

# Healing & Repair

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Healing and Repair

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# Healing and Repair

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- Definitions
- Major Causes of Tissue Destruction
- Regeneration
  - Control of Regeneration
  - Cell cycle
- Repair
  - Biosynthesis of proteoglycans
  - Biosynthesis of collagen
  - Types of collagen
  - Induction of Repair
    - 1. Organization
    - 2. Progressive fibrosis
  - Cell-Matrix Interactions

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# Healing and Repair – Continue ...

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- Wound Healing
  - Stages in wound healing
  - Healing by First Intention:
  - Healing by second Intention:
  - Factors influencing wound healing
  - Factors accelerating wound healing
  - Complications of wound healing
  - Healing of Fractures
  - Healing of tooth socket
  - Complications of fracture healing
  - Pathological Fractures

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# Definitions

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Healing is the replacement of destroyed or lost tissue by viable tissue. Healing is achieved in two ways:

- **Regeneration**: Is the replacement of the damaged tissue by the same tissue type as was originally there.
- **Repair**: Is the replacement of damaged tissue by fibrous tissue. Repair occurs when regeneration is not possible and usually ends by fibrosis and scar formation..

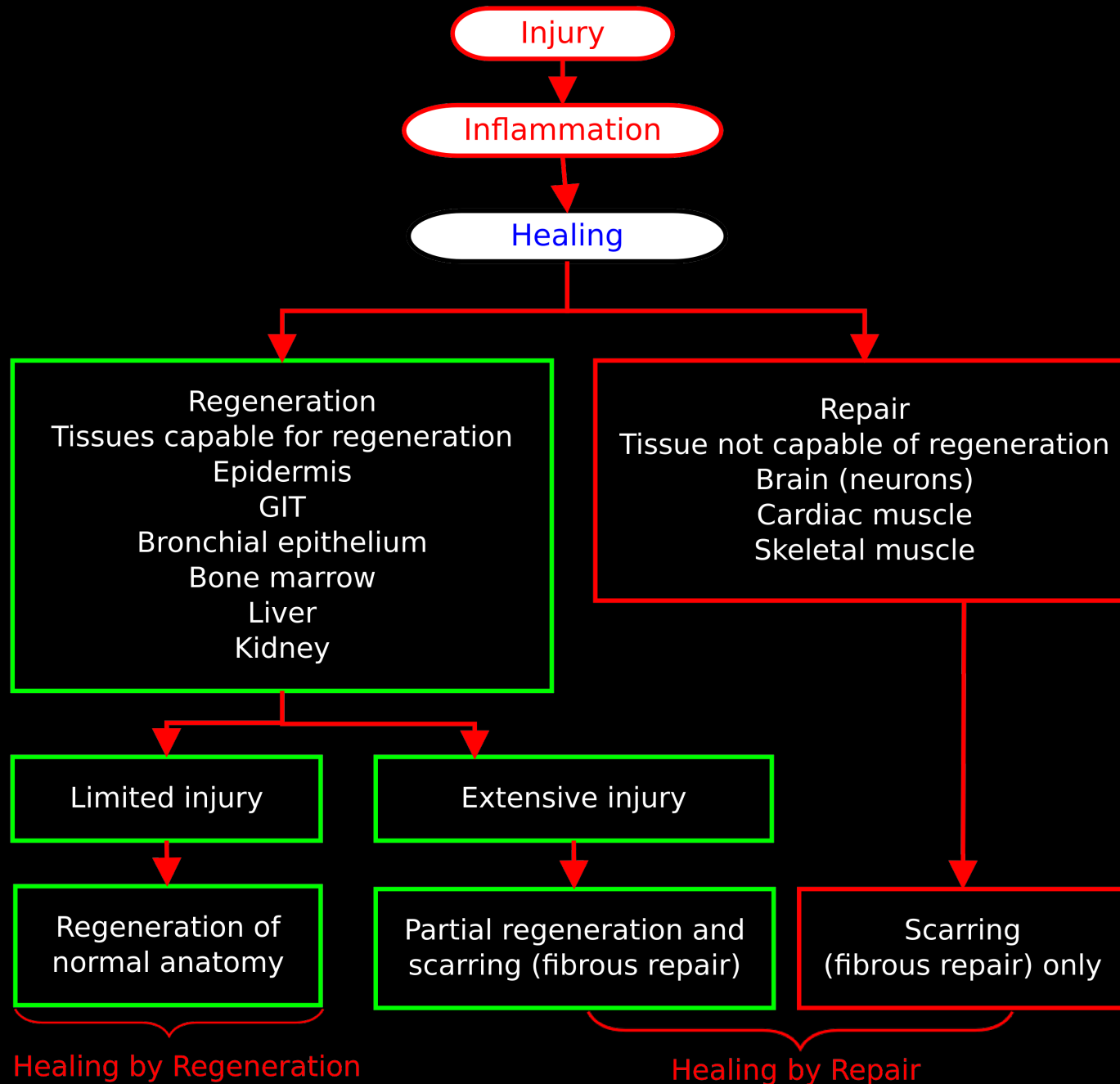
Most organs heal using a mixture of both mechanisms.

