Case Studies

Insights from Notable Cases in Non-Operative Regenerative Practice

BOSTON SPORTS & BIOLOGICS

NO DISCLOSURES

THE LINEUP

1. Percutaneous Ultrasound-Guided Intraosseous Bone Marrow Aspirate Concentration Injection for the Treatment of Fifth Metatarsal Head Stress Fracture without Surgical Fixation

2. Ultrasound Guided High Volume Pressure Hydrodialation for Postoperative Adhesive Capsulitis of the Hip

3. Calcification of the Medial Collateral Ligament: Our Experience Treating with an Ultrasonic Vacuum Debridement

4. Ultrasound Guided Plantaris Tendon Thread Release in an Elite Runner

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BMAC FOR 5TH METATARSAL HEAD

PATIENT INFORMATION

21 year old male Division 1 Basketball player

Insidious onset of pain over the fifth metatarsal head during preseason. (July)

Increased pain with running, jumping, cutting activity. Described the pain as throbbing and aching.

No prior history of foot/ankle trauma

Relevant medical history includes Chrons which was managed with Repatha

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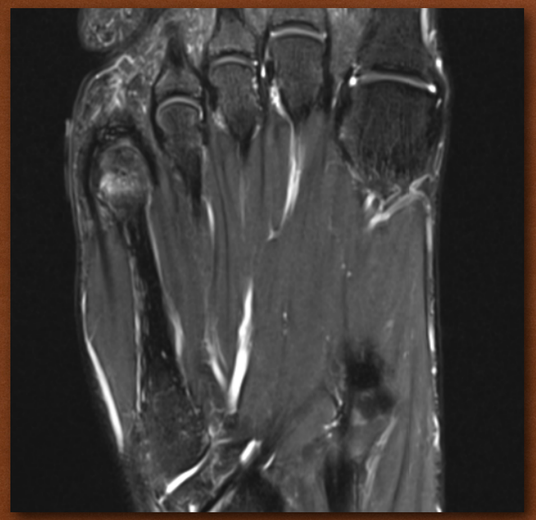
IMAGING AND DIAGNOSTICS

X-RAYS OF THE FOOT 4 WEEKS AFTER THE ONSET OF PAIN WERE NORMAL

MRI OF THE RIGHT FOOT DISPLAYING A SUBACUTE FRACTURE OF THE FIFTH METATARSAL HEAD ACCOMPANIED BY REACTIVE BONE MARROW EDEMA AND EROSIVE CHANGES
9/13- 2 MONTHS AFTER ONSET OF SX



REPEAT MRI SHOWED CONTINUED EVIDENCE OF BONE EDEMA
11/1- 4 MONTHS AFTER SX ONSET

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8/21- 2/22 CONSERVATIVE TREATMENTS

- IMMOBILIZATION- WALKING BOOT 3 MONTHS
- EXOGEN BONE STIMULATOR
- ORTHO LAZER (6 TREATMENTS)
- RADIAL SHOCKWAVE (4 TREATMENTS)
- BLOOD FLOW RESTRICTION THERAPY
- FOOTWEAR MODIFICATION

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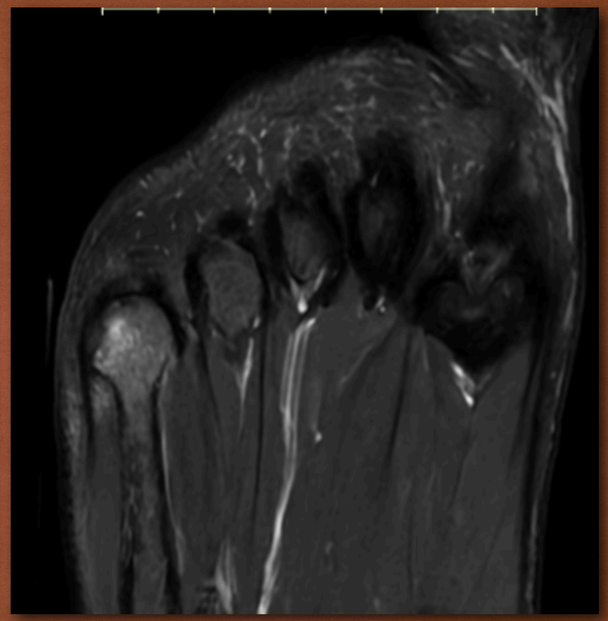
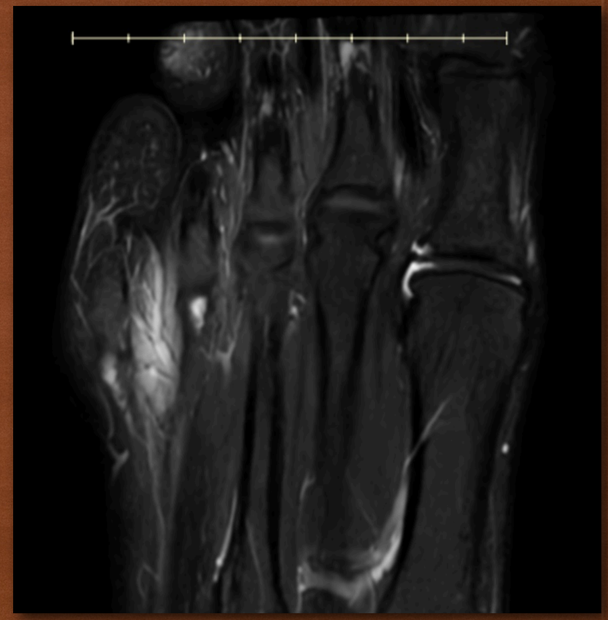
2/22 POST TREATMENT MRI

FINDINGS:

Bones: Focally intense bone marrow edema pattern about the fifth metatarsal head
and neck, with a small area of new cortical impaction secondary to a subacute fracture. When compared to the previous examination performed on November 1, 2021, these findings have progressed in severity.





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4/22 BMAC PROCEDURE

Bone marrow aspiration was performed from the right posterior iliac crest. After identifying the bony landmarks on ultrasound guidance, the area over the harvest site was prepped with antimicrobial solution and sterile draping. A skin wheal was placed with 2 mL of 1% lidocaine with epinephrine using 30-gauge 1 inch needle. The periosteum was anesthetized with 10 mL of 1% lidocaine and 10 mL of 0.5% ropivacaine. A stab incision with an 11 blade was made through the wheal. A trocar was inserted through the skin and was guided through the posterior superior iliac spine (PSIS) under ultrasound guidance. A 17-gauge infiltration cannula was inserted into the PSIS, and 60 mL of bone marrow was aspirated from the right iliac crest. Sterile gauze was used to cover the tissue harvest area. The bone marrow collected was processed in the closed system (PUREBMC SupraPhyisiologic, EmCyte, FL) A therapeutic injection of 2.5 mL of BMAC was given under sterile technique using a25-gauge 1.5-inch needle into the intra-osseous space of the fifth metatarsal head using ultrasound-guidance

POST PROCEDURE PROTOCOL

- 6 weeks in walking boot
- Running on alter g at 50% BW for 2 weeks
- Progress to shooting, jumping, cutting at 8 weeks
- Repeat xrays at 2, 6, and 8 weeks post procedure were normal
- CT scan of the foot 12 weeks post procedure showed resolution of the distal 5th met fx
- Patient was able to play without incident the following season. No recurrence of pain at the 6 and 12 month f/u

