Articular Cartilage Defects in the Knee

Pathophysiology and Defining the Functional Problem

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Articular Cartilage Defects in the Knee

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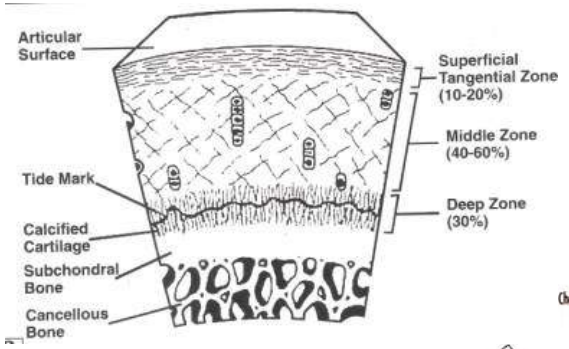
Outline

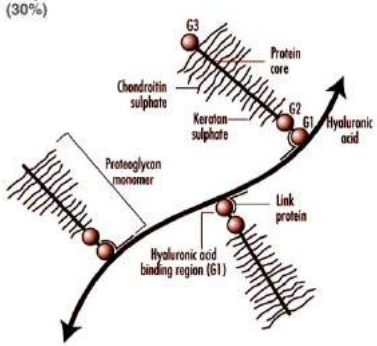
- **Anatomy**
- **Function**
- **Pathophysiology**
- **The Problem(s)**

Articular Cartilage Defects in the Knee

Anatomy

- **Hyaline Cartilage**
  - **Extracellular matrix**
    - **Water (80% total mass)**
    - **Collagen (10%)**
      - **90% Type II**
    - **Proteoglycans (5%)**
  - **Cells**
    - **Chondrocytes (5%)**

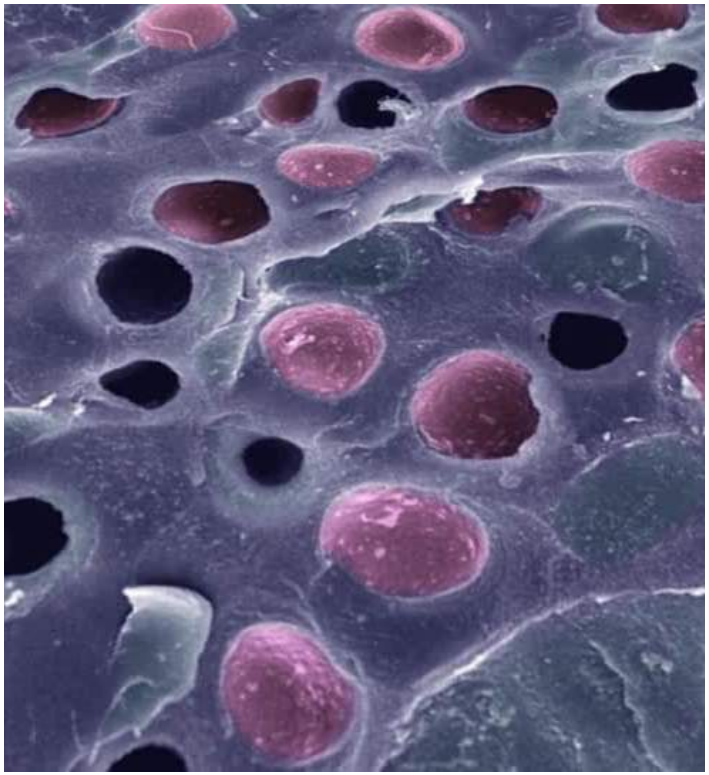




Articular Cartilage Defects in the Knee

Anatomy

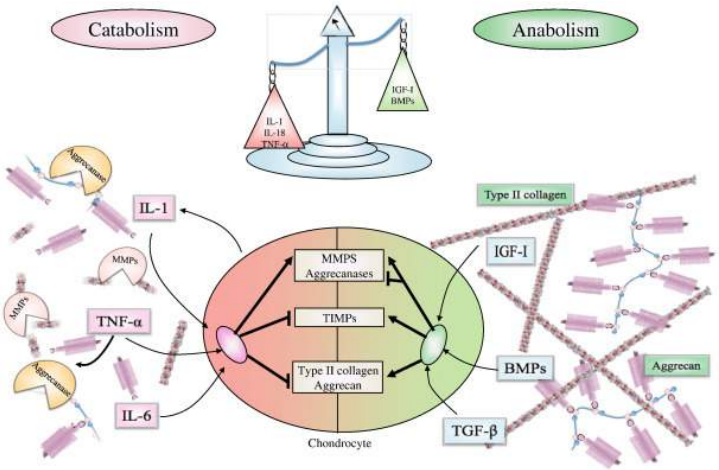
- **Chondrocytes**
  - **Housed in lacunae**
  - **Synthesize, maintain matrix**
    - **Collagen**
    - **Proteoglycans**



Articular Cartilage Defects in the Knee

Anatomy

- **Chondrocytes**
  - **Survival and productivity driven by chemical mediators & mechanical stimuli**
    - **PDGF, FGF, TGF-β, IGF-1**
    - **IL-1, TNF-α**
    - **Physiologic loading**

