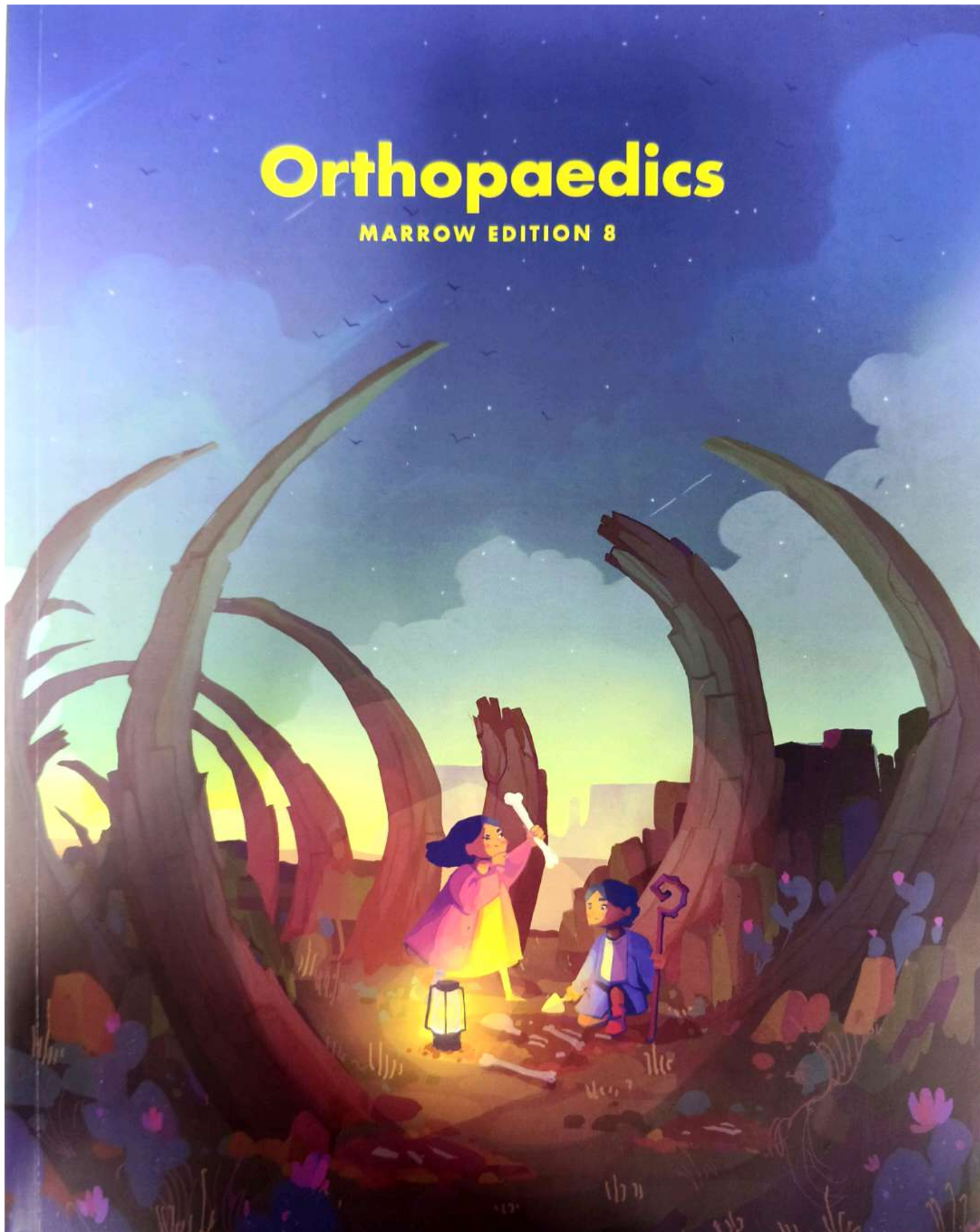


Orthopaedics

MARROW EDITION 8



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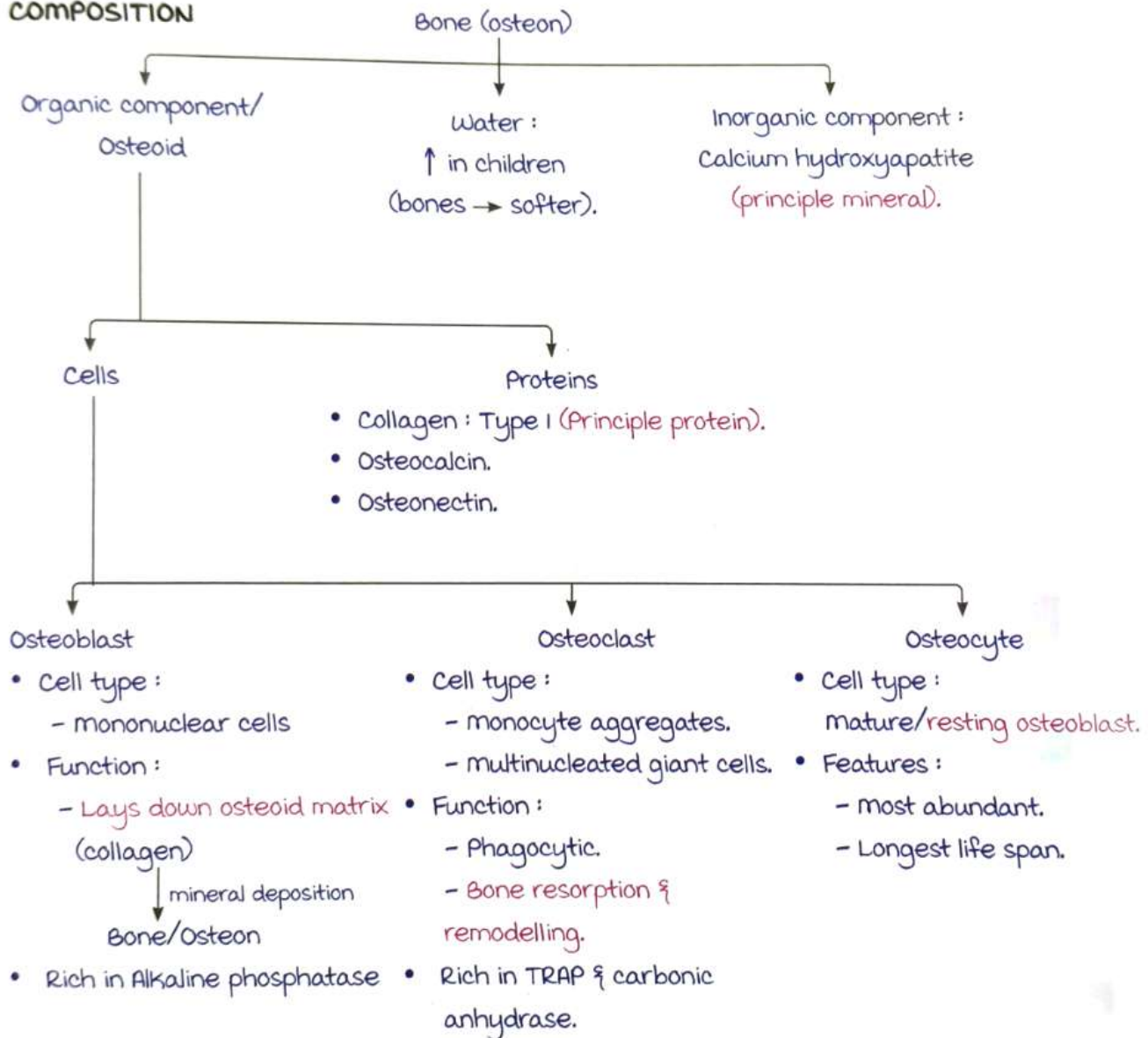
BASIC ANATOMY AND PHYSIOLOGY OF BONES

----- Active space -----

Bone composition & markers

00:00:38

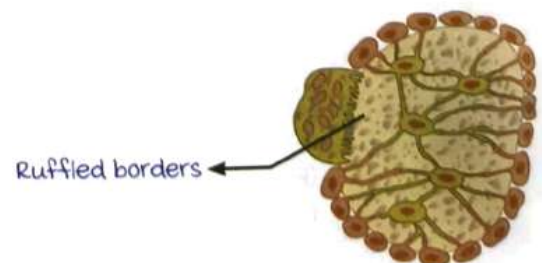
COMPOSITION



Note : Collagen types

Type I	Type II
- Bones. - meniscus. - Annulus fibrosis.	- Articular hyaline cartilage. - Nucleus pulposus.

- Strength of bone depends on osteoblasts & osteoclasts.



----- Active space -----

BONE MARKERS

markers

Bone formation

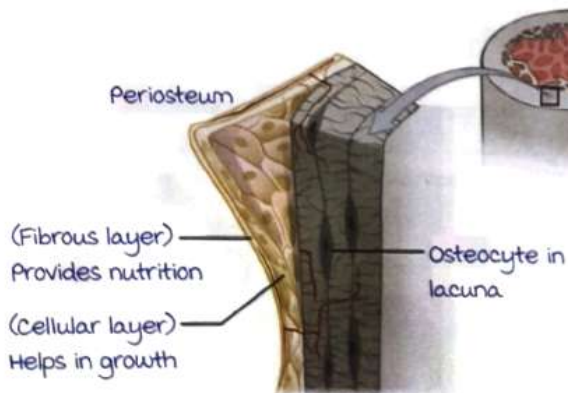
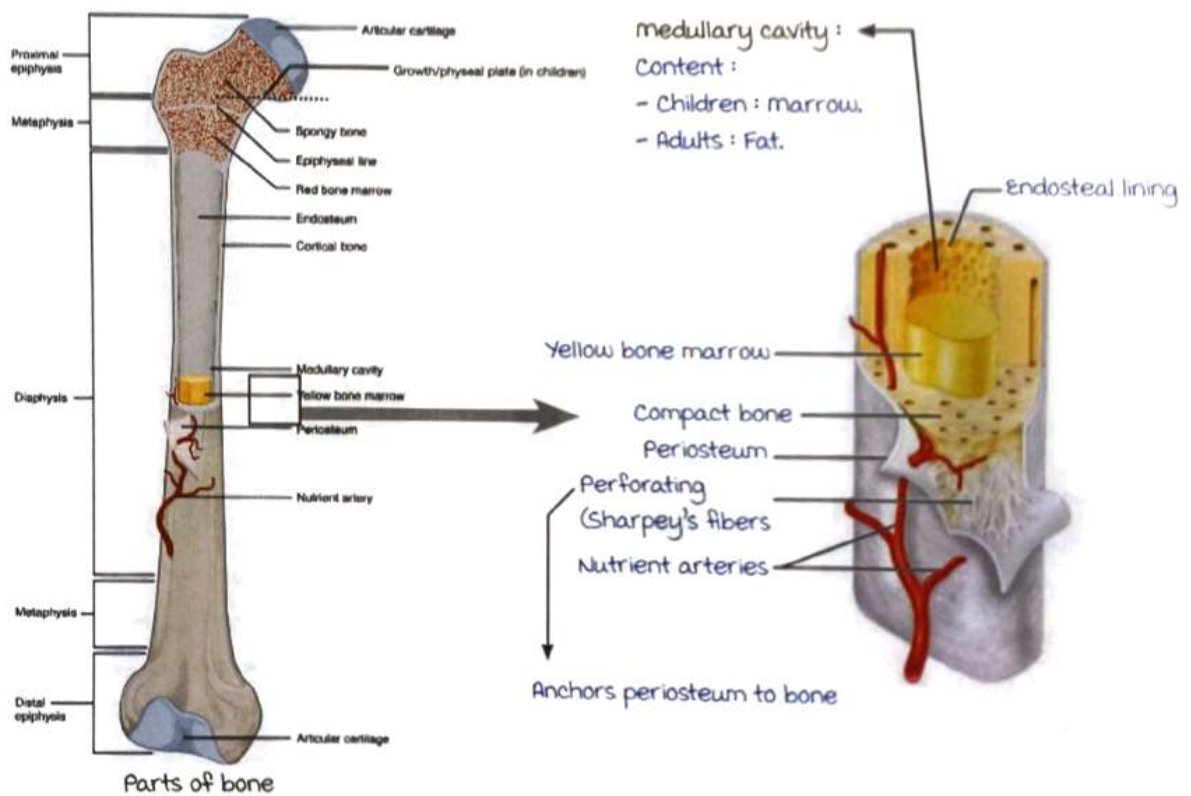
- Alkaline phosphatase (ALP)
- Procollagen I
- Osteocalcin
- Osteonectin

Bone resorption

- Hydroxyproline } Collagen breakdown
- Hydroxylysine } products
- NTC telopeptide
- TRAP

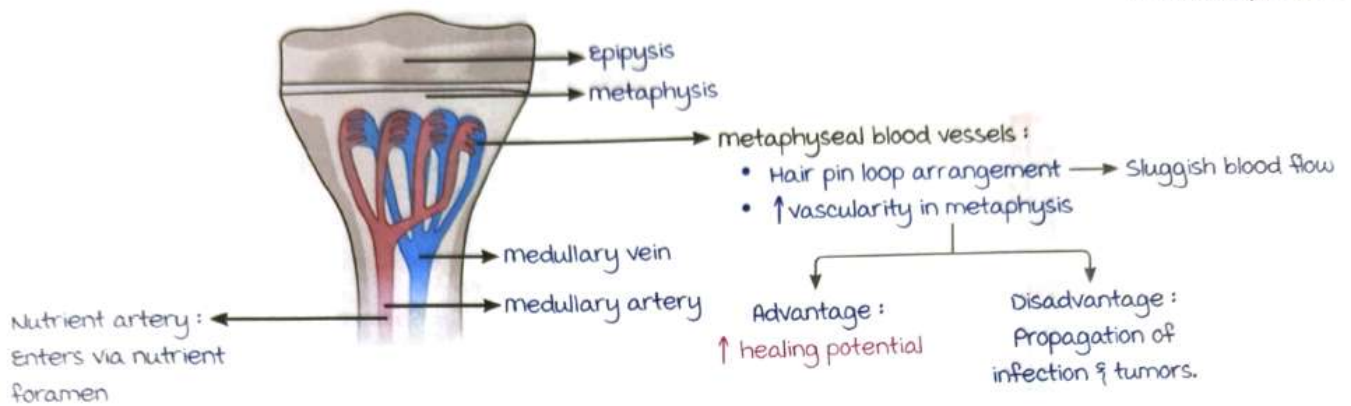
Anatomy

00:09:28

**Periosteum :**

- Present in all long bones
- Absent in :
 - Articular surface of long bones.
 - Sesamoid bones (eg : Patella).

----- Active space -----



Note: metaphysis has very few macrophages/monocytes.

TYPES OF BONE ARCHITECTURE

Immature woven bone:

- Improperly arranged collagen.
- Weak.
- Seen in:
 - Children.
 - Bones healing from fracture (eg: callus).

mature/lamellar bone:

	Cancellous/spongy	Cortical/compact
Site	metaphysis	Diaphysis
Consistency	Soft	Hard
Bone cells	↓	↑
vascularity	↑	↓
Fracture healing	Fast	Slow
Risk of infection	↑	↓
Fracture complication	malunion	Non union

Note:

Epiphyseal fractures (Intraarticular) → Osteoarthritis → ↓ Range of motion.

Bone Growth

00:20:40



a). Lateral view

b). Anteroposterior view

X-ray : Left hand (child).

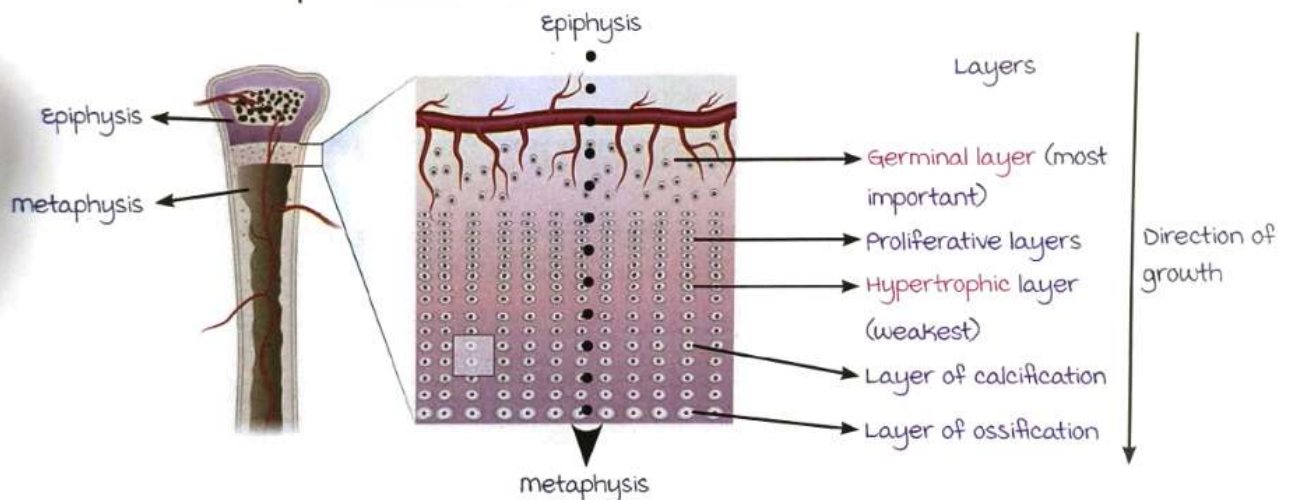
Epiphysis

Physis : Only in children

↑ ses length of bone

metaphysis

Growth plate structure :



Applied aspect :

Growth plate (germinal layer) injury

Complete

Partial

- I/L side (bone) : Stops growing.
- C/L side (bone) : Continues to grow.

Limb length discrepancy

Asymmetrical growth

Deformity (varus/valgus)

Appositional growth (↑ ses thickness) : By endosteum & periosteum.

BASIC TERMINOLOGY OF FRACTURE AND HEALING

----- Active space -----

Fractures

00:00:49

Break in continuity of bone cortex.

GENERAL FEATURES OF FRACTURE

Clinical signs :

- Abnormal mobility at fracture site > crepitus (Pathognomonic).
- Tenderness (most consistent).
- Swelling.

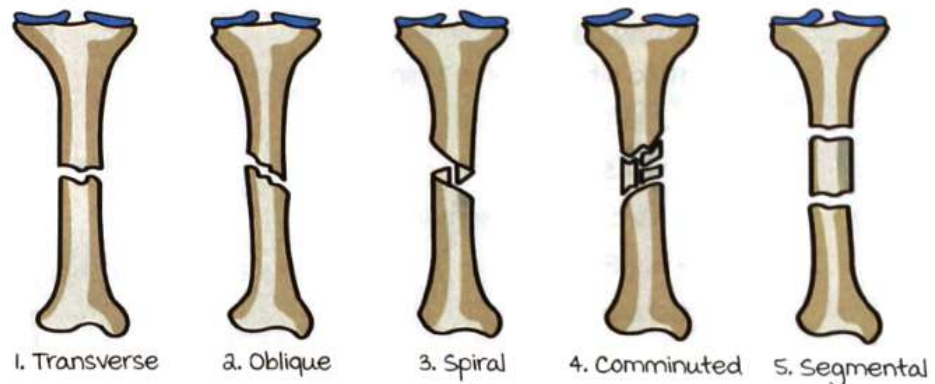
Radiological :

- X-ray : Discontinuity of bone.

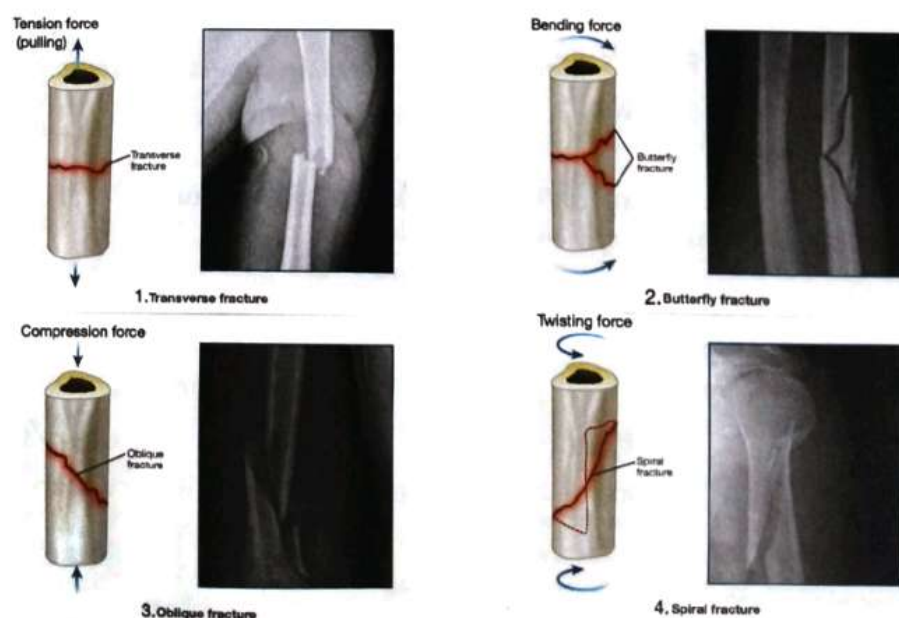
CAUSES

Fractures with significant trauma :

Types :



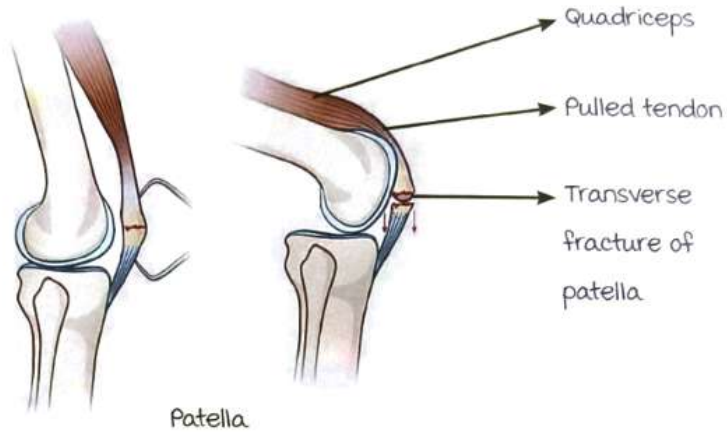
mechanism of injury :



----- Active space -----

Avulsion fractures :

- Violent pull of tendons → Avulsion of bone.
- Eg : Patella, olecranon.



Fractures without significant trauma : Pathological fractures

Localized causes

- Infection.
- Ischemia.
- Lesions.
- Cysts.
- Radiation.

Generalized causes

- Osteoporosis (m/c cause) :
m/c sites : spine > hip > wrist (Colle's).
- metastasis :
- m/c site : Proximal femur.
- Ix : FDG-PET
- Osteomalacia.
- Rickets.
- Osteogenesis imperfecta.
- Paget's disease.
- Scurvy.

- Pain before the fracture (d/t micro fractures).

- Investigation :

- X-ray : Shows primary lesion.

- management :

A. mirel's criteria :

- used to predict risk of pathological fracture d/t lesions.
- Score of ≥ 8 : Requires prophylactic fixation with internal fixation devices.

B. Treat underlying cause.



Fracture 2° to cyst



Fracture 2° to Paget's disease

Stress fracture :

- D/t sudden & repetitive loading of bone.
- Common sites :
 - a. Tibia.
 - b. Fibula.
 - c. metatarsal (march fracture) : } weight bearing bones
 - 2nd > 3rd metatarsal.
 - Neck > shaft.
- Pain :
 - Prior to fracture.
 - ↑ on activity.
- Investigations :
 - X-ray : Fracture visible after 2-3 wks of symptoms.
 - MRI (IOC) :
 - Identifies → Soft tissue edema
 - Occult fractures.
 - Bone scan : For multiple stress fractures.
- management :
 - Stop the stressors.
 - Immobilization of affected limb.



march fracture



Runner's fracture

Shin splints :

AKA medial Tibial Stress Syndrome (MTSS).

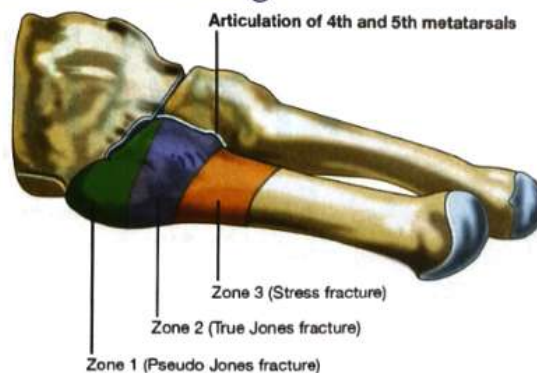
- Seen in runners.
- medial periostitis of tibia.
- mechanism of injury :
 - Repetitive muscle contractions → inflammation of periosteum at site of muscle attachment

↓
Pain over anteromedial side of leg

- X-ray : Normal.

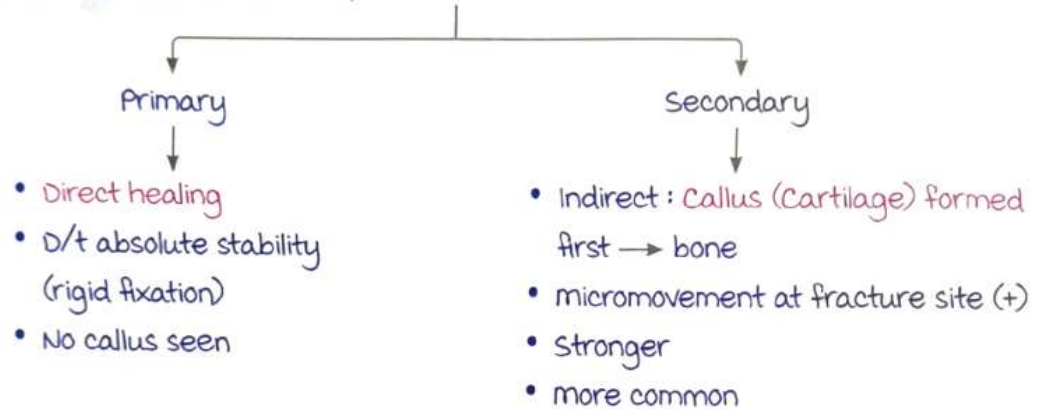
Note :

Robert Jones : Fracture of 5th metatarsal base.



Robert Jones fracture

TYPES OF FRACTURE HEALING



1 Hematoma formation (2-3 days)



2 Granulation Tissue Formation (Inflammation) (2-3 weeks)



3 Callus Formation (2-3 months)



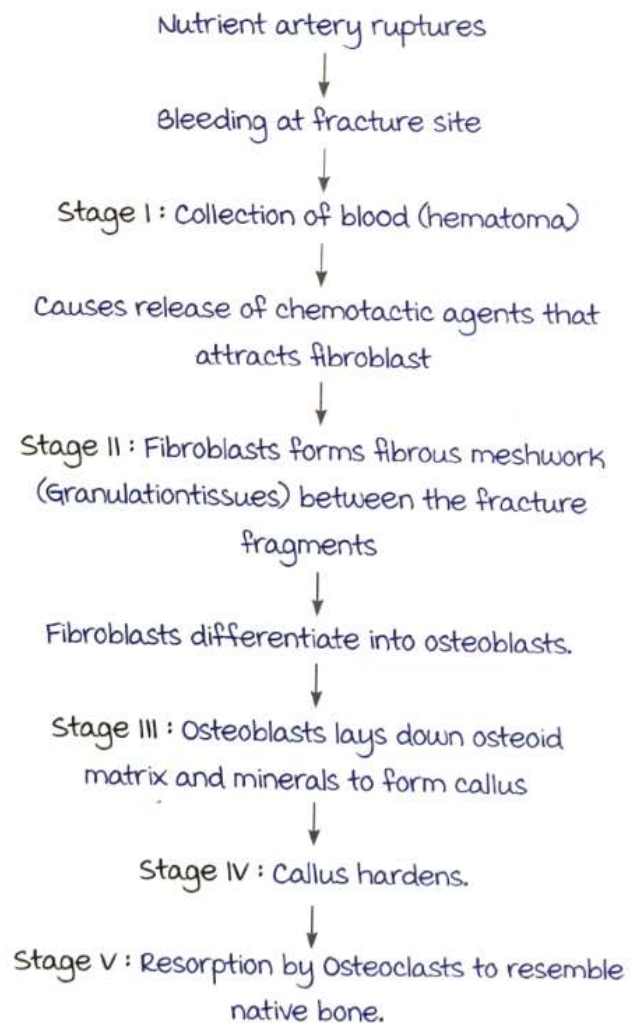
4 Consolidation (2-3 years)



5 Bone remodelling (3 years)



STAGES OF FRACTURE HEALING (2°)



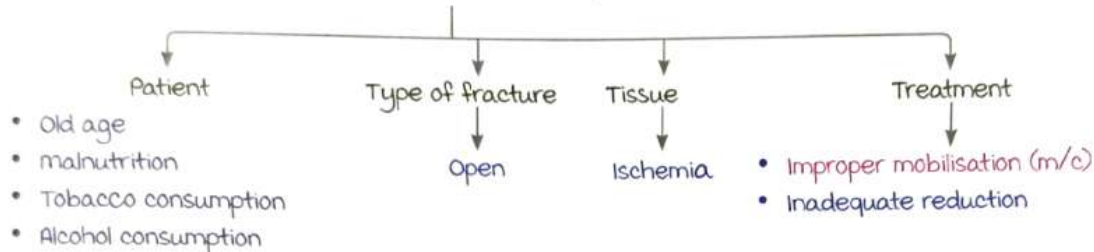
Callus :

- Disorganised mass of immature bone.
- **visible on x-ray** after 2-3 weeks of fracture.

----- Active space -----

Note : compression at fracture site → promotes union.

FACTORS INHIBITING FRACTURE HEALING



Complications in fracture healing

00:26:19

NON-UNION

- Callus formation absent for > 9 months.
- Risk factor : Diaphyseal bone fractures.
- m/c site : **Lower 1/3rd Tibia**.

Types :



Differences between Hypertrophic & Atrophic Non-Union :

	Hypertrophic	Atrophic (typical)
Ends of fracture	Smooth & sclerosed (↑ density)	
Fracture line	Visible	
X-ray appearance		
Callus formation	↑↑	Absent
Bone biology	Good	Abnormal
Immobilisation	Improper	±
Treatment	Immobilization	Autologous bone grafting

----- Active space -----

Bone Graft :

m/c source : Iliac crest.

Ideal bone graft characteristics :

1. Osteogenesis : Graft itself makes bone using osteoblasts.
2. Osteoconduction : Allows bone to grow on it as a scaffold.
3. Osteoinduction : Stimulates surrounding host bone to form bone
(Growth factors : differentiates mesenchymal cells → bone forming cells).

Substitutes of bone graft :

Property	Substitute
Bone conduction	• Calcium phosphate • Calcium sulphate • PMMA (Poly methyl methacrylate)
Bone induction	Bone morphogenic protein (improves bone union)

MALUNION

- Fractures healing in anatomically abnormal position.
- Rx : Osteotomy (Bone realigned & fixed if functional abnormality (+)).

Note : Bones with ↑ risk of malunion vs non-union.

malunion	Non-union
• Clavicle (m/c) • Supra-condylar humerus • Colles • Intertrochanteric (extracapsular) femur	• Lower 1/3rd of tibia (m/c) • Scaphoid • Lateral condyle of humerus • Neck of femur (intracapsular) • Neck of Talus

Fractures that undergo malunion, rarely/never undergo non-union (& vice-versa).

Management of Fracture

00:36:42

Important Terms :

Displacement : movement of distal fracture segment d/t pulling forces by muscle.

Reduction : Bringing fracture segment back to normal anatomy with counter-forces.

Traction : Counter-force applied.

Fixation : maintaining fracture in reduced position till it heals.

REDUCTION

methods :



manual closed Reduction :

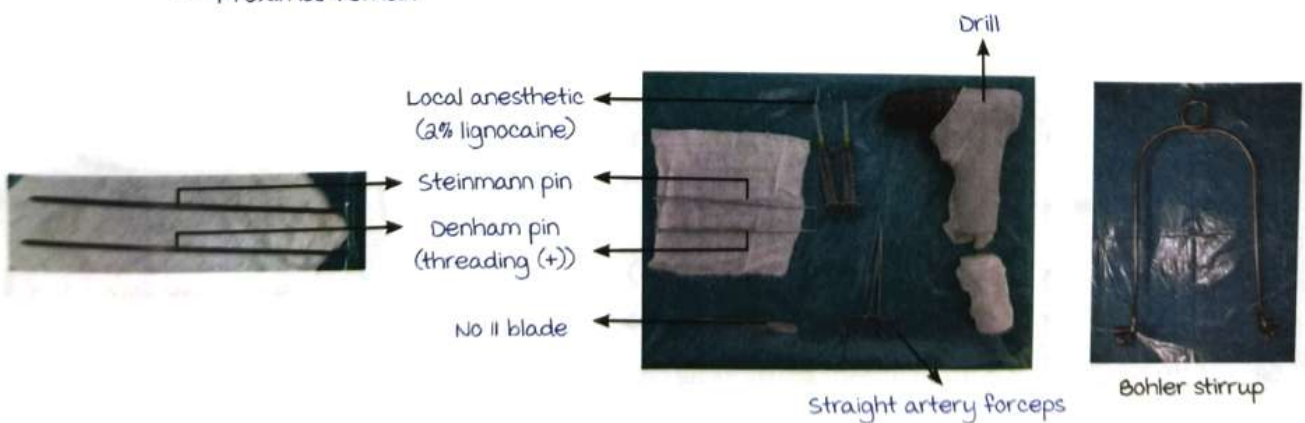
- Done using manual 'traction' and counter traction.
- Followed by POP application.
- Repeat X-ray to confirm reduction.

Skin traction :

Bandage wrapped → Force on bandage → Force on skin → Force on soft tissue
→ maintains fracture reduction

Skeletal traction :

Site of pin → upper tibia (m/c).
→ Lower tibia.
→ distal femur.
→ Proximal femur.



Instruments used for skeletal traction

----- Active space -----

		Denham pin	Steinmann pin
Threading		+	-
Indications	1. Type of bone fractured	Osteoporotic	Normal
	2. Site of traction	Calcaneal	Tibia / femoral

Procedure (upper tibial skin traction) :

1. Site : Draped and prepared.
2. Local anesthetic given : Bone deep on either side of bone laterally.
3. Stab wound $\begin{cases} \rightarrow 2.5 \text{ cm below and behind tibial tubercle.} \\ \rightarrow \text{made using No. 11 scalpel reaching bone} \\ \quad \text{(to avoid friction while inserting pin).} \end{cases}$
4. Dilate entry site using artery forceps.
5. Pin placed in drill and inserted into entry wound.
6. Pin drilled through the bone and brought out at opposite site.
7. Drill removed and wound dressed.
8. Böhler's stirrup mounted onto pin and locked.
9. Weights applied using ropes.
10. Patient mounted onto a splint.

Complications :

- *Staphylococcus aureus* infection : m/c infection at pin traction sites.
- Pin-tract sequestrum : ring shaped sequestrum at entry & exit sites.

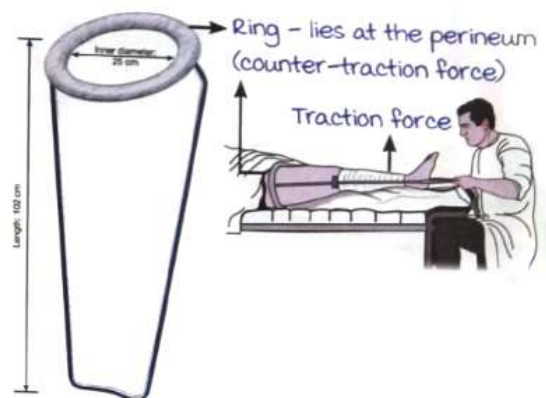
uses : for traction of lower limb fractures : Intertrochanteric, Distal femur.

TEMPORARY MANAGEMENT : SPLINTS

To stabilize fracture.

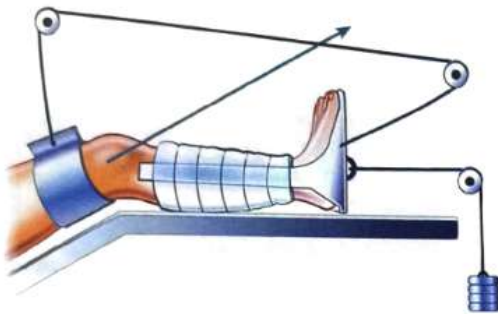
Thomas splint :

- Inventor : H.O Thomas.
- First use : to treat TB knee.
- Fixed traction device (has both traction & counter-traction forces).
- Advantage : Patient mobility (+).
- Indication : lower limb fractures (m/c : femur fractures).



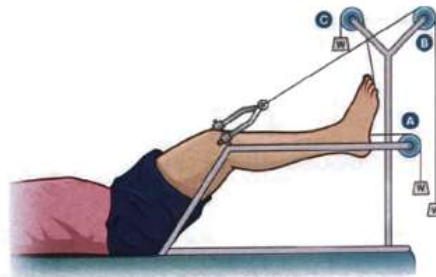
Bohler & Braun Splint :

- Sliding traction device used in wards.
- Force :
 - Traction : Weights
 - Counter traction : Gravity (footend of bed raised)
- Location of pulleys :
 - A : For Tibia fractures.
 - B : For Femur fractures.
 - C : To prevent foot drop.



Russell's Traction

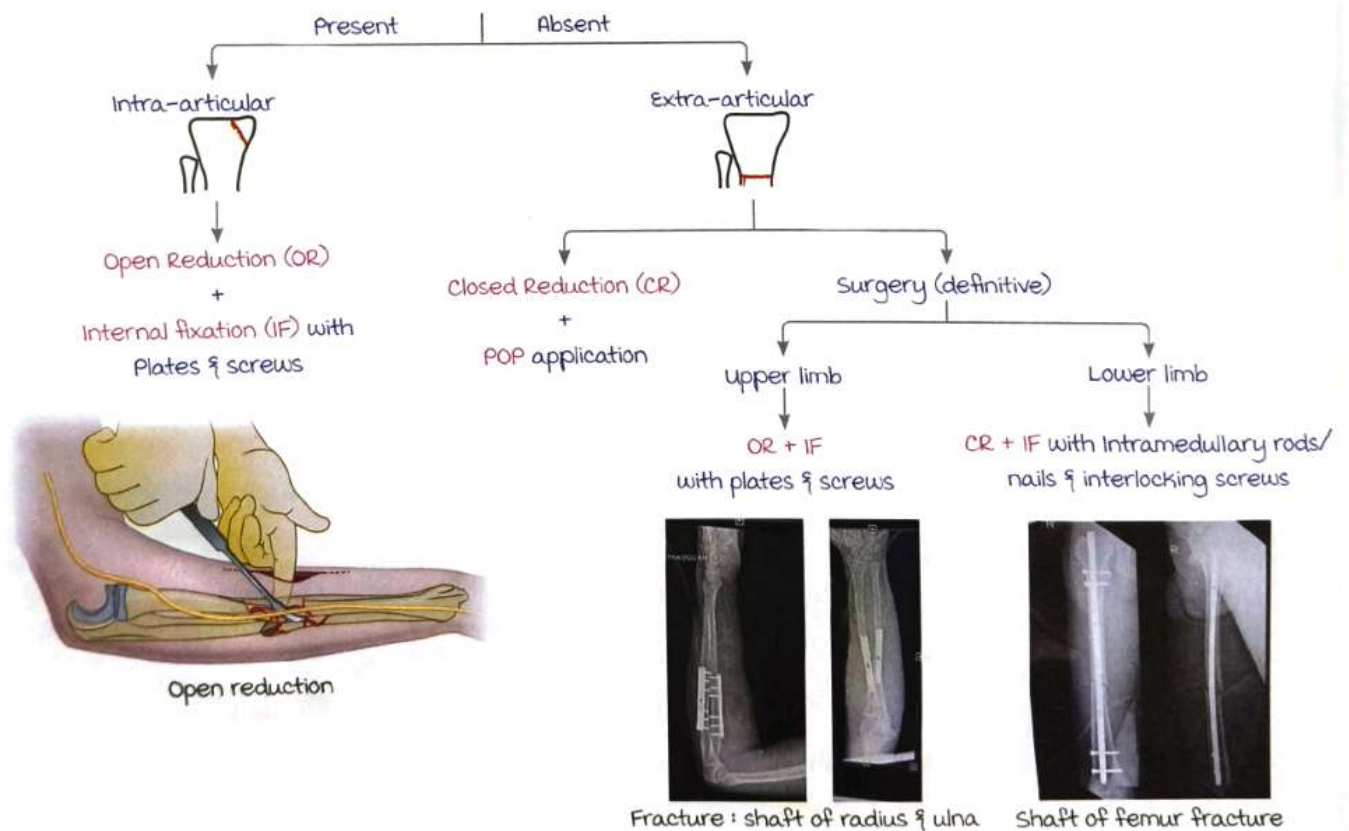
Indication : Inter-trochanteric fracture of femur



Bohler & Braun splint : location of pulleys

DEFINITIVE TREATMENT

Algorithm : Assess for involvement of articular surface.



----- Active space -----

Reduction $\begin{cases} \text{Open : Fracture visualised and reduced} \\ \text{Closed : Done without opening fracture site and confirmed with X-ray} \end{cases}$

Accuracy of reduction : $\text{Open} > \text{closed}$

Hence preferred in intra-articular fractures (to prevent osteoarthritis)

POP application :

Disadvantages	Advantages
• Cumbersome • Requires joint immobilization above & below fracture	• Non-invasive • Cheap • Easy application & removal
Disuse atrophy Stiffness	

CR+IF :

Reduction : using C-arm (image intensifier)

Fixation : Rod/nail passed into the bone medullary cavity

interlocking screws placed (to avoid rotation of rod)

Fractures due to avulsion forces :

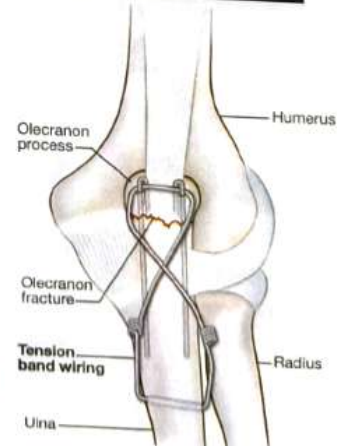
Patella fracture
(d/t Quadriceps pull)



Olecranon fracture
(d/t Triceps pull)



Rx : OR + IF with Tension Band Wiring (TBW)



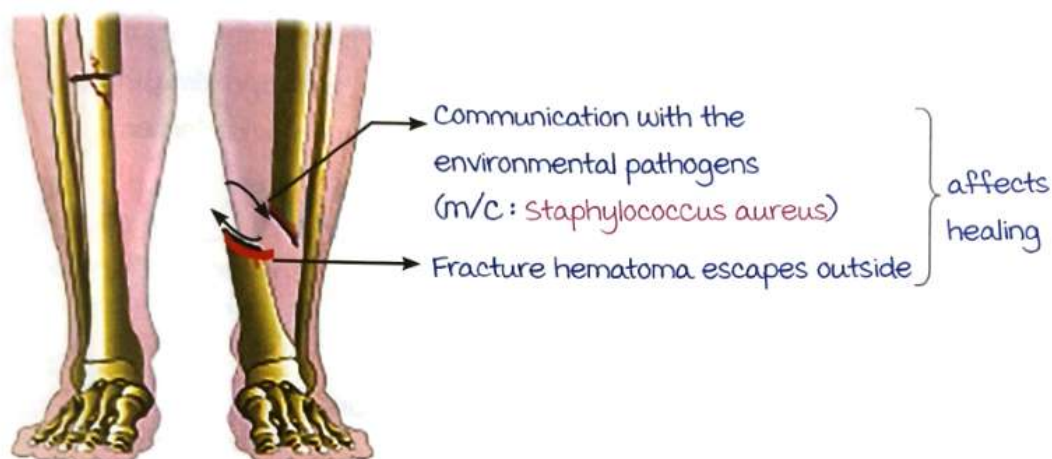
OPEN FRACTURE, AMPUTATIONS AND POLYTRAUMA

----- Active space -----

Open fracture

00:00:27

- Fracture + break in skin and underlying soft tissue.
- m/c involved : Tibia and phalanges.



GUSTILO ANDERSON CLASSIFICATION

Type I	Type II	Type IIIa	Type IIIb	Type IIIc
• Wound <1cm long. • Cause : D/t impingement of fracture fragments on skin. • AKA inside out injury.	Wound 1-10 cm	Open fracture + contaminated environment : sewage, farms or firearm injury.	Open fracture with periosteal stripping	Open fracture + vascular injury
usually > 10 cm				

----- Active space -----

MANAGEMENT**Wound management (more important) :**

1. Antibiotics

2. Wound toilette :

- Wound wash : Povidone iodine & sterile NS.
- Wound debridement.

3. Wound closure :

Primary closure :

Only in clean wounds where the edges are approximating

+

Satisfactory debridement

Secondary/delayed closure :

- If > 6 hrs - 12 hrs (golden period).
- Associated neurovascular injury.
- Edges cannot be approximated.
- Not satisfied with debridement.

4. Wound healing : manage like a closed fracture.

Fracture :

Grade I : managed like closed fracture.

Grade II, IIIa :

- If clean (<6-12 hrs) → manage like a closed fracture.
- Otherwise like open (external fixation).

Grade IIIb, IIIc : External fixation (immobilization/stabilization of bone outside the body).

Note : Internal fixation is C/I in open fractures.

Placing a device inside the bone → growth of organisms & biofilm formation → Infection.

External Fixation

00:07:47

Fixation of bone outside the body.



Schanz pins

- Placed proximal and distal to the wound
- They immobilize the bone

Rods to immobilize the pins



Schanz pins



Connecting Rod



Clamps

stability :

↑ stability by :

- ↑ number of pins.
- ↑ number of rods.
- ↑ number of planes used to stabilize the fracture (Biplanar > uniplanar).

----- Active space -----

TYPES**1. Rail fixator/Limb reconstruction system :****2. Ilizarov ring fixator :**

- multiplanar
- **most stable external fixator.**
- Allows for compression and distraction of fracture site.
- Pins can be put in any direction.



multiplanar system

Distraction Osteogenesis :

Done in open fractures with bone loss.

Indications :

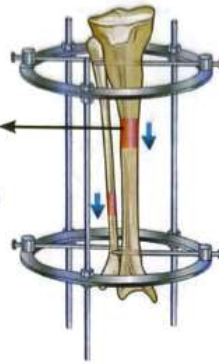
- Open fractures.
- Non union.
- Infected non union.
- Deformity correction or malunion.
- Fracture with bone loss.
- Limb lengthening.

----- Active space -----

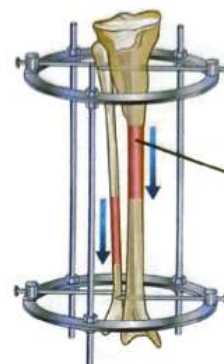


1. Corticotomy

Stretching of
callus and new
bone formation
(Callotaxis)



2. Distract the rods (1 mm/day) - physiological limit

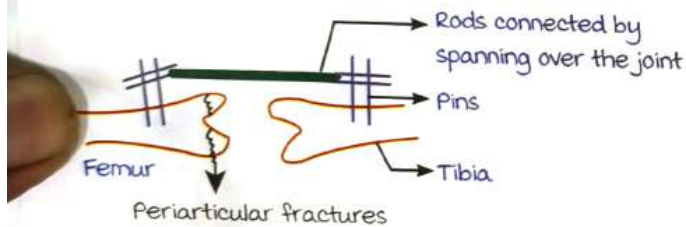


3. growth of new bone

3. Spanning external fixator :

Uses : Periarticular open fractures.

Eg : Side swipe injury/baby car injury.



Crushing of distal
humerus and
proximal ulna



Spanning external fixator

Complications :

Necrosis of site where pin is placed (infection/heat d/t drilling).

Note : Compartment syndrome.

- Equal incidence in high and low energy injuries.
- Can occur in open fractures.
- High index of suspicion and be vigilant in patients with altered level of consciousness.



Amputation

00:19:50

Damaged limb/contaminated/not salvageable

Amputation :
Cutting the limb off the body
through the bone

Disarticulation :
Cutting the limb off the body
through the joint

Indications : Dead, dangerous or dumb limbs

- Crush injury/RTA.
- Peripheral vascular disease (PVD) like diabetes mellitus.
- Frost bite, gas gangrene, malignant tumour.
- Congenital absence of limb/neuromuscular disease like polio.

----- Active space -----

Trauma scores :

1. Mangled extremity severity score (MESS) : Score ≥ 7 = Amputation.

- V : Velocity of injury or soft tissue coverage.
- I : Ischemia time (most important).
- S : Shock.
- A : Age of patient.

2. Limb salvage score

3. Ganga score

Types :

1. Closed amputation :

Skin is closed in 1^o surgery.



2. Open or guillotine :

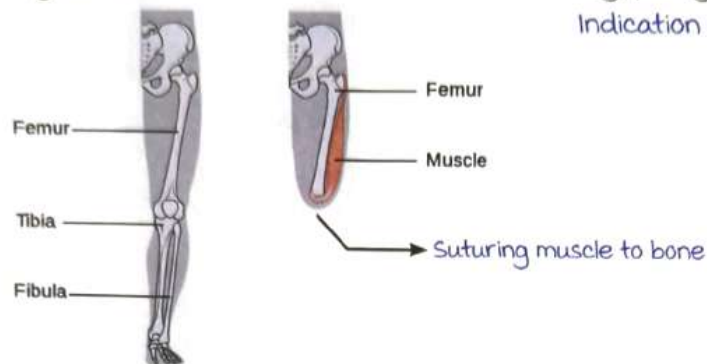
- Skin is kept open after amputation & closed in a 2nd stage.
- Indications :
 - Infected/contaminated stump.
 - Amputation for ischemic conditions.



Principles :

1. Use of tourniquet : Reduces bleeding
C/I if cause of amputation is ischemia or PVD.
2. Structures cut :
 - Amputation : Everything is cut.
 - Disarticulation : Sparing of bone.
3. Bone has to be cut 5cm shorter than soft tissue.
4. Double ligate the vessels.

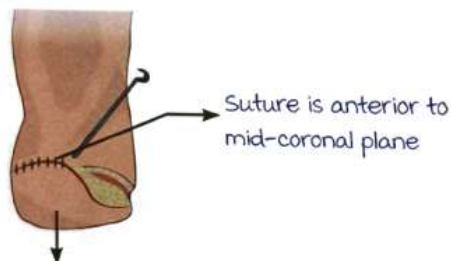
----- Active space -----

methods of closure :**1. myodesis :**

- Provides stable stump.
- C/I in PVD amputations.

2. myoplasty : Suturing muscle to muscle

Indication : Ischemia/PVD.

Skin flaps :**1. Skewed flap :**

Posterior flap is longer than anterior

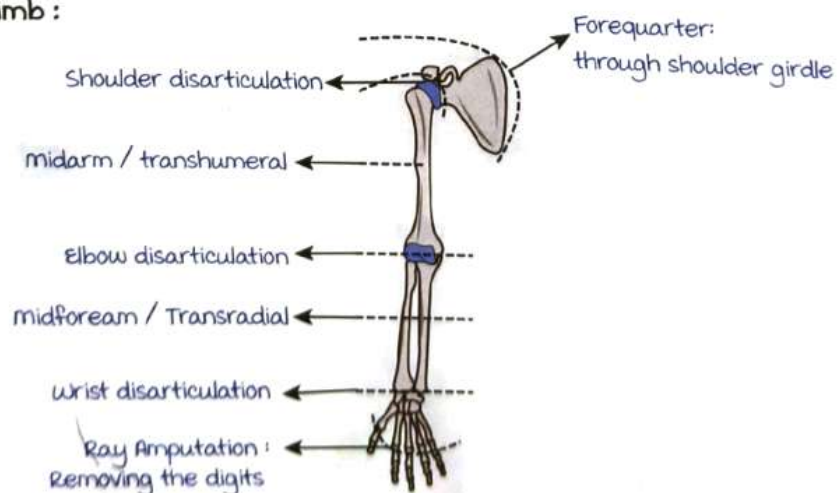
- ↓ Problems of application of the limb prosthesis and ↓ risk of wound dehiscence.

2. Symmetric flap :

- Anterior and posterior flap are of same length.
- Suture line is on the mid-coronal plane.
- Disadvantage : Pain while placing prosthesis.

