Surgical Repair of Partial Thickness Patellar Tendon Injury

Southern Orthopaedic Association

SEC

SOA at the SEC – March 12-14, 2026

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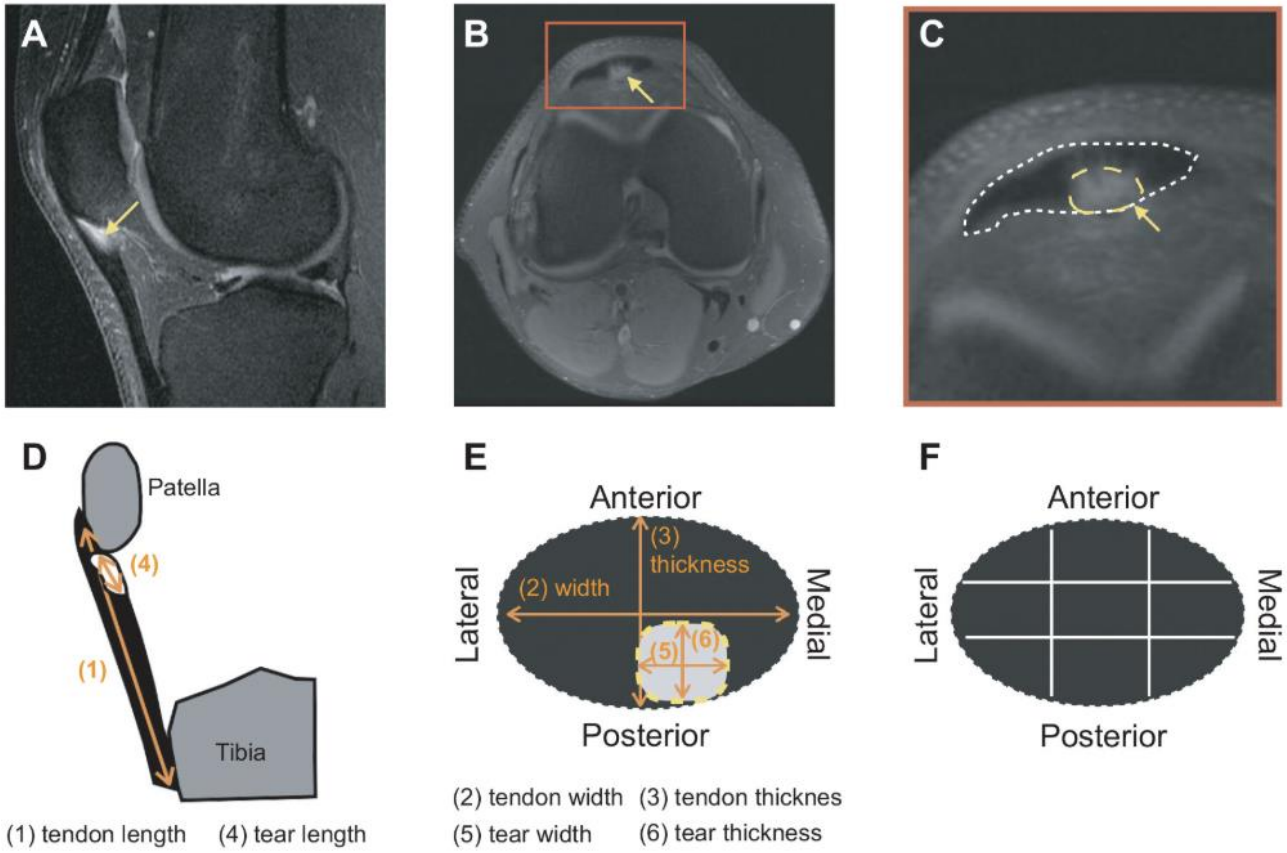
Disclosures

- **Consultant for Arthrex**
- **Research Funding:**
  - AOSSM
  - DoD
  - NIAMS
  - Louisiana Orthopaedic Association
  - Arthrex

Learning Objectives

1. **Identify** tear patterns that are surgical lesions
2. **MRI**: How to measure the lesion to guide the surgical plan
3. Repair technique(s)
4. **Rehab** milestones + pearls for RTP



Golman et al., AJSM, 2020

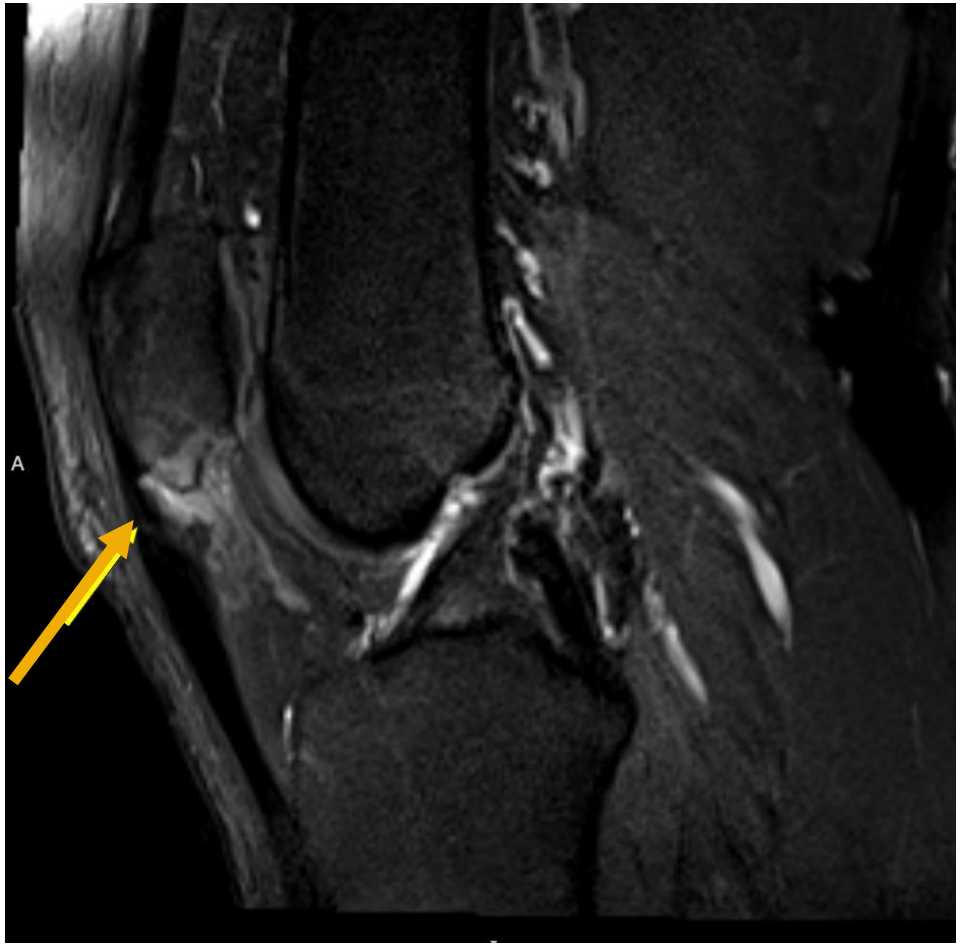
The Scope of the Problem

- Repetitive use injury frequently affecting athletes in **jumping and cutting sports**
- Present in up to **55% of elite basketball players**; basketball is the #1 sport in study cohorts (28%)
- **53% retire** from sport over 15-year FU (vs 7% of controls)
- Also: Offensive linemen, kickers, volleyball, powerlifters
- **Pathology**: Microinjury to tendon fibers, mucoid degeneration, necrosis

Golman et al., AJSM, 2020; Kettunen et al., 2002

Not Just Tendinitis

- **Definition**: Structural fiber disruption <100% thickness with a discrete tear plane (
- Distinguish from diffuse tendinosis: **Tear plane vs signal**
- Many of these present with years of symptoms
- Most reliable exam finding is point tenderness on the proximal tendon-patella junction



The Compression Hypothesis

- Not **purely tensile overload**
- **Compressive Environment:**
  - Inferior pole **compresses posterior tendon** during flexion
  - Patella–tendon angle: **157°→145°** (max at 50–70° flexion)
  - **Chondroid metaplasia** = adaptive response to compression
  - Adapted tissue → **stress shielding**
- **Clinical Implication:**
  - Weakened surrounding tissue → **tensile failure, pain, tearing**

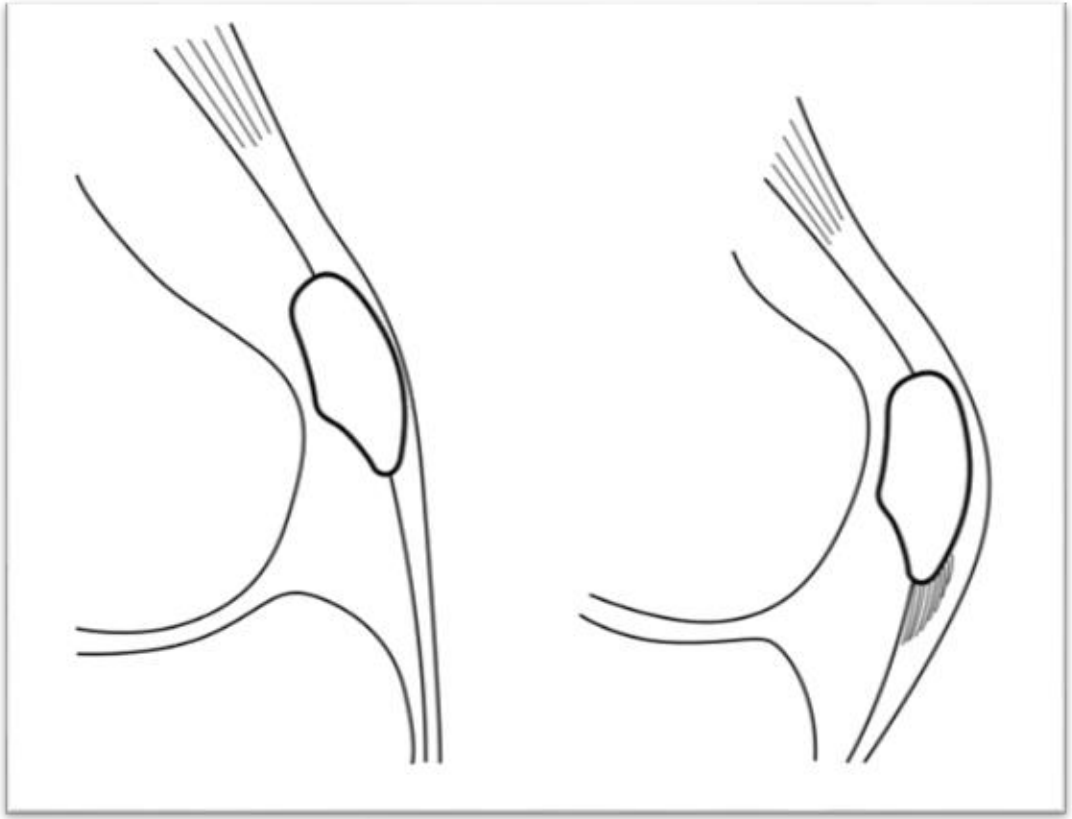


Fig 1. Proposed area of patellar tendon compression during knee flexion

Hamilton & Purdam, BJSM, 2004

Inferior Pole Morphology and Impingement

- Cadaveric study: **100 legs**, patella shape + tendon attachment

Pole Morphologies:

- **Pointed 57%** | Intermediate 21% | Blunt 22%

Attachment Types:

- **Anterior (46%)** vs Posterior (54%)

Impingement Mechanism:

- Pointed + anterior → **impingement during flexion**
- Pointed = **most common (57%)** → compression-dominant
- Blunt + posterior → tensile overload (less common)

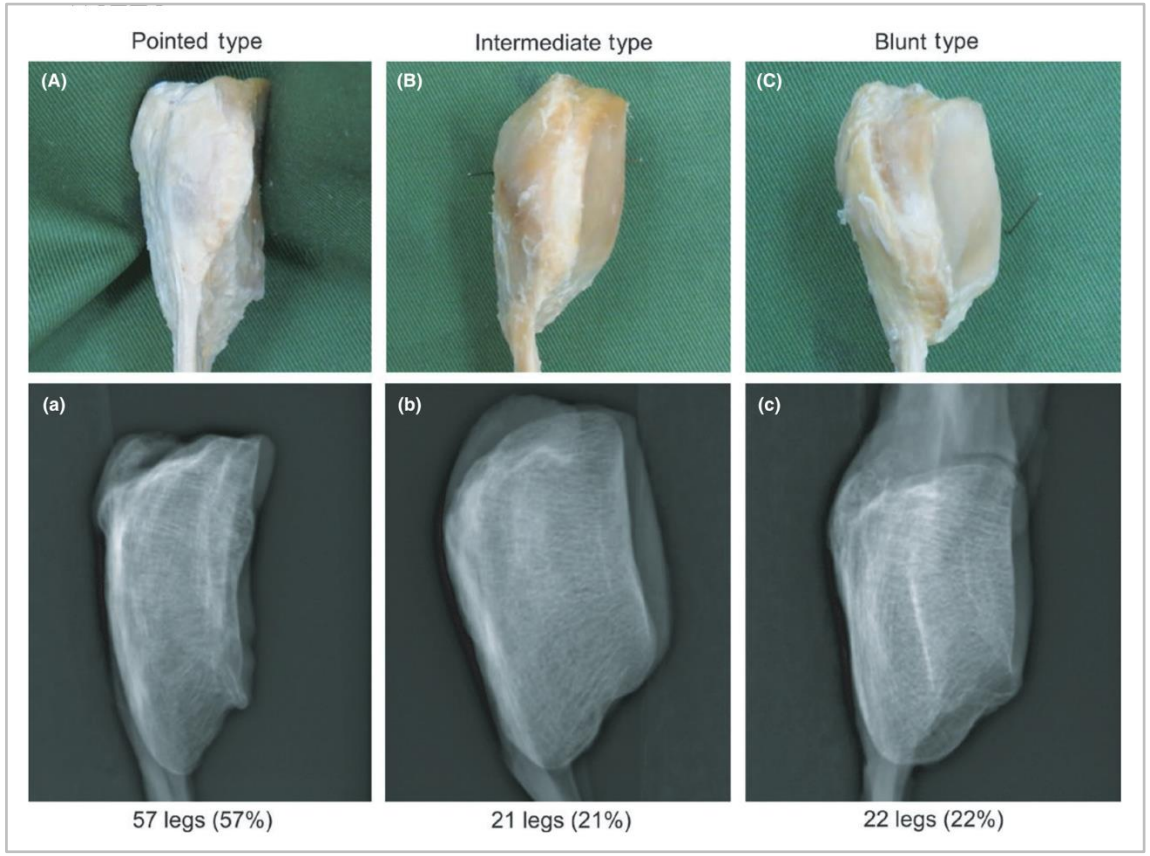


Fig 3. Inferior patellar pole classification: Pointed (A), Intermediate (B), Blunt (C)

