THE UNIVERSITY OF JORDAN

Normal Wound Healing

Prepared by : Dr. Bareka Salah

- Wound closure:

A. Primary closure: Immediate suturing of the wound

B. Delayed primary closure: Leave stitches in the wound and close it after 3-5 days when wound is clean. We do this method for contaminated wounds.

C. Secondary closure: By scar formation and epithelisation. ↳ afraid of wound infection

D. Tertiary: By graft or flap. (تدخل جراحي)

- Phase of Wound Healing: Look at the diagram

A. Inflammatory

B. Proliferative phase

C. Remodeling phase

Please refer to these links:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2903966/

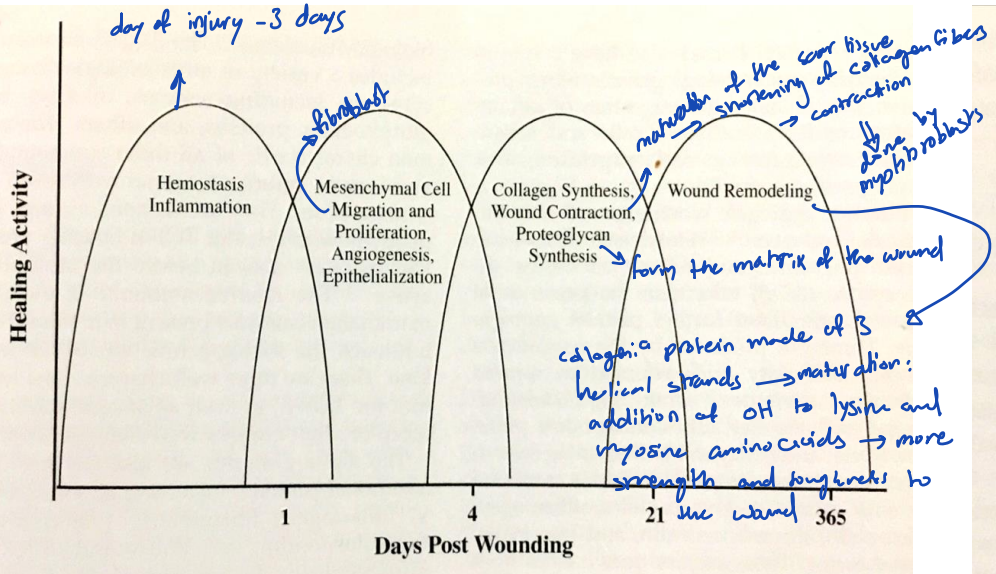


Figure 1. Phases of the healing process.

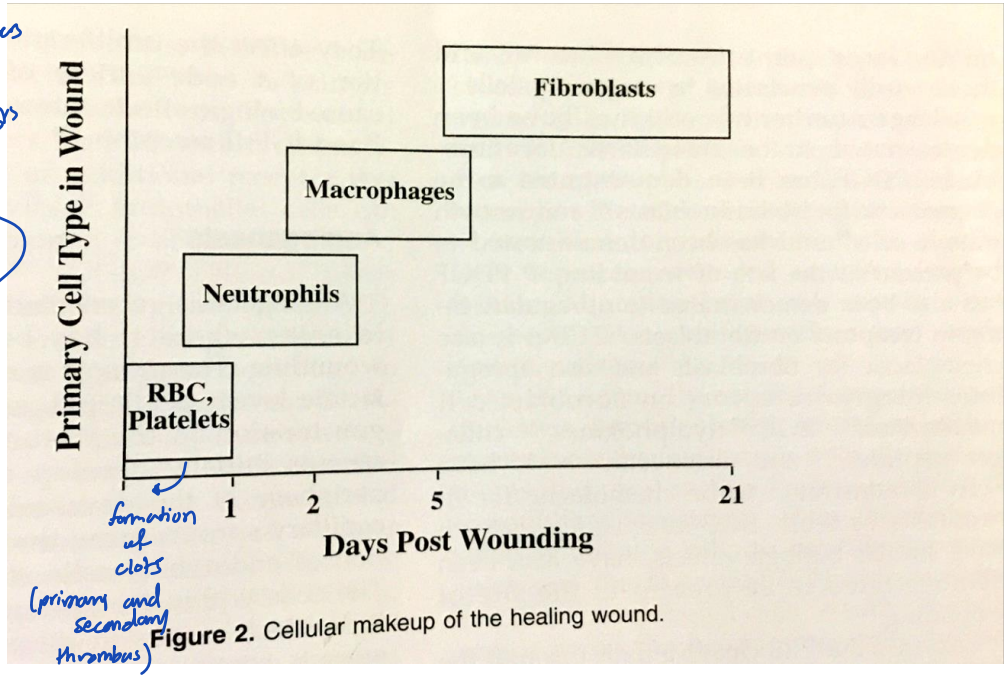


Figure 2. Cellular makeup of the healing wound.

* wound healing requires:

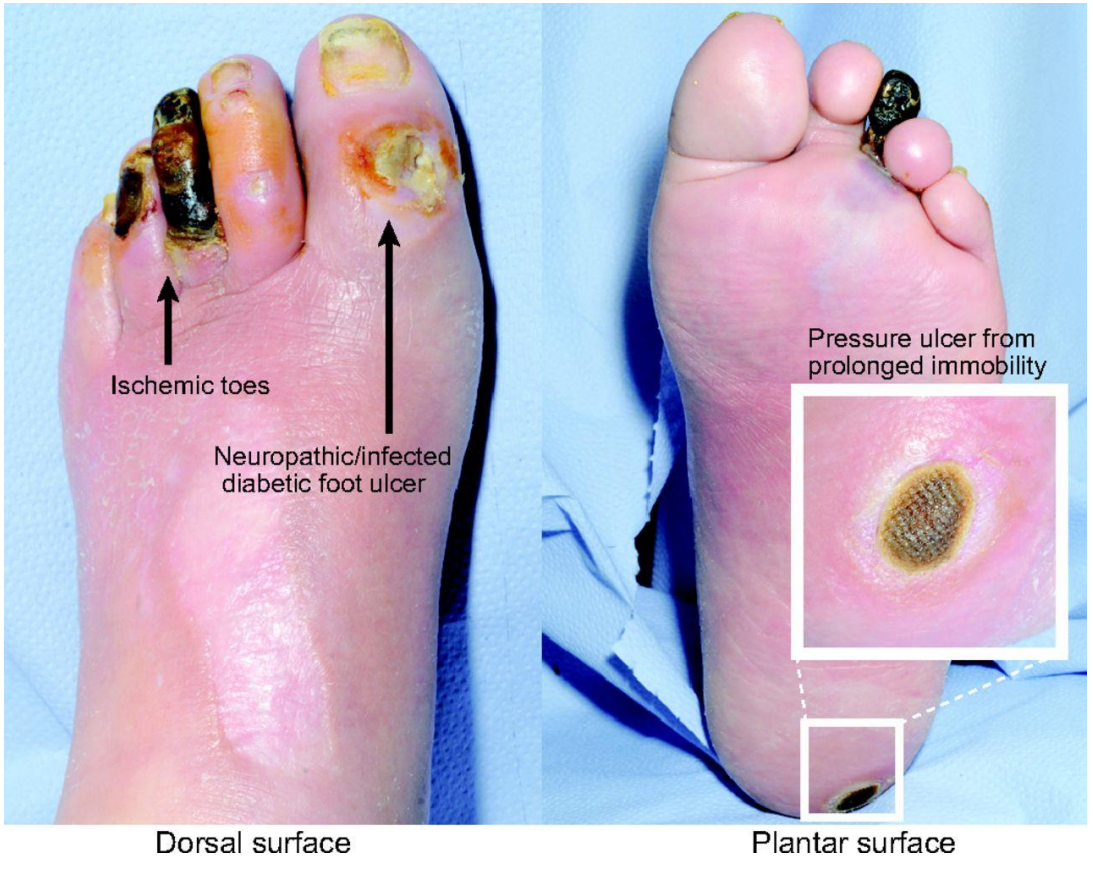
1- iron
2- zinc
3- vitamin C
4- other trace elements

