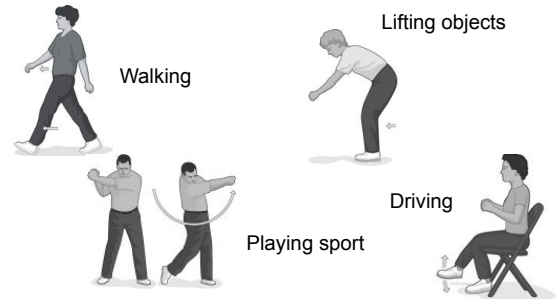


Articular cartilage: structure, function and healing



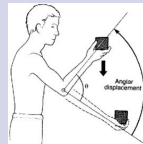
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30 January 2013

Importance of joints



Aims and Objectives

- Joints
 - Cartilagenous
 - Fibrous
 - Synovial
 - Different degrees of movement
- Articular cartilage biology
- Examples of joints
 - Upper limb
 - Spine
 - Lower Limb
- Injuries and joint failure
- Examination and Investigation
 - Look
 - Feel
 - Move
- Principles of treatment



Joints

Definition of joint

- What is a joint?
 - A joint is the location at which two or more bones make contact
 - They are constructed to allow movement and provide mechanical support
 - Classified
 - Fibrous / Cartilagenous / Synovial
 - Synovial joints are sub-classified

What maintains structure and function

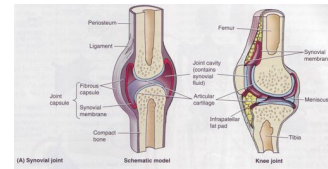
- Bone and structure
- Cartilage
- Soft tissues around the joint
 - Ligaments
 - Muscles
- Soft tissue within the joint

Three types of joints within the body

- Classified type of joint
 - Synovial joint (Diarthroses)
 - Most Joints
 - Fibrous (Synarthroses)
 - Syndesmosis
 - Sutures
 - Cartilagenous (Amphiarthroses)
 - Spine
 - Vertebrae seperated by discs (Type I and II collagen)

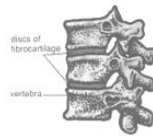
Synovial Joints

- These are freely movable joints
 - The ends of the bones covered with hyaline cartilage
 - Capsule encloses joint and synovium secretes synovial fluid to lubricate the joint
 - Ligaments and muscles are important for stability of joint
 - Articulating surfaces of adjacent bones are reciprocally shaped



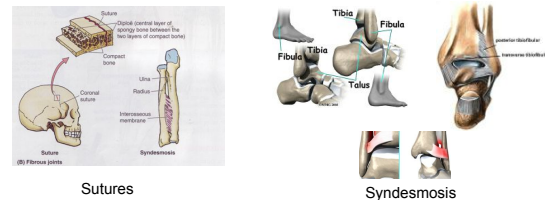
Cartilaginous Joints

- Articular surfaces of the bones forming the joints are attached to each other by
 - white fibro cartilaginous discs
 - ligaments
- Allow limited degree of movement.
- Examples of cartilage
 - between vertebrae
 - in the symphysis which binds the pubic bones together at the front of the pelvic girdle and the
 - between sacrum and the pelvis



Fibrous Joints

- Held together by thin layer of strong fibrous tissue
- Do not allow any movement between bones

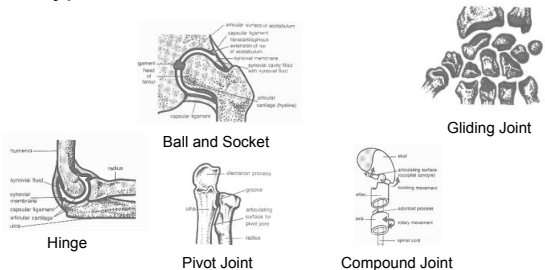


Synovial joint sub-classification

- Uniaxial
 - Hinge
 - Pivot
- Biaxial
 - Condylloid
 - Saddle
- Triaxial
 - Ball and Socket
 - Planar

Synovial joint sub-classification

- Type of movement





Function of Ligaments

- Joint stability

KNEE JOINT front view

Function of Muscles

- Movement
- Stability

Articular cartilage Biology

- Describe anatomy
- Basic structure of articular cartilage

Articular Cartilage

- Lines synovial joints
- Provides
 - Smooth gliding surface
 - Transfers weight
 - Acts as a shock absorber