Edama et al., SJMSS, 2017

Tear Pattern Taxonomy

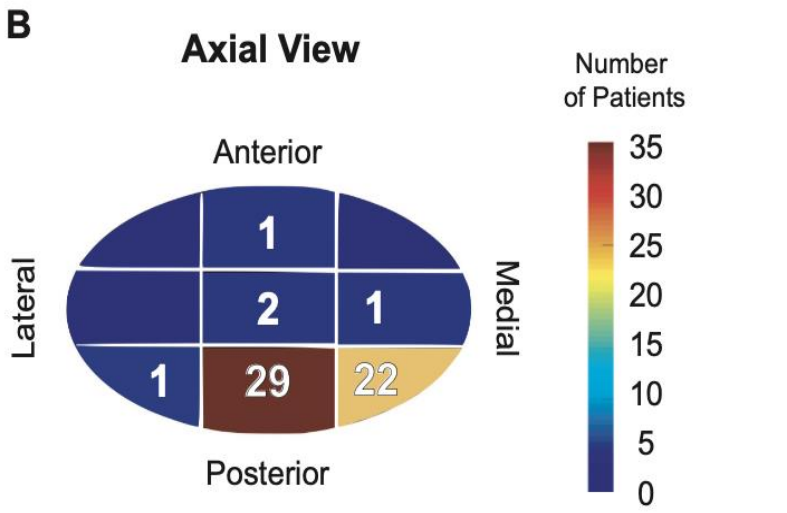
Popkin-Golman (PG) - MRI Grading

(axial tear thickness %)

- **PG 1:** Tendinopathy / edema without tear
- **PG 2:** <25% tear thickness
- **PG 3:** 25-50% tear thickness
- **PG 4:** >50% tear thickness (severe partial tear)

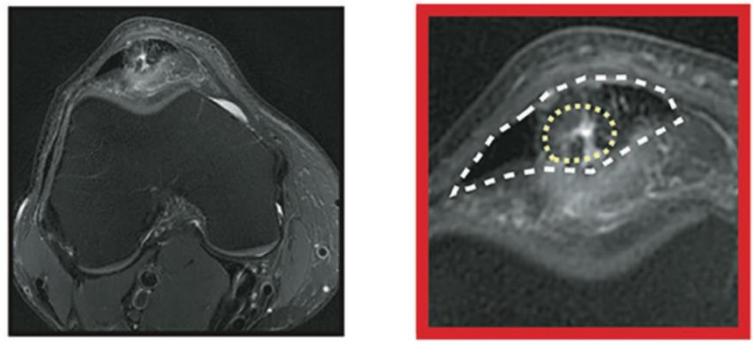
91% (n=56) partial-thickness tears are proximal and involve the posterior/ or posteromedial tendon

Golman et al., AJSM, 2020



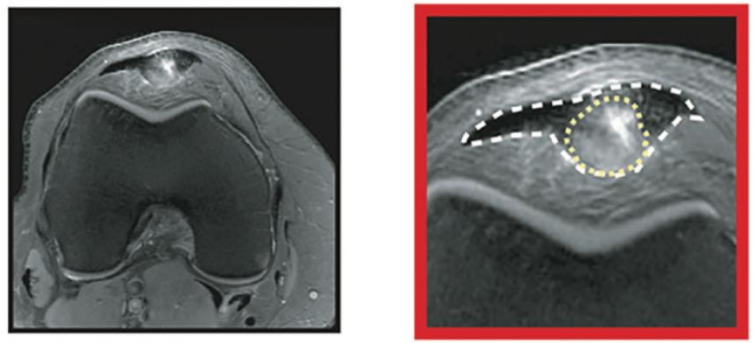
Grade 3

25%< Tear < 50 %

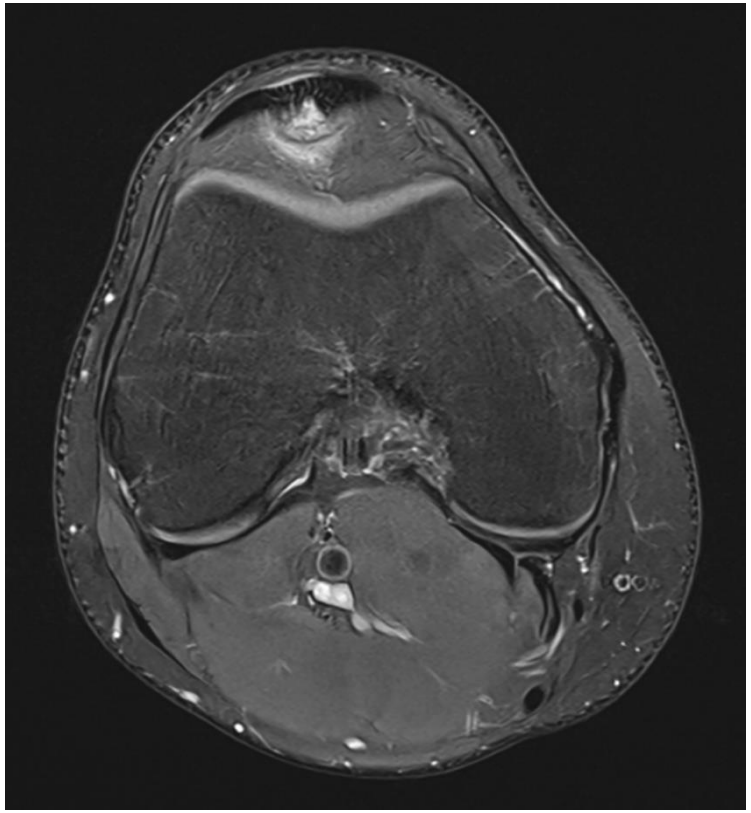


Grade 4

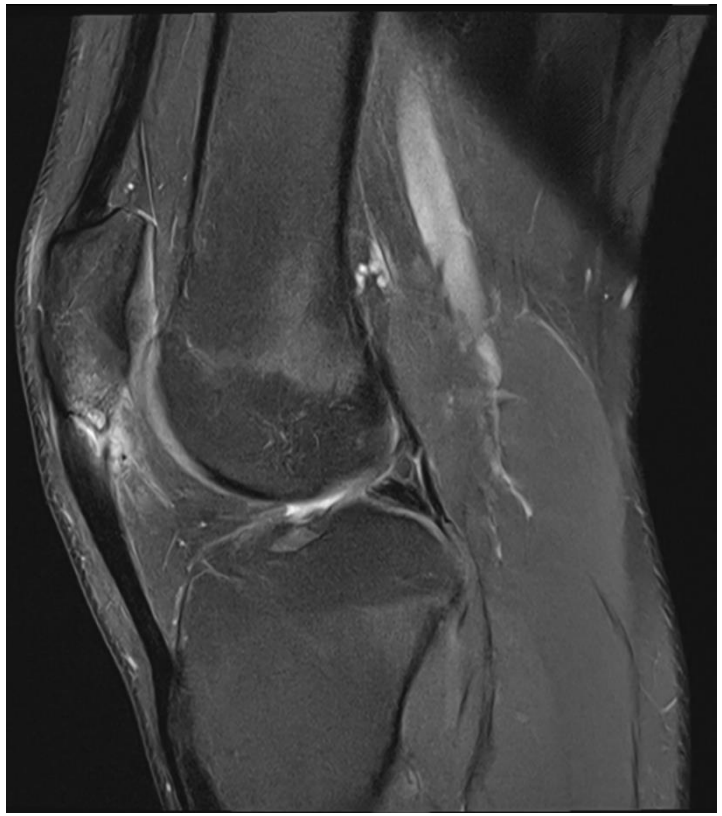
Tear Thickness > 50 %



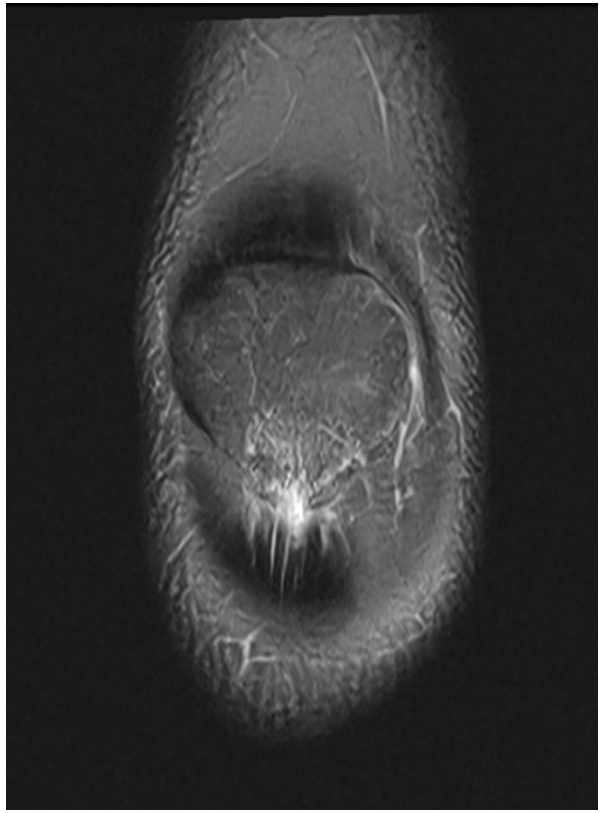
MRI Examples



PG Grade 3
9.0 X 10.2 mm

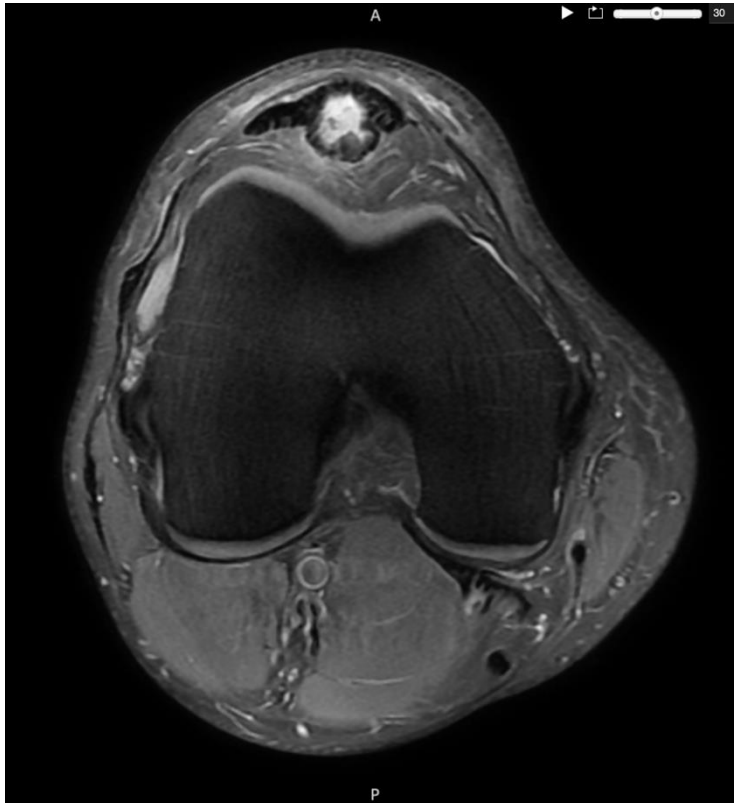


PG Grade 3
17.4 X 9.2 mm

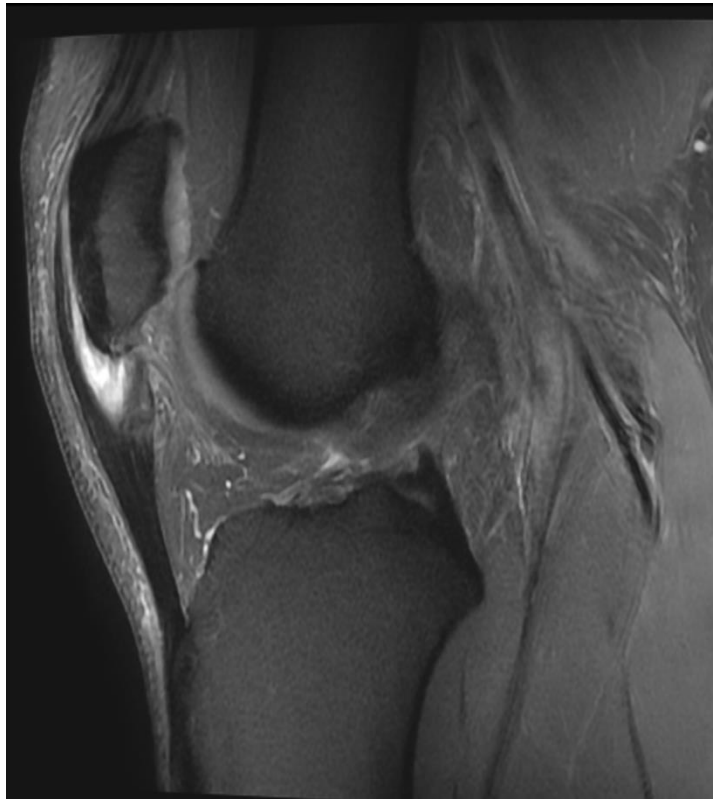


PG Grade 3
19.9 X 14.1 mm

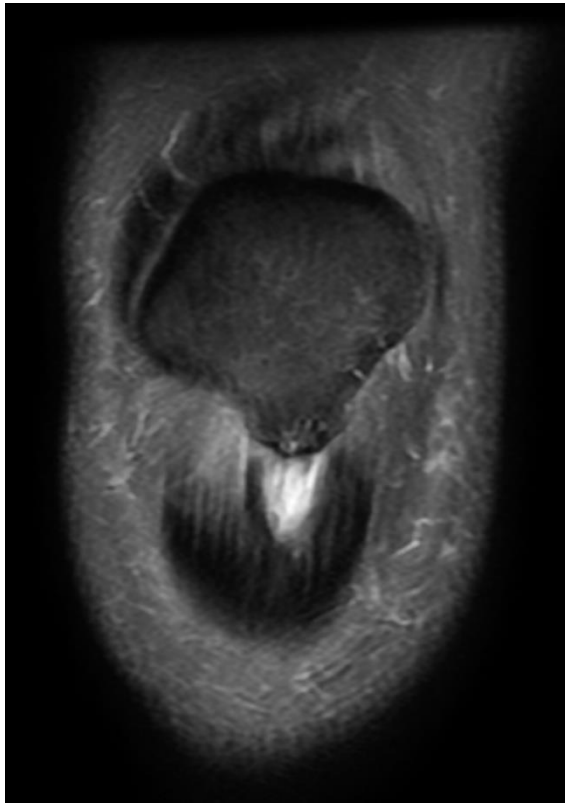
MRI Examples



PG Grade 4
10.5 X 9.5mm

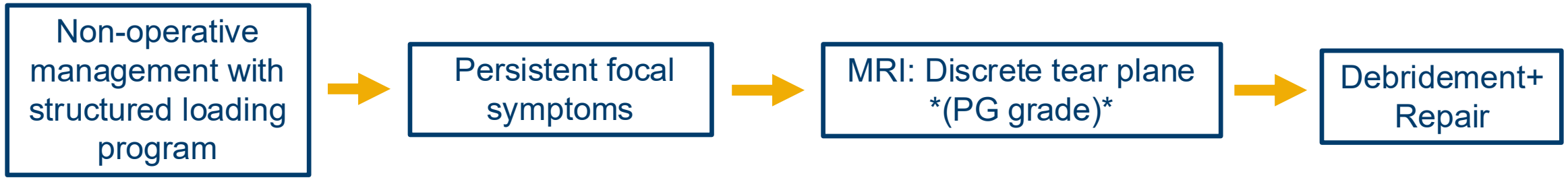


PG Grade 4
19.5 X 11.7 mm



PG Grade 4
15.1 X 10.2 mm

Surgical Indications For Elite Athletes



Operative Indications:

- **PG4 tear (>50%)** + symptom correlation; *consider PG3 tear*
- Persistent sport-limiting pain despite **compliant rehab**
- **Performance constraint:** Unable to train/compete at required level
- Thickened tendon on axial MRI *(supportive)*

Continue Non-operative treatment:

- **Diffuse tendinosis without** a discrete tear plane
- Imaging does not match symptoms / alternate pain generator
- Nonadherence to rehab or unresolved kinetic-chain deficits

Case Example

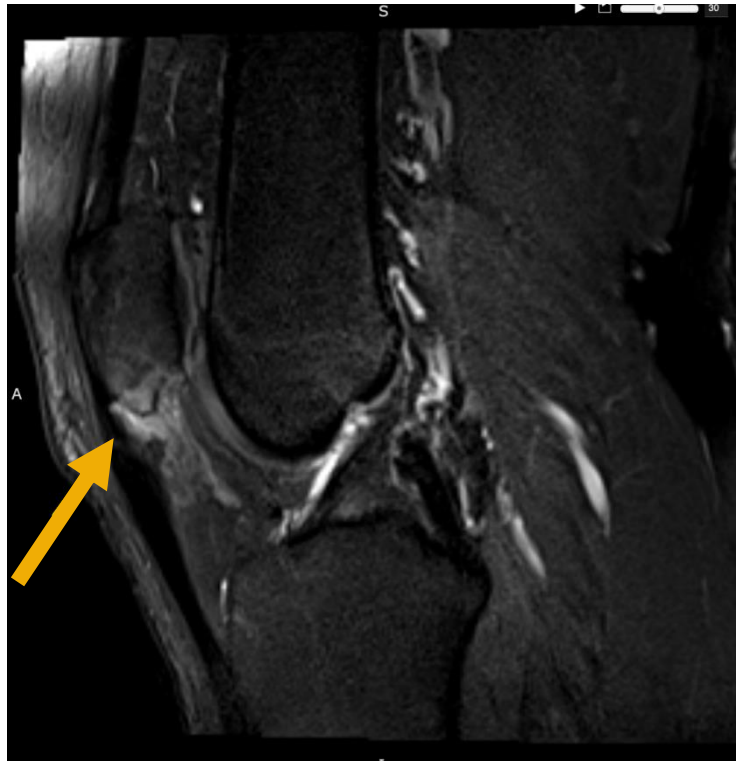
17M FB LB with 2+ years - bilateral anterior knee pain; progressively worsening despite extensive nonoperative management

- Failed structured physical therapy
- Pain is activity-related and now present with walking
- **Exam:** Focal tenderness at the patellar tendon/inferior pole
- **Knee ROM preserved:** 0–120°
- Stable ligamentous and meniscal exam

Case Example: MRI Imaging

What to measure on MRI

- **Depth** (% thickness), **Length** (mm), **Mediolateral width** (mm), **Footprint**, **Bony edema** (supports tear diagnosis)



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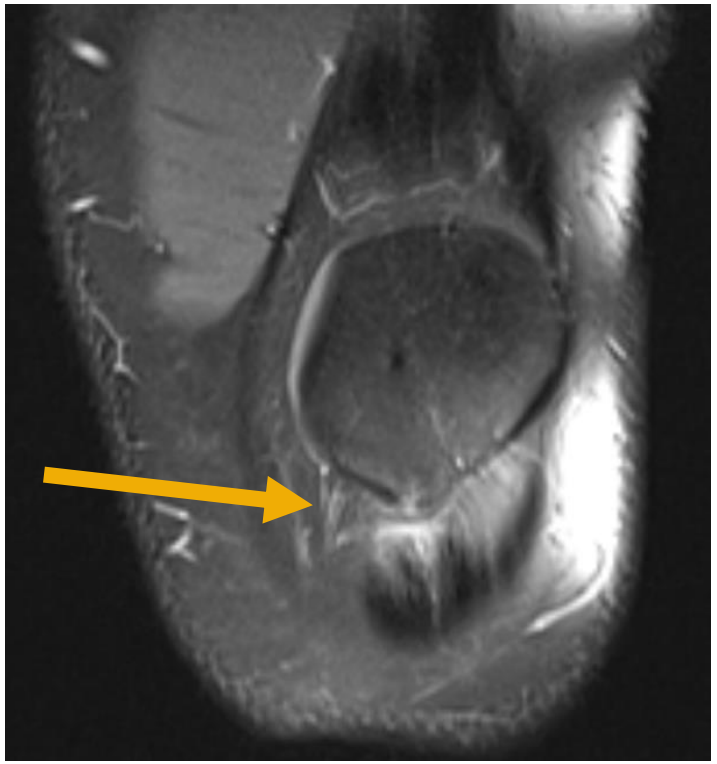

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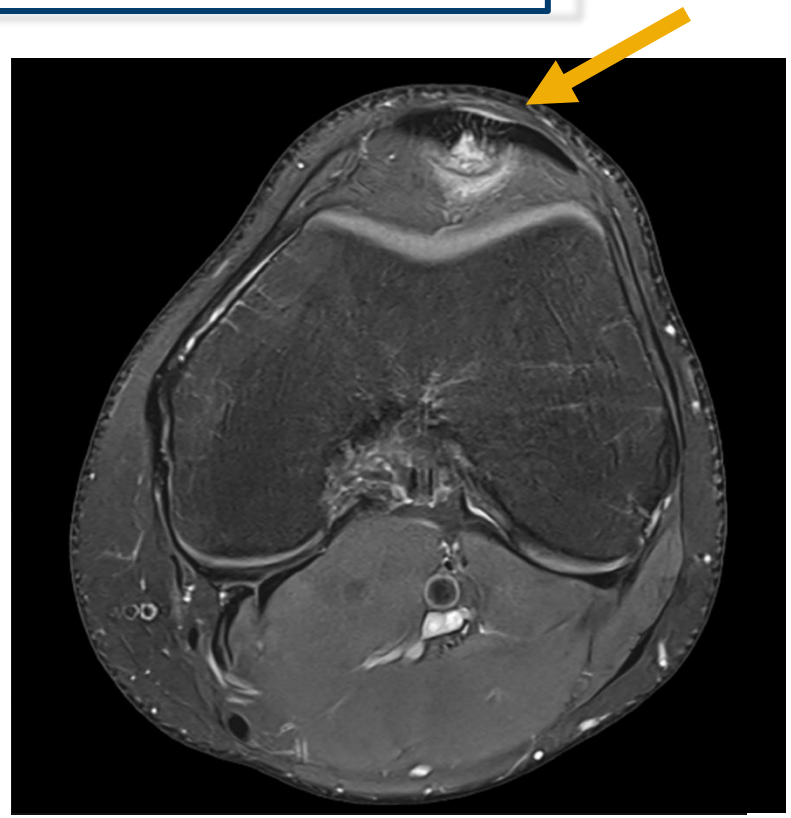
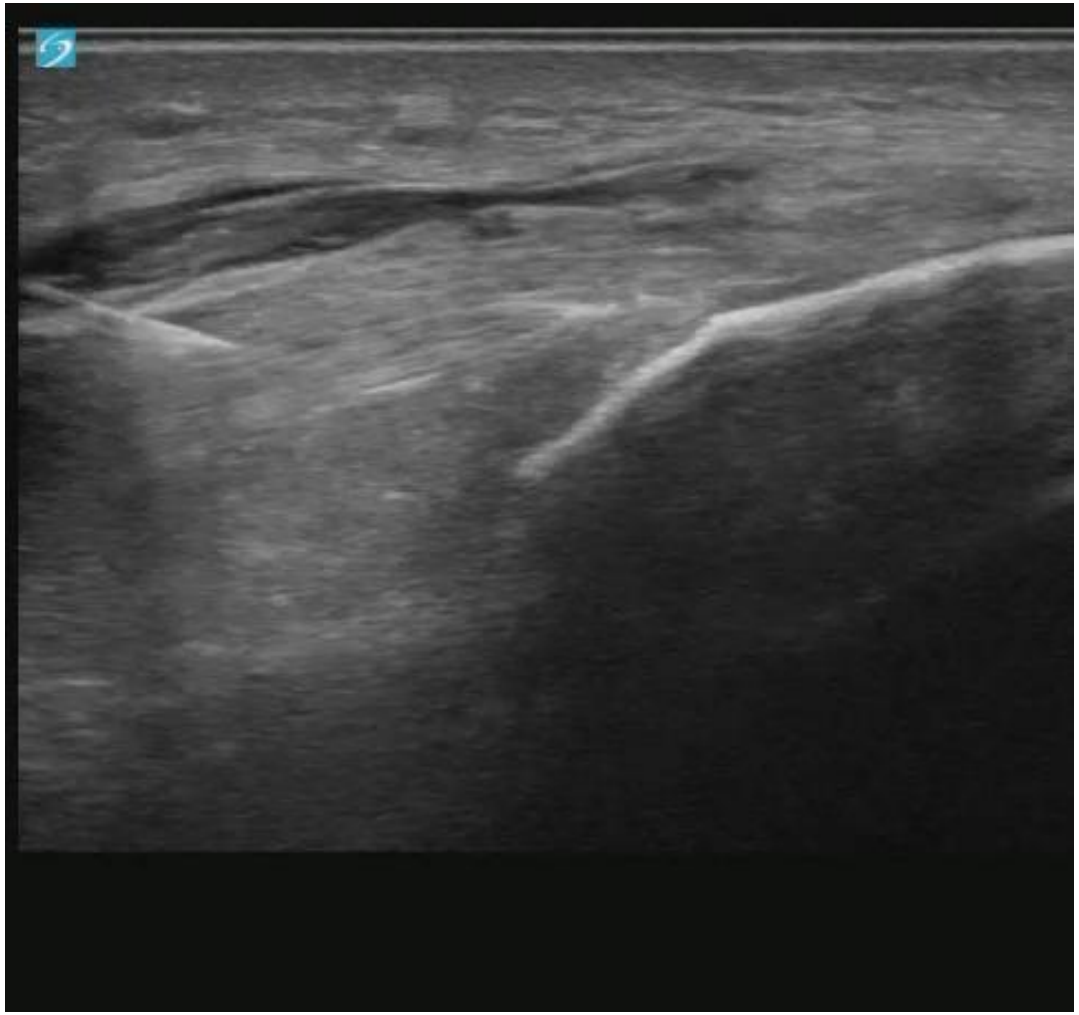
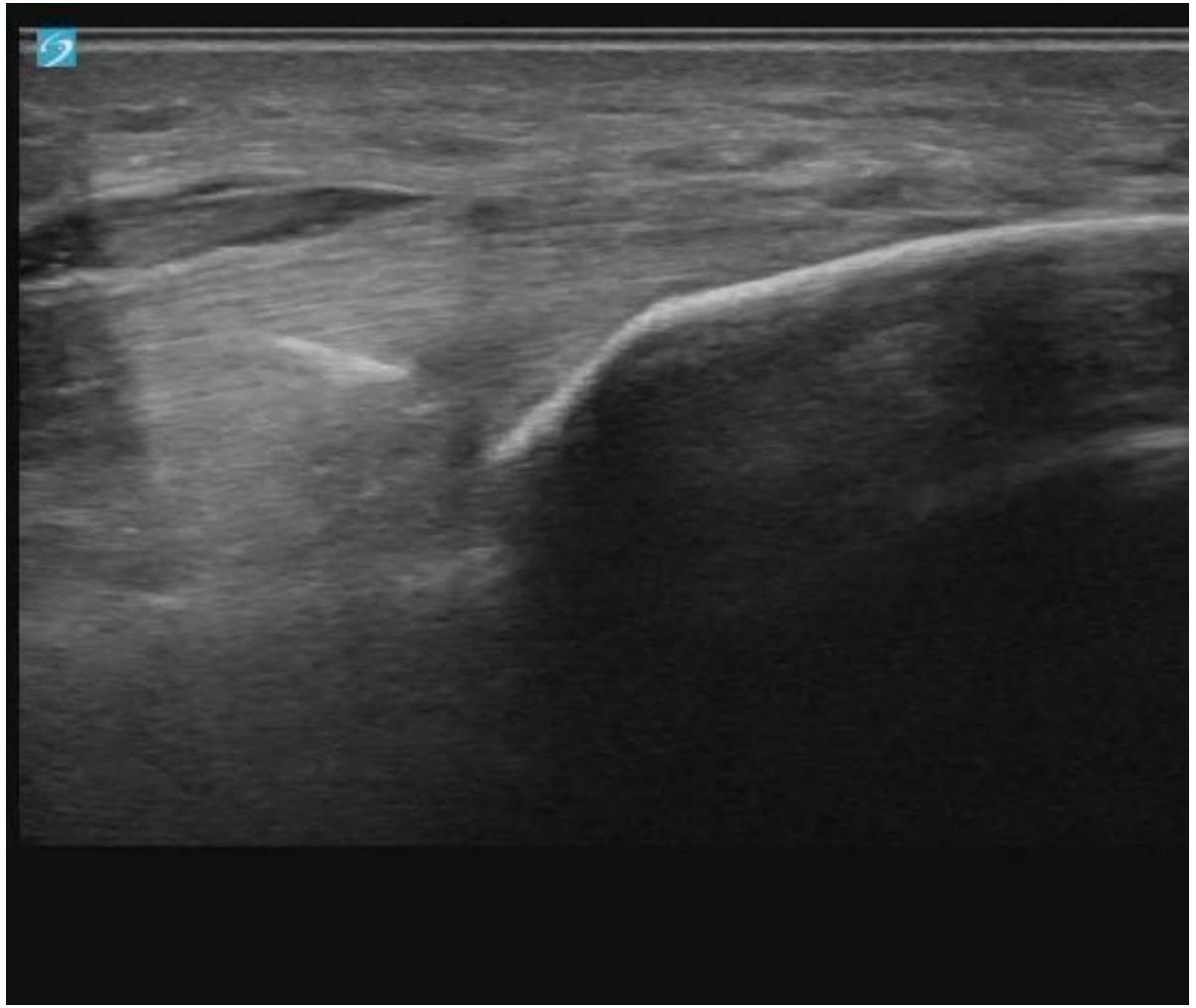