Table 1. CYTOKINE INVOLVEMENT IN WOUND HEALING FUNCTIONS

Healing Function	Cytokines Involved
Inflammatory Cell Migration	PDGF
	TGF-β
	TNF-α
Fibroblast Migration	PDGF
	TGF-β
	EGF
Fibroblast Proliferation	PDGF
	TGF-β
	EGF
	IGF
	TNF-α
	IL-1
Angiogenesis	bFGF (FGF2)
	aFGF (FGF1)
	TGF-β
	TGF-α
	EGF
	TNF-α
	VEGF
	IL-8
	PD-ECGF
Epithelialization	EGF
	TGF-α
	KGF (FGF7)
	bFGF (FGF2)
	IGF
	HB-EGF
Collagen Synthesis	PDGF
	TGF-β
	bFGF (FGF2)
	EGF

PDGF = platelet-derived growth factor; TGF-β = transforming growth factor-β; TNF-α = tumor necrosis factor-α; EGF = epidermal growth factor; IGF = insulin-like growth factor; IL-1 = interleukin-1; bFGF = basic fibroblast growth factor; aFGF = acidic fibroblast growth factor; TGF-α = transforming growth factor-α; VEGF = vascular endothelial growth factor; IL-8 = interleukin-8; PD-ECGF = platelet-derived-endothelial cell growth factor; KGF = keratinocyte growth factor; and HB-EGF = heparin binding epidermal growth factor.

Chronic Wound (> 3-6 week and improper wound healing)



Chronic Wound

bed sore

Vasculitis

Factors contributing to impaired wound healing

A. Local factors	B. Systemic factors
Arterial insufficiency Venus insufficiency Edema Infection Pressure Radiation Foreign material Necrotic tissue	DM Malnutrition Vitamin deficiency Chemotherapy Smoking Aging Steroids

will not return to the baseline

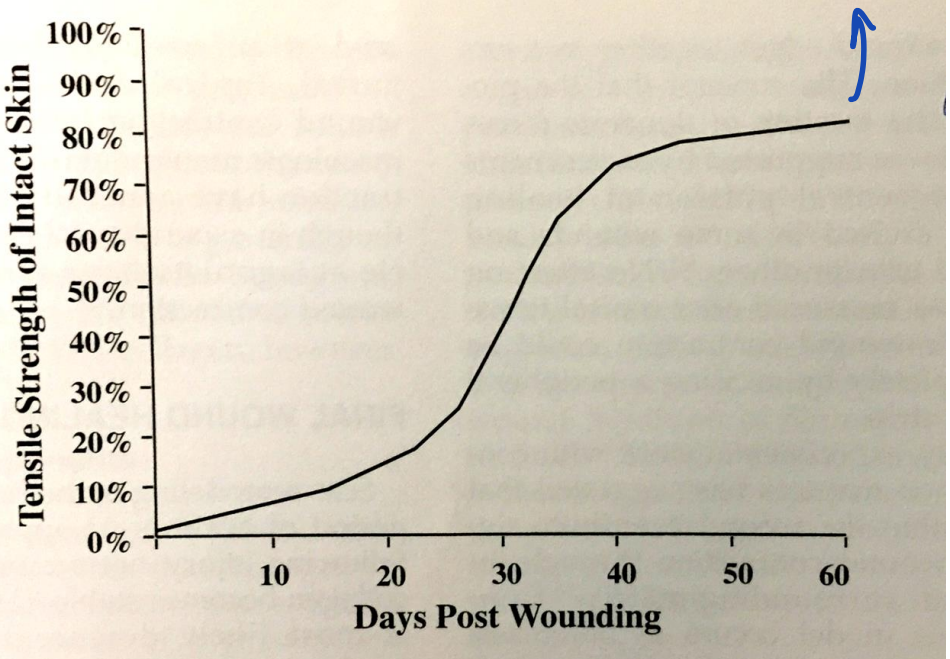


Figure 3. Tensile strength of the healing wound.

Table 1. THE ESTIMATED PREVALENCE AND HEALTH CARE COSTS OF CHRONIC WOUNDS.

Wound Type	Total Prevalence	Estimated Annual Cost
Pressure Ulcer[1]	0.04–0.08%	$1.3 billion
Venous Ulcer[2]	1–2%	$1 billion
Diabetic Ulcer[3]	Total 0.15–0.3% (Diabetics 5–10%)	$1 billion

* Don't apply pressure to the wound to avoid opening or herniation of it

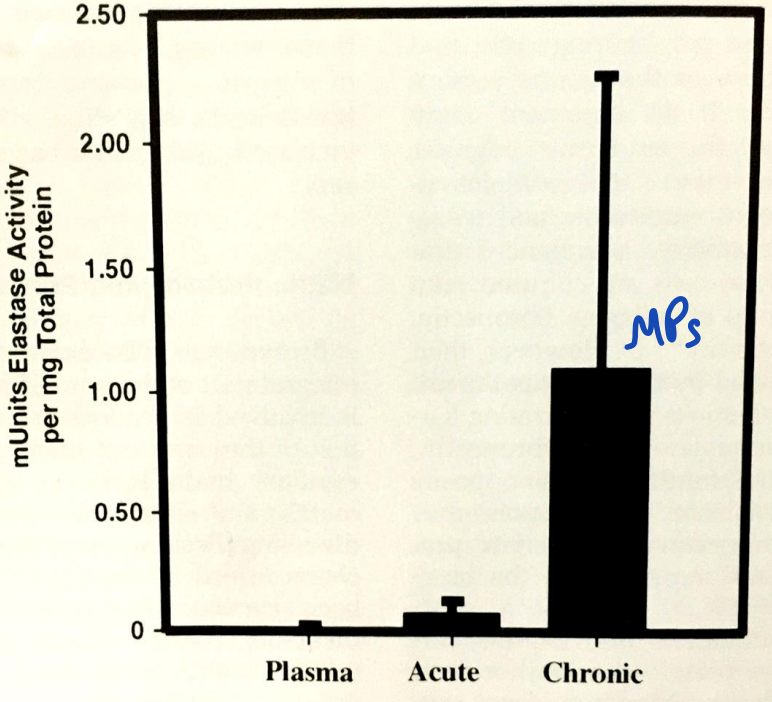


Figure 2. Levels of elastase activity are significantly higher in chronic wound fluid compared with acute wound fluid. Elastase activity was determined by a colorimetric assay using methoxysuccinyl-ala-ala-proval-p-nitoanilide substrate. (*From* Yager DR, Chen SM, Ward BS, et al: Ability of chronic wound fluid to degrade peptide growth factors is associated with increased levels of elastase activity and diminished levels of proteinase inhibitors. Wound Repair and Regeneration 5:23, 1997; with permission.)

