

# ORTHOPAEDICS

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RR-8.0

# Contents

Basics and General Concepts of Trauma	1
Upper Limb Trauma	12
Lower Limb Trauma	27
Cumulative Trauma Disorders	37
Orthopaedic Oncology	43
Nerve Injuries	51
Metabolic Diseases of Bone	61
Orthopaedic Infections	72
Spine : Injuries and Disorders	79
Joint Disorders	86
Paediatric Orthopaedics	91
Sports Injuries	97

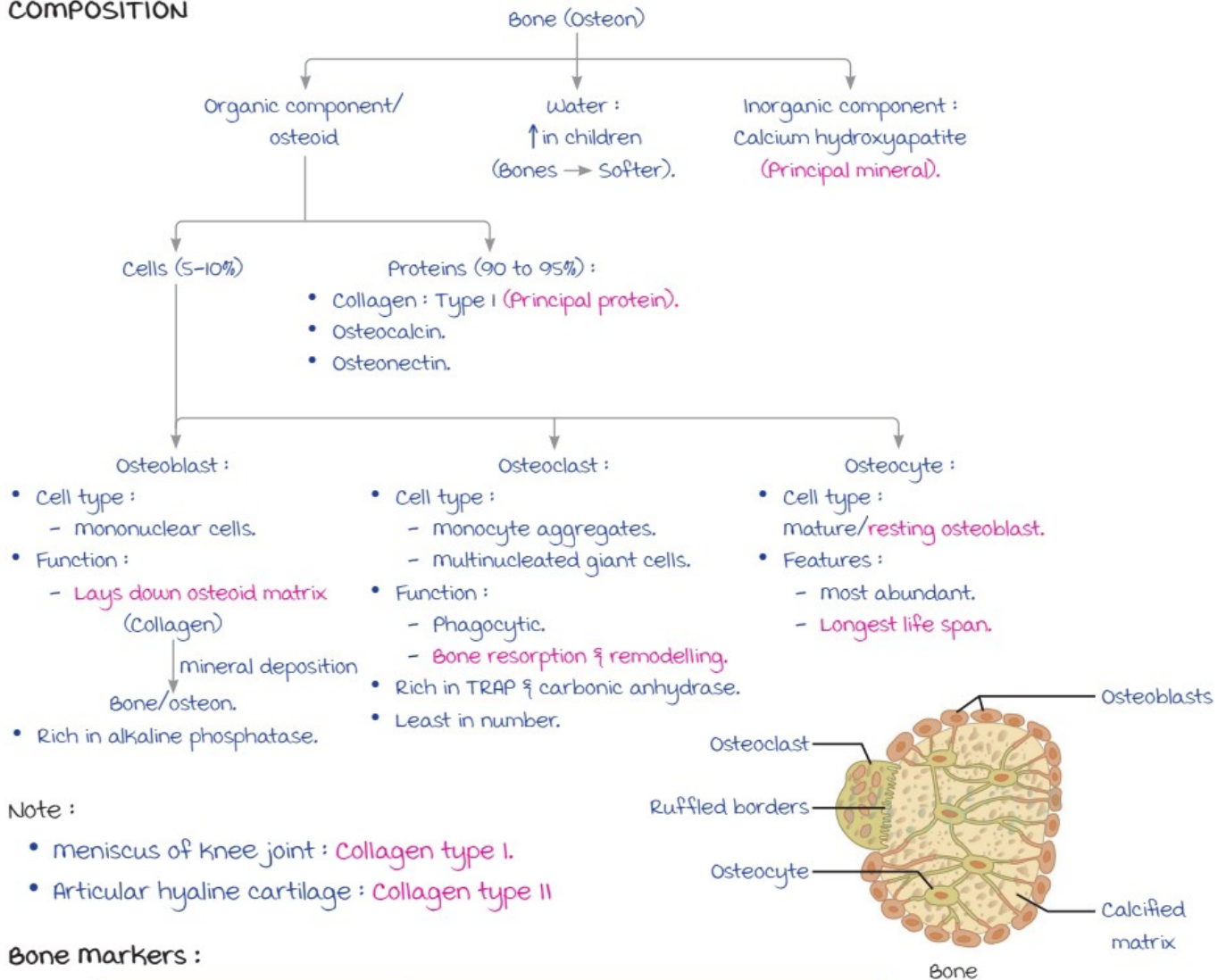
