Management of Articular Cartilage Lesions

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Disclosures

- Research
  - Moximed
  - Zimmer
- Orthopaedic Surgeon
  - Enjoys operating
  - Like to see patient do well after surgery

why do we fix articular lesions?

How come my knee hurts?
Joint pain

- Different causes
  - Trauma with fracture
  - Ligament tear
  - Overuse
  - Infection
  - Muscle weakness/imbalance
  - Cartilage wear and injuries

Treatment of Articular Injuries

- Age
- Activity
- Symptoms
- Need

Articular Cartilage Injuries

How do you diagnose articular cartilage injuries?
- Physical examination
- X-rays
- MRI
- Arthroscopic surgery
Knee surgery—Arthroscopic evaluation

Arthritic knee

Treatment of Articular Injuries
- Palliative
  - debridement
- Reparative
  - Marrow stimulation
- Restorative
  - Osteochondral plugs
  - Cartilage Transplantation
- Realignment
- Replacement

Treatment
- Palliative
- Lavage/Debridement
  - 52-74% Good
- Mechanical
  - Shaver
  - Curette
  - Rongeur
- Thermal / Radiofrequency
- Clean up Surgery
Abrasion Chondroplasty

Clean up surgery

- Multiple randomized controlled study
  - Arthroscopic debridement vs

  **CLEAN UP SURGERY DOESN’T WORK!**

  Sihvonen et al, New Eng J Medicine 2013
  Kirkley et al, New Eng J Medicine 2008

Microfracture

- Rough Surfaces for Blood Clot Attachment
- Access to Mesenchymal Stem Cells and Growth Factors
- No weight on leg
- Continuous Passive Motion machine 6 hours/day
- Fibrocartilage

Steadman JR et al, Arthroscopy
Microfracture

Mosaicplasty / OATS
Bulk Allograft
Autologous cartilage transplantation - ACI

Restorative Treatment

- Mosaicplasty / OATS
- Bulk Allograft
- Autologous cartilage transplantation - ACI

Meyers et al. JBJS, 1989

Osteochondral Plugs

Advantages

- Intact “ORGAN”
- Duplicates Complex Multilayer Structure
- May Duplicate Normal Biomechanical Role
- Rapid Healing & Incorporation of Bone

Hangody et al, AJSM 2010
Osteochondral Plugs

- Harvest within 24° of Asystole
- Aseptic Processing
- Bacterial / PCR Testing
- “Fresh” 24°-7d
- “Prolonged-Fresh” 7-42d

Mosaicplasty

Bulk Osteochondral Allograft
Osteochondral allograft

Growing cells – Autologous Chondrocytes Implantation

- Smith, 1965 – 1st Isolation & Culture Chondrocytes
- Peterson, 1984 – Autologous Cultured Chondrocytes Rabbit Patella Defects
  - Hyaline-Like Cartilage -
  - 82% of ACI & 18% of controls
- Peterson, 1987 – Gothenburg – 1st Human ACI
- > 10,000 ACI’s Done Since 1987
**ACI - Technique**

- Biopsy & Grow
- Open/Mini-Open
- Periosteal Patch
- Suture Patch
- Seal
- Inject Cells
- Complications
  - Graft hypertrophy
  - Viability/Fill

Brittberg M et al, NEJM 1994

**2nd Generation**

**Scaffolds**

- Biocompatible
- Biodegradable
- Not Cytotoxic
- Mechanically Stable
- Hold Cells
- Support Cells

**M.A.C.I.**

- Membrane / Matrix
- Autologous
- Chondrocyte Implantation
- Spain
- Guillen-Garcia

Zak L et al, AJSM 2012
M.A.C.I.

- 34 Knees
- Start Feb 2002
- Multiple Associated Procedures
- Scaffolds
- No Suturing
- No Periosteum

Not FDA Approved
Used in Asia and Europe

3rd Generation

Neocart™

- FDA Phase III Trial
- UCSF part of Phase I and II
- Autologous Cartilage Disc

3rd Generation - Neocart

- Implant Neocart – Cartilage Disc
- Size To Defect
- Scaffold ‘pressurized’ to preserve integrity of cells
- Fix: Proprietary Glue
- No Sutures
- No Arthroscopy / Arthroscopic Implant

Implantation of Neocart: Three-dimensional Autologous Cartilage Patch

Crawford D et al, JBJS 2012
Neocart

- Phase III clinical trial
- Not approved for clinical use
- UCSF is part of the research group
- Focal cartilage injuries
- Not for generalized cartilage wear