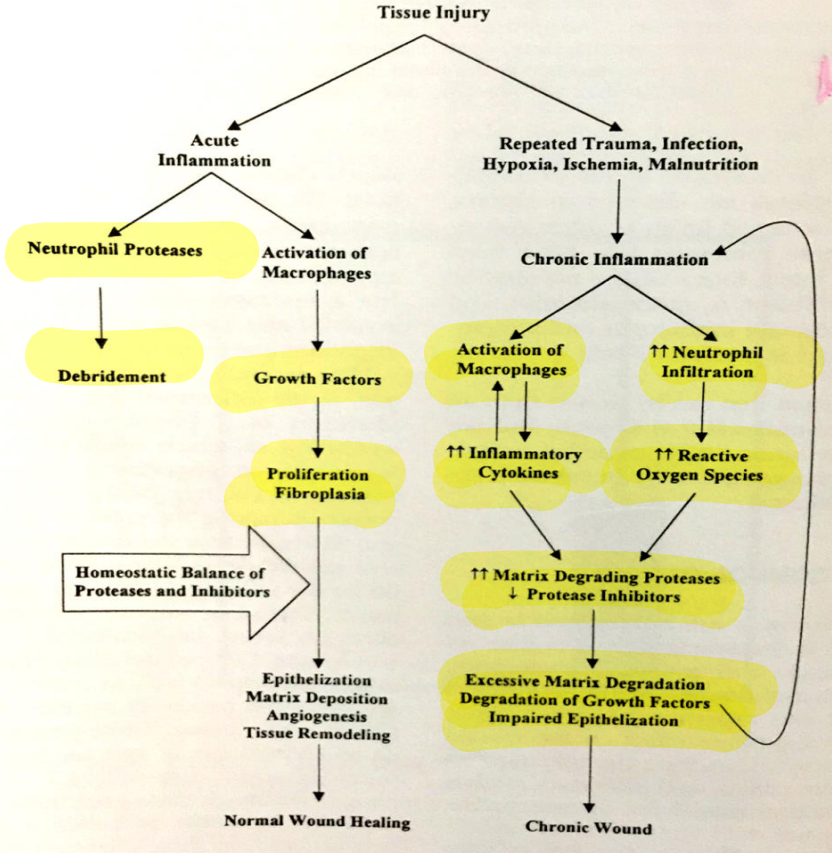


Figure 4. The final common pathway in the pathophysiology of chronic wounds.

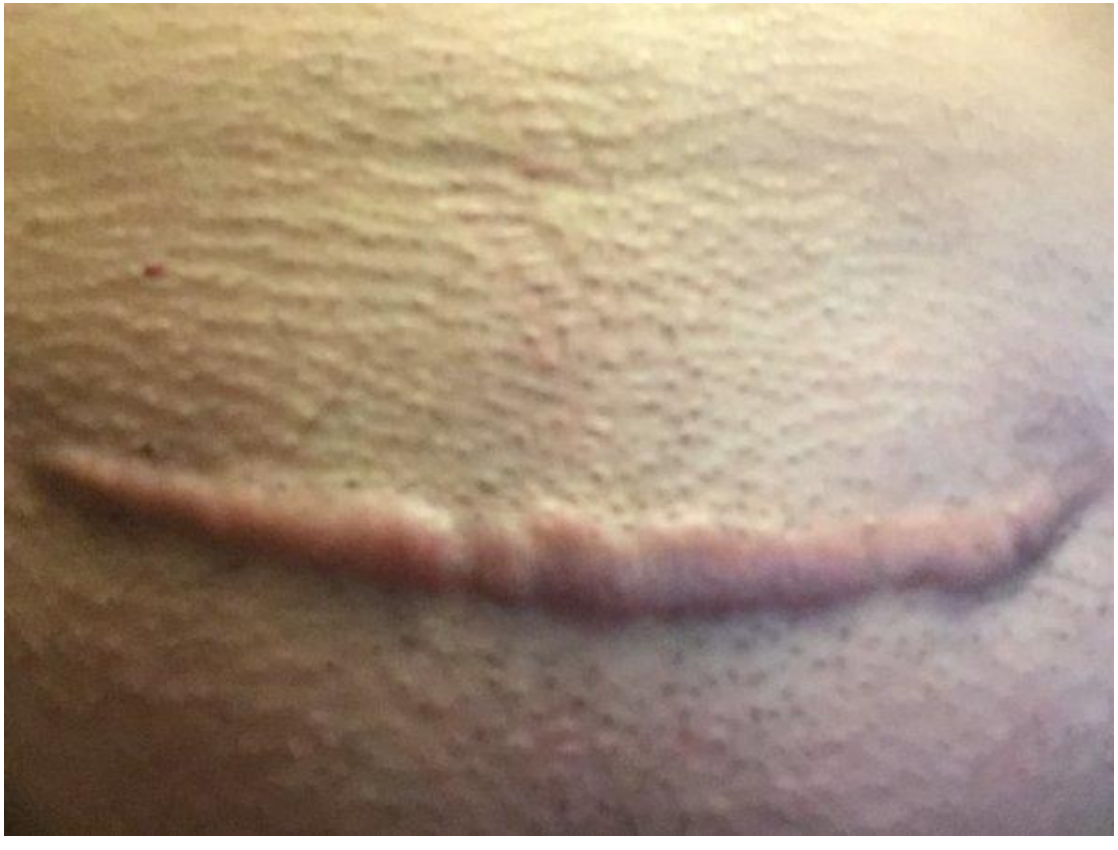
Excessive Wound Healing

1. Keloids → usually occur in black people + genetic background
2. Hypertrophic scars

Please refer to this link:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4129552/

complicated hypertrophic scar



- Etiology
- Histology → hypertrophic scar: less collagen than keloids but the arrangement of collagen parallel to the wounds in hypertrophic while keloid: circular
- Treatment
  - ❖ Surgical excision
  - ❖ Z-Plasty
  - ❖ W-Plasty
  - ❖ Steroids
  - ❖ Silicon
  - ❖ Pressure garment
  - ❖ Laser
  - ❖ Interferon

↳ hypertrophic → hypertrophic: Surgical excision | keloid: Z plasty, steroids

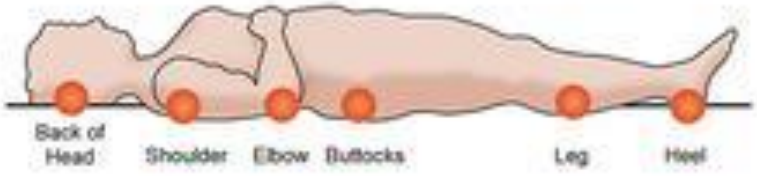
↳ keloids

Pressure Ulcers
Bed sores

- Definition
- Etiology
- Pre-disposing factors
- Locations
- Prevention
- Work up
- Treatment : Medical surgical
- Complications of surgery

Please refer to the following links:

https://www.researchgate.net/publication/257777910_Bedsores_Top_to_bottom_and_bottom_to_top



especially when the skin is wet

* Treatment: high protein diet, continuous mobilization every 2 hours for 15 minutes

