

Wound Healing

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Types of cells in the body

- There are different types of cells in the body in terms of regeneration
 - Labile cells
 - These cells proliferate throughout life.eg. Epidermis, mucosal lining cells
 - Stable cells
 - Under normal conditions these cells have limited regenerating capacity but are capable of rapid cell division with cell injury.
 - eg. Liver, renal tubular epithelium, smooth muscle cells.
 - Permanent cells
 - These cells do not have the capacity to proliferate
 - eg. Cardiac muscle, Neurones

Healing

- Healing is replacement of dead or injured tissue by healthy tissue
- Healing may occur in
 - Regeneration
 - Repair

Regeneration

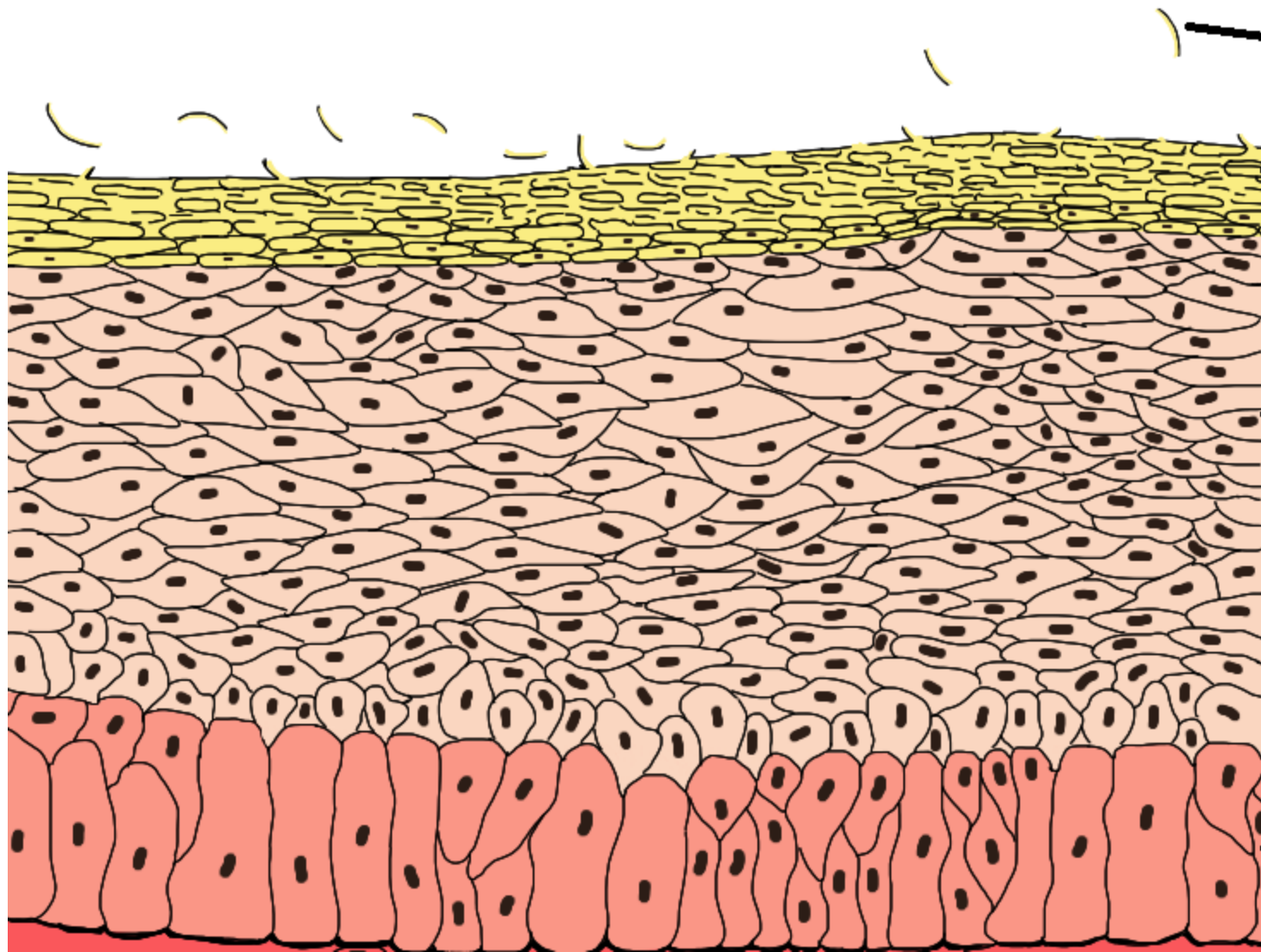
- Regeneration is the replacement of injured tissue by an exactly similar cell population.
- Regeneration takes place only when
 - the injury is mild with
 - preservation of connective tissue framework and when
 - labile cells are damaged
- Eg.
 - Superficial abrasions of the skin
 - Gastric erosions
 - Acute hepatitis