# BASICS AND GENERAL CONCEPTS OF TRAUMA

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## Anatomy of Bone

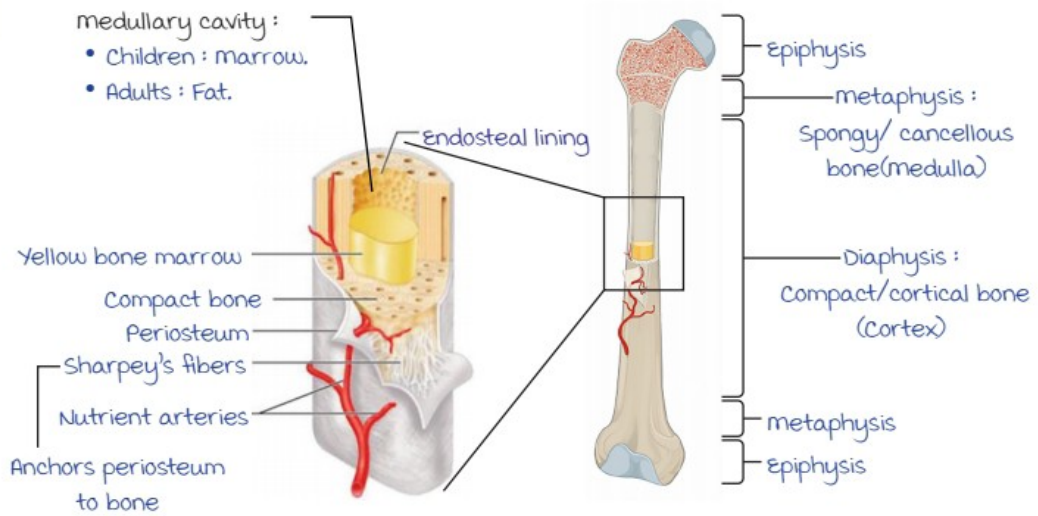
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### COMPOSITION



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**Parts of Bone :**



**Growth Plate :**

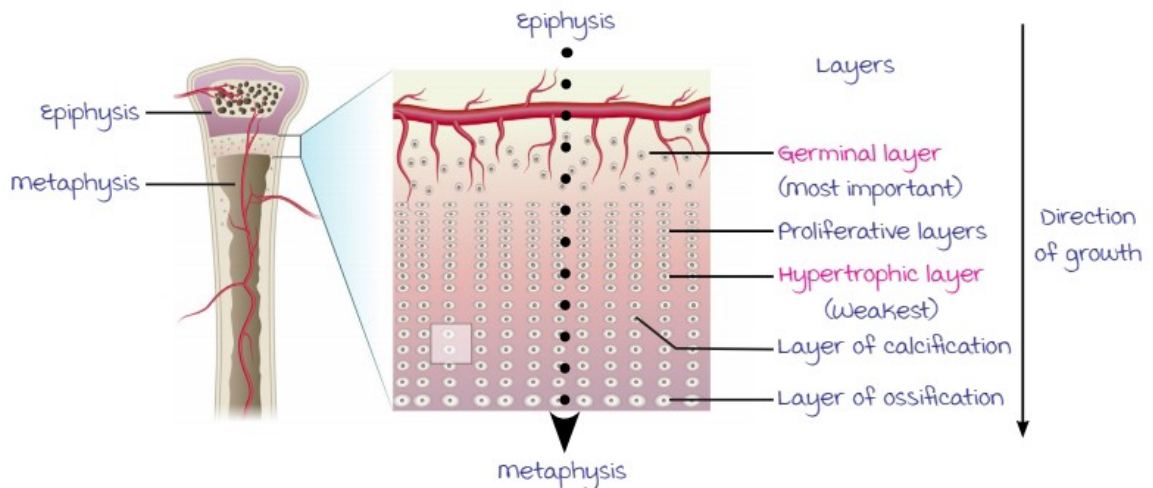


X-ray AP view (Child)

Note :

Growth plate → Longitudinal/interstitial growth.