CLINICAL TAKEAWAYS

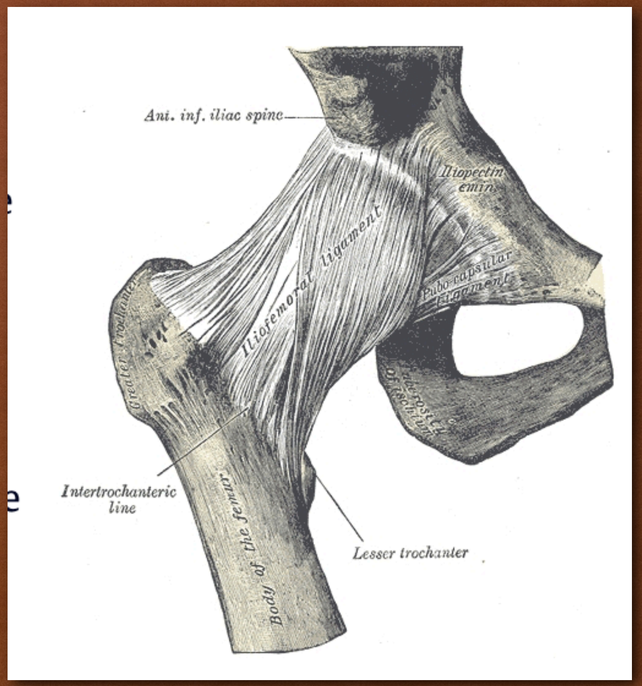
- ORIF is the most commonly reported treatment option for metatarsal head fractures after failed conservative treatment (Missaoui, et al), but there have been reports of complications including plantar protrusions of the screw tips and residual stiffness of the MTP joint
- The exact mechanism of action of BMAC is not fully understood (Imam et al). BMAC may provide direct a source of cells as it contains several types of stem cells including MSCs, HSC, endothelial progenitor cells. BMAC also contain various growth factors including bone morphogenetic proteins, platelet-derived growth factor, transforming growth factor-beta, vascular endothelial growth factor, interleukin-8 and interleukin-1 receptor antagonist. These growth factors are believed to create microenvironment that favor differentiation of stem cells into osteogenic progenitor cells. Furthermore, these stem cells also exert paracrine effect to recruit host cells to the site of injury to promote tissue recovery. (Harford, et al).
- More research needed to assess dosing as well as its ability to treat larger fractures in other poorly vascularized locations and long bones

ULTRASOUND GUIDED HIGH VOLUME PRESSURE HYDRODIALATION FOR POST OPERATIVE ADHESIVE CAPSULITIS OF THE HIP JOINT

PATIENT INFORMATION

48 YEAR OLD MALE WITH A MED HX OF EPILEPSY PRESENTS IN CLINIC 6 MONTHS STATUS POST LABRAL REPAIR, ACETABULAR RIM TRIMMING, SYNOVECTOMY, CHONDROPLASTY, AND CAPSULAR CLOSURE

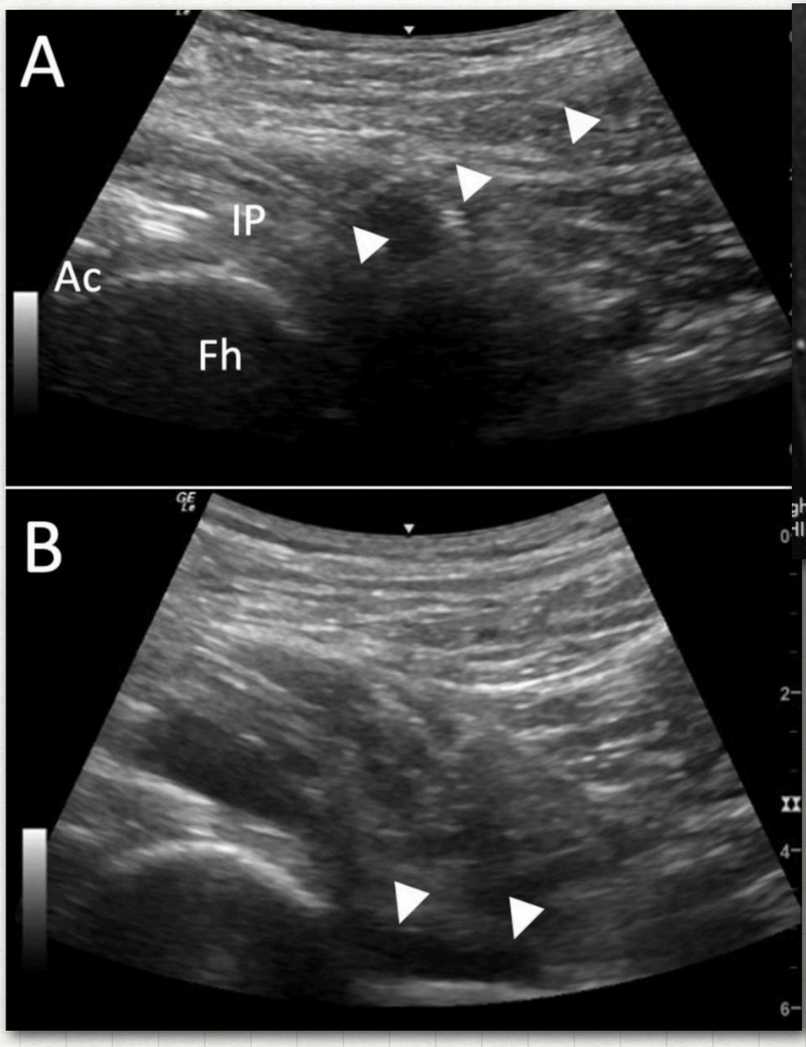
REPORTED COMPLETE RESOLUTION OF HIS SYMPTOMS 5 MONTHS POST OP UNTIL HE STARTED A FOUR WEEK RETURN TO RUN PROGRAM, AFTER THAT HE REPORTED DULL ACHY PAIN OVER THE ANTERIOR HIP WITH ACTIVITY OR WHEN GETTING UP FROM A CHAIR



PHYSICAL EXAM AND DIAGNOSTICS

MRI, MSK ULTRASOUND

- No TTP, NV intact
- No pain with provocative testing (scour, FABER, FADER)
- Log roll painless but decreased IR ROM compared bilaterally
- Diagnostic ultrasound normal
- Post operative MRI showed post surgical changes to the labrum



