



Meniscus Repair Techniques

Presented by Mr Simon Moyes

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simonmoyes.com

First Meniscus Repair

Thomas Annandale:

- 1883, England
- 10 Months of Pain
- “Great Swelling”
- Medial JLP
- Initial Rx.
 - Rest
 - Blistering
 - Topical Iodine
 - Liniments
- Displaced MM Tear
- Reduced
- Ant Repair
 - Catgut X3
- Splint X 7 Weeks
- Follow-up 2 Months
- All Good

Meniscus Management

- Meniscectomy
- Meniscus Repair
- Meniscus Transplant
- Meniscus Replacement

Meniscus Management

- Meniscectomy
- **Meniscus Repair**
- Meniscus Transplant
- Meniscus Replacement

Meniscal Repairs

- Approx. 1,000,000 meniscal procedure annually
- An estimated $< 10\%$ are repair procedures
 - Greater Than 900,000 Meniscectomies Each Year

Meniscal Repairs

- Approx. 1,000,000 meniscal procedure annually
- An estimated $< 10\%$ are repair procedures
 - Almost 100,000 Meniscal Repairs Per Year

Function

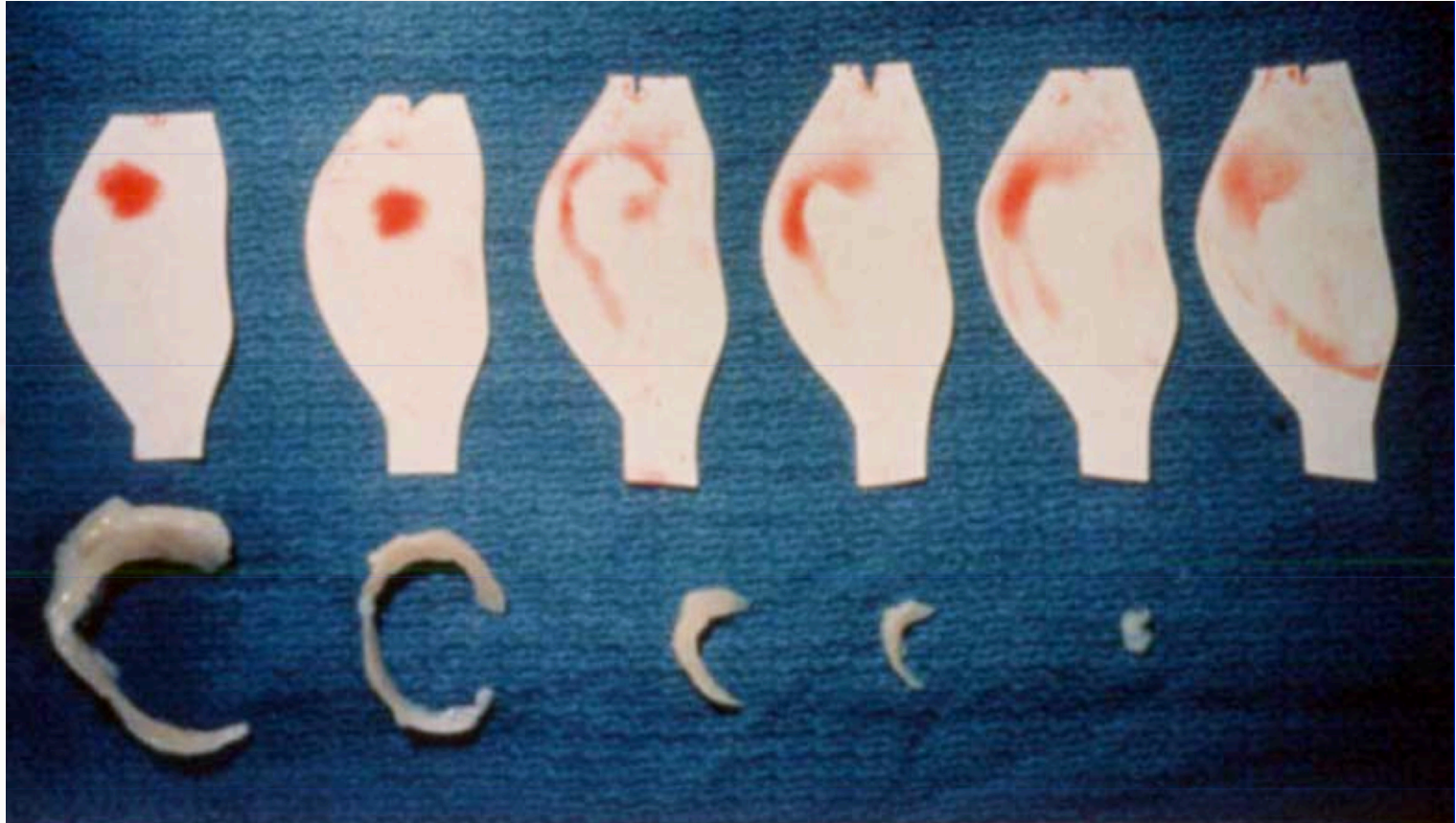
- Loadsharing
- 2° Restraint (MM)
- Lubrication
- Nutrition

Function

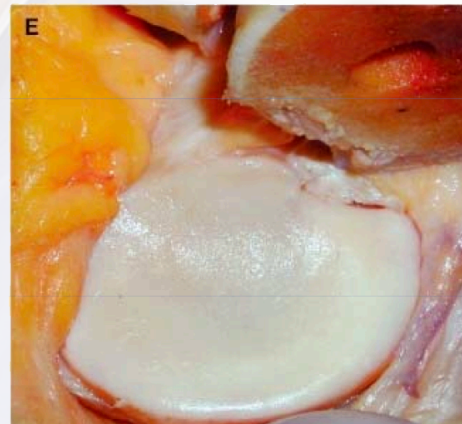
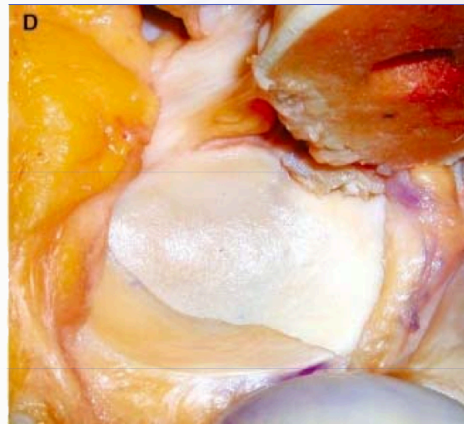
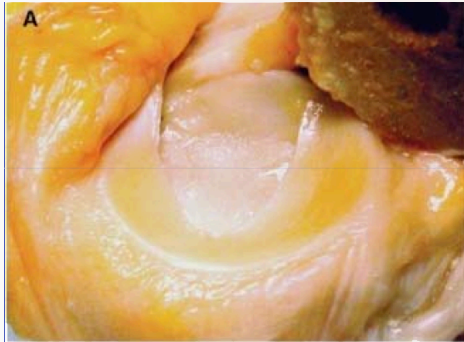
- Loadsharing
- 2° Restraint
- Lubrication
- Nutrition

Load Sharing

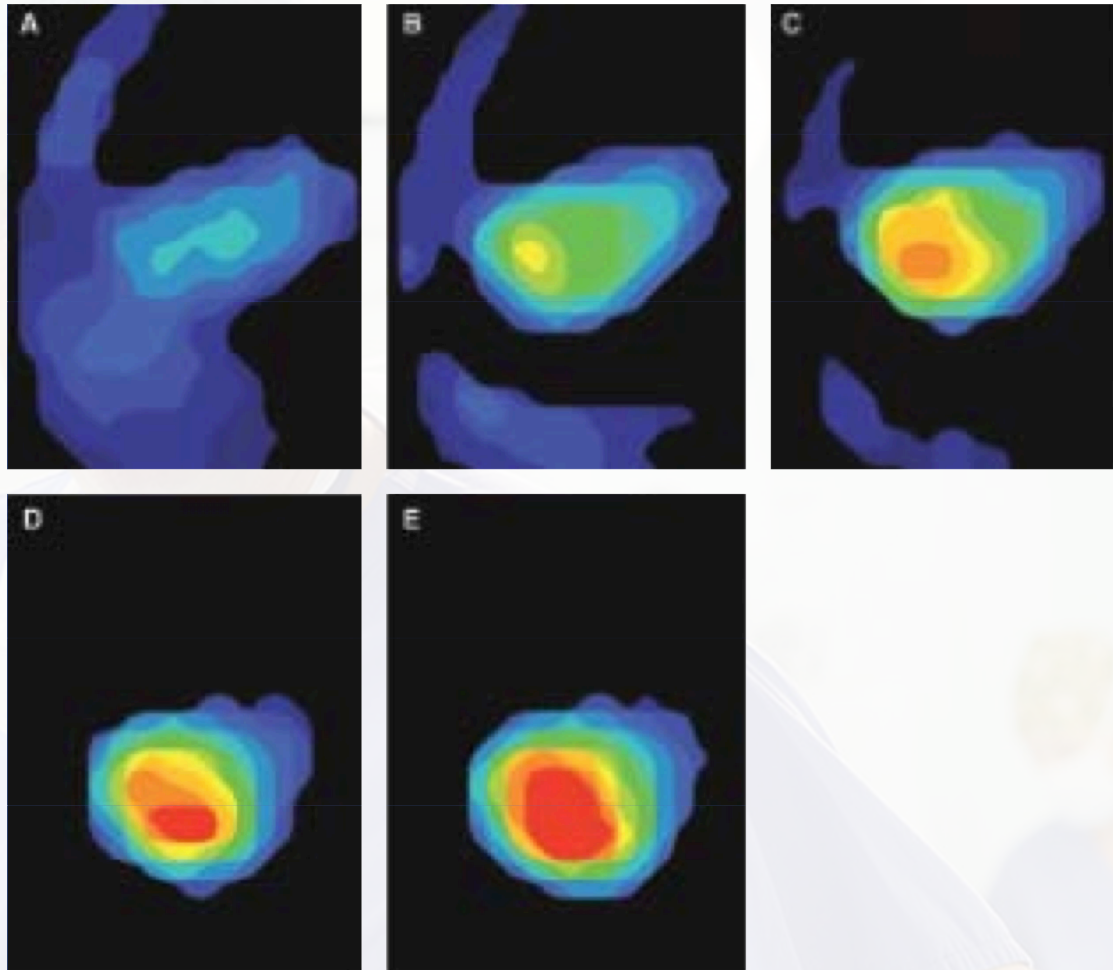
- Lateral Bears Higher %
- Lateral ~ 70%
- Medial ~ 50%



Sequential Partial Medial Meniscectomy



The American Journal of Sports Medicine Lee SJ, et al. 2006



The American Journal of Sports Medicine Lee SJ, et al. 2006

Management of Meniscal Tears

- Morphology
- Location
- Size
- Patient

1. Morphology

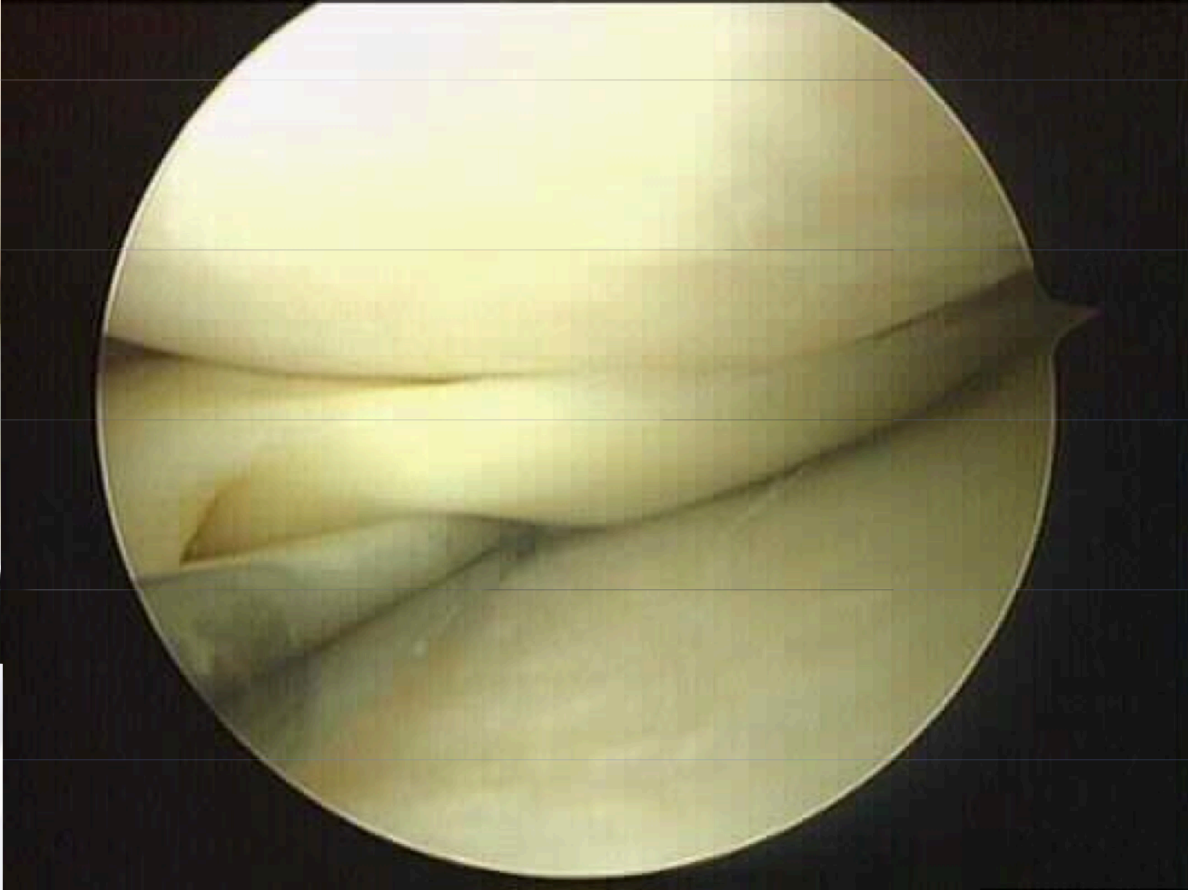
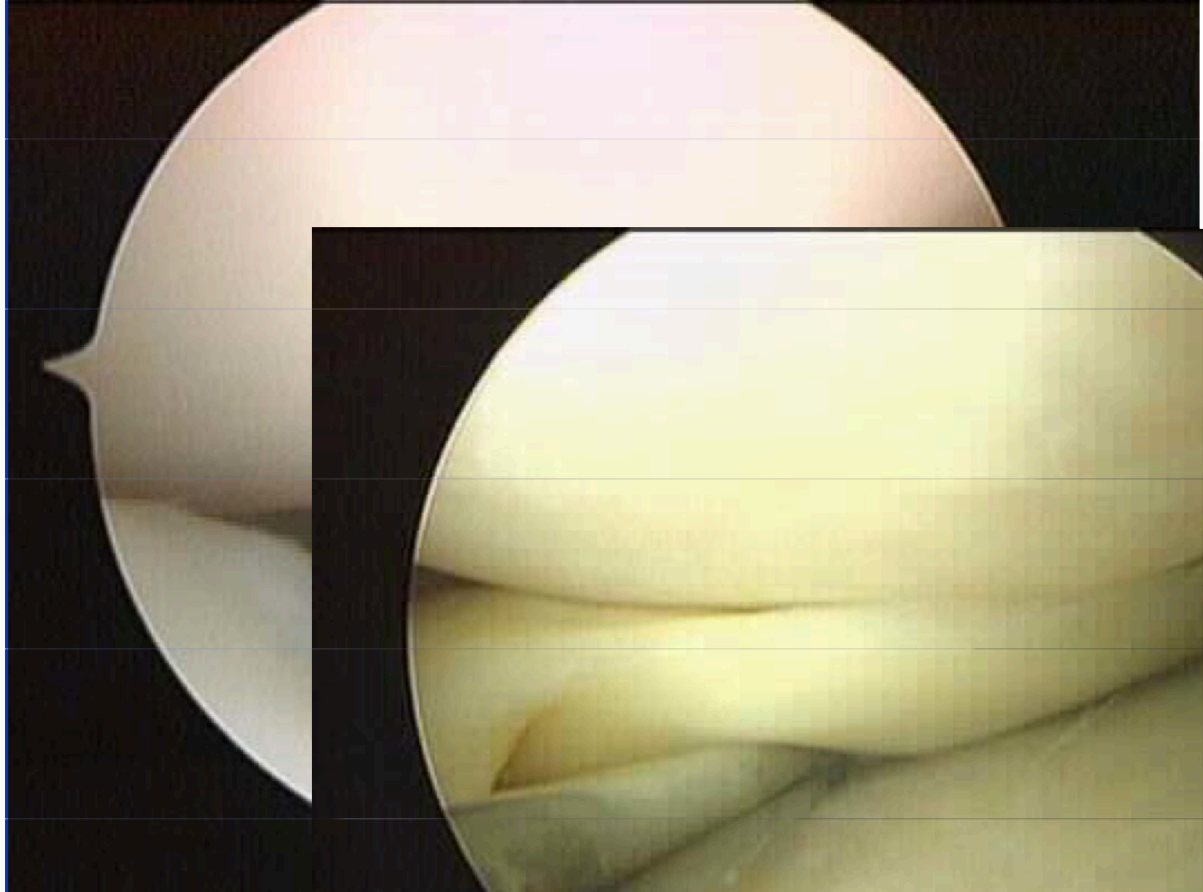
- Vertical Longitudinal
- Oblique / Flap
- Horizontal Cleavage
- Radial
- Degenerative Complex

