The Treatment of the Early Degenerative Knee and Use of Biologics

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Disclosures

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The meniscus

- The meniscus is a critically important structure that functions to minimize joint contact stresses by providing maximum contact area.
• In a loaded knee the medial meniscus transmits 50% of the medial compartment load compared to the lateral meniscus, which transmits 70% of the lateral compartment load.
  – Seedholm et al., JBJS Br 1974
The meniscus

• Biomechanical studies have proven that meniscectomy leads to higher contact forces and lower contact areas than when meniscus repair is performed.
  – Baratz et al., AJSM 1986

• Contact forces have been shown to increase by as much as 65% following partial meniscectomy and 235% following total meniscectomy.
  – Baratz et al., AJSM 1986

• These changes could lead to medial and/or lateral knee pain following meniscectomy as a result of compartment overload with the potential for progressive articular cartilage degeneration.
The menisectomized knee

- Prospective 40-year follow up study
- 53 patients who underwent total meniscectomy as adolescents
- Conclusion - meniscectomy leads to symptomatic osteoarthritis of the knee later in life
- A 132-fold increase in the rate of total knee replacement when compared to age matched controls.
  - Pengas et al., JBJS Br 2012
The menisectomized knee

• Relative risk of developing advanced osteoarthritis following meniscectomy was 14.0 compared to matched controls.
  – Roos et al., Osteoarthritis and Cartilage 2001
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• Many other authors have found a strong association between meniscectomy and the development of radiographic and symptomatic osteoarthritis.
  – Englund et al., Arthritis Rheum 2003
  – McNicholas et al., JBJS 2000
  – Alford et al., AJSM 2005
Menisectomized knee Sub-groups

- **Pain without chondrosis**
  - Recent meniscectomy
  - No damage yet to articular cartilage
  - Pain usually only with higher impact activities

- **Focal cartilage defect(s)**
  - Meniscectomy 1-5 years ago
  - Focal damage to condyle, and occasionally tibia
  - Pain with normal weightbearing activities
  - Some swelling

- **Advanced arthritic changes**
  - Remote meniscectomy
  - Diffuse bipolar damage and radiographic changes (Fairbanks)
  - Rest pain
Surgical Intervention...

• Considered for symptomatic patients who fail nonoperative treatment, especially for young patients at high risk for rapid joint deterioration.

• Patient age, goals, activity level, and the extent of disease process should all be highly considered when deciding on a surgical plan.
Surgical Options

• Surgical options include
  – cartilage repair/restoration
  – Meniscus repair
  – meniscal allograft transplantation (MAT)
  – osteotomy
  – unicompartmental knee arthroplasty
  – total knee arthroplasty.
Meniscal Allograft Transplantation (MAT)

- For young patients with meniscal deficiency, meniscal allograft transplantation can be considered.
- The first human meniscal allograft transplantation was performed in 1984.
- Biomechanical studies – demonstrate improved intra-articular contact area and pressures.
  - Milachowski et al., Int Orthop 1989
  - Paletta et al., AJSM 1997
Meniscal Allograft Transplantation (MAT)

• The primary indication - symptomatic compartment of the knee in a patient with a history of total or subtotal meniscectomy.

• There is no consensus in regards to the upper age limit of the procedure
  – 50-55 is commonly used as a cut off

• Controversy exists in regards to how much chondral loss is acceptable cartilage defects greater than ICRS grade III articular should ideally be focal and small so that they can be addressed concurrently with cartilage repair
Meniscal Allograft Transplantation (MAT)

- Contraindications
  - obesity
  - ligamentous instability (unless it is addressed prior to or in conjunction with transplantation)
  - previous joint infection
  - squaring of the femoral condyles.

