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Study materials for FMGE

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ORTHOPEDICS

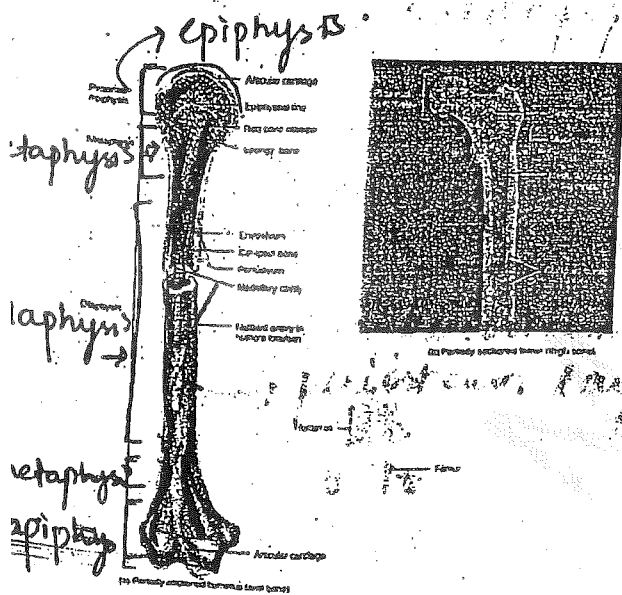
MIST - ORTHO (General Orthopaedics & Polytrauma)

Introduction

- Orthopaedics is a term derived from two words :
 - Ortho - straight
 - Paedics - Child
- Term Orthopaedics was coined by Nicholas Andry, a French physician
- Antonius Mathysen - Invented POP bandage
- Joseph Lister - Introduction of antiseptis
- Hush Owen Thomas - Thomas Splint (TB Knee), Thomas Test, Thomas Heel { Also k/a Father of British Orthopaedics }
- William Lane - First to advocate the use of Internal Fixation in Orthopaedics
- Wilhelm Conrad Roentgen - Discovery of X Rays

Anatomy of Long Bone

- Epiphysis : Ends of Bone
- Diaphysis : Intermediate portion/shaft mainly composed of compact bone surrounding medullary cavity
- Metaphysis : Part of shaft adjoining Epiphysis *B/w Epiphysis and Diaphysis*
- Epiphyseal Plate/ Growth plate : Thin plate of growth cartilage, one at each end- It causes increase in length of bone
- Bone is covered with Periosteum all around except at ends where Articular Cartilage (Hyaline Cartilage) is present



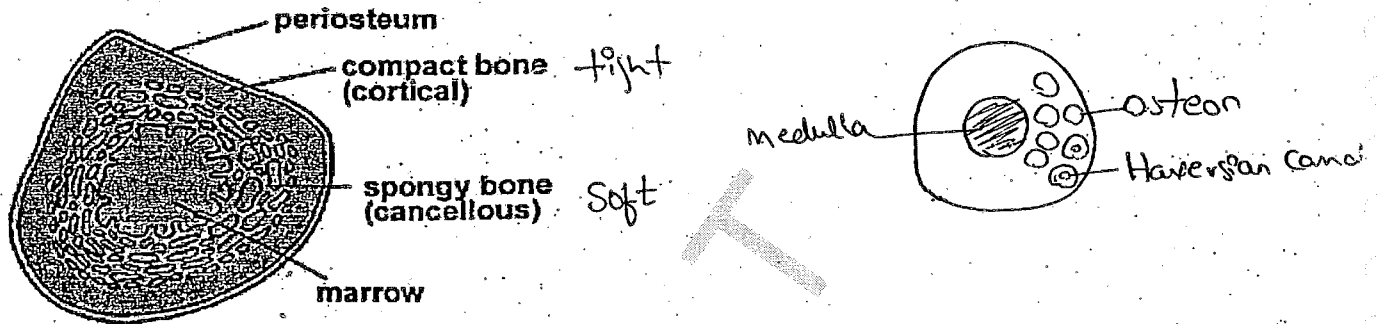
→ osteoblasts is produced

- Periosteum has 2 layers :
 - Outer Fibrous layer
 - Inner Cellular Layer (Cambium Layer) containing Oteoprogenitor cells and Osteoblasts. It helps to increase the thickness of bone.
- *stud* Sharpe's Fibres : Strands of Fibrous tissue connecting Bone to Periosteum
- In a child, periosteum is :
 - Thicker
 - More vascular *heals in 2w*
- Loosely attached to bone as c/t adults
- Endosteum : Connective tissue membrane lining Internal bone surfaces

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Structure of Bone

- There are 2 types of Bone :
- **Woven/Immature Bone** (Random arrangement of bone cells & collagen)
- **Lamellar/Mature Bone** (Orderly arrangement is +nt)
- All bones consist of a dense, solid outer layer known as compact bone and an inner layer of spongy bone
- In Diaphysis ; there is predominantly Compact bone *more cortex*
- In Metaphysis, there is predominantly Spongy bone. *Less u*



Structure Of Compact Bone

- **Osteon** : Basic structural unit of Lamellar/Compact Bone. They are arranged parallel to one another along long axis of bone
- Each Osteon has a central canal k/a **Haversian Canal** running Longitudinally in Bone
- Haversian Canals allow passage of blood vessels, lymphatics and nerve.
- Haversian canals are surrounded by concentric Lamellae *Perpendicular*
- **Volkman's Canal** : Horizontal canals connecting Endosteal to Periosteal surfaces
- In Trabecular bone, New bone is laid in lines of stress - **Wolf's Law**

Composition of Bone

- Bone Cells + Extra-Cellular Matrix
- **Bone Cells** :
 - **Osteoblasts** - Bone-forming cells rich in ALP, glycolytic enzymes & phosphorylases *Alkaline phosphate*
 - **Osteocytes** - Mature Bone cells, rich in glycogen & PAS+ve granules *PER IODIC ACID STAINING*
 - **Osteoclasts** - Multi-nucleate giant cells concerned with Bone resorption
- **Extra-Cellular Matrix** :
 - Organic (25%) : **Collagen (95%)**, polysaccharides & lipids (Secreted by Osteoblasts) *Type I*
 - Inorganic (65%) : **Hydroxyapatite crystals** *{ Osteogenesis imperfecta }*
 - Matrix *Strong → Supplement Ca⁴⁺ ↓ matrix*

Formation of the Bony Skeleton

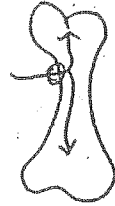
- Before week 8, the human embryonic skeleton is made of fibrous membranes and hyaline cartilage.
- After week 8, bone tissue begins to replace the fibrous membranes and hyaline cartilage. *Long*
- The development of bone from a fibrous membrane is called **Intramembranous ossification** Eg **Skull, Clavicle, facial bones** etc
- The replacement of hyaline cartilage with bone is known as **Endochondral ossification**. Most bones develop through this mechanism.
- A **Primary centre of Ossification** is present at the middle of shaft (Before Birth) *IV life*

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- Secondary Centre appears at the ends after birth (Except at Distal end of Femur which is present at birth)

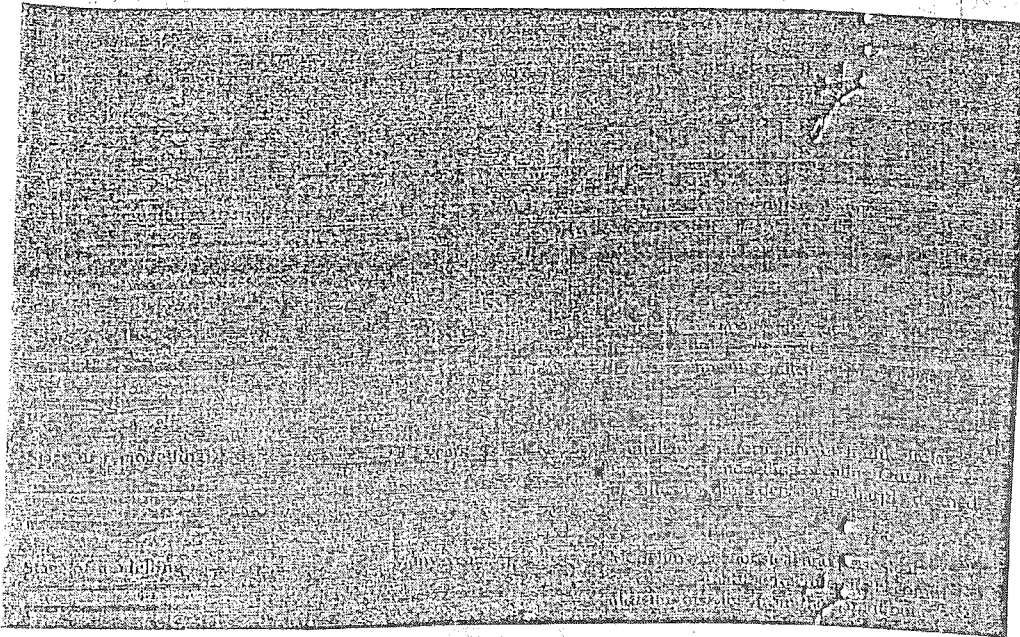
Blood Supply Of Long Bone :

- Nutrient Artery : Enters through nutrient foramen and divides into 2 branches, one for each end.
- Metaphyseal Vessels : (From Anastomosis around joint)
- Epiphyseal Vessels



Fracture Healing

- End result of bone healing is Mineralised Mesenchymal Tissue
- Stages In Fracture Healing of Cortical Bone: (Frost, 1989)



Factors Affecting Fracture Healing

- Age : # unites faster In children
- Type of Bone : Flat/Cancellous >> Tubular/Cortical bone
- Pattern of # : Spiral > Oblique > Transverse (Surface area in spiral is more)
- Soft Tissue Interposition or Areas with precarious blood supply like Talus, Scaphoid unite slowly
- Type of Reduction
- Open Fractures : Go into Delayed union/ Non union
- Compression at # site : Increases chances of union

Classification of Fractures

- ^(Cause) On the Basis of Aetiology :
 - Traumatic
 - Pathological : # in a bone weakened by underlying pathology fractures - MC Pathological fracture
 - On Basis of Displacements :
 - Undisplaced
 - Displaced (Displacement of Distal fragment in relation to Proximal)
 - On Basis of Relationship with External Environment
- ↓
osteoporosis

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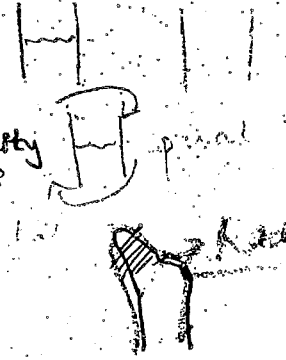
- Closed/Simple #: Bone ends don't penetrate the skin
 - Open/Compound #: Bone ends penetrate the skin eg Tibia *bone outside*
- Classification given by 'Gustilo & Anderson'
Not complex

TABLE 1. Open Fractures—Gustilo Classification^{1,2}

Type I	Open fracture with a skin wound <1 cm in length and clean.
Type II	Open fracture with a laceration >1 cm in length without extensive soft tissue damage, flaps, or avulsions.
Type III	Open segmental fracture with >10 cm wound with extensive soft tissue injury or a traumatic amputation (special categories in Type III include gunshot fractures and open fractures caused by farm injuries).
III _A	Adequate soft tissue coverage.
III _B	Significant soft tissue loss with exposed bone that requires soft tissue transfer to achieve coverage.
III _C	Associated vascular injury that requires repair for limb preservation.

→ gunshot
 → farm injuries

Transverse oblique



- On the Basis of Pattern of Fracture :
 - Transverse : Bending/Angulation force (horizontal) → highest velocity
 - Oblique : Bending
 - Spiral : Twisting or Torsional force, # line in more than 1 plane → lowest velocity
 - Comminuted : Crushing/Compression force along Long axis → multiple pieces
 - Segmental : 2 fractures but at different levels
- cheek slides →*
Fracture Eponyms



- *ie who have* Night Stick Fracture - # shaft Ulna while attempt to ward off a blow
- Chauffeur Fracture - Intra-articular oblique # of Radial styloid → *Styloid*
- *Side-swipe* Fracture / Baby Car Fracture - Injury to protruding Elbow, combination of Distal Humerus & Proximal Radius/Ulna fractures
- Bumper Fracture - Comminuted, Depressed # of Lateral Condyle of Tibia
- Pott's Fracture - Bimalleolar Ankle #
- Cotton's Fracture - Trimalleolar ankle #
- Maisonneuve fracture - Ankle injury associated with Spiral # of Proximal third fibula
- *Pilon* Pilon Fracture - Comminuted Intra-articular # distal end Tibia
- Aviator's Fracture - # Neck Talus
- Jone's Fracture - Avulsion # Base 5th Metatarsal *Sport people*
- Lisfranc's fracture-Dislocation - Fracture-Dislocation through Tarso-Metatarsal joints
- Chopart's fracture-dislocation - Fracture-Dislocation through Inter-tarsal joints
- Jefferson's Fracture - # first cervical vertebrae *A C1 (atlas)*
- Whiplash Injury - Sudden flexion /b Hyperextension injury of Cervical Spine
- Chance Fracture /Seat Belt Fracture : Horizontal #through vertebral body till posterior elements
- Burst Fracture - Comminuted # of vertebral body with decreased height & widening of vertebral body
- Clay-Shoveller Fracture - Avulsion # of Spinous process of lower cervical/upper thoracic vertebrae
- Hangman's Fracture - B/L lamina and pedicle fracture at C2 *C7 T1*
- usually associated with Anterolisthesis of C2 on C3
- Dashboard Fracture - # posterior lip Acetabulum (A/w Post hip Dislocn)
- March Fracture - Stress # shaft of 2nd/3rd Metatarsal *2nd*
- Straddle Fracture - B/L Superior & Inferior Pubic Rami Fractures

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Pathological Fracture

- Fracture in a bone weakened by some underlying pathology
- M/C cause is Osteoporosis
- Other Causes are:
- Inflammatory : Osteomyelitis
- Neoplastic : Benign & Malignant tumours
- Hereditary : Osteogenesis Imperfecta,
Osteopetrosis (Marble bone disease)
- Acquired : Osteoporosis,
Osteomalacia
Rickets, Scurvy

Injury to Ligament : Sprain (1st, 2nd and 3rd degree)

Injury to Muscle : Strain

Splints in Orthopaedics

- Any material used to support a fracture is known as splint.
- Cramer-wire splint - Used for Emergency immobilization of fractures
- Thomas Splint :
Devised by Hugh. Owen Thomas.
Initially used for immobilisation for tuberculosis of the knee.
It is now used for immobilization of Hip and Thigh injuries
- Bohler-Braun Splint : Fracture Femur , doesn't have a mechanism for counter traction
- Aluminium Splint : Immobilisation of fingers
- Dennis Brown Splint- CTEV *Congenital Talipes Equino Varus*
- Cock up Splint : Radial Nerve Palsy l/t Wrist Drop
- Knuckle Bender Splint - Claw hand d/t Ulnar Nerve Injury (Intrinsic Minus Hand)
- Volkman's Turn Buckle Splint - VIC
- Aeroplane Splint : Brachial Plexus Injury
- SOMI Brace : Cervical Spine Injury *Sternocleidomastoid Immobilizer*
- ASHE (Anterior Spinal Hyperextension Brace) : Dorso-Lumbar Spinal injury (Dynamic Brace)
- Taylor's Brace : Immobilisation of Dorso-Lumbar Spine
- Milwaukee Brace : Scoliosis
- Boston Brace : Scoliosis
- Ankle Foot Orthosis (AFO)/Foot Drop Splint : Foot Drop d/t CPN Palsy *Common peroneal Nerve.*
- Von Rosen's Splint : Congenital Dislocation of Hip *CDH DDH (Tibialis anterior muscle)*

Tractions

Traction is a method of restoring alignment to a fracture through gradual neutralization of muscular forces.

Uses :

- Reduction of fractures and dislocations.
- Immobilizing painful and inflamed joint.
- Preventing deformities.
- Correction of soft tissue contractures.

Types :

FIXED TRACTION

Counter-traction is provided by a part of the body. Eg Ischial Tuberosity in Thomas Splint

SLIDING TRACTION

Weight of the body under influence of gravity provides counter-traction.