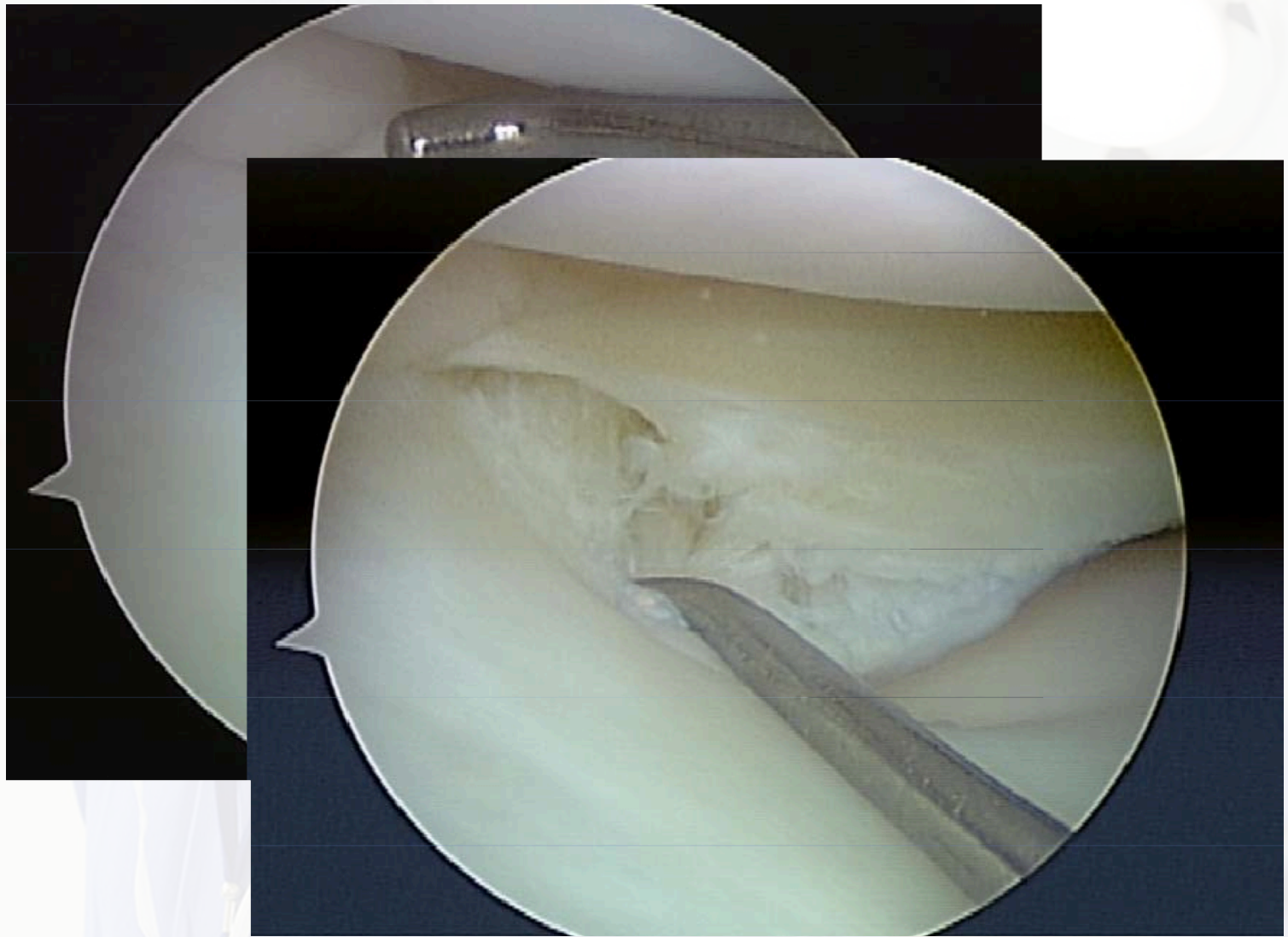
Does MRI Predict Reparability of Meniscus Tear?

- 58 Patients Who Underwent Repair Matched With:
- 61 Patients Undergoing Meniscectomy
- Two Musculoskeletal Radiologist Independently and Blindly Reviewed Pre-op MRI's

Does MRI Predict Reparability of Meniscus Tear?

- Estimation of Reparability Was Poor
 - 58.0% and 63%
 - Identical Scores 38% of Time
- Status of Inner Fragment Most Predictive
- Conclusion: MRI Not Effective or Efficient Predictor of Reparability





Contact Pressures and Radial Tears- Medial Meniscus

- Cadaveric Testing:
 - Intact MM
 - Radial Tear of 30% MM
 - Radial Tear of 60% MM
 - Radial Tear of 90% MM

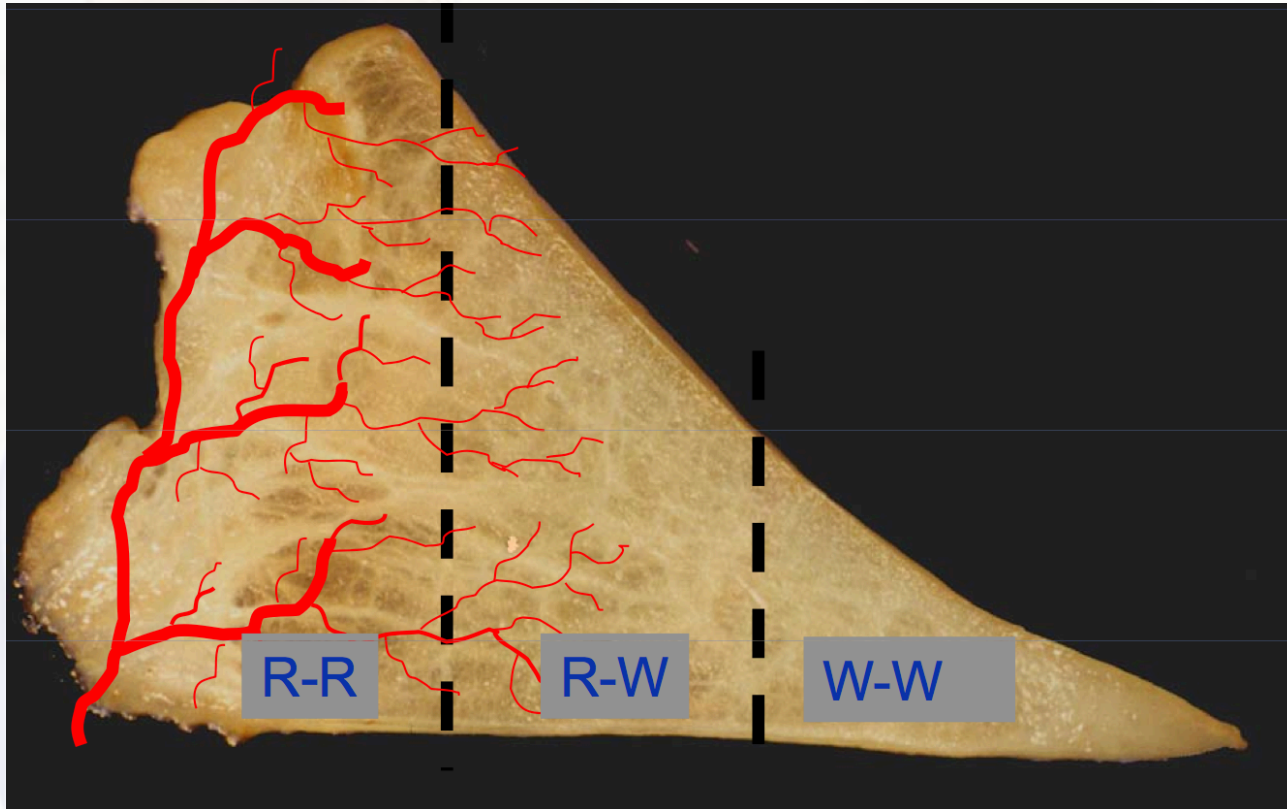
Contact Pressures and Radial Tears- Medial Meniscus

- Magnitude and Location of Peak Pressures Unaffected by Tears $\leq 60^\circ$
- 90% Tears Resulted In a Posterocentral Shift In Peak Pressure
- Meniscus Repair Did Not Restore Normal Pressures
- Meniscectomy Resulted in Further Increase in Posterocentral Pressure

2. Location

- Red/Red 0-3 mm
- Red/White 3-5 mm
- White/White >5 mm

Location (blood supply)



Red/red Red/white White/white

3. Size (Acute Tears)

- < 1.0 cm — Stable
- > 1.0 cm — Unstable

Leave

- Acute
- Small (< 1.0 cm)
- Stable
- Red/Red

Ideal Tear To Repair

- Vertical Tear
- Clean
- Red/Red Zone
- > 1.0 cm



4. “Young”

~ 40 Y/O

Acute Macrotrauma

vs.

Repetitive Microtrauma

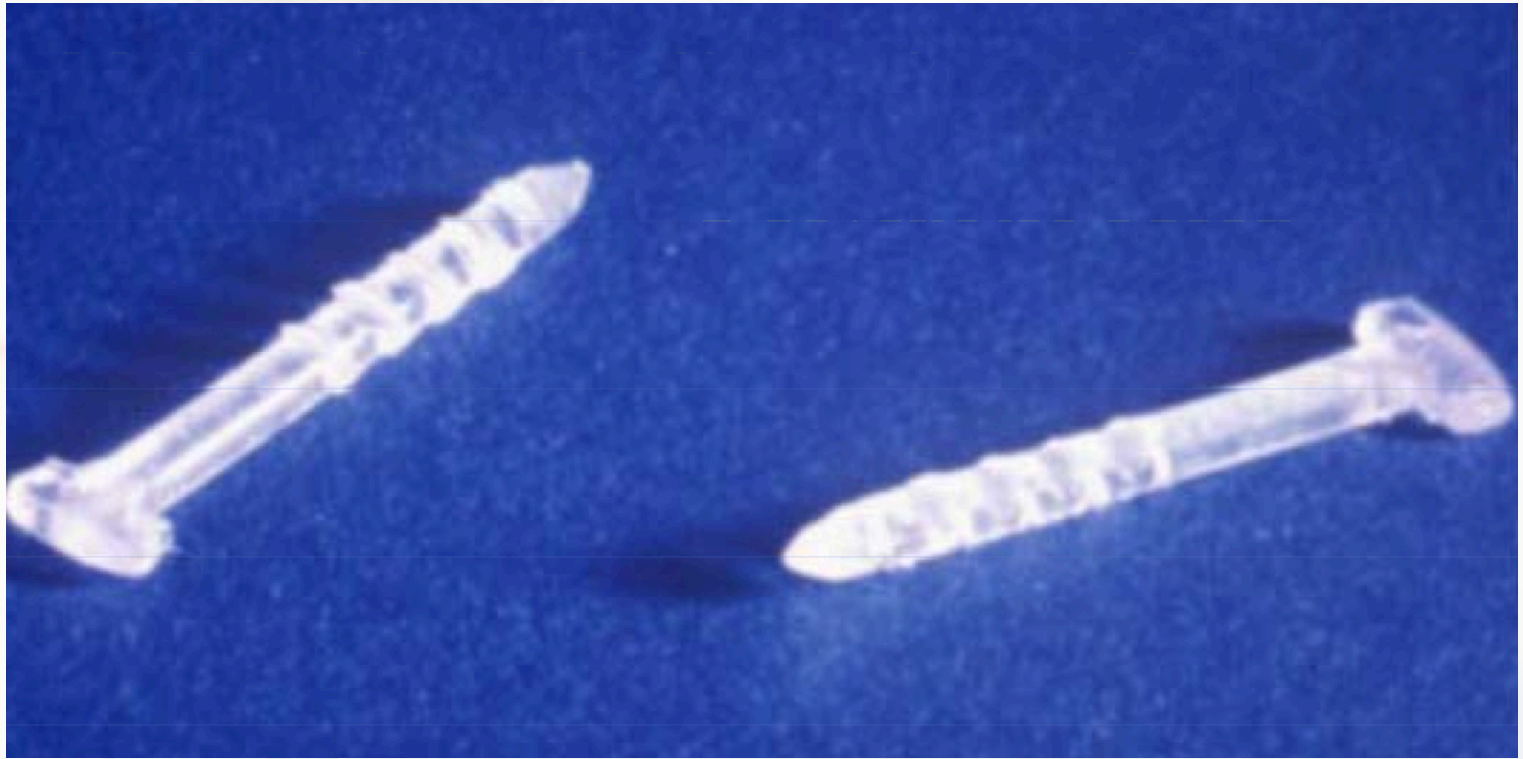
History of Arthroscopic Meniscal Repair

- 1969 the first arthroscopic meniscal repair by Hiroshi Ikeuchi (Tokyo)
- 1980 the first arthroscopic meniscal repair in North America by C.D.Henning. (Henning Inside-Out Repair)



