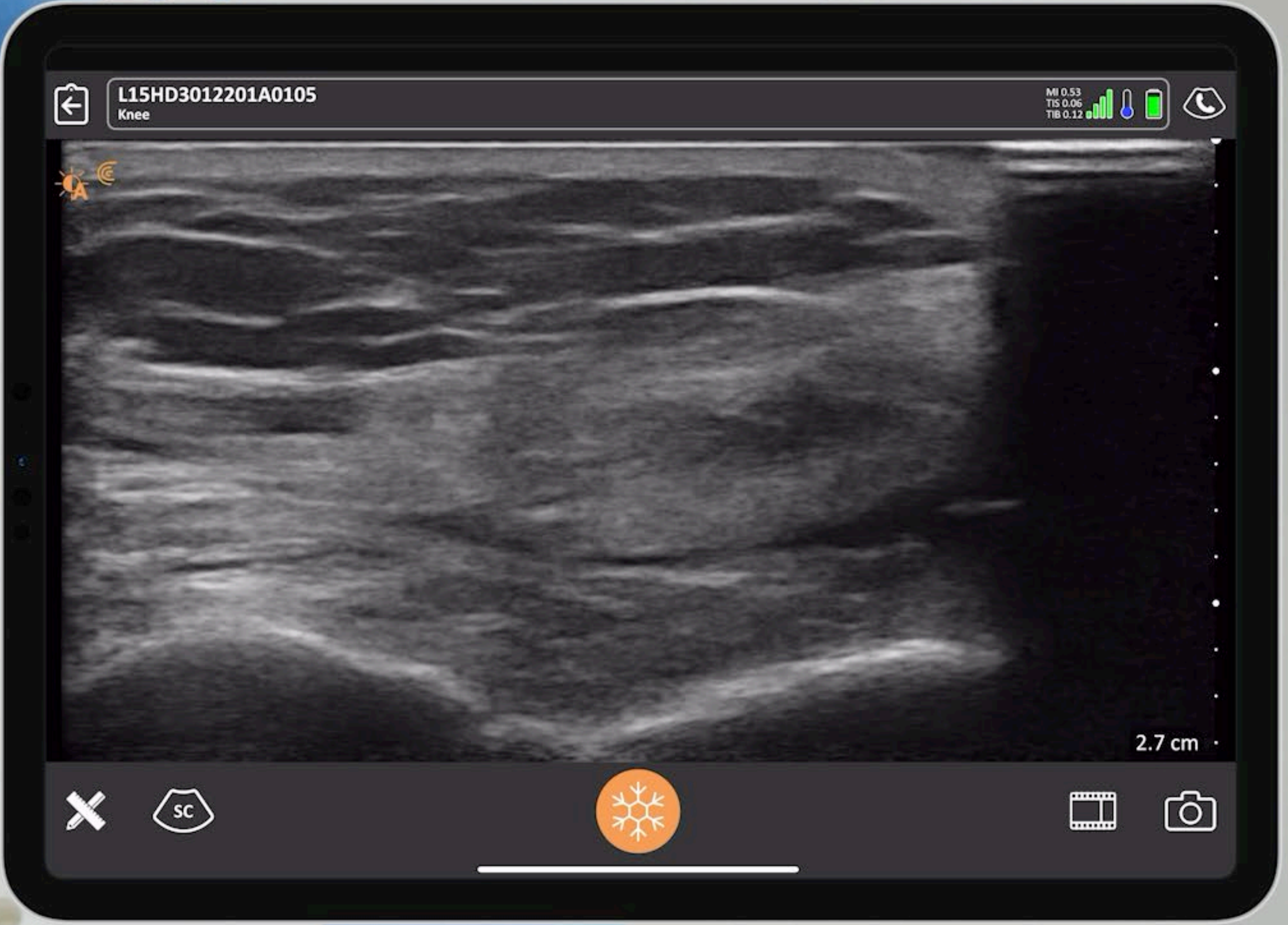


4 months post injection



8 months post injection





HOW DO I DO INJECTIONS?



What Do You Need?

- Sterile gloves / gown / mask / hat
- Sterile drapes
- Sterile transducer sheath or cover
- Sterile gel
- Sterile operating room



In Clinic: Injections, No Lost Time!