Methods of Applying Traction :

- SKIN TRACTION
- SKELETAL TRACTION

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- **Gallow's Traction & Bryant's Traction** : # Shaft Femur in a child < 2 yrs
- **Russell's Traction** : Trochanteric fractures
- **Buck's Traction** ; Coventional Skin Traction
- **Perkin's Traction** : Skeletal Traction via upper Tibial Pin : # Shaft Femur in Adults
- **90-90 traction** : Fracture shaft femur in children

- **Dunlop's Traction & Smith's Traction** : Supracondylar # Humerus
- **Crutchfield Traction & Head Halter traction** : Cervical Spine Injuries
- **Halo-Pelvic Traction** : Scoliosis

Plaster casts and braces	
of the cast	
Uninjury cast	Cervical spine disease
Refract cast	Scoliosis
Two buckle cast	Scoliosis
Shoulder splint	Shoulder immobilization
Elbow	Fracture of the humerus
Forearm cast	Fracture of the humerus
Golfers cast	Collar fracture
Popliteal	Fracture of distal femur
Wrist cast	Fracture of the patella
Clavicle cast	Fracture of the tibia

Complications Of Fractures :

- **Immediate Complications :**
 - Hypovolaemic Shock
 - Injury to Blood Vessels, Nerves and other tissues
- **Early Complications :**
 - ARDS
 - Fat Embolism Syndrome
 - DVT & Pulmonary Embolism
 - Crush Syndrome
 - Compartment Syndrome
- **Late Complications :**
 - Delayed Union/Non union/Malunion
 - AVN
 - Sudeck's Dystrophy
 - Myositis Ossificans
 - Shortening, Deformity, Stiffness & OA

- **Hypovolaemic Shock :**
 - Around 1500-2000 ml blood loss take place in Pelvic fractures & around 1000-1500 ml in Femur shaft Fractures
 - Mx : Crystalloids f/b Colloids
- **Adult Respiratory Distress Syndrome :**
 - d/t inflammatory mediators which cause disruption of microvasculature of Pulmonary Tree
 - Onset usually 24 hours after injury
 - Tachypnoea with PaO₂ less than 50%
 - X Ray shows Diffuse Pulmonary Infiltrates Hallmark of ARDS (X-ray)
 - Mx : 100% O₂ + Assisted ventilation
- **Fat Embolism Syndrome :**
 - D/t release of fat globules after long bone fractures
 - Toxic vasculitis by free fatty acids and Actual Obstruction of small pulmonary vessels
 - Manifestations are Cerebral & Pulmonary, petechial rash in conjunctiva, anterior axillary folds etc
 - X Ray : Snow storm appearance - Patchy pulmonary infiltrates
 - Urine & Sputum - Fat globules

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- **Shortening** : In lower limbs,
If it is < 2cm - Shoe Raise
If > 2 cm - Limb Lengthening procedures like Ilizarov
- **Avascular Necrosis:**
Site (NECROSIS) Cause # → Blood Supply X
- Head of Femur # Neck Femur
Posterior Dislocation Hip
Proximal Pole of Scaphoid # Waist Scaphoid
Body of Talus # Neck Talus

NX#

It is earliest visible on Bone Scan as 'Cold Spot' ← PET
X Rays : Sclerosis of Necrotic area
Deformity because of Collapse
OA changes

T/t : Delayed weight bearing,
Revascularisation procedures [# X ANI]
Total joint replacement

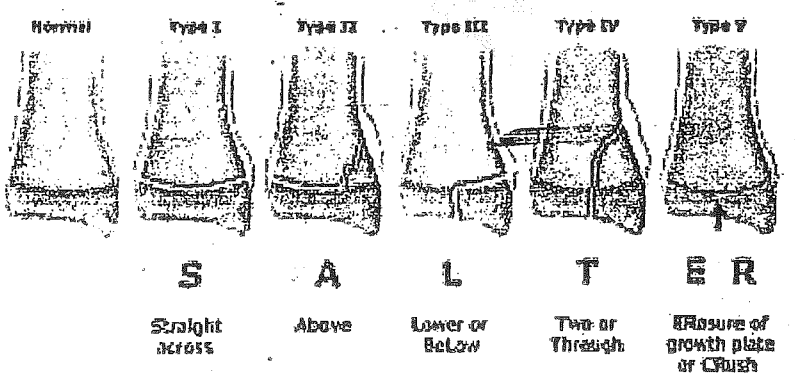
(Single cortex fracture)

- **Greenstick fracture** : Greenstick fractures are incomplete fractures of long bones
- **Torus Fracture** : Cortical buckling, m/c in distal radius

Epiphyseal Injuries

Proximal humerus	Distal humerus	Proximal radius	Distal radius	Proximal ulna	Distal ulna	Proximal tibia	Distal tibia	Proximal fibula	Distal fibula
Proximal humerus	Distal humerus	Proximal radius	Distal radius	Proximal ulna	Distal ulna	Proximal tibia	Distal tibia	Proximal fibula	Distal fibula
Proximal humerus	Distal humerus	Proximal radius	Distal radius	Proximal ulna	Distal ulna	Proximal tibia	Distal tibia	Proximal fibula	Distal fibula
Proximal humerus	Distal humerus	Proximal radius	Distal radius	Proximal ulna	Distal ulna	Proximal tibia	Distal tibia	Proximal fibula	Distal fibula
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Proximal humerus	Distal humerus	Proximal radius	Distal radius	Proximal ulna	Distal ulna	Proximal tibia	Distal tibia	Proximal fibula	Distal fibula
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Proximal humerus	Distal humerus	Proximal radius	Distal radius	Proximal ulna	Distal ulna	Proximal tibia	Distal tibia	Proximal fibula	Distal fibula

Salter-Harris classification of physcal fractures

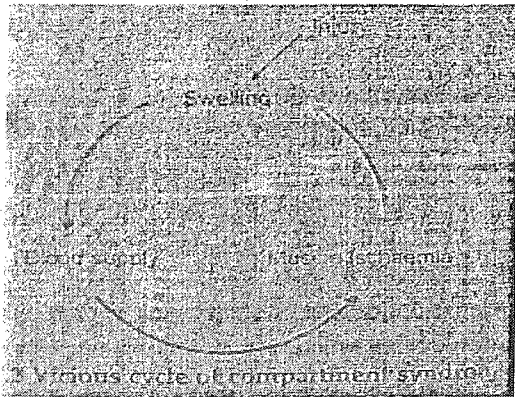


- Type I and Type II have got good prognosis
- 'Thurston-Holland Sign' - Type 2 Epiphyseal injury with Metaphyseal beak. Also k/a 'Shiny Corner Sign'

Stress Fracture : Stress
caused by repetitive trauma or Sub maximal loading of Bone

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- T/t : Respiratory support, Heparinisation, LMW Dextran & Steroids
- **Deep Vein Thrombosis :**
- Venous stasis d/t Prolonged Immobilization/Spinal Injuries
- Pt has Swelling & Calf Tenderness
- **Homan's Sign & Moses Sign Positive**
- Can l/t Pulmonary Embolism within 4-5 days
- T/t : Elevation, DVT stockings and Anticoagulant therapy
- **Crush Syndrome :**
- D/t massive muscle crushing as in Earthquakes, mining accidents
- Release of **Myohaemoglobin** into blood circulation → Precipitates in Renal Tubules → **ATN** *Acute Tubular Necrosis*
ARF
- C/o : Scanty urine, Apathy, Restlessness & Delirium
- T/t : Supportive T/t for Renal failure+ Tourniquet application in crushed extremity with gradual release
- **Vascular Injury : (5 P's)**
- Causes Pain
 - Pulse-absent
 - Pallor
 - Paraesthesia
 - Paralysis
- **Compartment Syndrome**
- Rise in pressure in closed compartments decreases blood supply to muscles and nerves (Ishaemia) – Compartment syndrome
- Causes :
 - Injury l/t oedema of muscles
 - Fracture haematoma within compartment
 - Tight POP bandages
- **Diagnosis :**
- Excessive pain not relieved by usual doses of Analgesics



- Common injuries l/t Compartment Syndrome are :-
- **Supracondylar Fracture Humerus**
- **# BB Forearm**
- **Closed Tibial Fractures**
- **Crush Injuries**
- Earliest sign is **Stretch test** (d/t FDP & FPL in forearm)
- First muscle to get affected in Forearm CS is FDP & first nerve is **Median Nerve**
- Pressure higher than 30-45 mm Hg (Normal is 0-8 mm Hg)
- T/t : Fasciotomy

MIST - ORTHO (General Orthopaedics & Polytrauma)

- M/C in army recruits, marathon runners, dancers.
- March #: Stress # of 2nd (M/C) or 3rd Metatarsal
- IOC: 1) MRI
- 2) Bone Scan
- T/t: Rest & immobilization for 3-4 weeks

Stress # MRI
Callus formation

Metabolic Bone Disease

- Osteoporosis:** ↓ Bone density
- M/C metabolic Bone Disease
- Decrease in Bone mass/Density of bone (Resorption > Formation)

Causes:

- Senility
- Post-Immobilisation
- Post Menopausal ^{test}
- Protein Deficiency $G \rightarrow D$
- Endocrinal - Cushing's
- Hyperthyroidism

Chronic Intake Steroid → Osteoporosis
→ AVN

Drug Induced - Steroids

C/F: Usually asymptomatic, w/ fragility fractures

Dorso-Lumbar Spine is M/C area. D₁₂-L₁ / Area of maximum stress

X Rays: Cod Fish Vertebrae (Biconvex because of disc bulging)

Ground Glass appearance of bones
Singh's Index

← -1 → Normal
-1 to -2.5 → osteopenia
> -2.5 → osteoporosis

Biochemistry:

Normal S. Calcium, S. Phosphorus and (SALP) only Normal $\left\{ \begin{array}{l} Ca^{2+} \\ PO_4^- \\ ALP \end{array} \right.$

DEXA Scan - Gold standard in

T/T: Calcium + Vit D supplementation

Bisphosphonates: 'Atypical Fractures' → SUBTR

T/T of underlying cause

RICKETS & OSTEOMALACIA:

- Defect in Mineralization of Bone, large osteoid seams accumulate
- Rickets in Children and Osteomalacia in adults

Normally $+OH$

Cholecalciferol (Skin) → 25 Hydroxy cholecalciferol {Liver}

25 Hydroxy cholecalciferol → 1,25 - DHCC {Kidneys} ^{active Vit D}

1,25 DHCC helps in intestinal absorption of Calcium

Rickets:

- Nutritional rickets is M/C
- Failure of Mineralization at growth plate - Softening of Bones & Deformity

C/F: Craniotables - Softening of Skull Boones

Frontal Bossing

Broadening of Bone Ends

Delayed teeth eruption

Harrison's Sulcus

Pigeon Chest - Prominent sternum

Rachitic Rosary - Prominent Costo-chondral junctions

Knock Knees - Genu Valgum

X Rays: Delayed appearance of Epiphysis

Widening of Epiphyseal Plates

Cupping & Splaying of Metaphysis

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- **Biochemistry –**
- S. Calcium – Normal/Low
- S. Phosphorus – Low
- S. ALP – High
- T/t : Administration of Vit-D 6,00,000 units oral dose
- Line of Healing after 3-4 weeks on metaphyseal side of Growth plate
- Mermaid Splint

OSTEOMALACIA –

- Pt has Bone pains, muscular weakness & spontaneous fractures
- X Rays :

Looser's Zone/Pseudo-fractures/Milkman's Fracture :

Radiolucent zones are seen at sites of stress
(Pubic Rami, NOF, Scapula, Ribs)

N²⁺ Ca²⁺
↓ PO₄³⁻
↑ ALP

HYPERPARATHYROIDISM:

- **Brown's Tumour –** Expansile bone lesion affecting Maxilla and Mandible
Collection of Osteoclasts
- **Salt & Pepper Appearance.**
- **Loss of Lamina Dura –** thin bone surrounding teeth
- **Sub-Periosteal resorption of Phalanges**
- **Rugger-jersey Spine**

Ortho (Congenital disorders & miscellaneous bone & soft tissue affectins)

Congenital Deformities :

Congenital Talipes Equinovarus :

- Also k/a CTEV or Clubfoot
- Can be Idiopathic or Secondary (Paralytic disorders or AMC)

Deformity Components :

- **Equinus** : Ankle joint
- **Varus** : Hind foot (Subtalar joint)
- **Cavus** : Midfoot
- **Adduction** : Forefoot
- **Internal Tibial Torsion**

X Rays : Kite Angle (Talocalcaneal
Angles < 35 deg in both AP & Lat)

T/t : (Immediately after birth)

Ponseti Management : Correction achieved by Externally rotating foot with Fulcrum at Head of Talus
Kite's Method (Fulcrum at Calcaneo-cuboid joint)

Surgery :

- **PMSTR** : usually before 3 yrs
- **Dwyer's Osteotomy** : Calcaneal Osteotomy for correction of Heel varus
- **Dilwyn Evan's Procedure** : PMSTR + Calcaneo-cuboid fusion
- **Triple Arthrodesis** : > 12 yrs (Talo-Navicular fusion is most difficult)

Splints :

- **Dennis Brown Splint**
- **CTEV Shoes** (Straight Inner border, Outer raise & No Heel)
- **Steenbeek Splint**

Developmental Dysplasia of Hip :

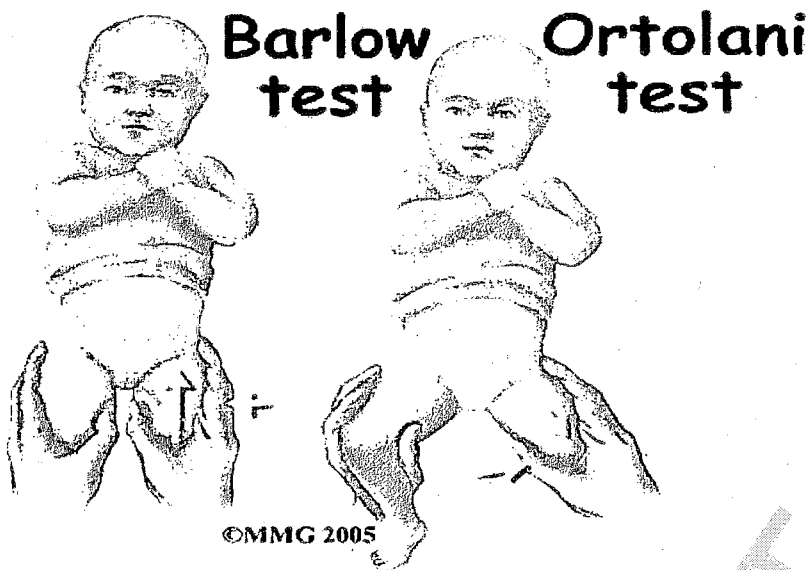
- Relatively uncommon in India as mother carries child on her waist – abduction
- F:M : 6:1
- **Cause**: Heredity
Hormone (Relaxin) induced joint laxity
Breech malposition

Pathoanatomy :

Acetabulum shallow
Femoral head dislocated upwards & Laterally
Excessive anteversion of Femoral neck
Hypertrophy of Ligamentum Teres
Inverted Limbus

- **Diagnosis** : In a young child, 2 tests are important

Ortho (Congenital disorders & miscellaneous bone & soft tissue affectins)



In Older child:

- Limitation of Hip Abduction on affected side
- Asymmetrical thigh & Gluteal folds
- Galeazzi's sign positive
- Trendelenburg's sign positive
- Trendelenburg's gait in U/L & Waddling gait in B/L DDH

X Rays :

- Delayed appearance of ossification centre
- Shallow & Dysplastic Acetabulum
- Break in Shenton's line
- T/t :
- CR + Hip Spica
- OR if CR fails +/- Osteotomy
- Osteotomies in older children
- Splints used are :
- Frog/Lorenz Cast
- Bachelor's Cast
- Von Rosen's Splint

Congenital Coxa Vara:

- Reduced Neck shaft angle
- Abduction & IR is reduced
- Fairbank's Triangle

Klippel -Feil Syndrome :

- Congenital short & Stiff neck d/t fused and deformed cervical vertebrae
-

Ortho(Congenital disorders & miscellaneous bone & soft tissue affectins)

Sprengel's Shoulder :

- Congenital High Scapula

Spondylolysis :

- Break in Pars Interarticularis
- M/C in L5 vertebrae
- It can lead to Spondylolisthesis
- Scottie Dog with broken neck

MISCELLANEOUS BONE AFFECTIONS :

- Achondroplasia:
- Autosomal Dominant (FGFR3)
- Failure of normal ossification of bones
- Disproportionate Dwarfism
- Lumbar Canal Stenosis is Common
- Osteogenesis Imperfecta :
- Brittle Bone Disease
- AD (Deficiency of Type 1 collagen)
- Defective collagen synthesis l/t weak & brittle bones
- C/o frequent fractures
- A/w Blue sclera, Dentinogenesis Imperfecta, joint laxity

Osteopetrosis :

