

# Types of fracture healing and association with fixation

**I found  
this**

**humerus**



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# What are we covering?

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## Types of Fracture Healing

- Primary (Haversian remodelling)
- Secondary (callus formation)

Clinical implications of fracture healing

Types of fracture immobilisation/fixation and the type of healing encouraged

# But First!.....Basics

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Fracture healing is dependent upon many factors.

Briefly:

- The type of injury (closed/open? High/low energy?)
- Local factors (soft tissue degloving or crush injuries fair worse)
- Patient factors (diabetic? Smoker?)
- Surgical factors (appropriate fixation, movement or lack of)

# Primary Bone Healing

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Occurs with absolute stability

Strain of <2%, meaning interfragmentary movement is almost non-existent. This is usually created by surgical intervention

Direct osteon/Haversian remodelling

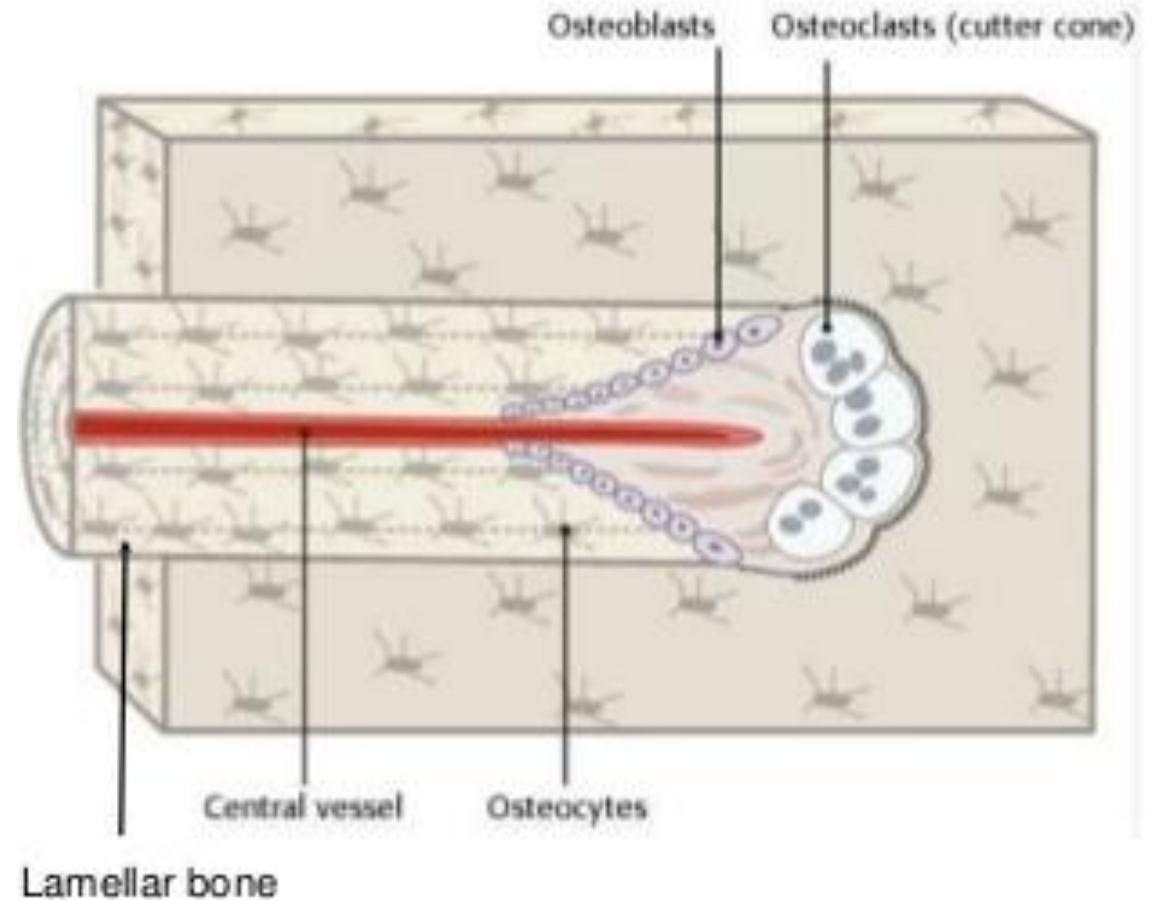
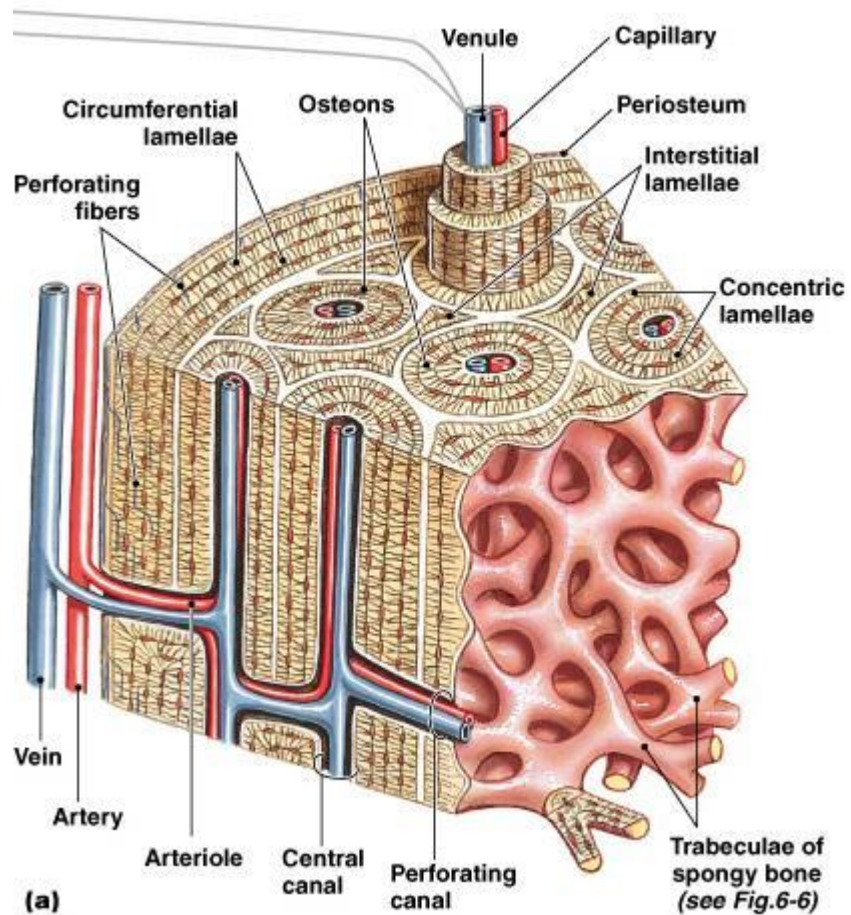
Without callus formation\*