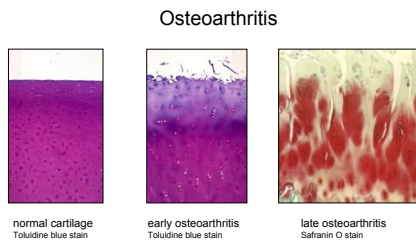
Hip
Synovial Joint (ball and socket)

Spine / vertebrae:
Disc: Type I (Annulus fibrosus) and type II collagen
Facet Joints: synovial joints

Articular cartilage

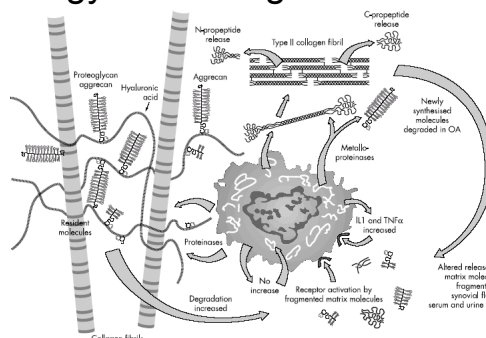
- Composition
 - Chondrocytes
 - Collagen II
 - Proteoglycans

Articular cartilage in disease



normal cartilage Toluidine blue stain
early osteoarthritis Toluidine blue stain
late osteoarthritis Safranin O stain

Biology of Cartilage

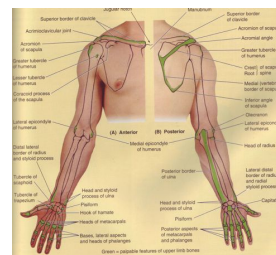


Examples of Joints

- Upper Limb
 - Sternoclavicular
 - Shoulder
 - Elbow
- Spine
- Lower Limb
 - Sacroiliac Joint
 - Hip Joint
 - Knee Joint
 - Ankle Joint

Upper limb

- Sternoclavicular
 - **Fibrous** with interosseous disc
- Acromioclavicular
 - **Fibrous with synovium**
- Shoulder
 - Ball and socket joint
 - **Synovial** (Glenohumeral)
- Elbow
 - Humerus and ulna / Hinge joint
 - **Synovial**
- Radius and ulna
 - **Synovial** - Superior radio-ulnar joint / Pivot joint
 - **Fibrous** - interosseous membrane – syndesmosis
 - **Fibrous with triangular fibrocartilage** - Distal radio ulnar joint
- Wrist
 - **Synovial** joint
- Fingers
 - hinge / saddle / condyloid
 - **Synovial** joints

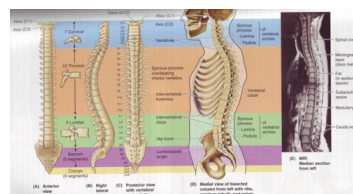


Example

- How many joints between radius and ulna?
 - Inferior radio-ulna joint fibrous (has interosseous cartilage)
 - Superior radio-ulna – pivot joint (annular ligament)
 - Between radius and ulnar – interosseous membrane = syndesmosis (pronate and supinate)

Spine

- Discs composed of type I and II collagen
- Discussed in detail elsewhere

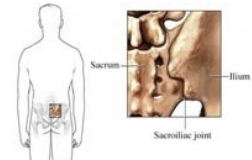


Lower Limb

- Sacroiliac joint
 - Largest joint in body / Stable
 - **Synovial**
- Hip joint
 - Ball and socket
 - **Synovial**
- Knee: Patellar / femur / tibia
 - **Synovial**
 - Sliding side to side and long axis
 - 6 movements
 - Vulnerable to injuries
 - 2 flat surfaces, curved surface.
 - Soft tissues maintain stability i.e. Popliteus, condensation of capsule.
 - Dip into articular surface. Intraarticular menisci.
- Tibia – Fibula
 - Like radius and ulnar
 - Tibia/Fibula **Fibrous** (syndesmosis)
- Ankle = true hinge, flexion and extension.
 - **Fibrous** (Syndesmosis)
 - **Synovial**

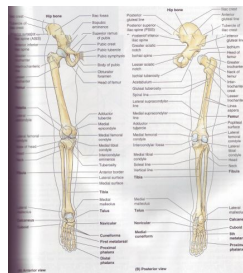
Sacroiliac joint

- Largest fibrous joint in the body (synovial articulation)
- Between sacrum and pelvis
- In standing position transfers body weight to lower limb
- Can be affected by inflammatory conditions and autoimmune diseases (Ankylosing Spondylitis)



Hip Joint

- Ball and socket joint.
- Configuration provides stability.
- If the ball and socket is shallow,
 - Developmental dysplasia
 - Dislocation,
- Compare the hip with shoulder, the shoulder is less stable and more likely to dislocate
- Hip joint bony configuration.