- Also k/a Marble Bone disease/Albers-Schonberg disease
- Osteoclastic disorder – defective bone resorption
- Dense but brittle bones
- 'Erlenmeyer Flask Deformity'
- Paget's Disease : (Osteitis Deformans)
- Disorganized bone remodelling
- > 40 yrs
- M/C Tibia
- T/t : Bisphosphonates

Osteochondritis

- Epiphyseal disorders in which a bony nucleus of epiphysis becomes softened and l/t deformity
- Common Osteochondritis :

Name	Site Affected
Perthes' Disease	Femoral Head
Panner's Disease	Capitulum
Kienbock's Disease	Lunate
Osgood Schlatter's Disease	Tibial Tuberosity
Sever's Disease	Calcaneal Tuberosity
Kohler's Disease	Navicular
Freiberg's Disease	Metatarsal Head
Scheurmann's Disease	Ring Epiphysis of Vertebrae

Ortho(Congenital disorders & miscellaneous bone & soft tissue affectins)

SOFT TISSUE DISORDERS :

BURSITIS :

Inflammation of Bursa. It is of 2 types :

- Irritative (M/C type)
- Infective

Prepatellar Bursitis : **Housemaid's Knee**

Infrapatellar Bursitis : **Clergyman's Knee**

Olecranon Bursitis : **Student's Elbow**

Ischial Bursitis : **Weaver's Bottom**

On Lateral Malleolus : **Tailor's Ankle**

On Great Toe : **Bunion**

TENOSYNOVITIS :

Inflammation of synovial lining of tendon sheath

It can be d/t :

- Irritative Tenosynovitis
- Infective Tenosynovitis (Tubercular Tenosynovitis of Flexor tendon sheath at level of wrist → **Compound Palmar Ganglion**)

DUPUYTREN'S CONTRACTURE :

- Contracture of Palmar Aponeurosis
- Cause : Heredity
- **Pathoanatomy :**
Flexion of fingers at MP and PIP joint
M/C affected finger : **Ring Finger**

May be associated with thickened plantar fascia or Penile Fascia (**Peyronie's disease**)

- **Clinically there is flexion deformity of fingers**
- T/t : Subtotal Excision of Palmar Aponeurosis

TENNIS ELBOW :

Lateral Epicondylitis (Inflammation at Common extensor origin)

GOLFER'S ELBOW:

Medial Epicondylitis (Inflammation at Common Flexor origin)

De QUERVAIN'S TENOVAGINITIS :

- d/t inflammation of common sheath of 1st Extensor compartment tendons – APL & EPB
- Tenderness over Radial styloid process
- **Finkelstein Test** positive

TRIGGER FINGER :

- d/t constriction of fibrous digital sheath → Locking of Finger

MIST-Ortho (upper Limb Trauma)

Injuries Around Shoulder

- Shoulder Girdle -
- Gleno-Humeral: Ball & Socket Joint (Shallow) (M/C Joint of Dislocation)
- Acromio-Clavicular
- Sterno-Clavicular
- Scapulo-thoracic
- Rotator Cuff: SITS Location - greater tuberosity.
- Rotator Interval - Subscapularis & Supraspinatus

SITS = Supra spinatus.
Infra spinatus.
Teres minor
Subscapularis.

Fracture Clavicle

- Fall on shoulder/outstretched hand
- Commonest Site: Junction of Middle/Outer thirds $M \frac{2}{3} \text{ to } O \frac{1}{3}$
- Treated conservatively with arm sling/fig 8 bandage
- ORIF: (neurovascular, skin tenting, compound etc) fig 8 bandage.

ORIF OPEN Reduction
Internal fixation.

Shoulder Dislocation

- M/C joint to Dislocate
- Types:

- 1) Anterior Dislocation (Most Common)
- 2) Posterior Dislocation

Less Seen in 3 Es: Epilepsy, Parent Electrocutation (kill by electrocution), Electroconvulsion therapy

- 3) Inferior Dislocation (Luxatio Erecta) - Subglenoid Arm → Abducted.
Anterior Dislocation → Upper limb standing straight up above the head.

Types:

- Preglenoid (In front of glenoid cavity) A
- Subcoracoid (Most common) (Sub coracoid) B
- Subclavicular Intraclavicular C

Mechanism: Fall on outstretched hand with shoulder abducted and externally rotated

Clinical Tests:

Dugas Test - (Inability to touch opposite shoulder) or on same line.

Milton Ruler Test - (Acromion & Lateral Condyle, in line)

Calloways Test - Increased Axillary circumference

Treatment: (Reduction under GA/Sedation)

Kocher's Manoeuvre: TEAM/TEAI

Hippocrates Manoeuvre

- TEAM
- 1) Traction
 - 2) External Rotation
 - 3) Adduction
 - 4) Internal Rotation

Axillary Nerve → Deltoid

Recurrent Dislocation

Dislocation of same shoulder

3 or more dislocations of same joint

Pathological changes:

Bankart's Lesion (90% cases) - M/C lesion / soft tissue defect / Labrum defect → MRI

Glenoid Labrum with (periosteal stripping) (Most Commonly Anterior and specifically Antero-inferior)

Hill Sach's Lesion: Defect in Poster-Lateral aspect of Humeral Head

Rounding off of anterior glenoid rim

Test: Apprehension test positive / We try dislocate → Patient stop / Labrum → MRI Done

Treatment:

Arthroscopic Bankart's Repair is TOC

Putti-Platt Operation (Double-breasting of Subscapularis)

Bristow's Operation (Coracoid osteotomized and attached to lower half of anterior margin of glenoid - Dynamic Support)

Bristow-Latarjet - Coraco brachial lig. / Pectoral minor

MIST-Ortho (upper Limb Trauma)

Proximal Humerus Fractures

- Neer divided Proximal Humerus into 4 parts -
 - Head
 - Shaft
 - Greater Tuberosity
 - Lesser Tuberosity
- Displaced #: A fracture part is considered displaced if angulation exceeds 45 degrees, or if the fracture is displaced by more than 1cm

Complications:

- Axillary Nerve Palsy - Deltoid Paralyse
- Shoulder Stiffness

Fracture Shaft Humerus :

- Due to Radial Nerve Injury
- D/t indirect twisting or bending force-fall on outstretched hand/direct injury
- Lateral angulation of fracture common (Deltoid pull, arm positioning)
- Treatment:
 - Conservative - U Slab, Hanging Cast, Chest arm bandage, Functional Brace
 - Surgery : (Compound, Non union, segmental, polytrauma etc)
- M/C nerve injury (Radial Nerve-most commonly Neuropraxia) - Leads to 'Wrist drop'
- Holstein-Lewis Fracture M 1/3
- If Radial nerve does not recover - Modified Jones Transfer (PT→ECRB, PL→EPL, FCU→EDC)
- Non Union - ORIF + BG (Most common site is Iliac Crest)
Bone Graft

Anatomy Of Elbow

- Elbow Joint-Hinge Joint (Ulna-humeral JOINT)
(Ulna-Trochlear & Radio-Capitellar joints)
- Radial head rotates within annular ligament - In children it can slip out (Pulled Elbow)
- 3 Point Bony Relationship (Medial epicondyle, Lateral epicondyle and Olecranon)
- In 90 deg flexed elbow - forms an Isocetes triangle ^
- In Extension they lie in straight line
- (Maintained in Supracondylar fracture) Q
- olecranon fossa
- Carrying Angle - Angle between long axis of arm and forearm when Elbow joint is fully extended and supinated.
(11 degrees in males
14 degrees in females) Normal Range : 5-15 deg

Ossification around Elbow - (CRITOE) - Time of appearance of epiphysis

- C - Capitellum 2 yrs
- R - Radial Head 4 yrs
- I - Internal Epicondyle 6 yrs
- T - Trochlea 8 yrs
- O - Olecranon 10 yrs
- E - External Epicondyle 12 yrs

Valgus & Varus

- Varus - Going towards midline
 - Valgus - Going away from midline
- (Cubitus - Elbow, Genu - Knee)

Cubitus Varus - Supracondylar fracture (Gunstock deformity)

MIST-Ortho (upper Limb Trauma)

Cubitus Valgus – Lateral Condyle fracture

Genu Varum – M/C in Osteoarthritis (Degeneration of Articular Cartilage , medial compartment affected first)

Genu Valgus – Rickets (Knock Knees)

Supracondylar Fracture :

- Fracture through Distal Metaphysis of Humerus just above condyles
- Caused by fall on out-stretched hand (Hyperextension injury)
- More common in children
- Types:
 - Extension Type (more common around 90-95 %)
 - Flexion Type (around 5-10%)

Displacements : (Distal fragment is displaced in)

- Posterior/Backward Shift
- Posterior / Backward Tilt
- Proximal Shift
- Medial (Rarely Lateral) shift
- Medial Tilt
- Internal Rotation
- **Diagnosis :**
- Pain, swelling and deformity around elbow.
- 3 point bony relationship is maintained
- M/C nerve involved – Median Nerve (Pointing Index)
- Brachial artery injury should be ruled out

Treatment :

- Undisplaced fracture – A/K POP Slab
- Displaced Fractures- CR +IF with K wires (TOC)
- ORIF in : Failure of CR
 - Open fractures
 - Brachial artery exploration
- Continuous Traction : (Excessive swelling/ Bad wounds around elbow)
 - Smith's Traction – K wire passed through Olecranon
 - Dunlop's Traction – B/E Skin Traction

Complications :

- **Immediate (At the time of Fracture)**
 - 1) Brachial artery injury (Pulse)
 - 2) Median nerve injury – usually Neuropraxia
- **Early (Within 2-3 days)**

Volkman's Ischaemia – Ischemic injury to flexor compartment muscles (m/c FPL and medial FDP) & Nerves d/t decreased blood supply

T/t – Fasciotomy
- **Late (Within weeks to months)**
 - 1) Malunion – Distal fragment unites in medial tilt and IR – 1/2 Cubitus Varus (Gunstock deformity)
Only cosmetic issue – T/t by French Osteotomy
- 2) Myositis Ossificans –

Calcification of Haematoma within muscle

M/c d/t massage

M/c in Brachialis muscle

M/c after Supracondylar fracture

T/t : Acute phase (Rest & Immobilization)

Old/Mature Myositis (Excision)

(Flexor Pollicis Long & F. Digitorum Profundus)

MIST-Ortho (upper Limb Trauma)

Replace of Normal health tissue with dead.

3) Volkmann's Ischemic Contracture

Sequel to Volkmann's ischemia

Ischaemic muscles are replaced by fibrous tissue - wrists and fingers in flexion

Volkmann's sign positive

Splint used is Turn Buckle Splint

Severe deformities - Maxpage muscle sliding operation (flexor muscle release from medial epicondyle)

Fracture Lateral Condyle Humerus

- Common in children
- Caused by Varus injury to elbow
- Fragment - Capitellum + lateral epicondyle
- Salter Harris Type IV epiphyseal injury (MPE) is Salter Harris Type II MILCH
- Fragment displaced d/t pull of Common extensor muscles ← ⊙ [Epiphysis + Phyysis ⊕] ⊙ → Flexor muscle
- T/t : OR and IF with K wires (Fracture of Necessity)
- Complications :
 - Non union LCH#
 - Cubitus Valgus deformity (Diminished growth of lateral side of distal humerus)
 - Ulnar Nerve Palsy - (2-20 yrs) Friction neuritis as it moves over medial epicondyle - T/T : Anterior Transposition of Nerve (Anterior transposition of ulnar nerve)

Elbow Dislocation

Posterior dislocation is commonest

3 point bony relationship is reversed

Associated median nerve palsy is seen

T/t : CR & POP slab x 3 weeks

Pulled Elbow : (Nursemaid's Elbow)

Children b/w 2-5 yrs of age

Radial Head pulled out of annular ligament

Forearm in an attitude of pronation

X Rays show no bony injury

T/t : Head reduced by supinating forearm + Direct pressure on radial head

Fracture Olecranon :

Undisplaced fractures - POP slab in 30 deg of flexion (Rest in 90 deg)

Displaced : ORIF with TBW

Fractures around elbow commonly missed on X Rays :

- # Capitellum
- # medial epicondyle
- # Head/Neck Radius
- # Lateral Condyle

Colle's Fracture: [Prototype of osteoporosis] Elderly osteoporotic.

- Extra-articular Fracture lower end radius at Cortico-cancellous junction (about 2 cm from distal articular surface)
- Caused d/t fall on outstretched hand
- M/C fracture in > 40 yrs age group
- M/C fracture in osteoporosis

Displacements :

Dorsal displacement (most characteristic)

MIST-Ortho (upper Limb Trauma)

- Dorsal Tilt
- Lateral Displacement
- Lateral Shift
- Impaction
- Supination

- Pain, swelling and deformity around wrist
- Dinner fork deformity is seen
- Treatment: Closed reduction and B/E POP (Colle's cast) - In Palmar flexion and Ulnar deviation
- Complications:
 - ① Stiffness of joints - Below elbow ②
 - ① Finger stiffness is commonest complication
 - ② Malunion - Dinner fork deformity (Non union is not seen)
 - Subluxation of Inferior Radio-ulnar joint - (Shortening of radius because of impaction)
 - Carpal Tunnel Syndrome (Median nerve compression)

5) Sudeck's Osteodystrophy: (Sudeck's atrophy/Reflex Sympathetic Dystrophy/Shoulder Hand Syndrome/Causalgia/Complex Regional Pain Syndrome) CRPS ^{RSD}

M/C after Colle's fracture
 Pain, stiffness and swelling of hand, overlying skin shiny
 Localized/Patchy Osteoporosis (Characteristic X Ray finding)

→ Celiac ganglion

T/t: Physiotherapy/Analgesics

If no relief, then Beta blockers, Sympathectomy and Sympathetic Blockers

extended pol's longus

Extensor Indis Propius

Extensor Pollicis Longus

Extensor digiti 5

6) EPL Rupture - T/t by EIP to EPL transfer

• Smith's Fracture - (Reverse of Colle's fracture) - Distal segment displaces & tilts ventrally → dorsal flexion

• Barton's Fracture - Intra-articular Fracture distal radius with subluxation/dislocation of carpus

Scaphoid Fracture:

- M/C carpal bone to be fractured
- M/C site is waist of scaphoid
- Caused by fall on outstretched hand in young adult
- Tenderness in Anatomical snuff box (B/w EPL and ECRB)

Scaphoid + lunare → actual Radius

6 Extensor compartments

T/T: Scaphoid Cast (B/E POP cast including IP joint of thumb) for 3-4 months

Wrist maintained in slight Dorsiflexion & Radial deviation (Glass Holding Position)

In Displaced # - ORIF with Compression screws (Herbert's screw) ^{Headless}

- Complications:
 - Avascular Necrosis - Blood supply from distal to proximal
 - In waist fractures, proximal fragment becomes avascular
 - T/t: Excision of avascular segment
 - If wrist develops OA, then Arthrodesis (Carpal fusion)
 - {M/C site of AVN - Femur Head, T/T-Arthroplasty}

MIST-Ortho (upper Limb Trauma)

{Other sites of AVN – Talus Head , Humerus head}

{Arthrodesis- Surgical fusion of joint, Ankylosis – Pathological fusion of joint}

2) Non Union & Delayed Union – T/t is ORIF +BG

3) Wrist OA

Hand Injuries

- ~~Bennett's Fracture Dislocation – Oblique intra-articular fracture of base of 1st metacarpal with subluxation/dislocation of trapezio-metacarpal joint:~~
- ~~Rolando's Fracture – Extra-articular fracture base of 1st MC~~
- ~~Boxer's Fracture – Fracture Neck 5th Metacarpal~~
- ~~Mallet Finger/Baseball Finger –~~
- ~~Avulsion of extensor tendon from its insertion at base of DP~~
- ~~D/t sudden flexion of DIP joint~~
- ~~T/T: Splint given in position of hyperextension~~

Bennett's Fracture Dislocation →

Ortho (upper Limb Trauma)

Undisplaced fractures - POP slab in 30 deg of flexion (Rest in 90 deg)

Displaced : ORIF with TBW

• **Fractures around elbow commonly missed on X Rays :**

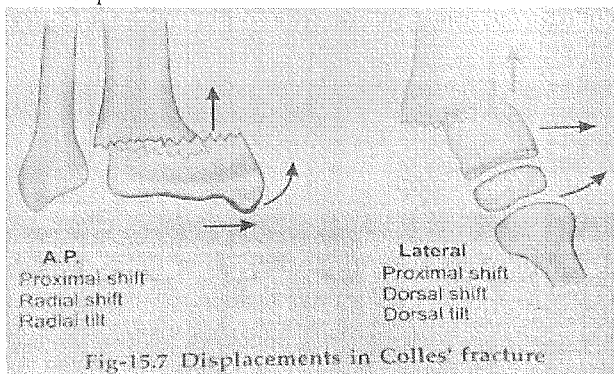
- # Capitellum
- # medial epicondyle
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- # Lateral Condyle