- Patients with greater than 3 degrees of varus or valgus malalignment should be considered for concurrent osteotomy (high tibial osteotomy vs distal femoral osteotomy).
MAT Outcomes

• McCormick et al., AJSM 2014
  – 95% survival rate in 172 patients at 5 years

• Vundelinckx et al., AJSM 2014
  – Followed 49 patients for an avg of 12 years and 8 months
  – 90% of patients reported being very satisfied or satisfied and stated that they would undergo the procedure again.
  – 6 (12.2%) failures requiring conversion to TKA

• Rosso et al., AJSM 2015
  – A systematic review of 55 studies concluded that meniscal allograft transplantation provides good clinical results at short-term and midterm follow up, with improvement in function and acceptable failure and complication rates.
Biologic Reconstruction with MAT

• Harris et al., Arthroscopy 2015
• followed 18 patients who underwent meniscal transplantation, osteotomy, and cartilage repair
  – statistically significant improvements in IKDC, Lysholm, and 4 KOOS subscores at a mean follow up of 6.5 years.
  – 13 reoperations in 10 patients (55.5% reoperation rate) but only one patient was converted to total knee arthroplasty (5.6%)
Case 2
30yo female with left knee pain

- History of left meniscus repair 5-10 years ago. States her knee has never felt the same since then. Complains of mostly medial based pain but occasionally has anterior pain as well. Pain is daily with every day activities including walking to and from work.
Case 2
24yo female with right knee pain

- Patient previously underwent partial lateral meniscectomy / subtotal lateral meniscectomy 6 years ago for a torn discoid lateral meniscus
- Localizes pain to lateral aspect of knee and reports pain with everyday walking
Meniscal root tears / avulsions

• Posterior meniscal root tears lead to altered tibiofemoral contact pressures and contact areas, which have been reported to be functionally similar to a total meniscectomy. 2,16,21,25 (LaPrade paper)
• If left untreated can lead to progress degeneration of knee
• Several studies report delayed progression of degenerative changes seen on imaging following repair when compared to matched controls (6,11,12 from Laprade paper)
  – Chung et al., Arthroscopy 2015
  – Kim JH et al., Arthroscopy 2011
  – Kim SB et al., Arthroscopy 2011
Anatomic Transtibial Pull-Out Technique

- LaPade et al. 2016
Meniscal root repair outcomes

- LaPrade et al. AJSM 2016
- 50 knees in 49 patients, 45 for analysis
- 3 of 45 (6.7%) required revision surgery
- Significant improvements in postop Lysholm and WOMAC scores
- No difference in outcomes between patients <50 to those >50
Case 3
23yo male with right knee pain

- Reports wrestling with a friend and twisting his knee. Felt a “pop” followed by pain and swelling. Pain is located posteromedial and he has difficulty bearing weight.
23yo female with right knee pain following recent PCL reconstruction 3 months prior

- Patient was 3 months post op from right PCL reconstruction. Was doing well with rehab but slipped and fell resulting in a twisting mechanism. This was followed by pain and swelling of the knee.
Horizontal Cleavage Tears of the Meniscus

- Beamer et al., Arthroscopy 2016
Osteotomy

- Osteotomies (distal femoral vs proximal tibial) are joint-preserving procedures that can be used to treat early compartment osteoarthritis in young patients
- Varus-producing distal femoral osteotomy - lateral compartment disease
- Valgus-producing proximal tibia osteotomy - medial compartment disease
- Advantageous for young patients
  - no long-term activity restrictions
  - need for joint arthroplasty can be delayed or potentially prevented.
Osteotomy

• Opening and closing wedge osteotomies have been described but there is a lack of literature supporting one technique over another.
  – Smith et al., The Knee 2011
  – Brouwer et al., JBJS Br 2006

• With the advent of improved plating technology and various bone graft substitutes, opening wedge osteotomies have become the technique of choice.
  – Lobenhoffer et al., Tech Knee Surg 2002
  – Stoffel et al., Clin Biomech Bristol Avon 2004
Osteotomy Outcomes

• LaPrade et al., Arthroscopy 2012
  – 47 young adults (< 55 years) who underwent proximal tibia opening wedge osteotomies for medial compartment osteoarthritis and genu varus alignment.
  – At a mean of 3.6 years of follow up Modified Cincinnati Knee Scores improved from 42.9 preoperatively to 65.1
  – Only 3 (6%) failures requiring revision osteotomy or conversion to total knee arthroplasty.
Osteotomy