Repair

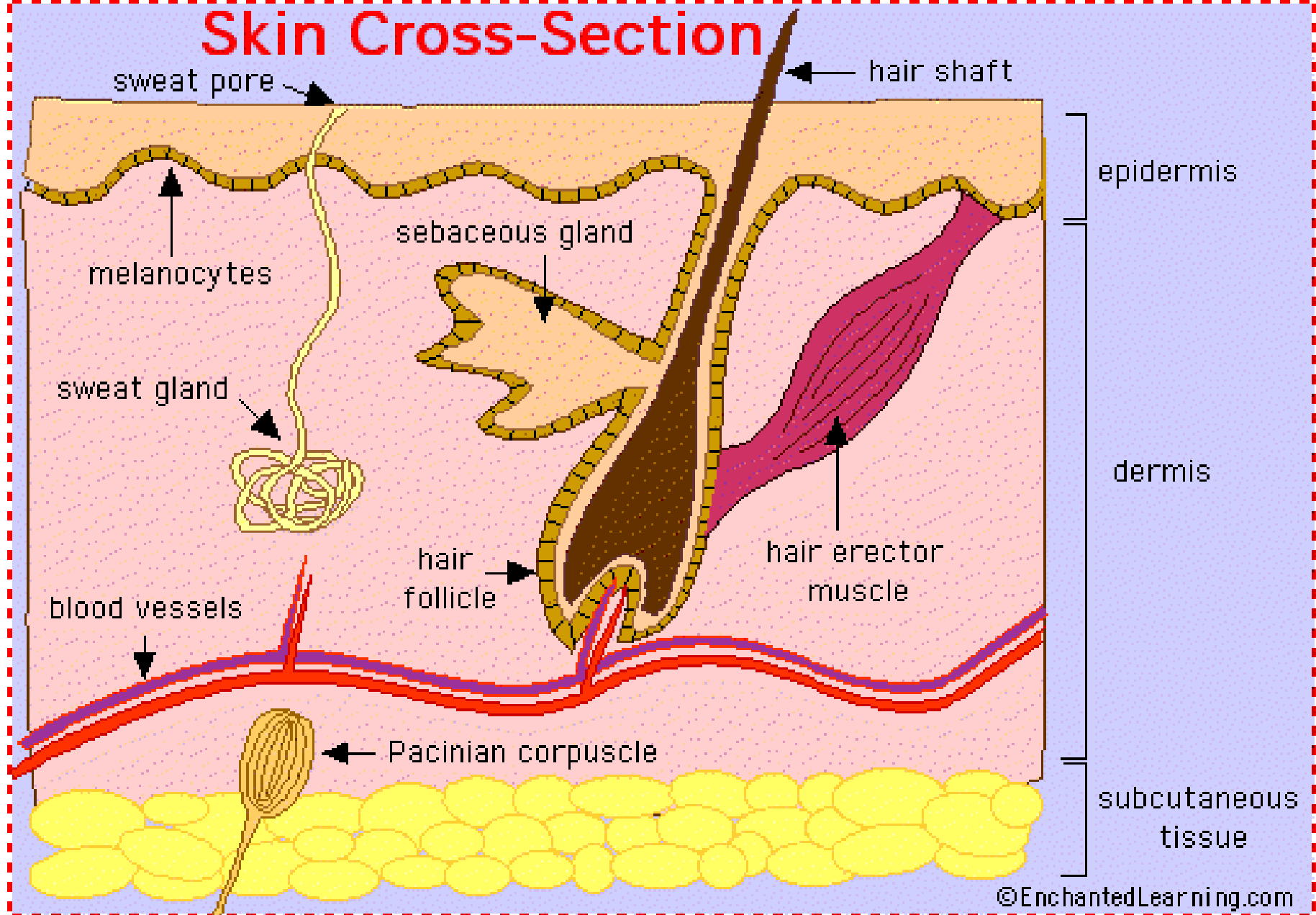
- Repair occurs when
 - permanent cells are injured or
 - when the connective tissue network is damaged.
- When repair takes place there is granulation tissue formation with subsequent fibrosis or scarring.