PG Grade 3

Proximal patellar tendinosis, small partial tear and minor adjacent inferior patellar marrow edema

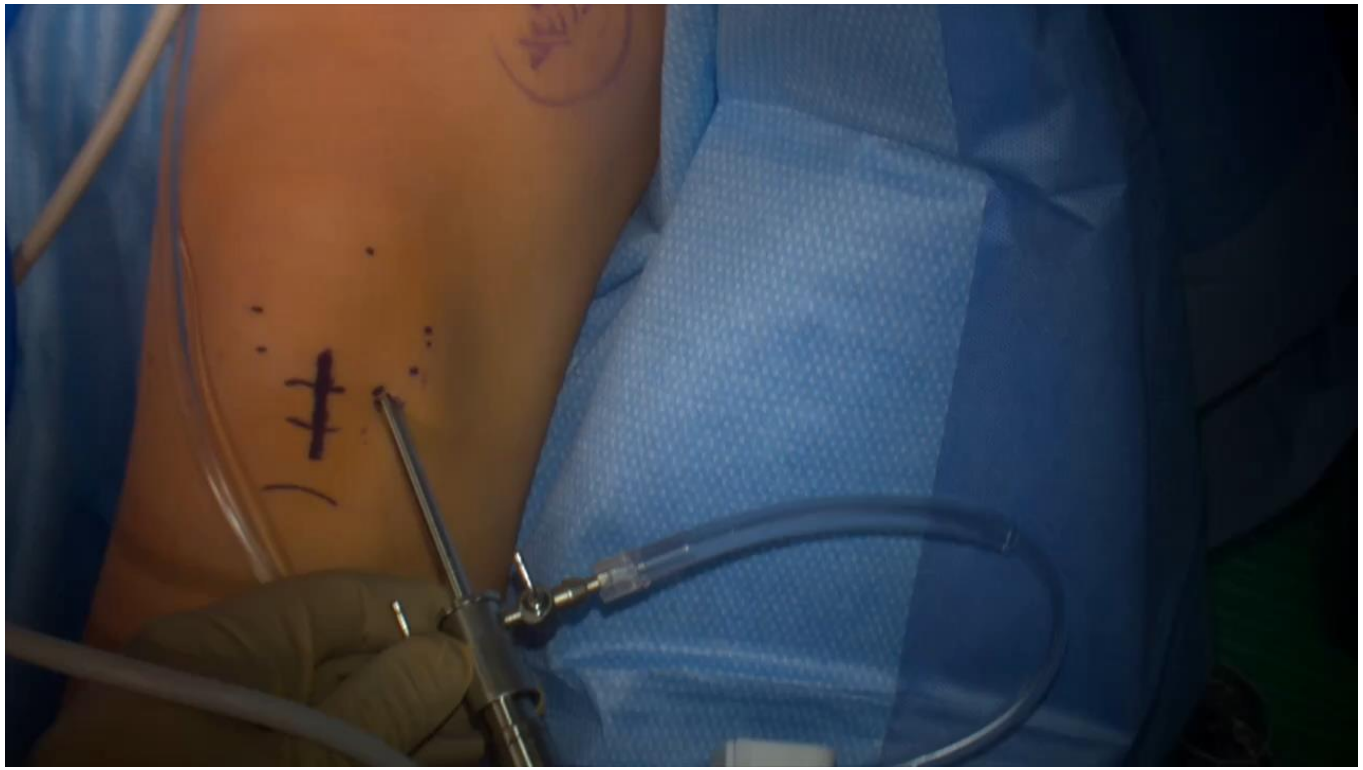
US Guided PRP





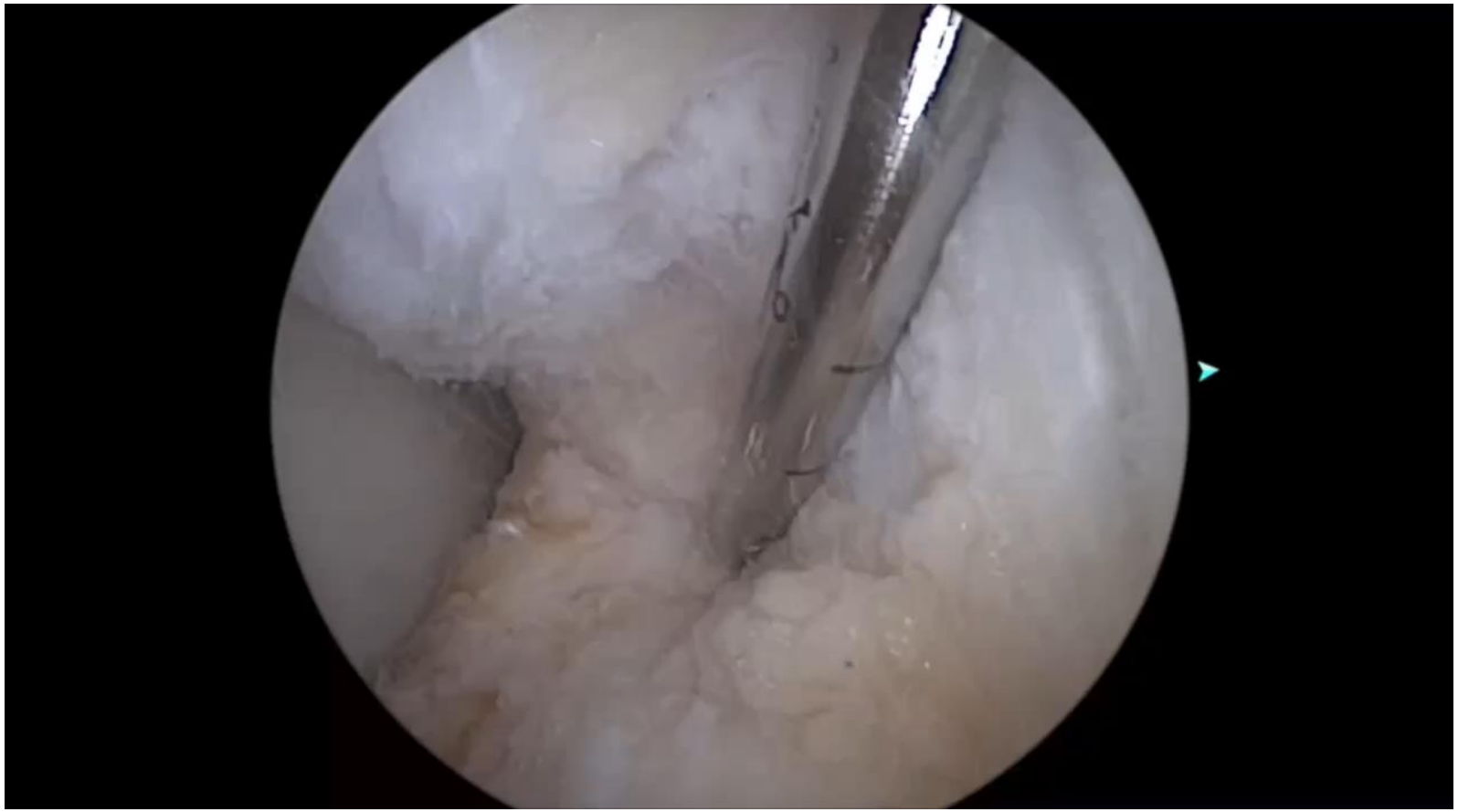
Case Example: Arthroscopy First

- Assessment of patellofemoral compartment, synovitis, articular sided pathology, concomitant meniscal pathology
- Debride fat-pad if impinging
- Inspect undersurface patellar tendon flap or delamination
- Probe tendon split if possible

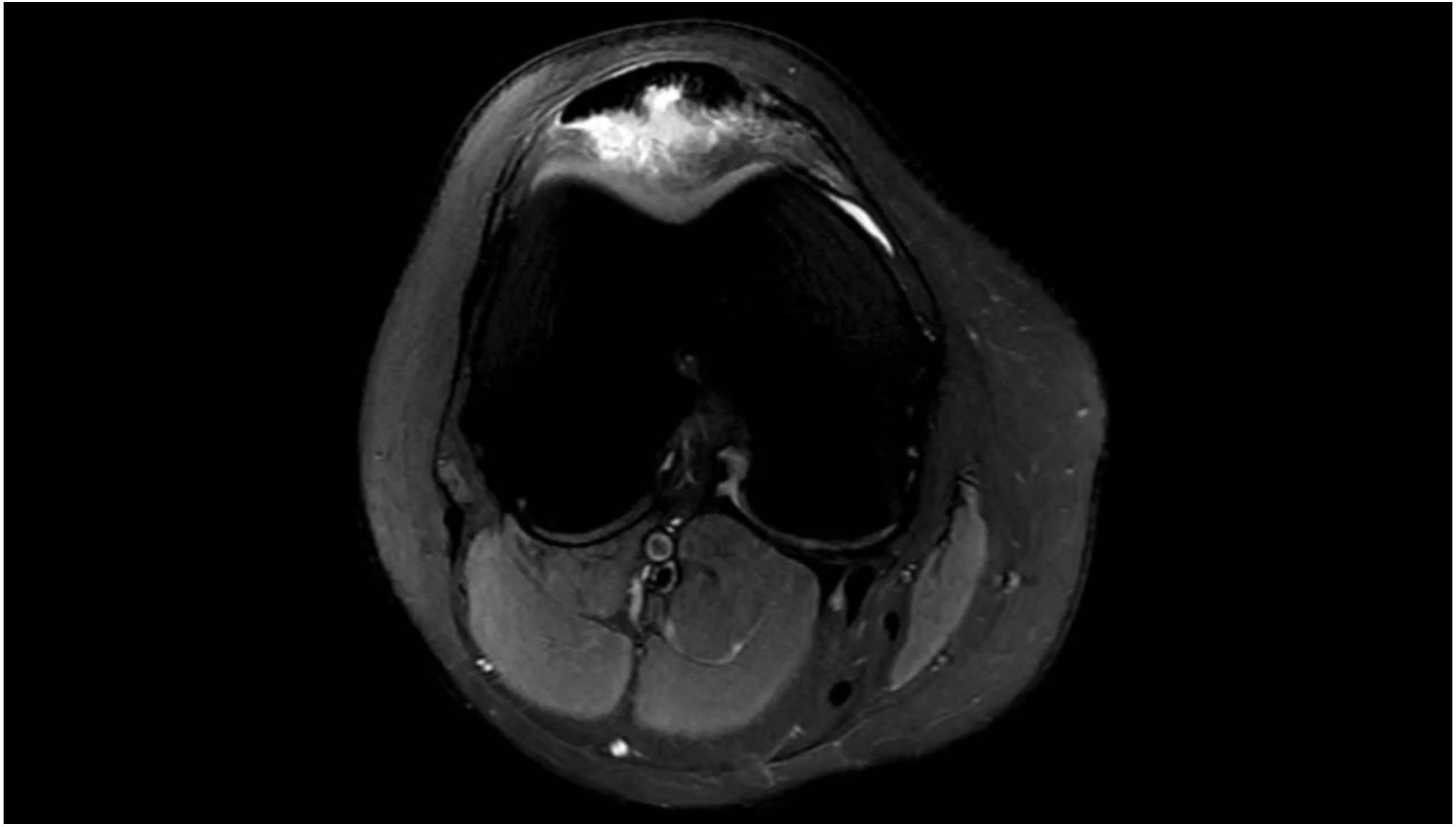


Case Example: Tendon Debridement, Mini-open Exposure, Paratenon Preservation, & Footprint Preparation