Terminologies of Amputation

00 :26 :13

upper limb :

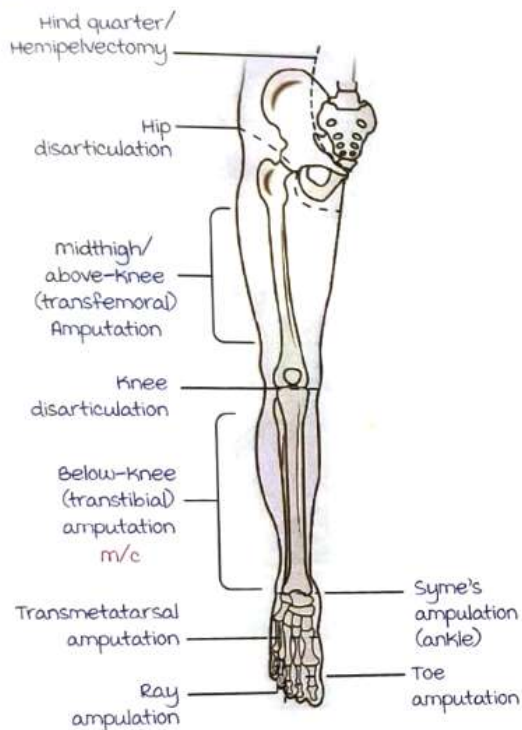
Krukenberg amputation :

----- Active space -----

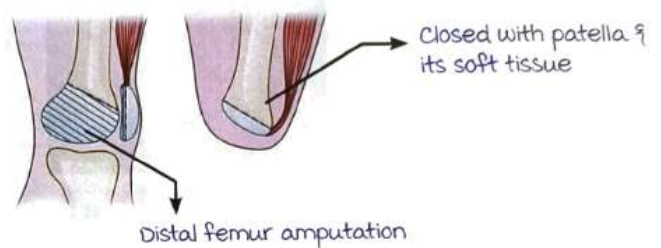


To use radius & ulna
as pincers - performed
in blind people

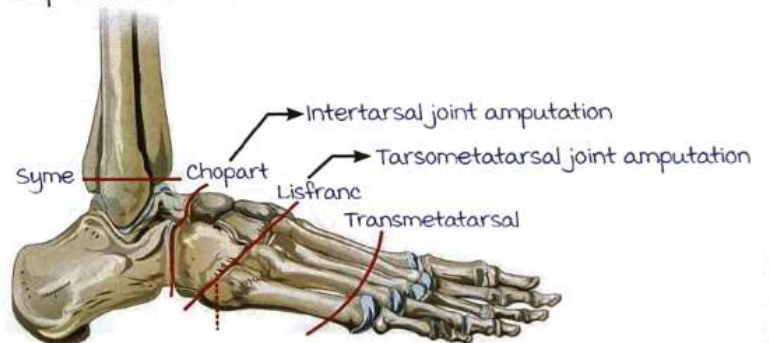
Lower limb :



Gritti-Stokes amputation :



Amputation of the foot :



Complications of amputations :

1. Amputation neuroma :

- Constant pain at amputation site.
- Cause : When nerves are not stretched & cut under tension → they do not retract into soft tissues → form neuroma.
- Rx : **Excision (best)**, Transcutaneous electrical nerve stimulation (TENS), Interferential therapy.

2. Phantom limb (seen in 50-80% cases) :

- Patient **feels** amputated limb is **attached** to the body.
- Sensation disappears in a distal to proximal fashion.

3. Infection.

4. Bleeding.

5. Flap necrosis : D/t tight suturing.

Prosthesis & Orthosis

00:30:59

Prosthesis :

- Device that replaces normal anatomy.
- E.g : Artificial limb after amputation.

Orthosis :

- Device that supports normal anatomy.
- E.g : Cock up splint for wrist drop.

PARTS

Socket : where amputation stump attaches

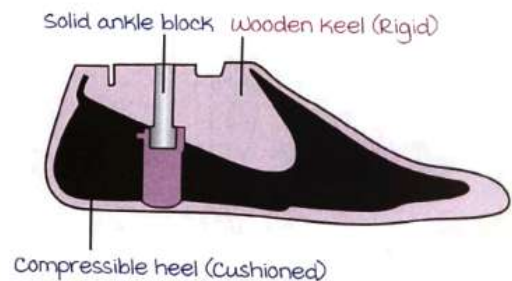
Connecting rod

Knee : Point where connecting rod meets terminal device

Terminal device

Types of terminal device :**1. Jaipur foot :**

more suitable for Indian population

**2. Solid ankle cushion heel (SACH) foot :**

Prosthesis	SACH	Jaipur foot
Appearance	Does not look normal	Looks normal
Walking barefoot and on uneven surfaces	Not possible	Possible
mobility	Restricted	Allowed
Dorsiflexion	Absent	Present
Inversion/Eversion	Absent	Present
Squatting	Not possible	Possible
Cost	High	Low

Note :**Amputations in children :**

- Save as much bone as possible.
- Disarticulation is preferred over amputation : It does not disturb bone growth by protecting the growth plate.
- Multiple revisions of stump is required.
- Children adapt well to prosthesis.

Reimplantation of Limb

00:34:16

----- Active space -----

Prerequisite : Clean wound with low MESS score.

Transportation of appendage :

- Clean in sterile NS or RL.
- Wrap in sterile gauze piece soaked in NS or RL.
- Keep in a plastic bag and seal it.
- Then keep it in an ice box (↑ Ischaemia time to 12-24 hrs).
- Then keep it in a box.

Order of reconstruction :

Mnemonic : BE FAN of virender sehwaq.

1. Bone.
2. Extensor tendons.
3. Flexor tendons.
4. Artery.
5. Nerve.
6. Vein.
7. Skin.

Advanced trauma life support (ATLS)

00:35:30

Simultaneous diagnostic and therapeutic activities intended to identify and treat life and limb threatening injuries beginning with the most immediate.

Indications :

Non-cardiac arrest patients who have had polytrauma.

Objective : To prevent death in the golden hour of trauma.

Components :

1. Airway :
Chin lift/jaw thrust with restriction of cervical spine motion.
2. Breathing.
3. Circulation (stop the bleeding).
4. Disability or neurological status.
5. Exposure (undress) and environment (temperature control).

Stabilises the cervical spine



Philadelphia collar

Pelvic fracture management :

Can cause 1.5 - 2L of blood loss → hemorrhage & death.

1. Pelvis binder/hands/bedsheets
Tamponade the blood loss.
2. IV fluids : RL > NS.
3. External fixation of pelvis.



----- Active space -----

Damage control orthopaedics

00:41:37

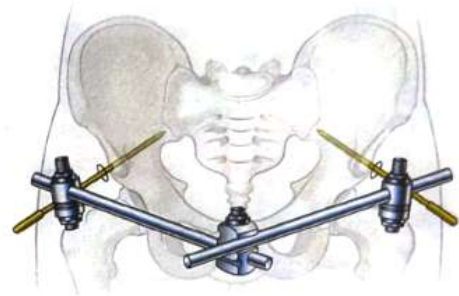
Limited surgical intervention to control hemorrhage & contamination.

Indications : unstable patients (Do not take them up for Sx → Sepsis and death)

Eg : Fat embolism syndrome, chest injury, coagulopathy, hypothermia, severe acidosis.

Steps :

1. Early temporary fixation using external fixator.
2. Patient is optimized (in ICU).
3. Definitive treatment.



External fixation of pelvis

Crush Syndrome

00:43:36

Pathogenesis :

Compression of limb for prolonged period



Hypoperfusion, myonecrosis



release of compression



Toxic metabolites get released



Reperfusion injury (Systemic manifestations of toxic metabolites)

myonecrosis → acute tubular necrosis, renal failure
 → metabolic acidosis, hyperkalemia, hypocalcemia

management :

1. Fluids :

Encourage high urine flow.

2. Alkalinization of urine with sodium bicarbonate :

Prevents myoglobin precipitation in renal tubules.

METABOLIC DISORDERS OF BONE

----- Active space -----

Diseases affecting development of bone.

Causes bone weakness $\rightarrow$ microscopic fractures (pain) $\rightarrow$ further weakens bone $\rightarrow$ Pathological fracture.

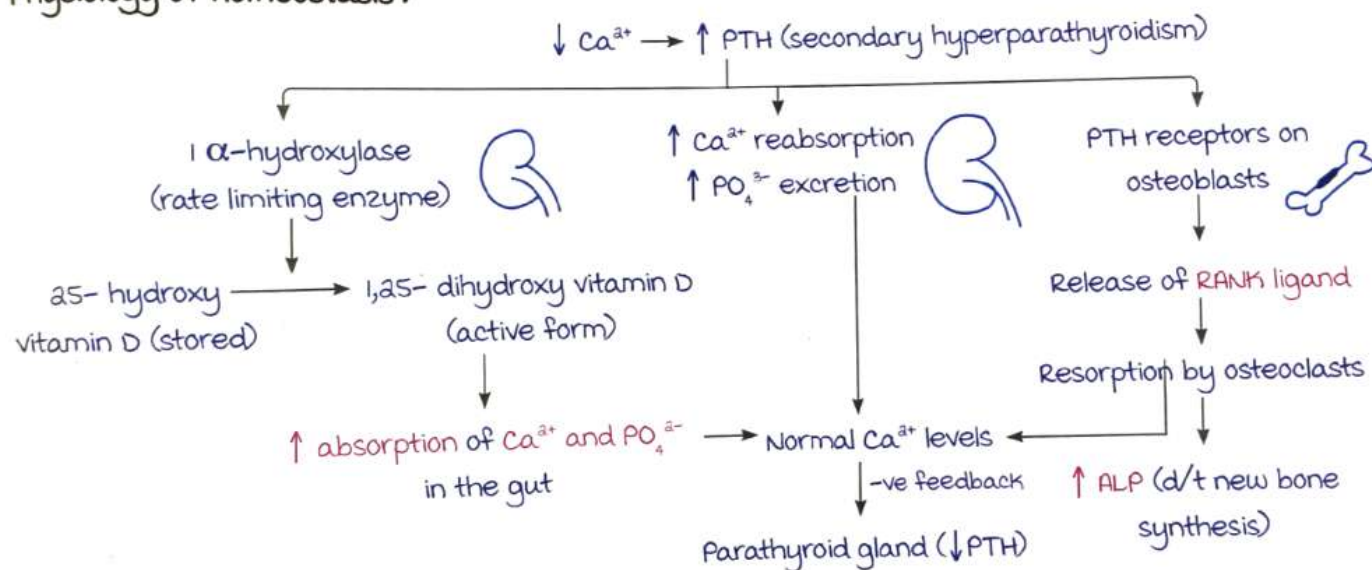
Calcium Homeostasis

00:00:30

maintained by: $\begin{cases} \text{Parathyroid hormone (PTH).} \\ \text{Vitamin D} \end{cases}$

HYPOCALCEMIA

Physiology of homeostasis:



Causes: vitamin D deficiency (rickets/osteomalacia).

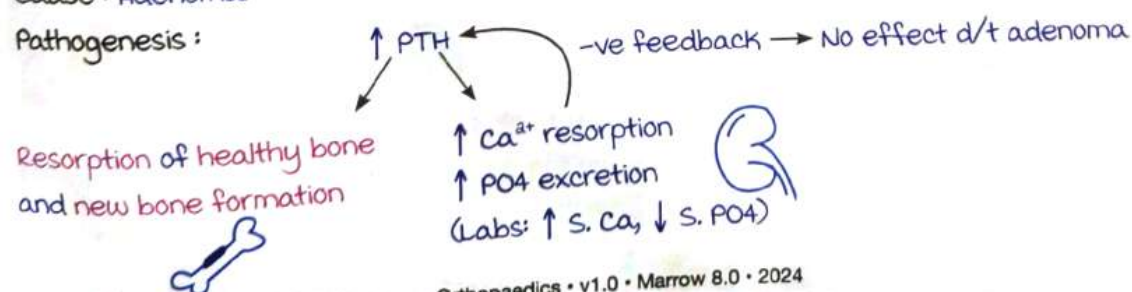
Lab parameters: $\uparrow$ /Normal Ca^{2+} , PTH, PO_4^{3-} , ALP $\uparrow$.

Note: Denosumab $\xrightarrow{(-)}$ RANK ligand $\rightarrow$ inhibits osteoclast activity.

Primary hyperparathyroidism:

Cause: Adenoma.

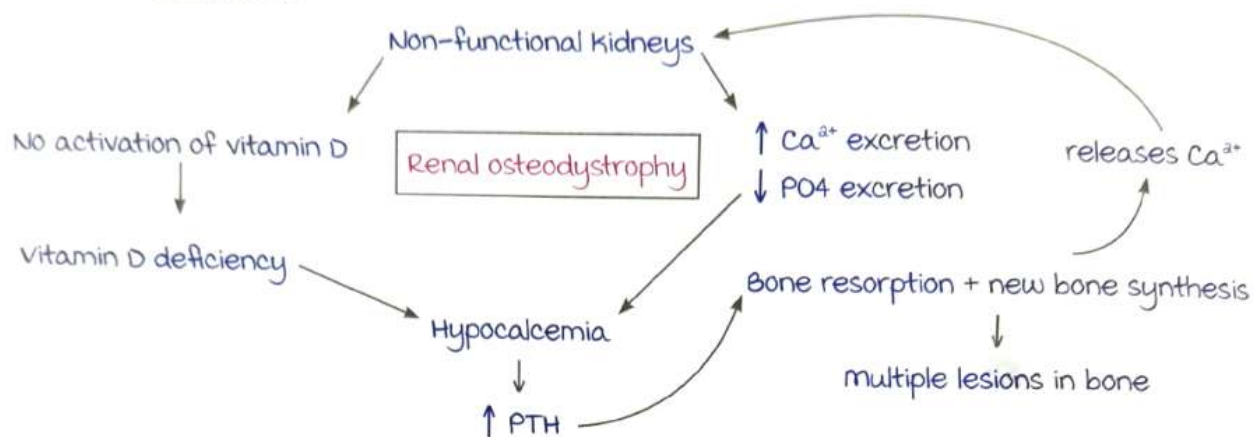
Pathogenesis:



----- Active space -----

Renal failure :

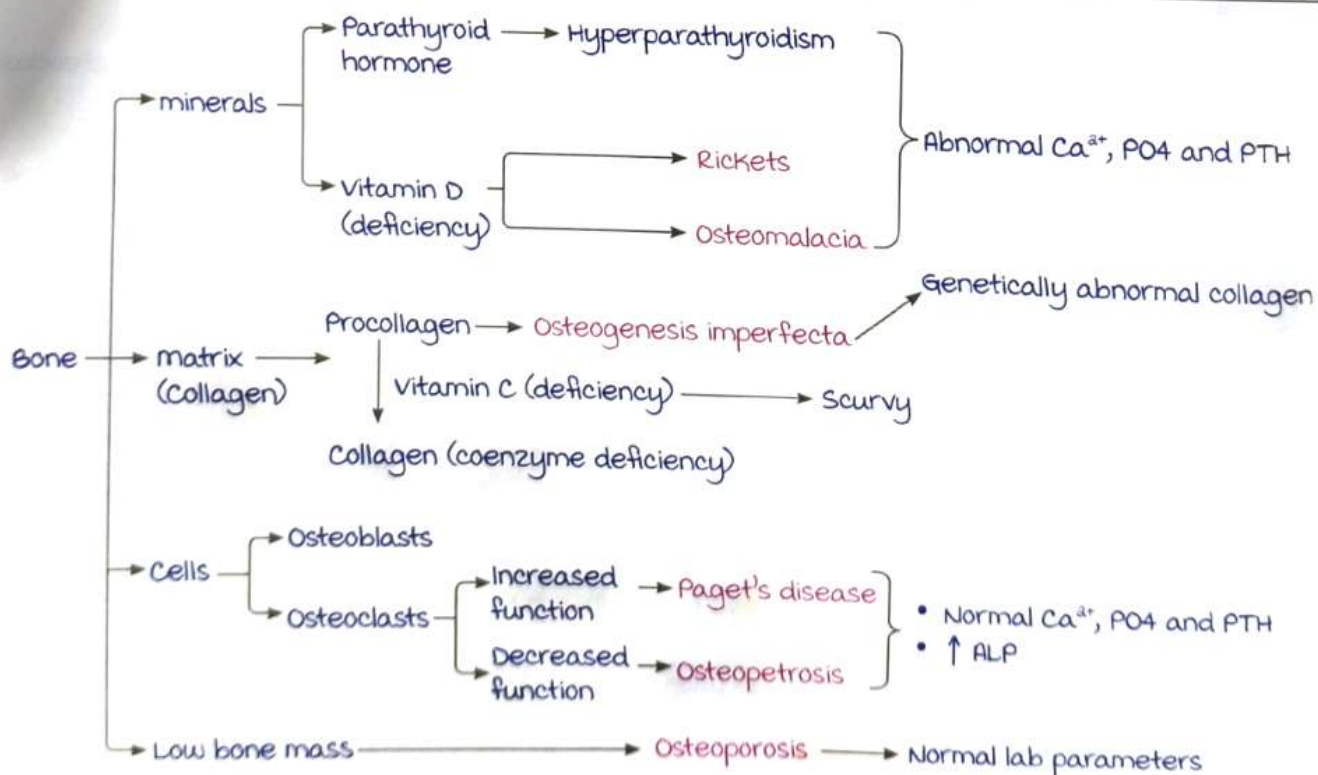
mechanism :

**Laboratory picture in hyperparathyroidism :**

Hyperparathyroidism		Ca ²⁺	PO ₄	PTH	ALP
1. Primary		↑	↓	↑	↑
2. Secondary	d/t vitamin D deficiency	↓/Normal	↓	↑	↑
	d/t renal failure	↓	↑	↑	↑

Overview of metabolic bone disorders

00:13:22



Rickets

00:18:17

----- Active space -----

CAUSES

- vitamin D deficiency : m/c cause
 - Nutritional (m/c cause).
 - malabsorption.
 - Lack of sunlight exposure.
 - Liver and kidney disease.
 - Drugs.
- Ca^{2+} deficiency.
- PO_4 deficiency.

LABS

↓ / normal Ca^{2+} , ↓ PO_4 -, ↑ PTH, ↑ ALP.

CLINICAL FEATURES

1. Skull :

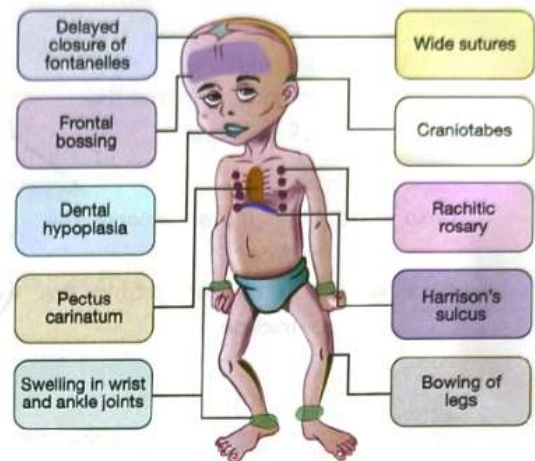
- **Craniotabes**/softening of skull/ping pong skull : Earliest change.
- Frontal bossing.
- Delayed closure of fontanelle.

2. Chest :

- **Rachitic rosary** : Costochondral junction swelling (blunt and non-tender).
- **Pigeon chest**/pectus carinatum : Prominent sternum.
- **Harrison sulcus** : Due to bending of softened ribs by diaphragm contraction.

3. Long bone deformities :

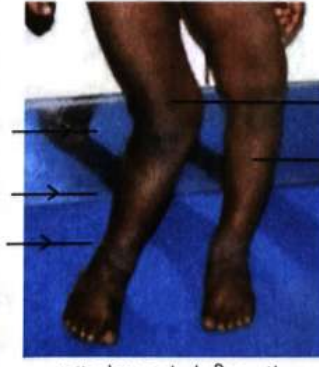
- Only seen once child starts weight bearing.
- Not seen in infants.



B/L genu varum
(m/c presentation)



B/L genu valgus



windswept deformity

Valgus on one side
Varus on one side

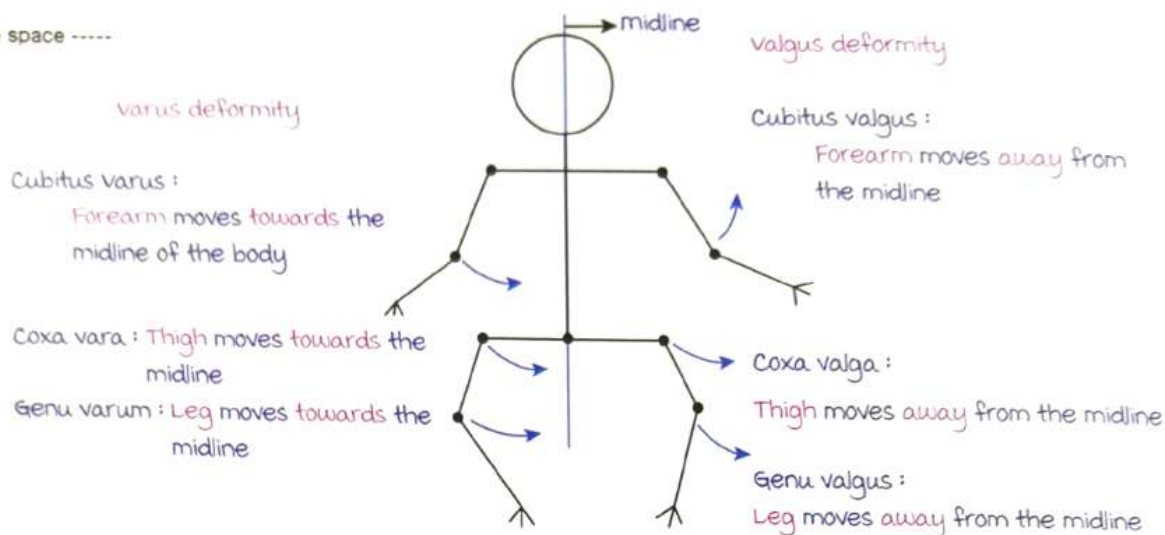


B/L genu varum

Note :

Scorbutic rosary (d/t vitamin C deficiency) : Painful as they are due to bleeding.

----- Active space -----



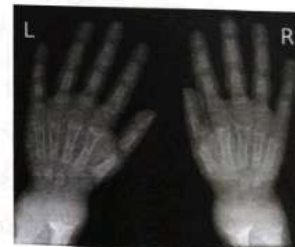
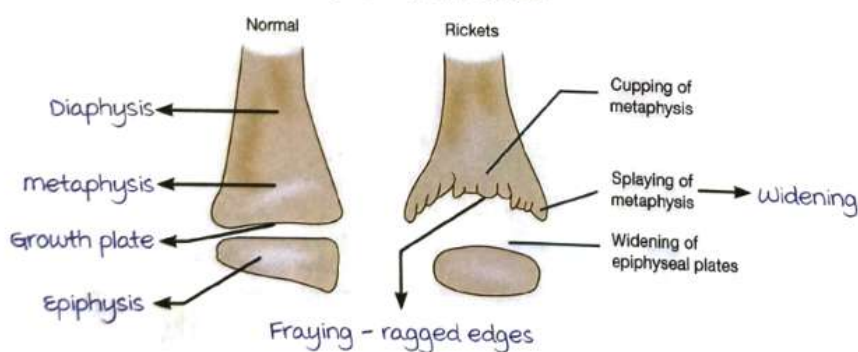
	B/L genu varum (Bow legs)	B/L genu valgus (Knock knees)	Windswept deformity
m/c cause in children	Rickets > Idiopathic	Idiopathic > rickets	Rickets
m/c cause in adults	OA > RA	RA > OA	RA

Genu varum seen in a child more than 2 yrs of age → Rickets.

Deformities at the hip :

- Coxa vara ($<120^\circ$)
- Normal ($120-135^\circ$)
- Coxa valga ($>135^\circ$)

RADIOLOGICAL FEATURES



Healing rickets :

- Best method to assess healing of rickets is X-Ray and serum ALP.
- Ca^{2+} normalises
- PTH ↓
- PO_4^{3-} ↑
- ALP ↓

White line of Frankel (mineralization of growth plate)



Healing rickets

TREATMENT

- Young children : Deformities are reversible upon starting treatment.
- Older child : Osteotomy for residual deformity after bone activity is reduced.

----- Active space -----

Osteomalacia

00:31:44

FEATURES

- Female > males.
- Young people.

Symptoms :

- Poly arthralgia.
- Bone pains.
- Proximal myopathy.

INVESTIGATIONS

Radiological :

X-Ray :

1. Pseudofractures :

- AKA *milkman's fracture/looser zone*.
- m/c site : Neck of femur, clavicle
Ribs, scapulae, pubic rami.



Transverse band of rarefaction

2. Protrusio acetabuli :

Head of femur pushes into the acetabulum.



3. Champagne bottle deformity :

Also seen in achondroplasia.



4. Triradiate pelvis.

5. Trefoil pelvis.

Biopsy : Diagnostic.

Note :

Other conditions where *looser's zone* can be seen :

- Hypothyroidism.
- Paget's disease.
- Fibrous dysplasia.
- Osteogenesis imperfecta.
- X linked hypophosphatemic rickets.

----- Active space -----

TREATMENT**Vitamin D :**

1. **Stoss regimen** : 3 lakh - 6 lakh IU deep IM/oral (stat or over 1-5 days).
2. Daily 2k - 5k IU for 4-6 weeks.
3. Weekly 50k - 60k IU for 8-12 weeks.

Note :• **Tumor induced osteomalacia :**

- Fibrosarcoma.
- Osteoblastoma.
- Osteosarcoma.
- Non-ossifying fibroma.

• **X-Ray scanogram :**

- Full length X-Ray of weight bearing lower limb.
- measures and quantifies deformity.

Scurvy

00:39:38

Collagen maturation and osteoid formation defect d/t vitamin C deficiency.

Features of scurvy**Bone (Radiological features)**

- Diaphysis
 - Ground glass appearance
 - Pencil thin cortex
- metaphysis
 - Whiteline of Frankel
 - Scorbutic zone
 - Pelkan's spur
- Epiphysis
 - Wimberger Ring Sign

D/D :

- Healing rickets
- Congenital syphilis
- Plumbism
- Leukemia

**Blood vessel (Symptoms)****Bleeding Gums****Costo Chondral Junction :**

Scorbutic Rosary

Bleeding gums**Bone :****Subperiosteal hemorrhage**

B/L knee pain

**Findings in Scurvy**

Treatment : Vitamin C.

----- Active space -----

Note :

Barton disease :

- Vitamin C and D deficiency.
- Features of both are seen.

Hyperparathyroidism

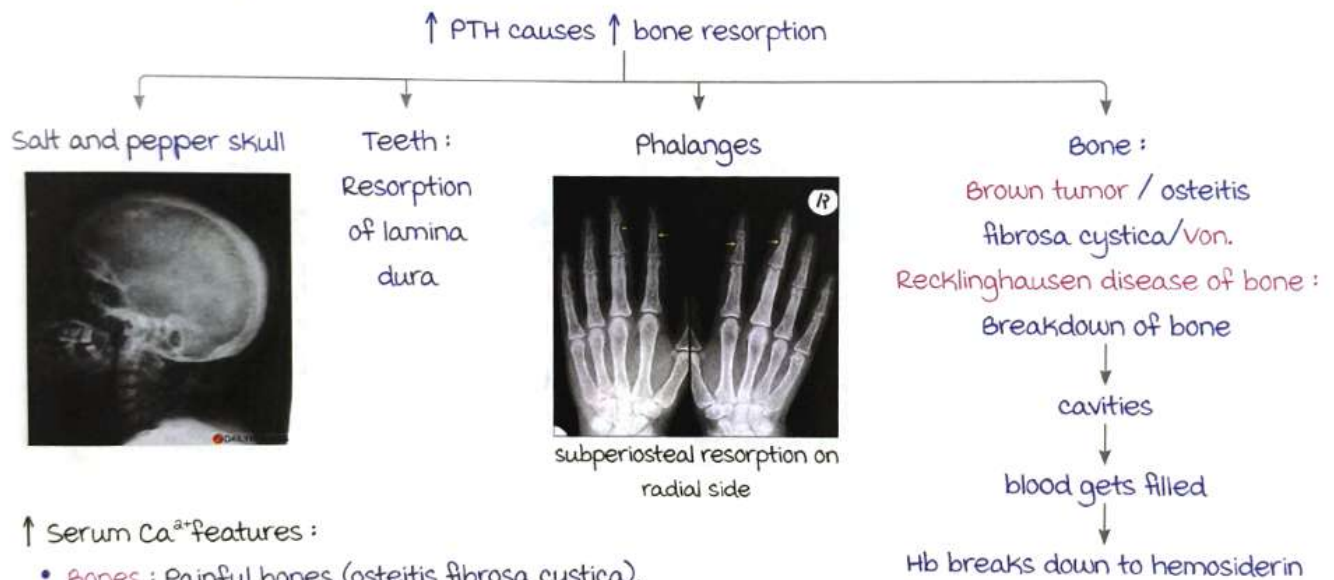
00:42:41

1° hyperparathyroidism : $\uparrow$ PTH irrespective of Ca^{2+} levels.

- m/c cause : adenoma.
- Rx : surgical excision of adenoma.

2° hyperparathyroidism :

- Hypocalcemia.
- Vit D deficiency.
- Renal failure.
- Liver failure.



$\uparrow$ Serum Ca^{2+} Features :

- **Bones** : Painful bones (osteitis fibrosa cystica).
- **Stones** : kidney stones.
- **Groans** : Abdominal symptoms.
- **Psychiatric overtones** :
 - Nervous system : Lethargy, fatigue, memory loss, depression, psychosis.

Note :

Renal osteodystrophy X-Ray :



Rugger Jersey spine

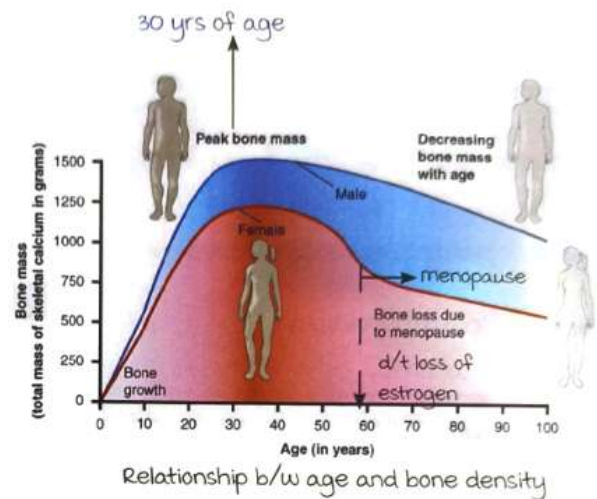
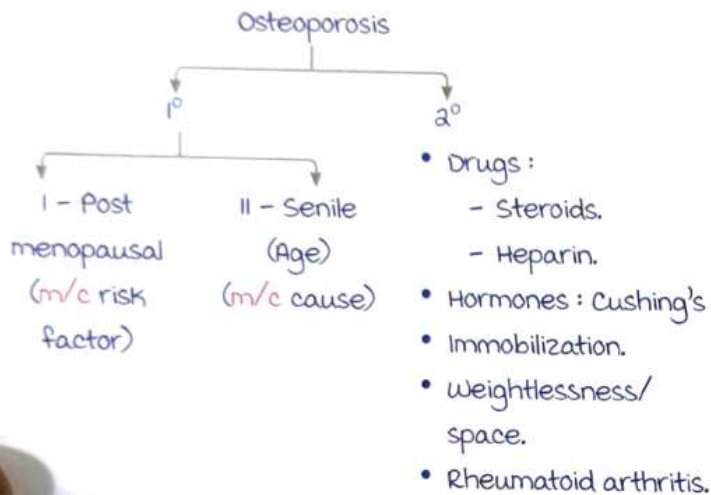
→ Alternating zones of
→ $\uparrow$ and $\downarrow$ bone density

----- Active space -----

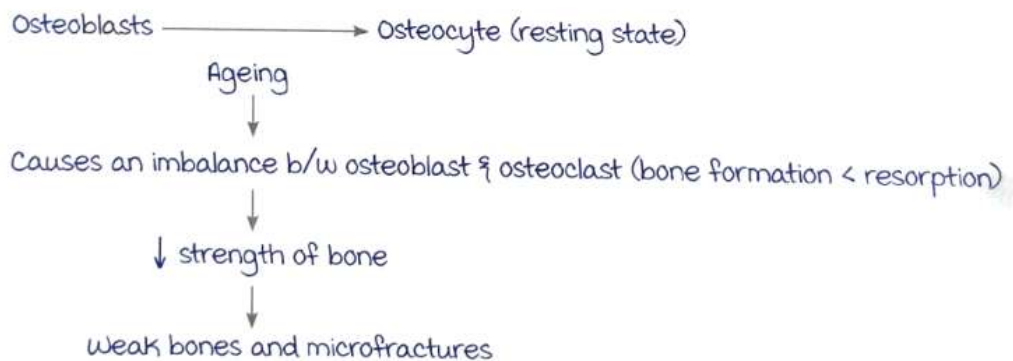
Osteoporosis

00:47:09

- Porous defect of bone.
- Normal quality, ↓ quantity.

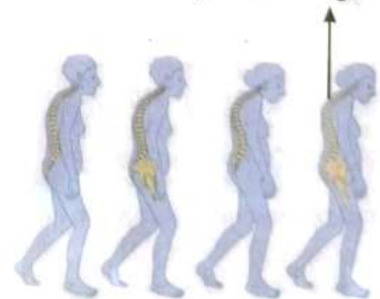
ETIOLOGY

- Estrogen: Has a protective effect against osteoporosis.

PATHOGENESIS**CLINICAL FEATURES**

- Back pain: **Earliest symptom.**
Pain before fracture (constant weight bearing).
- Fragility fracture:
 - m/c complication.
 - Sites: Spine, Neck of femur/ hip, colle's fracture.
- Deformity: **Kyphosis.**

Forward bending of spine: kyphosis



Deformity d/t spine fracture

Lab findings :

Normal.

----- Active space -----

Radiological features :

x-ray changes are only seen after 30 % bone loss.



Spine : Lateral view



Neck of femur fracture



Cod fish vertebrae/Fish mouth vertebrae/Biconcave vertebrae



Colle's fracture

Note :

D/D for cod fish vertebrae :

- Osteogenesis imperfecta
- Osteomalacia

SCREENING

Prerequisites/ criteria to screen :

- Women age $\geq$ 65 yrs.
- Men of age $\geq$ 70 yrs.
- Fractures seen after 50 yrs of age.

----- Active space -----

DEXA scan (Dual energy X-ray absorptiometry) :

- 100
- Assesses spine (preferred), hip & calcaneum.

T score :

- Density is compared with a population having peak bone density.
- Young reference male/ female, 30 yrs of age.
- WHO classification of osteoporosis (based on T-score).
 - 0 to -1 : Normal.
 - -1 to -2.5 : Osteopenia.
 - < -2.5 : Osteoporosis.
 - < -2.5 with fracture : Severe osteoporosis.

TREATMENT**Drugs ↓ bone resorption :**

Inhibit osteoclastic activity.

1. Bisphosphonates : First line drugs.
 - Risedronate, Ibandronate, Zoledronate.
 - Adverse effects :

Prolonged use of bisphosphonates (5 - 7 yrs)

↓ osteoclastic activity
(lower than osteoblastic activity)

Atypical fractures around hip

- Drug holiday : Temporarily stop using bisphosphonates & switch to other drugs (Teriparatide).

2. Denosumab : monoclonal Ab against RANK ligand.
3. SERM : Raloxifene.
4. HRT : For post menopausal symptoms.

Drugs that ↑ bone formation :

↑ activity of osteoblast (anabolic).

1. Teriparatide : Synthetic PTH (small doses increase only osteoblasts).
 - First line in severe osteoporosis.
 - used for shorter duration.
 - Adverse effect : Cancer in rat models.
2. Abaloparatide : Synthetic PTH.
3. Romosumab : Anti sclerostin Ab (Sclerostin → Osteoblasts)



Atypical fracture

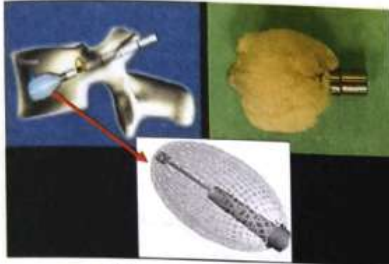
Drugs that ↓ bone resorption & ↑ bone formation :

- Strontium Ranelate : ↑ complications.

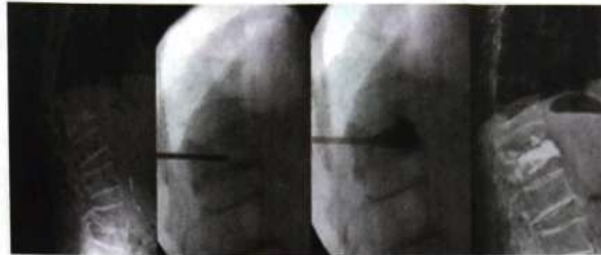
----- Active space -----

Treatment of deformities :

- vertebroplasty : Inject PMMA bone cement.
- Balloon kyphoplasty : Restores height of vertebra → Inject bone cement.



Balloon Kyphoplasty



Vertebroplasty

Paget's Disease/ Osteitis Deformans

01:07:43

- male > female.
- Incidence : 5th decade.

Etiology :

- Idiopathic (m/c).
- SQSTM1 gene mutation.
- Paramyxovirus.
- Pelvis > tibia.

Pathogenesis :

↑ osteoclast activity → ↑ bone resorption → ↑ bone formation by osteoblasts
(↑ ALP)

Stages :

- Lytic phase.
- Mixed phase.
- Blastic phase.

Clinical features :

1. Pain (m/c).
2. Bone is warm to touch & thickened.
3. Weak bone (Banana fracture).
4. Cranial foramen stenosis : CN 2, 5, 7, 8 (hearing disturbances).
5. Otosclerosis.
6. Thickening of skull : Frequent changes in hat size.

Investigations :

- Biopsy (IOC) : mosaic pattern.
- ↑ ALP.



Banana fracture

----- Active space -----

Radiological features :

1. Lytic phase :

- Blade of grass/flame shaped appearance.
- Osteoporosis circumscripta : Circumscribed lesion in the skull.



Blade of grass deformity

2. mixed phase :



Picture frame vertebrae



Ivory vertebrae



Cotton wool skull

3. Blastic phase :

Thickening of skull



Tam O shanter skull

Treatment :

1. Zoledronate :

- Long acting bisphosphonate.
- Suppress osteoclastic activity.

2. Calcitonin : To manage pain.

Complications :

- High output cardiac failure (causes death).
- Transformation to osteosarcoma (d/t ↑ bone turnover).

Osteogenesis Imperfecta/ Brittle Bone Disease

01:14:27

- Genetically abnormal collagen.
- COLA I gene defect.

Types :

1. AD/ Type I/ Classical :

Weak bone → Recurrent pathological fractures.

2. AR/ Type II : (Still born/lethal form)

multiple fractures in utero (seen in antenatal scan).

Investigations :

Normal laboratory values.

Clinical features :

1. Deformities : D/t multiple fractures in the same bone.



2. Blue sclera :



----- Active space -----

Choroid is visible d/t thin sclera

3. Easy bruising.

Treatment :

1. Braces :

Prevention of fractures.

2. Realignment osteotomies :

Seekh Kabab operation.



Laboratory Values in Metabolic Bone Disorders

01:16:48

	Calcium	PTH	PO4	ALP
2° hyperparathyroidism/ Rickets/ Osteomalacia	↓ / Normal	↑	↓	↑
Renal osteodystrophy	↓↓	↑	↑↑↑	↑
Osteoporosis	Normal			
1° hyperparathyroidism	↑↑↑	↑	↓	↑
Paget's disease	Normal			↑↑↑

----- Active space -----

UPPER LIMB TRAUMA : CLAVICLE AND SHOULDER

mechanism of Injury :

Fall on an outstretched hand.



Xray shoulder : AP view

Clavicle

Acromion

Proximal humerus

Lateral border of scapula

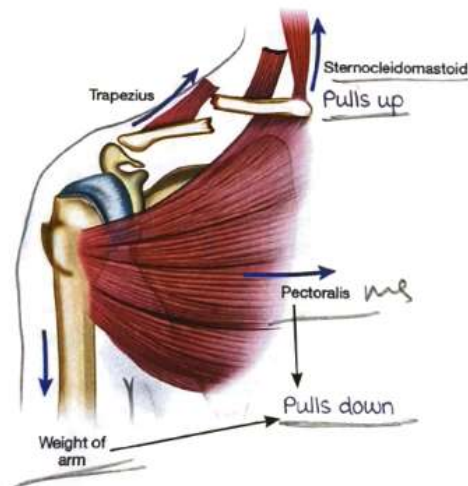
Fracture of Clavicle

00:04:01

Clavicle most commonly fractured at medial 1/3 - tubular. lat. 2/3 - flat.

- m/c fracture
 - At birth
 - In newborn
 - Overall : D/t anatomy
 - medial 1/3rd : Tubular.
 - Lateral 2/3rd : Flat.
- m/c site of fracture : Junction of medial 2/3rd (3/5th) and lateral 1/3rd (2/5th).

DISPLACING FORCES IN FRACTURE CLAVICLE



Lateral fragment : Pushed down

medial fragment : Pulled up



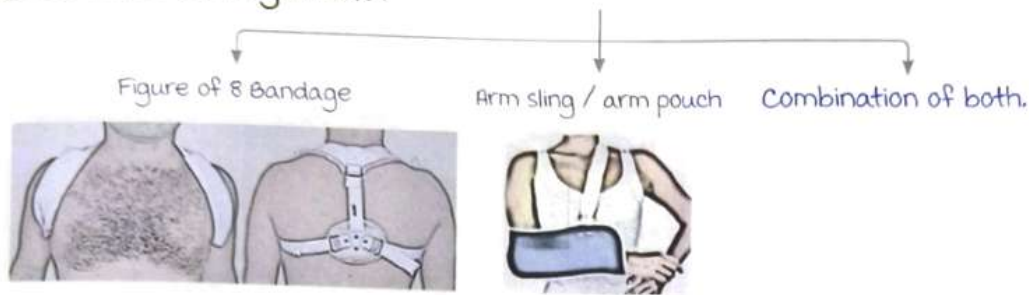
Fracture of Clavicle

COMPLICATIONS :

- malunion (m/c) : D/t displacement.
- Neurovascular injury to
 - Brachial plexus.
 - Subclavian vessels.
- Non-union (Very rare).

MANAGEMENT**Conservative management :**

----- Active space -----

**velpeau bandage :**

- Indications →
- Fracture of clavicle.
 - Acromion injuries.
 - Shoulder dislocations.

**Surgery :****Indications :**

1. Open clavicle fracture.
2. massive displacement (Skin tenting +).
3. Acromioclavicular joint involved.
4. Neurovascular injury.
5. Floating shoulder injury (Clavicle fracture + glenoid fracture).

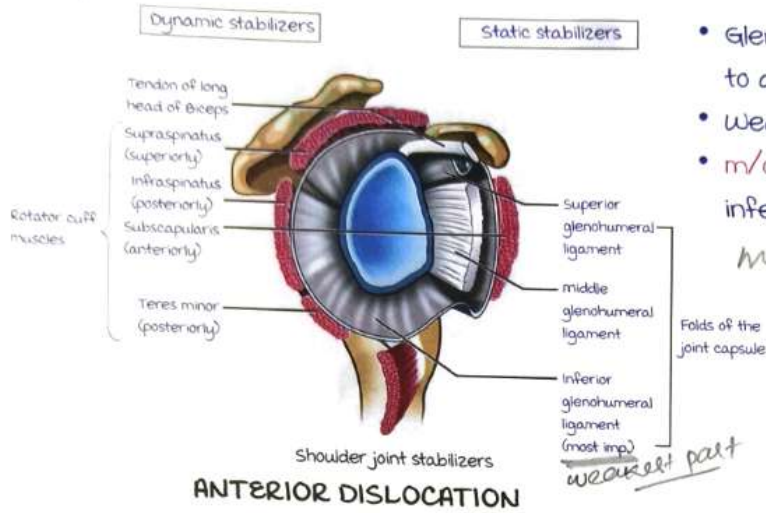
Procedure : Open Reduction + Internal Fixation.**Shoulder injuries**

00:09:36

ANATOMY OF SHOULDER JOINT

- Type of joint : Ball (Head of humerus) & socket (Glenoid) joint.
- Size of head : 4x size of socket
 - High mobility → most commonly dislocated.
 - Low stability.

----- Active space -----



- Glenoid labrum: Provides some concavity to accommodate head of humerus.
- Weakest point of shoulder joint: Inferior.
- m/c dislocation: Anterior > posterior > inferior.

Most mobile & m/c dislocation jt

Subtypes:



Pre glenoid



Subcoracoid (m/c)



Subclavicular



Intrathoracic

Presentation:

Attitude of limb (Abnormal position of limb after dislocation).

- Loss of shoulder contour → Flattened.
- Abduction & external rotated → Loss of adduction & internal rotation.

Arm by side of the body

Mechanism of injury → H/o trauma.

→ Fall on outstretched hand.

Acute dislocation: Emergency → Requires immediate reduction.

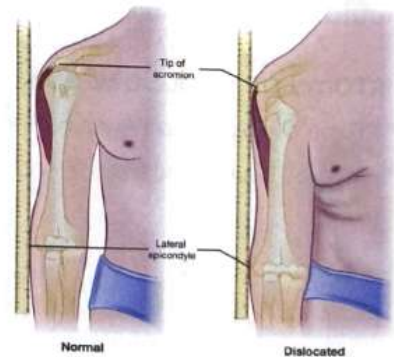
On examination:

1. Hamilton Ruler Test

Ruler placed against lateral epicondyle of humerus

↓

Ruler touches acromion d/t displaced head of humerus



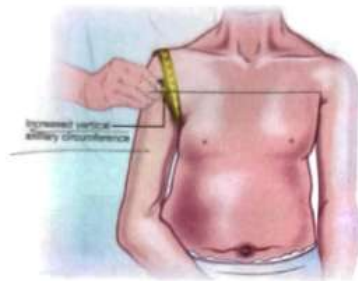
Loss of shoulder contour in anterior dislocation

2. Dugas test



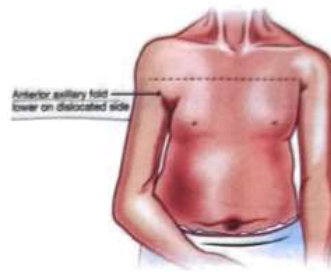
unable to touch
opposite shoulder

3. Callaway test



Increased vertical
axillary circumference

4. Bryant's test



Anterior axillary fold
lower on dislocated side

----- Active space -----

5. Axillary nerve injury :

Loss of → motor function of → **Deltoid**
→ **Teres minor.**

→ Sensory function : **Regimental badge sign** (Paresthesia/tingling/
numbness/tenderness over lateral aspect of
upper arm).

X-ray :

- AP view.
- Lateral view.



X-ray : Anterior dislocation of shoulder joint

Techniques of Reduction :

1. modified Kocher's Technique (**TEAM**) : m/c to be used.



1. Traction



2. External rotation



3. Adduction

4. medial / Internal
rotation

----- Active space -----

Note :

Attempt closed reduction under analgesia

Fails d/t muscle spasm

Attempt closed reduction under anesthesia (Causes muscle relaxation)

Fails

Open Reduction

2. Stimson's technique :



Patient prone

Heavy object tied to dislocated limb

Hang limb at the edge of table/bed

Gradual traction overcomes muscle spasm

Reduction achieved

After reduction

Place arm in arm pouch/ sling/ velpeau bandage

Promote healing of soft-tissue injuries

↓ risk of recurrent dislocations

3. Hippocratic technique :



• Countertraction :

with foot

• Traction : With arm

Stabilise ft by
arm, arm pouch
or velpeau bandage

Complications of recurrent dislocations :

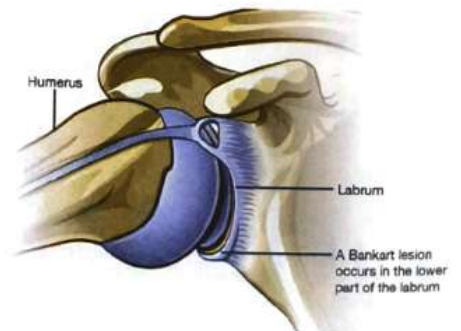
1. Bankart lesion (m/c).

Glenoid labrum tears antero-inferiorly

Laxity of inferior glenohumeral ligament

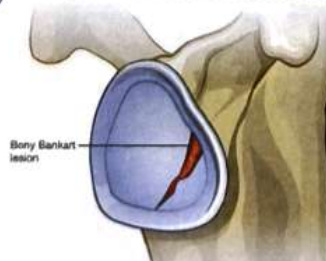
↓ stability

Recurrent dislocations



• Bony bankart : Avulsion fracture of antero-inferior glenoid

Due to tear of inferior glenohumeral lig.



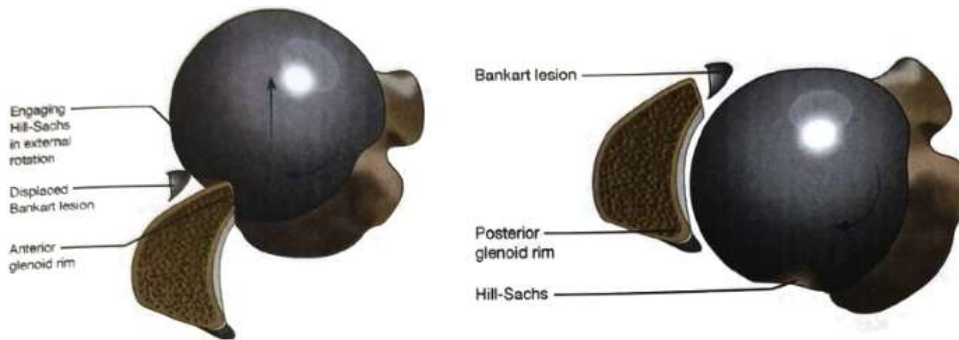
Bony bankart

2. Hill-Sachs lesion

Recurrent dislocation → Head of humerus repeatedly hits anterior glenoid rim

----- Active space -----

Indentation on posterolateral surface



mechanism of Hill-Sachs lesion



X-ray : Hill-Sachs lesion

Note :

- m/c complication of shoulder dislocation : Recurrent dislocation.
- m/c → Early complication : Axillary nerve injury
- Late complication : Recurrent shoulder dislocation
- m/c nerve injured in shoulder dislocation : Axillary nerve.

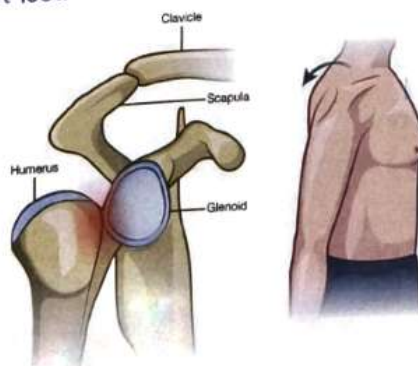
POSTERIOR DISLOCATION

mechanism of injury :

1. High velocity muscular violence (Specific)
 - In seizures.
 - High voltage electric shock.
 - In Electroconvulsive therapy (ECT).
2. Fall on outstretched hand
3. Trauma

Attitude of limb :

- Adducted and internally rotated
- Loss of abduction & external rotation
- Shoulder contour : Not lost.
- Pain (+).



----- Active space -----

X-ray :

Electric light bulb sign.



Normal X-ray



X-ray in posterior dislocation

Complications :

- Lesions
 - Reverse Bankart : Postero-inferior tear of glenoid labrum.
 - Reverse Hill-Sachs : Antero-medial indentation of head of humerus.
- Nerve injury : Axillary nerve (m/c).

INFERIOR DISLOCATION :AKA *Luxatio Erecta*.

mechanism : Hyperabduction injury.

Note :

Tests for shoulder instability.

Instability	Test
Anterior	Fulcrum
	Crank
	Apprehension
Posterior	Jerk
Inferior	Sulcus

Treatment of unstable shoulder : Surgery.

1. Arthroscopic
 - Bankart's repair
 - Hill Sach's repair
2. Bristow Latarjet operation
3. Putti-platt operation

} Obsolete

UPPER LIMB TRAUMA : ARM AND ELBOW

----- Active space -----

Proximal Humerus Fracture

00:00:08

- Risk factor : Postmenopausal osteoporotic females (rate of osteoporosis : In proximal humerus > other parts).
- m/c site : **Surgical neck of humerus** (passes through lesser & greater tuberosities).
- m/c injured nerve : **Axillary nerve**.

78

NEER'S CLASSIFICATION



Fracture : Surgical neck of humerus

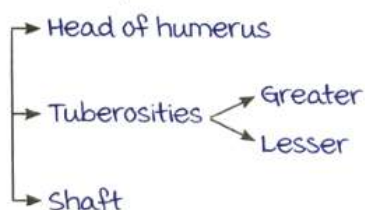


NEER's type 2 proximal humerus fracture

Depending on the parts (fragments) displaced from normal anatomy :

Type	No. of fragments
I	0 (undisplaced)
II	2
III	3
IV	4

Parts of proximal humerus :



No. of parts $\propto$ risk of complications (E.g : Avascular necrosis).

TREATMENT

Definitive :

Open Reduction (OR) + Internal fixation (IF) with plates & screws.



Fracture



OR+IF with plates & screws

----- Active space -----

Shaft of Humerus Fracture

00:05:14

- Fracture between surgical neck of humerus & supracondylar area.
- Associated injured nerve : Radial nerve (runs in radial groove on the shaft of humerus).

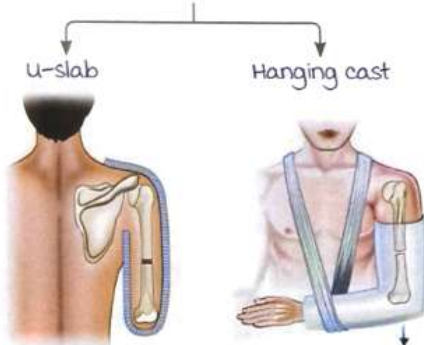
Treatment :

Closed reduction (CR)

+ POP application

Open Reduction (OR)

+ IF with plates & screws } Best



Note :

Hanging cast : Keeps fracture reduced with gravity → Requires patient to be in upright position to work.