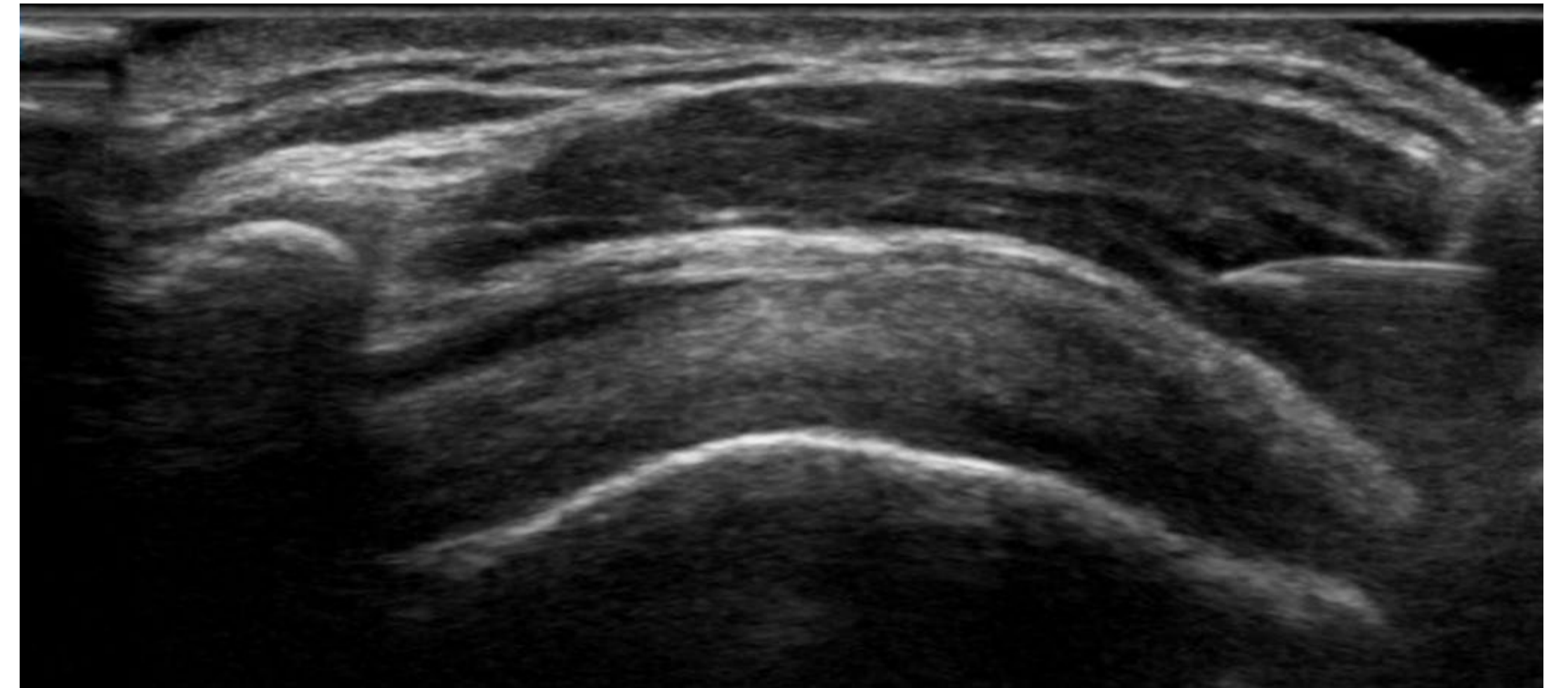


KNEE JOINT INJECTIONS



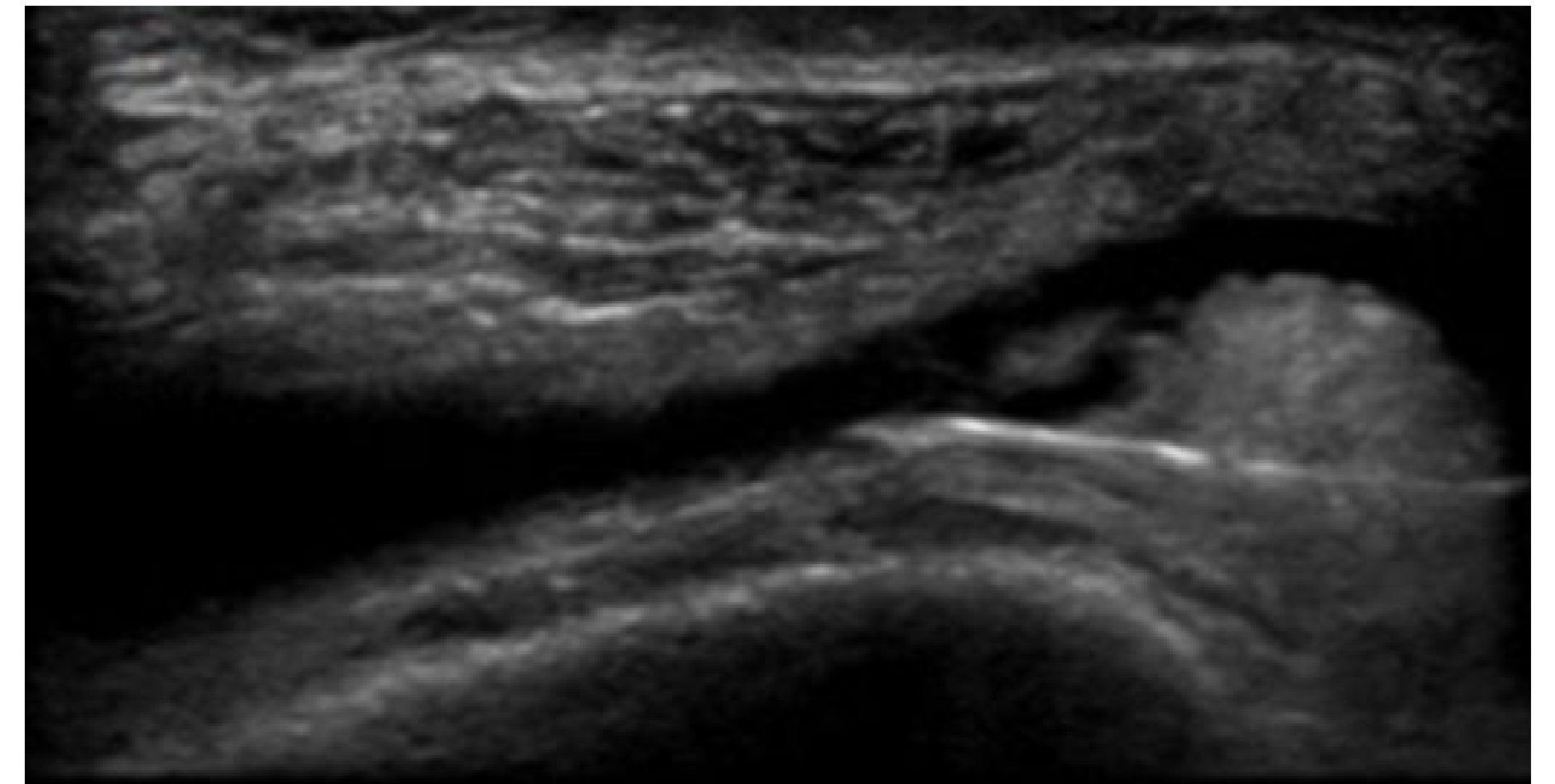
Improved Accuracy

- Despite overwhelming evidence that accuracy in injections is quite low and ultrasound significantly improves this accuracy, many DO NOT BELIEVE
- Many physicians will feel that they are “excellent” at injections and “never” miss



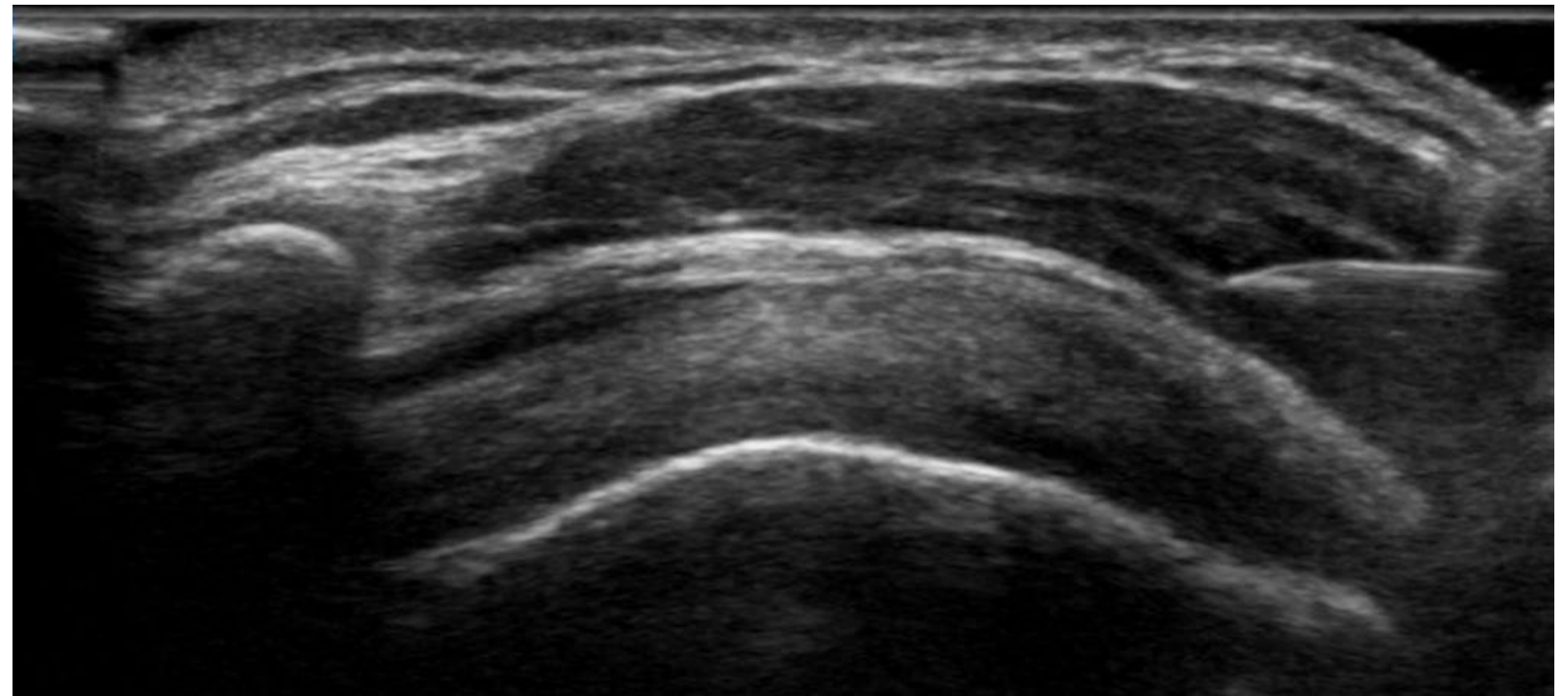
Accuracy of Knee Injections

- Jackson et al, JBJS-A, 2002
 - 7-29% of knee injections are NOT intra-articular
- Berkoff et al, Clin Interv Aging, 2012
 - Needle placement accuracy ranges from 39-100%
 - Avg 22.2% miss rate
- Sibbitt et al., J Rheumatol, 2009
 - 43% reduction in procedural pain ($p < 0.001$)
 - 59% reduction ($p < 0.001$) in absolute pain scores at 2 weeks vs. anatomical-guided injections