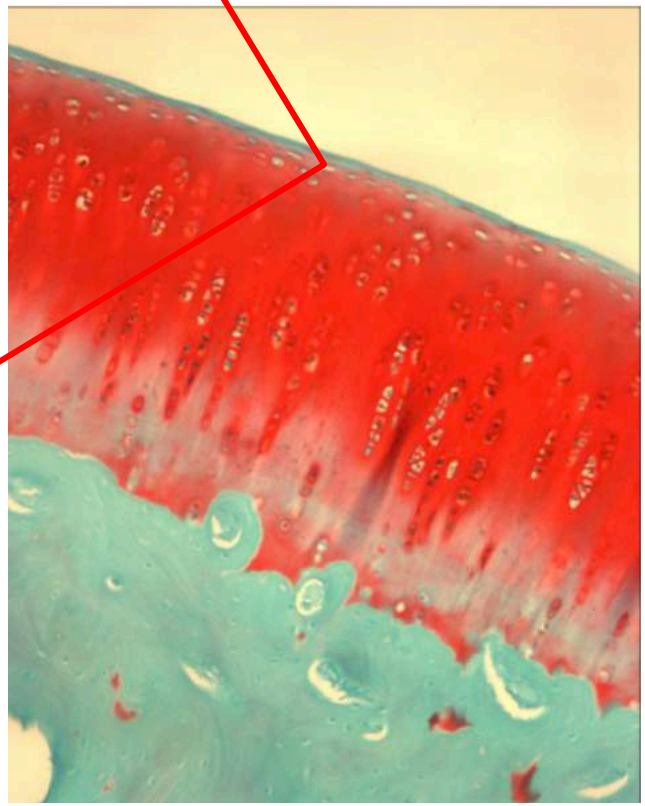


Articular Cartilage Defects in the Knee

Anatomy

- **Hyaline Cartilage**
  - **<u>Avascular</u>**
  - **Aneural**
  - **Alymphatic**
  - **Hypocellular**
  - **Nourished by synovial fluid, bone**

