The Meniscus

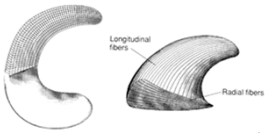
W. Randall Schultz, MD, MS
Austin, TX
January 23, 2016

History

- Meniscus originally thought to represent vestigial tissue
- 1883 first reported meniscal repair (Annandale)
- Total menisectomy treatment of choice for nearly a century
- 1948 radiographic changes following total menisectomy first described
- Over the last 30 years abundant literature documenting functional importance of meniscus and degenerative changes which follow its removal

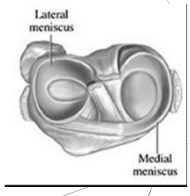
Anatomy

- Blood supply enters from the periphery during fetal development
- By 9th month inner one third is avascular
- Densely cellular at birth
- Cellularity decreases with age
- Fibrochondrocyte major matrix producer
- Type I collagen predominates but II, III, V, and VI also present
- Most fibrils arranged circumferentially
- Some radial, oblique and vertical fibers as well



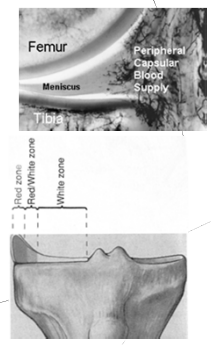
Anatomy

- Medial meniscus covers greater than half of the weight bearing articular surface of the medial tibial plateau
- Lateral meniscus covers greater than three fourths
- Both firmly anchored to the tibial surface both anteriorly and posteriorly



Blood Supply

- 30% medial meniscus vascularized
- 10-25% lateral meniscus vascularized
- Small synovial fringe of 2-3 mm extending over peripheral rim does NOT contribute blood supply
- Popliteus hiatus region in posterior lateral meniscus area of decreased blood supply
- Commonly referred to as zones:
  - red zone
  - red/white zone
  - white zone

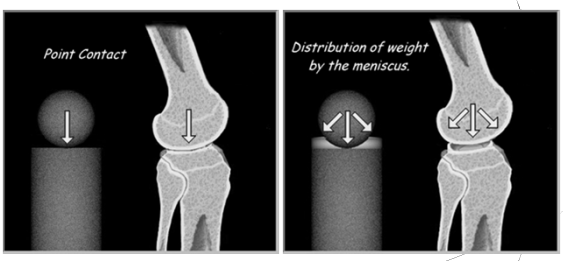


Attachments

- menisci anchored via meniscotibial ligaments (coronary ligaments)
- medial meniscus connected anteriorly to lateral meniscus via transverse ligament
- middle aspect of medial meniscus attached to deep fibers of the MCL
- lateral meniscus not attached to LCL
- lateral meniscus attaches to PCL posteriorly via the posterior meniscofemoral ligament (ligament of Wrisberg)
- attaches to PCL anteriorly via the anterior meniscofemoral ligament (ligament of Humphrey)
  - 70% of knees one will be present
  - only about 6% will be both be present

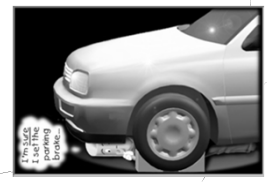
Physiology

- may contribute to nutrition of articular cartilage by enhancing synovial fluid distribution
- secondary restraint for knee stability
- share load bearing
- ? Proprioceptive function
- increases the articular contact area
  - lowers the load/unit area
  - circumferential fiber orientation increases ability to support hoop stresses
  - menisci transmit 30-55% of the load across the joint in the standing position
  - after menisectomy contact stress may increase by 235%



Role as a Stabilizer

- medial meniscus stabilizes against anterior translation of the tibia (particularly in ACL deficient knee)
- medial meniscus thus subject to greater shear forces in ACL deficient knee
- lateral meniscus more mobile and less likely to experience shear forces



