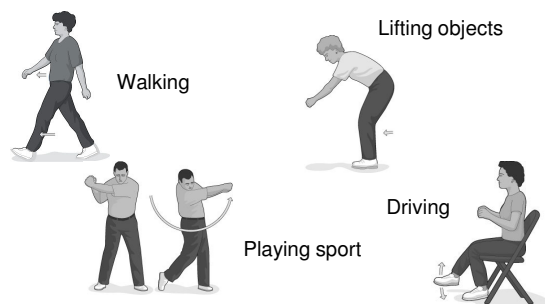


## Articular cartilage: structure, function and healing



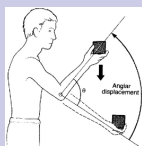
**Vipin Asopa MRCS**  
 Specialist Registrar, Trauma and Orthopaedic Surgery.  
 10 February 2010

## 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

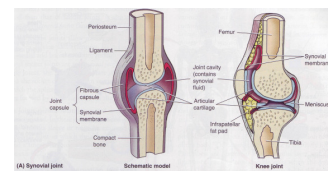
- Bone and structure
- Cartilage
- Soft tissues around the joint
  - Ligaments
  - Muscles
- Soft tissue within the joint

## 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)

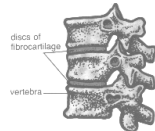
## Synovial Joints

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



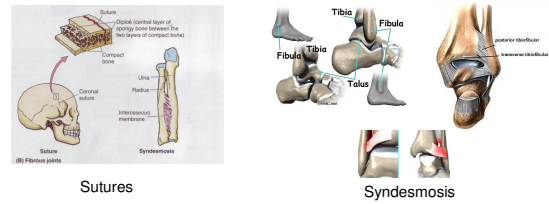
## Cartilaginous Joints

- 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

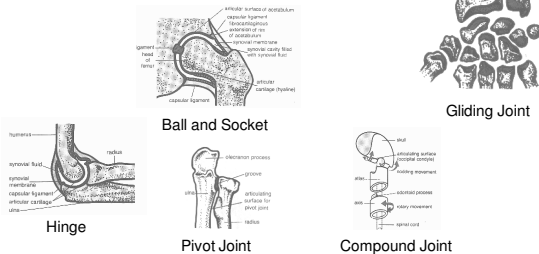


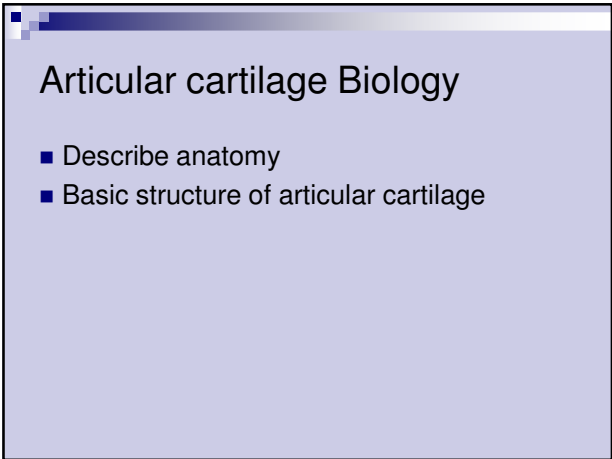
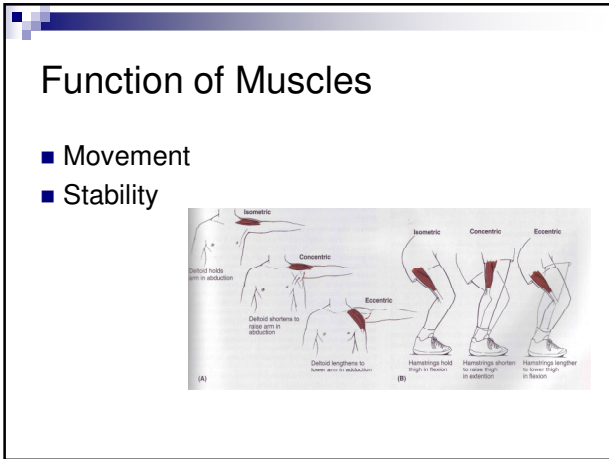
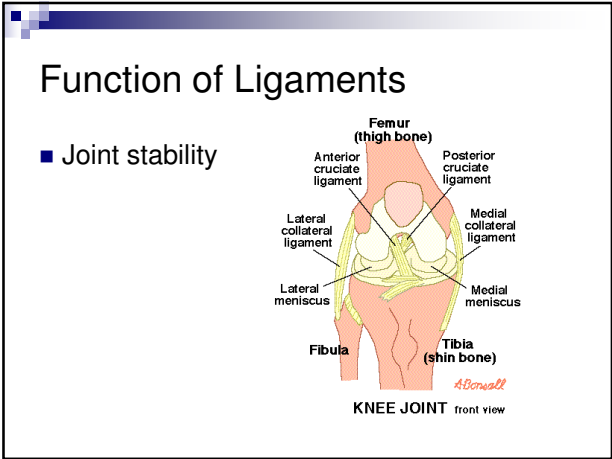
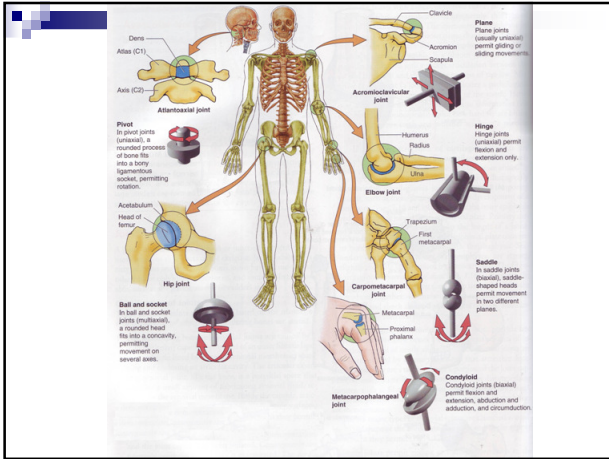
## Synovial joint sub-classification

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

