

# Classification and management of wound, principle of wound healing,

1

**LEC:2**

**PRINCIPLE OF SURGERY**

**DR. BASHAR AL-AARAJI**

# WOUND

# What is a wound?

3

- It is a circumscribed injury which is caused by an external force and it can involve any tissue or organ.  
surgical, traumatic  
It can be mild, severe, or even lethal.

Simple wound

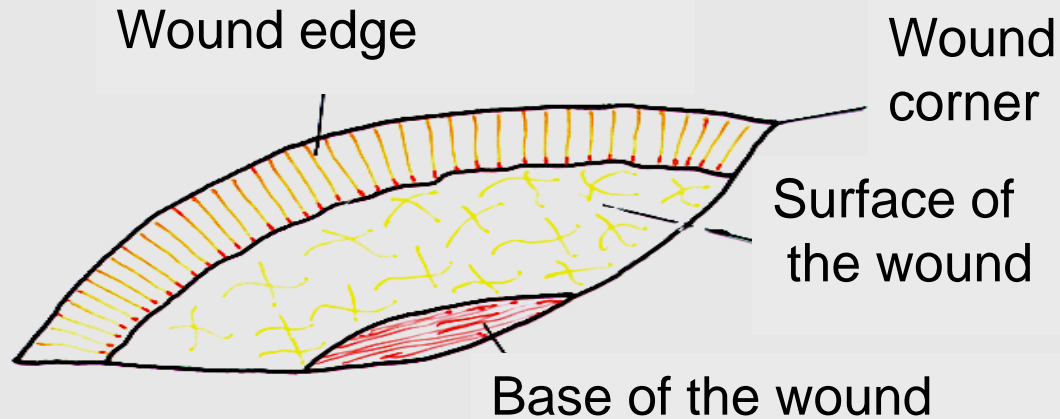
Compound wound

Acute

Chronic

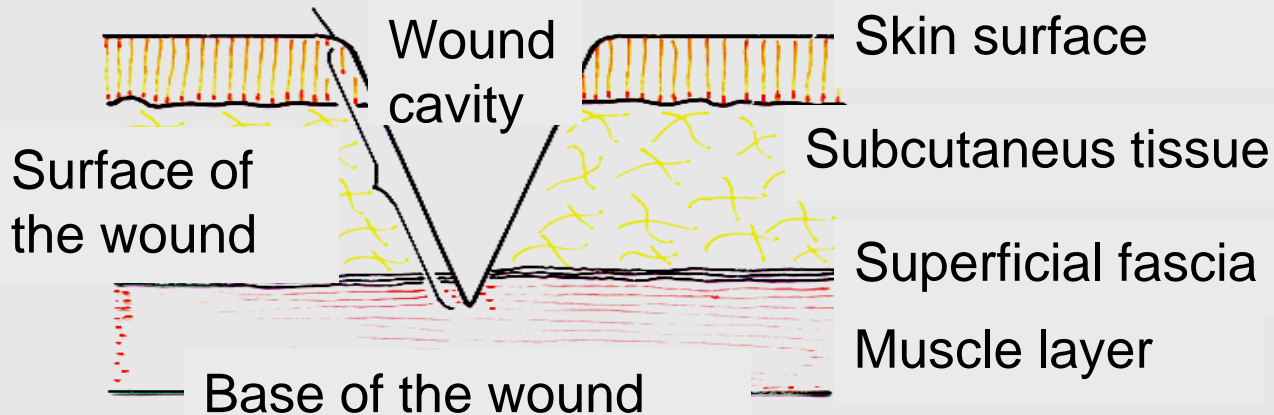
# Parts of the wound

4



## Cross section of a simple wound

Wound edge



# The ABCDE in the injured assessment

5

The mnemonic ABCDE is used to remember the order of assessment with the purpose to treat first that kills first.

