General Pathology

Healing & Repair

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Healing and Repair:

- **Healing** is the process by which the body replaces and restores damaged tissue.
- **Repair** refers to the restoration of tissue architecture and function after injury.

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Healing and Repair:

- It involves two main processes:
  - **Regeneration** – replacement of damaged tissue with **identical** tissue (common in skin, liver).
  - **Fibrosis (Scar Formation)** – replacement with **fibrous** tissue when regeneration is not possible.

Regeneration

Fibrosis

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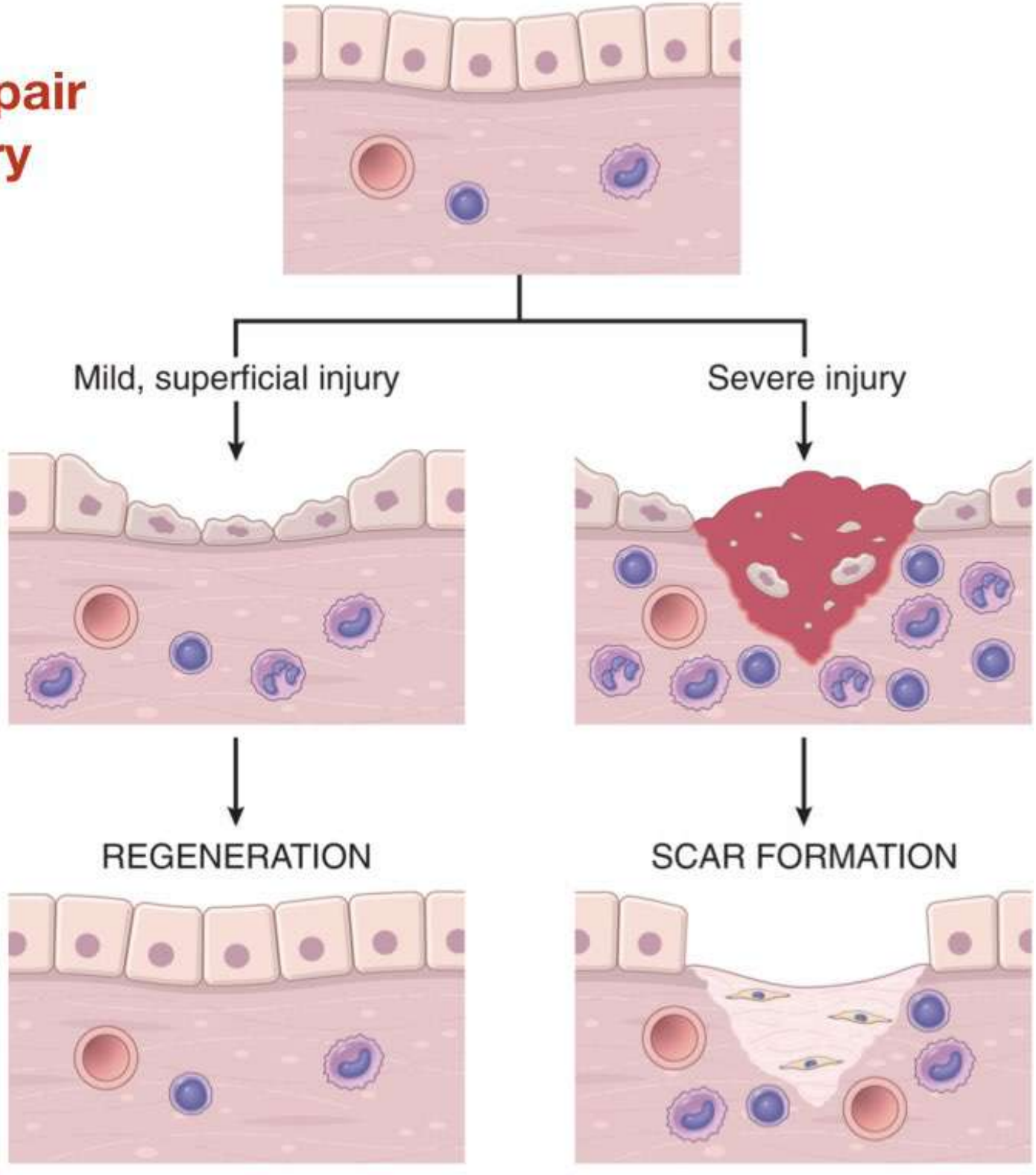
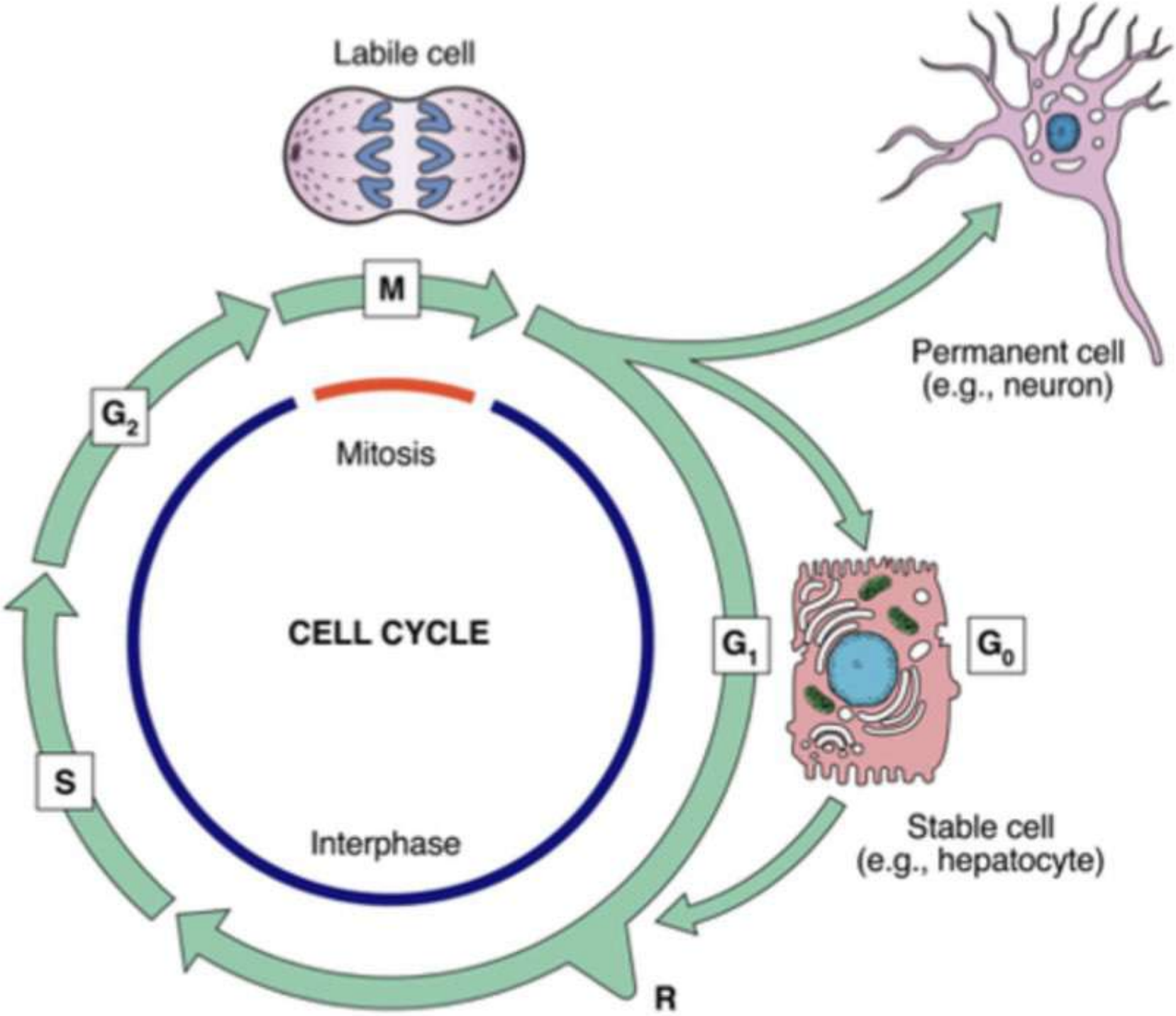
Mechanisms of repair after tissue injury





