Meniscus Transplantation
2 Decades of Experience

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I (and/or my co-authors) have something to disclose.

Detailed disclosure information is available via:

The course syllabus, or

AAOS Disclosure Program on the AAOS website at
http://www.aaos.org/disclosure
Meniscus Allograft Transplantation

500-750K Meniscetomy/yr
1500-2000 MAT/yr
600+ in 20 years
10 of my “own”
Allograft Experience

- 20 Years
- Rush Cartilage Restoration Center™
- Manual → Socrates → OBERD
- 2-3 RA/3 Clinical Associates
- Biochemistry, Biomechanics, Anatomy
- 600+ MAT/725 OA Grafts
- Most common transplant…
  - MAT + OAG
  - 30-40 MAT/Year
  - 50-60 OAG/Year
Tibiofemoral Contact Mechanics After Serial Medial Meniscectomies in the Human Cadaveric Knee

AJSM, 2006

Stephen J. Lee,* MD, Kirk J. Aadalen† MD, Prasanna Malaviya,‡ PhD, Eric P. Lorenz,§ MS, Jennifer K. Hayden,† MSN, Jack Farr,‖ MD, Richard W. Kang,¶ and Brian J. Cole,†‖ MD, MBA
Trends in Meniscus Repair and Meniscectomy in the United States, 2005-2011

Geoffrey D. Abrams,*† MD, Rachel M. Frank,† MD, Anil K. Gupta,† MD, MBA, Joshua D. Harris,† MD, Frank M. McCormick,† MD, and Brian J. Cole,† MD, MBA

Investigation performed at the Department of Orthopedic Surgery, Rush University Medical Center, Chicago, Illinois
“Absolute” Indications

Absent meniscus

Pain and/or instability

Corrected co-morbidities

Intact Cartilage

- **No** flattening
- **No** subluxation
- **No** > Grade III
Should we do it early?

- Underpowered (8 I- vs 10 D-MAT)
- Unmatched groups

Comparative Study on Immediate Versus Delayed Meniscus Allograft Transplantation
4- to 6-Year Follow-up

Dong Jiang,* MD, Ying-fang Ao,* MD, Xi Gong,* MD, Yong-jian Wang,* MD,
Zhuo-zhao Zheng,† MD, and Jia-kuo Yu,*+ MD, PhD
Investigation performed at the Institute of Sports Medicine
of Peking University Third Hospital, Beijing, China

AJSM 2014

- Will not last forever (8-10 yr scaffold)
- Chondral progression without vs Chondroprotection with MAT
- Risk vs Benefit…. Must now live a life of meniscal protection

Comparative Study on Immediate Versus Delayed Meniscus Allograft Transplantation: Reply to Response

Letter to Editor, AJSM 2015
Meniscal Preservation

Multiple Freeze-Thaw Cycled Meniscal Allograft Tissue: A Biomechanical, Biochemical, and Histologic Analysis

Performance of a Sterile Meniscal Allograft in an Ovine Model

Allison G. McNickle MS, Vincent M. Wang PhD, Elizabeth F. Shewman MS, Brian J. Cole MD, MBA, James M. Williams PhD
Index Arthroscopy
35 y.o. s/p MM’y
Plain Radiographs (Pollard, 1995)

- A/P radiograph (width)
  - 1:1 ratio

- Lateral radiograph (length)
  - MM = 80% sagittal diameter
  - LM = 70% of sagittal diameter
Effect of Lateral Meniscal Allograft Sizing on Contact Mechanics of the Lateral Tibial Plateau
An Experimental Study in Human Cadaveric Knee Joints

Michael Dienst, *† MD, Patrick E. Greis, ‡ MD, Benjamin J. Ellis, § Kent N. Bachus, †‖ PhD, and Robert T. Burks, ‡ MD

- Oversized grafts → Increased TF contact force
- Undersized grafts → Increased meniscal forces
- Correctly sized → Normal TF contact forces
- 10% size mismatch acceptable
Bony Fixation

Should we maintain bony insertions?

