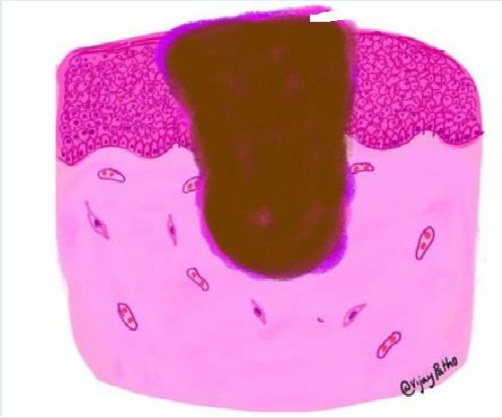
NO SAQ

# Tissue Repair



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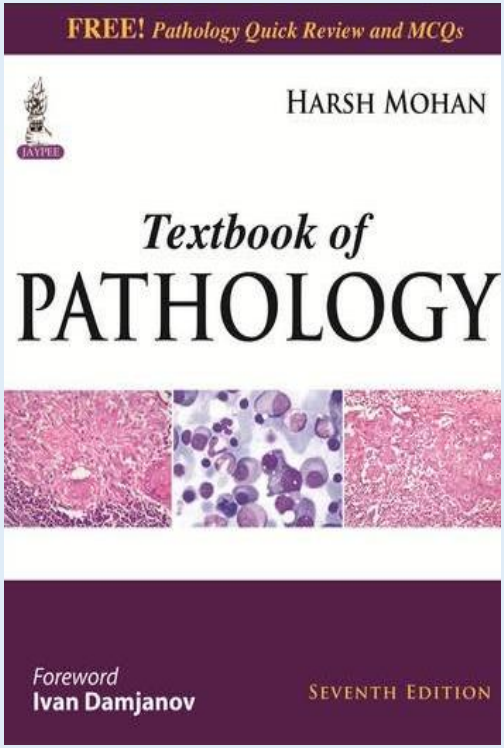
# Intended Learning Outcomes

1. Define regeneration, repair and renewal
2. Explain mechanisms involved in tissue repair along with wound healing pathology
3. Explain the clinical outcomes of primary and secondary intention of wound healing
4. Analyze the various factors that influence wound healing and their clinical importance
5. List the complications of wound healing

# References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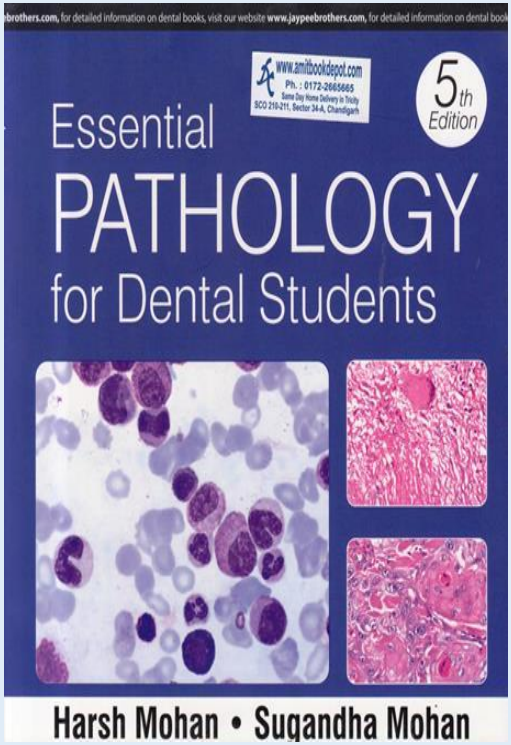
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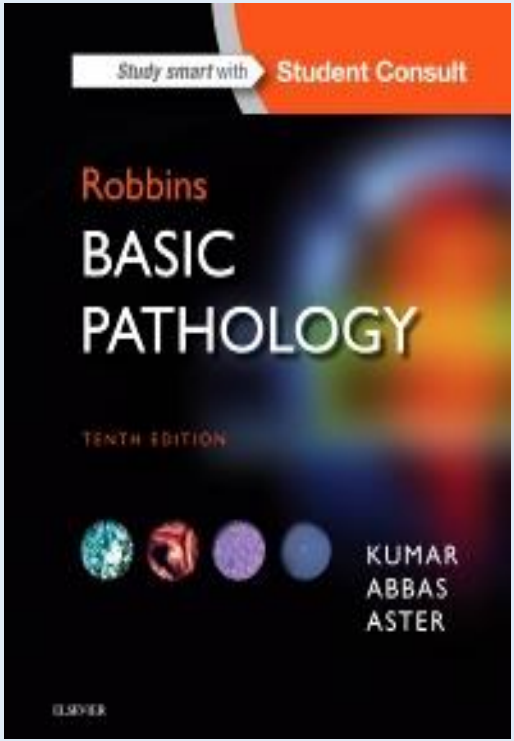
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# Healing and Repair