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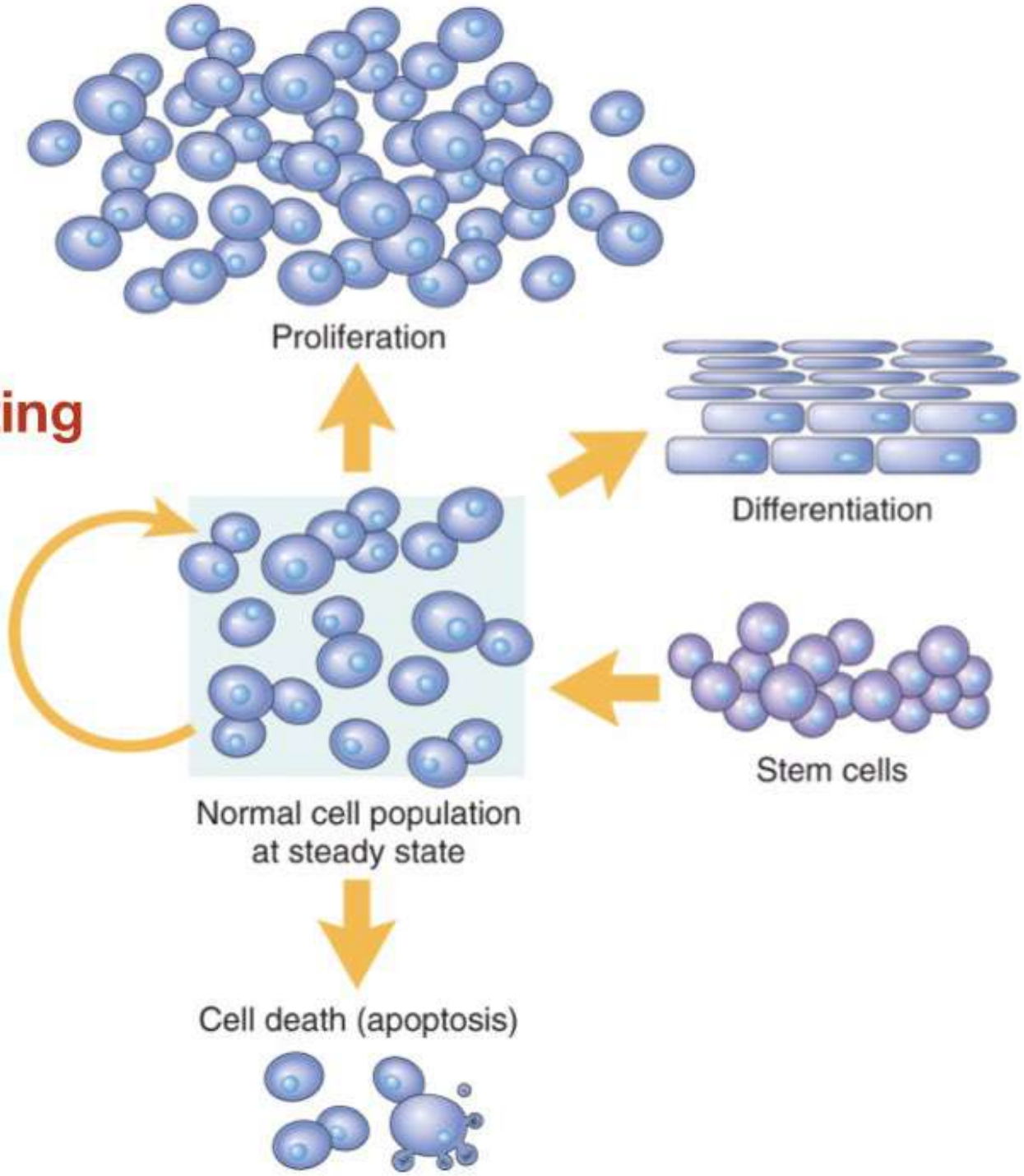
Mechanisms regulating cell populations.



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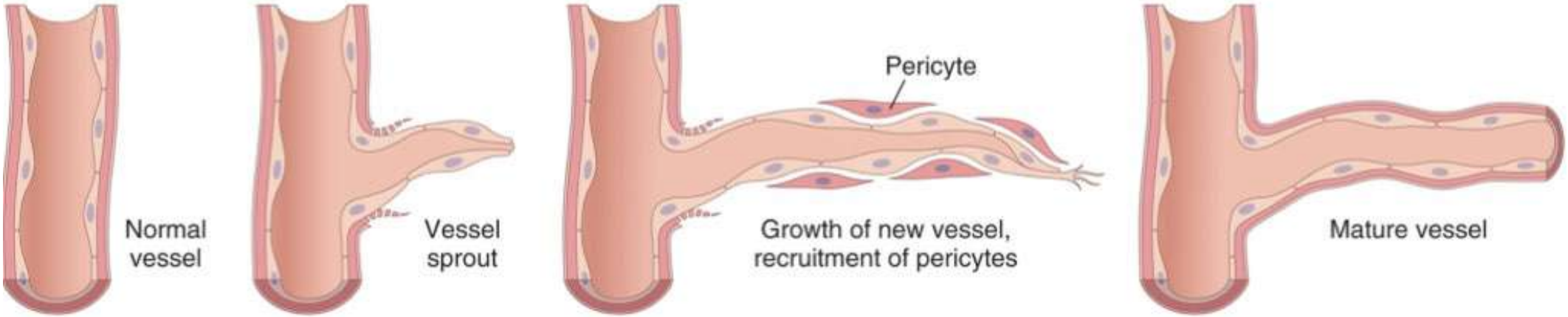

Mechanism of angiogenesis.