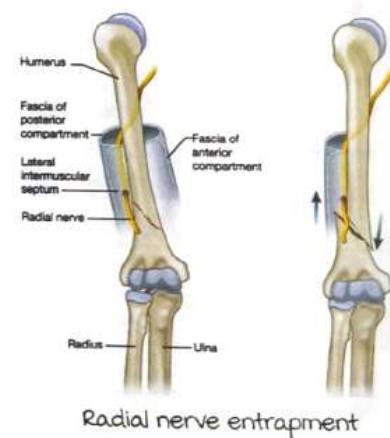
Holstein-Lewis Fracture :

Site : Junction of upper 2/3rd & lower 1/3rd
(radial nerve perforates lateral intermuscular septum)

↓
Causes entrapment of tethered radial nerve

↓
Wrist drop + sensory loss

↓
Rx : Cock-up splint



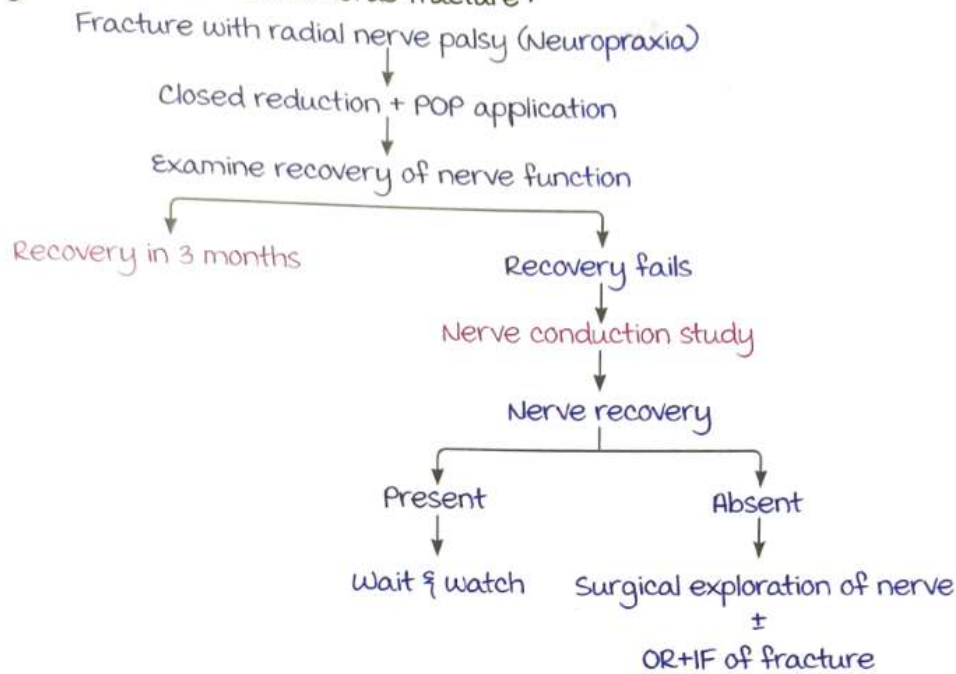
Holstein-Lewis Fracture



Cock-up splint

----- Active space -----

management of shaft of humerus fracture :

**Fractures around elbow**

00:18:23

Types :

- Supracondylar humerus (m/c).
- Lateral condyle fracture (and m/c).
- medial condyle fracture.
- Transcondylar fracture.
- Intercondylar fracture.
- Olecranon fracture.

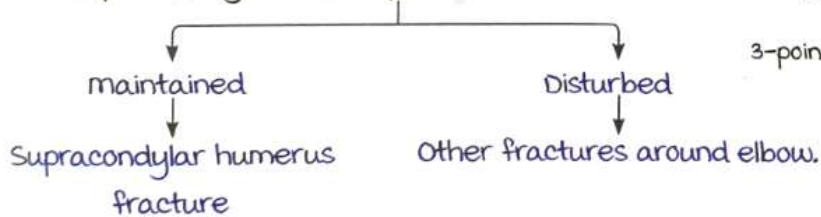
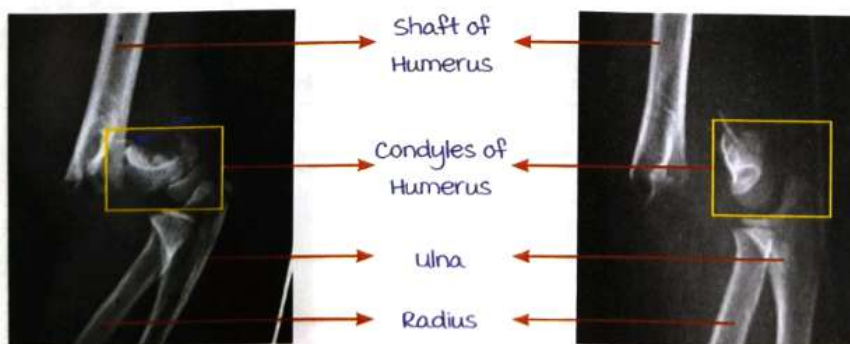
Note :

Elbow joint : hinge jt
ulnohumeral joint.



3-point Bony relationship in elbow

Three point bony relationship in elbow :

**SUPRACONDYLAR HUMERUS FRACTURES**

----- Active space ----- Salter Harris type 2 (Extraarticular) fracture :

- m/c fracture around : elbow in children : D/t anatomy

Soft, thin, narrow bones in children Flattened supracondylar area Thin d/t olecranon & coronoid fossa

- m/c mode of injury : Fall on an outstretched hand
 - m/c mechanism of injury : Hyperextension
- } → Posterior displacement.

Types based on displacement of distal fragment :

Extension type
(posterior displacement)

Flexion type
(anterior displacement)

mechanism

Fall on extended elbow
+
Triceps pull

Displacements in extension type

1. Proximal migration
 2. medial tilt and medial shift
 3. Internal rotation
 4. Posterior (dorsal) tilt & shift
- } m/c

Gartland Classification :

	Type I	Type II	Type III
Appearance	Undisplaced (fracture line may not be visible)  fat pad sign	• Anterior cortex : breached • Posterior cortex : intact (incomplete fracture). 	Displaced complete fracture  Fish tail sign
Definitive treatment	POP applied in 90° flexion of elbow	Reduction ↓ Adequate Inadequate ↓ ↓ POP K wires applied inserted	Open/closed reduction + IF with K-wires

• **Fat pad/Sail sign:**

Hematoma around fracture pushes away fat
 ↓
 Sail-shaped lucency around supracondylar area

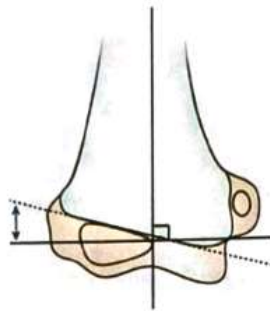


Fish-tail deformity

----- Active space -----



Dunlop traction
 (For temporary stabilisation of fracture)



Baumann's angle
 (to determine adequate fracture reduction)



ORIF of supracondylar fracture

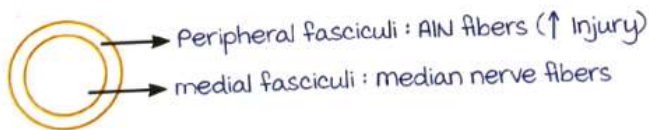
Complications:

Early (neurovascular)

- vessel injury : m/c → **Brachial artery**
- Compartment syndrome
- Volkmann Ischemic contracture
- Nerve injury : m/c → **Anterior interosseous** > median > Radial

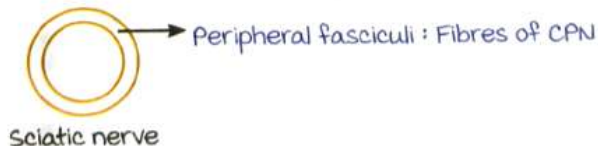
Late

- malunion (m/c) → cubitus varus / gunstock deformity (↓ carrying angle)
- myositis ossificans

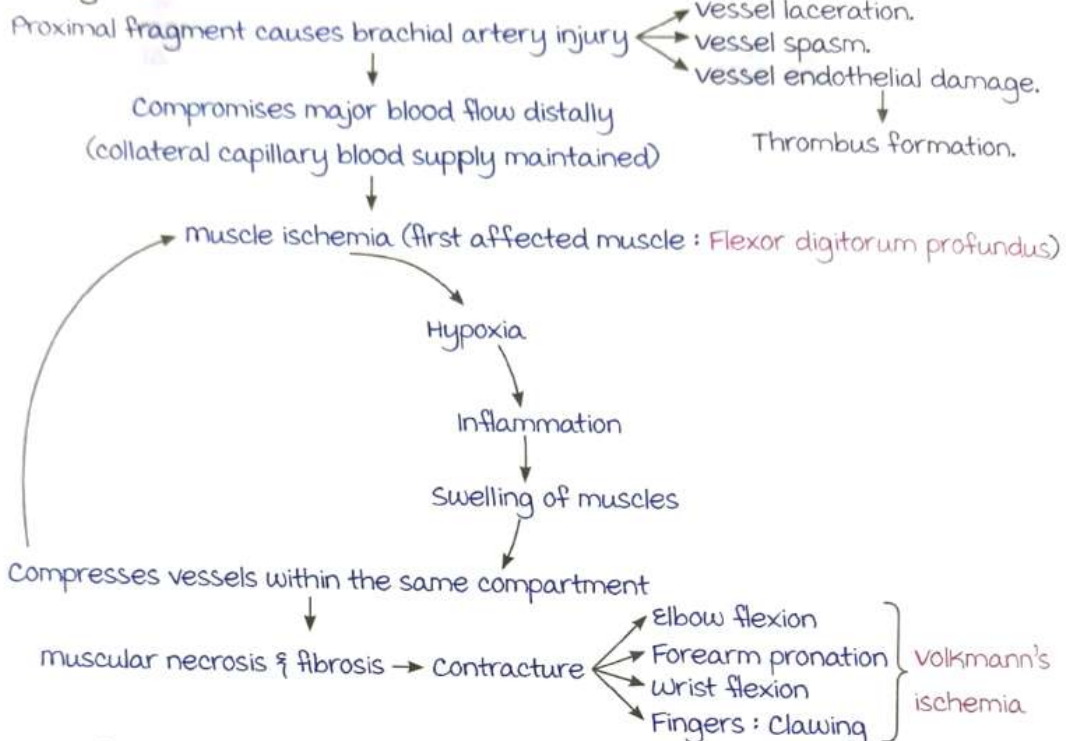


Cross-section of median nerve above elbow

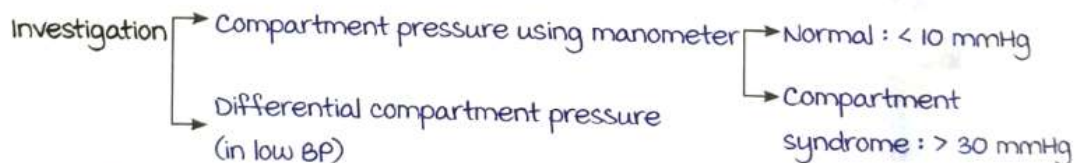
Note: Foot drop in posterior dislocation of hip : D/t common peroneal nerve (CPN) palsy.



----- Active space -----

Compartment Syndrome :**Pathogenesis :****Clinical features :**

1. Pain on passive stretch : most important sign.
2. Puffiness (Swelling).
3. Pallor.
4. Paraesthesia.
5. Paralysis (Late sign).
6. Pulselessness (very late sign).

**Treatment :**

Fasciotomy : Longitudinal incisions on superficial & deep fascia in all compartments

↓

Fall in compartmental pressure

↓

Improves vascularity → wound left open till pressure falls



Fasciotomy

After few days

- Skin graft
- vacuum/negative pressure therapy

Volkman's Ischemic Contracture :

Features :

- Deformity
 - Elbow flexion.
 - Forearm pronation.
 - Wrist flexion.
 - Fingers clawing.

- Sensory loss and motor paralysis in forearm & hand.

flexor group of muscles die

Treatment (Based on severity of contracture):

- mild : Turn buckle splint.
- moderate : max page (muscle sliding) operation.
- Severe : Bone shortening.



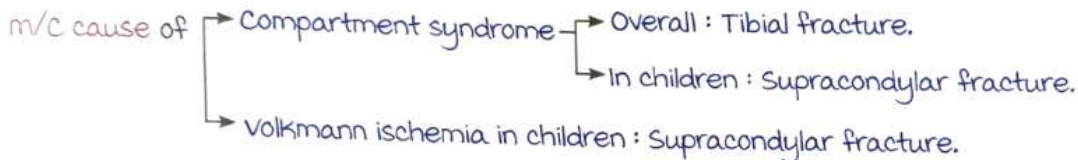
Volkman's Ischemic Contracture of upper limb

----- Active space -----



Turn buckle splint

Note :

**Pink Pulseless Hand :****Supracondylar humerus fracture**

Brachial artery compression / spasm

Radial pulse (-)

Collateral perfusion maintained

Limb appears pink

Rx : Fracture reduction (improves vascularity)

Malunion :

- m/c complication.
- D/t medial tilt + internal rotation of distal fragment → Gunstock / cubitus varus deformity.
- Extraarticular fracture → Elbow function : Normal.
- Rx : modified French osteotomy.

Note : Normal carrying angle

- : 5°.
- ♀ : 10-15°.

Myositis Ossificans :

- massage of fracture
 - Fracture hematoma dislodges
 - ↓ *brachialis*
 - Settles inside muscle
 - ↓
 - Bone forms inside muscle
 - ↓
 - ROM / restriction of movement



myositis Ossificans

----- Active space -----

- m/c muscle involved : **Brachialis**.
- m/c joint involved : **Elbow** > hip.
- Only cause for elbow ROM in supracondylar fracture.
- Rx → Active phase (pain, redness, swelling (+)) : NSAIDs, limb immobilisation.
- Latent phase : Active physiotherapy.
- ↓ Elbow function not restored
- Surgical excision of mass

Fat embolism syndrome :

Polytrauma/long bone fracture $\xrightarrow{24-48 \text{ hours}}$ Difficulty breathing, tachypnea, petechial rashes.

LATERAL CONDYLE HUMERUS FRACTURE

mechanism of injury : Fall on outstretched hand with slight varus force.

	Lateral condylar fracture	supracondylar fracture
Type of fracture	Intraarticular	Extraarticular
Salter-Harris classification Type	Type iv	Type i/ii
3-point bony relationship	Disturbed	maintained

Note :

Fracture of necessity (requires surgical management).

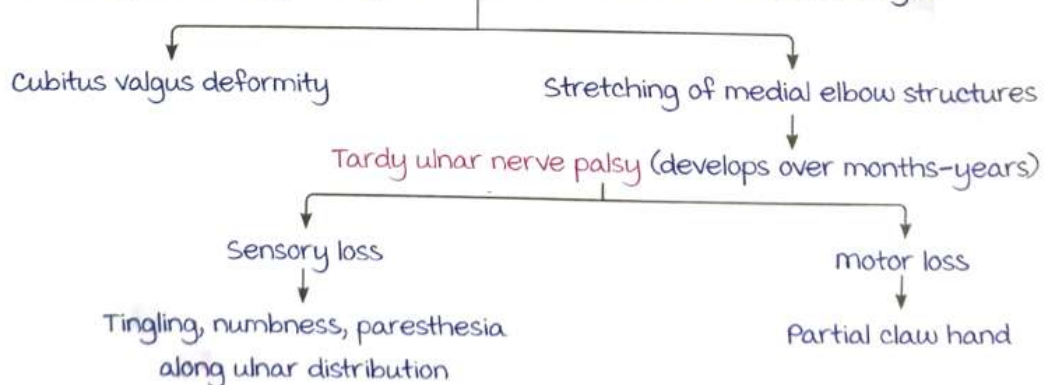
1. Intraarticular fractures.
2. Lateral condylar humerus.
3. Monteggia / Galeazzi.
4. Neck of femur.



Lateral condyle humerus fracture

Complications :

1. Elbow stiffness.
2. Non-union : D/t → Pull by common extensor group of muscles.
→ Compromised vascularity.
3. Damage to lateral growth plate → Growth of medial > lateral condyle.



Treatment : ORIF.

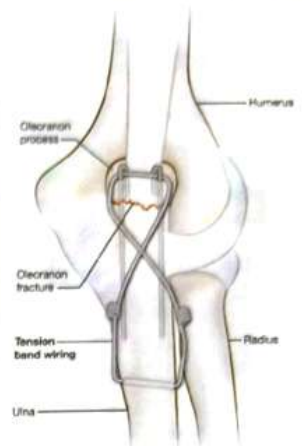
OLECRANON FRACTURE



X-ray appearance



Treatment



Rx : OR + IF with tension band wiring (TBW)
(Converts distractive forces → Compressive forces).

Elbow dislocation

01:03:01

- ulno-humeral dislocation.
- m/c dislocation in children.
- m/c type : Posterior.

Clinical features :

- 3-point bony relationship : Reversed.
- Attitude of limb : Flexion at elbow.
- Bow string sign : Posterior dislocation of elbow → Laxity of triceps muscle.



Elbow dislocation

Note :

Terrible (Hotchkiss) triad of elbow :

1. Posterior elbow dislocation.
2. Coronoid fracture.
3. Radial head fracture.

PULLED ELBOW / NURSEMAID'S ELBOW

Radial head pulled out of annular ligament.

----- Active space -----

mechanism :

In children <4-5 years : unossified smaller radial head in larger annular ligament

↓
Axial traction of extended & pronated elbow

↓
Radial head subluxates out

Clinical features :

- Attitude of limb : **Extended elbow & pronated forearm.**
- 3 point bony relationship : not affected.
- X-ray : Normal.



Treatment :

- Self limiting.
- If painful $\begin{cases} \rightarrow \text{Flex elbow \& forcefully supinate forearm.} \\ \rightarrow \text{Extend elbow \& pronate forearm.} \end{cases}$

UPPER LIMB TRAUMA : FOREARM, WRIST AND HAND

----- Active space -----

Fractures of Forearm

00:01:01

Forearm bones → Radius : Articulates with carpal bones (wrist).
 → Ulna : Articulates with humerus (Ulnohumeral joint).

- Ulna : Static
 - Radius : Rotates around ulna
 - Triangular fibrocartilage complex (TFCC) : Stabilizes DRUJ.
- } Results in pronation & supination.

Both bone fracture of forearm :



Note :

POP position in forearm fractures :

Fracture of → Proximal 1/3rd : Supination
 → middle 1/3rd : mid prone
 → Distal 1/3rd : Pronation

Rx → Closed reduction (CR) + POP
 → Open reduction (OR) + IF with plates & screws (Best)

Monteggia fracture :

Fracture of upper 1/3rd ulna (Fracture of necessity)

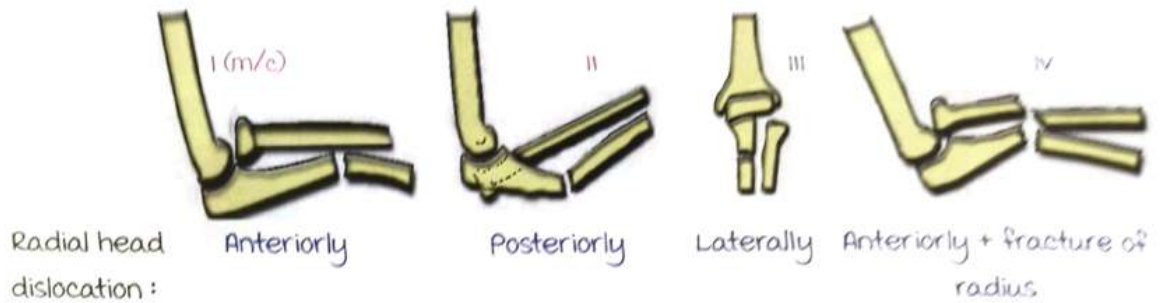
+

Proximal RUJ disruption (Radial head dislocation).



monteggia fracture

----- Active space ----- BADO classification



Treatment: OR + IF with plates (On ulna) & screws $\pm$ K-wires to stabilise PRU.

Complications:

m/c injured nerve: **Posterior interosseous nerve** (Branch of radial nerve)

↓
Causes finger & thumb drop without any sensory deficit.

Note:

m/c injured nerve in

- Shoulder dislocation: **Axillary nerve**.
- Supracondylar humerus fracture: **Anterior interosseous** > median nerve.



Monteggia fracture

Galeazzi/Reverse Monteggia fracture/Pied mont fracture:

Fracture of radius + DRUJ disruption/TFCC injury.

Rx: Open reduction (OR) + Internal fixation (IF) with plates & screws.



Galeazzi fracture

Nightstick fracture :

- Isolated *ulna fracture*.
- *Self-defense injury*.

Rx
 ↳ CR + POP application.
 ↳ ORIF with plates & screws.

Note :



Monteggia fracture type I



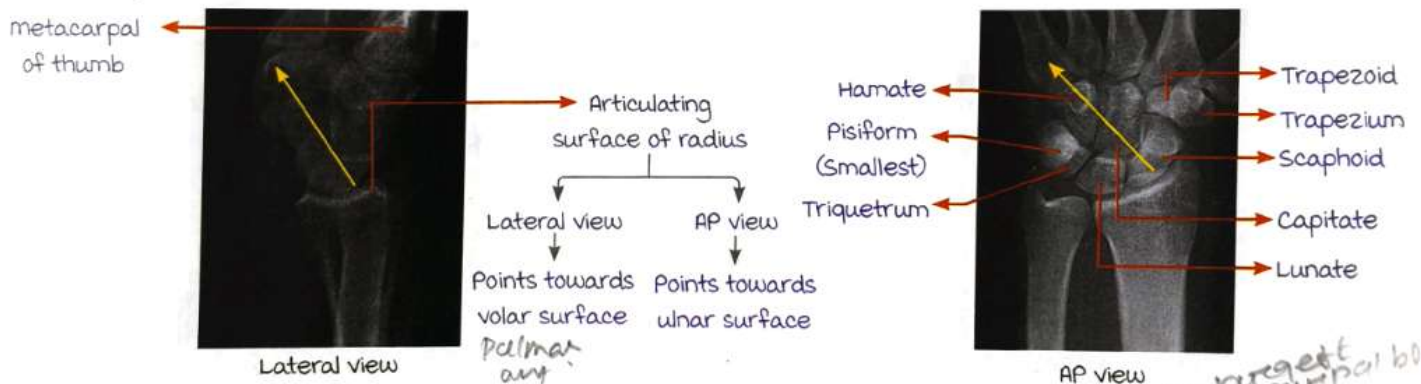
Nightstick fracture

----- Active space -----

b. Nerve injured in posterior dislocation of elbow → Ulnar nerve.

Fractures of Distal End of Radius

00:10:03

Anatomy of wrist :**Fractures at wrist :**

Name	Fracture	Distal fragment displacement
Colles's	Extraarticular	Dorsally
Smith		Ventrally
Barton	Intraarticular	Dorsal/ventral + carpal subluxation
Chauffeur		Isolated radial styloid

capitate - biggest carpal bone
 take 2 months to ossify



Colles fracture



Smith's fracture



Bartons fracture



Chauffeur's fracture

----- Active space -----

COLLE'S FRACTURE

- m/c fracture of distal end of radius.
- Fracture of distal end of radius at cortico-cancellous junction.
- Extra-articular fracture.
- Common in elderly **post-menopausal females**.
- mechanism of injury : Fall on an outstretched hand with wrist in extension.



Colle's fracture

Displacements

1. Dorsal tilt/shift
 2. Lateral tilt/shift
- } Dinner fork deformity.



Dinner fork deformity

Treatment

1. Closed reduction (CR) (Sequence : Traction → Palmar flexion → Ulnar deviation) + POP application (Position : Hand shaking position).
- 2.



Colle's cast

Note :

Colle's cast : **Below elbow**

↓
To avoid stiffness of joint
(m/c complication)

3. Definitive : ORIF with plates & screws.

Complications

- Stiffness of fingers (m/c).
- **malunion** → Dinner fork deformity (2nd m/c).
- **Sudeck's dystrophy**/Complex regional pain syndrome/Reflex sympathetic dystrophy fracture → Nerve injury → Autonomic nervous system mismatch
↓
Tense swelling, shiny skin,
tingling & numbness, paresthesia.
- Rupture of extensor pollicis longus tendon.
- Carpal tunnel syndrome : Fracture haematoma → median nerve compression.
- Non-union (Rare).

SMITH FRACTURE

- Extra-articular fracture of distal end of radius with volar displacement.

↓
Garden spade deformity.

- mechanism of injury : Fall on an outstretched hand with wrist in flexion.



Garden spade deformity

BARTON'S FRACTURE

- Intra-articular fracture of distal radius + Carpal subluxation.
- Rx : ORIF with plate & screws.



Barton's fracture



Chauffeur's fracture

CHAUFFEUR'S FRACTURE/DRIVER'S FRACTURE

- Isolated radial styloid fracture.
- Intra articular fracture.

Fractures of Hand

00:31:25

Carpal bones

'She Looks Too Pretty, Try To Catch Her'

- Scaphoid (S).
- Lunate (L).
- Triquetrum (T).
- Pisiform (P) → Smallest.
- Trapezium (Tz).
- Trapezoid (Td).
- Capitate (C) → Largest.
- Hamate (H).



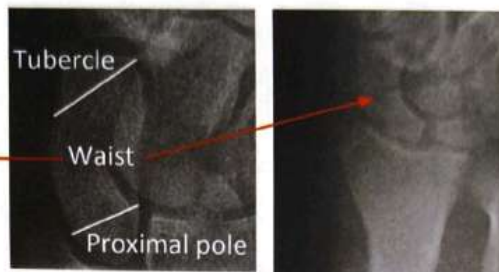
Carpal bones

- Carpal bone to ossify
 - First : Capitate (At 2 months of age).
 - Last : Pisiform.
- m/c carpal bone to
 - Fracture : Scaphoid.
 - Dislocate : Lunate → Causes median nerve injury.

----- Active space -----

SCAPHOID FRACTURE

m/c site of fracture



mechanism of injury : Fall on an outstretched hand.

Age group : Young adults.

Clinical features :Pain/swelling in *anatomical snuff box*.**Evaluation :**

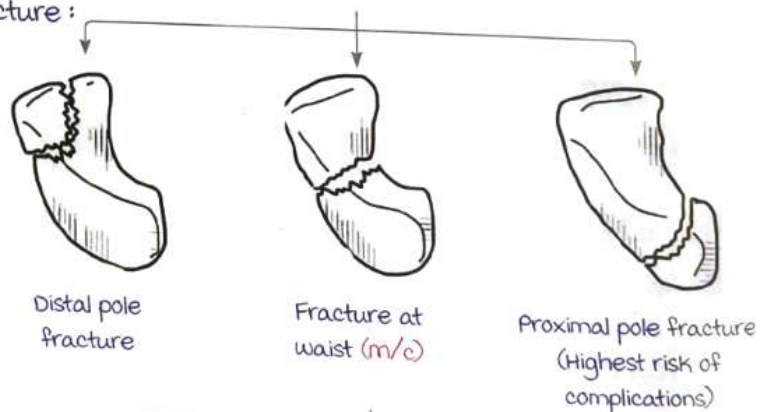
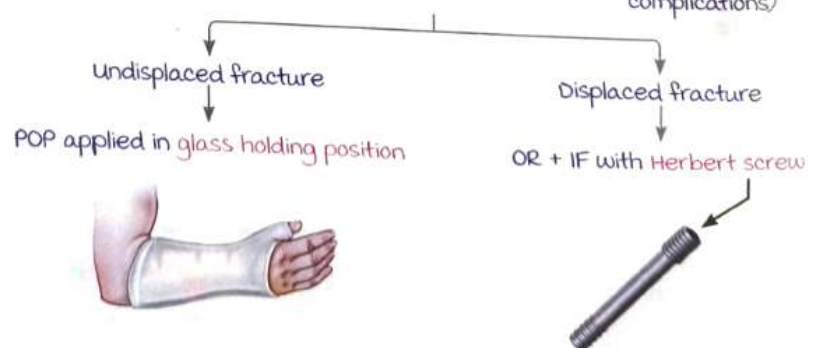
- X-ray
 - Oblique view (*Best*)
 - AP
 - Lateral
 } Fracture may not be visible.
- MRI : For fractures not visible on X-ray.

Complications :

- Non-union (*m/c*).
- Avascular necrosis of proximal fragment.

Types :

Based on location of fracture :

**Treatment :**

Scapho-Lunate ligament injury :

Ligament injury → Scapho-lunate dissociation : **Terry Thomas sign**.
 (↑ gap between the bones : >3-4 mm)

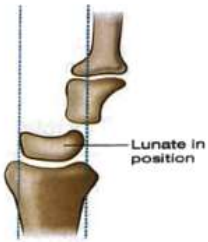
Note :

- Normal gap between scaphoid & lunate : 2-3 mm.
- **Keinbock's disease** : Osteonecrosis of lunate.



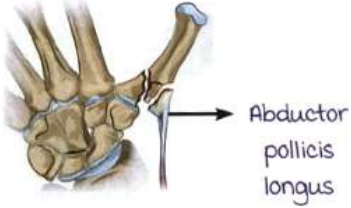
Scapho-lunate ligament

Carpal instabilities :

	Lunate dislocation	Peri-lunate dislocation (mv/c)
Type of dislocation		
Additional features	Spilled coffee-cup sign	Rx : Reduction with Tavernier's maneuver

FRACTURE OF BASE OF FIRST METACARPAL

- Intra-articular fracture of trapezio-metacarpal joint.
- Displacing forces : Abductor pollicis longus pull.

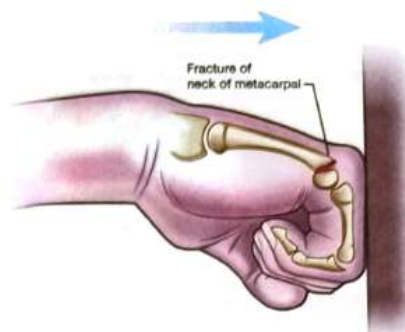
Bennet's fracture	Rolando's fracture
	
Partial	Complete comminuted (T/Y shaped)
Displaced fracture	Undisplaced fracture
	

----- Active space -----

BOXERS FRACTURE

- Fracture of 5th metacarpal.
- Extraarticular.

Rx : CR + POP application → In Jame's position
(For safe immobilization).

**MALLET FINGER V/S JERSEY FINGER**

	mallet finger	jersey finger
mechanism of injury	Hyperflexion injury (Eg : When ball hits the finger) ↓ Injury to extensor digitorum communis tendon (Tear/avulsed) ↓ Flexion of distal phalanx	Hyperextension injury ↓ Injury to flexor tendon (Tear/avulsed) ↓ Extension at DIP
On examination	• Extension at DIP → Passively (+) → Actively (-) • Bony fragment on dorsal side (+)	• Flexion at DIP → Passively (+) → Actively (-) • Bony fragment on volar side (+)
Treatment	mallet/stax/frog splint	-

LOWER LIMB TRAUMA : PELVIS AND TESTS

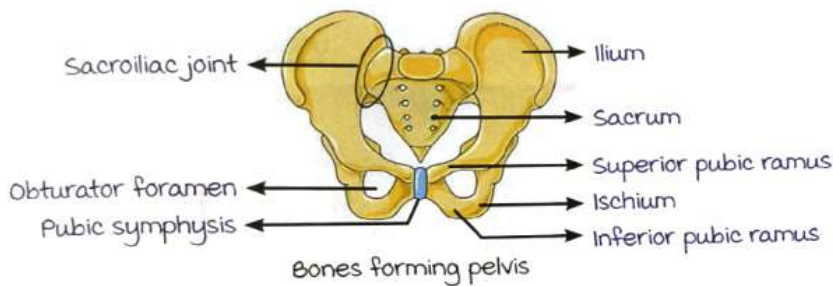
----- Active space -----

Anatomy of Hip Joint

00:00:59

Hip joint is formed by proximal femur & acetabulum of the pelvis.

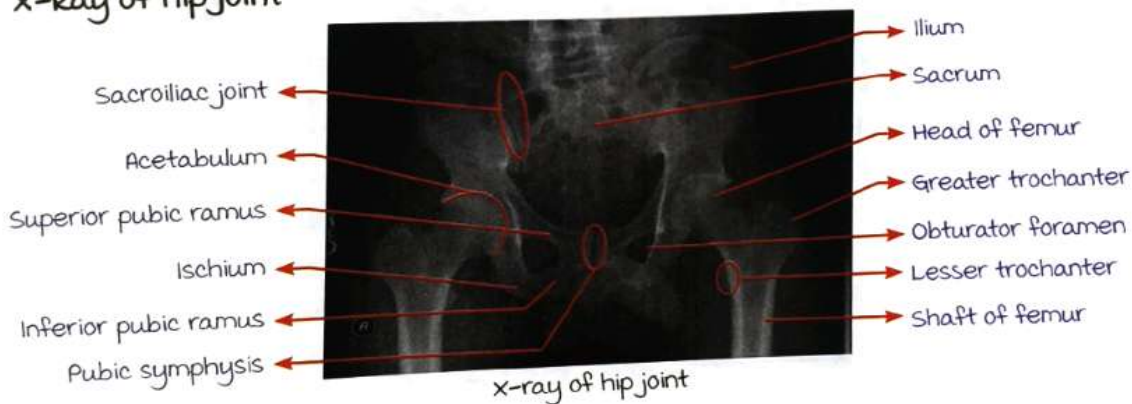
Pelvis :



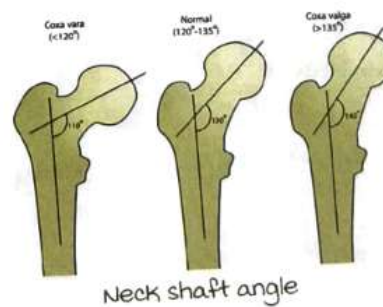
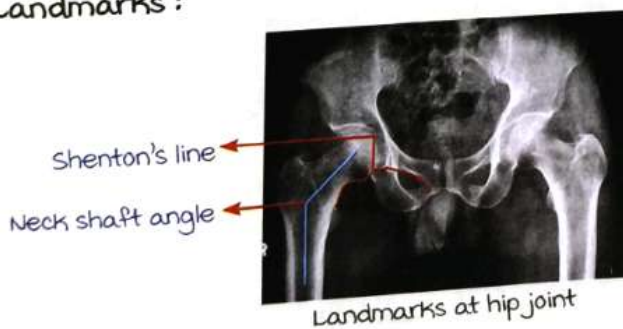
Proximal femur :



X-Ray of hip joint



Landmarks :



Neck shaft angle

1. Shenton's line :

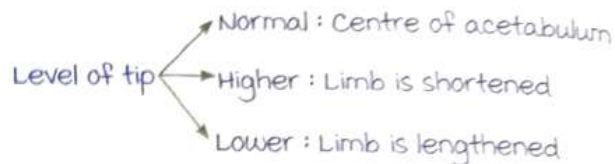
- Continuous line from lower border of superior pubic ramus, laterally towards head and neck of femur.
- Disturbed in any pathology of the hip.

----- Active space -----

2. Neck shaft angle :

- Normally 120° – 135° .
- $<120^{\circ}$: Coxa vara.
- $>135^{\circ}$: Coxa valga.

3. Greater trochanter :



4. Lesser trochanter : Gives an idea about rotation of limb.

- Disappears on X-ray : Internal rotation of limb.
- Prominent on X-ray : External rotation of limb.

Disruption of shenton's line :

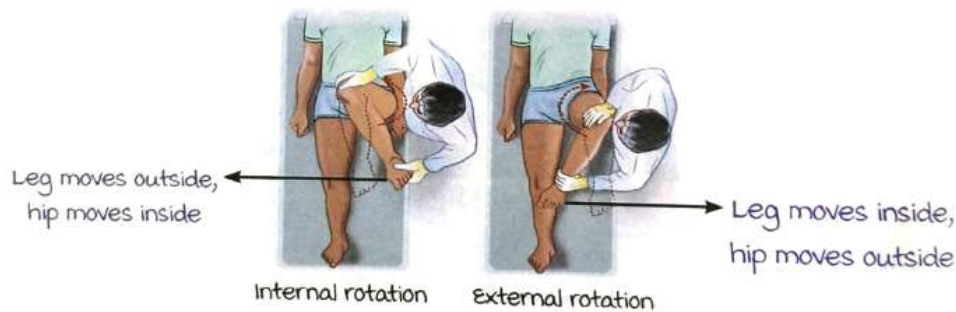


Dislocation of head of femur



Fracture of neck of femur

movements at the hip :



Pelvis Fracture

00:11:03

Pelvis fractures are high velocity injuries.

Jumpers fractures :

- U or H-shaped fracture.
- Etiology : Fall from height.



U shaped fracture



H shaped fracture

TILES CLASSIFICATION (PELVIC FRACTURES)

- Stable : Injury other than the pelvic rim.
- Unstable : Injury to the pelvic rim/ring.

Stable fracture :

Isolated fractures of :

- Ilium.
- Ischium.
- Anterior superior iliac spine (ASIS).
- Anterior inferior iliac spine (AIIS).

Eg : **Duverney's fracture**

Isolated fracture of iliac wing.

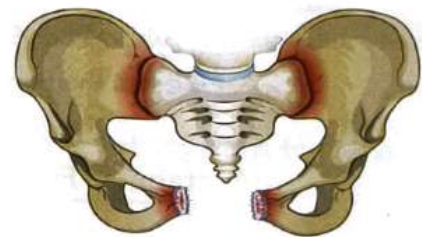
Unstable fracture :

Pelvic ring injured.

Young and Burgess classification : Based on forces causing injury.

1. Anteroposterior compression :

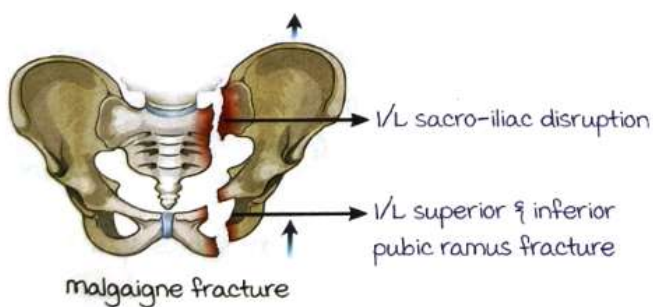
- Force from the front in anteroposterior direction → Pelvis opens up → **Open book fracture**.
- Horizontally unstable fractures.



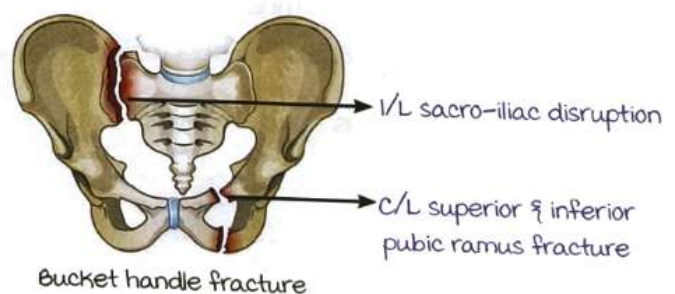
Open book fracture

2. Lateral compression

- Force from the side → Lateral compression of pelvis.
- Pelvis becomes vertically unstable.
- Eg : **malgaigne fracture** and **Bucket handle fracture**.



malgaigne fracture



Bucket handle fracture

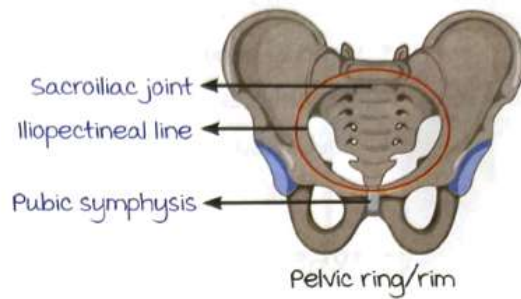
3. Complex force :

- Bilateral superior and inferior pubic ramus fractures.
- Eg : **Straddle fracture**.



Straddle fracture

----- Active space -----



Duverney's fracture

----- Active space -----

Consequences of pelvic fractures

massive bleeding (1.5 - 2L) due to :

- venous plexus around pelvis.
- Cancellous bone.
- Soft tissues around pelvis.
 - urethral injury (m/c).

EMERGENCY MANAGEMENT

Pelvic fractures d/t polytrauma are managed by ATLS (Advanced trauma life support).

- A : Airway.
- B : Breathing.
- C : Circulation, stop the bleeding and resuscitate.
- D : Disability evaluation.
- E : Exposure control.

1. management of bleeding :

- External bleeding : Compression.
- Internal bleeding : Pelvic tamponade.
 - Pelvic binders.
 - Bed sheets/towels.

2. IV fluids : RL/NS to restore the volume.

3. External fixation : In compression mode to maintain tamponade.

Acetabular Fractures

00:23:06

Parts of acetabulum :

- 2 columns.
- 2 walls.

X-Rays : Judet views.

Classification of acetabular fractures :

Judet classification

- Anterior wall.
- Anterior column.
- Posterior wall (m/c).
- Posterior column.
- Bi-columnar : X-Ray shows spur sign.

Lower Limb Tests

00:24:43

----- Active space -----

Trendelenburg test :

- To assess **abductor mechanism of hip**.
- Principle abductors of hip :
 - Gluteus medius
 - Gluteus minimus
 Supplied by superior gluteal nerve.
- Abductors help maintain gait : I/L abductors help swing C/L limb.
- Helps moving the limb when other limb is in stance phase.

Abductor failure :

Causes of abduction failure :

- Gluteus medius weakness.
- Gluteus minimus weakness.
- Superior gluteal nerve palsy.
- Coxa vara.

mnemonic : **SSS**Sound Side Sinks
(Normal side sinks)

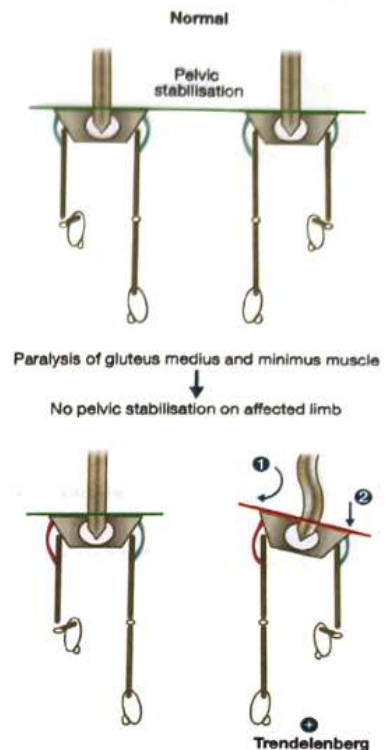
Test procedure :

Ask patient to stand on each limb for 30 sec, to assess its integrity

↓
Observe the ASIS on both sides

↓
When patient stands on the **pathological side**, **Sound side sinks down** → Patient leans to pathological side.

Positive test : ASIS/PSIS of other side goes down.



- 1 Sign positive when made to stand on affected limb
- 2 Pelvic sags on healthy side

Trendelenburg test

Trendelenburg gait :

Patient walks by leaning the spine towards the pathological side to maintain balance.

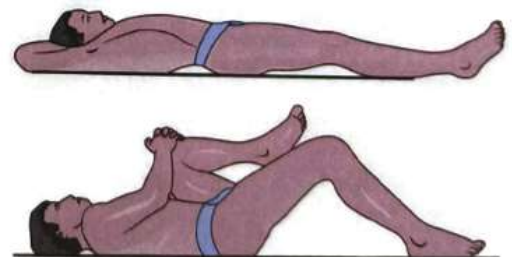
Hand to Knee gait :

Seen in **quadriceps weakness** due to poliomyelitis.

Thomas test :

AKA Hugh Owen Thomas well leg raise test.

Used to assess **flexion contracture/flexion deformity of the hip**.



Thomas test

----- Active space ----- Steps :

Patient lies supine
 ↓
 Observe for exaggerated lumbar lordosis
 ↓
 Flex the unaffected hip the lordosis is obliterated
 ↓
 Look for flexion of other hip (Pathological side)
 ↓
 measure angle b/w the flat table & femur (goniometer)

Thompson test :

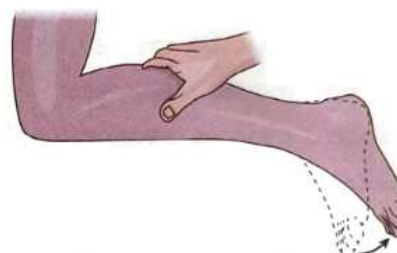
Assess integrity of **tendo achilles**.

AKA Simmonds Thompson test.

Tendoachilles :

- Common tendon of gastrosoleus that inserts on calcaneum.
- Action : **Plantar flexion**.

+ve Thompson test : Failure of plantar flexion on squeezing the calf d/t tendo achilles damage.



Squeezing calf produces plantar flexion of foot when heel cord is intact



Squeezing calf produces no motion of foot in injured leg

Thompson test

LOWER LIMB TRAUMA : HIP DISLOCATION AND FRACTURES

----- Active space -----

Hip joint :

Stable ball and socket joint.

Stability provided by :

- Concave acetabulum that accommodates the femoral head
 - Ligaments : Iliofemoral ligament (strongest ligament of the body)
- ↓ chances of recurrence after reduction of dislocation

Hip dislocations

00:00:53

TYPES OF DISLOCATION

Pure dislocation

Head of femur comes out of acetabulum without any other associated injury.

	Posterior dislocation (m/c)	Anterior dislocation
mechanism of injury	Dashboard injury	Deceleration injury Fall from height
Attitude of limb	F, AD, IR : 1. Internal rotation 2. Thigh is adducted, knee is on the other limb   medial side of foot touches the bed d/t internal rotation.	 F, AD, IR : 1. Flexion at hip 2. Abduction at thigh 3. Externally rotated limb (Lateral part of foot touches the bed)

----- Active space -----

Length of limb	Shortening	Lengthening
X-Ray features	 Posterior dislocation Shenton's line is broken Internal rotation of limb Lesser trochanter is not visible	 Head lies outside acetabulum Shenton's line is broken Abduction and External rotation of limb
Palpation	Head palpable in gluteal region	Head palpable in femoral triangle region

Fracture dislocation

Dislocation a/w fractures (acetabulum, head/neck of femur).

	Posterior fracture dislocation	Anterior fracture dislocation	Central fracture dislocation
Palpation of head of femur	Gluteal region	Femoral triangle	On per rectal examination



Head has breached into the acetabulum and is in the pelvic cavity

Central fracture dislocation

MANAGEMENT

Hip dislocations are an emergency: ↑ risk of avascular necrosis.

Closed reduction

↓ not reducing d/t muscle spasm

Closed reduction under anesthesia

↓ still not reducing

Open reduction

↓

Apply skeletal traction

Note: Shoulder reduction by modified Kocher's technique.

Examples:

- Allis manoeuvre
- Bigelow manoeuvre
- Stimson manoeuvre
- East Baltimore lift manoeuvre

Complications :

1. **Avascular injuries** : m/c (in 6-12 hrs).
2. **Sciatic nerve injury** : In post dislocation.
Presents with foot drop.
3. **Femoral vessel injury** > Femoral nerve injury : In anterior dislocation.

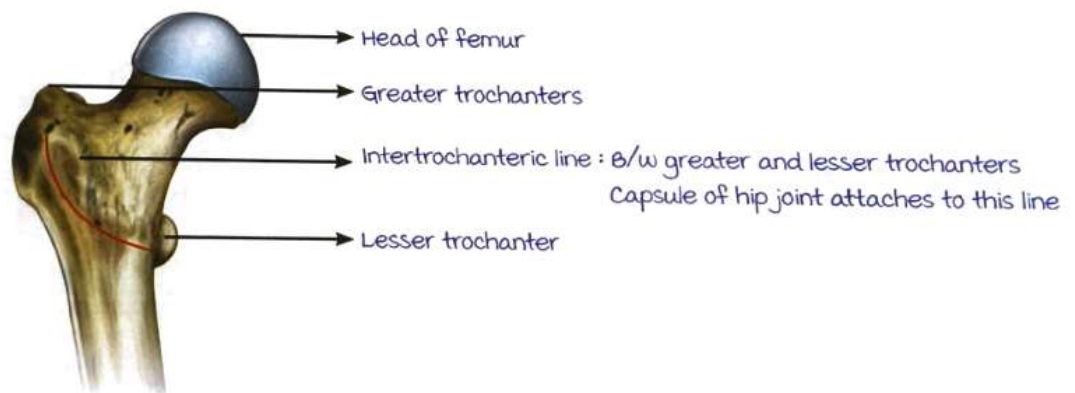
----- Active space -----

Note : vascular sign of narah

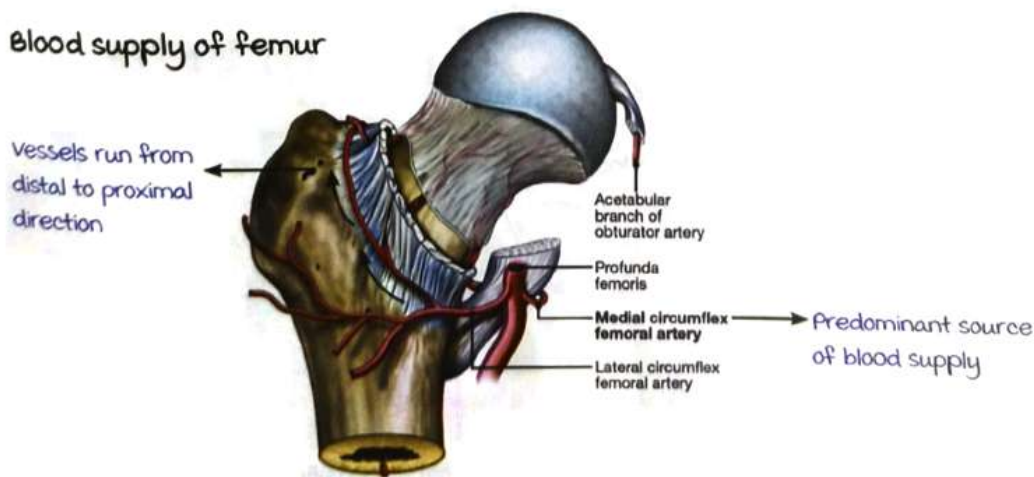
- Inability to palpate the femoral artery against the femoral head while popliteal, dorsalis pedis and posterior tibial artery are palpable.
- Seen when femoral head is not in its original place.
 - Hip dislocation.
 - Congenital dysplasia of hip.
 - Excision of femoral head.

Proximal femur fractures

00:17:04

ANATOMY

Anatomy of proximal femur

Blood supply of femur

----- Active space ----- TYPES

1. Neck of femur fracture : Intracapsular (Proximal to intertrochanteric line).
2. intertrochanteric fracture : Extracapsular (Distal to intertrochanteric line).