Skin and the tissue below

(1) non blanchable
(2) break down of the skin
(3) muscle and fascia
(4) bone

* shearing forces and frictions between blood supply and skin

ما يتجي بال ← الجلد

Blood supply that's perpendicular on the skin from fascia → strangulation

it could result from nail biting, Paediome ... , thumb sucking in children

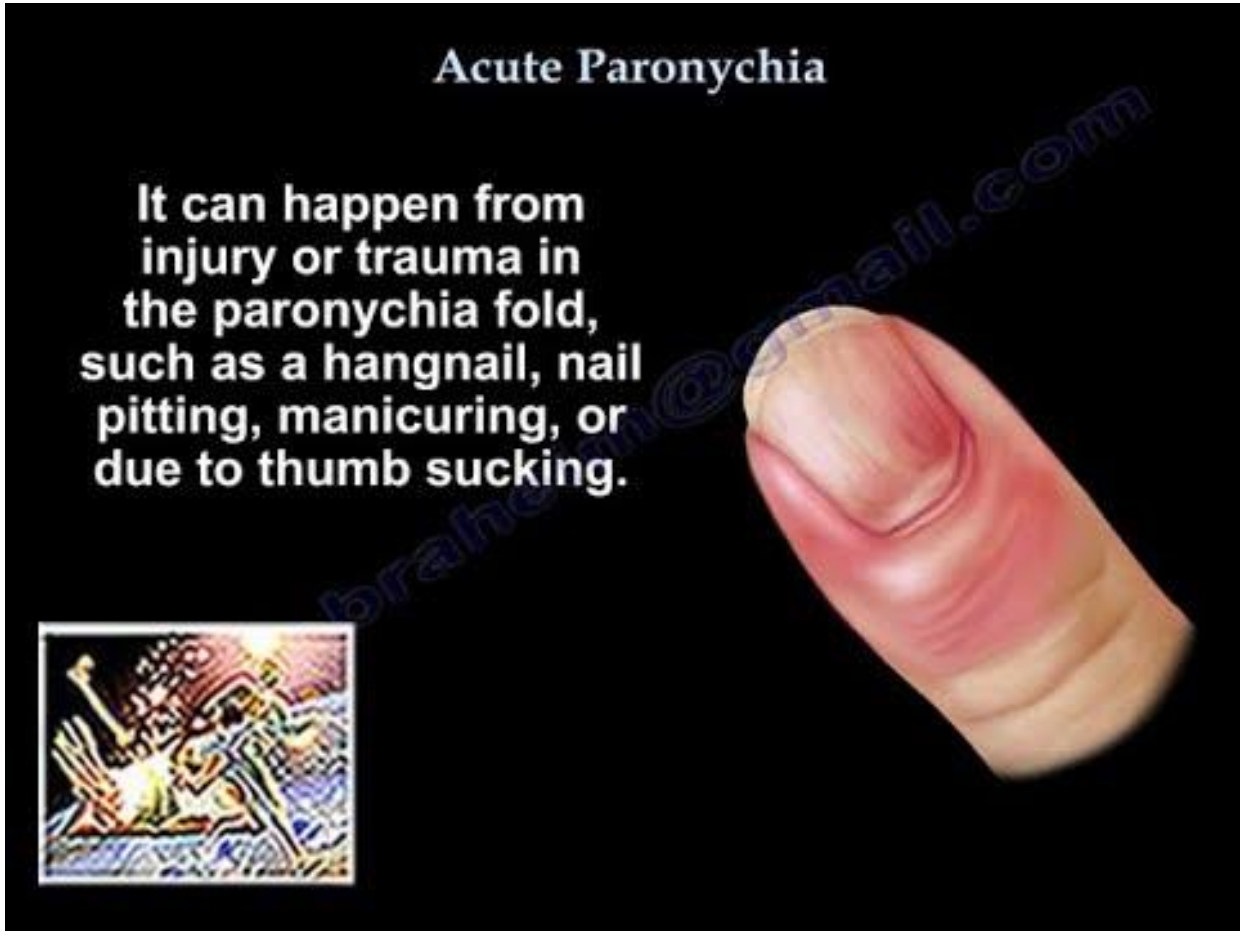
Common hand conditions

inflammation of the nail fold around the nail itself

- Paronychia

Refer to the following link:

https://www.health.harvard.edu/a_to_z/paronychia-a-to-z



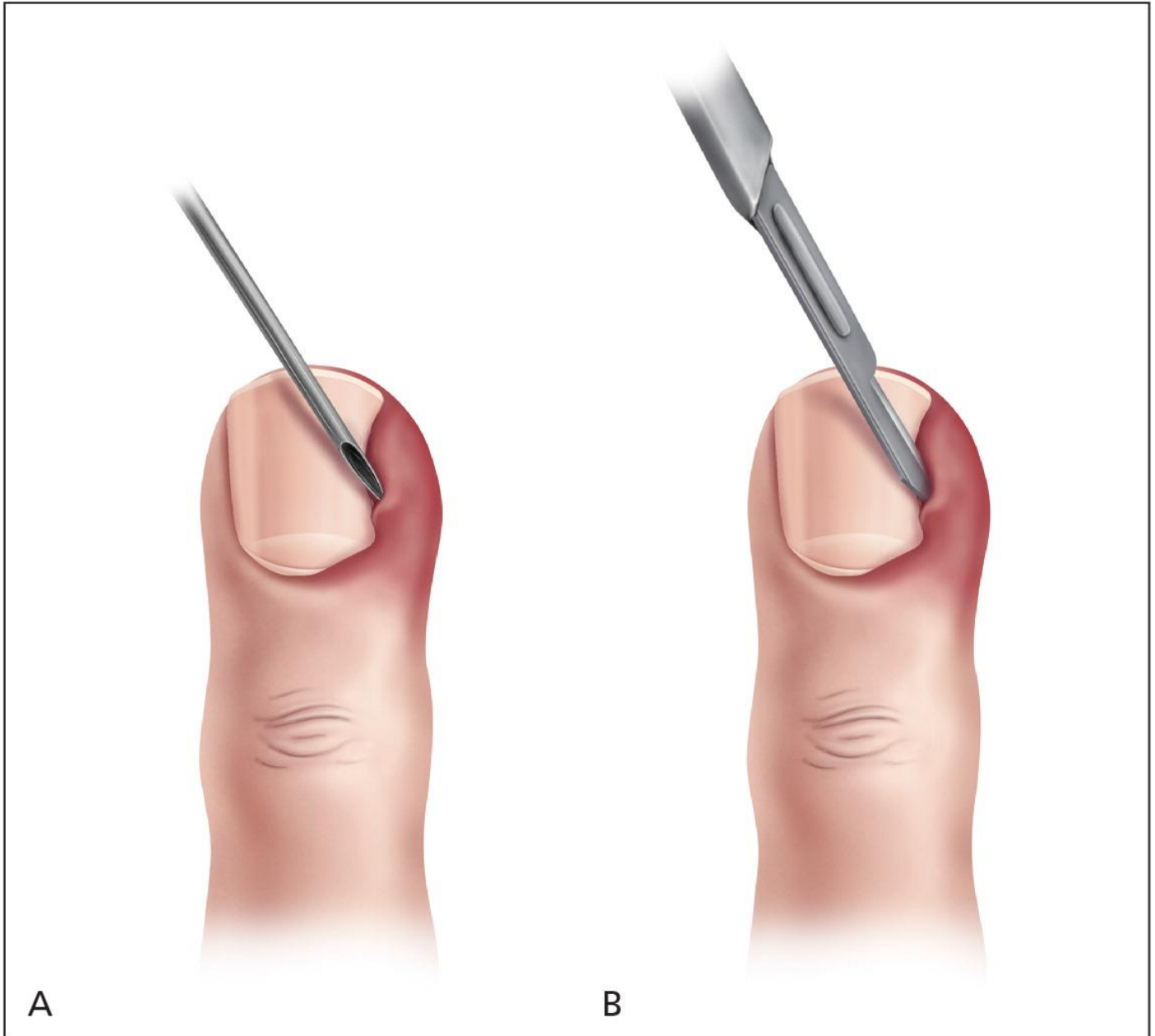
↳ acute retinal necrosis

↳ delayed treatment
↓
pus changing

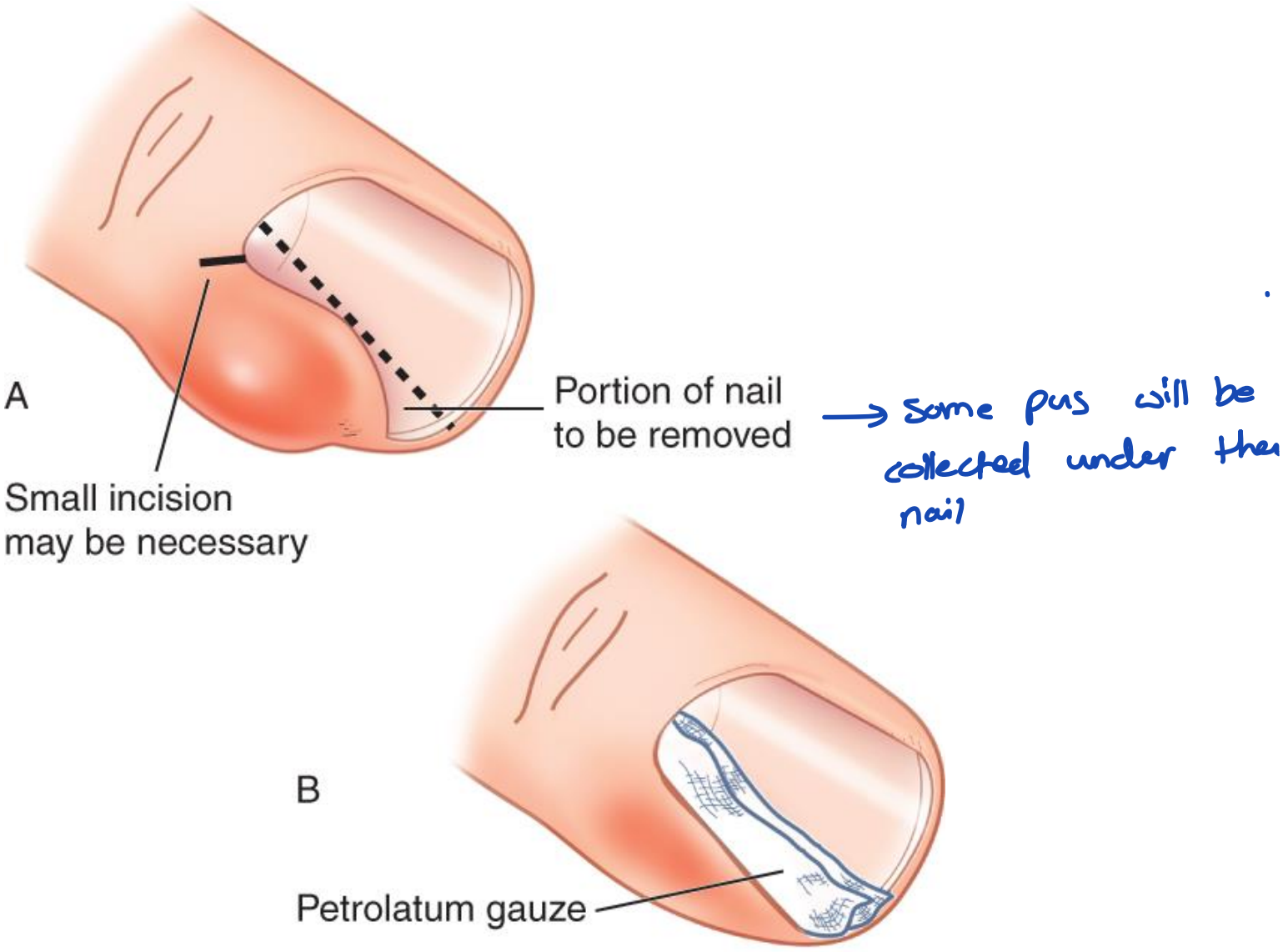
* In the first stages when cellulitis → staphy and strep antibiotics,
* late: pus collection → incision and drainage

Chronic paronchyia → most common cause

candida albicans → antifungal
(local + systemic)



ILLUSTRATIONS BY DAVE KLEMM



→ Some pus will be collected under the nail

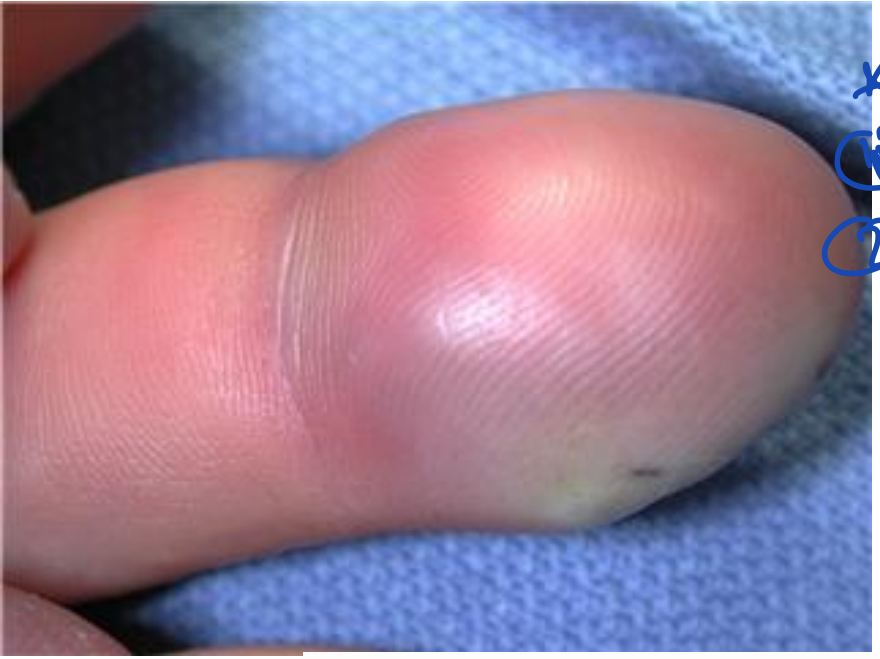
Source: Reichman EF: *Emergency Medicine Procedures, Second Edition:* www.accessemergencymedicine.com