**Growth plate structure :**








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**Physeal Injuries :**

- Hypertrophic layer : **m/c involved in traumatic injury.**
- Germinal layer : Injury → Growth affected.

Salter & Harris classification of physeal injuries :

mnemonic : **SALTER.**

Type	Image	Features	Prognosis
I (Split fracture)		<ul style="list-style-type: none"> <li>• Fracture splits the growth plate without injuring germinal layer (Through hypertrophic layer).</li> <li>• Normal growth on reducing the fracture.</li> </ul>	Good (Best)
II : <b>m/c</b> (Away)		<ul style="list-style-type: none"> <li>• Fracture splits the growth plate.</li> <li>• Fracture line goes towards the metaphysis.</li> <li>• No injury to the germinal layer.</li> <li>• Normal growth on reducing the fracture.</li> <li>• metaphyseal fragment : <b>Thurston holland.</b></li> </ul>	Good
III (Lower)		<ul style="list-style-type: none"> <li>• Fracture line splits the growth plate and goes towards the epiphysis.</li> <li>• Germinal layer <b>will be injured.</b></li> <li>• No growth on reducing the fracture.</li> </ul>	Bad
IV (Through everything)		<ul style="list-style-type: none"> <li>• Fracture line through <b>all layers.</b></li> <li>• Germinal layer injured.</li> <li>• Growth is impacted even on reducing the fracture.</li> </ul>	Bad
V (Rammed/crushed)		<ul style="list-style-type: none"> <li>• Impaction injury → Crushes growth plate.</li> <li>• Fracture is missed on X ray (No obvious # line).</li> <li>• Late presentation with limb length discrepancy.</li> </ul>	<b>worst</b>

**Fractures**

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Diagnosis : Clinical → Abnormal mobility/Radiological → X-ray.

**Causes of Fractures :**

- Significant trauma
- Insignificant trauma → Stress # (Normal bone ; abnormal loading) : Point tenderness (+)
- Pathological # (Abnormal/weak bone) : **pain before fracture** d/t pre-existing lesion.

Localized causes :

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

Generalized causes :

- **Osteoporosis (m/c)** : Spine > hip > Colle's.
- **metastasis** : Proximal femur & spine.
- Osteogenesis imperfecta.
- Osteopetrosis.
- Scurvy, Rickets/osteomalacia.
- Paget's disease.

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Note :

- vertebral compression fractures : **Wedge fractures**.  
(m/c bone involved in pathological #)
- Subtrochanteric proximal femur # : **Banana #**.
- **Mirel's criteria** : To plan for prophylactic fixation of pathological # (Score >8 : **Prophylactic internal fixation**).

Pathological # :  
Head of humerus**Stress Fractures :**

- Pain **after** activity (Sudden ↑ in intensity/frequency).
- **Lower limb bones** > upper limb bones.
- X-ray positive : 2 to 3 wks later.
- IOC : **MRI** (Soft tissue edema ⊕) → Detects occult fractures (IOC).
- multiple stress # : Bone scan.

Sites :

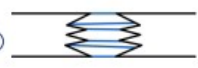

1. Tibia.
2. metatarsal : march fracture  
**2<sup>nd</sup>** > **3<sup>rd</sup>** metatarsal; **Neck** > shaft.
3. multiple stress fractures → Requires bone scan.



march fracture

**Fracture Healing**

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	Primary healing	Secondary healing
Type of healing	Direct/intramembranous healing	Indirect/endochondral healing
Callus formation	Callus ⊖ 	Callus ⊕ 
movement at # site	Absolute stability	Micromovements ⊕ (Relative stability)
Devices	<ul style="list-style-type: none"> <li>• Compression plates</li> <li>• Lag screws</li> </ul>	<ul style="list-style-type: none"> <li>• Pop/braces</li> <li>• External fixation</li> <li>• Bridge plating</li> <li>• Intramedullary nailing</li> </ul>



Rigid fixation (1° healing)



Callus formation (2° healing)

Stages of Secondary Healing :

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1 Hematoma formation (2-3 days)



2 Granulation tissue formation (2-3 weeks) :  
Inflammation + fibroblasts



3 Callus formation (2-3 months) :  
Fibroblasts → Osteoblasts



4 Consolidation (2-3 years)



5 Bone remodelling (3 years) :  
Woven bone → Lamellar bone



Non-union

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Factors Affecting Fracture Healing :



Patient : Age, nutrition, tobacco, alcohol.