	Neck of femur/intracapsular fracture	Intertrochanteric/extracapsular
Age (elderly)	50-60 yrs	50-60 yrs
Sex	Female >>> males	Female > males
Trauma	Trivial fall	moderate to severe fall
Pain	mild pain	moderate to severe pain
Location of pain	Scarpa's triangle	Trochanteric region
Shortening	< 1 inch	> 1 inch
Deformity/attitude	External rotation < 45° (Capsule limits it)	External rotation > 45° (Lateral part of foot touches the bed)
Complication	AVN (45°) > Non-union (30%) Due to disruption of blood supply	malunion → Coxa vara Does not disrupt blood supply
X-Ray	 Intracapsular fracture Shenton's line Joint capsule	 Extracapsular fracture Joint capsule

Non-union : Seen in neck of femur fracture

Causes :

- Synovial fluid washes the fracture hematoma } Prevents healing
- ↓ vascularity
- Neck of femur lacks cambium layer that has osteoprogenitor osteoblasts

NECK OF FEMUR FRACTURE :**Classification :**

Anatomical classification : Based on location

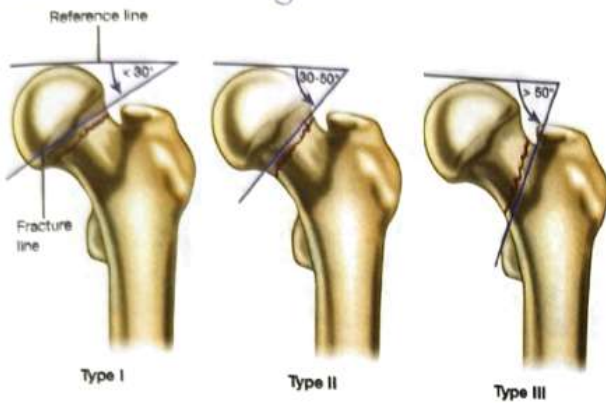


Subcapital fractures : **Highest** chances of avascular necrosis and non-union

----- Active space -----

Pauwels' classification of transcervical fractures :

Based on Pauwels' angle



Significance : more vertical the angle

Greater is the displacement

Poor prognosis

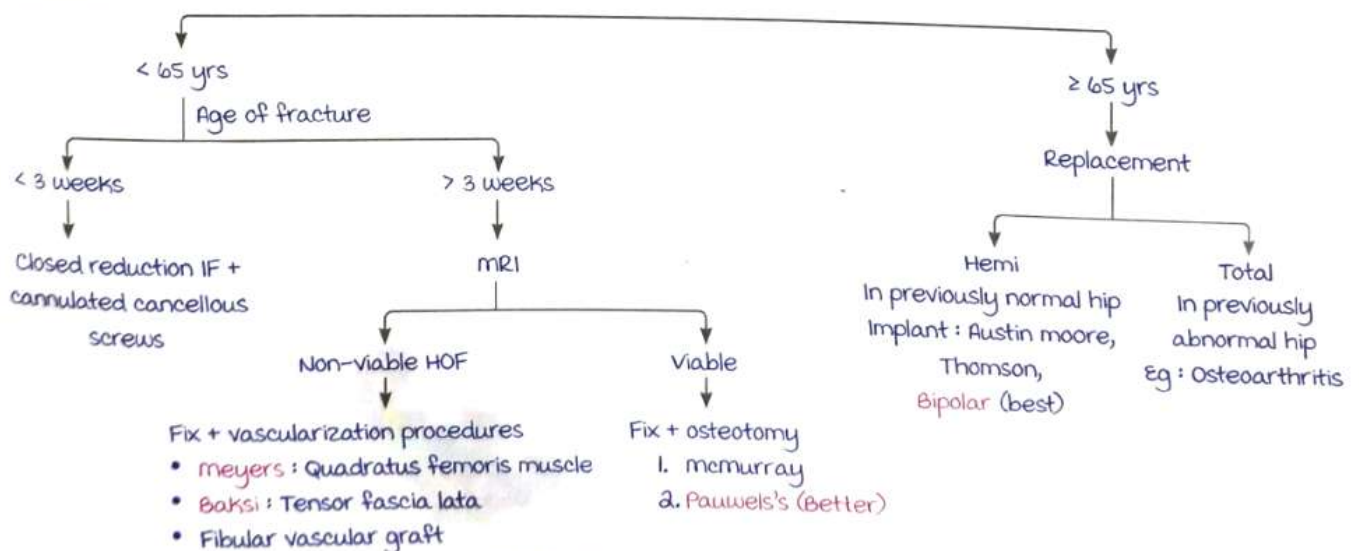
Prognosis : Pauwels' I > II > III

Garden's classification :

	Stage I	Stage II	Stage III	Stage IV
Images	 Trabeculae bending only Valgus impacted	 Trabeculae between head and neck broken and displaced	 All three sets of trabeculae out of alignment	 Acetabular and head trabeculae in alignment, between head and neck not aligned
Type	Incomplete	Complete	Complete	Complete
Displacement	undisplaced	undisplaced	Partially displaced	Completely displaced

Prognosis : I > II > III > IV

Treatment :



----- Active space -----

Hemi replacement : Replacement of only head and neck of femur.

Total replacement : Replacement of head & neck of femur + acetabular cup.



CRIF with calculated cancellous screws



Hemi replacement



Total replacement

Prosthesis :



Bipolar



Austin moore



Thompson

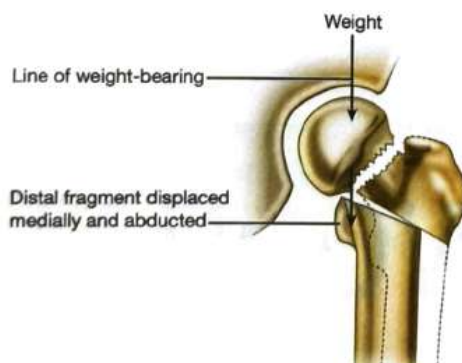
Vascular procedures :



meyer's muscle graft

Osteotomy :

1. mcmurray's osteotomy



- Cut the bone such that shaft is medialised
- weight is transmitted from HOF → shaft bypassing fracture line

2. Pauwells's osteotomy

- Converts vertical fracture pattern to horizontal pattern
- ↓
change in fracture orientation
- when patient puts weight → Impaction + healing

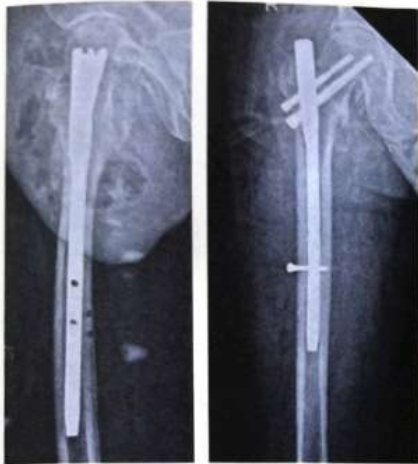
Note : In patients with H/o fall and hip pain with no abnormality on X-ray

MRI to rule out occult neck of femur fracture

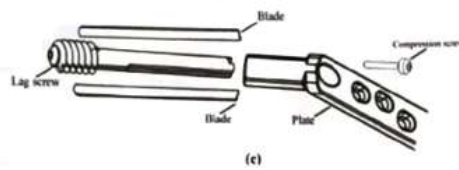
INTERTROCHANTERIC FRACTURE management :

----- Active space -----

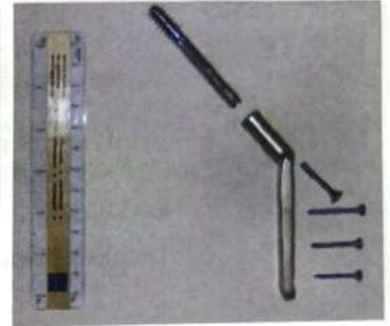
1. Surgical : maintain neck shaft angle with devices & prevent Coxa Vara.



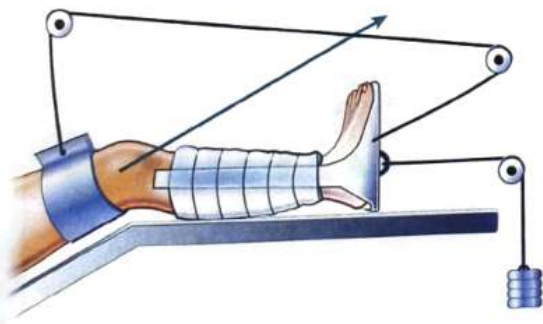
a. Proximal femoral nail with locking and stabilization screws



b. Dynamic hip screw



2. Conservative management :



a. Russell's traction



b. Derotation boot

----- Active space -----

LOWER LIMB TRAUMA : FEMUR, KNEE, LEG AND FOOT

Shaft of Femur Fracture

00:00:06

BASICS

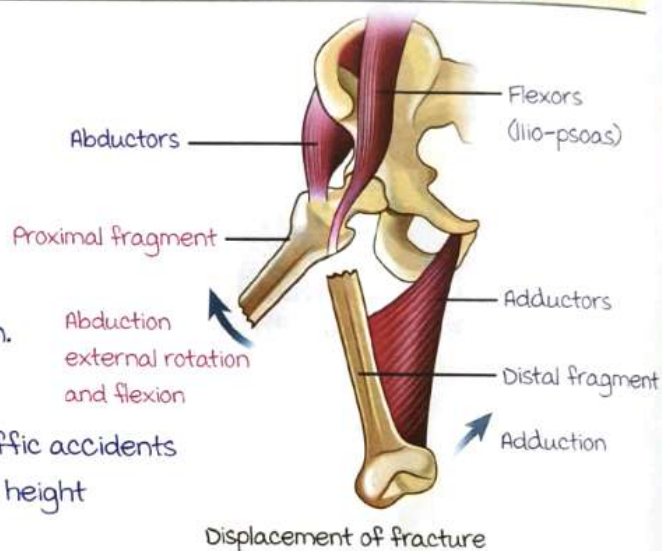
Displacement of fragments :

Classification :

Winkler and Hansen classification.

Mechanism of Injury :

High velocity injuries → Road traffic accidents
→ Fall from height

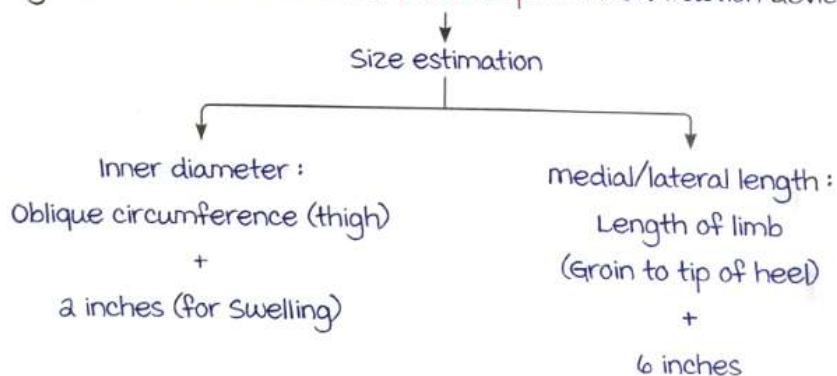


Displacement of fracture

MANAGEMENT

mx in adults

Temporary fixation : Stabilisation with Thomas splint (fixed traction device).



Definitive management : CRIF with intramedullary nail with Interlocking screws.

Complications :

1. Stiffness of knee joint.
2. Delayed/non-union.
3. Hypovolemic shock (1 - 1.5L blood loss).
4. Fat embolism syndrome.

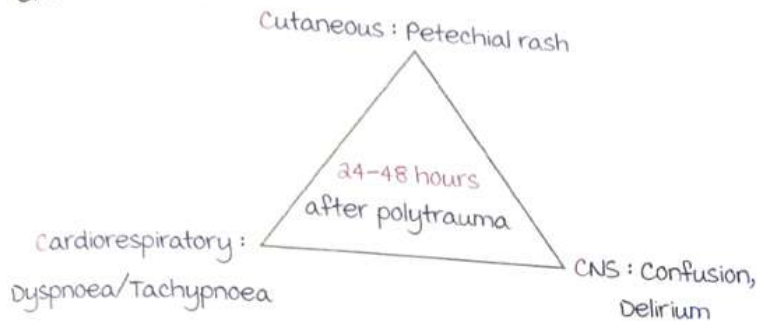


Intramedullary Rod

Fat Embolism

Pathogenesis : Leaking of intramedullary fat into circulation.

Clinical features :



Note :

- Pain on passive stretch → Compartment Syndrome.
- H/o massage → myositis ossificans.

D/d : Acute respiratory distress syndrome (ARDS)

GURDS Criteria :

major Criteria (4)	minor Criteria (8)
• Axillary/Subconjunctival petechia • PaO₂ below 60mmHg • CNS Depression • Pulmonary edema	• Tachycardia • Fever • Anemia • Thrombocytopenia • Fat globules in sputum • Fat globules in urine (Lipuria) : Gurd test • ↑ ESR • Retinal emboli
1 major + 4 minor = Fat embolism	

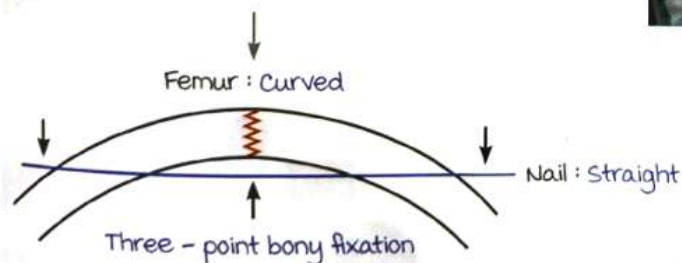
management → Prevention : Immobilize and fix fracture early.
 → Treatment : Damage control orthopaedics
 External fixation → ICU Stabilization → Definitive mx

mx in children

- <6m : Pavlik Harness.
- 6m-5y : Hip spica cast.
- 5-10 y : Flexible nails (Enders nail/Titanium Elastic Nail System, TENS).
- >10y : Intramedullary Interlocking nails.

Note :

- <2yrs/<12kgs : Gallows traction.
- Kuntscher Nail : Isthmus of femur.



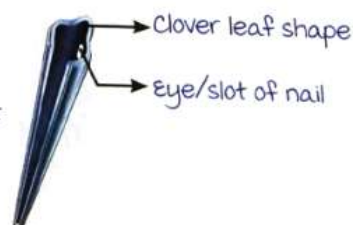
Pavlik Harness



Hip spica cast



Gallows traction



Kuntscher nail



TENS

----- Active space -----

Leg Injuries

00:11:25

X-ray knee joint
lateral view**PATELLA FRACTURE**

Direct trauma to knee.

Transverse fracture of patella → Stimulation of quadriceps tendon → Strong force displacing proximal patellar fragment.

X-ray knee : AP view/lateral view (Skyline view).

management :

- Convert distractive forces into compressive forces → Tension Band wiring (Best) with K-wires.
- Cylinder cast (Tube cast).

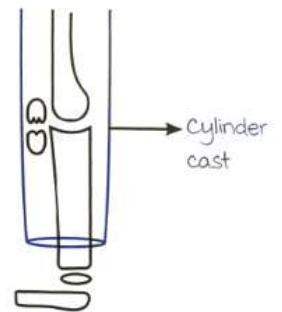
Note :

Olecranon fracture

(Displacement of fragments d/t triceps tendon) : Tension band wiring.



Tension band wiring (TBW)



Cylinder cast

Bipartite Patella :

Congenital Anomaly.

small separated fragment d/t incompletely fused patella at superolateral pole.

Incidental finding on X-ray : $B/L > W/L$.

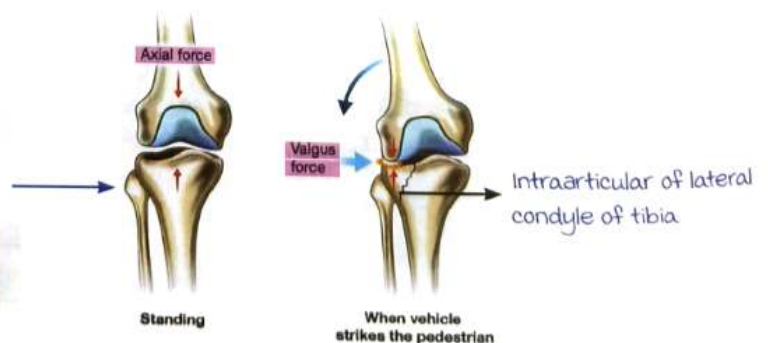
management : conservative.



Bipartite patella.

BUMPER FRACTURE

mechanism of injury : valgus force with Axial loading.



management : Open reduction + internal fixation with plates.

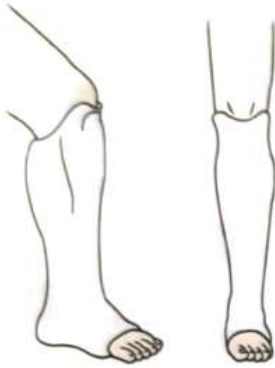
TIBIAL SHAFT FRACTURE

management :

1) Patellar tendon bearing cast

2) Definitive treatment : CRIF with intramedullary rod/nail with interlocking screws

----- Active space -----



Patellar tendon bearing cast

Intramedullary Rod/
Nail with screwsTibia and fibular shaft
fracture

Foot Injuries

00:18:40

Anatomy of Ankle :



AP view



Lateral view



mortis view

Ankle fractures :

Types :

Lateral malleolus



Lateral malleolus fracture

Lateral malleolus medial malleolus



Bimalleolar (Pott's) fracture

Posterior malleolus medial malleolus Lateral malleolus



Trimalleolar (Cotton's) fracture

----- Active space -----

management :

Neurovascular assessment

Closed Reduction

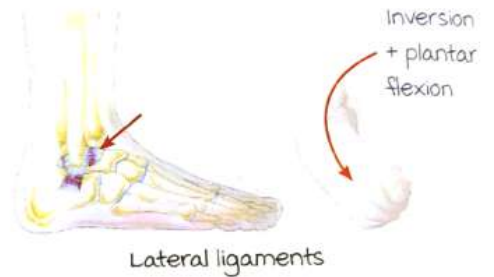
Neurovascular assessment

Slab application

Tibiotalar
dislocationLateral
malleolar

Ankle sprain :

movement	Ligament Injured
Inversion and Plantar Flexion	Anterior Talofibular Ligament (m/c injured in whole body)
Eversion (Rare)	Deltoid Ligament



Pilon/ceiling fracture :

Intra articular comminuted fracture of
distal end of tibia.

Calcaneum fracture



mechanism of injury :

Fall from height landing on feet.

Angles :

- ↓ Bohler's angle
- ↑ Gissane's angle



Lover's fracture :

B/L calcaneum Fracture + vertebral compression fracture



----- Active space -----

Aviator's fracture :

- Fracture talar neck.
- ↑ Risk of avascular necrosis of body of talus.
- Hawkins classification of talar neck fracture.

Note :

Hawkins sign : Sign of viability.

Fracture neck of talus



Type I
Undisplaced



Type II
Subtalar dislocation



Type III
Subtalar and tibiotalar
dislocation



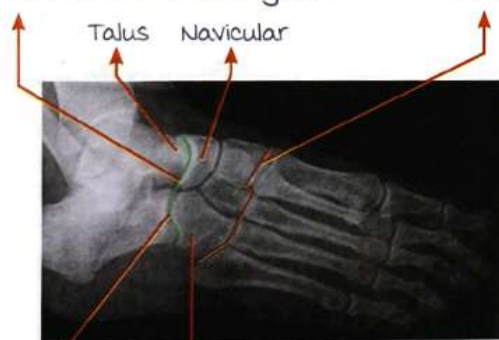
Type IV
Subtalar, tibiotalar, and
talonavicular dislocation



Hawkin's sign

Chopart's fracture :

Fracture of intertarsal joint.



Talus Navicular

Calcaneum Cuboid

Lisfranc's fracture :

Fracture of tarso-metatarsal joint.

Dislocation of
second metatarsal
from the middle
cuneiform



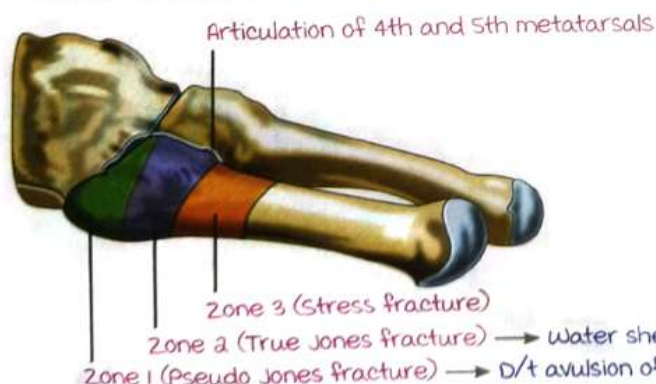
Widened 1st
intermetatarsal
space

Fracture

Fleck sign : Injury
To Lisfranc ligament
(Between 1st and 2nd
metatarsal)

Robert Jones fracture

Fracture of base of 5th metatarsal.



Articulation of 4th and 5th metatarsals

Zone 3 (Stress fracture)

Zone 2 (True Jones fracture)

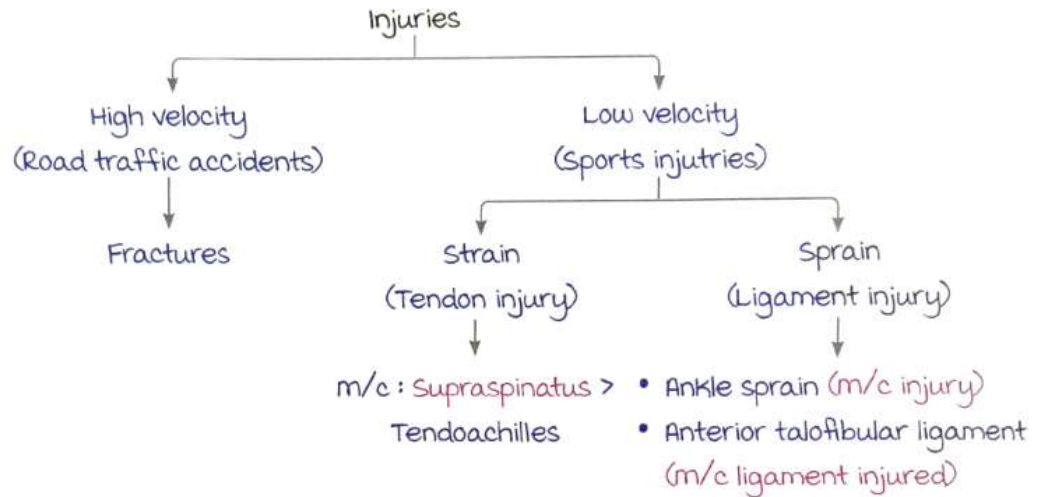
Zone 1 (Pseudo Jones fracture)

→ water shed area (↓ vascularity) → Non-union.

→ D/t avulsion of peroneus brevis tendon.

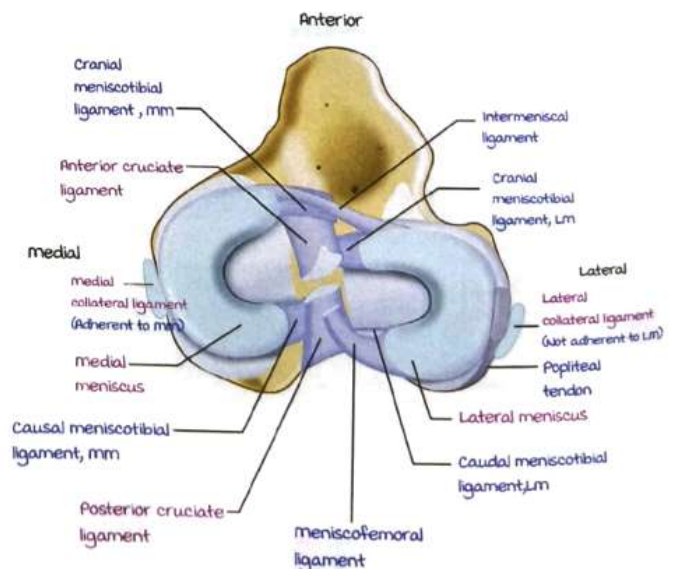
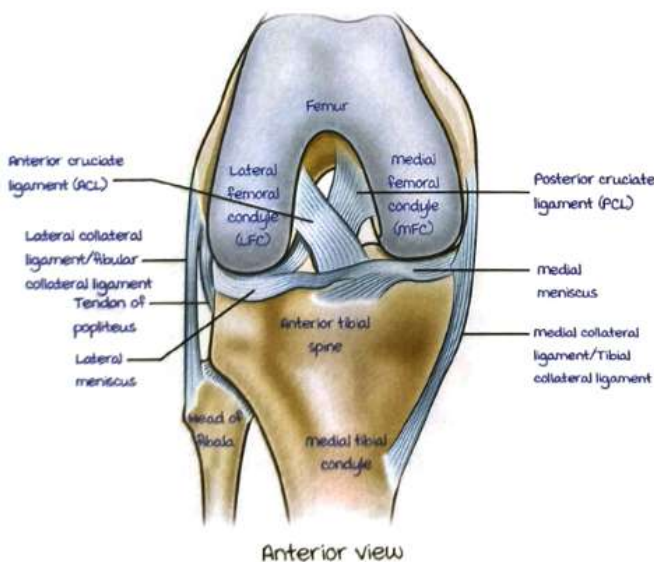
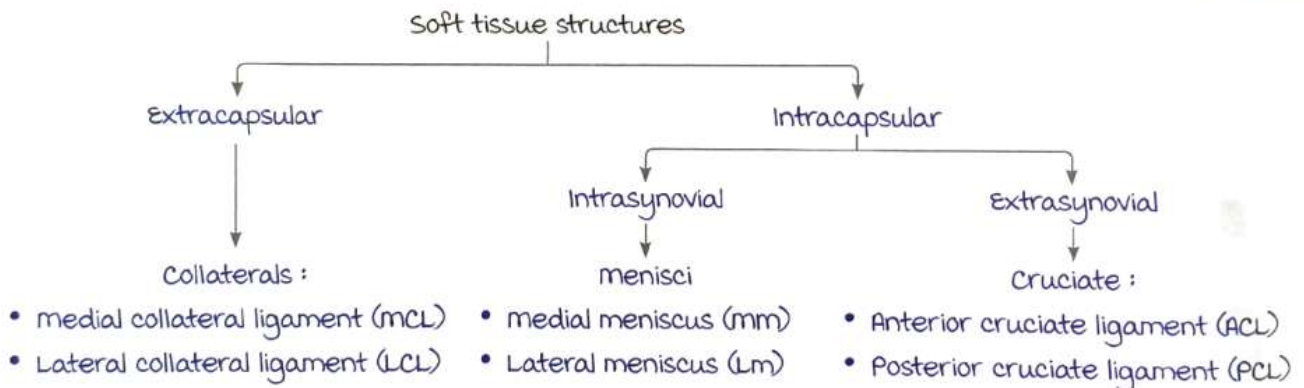
----- Active space -----

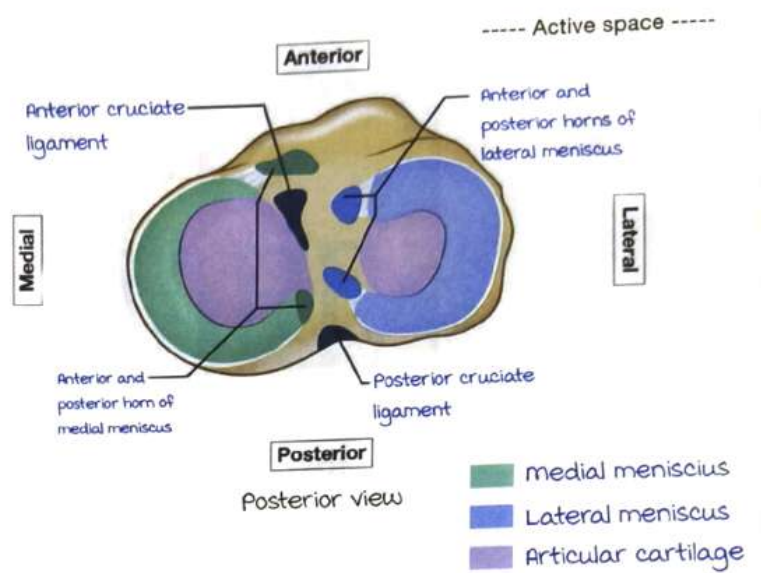
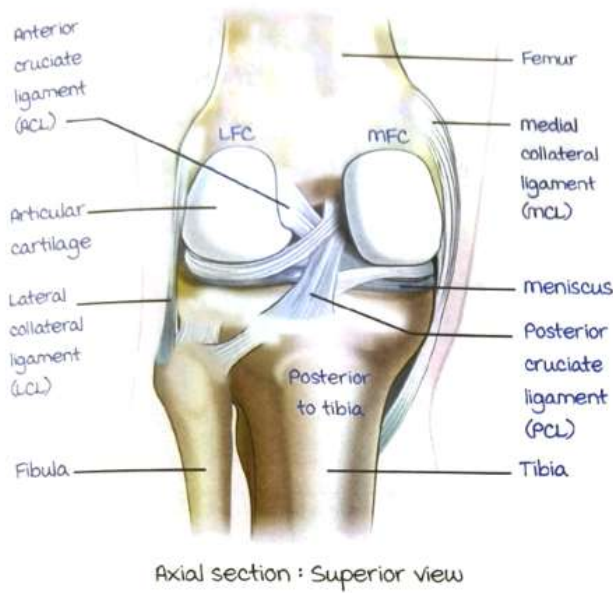
SPORTS INJURIES AROUND KNEE



Anatomy of Knee Joint

00:01:33





Note : For sports injuries

- Gold standard : Arthroscopy.
- IOC : MRI.

Injury to Collaterals

00:08:08

MECHANISM OF INJURY

Function of collaterals :

Coronal plane stability.

Forces :



MCL (m/c injured around knee) > LCL.

CLINICAL FEATURES

	MCL injury	LCL injury
Knee pain	medial side	Lateral side
Examination (Provoke symptoms/open joint space)	At 30° flexion of knee	
	valgus stress test	Varus stress test

----- Active space -----

MANAGEMENTEdema d/t
MCL tear

IOC : MRI (Coronal view)

Treatment

Conservative brace (90%)

Surgery (10%)

Injury to Menisci

00:17:10

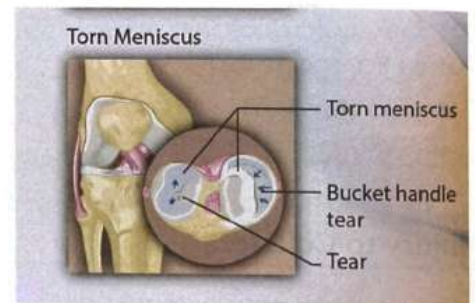
menisci are semilunar structure : Consists of type I collagen.

MECHANISM OF INJURY**Function of menisci :**

1. Shock absorbers.
2. Rotational stabilizers.

Forces

- Torsion/forceful twisting of knee.
- **Bucket handle tear** (m/c type of injury).
- **mm > Lm** injury.



Torn meniscus

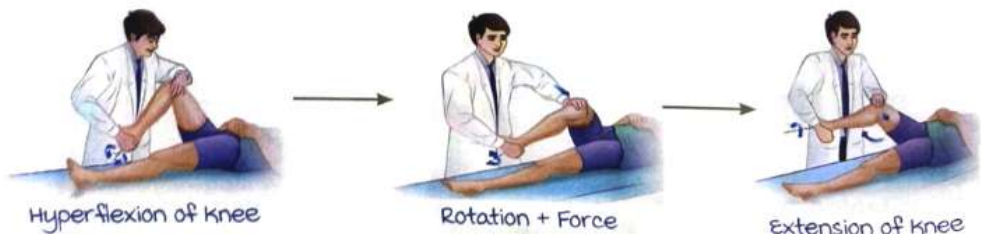
CLINICAL FEATURES**Symptoms :**

Delayed onset.

- Knee pain.
- Swelling : mild to moderate effusion.
- **Pathological locking of knee** (Incomplete extension) : D/t trapping of fragment of menisci between tibial and femoral condyles.

Examination :

To provoke symptoms.

1. **McMurray's test :**

↑ pain/click on :

- Internal rotation + varus force : Lm injury.
- External rotation + valgus force : mm injury.

a. Apley's grinding test :



Prone position → At 90° flexion of knee

a. Rotate menisci between tibial & femoral condyle

+

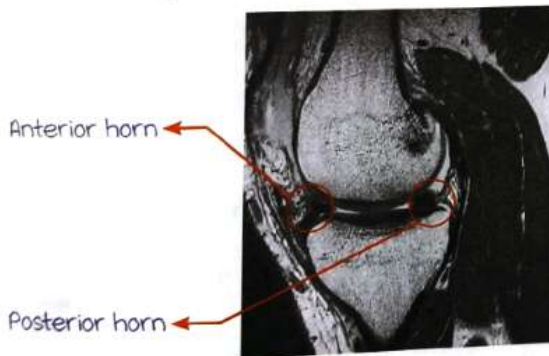
b. Push tibia towards table

3. Joint line tenderness : Best test.

Tender point	Structures injured
Anteromedial	Anterior horn of mm
medial	Body of mm
Posteromedial	Posterior horn of mm
Anterolateral	Anterior horn of Lm
Lateral	Body of Lm
Posterolateral	Posterior horn of Lm

MANAGEMENT

IOC : MRI (Sagittal view).



Normal

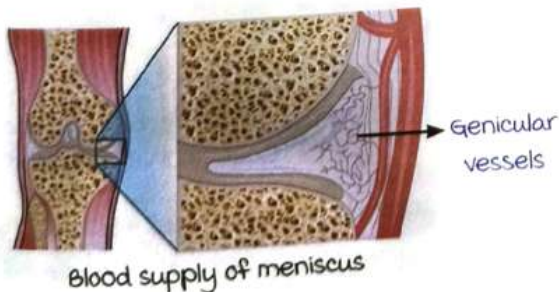


Posterior horn meniscal tear

Heterogenous appearance

Gold standard : Arthroscopy.

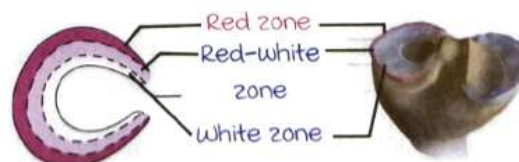
Note :



Blood supply of meniscus

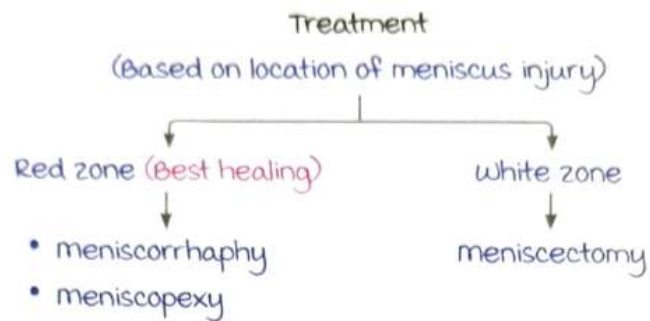
Nutrition to meniscus :

- Peripheral : Genicular vessel.
- Central : Synovial fluid.



Zones based on blood supply

----- Active space -----



Injury to Cruciate

00:29:54

MECHANISM OF INJURY

Function :

Sagittal plane stabilizers.

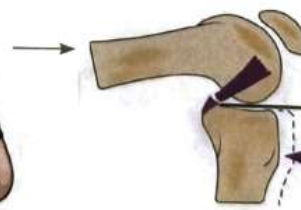
	ACL	PCL
Prevent translation of tibia	Anteriorly	Posteriorly
Knee movement prevented	Hyperextension	Hyperflexion

Forces :

1. Forceful anterior translocation/hyperextension
2. Forceful posterior translocation/hyperflexion



Dashboard injury



CLINICAL FEATURES

Symptoms :

Acute onset

- Twisting injury to knee with a pop → Hemarthrosis (Collection of blood in the joint).
- Instability on walking.

examination :

To test ACL injury

1. **Anterior drawer test :**

- In acute knee : Pain and spasm of muscle inhibits anterior translation.



Anterior drawer test

----- Active space -----

90° flexion of knee
(45° hip flexion)Anterior translation
of tibia for >3 mm2. **Lachmann's test :** most sensitive/best test.

15°-20° flexion of knee

Anterior translation of tibia

3. **Pivot shift test :** most specific

To test PCL injury :

1. **Posterior drawer test :**

90° flexion of knee

Posterior translation/
sag of tibia2. **Godfrey sag test :** Preferred in U/L injury

90° flexion at hip & knee

Posterior translation
d/t gravity**MANAGEMENT**

IOC : MRI.

Gold standard : **Arthroscopy.**

Normal MRI



ACL tear with buckling of PCL

Treatment : **Arthroscopic reconstruction with grafts.**

Grafts :

- Hamstrings : Semitendinosus, Gracilis.
- Patellar tendon.

----- Active space ----- Note :

1. Arthroscopy :

m/c performed on joints : **Knee** > shoulders.

- Anteromedial portal : Instrumentation.
- Anterolateral portal : Arthroscope (4mm/30° scope).



Arthroscopy

2. ACL : 2 bundles :

	Posterolateral bundle	Anteromedial bundle
maintains stability in	Extension	Flexion
ACL tear	Involved in partial/complete tear	Involved in complete tear
Test to assess stability	Lachmann's test	Anterior drawer test

3. Second fracture

- Capsular avulsion in proximal lateral aspect of tibia.
- Associated with ACL tear.



Second fracture

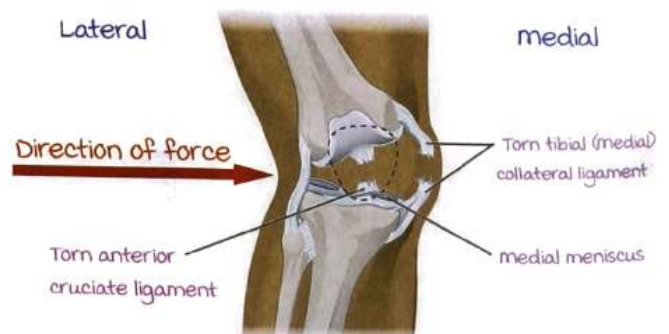
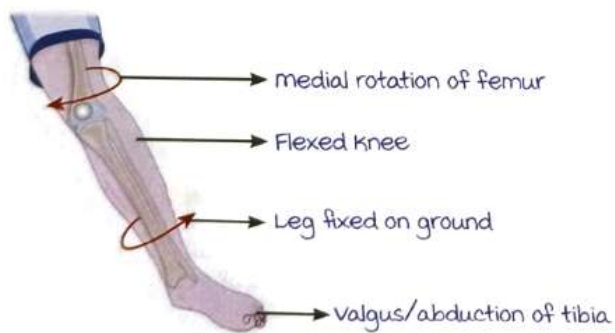
Avulsion of proximal lateral aspect of tibia

Rotational Injuries

00:58:07

TWISTING INJURY TO KNEE

mechanism of injury :



unhappy/painful/terrible/o' Donoghue triad



Sagittal plane : ACL tear



Coronal plane : MCL tear



Sagittal plane : medial meniscus injury

O'Donoghue triad on MRI

----- Active space -----

Note :

Insall-Salvati Index : To assess patellar instability.

- Tendon length (TL)/Patellar length (PL) = 0.8-1.2
- $\uparrow$ TL (>1.2) : Patella alta (Recurrent patellar dislocation).
- $\downarrow$ TL (<0.8) : Patella baja.



Lateral X-ray knee

INJURY DUE TO ROTATIONAL INSTABILITY

	Anterolateral rotatory instability	Posterolateral rotatory instability
Structures injured	• ACL • Anterolateral ligament complex	• PCL • Posterolateral corner structures
Test	Pivot shift test	Dial test

----- Active space -----

PAINFUL REGIONAL CONDITIONS AND AVN

Independent conditions with : Repetitive microtrauma → Pain.

Clinically diagnosed : using tests that replicate the movement causing pain.

Conditions of Shoulder

00:01:36

Presents with shoulder pain.

Absent h/o trauma.

FROZEN SHOULDER (ADHESIVE CAPSULITIS)

- **Periarthritis** of shoulder joint.
- Self limiting condition.
- 30% bilateral.

Associated conditions :

- Diabetes mellitus (Uncontrolled hyperglycemia).
- Thyroid disorders.

Pathophysiology :

Capsulitis (Inflammation of capsule) of shoulder joint → Pain

↓
Thickening & fibrosis

↓
Contracture of capsule

↓
Restriction of **active & passive** movements of shoulder

Stages :

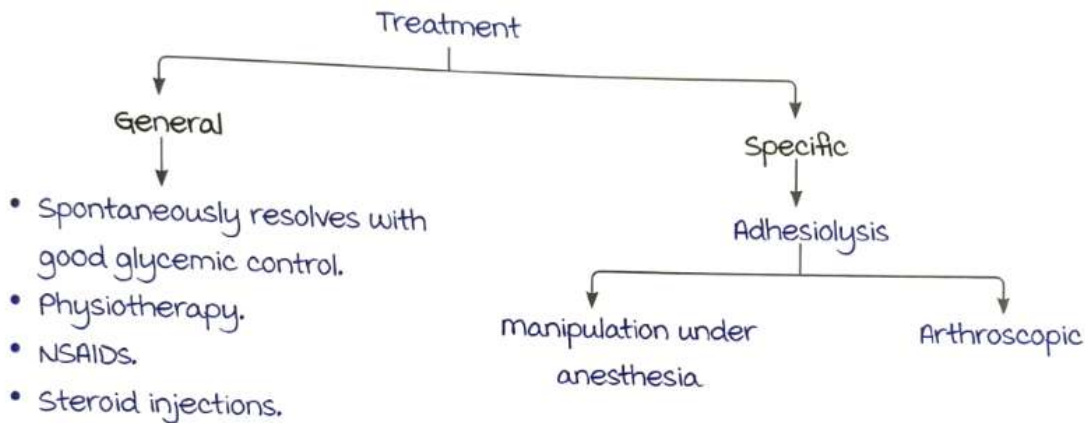
Stage	Pathology	Pain	Stiffness
I : Freezing	Capsulitis	+	-
II : Frozen	Adhesions formed	↓ pain	↑ stiffness
III : Thawing	Resolution	↓ pain	↓ stiffness

Evaluation :**Clinical :**

- Global ROM (Restriction of movements).
- Earliest movement restricted : **Rotation** (External > Internal).

X-ray : Normal.

MRI : Capsulitis (+).

Treatment :**IMPINGEMENT SYNDROME (PAINFUL ARC SYNDROME)****Anatomy of shoulder joint :**

Type of joint : Ball & socket.

Stabilizers : **Soft tissue** > bony.

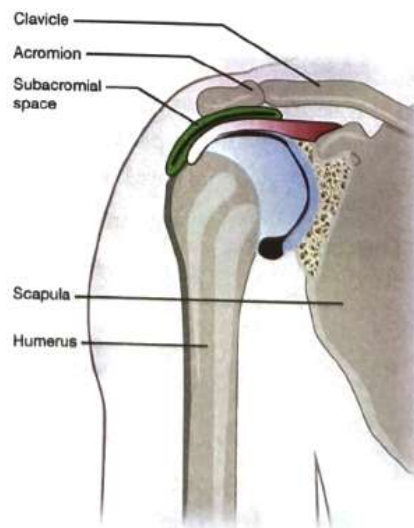
1. Long head of biceps tendon.

2. Rotator cuff muscles.

- Supraspinatus superiorly.
- Subscapularis anteriorly.
- Infraspinatus.
- Teres minor. } Posteriorly

Subacromial space :

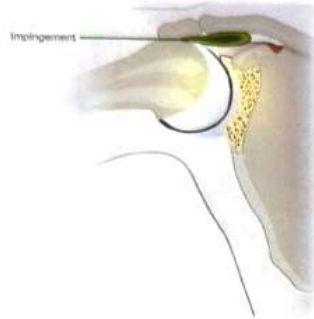
- Space between : Acromion & head of humerus.
- Contents :
 - a. Subacromial bursa.
 - b. Supraspinatus tendon.



----- Active space -----

• Clinical aspect :

In individuals with narrow subacromial space : Shoulder abduction



Shoulder abduction

Inflammation of

Subacromial bursa

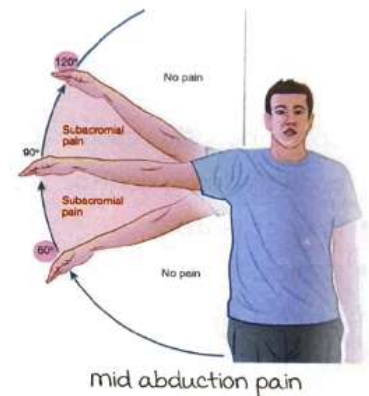
Subacromial bursitis → Supraspinatus tendonitis

Clinical features :

• Shoulder pain :

- Exaggerated on shoulder abduction.
- Maximal pain : mid-abduction

Hence k/a painful arc syndrome



Diagnosis :

Neer's impingement test :



Keeping the scapula stable, the affected arm is raised fully in passive flexion, abduction, & internal rotation

Hawkins-Kennedy impingement test :



The affected arm is elevated 90 degrees in the scapular plane with the elbow in 90 degrees flexion. The upper arm is then stabilized & rotated internally

Treatment :

Conservative :

- NSAIDs.
- Physiotherapy.
- Avoid overhead abduction activities.

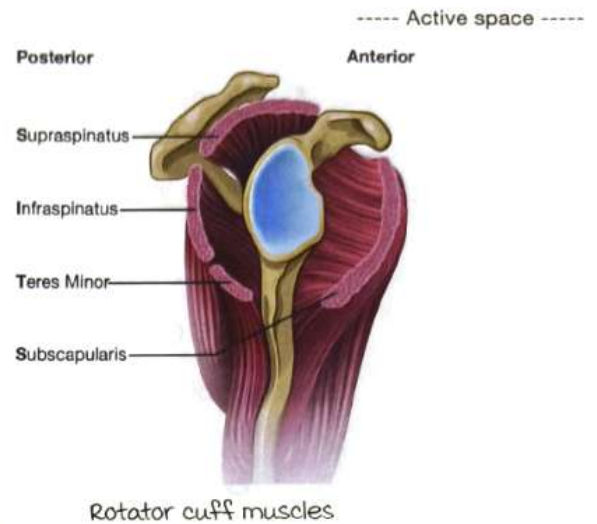
Interventions :

Subacromial decompression

ROTATOR CUFF TEAR & RCT ARTHROPATHY

- m/c tendon to tear: **Supraspinatus** > tendo achilles.
- Forgotten tendon of rotator cuff: **Subscapularis**.

Pathophysiology:



Etiology:

1. Degeneration in elderly.
2. Trauma in young individuals.

Evaluation:

X-ray: Normal.

MRI: **IOC**.

Clinical examination:

Clinical features:

- Pain at the shoulder.
- ↓ ROM of shoulder.
- Pain on performing activity of torn tendon.
- ↑ Pain on movement against resistance.

muscle	Action	Test
Supraspinatus	Abduction	Beer can test, empty can test, Jobe's test
Infraspinatus	External rotation	Horn Blower's test
Teres minor		
Subscapularis	Internal rotation	Lift off test, belly press test, bear hug test



Empty can test

The patient is asked to resist the downward force by the examiner when the arms are in the position of 90° abduction, 30° flexion, and complete internal rotation.



A



B

Tests for subscapularis



Jobe's test

Arms elevated in the scapular plane, elbows extended with the thumb pointing downwards, while the examiner applies downward pressure.

----- Active space -----

Treatment :

- Avoid painful & overhead activities.
- Physiotherapy.
- NSAIDs.
- Steroid injections.
- Arthroscopic tendon repair.

RUPTURE OF LONG HEAD OF BICEPS

Chronic rotator cuff tear → Shoulder instability

↓
Excess stress on other stabilizers of shoulder

↓
Degeneration & rupture of tendon of long head of biceps

↓
muscle belly retracts into distal arm

↓
Popeye sign : Bulge in the distal arm

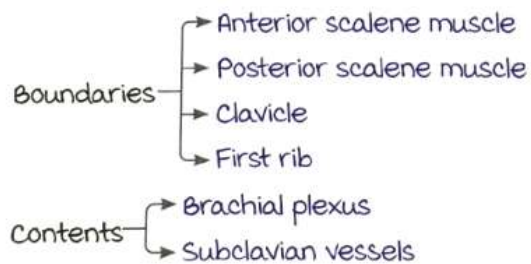


→ Belly of biceps muscle

Popeye sign

THORACIC OUTLET SYNDROME

Entrapment of neurovascular structures as they pass through the thoracic outlet.

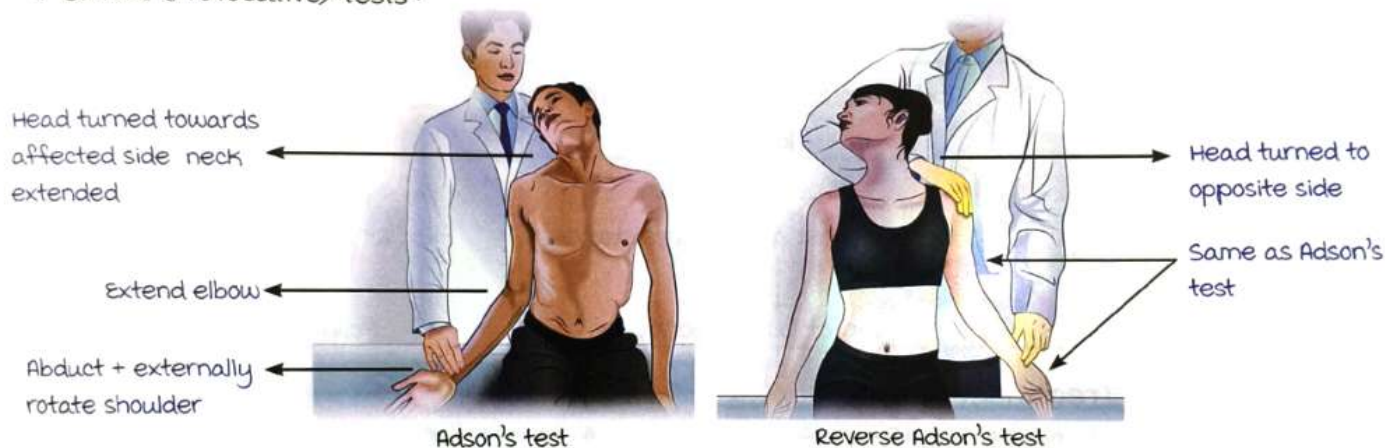
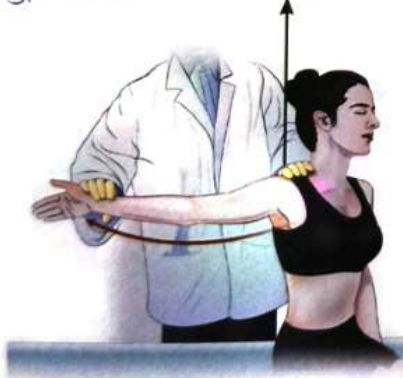
Thoracic outlet :**Causes of obstruction :**

- Abnormal positioning of neck.
- Lung tumor (upper lobe) causing compression.
- Cervical rib (Adventitious rib at C7).

----- Active space -----

Symptoms :

- Pain around shoulder, radiating to arm.
- Hand turns pale.
- Neurological Progresses to → vascular (Symptoms of claudication)
 - ↓
 - compression of brachial plexus at C8, T1
 - ↓
 - Humpke's palsy
- Risk of compression : Brachial plexus > Artery > Vein.

Evaluation :**1. Clinical (Provocative) tests :****Hyperabduction of shoulders****c. Wright's hyperabduction test :**

a. MRI : IOC.

Treatment :**Conservative :**

- Rest.
- Splint.
- Physiotherapy.

Surgical :

Excision of first rib/cervical rib/tumor (Lung).

- Abduct shoulder + Flex elbow.
- Open & close hands for 3 mins.

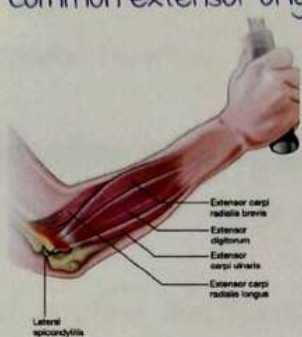
Reproduces symptoms of vascular claudication

**d. Roo's test :**

----- Active space -----

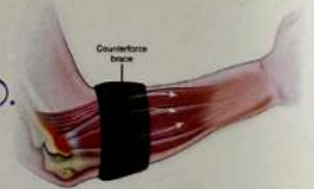
Conditions Around Elbow

00:33:55

	Tennis elbow (m/c)	Golfer's elbow
Pathology	Lateral epicondylitis (Inflammation of common extensor origin) 	medial epicondylitis (Inflammation of common flexor origin) 
Earliest affected muscle	Extensor carpi radialis brevis > longus	Flexor carpi radialis
Evaluation	Cozen's test : Extend wrist against resistance ↓ Pain at lateral condyle	Reverse cozen's test : Flex wrist against resistance ↓ Pain at medial condyle

Treatment :

1. Activity modification.
2. NSAIDs.
3. Ortho-biologics (Helps in healing) :
 - a. Blood : ↑ healing and ↑ inflammation.
 - b. Platelet-rich plasma : Only ↑ healing (WBCs removed).
 - c. Stem cells from :
 - Adipose tissue.
 - Bone marrow.
 - Periosteum.
4. Counterforce brace (Prevents movement from reaching the origin of muscle)

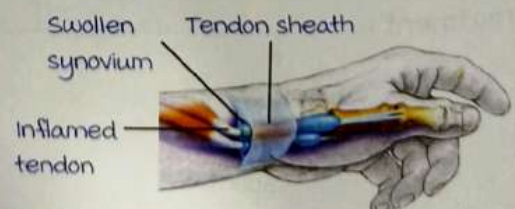
**Conditions Around Wrist & Hand**

00:42:54

DeQuervain's disease :

stenosing tenosynovitis of { Abductor pollicis longus } At the first dorsal compartment of wrist
 { Extensor pollicis brevis }

etiology { Overuse,
 { Rheumatoid arthritis.



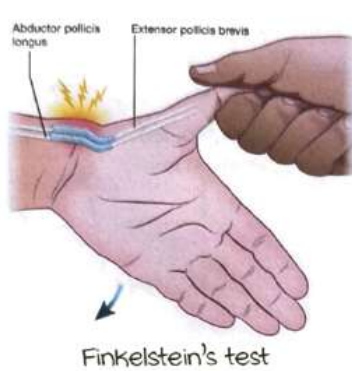
Dequervain's disease

Clinical features :

- F > m.
- Pain over radial styloid.

----- Active space -----

Evaluation :



Treatment :

- Rest.
- Immobilisation (Splints).
- Steroid injections.

Dupuytren's Contracture :

Abnormal cord like fibrosis of palmar fascia → Contracture of finger.