Arthroscopic Men. Repair

- Mid-80s Acufex Double Lumen
- '93 Acufex T-Fix
- '96 Bionx Arrow



All-Inside Meniscus Repair

- 1st Generation: Headed Arrows
- 2nd Generation: Headless “Arrows”
- 3rd Generation: Suture Through the Meniscus
- 4th Generation: All Suture Repair

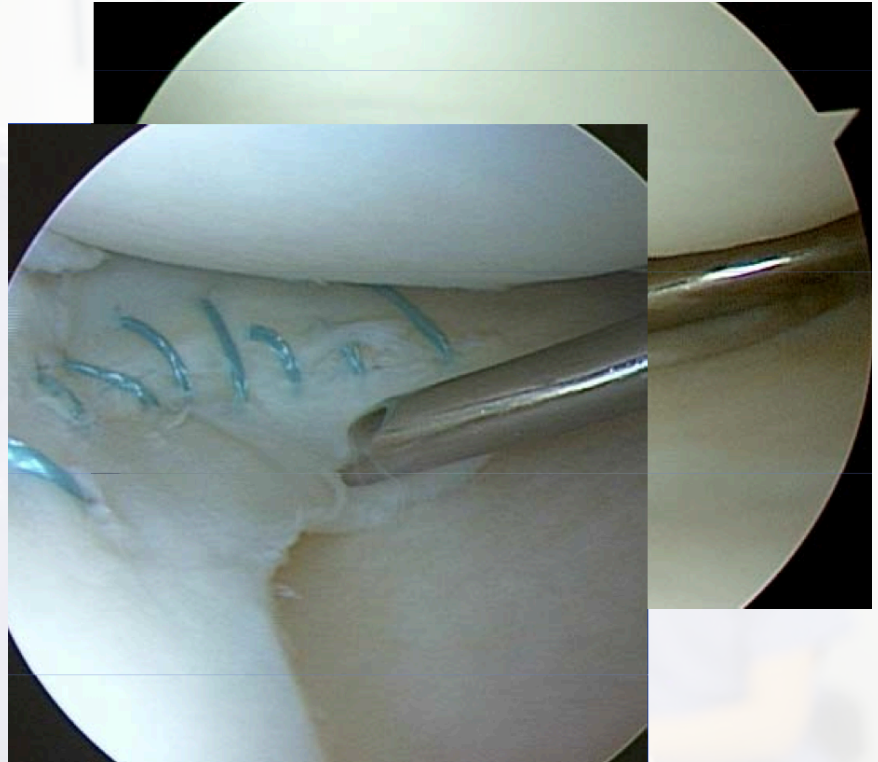
Inside-Out Sutures Are Still The Gold Standard

- Horizontal Mattress
- Vertical Mattress
- Superior Surface
- Under Surface
- Post. Horn To Ant. Third
- Red-Red & Red-White Zones

“Classic” Meniscal Repair

Vertical Suture Repair

- Inside-out
- 2-0 Non-absorbable
- 5 mm apart
- Cannula system





Mensical Repair

Meniscal Fixation

Meniscal Repair
(Inside – Out)

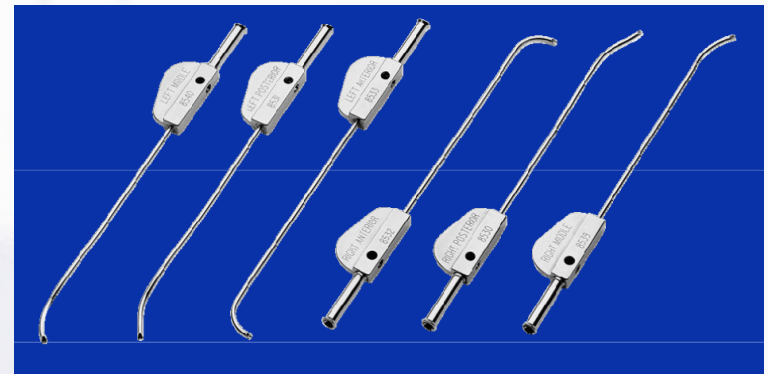
Linvatec

Mensical Repair Instruments

Inside out technique

- Zone Specific[®] II cannula
- SharpShooter[®] System
- 2-0 Polyester Braid
- Posterior incision

Linvatec



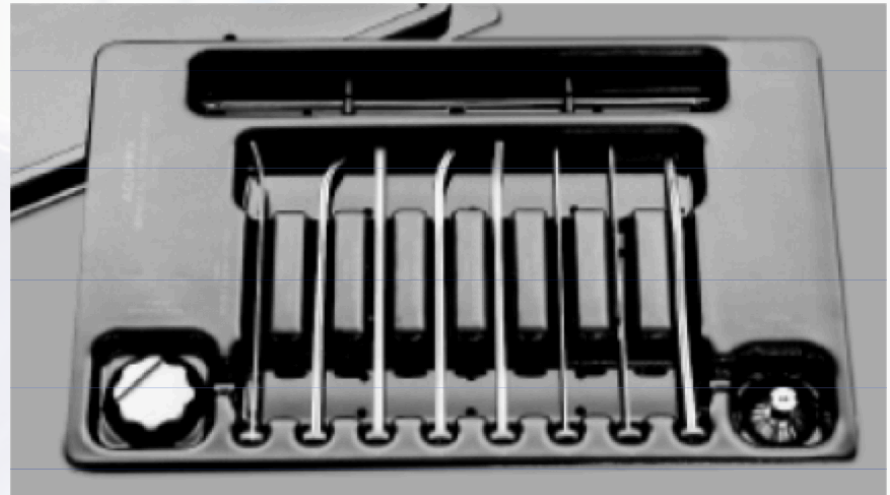
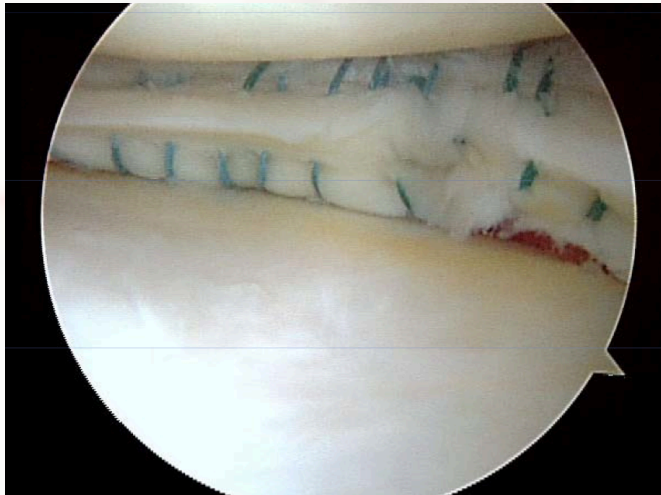
Zone Specific II Cannula System



Sharp Shooter
Soft Tissue
Repair System

Meniscal Stitcher Set

Inside-out technique



Smith & Nephew

Repair

Inside – Out

- Prepare Meniscus
- Expose Corner
- Pass Sutures
- Retrieve Sutures
- Tie Knots

Time Comps
Motion Cosmetics

FAST-FIX™ 360 Meniscal Repair System

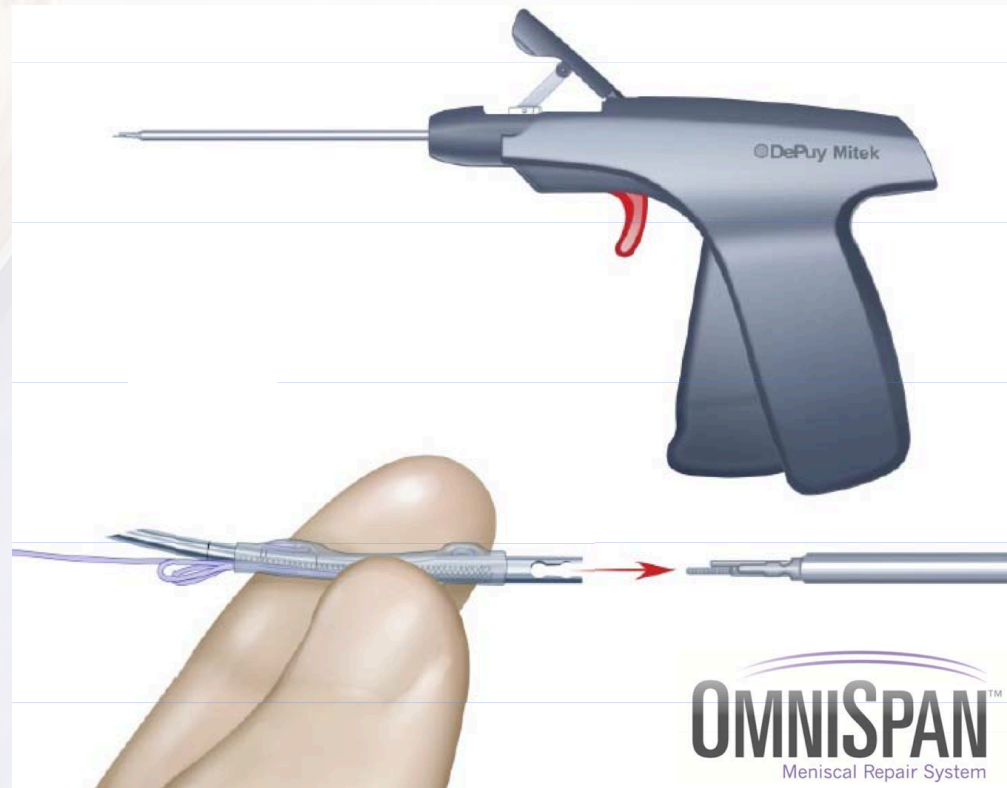


Smith & Nephew

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Surgical Technique

Open lever on applicator to expose the connection; snap on needle with slot and implants facing up; close the lever



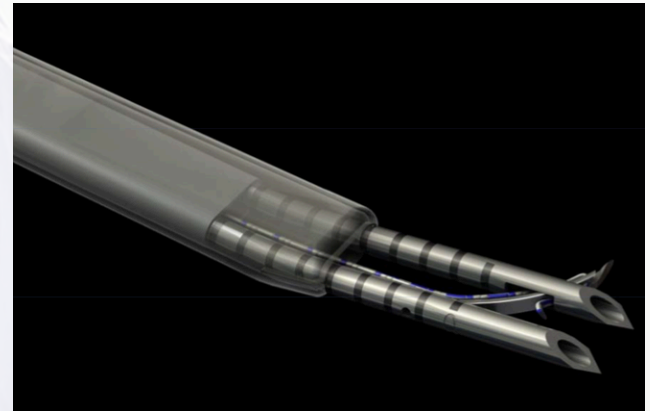
Cayenne Medical's CrossFix™

Design Rationale

Develop an all-inside device with a fast and easy technique that produces results comparable in strength and safety to open suturing methods

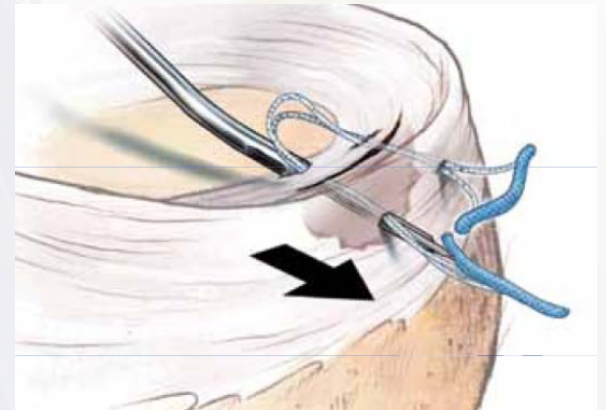
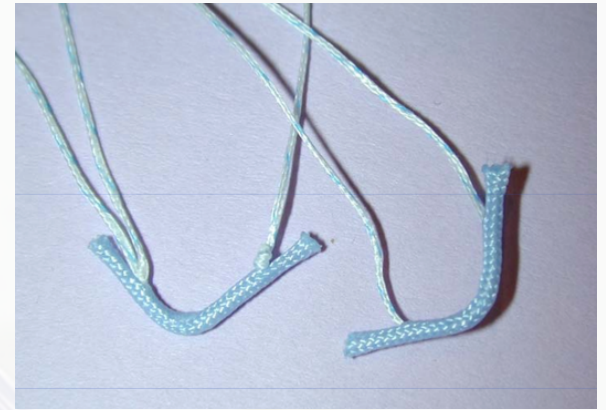
CrossFix™ Design :

- Dual needle suture passer creating 3 mm mattress stitch
- Pre-tied sliding knot for simple tear reduction
- Incorporated depth limiter controlling needle length exposure
- All suture repair
- Fast and easy technique



MarXmen (Biomet)

- MaxFire repair stitch
- #0 MaxBraid PE (UHMWPE) covered by two polyester or polyethylene sleeves
- Curved needle
- Self-locking sliding knot