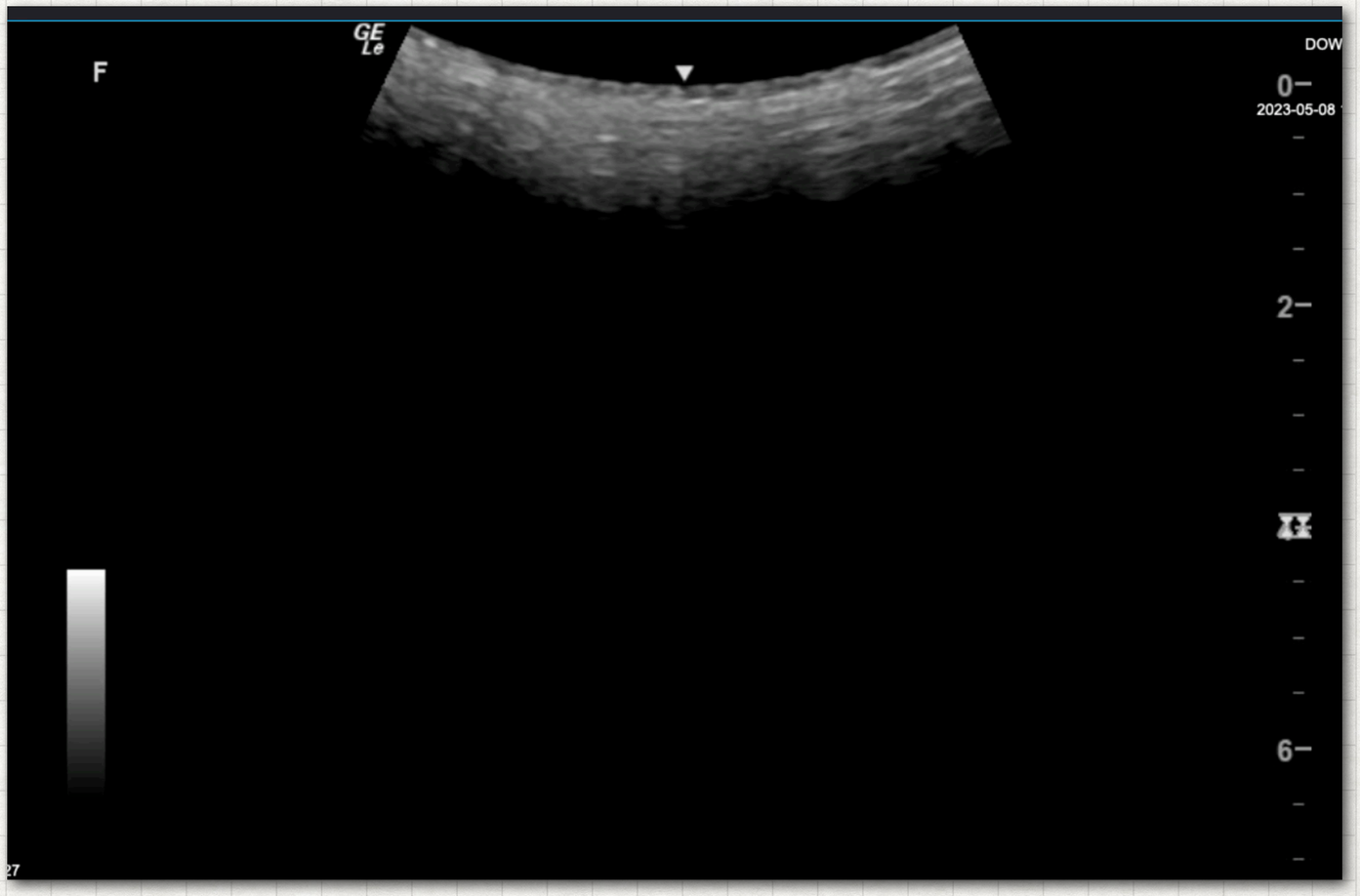
DIFFERENTIAL DX

- Infectious- septic arthritis, Lyme disease, osteomyelitis of the femoral head or pelvis, psoas abscess, and referred pain from appendicitis or an abdominal abscess
- Inflammatory- transient synovitis, systemic arthropathies, idiopathic chondrolysis of the hip, and chronic recurrent multifocal osteomyelitis.
- Mechanical- femoroacetabular impingement, developmental dysplasia of the hip, acetabular labral tears, avascular necrosis, stress fractures, Legg Calvé-Perthes, and slipped capital femoral epiphysis
- Neoplastic- osteoid osteoma, primary or metastatic tumors, leukemia, and pigmented villonodular synovitis

TREATMENT

HIP CAPSULE DILATION

- Initial management was an intra articular steroid injection that provided 10 days of relief
- At the next visit the patient elected to undergo the dilation procedure (20 ml NS, 2 ml lidocaine 1%)
- He was cleared to return to activity and reported resolution of his pain with running at 1 month post dilation



LITERATURE REVIEW

TABLE 1. Review of Studies on Treatment of Hip AC

Authors	Year	Type	Sample Size	Mean Follow-up (mo)	Nonoperative Treatment	Operative Treatment	Pain Level Post Treatment	Other Outcomes
Chard and Jenner[24]	1988	Case series	3	10.7 (8-12)	NSAIDs, PT	Open removal of anterior osteophytes, open exploration, and none	Pain free	Resolution of symptoms
Modesto et al[25]	1995	Case report	9	12	NSAIDs, PT	MUA	Pain free	Functionally autonomous
Mont et al[26]	1999	Case report	1	24	NSAIDs, PT	Anterolateral capsulectomy	Pain free	Returned to work 2 wk postoperation
Byrd and Jones[9]	2006	Case series	9	17.3 (12-24)	Intra-articular anesthetic injection	Arthroscopy, MUA	NR	Arthroscopy 100 point scale (average of 32 points CFB)
Luukkainen et al[27]	2008	Case report	1	NR	PT, NSAIDS, corticosteroid injection with lidocaine	MUA and pressure dilatation	Pain free	Symptomless without any limitation in ranges of motions
Lowe[28]	2013	Case report	1	NR	NSAIDs, PT	None	5/10 pain only after prolonged sitting	Able to continue daily activities
Kim et al[29]	2017	Prospective observational study	44	3	ASE	None	Pain decreased or disappeared with time	No evidence that ASE induced earlier or more recovery of hip motion
Yoon et al[30]	2021	Prospective observational study	84	6	Two ultrasound-guided IA injections at an interval of 2 wk	None	8% of patients, symptom recurrence was reported a mean of 4.1 mo after the latest injection, but no independent risk factor for recurrence was identified	HOOS improved in all subsets. The mean DFK decreased from 17.9 ± 4.8 to 9.7 ± 2.8 cm
Eberlin et al[31]	2022	Case report	1	4	None	Subtotal synovectomy with operative dislocation	Pain free	Able to resume work

ASE, active stretching exercise; CFB, change from baseline; IA, intra-articular; NR, not reported; NSAIDs, nonsteroidal anti-inflammatory drugs; PT, physical therapy.

The Open Rheumatology Journal, 2008, *2*, 31-32

Successful Treatment of Frozen Hip with Manipulation and Pressure Dilatation

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[2]*Turku University Hospital, Alvar Aallontie 275, 21540 Paimio, Finland*

[3]*Satakunta Central Hospital, Sairaalantie 3, 28500, Pori, Finland*

Abstract: A 44-year old man with prolonged frozen hip was treated with manipulation under anesthesia and pressure dilatation of the left hip joint. The treatment was successful and after one year the hip was symptomless.

INTRODUCTION

Frozen shoulder or adhesive capsulitis is a well-known and rather common clinical disorder [1, 2]. An analogous condition in the hip joint seems, in contrast, to be very uncommon. According to earlier reports it is resistant to conventional treatment but spontaneous resolution can be expected in periods varying from 3 to 18 months [3-6]. Chard and Jenner have named this condition as frozen hip and according to them it is probably underdiagnosed [5]. We describe a case of frozen hip that was treated with manipulation and pressure dilatation.

The method of dilatation was by infusing isotonic sodium chloride with pressure up to 281 ml and controlling the procedure by fluoroscopy and contrast medium

CLINICAL TAKE HOME

Cortisone injections alone offer short-term symptom relief but may have limited long-term efficacy, especially in patients with prior labral pathology, and do not address capsular fibrosis or adhesions as directly as hydrodilatation.

Manipulation under anesthesia can improve range of motion but carries a risk of capsular or labral injury in patients with prior labral repair, and current evidence does not show clear superiority over less invasive interventions such as hydrodilatation or corticosteroid injection. In patients with a history of labral repair, there is particular concern for iatrogenic instability or damage to the repaired structures if manipulation is performed aggressively

Conservative treatments should be exhausted, recommended at least three months post operatively.

Thickening of the hip joint capsule is not always well visualized on MRI and the use of diagnostic ultrasound in conjunction with the physical exam should be considered when making the diagnosis

MCL CALCIFICATION

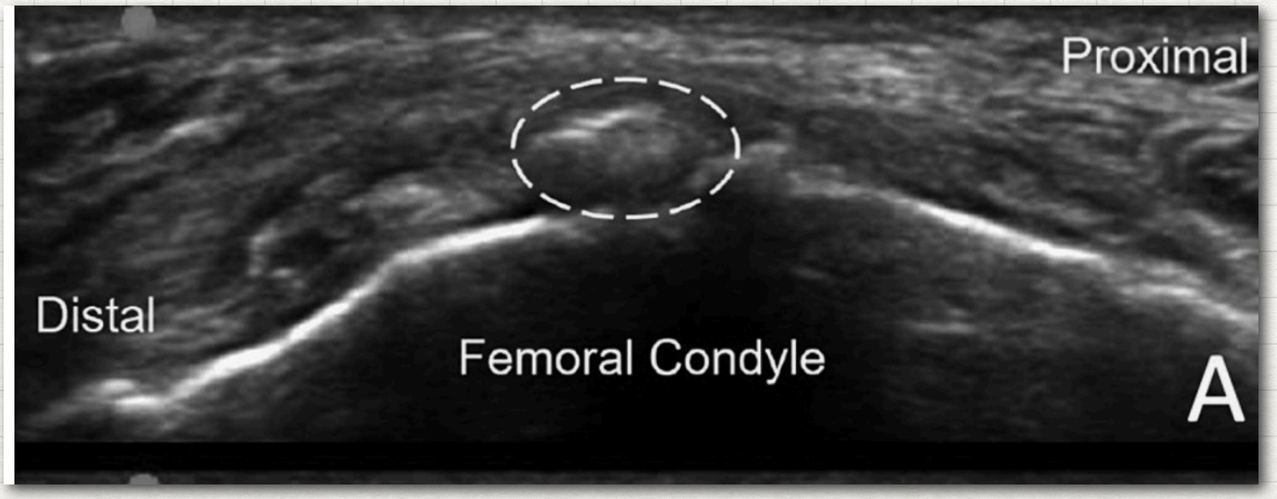
PATIENT INFORMATION

- 82 year old retired male presents with insidious onset of right medial knee pain
- Denies trauma or relevant pmhx
- Medical history of asthma, venous insufficiency, and high blood pressure
- Severity between 4/10 and 6/10. Characterization: dull, achy. Denies instability
- Sx worsen with activities like biking and prolonged sitting