Dupuytren's contracture

Clinical features :

- m > F.
- Bilateral.
- m/c involved → Finger : Ring finger
Joint : metacarpophalangeal joint

Ectopic types (In other parts of the body)

Peyronie's
(Penis)



Ledderhose disease
(Soles of feet)



----- Active space -----

Treatment :

1. Conservative.
2. Collagenase injections.
3. Fasciectomy.

Trigger finger :

Pathophysiology :

Trauma → Stenosis of A-1 pulley

Obstruction of flexor tendon passing through it

Difficulty in opening the finger

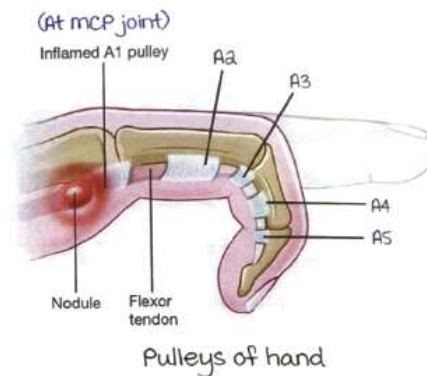
Finger suddenly opens on forceful extension

Etiology →

- Trauma (m/c)
- Rheumatoid arthritis

Clinical features :

- F > m.
- m/c involved →
 - Finger : Ring finger
 - Tendon : Flexor digitorum profundus (FDP)

**Gamekeeper's thumb / Skier's thumb**

Hyperabduction of thumb

Tear/avulsion of ulnar collateral ligament (UCL) of thumb.

Treatment :

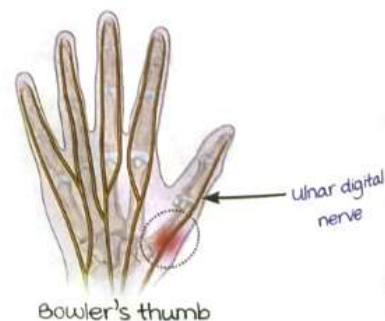
- Thumb spica
- Surgical repair : If stener lesion (+)
(Adductor pollicis tendon trapped between the torn UCL)



Gamekeeper's thumb

Bowler's thumb :

Neuroma of ulnar digital nerve of thumb (D/t perineural fibrosis).



Ganglion :

m/c swelling at the wrist : **Dorsal** > Ventral
unilocular cystic swelling.

Origin : Synovium.

Contents : mucinous fluid.

Treatment :

- Conservative.
- Aspirate contents → Inject steroids/sclerosants.
- Surgical excision.

Ganglion cyst



----- Active space -----

Compound palmar ganglion :

misnomer.

Pathophysiology :

Chronic inflammation of flexor sheath of forearm & hand

↓
Swelling of flexor sheath except at the wrist
(D/t flexor retinaculum)

↓
Hour glass appearance of forearm & hand

Etiology → TB
→ Rheumatoid arthritis



Compound palmar ganglion

Conditions Around Knee

01:00:18

Osteochondritis dissecans :

Bone fragment breaks away at bone & cartilage interface

↓
Prevents gliding movement of knee joint (Locking of knee joint)

m/c site : **knee** > elbow

↓
Lateral part of medial femoral condyle

C/F → knee pain
→ Sudden locking of knee



CT



X ray

----- Active space -----

Evaluation :

Wilson's test :

Pain on extension of internally rotated leg

↓
Relieved on external rotation of leg

Wilson's test

Loose bodies :

- m/c cause of loose body in knee joint : Osteophytes in osteoarthritis.
- m/c cause of loose body in knee — In young : Osteochondritis dissecans,
In elderly : Osteophytes in osteoarthritis.
- m/c cause of multiple loose bodies in knee : Synovial chondromatosis

↓
metaplasia of the synovium↓
multiple cartilagenous bodies in joint↓
On Xray : Snowstorm appearance of knee

Synovial chondromatosis

Chondromalacia patellae :

- Softening of cartilage.
- m/c cause : Idiopathic.
- m/c cause of anterior knee pain.
- F > m.
- Aggravating factors : Getting up from sitting position after prolonged sitting (movie sign).



Normal

Chondromalacia patella

Baker's cyst :

Pulsion/pressure diverticulum of synovium.

Location : Posterior aspect of knee.

Etiology : Osteoarthritis, rheumatoid arthritis.

On examination : Prominent on knee extension,
disappears on knee flexion.

Diagnosis : USG.

Treatment : Excision.



Baker's cyst

Note :

Function of synovial sac :

- minimizes friction.
- Allows smooth gliding of tendons.

Bursitis :

Inflammation of synovial sac d/t repetitive loading.

Types :

1. Housemaid's knee



2. Clergyman's knee



3. Student's elbow



4. Haglund deformity



5. Tailor's bunion



6. Weaver's bottom : Ischial bursitis.

01:11:14

Conditions of Foot



Hallux valgus :

Lateral deviation of great toe → Swelling at first MTP → Causing pain

D/d for pain at first MTP : Gout.

- Pain d/t inflammation & destruction of first MTP joint.
- On knee aspiration : Needle-shaped monosodium urate crystals.

Treatment : Osteotomy.

Inflammation (+)
No valgus deformity



----- Active space -----

Avascular Necrosis (AVN)

01:12:24

Bones with tendency of AVN :

- Head of femur (Spontaneous AVN in Chandler's disease).
- Proximal pole of scaphoid (Spontaneous AVN in Preiser's disease).
- Body of talus.

ETIOLOGY

Conditions associated with Idiopathic AVN :

- Sick cell disease.
- Gaucher's disease.
- Caisson's disease.
- Perthes' disease.
- Alcohol consumption.
- Corticosteroid use : Causes ↑ pressure in head of femur

↓ blood supply to head of femur → AVN → Pain at hip

CLINICAL FEATURES

- Young individuals : m > F.
 - B/L in {
 - 50% cases of AVN.
 - 80% in cases of AVN with h/o steroid use.
 - Pain at hip {
 - Limping : Antalgic gait
 - Radiates to knee
 - Restriction of movements : Internal rotation > Abduction
- ↓
Sectoral sign

INVESTIGATIONS

X-ray :

1. Incongruent/ deformed head with ↑ density (Takes weeks-months to appear).

a. Crescent sign :

- Early sign.
- D/t subchondral collapse of head of femur.

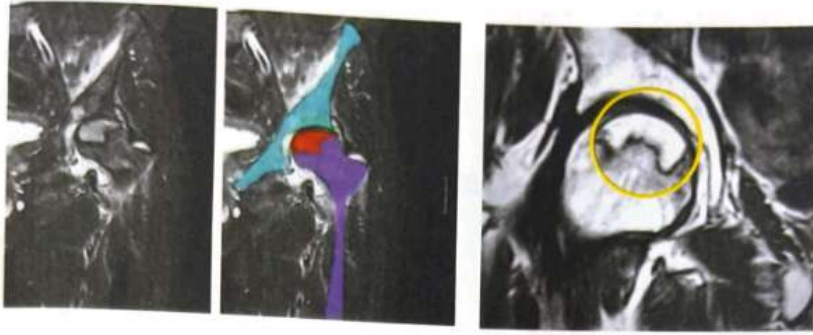


Incongruent head of femur



Crescent sign

MRI: IOC.



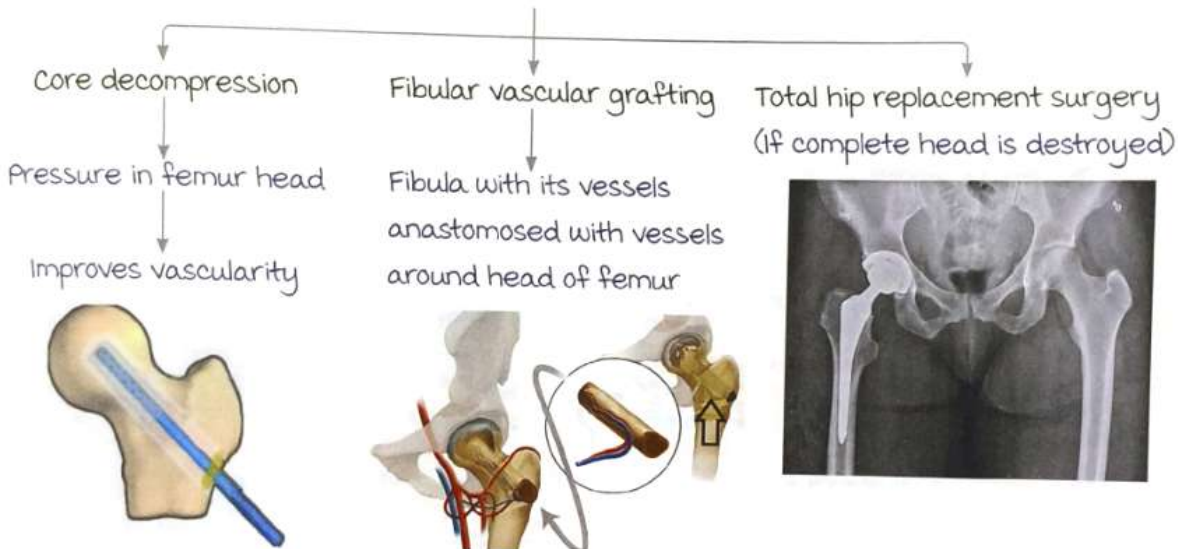
----- Active space -----

Bone scan: Donut sign

- ↓ uptake of radionuclide by head of femur.
- Surrounding bone: Normal uptake.



TREATMENT



TRAUMATIC AVN

- Prolonged hip dislocation
 - Neck of femur fracture
- AVN of head of femur
- waist of scaphoid fracture
- AVN of proximal pole of scaphoid
- Neck of talus fracture
- AVN of body of talus



----- Active space -----

ADDITIONAL RADIOLOGICAL FEATURES**Hawkin's sign :**

On X-ray : Subchondral lucency

↓
Indicates **viable bone** with adequate vascularity

Hawkin's sign

Snowcap sign :On X-ray of AVN of **head of humerus**.**Note :**

- Intertrochanteric fracture : ↑ risk of malunion.
- Hawkin's classification : For talus fractures.



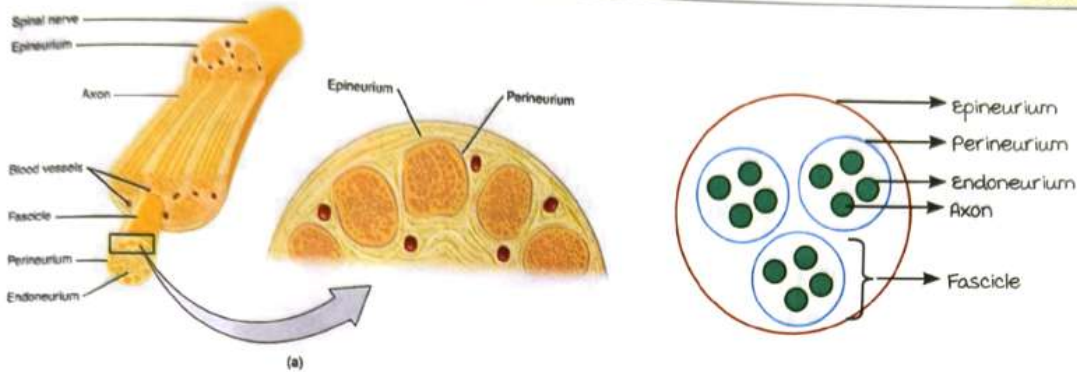
Snowcap sign

NERVE INJURIES : PART 1

----- Active space -----

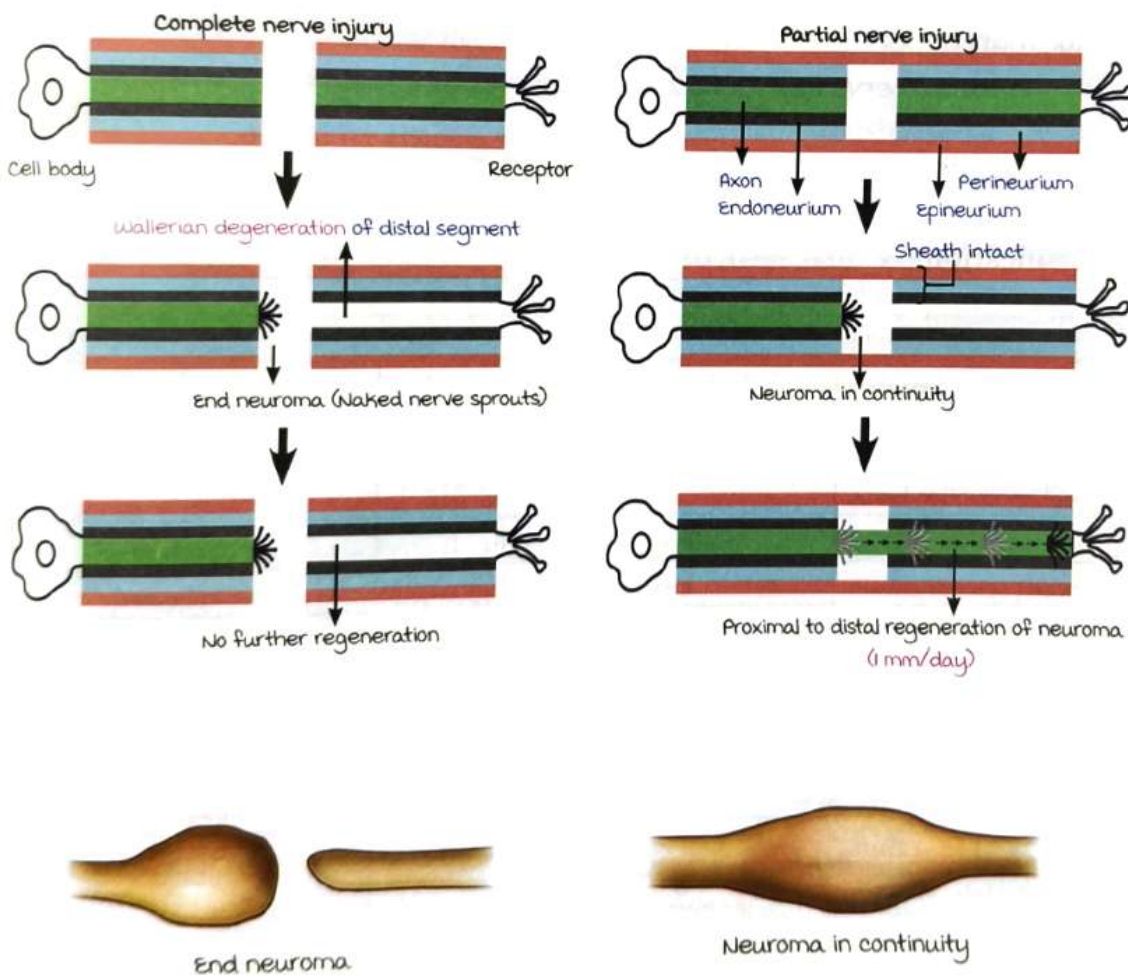
Structure of Nerve

00:01:56



Pathology in Nerve Injuries

00:02:58



----- Active space -----

Tinel sign :

Distal to proximal percussion of nerve

Pain/ shock-like sensation in limb
d/t stimulation at neuroma (+)

Non-progressive

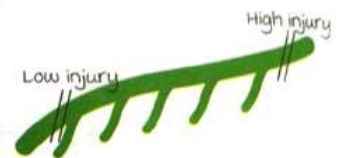
Progressive

End neuroma

Neuroma in continuity

High injury vs low injury :

- Higher (Proximal) the injury → more the disability/ deformity.
- Lower (Distal) the injury → Lesser the disability/ deformity.

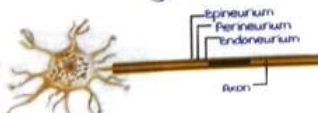
**motor march :**

In partial nerve injury : Recovery of nerve with neuroma in continuity

Gradual, progressive proximal to distal recovery of muscle functions

Classification

00:14:06

	Neuropraxia	Axonotmesis	Neurotmesis
Seddon's	Nerve compression ↓ Temporary reversible physiological conduction block	Axons injured with atleast one nerve sheath intact	Complete transection of nerve
	No neuroma	Neuroma in continuity	End neuroma
	100 % recovery spontaneously	< 100% recovery	No recovery
	-	Progressive +ve Tinel's	Non-progressive +ve Tinel's
	-	motor march (+)	
	Eg : Tourniquet palsy, Saturday night palsy, crutch palsy.	Eg : Fracture, dislocations.	Eg : Lacerations, cut wound, incised wound.
Sunderland's	Type I 	Type II : Only axon injured Type III : Axon + endoneurium injured Type IV : Axon + endoneurium + perineurium injured	Type V 

Management

00:19:57

----- Active space -----

DIAGNOSIS

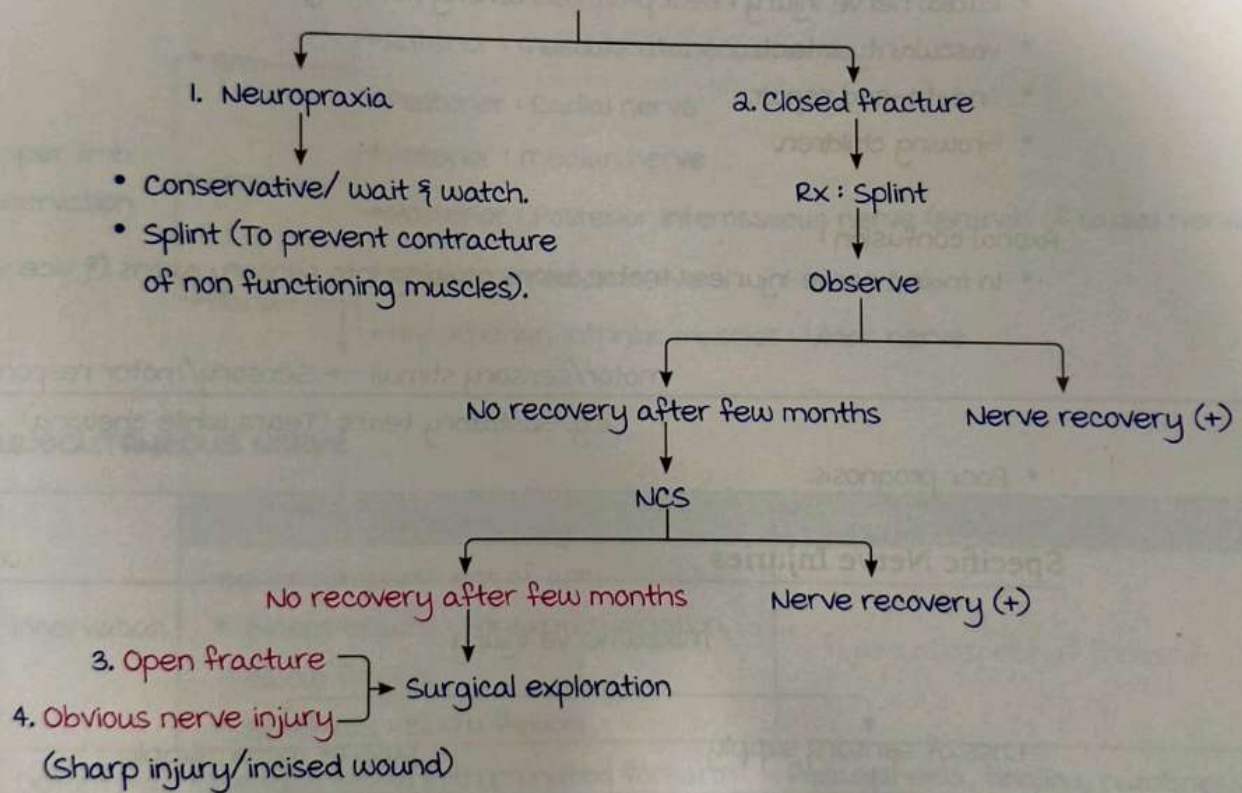
1. Tinel's sign (For **assessment of nerve recovery**).

2. Nerve conduction study :

- **IOC** to determine type of nerve injury.

- Parameters
 - Nerve conduction velocity (**Best**) : measures velocity of impulse transmitted through different segments of the nerve (Compression → ↓ velocity)
 - Electromyography

TREATMENT



NERVE REPAIR

- Types
- Primary : In < 6 hours
 - Delayed primary : In 7-18 days

- methods
- End-to-end repair
 - End-to-side repair



Nerve graft :

- Indication : If nerve ends do not approximate.
- Sources
 - Sural nerve (m/c)
 - Saphenous nerve

----- Active space -----

Tendon transfer :

- Indication : Nerve injuries not repaired within **one year** of injury
 - ↓
 - motor end plate of the nerve die d/t lack of stimulation
 - ↓
 - Non-functional neuromuscular junction
- Procedure : Tendons & their muscle (Functional neuromuscular junctions (+)) repositioned to perform desired action.

Good prognostic factors :**NERVE - GROW**

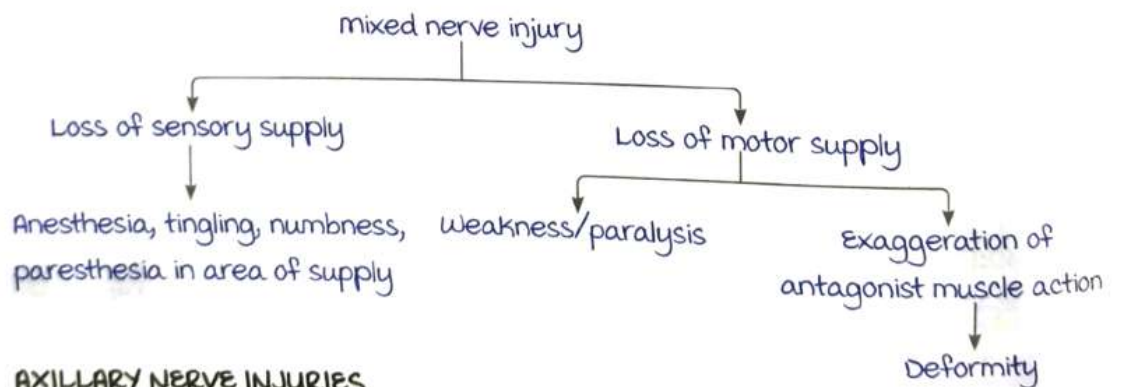
- Neuropraxia.
- Early repair.
- Radial nerve injury : **Best prognosis** among nerve injuries (motor nerve).
- Vascularity intact.
- End-to-end repair.
- Growing children.

Axonal confusion :

- In mixed nerve injuries : motor axons growing into sensory axons (& vice versa)
 - ↓
 - motor/sensory stimuli → Sensory/motor response
e.g. Gustatory tears (Tears while chewing)
- Poor prognosis.

Specific Nerve Injuries

00:26:45

**AXILLARY NERVE INJURIES**

Origin : Brachial plexus.
 Root value : C5, C6.
 mixed nerve.

	motor supply	Sensory supply
Innervation	• Deltoid (Abduction of shoulder). • Teres minor (External rotation of shoulder).	Lateral aspect of proximal shoulder
Deformity	Adducted & internally rotated	Regimental badge sign

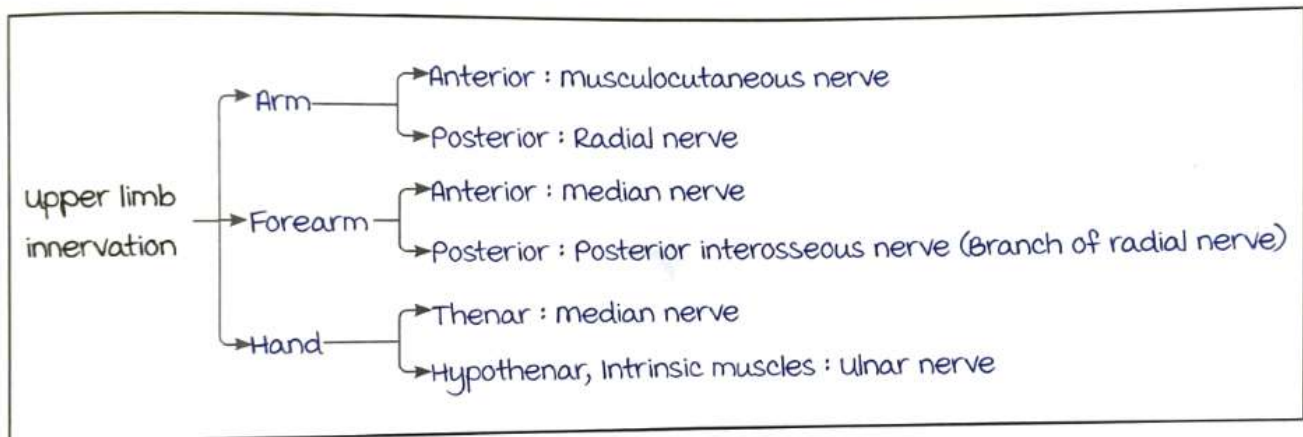
----- Active space -----

mechanism of injury :

- **Shoulder dislocation** (m/c).
- Proximal humerus fracture
 - Surgical neck fracture
 - Glenoid fractures
- Iatrogenic.

Note :**Shoulder abduction :**

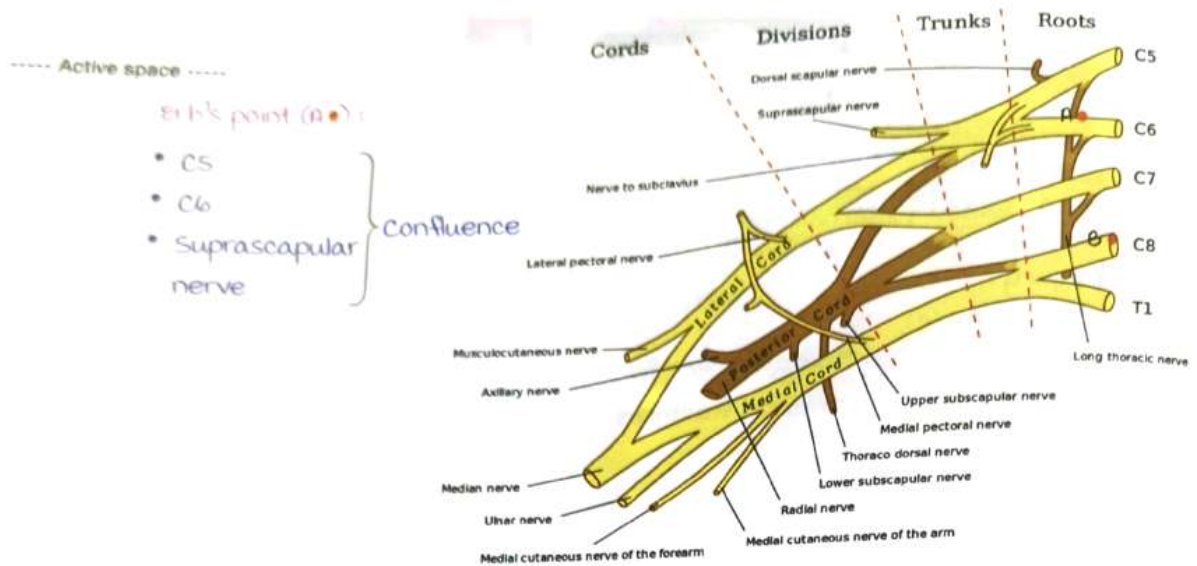
- Supraspinatus : 0-15°.
- Deltoid : 15-90°.
- Serratus anterior & trapezius : Overhead abduction.

**MUSCULOCUTANEOUS NERVE**

	motor supply	Sensory supply
Innervation	Anterior compartment of arm : • Biceps brachii : Forearm supination, elbow flexion. • Brachialis : Elbow flexion.	Lateral aspect of forearm
Deformity	Extended elbow with pronated forearm	Paraesthesia, tingling, numbness

BRACHIAL PLEXUS INJURIES**Anatomy of brachial plexus :**

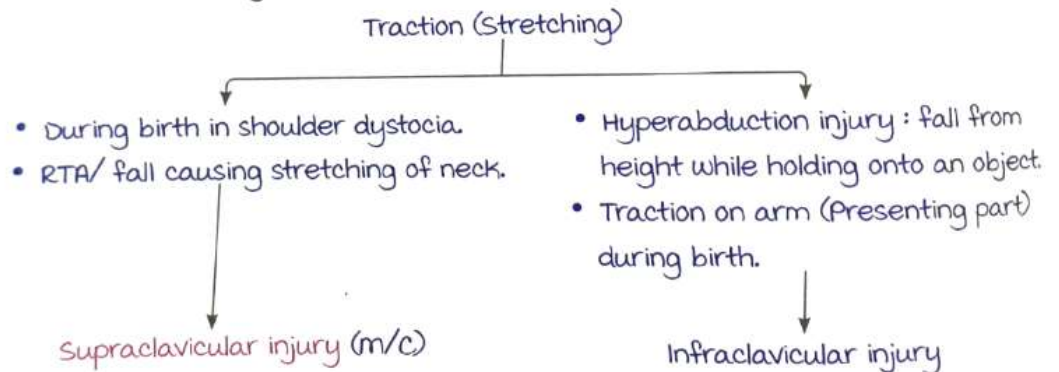
- Roots : C5, C6, C7, C8, T1.
- Trunks : upper, middle, lower.
- Divisions : Anterior & Posterior.
- Cords : Lateral, medial, posterior.



Types of brachial plexus injuries :

- Supraclavicular injury (upper roots & trunks) → Erb's palsy (Best prognosis).
- Infraclavicular injury (Lower roots & trunks) → Klumpke's palsy.
- Combined/mixed palsy (Worst prognosis).

Mechanism of injury :



Long thoracic nerve of bell :

- Root value : C5, C6, C7.
- Muscle innervated : Serratus anterior.
- If injured : On pushing against wall → Winging of scapula (Scapula lifts up).



Winging of scapula

Suprascapular nerve :

- motor supply — {
 - Supraspinatus : Shoulder abduction
 - Infraspinatus : External rotation of shoulder
- Deformity on injury : Adduction & internal rotation of shoulder.

erb's palsy :

Nerves injured

1. Suprascapular : Adduction, internal rotation.
2. Axillary : Adduction, internal rotation.
3. musculocutaneous : Elbow extension, forearm pronation.

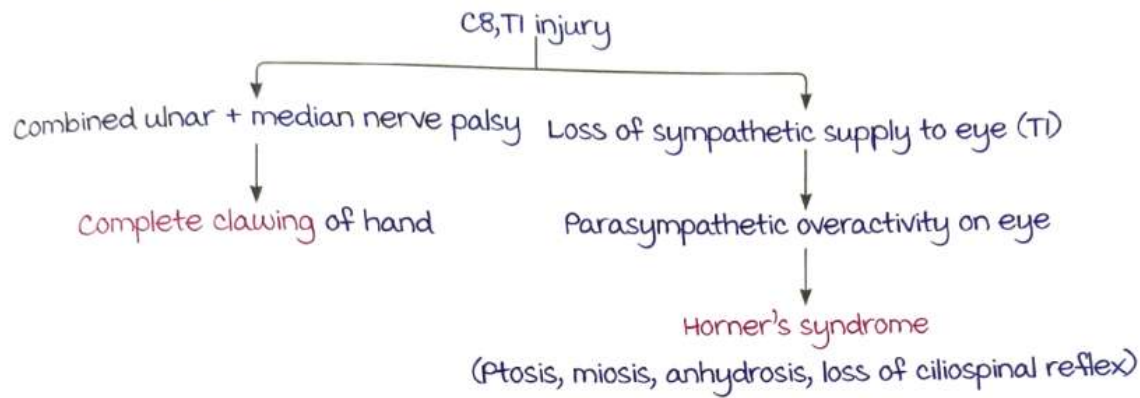
Deformity

Policeman's/waiter's/
Porter's tip deformity

----- Active space -----



erb's palsy

Klumpke's palsy :**Treatment of brachial plexus injury :**

Aeroplane splint.



Aeroplane splint

----- Active space -----

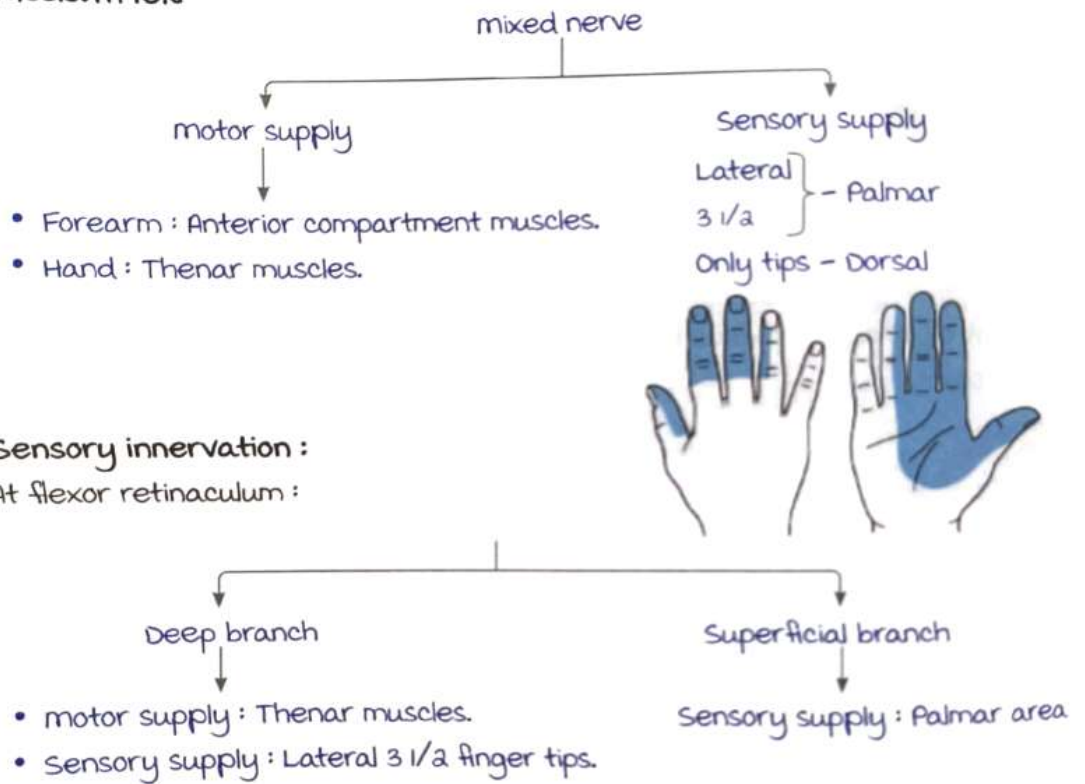
NERVE INJURIES : PART 2

Median Nerve

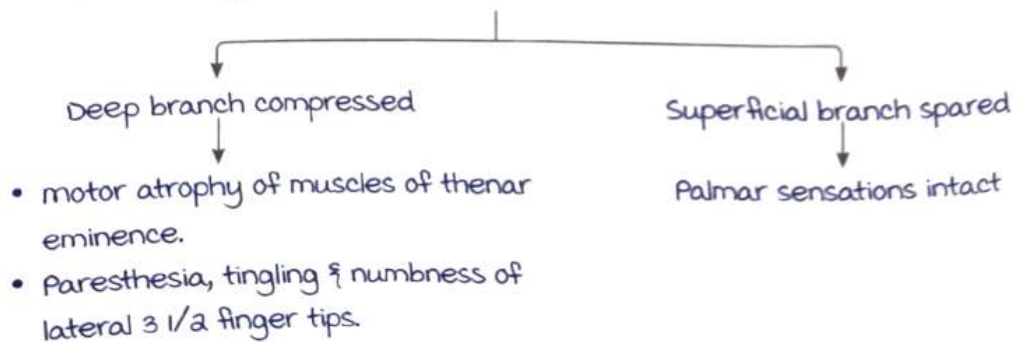
00:00:14

AKA labourer's nerve.

INNERVATION



In carpal tunnel syndrome :

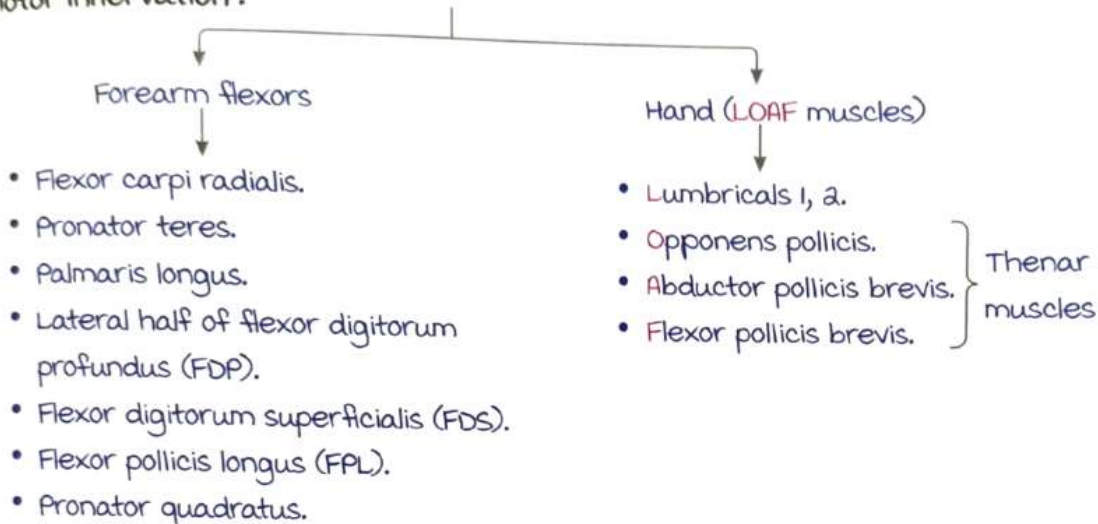


Autonomous zone :
Independent zone supplied by a single nerve.

----- Active space -----

Nerve	Autonomous zone
median nerve	Tip of index finger
ulnar nerve	Tip of little finger
Radial nerve	Dorsum of first web space

motor innervation :



muscles innervated by median nerve :

Arm : No supply.

Forearm : All muscles of anterior (Flexor) compartment except
 Hand : All thenar muscles except adductor pollicis (Ulnar nerve)
 +
 lumbricals 1,2.

Flexor carpi ulnaris }
 medial half of FDP } supplied by ulnar nerve

MEDIAN NERVE INJURIES

Etiology -- At wrist : Carpal tunnel syndrome
 -- At elbow : Supracondylar humerus fracture

Anterior interosseous nerve (Branch of median nerve) >

median nerve > Radial nerve > Ulnar nerve

Median nerve injury at wrist :

manifestations :

• Loss of sensation of lateral 3^{1/2} fingers.

• Wasting of thenar eminence

• Loss of thumb -- Abduction
 -- Flexion
 -- Opposition

Ape hand/thumb deformity



----- Active space ----- Treatment : **Opponens splint.**

Median nerve injury at elbow :

manifestations of wrist lesion + loss of functions of

→ FPL
→ FDS
→ FDP

Evaluation :

1. Pen test :

- Evaluates function of **adductor pollicis brevis** (Abduction of thumb).

• Procedure :

- Patient's hand placed on table palm facing up.
- Patient asked to touch tip of pen hovering above palm with tip of thumb



Unable to touch pen (Positive pen test)

2. Pointing index/Benediction sign/Pope sign/Oschner clasp sign :

Evaluates function of

→ FDS : Flexion of PIP & MCP joints

→ FDP : Flexion of DIP, PIP, MCP joints



Index finger doesn't flex on making a fist in median nerve injury at wrist

Note : Actions of thumb

- Abduction : Perpendicular to plane of palm.
- Extension : Parallel to plane of palm.

ANTERIOR INTEROSSEOUS NERVE

- Branch of median nerve.
- Purely motor nerve : Supplies
 - Flexor pollicis longus
 - Lateral half of FDP

m/c injured nerve in **supracondylar humerus fracture**

	AIN palsy	Median nerve palsy
Sensory deficits	-	+
Difficulty making fist	-	+

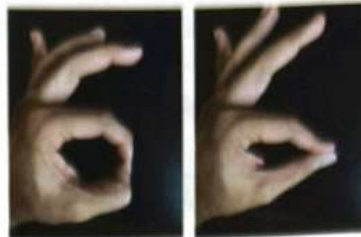


Evaluation :

Kiloh-Nevin sign : weak OK sign.

Note :

Lunate dislocation : Causes compression injury of median nerve.



Normal OK sign Weak OK sign

----- Active space -----

Summary on median nerve assessment :

1. median nerve → Pen test : For adductor pollicis brevis
→ Pointing index : For FDP & FDS
2. Anterior Interosseous nerve → Kiloh-Nevin sign (weak OK sign).

Ulnar Nerve

00:17:37

AKA musician's nerve.

Root value : C8, T1.

INNERVATION

motor supply :

Arm : No supply.

Forearm :

- medial half of FDP.
- Flexor carpi ulnaris.

Hand :

- Hypothenar muscles.
- Adductor pollicis (Thenar muscle) → Thumb adduction.
- Interossei group of muscles → Palmar → Adduction (PAD) of fingers
→ Dorsal → Abduction (DAB) of fingers
- Lumbricals 3,4.

Sensory supply : medial 1 1/2 fingers anteriorly & posteriorly.

Autonomous zone : Tip of little finger.

SITES OF ULNAR NERVE INJURIES

1. Cubital tunnel (Behind medial epicondyle).
2. Guyon's canal (Under piso-hamate ligament).

Ulnar nerve injury at wrist (In Guyon's canal) :

Manifestations :

- Partial clawing of hand.
- Hypothenar wasting.
- Loss of sensations in medial 1 1/2 hand.

Note :

Complete clawing : median + ulnar nerve palsy

----- Active space -----

Treatment : Knuckle bender splint



Knuckle bender splint



Partial claw hand



Complete claw hand

Evaluation :

1. Card test :



Card test

- To evaluate : **Palmar interossei** (Adduction of fingers).
- Procedure : Insert card between two extended fingers

↓
Examiner tries to pull card out from patient's fingers

↓ Weak interossei muscles

Card slips out easily (Positive card test)

2. Egawa test :

- To evaluate : **Dorsal interossei** (Abduction of 2nd, 3rd, 4th, 5th fingers).
- Method : moving middle finger away from midline.

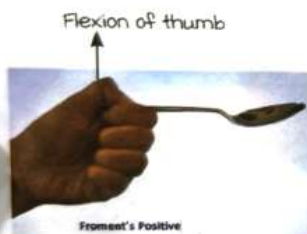
3. Fanning fingers against resistance : To evaluate **dorsal interossei**.

4. Book test :

- To evaluate : **Adductor pollicis**.
- Procedure : Patient asked to hold an object between thumb & index finger

↓
Lack of adduction compensated by flexors (AIN supply +)

↓
Flexion of thumb (Froment sign)



Flexion of thumb

Froment's Positive

ulnar nerve injury at elbow :

Site of injury : In cubital tunnel, behind medial condyle

manifestations :

Loss of function of medial half of flexor FDP

↓
Loss of flexion at DIP, PIP and MCP joints

↓
Less significant clawing

ulnar paradox : Higher the injury of ulnar nerve → Lesser the clawing/deformity.

Summary on ulnar nerve assessment :

1. For Interossei :
 - Palmar : Card test
 - Dorsal :
 - Egawa test
 - Fanning of fingers
2. For Adductor pollicis : Book test.

----- Active space -----

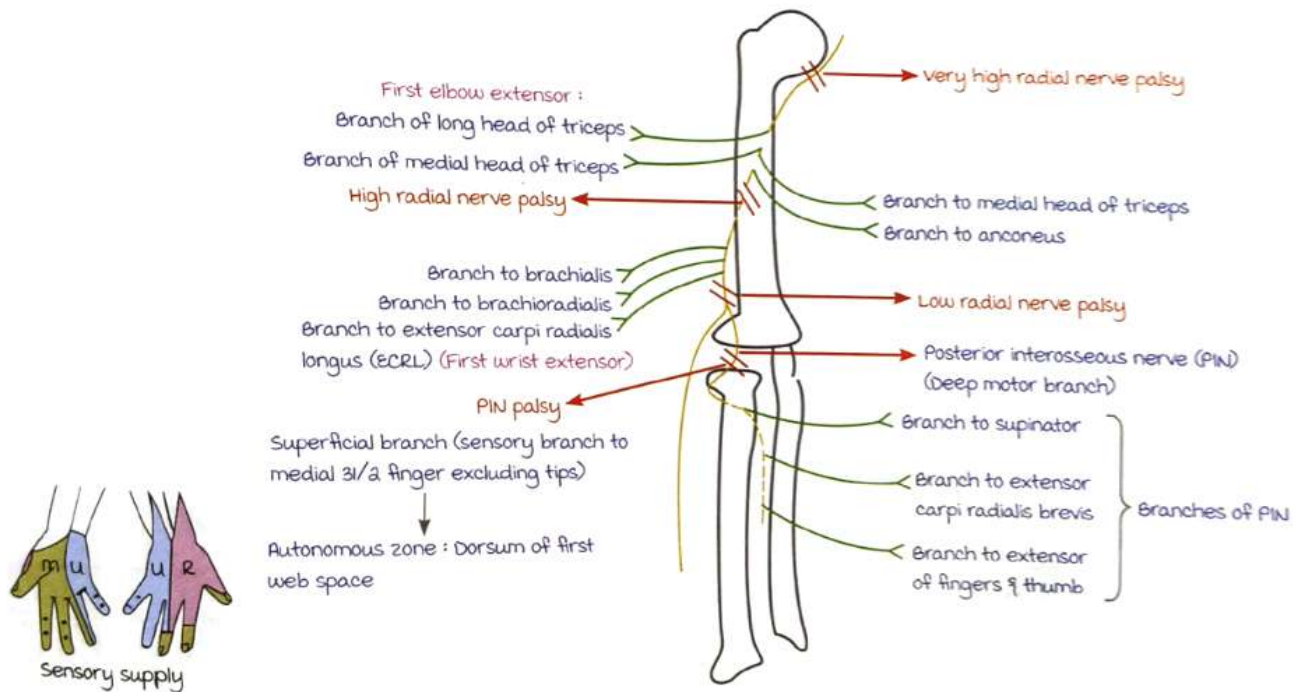
Radial Nerve

00:35:59

m/c injured nerve but best prognosis (Purely motor nerve).
Function : Extension of elbow, wrist & fingers.

Course & branches of radial nerve :

Origin : Posterior cord of brachial plexus.



Level of injury	Location of injury	manifestations
PIN palsy	Radial head	Finger drop, thumb drop
Low radial nerve palsy	Lateral condyle	Finger drop, thumb drop, sensory loss
High radial nerve palsy (m/c)	Spiral groove	Finger drop, thumb drop, sensory loss, wrist drop
Very high radial nerve palsy	Axilla	Finger drop, thumb drop, sensory loss, wrist drop, inability to extend elbow

Injury — Proximal to ECRL (Spiral groove) : wrist drop +
 — Distal to ECRL (Spiral groove) : wrist drop -

----- Active space -----

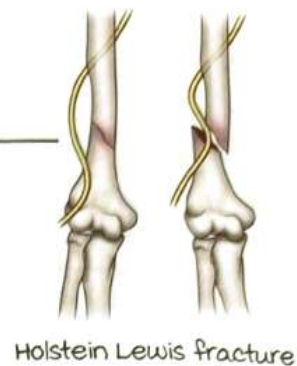
Holstein Lewis fracture :

m/c cause of radial nerve injury.

Fracture of shaft of humerus between
upper 1/3rd & lower 1/3rd of humerus

Causes radial nerve entrapment

Wrist drop, finger drop, thumb drop, sensory loss



Holstein Lewis fracture

Treatment :



Cock up splint

Cock up splint (Rx for wrist drop)

Static

(Extends wrist)

Dynamic

(Extends wrist + allows flexion of fingers)



Wrist drop

SUMMARY OF NERVE FUNCTION TESTS

Nerve	Test/sign	muscle
ulnar	Book test	Adductor pollicis
	Froment sign	Flexor pollicis substitutes for adductor pollicis
	Card test	Palmar interossei
	Egawa test	Dorsal interossei

Nerve	Test/sign	muscle
median	Ape thumb	Thenar muscle wasting
	Pen test	Abductor pollicis brevis
	Kiloh nevin sign/pincer grasp	Flexor digitorum profundus + flexor pollicis longus (AIN)
	Pointing index/benediction sign/oschsner clasp	Flexor digitorum superficialis + lateral half of flexor digitorum profundus
Radial	Finger & thumb drop	Extensors (PIN)
	Wrist drop	Extensors of wrist ECRL

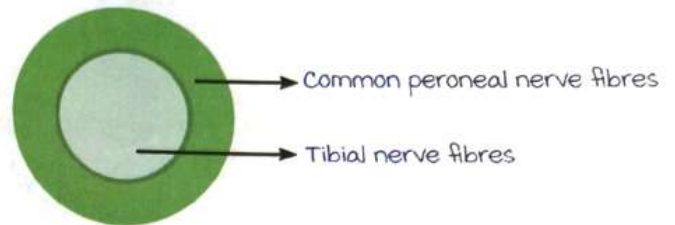
Lower Limb Injuries

sciatic nerve :

If injured causes manifestations of CPN nerve injury.

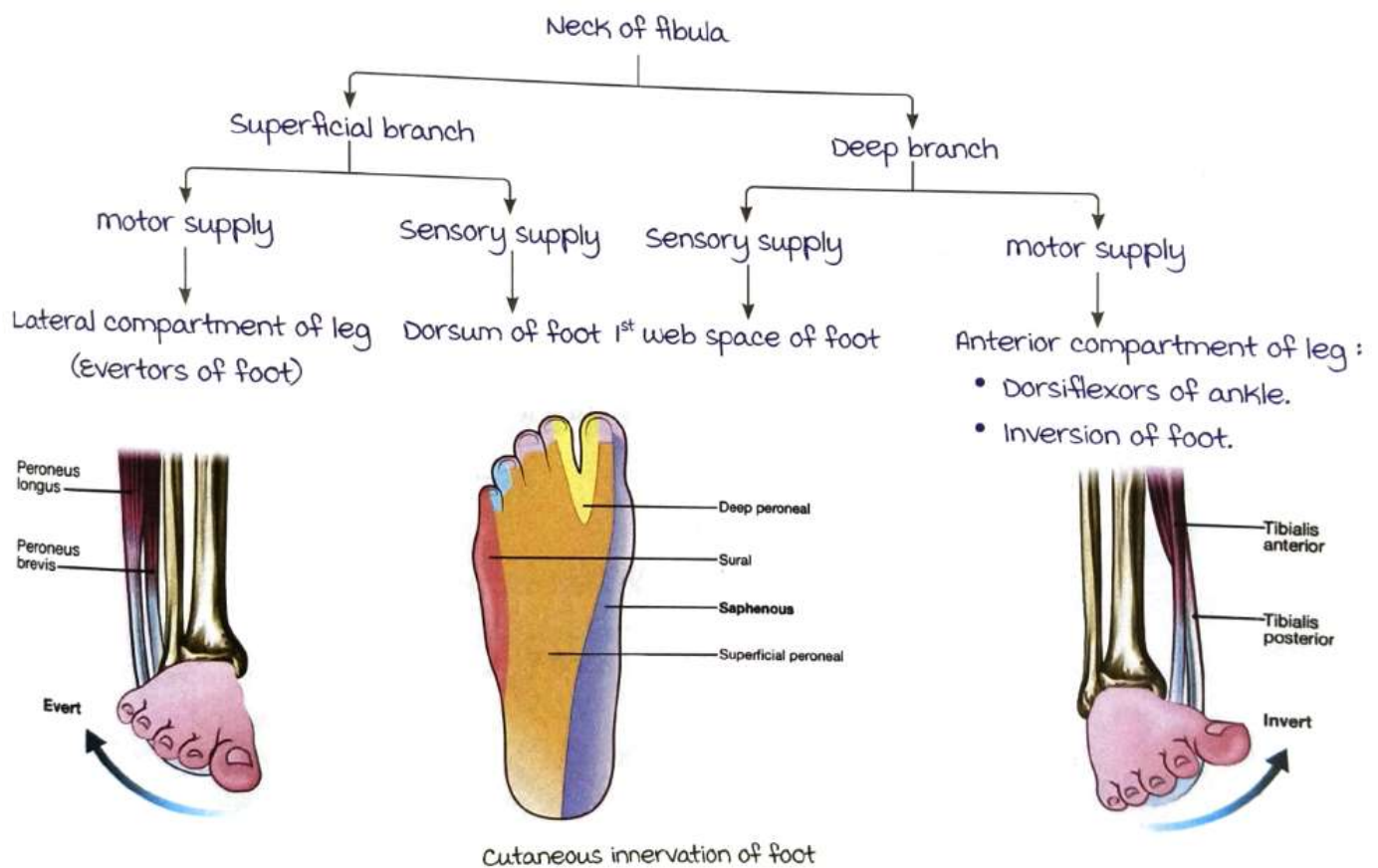
causes of injury :

- Iatrogenic (Hip surgeries) : m/c cause.
- Posterior dislocation of hip.
- Gunshot injuries.
- Gluteal injections.



Sciatic nerve : Cross section

Common peroneal nerve :



Causes of injury: Fracture of neck of fibula

manifestations:

- Loss of ankle — { Dorsiflexion } Equinovarus deformity
 { Eversion } (Plantar flexion & inversion)
- Gait : High stepping/foot-drop gait/steppage gait
(to overcome dragging of foot d/t foot drop)

----- Active space ----- Splint : Foot drop splint/Ankle Foot Orthosis (AFO).



Ankle foot orthosis



Foot drop



Fracture neck of fibula

Entrapment Neuropathies

00:57:05

Nerve trapped under a structure → Delayed conduction of stimulus.