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M/C after Colle's fracture

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Localized/Patchy Osteoporosis (Characteristic X Ray finding)

Tt : Physiotherapy/Analgesics

If no relief, then Beta blockers , Sympathectomy and

Ortho (upper Limb Trauma)

Sympathetic Blockers

6) EPL Rupture – T/t by EIP to EPL transfer

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- **Barton's Fracture** – Intra-articular Fracture distal radius with subluxation/dislocation of carpus

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(B/w EPL and ECRB)

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• **Complications :**

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Blood supply from distal to proximal

In waist fractures, proximal fragment becomes avascular

T/t : Excision of avascular segment

If wrist develops OA, then Arthrodesis

{M/C site of AVN – Femur Head, T/T-Arthroplasty}

{Other sites of AVN – Talus Head, Humerus head}

{Arthrodesis- Surgical fusion of joint, Ankylosis – Pathological fusion of joint}

2) **Non Union & Delayed Union** – T/t is ORIF +BG

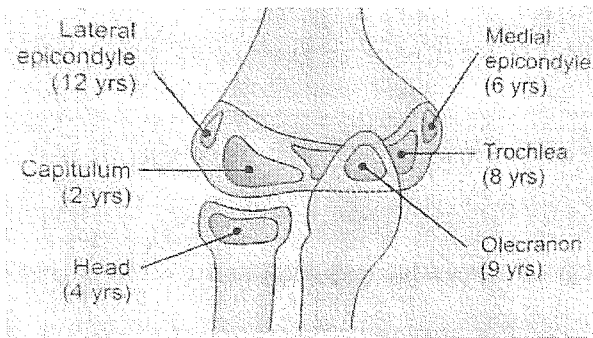
3) **Wrist OA**

Hand Injuries

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- **Rolando's Fracture** – Extra-articular fracture base of 1st MC
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- **Mallet Finger/Baseball Finger** –
 - Avulsion of extensor tendon from its insertion at base of DP
 - D/t sudden flexion of DIP joint
 - T/T : Splint given in position of hyperextension

Ortho (upper Limb Trauma)



Valgus & Varus

- **Varus** – Going towards midline
- **Valgus** – Going away from midline
(Cubitus – Elbow, Genu – Knee)

Cubitus Varus – Supracondylar fracture (**Gunstock deformity**)

Cubitus Valgus – Lateral Condyle fracture

Genu Varum – M/C in Osteoarthritis (Degeneration of Articular Cartilage , **medial compartment** affected first)

Genu Valgus – Rickets (Knock Knees)

Supracondylar Fracture :

- Fracture through Distal Metaphysis of Humerus just above condyles
- Caused by fall on out-stretched hand (Hyperextension injury)
- More common in children
- Types:
 - Extension Type (more common around 90-95 %)
 - Flexion Type (around 5-10%)

Displacements : (Distal fragment is displaced in)

- Posterior/Backward Shift
- Posterior / Backward Tilt
- Proximal Shift
- Medial (Rarely Lateral) shift
- Medial Tilt
- Internal Rotation
- **Diagnosis :**
- Pain, swelling and deformity around elbow
- 3 point bony relationship is maintained
- M/C nerve involved – Median Nerve (Pointing Index)
- Brachial artery injury should be ruled out

Treatment :

- Undisplaced fracture – A/K POP Slab
- Displaced Fractures- CR +IF with K wires (TOC)
- ORIF in : Failure of CR
 - Open fractures
 - Brachial artery exploration
- Continuous Traction : (Excessive swelling/ Bad wounds around elbow)
 - Smith's Traction – K wire passed through Olecranon
 - Dunlop's Traction – B/E Skin Traction

Ortho (upper Limb Trauma)

Complications :

- **Immediate (At the time of Fracture)**
 - 1) Brachial artery injury
 - 2) Median nerve injury – usually Neuropraxia
 - **Early (Within 2-3 days)**

Volkman's Ischaemia – Ischemic injury to flexor compartment muscles (m/c FPL and medial FDP) & Nerves d/t decreased blood supply

T/t – Fasciotomy
 - **Late (Within weeks to months)**
 - 1) Malunion – Distal fragment unites in medial tilt and IR – l/t Cubitus Varus (Gunstock deformity)
Only cosmetic issue – T/t by French Osteotomy
- 2) Myositis Ossificans –
Calcification of Haematoma within muscle
M/c d/t massage
M/c in Brachialis muscle
M/c after Supracondylar fracture
T/t : Acute phase (Rest & Immobilization)
Old/Mature Myositis (Excision)
- 3) Volkman's Ischemic Contracture
Sequel to Volkman's ischemia
Ischaemic muscles are replaced by fibrous tissue – wrists and fingers in flexion
Volkman's sign positive
Splint used is Turn Buckle Splint
Severe deformities – Maxpage muscle sliding operation (flexor muscle release from medial epicondyle)

Fracture Lateral Condyle Humerus

- Common in children
 - Caused by Varus injury to elbow
 - Fragment – Capitellum +lateral epicondyle
 - Salter Harris Type IV epiphyseal injury
 - Fragment displaced d/t pull of Common extensor muscles
 - T/t : OR and IF with K wires (Fracture of Necessity)
 - **Complications :**
 - Non union
 - Cubitus Valgus deformity (Diminished growth of lateral side of distal humerus)
 - Tardy Ulnar Nerve Palsy – (2-20 yrs) Friction neuritis as it moves overmedial epicondyle – T/T : Anterior Transposition of Nerve
 - **Elbow Dislocation :**

Posterior dislocation is commonest
3 point bony relationship is reversed
Associated median nerve palsy is seen
T/t : CR & POP slab x 3 weeks
 - **Pulled Elbow : (Nursemaid's Elbow)**

Children b/w 2-5 yrs of age
Radial Head pulled out of annular ligament
Forearm in an attitude of pronation
X Rays show no bony injury
T/t : Head reduced by supinating forearm + Direct pressure on radial head
 - **Fracture Olecranon :**
-

mm

MIST - ORTHO (lower Limb Trauma) → ANATOMY REVERSE

Injuries Around Hip

Hip joint : Ball & Socket Joint
Acetabulum - 30 deg outwards and anterior
Neck Shaft angle - 125 deg, anteversion 15 deg

Blood Supply -

- Medullary vessels
- Retinacular vessels
- Foveal vessels

Dislocations of Hip

Types:

- Posterior (adduction + flexion + internal rotation)
- Anterior
- Central Fracture Dislocation

Posterior Dislocation -

- M/C type
- Also called as Dashboard injury
- Deformity is **FIRAD** (Flexion, Adduction & Internal Rotation)
- T/t - Closed Reduction

Techniques - Allis

Bigelow's --- (Iliofemoral Ligament, Y shaped - strongest ligament in body, It prevents trunk from

Hyperextension) *(Strongest ligament of the Body)*

Stimson's

Complications

- M/C is Sciatic nerve injury (Usually Neuropraxia) → Compression stays until relieved. *Sciatic nerve injury → foot drop*
- AVN femoral head (15-20%) → late complication
- Osteoarthritis

Myositis Ossificans (Common in Head Injury) *(extra growth after hip dislocation)*

Anterior Dislocation -

FABER - Flexion, Abduction & External Rotation → Test for S-I joint (Sacroileal joint) → A.S. *Sacroiliac*

lengthening of affected limb

Central Fracture Dislocation - Lateral traction is applied (Head of the femur, fracturing the acetabulum & entering the pelvic girdle).

Fracture Neck Femur

Common in elderly osteoporotic individuals (trivial fall)

2 types -

- Intra-capsular (# NOF)
- Extra-Capsular (IT #)

Classification

- Anatomical
- Subcapital
- Transcervical
- Basal

capital has worst prognosis while basal has good

Pauwel's Classification

Angle of inclination of fracture with horizontal

e 3 unstable/worst prognosis

Type 1 → best prognosis

arden's Classification : (based on change in direction of medial trabecular stream)

Type 1 : Incomplete

Anatomical Classification

- Subcapital
- Transcervical
- Basal

MIST - ORTHO (lower Limb Trauma)

- Type 2 : Complete but undisplaced
- Type 3 : Complete but partially displaced
- Type 4 : Complete and Fully Displaced

1) Undisplaced & Conservatively
→ multiple screws

2) Displaced
a) 60 yrs
b) > 60 yrs

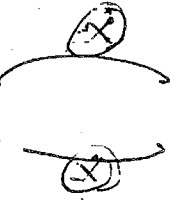
Acute Fractures (Head preservation in Young and Head Replacement in Elderly)

- Hemiarthroplasty: (Half Head replacement) → ~~not~~ ^{not} muscle action patients
 - Earlier Unipolar prosthesis were used (AM Prosthesis, Thompson's)
 - Nowadays Bipolar Prosthesis are used (2 planes of movement)
 - Total Hip Replacement : Pre-existing OA changes in hip (old patients)
 - McMurray's Osteotomy - Arm-chair effect
 - Vascularized muscle pedicle bone graft :
 - Meyer's Procedure (Quadratus femoris)
 - Baksi's Procedure - TFL
- OLD FRACTURE (> 3 weeks old)
- If head is Vascular - Osteotomy */Reconstruction procedures eg Meyer's procedure
 - If Head is Avascular - Replacement

{ * Osteotomy - Cutting a piece of bone so that shearing forces are converted to Compression forces }

• Complications :

- Non Union (30-40%)
- Avascular Necrosis - MRI is Investigation of choice to diagnose (Avascular head becomes sclerotic → head collapse → OA)
- Osteoarthritis



Intertrochanteric Fracture (external / extracapsular)

- Seen in elderly osteoporotic
- Distal fragment rides up → Coxa Vara (femoral neck shaft lie less than 120-130°) [< 120° - dis]
- External rotation more as c/t # NOF (Extracapsular)
- Unite readily as c/t # NOF
- T/t :
- Most commonly used traction is Russell's traction (Rarely used)
- Closed reduction & IF with Dynamic Hip Screw (TOC)
- Complications :
- Malunion (c/t # NOF in which Non union is found)
- OA

TRENDELEBURG GAIT TEST & Hip → abduction (gluteus medius) & Knees → Quadriceps

Fracture Shaft Femur :

- High velocity injury in young adults, in old can be d/t twisting injury
- Displacements (Proximal fragment is F AB ER ; Distal is Adducted)
- T/t :
- In Children - < 2yrs - Gallow's traction is TOC
- > 2 yrs CR + Hip Spica (when # is sticky)
- In older children - TENS
- In Adults - CR/OR + Intramedullary Nailing

{ Kuntscher's Clover leaf Nail or K Nail used earlier - Isthmus fractures; Nowadays Interlocking nail is used } Rotationally Stable construct

(Titanium elastic Nailing System)

- Complications :
- Shock (Around 1000-1500 ml blood loss in closed femur fractures) → Hypovolaemic shock
- Fat Embolism - > 24-48 hrs
- Femoral artery injury (middle/distal third junction)
- Sciatic nerve injury
- Late - Delayed union/ Non union/Malunion

Muscles of knee joint - Hamstrings group
 Quadriceps group

MIST - ORTHO (lower Limb Trauma) + Semimembranosus

Knee Anatomy

- Knee is hinge joint b/w Tibia and femur, patella glides & forms Patello-femoral joint.
- In OA - M/C involved Compartment is Medial Tibio femoral
- Knee ligaments :
- ACL : prevents ant. tibial translation
- PCL : prevents post. Tibial translation
- MCL : prevents medial opening up
- LCL : prevents lateral opening up
- Extensor Apparatus : (prox to distal) - quadriceps muscle, tendon, patella, patellar tendon & patellar retinaculum

* Semitendinosus
 * Biceps femoris
 Quadriceps group
 * vastus lat. medialis
 * tensor fasciae latae
 * rectus femoris

Structures Anterior To Posterior on Tibial Articular Surface :

- M (Medial Meniscus Ant Horn) -
 - C (Ant Cruciate Ligament) -
 - L (Lateral Meniscus Ant Horn) -
 - L (Lateral Meniscus Post Horn) -
 - M (Medial Mensicus Post Horn) -
 - C (Post Cruciate Ligament) -
- 4 Meniscus
 Ligament

Patella fracture

- d/t direct or indirect force
- It can be transverse # , stellate # etc
- Extensor lag is present d/t disruption of extensor mechanism
- X rays may involve AP, Lat or Skyline view
- T/t :
- Transverse # : TBW
- Comminuted or Stellate # : Total patellectomy
- Upper or Lower Pole # : Partial patellectomy
- Complications :
- Knee stiffness
- Extensor weakness
- Patello-femoral OA

Knee Ligament Injuries

- MRI is investigation of choice for ligament/meniscal injuries
- Medial Collateral Ligament :
 Injured d/t valgus (Abduction) force → from outside
 Ruptures from femoral attachment
 Test : Valgus stress test at 30 deg knee flexion
- Lateral Collateral Ligament :
 Injured d/t varus (Adduction) force
 Lig. avulsion from fibular head
 Test : Varus stress at 30 deg knee flexion
- Anterior Cruciate Ligament : (M/C knee lig. injury) (ACL)
 Prevents anterior tibial translation
 M/C knee ligament injury
 d/t twisting force on semi-flexed knee
 ACL+ MCL+ Medial Meniscus (O'Donoghue triad)

medial meniscus MCL

MIST - ORTHO (lower Limb Trauma)

Tests :

- Lachmann Test (in 10-15 deg of knee flexion) - done in fresh injuries
- Anterior Drawer test
- Pivot shift test

T/t :

- TOC is Arthroscopic ACL Reconstruction *graftless / semitendinosus*

Posterior Cruciate Ligament :

- Prevents posterior Tibial Translation
- Injury d/t backward force on tibia
- Tests : Posterior Drawer Test

Meniscal Injuries: (M/C) → Soft tissue injury

- Medial meniscus injury is more common because of relative immobility/fixity
- Mechanism : Twisting injury to a Semi-flexed Knee
- Pathoanatomy :
- Most commonly at Posterior Horn
- M/C type is Bucket Handle type (Others are Radial, Anterior Horn etc)
- Meniscus being avascular does not heal (except peripheral meniscal tears - vascular area)
- C/F :
- Recurrent episodes of pain & Locking of affected knee (torn meniscus interposed b/w femoral & Tibial condyles)
(Popliteus unlocks knee joint by internally rotating tibia in normal gait)
(Pseudo locking - in loose bodies, hamstring spasm)
- Tests : McMurray's test & Apley's grinding test
- T/t : Arthroscopic Meniscectomy (In outer thirds, repair is attempted)

normal unlocking muscle for knee joint → **POPLITEUS**

Locking → Meniscal injury

Meniscus → function : equal weight bearing

Ankle Sprain :- * dorsiflexion, plantar flexion (2 movement points)

Classification :- Lauge Hansen

1/3 mode of injury is supination → ext. Rotation injury

Tibio-fibular syndesmosis is ruptured in pronation - ER injury
ant. Talofibular lig → most common
(ATFL) lig injury.