Wound healing

- Wound healing is the process of repair that follows injury to the skin and other soft tissues.
- Provides a classical example of combination of the two processes, regeneration and repair.



Skin Cross-Section



Wound healing Stages

- **Hemostasis phase**
- **The inflammatory phase:** a clot forms and cells of inflammation debride injured tissue.
- **The proliferative phase:** epithelialization, fibroplasia, and angiogenesis occur.
- **The maturation phase:** Collagen forms tight cross-links to other collagen and with protein molecules, increasing the tensile strength of the scar.

Wound healing cont.

- Depending on the **nature** and the **size** of the wound, the healing may occur by
 - First intention or
 - Second intention

Healing by First Intention

- Primary union
- Healing of a
 - Clean
 - Uninfected
 - Surgical incision
 - Approximated by surgical sutures



Healing by First Intention cont.

- The incision causes only
 - focal disruption of epithelial basement membrane continuity and
 - Death of relatively few epithelial and connective tissue cells.
- The principle mechanism of repair is epithelial regeneration.

Within seconds

- The body responds quickly to any disruption of the skin's surface.
- The early events of wound healing are characterized by a vascular and cellular response to injury.
- An incision made through a full thickness of skin causes a disruption of the microvasculature and immediate haemorrhage.

Within seconds cont.

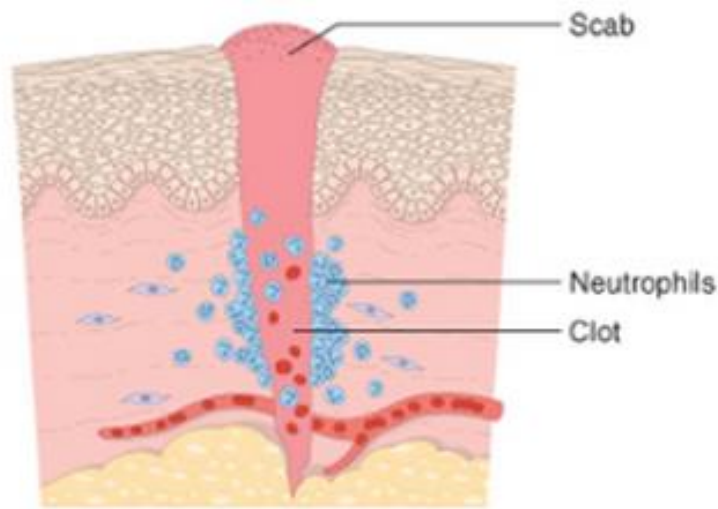
- Blood vessels constrict to control bleeding at the site.
- Platelets coalesce within minutes to stop the bleeding and begin clot formation.
- Blood clot dries and forms a scab which prevents the wound from dehydration and infection.

Within Minutes

- 5 to 10 minute period of vasoconstriction ensues, mediated by epinephrine, norepinephrine, prostaglandins.
- Vasoconstriction causes temporary blanching of the wound.

Within 24 hours

- Neutrophils are seen at the incision margin.
- Basal cells at the cut edge of the epidermis burst into mitotic activity and begin to divide.



