



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

BMST4004

Cartilage Healing

Trawsnewid Addysg; Trawsnewid Bywydau
Transforming Education; Transforming Lives



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Learning Outcomes

- Describe types of Cartilage found in the body
- Discuss cartilage healing including timescales and timeframes that facilitate appropriate cartilage healing
- Discuss cartilage tolerance to loading and types of cartilage injury



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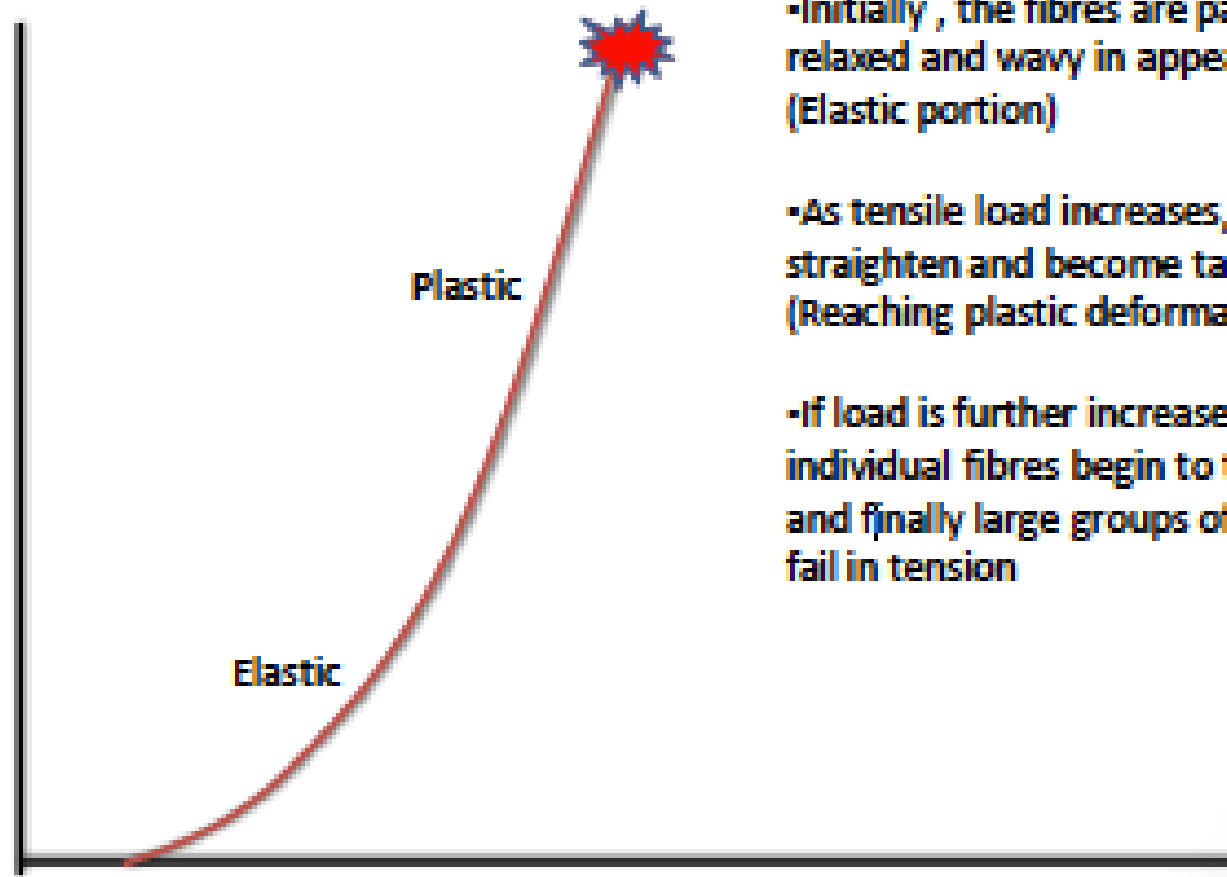
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Articular Cartilage

- Thin layer of hydrated soft tissue covers end of bones of diarthrodial joints
- 'perform their functions so well that we are often not aware of their existence nor their function until injury strikes or arthritis develops' (Mow, Ratcliffe & Poole. 1992)
- Type II collagen principal fibrous protein in hyaline cartilage
- These collagen fibres are recruited as a tensile load is applied