**Healing** :Body's response to injury to restore normal structure and function. It involves 2 processes:

## 1-Regeneration

Replacement of damaged tissue by specialized(parenchymal) cells

- **Results in** : complete restoration of the original tissues. small damage

**Occur in**:

Cells with ↑capacity to proliferate

## 2-Repair by scar formation

Replacement of damaged tissue by connective tissue .

- **Result in**: fibrosis large damage

**Occur in**:

Cells without capacity to proliferate

## Type of cell by their capacity to proliferate

which of the following ..... is this cell? 1,2,3

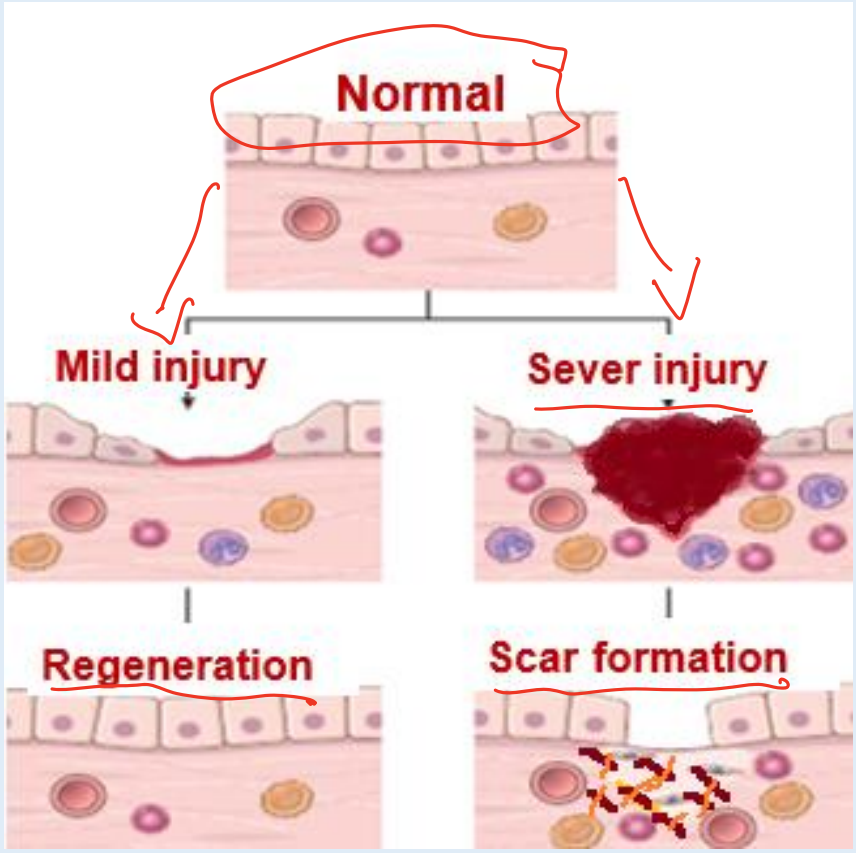
1- **Labile cells** : continue to proliferate : e.g **skin** and **GIT mucosa** regeneration

2- **Stable cells** : ↓ability to proliferate after adolescence but can response to injury: e.g **liver**, **kidney**