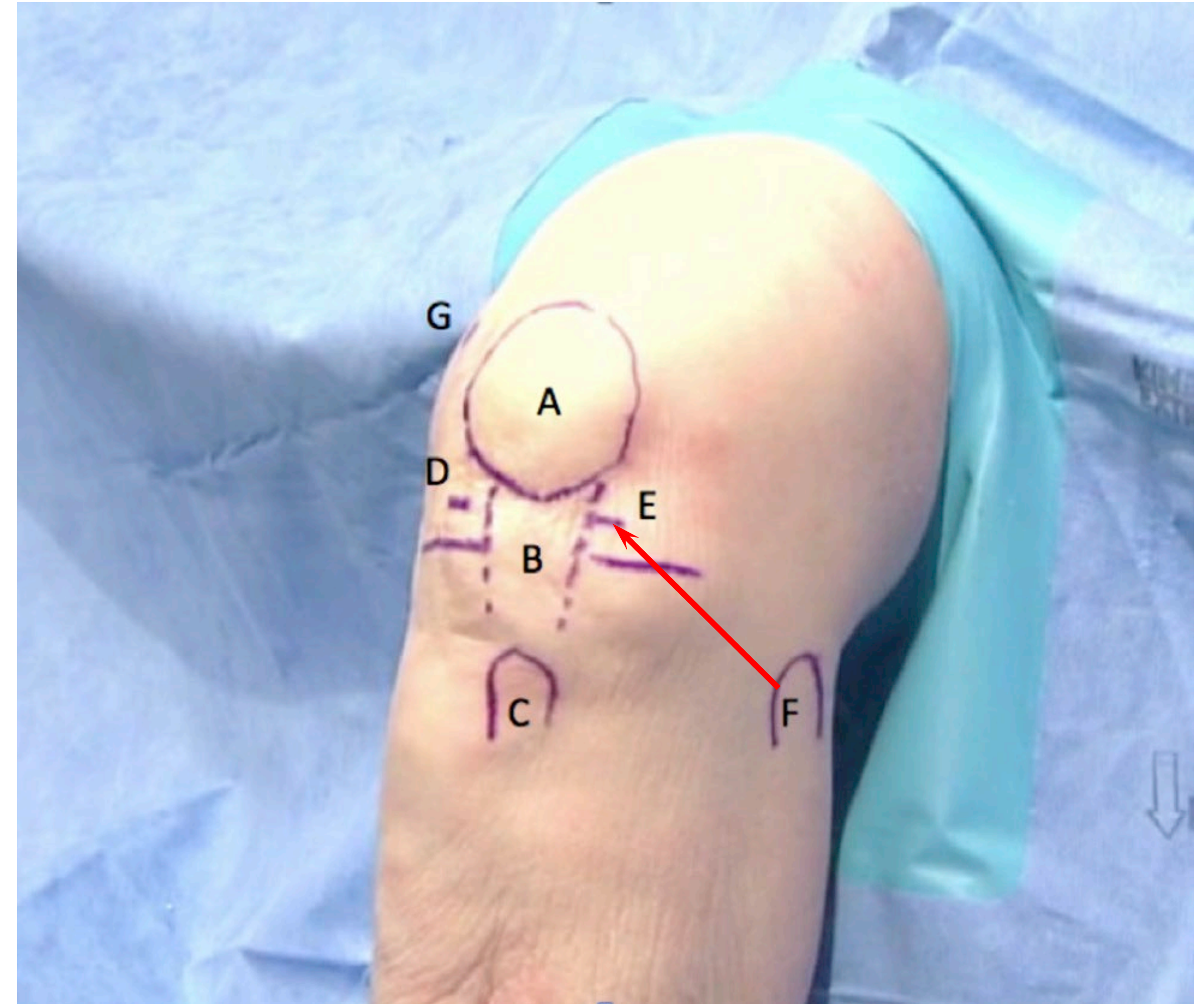


My Experience

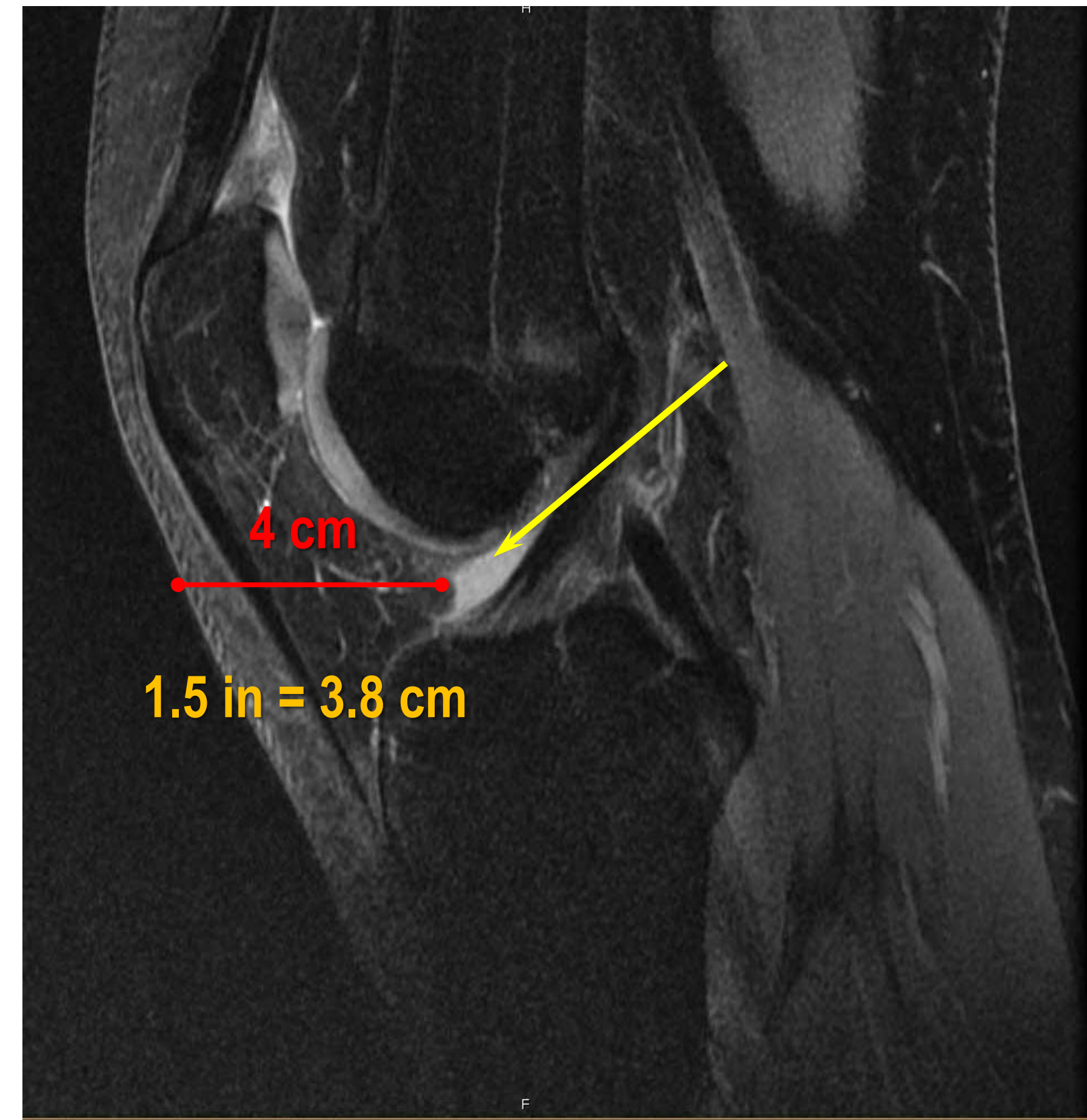
- “My patients have significantly less pain when done under ultrasound guidance”
- My Explanation:
 - *“I was missing!”*