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# Major Causes of Tissue Destruction

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1. Lack of blood supply- ischemic necrosis
  2. Inflammatory agents
    1. By direct physical or toxic effects
    2. Indirectly as a result of the host response
  3. Traumatic excision
    1. Accidental
    2. Surgical
  4. Radiotherapy
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# Regeneration

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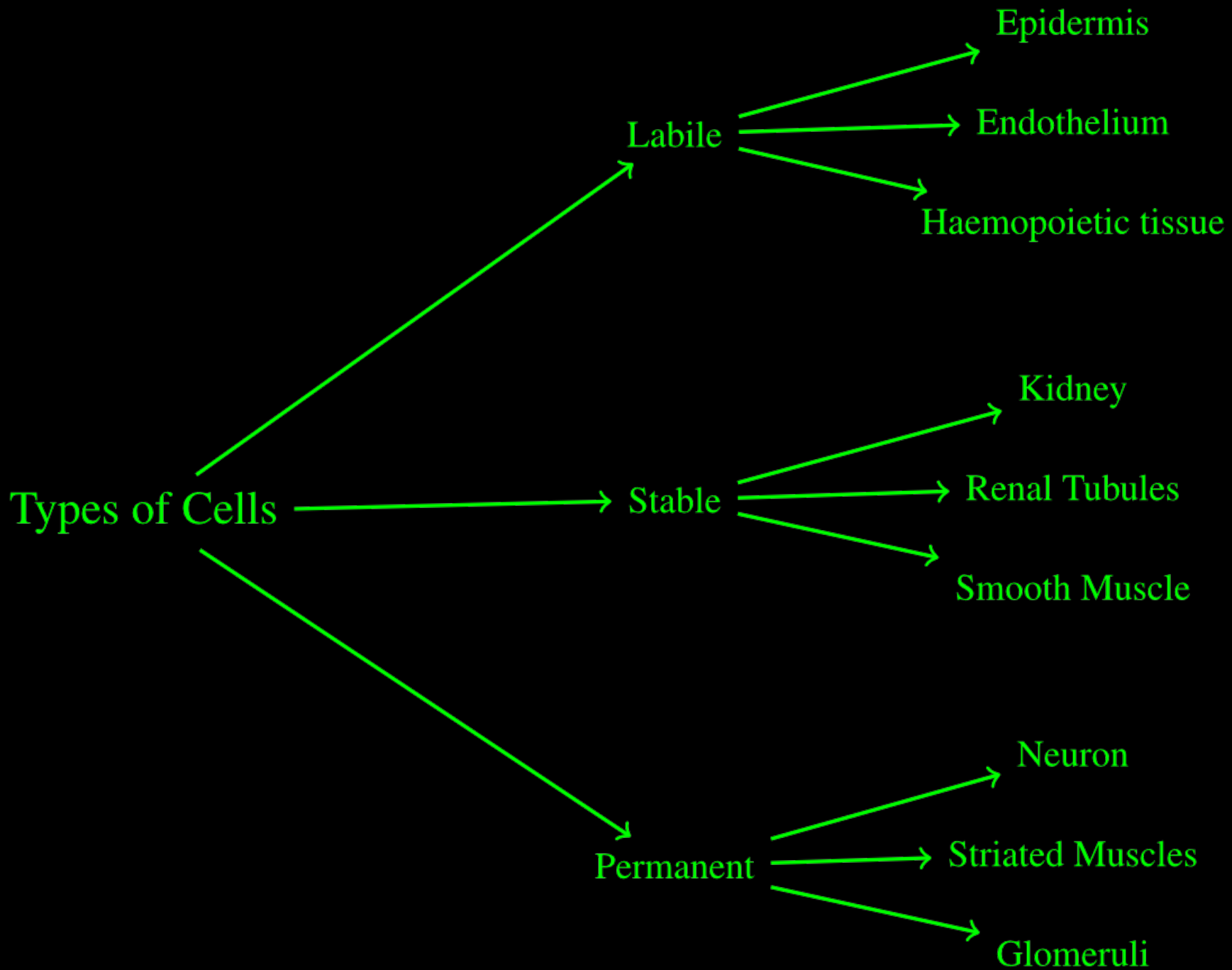
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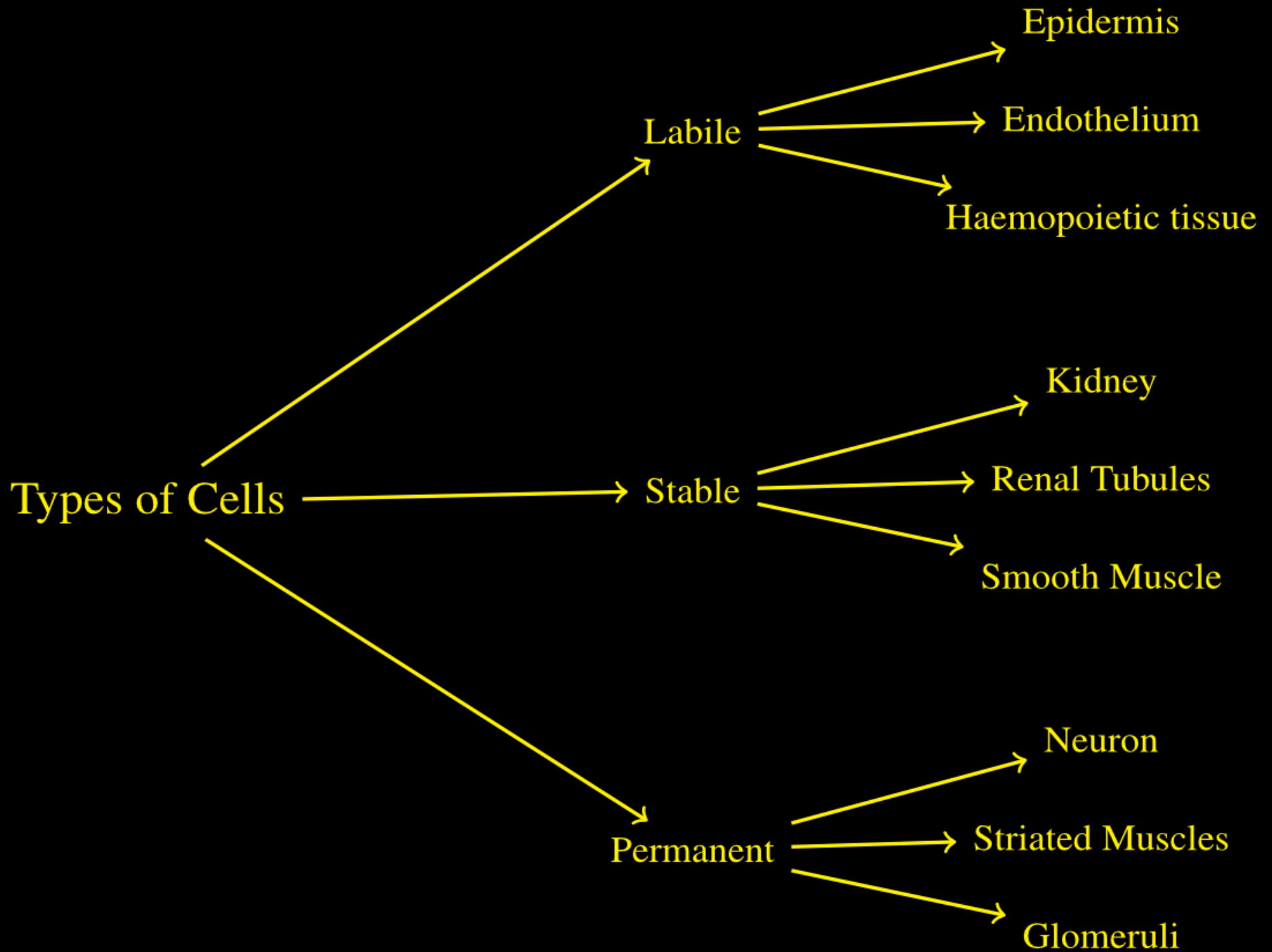