FAST-FIX™ 360 Meniscal Repair System



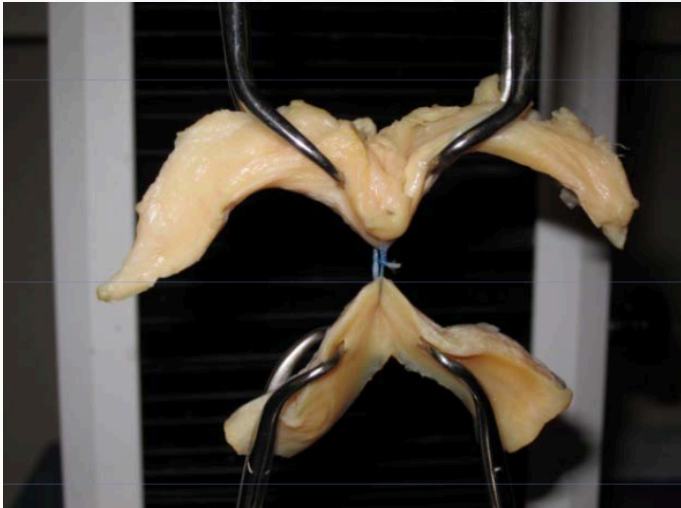
Sequent Repair Linvatec

- 6 continuous stitches
- Many possible stitch configurations
- “V”, “W”, “continuous”, “X”



Biomechanical Testing

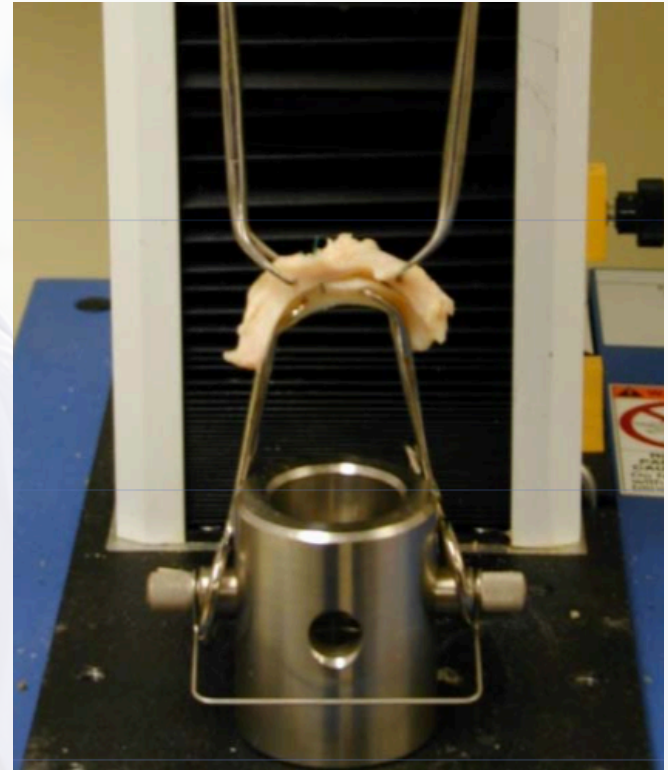
- Human meniscus
- Cyclic loading



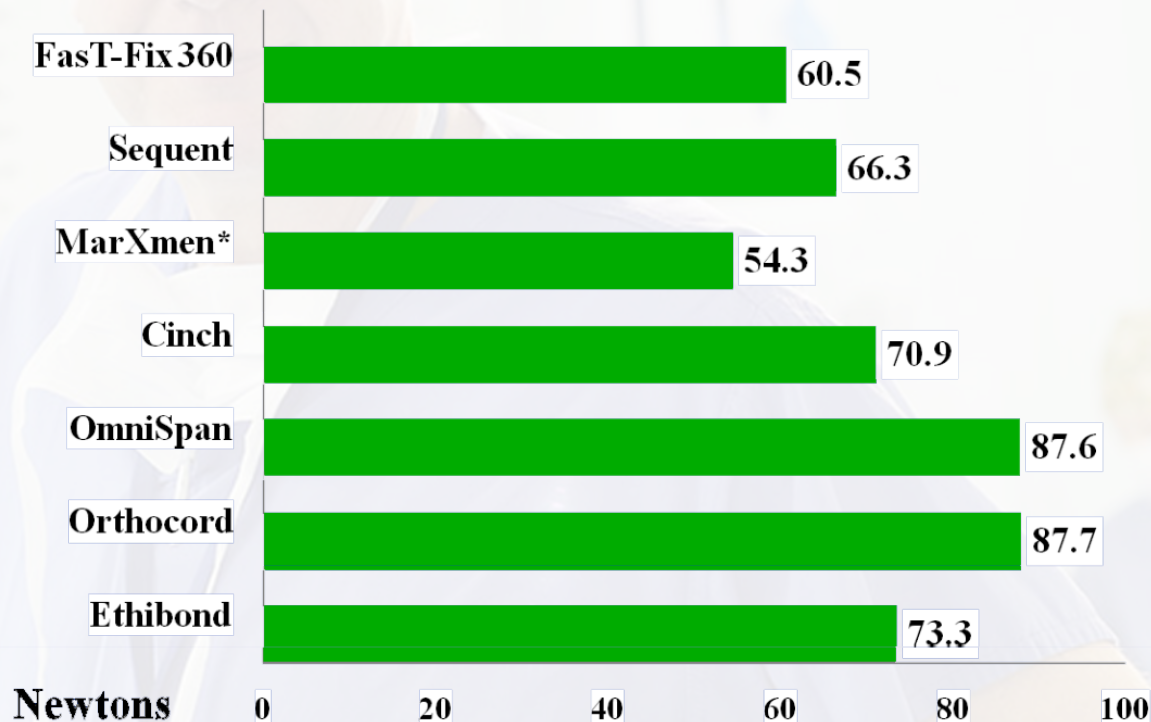
Alan Barber

End Points

- Maximum failure load
- Cyclic displacement
- Stiffness
- Failure Mode



Load to Failure Testing Cyclic Load (Human Meniscus)



MarXmen lower than Ethibond $p=0.03$

Single/Double Pass All-Inside

- Only Useful For the Posterior 1/3 to 1/2 of the Meniscus
- Need A Strategy For the Anterior Half



My Technique/ Anterior Tear

Outside-In Technique
(The Platinum Standard)

Repair

Outside - In:

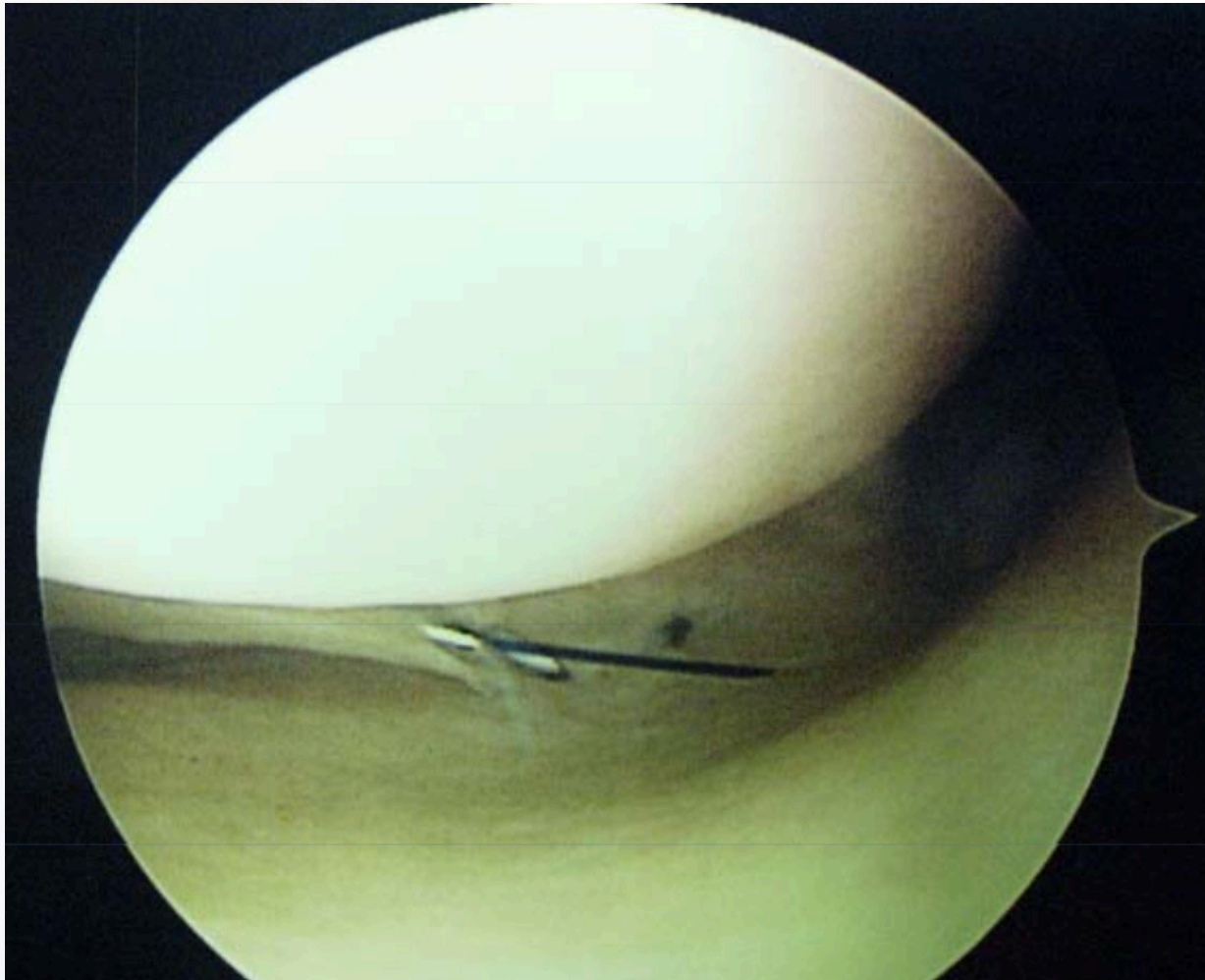
- 18g Needle x 2
- 0-PDS
- 3-0 Wire
- 5.5 mm Scope Cannula
- Grasper

