Meniscal Tears:
Take it or Leave it??
Resection vs Repair??

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Disclosures

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Meniscal Epidemiology

- >900,000 knee arthroscopies performed per year in U.S. and > 50% meniscal procedures
  - Kim et al., JBJS 2011

- MRI study Asymptomatic patients > 50 yrs old
  - Meniscal tears = 19% females & 33% males
    - Englund NEJM 2008
Why Preserve the Meniscus??
Fairbanks 1948 “Classic Article”
Findings at Long term F/U after Total Meniscectomy

- 107 patients after TOTAL Meniscectomy
- 3 month to 14 year follow-up
- 3 Typical Radiographic Findings
- 1=Femoral Condyle Ridge Formation
- 2=Femoral Condylar Flattening
- 3=Joint Space Narrowing on Operative side
- ARTHRITIC COMPARTMENT
Long Term Radiographic Results after Open Meniscectomy

- 107 patients followed up after 21 YEARS
- 68 Sex and Age matched Controls

Meniscectomy:
  - At least Mild OA in 71% and Advanced in 48%

Control Group:
  - Mild OA in only 18% and Advanced in only 7%

Relative Risk of OA after Meniscectomy = 14.0
  - Roos et al., Arthritis Rheum 1998
Meniscal Anatomy: Biomechanics

- When the Peripheral Margin of the meniscus and Root attachments are intact “Normal Hoop Stress” increases contact area, decreases contact pressures, and protects the knee:
  - Lateral Meniscus decreases compartment loads by 70%
  - Medial Meniscus decreases compartment loads by 50%
    - Walker et al., CORR 1975
Meniscal Anatomy: Biomechanics

• **In Vitro Study of Meniscal function:**
  – Partial Meniscectomy
    • Increased Contact stresses by 65%
  – Total Meniscectomy
    • Increased Contact stresses by 235%
      – Baratz et al., AJSM 1986

• **Partial Meniscectomy** WITHOUT an Intact Peripheral Rim or Root Attachment results in Loss of Normal Hoop Stresses
  – Approaches those after **TOTAL Meniscectomy**
    • Lee et al., AJSM 2006
Meniscal Anatomy: Stability and ACL

• **Medial Meniscus** = “Brake Stop”
  – Sectioning MM increased tibial translation and strain on ACL
    – Spang et al., Arth 2010
  – MM secondary stabilizer in ACL deficient knee
    – Musahl (Bedi) et al., AJSM 2010

• **Lateral Meniscus** = “Pivot Shift”
  – Found to be important stabilizer for Rotatory and Valgus Loads during “Pivot Shift” in ACL deficient knee
    – Musahl (Bedi) et al., AJSM 2010
    – Shybut et al., AJSM 2015
Anatomy: Meniscal Healing Potential Considerations
Meniscal Anatomy: Vascularity

- **Vascular Supply** extends from the periphery inwards:
  - 10-30% for Medial Meniscus
  - 10-25% for Lateral Meniscus

- Tears within **3mm** of the periphery are vascular
  - **RED ZONE**
    - ? REPAIRABLE

- Tears > **5mm** from the periphery are avascular
  - **WHITE ZONE**
    - ? NOT Ideal for REPAIR
Tear Classification

- Horizontal
- Complex
- Longitudinal / Vertical
- Bucket Handle
- Oblique / Flap
- Radial
- Meniscal Root
- Discoid
Surgical Treatment??

- **Horizontal Cleavage tears**
  - Typically **Resection** White/White
  - Some Interest in Repair for Younger Patients

- **Longitudinal Tears**
  - Red / Red or Red/White **Repairable**
  - If less than 1cm in length = Stable / Leave alone

- **Bucket Handle Tears**
  - Repair whenever Possible
  - Some thin white/white tears = Resection
  - Chronic and degenerative = Resection
Surgical Treatment??