Orthopaedics (Arthritis Notes)

ARTHRITIS

- Arthritis : Inflammation of joint l/t pain , swelling and limitation of joint movement
- Arthralgia : Pain in joint
- Classification :

MONOARTHRITIS

Pyogenic
Tubercular
Haemophilic arthritis
Secondary OA
Gout

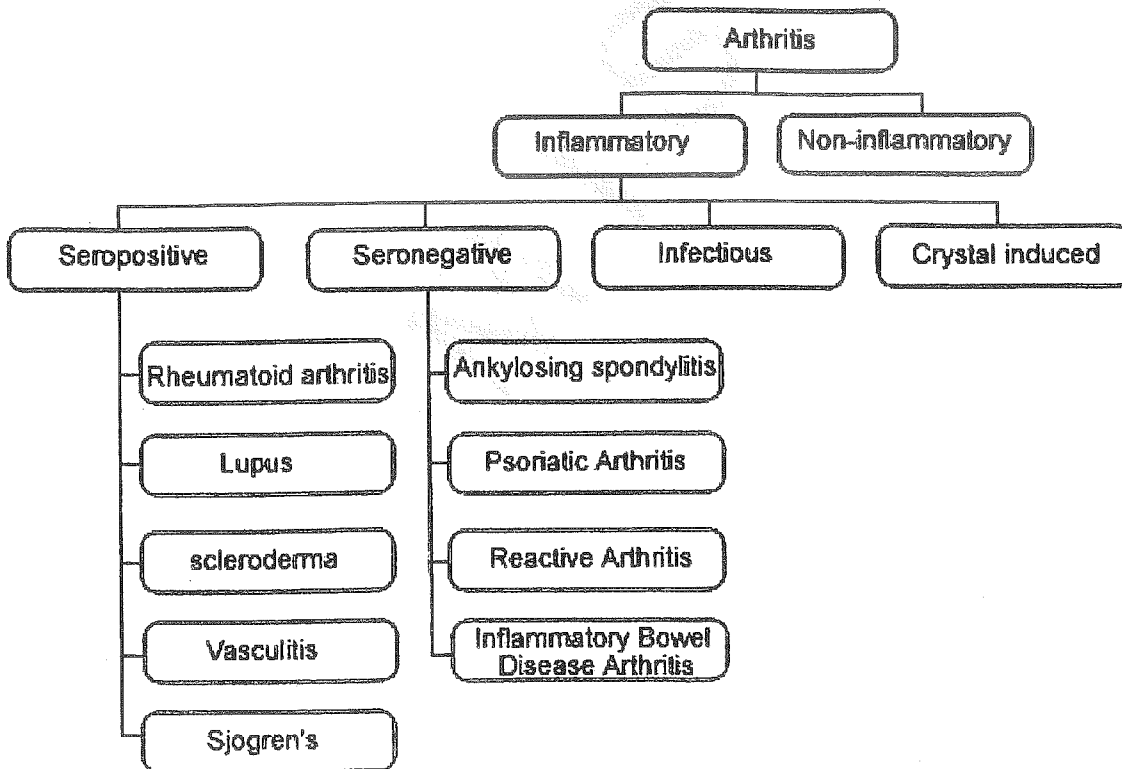
POLYARTHRITIS

Rheumatoid arthritis
Rheumatic Fever
Juvenile Chronic Polyarthritis
Primary OA
Seronegative spondyloarthropathy

Inflammatory & Non Inflammatory Arthritis

- Inflammatory :
 - Seropositive (RA) – Rheumatoid Factor positive
 - Seronegative (AS) – Rheumatoid factor negative
- Non Inflammatory:OA

Classification of Arthritis



Rheumatoid Arthritis

Orthopaedics (Arthritis Notes)

Table 2 – The 1987 revised American College of Rheumatology criteria for the classification of RA^a

Criterion	Definition
1. Morning stiffness for 6 weeks	Morning stiffness of joints lasting at least 1 hour before maximal improvement
2. Arthritis of 3 or more joint areas for 6 weeks	At least 3 joint areas simultaneously have soft tissue swelling or fluid observed by physician
3. Arthritis of hand joints for 6 weeks	At least 1 joint area swollen (as in criterion 2) in the wrists, MCP joints, or PIP joints
4. Symmetrical arthritis for 6 weeks	Simultaneous involvement of the same joint area (as in criterion 2) on both sides of body
5. Rheumatoid nodules	Subcutaneous nodules over bony prominences or extensor surfaces, or around joints
6. Serum rheumatoid factor	Presence of abnormal amounts of rheumatoid factor by any method, with < 5% in controls
7. Radiographic changes	Changes typical of RA on hand and wrist radiographs, such as erosions and periarticular osteopenia

RA, rheumatoid arthritis; MCP, metacarpophalangeal; PIP, proximal interphalangeal.

^a A patient is said to have RA if at least 4 of the 7 criteria are present.

Sensitivity: 93% & Specificity : 90%

Aetiopathology:

- Genetic Predisposition (HLA DR 3 & DR 4)
- Autoimmune IgM complexes gets deposited in **Synovial membrane** causing joint inflammation.
- **Pannus** - Inflamed synovium surrounding articular cartilage –causes Cartilage destruction

Joints Involved :

M/C joint involvement is **Metacarpophalangeal joint particularly of Index finger**

Large joint involvement – Knee joint

PIP joint is involved but **DIP joints are not involved**

M/C Spine involvement is – **Cervical Spine**

C/F :

- Presence of swollen , boggy joints d/t synovial hypertrophy, intra-articular effusion and edema of peri-articular tissues

Deformities in RA

- Hand : Radial deviation of Wrist with Ulnar Drift of fingers (Z Deformity)
 - Boutonniere deformity
 - Swan Neck Deformity
 - Hitch hikers thumb
 - Elbow : Flexion Deformity
 - Knee : Early – Flexion
 - Late – Triple Deformity
- (Flexion, Posterior Subluxation & ER)

Orthopaedics (Arthritis Notes)

- Ankle : Equinus deformity
- Foot : Hallux Valgus, Hammer Toe

Extra-Articular Manifestations of RA

<i>Vasculitis</i>	Digital arteritis Raynaud's phenomenon Peripheral neuritis Necrotising arteritis
<i>Rheumatoid Nodules</i>	Olecranon (Most common site) Dorsal surface forearm
<i>Serositis</i>	Pleurisy, Caplan's syndrome Cardiomyopathy, Pericarditis Iridocyclitis Carpal tunnel syndrome
<i>Others</i>	Anaemia Felty's syndrome Sjogren's syndrome (Sicca syndrome) Amyloidosis

- **Investigations :**
- **X Rays :**
Reduced joint space
Erosions of articular margin
Peri-Articular Osteopenia
Skeletal Deformities
- **Blood :** ↑ ESR, RA factor positive (It is most commonly IgM antibody against Fc fragment of IgG)
- **Synovial fluid Ex**

T/T:

- NSAID's
- DMARD's (Methotrexate, Sulfasalazine)
- Steroids
- **Anti TNF & Anti IL-1** agents (Can cause reactivation of tuberculosis)

For Small Joints – Synovectomy
For Large Joints - Replacement

RA Factor is seen in following conditions:

- RA
- Infectious Mononucleosis
- SLE
- Influenza
- Hepatitis

Orthopaedics (Arthritis Notes)

- Endocarditis
- AIDS
- Tuberculosis
- Liver Disease
- Sarcoidosis
- Syphilis

Ankylosing Spondylitis

- Also k/a **Marie Strumpell Disease**
- Stiffness of joints of **Axial Skeleton**
- 1st joint affected is **Sacro-Iliac Joint (Sacroilitis)** , then Spine from Lumbar region upwards – Pain and Stiffness of joints
- Association with **HLA – B 27** (> 85% cases)
- More common in Males (M:F = 10:1)

- **Pathology :**

Synovitis → Cartilage destruction/Bony Erosions → **Bony Ankylosis**

- O/E : Lumbar flexion decreased (**Schober's test positive**)
Chest Expansion reduced (< **5 cm**)
Test for SI joint: (**FABER, Gaenslen, Pump Handle positive**)

Extra-Articular Manifestation of AS

<i>Ocular</i>	Acute iritis
<i>Cardiovascular</i>	Aortic incompetence Cardiomegaly Conduction defects Pericarditis
<i>Neurological</i>	Dislocation/ subluxation of atlanto-axial joint
<i>Pulmonary</i>	Costovertebral joints involvement Apical lobe fibrosis with cavitation
<i>Systemic</i>	Generalised osteoporosis Amyloidosis

X Rays :

- 1st X Ray finding is **Sclerosis of SI joints**
- **Enthesopathy** – Calcification at Tendinous attachments (Pain)
- **Squaring of Vertebrae** (d/t Calcification of ALL)
- Bridging osteophytes – **Syndesmophytes**
- **Bamboo Spine** appearance
- **T/t :**

Orthopaedics (Arthritis Notes)

- Physiotherapy
- NSAID : **Indomethacin**
- Immunomodulators

Eg: Infliximab

Reiter's Disease:

- Seronegative arthritis
- Triad of **Conjunctivitis, Arthritis & Urethritis**

Psoriatic Arthropathy:

- Seronegative polyarthritis with involvement of **Distal Interphalangeal joints** of Hand (c/f RA where they are spared)
- **Alkaptonuric Arthritis (Ochronosis) :**
- Defect in enzyme responsible for metabolism of Phenylalanine and Tyrosine
- Excretion of Homogentisic acid in urine (Turns dark brown on standing d/t oxidation of Homogentisic acid)
- H. acid accumulates in cartilage and other tissues
- Causes disc space and peri-articular calcification (**Chondrocalcinosis**)
- **M/C joints** involved – Spine, Shoulder
- **Neuropathic Arthropathy : (Charcot's Joint)**
Repeated trauma to joint d/t loss of sensations.

Crystal Arthropathy

Gout:

- Excessive Uric acid accumulation in blood (Impaired Purine metabolism or Impaired excretion in Urine)
- Accumulation of **Monosodium Urate** crystals
- Predilection for **Small Joints**, Cartilage, Tendon, Bursa
- **1st MTP joint** is M/C affected
- **Bursitis** – M/C **Olecranon bursa**
- **Tophi** formation – deposition of Uric acid salts in soft tissues
- C/F : Pain, Swelling & Redness of affected joint
- Dx :

Synovial Fluid Analysis - Crystals show **Negative birefringence** under Polarized Microscopy
They are **Needle shaped**

Pseudogout:

- Crystals of Calcium Pyrophosphate Dihydrate (CPPD) deposition, also k/a **CPPD disease**
- Predilection for **Large joints**
- **Knee joint** is M/C affected
- **Meniscus Calcification** and Chondrocalcinosis is seen on X Rays Also seen in **Alkaptonuria**)
- Dx: Synovial Fluid - Crystals show **Positive birefringence** under Polarized Microscopy
Crystals are **Brick shaped or Rhomboid**

Osteoarthritis

- Degenerative joint disease affecting **Articular Cartilage**
- **2 types :**
- **Primary** – Inweight bearing joints like Hip, Knee.

M/C in Knee

- **Secondary** – Secondary to an underlying primary disease

M/C in Hip

Orthopaedics (Arthritis Notes)

Pathology:

- Loss of Articular Cartilage
- Underlying Subchondral Bone Becomes hard & Glossy (**Eburnated**)
- **Osteophyte formation** – Bone spurs
At margins of joint
- **Subchondral Cyst & Sclerosis**

C/F:

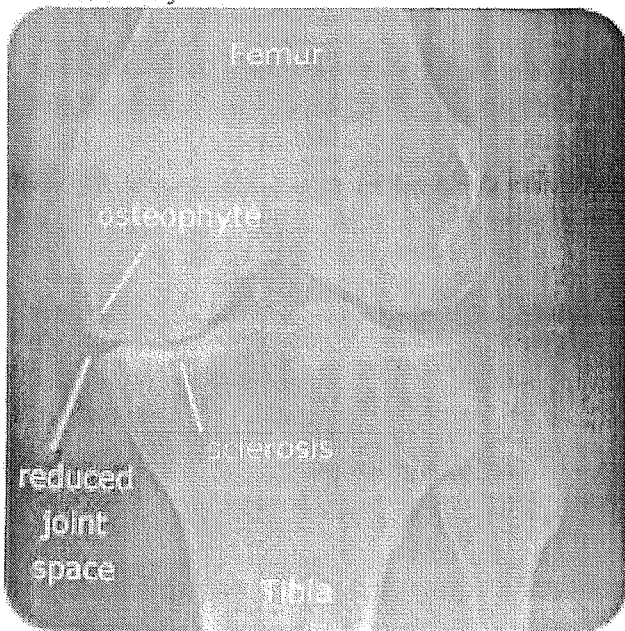
- Pain is earliest symptom
- **Knee joint** is more commonly involved in Asian population while Hip joint is more involved in Western population
- In Hands :

PIP joint involvement – **Bouchard's Nodes**

DIP joint involvement – **Heberden's Nodes**

X-Rays:

- Narrowing of Joint Space
(**Medial** comp. in OA Knee)
- Subchondral Sclerosis
- Subchondral Cysts
- Osteophyte
- Loose Bodies
- Deformity



Treatment :

- Osteotomy – High Tibial Osteotomy (in young Unicompartamental OA)
- Joint Replacement – Unicompartamental & TKA

Cervical Spondylosis: M/C at **C5-6** level

Lumbar Spondylosis: M/C at **L5/S1** level

Infections of Bone & Joints

Key Points

- M/C Parasite infesting the bone & Joint is Echinococcus Granulosus (Hydatid Cyst)
- M/C cause of Bacterial OM : Staphylococcus Aureus
- M/C bacteria in child < 4 yrs : Haemophilus Influenza
- M/C bacterial infection in I/V drug users/ Heroin addicts : Pseudomonas
- M/C infection in Haemoglobinopathies e.g. Sickle cell anemia : Salmonella OM
- M/C joint affected is Knee joint f/b Hip
- M/C site : Proximal Tibia

Acute Osteomyelitis

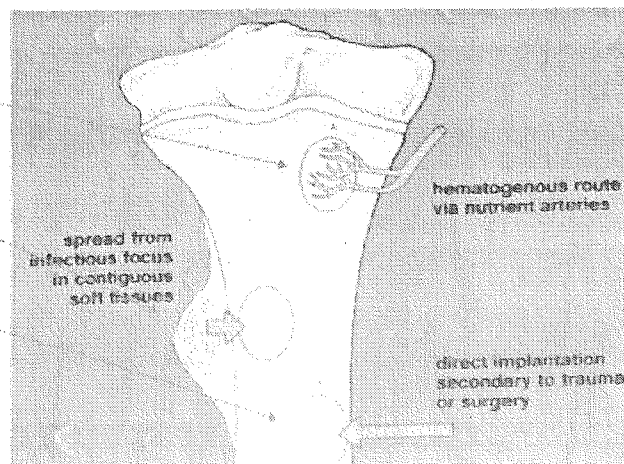
- Osteomyelitis : Infection of Bone by pyogenic organisms
- Most common : Acute Haematogenous OM
- Site : M/C Metaphysis because of
 - Hair pin arrangement of vessels → blood stasis
 - Vascular area owing to Growth plate activity
 - ↓ phagocytic activity of lining cells
- If metaphysis is intra-articular (eg Hip) , then it can l/t pyogenic arthritis

Classification :

Acute:	<2weeks	<ul style="list-style-type: none"> ■ Early acute ■ Late acute(4-5days)
Subacute:	2weeks— 3months	Less virulent – more immune
Chronic:	>3months	

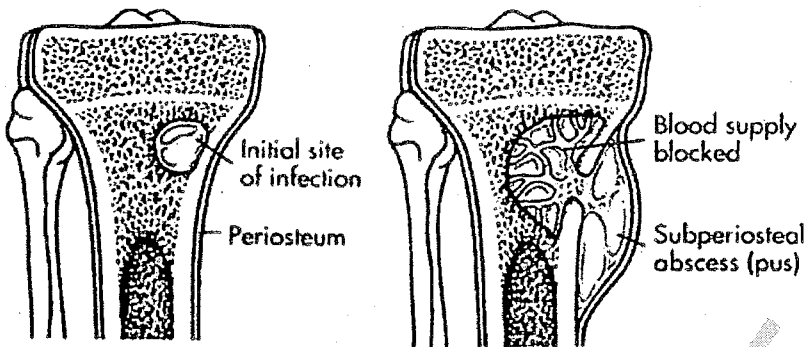
Source of Infection:

- Hematogenous
- Direct spread
- Exogenous



Actiopathogenesis

- **Staph Aureus** is M/C organism
- **Pathology** : Inflammatory reaction → Pus formation/ Bone destruction
- Pus spreads :
Along medullary cavity
Breaches cortex → Periosteal abscess
- Pus reaches in soft tissues , joints etc
- Causes Septic Arthritis if Metaphysis is I/A e.g. Hips



- C/c: Pain, Swelling, Redness, fever & Loss of movements of nearby joints
- **Investigations** :
- **Blood** : TLC ↑, DLC – Neutrophilia , ESR ↑, CRP ↑ { CRP is earlier to rise}, Blood culture (positive in < 50 % patients because bacteria reside in Metaphysis)
- **X Rays** : Earliest sign is **Periosteal Reaction** (10-14 days)
- **Bone Scan** : Tc 99 bone scan – Hot spots (increased uptake)
- **Investigation of Choice** : Aspiration of Pus
- **D/D** :
- Acute Septic Arthritis
- Acute Rheumatic Arthritis (Elevated ASLO titres)
- Scurvy (Subperiosteal haematomas mimic radiologically)
- Acute Poliomyelitis

Treatment

- **If Pus present** :
- Surgical Drainage of pus + Rest/I/V fluids/Antibiotics
(Antibiotics : I/V for 2 weeks followed by 6 weeks of Oral)
- **Complications** :
- Chronic Osteomyelitis (M/C complication)
- Acute pyogenic arthritis (In intra-articular metaphysis, e.g upper femoral)
- Pathological Fracture
- Growth Plate Disturbances