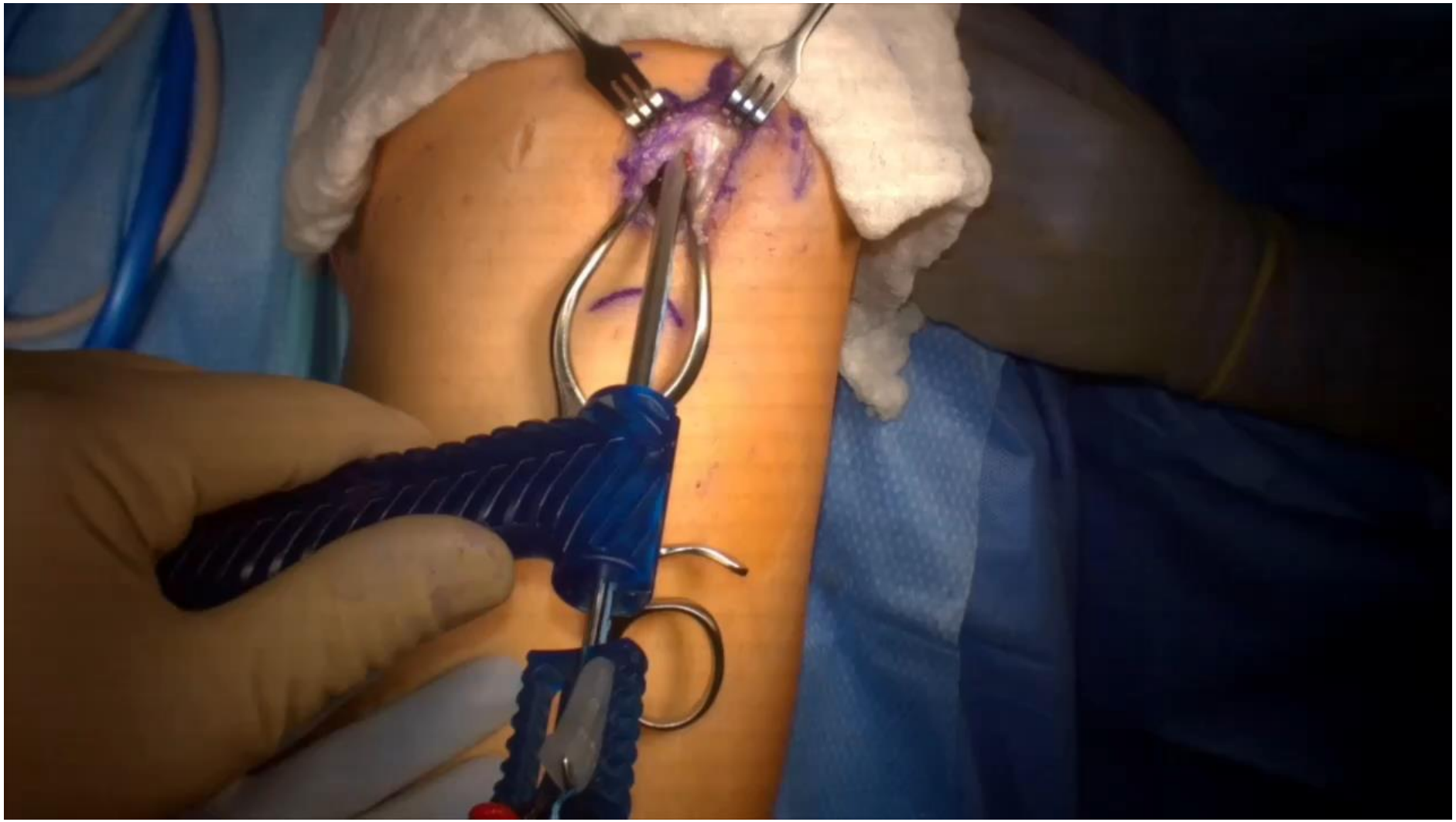
- Small longitudinal incision over inferior patellar pole
- Elevate skin flaps
- Identify and preserve paratenon
- Probe the tendon to find defect
- Debride nonviable tissue



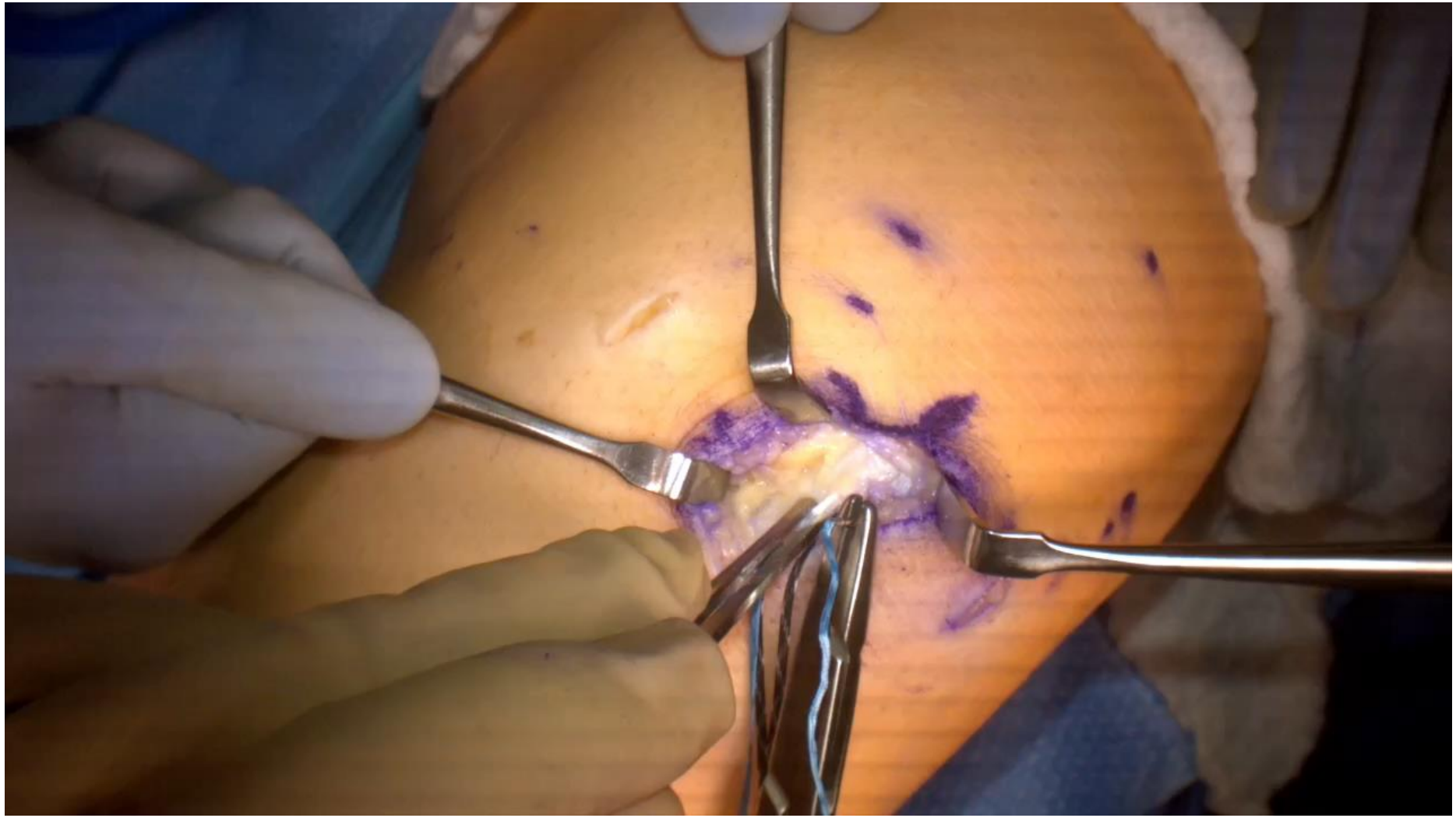
Case Variation: Pointed Patellar Morphology



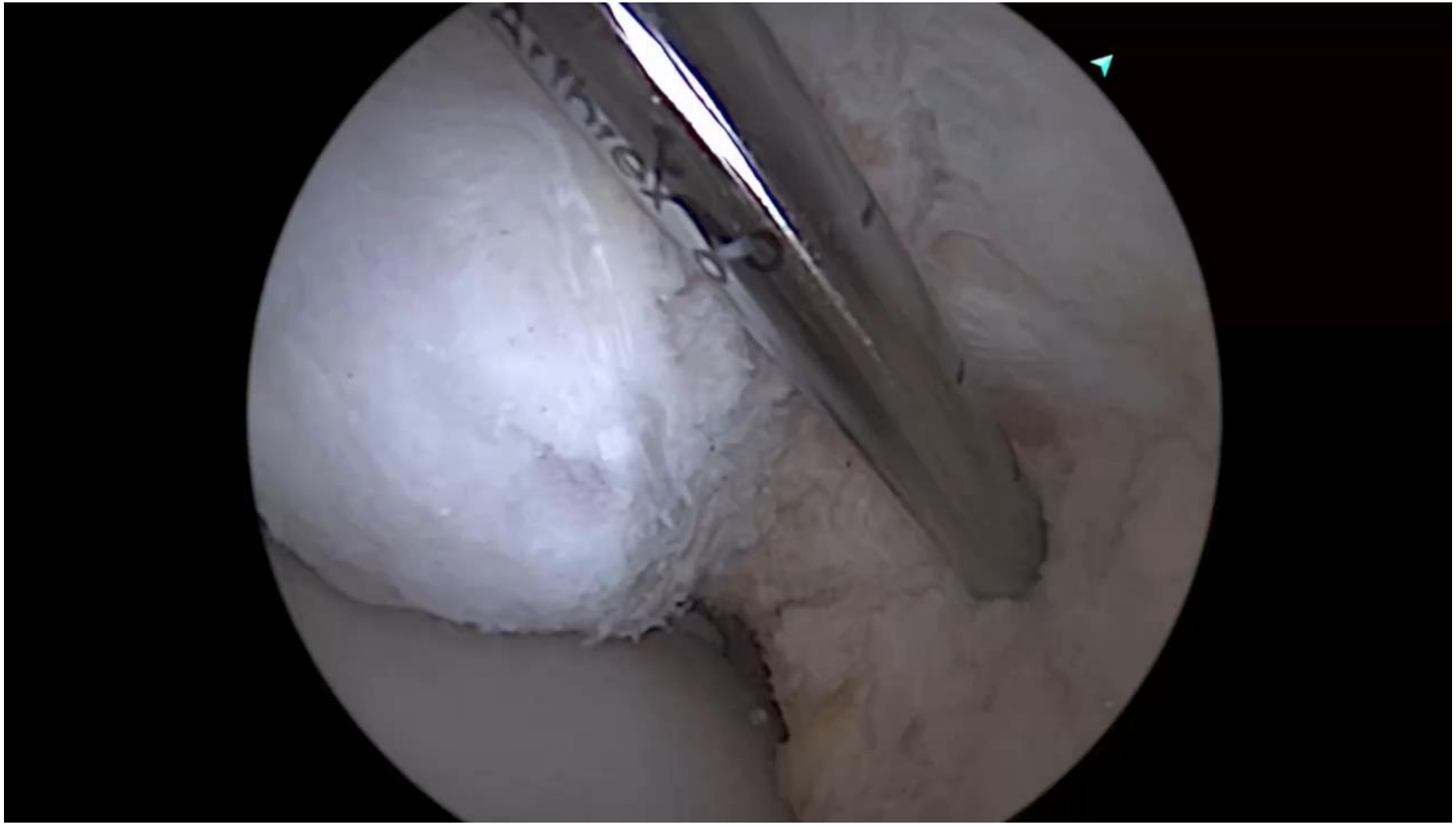
Case Example: Knotless All-Suture Anchor Placement