DIAGNOSTIC TESTING

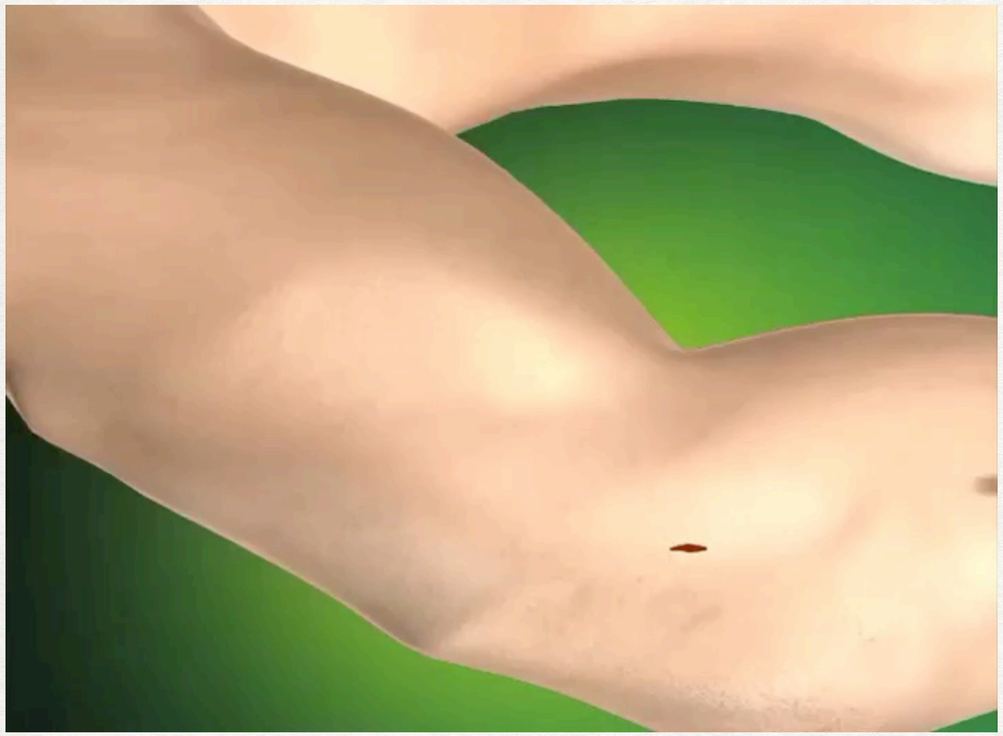
X RAY, ULTRASOUND

- X ray preformed showed quadriceps enthesopathy, joint effusion, and small marginal osteophytes
- Ultrasound in the office showed an enthesophte within the proximal fibers of the MCL and pain with sonopalpation



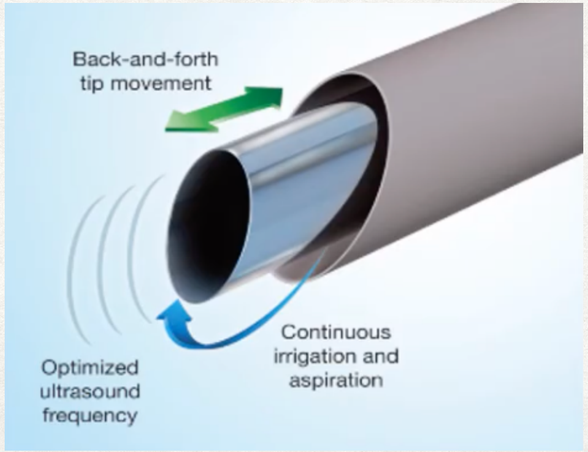
TREATMENT

TENEX



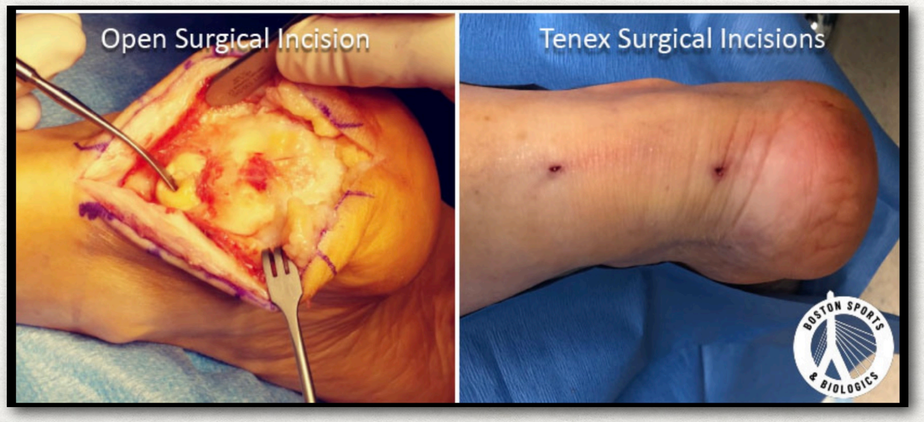
Developed in 2012 by the Mayo Clinic for chronic/recalcitrant tendinopathies

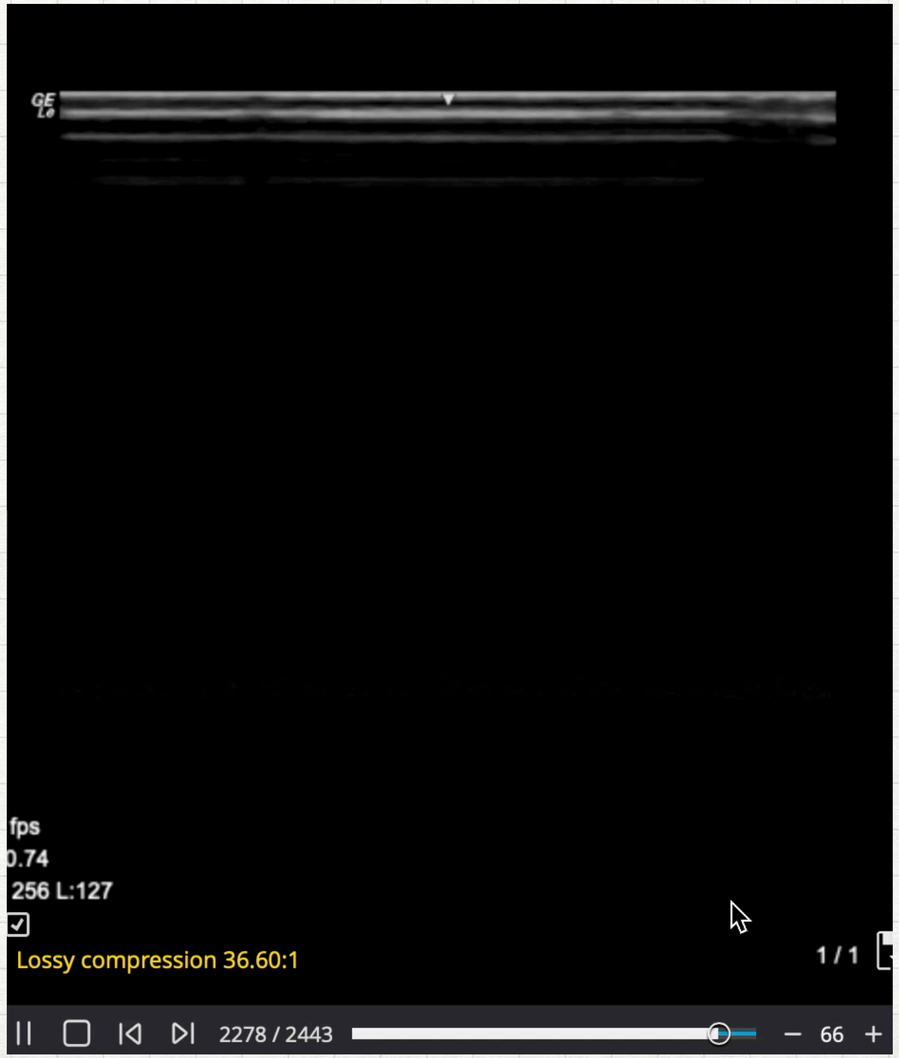
Needle tenotomy/fenistration has been reported since the 1960s but this is faster, more accurate and uses a vacuum to clear debris