Type of # : Open, contaminated, interposed.

Treatment : Improper immobilization (m/c) ;  
inadequate reduction.

Tissue : Ischemia.

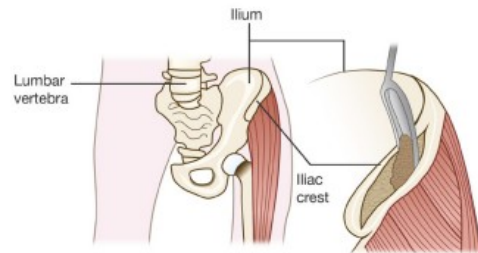
Types :

	Hypertrophic	Atrophic
Fracture	Smooth & sclerosed ends + visible fracture line	
X-ray appearance		
Callus formation	Exuberant	Absent
Bone biology	Good	Abnormal
Immobilisation	Improper	⊕
Treatment	Immobilization	Autologous bone grafting

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**Bone graft :**

- m/c site : **Iliac crest.**
- MOA : Creeping substitution (Canvas for bone to grow).



Bone graft extraction

**Malunion**

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- Healing in anatomically abnormal position.
- TOC : Osteotomy (Cut, realign & fix bone).

Note :

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



Angulated malunion

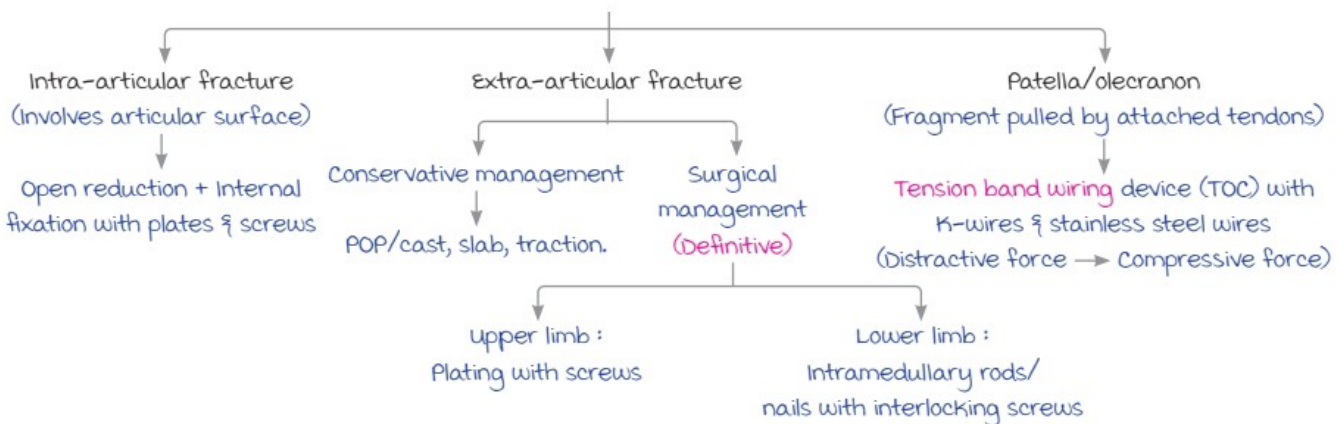


Osteotomy

Bones with ↑ risk of malunion vs non-union :

malunion	Non-union
<ul style="list-style-type: none"> <li>• Clavicle (m/c)</li> <li>• Supra-condylar humerus</li> <li>• Colle's</li> <li>• Intertrochanteric (Extracapsular) femur</li> </ul>	<ul style="list-style-type: none"> <li>• Lower 1/3<sup>rd</sup> of tibia (m/c)</li> <li>• Scaphoid</li> <li>• Lateral condyle of humerus</li> <li>• Neck of femur (Intracapsular)</li> <li>• Neck of Talus</li> </ul>

**MANAGEMENT OF FRACTURES**



Fractures of necessity : Require **surgical management.**

- Intra-condylar #.
- Lateral condylar humerus #.
- Monteggia/Galeazzi #.
- Neck of femur #.