- **Flap and Radial Tears**
  - Generally Resected (white / white)
  - If go to the Periphery Consider Repair
  - Complete Radial tear similar to total meniscectomy

- **Meniscal Root Tears**
  - If acute and or relatively healthy joint = REPAIR
  - If older > 50, Degenerative Changes, Malalignment, Obese = Resection / Injections … Eventual Arthroplasty

- **Discoid Meniscus**
  - Saucerization / Partial resection
  - If no posterior attachment (Wrisberg Variant) = repair
Meniscal Surgical Treatment Options

What’s the Evidence??
Repair vs Partial Meniscectomy: Systematic Review 2011

• At Early F/U (0-4 years)
  – Reoperation rate: Partial Meniscectomy (1.4%), Repair (16.5%)

• At Longer F/U (> 10 years)
  – Reoperation rate: Partial Meniscectomy (3.9%): Repair (20.7%)

• Lateral repairs lower reoperation rate than Medial side

• Lower Failure rate with ACLR than isolated Repair

• Limited # Long term Studies but:
  • Repairs had better PROM’s and less radiographic OA than Resections

  Paxton et al., Arth 2011
Meniscal Repair Outcomes: Systematic Review 2012

- > 5 year F/U studies, 13 studies included

- Pooled rate of Meniscal Failure = 23.1%
- 30% occurred After 2 YEARS

- Medial Meniscal Failure = 24.2%
- Lateral Meniscal Failure = 20.2%

- ACL intact repair Failure = 22.7%
- ACL deficient repair Failure = 22.1%
- ACL reconstructed repair Failure = 26.9%
  
  - Nepple et al., JBJS 2012
Red-White Zone Repairs? Systematic Review 2014

- 23 articles met criteria, Mean F/U 4 Years
- 767 meniscal repairs in R/W zone
- ACLR in 78% of cases and Mean age 25 years
- 83% of repairs Healed clinically
  - Westin and Noyes, Arth 2014
Repair of Horizontal Meniscal Tears: Systematic Review 2014

- 9 articles met inclusions criteria
- Total = 98 horizontal cleavage meniscal repairs
- Median Age = 23 years old (YOUNG)
- Overall success rate 77.8%
- Comparable success rates to other types of tears in young individuals
- Consider in Younger Patients??
  - Kurzweil et al., Arth 2014
Arthroscopy for Degenerative Meniscal Tears and Mild OA: Systematic Review 2014

- 7 RCT’s included (805 patients)
- Mean Age 56 years
- Pooled treatment did NOT show minimally important difference (MID) between arthroscopy and sham / non-surgical treatment
- Moderate evidence to suggest NO benefit to arthroscopy for degenerative meniscal tears in middle aged pt with mild OA compared to non-operative treatment.
  - Khan et al., CMAJ 2014
Meniscal Root Injuries

- Meniscal Root tears disrupt circumferential “hoop” tension with resultant biomechanics similar to a Total Menisectomy.
  - **MMRT** = Older patients, more OA, more extrusion
  - **LMRT** = Younger patients, often traumatic with ACL
    - Koo et al., PLOSE ONE 2015

- Cadaveric / Biomechanical studies show that root repairs can restore contact area and contact pressures to that seen in the Intact meniscus
  - Laprade et al, JBJS 2014, Padalecki et al., AJSM 2103
Clinical Studies: Medial Meniscal Root Repairs

- **Prognostic Factors** at min 5 years (40 repairs)
- **Poorer Prognosis** = Outerbridge > 3 chondral changes, mechanical varus > 5 degrees, older age
  - Chung et al., Arth 2016

- Systematic review, 172 repairs, mean age = 55 yrs
- 83% were females, mean f/u 30 months
- Lysholm improved 52 to 86 points
- OA = no progression in > 80%
- Complete healing / Reduction of Extrusion in only 60%
Discoid Meniscus

- Typically **Lateral**, Rarely Medial
- Typically **Diagnosed in Children**

- **Locking**, “Snapping” with flexion / extension
- **Widening of Lateral Joint space on X-rays**

- Abnormally thick Meniscal Tissue  = Prone to Tearing
- If asymptomatic finding on MRI  = No treatment
- IF SYMPTOMS &:
  - Incomplete, Complete Type  = **Saucerization**
  - Deficient Posterior Attachment  = “**Wrisberg Variant**”  = partial resection and posterior repair
Discoid Meniscus:
Limited Outcomes Available
Recent 2015 study

- 48 discoid mensci = 10 years F/U
  - PMM (22 knees)
  - PMM with repair (18 knees)
  - Subtotal Meniscectomy (8 knees)

- LFU = 94% good / excellent results (Lysholm/Tegner/HSS)