Chronic Osteomyelitis

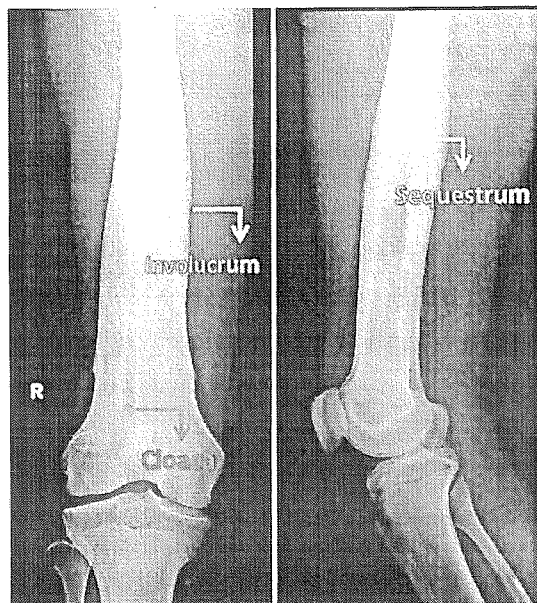
- Occurs d/t :
- Delayed and Inadequate Treatment
- Virulence of Organism
- Reduced Host Resistance
- Hallmark is :
- **Sequestrum** (Dead bone surrounded by infected granulation tissue and Pus)

- **Involucrum** : Dense new Bone surrounding sequestrum
- **Cloacae** : Opening in involucrum for pus to drain out

- **C/F** :
- **Chronic Discharging Sinus**
- **Thickened/Irregular bone**

X Rays :

- Sequestrum (More Radiodense because of no decalcification)
- Involucrum
- Cloacae
- Thickened & Irregular cortices , patchy sclerosis



Treatment :

T/t : (Removal of dead bone & infected granulation tissue)

- Sequestrectomy
- Saucerisation (Free Pus drainage)

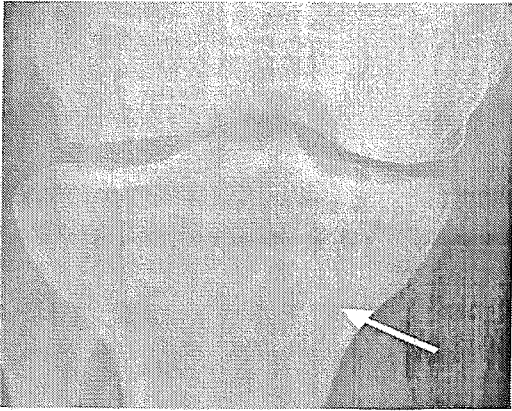
Complications :

- M/C is **Acute exacerbation/flare up**
- **Pathological fracture**
- **Growth Abnormalities** (Shortening, Lengthening, deformities)
- **Joint stiffness**
- **Amyloidosis**
- **Sinus Tract Malignancy : Squamous Cell Ca (<1%)**

Subacute Osteomyelitis

- **Garre's Osteomyelitis** :
- **Sclerosing , non-suppurative OM of Shafts of Femur/Tibia**
- **Brodie's Abscess** :
- **Chronic bone abscess surrounded by a zone of sclerosis**
- **Young adults b/w 11-20 yrs**
- **Site : Metaphysis**
- **X Rays : circular or oval lucent area (Pus) surrounded by a zone of sclerosis**

- T/t : Surgical evacuation + curettage + Abx



Septic Arthritis :

- Caused by pyogenic organisms
- M/C organism – Staph Aureus

Organisms reach joint by :

- Haematogenous Route (M/C)
- Secondary spread by nearby OM
- Penetrating wounds
- M/C joint involved is **Knee Joint**

C/c :

- Pain, swelling & Redness of affected joint
- High grade fever , malaise etc.

IOC : Joint aspiration & testing

- **Treatment :**
- Abx + Arthrotomy if pus is present on aspiration
- **Complications :**
- Deformity / Bony ankylosis
- Pathological Dislocation
- Osteoarthritis
- **Tom Smith Arthritis (Septic Arthritis in Infancy) –**
- Femoral head being cartilaginous gets completely destroyed
- D/d : DDH

- **Madura Foot :**
- Caused by Maduramycosis

Tuberculosis

- Spine is most commonly affected (50%) f/b Hip and then Knee
- Caused by Mycobacterium Tuberculosis, infection is **secondary** to a primary focus
- Route of Spread : Haematogenous
- **Musculoskeletal Tuberculosis**
- In Spine – Pott's Spine
- In short bones (Phalanges) – Spina Ventosa

- Hip is M/C site for Tubercular Arthritis
- Knee is M/C site for Tubercular Synovitis
- Tubercular Tenosynovitis of flexor tendons at wrist – Compound Palmar Ganglion
- Tuberculosis of Shoulder with no Pus – ‘Caries Sicca’

Pott's Spine

- M/C site of Bone & Joint Tuberculosis
- M/C site in Spine is Dorso-Lumbar Region
- **Pathology:**
 - Secondary infection
 - Spreads via Para-vertebral plexus of veins (Batson's Plexus)
 - M/C part affected - Vertebral Body
 - Types: Paradiscal is M/C type (Two adjacent vertebrae + Disc)
 - Central – 1/t wedge or concertina collapse
 - Anterior
 - Posterior – Least common

Pathology:

- Wedging/Collapse of vertebrae – Wt bearing line anterior in Dorsal Sp.
- Cold Abscess – Pus + Tubercular Debris
- Healing by Bony Ankylosis

C/F :

- Back pain is M/C presenting symptom
- Stiffness
- Cold Abscess (Retropharyngeal , Psoas abscess)
- Deformity & Paraplegia
- Constitutional Symptoms

X Rays :

- Reduction of Disc Space is earliest sign
- MRI is IOC – for type /extent of cord compression, Bony Marrow Edema is seen very early

T/t :

- Rest (Braces for support)
- ATT (Anti Tubercular Treatment)
- Treatment of Cold Abscess – Aspiration/Drainage/ALD

Complications :

- Cold Abscess is M/C complication
- Pott's paraplegia

Pott's Paraplegia (TB spine + Neurological Involvement)

- Incidence is 20%
- M/c in TB of dorsal spine
- **Types :**
 - Early Onset – within 2 years
 - Late Onset – after 2 years
- **Stages :**
 - Muscle weakness → Paraplegia In Extension → Paraplegia In Flexion → Complete Flaccid Paraplegia
- **T/t:**
 - Costo transversectomy
 - Antero Lateral Decompression – M/C surgery done
 - Radical Debridement & Arthrodesis – Hong Kong operation
 - Laminectomy – for post spinal disease/ Spinal tumour syndrome

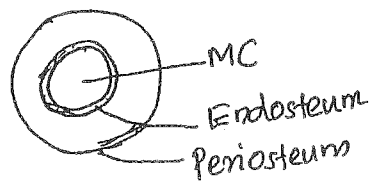
Tuberculosis Hip

- Second M/c site
- **Stages :**
- Stage of Synovitis (FABER)
- Stage of Arthritis (FIRAD)
- Stage of Ankylosis (Fibrous) – Deformity is FIRAD
- **Treatment :**
- **In Early stages – ATT with Rest and Traction**
- **In Late Stages - Joint Debridement**
 - Arthrodesis
 - Girdlestone Arthroplasty
 - Total Hip Replacement

Tuberculosis Knee :

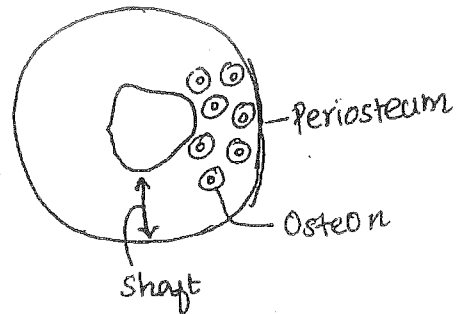
- Begins as a Synovial Disease
- Leads to **Triple Deformity (Flexion, Posterior Subluxation & ER)** in advanced cases
- Leads to healing by Fibrous Ankylosis
- **T/T :**
- Rest & Traction
- ATT
- Synovectomy, Debridement and Arthrodesis

- * Thomas test → used for hip flexion
- * Thomas splint → used for fractures of femur, thigh, shaft
- * Internal fixation → use of nails / some substances to fix fractures
- * Ends of long bone: Epiphysis (2 ends)
- * 2 metaphysis (blw epi & diaphysis)
- * 1 diaphysis
- * Epiphyseal plate / Epiphyseal growth plate / Physis → cells from the cartilage produces bone cells.
- * Shoulder joint → blw humerus & glenoid cavity of scapula.
- * Periosteum → inner layer → cambium cells → grows in width
- * Outer fibrous layer → grows in length.
- * Medullary cavity → inside bone cavity.



- * MC → responsible for blood cell formation.
- * Bone strength is based on the diaphysis.

- * Soft bone / Woven / Spongy bone.
 - ↓
 - Basic unit of Spongy bone is trabeculae. (MCR)
 - ↓
 - cells are loosely arranged.
- * Lamellar bone / Compact bone
 - ↓
 - Basic unit is Osteon (MCR)
 - ↓
 - Contributes to strength of bone
- * Lamella: sheets
- * Epiphysis → soft spongy bone
- * Metaphysis
- * Diaphysis → Compact bone. (predominantly)



- * Centre of Osteon → has Haversian canal → bone receives blood supply.
- * When # pain due to haversian canal. (runs longitudinally)
- * Called as Haversian system
- * Horizontal connection blw haversian canal → Volkmann's canal (⊥ to Hc)

- * HC links blood vessels, nerves, lymphatics
- * Intramembranous ossification
 ‡ (bones from membrane)
- Endochondrial ossification
 (bones from cartilage)

* Clavicle → Only long bone in body formed by intramembranous ossification.

* All other bones → Endochondrial. O

* Artery of ligamentum teres

* Composition of bone:

Bone cells + Extracellular matrix

↓
 ① Osteoblast
 (bone formation)

↓
 Alkaline phosphatase enzyme (ALP)

* ↑ serum ALP indicates ↑ activity of osteoblast.

* Osteomalacia (Vit D defi.) → ↑ ALP

* Osteocytes → matured osteoblast

② bone cells → rich in glycogen & PAS (periodic acid Schiff stain staining) (PAS +ve)

* ③ Osteoclast → multinucleated giant cell → bone resorption.

* Bone re-modelling cycle → bone continuous bone form? ‡ continuous bone resorption.

* Extra-cellular matrix

1) Organic matrix:

Collagen (95%)

2) Inorganic

Hydroxyapatite

3) Water

* Osteogenesis imperfecta
 (collagen deformity)

* Fracture (#): A break/breach or discontinuity of cortex of bone

* Painful → leads to edema/swelling.

Stages of fracture healing
 of cortical bone

1) Stage of Hematoma (< 7 days)

- Fracture end necrosis

- Sensitization of precursor cells

2) Stage of granulation tissue
 (2-3 wks)

- Proliferation & differentiation of daughter cells into vessels, fibroblast, osteoblast etc

- Fracture still mobile

3) Stage of Callus (3-12 wks) ^{Imp}

MCA Callus → Mineralised granulation tissue (end of 3 wks)

- In x-ray healing is visible

- First stage in which radiologically visible

- Fracture not mobile
 (first stage)

- Appear at end of 3 wks after fracture Rx.

5) Stage of Remodelling (1-2 yrs)

Callus → Lamellar bone

6) Stage of Modelling (many years)

(10-12 yrs)

Lamellar bone → Normal looking bone.

* Displaced → # fragment does moves away.

* Displacement is always the movement of distal fragment in relation to proximal

* MC dislocation of shoulder → Anterior

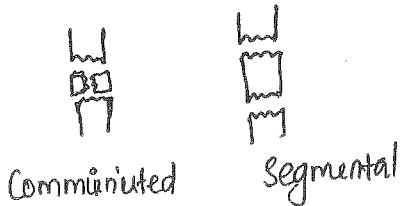
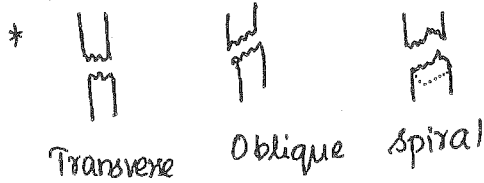
* MC dislocation of hip → Posterior

* " in elbow → Posterior

* Closed fracture / Simple fracture
Overlying skin intact.

* Open # / Compound # (not complex)
Skin open, wound, bone can be seen.

* Complex # → when multiple # here skin can be intact or not.



* Medial & posterior malleoli is part of tibia

* Lateral malleolus → part of fibula.

* So total 3 malleoli

* Intra-articular # → # line goes inside the joint.

* Extra-articular → # line is not communicating with joint.

* Painful restriction of movement, after PTA (post traumatic traumatic arthritis) → so in intra articular # should be corrected with Sx.

* 7 tarsal bones [Talus, Navicular, calcaneus, cuboidal, cuneiforms (3)]

* 5 metatarsal bones of foot:

1st → medial one

5th → outer most one.



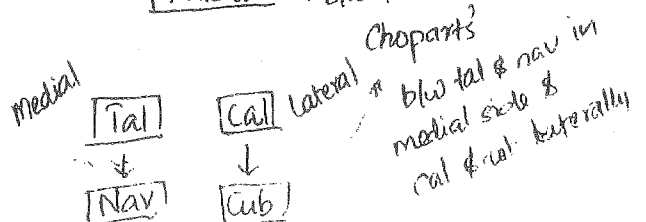
* Loss of medial longitudinal arch → Flat foot

* 1st metatarsal : Supports medial arch
5th metatarsal : » lateral arch.

* Metatarsal

↓ → # : Lisfranc's #

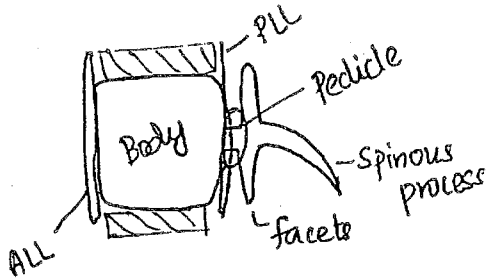
Tarsals → B/w tarsal bone # :



* Cervical vertebra (C₁-7)

C₁: Atlas

C₂: Axis



ALL: Anterior longitudinal ligament

PLL: Posterior longitudinal ligament

The

* Most prominent spinous process: T₁

* First most prominent spinous process seen → C₇ (C)

* Clay-shoveller #: C₇ > T₁

* Odontoid process is an extension of C₂ vertebra.

* Odontoid process / dens →

* Right to left head movement: C₁ & C₂ rotation

* Head up & down: Atlantooccipital

* Ligament → b/w bones → most important stabilizing structure in a joint.

* Tendon → muscles to bone → when muscle contracts it helps in movement along the joint.

* MC used splint in orthopedics: Thomas splint

* Gluteus medius → main abductor → without it can't walk properly → Trendelenberg test.

* Prime flexor of hip → Iliopsoas muscle → attaches to lesser trochanter

* Radial nerve → supplies wrist extensors (extensor carpi radialis longus & ECR brevis) → paralyzed in wrist drop.

* Claw hand: Hyperextension at metacarpophalangeal joint & flexion at interphalangeal joint → paralysis of intrinsic muscles of joints (lumbricals & interossei) → intrinsic minus hand.

* 4 lumbricals, 8 interossei (4 palmar & 4 dorsal)

* Lumbricals → flexion at the metacarpophalangeal joint & extension at interphalangeal joint.

* Deltoid → abductor (aeroplane splint)

* SOMI (sterno occipito mandibular immobilizer)

* Dynamic → both support & correction.

* Usually splints only support

* Scoliosis: S-shaped deformity in coronal plane.

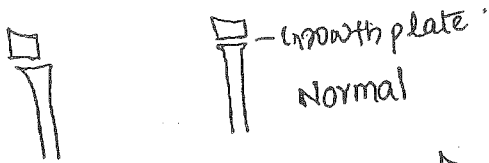
* Orthosis → splint/support

* Prosthesis → implant (eg: Pacemaker)

* CDH/DDH (Congenital dislocatⁿ of hip earlier, now developmental dysplasia of the hip.

Salter-Harris

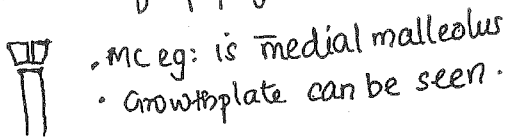
1) Type I: Epiphysis separates at physis
MC seen in neck of radius (around the elbow)



2) Type II: Epiphysis & metaphysis #
MC: distal radius

Thurston-Holland sign / Shiny corner sign.

3) Type III: # of epiphysis + physis.