Mean movement of the meniscus during flexion

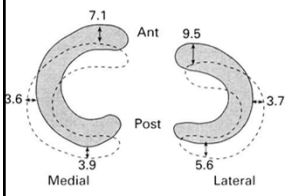


Fig. 3a

Erect and weight bearing

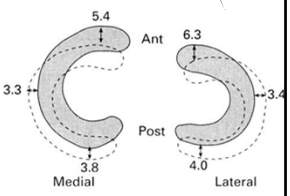


Fig. 3a

Sitting, non-weight bearing

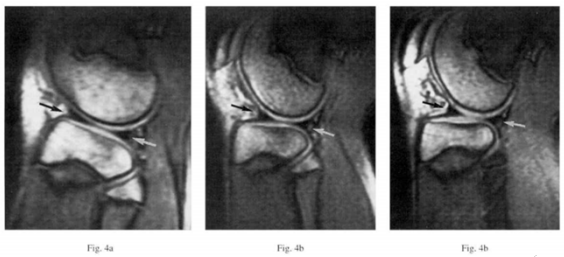
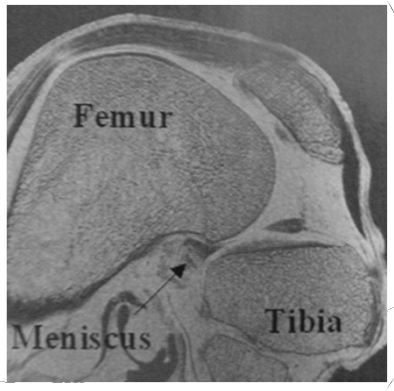
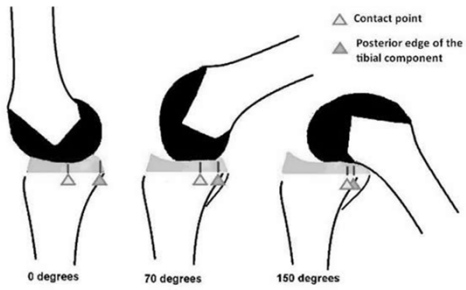


Fig. 4a Fig. 4b Fig. 4b

MR image in the sagittal plane of a knee a) in extension b) in 40 degrees of flexion and c) in 75 degrees of flexion. The arrows show the position of the anterior and posterior horns of the lateral meniscus.





Meniscal Injury

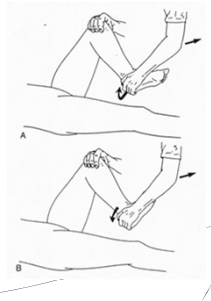
Diagnosis

- History of twisting injury
- +/- ligamentous injury
- Effusion
- Mechanical Sx's
- Joint line tenderness
- Provocative tests


Fig. 98 A slow speed turn in snow skiing may cause a meniscal tear if the bindings do not release.

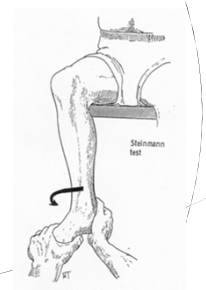
McMurray Test

- 58% true positives
- 5% false positives
- forced tibial rotation with flexion and varus/valgus stress
- results:
  - negative
  - joint line pain
  - both pain and clunk (painless clunk not truly "positive")



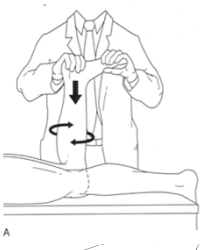
Steinman Test

- knee flexed at 90 degrees (sitting or lying)
- external rotation produces pain at medial joint line
- internal rotation produces pain at lateral joint line
- perform test at various degrees of flexion
  (pain which moves posteriorly with increasing flexion distinguishes meniscal injury from ligamentous injury and injury to osteophytes)

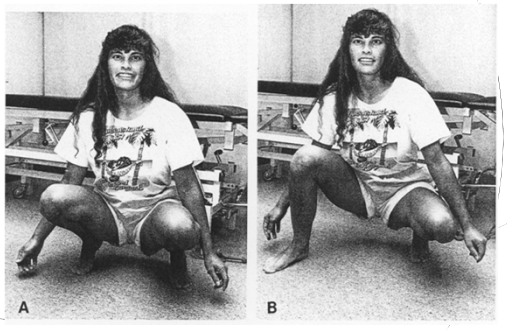


Apley Test

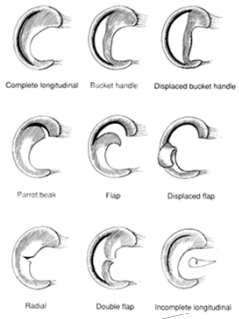
- patient prone
- knee flexed 90 degrees
- compression/distraction/rotation
- pain with compression suggestive of meniscal pathology
- pain with distraction suggestive of ligamentous injury