Common hand conditions

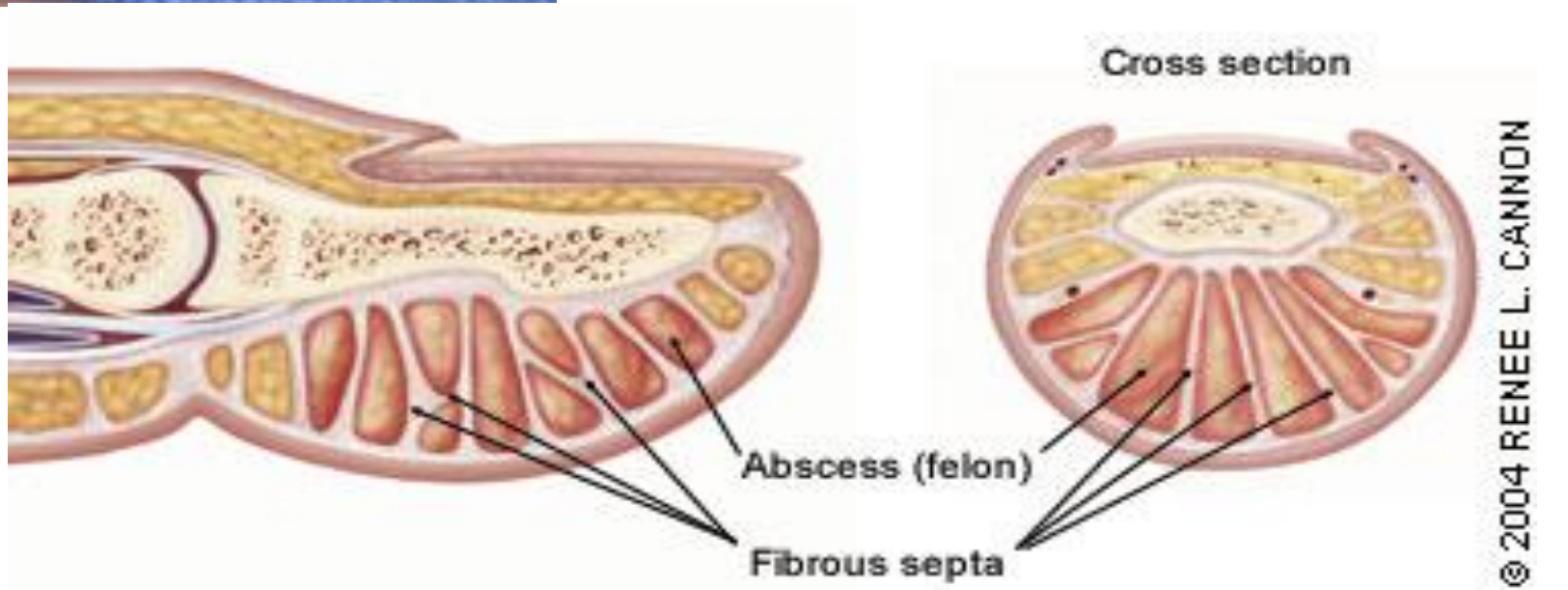
- Felon (Pulp abscess) → considered severe because the infection could reach both the underlying bone and the nail and skin

https://www.health.harvard.edu/a_to_z/felon-a-to-z

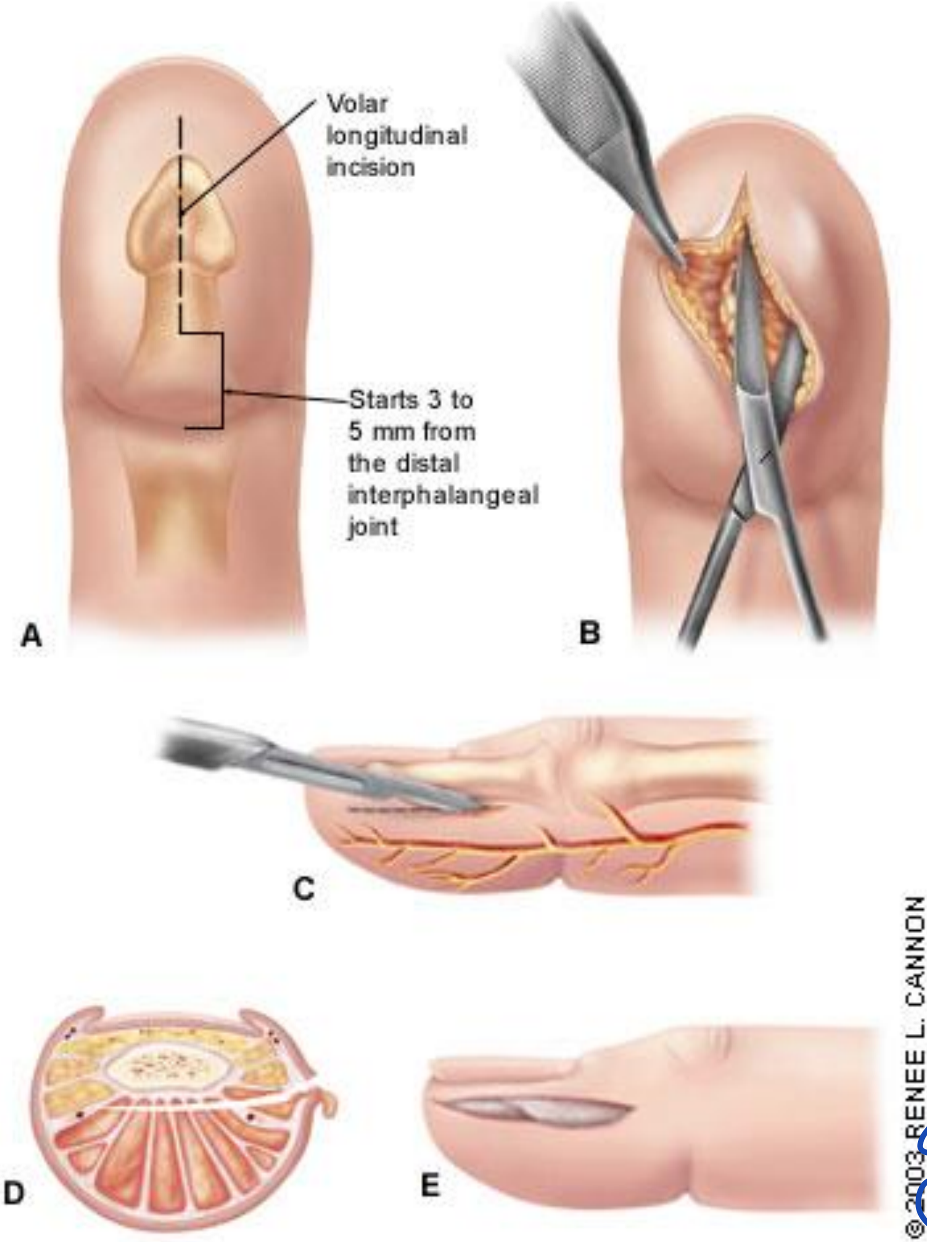
- acute osteomyelitis
- skin necrosis
- flexor tenosynovitis



*Investigations:
① WBCs
② X-ray
(mandatory)




* patient unable to elevate
his finger → pain. Should rule
out tenosynovitis



* Antibiotics should be given here because the pus is located between the septa → it should be drained!