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Wound Healing

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The **four phases** of wound healing:

1. **Hemostasis** – clot formation to stop bleeding.
2. **Inflammation** – immune cells clear debris and pathogens.
3. **Proliferation** – new tissue and blood vessels form.
4. **Remodeling (Maturation)** – tissue strength and function are restored over time.

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Key features:

- **Epithelial cells** help re-epithelialize.
- **Fibroblasts** deposit collagen.
- **Angiogenesis** restores blood supply.

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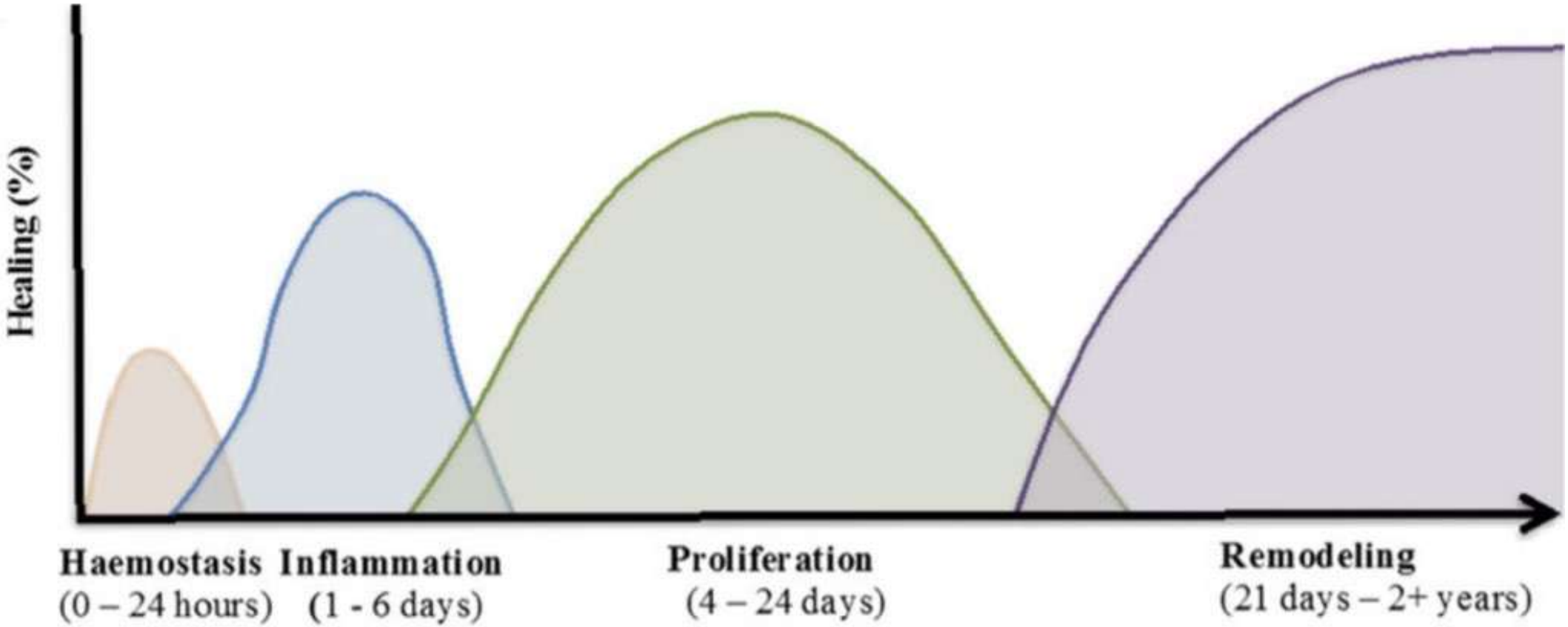

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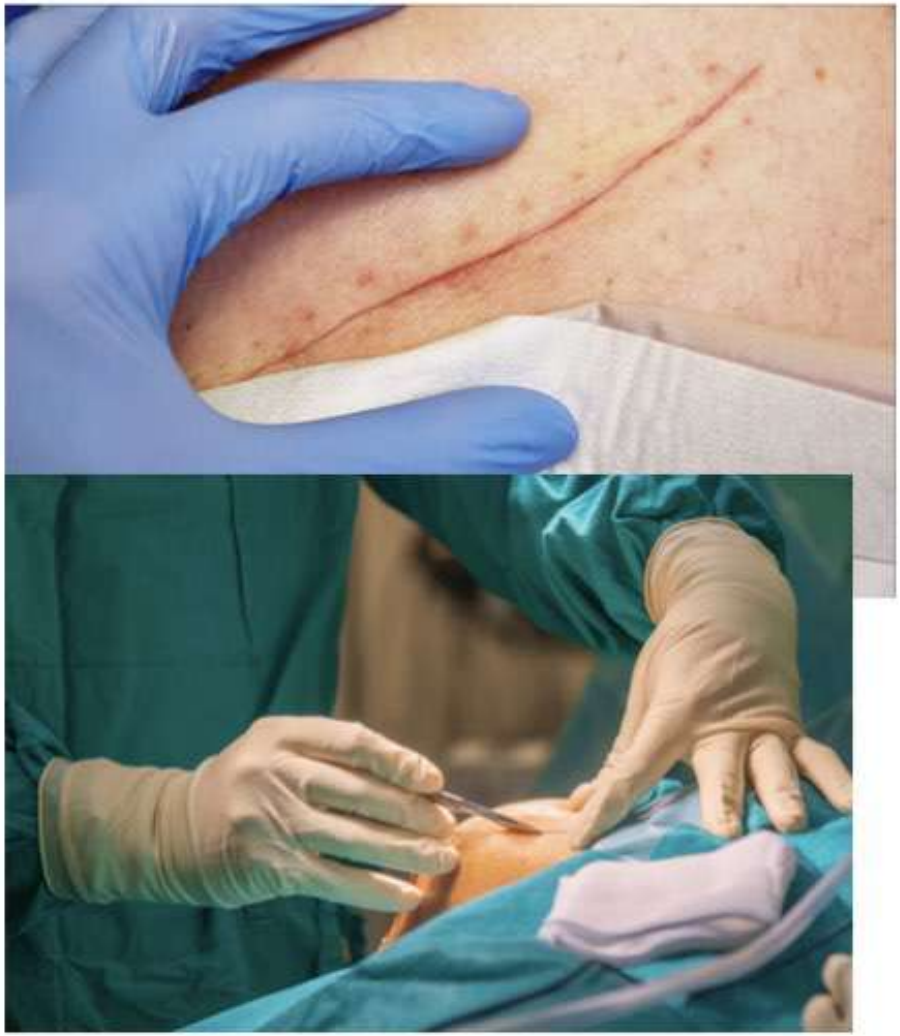
Healing of Skin Wound

There are two main types:



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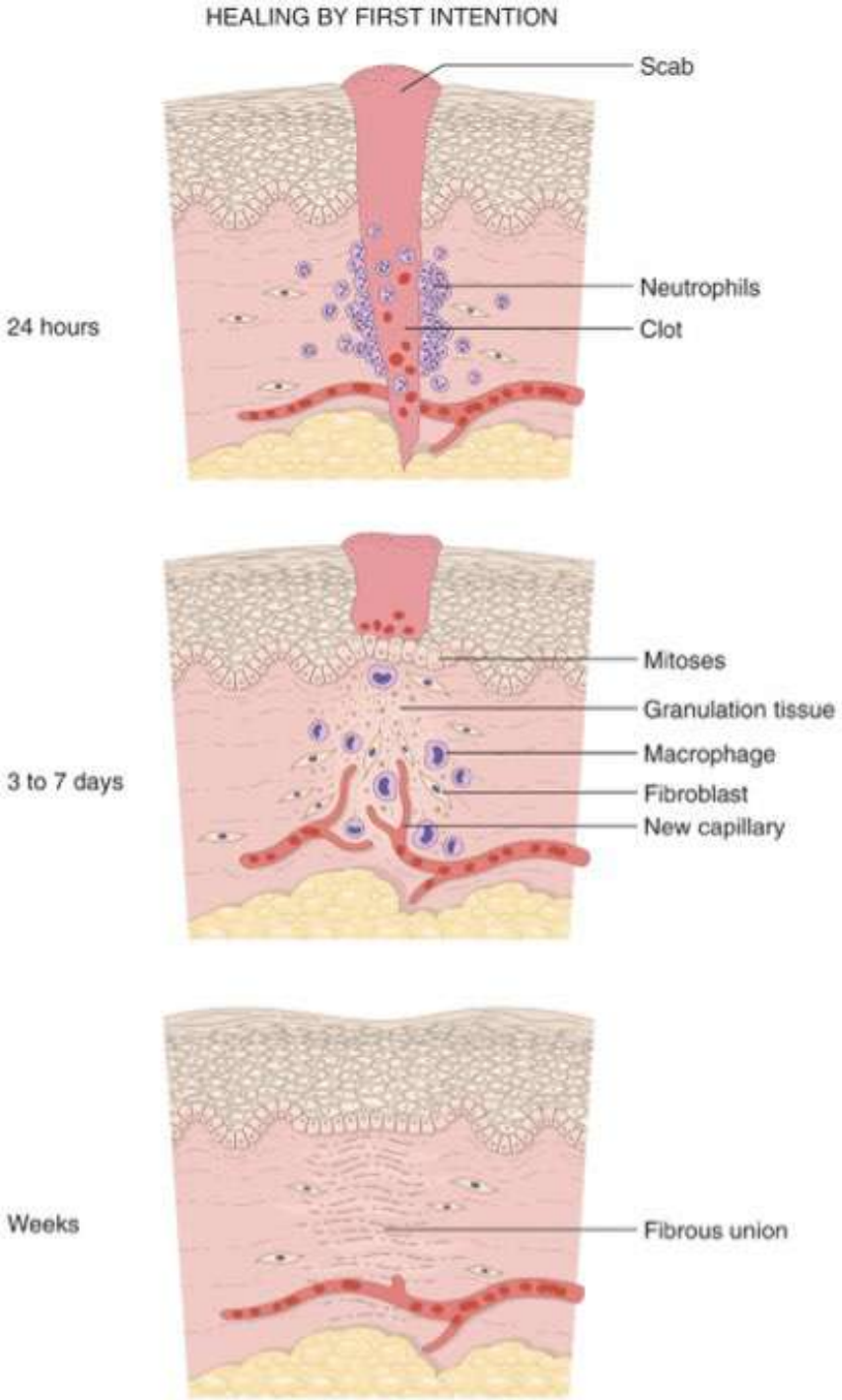
Primary Intention (clean, surgical wounds):

- Edges are closely apposed.
- Minimal tissue loss and scarring.



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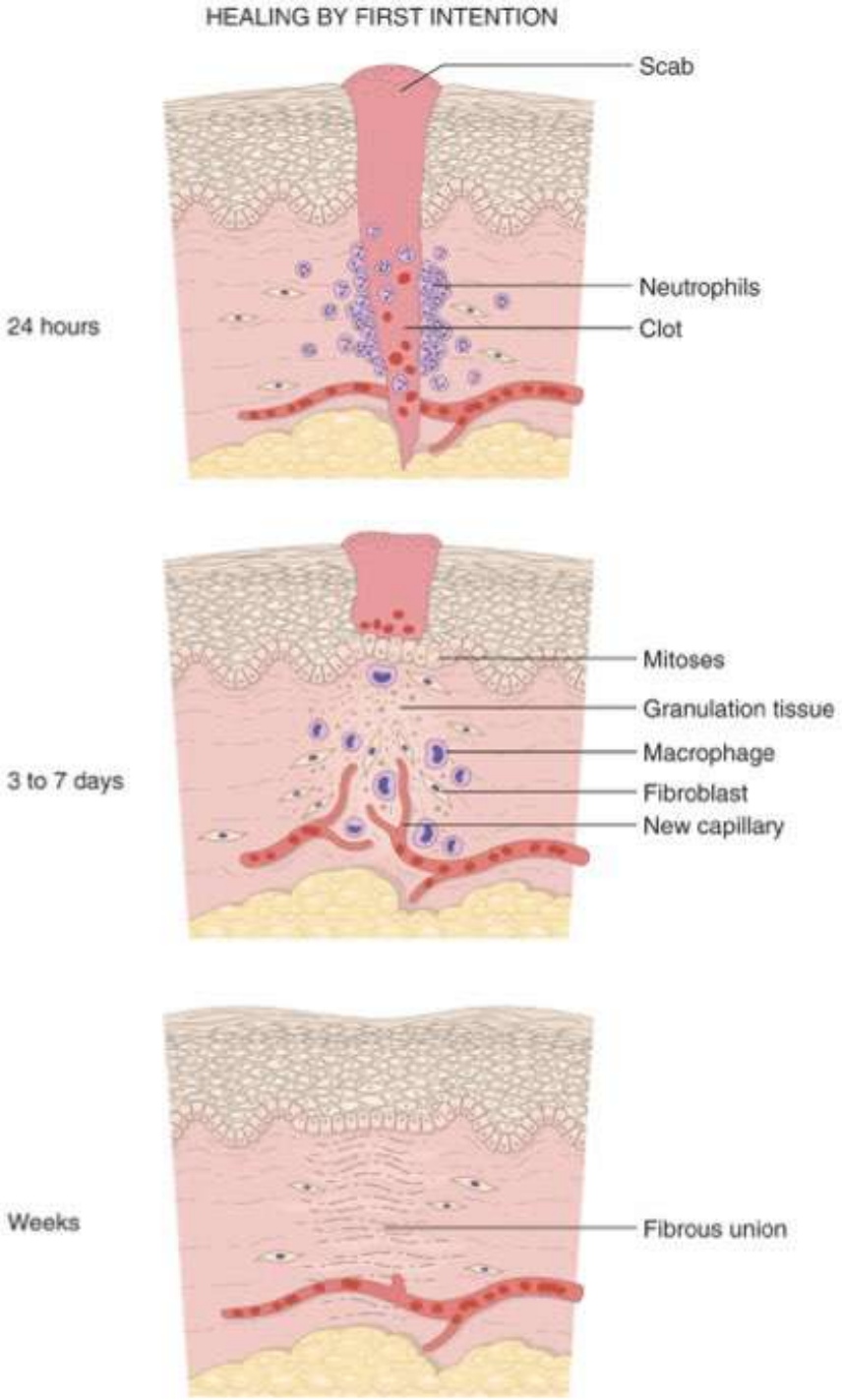
Primary Intention (clean, surgical wounds):