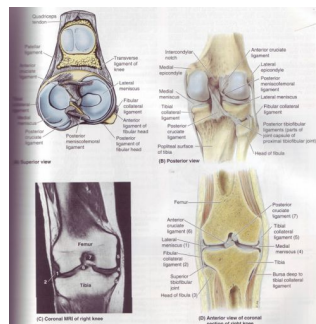


Knee Joint

- The knee joint has 6 degrees of movement.
 - Flexion / Extension
 - Valgus / Varus
 - Internal / External rotation
- Stability is maintained by strong ligaments
- Vulnerable to injury

Knee Joint

- Complex structure
 - Bone
 - Muscle
 - Cartilage
 - Meniscus
 - Ligaments



MRI scan can show the structures within the joint.

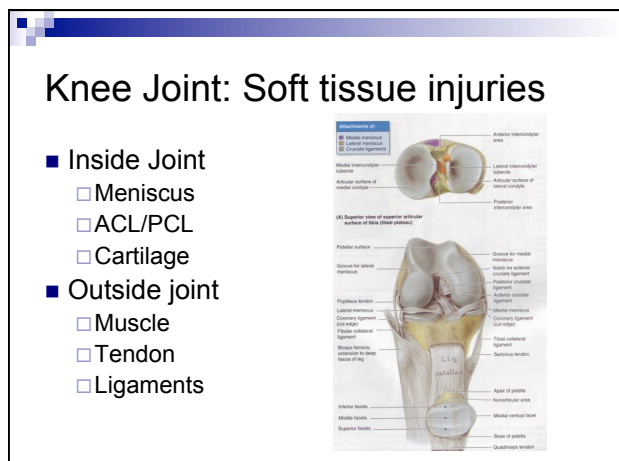
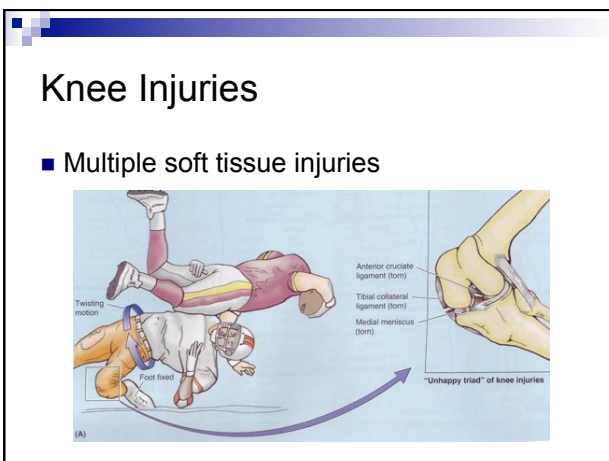
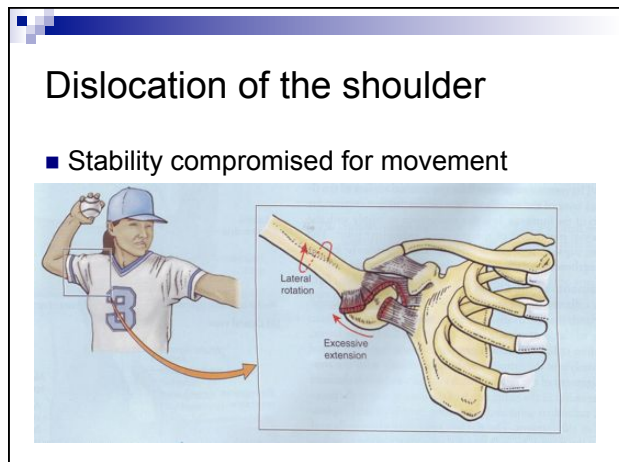
Ankle

- Hinge joint
- Bony configuration maintains stability, but ligaments are also important.