## Synovial joint sub-classification

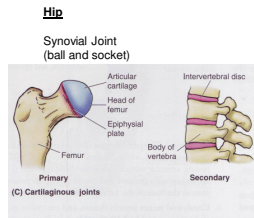
- Type of movement





## Articular Cartilage

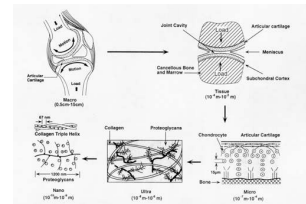
- Lines synovial joints
- Provides
  - Smooth gliding surface
  - Transfers weight
  - Acts as a shock absorber



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

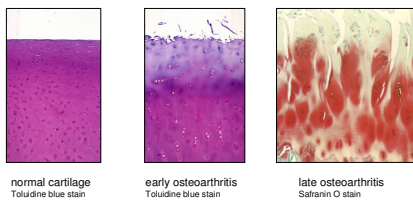
## Articular cartilage

- Composition
  - Chondrocytes
  - Collagen II
  - Proteoglycans

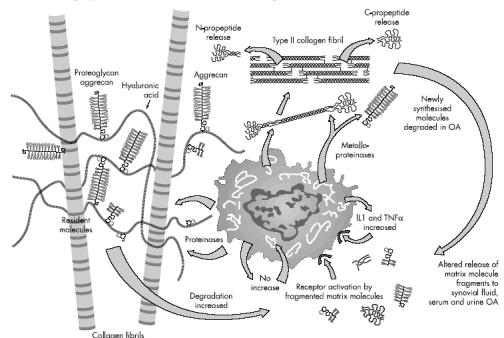


## Articular cartilage in disease

### Osteoarthritis



## Biology of Cartilage

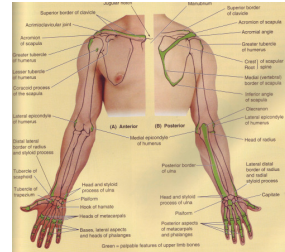


## Examples of Joints

- 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

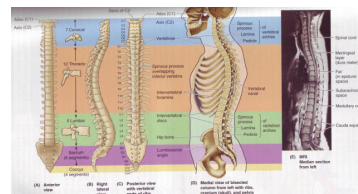


## Example

- 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

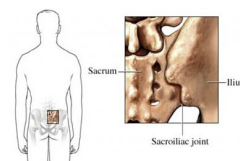


## Lower Limb

- 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**

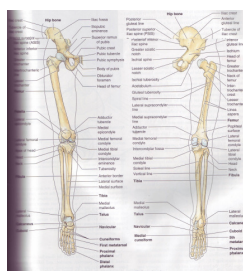
## Sacroiliac joint

- 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.