- **A:** Airway and C-spine stabilization
- **B:** Breathing
- **C:** Circulation
- **D:** Disability
- **E:** Environment and Exposure

# Classification of the accidental wounds

## 1. Based on the origine

6

- **I. Mechanical:**
  - 1. Abraded wound (vulnus abrasum)
  - 2. Puncured wound (v. punctum)
  - 3. Incised wound (v. scissum)
  - 4. Cut wound (v. caesum)
  - 5. Crush wound (v. contusum)
  - 6. Torn wound (v. lacerum)
  - 7. Bite wound (v. morsum)
  - 8. Shot wound (v. sclopetarium)
- **II. Chemical:**
  - 1. Acid
  - 2. Base
- **III. Wounds caused by radiation**
- **IV. Wounds caused by thermal forces:**
  - 1. Burning
  - 2. Freezing
- **V. Special**

# Mechanical wounds

7

## 1.) Abraded wound (v. abrasum)

- Superficial part of the epidermal layer
- Good wound healing

## 2.) Punctured wound (v. punctum)

- Sharp-pointed object
  - Seems negligible
- BUT
- Anaerobic infection
  - Injury of big vessels and nerves

# Mechanical wounds

8

## 3.) Incised wound (v. scissum)

- Sharp object
- Best healing

## 4.) Cut wound (v. caesum)

- Sharp object + blunt additional force
- Edges - uneven



# Mechanical wounds

9

## 5.) Crush wound (v. contusum)

- Blunt force
- Pressure injury
- Edges – uneven and torn
- Bleeding

## 6.) Torn wound (v. lacerum)

- Great tearing or pulling
- Incomplete amputation

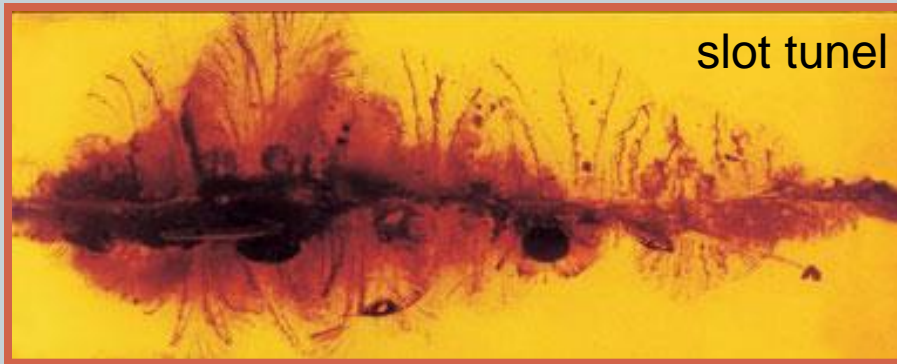
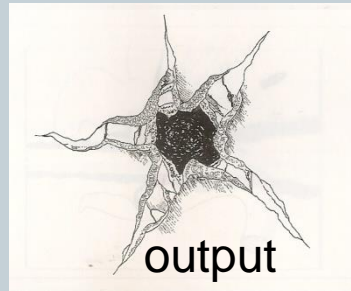
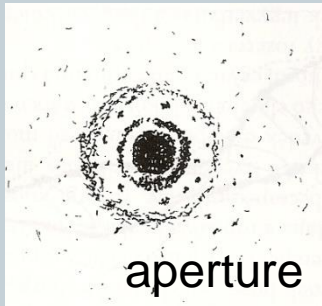
(v. laceroccontusum)

# Mechanical wound

10

## 7.) Shot wound (v. scolperatium)

- Close - burn injury
- Foreign materials



unijured tissue  
necrobiotic zone  
necrotic zone  
foreign bodies

# Mechanical wounds

11

## 8.) Bite wound (v. morsum)

- Ragged wound
- Crushed tissue
- Torn
- Infection
- Bone fracture
  
- Prevention of rabies
- Tetanus profilaxis

# Chemical wounds

12

## 1.) Acid

- in small concentration – irritate
- in large concentration – coagulation necrosis

## 2.) Base

- colliquative necrosis

# Wounds caused by radiation

13

## Symptoms and severity depend on:

- Amount of radiation
- Length of exposure
- Body part that was exposed

Symptoms may occur immediately, after a few days, or even as long as months.

