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
    - Reduce joint stress
    - Decrease surface friction
- Accomplished through intrinsic ability to deform and enlarge surface contact area
    - Decreases effect of load by reducing applied stress and contact pressure
- Cartilage has a limited capacity for self repair
    - 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 retrosurface 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 characteritics
    - 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
- Biomechanics: Contact Surfaces
    - 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

VIDEO

- **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

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