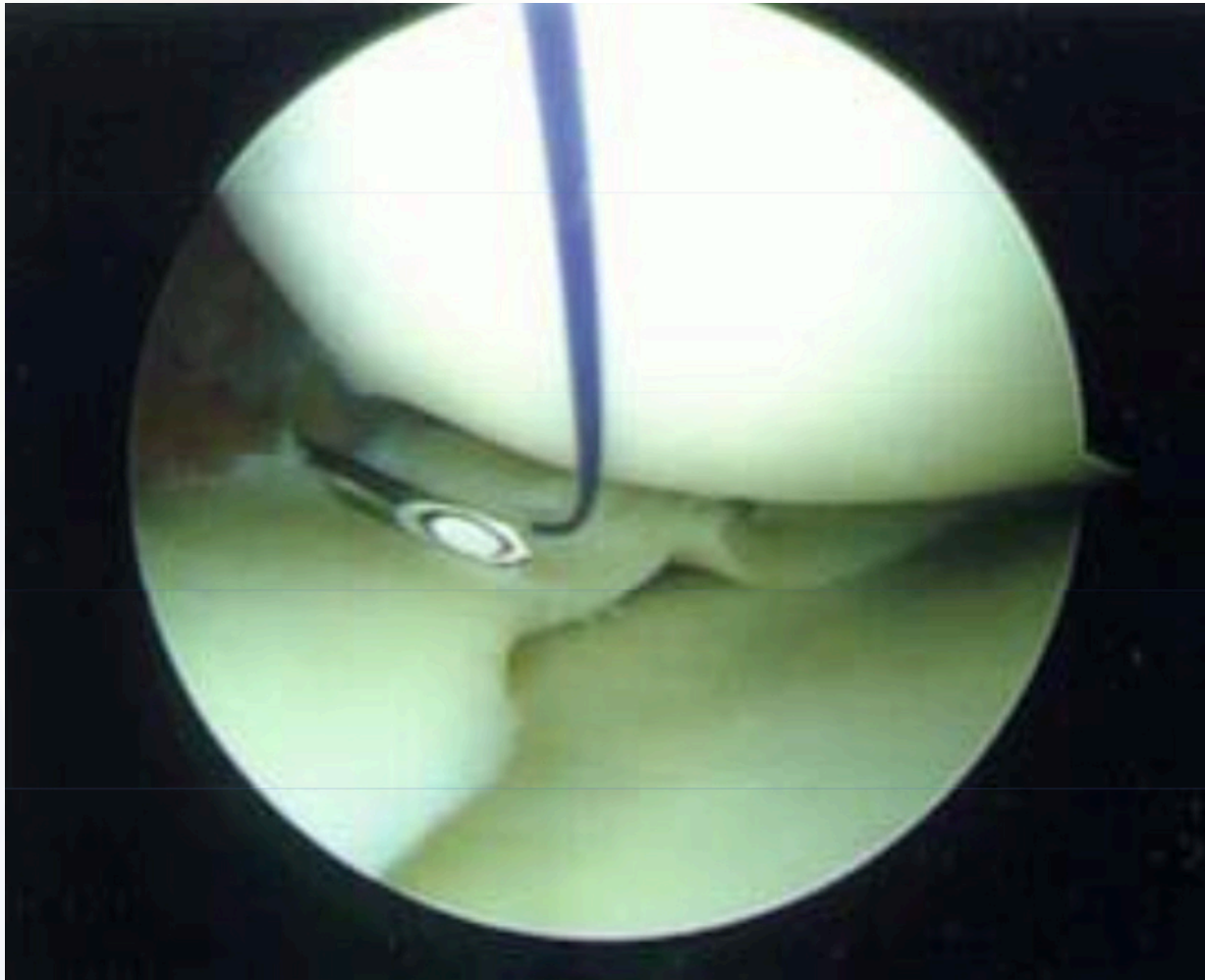


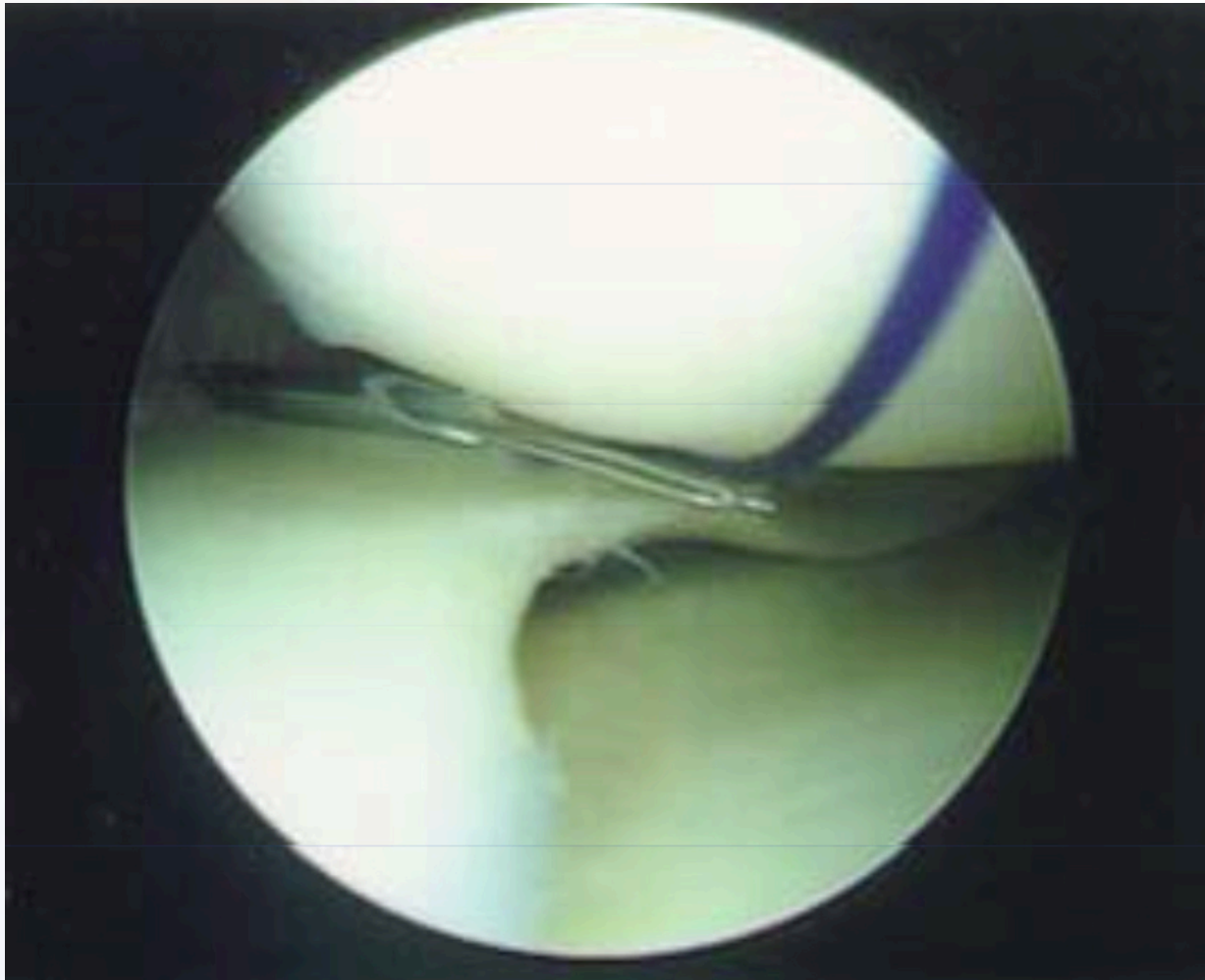


Outside-In Technique

- Prepare Meniscus
- Pass 18g Needle
- Pass Suture (0-PDS)
- Retrieve Suture



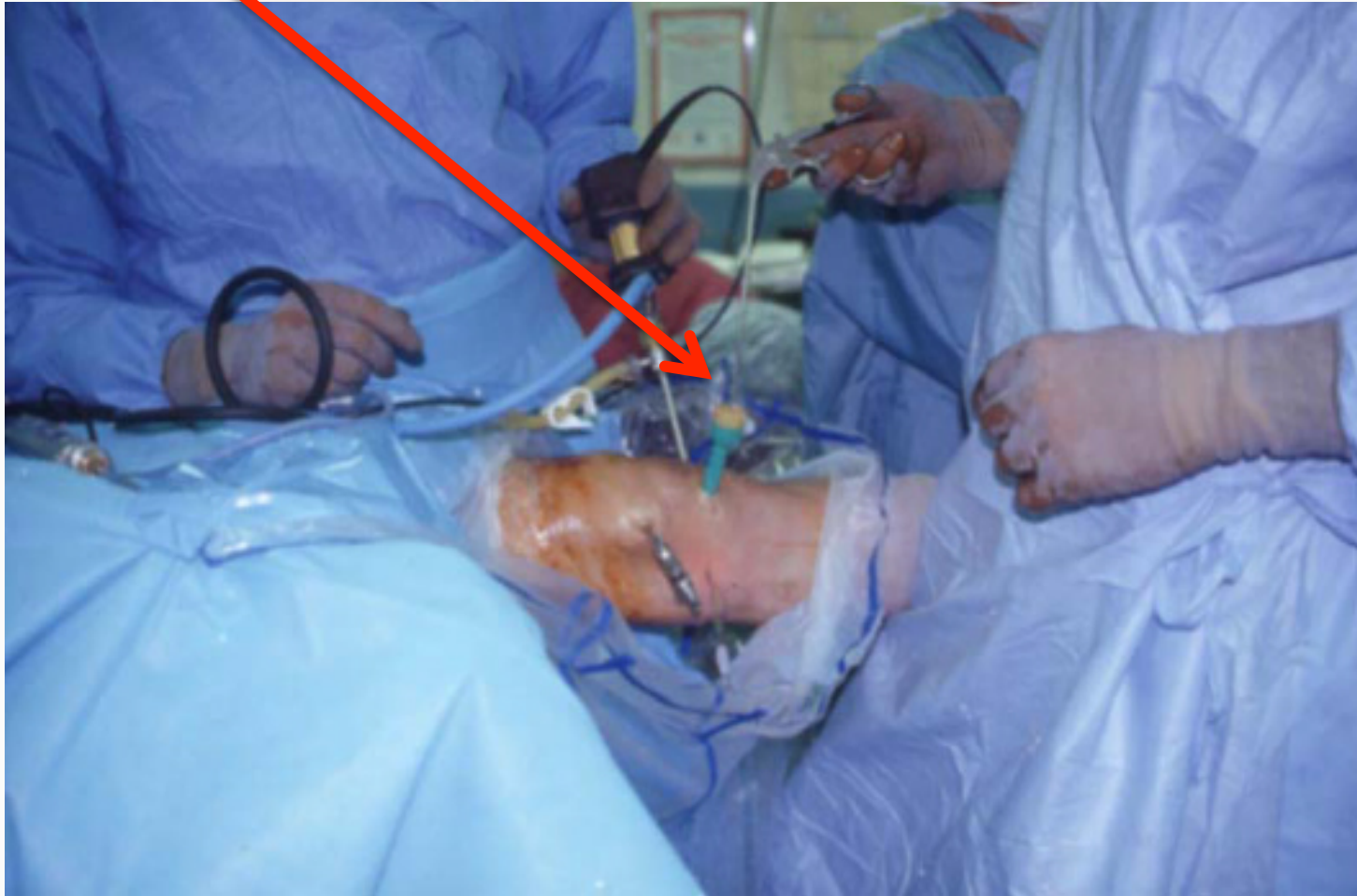


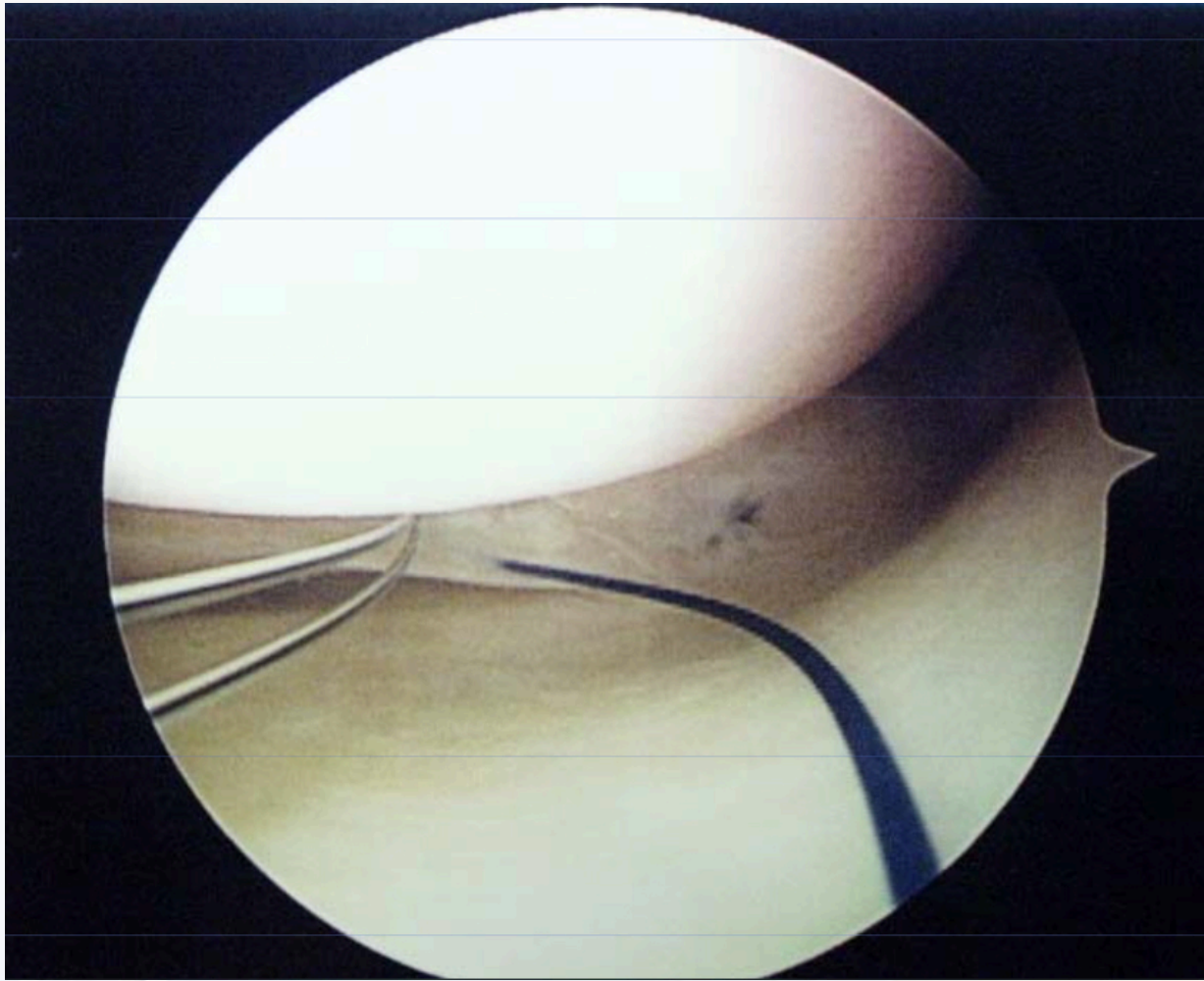


Outside-In Technique

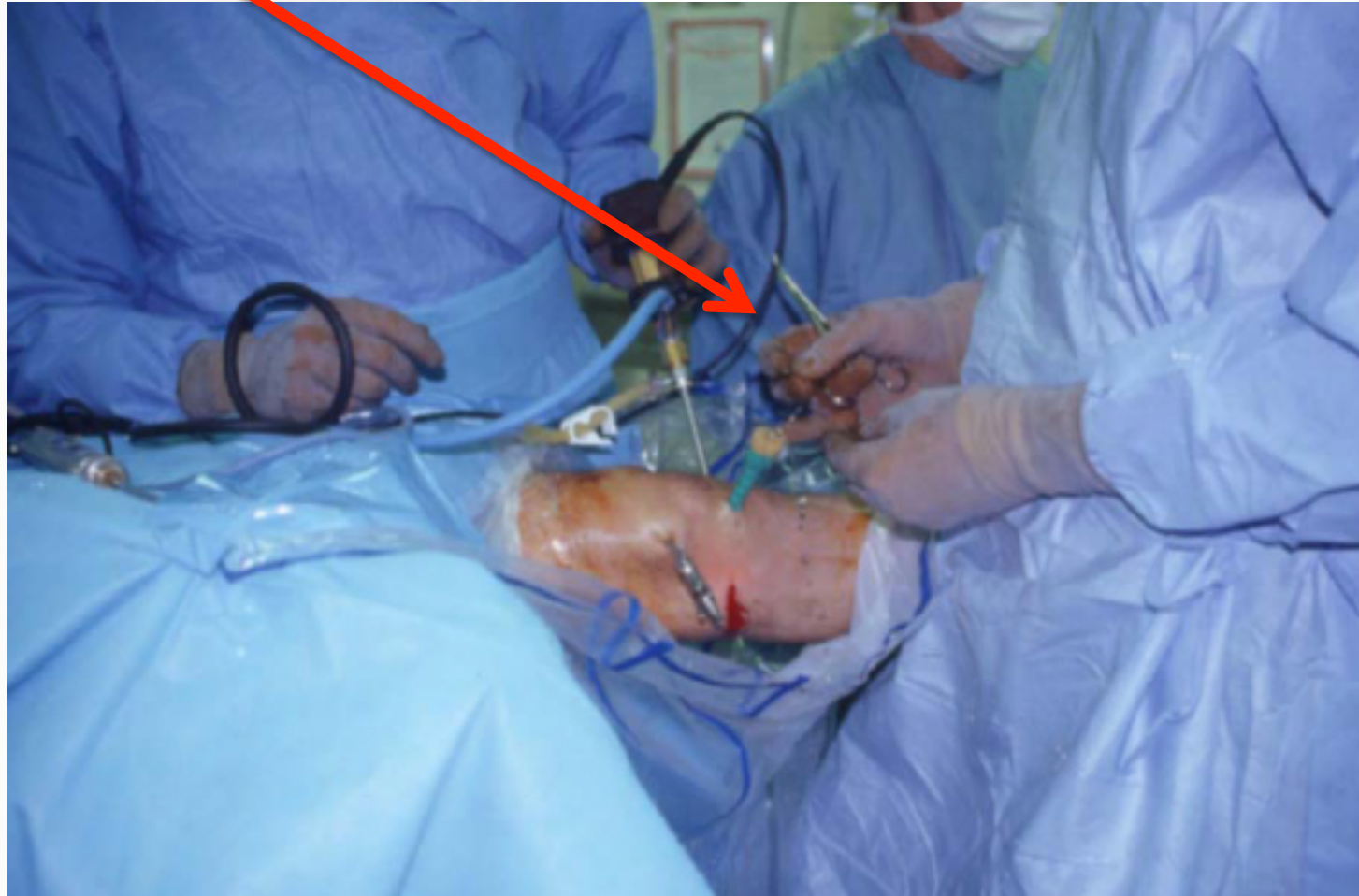
- Pass 18g Needle
- Pass Loop (3-0 Wire)
- Retrieve Loop
- Suture In Loop