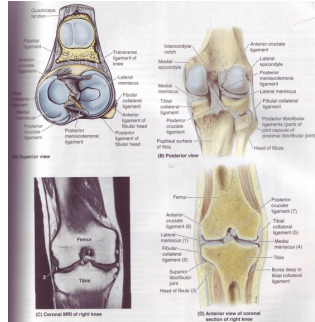
## Knee Joint

- 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.

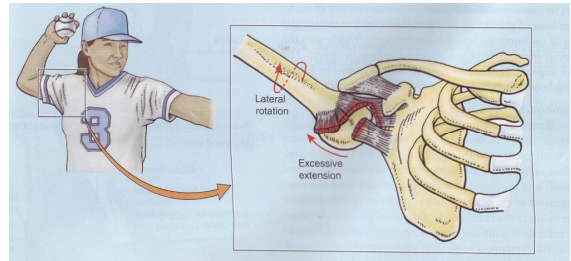


## Trauma

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

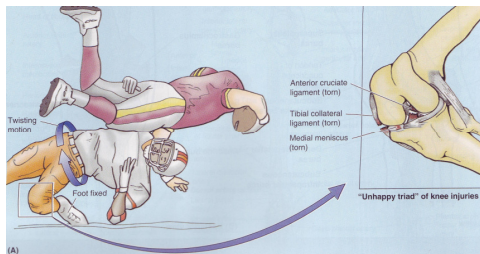
## Dislocation of the shoulder

- Stability compromised for movement



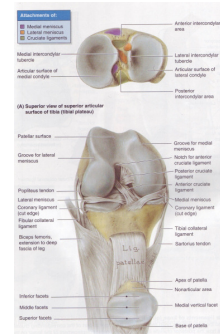
## Knee Injuries

- Multiple soft tissue injuries



## Knee Joint: Soft tissue injuries

- Inside Joint
  - Meniscus
  - ACL/PCL
  - Cartilage
- Outside joint
  - Muscle
  - Tendon
  - Ligaments