**What part of the body is most sensitive during radiation sickness?**

bone marrow  
gastrointestinal tract

# Wounds caused by thermal forces

14

## 1.) Burning

Metabolic change! - toxemia

- a – normal skin
- 1 - **1<sup>st</sup> degree** – superficial injury (epidermis)
- 2 – **2<sup>nd</sup> degree** –partial or deep partial thickness (epidermis+superficial or deep dermis)
- 3 – **3<sup>rd</sup> degree** – full thickness (epidermis + entire dermis)
- 4 – **4<sup>th</sup> degree** – (skin + subcutaneous tissue + muscle and bone)
- Treatment:
- Cooling – cold water and clean covering

## 2.) Freezing

- mild, moderate, severe (redness, bullas, necrosis)
- rewarm – not only the frozen area but the whole body

# Special wounds

15

## Exotic, poisonous animals

- Toxins, venom - toxicologist
- Skin necrosis

# Classification of the wounds

## 2. According to the bacterial contamination

16

- Clean wound
- Clean-contaminated wound
- Contaminated wound
- Heavily contaminated wound

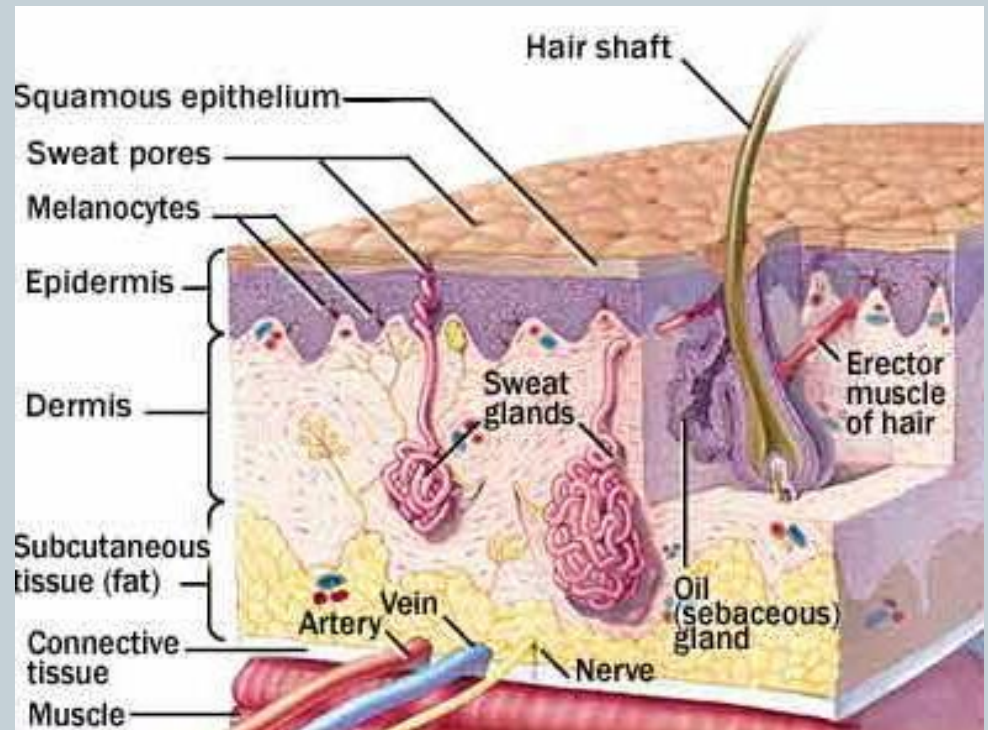


# Classification of the wounds

## 2. Depending on the depth of injury

17

- Superficial
- Partial thickness
- Full thickness
- Deep wound



+ bone, opened cavities, organs...etc.

# The wound management

18

- Temporary wound management (first aid)
  - clean, hemostasis, covering
- Final primary wound management
  - clean, anaesthesia, excision, sutures
  - **ALWAYS:** thoracic cavity, abdominal wall or dura mater injury
  - **NEVER:** war injury, inflammation, contamination, foreign body, special jobs, bite, shot, deep punctured wound
- Primary delayed suture (3-8 days)
  - clean, wash – saline, cover
  - excision of wound edges, sutures

