Treatment of Cartilage Injuries in Young Patients
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Harvest the Fruits of Orthopedic Care Conference
October 2018

Disclosures
• I have no financial disclosures
• I will not discuss any off label use of any products

Objective
• Provide background on the etiology of cartilage disease in young patients
• Overview of the treatment options available for cartilage defects in young patients

Agenda
• Cartilage Basic Science
• OCD background
• OCD Specific treatments
• All Cartilage lesion treatments
• Questions

Articular Cartilage Basic Science
• Avascular, aneural
• Large extracellular matrix
• Chondrocytes
  • Responsible for formation and maintenance of articular cartilage

Articular Cartilage Clinical
• Shock Absorber
• Distributes load to subchondral bone
• Low surface friction
  • Teflon coating
• Exceptional wear characteristics for gliding
Not all chondral injuries are the same

- Bone bruise/subchondral fracture
- Osteochondritis dissecans
- Traumatic chondral defect
- Osteonecrosis

Other Factors
- Location
- Size
- Subchondral bone
- Alignment
- Meniscal status
- Concomitant ligament tear
- Skeletal maturity
- Patient factors

Osteochondritis Dissecans

- Disease of subchondral bone
  - NOT CARTILAGE

Incidence

- Children ages 5-17
  - OCD 4th most common overall at 6%
  - Meniscus tears 10th most common overall at 3.4%
  - ACL tears 3rd most common overall at 9.4%
  - Referral Center bias?
  - Overall 15-30/100,000
  - Bilateral in 12-30%

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Brainless Application of Radiological Findings

VOMIT

Victim of Modern Imaging Technology

Richard Hayward, BMG, 2003

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A Shameless Plug

AOSSM & AAOS
- Free posters and brochures for all sports
- Resources for coaches, parents, physicians, & athletes

https://www.orthoinfo.org/onesportinjury
OCD Considerations

- Age – Open physis correlates with better prognosis for non-op management
- Location – Poor prognosis on LFC and PF jt
- Stability – Fluid behind lesion on MRI
- Size of lesion
- Patient’s alignment – protective or not
- How much subchondral bone is involved
- Containment

Management of OCDs

- Activity modification
- Debridement
- Marrow Stimulation
  - Drilling (antegrade or retrograde)
  - Screw fixation
  - Microfracture?
- Restorative
  - Osteochondral autograft/Mosaicplasty
  - Osteochondral allograft
  - ACI/MACI (Sandwich technique)
  - Cartiform
  - Biocartilage

To cut or Not to cut, that is the question

- Non-operative
  - Stable lesion in skeletally immature patient
  - Asymptomatic lesion in adult
- Surgical indications
  - Failure to improve after 6 months of non-operative management
  - Unstable lesion
  - Large lesion in patient within 1 year of skeletal maturity

Activity Modification

- Initial 6 weeks
  - Depends on patient compliance, severity of symptoms, and location
  - Crutches vs weight bearing cylinder cast vs unloader brace
- RTP: Radiographic evidence of reossification

“The art of medicine consists of amusing the patient while nature cures the disease.”
- Voltaire

Fragment excision & Debridement

- Temporary
- Doesn’t burn any bridges
- 71% degenerative changes at 11 years follow-up if on fragment excision and debridement (Murray, Knee 2007)

Drilling

- Perforation of the dense rim creates a healing response with neovascularization and ossification of the cartilaginous lesion
- Healing rate for stable lesions reported as 82-100%
- Transarticular drilling
  - Technically easier
  - Violates articular surface
- Retrograde drilling
  - Technically difficult
Screw fixation
- +/- Open debridement
- Healing rate: 84.6%
- Metal
  - Requires removal
- Biocomposite
  - Can create cysts (older generation)

Treatments for all Cartilage Lesions

Cartilage Repair Landscape

Microfracture
- Need intact subchondral plate (OCD?)
- Well shouldered lesion
- Fibrocartilage
- NWB x 6-8 weeks, full maturation of repair tissue at 12 months postop
- Best in low demand individuals

Allogenic Dehydrated Scaffold
- Dehydrated and micronized cartilage scaffold
- 5 year shelf life
- Contained lesions
- Retention of:
  - ECM: Type II Collagen, Aggrecan, Decorin
  - GF: TGF, FGF, PDGF, VEGF, BMP-7, EGF, IGF, etc.

Particulated Juvenile Cartilage
- Refrigerated particulated juvenile cartilage applied with fibrin glue
- Viable cells (shelf life 44 days)
- Contained lesion
- Good for PF joint (contour)
Cryopreserved Osteochondral Allograft

- Stored at -80°C
- Properties
  - Preserved architecture and biology of articular cartilage
  - Promotes MSC migration
  - Induces chondrogenesis
- Useful in uncontained lesions with irregular contour (PF workhorse)

Osteochondral Autograft Transfer (OATs)

- Mosaicplasty
- Lesions <2.5cm² (Donor site morbidity)
- Donor site
  - Periphery of LFC
  - Intercondylar notch

Osteochondral Allograft Transplant

- Workhorse
- Fresh Refrigerated Graft
- Size matched to patient
- Implanted between 14-28 days post mortem
- Indications
  - Revisions
  - Large size
  - Subchondral bone involvement
  - MFC and LFC lesions

Timing is Key

Percent of Cell Viability
Percent of Cell Viability
Proteoglycan Synthesis
Proteoglycan Synthesis

Outcomes

<table>
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<tr>
<th>Study</th>
<th>Mean follow-up (years)</th>
<th># of knees</th>
<th>Diagnosis</th>
<th>Failure rate</th>
<th>Graft survival rate</th>
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<td>Lafortune 2009</td>
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<tr>
<td>Goltz 2010</td>
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<td>Chondromalacia</td>
<td>3%</td>
<td>97%</td>
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<tr>
<td>Emmerson 2007</td>
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<td>65</td>
<td>Osteoarthritis</td>
<td>9%</td>
<td>97%</td>
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<tr>
<td>Grossi 2005</td>
<td>10</td>
<td>60</td>
<td>Post-traumatic</td>
<td>20%</td>
<td>80%</td>
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</tbody>
</table>

ACI/MACI

- Autologous cells harvested, expanded, and re-implanted
- Two surgeries
- Fits any curvature
- Newer 3D membranes
- 75% RTS
  - Start-stop sports difficult
ACI & OCA are superior at restoring hyaline cartilage

The Future
- Microfracture +
- Biocartilage + BMAC
- OCA + PRP

Summary
- Always consider the knee's alignment and stability
- Nonoperative is first line treatment for most stable lesions
- There is no one solution for all cartilage problems (But OCA is close)
- Biologics are the future, Arthroplasty is an epidemic

Questions