Chen, 1996
Bridge = Plug = Intact Meniscus

Paletta, 1997
Allograft without bone = Total Meniscectomy
230-330%

T=0 “maintain”
Clinically, acceptable to do without bone....
Surgical Techniques
The Effects of Medial Meniscal Transplantation Techniques on Intra-Articular Contact Pressures

Nikhil N. Verma, MD
Edward Kolb, MD
Brian J. Cole, MD, MBA
Eric Berkson, MD
Ralph Garretson, MD
Jack Farr, MD
Benjamin Fregly, PhD

JKS, 2007
What can we tell our patients?

- Reduced Pain
- Improved Function

Clinically Relevant ▲
Case Series
Level IV

Prospective Evaluation of Allograft Meniscus Transplantation
A Minimum 2-Year Follow-up
AJSM, 2006

Prospective Long-Term Evaluation of Meniscal Allograft Transplantation Procedure:
A Minimum of 7-Year Follow-Up
JKS 2012

Long-Term Survival Analysis of Meniscus Allograft Transplantation with Bone Fixation
Kim et al, In press

Meniscal Transplantation in Symptomatic Patients Less Than Fifty Years Old
AJSM, 2006

Long-term Clinical Outcome of Open Meniscal Allograft Transplantation
AdSM, 2009

Meniscal allograft transplantation. Part 2: systematic review of transplant timing, outcomes, return to competition, associated procedures, and prevention of osteoarthritis
Knee Surg Sports Traum 2015
Meniscal Allograft Transplantation: How Should We Be Doing It? A Systematic Review


Meniscal allograft transplantation. Part 2: systematic review of transplant timing, outcomes, return to competition, associated procedures, and prevention of osteoarthritis

Gonzalo Samitier · Eduard Alentorn-Geli · Dean C. Taylor · Brian Rill · Terrence Lock · Vassilis Moutzouris · Patricia Kolowich

Meniscal Allograft Transplantation

A Systematic Review

Federica Rosso,* MD, Salvatore Biscicchia,† MD, Davide Edoardo Bonasia,‡ MD, and Annunziato Amendola,§† MD, PhD

Investigation performed at the UI Sports Medicine Center, Department of Orthopaedic Surgery, University of Iowa Health Care, Iowa City, Iowa, USA

Knee Surg Sports Traumatol Arthrose
DOI 10.1007/s00167-014-3310-0

Meniscal allograft transplantation in a symptomatic meniscal deficient knee: a systematic review

Nick A. Smith · Nicola MacKay · Matthew Costa · Tim Spalding
Lysholm at Final Follow-up

Meniscal allograft transplantation in a symptomatic meniscal deficient knee: a systematic review

Nick A. Smith · Nicola MacKay · Matthew Costa · Tim Spalding


Between 80 and 85 (0-100)
Tegner at Final Follow-up

Meniscal allograft transplantation in a symptomatic meniscal deficient knee: a systematic review

Nick A. Smith · Nicola MacKay · Matthew Costa · Tim Spalding


Tegner of 5 (0-10)
Meniscal allograft transplantation in a symptomatic meniscal deficient knee: a systematic review

Nick A. Smith · Nicola MacKay · Matthew Costa · Tim Spalding


IKDC of 70 (0-100)
Overall Satisfaction

Meniscal Allograft Transplantation: A Systematic Review
Federica Rosso, Salvatore Biscicchia, Davide Edoardo Bonasia and Annunziato Amendola

- 14 studies
- Overall Satisfaction = 81.6%
Return to Sport

Knee Surg Sports Traum 2015

- 3 Level IV studies, 39 athletes

Arthroscopy 2013

- HS, collegiate and professional

Cumulative RTS = 84%
- 37 MAT mean 15 yo
- 11 open physes
- 84% Lateral
- Mean 7.2 years
- 22% re-operation
- No revisions
- Improved KOOS, Lysholm
  IKDC, WOMAC
Complications

- Data from 20 studies
- **Cumulative complication rate = 10.6%**
  - 59.7% tear of allograft
  - 30.7% synovitis
  - 6.2% superficial infection
  - 2.4% deep infection