POST PROCEDURAL PROTOCOL

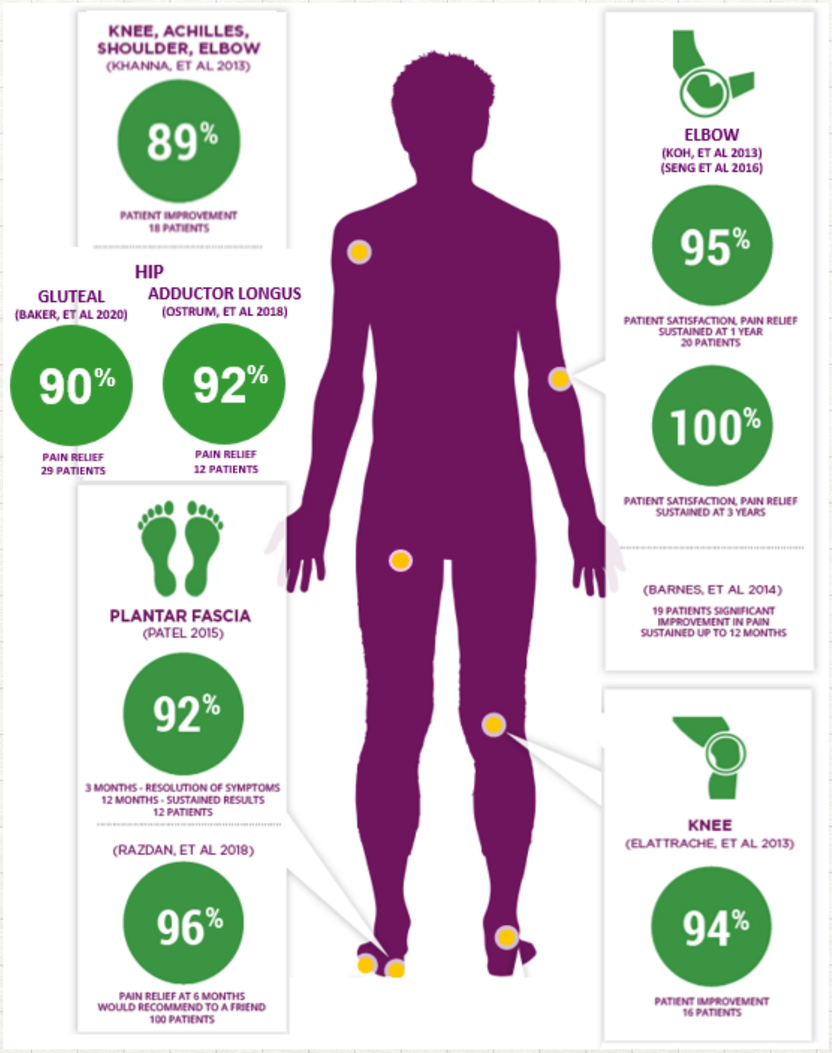
- Hinged knee brace for 2 weeks following procedure
- Close with steri strips, no soaking/ immersion until closed
- Ice/tylenol as needed for pain
- Begin to return to activity at 2 weeks, return to cutting/lateral at 6 weeks





OUTCOMES AND CLINICAL TAKEAWAYS

- Patient reported pain free with biking and ADLs at 2 weeks.
- No recurrent issues
- Calcifications not always visualized on plain films and diagnostic ultrasound becomes preferred in these scenarios
- In the absence of trauma/instability consider calcifications as a source of pain



ULTRASOUND GUIDED THREAD PLANTARIS RELEASE

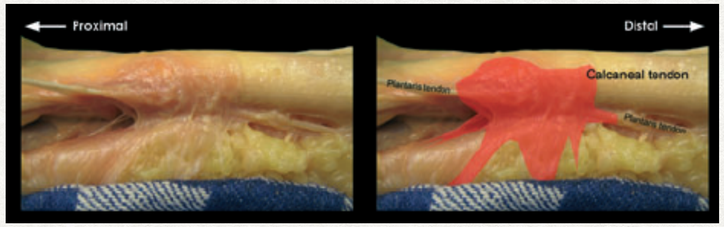
A NOVEL CASE

- 35 year old male elite ironman try athlete with 20 years of achilles tendinopathy
-

ANATOMY REVIEW

PLANTARIS

- Plantaris tendinopathy reported in 12% of achilles tendinopathy cases (Khullar 2019)
- Between 5-9 pathways/insertions (sterkenburg 2011)
- May adhere to the achilles in 10% of patients (sterkenburg 2011)
- It is stronger, stiffer, and less extensible (lintz 2021)



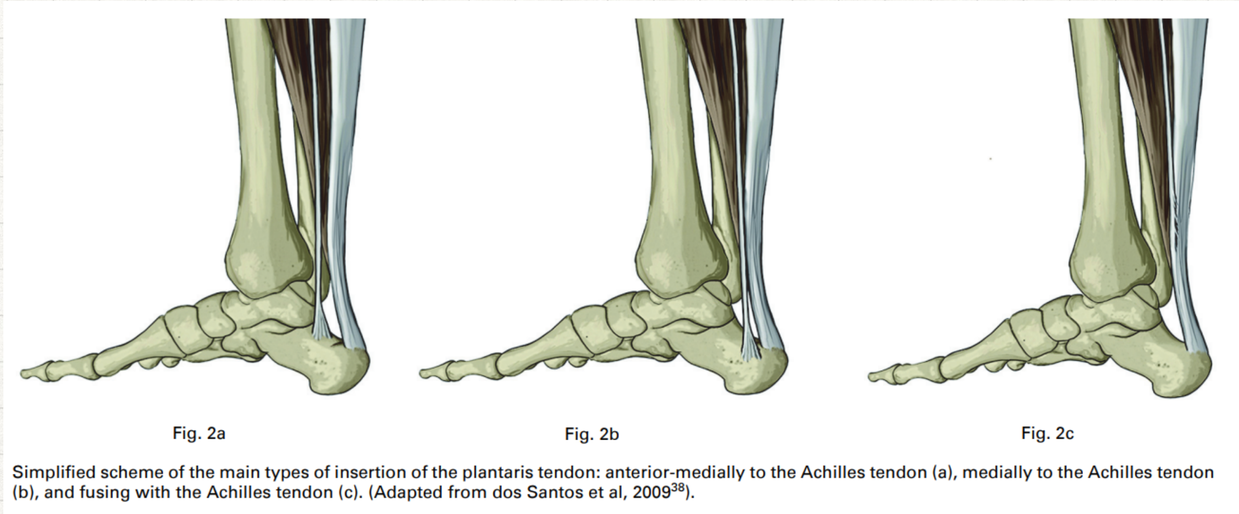
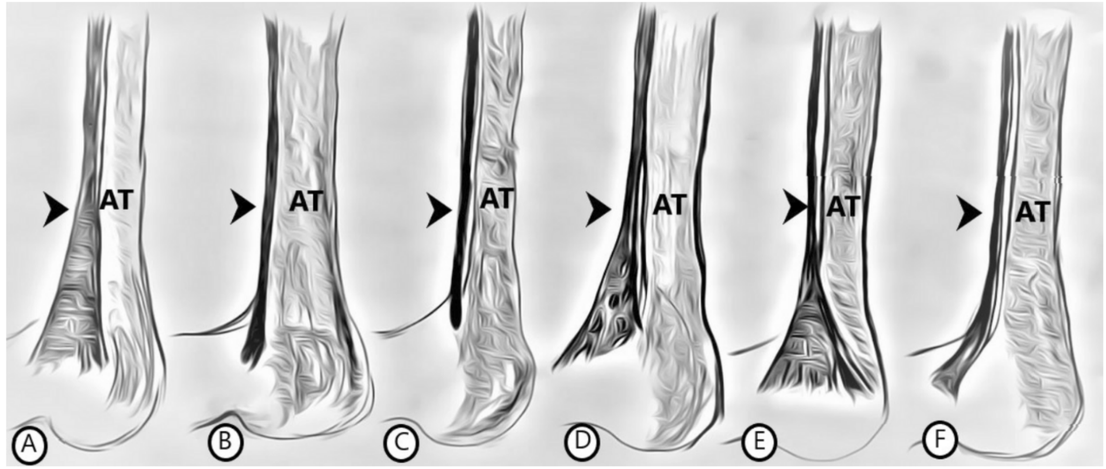