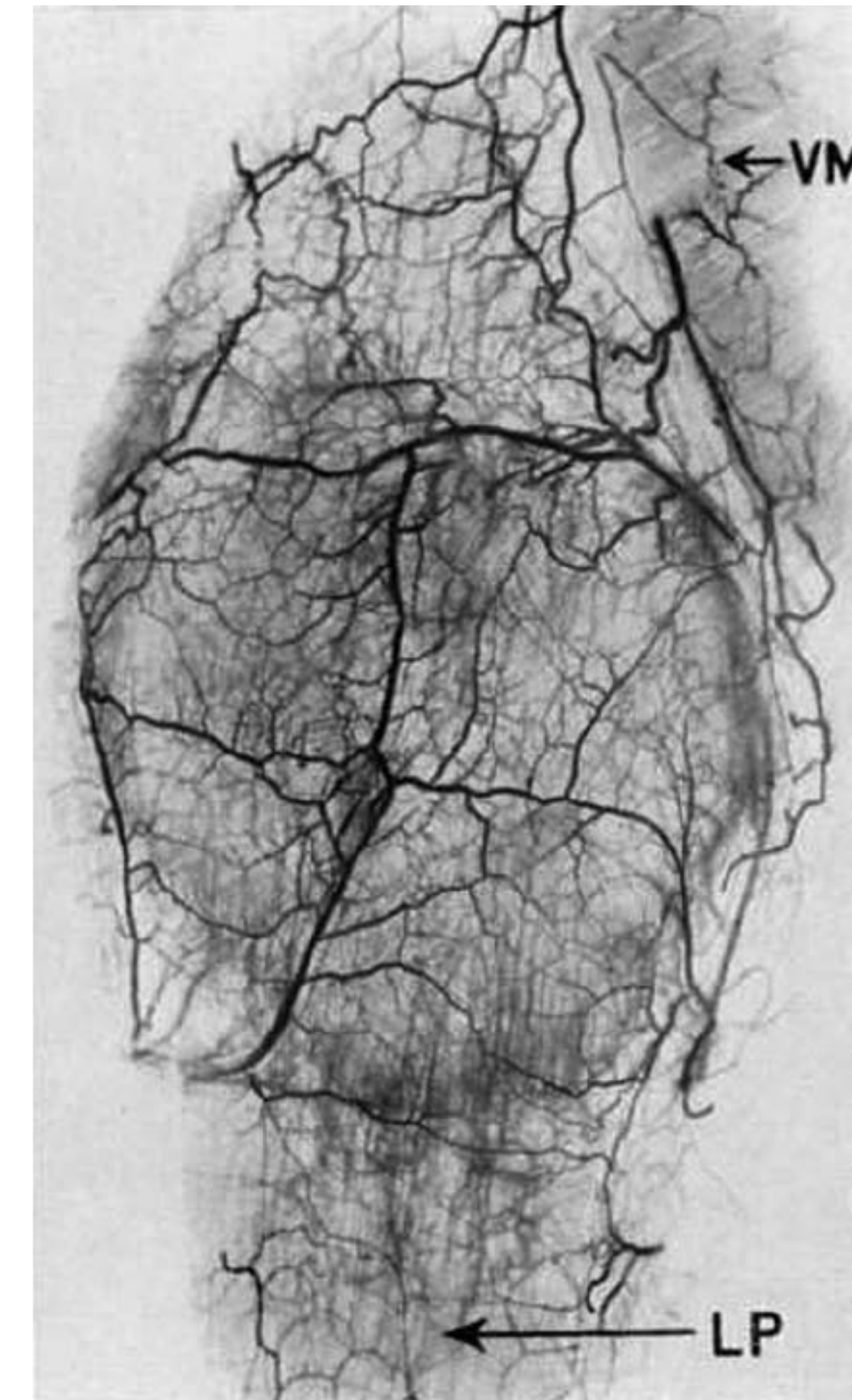
The Knee Joint



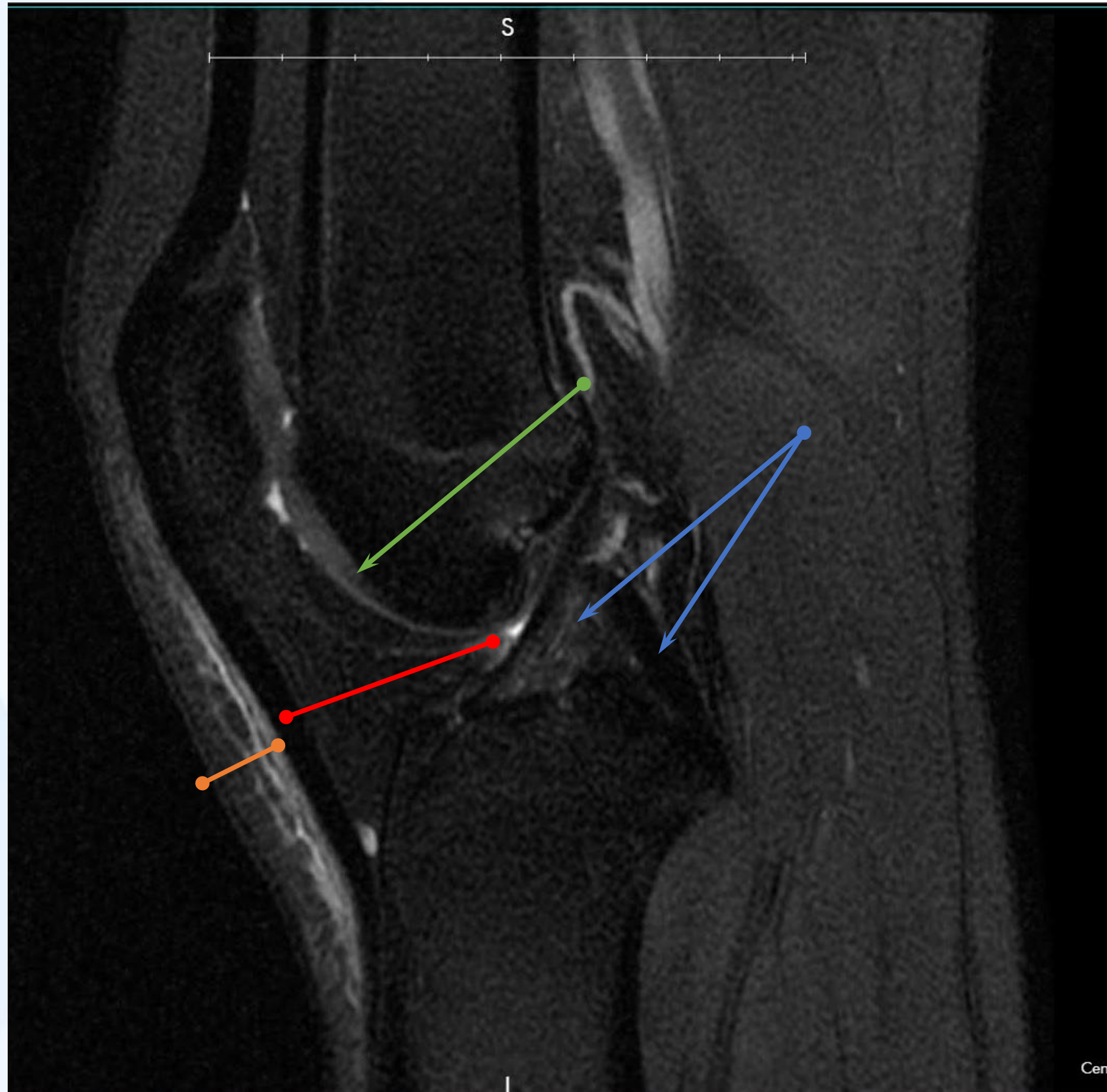
The Knee Joint



The Joint Space – Painful?



The Joint Space – Painful?

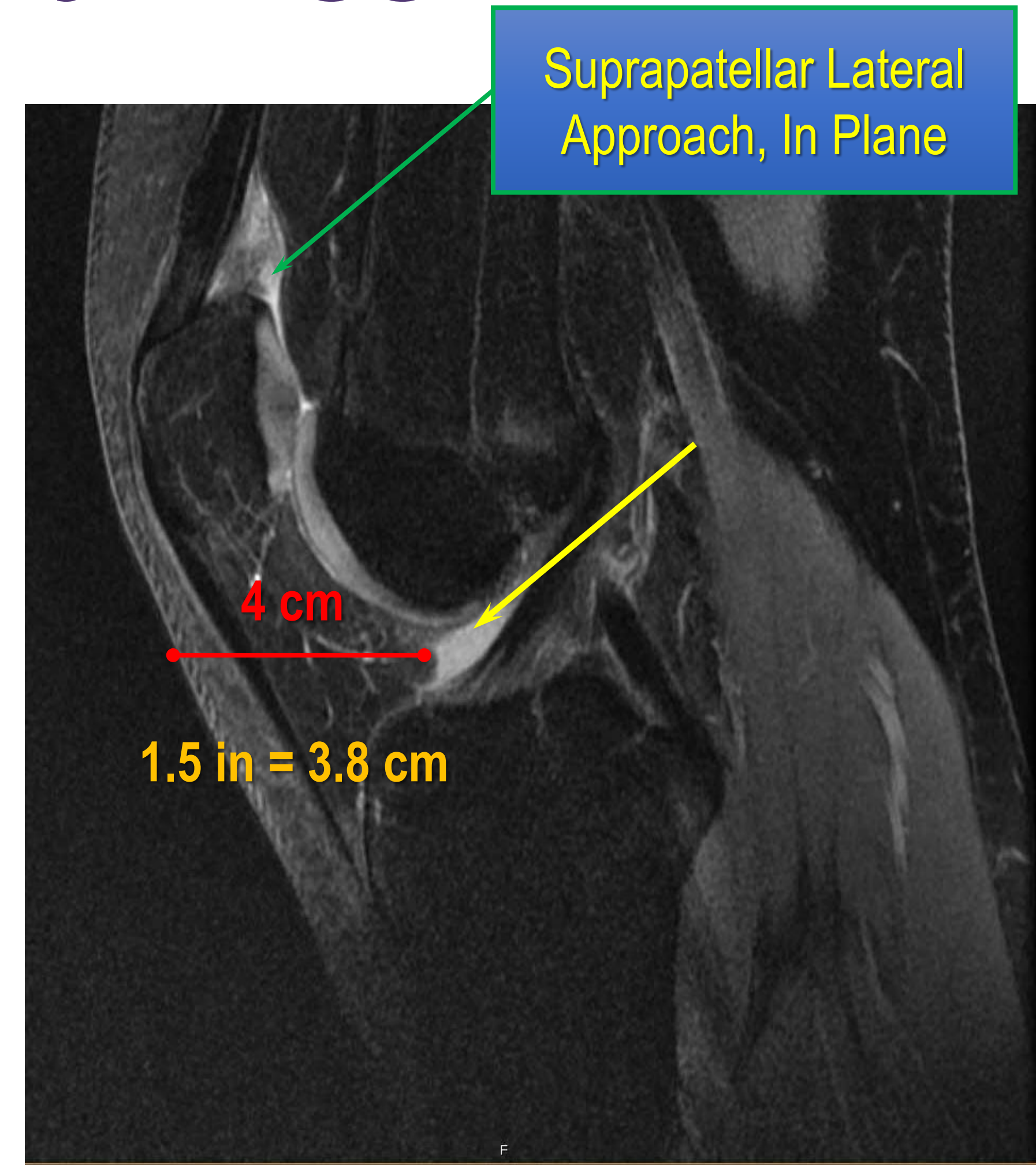
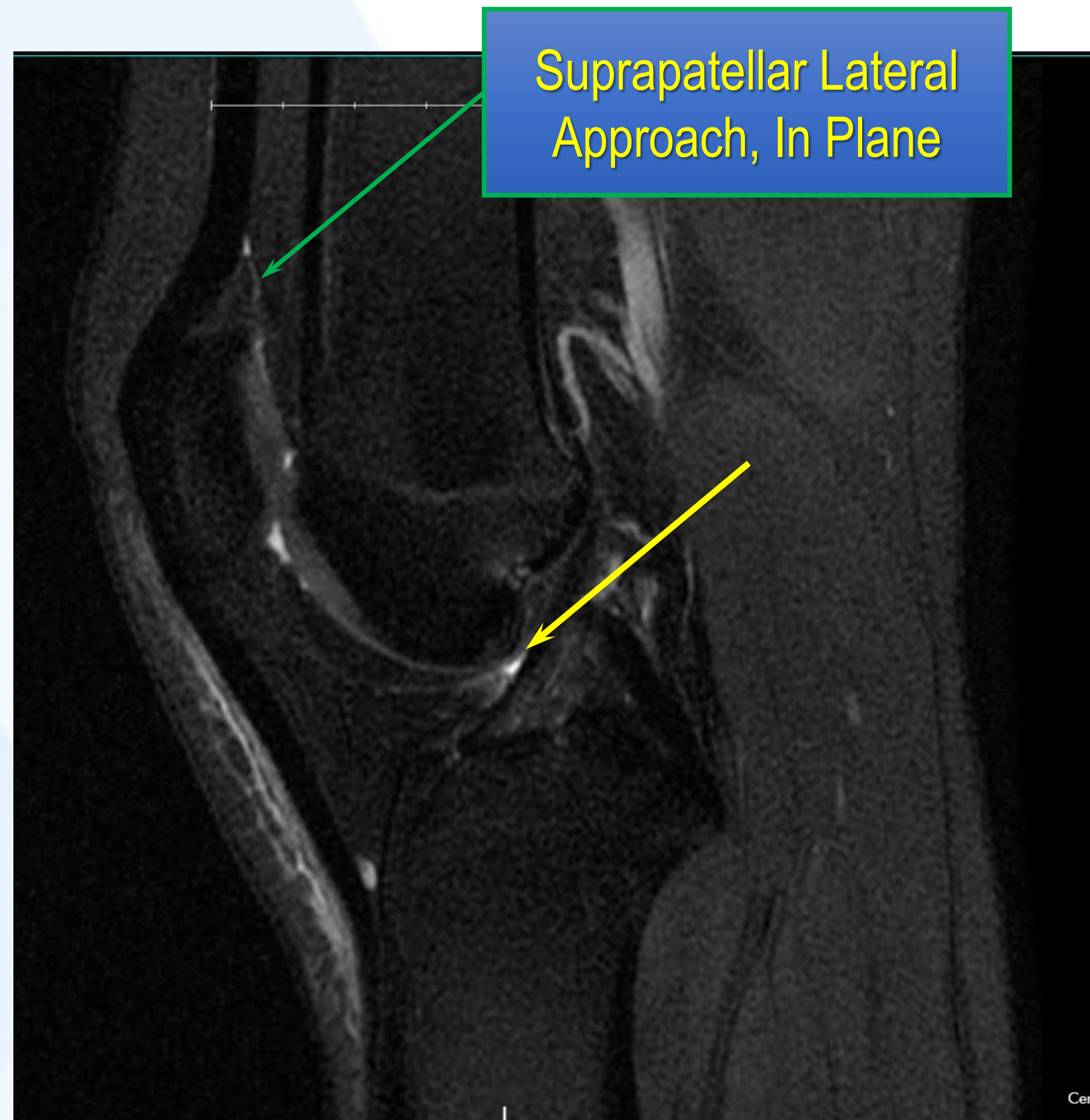


What Could You Hit?