Case Example: Overlapping Krakow Repair

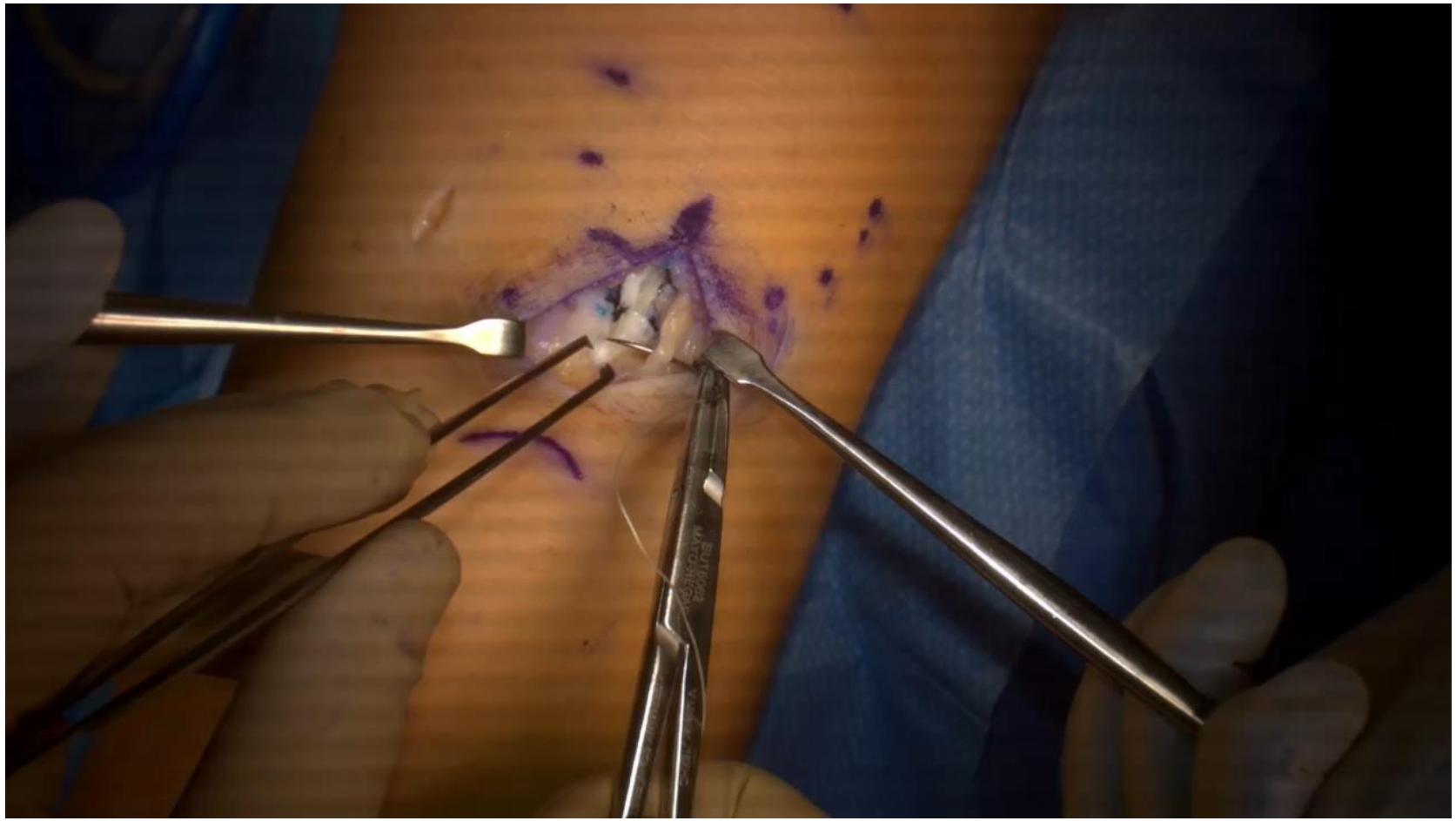


Case Example: Arthroscopic Repair



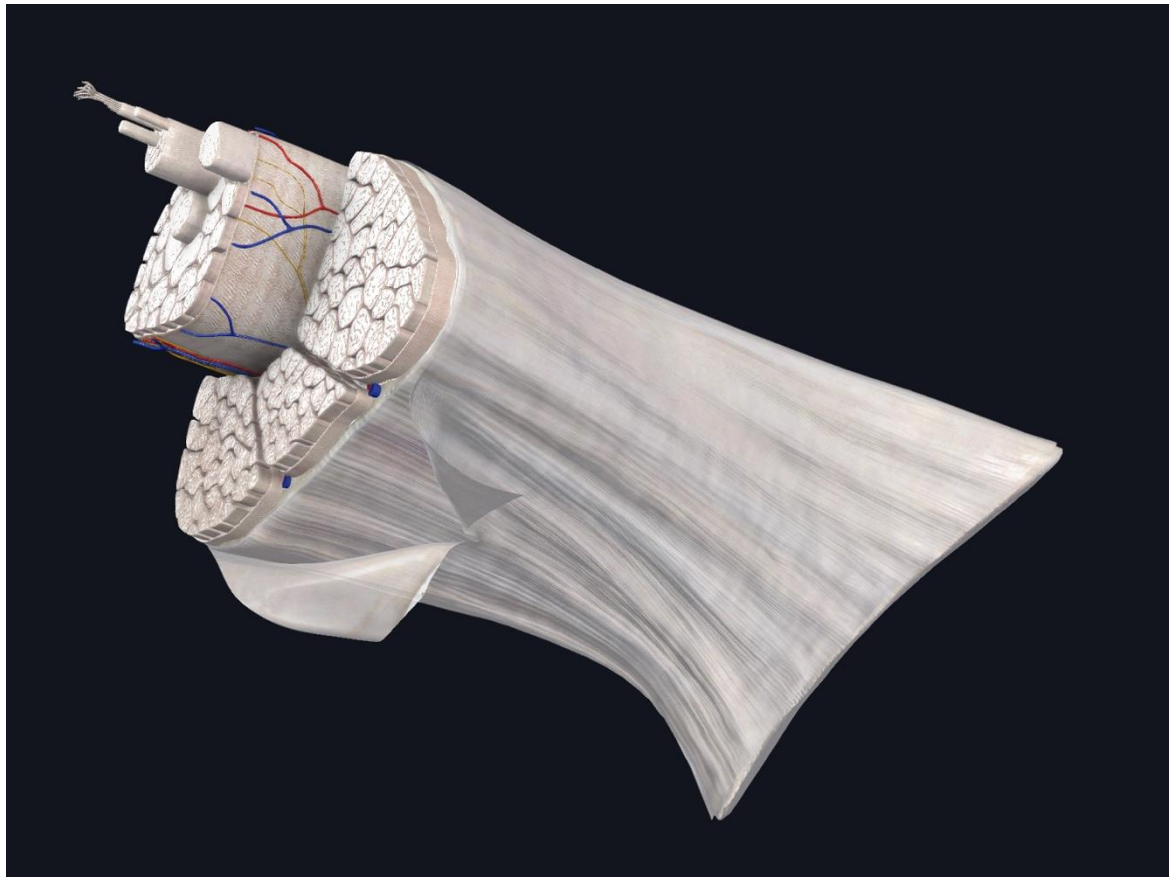
Application of Amniotic Membrane & Paratenon Closure

- Amniotic adjunct has shown to enhance tenocyte proliferation and healing
- Ensure low-profile closure over the construct



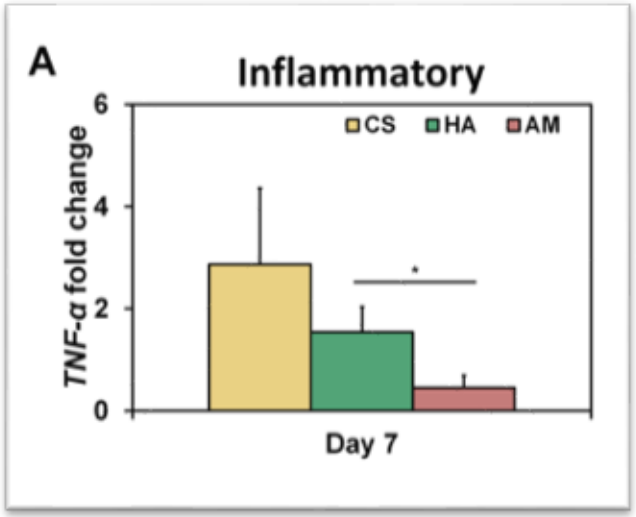
The Paratenon Plays an Important Role

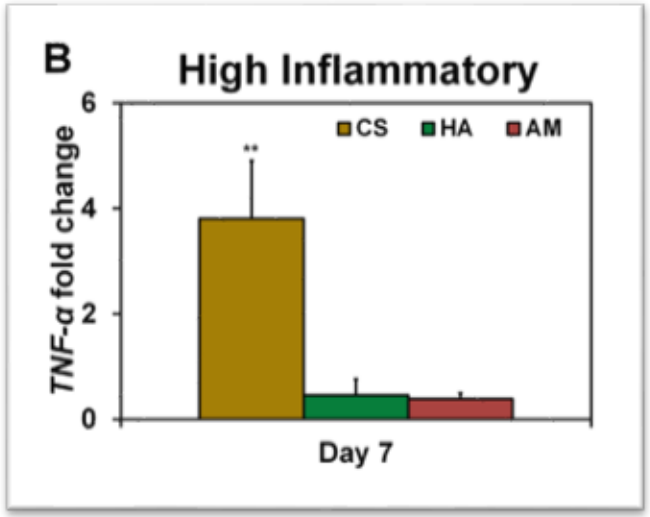
- Provides **vascularity** and **innervation**
  - **Watershed zone** of tendons supplied only by extrinsic/paratenon supply
- From the MTJ, **nerve fibers** enter the endotenon and paratenon, and then innervate epitenon & surface of tendon
  - Mechanoreceptors/Golgi organ
    - Pressure & Tension
    - Proprioception

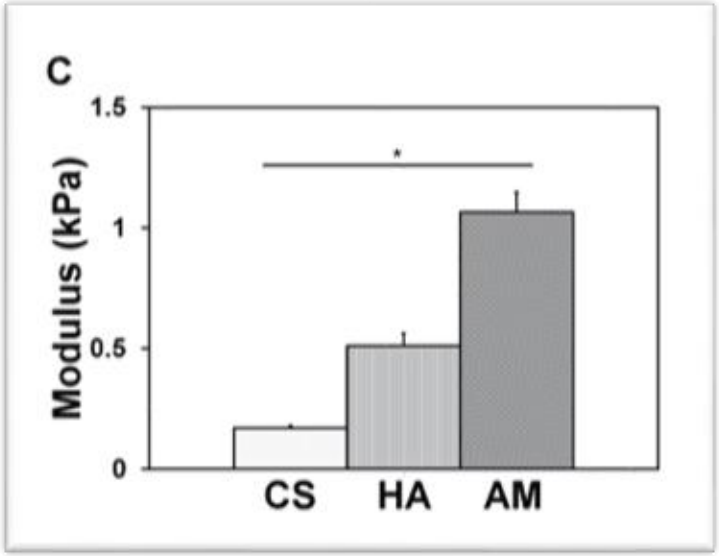


Amniotic Matrix Improves Collagen Healing

- Tendon repair normally occurs through disorganized collagen formation & inflammation
  - Poor mechanical properties
  - Scarring and adhesion
- Collagen scaffolds containing AM
  - Lower inflammatory markers
  - Higher metabolic activity of tenocytes
  - Better tensile properties







Immunomodulatory effects of amniotic membrane matrix incorporated into collagen scaffolds

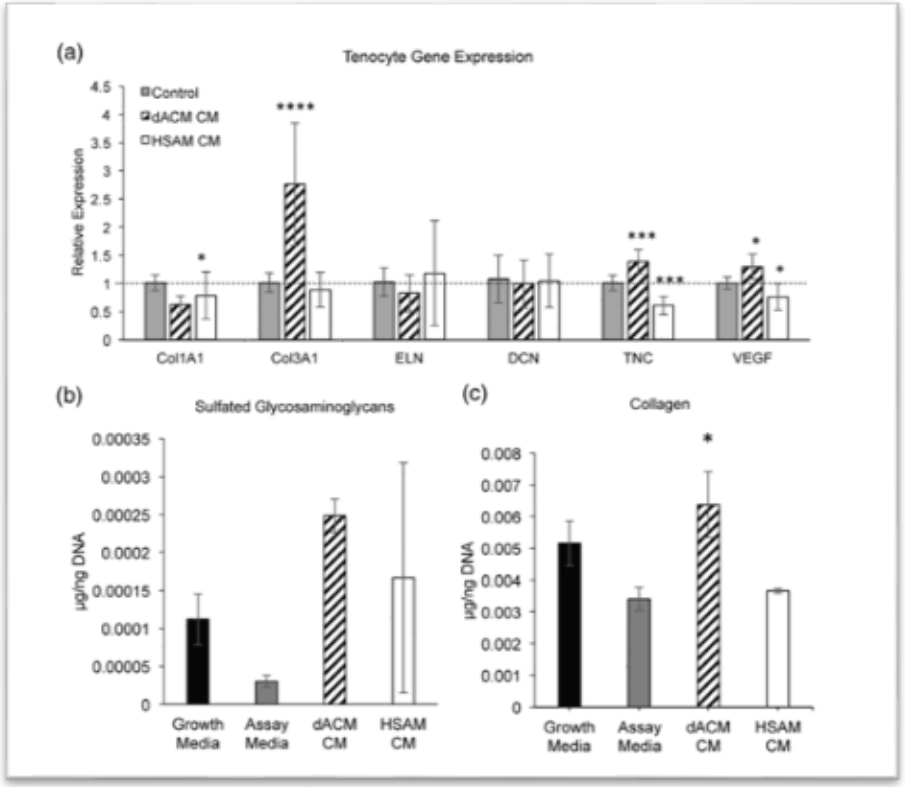
Rebecca A. Hortensius[1], **Jill H. Ebens**[2], and **Brendan A. C. Harley**[2,3]

Amniotic Matrix Encourages Tenocyte Proliferation & Collagen Formation

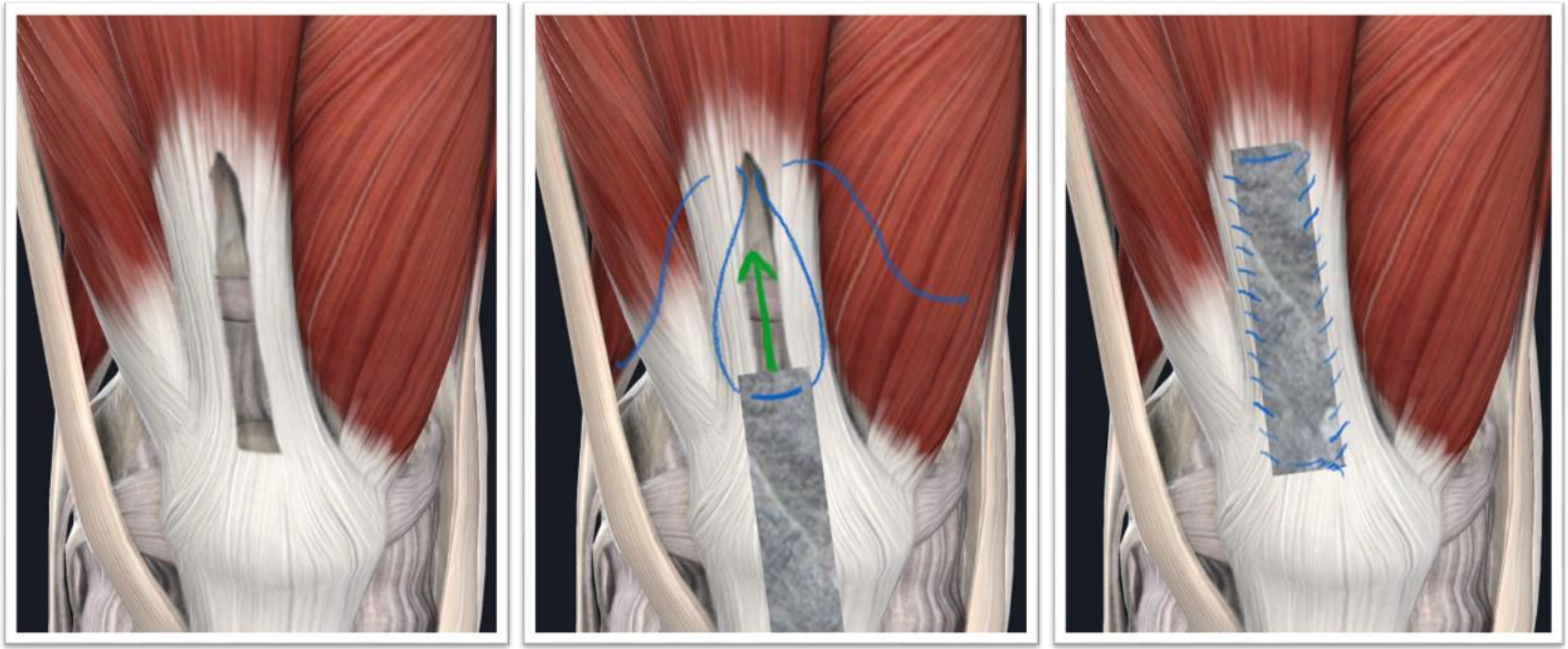
- Dehydrated amniotic matrix
  - Physiologically relevant growth factors necessary for tendon healing
  - 3.5x increased **tenocyte proliferation**
  - 2.27x **increased tenocyte migration**
  - Increased collagen gene expression and actual collagen proliferation

Evaluation of two distinct placental-derived membranes and their effect on tenocyte responses in vitro

John P. McQuilling[1] | Kelly A. Kimmerling[1] | Miranda C. Staples[2] | Katie C. Mowry[1]