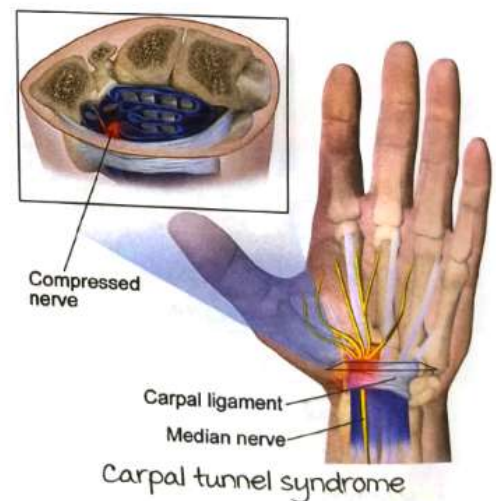
CARPAL TUNNEL SYNDROME

median nerve entrapment in carpal tunnel (at wrist) under flexor retinaculum/transverse carpal ligament.

m/c entrapment neuropathy (m/c entrapped nerve : median nerve).

Etiology (Conditions causing ↑ pressure inside carpal tunnel) :

- Idiopathic : m/c cause.
- Hypothyroidism (Myxedema).
- Rheumatoid arthritis (Inflammation).
- Pregnancy (Fluid retention).
- Acromegaly (Excessive growth of bone & soft tissue).
- Activity causing wrist compression (Eg : typing).
- Colle's fracture (Hematoma → Compression).
- Gout.
- Amyloidosis.
- Diabetes mellitus.



Clinical features :

- middle aged female.

- c/o pain :

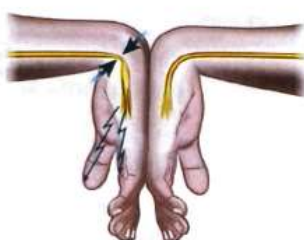
- Type of pain : **Burning pins & needle** type of pain.

- Distribution : Along lateral 3 1/2 fingers — **maximum at night**
 — Relieved on — Shaking her hand
 — Hanging hand at the edge of bed

- Thenar muscle wasting & weakness.

Evaluation :**Clinical tests :****1. Phalen's test**

Position held for
approx. 1 minute



Dull aching pain, numbness,
paraesthesia, tingling along
median nerve distribution

2. Reverse Phalen's test

Position held for
approx. 1 minute

3. Durkan's test :

- Best clinical test.
- Direct median nerve compression between thenar & hypothenar eminence for 30 seconds → Reproduces symptoms.

4. Tourniquet test.**Nerve conduction studies :**

- **100.**
- Determines nerve conduction velocity.
- **Decreased velocity** d/t nerve compression under flexor retinaculum.

Treatment :

Conservative : Rest, steroids, splints

↓ No improvement

Surgery : Release of flexor retinaculum/transverse carpal ligament.

Note :

Allen's test : To assess patency of vasculature of hand before performing arterial procedures (Arterial line).

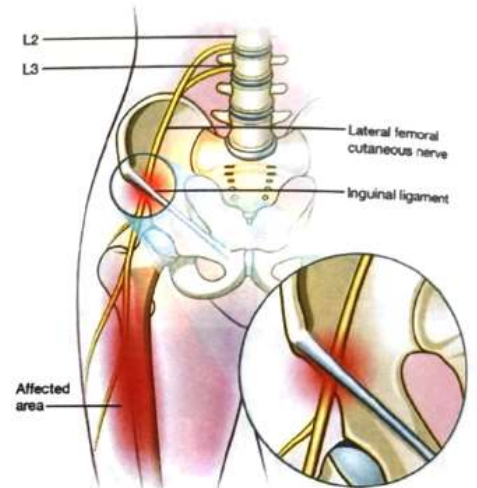
----- Active space ----- Opposition of thumb :

- muscle involved : Opponens pollicis → Supplied by deep branch of median nerve.
- Only function completely lost in CTS.

MERALGIA PARAESTHETICA

- Entrapment of lateral cutaneous nerve of thigh under inguinal ligament.
- Burning sensation along lateral aspect of thigh.

Etiology — { Overweight
Tight clothing around hip



The nerve is compressed by the inguinal ligament.

ENTRAPMENT NEUROPATHIES

Syndrome/pathology	Nerve	Site of compression/injury
Carpal tunnel syndrome (m/c)	median	At wrist
Cubital tunnel	ulnar	Behind the medial condyle humerus
Guyon's canal	ulnar	under the Pisio-hamate ligament
Pronator syndrome	median nerve	Heads of pronator teres
Kiloh Nevin syndrome	AIN	Supracondylar humerus fracture
Cheralgia paraesthetica	Superficial radial nerve	Radial styloid, insertion of brachioradialis (wrist watch, cuffs, bangles)
meralgia paraesthetica	Lateral cutaneous nerve of thigh	under inguinal ligament (tight belt)
Pyriformis syndrome	Sciatic nerve	Pyriformis & obturator internus muscle
Tarsal tunnel syndrome	Posterior tibial nerve	Behind medial malleolus below the flexor retinaculum of foot (RA)
morton metatarsalgia	Interdigital nerve of foot	Between 3 rd & 4 th toe

ORTHOPAEDIC ONCOLOGY : PART 1

----- Active space -----

Classification of Bone Tumors

00:01:46

Enneking classification :

Father of orthopaedic oncology : William Enneking.

Benign bone tumor	Malignant bone tumor
1. Latent : Thick capsule Eg : Non ossifying fibroma	I : Low grade → A : Intra compartmental (Within bone) → B : Extra compartmental (Outside bone)
2. Active : Thin capsule Eg : Aneurysmal bone cyst	II : High grade → A : Intra compartmental → B : Extra compartmental
3. Aggressive : Capsule is breached Eg : Giant cell tumor	III : metastasis

Classification based on cell type :

Cell type	Benign	Malignant
Chondrocytes (Cartilage forming cell)	• Osteochondroma • Enchondroma • Chondroblastoma	Chondrosarcoma
Osteoblast (Bone forming cell)	• Osteoid osteoma • Osteoblastoma	Osteosarcoma
Osteoclasts (Giant cell rich tumor)	Osteoclastoma/Giant cell tumor	
	• Aneurysmal bone cyst • Non-ossifying fibroma	

Appearance on X-ray :

Cell type	Appearance
Chondrocytes	Lucent/hazy with calcification
Osteoblasts	Dense/sclerosed
Osteoclasts	Bone destruction

Miscellaneous bone tumors :

Tumor	Type	Features
Hemangioma	Benign	• Vascular tumor • Occurs in spine
Simple bone cyst	Benign	• Mesenchymal tumor of bone
Fibrous dysplasia	Benign	• Mesenchymal tumor of bone • Bone is replaced by fibrous tissue
Ewing's sarcoma	Malignant	• Small round blue cell tumor family • Arises from medullary cavity of bone

----- Active space ----- Note : Osteoid osteoma produces maximum bone matrix.

Classification based on location in the bone :

Location	Tumors
Epiphysis	- Chondroblastoma : Growth plate visible (Child). - Giant cell tumor : No growth plate (Adult).
Diaphysis	- Ewings sarcoma - Osteoid osteoma (Night pains responding to aspirin). - Adamantinoma.
metaphysis	- Osteosarcoma. - Osteochondroma. - Aneurysmal bone cyst. - unicameral bone cyst. - Non-ossifying fibroma. - Chondromyxoid fibroma.

Classification based on nature of tumor :

Benign	Benign tumors with malignant potential	Malignant
- Osteoid osteoma - Simple bone cyst	- Giant cell tumor - Osteoblastoma - Osteochondroma	- Chondrosarcoma. - Osteosarcoma. - Ewings sarcoma. - Adamantinoma. - Chordoma.

Classification based on age groups :

Age	Tumor	Remarks
5-25 years	Ewings sarcoma	- m/c malignant tumor in the 1st decade of life. - m/c occurs in 2nd decade of life.
10-20 years	Primary osteosarcoma	m/c malignant bone tumor in children
	Secondary osteosarcoma (40-60 years)	
20-40 years	Giant cell tumor/osteoclastoma	D/t Paget's disease or radiation exposure
40-60 years	Secondary osteosarcoma Chondrosarcoma	
>60 years	metstasis, multiple myeloma Adamantinoma, Chordoma	

Miscellaneous Topics

00:20:40

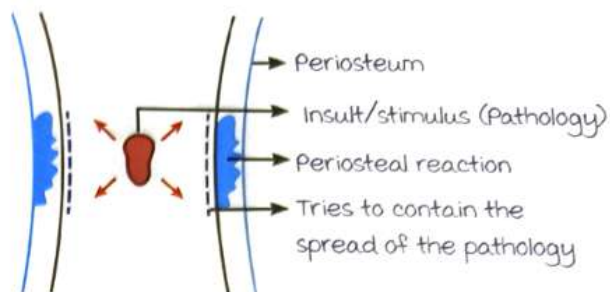
----- Active space -----

periosteum

- Reaction of periosteum to an insult/stimulus.
- Periosteal insult → New bone formation → Prevents the spread of underlying pathology.

Types :

- Slow growing/indolent lesion : Thick/solid periosteal reaction.
- Rapidly growing/aggressive lesion : Thin/lamellated periosteal reaction.



Reaction of periosteum to an insult/stimulus

x-ray features of periosteal reaction :

Features	Tumors
Onion peel	Ewings sarcoma
Sunburst	Osteosarcoma
Codman's triangle	Osteosarcoma
Solid	Osteomyelitis



Codman's triangle



Lamellated/layered



Sunburst appearance
: D/t calcification of
Sharpey's fibres

Pulsatile bone tumors

Vascular → Hence they are pulsatile → Bruit present.

Eg :

- Osteosarcoma → most pulsatile.
- Aneurysmal bone cyst.
- Giant cell tumor.
- METS from kidney.
- METS from thyroid.

----- Active space -----

Polyostotic lesions : multicentric

Can occur in multiple parts of same bone or in multiple bones (Not metastatic).

- Fibrous dysplasia.
- Giant cell tumor.
- Enchondroma.
- Osteochondroma.

Fibrous cortical defect/non-ossifying fibroma

- Location : Cortex.
- Defect is filled with fibrous tissue.
- Eccentric lesion (Away from centre).
- Self-resolving lesion.
- Occurs in metaphysis.
- Occurs in 1st decade of life.

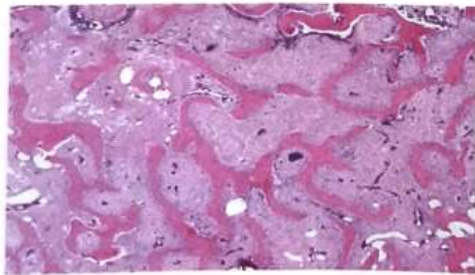
**Fibrous dysplasia****Pathology :**

- Developmental anomaly of the bone.
- Bone tissue replaced by fibrous tissue.
- m/c occurs in femur.

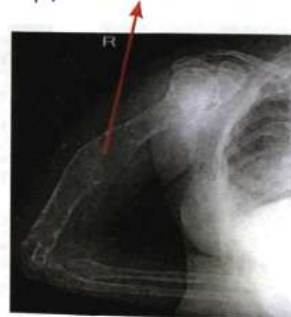
Types $\begin{cases} \text{monostotic (m/c)} \\ \text{Polyostotic} \end{cases}$

Biopsy (Best ix) :

Chinese letter pattern appearance.

**X-Ray :**

1. Ground glass appearance



2. RIND sign



3. Shepherd crook deformity :

**Syndromes associated with fibrous dysplasia :**

1. McCune-Albright syndrome :

- Polyostotic fibrous dysplasia (multicentric).
- Pigmentation : Café au lait spots.
- Precocious puberty.

2. Mazabraud syndrome :

- Polyostotic fibrous dysplasia.
- Intramural (muscular) myxomas.

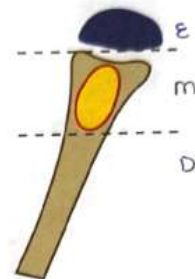
Bone Cyst

00:34:51

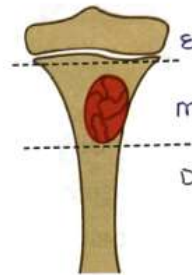
----- Active space -----

simple bone cyst (SBC) v/s Aneurysmal bone cyst (ABC) :

simple bone cyst (SBC)	Aneurysmal bone cyst (ABC)
unilocular	multi-loculated
symmetrical expansion	Assymetric expansile/ballooning
centric	Eccentric
metaphyseal	
10-20 years old	
Proximal humerus	Around the knee
Contains clear/straw coloured fluid	Contains blood
Ex:	
- Aspiration ± injection of steroids/sclerosants - Excision & curettage with autologous bone graft	Extended curettage using liquid nitrogen, phenol or bone cement



Simple bone cyst



Aneurysmal bone cyst

Note : Extended curettage is also done in giant cell tumor.

Radiological features of simple bone cyst :



Simple bone cyst

Growth plate (+)
(child)

metaphyseal lesion



Fallen leaf sign

Chip of the cortex breaks
& freely falls down

Trap door sign

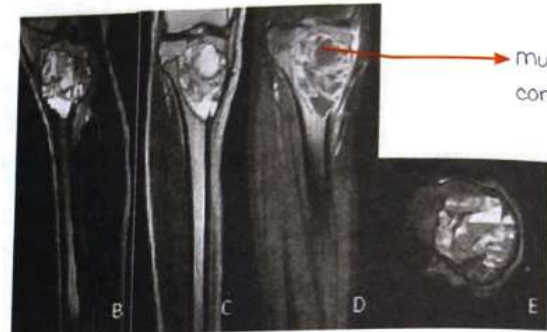
Chip of bone hinges
at the cortex

----- Active space ----- Radiological features of aneurysmal bone cyst :



Aneurysmal bone cyst

- Growth plate (+)
(Indicates its a child)
- multiloculated lesion in the metaphysis



MRI of aneurysmal bone cyst

multiple fluid containing levels

Note :

1. D/D for multiple fluid containing levels :

- Aneurysmal bone cyst.
- Giant cell tumor.
- Telangiectatic osteosarcoma.

2. D/D for cystic lesion of bone :

Centric	Eccentric
• Simple bone cyst • Enchondroma • Brodie's abscess	• Giant cell tumor • Aneurysmal bone cyst • Non ossifying fibroma

ORTHOPAEDIC ONCOLOGY : PART 2

----- Active space -----

cartilaginous lesion & calcifications :

- chondrocyte predominant.
- popcorn calcification/Ring and arc calcification/O ring sign :
 - chondroma.
 - osteochondroma.
 - chondrosarcoma.



Popcorn calcifications

Chondrocyte Predominant Tumors

00:01:04

OSTEOCHONDROMA/EXOSTOSIS

General features :

- m/c benign bone tumor.
- m/c site : Distal femur.
- Presents as mass around the joint.
- sessile/pedunculated.
- Developmental malformation of growth plate : Aberrant development.
- Follows normal direction of growth : Epiphysis to metaphysis (Away from the joint).
- Stops growing after skeletal maturity (Not a true tumor).

Clinical features :

- Asymptomatic, grows with skeleton.
- Stops growing after skeletal maturity.
- Pain.
 - Bursitis (m/c cause).
 - Nerve compression.
 - Fracture.
- malignant transformation → Chondrosarcoma.

Signs :

- >2 cm cap (On MRI).
- Heavy calcification of cap (On X-ray).
- Persistence of growth after skeletal maturity.



X-ray osteochondroma

----- Active space -----

management :**Radiological features :**

- Large to feel but small on X-ray.
- Cartilaginous cap (<2 cm) cannot be visualized.

Architecture of the lesion matches normal bone



CT of osteochondroma.

Treatment :

Extraperiosteal excision after skeletal maturity.

Hereditary/multiple exostosis/diaphyseal aclasis :

- Autosomal dominant inheritance.
- EXT 1, 2 gene mutation.
- 5% cases → Chondrosarcoma.



multiple exostosis

ENCHONDROMA**General features :**

- m/c bone tumor in small bones of hands & feet.
- Location : metaphyseal.
- Rx : Extended curettage + bone graft.

Lucent lesion in metacarpal (Cartilaginous)



Enchondroma

Associated syndromes :**1. Ollier's syndrome**

- multiple enchondromas.
- 30% cases are premalignant.
- very rare.

2. Maffucci's syndrome

- multiple enchondromas.
- Cavernous hemangiomas, lymphangiomas.



Ollier's syndrome



multiple hemangiomas of hand

Note :

- m/c tumor of the hand : Squamous cell carcinoma.
- D/D for enchondroma : Spina ventosa/TB dactylitis.
 - variant of TB involving fingers.

CHONDROBLASTOMA

- AKA **Codman's tumor**.

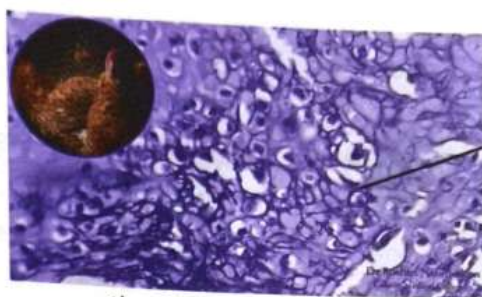
- Epiphyseal lesion.

- m/c in children.

- 10-25 yrs (Before skeletal maturity).

X-ray : Punctate/stippled calcification.

Treatment : Excision curettage with autologous bone graft.



Chondroblastoma : Biopsy

Osteoblast Tumors

00:13:54

OSTEOID OSTEOMA

- m/c **true benign tumor**.

- Children and adolescents.

- Location : Diaphysis.

- m/c site : **Femur**.

- Eccentric/cortical lesion.

Clinical features :

- Central nidus → Produces prostaglandins → Pain.
- Night pain that responds to aspirin.
- Swelling (In thigh or leg).

X-ray :

Central lucent nidus with dense sclerosis around

Osteoid osteoma

Treatment :

- NSAIDs (Pain relief).
- Radiofrequency ablation.
- Excision curettage.
- MR guided focused ultrasound destruction.

OSTEOBLASTOMA

- Central nidus > 2 cm.

- Occurs in spine.

- May not respond to aspirin.

- Risk of malignant transformation → **Osteosarcoma**.

Treatment :

- Surgical excision.



Osteoblastoma

----- Active space -----

Giant Cell Tumor/Osteoclastoma

General features :

- Locally aggressive.
- Location : Epiphysio-metaphyseal.
- Females > males.
- Age : 20-40 years (After skeletal maturity).
- Site :
 - Distal end of femur (m/c).
 - Proximal end of tibia.
 - Distal end of radius (Classical).
- m/c tumor occurring in distal end of radius : Osteoclastoma.



Osteoclastoma/Giant cell tumor

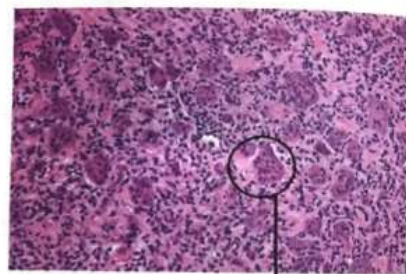
Clinical features :

Eggshell crackling (Thin cortex breaks on palpation).

X-ray : Soap bubble appearance (Left over bony trabeculae after destruction).

Biopsy :

- multinucleated osteoclast like giant cells, surrounded by mononuclear cells (Tumor cells).
- Tumor cells → ↑ RANK ligand production.



Osteoclastoma : multinucleated osteoclast like giant cells

Treatment :

- Extended curettage with liquid nitrogen, phenol or bone cement (To destroy residual cells).
- Followed by autologous bone graft.

Mnemonic : E

- Epiphyseal location.
- Occurs after epiphyseal fusion.
- Eccentric.
- Expansile.
- Eggshell crackling.
- Extended curettage.

Giant cell tumor variants :

Tumors rich in giant cells :

- Non-ossifying fibroma (m/c).
- Aneurysmal bone cyst (Closest resemblance).
- Chondromyxoid fibroma.
- Chondroblastoma.
- Fibrous dysplasia.
- Simple bone cyst.
- Brown's tumor.
- Osteosarcoma (Telangiectatic).

----- Active space -----

Note :

1. <5% cases : Risk of malignant transformation.

- 2° osteosarcoma.

- Fibrosarcoma.

- malignant fibrous histiocytoma (Pleomorphic sarcoma).

} 3% metastasise to lungs.

2. 20% cases : Local recurrence.

Hemangioma

00:29:43

General features :

- Occurs in elderly population.
- Benign, asymptomatic vascular bone tumor.
- Site : Spine > Skull > Pelvis.

Radiological features :

X-ray :

- Vertical striations : Jail bar/jail house appearance.
- Corduroy appearance.



Jail bar/jail house appearance

CT scan :

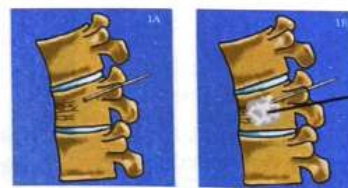
Polka dot sign (Axial view).



Polka dot sign

Treatment :

- Conservative.
- Radiotherapy.
- Vertebroplasty.



vertebroplasty

Injecting bone cement

Chondrosarcoma

00:31:04

General features :

- Location : metaphysis.
- Age : 40-50 yrs.
- Site : Pelvis, proximal femur (Calcified tumor).
- A/w paraneoplastic syndrome : Hyperglycemia.

X-ray :

Endosteal scalloping and punctate calcification.



Chondrosarcoma

----- Active space -----

Osteosarcoma

00:32:43

General features :

- m/c bone tumor seen in children.
- Bimodal presentation
 - 2nd decade : 1° osteosarcoma.
 - Older population : 2° osteosarcoma.
(D/t paget's disease or radiation exposure)
- 1° osteosarcoma > 2° osteosarcoma.
- Radiation-induced osteosarcoma usually occurs 10 yrs after exposure.
- Location :
 - metaphysis.
 - Distal end of femur.
- most radio-resistant tumor.
- m/c radiation induced bone tumor.
- Bone forming tumor : Forms abnormal osteoid and matrix.
- 15% cases : micrometastasis to lungs during presentation
 - ↓
 - Pneumothorax.

X-ray :

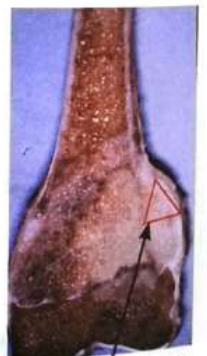
Periosteal reaction

Elevated
periosteum

Codman's triangle

Sunburst
appearanceCalcified
Sharpey's fibres

Calcified Sharpey's fibres



Codman's triangle

Gross specimen :**Types :**

1. Classical/intermedullary (m/c).
2. Periosteal.
3. Parosteal.
4. Telangiectactic.

Treatment :

Neoadjuvant chemotherapy (Prior to surgery)

Surgery/limb ablation

Adjuvant chemotherapy (Post surgery)

chemotherapeutic agents : T10 protocol.

- Actinomycin.
- Cyclophosphamide.
- Bleomycin.
- High dose methotrexate.
- Doxorubicin.
- Vincristine.

----- Active space -----

Ewings Sarcoma

00:38:18

General features :

- m/c tumor in 1st decade of life.
- Occurrence : m/c in 2nd decade (5-20 yrs).
- Location : Diaphysis of femur (mid thigh swelling).
- males > females.
- High grade sarcoma.

Poor prognostic features :

- metastasis.
- male.
- Fever, anemia.
- ↑ ESR.
- Age > 12 yrs.
- Leukocytosis.
- Chemoresistance.
- Relapse.
- Size of the lesion.

Clinical features :

- Presents like infection.
- mid thigh/leg swelling.
- Signs of inflammation.
- Incidental h/o trauma.

X-ray :

Onion peel/lamellated appearance.



Onion peel/lamellated appearance

Biopsy : Best Ix

- Small, round blue cells with pseudo-rosettes.
- PAS +ve & Diastase digestible.
- MIC-2 (CD99) on immunohistochemistry :
Specific marker.
- Karyotyping : Translocation $t(11;22)$ m/c.
Other translocations :
 - $t(2;12)$, $t(7;22)$.
 - Trisomy 18.
 - Trisomy 12.

Treatment :

- Radiosensitive (But radiotherapy is not preferred d/t ↑ chance of recurrence).
- Current trend : Chemotherapy + limb salvage/resection ± adjuvant radiation.

Note :

Primitive neuroectodermal tumors with small blue round cells on HPE :

- Neuroblastoma.
- Retinoblastoma.
- medulloblastoma.

Miscellaneous Tumors

00:43:49

Chordoma :

- Origin : Physaliferous cells of primitive notochord.
- m/c location : **Sacrum**, base of skull, vertebrae.
- Occurs in **elderly**.

Adamantinoma :

- Low grade **malignant epithelial tumor** (That grows into bone).
- m/c bone : **Tibia** (Subcutaneous bone).
- Location : Diaphysis.



Diaphyseal soap bubble appearance

Synovial sarcoma :

- Does not arise from synovium.
- Arises from capsule, bursae or tendon.
- D/t **t(x;18)** → **SYT : SSX fusion gene**.

Metastasis

00:45:58

- m/c malignant bone tumor : **metastasis**.
- Source : Breast > Prostate > Lungs.
- m/c go to : **Lumbar vertebrae** > Thoracic vertebrae.

Characteristics of secondaries :

1. Purely blastic :

- **Prostate**.
- medulloblastoma.
- Carcinoids.

2. Purely lytic :

- **Kidney (RCC)**.
- Follicular carcinoma of thyroid.

3. mixed : Breast (Or only lytic).

Destruction of pedicle



Winking owl sign

Bone to bone metastasis :

1. Ewing sarcoma.
2. Osteosarcoma.

Note :

1. m/c primary malignant bone tumor : **multiple myeloma** > Osteosarcoma.
2. m/c non hematological malignant bone tumor : **Osteosarcoma** > Chondrosarcoma.
3. m/c benign bone tumor : Osteochondroma.
4. m/c true benign bone tumor : Osteoid osteoma.

INFECTION OF BONE AND JOINTS

----- Active space -----

INFECTIONS OF SKELETAL SYSTEM

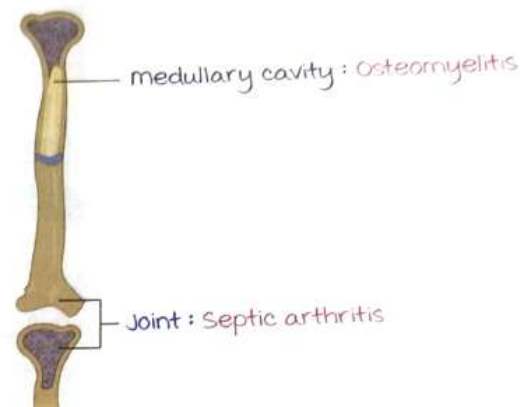
Based on site of infection :

Osteomyelitis :

- Bone & medullary cavity.
- m/c location : metaphysis of long bone.

Septic arthritis :

- Joint



Bone infections

Etiology :

Bacteria (m/c)

Pyogenic organisms :

Severe local/periosteal reaction

TB :

- Limited local reaction
(↓ inflammatory reaction)
- TB of short bones (Hand & foot) → Severe local reaction.

Osteomyelitis

00:03:08

In young children or elderly population : D/t relatively low immunity.

Routes/source of infection

- Hematogenous (m/c) : From pre-existing infection.
- Direct (Eg : Puncture wounds)
- Post surgical (iatrogenic)
- Open fracture.
- Septic arthritis : Joint Infection → Bone.

Etiology

Staphylococcus aureus :

- m/c organism infecting musculoskeletal system.
- m/c cause of :
 - Osteomyelitis overall.
 - Acute osteomyelitis.
 - Chronic osteomyelitis.
- m/c cause of osteomyelitis in :
 - Developed countries.
 - Developing countries.
 - Immunocompromised (HIV/AIDS).
 - Open fracture.
 - Post surgical.

----- Active space ----- Special cases :

Osteomyelitis in	Organism
Sickle cell disease patients	<i>Salmonella</i> → Diaphyseal involvement (If metaphysis involved : <i>Staphylococcus aureus</i>)
IV drug abusers	<i>Pseudomonas</i>
Following animal bite	<i>Pasteurella</i>
Following Human bite	<i>Eikenella</i>
Prolonged parenteral therapy	Fungal organisms

Site :

m/c :

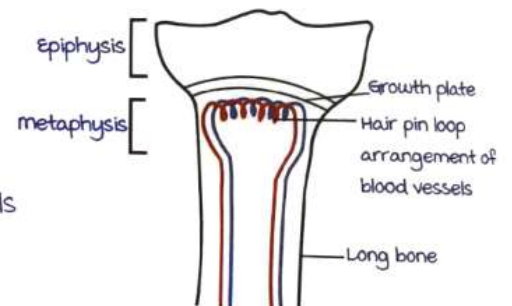
- Overall/infant/children : *Femur* (Distal > proximal) > *Tibia*.
- Adult : *vertebrae*.

Reasons of metaphyseal involvement :

- most vascular region of bone
(↑ nutrition for organism).
- Hair pin loop arrangement of blood vessels

↓
sluggish blood flow (Easy exit to bone).

- Few monocytes & macrophages
(↓ protection).

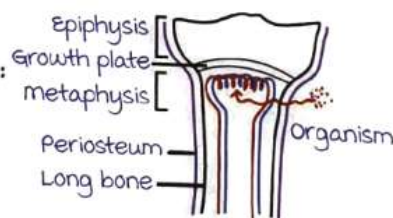


Pathophysiology & Clinical Features

00:11:07

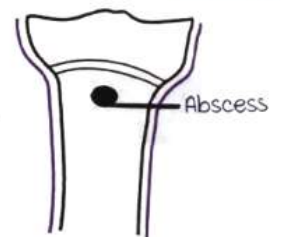
Pathophysiology :

Acute osteomyelitis :

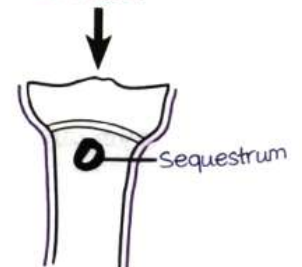


1. organism reach metaphysis : <24 hours
-Systemic manifestations : Fever, pain.

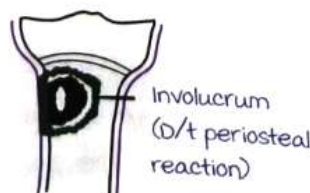
Chronic osteomyelitis :



2. Abscess formed : After 24 hours.

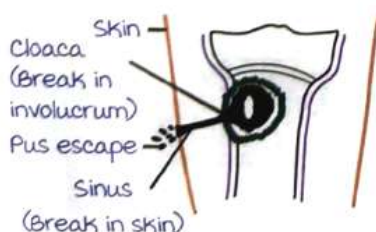


3. Sequestrum (Dead bone) formed



4. Periosteal reaction : 7-10 days

Involucrum (New bone that contain the spread of infection)



5. Cloaca
↓
Sinus
- Pus drains out

Clinical features :

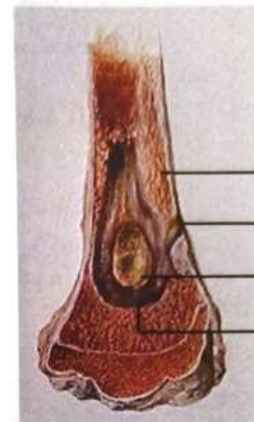
Young child presents with :

- High grade fever.
- Pain & swelling.
- Pseudo paralysis : Patient doesn't move limb d/t pain.

Note :

Causes of pseudo paralysis

- Septic arthritis
- Osteomyelitis
- Scurvy (vit C deficiency) :
Subperiosteal hemorrhage → Pain.



Osteomyelitis

	Acute	Chronic
Clinical hallmarks	Not specific (Fever & pain)	Sinus
Pathological hallmarks	Abscess	Sequestrum

Management & Complications of Acute Osteomyelitis

00:23:38

INVESTIGATIONS

Blood investigations :

- Blood culture : 50% +ve.
 - WBC : Neutrophil
 - ESR
 - CRP
 - Serum procalcitonin.
- High, not specific.
- Sensitive & specific marker for
- Acute osteomyelitis.
 - Septic arthritis.

Radiology :

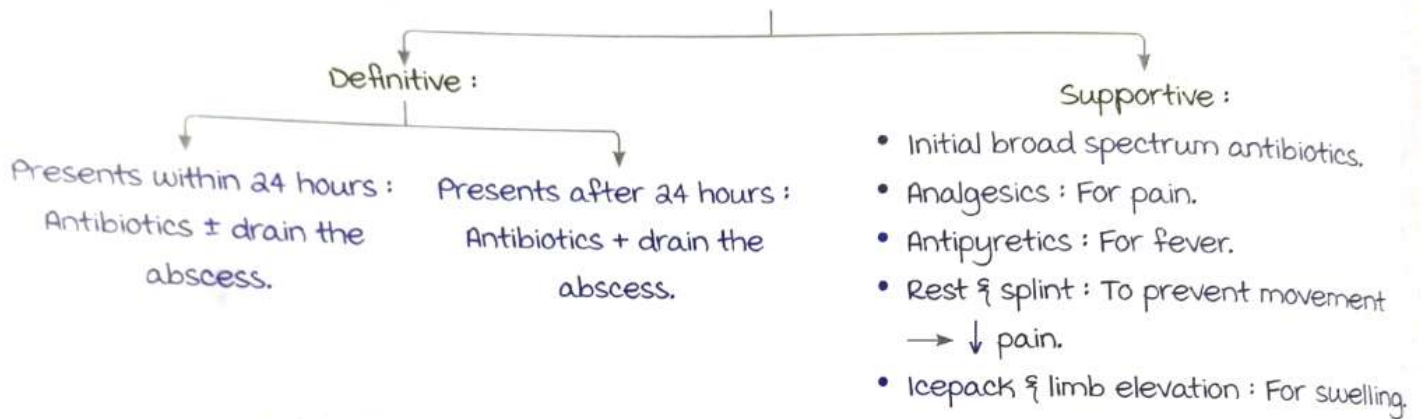
- MRJ :**
 - Picks up earliest changes within 24 hrs of disease onset : marrow edema.
- Bone scan :**
 - Technetium 99
 - Gallium 67
 - Indium III labelled WBC

Accumulation in infection
- X Ray :**
 - Changes detected after 24 hours of disease onset.
 - Earliest X-ray change (within 48 hours) : Soft tissue lucency/shadow around bone.
 - Earliest bony changes on X-ray (7-10 days/2 weeks) : Periosteal reaction..

----- Active space -----

Biopsy :

- Gold standard.
- Tissue sample collected from site of infection.

TREATMENT**Antibiotics :**

- 6 weeks : 2 weeks IV → 4 weeks PO.
- Long duration d/t low penetration of drug in bone.
- Response assessed using CRP measurements.

COMPLICATIONS

1. Chronic osteomyelitis : m/c.
2. Septic arthritis : Bone $\xrightarrow{\text{Infection}}$ Joint.
 - Prevented by growth plate.
 - Common in :
 - <2 yr : before growth plate formation.
 - Adults : After growth plate fusion.
3. Septicemia.
4. Growth disturbance.

Note : Duration

- Acute : <2 weeks
- Subacute : 2-4 weeks.
- Chronic : >4 weeks.

Chronic Osteomyelitis

00:33:27

- Sequelae/complication of acute osteomyelitis.
- >4 weeks following infection.
- Clinical hallmark : Sinus.



SEQUESTRUM

- Pathological hallmark of chronic osteomyelitis.
- Dead, dense, devascularized bone inside abscess.
- Surrounded by granulation tissue and involucrum.
- Microscopically: Destruction of haversian system.

----- Active space -----



Chronic osteomyelitis

Types of sequestrum :

Sequestrum	Associated conditions
Coraliform	Perthe's
Annular/ring	Amputation stump/pin tract sites
Tubular/diaphyseal	Acute pyogenic osteomyelitis
Feathery/flake/coarse sandy	Tuberculosis (TB)
Fine sandy	Viral osteomyelitis
Button hole	Post radiation
Ivory	Syphilis



Infection around pin tract

MANAGEMENT & COMPLICATIONS**Investigations :**

- Blood investigations : Culture, WBC, ESR, CRP.
- Radiology :
 - X-Ray : Sequestrum, involucrum, cloaca
- Sinogram : Dye injected through sinus → Anatomy of sinus tract seen → Plan Rx.
- Biopsy : Gold standard

Treatment :**Initial :**

- Broad spectrum antibiotics.
- Supportive treatment.

----- Active space ----- Definitive : Surgery.

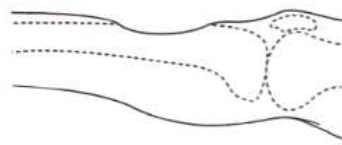
Antibiotic cover

Sequestrectomy : Removal of sequestrum.

Curettage : Till fresh bleed seen → Paprika sign



Debridement : Saucerization (wide mouth cavity made)



Closure of dead space with :

- Bone graft.
- Bone cement.



Skin covering with:

- Skin flap.
- muscle flap.
- Vacuum assisted covering (VAC)/Negative pressure wound therapy :
 - -75 to -120 mmHg
 - Promote granulation tissue formation
 - C/I : Eschar tissue or tumor.



VAC

Complications :

1. Pathological fracture (m/c).
2. Acute exacerbation.
3. Squamous cell carcinoma (SCC) : D/t Neoplastic changes of sinus tract.
4. Amyloidosis.

Variants of Osteomyelitis

00:44:13

----- Active space -----

No sinus or sequestrum.

Pathogenesis :

- Patient has good immunity.
 - Organism has low virulence.
- } Infection contained.

Types :

	Brodie's abscess	Garre's Sclerosing Osteomyelitis
Course	Subacute	Chronic
m/c site	Tibia (Proximal end)	mandible > tibia
Pus	+	-
Clinical feature	• Acute dull aching pain • Low grade fever	Bony swelling
Elevated ESR & CRP	+	-
X-Ray	 Thick sclerotic rim Central lucency	 Thick dense bone (d/t excessive periosteal reaction)
MRi	Penumbra sign : Central lucency surrounded by dense sclerotic rim 	-
Rx	Antibiotics ± Debridement	Antibiotics

----- Active space -----

Septic Arthritis

00:48:55

Introduction

- Surgical emergency : If pus not removed from joint immediately → Destruction of joint.
- Children (<5 years) > Elderly people (relatively low immunity)

Route :

m/c : Hematogenous

Site :

- m/c site : knee (ends of bone exposed).
- Infants : Hip (Tom Smith arthritis).

Organism :

- m/c : Staphylococcus aureus.
- IV drug abusers : Pseudomonas.
- Sexually active : Gonococcus.

Clinical features :

Young child presents with :

- High grade fever.
- Local inflammatory features :

- Swelling.
- Redness.
- Pain (Effusion in joint → Capsule stretches)

No movement at joint

- Joint in position of ease → ↑ volume of joint.
↓ capsular stretching
↓ pain.

- Signs : Patellar tap sign +ve

Hip : FABER

- Flexion
- Abduction
- External rotation

Knee : 5-30° flexion



Position of ease

Investigations :**1. Blood investigations :**

- CBC, ESR, CRP, TLC, blood culture.

2. Radiology**→ X-ray**

- Early : No changes ± widening of joint space.
- Late : Destruction of joint.

→ MRI : Synovial thickening.**→ USG guided arthrocentesis : Diagnostic & therapeutic.**

Bony ankylosis

Treatment:

Arthrotomy (TOC): Irrigation & debridement of septic joint contents under antibiotic cover.

Complication:

1. Bony ankylosis: End sequelae of neglected septic arthritis.

organisms release proteolytic enzymes: Collagenases, metalloproteinases, elastases.

Destroy articular cartilage → Raw ends of bone exposed → Heal with fusion → Bony ankylosis.

a. Fusion of bone:

Ankylosis (Fusion d/t disease process)

	Bony	Fibrous
Fusion between using:	Bony	Fibrous tissue
Causes:	Pyogenic septic arthritis TB spine (Spondylitis)	TB arthritis
movement ↓ Pain:	(-)	(+)
Stability of joint:	Stable	Unstable

Arthrodesis (Surgical fusion)

Eg: Neglected CTEV → Triple arthrodesis.



Arthrodesis

01:02:59

Tom Smith Arthritis

Septic arthritis of hip in infancy (<1 year).

Emergency: Need immediate intervention to preserve hip functions.

Pathogenesis:

Disease process (Pus & proteolytic enzymes)

Destroy capital femoral epiphysis (Cartilaginous in children)

Chondrolysis.

Clinical features:

- Hyper mobility of hip joint.
- Limb shortening.
- Telescopy test (+).

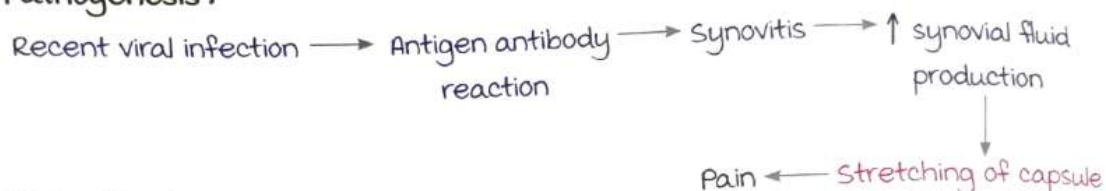


Septic arthritis

----- Active space -----

Transient Synovitis

- Self limiting inflammation of synovium.
- Age group : 6-12 years.

Pathogenesis :**Clinical features :**

- Pain.
- Limp.
- mild fever.
- Position of ease.

management :**Investigation :**

- Blood investigation : ESR, CRP, TLC.
- Aspiration of joint : **Best investigation** to differentiate from septic arthritis.

Treatment : Observation (Transient synovitis also called observation hip).

Kocher's criteria :

To differentiate between transient synovitis & septic arthritis.

- Difficulty in weight bearing/unable to walk.
- Temperature $>38.5^{\circ}\text{C}$ (101.3°F).
- ESR >40 mm/hr
- WBC $>12,000$ cells/ mm^3 .

- Each criteria has 1 point
- ↑ point → ↑ chance of septic arthritis.

Note :

Cause of limp in child : Transient synovitis (m/c) > septic arthritis > Perthes' disease

Infections of Hand**Paronychia (Running around the nail) :**

- m/c infection of hand.
- Infection around the nail and nail bed.

m/c organism : Staphylococcus aureus.



Paronychia

Treatment :

Antibiotics + drainage of abscess + removal of part of nail (if infection reaches nail bed).

----- Active space -----

Felon/whitlow :

Infection of subcutaneous tissue (Pulp) of the finger (Distal phalanx).

Finger affected : Thumb (m/c) > index finger.

m/c organism : Staphylococcus aureus.

Complications :

- Osteomyelitis of phalanx.
- Tenosynovitis.

Treatment : Antibiotics + incision (vertical incision to break adhesions/septae that hide infection) & drainage.



Felon/whitlow

Tenosynovitis :

Infection of tendon/tendon sheath.

m/c organism : Staphylococcus aureus.

Clinical features :

- Symptoms :
 - Fever.
 - Flexion attitude.
 - Fusiform swelling of fingers.
 - Pain on passive extension.
- Signs : Kanavel sign +ve (Pain on tapping affected tendon).



Tenosynovitis

Treatment : Antibiotics + incision & drainage



Tenosynovitis

----- Active space -----

TUBERCULOSIS OF BONE AND JOINTS

INTRODUCTION

AKA *Caries/koch's disease*.

Less severe local manifestation compared to pyogenic bacteria.

Faucibacillary infection by Koch's weak bacillus.

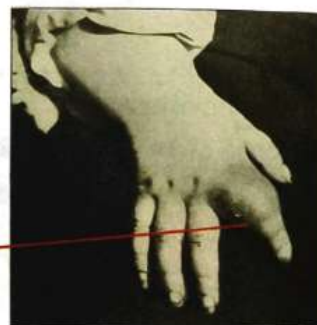
Organism : *Mycobacterium tuberculosis*. Route : Hematogenous (From 1° source).

m/c site :

- In the body : *Lung*.
- In musculoskeletal system : *Spine* (TB spondylitis) > hip > knee.
- In spine : *Dorsolumbar* > dorsal > lumbar
 - In children : Cervical spine.

Variants :

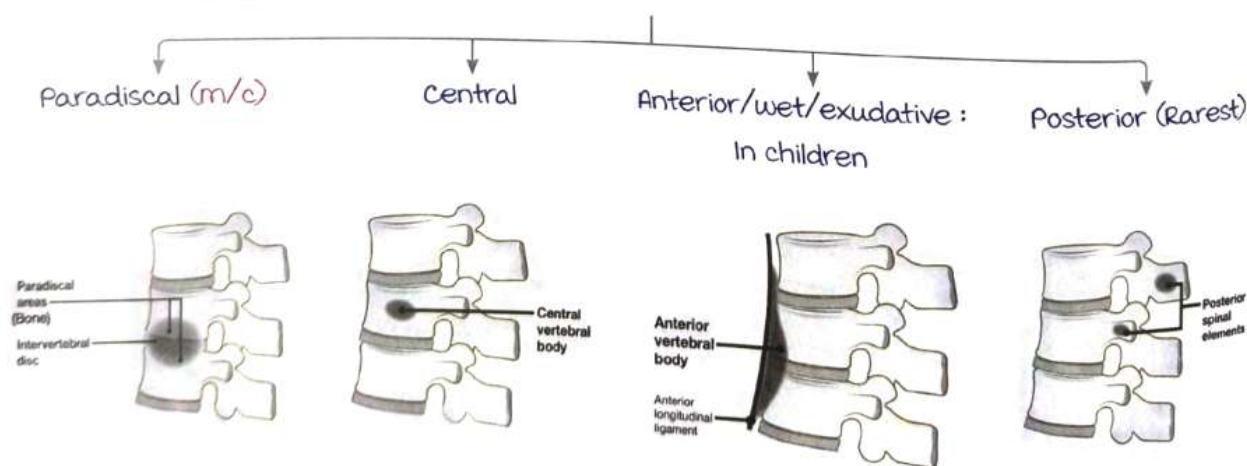
- *Caries sicca* : TB shoulder.
 - Dry/non-exudative TB
- *Spina ventosa* : TB fingers.
 - 'Filling up of air' like appearance of fingers.



TB Spine/TB Spondylitis/Pott's Spine

00:02:53

TYPES :



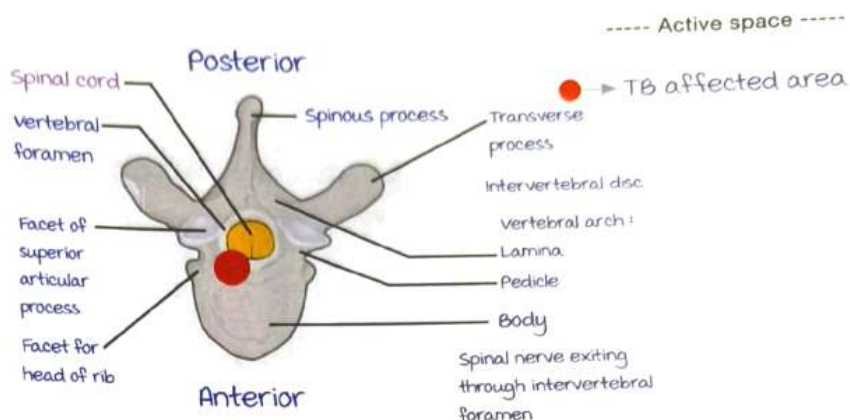
Paradiscal :

- 2 vertebrae involved :

Lower half of upper vertebrae
+ disc + upper half of lower
vertebrae.

(D/t development from common
somite/sclerotome → Common
blood supply).

- Anterior to spinal cord.



CLINICAL FEATURES

Constitutional features :

- Low grade fever.
- Malaise.
- Night pains.
- Evening rise of temperature.

Local findings :

- Back pain (Earliest symptom) & Paraspinal spasm/tenderness (Earliest sign)

military attitude ← Cautious gait

- Cold abscess.
 - Deformity (D/t vertebral collapse)
- Spinous process felt prominently on palpation :
- Knuckle : Prominence of 1 spinous process.
 - Gibbus : Prominence of 2-3 spinous process.
 - Angular Kyphosis : Prominence of >3 spinous process.

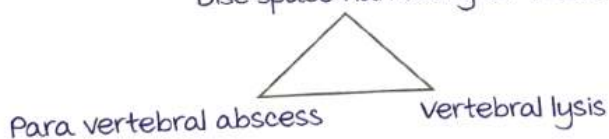


Gibbus formation

INVESTIGATION & COMPLICATIONS :

1. X-ray :

Disc space narrowing (D/t destruction/dessication of disc) : Earliest



mRI

2. MRI : IOC

- Disc involved.
- Paradiscal disease involving bone and cartilage.

3. CT guided biopsy : Gold standard
Organism identified from tissue.

Complication/end sequelae :

Neglected TB spine → Bony ankylosis.

Note : TB anywhere else → Fibrous ankylosis.

----- Active space -----

POTT'S PARAPLEGIA

TB spine (Pott's spine) → Compresses on spinal cord → Neurological manifestations.

Causes :

1. Mechanical : D/t granulation tissue.
2. Cord edema : D/t inflammation
3. Thrombosis of spinal artery → Ischaemia of spinal cord → Rapid onset paraplegia (Poor prognosis).



MRI : Cord compression

Clinical features :

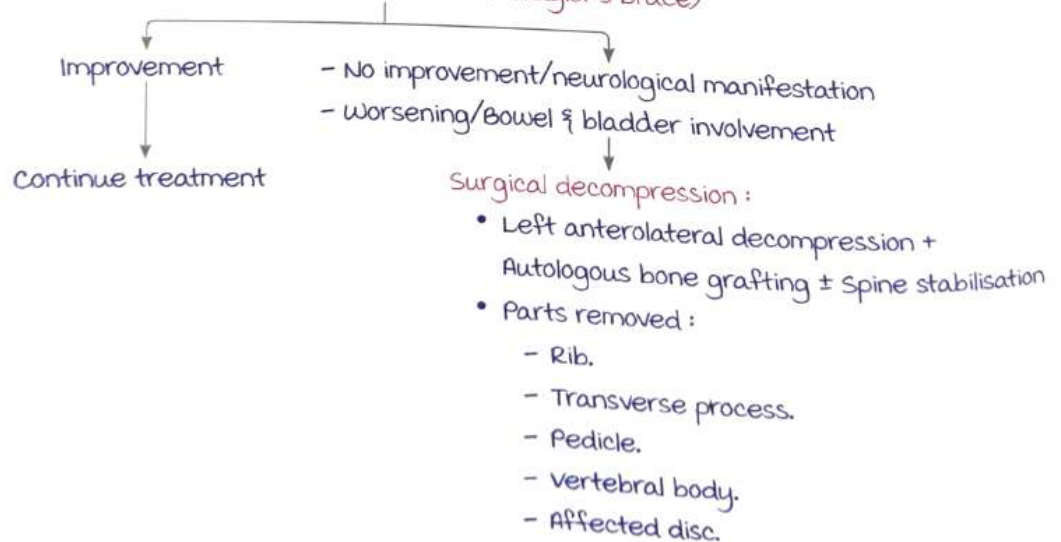
- Early neurological manifestations (UMN finding)
 - Ankle clonus/exaggerated deep tendon reflexes.
 - Extensor plantar.
- Late : Bowel & bladder involvement → Poor prognosis.

Prognostic factors :

	Better prognosis		Bad prognosis	
Age	Younger		Older	
Speed of onset	Slow		Rapid	
Onset	Early	Compression d/t granulation tissue	Late	Compression d/t bony deformity
Duration of cord involvement	Shorter history		Longer (>12 months)	
Vertebral disease	Active/exudative/wet		Healed	

TREATMENT**middle path regimen :**

ATT for 18-24 months + rest + brace (Taylor's brace)



TB SPINE VS METASTASIS (D/D)

----- Active space -----

MRI :

Disc involved (Bad disc) → TB spine (Good prognosis).
 Disc spared (Good disc) → metastasis (Bad prognosis).



MRI : TB spine (Disc involved)



MRI : metastasis (Disc spared)

X-ray :

metastasis : **winking owl sign** (D/t destruction of pedicle)



Absent pedicle →



Winking owl sign

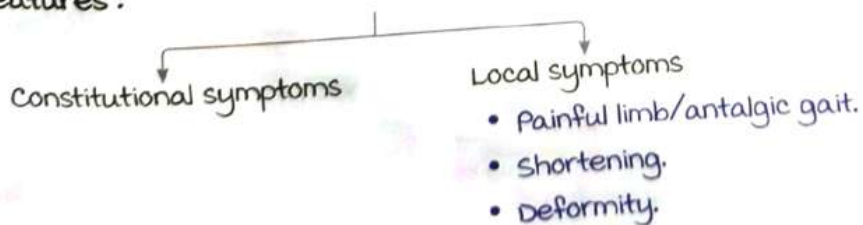
00:21:16

TB Hip

Site/first focus of appearance :

- Acetabulum.
- **Babcock's triangle**.
 - Area in neck of femur.
 - Deficient in monocyte & macrophage → Organism grows easily.