Grasping the wire





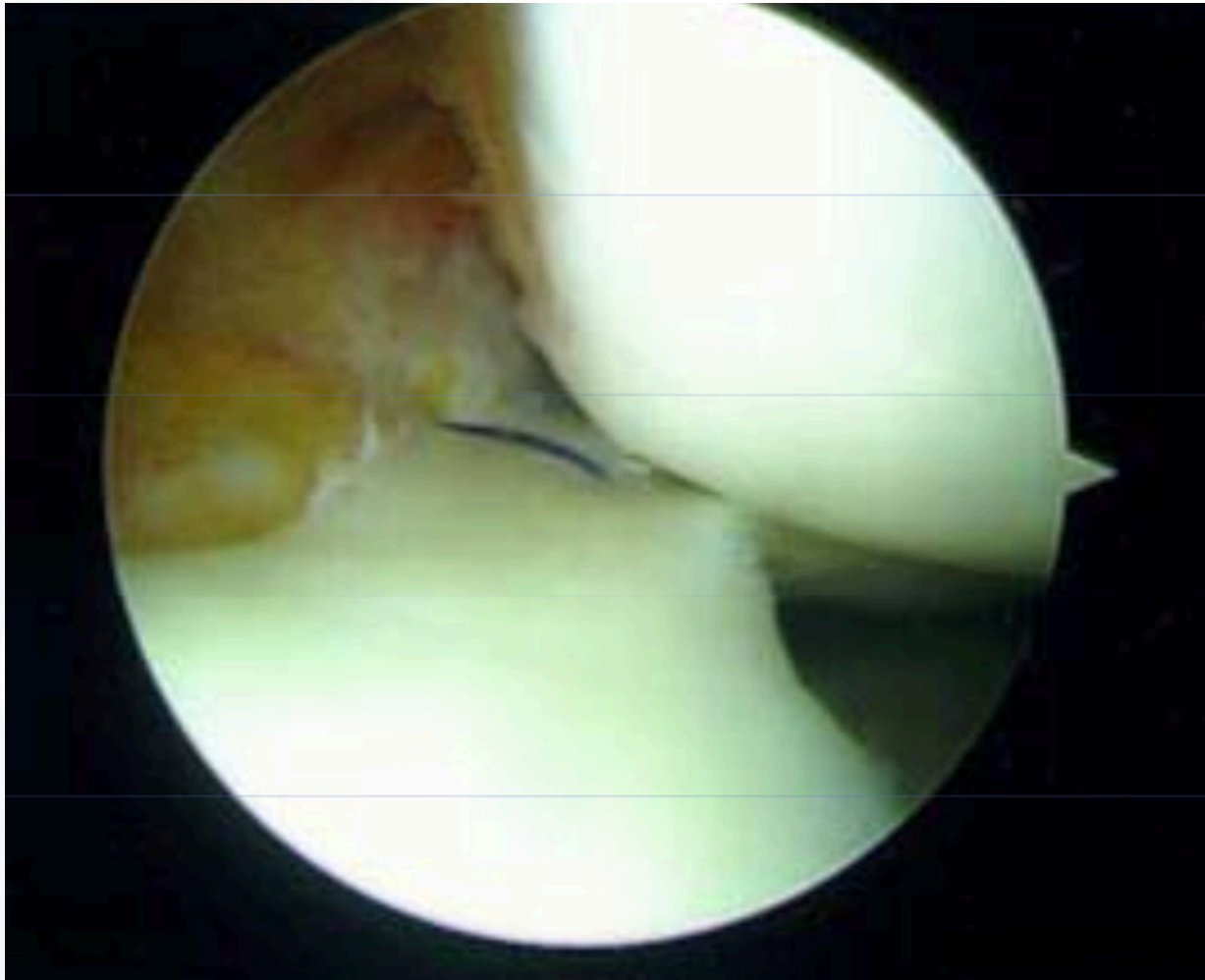
Suture passed through wire loop

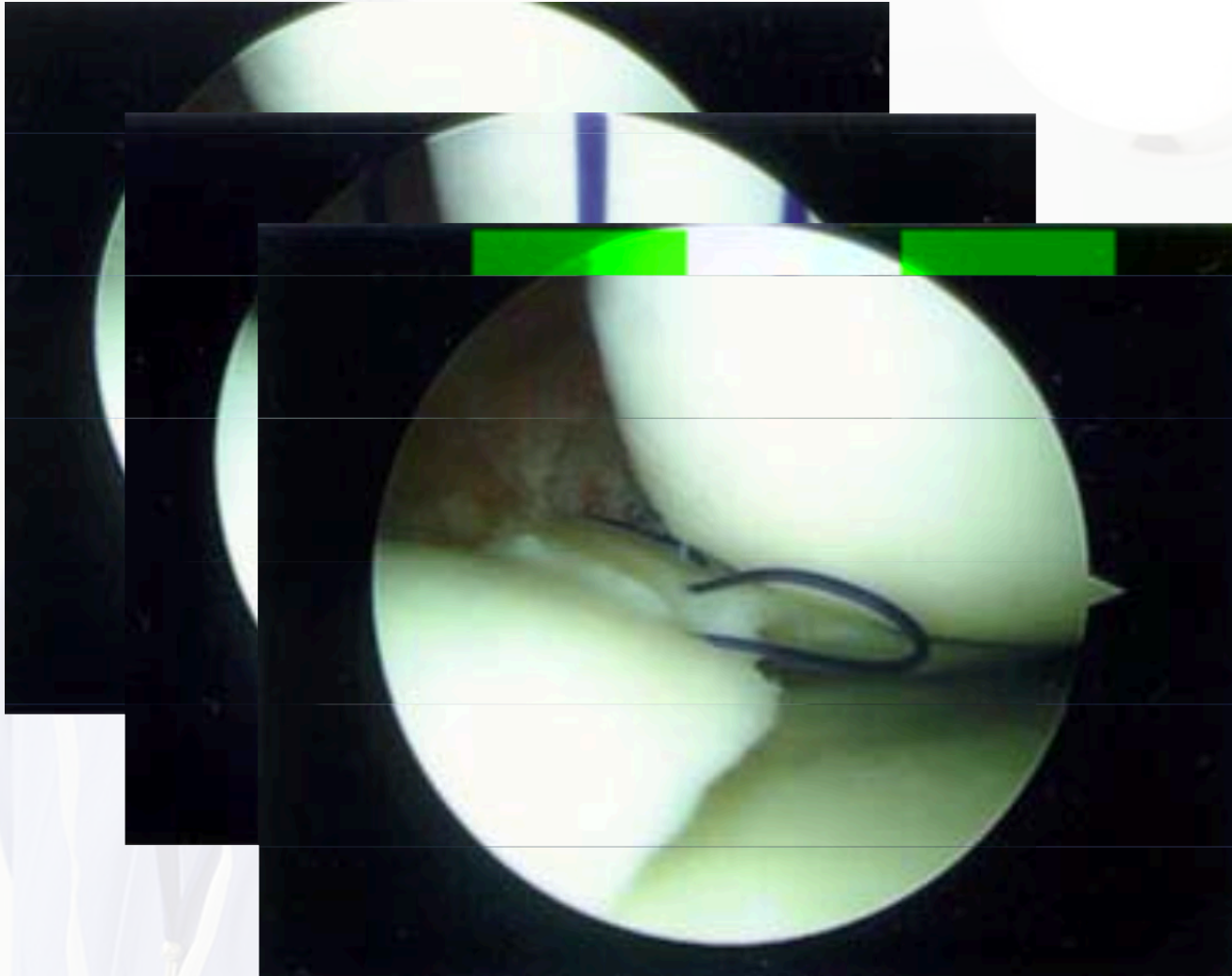


Repair

Outside - In:

- Suture & loop back out meniscus
- Tie over capsule

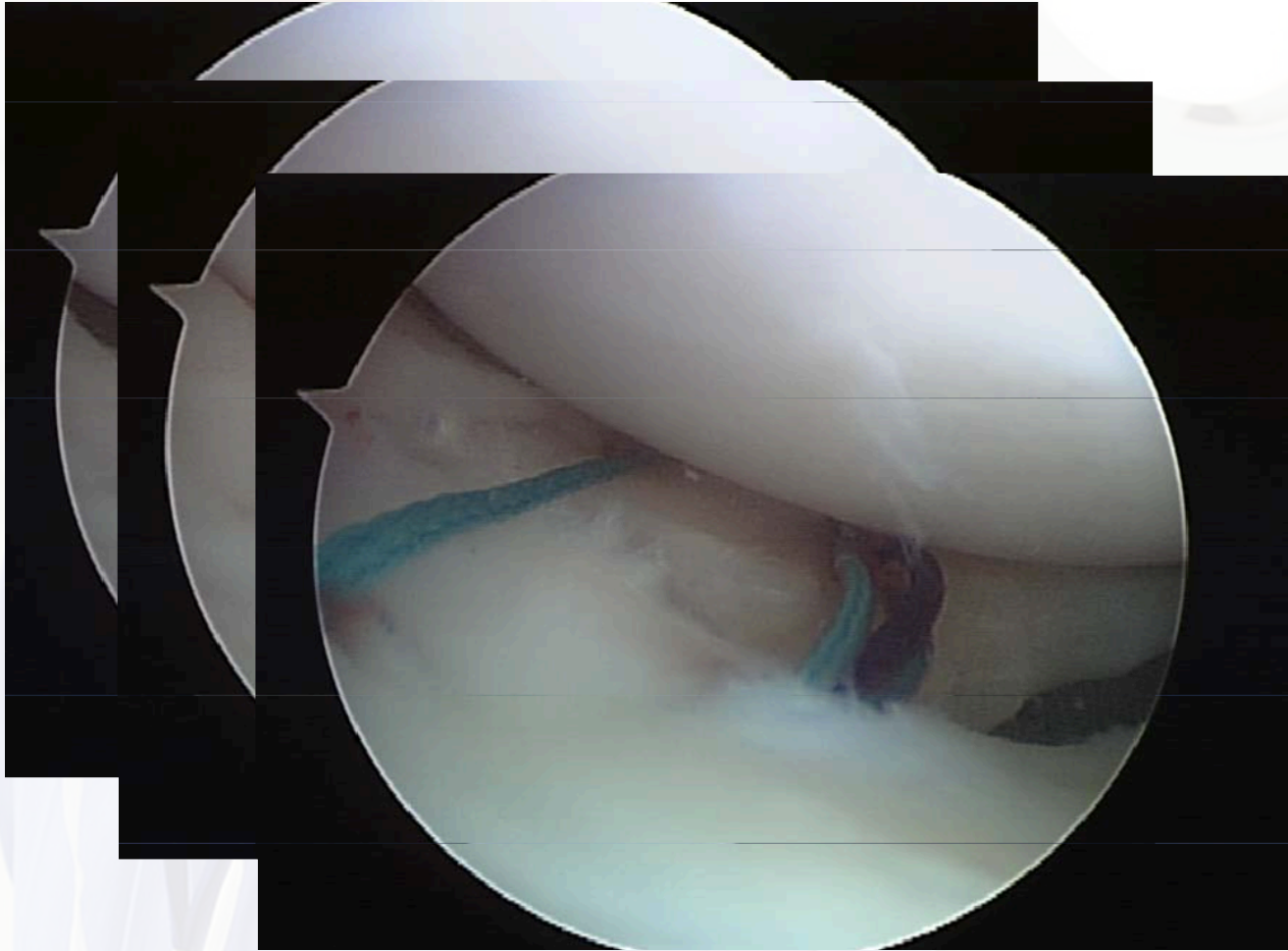






With a crochet hook, pull both sutures of the set

Tie each suture set against the capsule through one exit puncture



Repair of LM Radial Tears

- 14 Consecutive Patients With Radial Tear of Mid-third of LM
- All Tears To or Through R/W Zone
- Repairs Via All-Inside Technique

Repair of LM Radial Tears

- F/U Av 36 M
- MRI and/or Second Look
 - Healed 36%
 - Partially Healed 57%
 - Not Healed 7%

Repair of White/White Meniscus Tears

- 87 Patients Av Age 26 (13-54)
 - NI ACL
- Failure = Reoperation
- F/U Av 49 m (10-112)
- 28 Pats Required Repeat Sx.
 - Success Rate = 68%

Meniscus Repair vs. Meniscectomy

- Osteoarthritis Progression:
 - Repair 19.2%
 - Meniscectomy 60% (SS)

Meniscus Repair vs. Meniscectomy

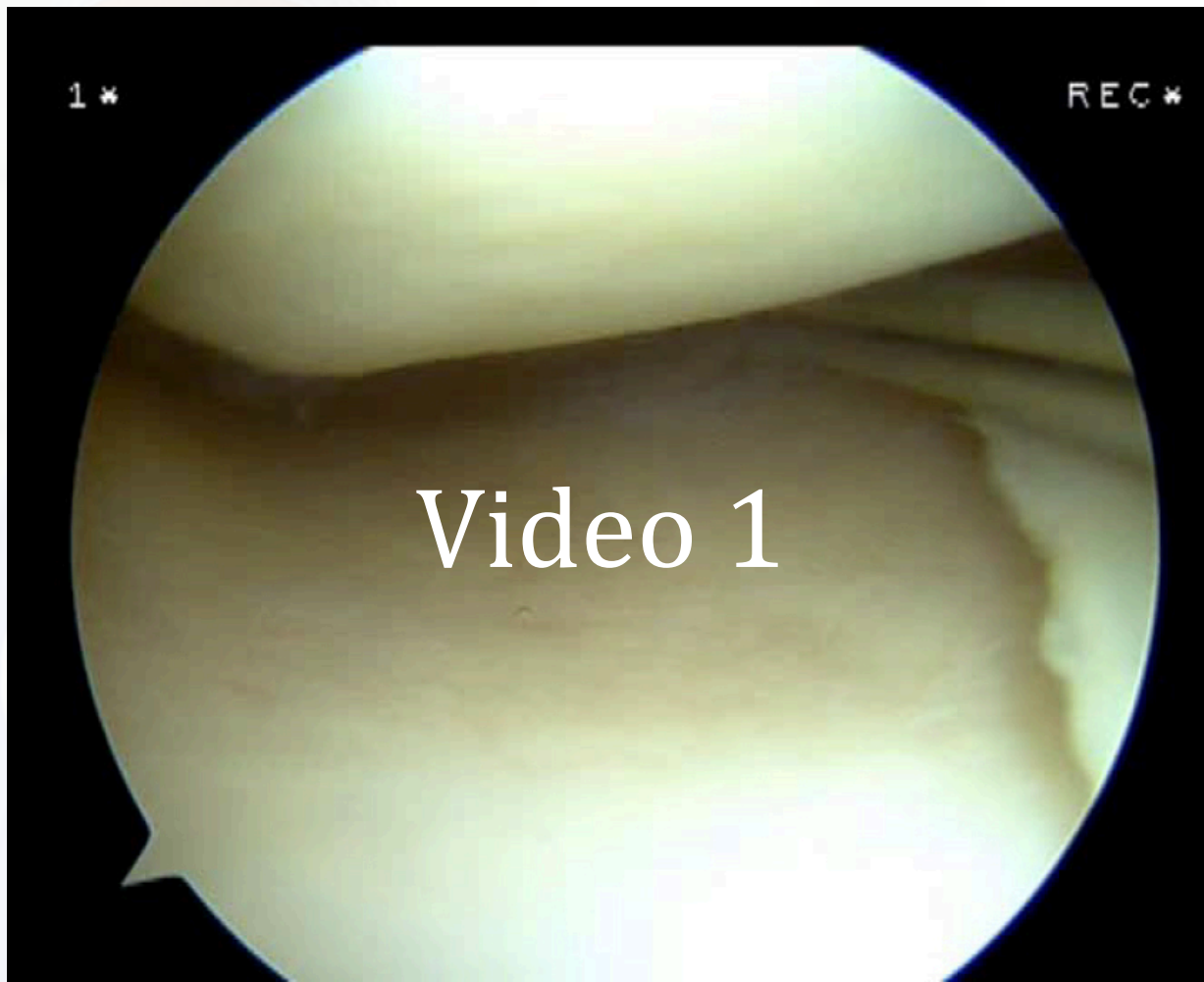
- Pre-injury Activity Level:
 - Repair 96%
 - Meniscectomy 50%