# Types of Cells

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- Labile cells (**intermitotic**) continue to proliferate throughout life, e.g. epidermis, endothelium, haemopoietic tissue, endothelial cells
  - Stable cells (**reversibly postmitotic**) which retain the capacity to regenerate and occasionally exhibit mitoses by virtue of normal cell-turnover, e.g. , liver, renal tubular epithelium, smooth muscle
  - Permanent cells (**irreversibly postmitotic**) which cannot reproduce themselves after attaining maturity, e.g. neurones of the C.N.S., sensory organs, renal glomeruli, striated muscle
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# Regeneration

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- Labile tissues heal by regeneration with little or no repair.
  - Permanent tissues are incapable of regeneration and heal entirely by repair.
  - Most organs show evidence of both processes.
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# Cell Cycle

 0 %  
Loading...

# Granulation Tissue – Mechanism of Formation

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1. Demolition: Removal of foreign and dead tissues by macrophages
    - Fibroblast activity
    - Ingrowth of capillaries
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## 2. Progressive fibrosis

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- Continued accumulation of intercellular collagen and diminution of vascularity and cellularity
    - Collagen re-orientation along lines of stress - remodeling
    - Diminished cellularity
    - Formation of an avascular, hypocellular scar
  - Further changes in scars:
    - Cicatrization -a late diminution in size resulting in deformity
    - Calcification
    - Ossification
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# Wound Healing

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- Stages in wound healing
- Healing by First Intention:
- Healing by second Intention:
- Factors influencing wound healing
- Factors accelerating wound healing
- Complications of wound healing
- Healing of Fractures
- Healing of tooth socket
- Complications of fracture healing
- Pathological Fractures



# Wound Healing - Types

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- A clean wound with closely apposed margins-  
an incised wound (healing by first intention)
  - An open or excised wound (healing by  
second intention).
  - There are no fundamental differences  
between these two types, they merely differ in  
the degree to which the various stages apply.
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# Stages in wound healing