Injuries and Joint failure

- ## How are joints damaged
- Trauma
 - Degenerative
 - Inflammatory (Rheumatologists)
 - Infective
 - Neoplastic
 - Synovium,
 - Bone - femur distal
 - Cartilage
 - Neuromuscular injuries
 - Charcot Joints
 - **Result**
 - Bone collapses and joint is destroyed
 - Deformity, instability, destruction.

- ## Trauma
- Can be simple or high energy
 - Damage can be to different structures
 - Bone
 - Soft tissue
 - Outside
 - Inside
 - Cartilage



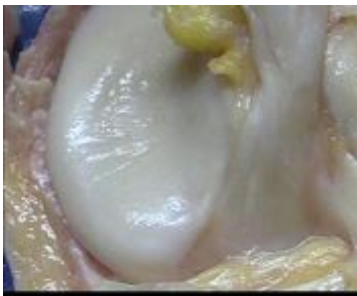
Knee Joint: Soft tissue injuries

- Torn medial co-lateral ligament
 - Results in valgus deformity
 - Lower leg is abducted
- Anterior cruciate ligament tear
 - increases gliding movement
 - knee gives way.
 - Can results in rupture of quads tendon
 - Synoival fluid Stops blood clotting and tendon healing
- Mensical damage – locking and instability
 - 20% of patients who have had a meniscectomy show degenerative changes within 2 years.
- Direct cartilage injury

What happens to damaged joint

- Altered joint
 - Abnormal stresses
 - Blood
 - Inflammation
- Results in degenerative joint disease
 - Osteoarthritis

Degeneration of cartilage

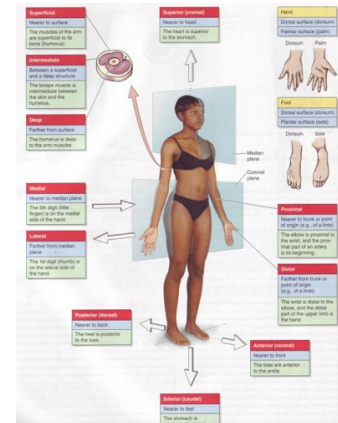


Examination and Investigation

Examination


- Look
 - Feel
 - Move
 - Active
 - Passive
 - Examination of radiographs
 - Arranging further investigations
- Always compare both sides when examining.
i.e. left and right knees**

Describing findings



Look

- Deformity
- Swellings
- Scars
- Neurological



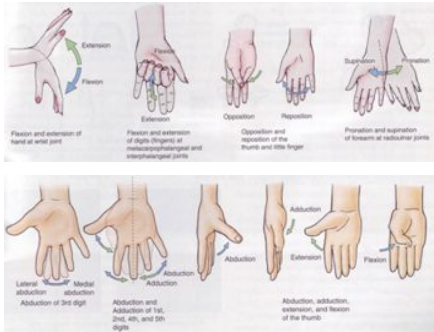
Valgus Knee



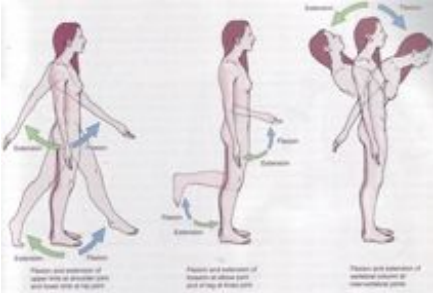
Move : Types

- Objective
 - Abduction
 - Adduction
 - Rotation etc.
- Subjective / functional
 - Reaching hair, middle of back, buttocks.
 - Throwing a cricket ball.




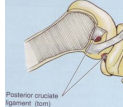
Movement



Movement

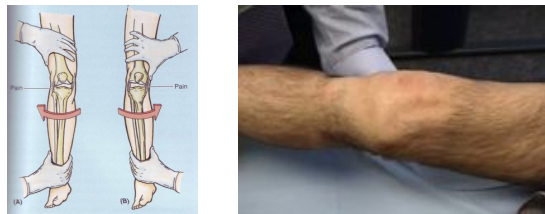


Special tests in the knee

- Anterior Draw - test for ACL rupture
 

- Posterior draw - test for PCL rupture
 


Medial and Lateral co-lateral ligaments

- Valgus and varus strain



Hip examination: Thomas' Test



Video apprehension test



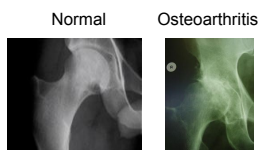
Investigations

- X-ray
 - Show bones
- CT scan
 - 3D imaging
 - Reconstructive CT can give further information.
- MRI scan
 - Soft tissue including the inflammatory responses.
- Other Scans and tests
 - Isotope and DEXA