3- **Permanent cells**: no proliferation e.g **nerves** and cardiac muscles all



Regeneration




Scar formation

# Mechanisms of Tissue Regeneration

- Replacement of damaged tissue by tissue of the same type
- **4 processes-**

1- **Cells migration** : inflammation + epithelial growth

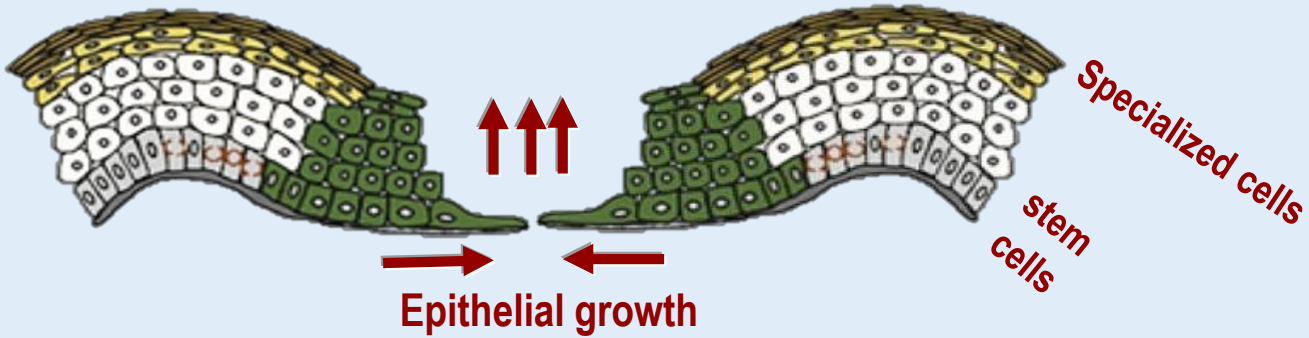
2- **Differentiation** Cells become specialized

3- **Proliferation** :↑ number of specialized and stem cells

4- **Matrix formation** :lay down of :-

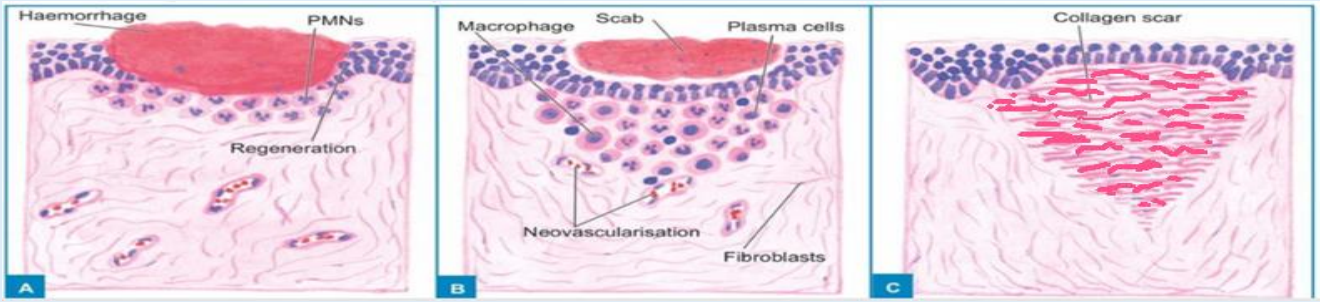
Interstitiel substances : collagen ( type 1 ), elastin, integrins

Bassement membrane : collagen type 4



# Mechanisms of scar formation

Occurs when injury is severe and regeneration can`t replace the lost tissue → Connective tissue and scar formation



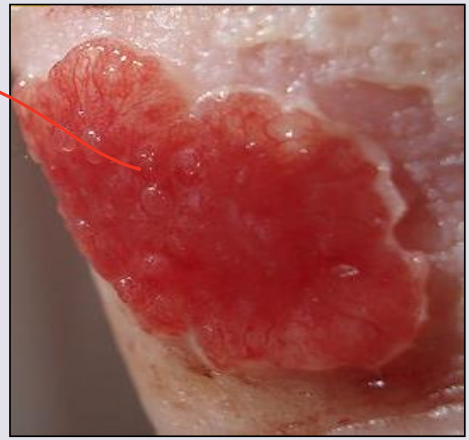

Large wound → Granulation tissue → Collagen scar

## Granulation tissue

Fibrosis + Angiogenesis

- **Fibrosis** is lay down of ECM (collagen ) by fibroblasts stimulated by macrophages mediators(TGF-β, )
- **Angiogenesis**: is New blood vessels formation

Regulated by VEGF , and extracellular matrix proteins and enzymes as matrix metalloproteinases MMPs,