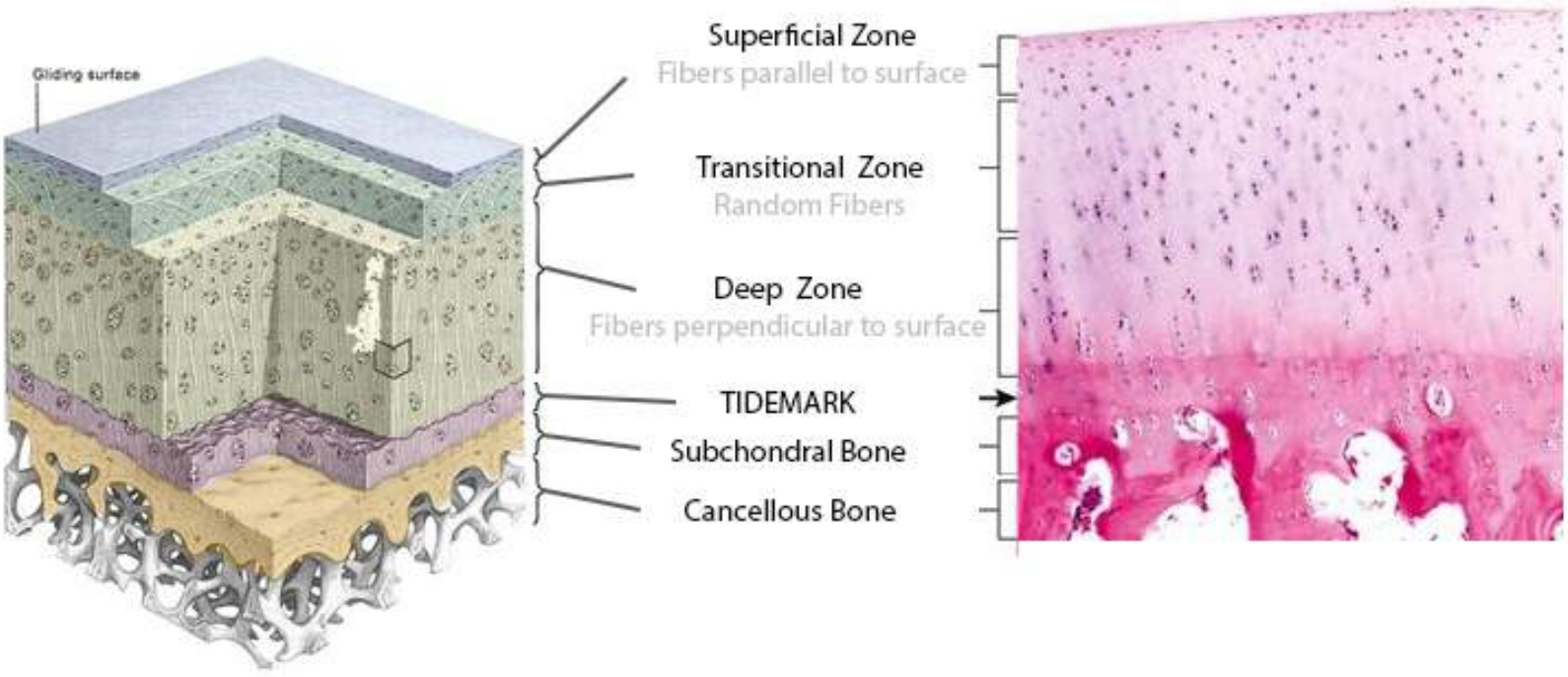
POOR HEALING POTENTIAL



Articular Cartilage Defects in the Knee

Anatomy

- **Articular Cartilage Zones**



Articular Cartilage Defects in the Knee

Function

- **Hyaline Cartilage**
  - **Form ←→ Function**
  - **Decreases friction**
    - **Parallel fibers at surface resist sheer**
  - **Distributes loads**
    - **Type II collagen, PG, H2O resist compression**

Articular Cartilage Defects in the Knee

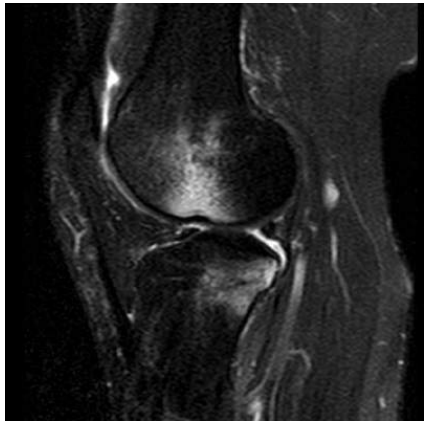
Function

- **Hyaline Cartilage**
  - **Complex Microstructure**
    - **Just 2-4 mm thick!**

Articular Cartilage Defects in the Knee

Pathophysiology

- ***Acute Trauma***
- **Chronic Repetitive Trauma / Overload**
- **Idiopathic**
  - **Osteochondritis Dissecans**



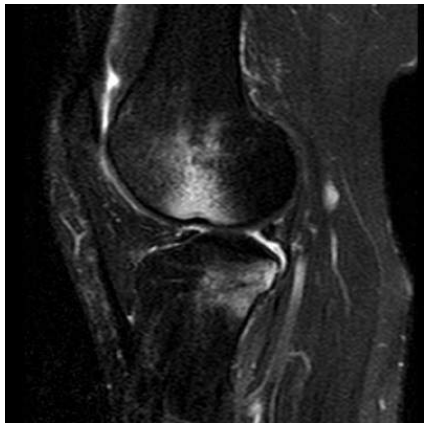
Articular Cartilage Defects in the Knee

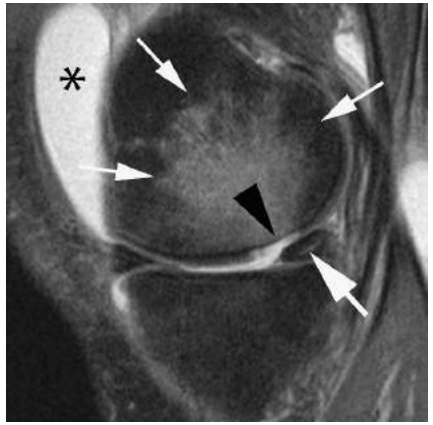
Pathophysiology

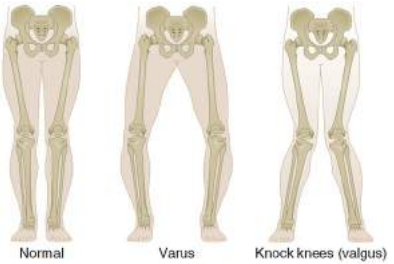
- **Acute Trauma**
- ***Chronic Repetitive***

  Trauma / Overload
- **Idiopathic**
  - **Osteochondritis**

    Dissecans



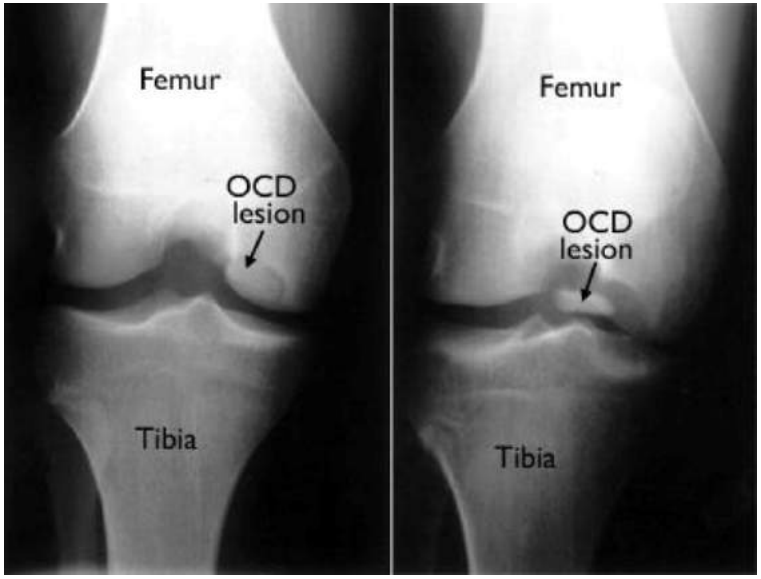




Articular Cartilage Defects in the Knee

Pathophysiology

- **Acute Trauma**
- **Chronic Repetitive Trauma / Overload**
- ***Idiopathic***
  - ***Osteochondritis Dissecans***