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- Escape of blood and exudate
  - Acute inflammatory response at the margins
  - Hardening of the surface forming a scab
  - Demolition by macrophages
  - Organization
  - Epidermal proliferation
  - Contraction of the wound
  - Progressive increase in collagen fibers
  - Loss of vascularity and shrinkage of the scar
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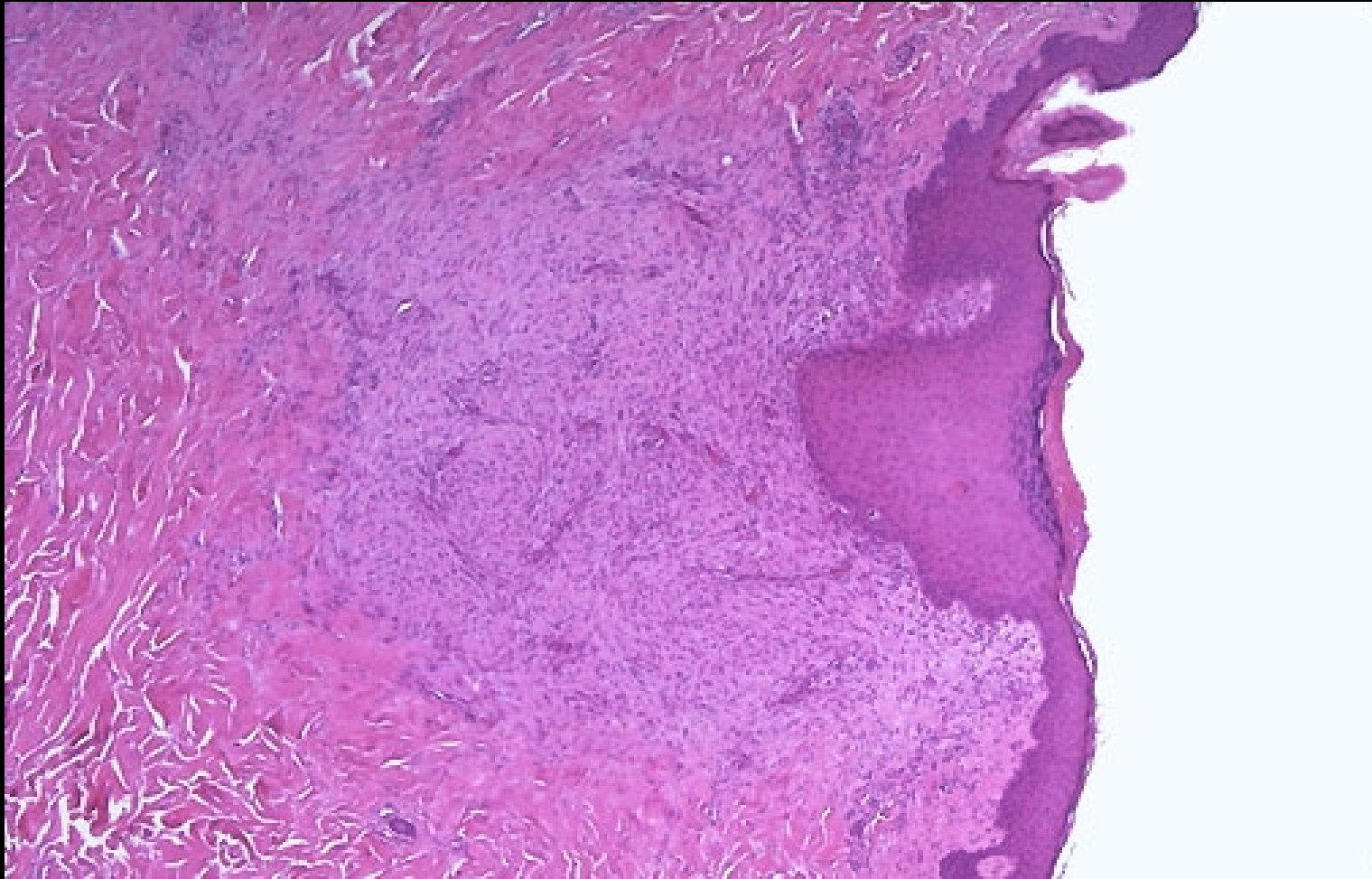
# Healing by First Intention:

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- Occurs in small wounds that close easily
  - Epithelial regeneration predominates over fibrosis
  - Healing is fast, with minimal scarring/infection
  - Examples:
    - Paper cuts
    - Well-approximated surgical incisions
    - Replaced periodontal flaps
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# Granulation Tissue - Healing

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# Healing by second Intention:

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- Greater tissue loss
  - More inflammatory exudate and necrotic tissue to remove
  - Wound contraction is necessary
  - More granulation tissue is required, a bigger scar is formed and this may result in deformity
  - Slower process
  - Increased liability to infection
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# Healing by Second Intention Key Facts:

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- Occurs in larger wounds that have gaps between wound margins
  - **Fibrosis** predominates over epithelial regeneration
  - Healing is slower, with more inflammation and granulation tissue formation, and more scarring
  - Examples: large burns and ulcers, extraction sockets, external-bevel gingivectomies
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# First Intention Versus Second