Treatment of Articular Injuries

- Palliative
  - Debridement
- Reparative
  - Marrow stimulation
- Restorative
  - Osteochondral plugs
  - Cartilage Transplantation
- Realignment
- Replacement

Realignment

Tibiofemoral joint

- Long-standing hip to ankle views
  - Mechanical and anatomic axis
  - Compared with contralateral normal side
  - Use 66% of tibial plateau as landmark for ‘normal’ alignment
Treatment

- History of lateral meniscus surgery
- Lateral sided knee pain
- Alignment
  - Valgus 8 degrees
  - Distal femoral osteotomy

Ligament Instability

- 24 yo status post ACL reconstruction MM
- Avid soccer player
  - Wants to continue high level soccer
- 1A Lachman
- Minimal pivot glide - no clinical sx
- Medial joint line tenderness

Preop radiographs
**Treatment**

- Medial compartment breakdown
  - Cartilage resurfacing
- Medial meniscectomy
  - Transplant - competitive soccer
- ACL insufficiency
  - Biplanar osteotomy
- Microfracture medial femoral condyle
- Biplanar osteotomy
  - Decreasing tibial slope
  - Medial opening wedge
Treatment of Articular Injuries

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Unicompartmental Knee Replacement

- Disease in isolated compartment
- Lower demand patient
- Partial Knee replacement
- Maintain range of motion

Unicompartmental Knee Replacement

- Best for older patients
- Sedentary lifestyle
- Higher failure rates with high BMI
- Good operation
- 90% successful at 10 years
- Isolated compartment

Bonutti et al J Arthroplasty 2011

Total Knee Replacement

- One of the most successful orthopaedic operations
- 90-95% successful at 10 years
- Limited range of motion
- Older age
Total Knee Replacement

- Estimated 4.0 million patients in US currently have TKR
- 4.2% of the population age 50 or older
- Prevalence higher for female (4.8%) than male (3.4%)
- 161.5% increase over the past 20 years

Weinstein et al, JBJS 2013

Complications of TKR

- Infection
- Loosening
- Dislocation

Revision Knee Replacement

- Results not as good as primary total knee replacement
- Higher infection rate
- Higher revision rate

Hossain et al, CORR 2010

New Technology

- New methods of detection
- Early detection of cartilage injuries
- Prior to xray changes
T1 rho imaging

- Detection of loss of proteoglycan – cartilage matrix
- Detect changes before cartilage loss
- Detect changes before bony changes

T1rho in controls vs. OA

A healthy volunteer

An OA patient

• T1ρ values were elevated in all regions of the knee

Application – 38 yo acute ACL tear

Lozano et al, JBJS 2006

Arthroscopic video
New Treatment

- Stem cell injection
  - No science
  - Doesn’t work
  - Kobe Bryant
- PRP (platelet rich plasma)
  - Hines Ward
  - No data
  - Doesn’t work

New Treatment

- Vitamin
- Supplements
- Massages?

Realignment Procedures

- High tibial osteotomy
- Realigning the limb
- Redistribute the load

Mechanical Axis and Knee Loads

- Valgus position (62 and 75%)
  - Increase lateral compartment contact pressure over medial compartment pressure 30 and 40%
Is Shifting the Weight to the Lateral Side Good?

- Increase pressure 30-40%
- Increase wear to lateral compartment
- Longevity limited by lateral compartment wear
  - 7-9 years even in well done realignment procedures

Is there any ability to load share?

- New technology to ‘offload’ instead of shifting the load
- More effective treatment may be joint “unloading”
  - Device to take up load instead of shifting load

Loadsharing - KineSpring

How The Implant Operates

- The spring absorbs load from the joint during each gait cycle
- As the knee extends, the absorber compresses and absorbs joint overload
- As the knee flexes, the absorber lengthens and becomes passive
**Force Reduction Up to 13 kg**

- **Medial Compartment**

  - Untreated Knee
  - KineSpring® System Knee

Intra-articular loading, simulated gait cadaver study

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**“My Initial Reactions”**

- Surely, the Screws Will Break!
- It Looks Too Bulky!

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<th>Flexion Angle (°)</th>
<th>Unloading</th>
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<tbody>
<tr>
<td>Knee</td>
<td>0°</td>
<td>13 kg (20 lbs) (maximum)</td>
</tr>
<tr>
<td>Absorber</td>
<td>0 - 30°</td>
<td>&gt;0 kg</td>
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Unlike HTO or fracture plate components, absorber will not bear full load.

Data on file at Moximed.

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Treatment of Articular Cartilage Lesions

- Made significant progress in cartilage resurfacing
  - Restorative
  - Cell-based treatment
- Improvement in longevity of knee replacement
- Meet the patient’s need and symptoms