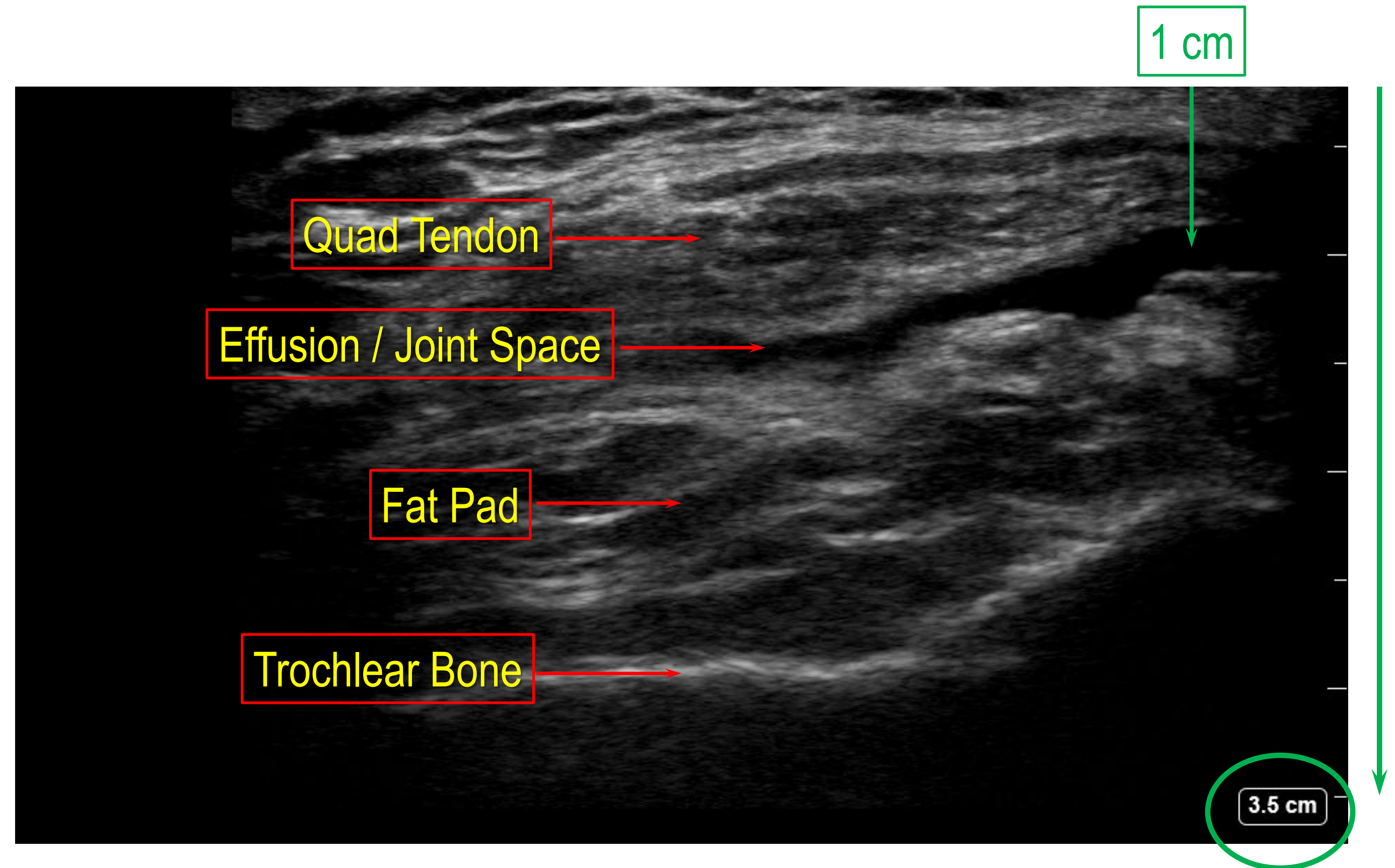
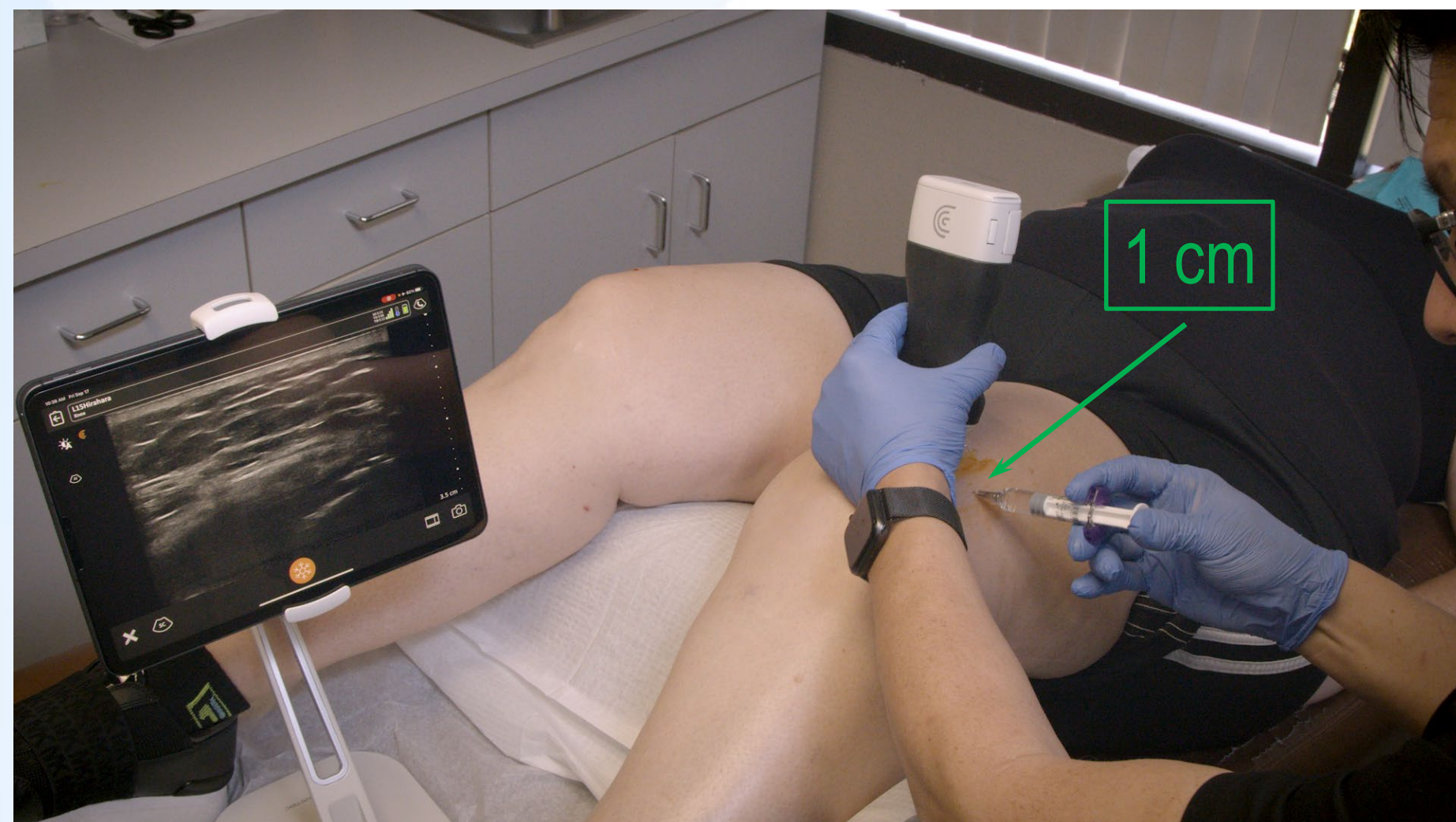
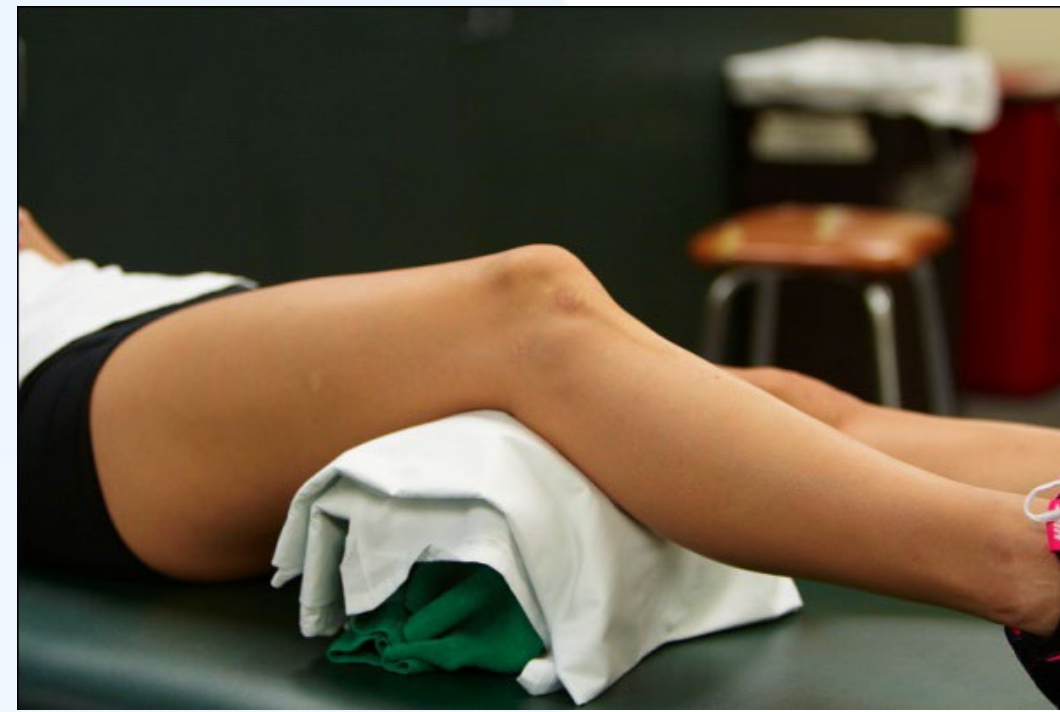
- Getting There:
 - Skin / Subcutaneous Fat
 - Hoffa's Fat Pad
- If you miss:
 - Cruciates
 - Condyles
 - Meniscus