Articular Cartilage Defects in the Knee

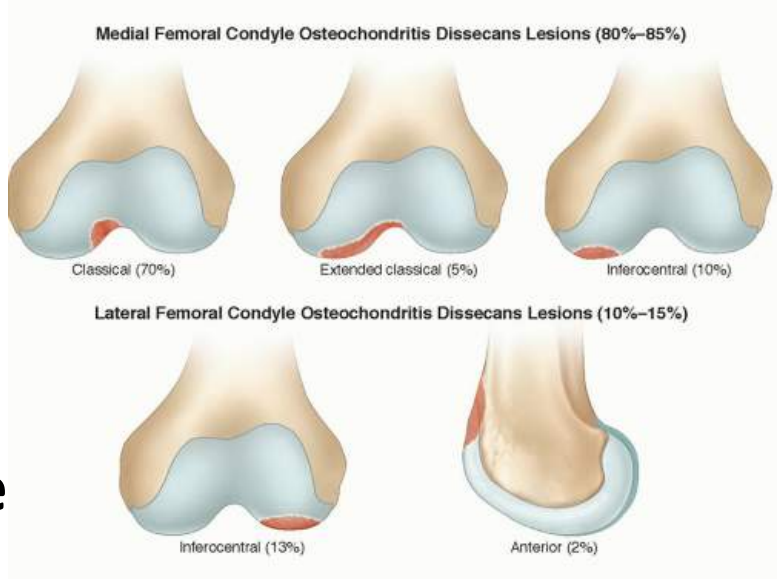
Pathophysiology

- **Osteochondritis Dissecans (OCD)**
  - **Vascular?**
  - **Traumatic (micro)?**
  - **Genetic predisposition?**
  - **Abnormal ossification?**
  - **Endocrine?**

Articular Cartilage Defects in the Knee

Pathophysiology

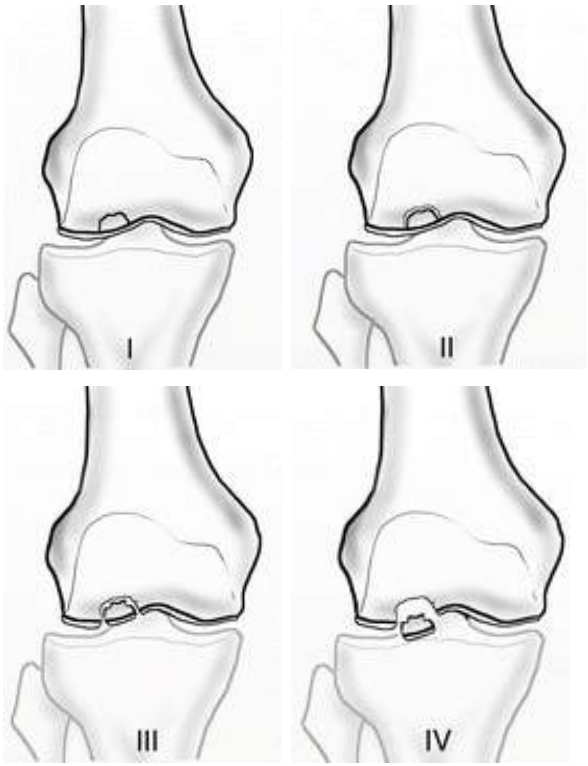
- **Osteochondritis Dissecans (OCD)**
  - **Medial femoral condyle**
  - **Bilateral 20-30% cases**
  - **Juvenile vs. Adult**
  - **“Inside-out”**



Articular Cartilage Defects in the Knee

Pathophysiology

- **Osteochondritis Dissecans (OCD)**
  - **Classification (Clanton/ICRS)**
    - **I – Depressed osteochondral fracture**
    - **II – Partially detached**
    - **III – Detached, nondisplaced**
    - **IV – Displaced fragment**



Brittberg M, Winalski CS. Evaluation of cartilage injuries and repair. JBJS AM 2003;85:58-69