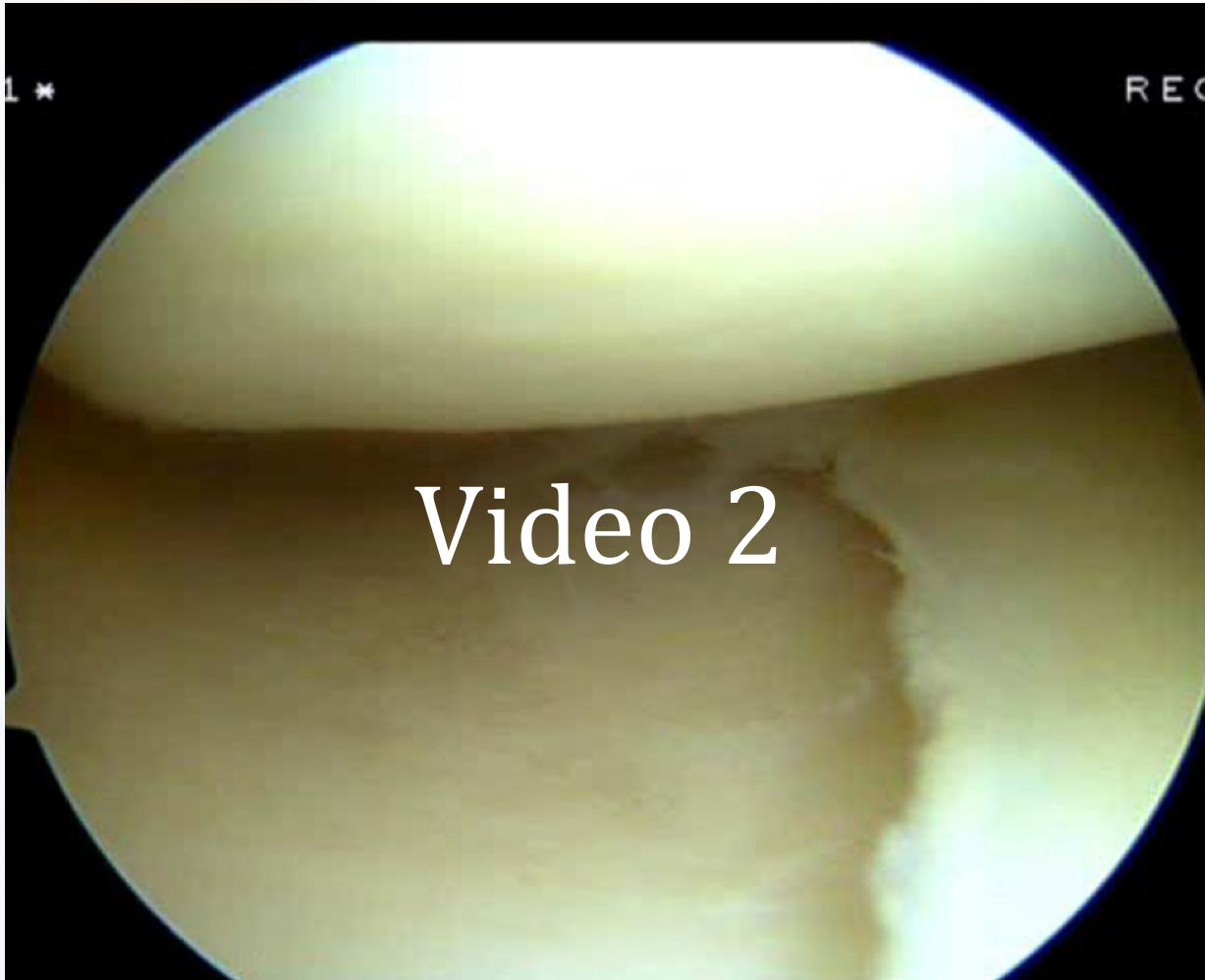
Meniscus Repair vs. Meniscectomy Re-operation Rates

- Literature Review
- Short Term:
 - Meniscectomy: 1.4%
 - Repair: 16.5%
- Long Term:
 - Meniscectomy: 3.9%
 - Repair: 20.7%

My Approach to Meniscus Repair:

- #1: Get a View
 - MCL Relaxing Procedure
- Prepare the Synovium With a Rasp Above and Below the Meniscus





Video 2



Video 3

My Approach to Meniscus Repair:

- Posterior Horn-Post 1/3: All-Inside
 - With a Posterior 1/3 LM, Be Aware of the N/V Bundle Which is Posterolateral

My Approach to Meniscus Repair:

- Mid- 1/3: All-Inside or Inside-Out
 - Inside-Out Doesn't Require a Safety Incision
 - Inside-Out Avoids Oblique Angle of Attack With All-Inside Techniques

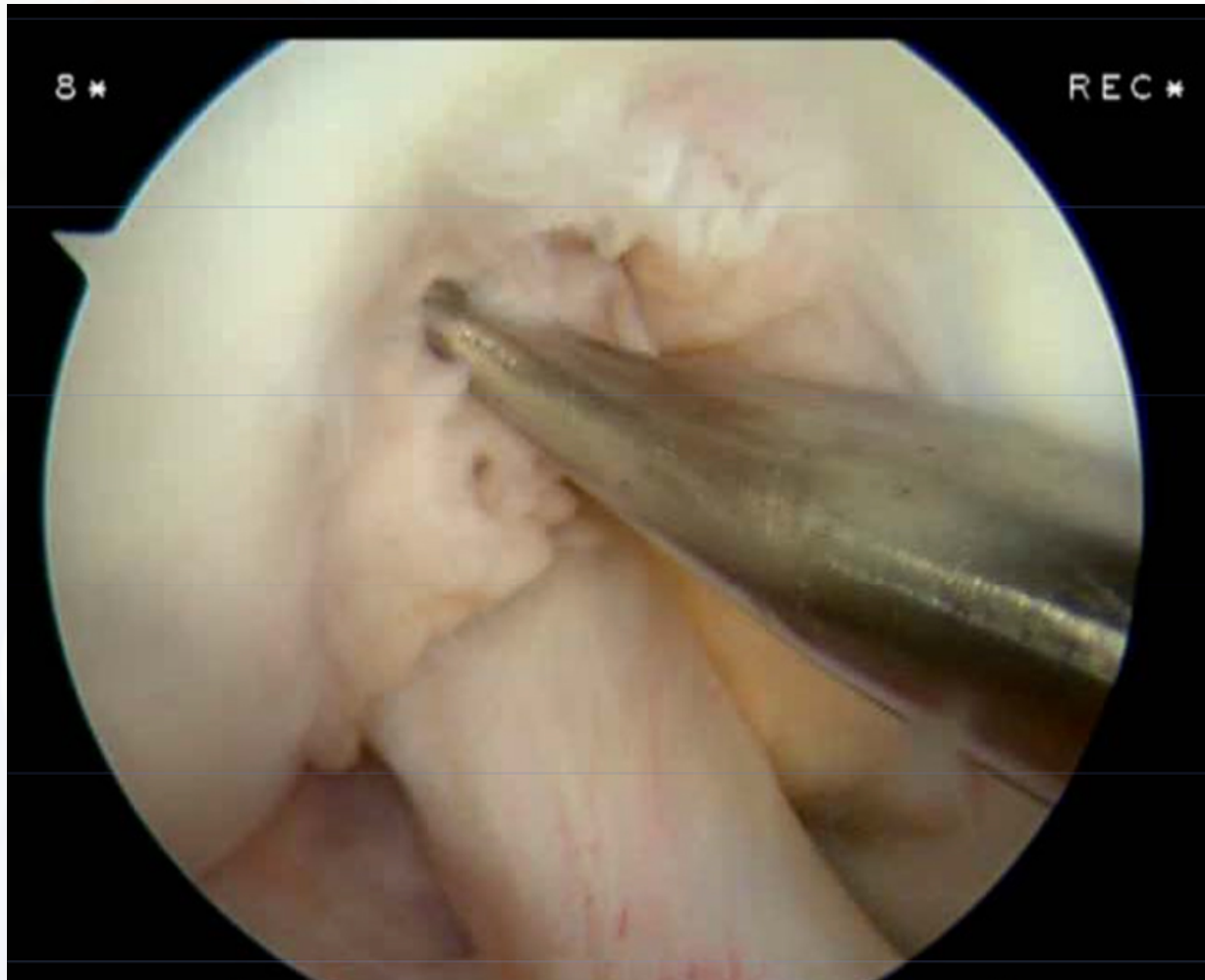


My Approach to Meniscus Repair:

- Anterior 1/3: Outside-In:
 - Easy
 - Quick
 - Cheap
 - Effective

My Approach to Meniscus Repair:

- Without ACL Reconstruction:
 - Microfracture Tool
 - Holes (4-6) in Intercondylar Notch Anterior to ACL
 - Promotes Bleeding and Marrow Elements to Fill the Gap of the Meniscus Repair





Posterior Root Tears and Associated Pathology

- 50 Patients Mean Age 36.5
- (Prevalence of 7.6%)
- 60% With Repair
- ACL Tear in 60% of Patients
- Patients With LMRT 10X More Likely to Have an ACL Tear
- Patients With MMRT 8.5X More Likely to Have a Chondral Defect (\geq Grade II)

Suture vs. FasT-Fix MR With ACLR

- 60 Patients: ACLR With Hamstring
- MMR Suture 35, FasT-Fix 25
- F/U Mean 47 M
- Functional Outcomes Equal
- Knee Stability Equal
- Suture:
 - Asymptomatic 86%
 - MRI
 - 74% Healed
 - 9% Partially Healed
 - 17% Not Healed
- FasT- Fix:
 - Asymptomatic 80%
 - MRI
 - 64% Healed
 - 24% Partially Healed
 - 12% Not Healed

LM Posterior Horn Radial Tear Repair

- 15 Patients (All With Associated ACLR)
- Repair With FasT-Fix
- F/U Mean 24 M
- Clinically Healed In 100%
- No Effusions or JLP
- 2nd Look: 87% Healed (\geq Partial)

Repair of Horizontal Cleavage Tears (HCT)

- Lit Search English Language
- HCT's Using Any Method
- Failure Defined as Reoperation
- 9 Articles 98 Repairs
- Success Rate 78%

All-Inside vs. Inside-Out Vertical Mattress Suture Repair

- 72 Porcine Menisci
- Omnispan and Fast-Fix 360 vs.
- Orthocord 2-0 and Ultrabraid 2-0
- All-Inside Comparable to Inside- Out
Even After 100,000 Cycles

Meniscus Root Tears



From: Sewick, Kelly and Kelly '13

Suture Anchors vs. Transtibial Sutures

- Porcine Tibiae
- Intact MM vs. Transtib vs. Anchor
- Cyclic Loading and LTF Tests
- Both Repairs < Intact
 - Displacement
 - LTF
- Anchor > Transtib
 - Displacement
- LTF Equal

Root Tear vs. Root Repair vs. Total Meniscectomy vs. Meniscal Transplant vs. Transplant With MCL Release

- Cadaveric Study
- Intact MM vs. Test Conditions
- 0°, 30°, 60°, 90°
- Contact Area and Peak Pressure

Root Tear vs. Root Repair (RR) vs. Total Meniscectomy vs. Meniscal Transplant (MT) vs. Transplant With MCL Release

- Contact Pressure
 - No Differences at 0°
 - 30° and 60°
 - RR > Tear
 - MT > Total Meniscectomy
 - Intact > RR and MT

Root Tear vs. Root Repair (RR) vs. Total Meniscectomy vs. Meniscal Transplant (MT) vs. Transplant With MCL Release

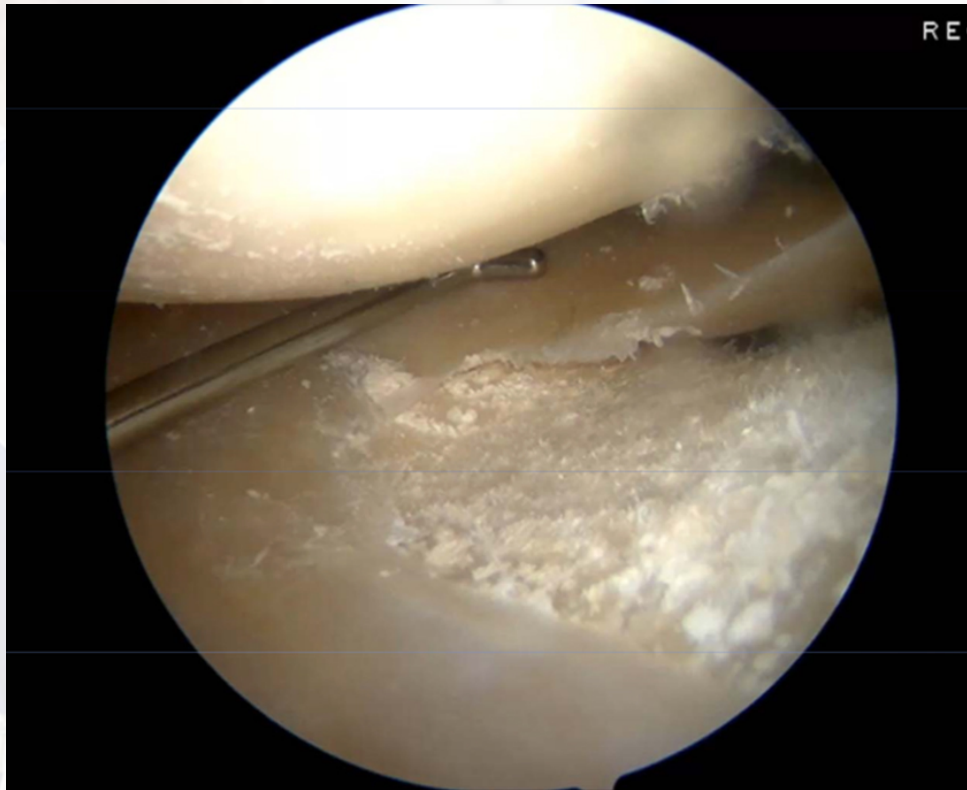
- Contact Area
 - Intact > Total Meniscectomy at all angles
 - MT > Total Meniscectomy at all angles
 - RR > Root Tear at 60°
 - Intact > RR at 60° and 90°
- MCL Release added to MT had No Impact