The Knee Joint – My Suggestion

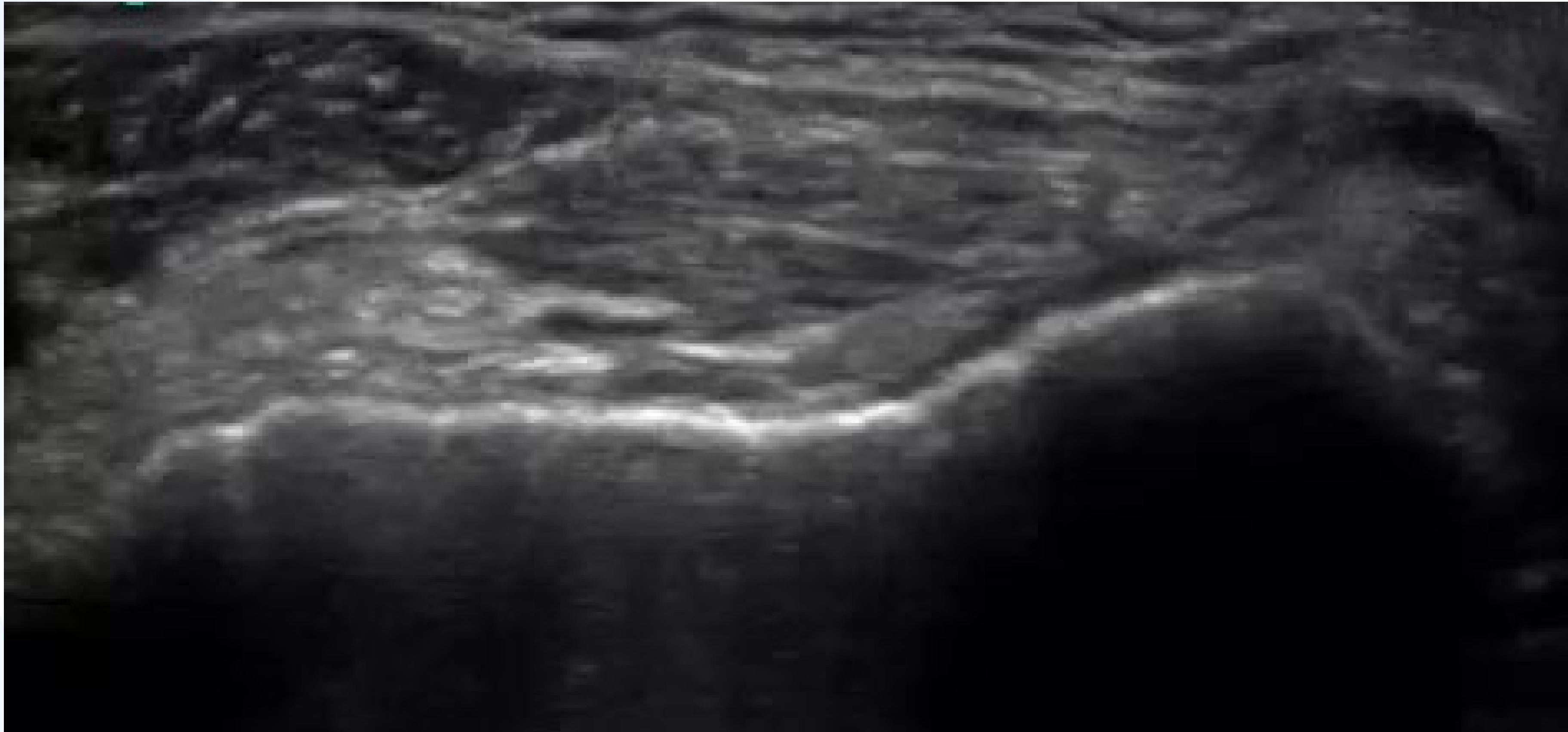


Knee Joint Suprapatellar Injection



Knee Joint Injection

No Effusion





L15HD3012201A0105
Knee

MI 0.53
TIS 0.06
TIB 0.12



2.7 cm

PES ANSERINE INJECTIONS





L15HD3012201A0105
Knee

MI 0.53
TIS 0.06
TIB 0.12



2.7 cm

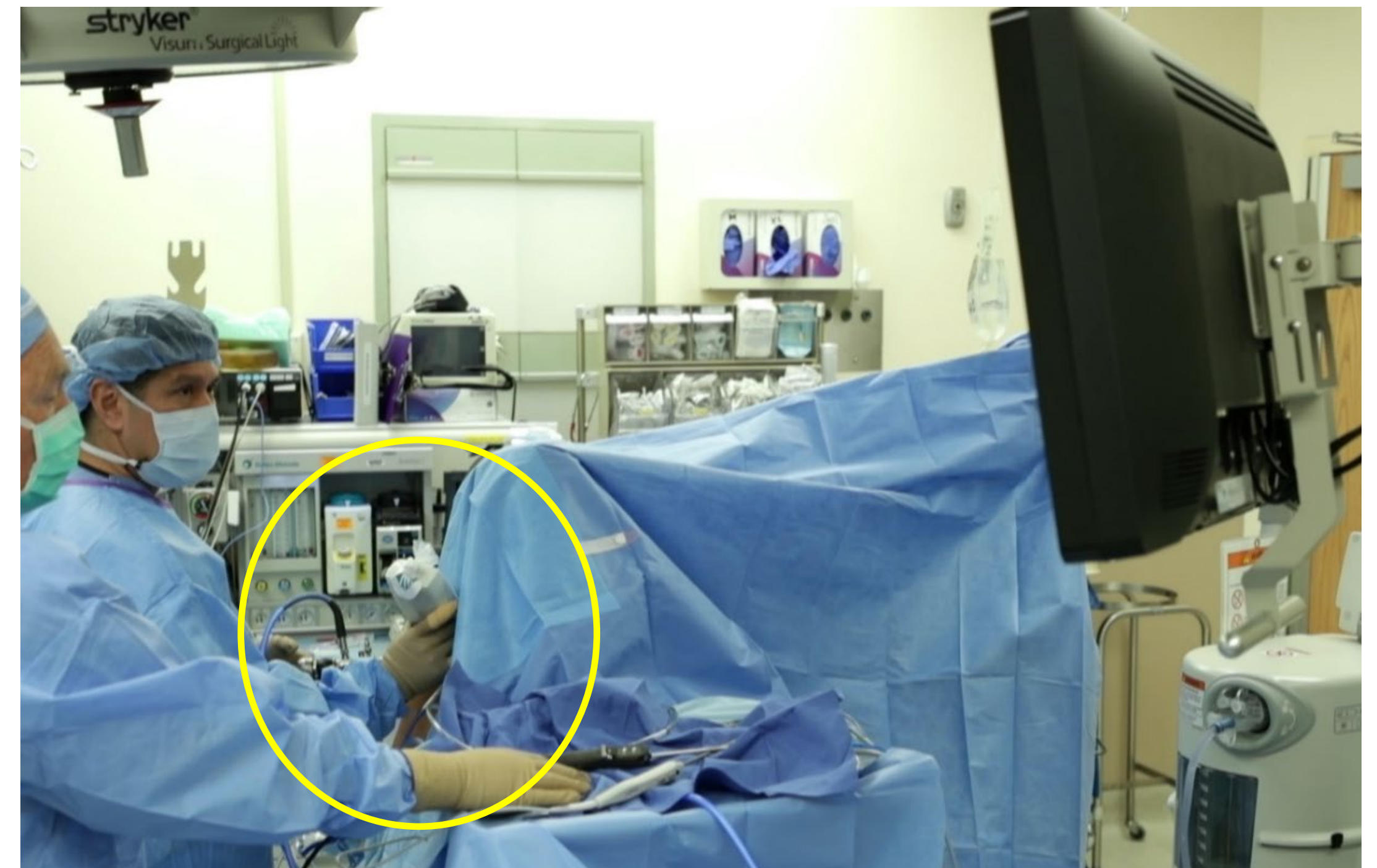
SURGICAL APPLICATIONS



Ultrasound Assisted Surgery

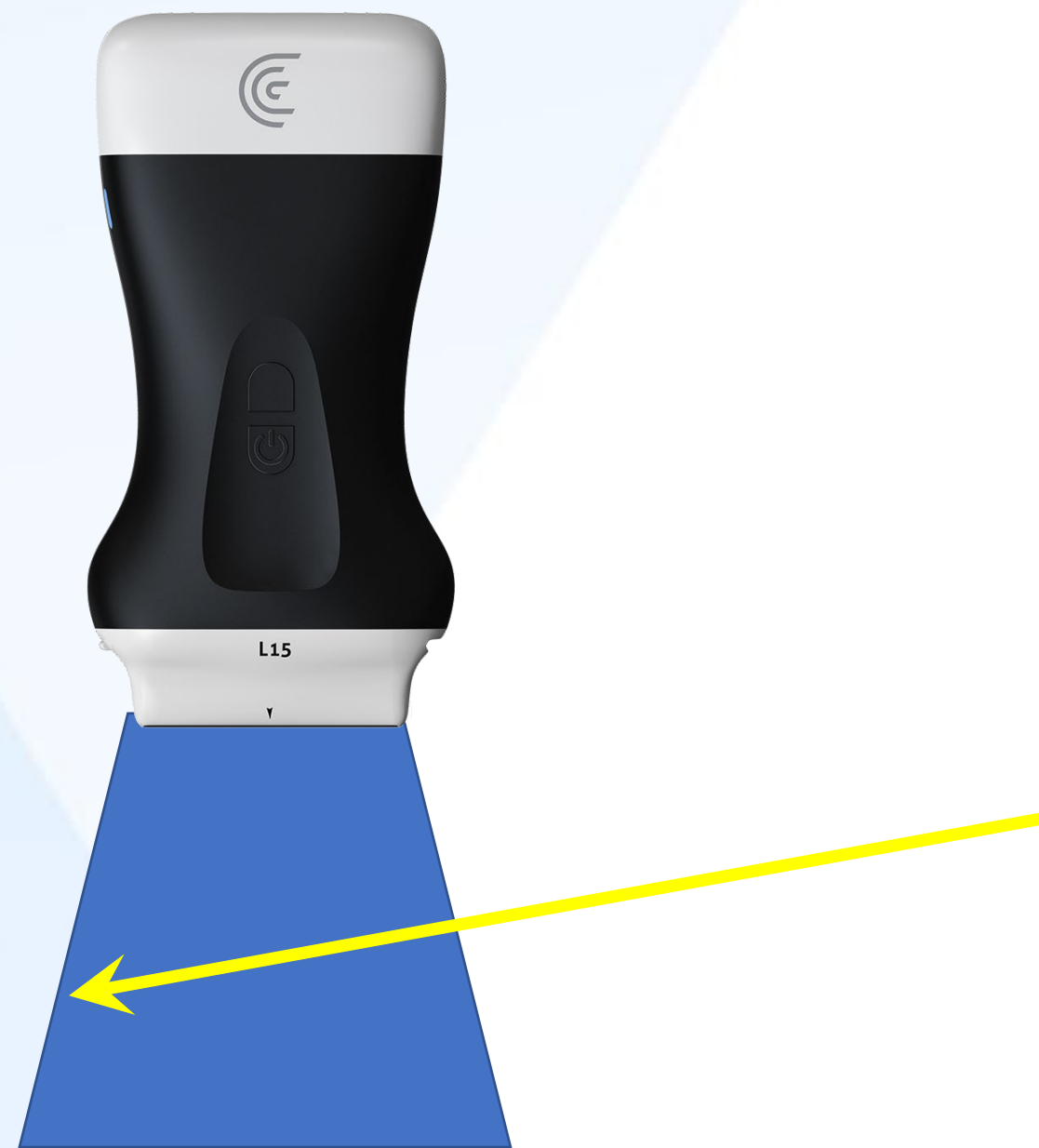
- Take advantage of the tools:
 - Can identify anatomy / pathology
 - Can put a needle on it
 - Can use the centerline function
 - Can use the crosshairs

—IN REAL TIME!