Articular Cartilage Defects in the Knee

Pathophysiology

- **Osteochondritis Dissecans (OCD)**
  - **Classification (Clanton/ICRS)**

STABLE

- **I – Depressed osteochondral fracture**
- **II – Partially detached**

UNSTABLE

- **III – Detached, nondisplaced**
- **IV – Displaced fragment**

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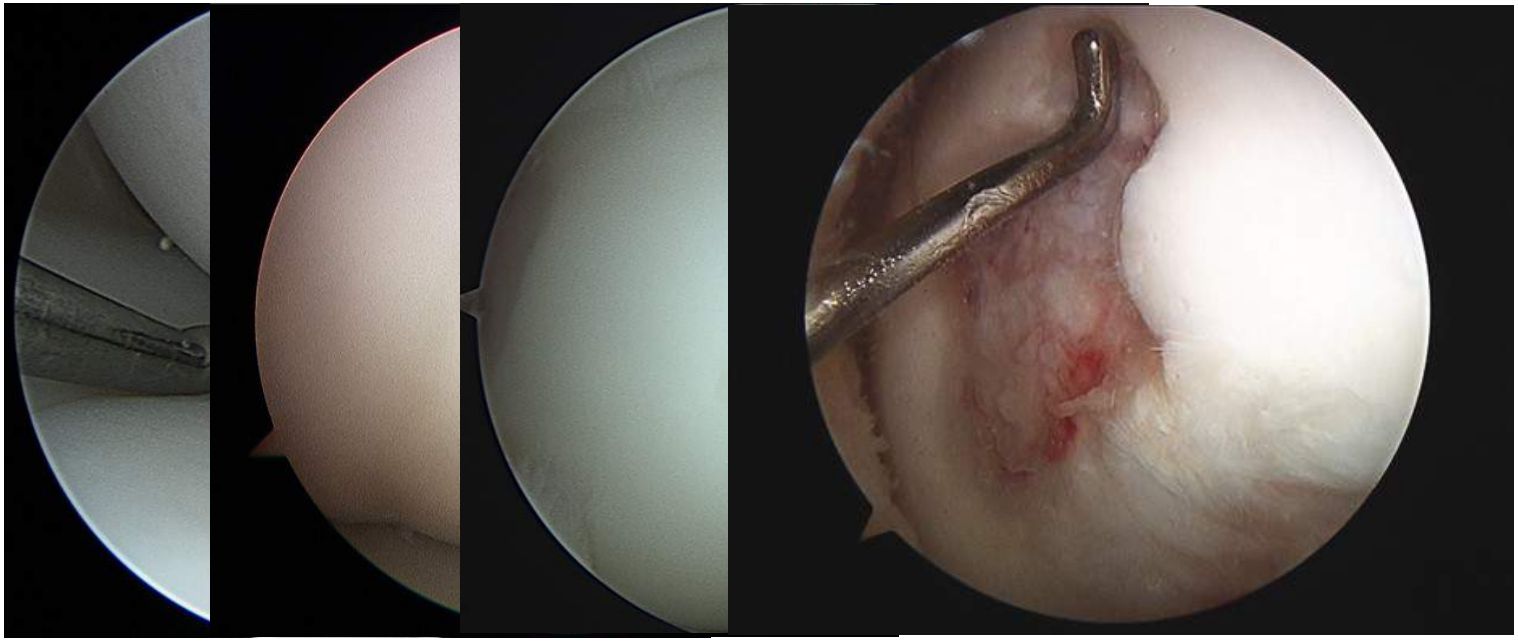
Articular Cartilage Defects in the Knee

Pathophysiology

- **Osteochondritis Dissecans (OCD)**
  - **Research in Osteochondritis of the Knee (ROCK)**

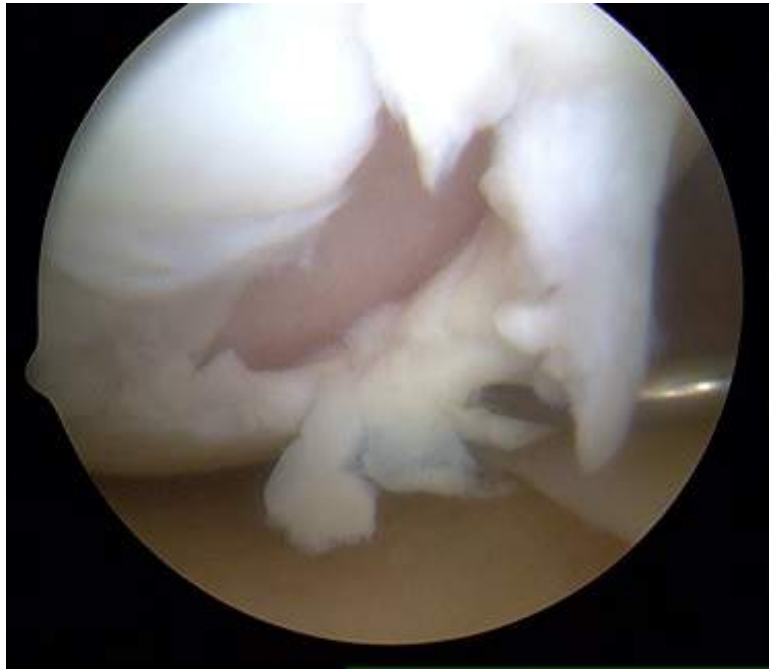


Carey JL, Wall EJ, Grimm NL, et al. Novel Arthroscopic Classification of Osteochondritis Dissecans of the Knee: A Multicenter Reliability Study. AJSM 2016;44:1694-8