Hyaline Cartilage and Tensile Load



- Initially, the fibres are partially relaxed and wavy in appearance. (Elastic portion)

- As tensile load increases, fibres straighten and become taut. (Reaching plastic deformation)

- If load is further increased, individual fibres begin to tear and finally large groups of fibres fail in tension



Cartilage Loading

- Cartilage has a natural tendency to swell
- Deformed cartilage draws water in to the extracellular matrix
- Cartilage also susceptible to creep (constant load)
- Cyclic loading required for normal matrix and cell health
- Excessive loading can be destructive to matrix
- Constant pressure will cause fluid to exude from matrix: stable compressive deformation
- Cyclic loading and unloading of cartilage allows for dynamic flow of fluids (with nutrients and waste products) in to and out of the tissue



Cartilage and Lubrication

- Coefficient of friction for Articular cartilage reported as 0.01 to 0.04
- Sliding on ice: 0.01-0.10
- 2 hypotheses
- **Boundary lubrication**
- Layer of molecules adhere to each of the two surfaces as they glide past each other
- **Fluid-film lubrication**
- 2 non-parallel surfaces move past each other on a thin layer of fluid
- Fluid maintains a distance between two surfaces 'hydrodynamic lubrication' 'elastohydrodynamic lubrication'



Articular Cartilage Adaptations

- Activities of Daily Living should provide enough load to provide adaption for optimal function
- Too much or too little leads to breakdown in quality of cartilage
- Loading facilitates exudate mobilisation
- Cartilage adaptations tend to be degenerative!



Cartilage Use v Disuse

- Exercise produces swelling
- Prolonged exercise:
 - chondrocyte hypertrophy
 - Increase in the pericellular matrix
 - Increase in # cells per unit of cartilage (Engelmark, 1961)
- Changes already evident after brief burst of exercise
- Long Term exercise produces more lasting change
 - Increased proteoglycans (Sammanen et al 1986)
 - Wear and tear changes (Vasan, 1983)



Cartilage Use v Disuse

- Excessive Loading
 - Decreased synthesis
 - Degradation of Cartilage
 - Leading to OA
- Reduced Loading
 - Decreased proteoglycans (Sammanen et al 1986)
 - Decreased synthesis
 - Increased fibrillation of cartilage surface
- Changes are greater with immobilisation



