Meniscal Root Tears: 
A Silent Epidemic

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Robert F. LaPrade, M.D., Ph.D.
Chief Medical Officer
Steadman Philippon Research Institute
Co-Director, Sports Medicine Fellowship
Complex Knee and Sports Medicine Surgeon
The Steadman Clinic, Vail, CO
Adjunct Professor, University of Minnesota
Affiliate Faculty, Colorado State University

Root Tears: The Silent Epidemic

• Not as rare as once thought
• Often missed on MRI and arthroscopy
• Can lead to rapid OA
  – Inability to resist hoop stress
  – Meniscal extrusion
  – Articular cartilage loss
  – Insufficiency fractures

Radial Root Tears

• Meniscal Radial Root Tears
  – Similar loading characteristics as root tears
  – Up to 28% of overall meniscal tears in some series
    (Bin, Arthroscopy 2004)

Medial Meniscal Radial Root Tears

• Radial tear near root attachment can simulate root avulsion both functionally and on imaging

Medial Meniscal Root Anatomy

• Medial meniscal posterior root:
  (Johannsen, AJSM 2012)
  – Distances from apex of MTE
    • 0.7 mm lateral
    • 9.6 mm posterior
  – Bony attachment
  – Adjacent to PCL

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MM Root Tears: Why you need to fix them

- PH root tear equivalent to total medial meniscectomy (Allaire, JBJS 2008)
  - Increased contact pressure also seen in the lateral compartment
  - Increased external rotation also seen
- PH MM root repair restores contact pressure to normal (Harner, JBJS 2009)
- Radial root tears (near root) equivalent to root tears (Padelecki, AJSM 2014; LaPrade CM JBJS 2014)

Consequences of Nonanatomic MM Root Repair
- Non-anatomic root repair does not restore contact pressure or contact area
- Implications: need to release subluxed root tear

LM Root Tears: Why you need to fix them

- Anatomic PH LM root repair restores contact area and minimize peak contact pressures

Lateral Meniscal Root Anatomy

- Anterior lateral meniscal root (LARA) intimately associated with ACL tibial insertion
- Broad lateral posterior attachments
- Distances from apex of LTE
  - 4.2 mm medial
  - 1.5 mm posterior

Lateral Meniscal Root Tears

- Microscopic Contact Mechanics Due to Lateral Meniscal Outfracture Root Anomalies and Radial Tears Can Be Restored with In Vitro Pull-out Root Repairs

MM Radial Root Tears: why you need to fix them

- Anatomic PH MM root repair restores contact area and minimize peak contact pressures
LM Root Tears: Why you need to fix them

- The MFLs protect the lateral compartment from changes in contact mechanics in the setting of a lateral meniscal posterior root avulsion
- Combination of lateral meniscal root avulsion and deficient MFLs leads to significant changes

Optimization of Suture Technique

- Two simple sutures (TSS) is the least technically challenging
- TSS resist displacement better than single double locking loop (S-DLL) or double double locking loop (D-DLL)
- Modified Mason-Allen (MMA) a viable alternative with greater failure load than TSS

Transtibial Pull-out Meniscal Root Repair - Challenging the “Bungee Effect”

- Greatest displacement after post-op rehab cyclic loading protocol:
  - Meniscal – suture interface > suture elongation or button-bone interface
  - Suture fixation needs to be optimized to increase strength at meniscus-suture interface

1 vs 2 Transtibial Tunnels

- Displacement after 1000 testing cycles:
  - 1 tunnel repair: 3.32 mm
  - 2 tunnel repair: 3.23 mm
  - not significant
  - 2 tunnel repair had 10.2% higher ultimate failure load (135 N vs 123 N)
  - not significant
  - Similar biomechanical properties between 1 and 2 transtibial bone tunnels

Associated Injuries with Root Tears (Matheny, KSSTA 2014)

- MM root tears - chondral injuries
- LM root tears – ACL tears
  - 10 times more likely to have ACL tears than patients with MM root tears
  - Iatrogenic tears reported in all 4 roots
Posterior Root Tears: When to Fix’em

- Not all root tears are the same
- MM Type II: extrusion, bone marrow edema, lower grade cartilage lesions
- LM Type II: extrusion, meniscofemoral ligaments torn

Diagnosis: H & P

- Describe “pop” with deep squat — e.g. skiing, snowboarding, plumbers, carpet layers, gardeners
- Up to 10% of ACL tears
- Pain with deep flexion; joint line pain; palpable extrusion
- “They see you even if you don’t see them” (Matheny, KSOTA 2014)