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first intention healing



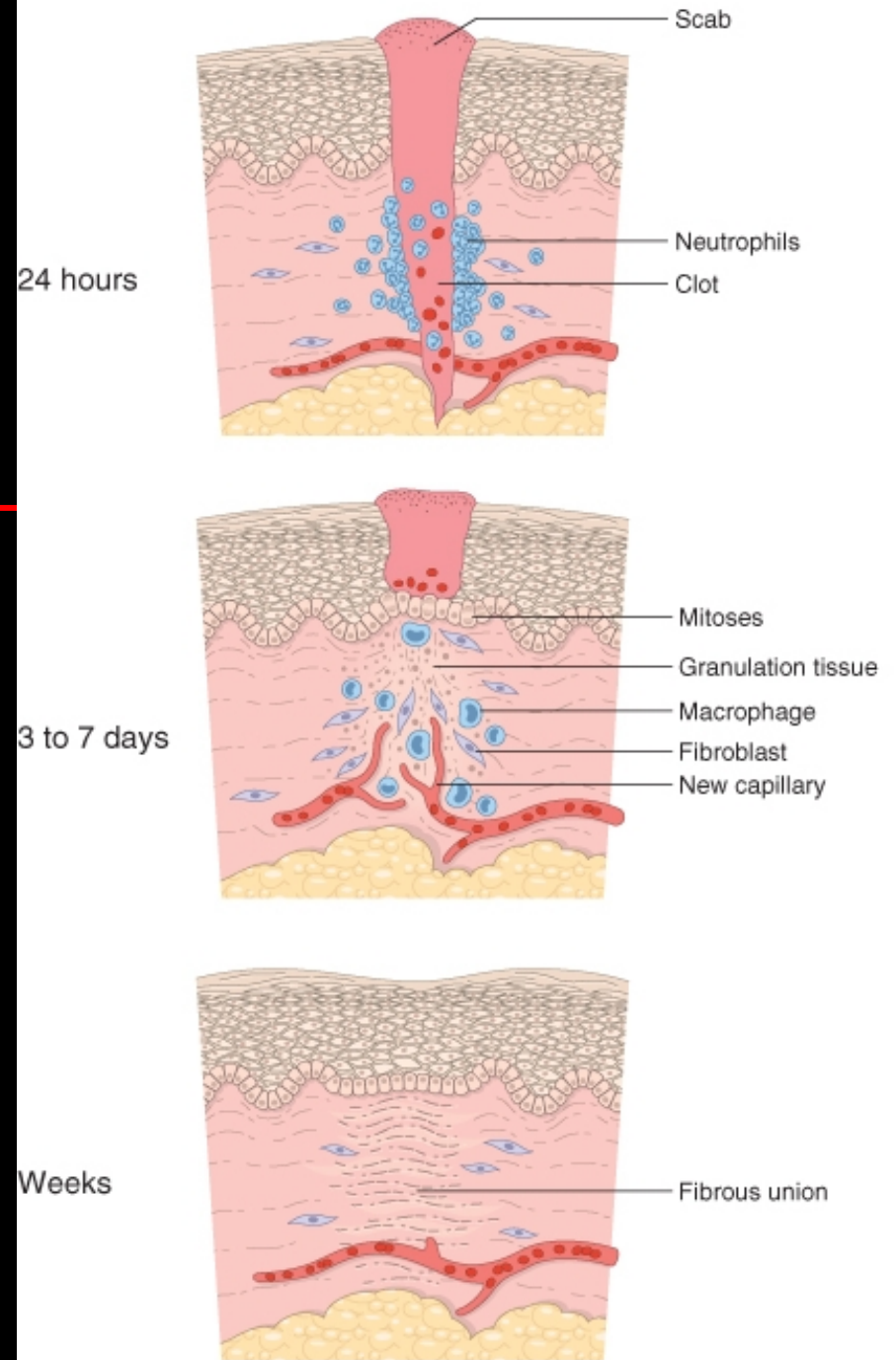
second intention healing

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# Healing by First Intention

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## HEALING BY FIRST INTENTION

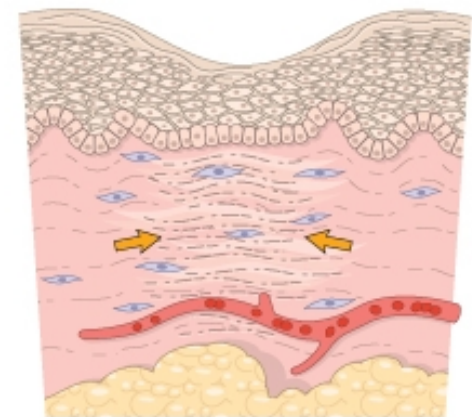
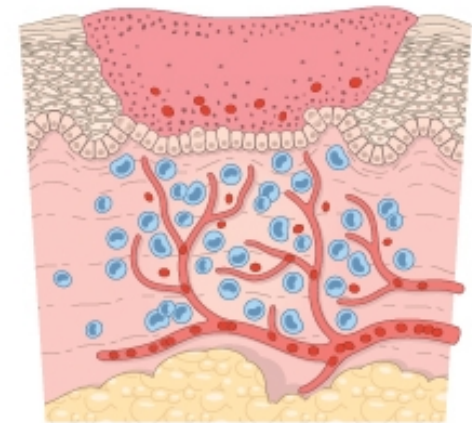
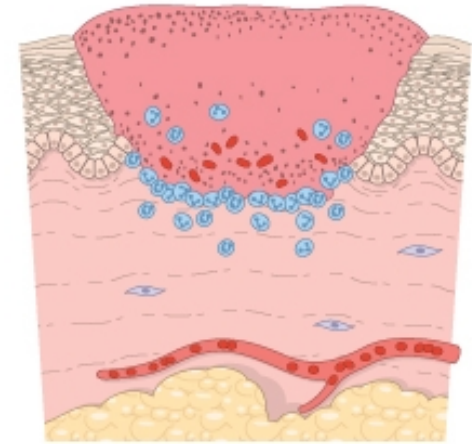