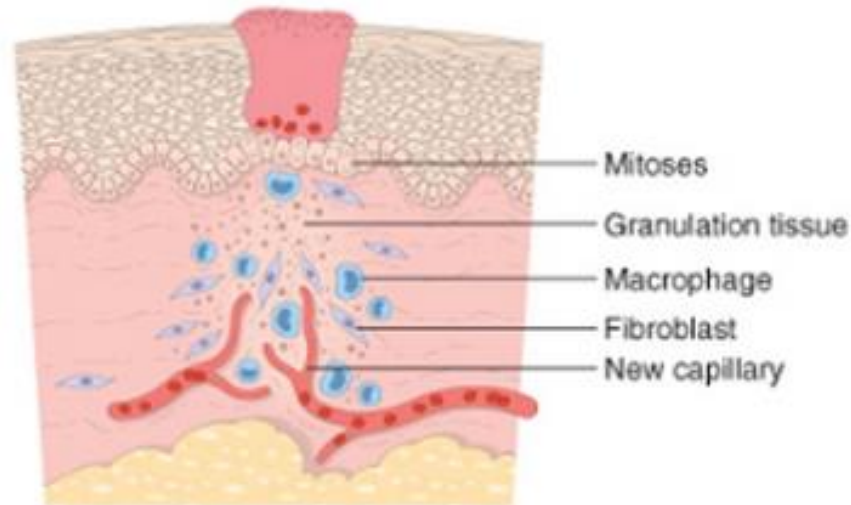
Within 24 to 48 hours

- Epithelial cells from both edges begins to migrate and proliferate along the dermis across the surface of the wound.
- They deposit basement membrane components as they progress.
- These cells meet in the midline beneath the scab, giving a thin, continuous epithelial layer.



By day 3

- Neutrophils largely replaced my macrophages
- Granulation tissue (new connective tissue and tiny blood vessels/capillary loops supported in the developing collagen matrix) grows into the incision space



By day 3 Cont.

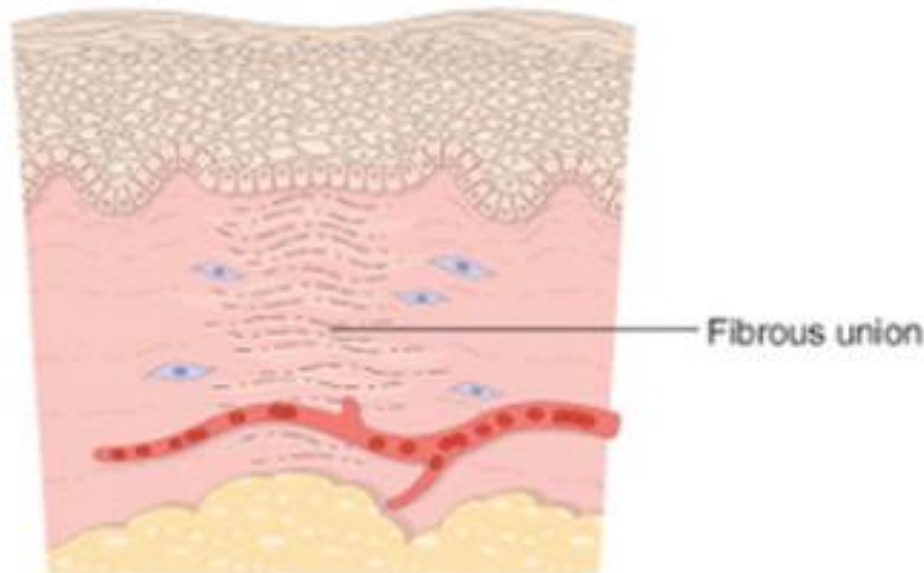
- Fibroblasts proliferate in the deeper parts of the wound. These fibroblasts begin to synthesize small amounts of collagen
- Collagen fibers are present at the incision margins. They are vertically oriented and do not bridge the incision.
- Epithelial cell proliferation continues and yields a thickened epidermal covering layer.

By day 5

- Neovascularization reaches it's peak as granulation tissue fills the incisional space.
- Collagen fibrils become more abundant and begin to bridge the incision. They are laid down randomly and are cross-linked into large, closely packed bundles.
- The epidermis recovers it's normal thickness.
- Differentiation of surface cells yields a mature epidermal architecture with surface keratinization.

Second week

- Continued collagen accumulation and fibroblast proliferation.
- Leukocyte infiltrate, oedema become less
- Vascular channels regress



By the end of first month

- Fibroblasts leave the wound and collagen is remodelled into a more organized matrix.
- The scar consist of a cellular connective tissue.
- Sparse inflammatory cells
- Covered by normal epidermis
- Dermal appendages destroyed in the line of the incision are permanently lost
- No hair follicles, sweat glands

Healing by Secondary Intention

- The basic process of healing by second intention is approximately the same as healing by first intention.
- When tissue loss is more extensive the repair process is more complex.
- When the defect is large, regeneration of cells cannot completely restore the original architecture. So abundant granulation tissue grows in from the margin to complete the repair.
- Involves regeneration and scarring

This type of healing occurs when

- The edges are separated
- The gap cannot be directly bridged
- Extensive epithelial loss
- Severe contamination
- Significant subepithelial tissue damage

Healing by Secondary Intention Cont.