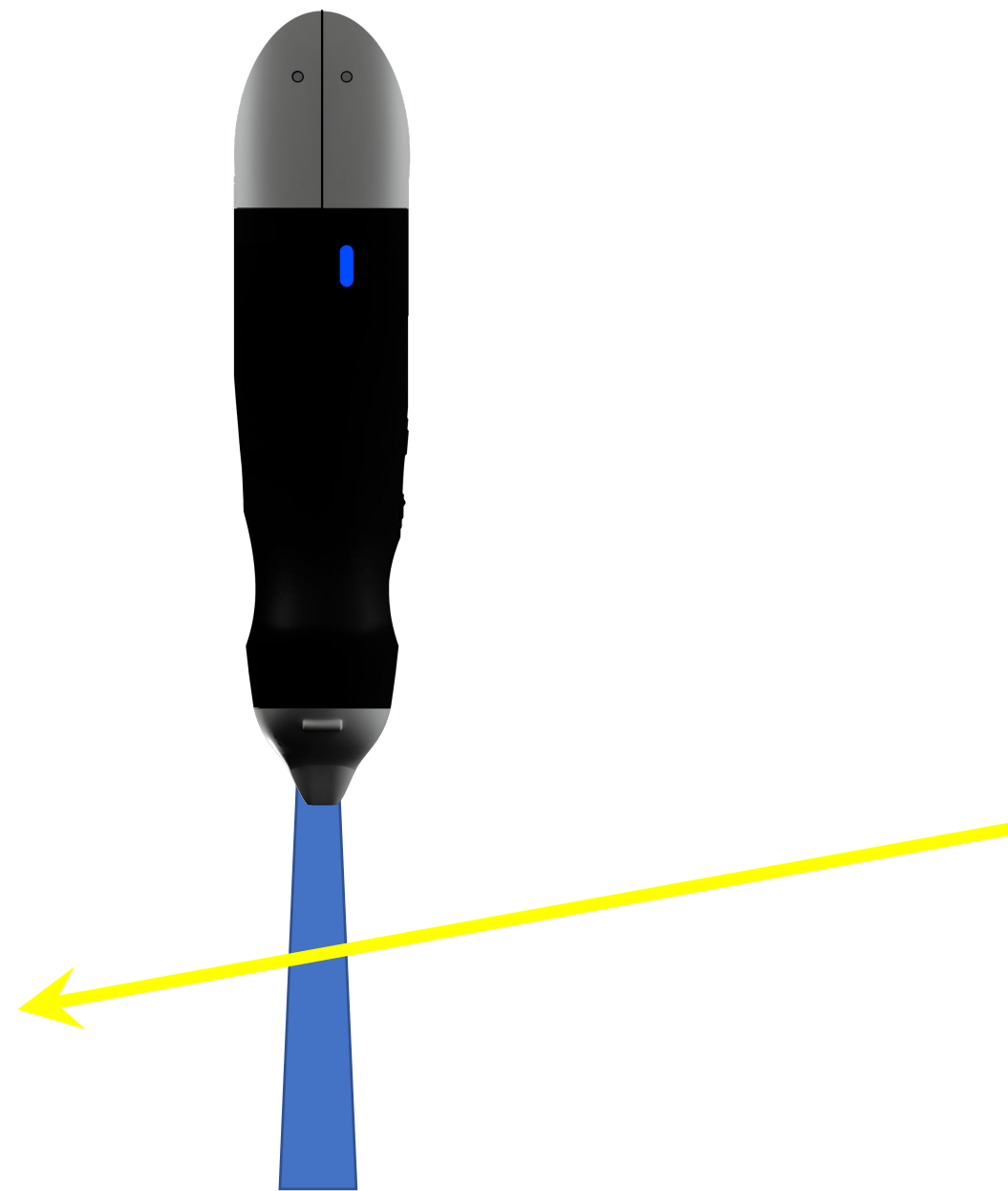


Ultrasound-Guided, Percutaneous Placement

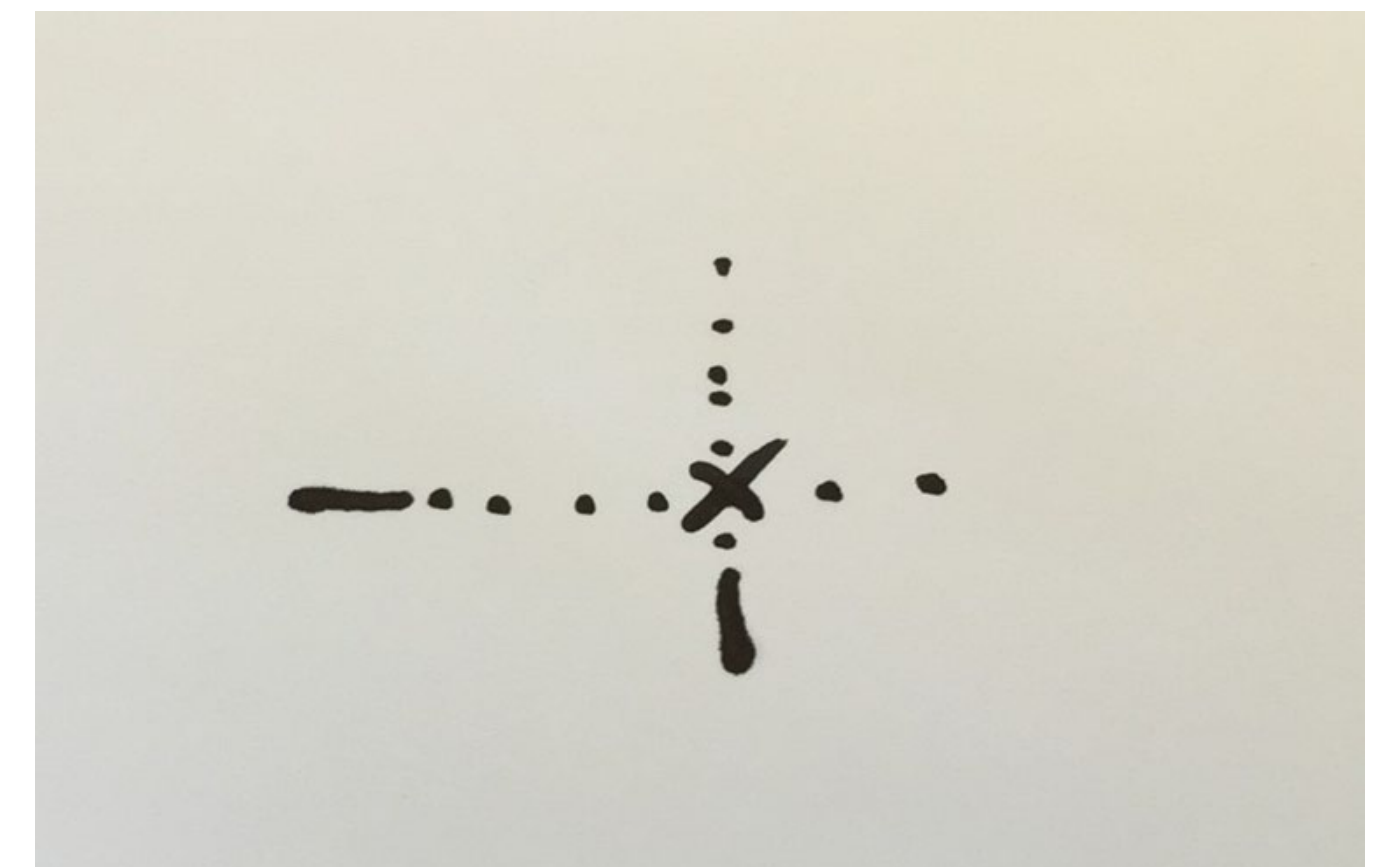
In plane needle



Out of plane needle



Crosshair markings



Publications

- A Guide to Ultrasound of the Shoulder, Part 3:
Interventional & Procedural Uses
 - Hirahara A, Panero A
 - Am J Orthop, Nov-Dec 2016



Orthopedic Technologies & Techniques

A Guide to Ultrasound of the Shoulder, Part 3: Interventional and Procedural Uses

Alan M. Hirahara, MD, FRCS(C), and Alberto J. Panero, DO

Abstract

Ultrasound is an extremely useful diagnostic tool for physicians, but recent advances have found that ultrasound's greatest utility is in interventional and procedural uses. Numerous studies have demonstrated a significant improvement in outcome and patient satisfaction when using ultrasound guidance for injections. Newer techniques are emerging to use ultrasound as an aid to surgery and interventional procedures. This allows the physician to use smaller incisions and less invasive methods, which are also easier to use for the practitioner and more cost-effective.

Ultrasound has classically been marketed and used as a diagnostic tool. Radiologists, emergency physicians, and sports physicians used ultrasound units to rapidly and appropriately diagnose numerous injuries and disorders, in a timely and cost effective manner. Part 1¹ and Part 2² of this series showed how to use ultrasound in the shoulder for diagnosis and how to code and get reimbursed for its use. Ultrasound can also be used to help guide procedures and interventions performed to treat patients. Currently, more physicians are beginning to recognize the utility of this modality as an aid to interventional procedures.

First-generation procedures use ultrasound to improve accuracy of joint, bursal, tendon, and muscular injections.³ Recent studies have shown a significant improvement in accuracy, outcomes, and patient satisfaction using ultrasound guidance

for injections.³⁻¹² Within the limitation of using a needle, second-generation procedures—hydrodissection of peripherally entrapped nerves, capsular distention, mechanical disruption of neovascularization, and needle fenestration or barbotage in chronic tendinopathy—try to simulate surgical objectives while minimizing tissue burden and other complications of surgery.⁴ More advanced procedures include needle fenestration/release of the carpal ligament in carpal tunnel syndrome and A1 pulley needle release in the setting of trigger finger.⁴ Innovative third-generation procedures involve the use of surgical tools such as hook blades under ultrasound guidance to perform surgical procedures. Surgeons are now improving already established percutaneous, arthroscopic, and open surgical procedures with ultrasound assistance.⁵ Aside from better guidance, reducing cost and improving surgeon comfort may be additional benefits of ultrasound assisted surgery.

Image-Guided Treatment Options

Prior to image guidance, palpation of surface anatomy helped physicians determine the anatomic placement of injections, incisions, or portals. Joints and bursas that do not have any inflammation or fluid can sometimes be difficult to identify or locate by palpation alone. Palpation guided joint injections often miss their target and cause significant pain when the therapeutic agent is injected into a muscle, tendon, ligament, fat, or other tissue. Ultrasound guided injections have proven to be more accurate and have better patient satisfaction when compared to blind injections.³⁻¹²

X-ray fluoroscopy has been the primary option for surgeons to assist in surgery. This is a natural modality for orthopedic surgeons; their primary use is for bone to help with fracture reduction and fixation as the bone, instrumentation, and

Authors' Disclosure Statement: Dr. Hirahara reports that he receives support from Arthrex as a consultant, royalties, and research support. Dr. Panero reports no actual or potential conflict of interest in relation to this article.

www.amjorthopedics.com

November/December 2016 *The American Journal of Orthopedics*[®] 1

Publications

- Hirahara, Andersen. Ultrasound-guided percutaneous reconstruction of the *anterolateral ligament*: Surgical technique & case report. Am J Orthop. 2016 Nov-Dec;45(7):418-60.
- Hirahara, Andersen. Ultrasound-guided percutaneous repair of the *medial patellofemoral ligament*: Surgical technique & outcomes. Am J Orthop. May-June 2017;46(3):152-157.