# Healing by Secondary Intention

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HEALING BY SECOND INTENTION



Wound contraction

# Inflammatory Cells

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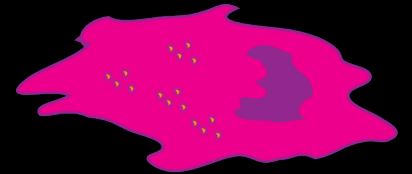
## Acute Inflammatory Cells

- PNL – Microphages

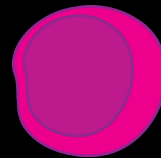


## Chronic Inflammatory Cells

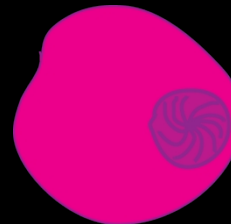
- Macrophages – Histiocytes – Monocytes



- Lymphocytes



- Plasma cells



# Factors influencing wound healing

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1. Local factors adversely affecting healing
  2. General factors adversely affecting healing
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# Local factors adversely affecting healing

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- Type of wounding agent; blunt, crushing, tearing etc.
  - Infection
  - Foreign bodies in wound
  - Poor blood supply
  - Excessive movement
  - Poor apposition of margins, e.g. large hematoma formation
  - Poor wound contraction
  - Infiltration by tumor
  - Previous irradiation
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# General factors adversely affecting healing

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- **Poor nutrition**
    - Deficiency of protein
    - Lack of ascorbic acid (vitamin C)
    - Zinc deficiency
  - **Excessive glucocorticosteroid production or administration**
  - **Fall in temperature**
  - **Jaundice**
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# Factors accelerating wound healing

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- Ultraviolet light
  - Administration of anabolic steroids, deoxycorticosterone acetate, and growth hormone
  - Rise in temperature
  - Hyperbaric oxygen
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# Complications of wound healing

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- Wound rupture
  - Infection
  - Implantation of epidermal cells giving rise to keratin-filled epidermoid cyst
  - Weak scars
  - Cicatrization and deformity
  - Keloid formation
  - Proud flesh: The swollen flesh that surrounds a healing wound, caused by excessive granulation tissue.
  - Malignant change
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# Keloid scar

Excessive fibrosis and Cicatrization



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## Proud flesh

The swollen flesh that surrounds a healing wound, caused by excessive granulation tissue.