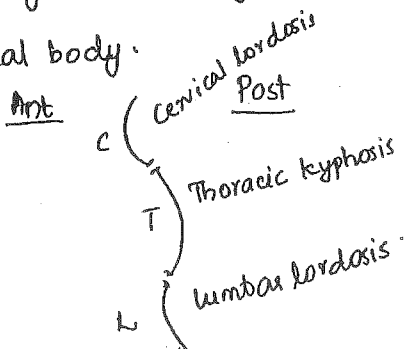


4) Type IV: # P + Epi + meta
- Lateral condyle humerus

5) Type V: Physis got crushed
- Injury in retrospect
- Child may grow up with some deformities.

- * 1, 2 → Good prognosis
- * 3, 4, 5 → Poor prognosis
- * Healing stage of # → Calus → in X-ray seen cloudy around #.

* Normal body.



Biconcave cod fish vertebra.

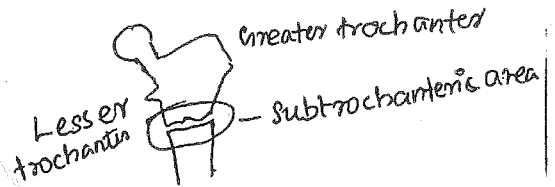
(L = Normal)

* Bisphosphates inhibits os resorption of bone (so bon.

- * To ↑ bone density we can
 - 1) ↑ osteoblastic activity
 - 2) ↓ osteoclastic activity

* ↑ osteoblastic activity by dr. Teriparatide (PTH related) (PTHrP) Cas injecti (helps ↑ bone density)

* Chronic use of bisphosphates can cause Atypical # (to sub-trochanter area in the femur)



* Bone density improves \bar{c} in 1-1½ yrs.

- * Rachitic rosary - Rickets - painless
- * Scorbutic rosary - Scurvy - painful
- * Knee is called as Genu, hip as coxa
- * Strongest tendon: Achilles tendon
- * Strongest ligament: Iliofemoral L / Bigelow's

* So MC complication of post. dislocation of hip → Sciatic N injury / Foot drop

* Faber test done in Sacroiliac (SI) joint deformity due to sacroiliacitis (Ankylosing spondilitis)

Disturbance in this 1° ET / medial trabecular stream is called as Gardeners classification



Acute # management

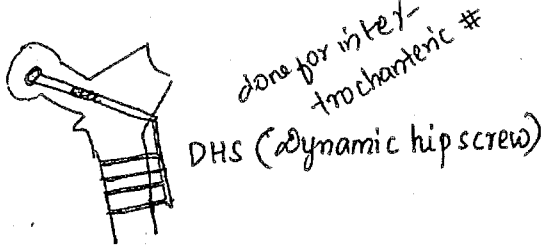
- 1) Undisplaced - Conservative, multiple screw
 - 2) Displaced:
 - a) < 60 yrs (half hip replacement)
 - b) > 60 yrs (hemiarthroplasty, total hip arthroplasty) (CR OR)
- (< 60 yrs - internal fixation with screws)

CR: Closed reduction
OR: Open reduction

Neck-shaft angle $\rightarrow \downarrow \rightarrow$ Coxa vara

Neck-shaft angle $\rightarrow \uparrow \rightarrow$ Coxa valgus

* N-S angle - Normal - 125°



* Quadriceps muscles (4) \rightarrow Rectus femoris + Vastus medialis + Vastus lateralis + Vastus intermedius.

Injuries around Ankle.

* Classification of Ankle injuries:

Lauge Hansen.

* MC mode of injury is Supination-External rotation injuries.

* Tibio-fibular syndesmosis is injured in pronation-ER injuries. (ankle opens)

Ankle sprain

• Injuries to ankle ligaments



- 1) Ant. talofibular
- 2) Post. talofibular
- 3) Calcaneofibular

• Deltoid

• Tibia & Talus forms ankle, it is a type of hinge joint.

• MC is lateral ligament complex: Ant. talofibular ligament injury.

• Spring ligament is ligament b/w calcaneus & navicular. (medially)

* Conjoint tendon: Coracobrachialis & short head of biceps brachii.

* Rotator cuff \rightarrow most important dynamic stabilizer of shoulder

(4) muscles: (SITS)

- 1) Supraspinatus (15° abduction)
- 2) Infraspinatus
- 3) Teres minor
- 4) Subscapularis (internal rotator)

* Axillary nerve injury is common in proximal humerus fractures.

* Slab \rightarrow On one side POP \rightarrow ^{probational} support

* Cast \rightarrow 360° POP \rightarrow For definitive Rx.

* Tendon transfer: dispensable tendons are taken out & fix in damaged # site.

Fracture of lateral condyle humerus

* Type I & II Milch classification

* Type I & Type 2

MCA * Type I lateral condyle humerus # is type IV Salter Harris epiphyseal injury.

MCA * Type II lateral condyle humerus # is Salter Harris type 3 epi. injury

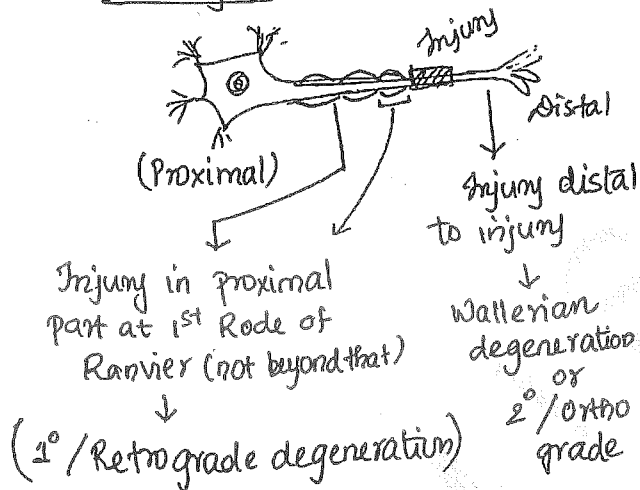
Fractures of forearm & wrist.

• Monteggia # \rightarrow # proximal $\frac{1}{3}$ of ulna with radial head disloc.

• Galeazzi # \rightarrow # of distal $\frac{1}{3}$ of radius with disruption of distal radio ulnar joint. (disruption/dislocation/subluxation)

Nerve injuries

- * Every myelinated nerve is covered by endoneurium
- * Bundle of neurons → fascicle
- * ~~Each~~ ~~By~~ Fascicle covered by perineurium
- * Bundle of fascicle → forms nerve → covered by epineurium
- * Nerve injury



- * Tinel's sign → Mark nerve ~~nerve~~ injury by taping at the area & note sensation

Regeneration rate 1mm/day

↓
Check after 30 days (30mm) → it regenerates & can check it by muscle contraction.

- * Motor march → Nerve re-innervation of muscles one after another from proximal to distal.

(Nerve gives branches to each muscles) - Endoneurial tube should be intact.

Classification

- * Seddon's C
 - from mildest to severe he. classified
 - Mild → Neuropraxia
 - Severe → Neurotmesis

- Forearm posterior
- * 1st compartment - APL + EPB
 - * 2nd - ECRL & ~~ERP~~ ECRB supplied by radial nerve
 - * 3rd - EPL
 - * 4th - ~~Extensor~~ Extensor indicis proprius, EIP + Ext. digi. communis EDC
 - * 5th - Ext. carpi ulnaris (ECU)
 - * 6th - Ext. digiti minimi (EDM)

Radial nerve

- * Before spiral groove: Supplies long & medial head of triceps
- * Within S.G - Lateral head of triceps Anconeus
- * After groove & before division BR, ECRL & ECRB

Forearm

- * 3 compartments:
 - Flexor (M + Ulnar)
 - Extensor (PIN) nerve
 - Mobile Wad of Henry (Radial) (BR + ECRL + ECRB)

⇒ Triceps: Extension of forearm at the elbow joint.

Tendon transfer

* ECRB → For wrist extension

by pronator teres (2 pronator
Pro. teres & pronator quadratus,
here PQ is working so function not
affected)

* EPL → For thumb ^(exten) movement
(by Palmaris longus)

* EDC → for finger extension
(done by flexor carpi ~~or~~
ulnaris or flexor carpi radialis)

⇒ Flexor compartment of arm: (Volar compartment)
1) Superficial - 5
2) Deep - 3

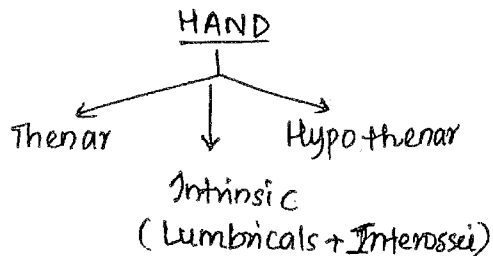
⇒ Superficial compartment muscles (5)

Median {
1) PT (Pronator teres)
2) FCR (flexor carpi radialis)
3) FDS (flexor digitorum superficialis)
4) PL (Palmaris longus)

Ulnar → 5) FCU (flexor carpi ulnaris)

⇒ Deep muscles (3)

media 1/2 - U ← 1) FDP (flexor digitorum profundus)
Lateral 1/2 - M {
AIN (Median) { 2) PQ (Pronator quadratus)
3) FPL (flexor pollicis longus)



Thenar

- Flexor pollicis brevis } Median
- Abductor PB }
- Opponens pollicis }
- Adductor pollicis (Ulnar)

Hypothenar

Deep branch of UL {
- Flexor digiti minimi } Ulnar
- Abductor D.M }
- Opponens digiti minimi }
Superficial branch of U.L {
- Palmaris brevis }

Lumbricals

1 & 2 → Median
3 & 4 → Ulnar

Interossei

Palmar (4) → ULNAR
Dorsal (4)

⇒ Flexor of metacarpophalangeal joint → Lumbricals

⇒ ESR (Erythrocyte sedimentation rate)
ESR ↑ in infection, during infection
↑ fibrinogen which causes RBC
clumping & it settles down in the
tube)

Ortho (Peripheral Nerve Injuries)

Anatomy

- **Peripheral nerve composition :**
- Nerve fibre is enclosed by connective tissue k/a **Endoneurium**
- Bundle of nerve fibres form fasciculi bound by **Perineurium**
- Number of fasciculi forming nerve bound by **Epineurium**
- **31 pairs** of spinal nerves are present
- Peripheral nerves are mixed nerves carrying motor, sensory and autonomous supply to limbs.
- **Autonomous zone :** Area of complete anaesthesia in a nerve injury

Pathology

- **Nerve Degeneration –**
- Part of nerve fibre distal to point of injury loses blood supply & undergoes necrosis k/a **Secondary / Wallerian Degeneration**
- Proximal part undergoes **Primary/Retrograde Degeneration** till first NOR
- **Nerve Regeneration –**
- Recovery is from **proximal to distal**
- Rate of recovery is **1mm/day**
- **Clinical Test : Tinel's Sign**
- If Endoneurial tube is intact – Reinnervation of end organ takes place (**Motor March**)
- If Endoneurial tube is interrupted –
Neuroma in continuity
End neuroma (If widely displaced)
Side neuroma forms in case of partial nerve cut
- **Tinel's Sign :** Pins & Needle sensation on tapping the nerve from Distal to Proximal, Advancing Tinel's suggests regeneration
- **Motor March**
- **Electrodiagnostic Test**
- **Electromyography**
- **Strength Duration Curve**
- **Nerve Conduction Studies**

Classification

- **Neurapraxia**
 - Minor contusion or compression of a peripheral nerve with preservation of the axis-cylinder
 - Physiological disruption of conduction with **Anatomical Continuity**
 - Minor disruption in **Myelin sheath** present
 - Wallerian deg. –nt, No neuroma
 - Tinel's sign **absent**
 - No particular treatment required , Recovery within 6 weeks

 - **Axonotmesis**
 - Also k/a **Partial Lesion/Lesion in continuity**
 - Breakdown of the axon but with preservation of the Schwann cell and endoneurial tubes
 - **Wallerian / Retrograde deg +nt , Neuroma in continuity**
 - **Tinel's sign present, Advancing Tinel's sign present**
 - Recovery +/- , Motor march +nt
 - Intervention required if there is no recovery
 - **Neurotmesis**
 - Complete anatomical severance of the nerve
 - Both Wallerian & Retrograde deg + nt
 - Tinel's Sign present but Advancing Tinel's sign **absent**
 - End or side Neuroma
-

Ortho (Peripheral Nerve Injuries)

- Recovery poor
- T/t : Nerve Repair / Graft , Tendon Transfers

Radial Nerve

- Continuation of Posterior Cord of Br. Plexus
- Runs in Radial/Spiral Groove in arm
- Pierces Intermuscular Septum at Middle/Distal third junction to come in Anterior compartment
- It divides into Superficial & Deep branches before crossing elbow
- Superficial continues as Sensory branch
- Deep branch continues b/w two heads of Supinator & becomes **Post Interosseus nerve** in forearm

Types of Radial Nerve Palsies :

- **Very High Radial Nv. Palsy** : Triceps is also affected
- **High Palsy** : Injury to nerve in radial groove (Triceps & Anconeus spared)
- **Low Palsy** : Around Elbow (Brachioradialis, ECRL & ECRB spared)
- High Radial nerve injury l/t **Wrist Drop**
- **Splint : Cock up Splint**
- **Tendon transfer : Modified Jones Transfer**
(PT→ECRB, PL→EPL, FCU→EDC)
- **PIN Palsy** → Finger Drop (d/t paralysis of EDC)
- **Saturday Night Palsy & Crutch Palsy** – Radial Nerve is affected (Neuropraxia)

Median Nerve

- Branches from Lateral & Medial cords of Brachial Plexus
- No motor supply in arm, runs adjacent to Brachial artery
- Enters forearm b/w two heads of **Pronator Teres**
- Gives rise to **Anterior Interosseus Nerve** in forearm (Supplies FPL, FDP-Medial half & Pronator Quadratus)
- Passes deep to Flexor retinaculum to enter Hand
- **High Median Nerve Palsy** – Injury proximal to elbow (All Ms involved)
- **Low Median Nerve Palsy** – Injury in distal forearm (Hand Ms involved)
- **Clinical Tests :**
- **Pointing Index/Ochsner's clasp test / Hand of Benediction:**
Attempt to clasp hand l/t pointing of index finger
(FDS and FDP of index finger paralyzed)
- **Ape Thumb/Simian Hand Deformity :**
Thumb in same plane as wrist
(d/t involvement of Opponens Pollicis)
- **Pen Test** : Involvement of **Abductor Pollicis Brevis**

Ulnar Nerve:

- Originates from Medial cord of Brachial Plexus
 - In arm lies close to Axillary artery
 - Pierces medial Intermuscular septum and comes to lie in Posterior compartment, reaches behind Medial Epicondyle
 - Enters forearm b/w two heads of FCU.
 - Enters wrist superficial to flexor retinaculum
 - **High Ulnar Nerve Palsy** – injury proximal to elbow (All Ms affected)
 - **Low Ulnar Nerve Palsy** – Injury in distal third forearm (Hand Ms affected)
 - **Clinical Tests :**
 - **Claw Hand (Main-en-griffe) – (Hyperextension at MCPJ & Flexion at IPJ) - k/a Intrinsic Minus Hand**
Develops only in **medial two fingers (only medial two lumbricals are supplied by Ulnar nerve) – { Complete clawing in combined Median and Ulnar nerve lesions}**
 - **Ulnar Paradox-** Clawing more marked in Low lesions as c/t High lesions
(d/t FDP paralysis in high lesions)
-

Ortho (Peripheral Nerve Injuries)

- **Egawa's Test :**
Patient is asked to move his middle finger sideways (Dorsal Interossei – Abduction)
- **Card Test :**
Patient is asked to hold a card tightly b/w two extended fingers
(d/t Palmar Interossei weakness – Adduction)
- **Froment's Sign / Book Test :**
Patient is asked to hold a book b/w thumb and Index finger (d/t involvement of **Adductor Pollicis** , patient uses FPL and flexes his thumb at IP joint)

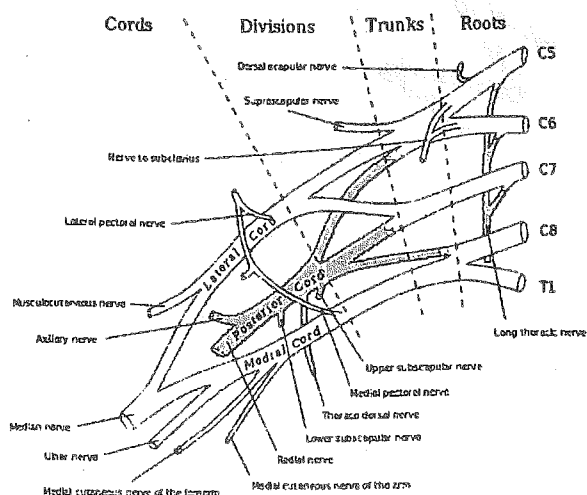
Splint used for Ulnar Nerve Injury – **Knuckle Bender Splint**