**Open Fractures**



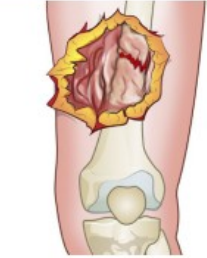
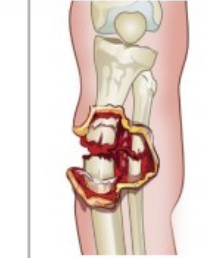

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- Fracture + break in skin and underlying soft tissue.
    - m/c pathogen : **Staph. aureus.**
    - Fracture hematoma escapes outside
- } Affects healing
- m/c involved : **Tibia and phalanges.**

**Gustilo Anderson Classification :**

Wound size usually >10 cm

Type I	Type II	Type IIIa	Type IIIb	Type IIIc
				
Wound <1 cm long.	Wound 1-10 cm	Open fracture + contaminated environment : Sewage, farms or firearm injury.	Open fracture with periosteal stripping	Open fracture + vascular injury : Distal pulses not palpable.

**management :**

**A. Wound management :**

1. Broad spectrum antibiotics.
2. Debridement.
3. Wound wash with
  - Sterile normal saline.
  - Povidone iodine.
  - H<sub>2</sub>O<sub>2</sub>.
4. Wound closure delay if
  - >6 hr old injury.
  - New neurovascular injury.
  - Edges cannot be approximated.

**B. Fracture management :**

**External fixation** → Wound management & closure → Definitive surgery.

1. Schantz pin with external rod :



uniplanar EF with one rod



multiplanar EF with 4 rods

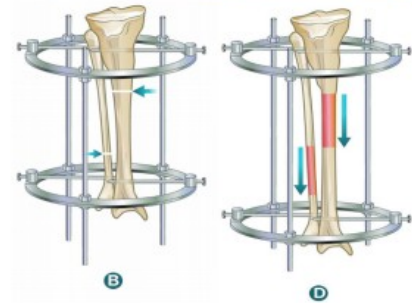


uniplanar EF with 2 rods

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## 2. Ilizarov ring fixator :

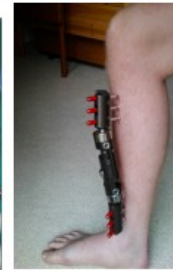
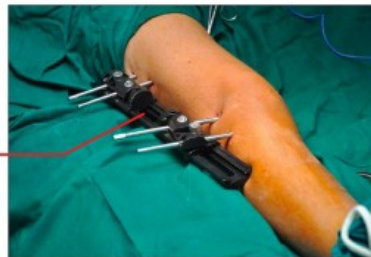
- Multiplanar.
- Rings and pins used.
- Distraction osteogenesis (AKA **callotaxis**) :  
At **1 mm/day**  
(Can lengthen bone if required).
- Indications/uses :
  - Open fracture.
  - Non-union.
  - Infected non-union.
  - Fracture with bone loss.
  - Limb lengthening.
  - Deformity correction/malunion.



Distraction osteogenesis

## 3. Rail fixators/limb reconstruction system :

Adjustable rods :  
Combination of compression  
& external fixation.



## 4. Spanning external fixator :

- Spans across joint → ↑ Stability.
- use : **Periarticular fractures**  
(Distal femur/proximal tibia #).

Rods connected by  
spanning over the joint

Pins



Complications of management : **Ring sequestrum** (m/c)

- Occurs at pin tract sites.
- Causes → Heat necrosis d/t drilling.  
→ Direct infection.

Stability of EF :

Improved by :

↑ Number of pins, rods, planes (Biplanar > uniplanar).