Fig. 2a Fig. 2b Fig. 2c

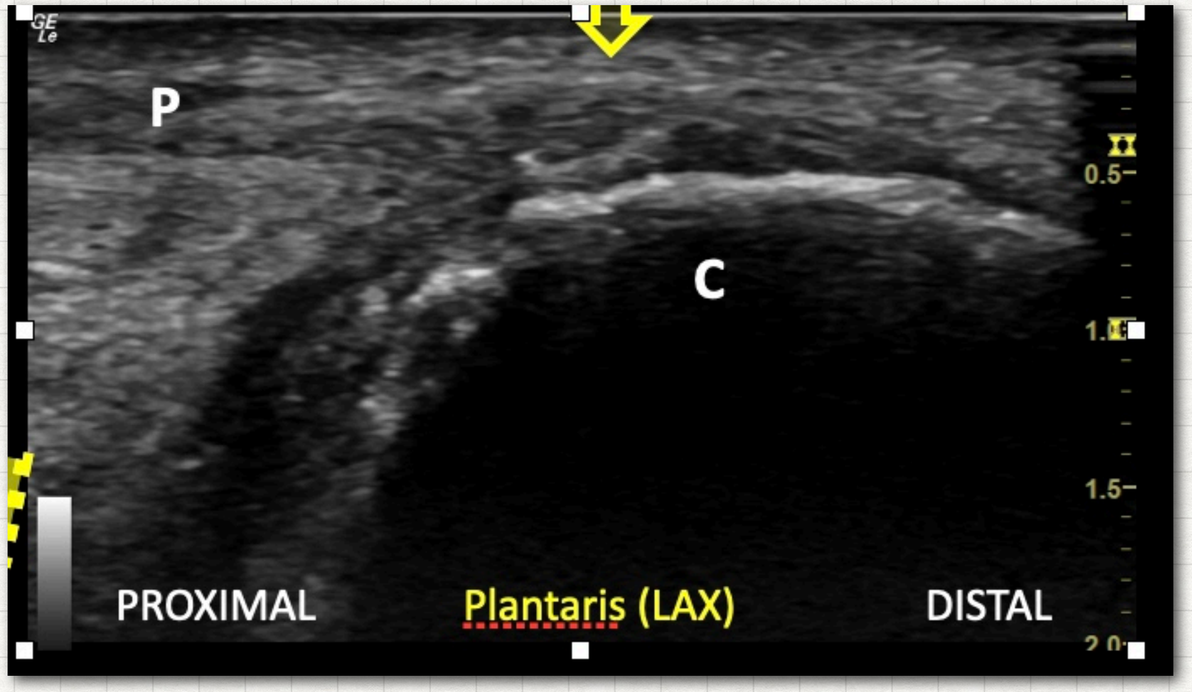
Simplified scheme of the main types of insertion of the plantaris tendon: anterior-medially to the Achilles tendon (a), medially to the Achilles tendon (b), and fusing with the Achilles tendon (c). (Adapted from dos Santos et al, 2009[38]).



Types of tendon attachments. (**A**) type I, (**B**) type II, (**C**) type III, (**D**) type IV, (**E**) type V, (**F**) type VI. *AT* Achilles tendon, *Arrow* plantaris tendon.

DIAGNOSTICS AND PRE PROCEDURE TREATMENT

- Diagnostic ultrasound showed insertional tendinopathy with partial thickness intrasubstance tears of the AT, small haglund's deformity, retrocalcaneal and retro-achilles busitis, and insertional planters tendinopathy
- PNT for insertional achilles pain which did resolve lateral/midline pain but medial pain remained



SURGICAL LITERATURE

- 2011 article sh
  pain and functi
- Small sample s
  elite athletes

Planta
tendin

James D F C

Corresponde

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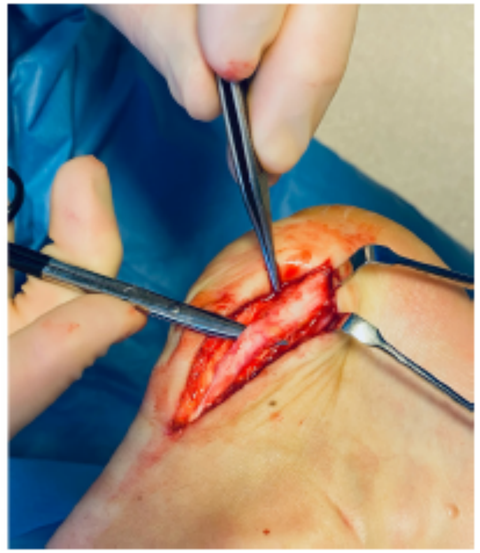


Figure 1 Surgical removal of a thickened and widened plantaris tendon on the medial side of the Achilles insertion. The plantaris is identified proximally, released and followed all the way down to the insertion, where the tendon is divided.

y in elite athletes. Recent research has

ndinopathy in elite athletes.

underwent plantaris tendon excision
al Achilles tendinopathy. Preoperative
ore (FAOS) as well as time to return to

d with the results. Thirty of the 32
oved from 5.8 to 0.8 ($p<0.01$) and the
xperienced short-term stiffness and

non-insertional Achilles tendinopathy.
mptoms enabling an early return to elite-

illes

UK;

SIMILAR TECHNIQUE

GUO THREAD

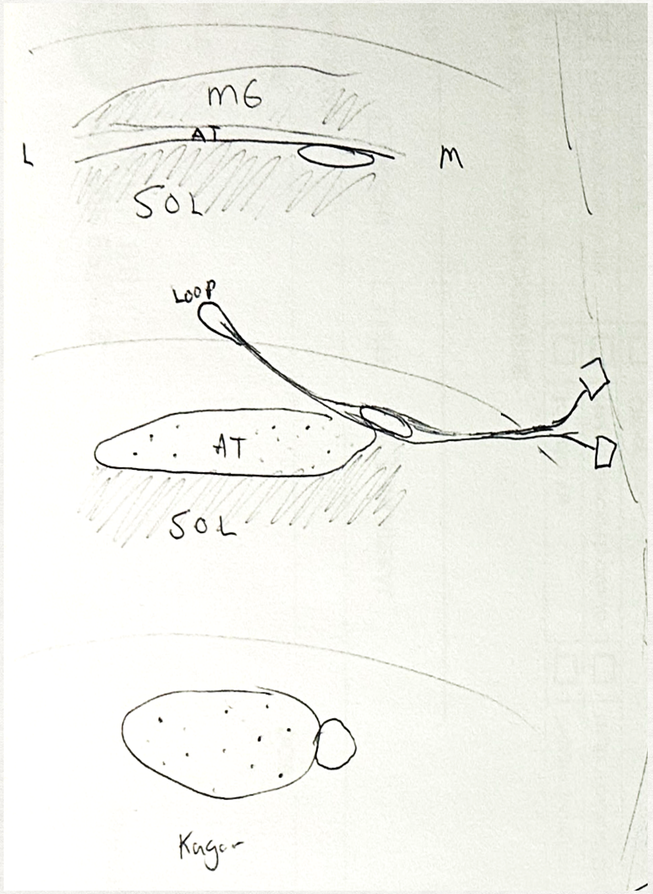
Access plantaris where it lies superficial