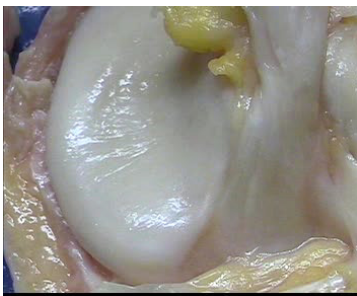
## Knee Joint: Soft tissue injuries

- 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

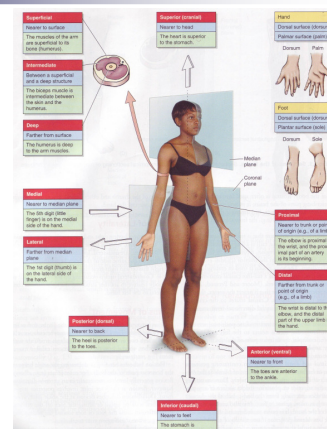


## Examination and Investigation

## 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



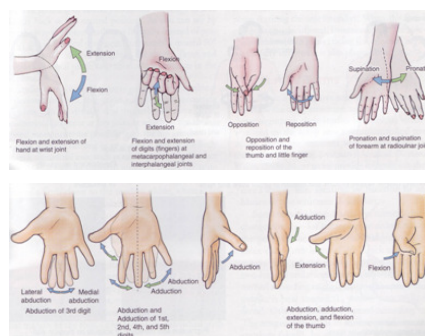
## Valgus Knee



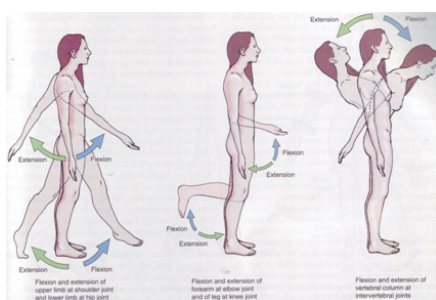
## Move : Types

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

## Movement

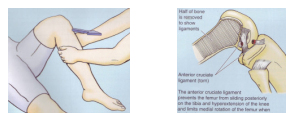


## Movement

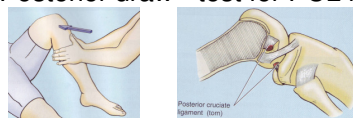


## Special tests in the knee

- Anterior Draw - test for ACL rupture

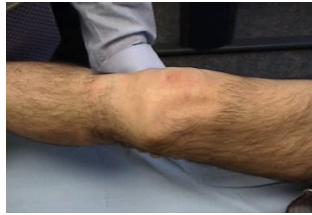
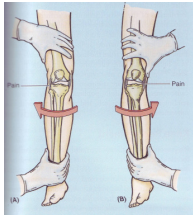


- Posterior draw - test for PCL rupture



## Medial and Lateral co-lateral ligaments

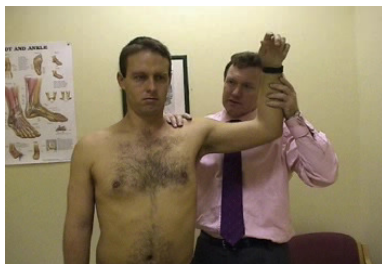
- Valgus and varus strain



## 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

Normal



Osteoarthritis



### X-Ray

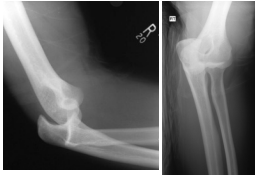
- What is missing?




### Dislocation and fracture

- Fractures
- Dislocations

Elbow dislocation



Fracture tibial plateau



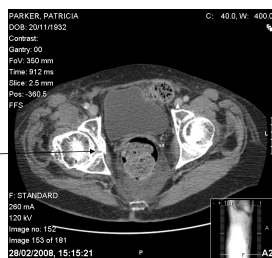
### Result of Joint Infection

- Joint destruction



## CT and MRI Scan

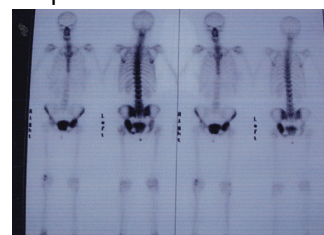
- Detail injuries



## Bone Scan

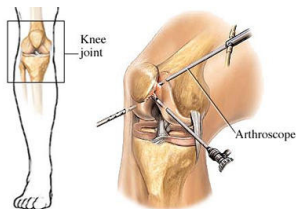
- Radioisotope uptake. Demonstrates abnormality in left hip.

- 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

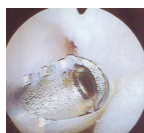
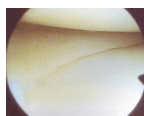
## Conservative Treatments

- Analgesia
- Glucosamine
- Physiotherapy
- Steroid Injection



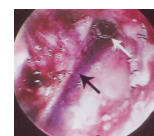
## Arthroscopy

- Diagnostic
- Therapeutic
  - Debridement of cartilage



## Anterior cruciate ligament injury

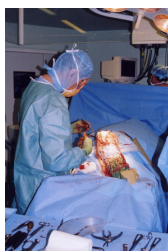
- Intra-articular
- Synovial fluid prevents healing. Repair will not occur when ends put together – lack of fibrinogen induced by synovial fluid.
- Therefore, cruciate ligament reconstruction.





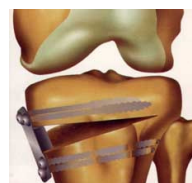
## Reconstruction following trauma

- 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



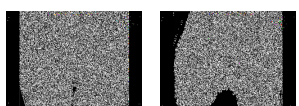
## Osteotomy

- 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, 5<sup>th</sup> Edition, KL Moore and AF Dalley.