# Healing of Skin Wounds:

**Wound** : Disruption of the normal structure and function of the skin and underlying soft tissues.

**Healing** : process of restoration of this structure and function

يذكر النقاط ويعطيك النوع

## 2 Modes of Wound Healing

### 1-Primary Intention.

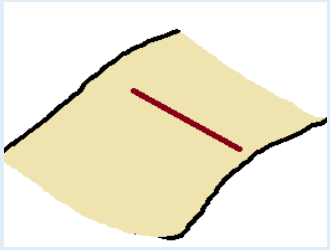
- ✓Clean surgical wound. small wound
- ✓Opposed edges -No gap
- ✓Little damage

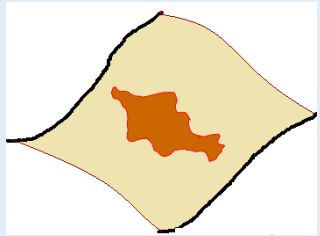
### 2- Secondary Intention -

- ✓Large/contaminated large wound
- ✓Separated edges -Wide gap-
- ✓More damage

**Outcome**

- Return to Normal
- • Permanent scar
- • Wound contraction





# General phases of wound healing

## 4-Maturation / Remodeling
- Collagen Strengthening
- Mature scar
- ↑Tensile strength (80%)

Day – 21- 2 years

## 3- Proliferative phase
- Angiogenesis
- Collagen deposition
- Epithelialization
- Extracellular matrix laydown

granulation tissue

Day – 14- 21

## 2- Inflammatory Phase
- Neutrophils influx
- Phagocytes and debridement
- Release of cytokines
- Release of growth factors

Day – 1- 4

## 1- Hemostasis
- Platelets aggregation
- Clot formation

24 Hours

timing is important
Give case and one Point is given and ask about time

MINI QUIZ

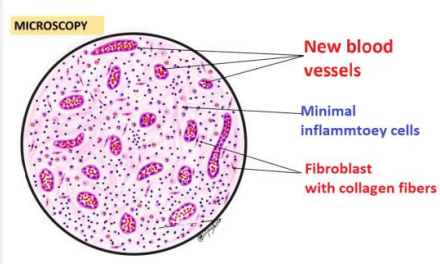
1-A tissue biopsy form wound area shows, collagen fibers , proliferating blood vessels with minimal inflammatory cells. What is the likely timing of this biopsy?

a- After 2 hours

b- After 2 days

c- After 2 weeks

d- After 2 years




2- A 22-year-old male develops a small cut on his gingiva during toothbrushing. Which is the first step in wound healing?