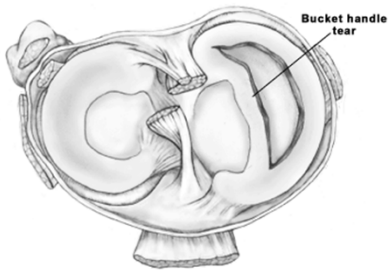
"Duck Waddling"



Tears



Locked Bucket Handle Tear



Surgical Treatment

Surgical Treatment (Arthroscopy)

- Partial Menisectomy
- Meniscal Repair

Partial Menisectomy

Meniscal Repair

Indications for Repair

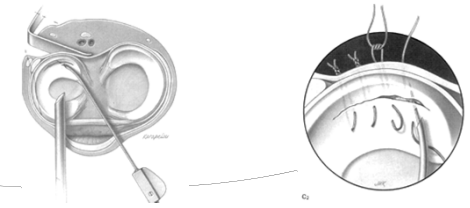
- Recommended for longitudinal tears in the peripheral 10-30%
- Tears which displace more than 3mm
- Tears which may be left to heal:
  - periheral tears < 10 mm
  - small radial tears < 3mm
  - (fenestration, rasping, or debridement of freed edges may expedite healing)

Meniscal Repair Technique

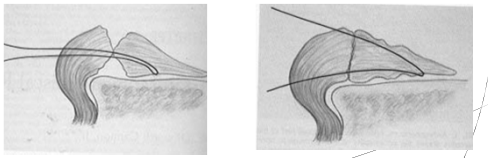
- 3 basic techniques for repair
  - inside out
  - outside in
  - all inside
    (saphenous and peroneal nerves always a concern)

Inside Out Technique

- suture passed through cannulas
- needle accepted outside via a posteromedial or posterolateral incision

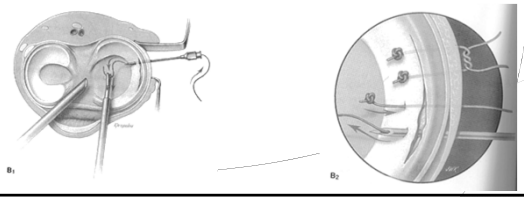


Vertical suture superior to horizontal biomechanically

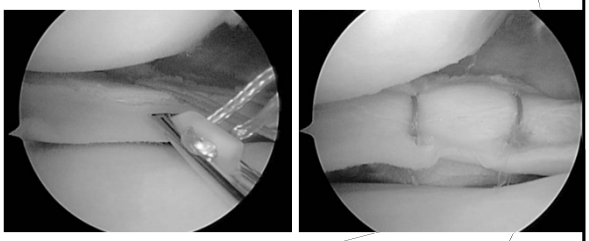


Outside In Technique

- suture passed from outside through straight or curved needle
- knot is created once suture passed across the tear
- suture then pulled tight and tied to adjacent suture



All Inside Suture Repair

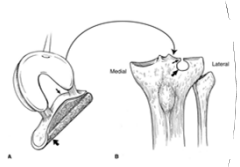


Results of Meniscal Repair

Study	No. of Repairs	Follow-up		Results
Eggli et al[26]	54	7.5 yr (average)	Clinical ± MRI	73% success
Albrecht-Olsen and Bak[27]	27	3 yr (median)	Clinical	63% success
Miller[28]	79	3.25 yr (mean)	Arthroscopy or arthrogram	84% healed (stable), 93% healed (recon)
Morgan et al[29]	74	8.5 mo (average)	Arthroscopy	65% healed (completely), 19% healed (incompletely), 16% failed
Cannon and Vittori[30]	90	10 mo (mean)	Arthroscopy or arthrogram	50% healed (stable), 93% healed (recon)
Buseck and Noyes[31]	66	1 yr (average)	Arthroscopy	80% healed (completely), 14% healed (partially), 6% failed
Tenuta and Arciero[32]	54	11 mo (average)	Arthroscopy	57% healed (stable), 90% healed (recon)
Johnson et al[33]	38	10 yr 9 mo (average)	Clinical	76% success

Transplantation

- Ideal candidate:
  - young
  - active
  - pain over previously menisectomized compartment
  - normal knee alignment
  - minimal to no damage to articular cartilage



Problems

- expensive - may exceed $15,000
- disease transmission
  - irradiation damages graft
- technically demanding (fixation)
- volume loss (up to 70%)
- probably just a scaffold
  - DNA analysis shows 95% transplanted meniscus at 1 year identical to **recipient**
- lack of long term follow up data

What's the latest?

