Advanced Hip Arthroscopy

SCOTT D. MARTIN, MD
DIRECTOR, JOINT PRESERVATION
DIRECTOR, MGH SPORTS MEDICINE FELLOWSHIP
ASSOCIATE PROFESSOR OF ORTHOPAEDICS
Disclosures

“Neither I nor my spouse/partner has a relevant financial relationship with a commercial interest to disclose.”
FDA APPROVAL

FDA Approval 361
- Homologous tissue
- Includes bone marrow
- Minimal manipulation – cannot take outside the OR
  - Cannot expand cells
FAI & Osteoarthritis

Abnormal contact creates a labral tear
  ◦ Pincer
  ◦ Cam
Articular cartilage defects
Narrowing of joint space

Degenerative Tear
Osteoarthritis
FAI: CAM IMPINGEMENT

- More common in males
FAI: CAM IMPINGEMENT

Causes chondrolabral damage & delamination

Type 1 Tear

Wave Sign
FAI: PINCER IMPINGEMENT

Pincer
- More common in females
- Acetabular rim over-coverage
- Global acetabular over-coverage

Nicole Wolf ©2018
FAI: PINCER IMPINGEMENT

Damage usually confined
- Labral tears
- Minimal chondral damage

Type II Tear

- Anterior
- Posterior
PRESERVING THE CHONDROLABRAL JUNCTION

Nicole Wolf ©2018
CAM Decompression
ACETABULOPLASTY
ANCHOR PLACEMENT
VERTICAL MATTRESS
LABRAL PRESERVATION
Shearing of articular cartilage
CHONDRAL FLAPS

Viable Cells found in chondral flaps

OSTEOARTHRITIS & THR

Articular cartilage has limited healing capacity

Standard surgical intervention for end stage pathology

PRESERVING THE NATIVE JOINT

Early Detection?

Get it right the first time

Preservation of the Chondrolabral Junction

Avoidance activities

Biologics
Histology: Chondrolabral Junction

Majority of tissue is Type 1 Collagen

Elastic property likely due to relaxed/crimped collagen ratio
  ◦ No elastin or laminin found in labrum
  ◦ Potentially lost with age

Fibrocartilage found in weight bearing area only

Increased substance P found close to labrum
  ◦ Suggests mechanical stress area
**Histology: Chondrolabral Junction**

(1) Cross section of the caprine acetabulum

(2a) Safranin-O stained chondrolabral junction at the anteroinferior zone and (2b) posterosuperior zone of the acetabulum demonstrating deep and shallow physiological cleft (black arrow), respectively.

(3a) Substance-p expression (green; blue, DAPI-stained nuclei) seen in chondrocytes closer to and (3b) away from chondrolabral junction.
Articular cartilage damage of OA and FAI differ

- Inflammatory cytokines greater in articular cartilage of FAI patients
- Earlier dx
- Preventive measures?
**METABOLIC MARKERS**

Damaged Tissue (arrow) secretes cytokines

Cytokines
1. regulatory proteinases that act as mediators to generate an immune response attract donor stem cells

Donor Stem cells
1. secrete proteins to stimulate stem cells
2. reduce inflammation
3. increase vascularity and blood flow
PARACRINE EFFECT

Paracrine Effect - inhibit and protect injured cells against death
  a. Cells stimulate endogenous cells to repair tissue
     1. Donor cells emit factors that signal endogenous cells
     2. Triggers patient's own cells to repair tissue

MSC - Mesenchymal stem cells
  a. Bone Marrow
  b. Adipose tissue
  c. Umbilical cord

Stem Cells
  a. Can directly replace diseased cells
  b. Differentiate into required cell type
    ◦ (Bone Marrow Transplant)
CARTILAGE REPAIR

Current repair techniques span 20 yrs

Most done in knee

May not be applicable to the hip

Distinct differences
- Constraint of joint
- Shear forces
- Morbidity
CELL-BASED THERAPIES

Introduce grafts to bridge defects
  ◦ mature cartilage
  ◦ undifferentiated stem cells

Autologous Chondrocyte Implantation (ACI)
Osteochondral Autograft Transfer (OAT)
Microfracture
Bone Marrow Aspirate Concentrate (BMAC)
KNEE VS HIP: CARTILAGE MANAGEMENT CHALLENGES

- ACI
- OATS
- Isolated Microfracture
- AMIC
- MACI
- DeNovo Tissue Grafting
- Mesenchymal Stem Cells (BMAC)

Technical Arthroscopic Limitations

Unreliable outcomes

HIP BIOMECHANICS & CARTILAGE MANAGEMENT

Increased shear force
  ◦ near peripheral aspect of femoral head and acetabulum

Pericapsular muscle weakness
  ◦ increases stressors & shear forces upon articular cartilage

Dysfunctional joint kinematics and force coupling around the joint
  ◦ lead to accelerated cartilage degeneration
    ◦ (i.e. increased forces on damaged cartilage yields further damage)

Snowball Effect
  ◦ Cartilage damage & dysfunctional kinematics

MESENCHYMAL STEM CELLS

Microfracture
- Disrupts subcortical bone
- Mesenchymal stem cells within blood clot along chondral defects
- Effective in small patient populations in the knee

Limitations
- Could accelerate cartilage degeneration
- Bone cyst formation
- Quicker progression to THR?
MESENCHYMAL STEM CELLS

BMAC
- Augment healing of chondral defects
- Single procedure
- No additional donor-site morbidity
- No disruption of subchondral bone

Previous early treatments mitigated symptoms
- not the disease process
BMAC

Can differentiate into BOTH
  ◦ Fibrocartilage
  ◦ hyaline cartilage

Important for chondrolabral junction healing

Samples analyzed from 10 patients (Ilium) showed
  ◦ CFUs visible within 24 hrs
  ◦ Number & activity highest seen in lab
Postero-superior zone

LAB

LAC

LB

LC

Zone 1

Zone 4

Zone 2

Zone 3
Antero-inferior zone
% of cells expressing Sub-P

Zone 1  Zone 2  Zone 3  Zone 4
Average fluorescence intensity per cell (A.U.)

- Zone 1
- Zone 2
- Zone 3
- Zone 4
SURGICAL TECHNIQUE

Early in Operation
- 51 cc venous whole blood drawn from median cubital vein
- Anticoagulant added

60 cc injected into processing centrifuge
- Separation of:
  - RBCs
  - PRP
  - PPP

~4 cc PRP + ~16 cc PPP aseptically drawn into a syringe
SURGICAL TECHNIQUE

Labral Repair with Chondrolabral Preservation
CENTRAL ANTERIOR PORTAL
ILIUM ASPIRATE
BONE MARROW ASPIRATION

~20-25 cc into 3 separate 60 mL syringes
  ◦ Total: 60-75 cc bone marrow aspirate
BONE MARROW PROCESSING

Injected into centrifuge
Concurrent with final stages of surgery
  ◦ No increased traction time
3 cc BMAC combined with 20 cc PRP/PPP
Thrombin added 3-5 mins prior to application
  ◦ Formation of “Megaclot”
MEGACLOT APPLICATION
MEGACLLOT APPLICATION
MEGACLLOT APPLICATION
MEGACLOT VISUALIZATION