Cartilage injury classification

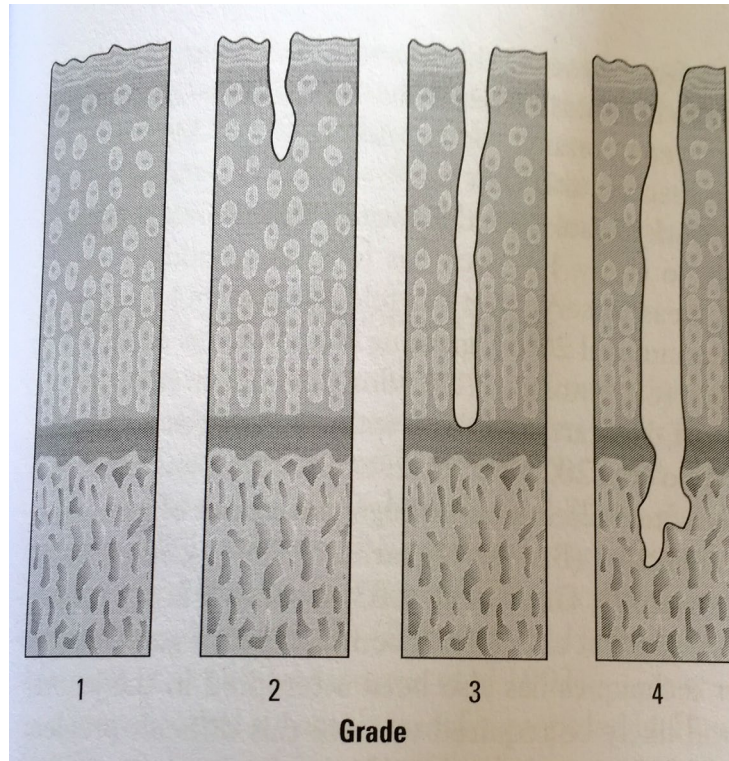


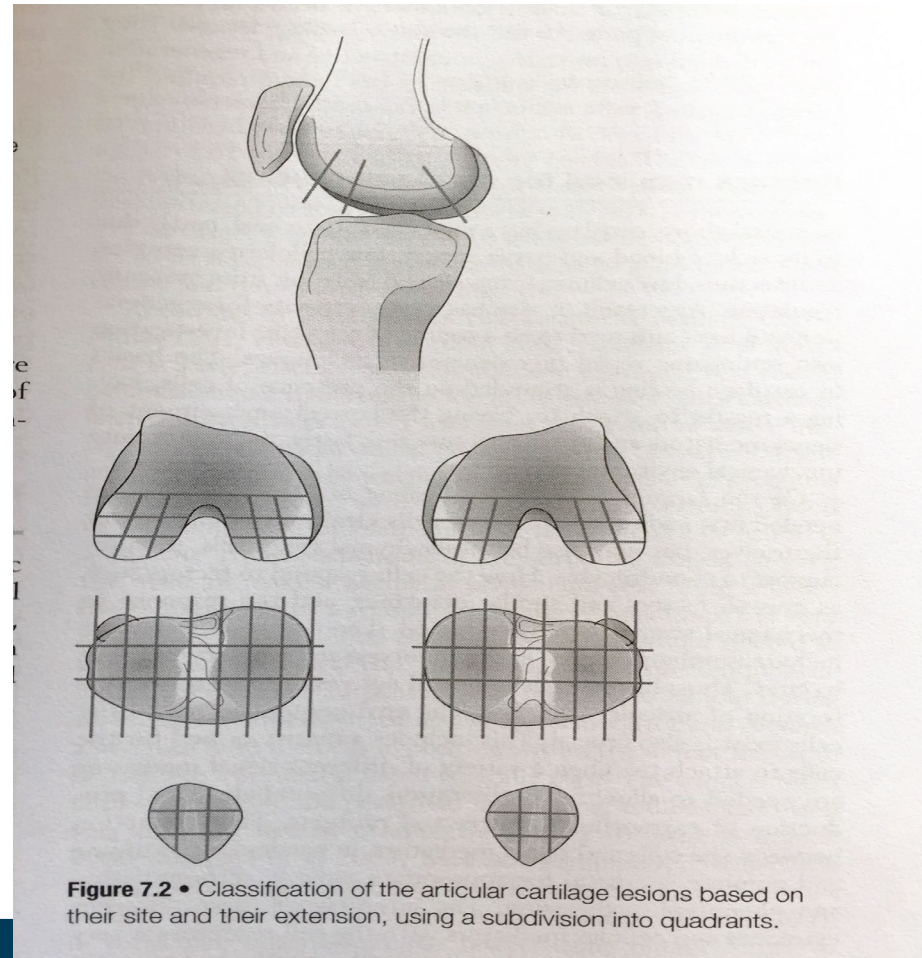
Table 7.1 The Outerbridge Morphological Classification (Outerbridge 1961)

Grade 1	The articular surface is swollen, soft and edematous, and is covered with vesicles
Grade 2	Includes non-full-depth lesions, with superficial fissurations that do not reach the subchondral bone. The lesions are never larger than 1.5 cm
Grade 3	The lesions reach the subchondral bone and are larger than 1.5 cm in diameter
Grade 4	There are full-depth cartilage erosions that include the subchondral bone, exposing it



Cartilage injury classification

Sites of common injury around the knee joint



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Articular Cartilage Healing

Time	Activity
48h	Fibrin clot is formed to fill the defect
5 d	Fibroblasts present in area and combine with collagen to replace clot
2 wk	Fibroblasts differentiate, islands of chondrocytes appear
1 mo	Fibroblasts have been completely differentiated
2 mo	Satisfactory repair occurred, defect resembling cartilage in appearance. Majority of collagen present is Type I
6 mo	Combination of Type I and Type II calcified cartilage Has a normal appearance



Task

- Please read the chapter in Kolt Synder-Mackler in relation to cartilage healing



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