This occurs as part of normal bone turnover

Osteoclasts – break down bone

Osteoblasts – lay down bone

# Anatomy of Haversian system



# Secondary Bone healing

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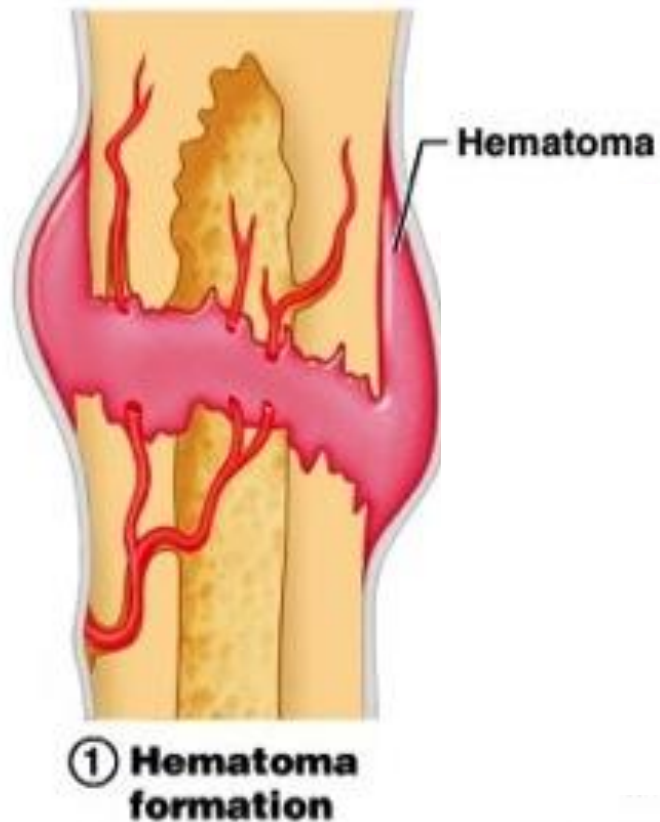
This is also termed as Indirect bone healing.

Healing is mediated by the formation of a callus.

Small degrees of movement occur here – relative stability.