- **Axillary Nerve :**
- Origin from Posterior cord of Br Plexus
- Injured in # surgical neck Humerus
- Causes Deltoid Paralysis
- Splint : Aero plane splint

- **Long Thoracic Nerve (Bell's Nerve)**
- From ventral Rami of C5, C6 and C7
- Injury causes paralysis of Serratus Anterior
- Causes 'Winging of Scapula'- Medial border of affected scapula becomes prominent on pushing wall with both hands

- **Sciatic Nerve :**
- Common peroneal component of sciatic nerve supplies Extensors (Tibialis Anterior) and evertors of foot
- Injury l/t 'Foot Drop'
- **High stepping gait**
- Splint : Foot Drop Splint/AFO

Brachial Plexus Injury



- **Branches from Root :**
Nerve to Serratus Anterior (C5, C6 & C7)
Dorsal Scapular Nerve (C5)
- **Branch From Trunk :**
Suprascapular Nerve (Upper Trunk)
Nerve to Subclavius

Ortho (Peripheral Nerve Injuries)

- Lateral Cord

- L — Lateral Pectoral Nerve
- M — Musculocutaneous Nerve
- L — Lateral Root of Median Nerve

- Medial Cord

- M — Medial Pectoral Nerve
- M — Medial Root of Median Nerve
- M — Medial Cutaneous Nerve of Arm
- M — Medial Cutaneous Nerve of Forearm
- U — Ulnar Nerve

- Posterior Cord

- U — Upper Subscapular Nerve
- L — Lower Subscapular Nerve
- T — Thoracodorsal Nerve (Nerve to Latissimus Dorsi)
- R — Radial Nerve
- A — Axillary Nerve

Erb's Paralysis : (C5,C6)

- Injury to Upper Trunk of Brachial Plexus
- 'Policeman Tip Deformity' – d/t paralysis of abductors/external rotators of shoulder & flexors/ Supinators of elbow

Klumpke's Paralysis : (C8, T1)

- Injury to lower trunk
- Associated with Horner's syndrome
- ANS + CNS involved
- Poor prognosis

Electrodiagnostic Studies

- Electromyography

- It is a graphic recording of electrical activity of a muscle.
- At Rest : No electrical activity
- Little activity: weak contraction, single motor unit potentials
- Full activity : Interference pattern
- Denervated Muscle : Spontaneous potentials (Embryonic activity) k/a Denervation potentials, appear 15-20 days after injury
- Reinnervation Potentials : **Earliest evidence of reinnervation of muscle**, progress can be monitored

- Strength – duration curve

- Rheobase : Minimal current strength required to elicit muscle contraction , measured in milliamperes
- Chronaxie : Duration of current required to excite a muscle with a current – strength of double the rheobase , measured in milliseconds

Nerve Curve – Normal SD curve

Muscle Curve – Denervated muscle

Partial Denervation

Entrapment Neuropathy

- **Carpal Tunnel Syndrome** – Median Nerve
Test : Phalen's , Durcan's & Reverse Phalen's
TOC : Decompression by cutting Flexor Retinaculum
 - **Tarsal Tunnel Syndrome** – Tibial Nerve
 - **Cubital Tunnel Syndrome** – Ulnar Nerve at Elbow
 - **Guyan's Canal** – Ulnar nerve at wrist
 - **Meralgia Paraesthetica** – Lateral cutaneous nerve of thigh
-

Classification of Tumours (WHO)

- 1) Bone forming tumour
 - Benign → Osteoid osteoma, Osteoblastoma.
 - Malignant → Osteogenic / Osteosarcoma.
- 2) Cartilage forming tumours
 - Benign → Osteochondroma, Enchondroma
 - Malignant → Chondrosarcoma (common in adult, difficult to treat)
- 3) Giant cell tumour (Osteoclastoma) (GCT)
- 4) Marrow tumour
 - Ewing's sarcoma (MC in first decade of life)
 - Multiple myeloma
- 5) Tumour like lesions:
 - Bone cysts
 - Fibrous dysplasia

Rheumatoid Arthritis

- 1) Morning stiffness
- 2) Arthritis of ≥ 3 joints
- 3) Arthritis for at least 1 hand joint area
- 4) Symmetrical arthritis
 - (Involves only small joints of ~~the~~ hand & foot. Not shoulder joint / elbow / knee)
- 5) Rheumatoid nodules

b) Serum rheumatoid factor
7) X-ray changes.

(if 4/7 +ve then rheumatoid arthritis)

Ortho (Orthopedics tumours)

TABLE 25.2. Classification of Primary Bone Tumours

HISTIOLOGIC DERIVATION	BENIGN	MALIGNANT
A. OSSEOUS TUMOURS		
I. <i>Bone-forming (osteogenic, osteoblastic) tumours</i>	Osteoma (10-50 yrs) Osteoid osteoma (10-20 yrs) Osteoblastoma (20-30 yrs)	Osteosarcoma (10-20 yrs) Parosteal (osteocortical) osteosarcoma (50-60 yrs)
II. <i>Cartilage-forming (chondrogenic) tumours</i>	Enchondroma (20-50 yrs) Osteochondroma (20-50 yrs) (Osteochondrogenous osteomas) Chondroblastoma (10-20 yrs) Chondromyxoid fibroma (20-30 yrs)	Chondrosarcoma (40-60 yrs)
III. <i>Haematopoietic (myeloid) tumours</i>	—	Myeloma (50-60 yrs) Lymphoplasmacytic lymphoma (50-60 yrs)
IV. <i>Unknown</i>	Giant cell tumour (20-50 yrs) (osteoclastoma)	Malignant giant cell tumour (50-50 yrs) Ewing's sarcoma (5-20 yrs) Adamantinoma of long bones (page 542)
V. <i>Notochordal tumour</i>	—	Chordoma (40-50 yrs)
B. NON-OSSEOUS TUMOURS		
I. <i>Vascular tumours</i>	Haemangioma	Haemangioendothelioma Haemangiopericytoma Angiosarcoma
II. <i>Fibrogenic tumours</i>	Non-ossifying fibroma (metaphyseal fibrous defect)	Fibrosarcoma
III. <i>Neuragenic tumours</i>	Neurileioma and neurofibroma	Neurofibrosarcoma
IV. <i>Lipogenic tumours</i>	Lipoma	Liposarcoma
V. <i>Histiocytic tumours</i>	Fibrous histiocytoma	Malignant fibrous histiocytoma

Figures in brackets indicate common age of occurrence.

Distribution of bone tumors in long bones

Epiphyseal lesions:

- Chondroblastoma (In children, also k/a Codman's Tumour)
- Giant cell tumor (In adults)

Metaphyseal lesions:

- Osteosarcoma
- Chondrosarcoma
- Aneurysmal bone cyst
- Nonossifying fibroma (NOF)
- Osteochondroma

Diaphyseal lesions:

- Osteoid osteoma
- Ewing's sarcoma
- Adamantinoma
- Lymphoma
- Myeloma
- Neuroblastoma
- Fibrous dysplasia
- Enchondroma

Key Points :

- M/C Malignant Bone Tumour – Secondaries/Metastasis
- M/C Primary Bone Malignancy – Multiple Myeloma
- Second M/C Primary Bone Malignancy - Osteosarcoma

Ortho (Orthopedics tumours)

- M/C Benign tumour of Bone – Osteochondroma
- M/C 'TRUE' benign tumour of Bone – Osteoid Osteoma
- M/C Bone Tumour in Hand – Enchondroma

BONE FORMING TUMOURS

- Benign: Osteoma, Osteoid Osteoma,
- Benign Aggressive: Osteoblastoma
- Malignant: Osteogenic Sarcoma

Osteoid osteoma

- M/C 'TRUE' benign tumour of Bone – Osteoid Osteoma
- Age – 5-25 years
- Site : Tibia is commonest bone affected, others are Femur etc
- Location : Diaphysis (Long Bones)
Posterior Elements (Vertebrae)
- C/F : Pain, characteristically more intense at night, relieved by NSAID/Salicylates
- X Ray/CT : Dense sclerotic bone surrounding a Radiolucent **Nidus**. (Contains high concentrations of Prostaglandins)
- **Nidus** : usually < 2 cm in size
- T/t : percutaneous radiofrequency ablation, or surgical removal (**Excision of Nidus**)

Osteoblastoma -

- Also called as Giant osteoid osteoma.
- Similar to an osteoid osteoma but **nidus > 2 cms** in
- Common Sites : Spine and jaw

Osteosarcoma :

- Second M/C Primary Bone Malignancy (after Multiple Myeloma)
- Malignant tumour of mesenchymal cells → osteoid formation
- **Classification :**
- **Primary :** Age : 15 – 25 yrs
No premalignant condition related

- **Secondary :** Age : > 45 yrs

Predisposing Conditions

- Paget's disease
 - Fibrous Dysplasia
 - Radiation exposure
 - Multiple Enchondromatosis
 - Multiple Osteochondroma
 - **Site :** In ↓ order
 - **Lower End Femur**
 - Upper End Tibia and
 - Upper end Humerus
 - **Location :** Metaphysis
 - **Genetic association:**
 - Rothmund-Thompson syndrome
 - Li-Fraumani syndrome
 - Hereditary form of **Retinoblastoma**.
 - **Metastasis :**
-

Ortho (Orthopedics tumours)

- **Haematogenous**, usually first to **Lungs**
- **Skip Lesions** - best detected by **Bone Scan**
- **Pathology** :
- Tumour cells with osteoid or bone formation
- Alkaline phosphatase increased in 50% cases

- **Radiological Ex** :
- Irregular Periosteal Reaction (as c/t OM where it is Regular)
- **Codman's Triangle** : triangular area of subperiosteal new bone formation
- **Sun Ray Appearance** : Tumour growth into soft tissues along the blood vessels

- **T/t** :
- Biopsy is mainstay of diagnosis
- It is a **Radioresistant** Tumour
- **Neoadjuvant Chemotherapy** is given initially,
- **Surgery** : Amputation vs Limb Salvage
- **Telangiectatic Osteosarcoma** : **Lytic** type of Osteosarcoma with **worst prognosis**
- **Parosteal Osteosarcoma** : Lower end Femur
Occurs in adults
Prognosis is better

CARTILAGE FORMING TUMOURS

- **Benign**: Enchondroma, Peri-osteal Chondroma, Osteochondroma.
- **Benign Aggressive**: Chondromyxoid Fibroma, Chondroblastoma.
- **Malignant**: Chondrosarcoma.

Osteochondroma/Exostosis

- M/C benign tumour of bone
- Growth stops with cessation of growth at Epiphyseal plate(2nd Decade)
- Cartilage cells grow centrifugally as a lump of bone covered by a cartilage cap – **Cartilage capped exostosis**
- Usually grows away from joint
- **Types** :
- Sessile
- Pedunculated
- **Site** : M/C is lower end femur
- **Location** : **Metaphysis**
- **Complications** :
- Bursitis (M/C complication)
- Restricted ROM of joint d/t mechanical block
- Pathological #
- NV compression
- Malignant Transformation (Usually into Chondrosarcoma)

- Single Osteochondroma – around 1% chance
- Multiple Osteochondroma / Multiple Hereditary Exostosis/ Diaphyseal Aclasis – around 10% chance

X Ray findings in Malignant transformation

- Rapid increase in size in short period
 - Increase in size of tumour
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Ortho (Orthopedics tumours)

{ If cartilage cap > 2 cm, sure malignancy)

T/t :

Extra periosteal Resection

Enchondroma

- Benign lesions of hyaline cartilage.
- M/C Bone Tumour in Hand
- M/C site is Phalanges of hand
- Multiple Enchondromatosis is k/a **Ollier's disease**
- Multiple Enchondromatosis + Cavernous haemangioma = **Maffuci syndrome** (25 % risk of malignant transformation)
- T/t – Curettage + BG

Chondrosarcoma –

- Malignant tumour of cartilage cells
- Common in **Flat bones** eg Scapula, Ribs etc
- Mottled calcification is seen within tumour (Pattern is described as “punctate,” “popcorn,” or “comma-shaped”)

Giant Cell Tumour

- Also k/a Osteoclastoma
- Benign but locally aggressive tumour
- Age : 20-40 yrs
- Site : **Lower Femur (M/C)**, Upper Tibia, Lower Radius
- Location : Epiphysis
- Tumour of ‘E’:
- **Expansile**
- **Eccentric**
- **Epiphyseal**
- **Egg shell crackling**
- **Excision**
- **X Rays : Soap Bubble appearance**
- T/t : **Excision + BG**
Curettage +/- BG

{Cryotherapy, Bone cement etc}

Fibrous Dysplasia

- Normal bone and marrow is replaced by fibrous tissue
- **One Bone – Monostotic**
Many Bones – Polyostotic
- Associated with : Hormone disorders
- **McCune-Albright's Syndrome** (Polyostotic FD + Precocious Puberty + Cutaneous Pigmentation)
- **Cushing's Disease**
- **Hormonal Abnormalities : PTH, GH & Gonadotropins**
- Age : children/adolescents
- Site : Upper ends of Femur (**Shepherd's Crook Deformity**), tibia , ribs
- X Ray : Ground-glass appearance

Simple Bone Cyst

- **Age** : First 2 decades
 - **Site** : Common at bone ends, M/C is **Proximal humerus**
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Ortho (Orthopedics tumours)

- Asymptomatic unless pathological fracture
- **X Rays : Centrally located** , purely lytic lesion with intact cortex (**Fallen fragment sign**)
- **Location: Metaphysis/Diaphysis**
- **T/t :**
 - Small, asymptomatic lesions treated with observation and serial radiographs
 - Large, symptomatic, and lesions in lower extremity are treated with **curettage or aspiration and injection.**

Aneurysmal Bone Cyst

- **Age : 10-40 yrs**
- **Site : Proximal Tibia**
- **Location : Metaphysis**
- **Blood filled space enclosed in a shell**
- **X Rays :**
 - Eccentric
 - Expansion of overlying cortex
- **T/t : Curettage + BG**

Ewing's Sarcoma

- **Malignant Round cell tumour**
- **Other Round cell tumours are:**
- Neuroblastoma
- Lymphoma
- **Age : 5-15 yrs**
- **Site : Femur, Tibia**
- **Location : Diaphysis**
- **Tumour cells surround a central clear area → 'Pseudo-rosette'**
- **X Rays : Onion Peel appearance (New Bone formation in layers)**
- **T/t :**
 - Highly Radio-sensitive tumour
 - Radiotherapy (6000 rads) for local control &
 - Chemotherapy for metastasis
 - Surgery for resectable masses

Multiple Myeloma

- **M/C Primary Bone Malignancy**
 - **Tumour arises from Plasma cells**
 - **Solitary - Plasmacytoma**
 - **Multiple - Multiple Myeloma**
 - **Age : > 40 yrs**
 - **Site : Flat Bones : Vertebrae, pelvis, skull & Ribs (Bone is replaced by Tumour Cells with no reactive new bone formation)**
 - **C/F : Back pain not responding to any T/t**
 - Pathological fractures
 - Neurological symptoms
 - **X Ray : Punched out lytic lesions in skull**
 - Vertebral wedge collapse
 - **Blood Ix : ESR ↑ (blood becomes viscous d/t rise in plasma cells)**
 - **Albumin : Globulin ratio reversed (1:1.2-2)**
 - Hypercalcemia, Alkaline phosphatase Normal
 - **Urine - Bence jones proteins (Light chain Immunoglobulin) in 30%**
 - **Serum Electrophoresis : M-spike/ M Band in 90% (mainly composed of IgG)**
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Ortho (Orthopedics tumours)

- **Beta 2 microglobulin** ↑
- Bone Scan – Normal (No osteoblastic activity)
- **Best Investigation** : Bone marrow aspiration to see plasma cells
- **T/t** : Chemotherapy (**Melphalan** is drug of choice)

Metastasis :

- M/C Malignant Bone Tumour – Secondaries/Metastasis
- M/C type of Secondaries are Osteolytic
- M/C cause of **Osteoblastic secondaries** :
- Ca Prostate in Males
- Ca Breast in Females
- Vertebral Bodies are m/c affected (Other sites are Ribs, Pelvis, Humerus)
- M/C cause of Bony metastasis in Males – Ca Prostate
- M/C cause of Bony Metastasis in Females – Ca Breast
- Ca Lung, Ca Thyroid & Ca Breast (Blastic >> Lytic)
- Ca Kidney – Lytic
- PET scan in **IOC** to detect early metastasis

ADAMANTINOMA :

- Common tumour of jaw bone , tibia
- 10-35 yrs
- Eccentric location
- Diaphysis
- **Honeycomb-like appearance**
- **T/t - Resection**