- Hirahara A, Mackay G, Andersen W. “Ultrasound-guided suture tape augmentation and stabilization of the *medial collateral ligament*”, Arthrosc Tech, 2018 Feb 5; 7(3): e205-10. doi: 10.1016/j.eats.2017.08.069. PMID: 29881691
- Andersen J, Barcelos M, Raffaelli M, Hirahara A. “Ultrasound-guided suprapectoral tenodesis of the long head of the *biceps brachii*”, Arthrosc Tech, 2020 Dec 21; 9(12): e2071-6. doi: 10.1016/j.eats.2020.08.039. PMID: 33381421



Ultrasound Assisted Knee Surgery

- MPFL repair or reconstruction
 - Published AJO May 2017
- ALL reconstruction
 - Published AJO Nov 2016
- MCL (or LCL) repair, reconstruction, or InternalBrace
 - Published, Arthrosc Tech 2017
- Patellar or Quad tendon partial tear repair



What's in My Bag?

- Linear, high-definition scanner
- Frequency: 5 – 15 MHz
- Depth Max: 7 cm
- Connection: Wireless (no cords)



MPFL Repair / Reconstruction

Orthopedic Technologies & Techniques

Ultrasound-Guided Percutaneous Repair of Medial Patellofemoral Ligament: Surgical Technique and Outcomes

Alan M. Hirahara, MD, FRCS(C), and Wyatt J. Andersen, ATC

WATCH on
amjorthopedics.com



Medial
Patellofemoral
Surgical Repair
Video

Abstract

A lateral patellar dislocation causes a medial patellofemoral ligament (MPFL) tear that begins affecting patellar biomechanics. Reconstruction is difficult because of the inability to reliably and accurately determine proper placement of sockets. Studies of MPFL anatomy have found significant variability in attachment site locations, which suggests MPFL procedures cannot be used universally and must be approached differently for each patient. Recurrent dislocations result in patellar and trochlear chondral and bony damage.

In this article, we present a novel technique that uses ultrasound to locate the MPFL tear and the MPFL attachment sites, and perform anatomical repair of the native tissue at the patellar attachment site, the femoral attachment site, or both. We also describe our retrospective analysis of 10 cases of this ultrasound-guided percutaneous procedure, performed since its development in 2013. In each case, patellar stability was restored completely and without complications.

The promising results, the ease of the surgery, and the limited rate of complications indicate this surgical technique should be considered before reconstruction and early in trauma cases, before onset of chondral or bony damage.

Take-Home Points

- Use ultrasound to identify integrity and location of MPFL tear.
- Anatomic repair allows native tissue to reintegrate into bone.
- Repairs done early can prevent complications of recurrent instability.
- Repair maintains biological and proprioceptive qualities of tissue.
- Ultrasound-guided percutaneous repair is quick and effective.

The medial patellofemoral ligament (MPFL) is the primary passive restraint to lateral patellar excursion^{1,4} and helps control patellar tilt and rotation.^{6,7} More than 90% of lateral patellar dislocations cause the MPFL to rupture, and roughly 90% of these detachments involve the femoral insertion.⁴ Ensuing patellar instability often results from MPFL insufficiency. It has been suggested that re-creating the anatomy and functionality of this ligament is of utmost importance in restoring normal patellar biomechanics.^{1,5,7,8}

Anatomical risk factors for recurrent patellar instability include patella alta, increased tibial tuberosity-trochlear groove (TTTG) distance, trochlear dysplasia, and torsional abnormalities.^{1,10} A medial reefing technique with a lateral tissue release traditionally was used to restore proper kinematics, but was shown to have associated postoperative issues.⁹ In recent years, ligamentous reconstruction has become the gold standard for surgical intervention.^{6,8} The precise location of the MPFL attachments, particularly at the femoral insertion, has been the subject of a great deal of debate. McCarthy and colleagues¹⁰ suggested that the anatomical location at the femur is just anterior and distal to the adductor tubercle, but they noted that determining this location during surgery is difficult. Use of fluoroscopy has become the gold standard for identify-

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Summary of Ultrasound

- *Tool* like fluoroscopy or arthroscopy
- *Inexpensive* and widely available
- Allows for *visualization* of anatomic structures
- Helps *guide* injections or surgeries
- Transforms surgeries from open to *percutaneous*



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Questions



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Thank you!