- **Sequence**:
  1. Clot formation
  2. Neutrophil infiltration
  3. Epithelial regeneration
  4. Collagen deposition
  5. Scar formation and remodeling



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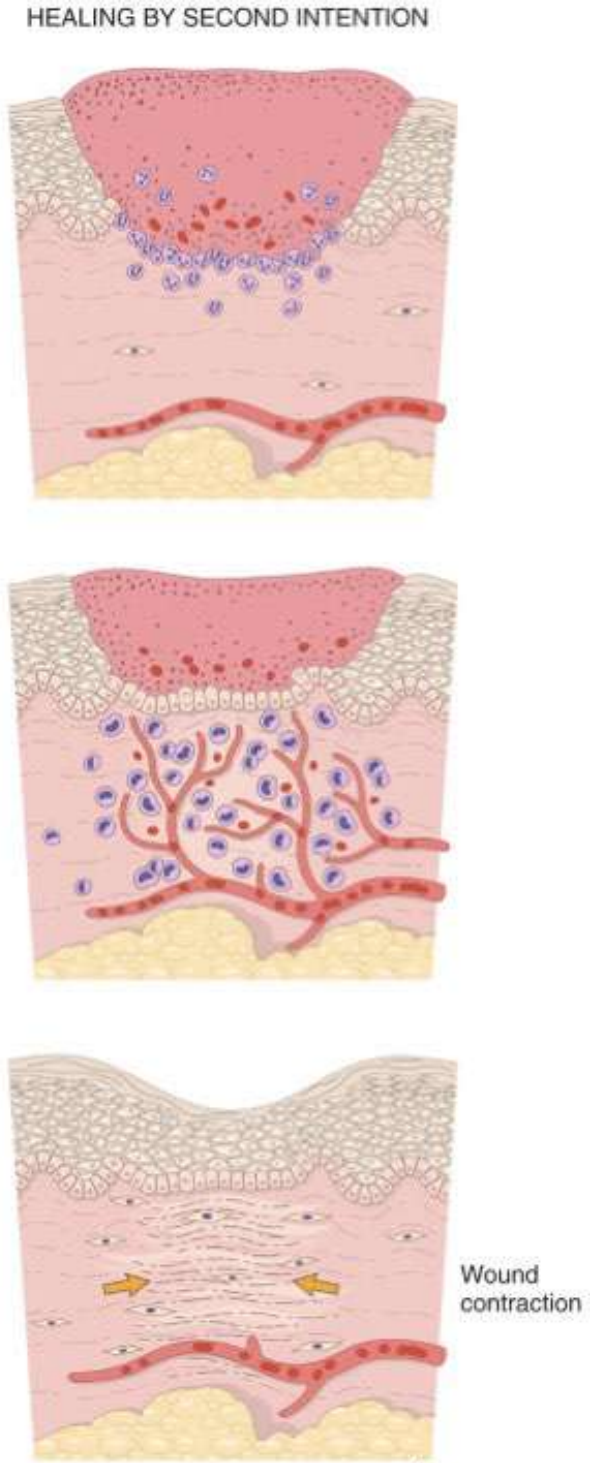
Secondary Intention (large or infected wounds):

- Edges are not approximated.
- More granulation tissue and wound contraction.
- Slower healing, more fibrosis and scarring.



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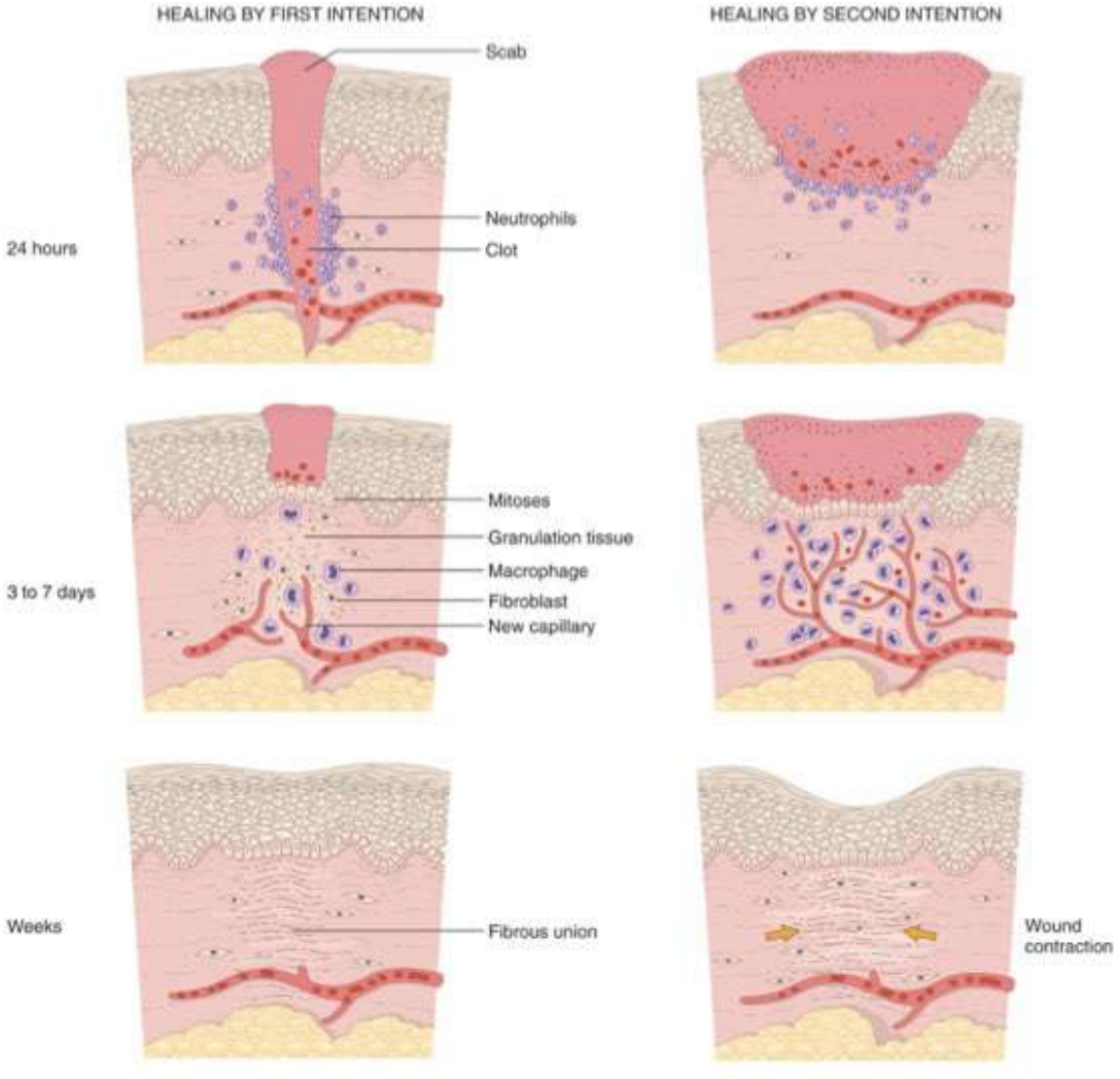