Clinical features :



----- Active space ----- **Stages :**

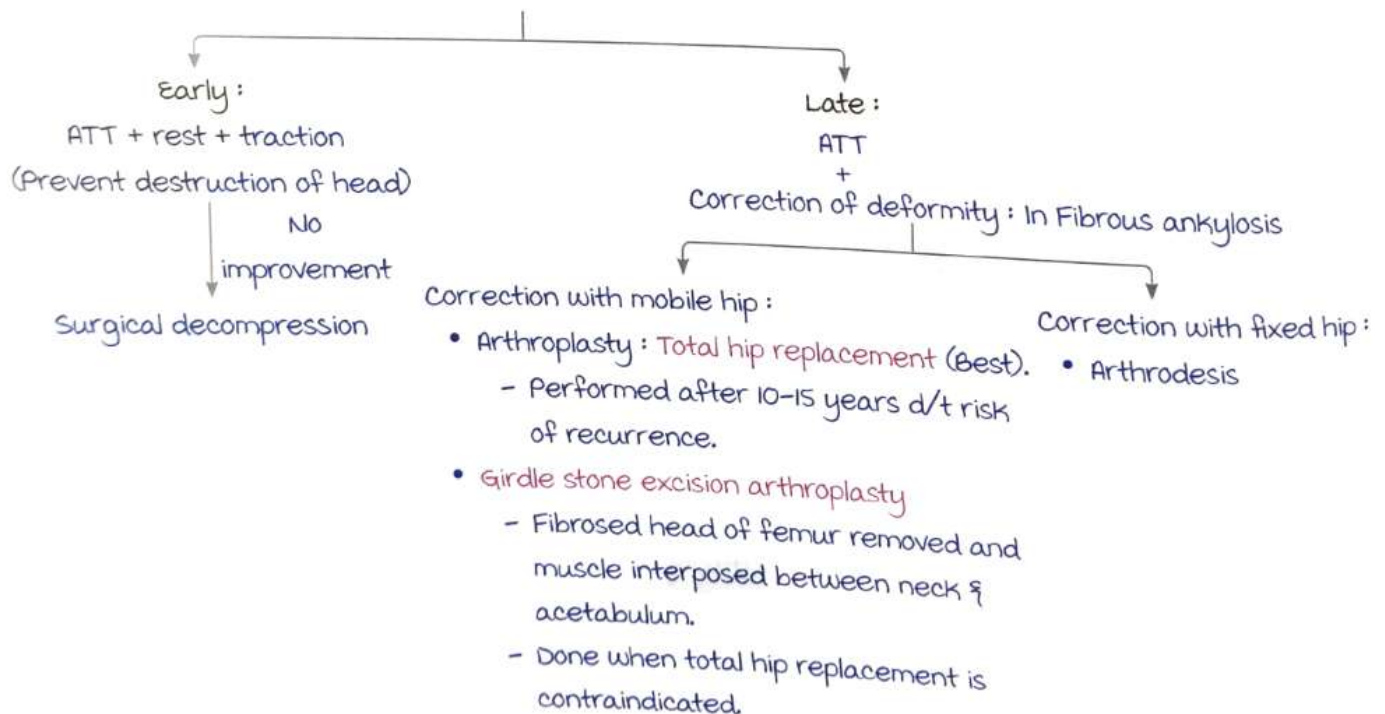
Stage I	Synovitis/stage of apparent lengthening	Inflamed synovium $\rightarrow$ $\uparrow$ synovial fluid secretion $\rightarrow$ distension of capsule $\rightarrow$ pain $\rightarrow$ position of ease (Flexion, abduction, external rotation)
Stage II	Early arthritis/stage of apparent shortening	- Destruction of articular cartilage begins - Flexion, adduction, internal rotation - Apparent shortening < 1 cm
Stage III	Late arthritis/stage of true shortening	- Significant destruction of articular cartilage - Flexion, adduction, internal rotation - True shortening > 1 cm
Stage IV	Advanced arthritis/wandering acetabulum	Destruction of head of femur (Small head against large acetabulum) $\rightarrow$ Pestle and mortar deformity
Stage V	Fibrous ankylosis	Painful, unstable hip with limited mobility

Investigation :

X-ray :

Phemister triad :

1. Juxta articular osteopenia/osteoporosis : **Earliest** sign in X-ray
2. Peripheral osseous erosions.
3. Narrowing of joint space.

Treatment :

TB knee

00:27:48

----- Active space -----

Clinical features :

Constitutional symptoms

Local symptoms :

- Painful limb/Analgic gait.
- Attitude of knee : $5-30^\circ$ flexion (Postion of ease d/t initial synovitis leading to effusion).
- Shortening.
- Deformity :

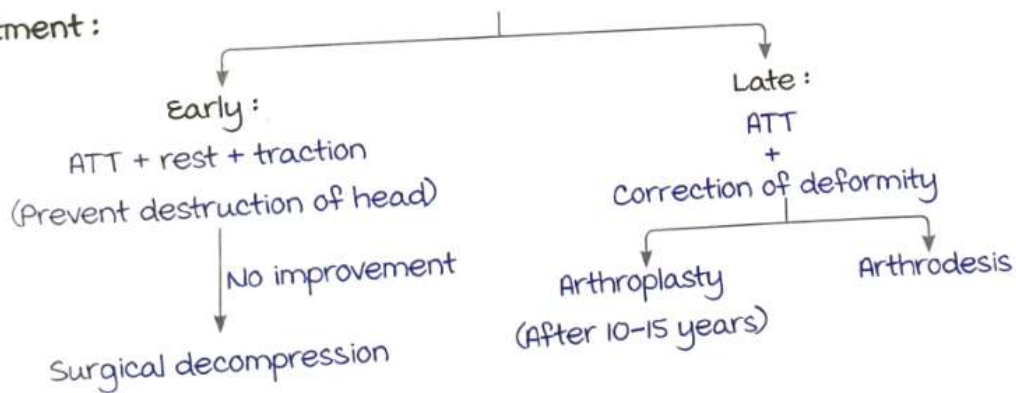
Triple deformity in late stage : PERF

1. Posterior subluxation of knee.
2. External Rotation of tibia.
3. Flexion of knee.

Investigations :

- MRI (IOC) : Synovitis seen.
- Biopsy : Gold standard.

Treatment :



Note :

- Non healing sinus in chronic osteomyelitis : D/t presence of sequestrum.
- Periosteal reaction not seen in tubercular osteomyelitis.
- Part of vertebrae least involved in TB spine : Spinous process.
- Paraplegia in TB spine commonest in upper thoracic region (Spinal cord thicker → Easier to compress).
- Charcot's joint seen in :
 - Syphilis.
 - DM.
 - Syringomyelia.

----- Active space -----

PAEDIATRIC ORTHOPAEDICS : TRAUMA, NECK AND UPPER LIMB

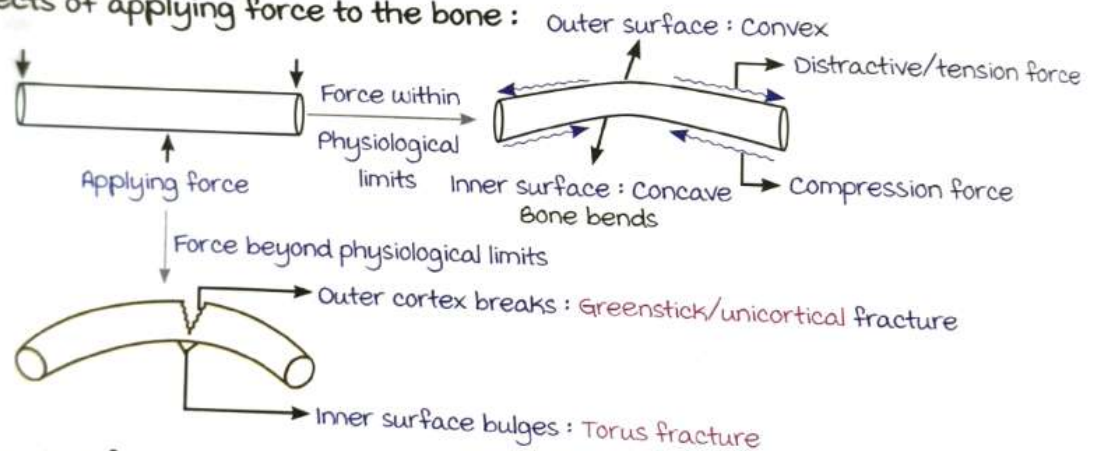
Characteristics of paediatric bones :

1. more water content :
 - Flexible and resilient to stress.
 - Bends > breaks.
2. Thicker periosteum.
3. Potential to remodel & correct deformities and fractures (Especially metaphysis).

Paediatric Fractures

00:02:52

Effects of applying force to the bone :



Greenstick fracture :

- m/c fracture occurring in children.
- mimics stem of a growing tree.
- Location : Radius > ulna.

Treatment : Break the other intact cortex (Osteoclasis) → Realign the bone.



Greenstick fracture



Torus fracture

Torus fracture :

- Occurs d/t buckling of bone.
- Resembles a tubular cylinder at base of a pillar.

Treatment : POP application.

Note :

1. m/c fracture at birth : Clavicle.
2. m/c fracture in a child after fall on outstretched hand : Supracondylar fracture.
3. m/c fracture overall : Clavicle.

Toddler's fracture

Spiral fracture of tibia.

Etiology : Trivial accidents.

Features :

- Intact fracture pattern (Undisplaced).
- Well supported fracture (D/t thick periostium).
- Fibula is intact so child can present walking.
 - Can bear weight on fractured bone.
 - Limp d/t pain.

Treatment : POP cast.



X-Ray : Spiral fracture

----- Active space -----

Battered Baby Syndrome

00:10:52

Features :

- multiple fractures (usually metaphyseal) or bruises in different stages of healing.
- Inconsistent history, signs of neglect.
- Long bone fractures in non-ambulatory children.
- Suspicion of battered baby syndrome → X-ray Scanogram.

metaphyseal bucket handle fracture

D/t violent to and fro shaking of children < 2 yrs age

→ Avulsion of capsule from the bone.



metaphyseal bucket handle fracture

Growth Plate Injuries

00:12:43

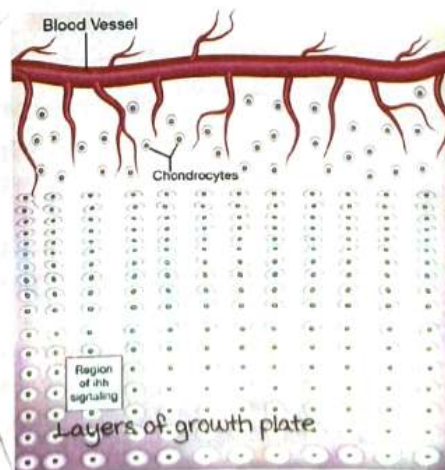
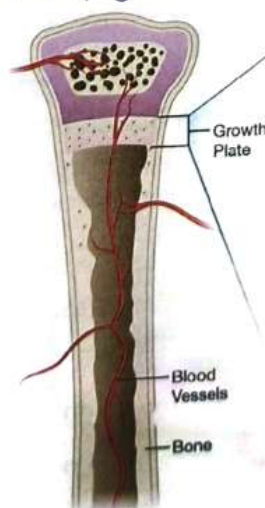
Direction of growth : Epiphysis to metaphysis.

Layers of growth plate :

1. Germinal : most important.
2. Proliferative.
3. Hypertrophic : weakest.
4. Calcification.
5. Ossification.



Growth plate



Growth plate zones

Chondrocyte stem cells in germinal zone

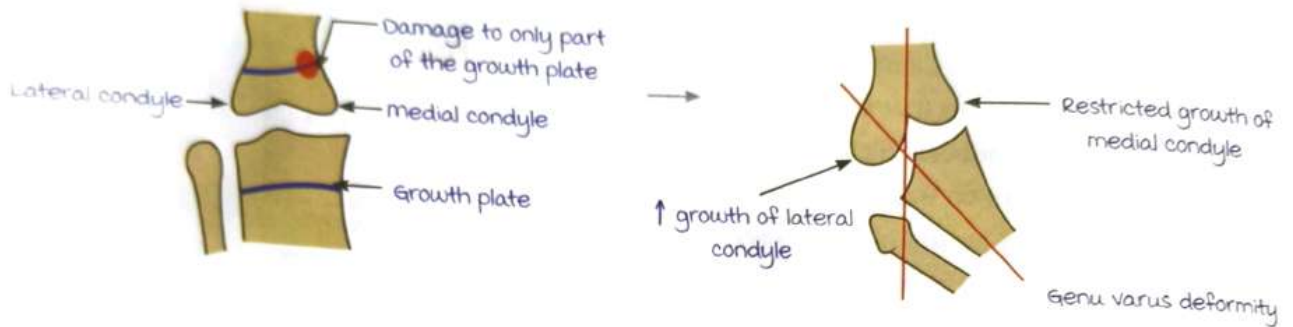
Proliferation zone

Zone of maturity and increase in cell size

..... Active space

Injuries affecting **germinal layer** → Impairs growth → Limb length discrepancy, Deformity.

Example : At the knee



Salter & Harris classification of physeal/growth plate injuries :

Type	Image	Features	Prognosis	Examples
I : Split fracture		- Fracture splits the growth plate without injuring germinal layer. - Normal growth on reducing the fracture.	Good	Slipped capital femoral epiphysis (SCFE)
II : m/c		- Fracture splits the growth plate. - Fracture line goes towards the metaphysis. - No injury to the germinal layer. - Normal growth on reducing the fracture. - metaphyseal fragment : Thurston holland.	Good	Supracondylar humerus fracture
III		- Fracture line splits the growth plate and goes towards the epiphysis. - Germinal layer will be injured. - No growth on reducing the fracture.	Bad	Fracture of lower end of tibia
IV		- Fracture line through all layers. - Germinal layer injured. - Growth is impacted even on reducing the fracture.	Bad	Lateral condyle of humerus fracture
V		- Impaction injury → Crushes growth plate. - Fracture is missed on X ray. - Retrospective diagnosis. - Late presentation with limb length discrepancy.	Worst	Fall from height

Paediatric Deformities

00:25:02

----- Active space -----

CONGENITAL MUSCULAR TORTICOLLIS/WRY NECK

- Tilting of head to one side.
- most commonly occurs on **right side**.

Etiology :

Birth trauma of sternocleidomastoid muscle.

- Breech presentation.
- Shoulder dystocia.
- Forceps delivery.

Pathogenesis :

- Contraction of sternocleidomastoid → Neck tilt.
- Ischemia of SCM → Necrosis of fibrosis → Contracture
 - At junction of upper 2/3rd and lower 1/3rd.
 - Affects **clavicular head** of SCM.

Clinical features :

- Only head tilt is appreciated soon after birth.
- Fibrotic mass maybe palpated 3 months after birth (SCM tumor).

Treatment :

1. Conservative :
 - Gradual stretching of the neck → Corrects itself.
 - most cases are self resolving.
2. Surgical release : If not corrected by 1 year of age.

Complication :

If not corrected by 1 year of age → **Plagiocephaly** (Head grows in an abnormal direction).

Note :

Acquired causes of torticollis : vision problems, extra ocular muscle palsy

SPRENGEL'S DEFORMITY

- Congenital undescended hypoplastic scapula.
- Associated with **Klippel Feil syndrome**.

Etiology :

Presence of **omovertebral bar** → Prevents scapular descent.



Congenital torticollis



Cock robin appearance



Sprengel's deformity : undescended scapula

----- Active space -----

Features :

- One scapula at a higher level than the other.
- Restricted movement of affected shoulder.

Treatment :

- Woodward operation (Between 3-8 years of age).
- If done after 8 years of age → Neural traction injury.

Klippel Feil syndrome :

Strong association with scoliosis.

Cause : **Segmentation defect** of cervical vertebrae.

Features :

- Short webbed neck.
- Restriction of neck movements.
- Low set hair line.

MADÉLUNG DEFORMITY

- Ulna radial mismatch.
- 50% cases are bilateral.

Etiopathogenesis :

Defect in the growth plate of distal end of radius.

- Affects radius growth.
 - Normal ulna growth.
- } **Ulna radial mismatch**



made lung deformity ulnar radial mismatch

Clinical features :

- Prominent ulna dorsally.
- **Dinner fork deformity** in children.

Treatment :

Darrach's procedure : Resect terminal end of ulna.

Limb Deficiency**TYPES****1. Amelia :**

- Both long and short bones absent/complete absence of limb.

2. Phocomelia :

- Long bones absent, short bones present.
- Cause : **Thalidomide**.



Amelia

00:32:38

3. Hemi-melia :

- Longitudinal deficiency of limb.
- m/c : **Fibular hemimelia**.
- Tibial hemimelia : Tibia is absent.
- Radial hemimelia/radial club hand : Absent radius.
 - Longitudinal deficiency of radial side of limb.

----- Active space -----



Fibular hemimelia

Absent fibula



Radial hemi-melia

Absent radius

Associated syndromes :

1. Holt-Oram syndrome.
2. Fanconi syndrome.
3. Tar syndrome.
4. VACTER syndrome.

MISCELLANEOUS

Cleido cranial dysostosis :

- Abnormality in **skull and clavicle**.
- Congenital absence of clavicle.
- Shoulders can be brought close to each other.



Absence of clavicle



Cleidocranial dysostosis

Poland syndrome :

- Congenital absence of muscle.
- m/c : **Pectoralis muscle absence**.



Poland syndrome

----- Active space -----

PAEDIATRIC ORTHOPAEDICS : HIP

Paediatric hip :

Features :

1. Shenton's line :

- Inferior margin of superior pubic ramus (Laterally) → medial part of head and neck.
- Pathology causes disturbance in Shenton's line.

Shenton's line

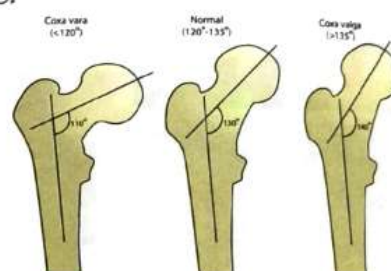
Neck shaft angle



xray of hip

2. Neck-shaft angle :

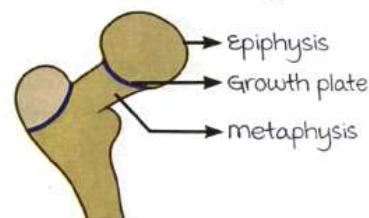
- Normal is $120-130^\circ$ (Adults).
- ↑ neck shaft angle : Coxa valga.
- ↓ neck shaft angle : Coxa vara.



Neck shaft angle

3. Proximal femur in children has 2 growth plates.

- Capital femoral epiphysis : Head of the femur epiphysis.



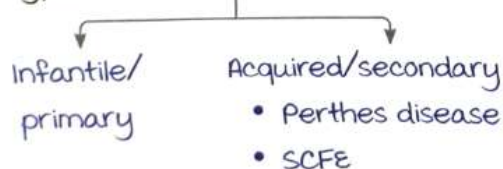
2 growth plates

Coxa Vara

00:01:20

Injury to the growth plate of head of femur → Greater trochanter continues to grow → Head and neck stop growing → Coxa vara

Types of coxa vara :



Clinical features :

- Trendelenburg gait : Failure of hip abduction.
- Obligate external rotation : External rotation of hip (knee goes out) on flexion of hip.
- Limitation of abduction and internal rotation.
- Limb shortening.



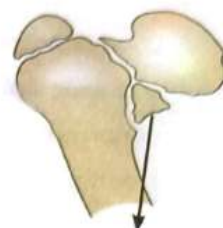
Obligate external rotation

CONGENITAL COXA VARA

Etiology :

- Damage to fairbank triangle.
- Fairbank triangle : Part of neck of femur.

Note : Babcock's triangle is seen in TB.



Fair bank triangle

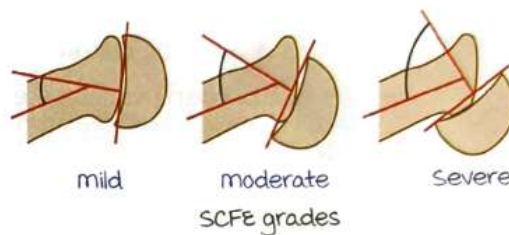
SCFE (SLIPPED CAPITAL FEMORAL EPIPHYSIS)

misnomer : Head remains inside the acetabulum whereas neck slips.

Pathogenesis :

Fracture of the growth plate (Type I Salter-Harris)

Head and neck are disrupted



mild

moderate
SCFE grades

Severe

Head remains in the acetabulum and neck slips.

Etiology :

- Idiopathic : m/c cause.
- Associated with endocrinopathy (D/t sex hormone : GH imbalance in puberty).
 - m/c : Hypothyroidism, hypogonadism, $\uparrow$ GH.

Bone growth

Bone fusion

General features :

- male > female.
- Risk factor : more weight for age in children.
- 40% cases are bilateral (60% cases if associated with endocrinopathy).

Clinical features :

Presents at puberty

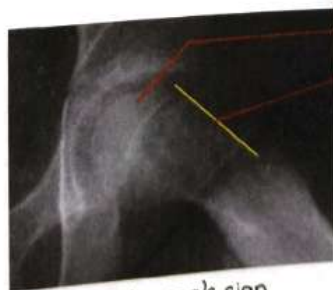
Males : 13-17 yrs

Females : 11-14 yrs

- Hypogonadism
 - Voice change
 - Gynecomastia
 - Coxa vara features.
- In endocrinopathy features

Trethowan's sign on X-ray :

Line drawn on the lateral aspect of neck of femur does not intersect with head of femur.



Trethowan's sign

Epiphysis

Kein's line : Does not intersect with head of femur

Treatment :

Closed reduction + internal fixation + in situ pinning.

----- Active space -----

Osteochondritis/Osteonecrosis

00:15:31

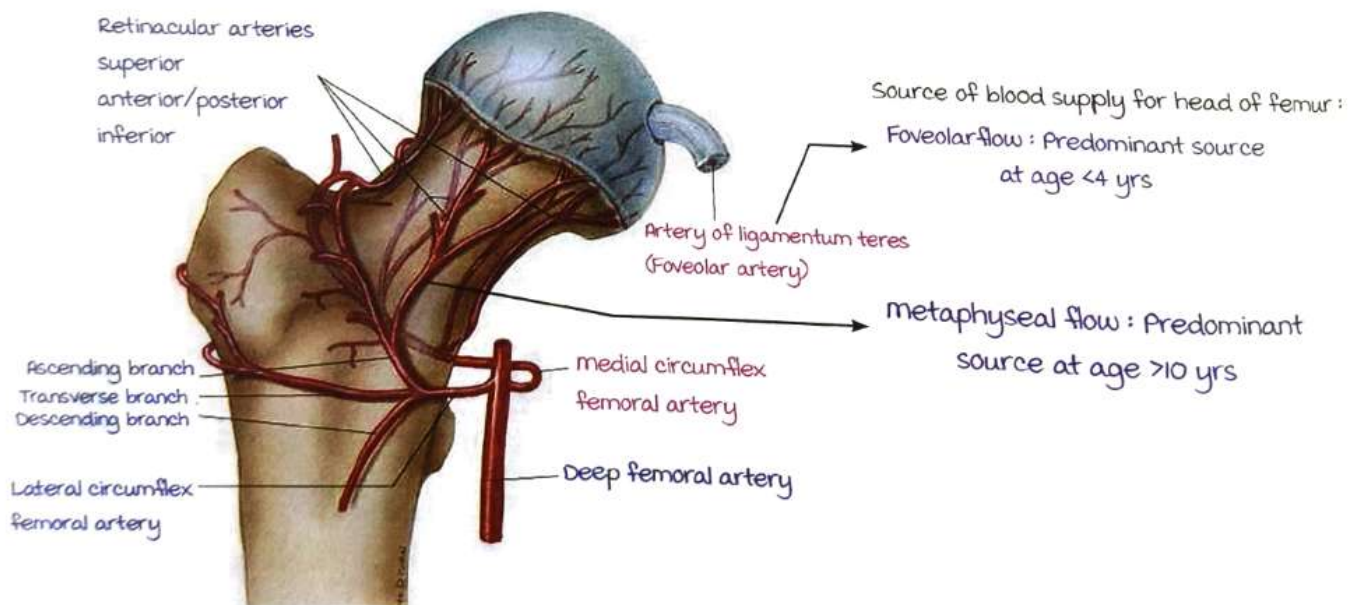
- Osteochondritis is a self-limiting abnormality of bone growth.
- Involves centres of ossification in the epiphysis.
- Begins in childhood as a **necrotic** condition.
- D/t primary **vascular** event or **repetitive trauma**.

Osteochondritis	Bone
Perthes disease (m/c)	Femoral epiphysis
Kohler's disease	Navicular bone
Keinbock's disease	Lunate
Panner's disease	Capitulum (Elbow pain)
Osgood-Schlatter's disease	Tibial tuberosity
Sever's disease	Calcaneal epiphysis

PERTHES DISEASE

AKA coxa plana/Legg-calve-perthes disease.

- Idiopathic, spontaneous osteonecrosis (Chandler's disease in adults).

Blood supply of femur :

Bridge phase between 4-10 yrs (Shift from foveolar to metaphyseal)

Head of femur is vulnerable

Any insult

Osteonecrosis

General features :

- m/c cause : Idiopathic.
- m/c association : Protein S deficiency.
- male > female
- 10-12% cases : Bilateral.
- Age > 6 years : Poor prognosis.

Clinical features :

- Painless limp, can be painful later.
- Pain radiates to knee/groin.
- Limitation of abduction and internal rotation.
- Obligate external rotators.

Investigations :

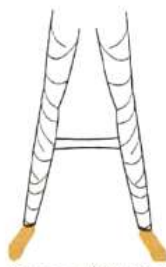
- MRI : IOC.
- X-Ray : Late change.



Osteochondritis of navicular bone



Oschgood schlatter



Broomstick cast



Osteochondritis of lunate

Treatment :

- Sustain the head till vascularity resumes.
- No weight bearing.
- Strict skin traction.
- Petrie cast/broom stick cast.
- Total hip replacement after skeletal maturity.

Development Dysplasia of Hip

00:24:58

- Previously called congenital dislocation of hip.
- Idiopathic spontaneous subluxation of femoral head.

Pathogenesis :

Flat/convex/shallow acetabulum



Head of femur lies outside the acetabulum (In utero).

Epidemiology :

- 1:1000 live births.
- Females > males.
- 20% cases are bilateral (B/L).
- Left side > B/L > right side.
- Usually seen in 1st born female child with fetal malformation (m/c breech).
- Strong family history.
- Caucasians > asians → D/t the way babies are carried in infancy.

----- Active space -----

Clinical features :

- Asymmetry of limbs : Shortening of affected side.
- ↑ thigh and gluteal folds.

Vascular sign of NARATH :

- Femoral pulses are not felt (As head of femur does not lie against it).
- Popliteal pulse can be felt.

Clinical diagnosis :

Performed in child <3 months age.

1. Barlow's test :

- mnemonic : **BAD**.
- Adduction : Hip is dislocated.

2. Ortolani's test :

- Abduction : Dislocated hip is reduced.

3. Allis/Galeazzi sign :

- Flexion of both hip and knee.
- Dislocated side has knee at a lower level.
- Only seen in U/L DDH.

4. Klisic test : For B/L DDH.

5. Trendelenburg gait/waddling gait



Ortolani's test

Investigations :

- Screening : USG for <6 months age.
- IOC : **MRI** (To confirm diagnosis & plan management).



Hilgenreiner's and Perkins line

Acetabulum in children :

- Triradiate cartilage (made of ilium, ischium, and pubis).
- **Hilgenreiner's line** :
 - Line passing through centers of both triradiate cartilage.
- **Perkins line** :
 - Line perpendicular to the Hilgenreiner's line.
 - Passes through lateral edge of acetabulum.
 - Head of femur
 - Normal : Inner, outer quadrant.
 - DDH : upper, outer quadrant.



von russen splint

Treatment :

Age	Treatment
0-6 months	Pavlik harness, von rosen splint
6-18 months	Reduction : Open/closed Smith peterson approach
18-36 months	Femoral osteotomy
>3 years	VDRO + pelvic osteotomy (Salter, Pemberton)
>10 years	Total hip replacement after skeletal maturity

----- Active space -----

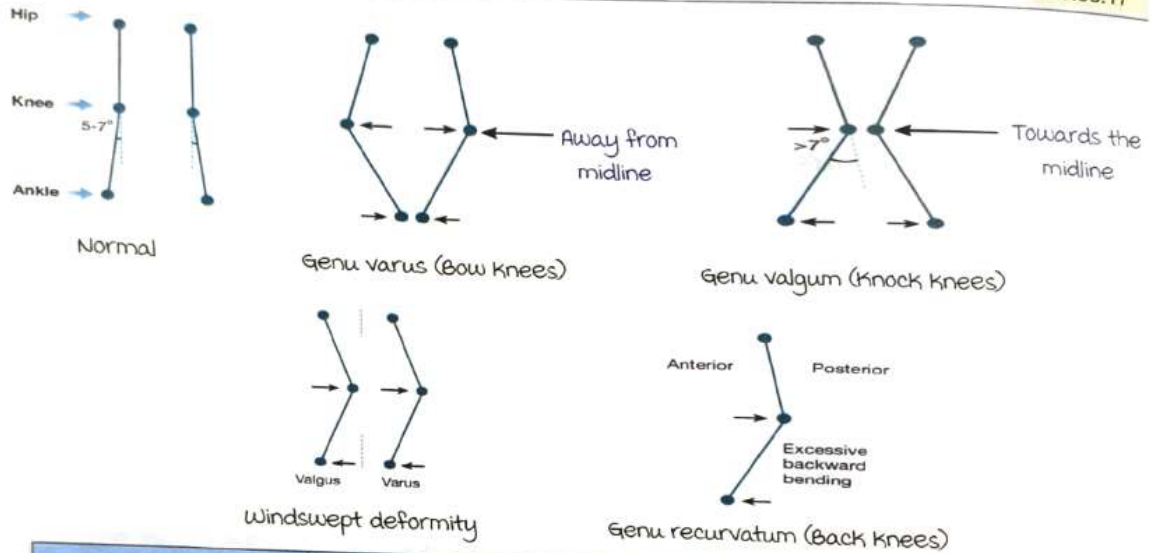


Pavlik harness

PAEDIATRIC ORTHOPAEDICS : KNEE AND FOOT

Deformities of Knee

00:00:17



	B/L genu varum (Bow legs)	B/L genu valgus	Wind swept deformity
m/c cause in children	Rickets > Idiopathic	Idiopathic > Rickets	Rickets
m/c cause in adults	Osteoarthritis > Rheumatoid arthritis	Rheumatoid arthritis > Osteoarthritis	Rheumatoid arthritis



Genu varum



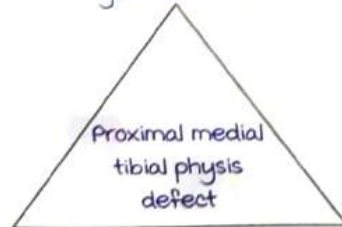
Genu valgus



Windswept deformity

Blount's disease/infantile tibia vara :

B/L idiopathic genu varum



Genu recurvatum (Hyperextension)

Sign : Siffert Katz sign

Internal rotation of tibia

X-ray :

metaphyseal beaking



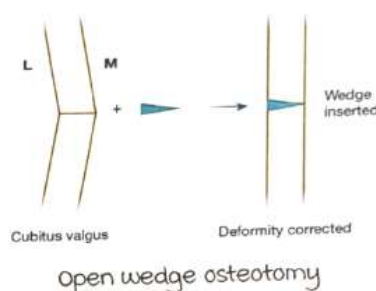
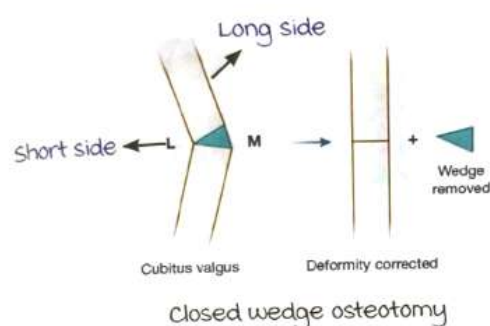
Blount's disease

causes of deformity :

- malunion.
- Growth plate injury.

Treatment :

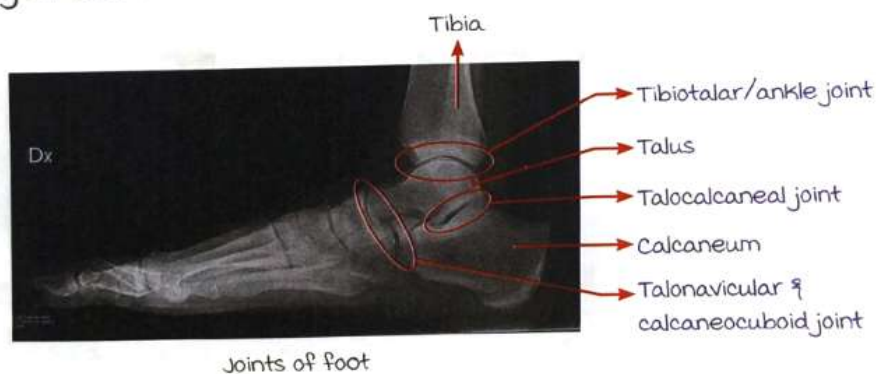
- open wedge osteotomy : Lengthen the short side by filling extra bone.
- closed wedge osteotomy : Shorten the long side by removing bone.



Deformities of Foot

00:09:35

Anatomy of foot :



Actions of the joints :

- Tibio-talar/ankle joint : Ankle plantar/dorsiflexion.
- Talocalcaneal/subtalar joint : Inversion/eversion of foot.
- Talonavicular & calcaneocuboid/midtarsal joint : Forefoot adduction/abduction.

Note :

medial longitudinal arch of foot : Provides concavity of the foot

Lost : Flat foot.
Exaggerated : Cavus of foot.

----- Active space -----

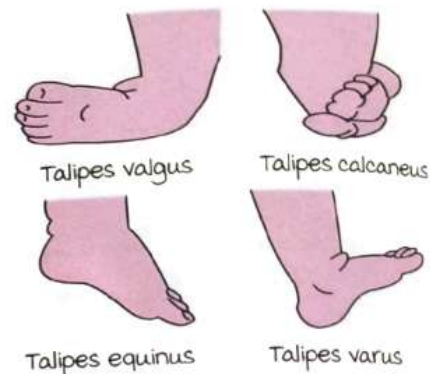
Deformities of the joint :

Joint	Position of deformity	Term of deformity
Ankle joint/Tibio talar joint	Ankle plantar flexion	Equinus deformity
	Ankle dorsiflexion	Calcaneus deformity
Subtalar/talocalcaneal joint	Inversion of foot	varus deformity
	Eversion of foot	valgus deformity

Terminology :

Talipes : Congenital deformity in which foot is twisted.

- Talipes cavus : High arched foot.
- Talipes equinus : Plantar flexion.
- Talipes calcaneus : Foot dorsiflexion.
- Talipes valgus : Abduction and eversion.
- Talipes varus : Adduction and inversion.

**Congenital Talipes Equinus Varus (CTEV)**

00:14:30

AKA **club foot** (Appears like a golf club).
m/c congenital abnormality of leg, ankle & foot.

Epidemiology :

- 50% : Bilateral.
- 1:1000 live births.
- males > females.
- 1st born child a/w fetal malpresentation like **breach**.



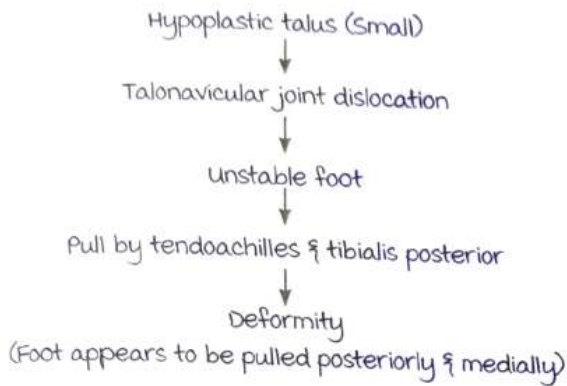
CTEV

Etiology :**1. Congenital/primary CTEV : m/c type**

- m/c cause : **Idiopathic**.
- Spina bifida.
- Arthrogryposis multiplex congenita (muscle fibrosis → contracture → deformity).

2. Acquired causes : Neuromuscular disorders (Poliomyelitis).

pathoanatomy :



----- Active space -----

Primary deformities of the foot :

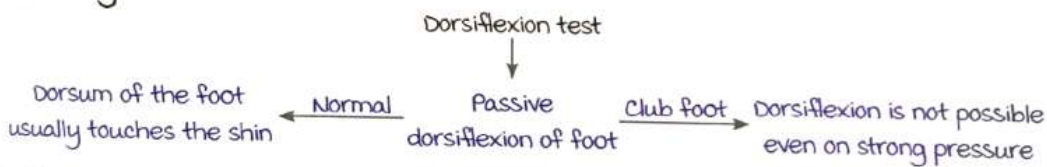
- C** → **Cavus**
Exaggeration of medial longitudinal arch

A → **Adduction**
At talonavicular/ mid tarsal joint

V → **Varus**
At talocalcaneal/ subtalar joint

E → **Equinus**
At ankle joint
- Internal rotation of tibia is also seen.

Screening test :

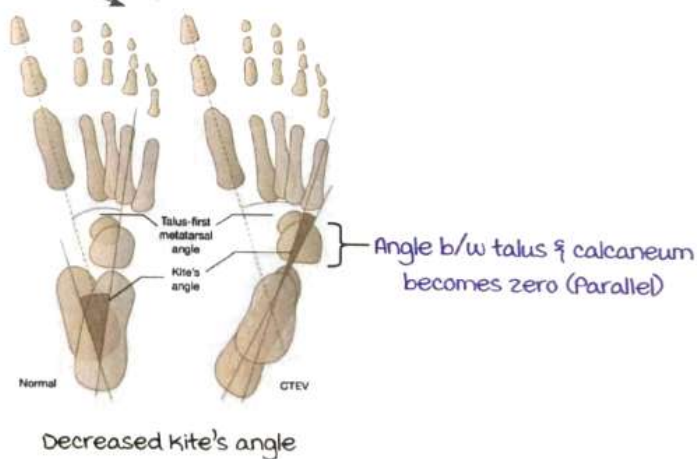


Confirmatory test :

Kite's angle : Talocalcaneal angle



Normal Kite's angle



----- Active space -----

Treatment in newborn :

- Start treatment by 2 weeks.
- manipulation of foot to correct deformity → maintain with POP (7-8 weeks).

Order of manipulation : Ponseti method
C → V & A → E

- Above the knee.
- Keep for 1 week.
- Repeat procedure after 1 week.

	Ponseti's method	Kite's method
Treatment starts	<2 weeks	1 month
Order of correction	Cavus → adduction → varus → equinus	Adduction → inversion → equinus
Fulcrum	Head of talus	Calcaneocuboid joint
POP type	Above knee cast	Below knee cast
Duration	6-8 weeks	6-9 months

Rocker bottom foot :**Causes :**

- Overcorrection of CTEV.
- Congenital vertical talus.



Rocker bottom foot



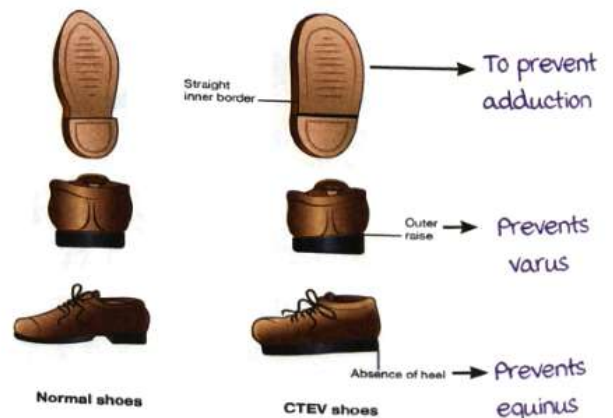
Dennis brown splint

Prevention of recurrence :**1. Dennis brown splint :**

- Till the baby learns to walk.
- mechanism : As baby moves the leg, deformity keeps getting corrected.
- Disadvantage : Low compliance.

2. CTEV shoes :

- Once the baby starts walking (up to the age of 3-5 yrs).
- use Dennis brown splint when baby sleeps.
- Should be worn at least 23 hrs/day.

**Treatment in late presentation :**

1. 1-3 yrs : Posteromedial soft tissue release $\xrightarrow{F/b}$ Ponseti manipulation.

- Soft tissues contract by 1 year of age.
- Turco's procedure : To release the soft tissue (Tendoachilles, tibialis posterior, flexor digitorum longus).

2. 3-5 yrs :

- By 3 yrs forefoot adduction becomes bony.
- PMSTR + Dilwyn Evans' procedure.
- Dilwyn Evans' procedure : Lateral column shortening by Calcaneocuboid fusion.

----- Active space -----

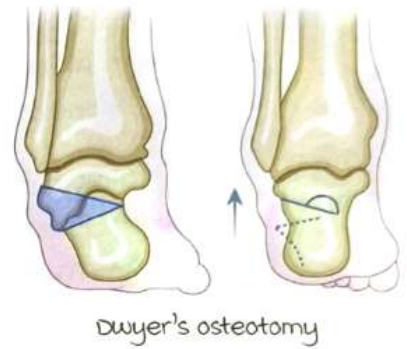
3. 5-8 yrs :

- By 5 years varus becomes bony.
- Dilwyn's Evans' + Dwyer's osteotomy (Wedge osteotomy).

4. 8-10 yrs : Wedge tarsectomy.

5. >10 yrs : Triple arthrodesis

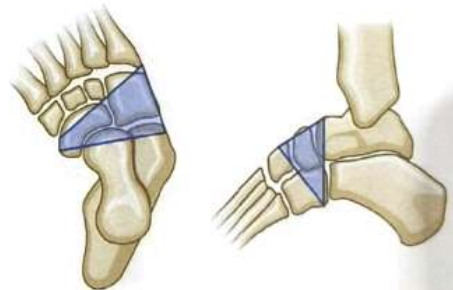
- Surgical fusion of talonavicular, talocalcaneal and calcaneocuboid joint.
- Complication : If performed below 10 yrs of age → Arthrodesis fails
→ Pseudoarthrosis.



Dwyer's osteotomy

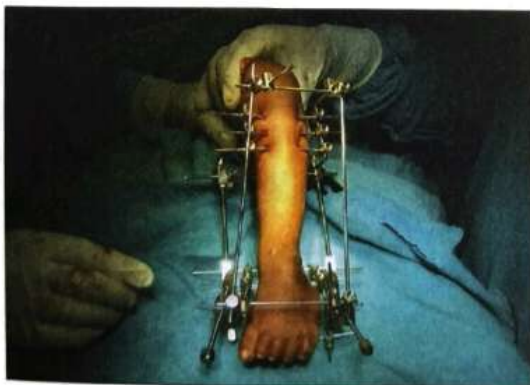


Triple arthrodesis



Wedge tarsectomy

Deformity correction device : Joshi's external stabilization system.
Based on Ilizarov's principle of external fixation.



Joshi's external stabilization system

----- Active space -----

Achondroplasia

00:33:10

m/c cause of **disproportionate dwarfism**.

Etiology :

- **FGFR₃** gene mutation on **chromosome 4**.
- **Autosomal dominant** inheritance or sporadic.

Pathogenesis :

- Affects **enchondral ossification** of **long bones**.
- Intramembranous ossification is normal (Flat bones of skull & clavicle).



Achondroplasia

Clinical features :

- Proximal limb shortening (**rhizomelic shortening**).
- Trunk is usually normal.
- Patients have **normal IQ and sexual development**.
- Brachydactyly : Short, stubby fingers.
- Frontal bossing of skull.
- Starfish hand.
- Trident hand.
- Bullet nose vertebrae.
- Champagne glass pelvis.
- Saddle nose.



Frontal bossing



Brachydactyly



Bullet nose vertebrae

Note :

- Shortening of middle part of limb : **mesomelic**.
- Shortening of distal part of limb : **Acromelic**.

SPINE : GENERAL AND TRAUMA

----- Active space -----

Spine : Components

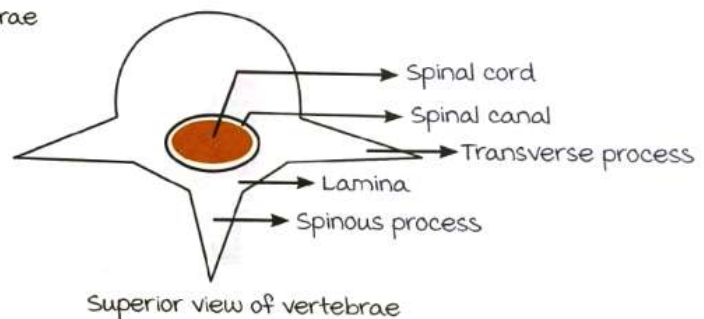
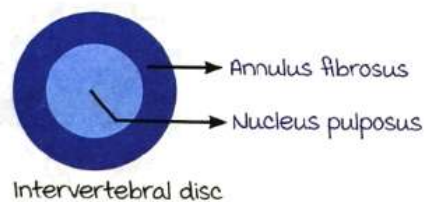
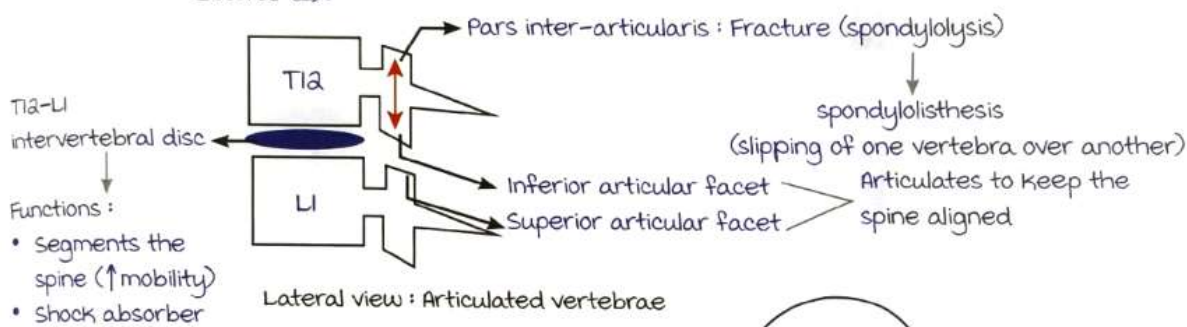
- musculoskeletal : vertebral column
- Neurological : spinal cord + spinal nerves

Anatomy of musculoskeletal elements of Spine

00:01:25

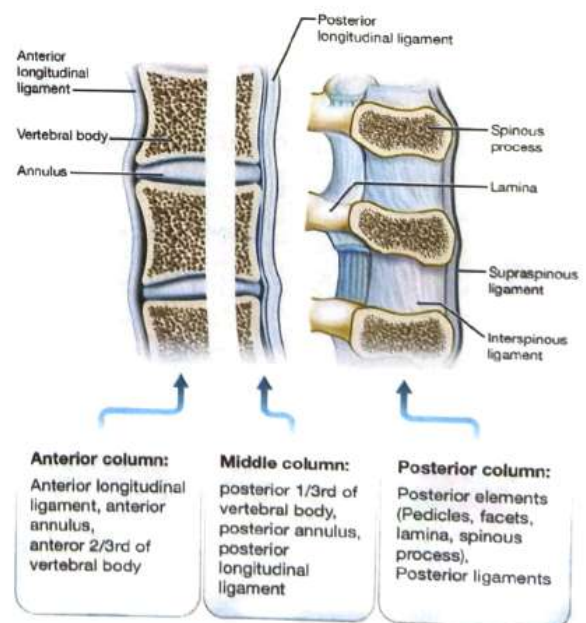
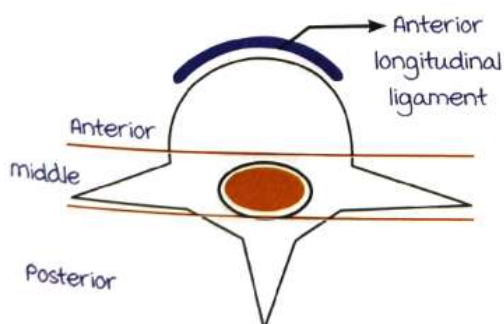
vertebrae

- Cervical (C).
- Thoracic (T)/Dorsal (D).
- Lumbar (L).
- Sacral (S).



DENIS' CONCEPT OF SPINE STABILITY

Based on 3 columns of vertebra :



----- Active space ----- Clinical aspect :

**Trauma to spine**

00:10:58

m/c site of

- vertebral fracture : Lower thoracic (T12)
- vertebral dislocation : Cervical spine d/t

Stabilizers : Ligamentous > bony.

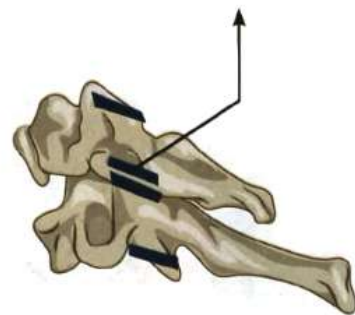
Horizontal arrangement of articular facets.



Lumbar spine

Vertical arrangement of articular facets

↑ risk of fracture > dislocation



Cervical spine

Highest risk of spinal cord injury : Cervical spine fracture.

Note :

Immediate management in cervical spine injury :

1. Turn patient onto their back.
2. Support placed behind neck.
3. Transported to nearest hospital.

JEFFERSON'S/C1 VERTEBRAL (ATLAS) FRACTURE

- m/c fracture on C1 vertebra.
- mechanism of injury : Axial loading/compression

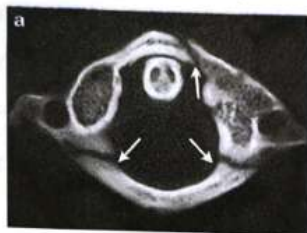
Fragments burst out away from spinal canal.

- No neurological deficits.

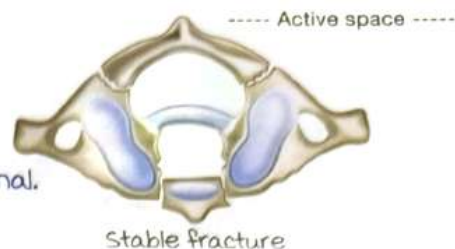
Investigations :

x-ray (open mouth view)

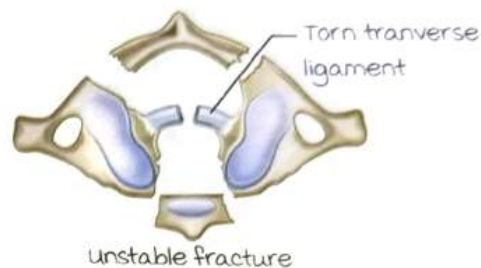
CT scan (best)



Treatment → Stable fracture : Conservative.
→ unstable : Surgery (Atlanto-occipital fusion)



Stable fracture



Unstable fracture

C2 VERTEBRAE (AXIS) FRACTURE

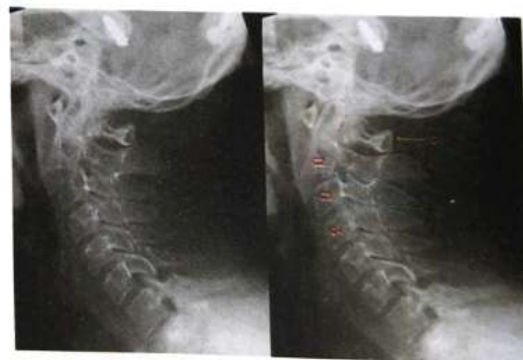
Types → Odontoid fracture : m/c fracture of C2.
→ Hangman's fracture.

Hangman's Fracture :

- Fracture of pars inter-articularis of C2 vertebra (Spondylolysis of C2)

causes dislocation of C2 over C3 (spondylolisthesis)

- No neurological deficit.
- m/c cause : RTA > Hanging.



Hangman's fracture-dislocation

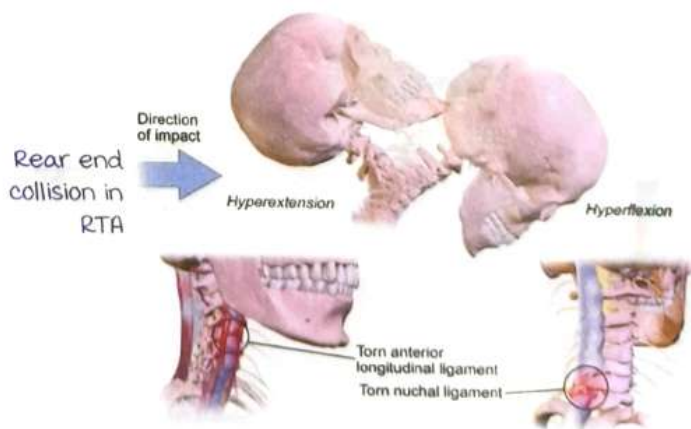
WHIPLASH INJURY

Soft tissue injury.

Mechanism : Hyperextension → Flexion.

C/f :

- Chronic neck pain.
 - No neurological deficits.
 - Normal x-ray/CT scan.
- Rx : Cervical collar.



----- Active space -----

CLAY SHOVELER'S FRACTURE

Shoveling
 ↓
 Strong contraction of paraspinal
 and upper limb muscles
 ↓
 Avulsion of C7 spinous process



Clay shoveler's fracture

CHANCE/JACK-KNIFE/SEAT-BELT FRACTURE

- Described by Dr. G.Q.Chance.
- Complete transverse splitting of
 - vertebra : Bony Chance
 - Ligament & disc : Soft tissue Chance

mechanism of injury :

Seatbelts without shoulder harnesses

Flexion of spine at lumbar vertebra

Complete transection of spinal cord
 (involves all 3 columns : unstable fracture)

Paraplegia (paralysis of lower limbs)



mechanism of jackknife fracture



Chance fracture

Rx : Stabilisation & surgery

COMPRESSION VS BURST FRACTURES

	Compression Fracture	Burst Fracture
Causative factor	Osteoporosis	Significant trauma
mechanism	Flexion → compression	Axial loading
Characteristic features	Wedging of vertebra (anterior column shortened, posterior column maintained)	Convex anterior & posterior walls
		

SCIWORA

00 :26 :00

----- Active space -----

- Spinal cord injury without radiographic abnormality.
- In **children** : Bone elasticity > spinal cord elasticity → Stretching of bone > spinal cord → Injury of spinal cord without fracture → Paraplegia/quadruplegia.
- Diagnosis : MRI.
- No fracture visible on X-ray/CT scan.