X-Ray

- Features of Osteoarthritis

- Subchondral sclerosis
- Cysts
- Loss of joint space
- Osteophytes



X-Ray

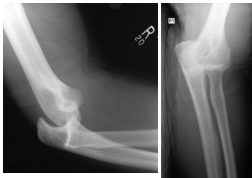
- What is missing?



Dislocation and fracture

- Fractures
- Dislocations

Elbow dislocation

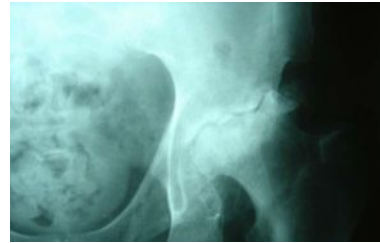


Fracture tibial plateau



Result of Joint Infection

- Joint destruction



CT and MRI Scan

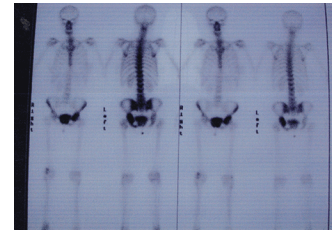
- Detail injuries



Bone Scan

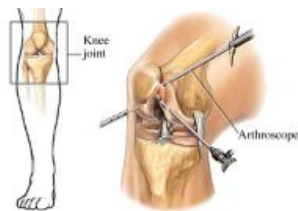
- Radioisotope uptake. Demonstrates abnormality in left hip.

- Infection
- Malignancy



Arthroscopy

- Investigative and therapeutic



Principles of treatment

Treatment of joint disorders

- Conservative
 - Rheumatologists / Physiotherapists
 - Steroid and local anaesthetic - temporary relief
- Arthroscopy
 - Debridement and joint reconstruction : cleaning and removing torn cartilage
- Further surgical procedures
 - Joint Reconstruction
 - Osteotomy
 - Hallux valgus – where we correct and re-align.
 - Arthrodesis
 - Fuse so no movement/no pain i.e. sub-talar or spine
 - Excision of joint
 - Carpal metocarpal joint in hand. Makes a false joint ~(i.e. kellers in foot), or excision of trapezium in the hand.) may weaken the hand but pain free.
 - Partial or total joint replacement.
 - Reconstruction is common. 48, 000 THR and 50,000 TKR in UK

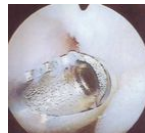
Conservative Treatments

- Analgesia
- Glucosamine
- Physiotherapy
- Steroid Injection



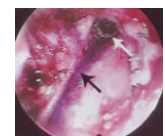
Arthroscopy

- Diagnostic
- Therapeutic
 - Debridement of cartilage



Anterior cruciate ligament injury

- Intra-articular
- Synovial fluid prevents healing. Repair will not occur when ends put together – lack of fibrinogen induced by synovial fluid.
- Therefore, cruciate ligament reconstruction.



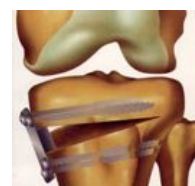
Reconstruction following trauma

- Fracture involving joint surface
 - If loss of congruity, fracture is reduced and fixed with plates and screws
 - Treated with plaster
- Medial and lateral co-lateral ligaments
 - Heal with rest followed by physiotherapy



Osteotomy

- To treat bone deformity



Hip joint replacement

- Re-surfacing



- Total hip replacement



Arthroplasty / Joint Replacement

- Uni-compartmental



- Total knee replacement



Summary

- Joint types
 - Fibrous
 - Cartilagenous
 - Synovial
 - Ball and Socket
 - Hinge etc.
- Examination / special tests
- Investigation
 - X-rays
- Treatment

Acknowledgements

Mr. R. Khan.

Clinically Oriented Anatomy, 5th Edition, KL Moore and AF Dalley.