- OA in 23% PMM, 39% PMM & Repair, and 88% Subtotal Meniscectomy

- AHN et al., Arth 2015
Meniscal Injury and Surgery in Elite Athletes
Meniscectomy in Elite Athletes

**NFL Study**
- Isolated meniscectomy reduced length of career (5.6 vs 7 years) and games played (62 vs 85)
- Isolated ACLR did not!
  - Brophy et al., AJSM 2009

**Professional Soccer**
- Longer RTP time for Lateral (7 vs 5 weeks)
- 69% experienced persistent pain and effusions after partial lateral meniscectomies
- 6 x more likely to RTP after medial compared to lateral meniscectomy
  - Nawabi et al., AJSM 2014
Meniscal Tears in Elite Athletes

- **NBA over 21 seasons = Treatment not Defined**
  
  - Lateral Meniscal tears more common up to 30 years old
  - Medial Meniscal tears more common after 30 years old
  - High BMI (>25) > risk Lateral MT

- 19.4% NOT RTP in NBA
- For Rest No effect on Performance
  - Yeh et al., AJSM 2012
Meniscal Repair in Elite Athletes

- 45 meniscal repairs, mean age 23 years
- Mean F/U 8.5 years
- 83% ACLR at the same setting
- 81% RT sports at similar level at mean 10.4 months (ACL)
- 24% Failure of Meniscal Repair
  - Mean time to Failed repair = > 3 years
  - Medial Failure = 36% vs Lateral Failure = 5.6%
  - Logan et al., AJSM 2009
Case Examples
Case:
Bucket Handle MMT / ACL Tear

- 30 year old male with injury 1 year prior while snow skiing

- Intermittent knee locking since a couple of months after the injury and presents with locked R knee

- Positive Lachman’s, 10 – 130 deg ROM
Imaging

- Bucket Handle Medial Meniscus Tear
- Chronic Appearing ACL Tear
Thoughts

• Medial Meniscal tear secondary to recurrent instability after ACL tear

• Repair the Medial Meniscus if possible to maintain normal Contact Pressures and restore the “Brake-Stop” mechanism
Case: Horizontal Cleavage and Flap Tear

• 43 y/o Orthopaedic Surgeon with acute injury playing basketball

• Off and on medial knee pain for years

• Medial joint line TTP and minimal effusion

• Pain with Squating, cutting and pivoting
• Horizontal cleavage medial meniscal tear
• ? Repair if younger with some data to support (in particular flap component)
Surgical Video
Case:
Discoid Lateral Meniscus

• 43 y/o male with chronic lateral knee playing club hockey

• Lateral joint line pain, positive McMurrays test, no effusion, no snapping
Imaging

- Wide joint space on plain radiographs
- Discoid lateral meniscal tear on MRI
- Preserve peripheral remnant to preserve Hoop Stresses
- Evaluate posterior attachment (Wrisberg)
Surgical Video
Case: LM Root tear and ACL tear

• 26 year old female with a chronic ACL deficient Left knee and increasing lateral sided knee pain and giving way

• Positive Lachman’s test, Positive Pivot Shift

• Trace Effusion, Lateral Joint Line Pain
Imaging

- Mild Joint space narrowing laterally
- ACL Tear
- Lateral Meniscal Root Tear
- ACLR and Repair the Root to preserve the Hoop Stresses and help restore the Pivot Shift (Lateral Meniscus)
Surgery

- Left ACLR with Hamstring Autograft
- Lateral Meniscal Root Repair
Case:
Recurrent Meniscal Tear s/p ACLR Elsewhere
Conclusions:

• The Menisci function to decreased contact stresses and protect the knee from articular cartilage damage

• The Menisci also help to stabilize the knee in particular in the setting of ACL injury

• Meniscal Preservation is key and its imperative to preserve the peripheral rim and root attachments

• Repair failure rates of at least 20-25% (> medial side) are expected and meniscal surgery in the degenerative knee should be entertained with extreme caution
Conclusions:

• Lateral meniscectomies seem to have poorer results but lateral meniscal repair rates are better than medial repairs

• Medial meniscectomies have better results than the lateral side but Failure after Medial repairs appears to be higher than after Lateral repairs

• Ultimately if the meniscus has a reasonable chance to heal and in particular for Younger patients we should do everything we can to preserve the meniscus
Thank You!

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