Articular Cartilage Defects in the Knee

Pathophysiology

- **Acute / Chronic Trauma**
  - **“Outside-in”**

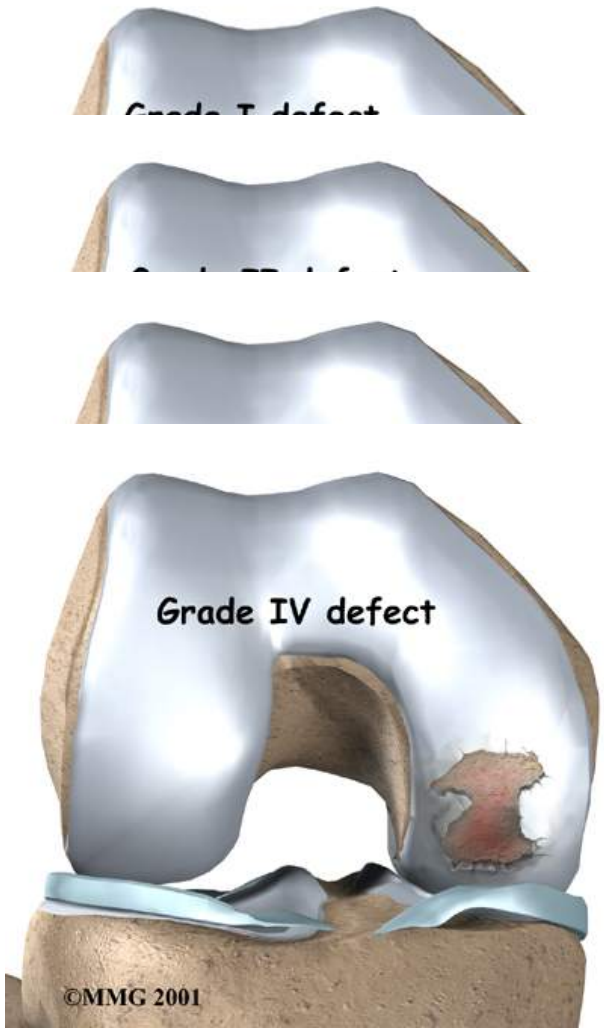


Articular Cartilage Defects in the Knee

Pathophysiology

- **Acute / Chronic Trauma**
  - **“Outside-in”**
  - **Classification**

    (Outerbridge/ICRS)
    - **0 – Normal**
    - **1 – Near Normal**
    - **2 – Superficial (<50%)**
    - **3 – Deep (>50%)**
    - **4 – Full Thickness**



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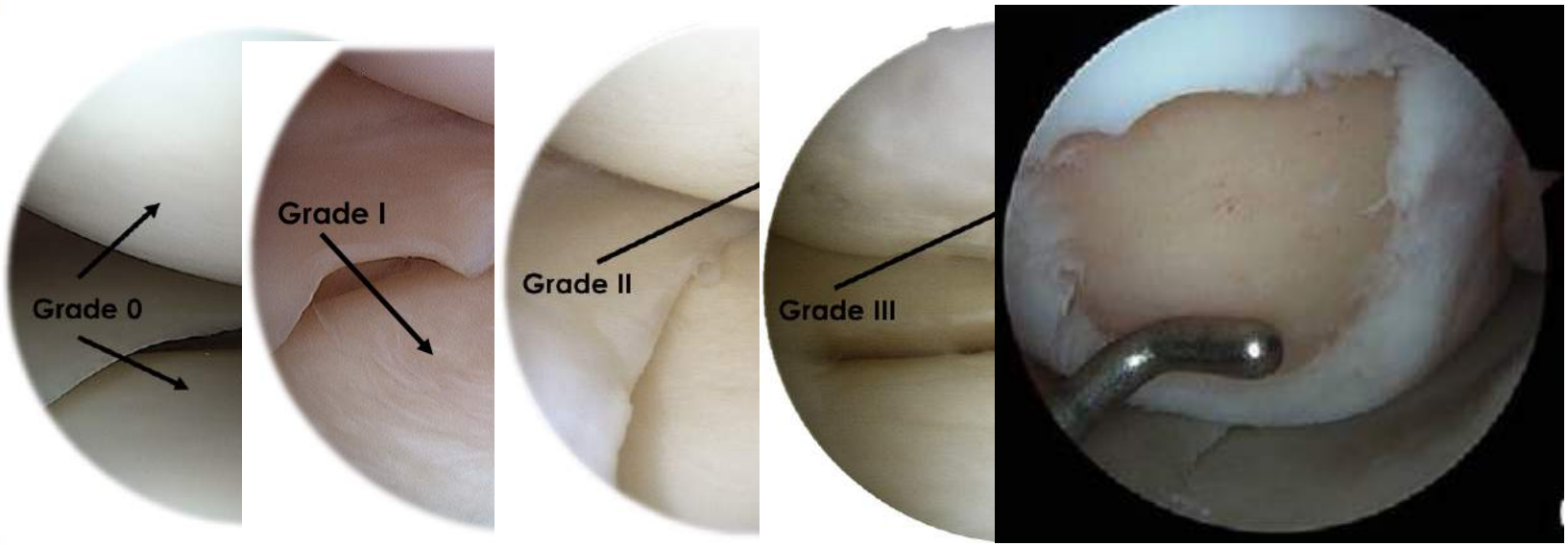
Pathophysiology