# The wound managemanet

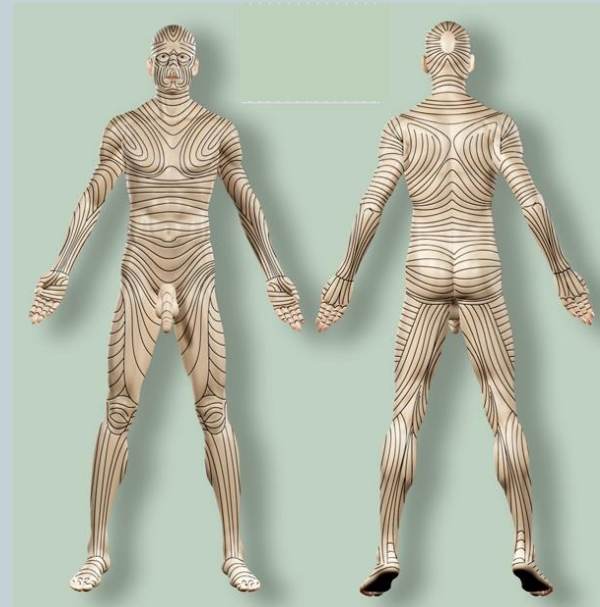
19

- **Early secondary wound closure (2 weeks)**
  - after inflammation, necrosis – proliferation
  - anesthesia, refresh wound edges, suturing and draining
- **Late secondary wound closure (4-6 weeks)**
  - anesthesia, scar excision, suturing, draining
  - greater defect – plastic surgery

# The surgical wound

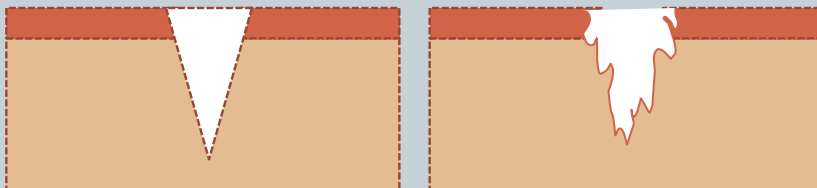
20

- Surgical incision
- Stretch and fix
- Handling the scalpel
- Langer lines
- Skin edges
- Vessels and nerves
- Hemostasis

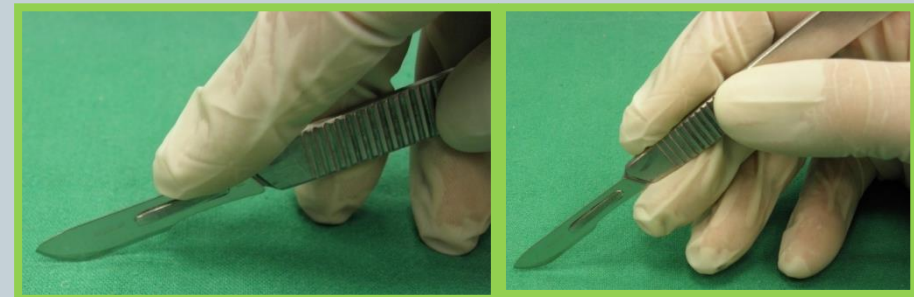


Langer lines

source: <http://www.med-ars.it/galleries/laner.htm>



The wound edges



Handling the scalpel

# Tissue unifying and dressing the wound

21

## Skin:

- Stiches
- Clips
- Steri-Strips
- Tissue glues

## Fascia and subcutaneous layers:

- Interrupted stiches

Fat – fat necrosis!