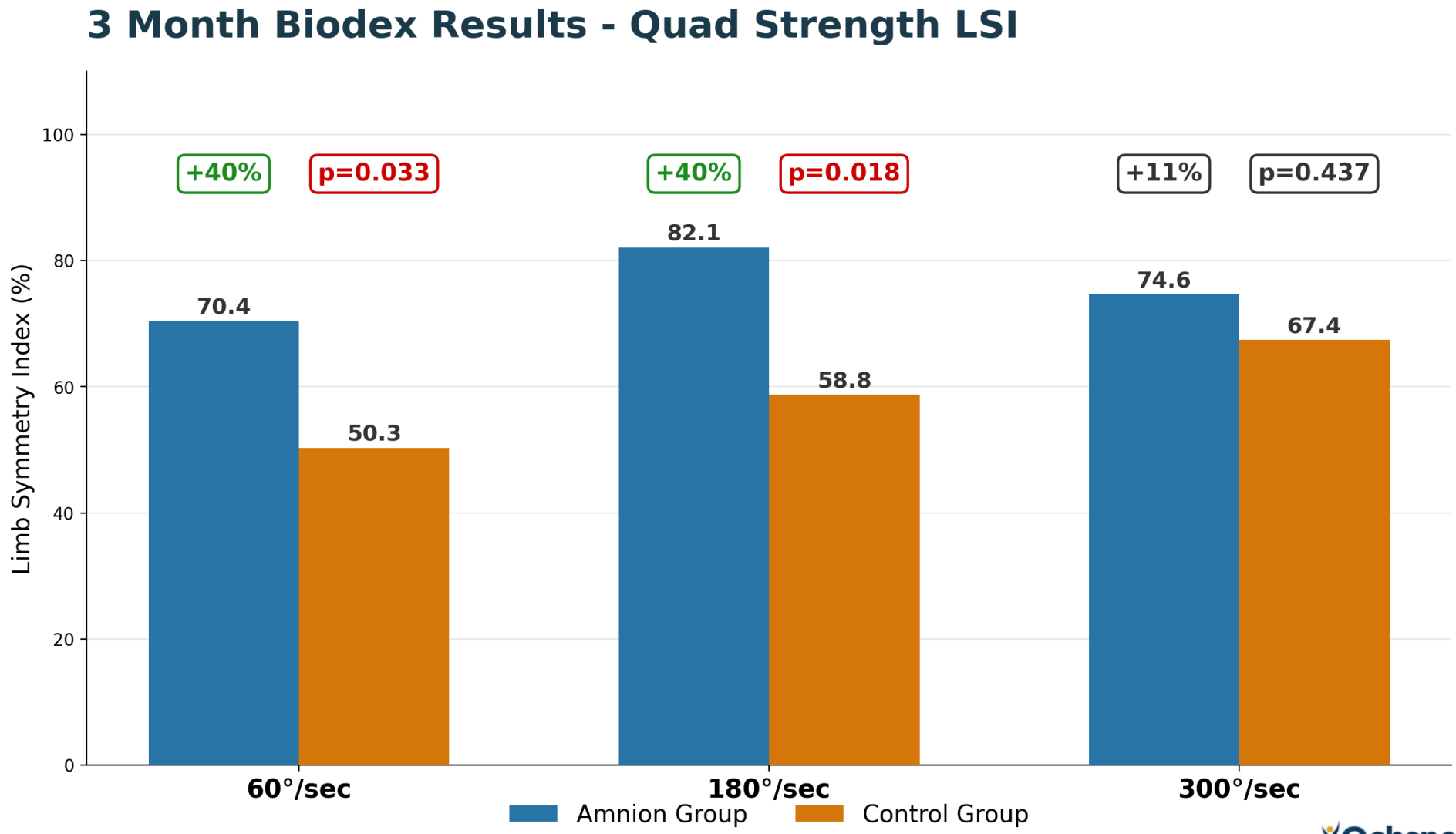
Quad Harvest Site – Amnion Technique



Harvest Site → Proximal Slide → Secure Graft

RCT - Amnion to Quad Harvest Site

n = 16



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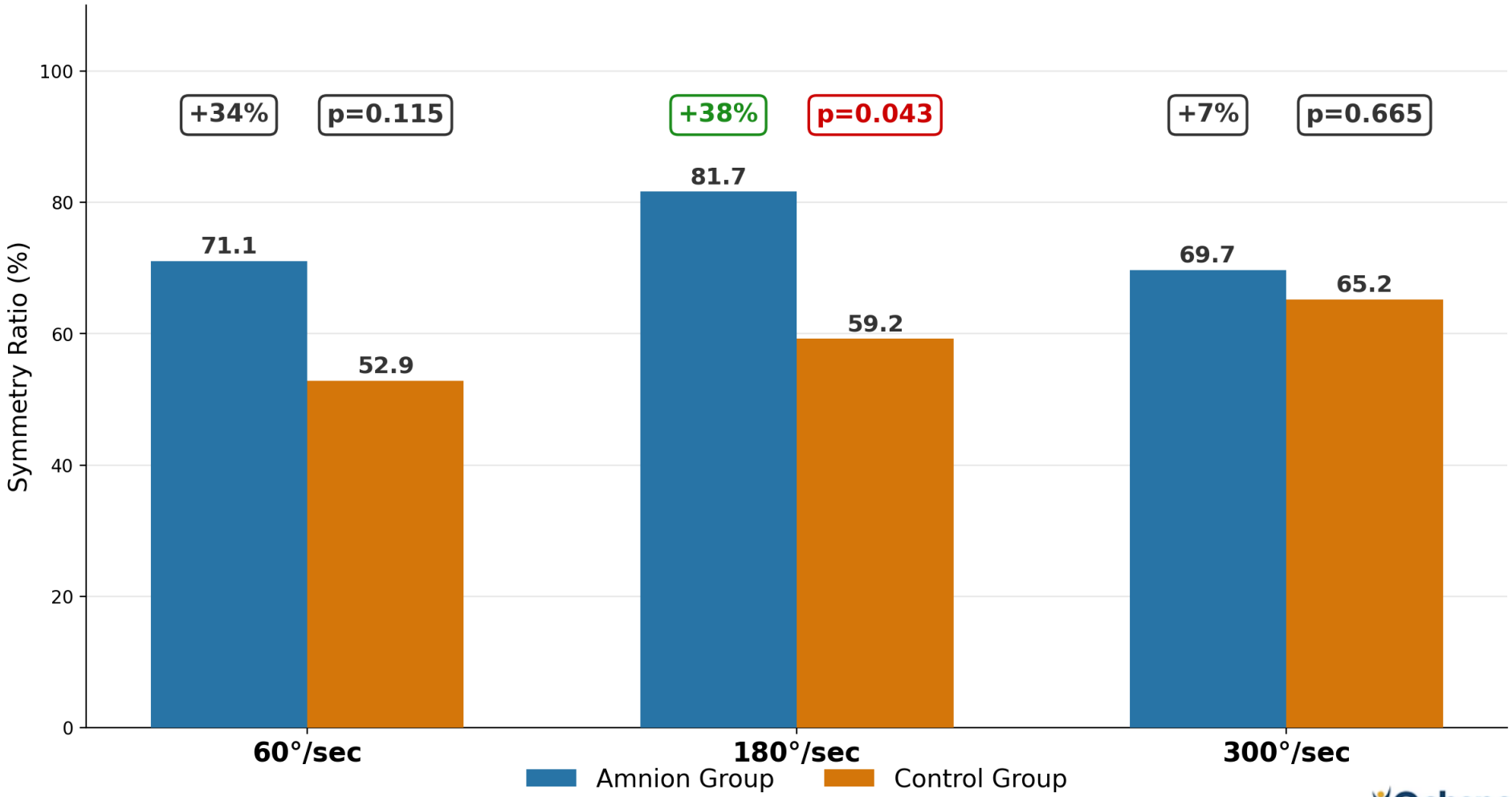
RCT - Amnion to Quad Harvest Site

n = 16

3 Month Biodex Results - Total Work Symmetry



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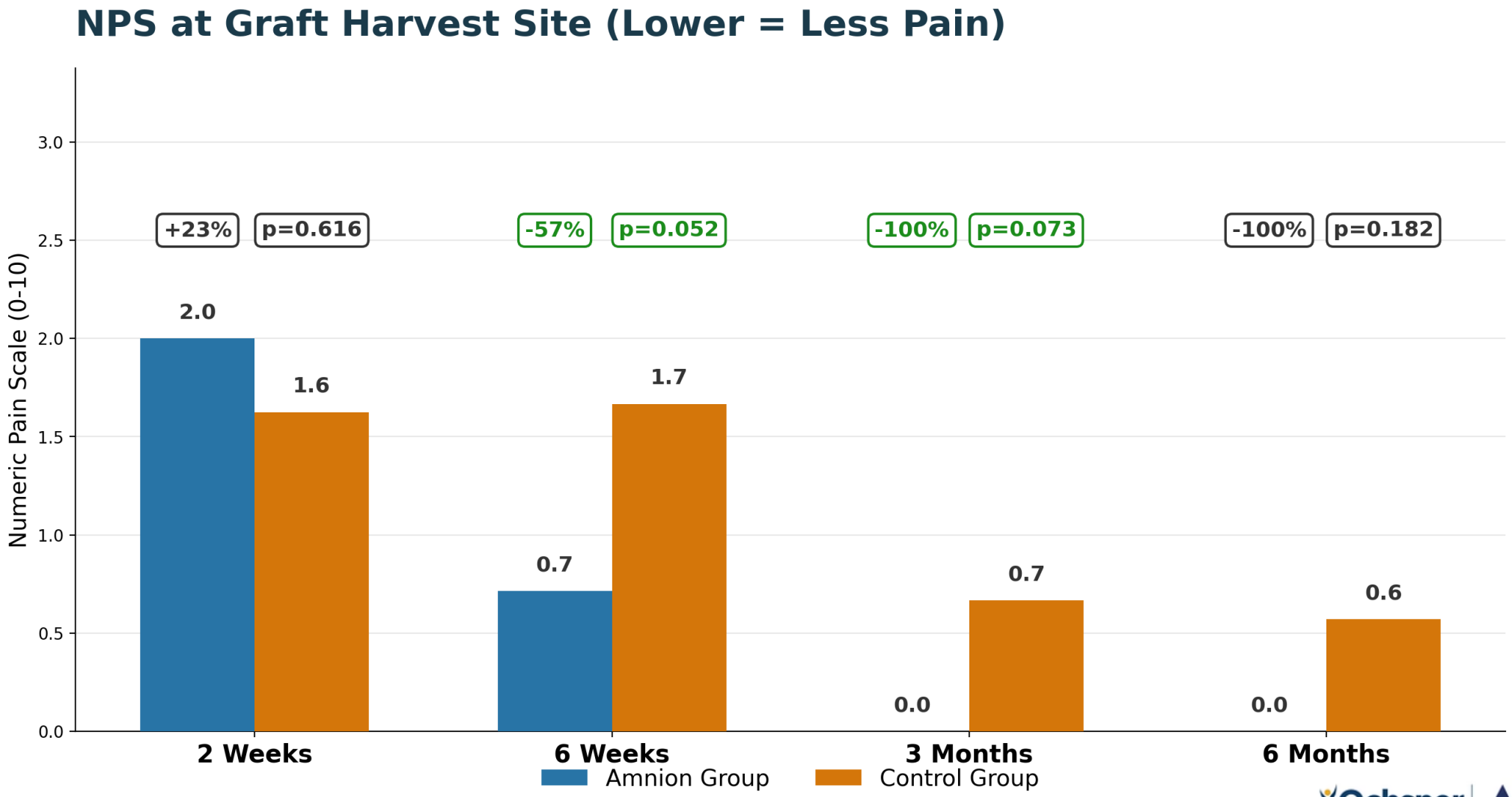

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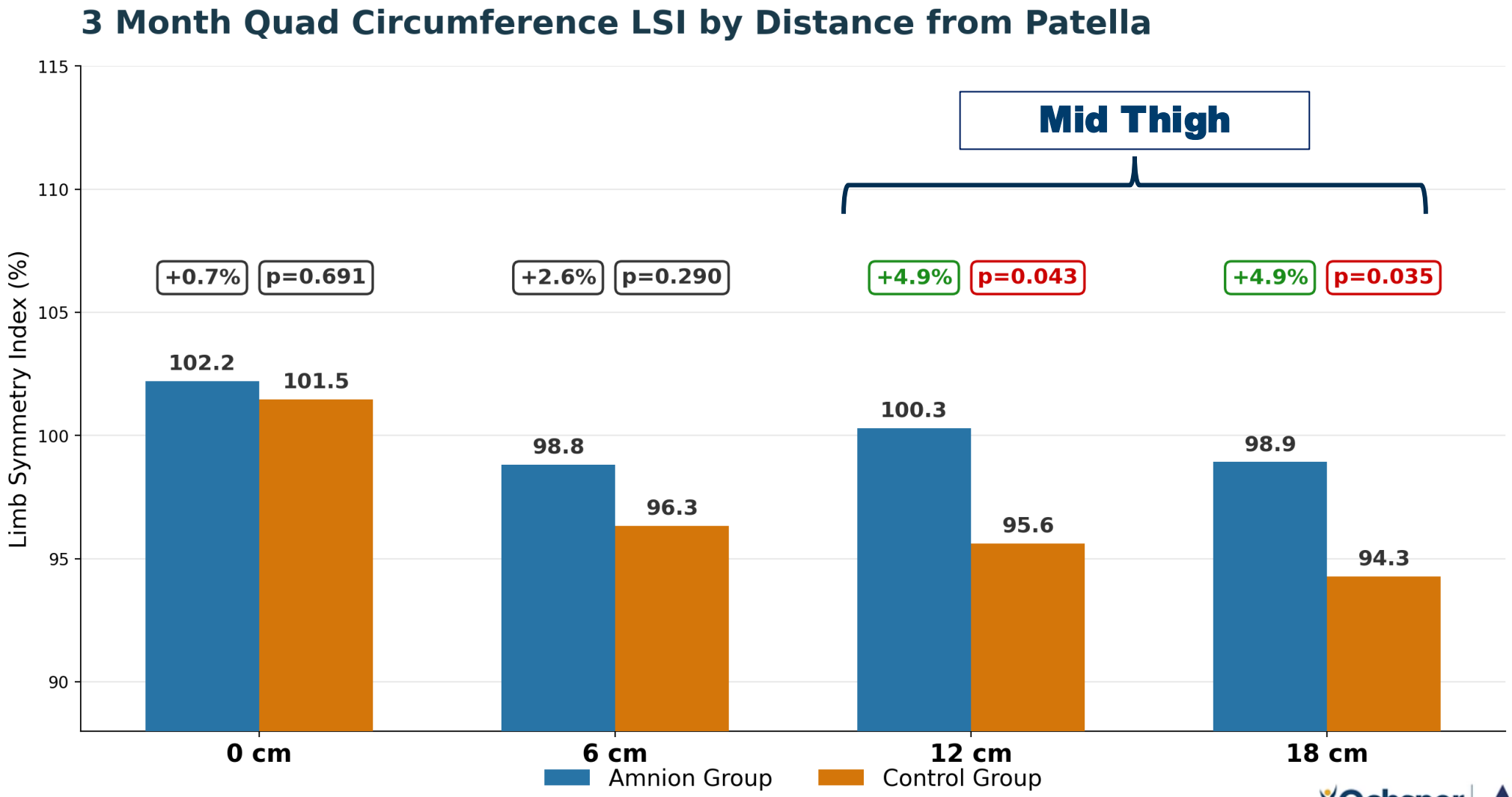
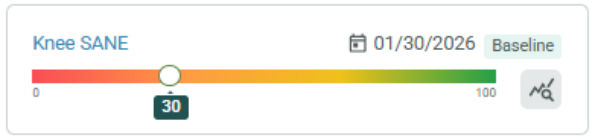