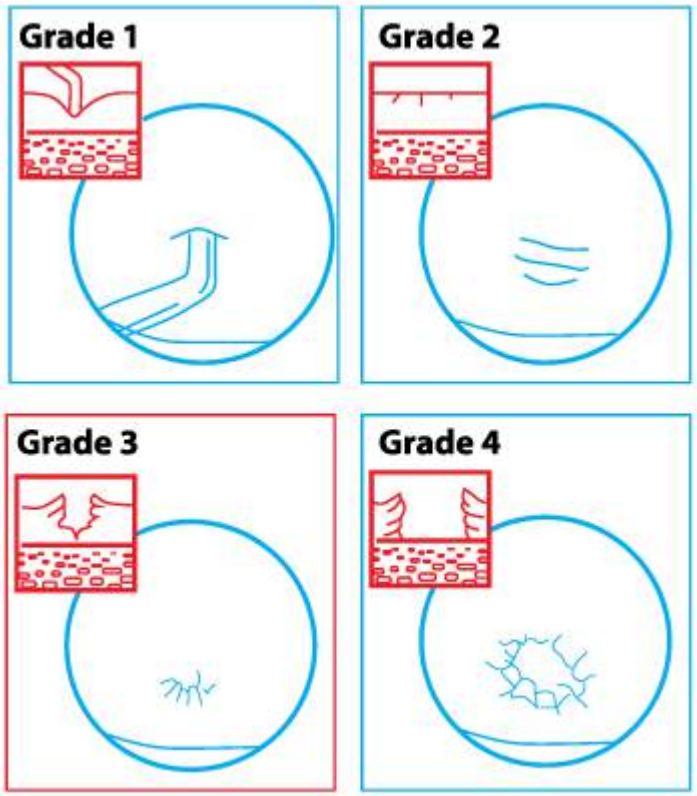
- **Acute / Chronic Trauma**
  - **“Outside-in”**
  - **Classification (Outerbridge/ICRS)**



Articular Cartilage Defects in the Knee

Healing

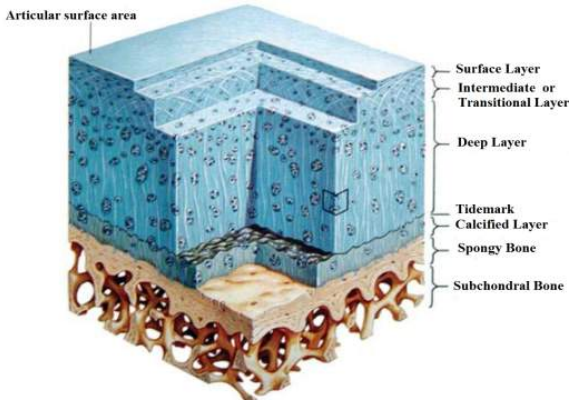
- **Superficial Injury (Grade 1-3)**
  - **No true healing due to avascularity**
  - **Limited chondrocyte proliferation**
  - ***Progressively worsens***

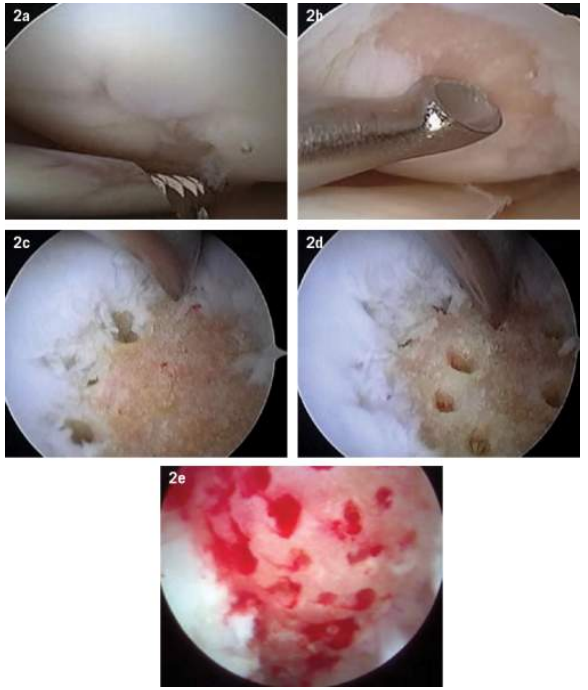


Articular Cartilage Defects in the Knee

Healing

- **Deep injury (Grade 4)**
  - **Through tidemark, into subchondral bone**
  - **Hematoma, stem cell migration, vascular ingrowth**
  - **…Fibrocartilage**