Dressing: sterile, moist, antibiotic-containing, non-allergic,  
non-adhesive

# The wound healing

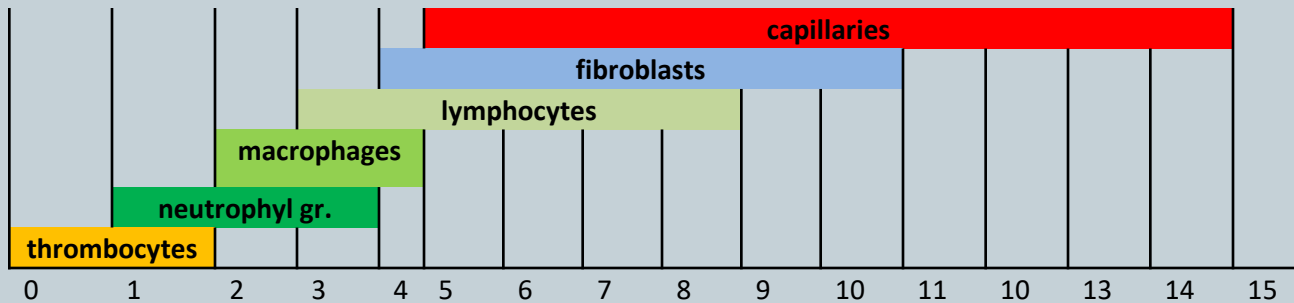
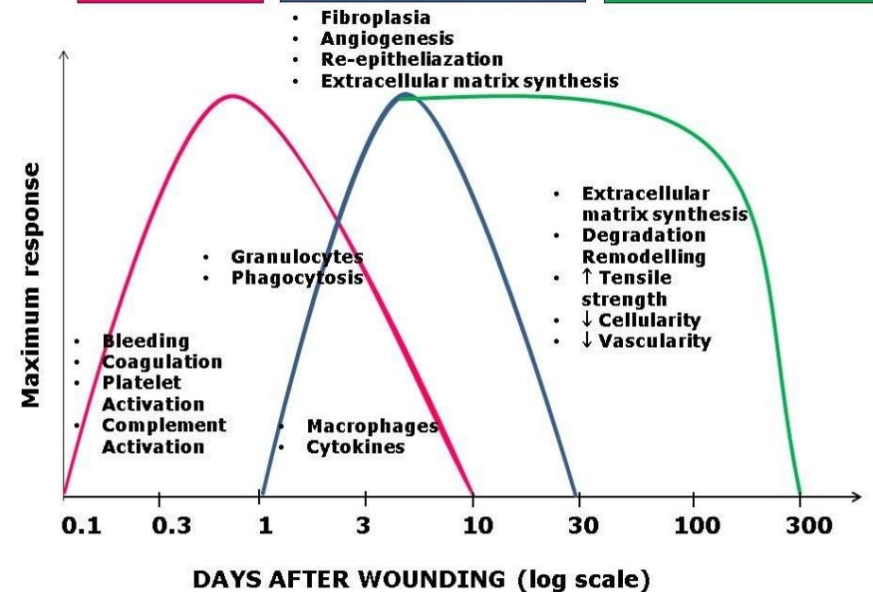
22

- Hemostasis-inflammation
- Granulation-proliferation
- Remodelling

## INFLAMMATION

## CELL PROLIFERATION AND MATRIX DEPOSITION

## MATRIX REMODELLING



# The main steps of the wound healing

23

## 1. Hemostasis-inflammation

vasoconstriction  
fibrin clot formation

proinflammatory cytokines and  
growth factors releasing

vasodilatation  
infiltration PMNs, macrophages

cytokines releasing  
→ angiogenesis  
→ fibroblast activation  
→ B- and T-cells activation  
→ keratinocytes activation  
→ wound contraction

## 2. Granulation-proliferation

fibroblast migration  
collagen deposition  
angiogenesis  
granulation tissue formation  
epithelisation  
contraction