Root Repair Results

- Jung et al AJSM '12
 - 13 Patients
 - MRI at 6 Months 50% Healed
- Kim et al Arthroscopy '11
 - 30 Patients
 - MRI Complete Healing in 56.7%, Partial in 36.7%
- Seo et al AJSM '11
 - 11 Patients
 - Second Look Arthroscopy
 - Healed in 36.4%
 - Lax Healing in 45.5%

Root Repair: Step 1

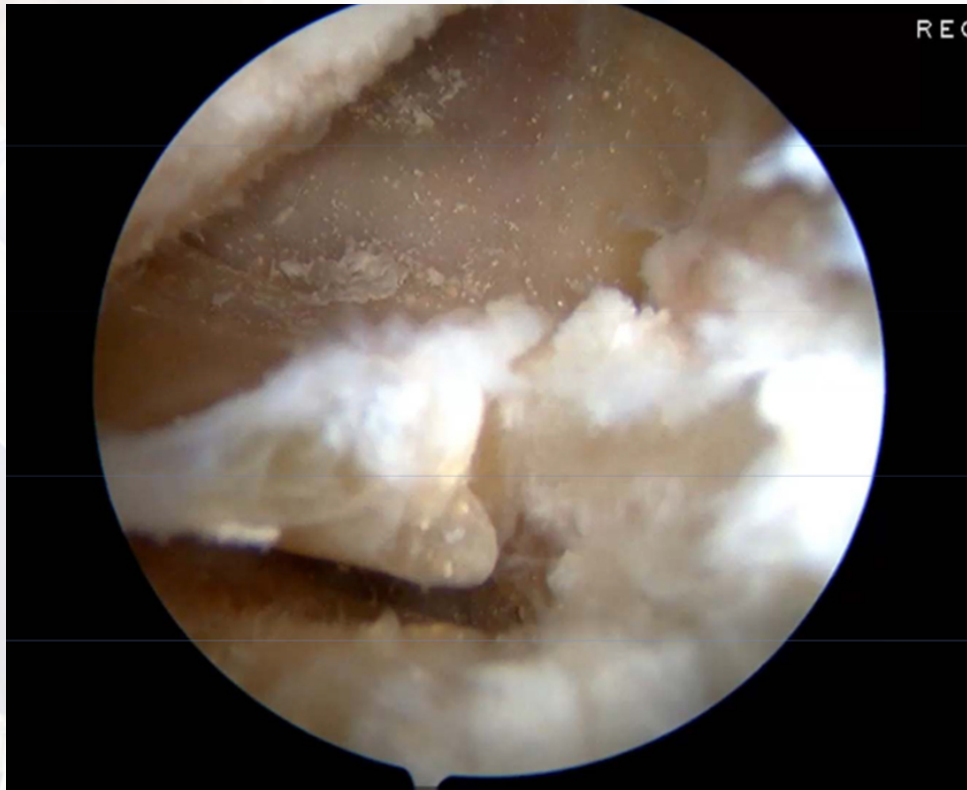
Evaluate the Meniscus and Tear



Root Repair: Step 2 Prepare the Tibial Hole

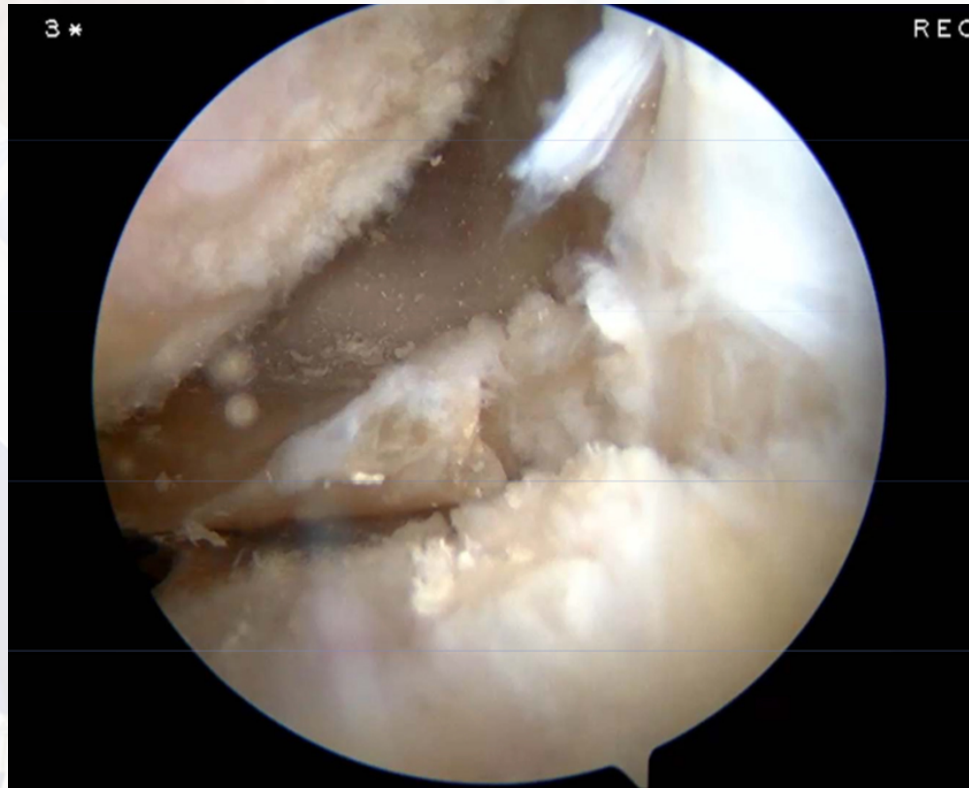


Root Repair: Step 2 Prepare the Tibial Hole



Root Repair: Step 3

Pass a Shuttle Suture

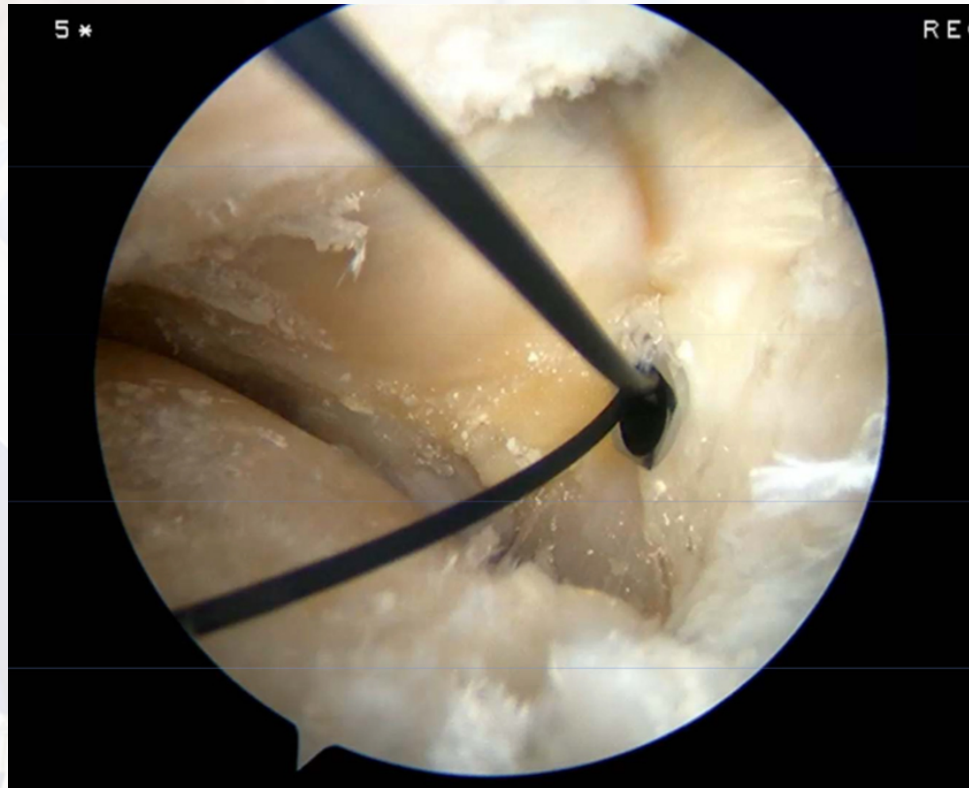


Root Repair: Step 3 Pass a Shuttle Suture

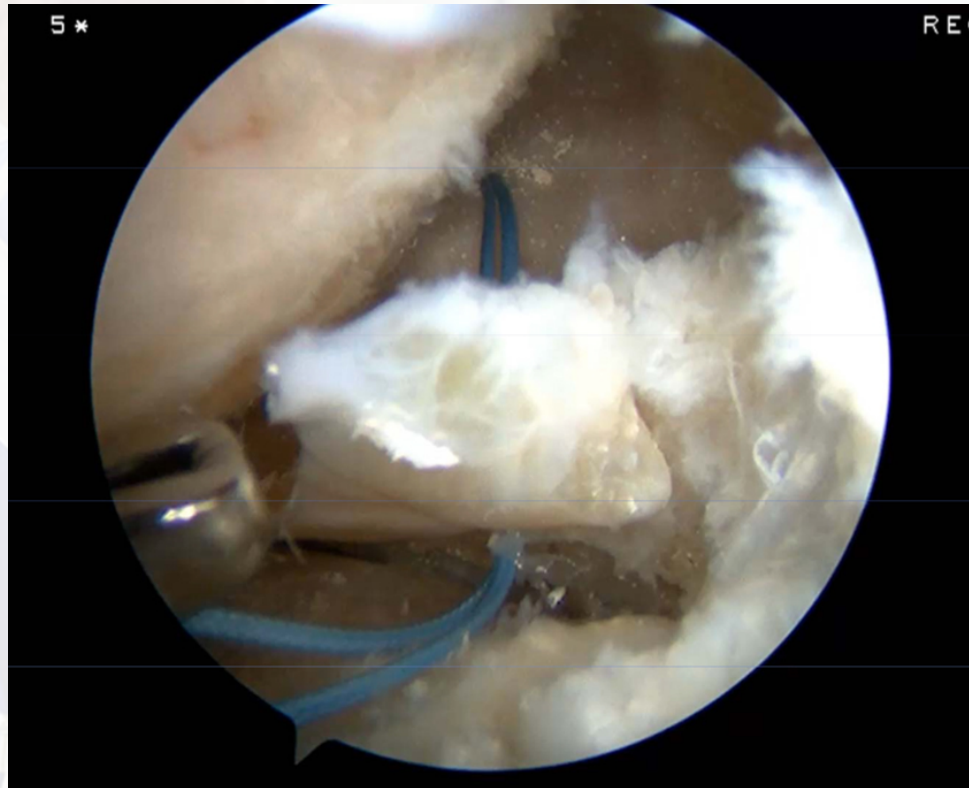


Root Repair: Step 4

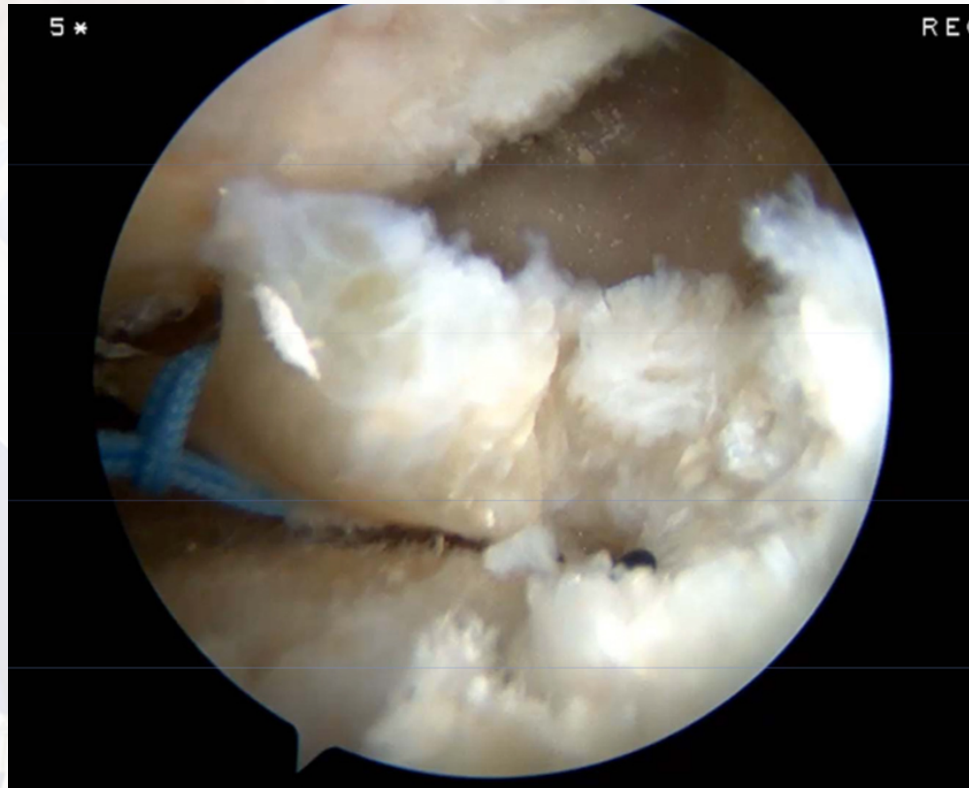
Pass a Loop of #2 Braided Suture



Root Repair: Step 5 Create a Loop Cinch of the Root



Root Repair: Step 6 Retrieve Suture Out the Tibia



A man in a surgical cap and mask, smiling, in an operating room. The background shows surgical lights and other medical equipment.

Thank You

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