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Bone Healing

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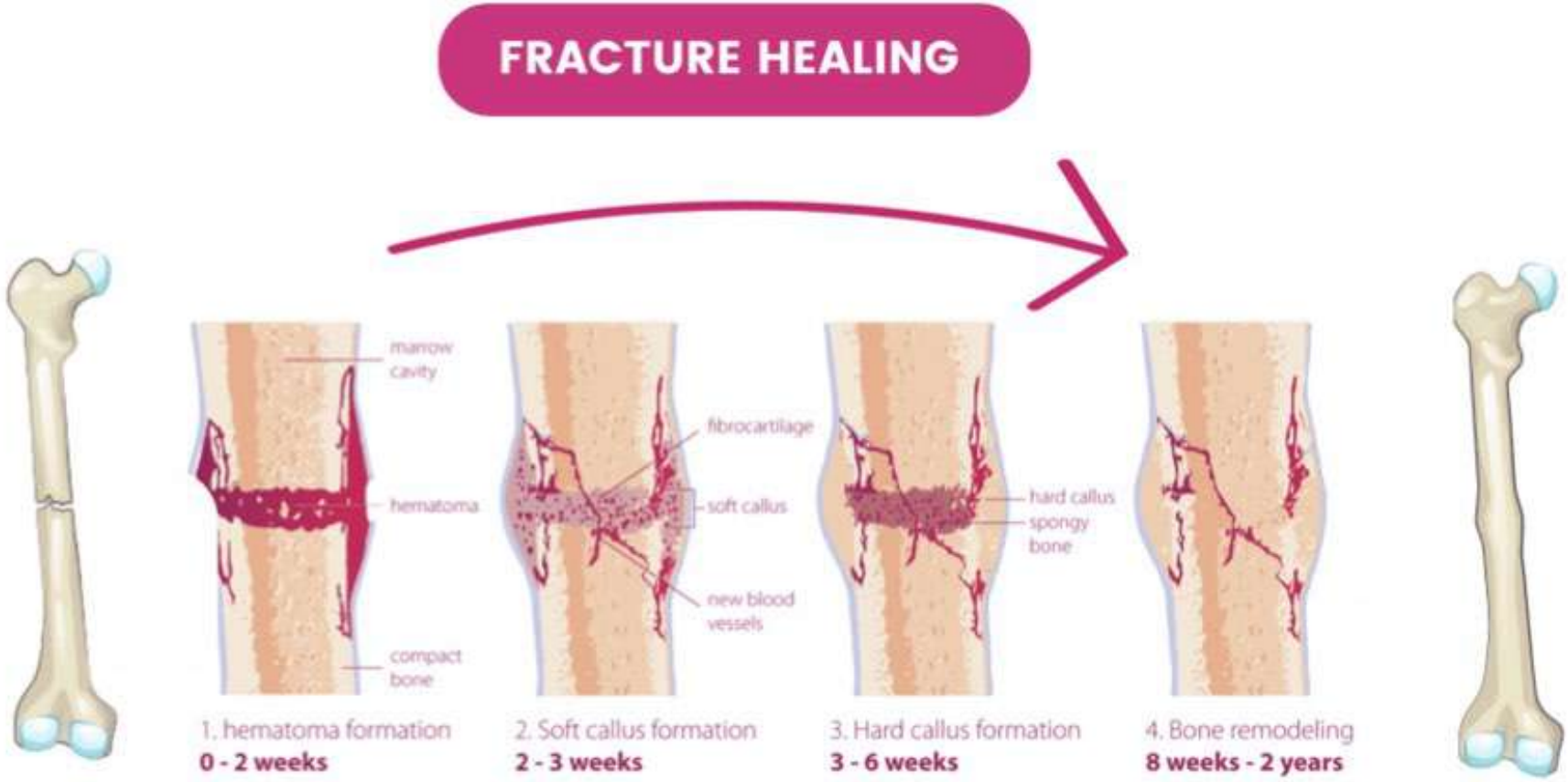
Healing of Bone

Bone healing is a **regenerative process** – the bone regains full strength.

Three major stages:



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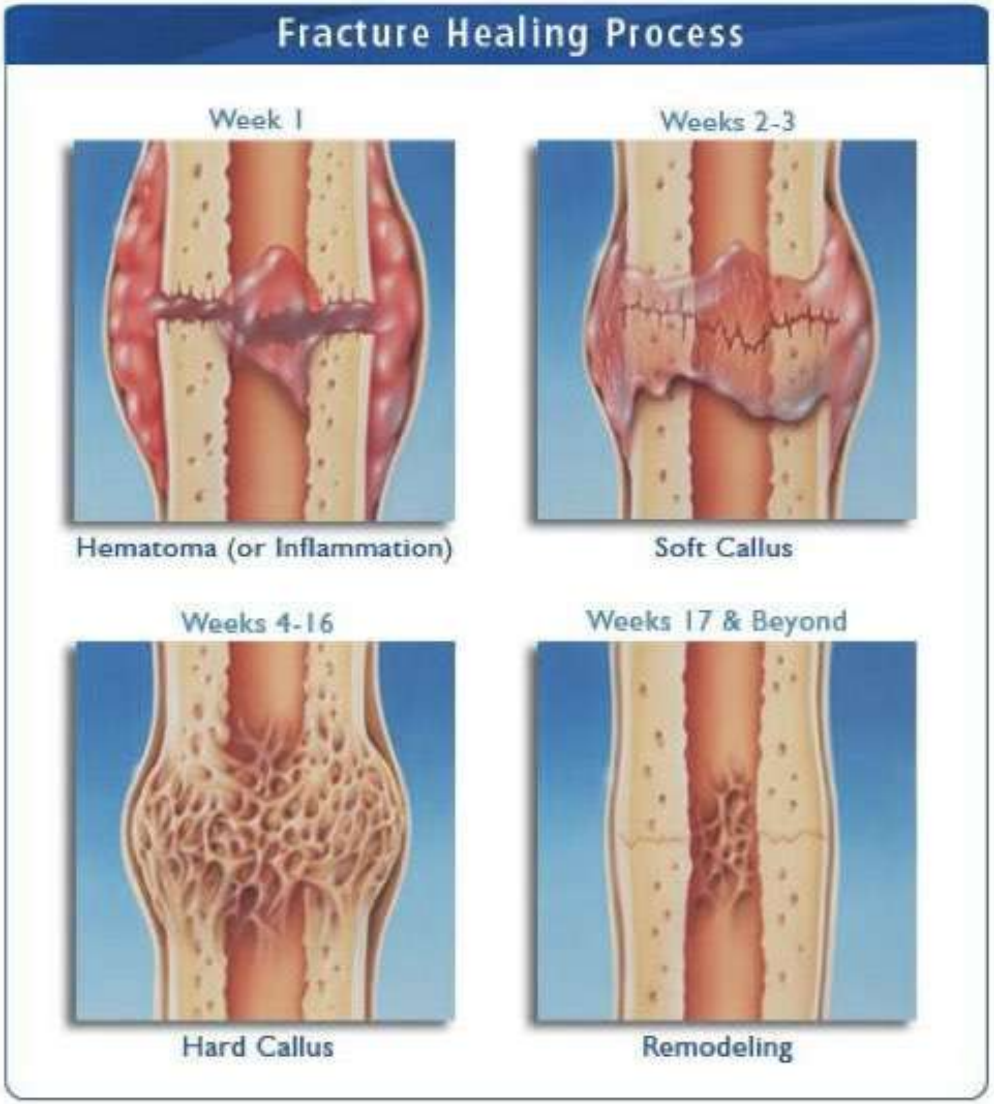
Inflammatory Phase (1–7 days):

- Blood vessels rupture → hematoma forms.
- Inflammatory cells clear debris.
- Cytokines stimulate bone repair.



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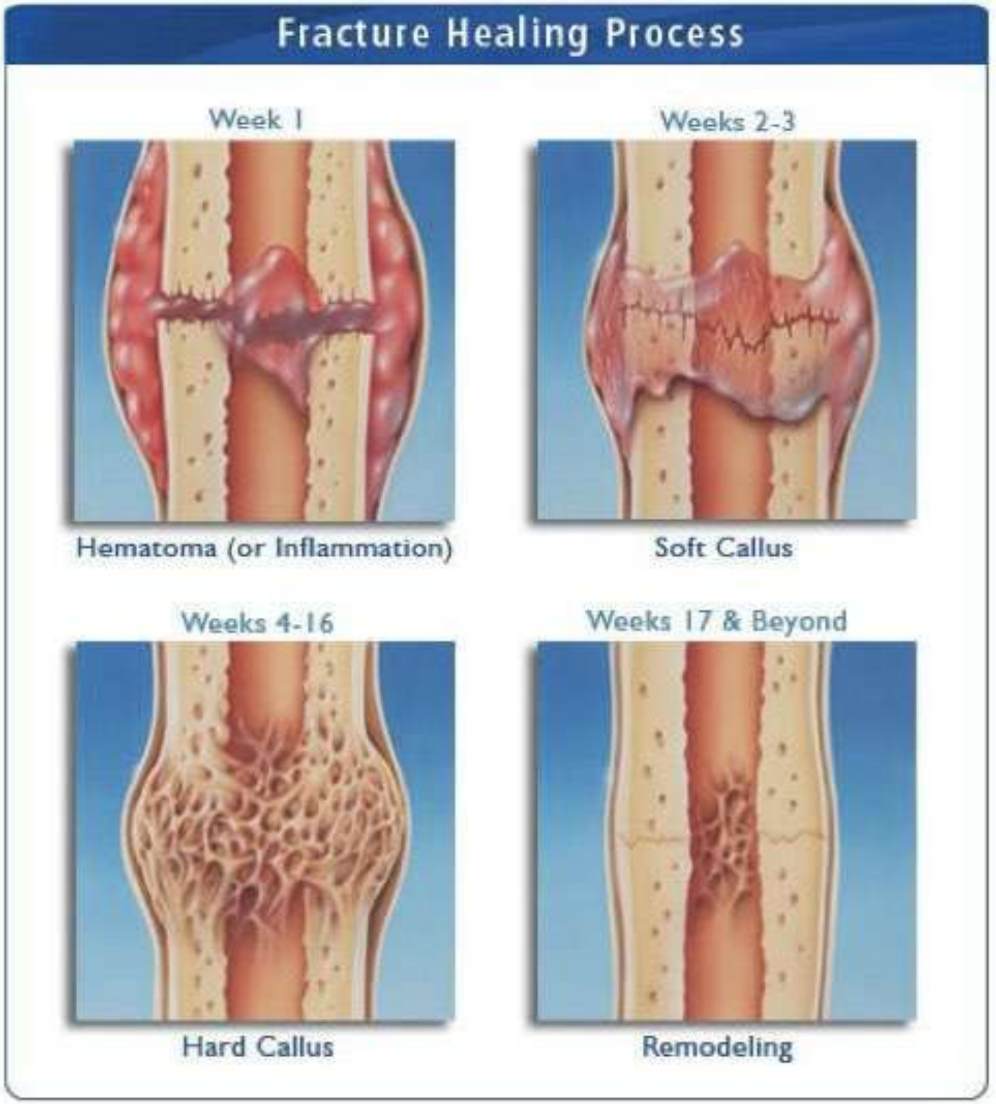
Reparative Phase (1–3 weeks):

- **Soft callus**: Fibrocartilage bridges the fracture.
- **Hard callus**: Osteoblasts form woven bone.