Diagnosis: Clinical Exam

- Deep posterior knee pain
  - Maximum knee flexion squatting
  - ± medial joint line pain
  - Feel extrusion on valgus stress test
  - Can be associated with 3+ Lachman test / Pivot shift test

MRI – Ghost sign

- Lack of meniscal signal
  - Sagittal view

Etiological Mechanisms for SONK

- Twenty-one (80.7%) of 26 articles implicated the role of the meniscus in the development of SONK
  - Meniscal tears or meniscectomy
  - Medial meniscus and posterior meniscal root tears implicated more frequently
  - Insufficiency fracture hypothesis as a pathological basis of SONK.
- Be cognizant of the high prevalence of medial meniscus root tears in patients with SONK.
- Increase contact pressures and create an environment from which insufficiency fractures can emanate.

MRI: SONK = root tear

SONKs PH MM Root tear until proven otherwise

The Role of Meniscal Tears in Spontaneous Osteonecrosis of the Knee
A Systematic Review of Suspected Etiology and a Call to Revise Nomenclature

Joseph J. Arend, MD, Jane Chang, BS, MD, Paul B. Yoon, MD, Tatsuo Ohashi, MD, Andrew W. Scott, MD, PhD, and Y. Yoshikawa, MD, PhD, with special thanks to Jonathan P. Scott, MD.
Posterior Meniscal Root Repair Techniques

Transtibial pullout technique
• facilitates anatomic repair with a high degree of accuracy and reproducibility
• transtibial tunnel drilling may enhance meniscal healing due to biologic augmentation
• able to restore tibiofemoral contact mechanics

Suture anchor technique
• all-inside meniscal root repair at the native root attachment site and eliminates the need for tunnel drilling
• suture anchors may loosen and protrude into the joint over time

Further optimization of both techniques should focus on eliminating nonanatomic displacement following repair

Repair of a posterior meniscal root tear is essential because of the consequences related to meniscal root deficiency

Meniscal Root Repair: Identification
• Identify the extent of the meniscal root tear
• Transtibial pull-out repair = Gold standard

Preparing the Meniscal Root Bed
• The bony attachment site should be cleaned with a curette to ensure adequate healing

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Tibial Tunnel Drilling
• The two tibial tunnels are drilled with an offset guide to increase fixation of the meniscal root

Passing First Suture

Passing Second Suture
Rehabilitation of Meniscal Root Repairs

- NWB x 6 wks
- "Safe Zone" ROM x 2 wks (0-90°)
- WBAT at 6 wks; ± unloader brace
- Avoid deep leg presses/squats > 90° x 4 months

Clinical Outcomes

Lee et al. (Arthroscopy 2009): MM root pull-out suture repair
  - 2 yr follow-up: almost complete healing in 27 knees at second look arthroscopy
  - HSS Score: 61.1 pre-op → 93.8 post-op
  - Lysholm Score: 17.0 pre-op → 93.1 post-op

Kim et al. (Arthroscopy 2011): MM root repair
  - 48.5 months follow-up: 14 patients better clinical and radiographic results compared to meniscectomy

Chung et al. (Arthroscopy 2015): MM root repair vs meniscectomy
  - Min 5 years postop
  - OA progression slower in repair cohort vs meniscectomy cohort

Clinical Outcomes

Feucht et al. (Arthroscopy 2015): Systematic review of transtibial pullout repair
  - Improved functional outcomes
  - Mean follow-up of 30 months
  - Radiographs: No OA progression in 84% of patients
  - MRI: No OA progression in 82% of patients

Choi et al. (Knee Surg Relat Res 2015): Incidence of MM Root tears in TKA
  - 72% knees requiring a TKA < 60 yr – Meniscal Root Tear
  - Root tears correlated with the severity of osteoarthritis (p<0.05)
  - varus deformity (p<0.05), mechanical axis deviation (p<0.05), and BMI (p<0.05)

Clinical Outcomes

Lee-Paule 2016

- Comparing outcomes in patients <50 and >50 yoa
- Level III Cohort Study
- 50 knees in 49 patients
- Mean FU 2.5 years (range 2.0 – 4.3 years)
Clinical Outcomes

LaPrade 2016

- Failures → 3/45 (6.7%) required revision meniscus surgery
- Significantly improved outcomes for transtibial two tunnel repair.
- No difference in outcomes > 50 or < 50 years.
- No difference in medial vs lateral root repairs.

Conclusions

- Don’t miss root tears (1/12 knee scopes, 1/10 ACLR)
- SONK = root tear
- Age doesn’t matter but cartilage status does
- Consider two–tunnel transtibial repair
- Follow proper rehab

Thanks!