- Systematic review of 21 studies
  - concluded that valgus high tibial osteotomy reduces pain and improves knee function in patients with medial compartment osteoarthritis.
  - Brouwer et al., The Cochrane Library 2014

- While the use of varus-producing distal femoral osteotomies is less common, encouraging outcomes have been documented in patients with lateral compartment disease and genu valgus alignment.
  - Wang et al. JBJS 2005
  - Saithna et al., The Knee 2014
  - Cameron et al., Clin Orthop Relat Res 205
Osteotomy

• My preference is to perform an osteotomy on patients younger than 55 with malalignment and isolated medial or lateral compartment disease.

• These patients tend to be more active and may not be willing to abide by the activity restrictions associated with unicompartmental knee arthroplasty.

• On the contrary, unicompartmental arthroplasty would be a good option for less active patients between the ages of 55-70 with isolated unicompartmental disease.
Case 5
60yo male with left knee pain

- Patient has several years of medial based pain. Previously underwent partial medial meniscectomy 10-12 years ago.
Patient complains of medial based knee pain. He has pain with every day walking. Previously underwent partial medial meniscectomy twice with the most recent surgery being 9 months ago.
Arthroplasty

• Unicompartmental knee arthroplasty (UKA) and total knee arthroplasty (TKA) are treatment options for advanced degeneration of the knee.

• Preferred for patients older than 55 who are lower demand due to the limited life span of the implants.

• They can also be used as salvage options following failed cartilage surgery
Unicompartmental Arthroplasty

• Isolated unicompartmental disease can be successfully treated with UKA while more diffuse disease that involves more than one compartment is better treated with TKA.

• In a consecutive series of 54 lateral unicompartmental arthroplasties the survivorship was 94.4% at 10 years and 91.4% at 15 years.
  – Lustig et al., The Knee 2014

• Similarly, medial compartment arthroplasty survival rates have been documented as 94% - 100% at 10 years.¹⁶²⁻¹⁶⁴
  – Murray et al., JBJS 1998
  – Keys et al., Knee 2004
  – Rajasekhar et al., JBJS Br 2004
Case 7
54yo male with left knee pain

- Patient reports medial based knee pain for several years. He previously underwent partial medial meniscectomy 8 years ago.
Decision making – osteotomy versus arthroplasty?

- Decision based on age and expectations
  - Osteotomy:
    - Younger (< 55? years)
    - More active
    - Don’t like or can’t have restrictions (sports, work)
    - Unicompartmental disease
  - Partial replacement:
    - Middle aged to older (55-70 years)
    - Unicompartmental disease
  - Total knee replacement:
    - Older (>70 years)
    - Several compartments affected
    - Low demand
What is new?....
- http://n.medi-post.com/cartistem/
Bioscaffolds....just to name a few....

- MACI (Matrix-Induced Autologous Chondrocyte Implantation)
- BST-CarGel
- AMIC (Autologous Matrix-Induced Chondrogenesis)
- Gelrin C
- Chondrotissue
- ChonDux
- MaioRegen
- Chondromimetic
- Agili-C
- Aseed Scasffold
- CAIS (Cartilage Autograft Implant System)
- CRT (Cell Replacement Technology)
- Cartistem
- Revaflex
- CariGro
- NeoCart
- CaReS/CartiPlug
- Hyalograft C
- Bioseed C
- Cartipatch
- Novocart 3D
What about PRP?...

- Harris et al, Arthroscopy 2016
- Systematic review of level 1 studies
- PRP to treat OA of the knee
- 6 studies with 739 patients and 817 knees
  - Mean age: 59.9 years
  - 38 week avg follow up
- Significant improvements in statistical and clinical outcomes (pain, function, stiffness)
- 5 out of 6 studies showed significant differences in outcomes between PRP and HA or PRP and placebo in pain and function
References


References

References