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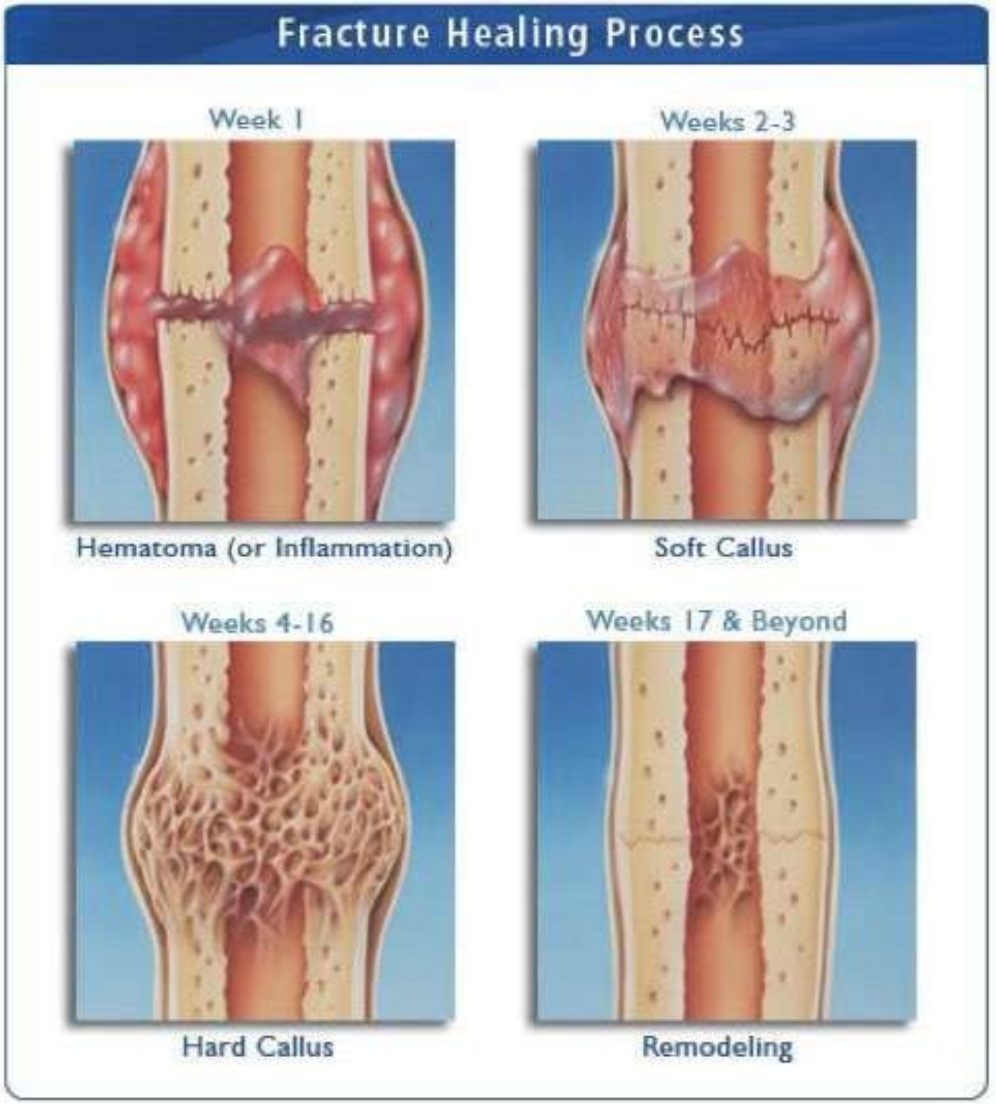
Remodeling Phase (weeks to months):

- Woven bone is replaced by lamellar bone.
- Restores original shape and strength.



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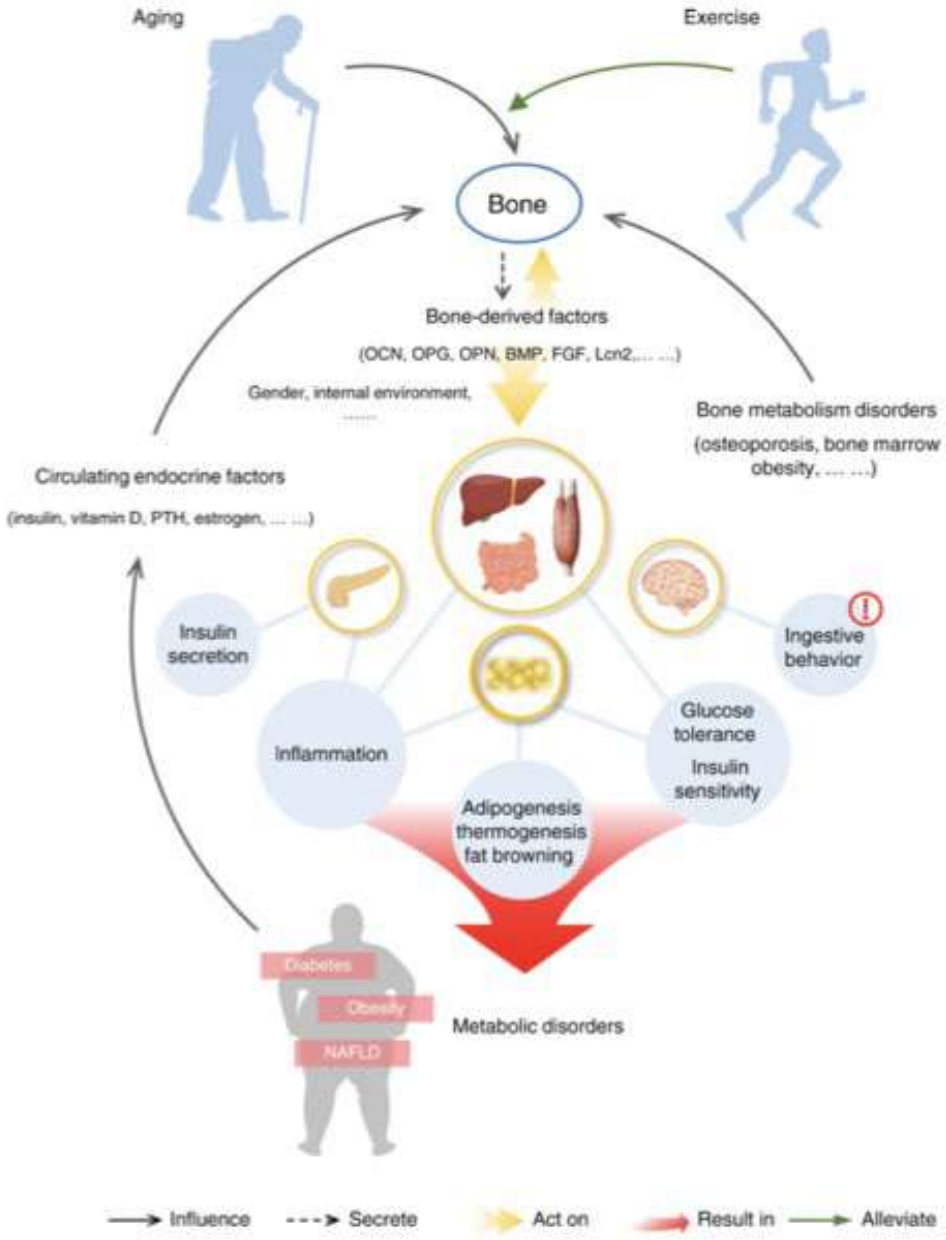
Factors affecting bone healing:

- Nutrition,
- Blood Supply,
- Stability,
- Infection,
- Age
- Hormones.



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Summary

- Healing involves **inflammation**, **proliferation**, and **remodeling**.
- Skin heals by **epithelial regeneration and fibrosis**, depending on the injury.
- Bone heals through **regeneration**, forming new bone with near-normal strength.

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