Articular Cartilage Repair and Post-Operative Rehabilitation

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Objectives

• Epidemiology
• Basic Science and Anatomy
• Diagnosis and Patient Evaluation
  a. Physical Exam
  b. Standard imaging and special considerations
• Non-Operative Treatment Options
  a. Principles of Physical Therapy
  b. Bracing
  c. Injections/Biologics
  d. Clinical Decision Making
• Available Surgical Procedures
  a. Indications/Contraindications
    i. Marrow Stimulation
    ii. Whole tissue transfer (autograft and allograft)
    iii. Cell based repair
• Post-Operative Management
  a. Principles of Rehabilitation
  b. Specific Rehabilitation Guidelines
  c. Return To Play Phase

Epidemiology

• Dramatic rise in cartilage surgery with expanding knowledge and innovation
• 5% annual incidence growth over the last decade
• Palliative techniques remain more common (>2:1 ratio for repair and 50:1 ratio for restoration)

Basic Science and Anatomy

• Articular cartilage is essential to joint function
  o Reduce joint stress
  o Decrease surface friction
• Accomplished through intrinsic ability to deform and enlarge surface contact area
  o Decreases effect of load by reducing applied stress and contact pressure
• Cartilage has a limited capacity for self repair
  o Poor vascular supply
Relies on diffusion for exchange of nutrients and waste products

**Diagnosis and Patient Evaluation**

- Patient history – what to ask?
- Physical Exam – what to look for?
- Treatment considerations for patient with cartilage pathology
  - Etiology is often multi-factorial
    - Must carefully evaluate for (1) Deformity, (2) Instability, (3) Articular/Meniscal Deficiency
- Role of Imaging
  - Routine radiographs
  - Alignment films
  - Magnetic Resonance Imaging (MRI)
    - Cartilage specific sequences

**Non-Operative Treatment Options**

- Principles of Preoperative Rehabilitation
  - Allow healing environment
  - Location of Lesion
    - Wt-bearing surface of femoral condyle (avoid compressive forces)
    - Within the trochlea or retro-surface of patella (avoid shear forces)
- Role of bracing
  - Unloader brace
    - Effect on joint load in varus/valgus knee
    - Effect on biomechanics and gait
    - Review of clinical evidence
- Role of intra-articular joint injections
  - Options and Evidence
    - Corticosteroids
    - Hyaluronic Acid
    - Platelet-Rich-Plasma (PRP)

**Available Surgical Procedures**

- Surgical considerations
  - Lesion etiology
    - Traumatic (acute)
    - Chronic/Degenerative
    - Osteochondritis Dissecans
    - Avascular Necrosis
    - Early osteoarthritis
  - Lesion characteristics
    - Location
    - Size
- Grade
- Character
  - Chondral vs. osteochondral lesion
  - Contained vs. uncontained lesion

- Surgical techniques
  - Intrinsic repair/Marrow Stimulation
    - Microfracture
    - Drilling
    - Abrasion arthroplasty/chondroplasty
      - Description of technique
      - Indications/contraindications
      - Advantages/Disadvantages
      - Clinical outcomes
  - Whole tissue transfer/transplantation
    - Autogenous bone (OATs/Mosaicplasty)
      - Description of technique
      - Indications/contraindications
      - Advantages/Disadvantages
      - Clinical outcomes
    - Allograft tissue
      - Fresh
      - Fresh Frozen
        - Description of technique
        - Indications/contraindications
        - Advantages/Disadvantages
        - Clinical outcomes
    - Cell based repair/Minced cartilage
      - Autologous chondrocyte implantation (ACI)
      - De Novo NT
        - Description of technique
        - Indications/contraindications
        - Advantages/Disadvantages
        - Clinical outcomes

- Post-Operative Rehabilitation
  - Guideline Considerations
    - Guidelines following Articular Cartilage repair *vary greatly*
    - Individualize programs pending
      - Characteristics of the lesion
      - Lesion location
      - Patient characteristics & goals
      - Area of repair
      - Type of surgical procedure performed
      - Concomitant injuries & repairs
  - Guideline Considerations
    - Based on anatomy & mechanics of joint & articular cartilage
- Respect healing cartilage, time frames, & impact of various loading environments
- **NOT to Overload healing Articular Cartilage**

- **Principles of Rehabilitation**
  - Individualized Program:
    - Quality of articular cartilage
    - Gradual degeneration -> Reduce load-bearing capacity
    - Age, Motivation, Activity Level
  - Size, depth, containment
  - Surgical procedure:
    - Arthroscopic (Chondroplasty or microfractures)
    - Larger incisions (OAT, ACI)

- **Principles of Rehabilitation**
  - Healing Environment
    - Weight bearing & ROM restrictions
    - Immobilization results in deleterious effects to healing cartilage
      - Resultant proteoglycan loss & gradual weakening
    - Controlled wt bearing/ ROM are essential to facilitate healing
      - Stimulates matrix production
      - Improves tissue mechanical properties.

- **Evidenced Based Practice:**
  - Proximal Hip and Core strengthening
  - Weight bearing and ROM Progression
    - Early initiation & controlled exercises weight bearing better than immobilized & NWB
  - Range of Motion:
    - PROM is safe & effective immediately post-op
    - CPM enhances cartilage healing

- **Biomechanics: Contact Surfaces**
  - Femoral Condyle- Tib Plateau
    - Articulation constant throughout ROM
    - Near-full ext, anterior surface of each femoral condyle is in articulation with middle aspect of tib plateau
    - Wt bearing
      - As knee moves into > flexion, femoral condyles roll posteriorly & slide anteriorly
      - Articulation shifts posteriorly on femoral condyles & tibial plateaus
  - Patella & Trochlea
    - Articulation btwn inferior margin of patella and trochlea begins at ~10- 20 degrees knee flexion depending on size of patella & length of patella tendon
    - Area increases with flexion
    - Review of Facet articulations with Flexion Degrees
Clinical Application Examples

- Address Pain/ Effusion
  - Quadriceps reflexive inhibition
  - Increased intra-articular joint temperature, detrimental effect on articular cartilage
  - Examples clinically

- Restoration of Soft Tissue Balance & Muscle Function
  - Soft Tissue Balance
    - Knee extension ROM is **vital**
    - Patellar mobility: Impact on quadriceps activation
  - Restoration of muscle Function
    - Clinical Examples
    - Electrical Muscle stimulation & biofeedback
    - Proximal Hip & Kinetic chain strengthening

Video

- Proprioception & Neuromuscular Control
  - Deficits have been noted in injured and post-op knee
  - Evidence based progression

- Controlled Application of Loading
  - Progression of increased stress applied to the knee
  - Healthy stimulus for healing cartilage tissues
  - Clinical Examples

Photos/ Videos

- Specific Rehabilitation Guidelines Following Specific Repairs
  - 4 Phases based on Cartilage Maturation
  - Each Guideline to be discussed
  - Phases: Progressed with different Timeframes
    - Protection/ Proliferation Phase
    - Maturation/ Transition Phase
    - Remodeling/ Functional Phase
    - Maturation Phase/ Return to Play

- Return to Play
  - Dependent on each individual & specific criteria

Videos/ Case Report