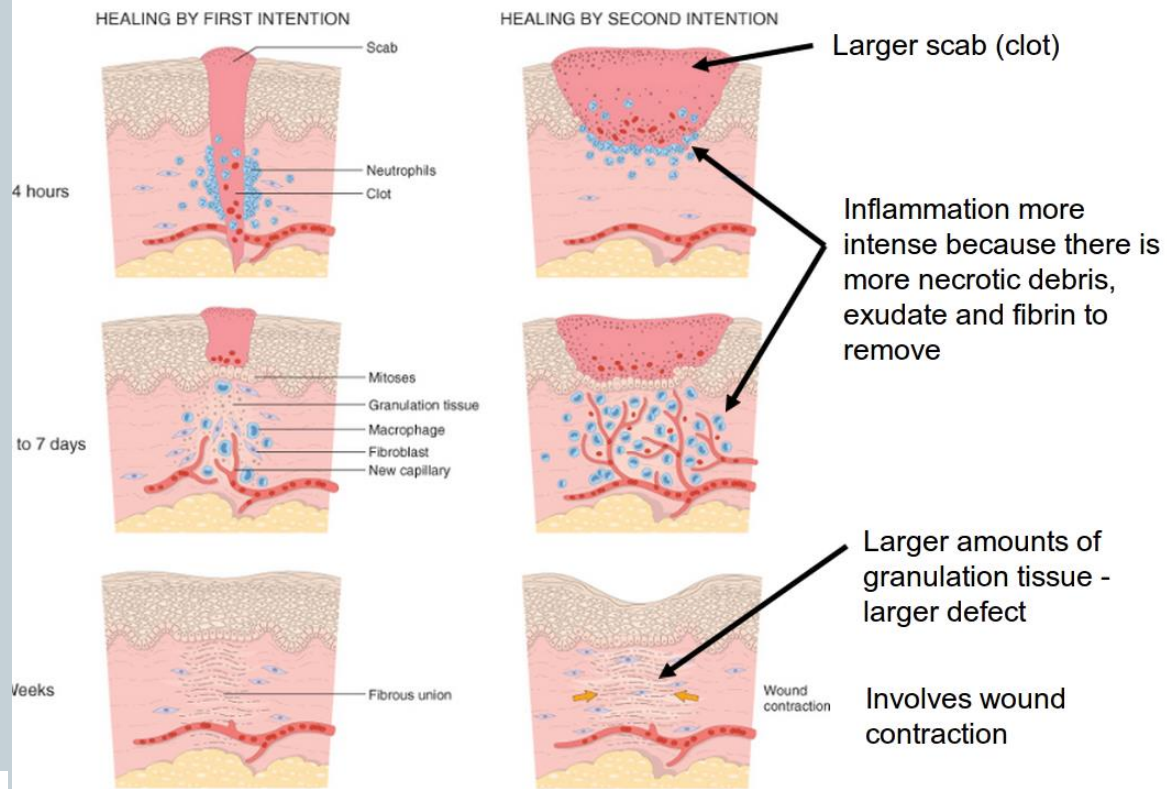
## 3. Remodelling

regression of many capillaries  
physical contraction – myofibroblasts  
collagen degeneration and synthetisation  
new epithelium  
tensile strength – max. 80%

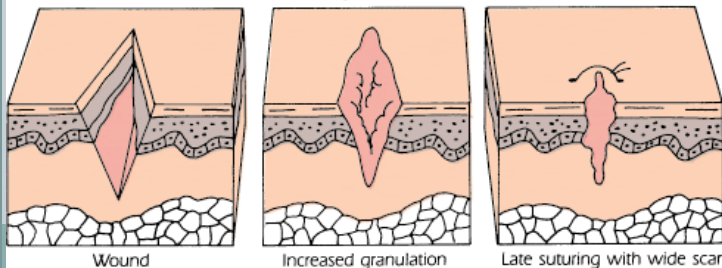
# Types of wound healing

24

- Healing by primary intention
- Healing by secondary intention
- Healing by tertiary intention



Tertiary intention





# Factors affecting wound healing

25

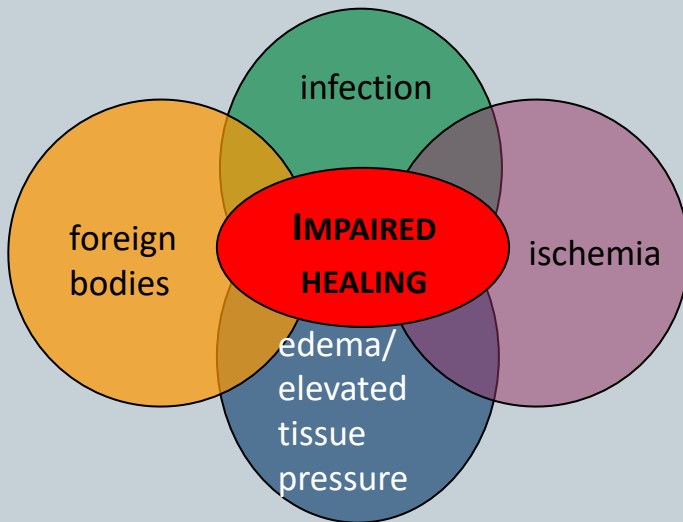
- **Local**

- Ischemia
- Infection
- Foreign body
- Edema, elevated tissue pressure

- **Systemic**

- Age and gender
- Sex hormones
- Stress
- Ischemia
- Diseases
- Obesity
- Medication
- Alcoholism and smoking
- Immunocompromised conditions
- Nutrition

Hyperbaric oxygen treatment



# Complications of wound healing

## I. Early complications

26

- Seroma
- Hematoma
- Wound disruption
- Superficial wound infection
- Deep wound infection
- Mixed wound infection

# Complications of wound healing

## II. Late complications

27

- Hypertrophic scar
- Keloid formation
- Necrosis
- Inflammatory infiltration
- Abscesses
- Foreign body containing abscesses