- The inflammatory reaction is more intense
- Development of abundant granulation tissue
- Accumulation of ECM
- Formation of large scar
- Wound contraction due to myofibroblasts

Complications of wound healing



Wound Infection



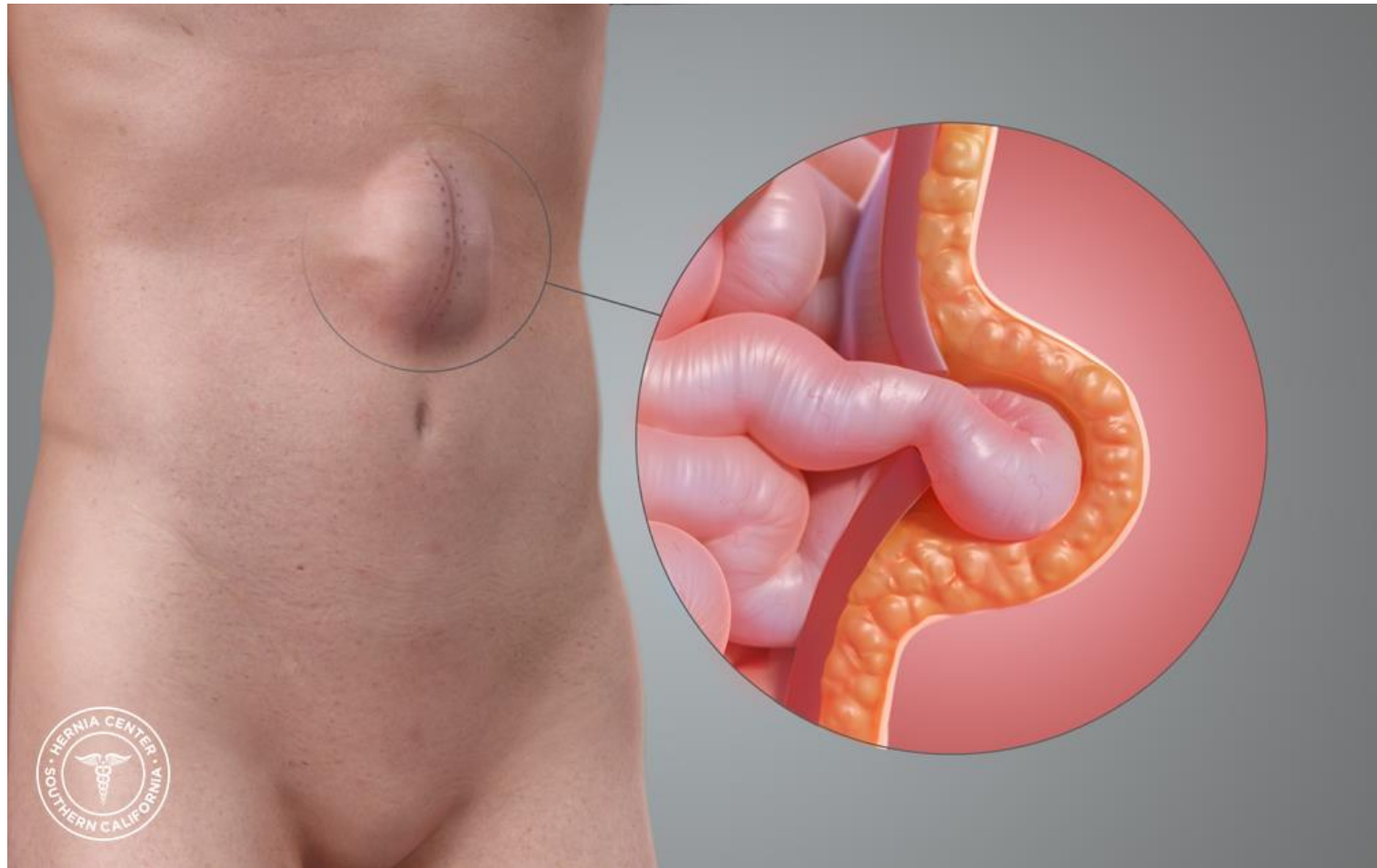
Keloid



Contracture



Incisional hernia



Other complications

- Implantation cyst
- Pigmentation
- Neoplasia



Factors affecting healing

- Local factors
- Systemic factors

Thank You