A. Collagen deposition

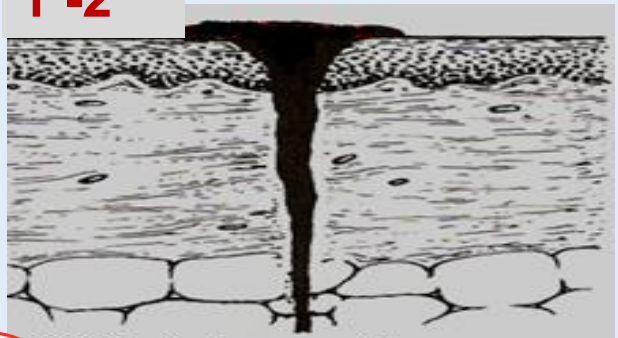
B. Clot formation and inflammation

C. Angiogenesis and fibrosis

D. Fibroblast proliferation

# Steps of healing by primary intension

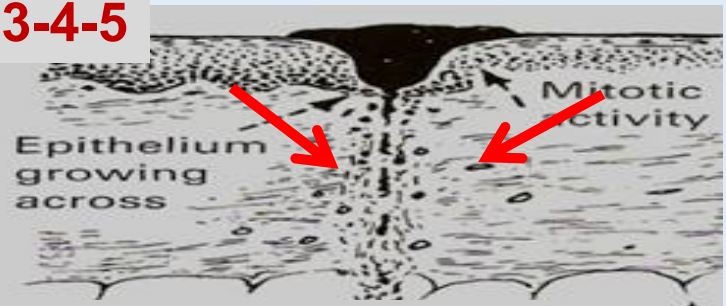
1 -2



1) *Clot formation

*Inflammation

3-4-5

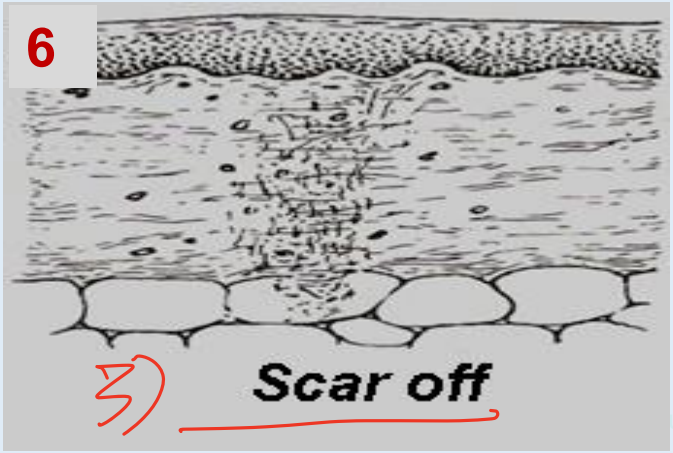



2) *Epithelial growth

*Granulation tissue

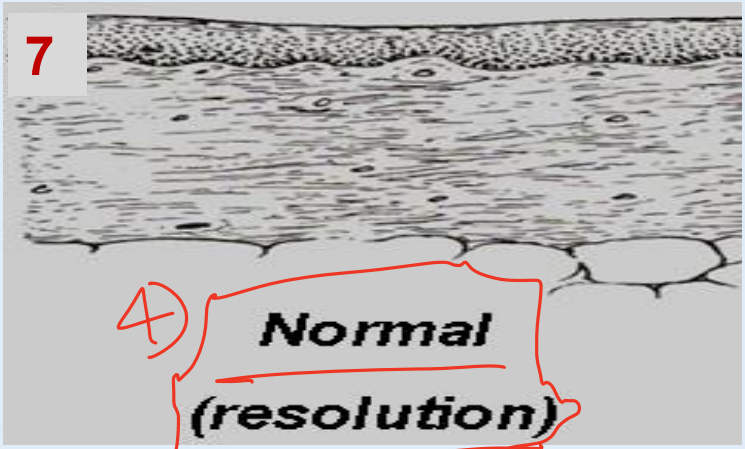
*Scar

6



3) Scar off

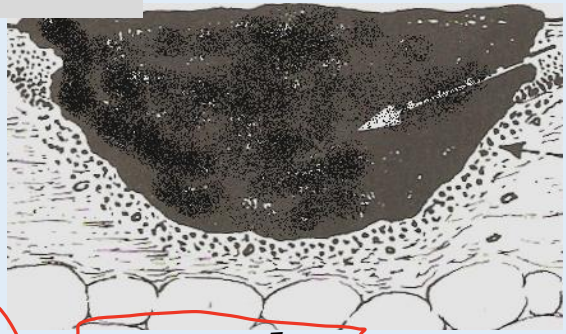
7



4) Normal (resolution)

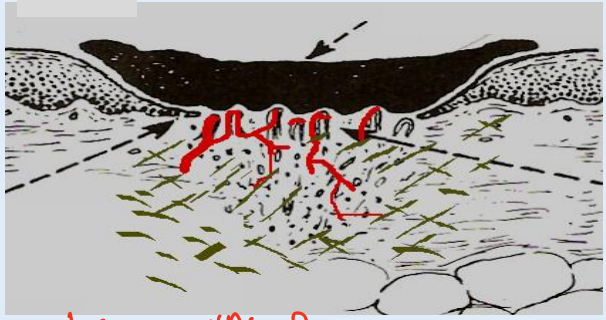
# Steps of healing by secondary intension