**Meniscal Allograft Transplantation: A Systematic Review**
Federica Rosso, Salvatore Biscicchia, Davide Edoardo Bonasia and Annunziato Amendola
Rate of Reoperation Following Meniscus Allograft Transplantation: 90-Day, 1-year, and 2-Year Analysis


- PearlDiver Database
- 291 MAT (2007-2011)
- Re-operation
  - 0% at 90 days
  - 14% at 1-year
  - 18% at 2-years
- Debridement/Chondroplasty/Meniscectomy
- Revision 5%/year
Prospective Long-Term Evaluation of Meniscal Allograft Transplantation Procedure: A Minimum of 7-Year Follow-Up

Bryan M. Saltzman, B.A.  
Sarvottam Bajaj, B.S.  
Michael Salata, M.D.  
Erika L. Daley, B.S.  
Eric Strauss, M.D.  
Nikhil Verma, M.D.  
Brian J. Cole, M.D., M.B.A.

JKS 2012

- N=22
- Mean 32 yo
- Mean F/U 8.5 yrs (+- 1.3)
- Mean Satisfaction 9/10
- 88% success
N=172/200 at mean 59 mo
- 60% combined
- 95% survival
- 32% reoperation
  mean of 21 months
  - 60% debrided
  - Odds ratio of 8.4 for future TKR or revision MAT
MAT Failure Over Time

- 2 years: 5%
- 5 years: 20%
- 10 years: 50%
Revision MAT

Clinical Outcome of Revision Meniscal Allograft Transplantation: Minimum 2-Year Follow-up

Adam B. Yanke, M.D., Peter N. Chalmers, M.D., Rachel M. Frank, M.D., Nicole A. Friel, M.D., Vasili Karas, M.D., and Brian J. Cole, M.D., M.B.A.

- N=11
- Time to revision: 3.5 (+- 2.5 yrs)
- Mean F/U 4 yr (+- 1.3 yrs)
- Satisfaction: 7.6 (+-2/6)/10
- No radiographic progression
Prospective Clinical and Radiographic Outcomes after Concomitant Anterior Cruciate Ligament Reconstruction and Meniscus Allograft Transplantation at a Minimum 2-Years Follow-Up

Saltzman BM, Meyer MA, Weber AE, Poland SG, Yanke AB, Cole BJ

- N=40
- F/U 5.7 +/- 3.2 Years
- 80% Revision ACL
- 80% Survivorship with Ave failure 7.3 yrs
- Improvement in 12/15 PROs
- 50% RTS
- KT Testing w/o S-S difference
- No change JSN
- 35% Re-Operation
- Failure: W/C and non-athlete
Is MAT Chondroprotective?

- 38 studies with 1056 allografts
- Weighted mean JSN 0.032mm at 4.5 years across 11 studies
- Meniscal extrusion was almost always present but was not associated with inferior outcomes

Conclusion: There is some evidence to support the hypothesis that MAT may reduce the progression of OA.
Consensus statements based upon the interpretation of the literature and practice experience of high volume surgeons who track and report outcomes following MAT
1. Indications
   - Pain in the presence of a “functional meniscectomy”
   - Concomitant to revision ACL
   - Concomitant to articular cartilage repair

2. Not routine in the asymptomatic meniscectomized patient

3. Caution KL grade 3 or above

4. Non-irradiated frozen or viable meniscal allografts

5. Quantitative methods for sizing (MRI or radiographs)

6. There is no superiority of one technique over another

7. Consider osteotomy w MA deviation

8. Caution w RTS in contact or collision athlete
Conclusions

- Proper indications!
- Early is better...but?
- MCID in multiple PROs (70-80%)
- High satisfaction (80%)
- Can get athletes back to play (75%)
- Survivorship minimum of 50% at 10 years
- Low serious complication rate (10%)

MAT Makes Patients more Age-Appropriate for Arthroplasty, but they may not fare as well when revised
THANK YOU

19th Annual AAOS/AOSSM
SPORTS MEDICINE COURSE
January 31 - February 3, 2018 • Park City, UT

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