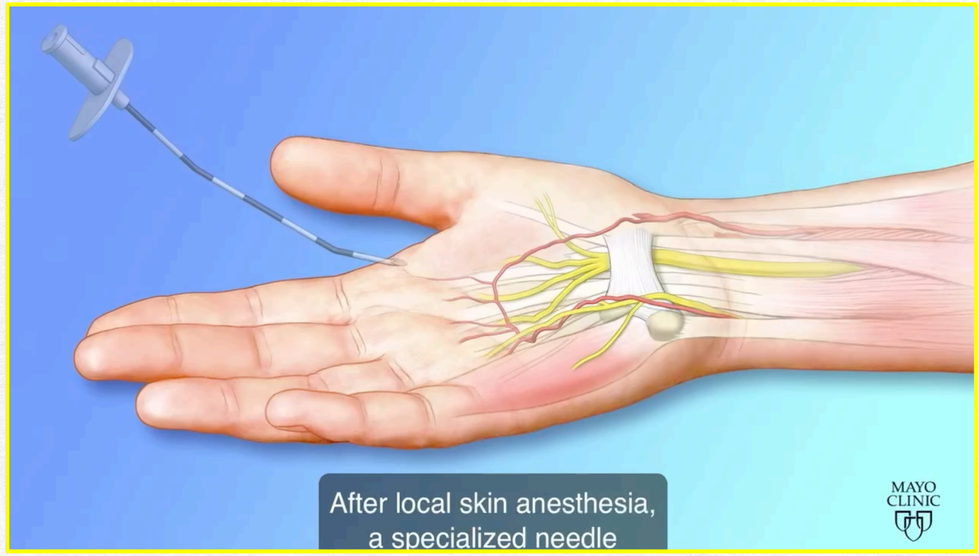
to the AT

Pull is medially-

Identify AT and

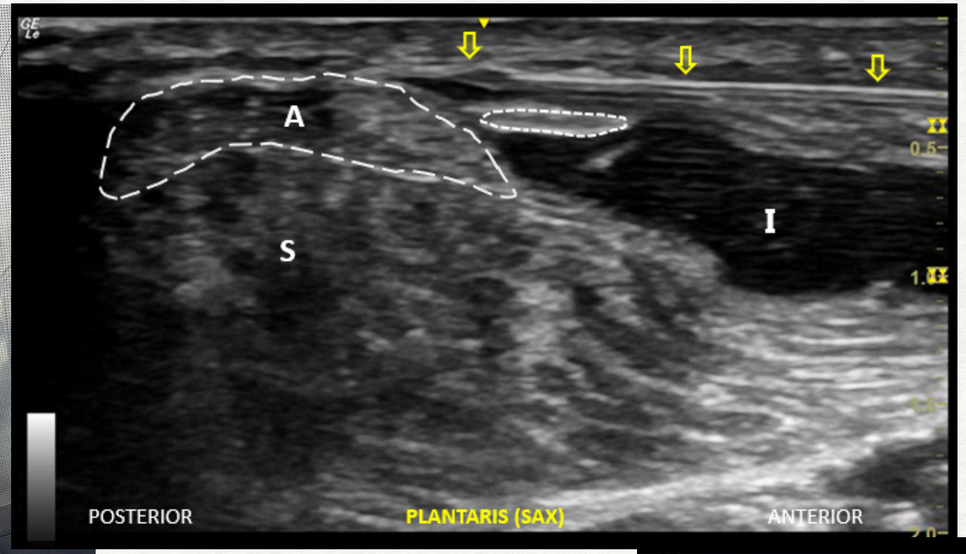
Sural nerve





FIRST PASS

DONEC QUIS NUNC



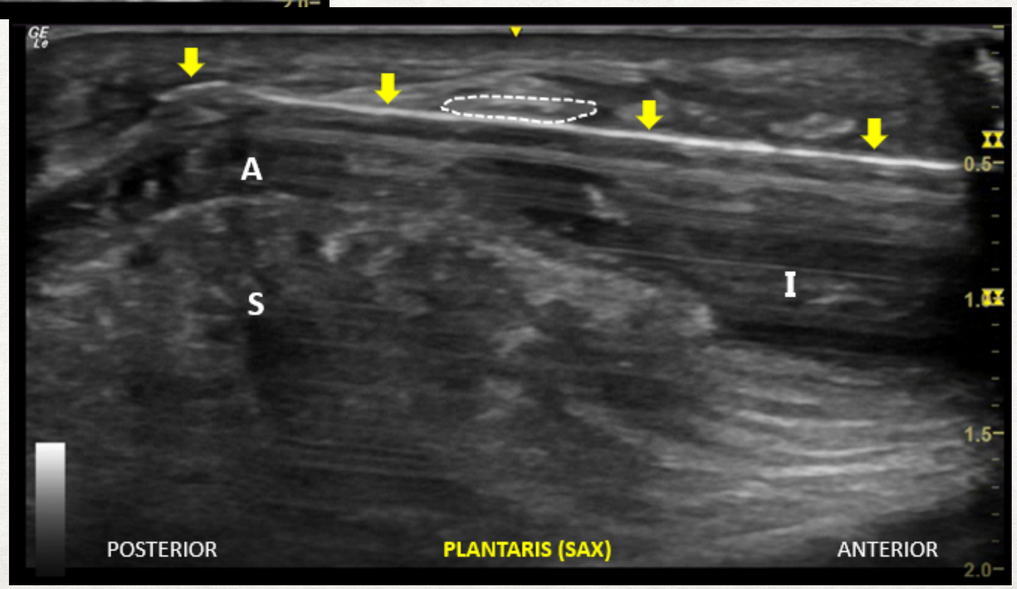
Hydrodissect the Plantaris from the

Adjacent structures first

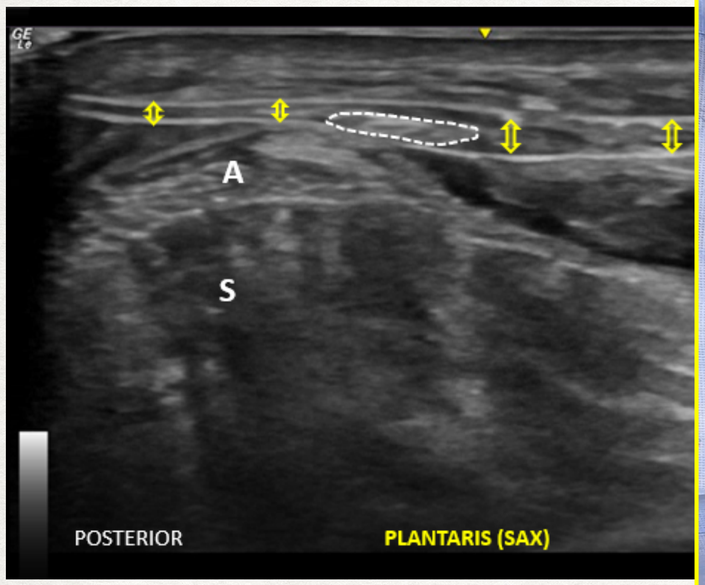
Then, pass the

Needle under the

Tendon



2ND PASS

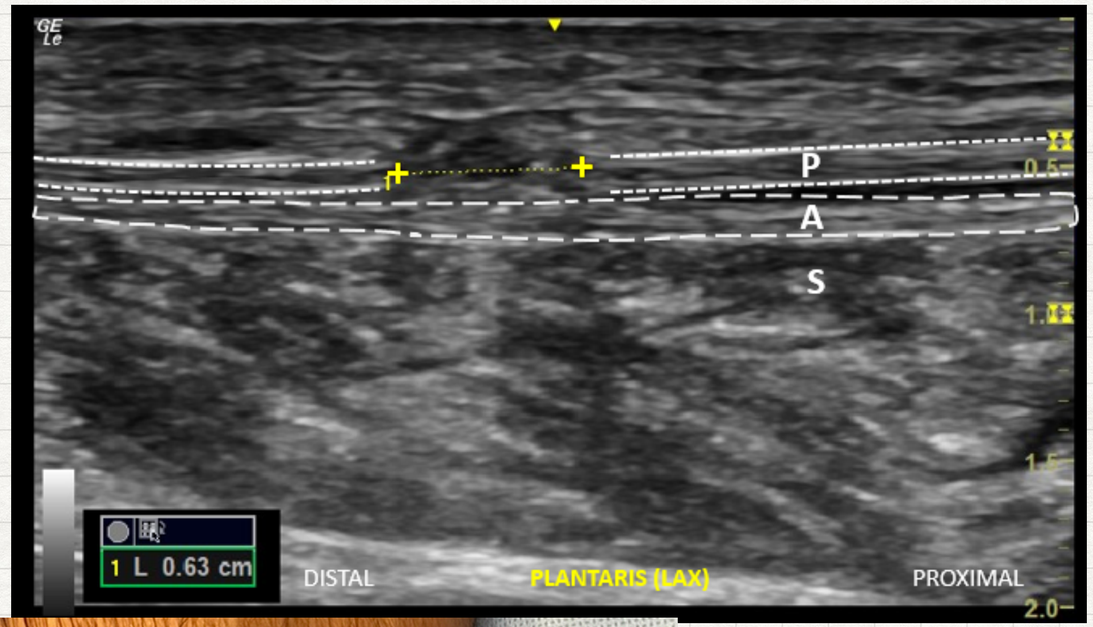


A: Achilles, I: Injectate, S: Soleus
Arrows: Thread, Narrow Dashes: Plar

CONFIRM TRANSECTION

POST PROCEDURE

- Band aid applied
- No boot, walks unassisted
- No activity restrictions
- Patient reported immediate improvement in his medial heel pain
- Cycled pain free next day
- Returned to running pain free



REFERENCES

Van Vugt TAG, Geurts JAP, Blokhuis TJ. Treatment of infected tibial non-unions using a BMAC and S53P4 BAG combination for reconstruction of segmental bone defects: A clinical case series. Injury. 2021;52 Suppl 2:S67-s71.

Benshabat D, Factor S, Maman E, Khoury A, Krespi R, Ashkenazi I, et al. Addition of Bone Marrow Aspirate Concentrate Resulted in High Rate of Healing and Good Functional Outcomes in the Treatment of Clavicle Fracture Nonunion: A Retrospective Case Series. J Clin Med. 274 2021;10(20).

Modest JM, Lemme NJ, Testa EJ, Evans AR, Reid DBC. Successful Fracture Healing for Femoral Neck Nonunion with Bone Marrow Aspirate Concentrate. R I Med J (2013). 277 2022;105(2):13-6.

Williams C, Redmond T, Stafford C, 2nd, Sussman W. Traumatic Humeral Shaft Non- union With Ulnar Nerve Transection: An Orthobiologics Success Story. Cureus. 280 2023;15(2):e35189.

Eberlin CT, Kucharik MP, Cherian NJ, et al. Adhesive capsulitis of the hip: a case presentation and review. Orthop Rev. 2022;14:37679.

Yoon BH, Shim JC, Lee M, et al. Ultrasound-guided hydrodilatation for adhesive capsulitis of the hip is a safe and effective treatment. Int Orthop. 2021;45:1455–1461.

Lim JY, Djaja YP, Won YS, et al. Comparison of clinical outcomes between arthroscopic debridement and conservative treatment of primary adhesive capsulitis of the hip. Int Orthop. 2020;44:2235–2241.

Park DJ, Rucci P, Sussman WI: Chronic medial collateral ligament sprain treated with percutaneous ultrasonic debridement: a case report. Clin J Sport Med. 2022, 32:e175-7. 10.1097/JSM.0000000000000909

Galletti L, Ricci V, Andreoli E, Galletti S: Treatment of a calcific bursitis of the medial collateral ligament: a rare cause of painful knee. J Ultrasound. 2019, 22:471-6. 10.1007/s40477-018-0353-y
Yan YY, Dous YN, Ouellette HA, Munk PL, Murray N, Mallinson PI, Sheikh MA: Periarticular calcifications. Skeletal Radiol. 2022, 51:451-75. 10.1007/s00256-021-03842-4

Alfredson H, Masci L, Spang C. Ultrasound and surgical inspection of plantaris tendon involvement in chronic painful insertional Achilles tendinopathy: a case series. BMJ Open Sport Exerc Med. 2021;7(1):e000979. doi:10.1136/bmjsem-2020-000979