A Comparative Study of Meniscectomy and Nonoperative Treatment for Degenerative Horizontal Tears of the Medial Meniscus

Ji-Hyeon Yim,* MD, Jong-Keun Seon,†‡ MD, PhD, Eun-Kyoo Song,† MD, PhD, Jun-Ik Choi,† MD, Min-Cheol Kim,† MD, Keun-Bae Lee,§ MD, PhD, and Hyoung-Yeon Seo,§ MD, PhD
Investigation performed at the Center for Joint Disease, Chonnam National University Hwasun Hospital, Jeonnam, Korea

Background: It is still debated whether a degenerative horizontal tear of the medial meniscus should be treated with surgery.

Hypothesis: The clinical outcomes of arthroscopic meniscectomy will be better than those of nonoperative treatment for a degenerative horizontal tear of the medial meniscus.

Study Design: Randomized controlled trial; Level of evidence, 1.

Methods: A total of 102 patients with knee pain and a degenerative horizontal tear of the posterior horn of the medial meniscus on magnetic resonance imaging were included in this study between January 2007 and July 2009. The study included 81 female and 21 male patients with an average age of 53.8 years (range, 43-62 years). Fifty patients underwent arthroscopic meniscectomy (meniscectomy group), and 52 patients underwent nonoperative treatment with strengthening exercises (nonoperative group). Functional outcomes were compared using a visual analog scale (VAS) for pain, Lysholm knee score, Tegner activity scale, and patient subjective knee pain and satisfaction. Radiological evaluations were performed using the Kellgren-Lawrence classification to evaluate osteoarthritic changes.

Results: In terms of clinical outcomes, meniscectomy did not provide better functional improvement than nonoperative treatment. At the final follow-up, the average VAS scores were 1.8 (range, 1-5) in the meniscectomy group and 1.7 (range, 1-4) in the nonoperative group ($P = .675$). The average Lysholm knee scores at 2-year follow-up were 83.2 (range, 52-100) and 84.3 (range, 58-100) in the meniscectomy and nonoperative groups, respectively ($P = .237$). In addition, the average Tegner activity scale and subjective satisfaction scores were not significantly different between the 2 groups. Although most patients initially had intense knee pain with mechanical symptoms, both groups reported a relief in knee pain, improved knee function, and a high level of satisfaction with treatment ($P < .05$ for all values). Two patients in the meniscectomy group and 3 in the nonoperative group with Kellgren-Lawrence grade 1 progressed to grade 2 at the 2-year follow-up.

Conclusion: There were no significant differences between arthroscopic meniscectomy and nonoperative management with strengthening exercises in terms of relief in knee pain, improved knee function, or increased satisfaction in patients after 2 years of follow-up.

Keywords: medial meniscus; degenerative horizontal tear; arthroscopic meniscectomy; nonoperative treatment

Long-term Evaluation of Posterior Lateral Meniscus Root Tears Left In Situ at the Time of Anterior Cruciate Ligament Reconstruction

K. Donald Shelbourne,*† MD, Troy A. Roberson,† MD, and Tinker Gray,† MA
Investigation performed at the Shelbourne Knee Center, Indianapolis, Indiana

Background: The long-term radiographic and subjective results of patients with posterior lateral meniscus root tears left in situ at the time of anterior cruciate ligament reconstruction has not been reported.

Hypothesis: The authors hypothesized that patients who had posterior lateral meniscus root tears left in situ would have statistically significantly lower subjective scores and greater joint-space narrowing as compared with a control group.