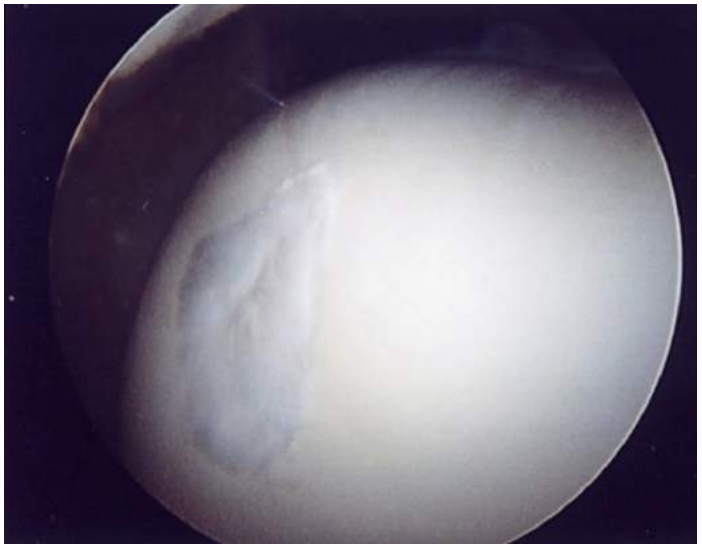




Articular Cartilage Defects in the Knee

Healing

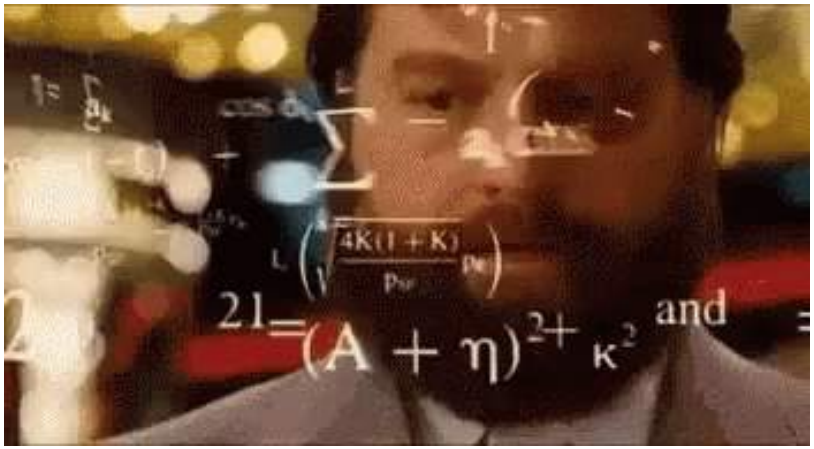
- **Deep injury (Grade 4)**
  - **…Fibrocartilage**
    - **Type I cartilage**
    - **Poor wear mechanics**
    - **Decreased resiliency**



Articular Cartilage Defects in the Knee

The Problem(s)

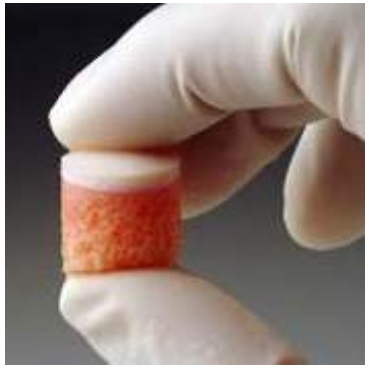
- **Poor Healing Potential**
  - **Avascular**
  - **Hypocellular**
  - **Fibrocartilage**
- **Progressive symptoms, functional disability**
  - **Pain**
  - **Swelling**
  - **Mechanical symptoms**

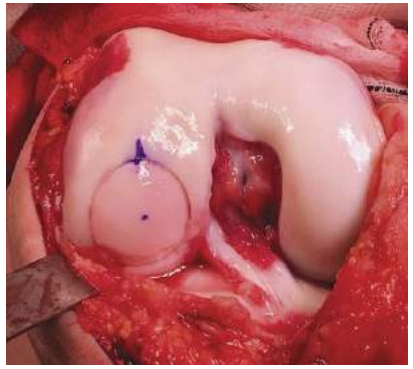


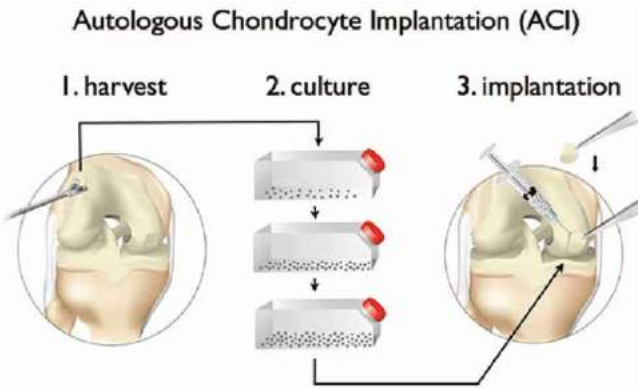
Articular Cartilage Defects in the Knee

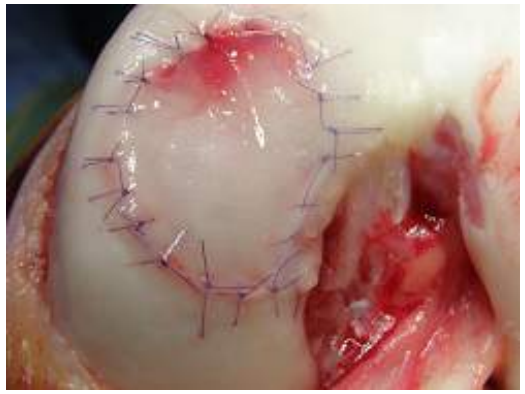
The Problem(s)

- **Challenging to Treat**
  - **Complex biochemistry**
  - **Complex structure**
  - **High mechanical demands**









Articular Cartilage Defects in the Knee

All The Answers!

Thank You!