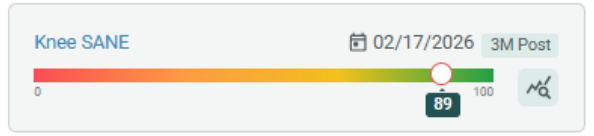
Patient Reported Outcomes (3 mths Post-op)

Knee SANE

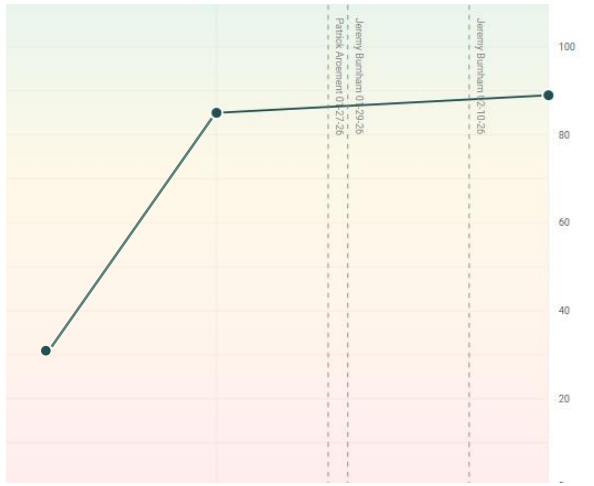
PRE



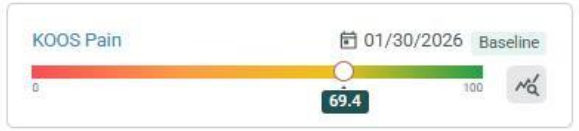
POST



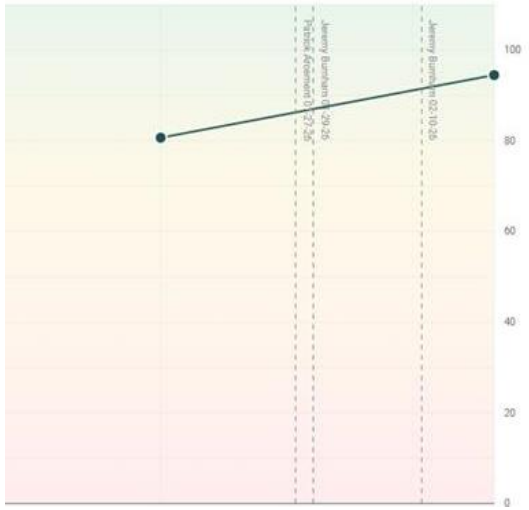
197% Increase



KOOS Pain

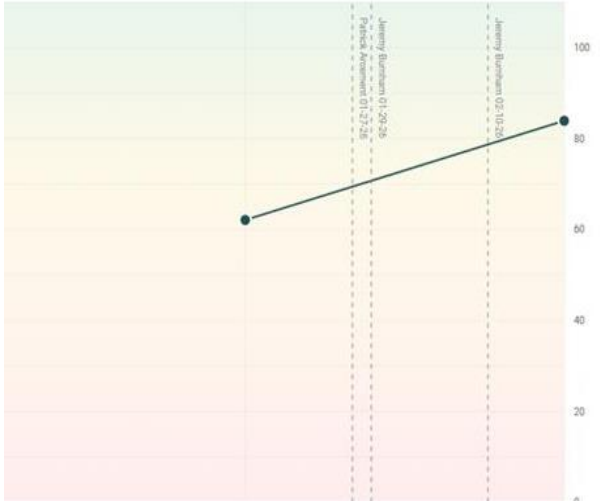


36% Increase



IKDC Score

62% Increase



Rehabilitation Milestones & Return-to-Sport Progression

Phase I: 0-2 Weeks – Maximal Protection

- Hinged brace, locked in extension
- WBAT in extension, PROM 0-30º
- No Active knee extension; NMES, SLR in brace

Phase II: 2-6 Weeks- Protected motion + early activation

- Unlock brace when >15 SLR without lag
- Advance ROM 10–20°/week; goal 100° by week 6
- Begin controlled quad loading, **Blood Flow Restriction (BR),** closed-chain activity 0–30°

Phase III: 6-10 Weeks – Restore ROM + Basic Strength

- Full weightbearing; discontinue brace once gait normalized
- Progress to full ROM by weeks 6–10
- Advance open- and closed-chain strengthening

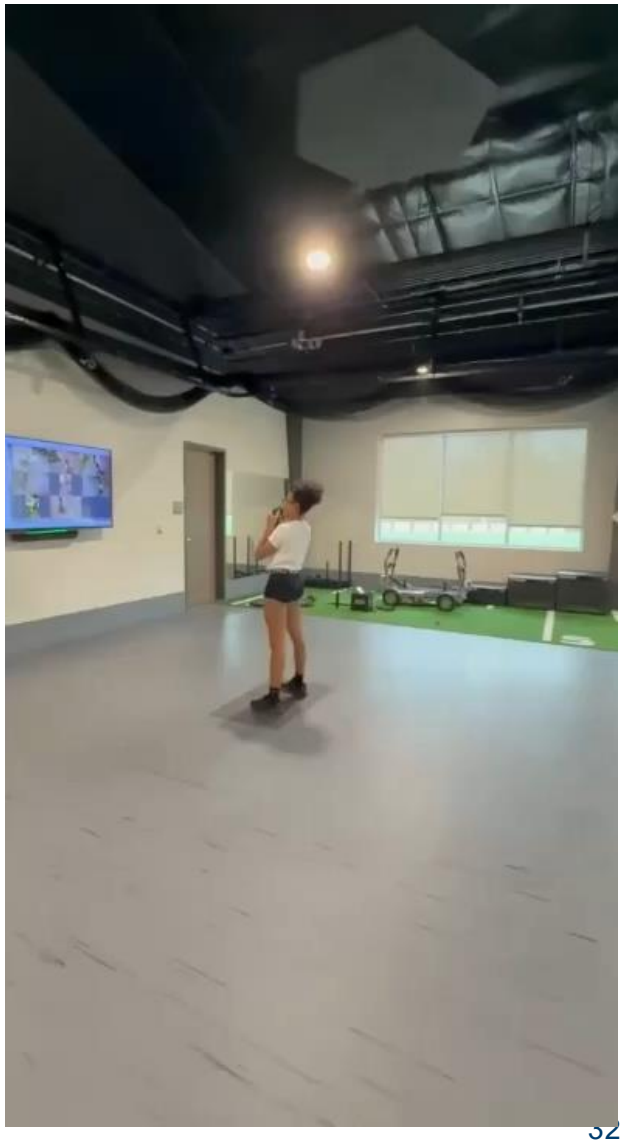
Rehabilitation Milestones & Return-to-Sport Progression

Phase IV: 10-12 Weeks – Functional Strengthening

- Progress quad loading, eccentric work,
- and squat-based strengthening
- Higher-level functional strength training

Phase V: 3-4 Months – Running + Plyometrics Can begin IF:

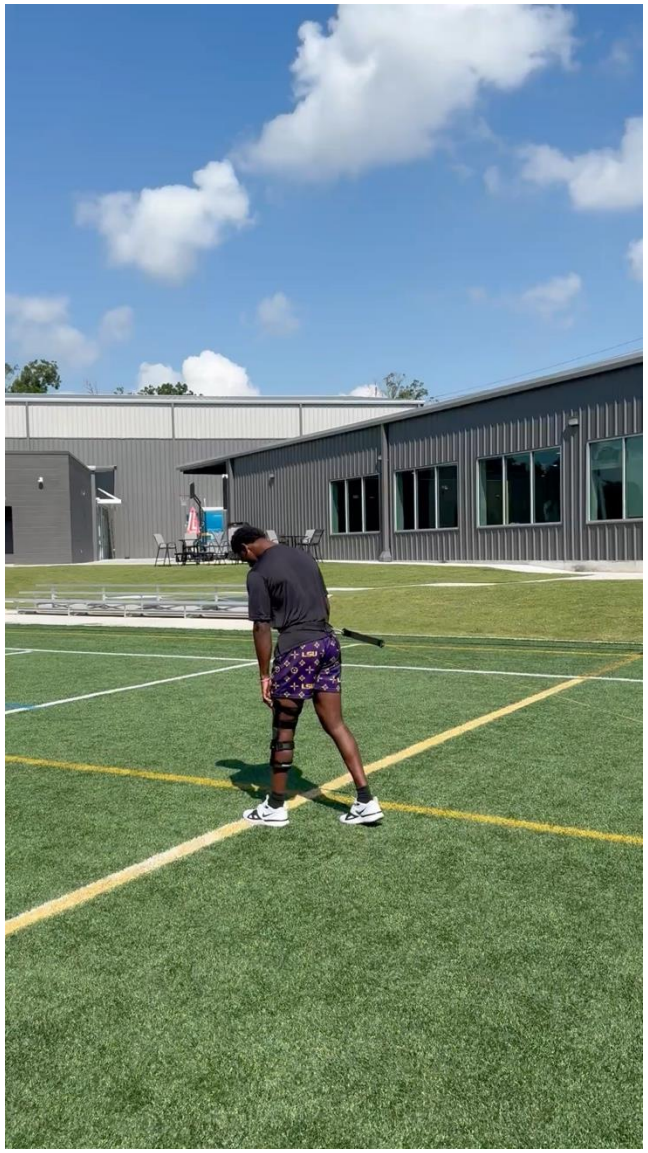
- Quad LSI ≥70%
- Hamstring LSI ≥70%
- Adequate single-leg squat / Y-balance control



Rehabilitation Milestones & Return-to-Sport Progression

Phase VI: 3-6 Months – Return to Sport

- Advance to higher-level plyometrics and sport drills after strength criteria met
- Full RTS battery at ~6 months
- ≥ 95% limb symmetry on strength and functional testing



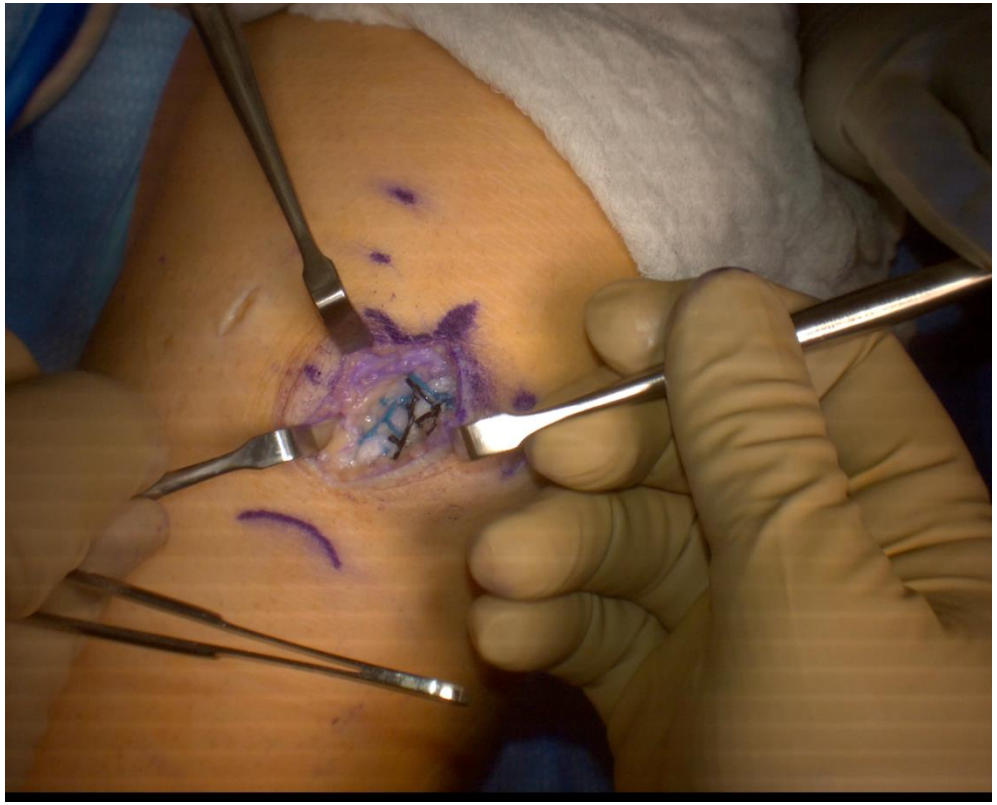
Pearls & Pitfalls

Pearls

- Quantify tear location and size on MRI → Plan anchor placement and resection
- Make portals more medial and lateral than standard
- Preserve intact fibers
- Osteoplasty to inferior patellar pole

Pitfalls

- Operating on diffuse tendinosis/no plane
- Over-debridement of tendon or under-resection of bone
- Anchor malposition/vector errors
- Too aggressive early eccentric movements or plyometrics



Thank you

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