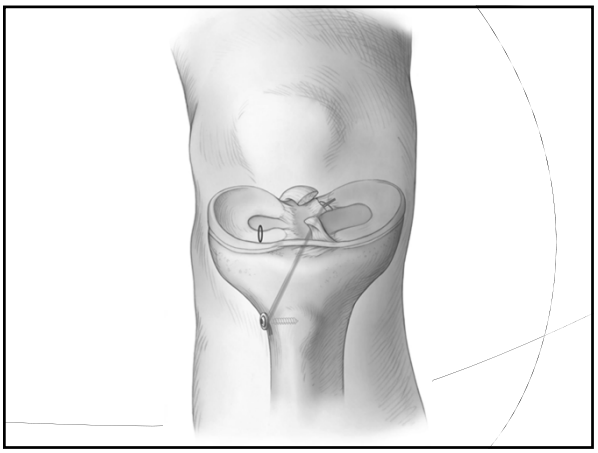
Study Design: Cohort study; Level of evidence, 3.

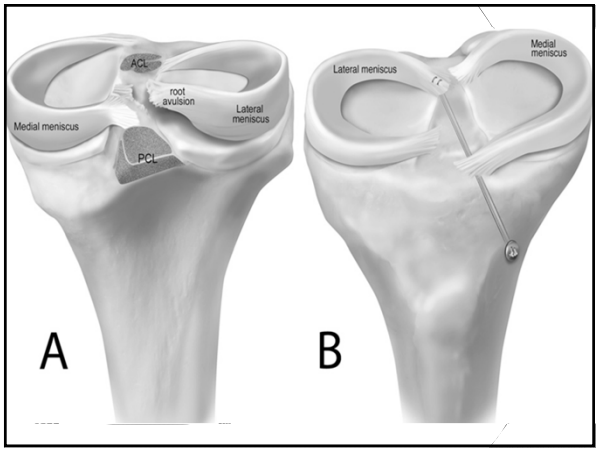
Methods: Thirty-three patients who had isolated posterior lateral meniscus root tear and >5 years objective and subjective follow-up were evaluated and compared with a matched control group without meniscal tears based on sex, chronicity of tear, age, and follow-up time. Patients were evaluated subjectively and objectively using the International Knee Documentation Committee criteria.

Results: The mean objective follow-up time was 10.6 ± 4.5 years. The mean subjective total score was 84.6 ± 14 in the study group versus 90.5 ± 13 in the control group ($P = .09$). Radiographs showed lateral joint-space narrowing rated as normal in 19, mild in 10, moderate in 3, and severe in 1 versus the control group, which was normal in 28 and mild in 5 patients. The measured amount of lateral joint-space narrowing compared with the other knee was 1.0 ± 1.6 mm in the study group versus 0 ± 1.1 mm in the controls on 45° flexed posteroanterior radiographs ($P < .006$).

Conclusion: At a mean of 10 years' follow-up of posterior lateral meniscus root tears left in situ, mild lateral joint-space narrowing was measured without significant differences in subjective or objective scores compared with controls. This study provides a baseline that can be used to compare the results of procedures used to treat these tears in other manners.

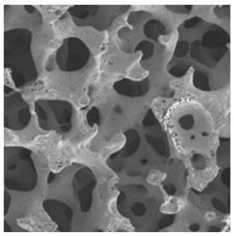
Keywords: lateral meniscus; posterior root tear; posterior horn tear; in situ; joint-space narrowing; anterior cruciate ligament; outcomes

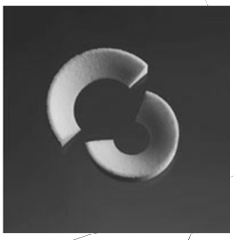


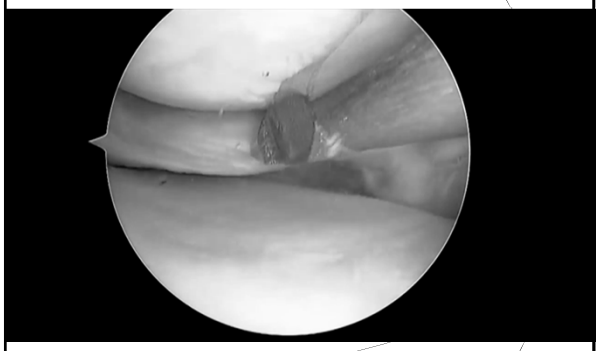


Future

Collagen Meniscal Implants







In Summary

- Meniscal tissue essential to joint preservation
- Meniscus serves secondary roles in knee joint function
- Repairable tears are rare but indications should expand in younger patients
- Meniscal replacement strategies evolving