* excision + drainage then antibiotics
↓
ما حاطيلها
بعد فترة
بتيجي مع
complications كتير
① acute osteomylitis

②Septic arthritis for DIP ③necrosis of skin

Common hand conditions

- Subungual hematoma

Please refer to the following link:

https://www.emedicinehealth.com/subungual_hematoma_bleeding_under_nail/article_em.htm#subungual_hematoma_facts

*if hematoma occupying more than 2/3 of the nail → most commonly we have nail bed injury

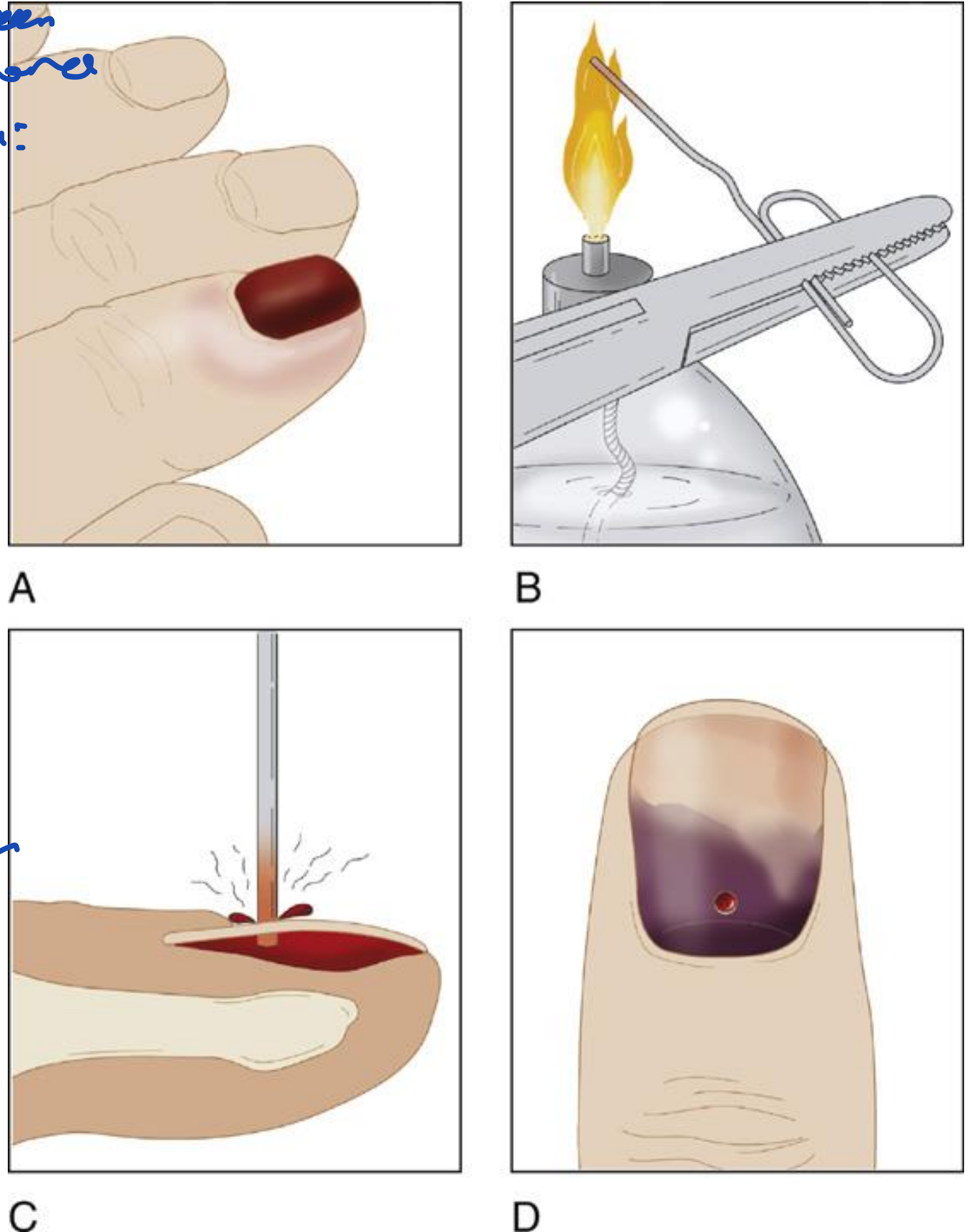
→ وقتها لو تركته لحاله

حيطلع أظفر جديد بس ما حيكون على طول nailbed

* Differentiation between subungual melanoma and hematoma:

هاي بتتحرك مع الوقت ، بتصل وبتزحف نحو رؤوس الظفر عكس melanoma

not a definitive treatment just to relief the pain



بتعقيم الـ nail

بنظف الـ blood

↓

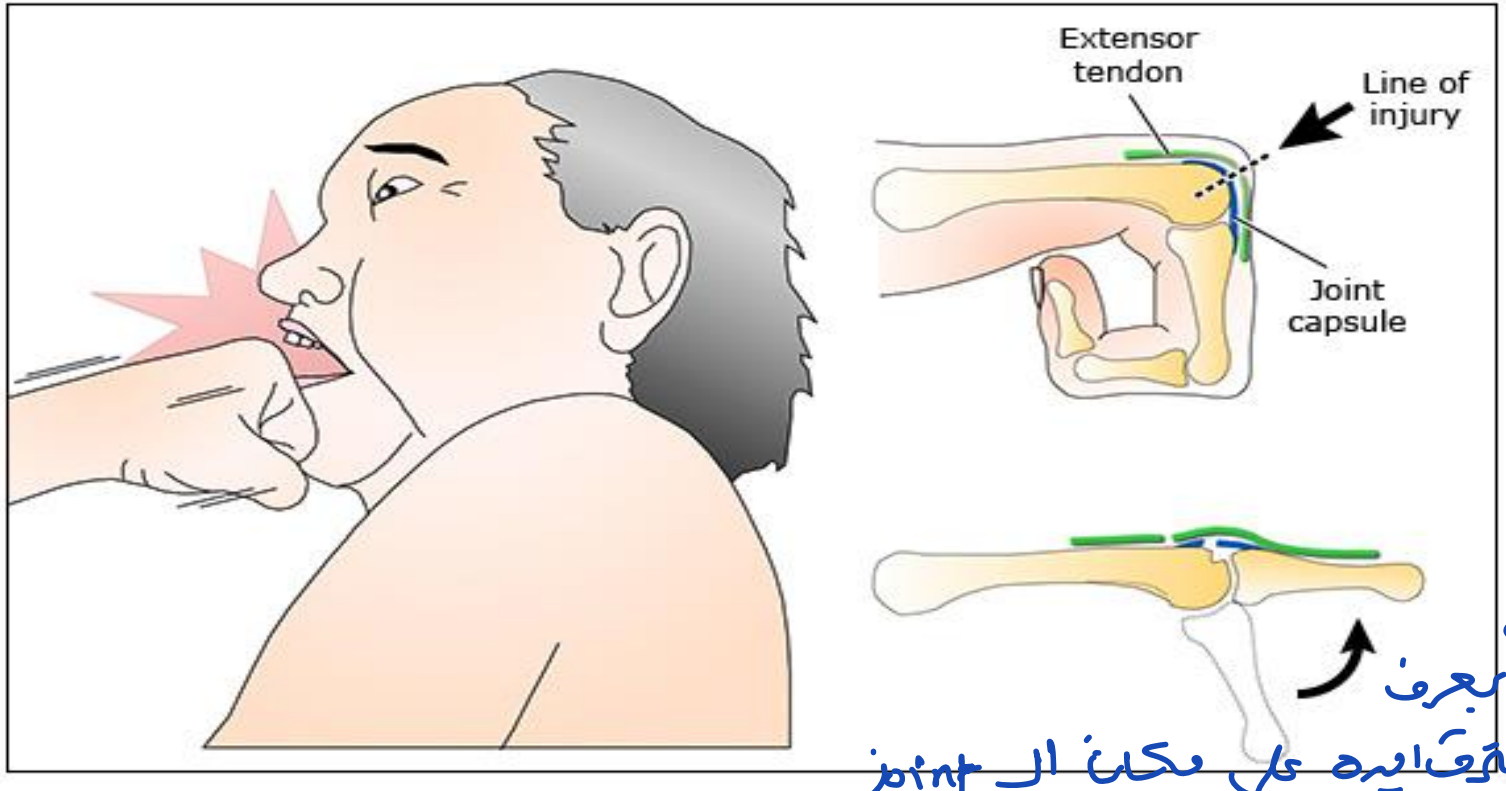
بعمل suturing بـ absorbable string

if left unsutured will turn into a scar tissue

* one of the differentials:
- Subungual melanoma

Common hand conditions

- Human fight bite (fist injury)



بس يفتح اليد بعرف انه اختراقيه على مكان ال joint

→ cellulitis
infection
tenosynovitis

Please refer to the following link:
https://epmonthly.com/article/fite-bite/

When atomsphere temp. below 0°c (should be sub zero) ← Frostbite → extremities

4th degree

Toes

second degree of frostbite.

Fingers

ear

nose and cheeks

Trench foot

Temp: above zero (1-10)

Please refer to this link:
https://medlineplus.gov/frostbite.html
https://www.healthline.com/health/trench-foot#qa

❄ Frostbites ❄

- Predisposing risk factors → humidity and cold weather, wind
- Classification
- Pathopgysiology

impaired sensation, hypersensitive patients, homeless pt, β-blockers intake, mental disease, very young and very old patients

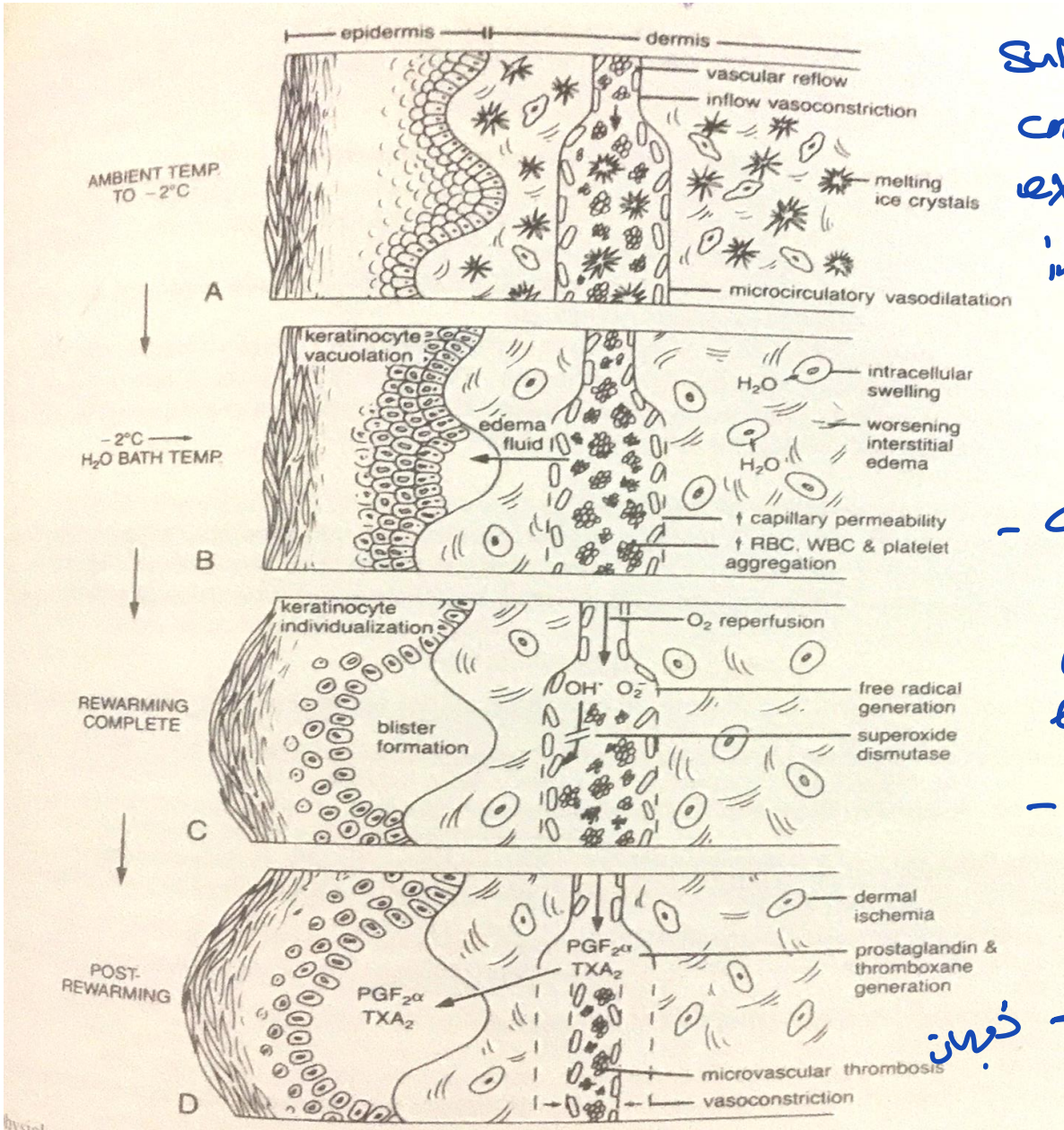
① Blanchable

② Non-blanchable erythema
- confine to epidermis

④ dermis and epidermis

⑤ bone invasion (gangrene)

يعني بتصير injury خلال التجلية freezing + ذوبان



Sub zero temp crystalization of extracellular and intracellular skin layers منه بيصير

↓

- constriction of blood vessels due to cold exposure
- crystalization & cells leads to rupture

ذوبان - ↑ in temp → more injury

release of free radicals
- formation of blisters

- Treatment

❖Re-warming → warm both ≤ 42° to avoid further thermal injury

❖Analgesia

❖Massaging X

❖ Antibiotics X → only if secondary infected

❖Steroids X

❖ Debridement → only when line of demarcation is present

❖Elevation → for edema

❖Topical thromboxane inhibitor → Given topical

❖Systematic antiprostaglandin agent

❖T.T → to avoid further clots

❖Dressing

❖Amputation

❖Adjuvant therapy: alpha blocker, free radical scavengers, thrombolytics → to vasodilation

❖Late sequelae.

- Cold intolerance
- Impaired (lengthening)

to avoid further propagation caused from them

* Complications of burns

- joint contractures (heterotropic calcification)
- keloid or hypertrophic scar
- motor weakness more than sensory loss (demyelination of motor nerve more than sensory)

bone chicken in children (epiphyseal plates) - another has bike easily especially in the cars

when the burn is uncovered for a long time with exposed joint

- late complication: cataract (electrical current in lens)

* ataxia (cerebellum affected) ⟹ electrical burn

- Post burn depression, trauma or anxiety