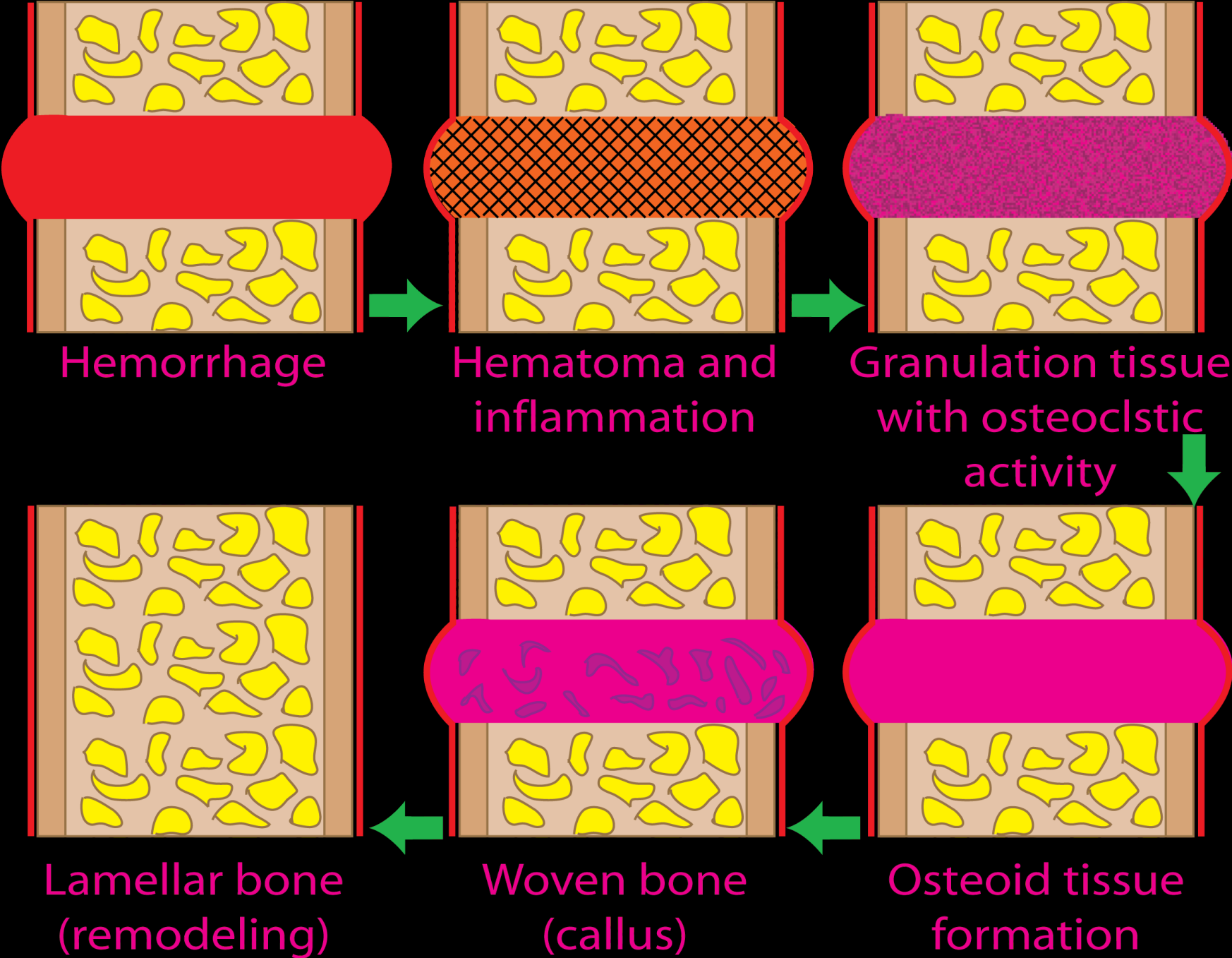
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# Healing of Fractures

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- Hemorrhage: This is due to torn blood vessels.
- Hematoma formation
- Transient inflammatory reaction
- Demolition
- Organization of the clot
- Osteoclastic activity
- Osteoid tissue formation
- Calcification of osteoid
- Remodeling

# Uncomplicated bone repair





## Healing of tooth socket

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- Extravasated blood which then coagulates
  - The blood clot is organized to form granulation tissue
  - Transient inflammatory reaction
  - Osteoclastic resorption of the crestal bone and small sequestra of bone
  - Gingival epithelial proliferation and migration occurs across the defect (10-14 days)
  - Osteoblasts appear and the GT is replaced by woven bone
  - After approximately 6 weeks, the outline of the socket can be discerned both histologically and radiographically
  - Formation of cortical and cancellous bone and disappearance of the lamina dura.
  - Radiographically, the socket is generally obliterated between 20 and 30 weeks after extraction (around 6 months)
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# Complications of fracture healing

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- Delayed union
  - Mal-union e.g. Angulation, Shortening,
  - Fibrous union resulting from: Excessive movement, Infection, Ischemia.
  - Non-union if soft-tissues such as muscle or fat are interposed between the severed ends
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# Pathological Fractures

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- Osteoporosis, especially steroid induced
  - Metastatic tumors
  - Primary tumors (benign and malignant)
  - Paget's disease
  - Bone lesions of hyperparathyroidism
  - Osteogenesis imperfecta
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