Alfredson H. Persistent pain in the Achilles mid-portion? Consider the plantaris tendon as a possible culprit! Br J Sports Med. May 2017;51(10):833-834. doi:10.1136/bjsports-2016-097360
Alfredson H. Midportion Achilles tendinosis and the plantaris tendon. Br J Sports Med 2011;45:1023–1025.
Bedi HS, Jowett C, Ristanis S, Docking S, Cook J. Plantaris Excision and Ventral Paratendinous Scraping for Achilles Tendinopathy in an Athletic Population. Foot Ankle Int. Apr 2016;37(4):386-93. doi:10.1177/1071100715619989
Calder JD, Freeman R, Pollock N. Plantaris excision in the treatment of non-insertional Achilles tendinopathy in elite athletes. Br J Sports Med. Dec 2015;49(23):1532-4. doi:10.1136/bjsports-2014-093827
Cook JL, Purdam C. Is compressive load a factor in the development of tendinopathy? Br J Sports Med 2012;46:163–168.
Ferguson A, Christophersen C, Elattar O, Farber DC. Achilles Tendinopathy and Associated Disorders. Foot & Ankle Orthopaedics. 2019;4(2):2473011419838294. doi:10.1177/2473011419838294
Hickey B, Lee J, Stephen J, Antflick J, Calder J. It is possible to release the plantaris tendon under ultrasound guidance: a technical description of ultrasound guided plantaris tendon release (UPTR) in the treatment of non-insertional Achilles tendinopathy. Knee Surg Sports Traumatol Arthrosc. Sep 2019;27(9):2858-2862. doi:10.1007/s00167-019-05451-0
Lintz F, Higgs A, Millett M, et al. The role of Plantaris Longus in Achilles tendinopathy: a biomechanical study. Foot Ankle Surg. Dec 2011;17(4):252-5. doi:10.1016/j.fas.2010.08.004
Masci L, Spang C, van Schie HTM, Alfredson H. How to diagnose plantaris tendon involvement in midportion Achilles tendinopathy - clinical and imaging findings. BMC Musculoskeletal Disorders. 2016/02/24 2016;17(1):97. doi:10.1186/s12891-016-0955-5
Olewnik L, Wysiadecki G, Podgorski M, Polguj M, Topol M. The Plantaris Muscle Tendon and Its Relationship with the Achilles Tendinopathy. Biomed Res Int. 2018;2018:9623579. doi:10.1155/2018/9623579
Olewnik L, Wysiadecki G, Polguj M, Topol M. Anatomic study suggests that the morphology of the plantaris tendon may be related to Achilles tendonitis. Surg Radiol Anat. Jan 2017;39(1):69-75. doi:10.1007/s00276-016-1682-1
Pollock N, Dijkstra P, Calder J, Chakraverty R. Plantaris injuries in elite UK track and field athletes over a 4-year period: a retrospective cohort study. Knee Surg Sports Traumatol Arthrosc 2016;24:2287–2292.
Smith J, Alfredson H, Masci L, Sellon JL, Woods CD. Sonographically Guided Plantaris Tendon Release: A Cadaveric Validation Study. PM R. Jan 2019;11(1):56-63. doi:10.1016/j.pmrj.2018.05.024
Waśniewska-Włodarczyk A, Paulsen F, Olewnik Ł, Polguj M. Morphological variability of the plantaris tendon in the human fetus. Scientific Reports. 2021 Aug 19;11(1):16871.

THANK YOU!