# Inflammatory Phase

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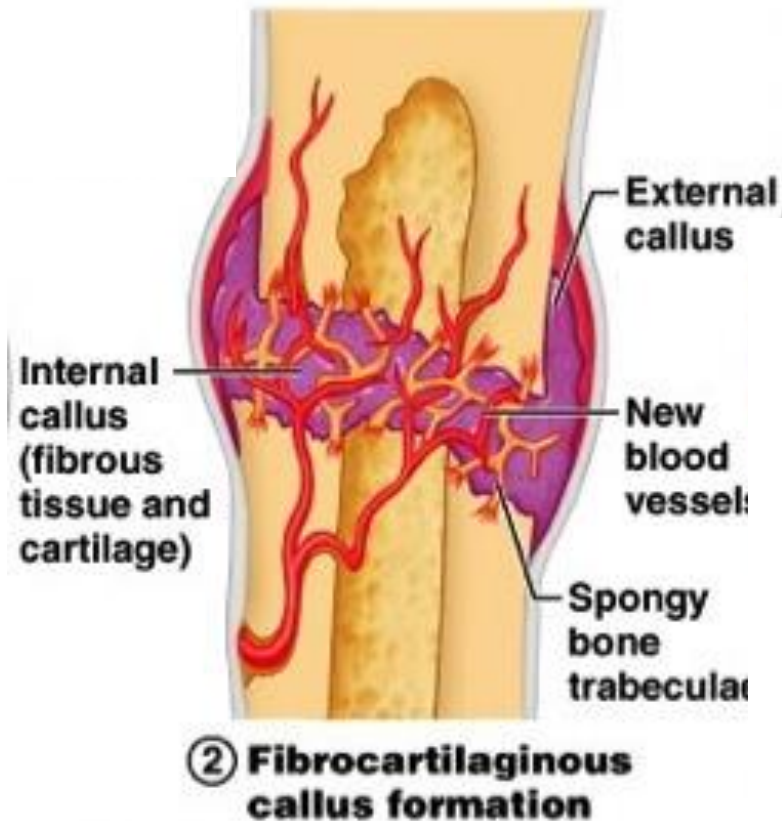


The injury leads to:

- Soft tissue injury
- Disruption of blood vessels
- Bony injury/fracture and separation of fragments
  
- Haematoma formation – assisted by inflammation and dilatation of blood vessels
- Macrophages, neutrophils, mesenchymal stem cells and inflammatory cytokines accumulate at the fracture site
- NOTE: bony fragments without soft tissue attachments become devascularised and are broken down by osteoclasts
- Fibrin stabilises the haematoma helping to help form a callus

# Granulation Phase

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This helps to form a soft callus.

New blood vessels invade the callus/haematoma

Fibroblasts originating from the periosteum move into the haematoma and form collagen

This leads to granulation tissue formation which helps link bone fragments together.

This then leads to fibrous tissue and fibrocartilage helped by osteoblasts and chondroblasts

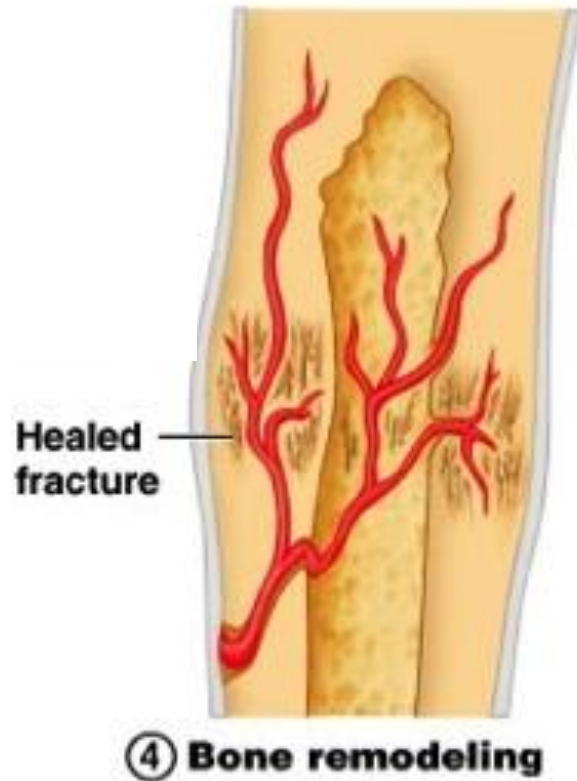




Hard callus is then formed by bone cuffs being formed at the periphery of the fracture and working towards the centre. This helps strengthen and stiffen the fracture site. This is known as endochondral ossification.

# Anatomy of a callus

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Remodelling occurs in response to mechanical stresses that are experienced around the injured site (Wolff's Law)

# Summary and clinical relevance

Timeline (Days)	Stage of healing	Clinical correlation	Physiotherapy/Rehabilitation
1-5	Haematoma	Unstable, mobile fragments	Decongesting techniques
5-10	Soft callus – capillary invasion	Unstable and mobile fragments. Muscles act in attempt to pull fracture site closer together	Decongesting techniques
10-15	Soft callus – Osteoclastic activity (dead bone), proliferation of osteoblasts/chondroblasts	Fracture still mobile	Passive movements
15-21	Formation of hard callus (endochondral ossification)	Reduced movement between fragments	Passive to active movements
21-60	Remodelling of callus	Becomes stable for exercises and movement	Active movements to potential weight bearing

# Indications for Primary and Secondary bone healing

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Primary or direct bone healing (absolute stability):

- Intra-articular fractures – preserve articular surface
- Forearm fractures – complex area where two bones are articulating with each other.

Secondary or indirect bone healing (relative stability):

These include:

- Diaphyseal or long bone fractures
- Extra-articular fractures

# Treatment methods: Primary Bone Healing

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# Treatment methods: Secondary/Indirect healing

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# Treatment methods: Secondary/Indirect healing

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**THIS ORTHOPAEDIC THING**



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