## 1 -2



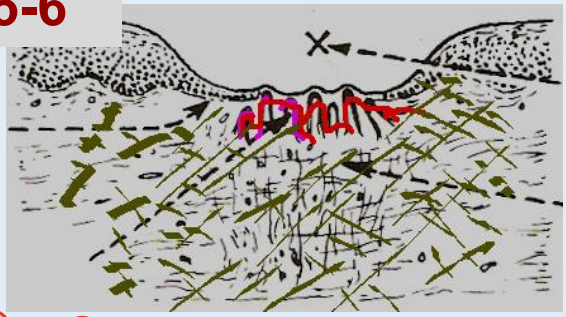
1) Large clot
Inflammation

## 3-4



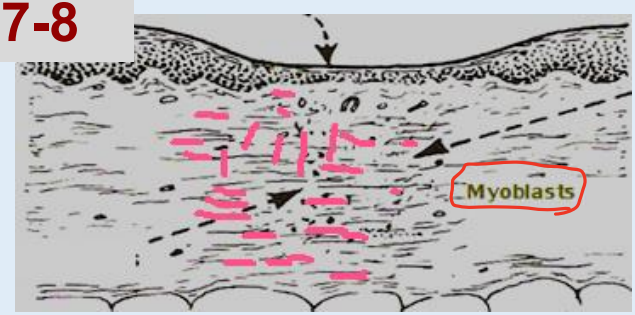
large amount of
2) ↑↑ Granulation tissue
↓ Epithelial migration
ineffective

## 5-6



3) ↓ Blood vessels
↑↑ fibers

## 7-8




fibroblast to myoblast lead to

4) Permanent scar
Wound contraction

SAQ or MCQ

# Differences between primary and secondary intension

| | Primary | Secondary |
|---|---|---|
| Edges | Opposed | Separated |
| Size | Small | Large |
| Cleanness | Clean | Contaminated |
| Amount of granulation tissue | Less | More |
| Scar | Off | Permanent |
| Wound contraction | No | Yes |

# 2- Factors Delaying Wound Healing

## 1- Systemic factors

| factors | Effect on healing process |
|---|---|
| ↓Proteins | ↓ fibroblasts growth and granulation tissue formation |
| ↓Vitamin C | ↓ carboxylation and maturation of collagen<br>Fragile blood vessels |
| ↓ Vitamin A | ↓Collagen stability |
| ↓ Zinc | ↓ epithelial growth , ↓ angiogenesis , ↓ immune cells functions |
| Steroids | ↓ inflammation by ↓ phagocytosis and chemotaxis |
| Diabetes | Neutrophils and macrophages dysfunction ( because glycation of cytoskeletal proteins ↓ chemotaxis and phagocytosis )<br>• ↓Vascular perfusion<br>• Insulin needed in early collagen synthesis |
| Smoking | Nicotine is vasoconstrictor , microvascular occlusion |
| Old age | ↓ cells proliferation capacity |

## 2- Local factors

- Type, size and location of the wound
- Ischemia.
- Infections
- Foreign bodies
- Radiation is bad except U.V is good (sun)
- Movement

**Saudi Board style questions**

**A patient with uncontrolled diabetes shows delayed wound healing after oral surgery. The primary mechanism is:**

A. Decreased neutrophil function
B. Increased angiogenesis
C. Increased fibroblast proliferation
D. Increased growth factor activity

# Complications of healing

1-Deficient scar formation:

a-Wound weakness → hernia formation

b- Ulceration → defect in surface epithelium

2-Excessive scar formation :

- Hypertrophic scars
- Keloid.

3- Epithelial implantation : epidermal cyst

4- Wound contraction

4- Infections

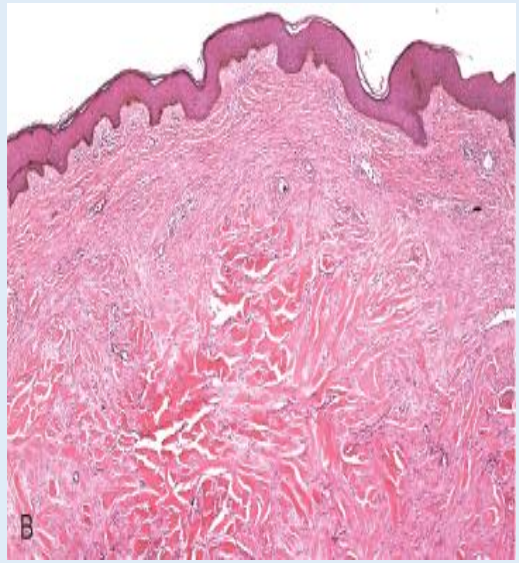
5- Cancer

Ulceration

Incisional Hernia

Keloid

Hypertrophic scar




Histopathology of scar

## Keloid and hypertrophic scar

Both are due to excessive scarring

Keloid goes beyond the wound with no regression

Hypertrophic scar confined to wound boundaries and regress

Histologically : ↑↑ collagen.

# Thank You