Spinal Cord Injury

00 :27 :31

EARLY MANIFESTATIONS

Spinal shock :

Temporary complete cessation of functions of spinal cord **below the level of injury**.

Anesthesia

Flaccid paralysis

Loss of bowel &
bladder controlLoss of reflex
activity

Recovery time : 24-48 hours (to weeks).

Bulbocavernosus Reflex :

- **First reflex to recover**
(marks end of spinal shock).
- Root value : S2, S3, S4

Note : If Foley's catheter in situ → tug on catheter → anal sphincter contracts.

Neurogenic shock :

manifestation of neurological deficits in spinal shock.

Pathophysiology :

Loss of sympathetic outflow → hyperactive parasympathetic outflow

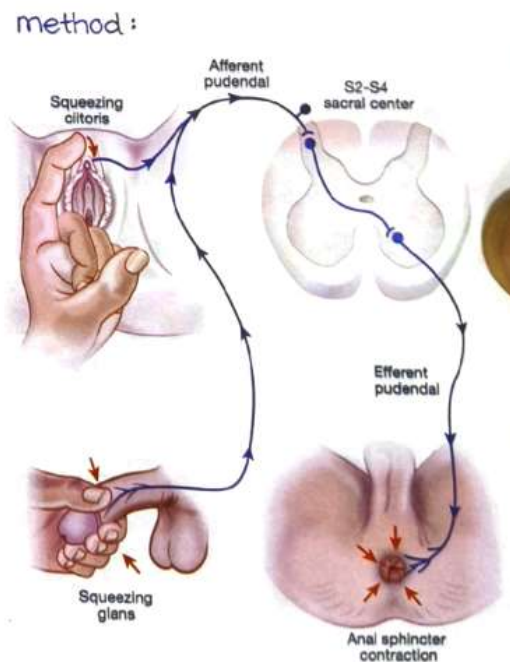
Bradycardia

Peripheral vasodilation

↓ peripheral vascular resistance

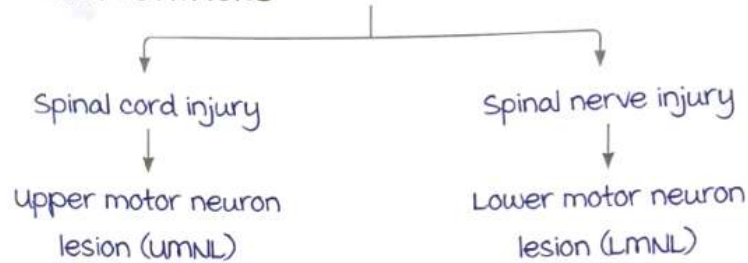
Peripheral pooling of blood

Fall in BP (hypotension)

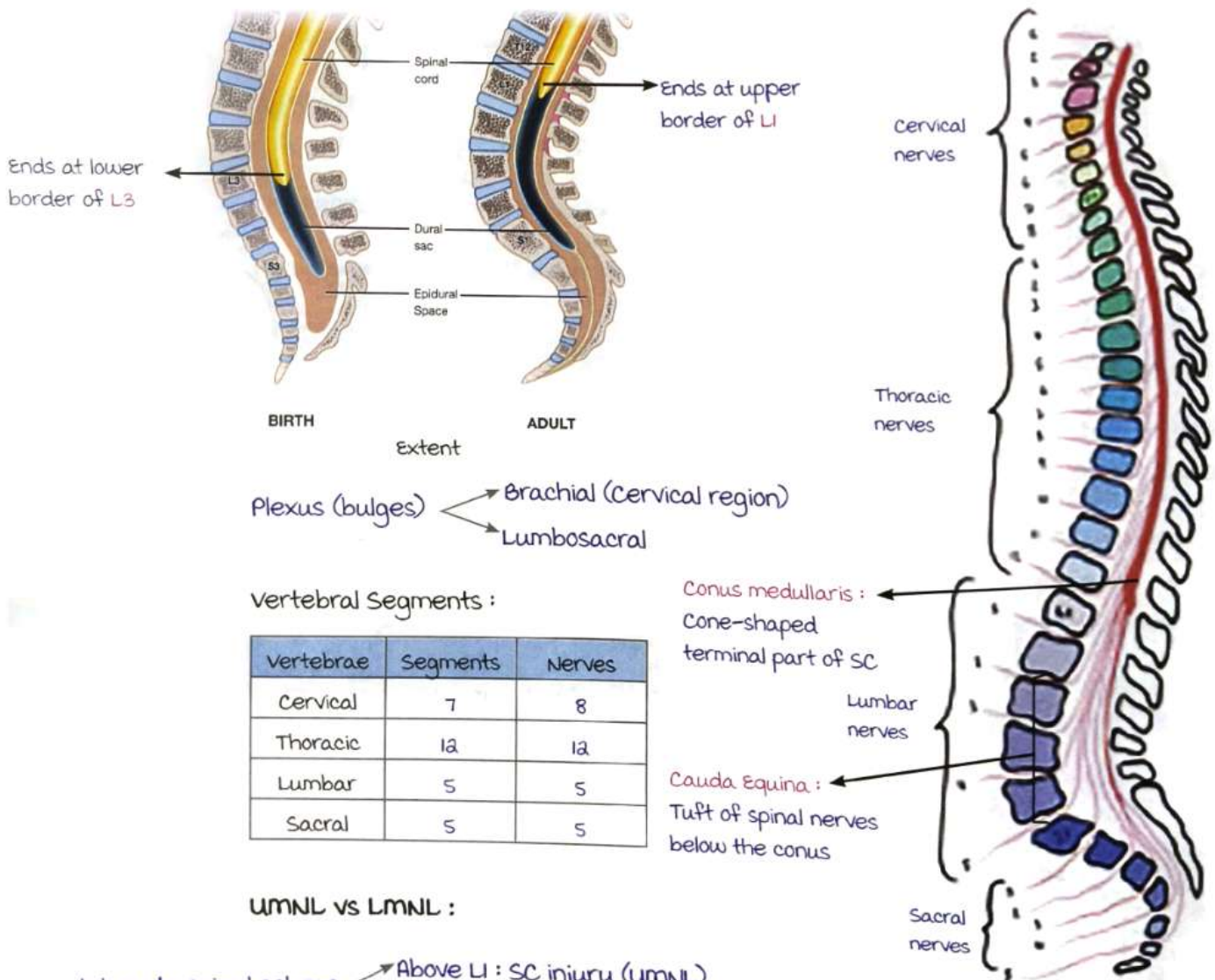


----- Active space -----

Note :

In hemorrhagic shock (blood loss) $\rightarrow \downarrow BP \rightarrow$ reflex tachycardia.**LATE MANIFESTATIONS****Relevant anatomy :**

Spinal cord :

**UMNL vs LMNL :**

Injury to spinal column

- Above L1 : SC injury (UMNL)
- Below L1 : Spinal nerve injury (LMNL)

----- Active space -----

		UMNL (Spinal cord)	LMNL (Spinal nerve)
At the level of injury :	• Sensory functions	Lost	
	• Motor functions	motor weakness (flaccid paralysis)	
	• Reflexes	Absent	
Below the level of injury :	• Sensory functions	Lost	Normal
	• Motor functions	Spastic paralysis	Normal
	• Reflexes	Exaggerated	Normal

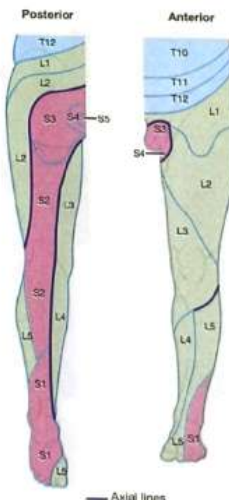
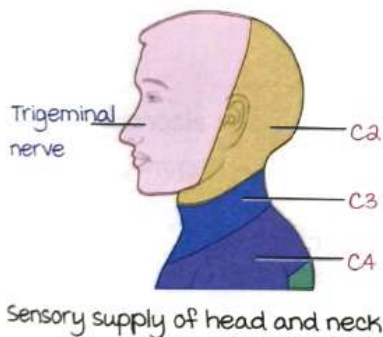
- Above the level of injury : All functions normal in both UMNL & LMNL.
- UMNL : Inhibitory action on LMN → In UMNL : Spastic paralysis with exaggerated reflexes.

Localization of injury :

Each spinal nerve supplies a particular

- Dermatome (cutaneous distribution)
- myotome (muscle groups)
- Reflex

Dermatomes : Cutaneous sensory supply of spinal nerves.



myotomes :

Root	myotome
C5	Elbow flexion (Biceps, Brachialis)
C6	wrist extension
C7	Elbow extension & wrist flexion
C8	Finger flexion
T1	Finger abduction
L2	Hip flexion/Iliopsoas
L3	Knee extension/Quadriceps
L4	Ankle dorsiflexors/Tibialis anterior
L5	Toe extensors/Extensor hallucis longus
S1	Ankle plantar flexors/Gastro soleus

----- Active space ----- Reflexes :

Root	Reflex
C5	Biceps
C6	Supinator (Brachioradialis)
C7	Triceps
L3 L4	Knee (Quadriceps)
S1	Ankle (Gastro soleus)

Note :

- Diaphragm : Nerve supply C3, C4, C5.
- Injury above C3 → affects breathing.

SPINE : DISORDERS

----- Active space -----

Prolapsed Intervertebral Disc (PIVD)

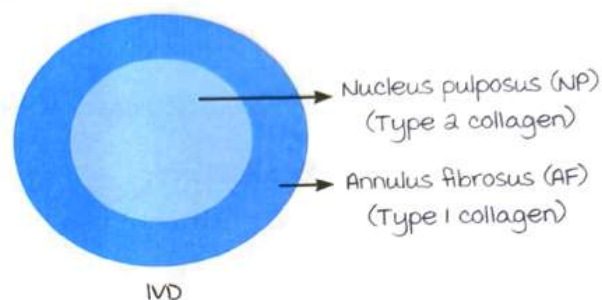
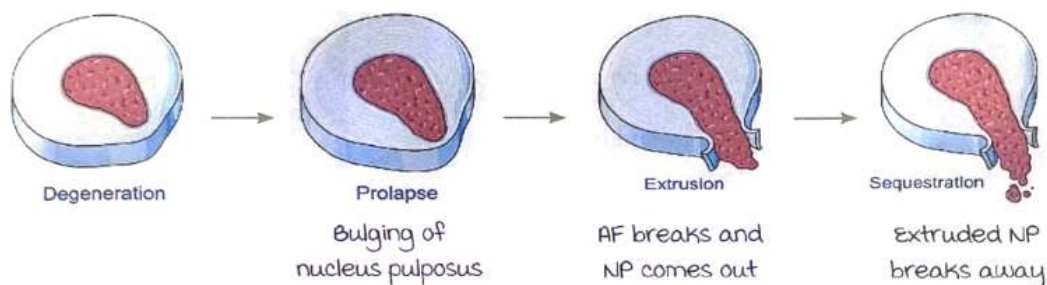
00:00:11

- Protrusion of disc $\rightarrow$ Compression of spinal cord/nerves.
- m/c disc to prolapse : $L_4-L_5 > L_5-S_1$.

Mechanism of injury :

- Abnormal loading of spine.
- Degeneration of spine.

Progression of disc degeneration :

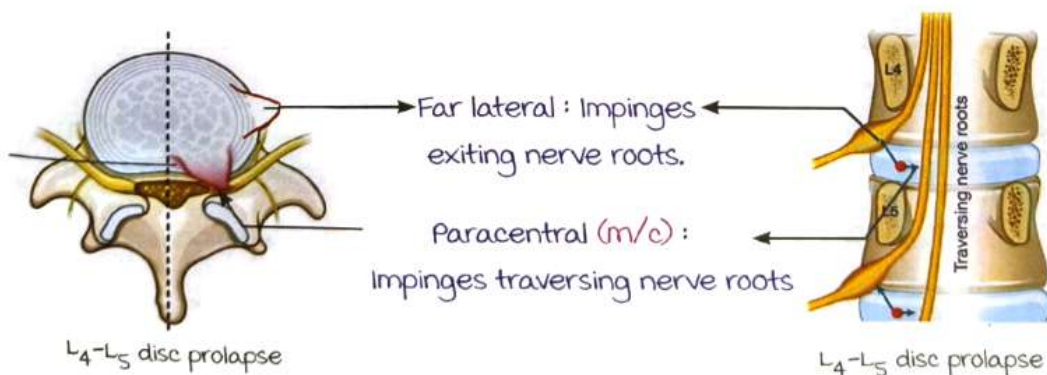


Canal stenosis :

Causes $\rightarrow$ PIVD
 $\rightarrow$ vertebral degeneration in OA $\rightarrow$ Excessive growth of abnormal bone
 (m/c site : Lumbar)

	PIVD	Canal stenosis
Age at presentation	Young	Elderly
Onset of disease	Acute	Chronic

Types of PIVD :



m/c injured nerve : L_5 (LMNL d/t nerve root involvement).

----- Active space -----

Clinical features :

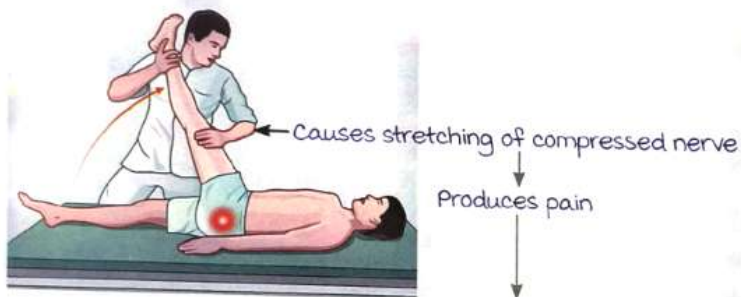
- H/o lifting heavy objects.
- Low back ache.
- Sciatica
 - Back pain radiating to lower limb.
 - Increases with
 - Flexion
 - Sneezing
 - Coughing
 - Sitting for prolonged duration
- Neurological deficits.

Note :

m/c cause of sciatica : PIVD.

Evaluation :

SLRT (Straight Leg Raising Test)

Unable to flex hip $>20-30^\circ$ (Positive test)

MRI (IOC) :

L₅-S₁ PIVD

Neurological examination : To localize the lesion depending on nerve roots involved.

Root	myotome
C ₅	Elbow flexion
C ₆	Wrist extension
C ₇	Elbow extension & wrist flexion
C ₈	Finger flexion
T ₁	Finger abduction
L ₂	Hip flexion/Iliopsoas
L ₃	Knee extension/Quadriceps
L ₄	Ankle dorsiflexors/Tibialis anterior
L ₅	Toe extensors/Extensor hallucis longus
S ₁	Ankle plantar flexors/Gastrosoleus

Root	Reflex
C ₅	Biceps
C ₆	Supinator (Brachioradialis)
C ₇	Triceps
L ₃ , L ₄	Knee (Quadriceps)
S ₁	Ankle (Gastrosoleus)

Treatment :

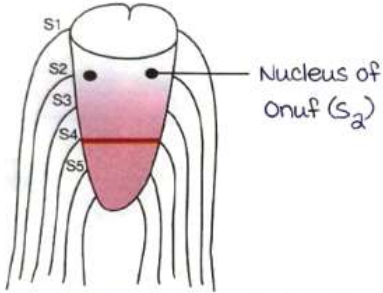
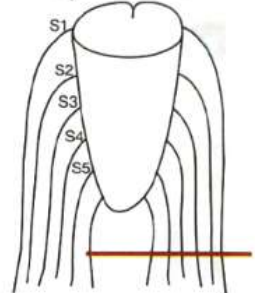
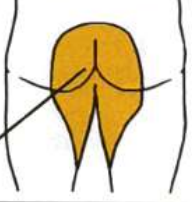
1. Rest in semi-fowler position (Supine with $30-40^\circ$ flexion of spine).
2. Physiotherapy.

3. Surgical disc compression :

- Total/hemi-laminectomy or laminotomy & discectomy.
- Indications :
 - Worsening symptoms despite conservative Rx.
 - Bowel & bladder involvement.
 - massive central disc prolapse compressing multiple nerve roots.
 - Cauda equina syndrome.

----- Active space -----

Conus medullaris v/s cauda equina syndrome :

	Conus medullaris	Cauda equina syndrome
Structure involved	 Spinal cord Nucleus of Onuf (S₂)	 Spinal nerves
Presentation	UMNL with LMNL features	LMNL
	 • B/I symptoms • Bowel & bladder involvement • Saddle anaesthesia	
	Symmetric, areflexic flaccid paralysis	Assymetrical, areflexic flaccid paralysis
Etiology	Injury at L ₁	Large disc prolapse below L ₁
Knee reflex	Normal	Lost
Ankle reflex	Lost	Lost

Lumbar Canal Stenosis (LCS)

00:24:06

Pathophysiology :

Spondylosis : Osteoarthritis of facet joints

↓

Excessive bone formation

↓

Stenosis of lumbar canal

↓

Neurogenic claudication



Lumbar canal stenosis

----- Active space -----

Clinical features :

Pain → Decreases with flexion : Sitting, leaning over, walking upstairs/uphill.
 → Increases with extension : Walking, standing upright

Neurogenic v/s vascular claudication :

Symptoms	Neurogenic	Vascular
walking (upright)	Causes symptoms	
Sitting	Relieves symptoms	
Pain	Starts in back	Starts in calf
Standing stationary	Causes symptoms	Relieves symptoms
Climbing upstairs	Relieves symptoms	Causes symptoms
Postural changes	Yes	No
Pulses	Normal	Abnormal

LCS v/s PVD :

	LCS	PVD
Age at presentation	Elderly	Young
Onset of disease	Slow & progressive	Acute
Pain on flexion	Decreases	Increases

Spondylolisthesis

00:28:26

- Slipping of 1 vertebrae over another.
- Cause : Trauma/fracture of the pars interarticularis.

Radiological features :

Normal spine
(Scottie dog sign)



Spondylolisthesis
(Beheaded Scottie dog sign)
m/c site : L₅-S₁



Spondylolysis
(Scottie dog with collar sign)
m/c site : L₅



Spondylolysis

Meyerding classification :
Based on percentage of slip.

----- Active space -----



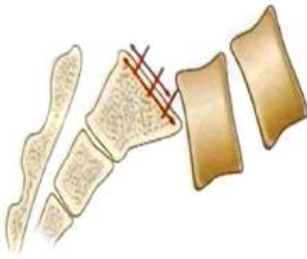
Normal



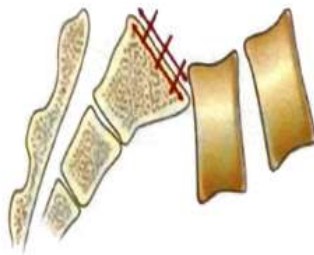
Grade I : 0-25% displacement



Grade II : 26-50% displacement



Grade III : 51-75% displacement



Grade IV : 76-100% displacement



Grade V : >100% displacement
(Spondyloptosis)

Clinical features :

- Back pain radiating to the lower limbs.
- Step sign : On palpation of spine
↓
Step off over the spinous process



Step sign

Spondylolisthesis

Note :

- Spondylosis : Degeneration of the spine (Elderly).
- Spondylitis : Inflammation seen in ankylosing spondylitis.
- Inverted Napoleon hat sign (In spondyloptosis).



Inverted Napoleon hat sign

----- Active space -----

Conditions With Fusion of Spine

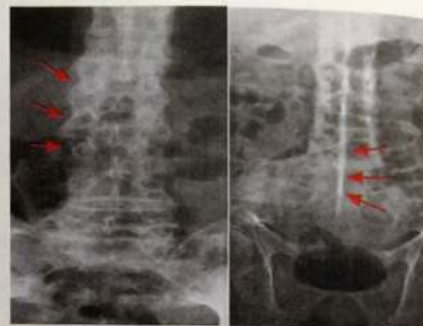
00:32:24

Ankylosing spondylitis

- Autoimmune.
- Males > females, young patient.
- HLA-B₂₇ (+) ; Rheumatoid factor (-).
- Pathology : Enthesopathy.

Clinical features :

- Characteristic feature : **Sacroiliac joint involvement** (Sacroiliitis).
- Morning stiffness (inflammatory exudates collect at night) → Improves with activity.
- Associated anterior uveitis.



Bamboo spine

Dagger sign

Radiological features (X ray)

- **Bamboo spine** : Enthesitis → vertical syndesmophyte fusion.
- **Trolley track sign** } D/t calcification of ligaments.
- **Dagger sign**

Diffuse idiopathic skeletal hyperostosis (DISH)

AKA Forestier disease.

- Ossification of anterior longitudinal ligament.
- Age at presentation : Elderly.



DISH

OPLL

Ossification of posterior longitudinal ligament (OPLL) :

- m/c site : Cervical spine.
- Age at presentation : Elderly.

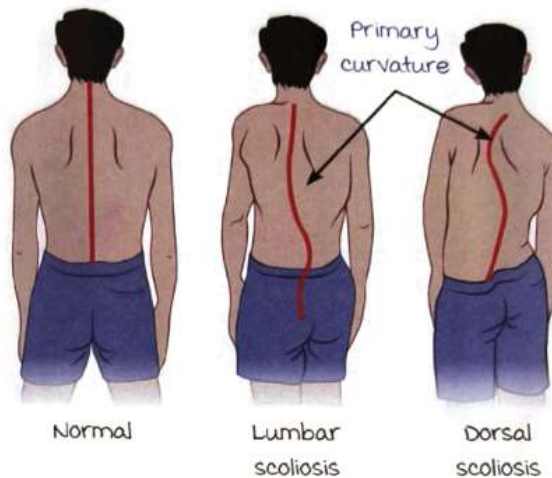
Scoliosis

00:35:17

Lateral deviation of spine by $>10^\circ$ from central axis.

SPINAL CURVATURES

- Primary curvature : The largest curve.
- Secondary curvature : Other smaller curves above & below primary curve.



----- Active space -----

Types of deviation of spinal column

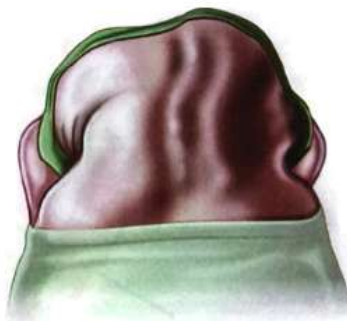
- Lateral.
- Sagittal (Forward bending).
- Rotational.

Scoliosis

- Structural (Fixed).
- Non-structural (Postural/compensatory) : No rotational component.

Adam's forward bending test :

Screening test to differentiate structural v/s non-structural.

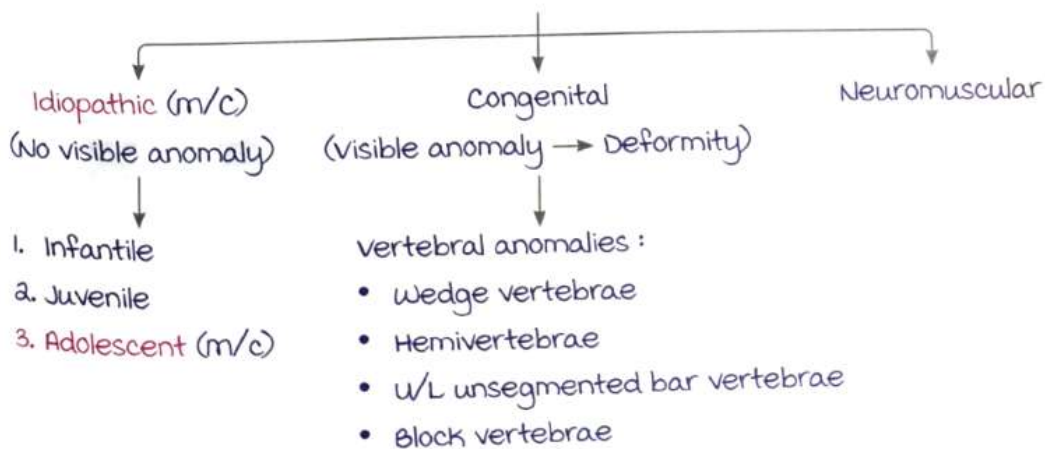


Structural scoliosis
Scoliosis persists on bending forward



Non structural scoliosis
Scoliosis disappears on bending forward

CLASSIFICATION OF STRUCTURAL SCOLIOSIS



----- Active space -----



Congenital scoliosis



Wedge vertebrae



Block vertebrae

CLINICAL FEATURES

- Asymmetry of shoulder.
- Lateral deviated spine.
- Rib hump d/t rotational abnormality.
- Deformity → Overcrowding of ribs → Compresses thoracic and abdominal structures.

EVALUATION

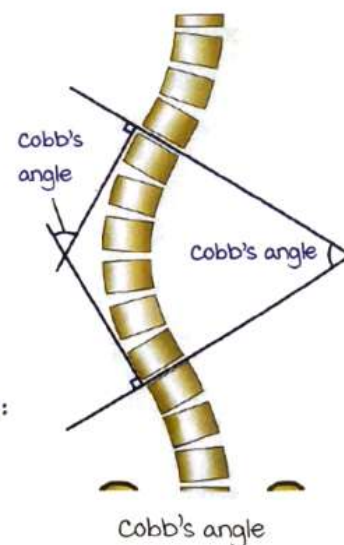
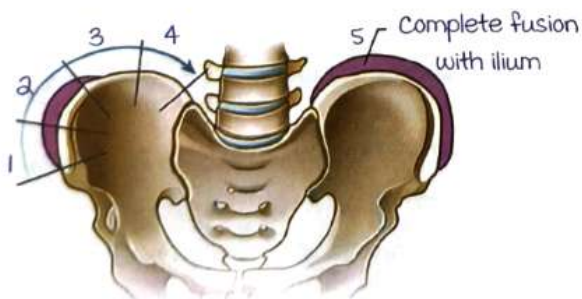
Severity of scoliosis :

Cobb's angle : Angle between abnormal vertebrae on both ends of primary curvature.

Prognosis :

Risser sign :

- To assess progression potential (α growth potential : High in children, low in adults).
- Determine skeletal maturity based on extent of fusion of iliac apophysis with iliac crest.



Risser grade	Description
Grade 1	Ossification of lateral 25%
Grade 2	Ossification of lateral 50%
Grade 3	Ossification of lateral 75%
Grade 4	Ossification of lateral 100%
Grade 5	Fusion with the ilium

TREATMENT

----- Active space -----

Depending on severity & prognosis

- Low cobbs angle (Low severity)
- High Risser (Good prognosis)

- High cobbs angle (High severity)
- Low Risser (Bad prognosis)

Conservative (Braces)

Surgical correction :



milwaukee brace
(Cervical-thoraco-lumbo-sacral orthosis)



Boston brace
(Thoraco-lumbo-sacral orthosis)



Charleston brace



Pedicle screw fixation with
Harrington rods
(Screw through pedicle involves
all 3 spinal columns)

Note :

- Incidence : Females > males.
- Prognosis : males > females.

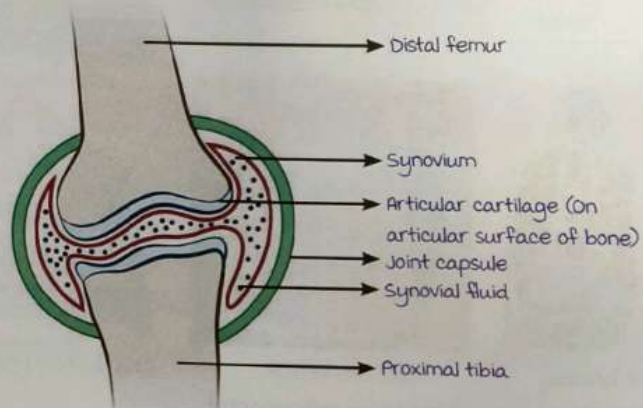
----- Active space -----

JOINT DISORDERS

Anatomy of a Joint

00:01:45

PARTS OF KNEE JOINT



Damage to articular cartilage

↓
Painful movement (active & passive) of the joint

Joints involved in osteoarthritis and rheumatoid arthritis

	Osteoarthritis	Rheumatoid arthritis
Joints involved	Distal interphalangeal joint (DIP) Proximal interphalangeal joint (PIP) 1 st carpometacarpal joint	MCP Wrist PIP
Joints spared	Wrist Metacarpophalangeal joint (MCP)	DIP



Osteoarthritis

00:06:38

m/c joint disease.

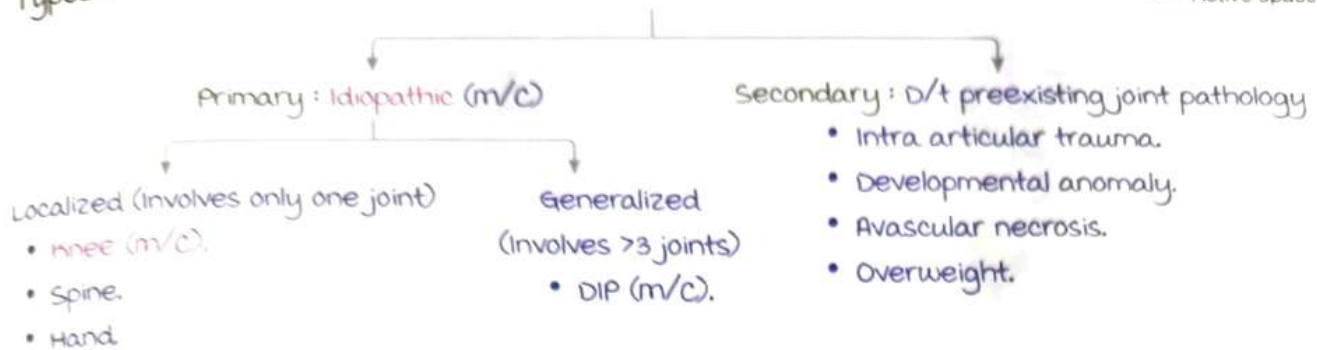
ETIOPATHOGENESIS

Etiology :

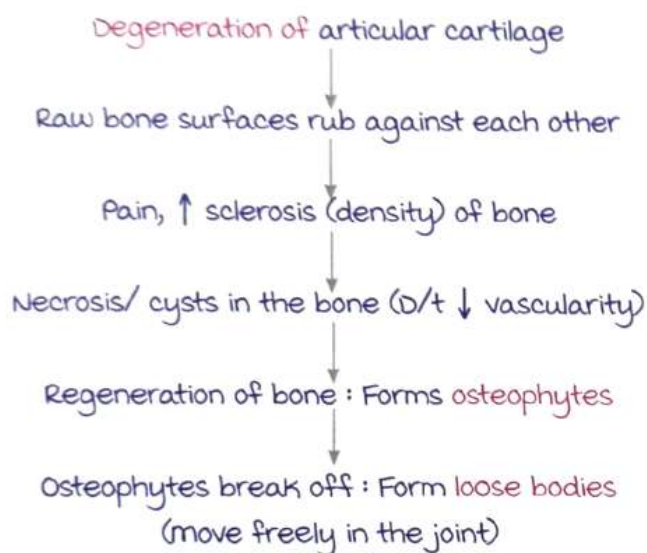
1. Age related degeneration.
2. Preexisting destruction of cartilage.

Types :

----- Active space -----



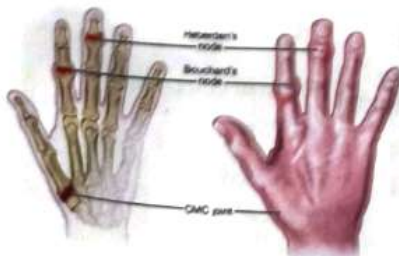
Pathogenesis :



FEATURES

Clinical features :

- Pain on active & passive movement.
- ↓ range of movement → ↓ muscle usage → Disuse atrophy (m/c : vastus medialis of quadriceps)
- Crepitations.
- Swelling and deformity.
 - Bouchard's and Heberden's nodes : D/t osteoarthritis of PIP and DIP.



DIP swelling (Heberden's node)
PIP swelling (Bouchard's node)



----- Active space -----

X-ray features :

1. Decreased joint space.
2. Bone on bone appearance.
3. Subchondral sclerosis.
4. Necrotic cysts & osteophytes.
5. Loose bodies.



Osteoarthritis



Normal Knees

Note :

- most of the weight bearing occurs on the medial side → Joint space decreases medially first → Genu varum.
- Osteoarthritis is the m/c cause of b/l genu varum.

Loose bodies in knee joint :

- m/c cause : Osteoarthritis.
- m/c cause in elderly : Osteoarthritis.
- m/c cause in young : Osteochondritis dissecans.
- m/c cause of multiple loose bodies : Synovial chondromatosis.

TREATMENT**1. Conservative :**

- Prevent progression : Weight loss.
- Physiotherapy.
 - Heat.
 - Strengthening exercises.
- Walking with support.
- Braces.

2. Medication (Supportive treatment) :

- NSAID's : Acetaminophen.
- Cartilage protectors : Glucosamine, chondroitin sulphate
- Help regenerate damaged cartilage in early stages.
- Lubrication : Inj. hyaluronic acid (Visco supplements).

3. Surgical (Definitive) :

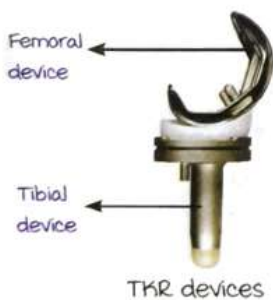
Arthroscopy : Joint wash to remove loose bodies.

High tibial/ medial opening wedge osteotomy : To correct varus deformity & ↓ pain.

Arthroplasty : To replace damaged joint.

1. Unicondylar replacement : Replacement of medial side of knee joint.

2. Total knee replacement (TKR) → Complication : Patellar clunk syndrome.



TKR devices



High tibial osteotomy



Unicondylar replacement



- Femoral component replacement
- Tibial component replacement

3. Total hip replacement :

- Head & neck of femur replaced.
- Acetabular component.



Total hip replacement

----- Active space -----

Rheumatoid Arthritis

00:18:54

INTRODUCTION

General features :

- m/c type of inflammatory arthritis disease of synovium.
- Systemic autoimmune multisystem disease (Lungs, heart, liver).
- Predominantly musculoskeletal manifestations.
- Erosive type of arthritis → Destroys joint.
- Females > males.
- Symmetrical (B/L involvement) peripheral joint involvement.

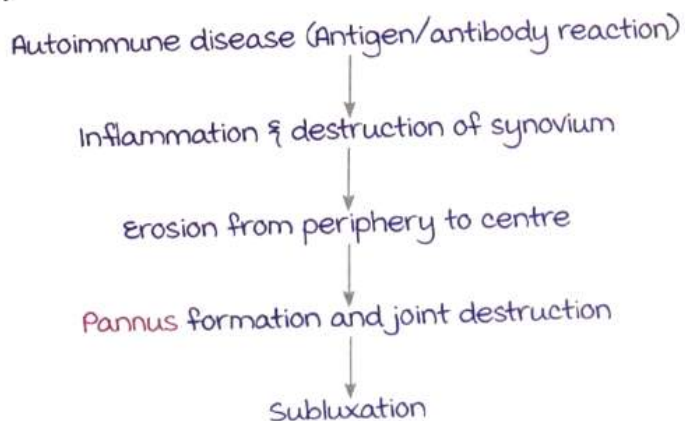
Joints involved :

- Hand : MCP > wrist, PIP.
- Knee and hip.
- Axial is rare (may involve cervical spine).
- Spares : DIP.

Note : Only non-erosive inflammatory arthritis is SLE.

PATHOLOGY

Pathogenesis :



----- Active space -----

multisystem associations :

↓ life expectancy

- Carditis.
- Pleuritis.
- Caplan syndrome.
- Felty syndrome.

INVESTIGATIONS**Diagnosis :**

- ↑ ESR, ↑ CRP.
- Rheumatoid factor : **most sensitive** marker.
 - IgM antibody against FC portion of IgG Ab.
- **Anti cyclic citrullinated peptide (Anti-CCP)** : **most specific**.

X-ray features :

1. Narrowing of joint space.
2. Osteoporosis (↓ bone density) and hyperemia :
 - D/t inflammation of joint.
 - Initially juxta articular, later generalised.
3. marginal erosion.
4. **No sclerosis, no osteophytes.**



Rheumatoid arthritis

Normal joint

Difference b/w OA and RA :

RA

OA

Note :

DeQuervain's synovitis : Tenosynovitis of abductor pollicis longus and extensor pollicis brevis.

DEFORMITIES IN RA

1. Hand :

----- Active space -----

ulnar deviation
of fingersRadial deviation
of metacarpals

1. Z deformity



2. Boutonniere deformity



3. Swan neck deformity

Boutonniere
deformitySwan-neck
deformity

Flexion of PIP & compensatory extension of DIP

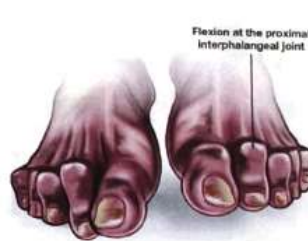
Extension of PIP & compensatory flexion of DIP

Note : In mallet finger, only injured finger is affected (DIP flexed).

2. Knee :

- B/L genu valgus.
- Wind swept deformity.
- Cause : Rickets > RA in children
RA in elderly.
- Triple deformity.

3. Foot :



1. Hammer toes



2. Hallux valgus

Note : ulnar nerve palsy → Claw hand.

MANAGEMENT

1. Physiotherapy : Preserves and improves joint function.

2. methotrexate : DOC.

3. DMARD's :

- Leflunomide : Immuno suppressant.
- Infliximab/Adalimumab : TNF- α inhibitors.
- Anakinra : IL-1 receptor antagonist.
- Rituximab : Anti CD20 antibody.

4. Surgical :

- Synovectomy : Removal of inflamed synovium.
- Joint replacement surgery.
- Deformity corrections.



3. Wind swept deformity

Spondyloarthropathies

00:32:07

Inflammatory disease processes involving spine and joints.

Conditions :

1. Ankylosing spondylitis : m/c.
2. Psoriatic arthritis.
3. Enteropathic arthritis : Inflammatory bowel disease (Crohn's, ulcerative colitis).
4. Reactive arthritis : Shigella, chlamydia.

Features :

- They are seronegative (RF -ve).
 - Young males > females.
 - HLA B27 positive.
 - A/w uveitis.
- Note : RA is a/w scleritis.

ANKYLOSING SPONDYLITIS

AKA *Marie Strumpell disease* / *Bechterew's disease*.

General features :

- males > females.
 - Joint involvement : Axial > peripheral.
- Involves :
- Sacroiliac joint (m/c).
 - Spine.
 - Hip.

Clinical features :

- Pain at gluteal region/back (Sacroiliitis).
- *morning stiffness* improving with activity.
- Decreased lumbar spine movement.
- ↓ chest expansion (D/t fusion of ribs with the spine).
- Anterior uveitis.

Pathogenesis :

Enthesopathy (Enthesis : Site of insertion of ligaments & tendons on bone).

Inflammation : Entesitis → Erosion → Abnormal regeneration & calcification →

Restriction of joint movement.

X-ray features :

1. Sacroiliitis :
Sclerosis and ankylosis (fusion) of sacroiliac joint.



Normal sacroiliac joint

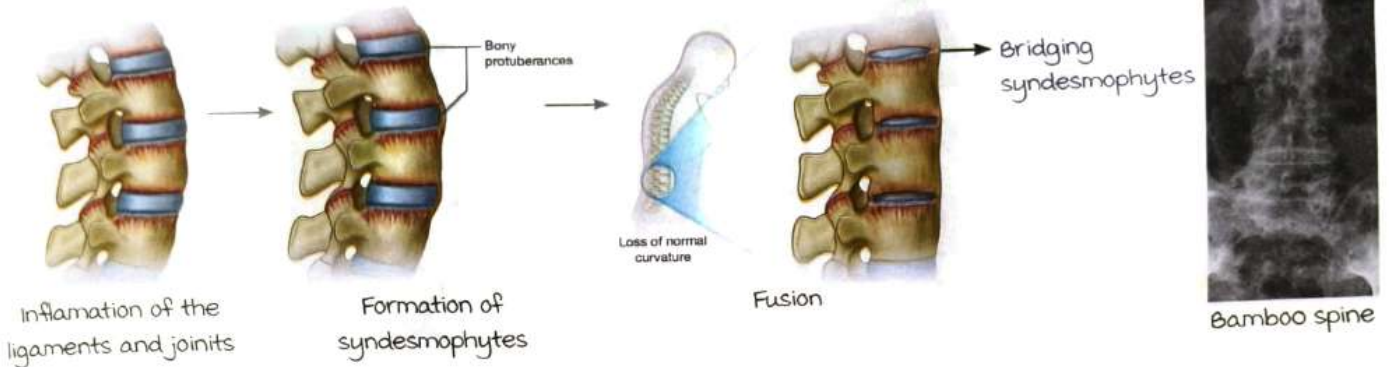


Ankylosis & sclerosis

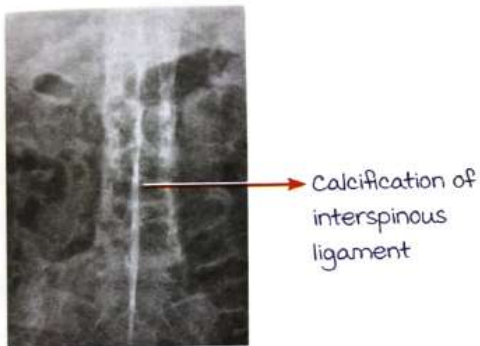
----- Active space -----

2. Bamboo spine :

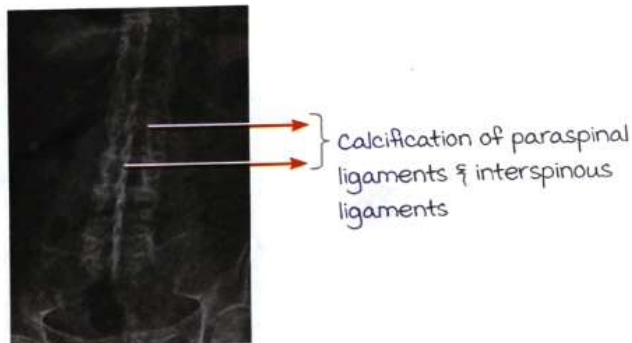
- Fusion and squaring of spine.
- Calcification b/w vertebrae.



3. Dagger sign :



4. Trolley track sign



Diagnostic criteria :

- Essential criteria : Sacroiliitis
 - MRI (IOC) : most sensitive (Earliest changes seen).
 - Inflammation of iliac > sacral side.
- Supportive criteria :
 - ↓ lumbar spine movement.
 - ↓ chest expansion.
 - Inflammatory back pain & morning stiffness.

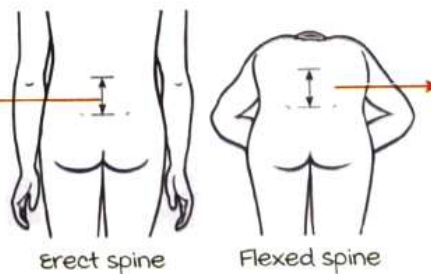
Clinical tests :

- ↓ chest movement (measure chest expansion)
- For sacroiliitis :
 - Gaenslen's test.
 - FABER test/ figure of 4 test.
 - Pump handle test.
- Testing lumbar spine motility :
Schober/ modified schober test.

Treatment :

- Chest physiotherapy.
- Exercises : Swimming, cycling.
- Medical management :
 - NSAID's.
 - Steroids.

1. measure distance b/w 2 points



2. measure same distance on flexion :
Spine does not open upon flexion (d/t fusion).
The distance b/w 2 points does not ↑.

----- Active space ----- Note :

Differential diagnosis for fusion of spine

1. DISH : Diffuse idiopathic skeletal hyperostosis

- AKA forestier disease.
- m/c in elderly.



Anterior longitudinal ligament calcification :
Flowing candle wax like ossification

2. OPLL : Ossification of posterior longitudinal ligament

- m/c in elderly.
- m/c in cervical spine.



Ossification of posterior longitudinal ligament

PSORIATIC ARTHRITIS

General features :

- Erosive arthritis.
- Females > males.
- Asymmetrical oligoarticular type (m/c involved : DIP).

CASPAR criteria :

- Psoriasis.
 - RF -ve.
 - X-ray changes.
 - Dactylitis.
 - Nail changes.
- } For diagnosis

Clinical features :

1. Dactylitis :

Sausage digit d/t swelling of fingers.



2. Shortening of digits :

- d/t destruction of the joints.
- Telescoping (pulling out) of fingers.



3. Arthritis mutilans :

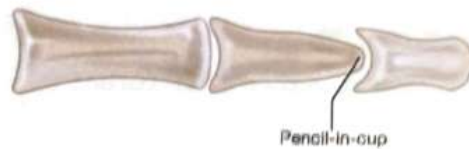
Total erosion and destruction of bone.

Treatment :

- Treatment of psoriasis.
- methotrexate.

4. Pencil in cup appearance :

Extreme destruction of phalanx.



----- Active space -----

Hemophilic Arthropathy

00:45:50

etiology :

- Hemophilia A : Factor 8 deficiency.
- Hemophilia B : Factor 9 deficiency.

Pathogenesis :

Recurrent bleeding into the joint → Destruction of synovium + inflammation.



Hemophilic arthropathy

Clinical features :

1. Pseudo tumors :

- muscular bleeding → Collection of blood in the muscle.
- m/c : iliopsoas > quadriceps.

2. Painful swelling of joints :

- D/t bleeding into it.
- m/c : knee.
- Present in flexed position : As its position of ease.

3. Arthritis mutilans.

X-ray :



1. Widening of intracondylar notch
2. Loss of joint space

3. Juxta articular osteopenia.
4. Squaring of patella.

Treatment :

- Treat hemophilia : Factor replacement.
- Compression bandage.
- Ice pack.
- Aspiration of the joint :
 - Only in severe pain.
 - Can cause infection.

----- Active space -----

Crystal Deposition Arthropathy

00:48:00

GOUT

Features :

- m/c crystal arthropathy. uric acid levels
- Purine metabolism abnormality.
- ↑ serum uric acid (Normal : 3.5 - 6.5 mg/dl).
- m/c involved : 1st MTP (Great toe).
- male (middle age) > females.
- Drugs : Furosemide, aspirin.

Pathogenesis :

Sudden change in → Crystal precipitation and deposition in cold peripheral joints
 ↓
 Local inflammatory reaction
 ↓
 Collateral damage to the joint



Acute gout

Painful swelling : Tophi

Investigations :

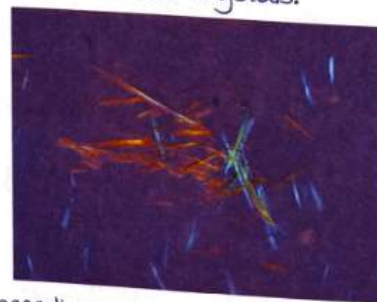
1. X-ray :

- Punched out lesion.
- Joint destruction.
- Overhanging bone/ martel & sign.



2. Synovial fluid analysis is :

- Best investigation.
- Light microscopy of joint aspirate.
- Characteristics of crystals :
 - Needle shaped, -ve birefringent, mono sodium urate crystals.



Gout : monosodium urate crystals on light microscopy

Treatment :

1. Acute gouty attack :

- Only NSAIDs : Indomethacin (Aspirin is C/D).
- Colchicine : Causes GI disturbances.
- Do not control serum uric acid during acute attack, as it can precipitate more pain.

2. Chronic gout :

a. Xanthine oxidase inhibitors :

- Allopurinol.
- Febuxostat.
- Rasburicase.

b. Uricosuric drugs :

- Probenecid.

----- Active space -----

PSEUDOGOUT

Deposition of calcium pyrophosphate dihydrate.

General features :

- m/c in elderly patients.
- A/w hypothyroidism.
- Female > male.
- m/c affects knee joint (Large joints).

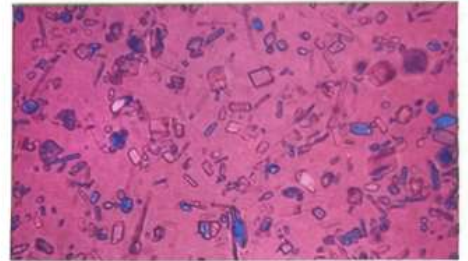
X-ray features :

Chondrocalcinosis.

**Note :**

Calcification of cartilage is also seen in :

- Ochronosis / alkaptonuria.
- Hemochromatosis.
- Hyperparathyroidism.

Synovial fluid study :
Polygonal, +ve birefringence**Neuropathic Joint**

00:54:10

Joint destruction d/t sensation & proprioception.

AKA Charcot joint.

Etiology :

1. Peripheral neuropathy : m/c cause.
 - Diabetes mellitus (m/c cause of peripheral neuropathy).
 - m/c involves : mid tarsal joints > Tarsometatarsal joint.
2. Leprosy.
3. Syphilis : Involves knee.

Features :

- m/c involves peripheral joints of lower limb.

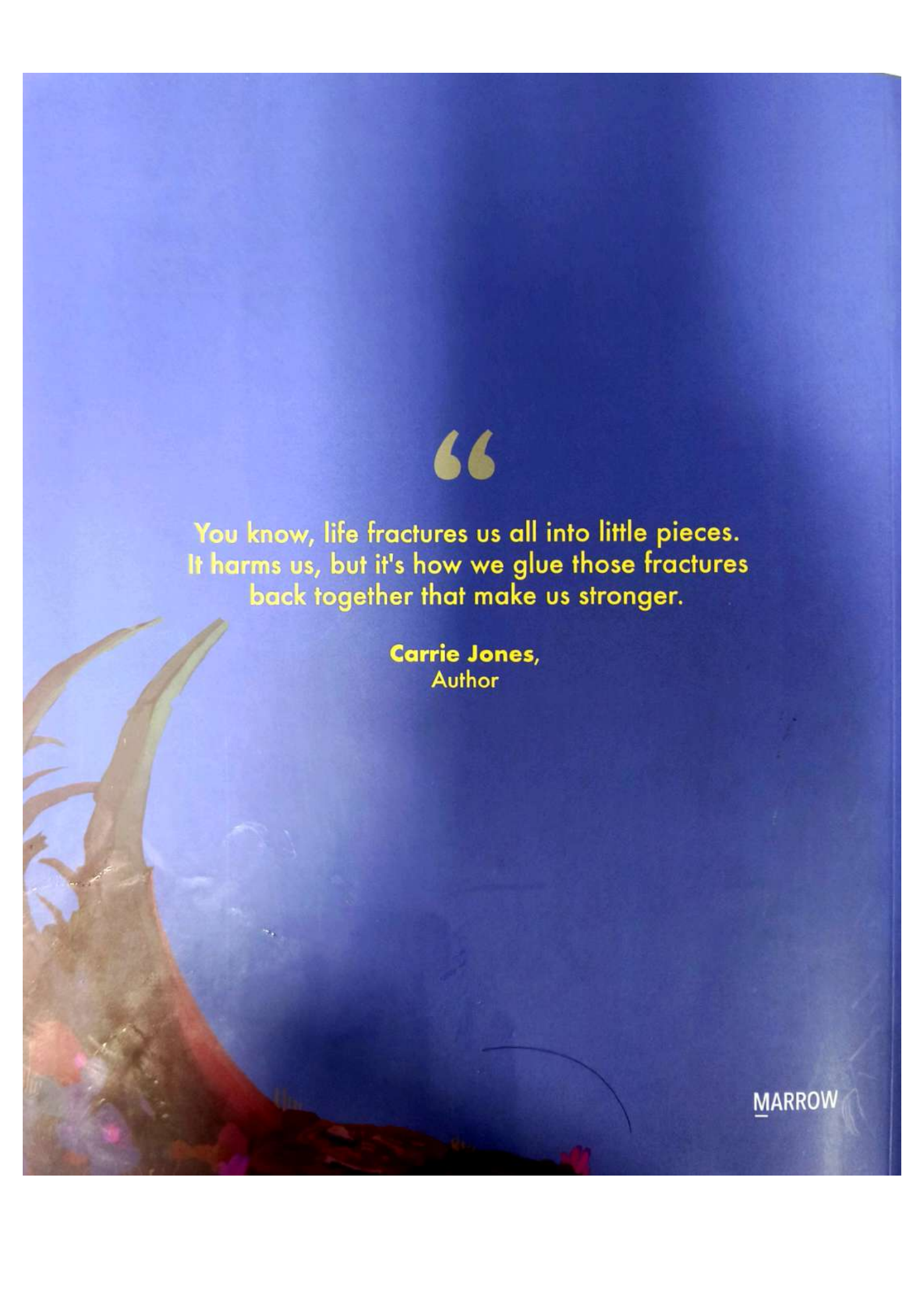
- Bag of bones appearance.
- No pain.

Treatment :

- Arthrodesis : Fusion of bones.
- Arthroplasty is C/I.



Destruction of joints & bone



“

You know, life fractures us all into little pieces.
It harms us, but it's how we glue those fractures
back together that make us stronger.

Carrie Jones,
Author

MARROW