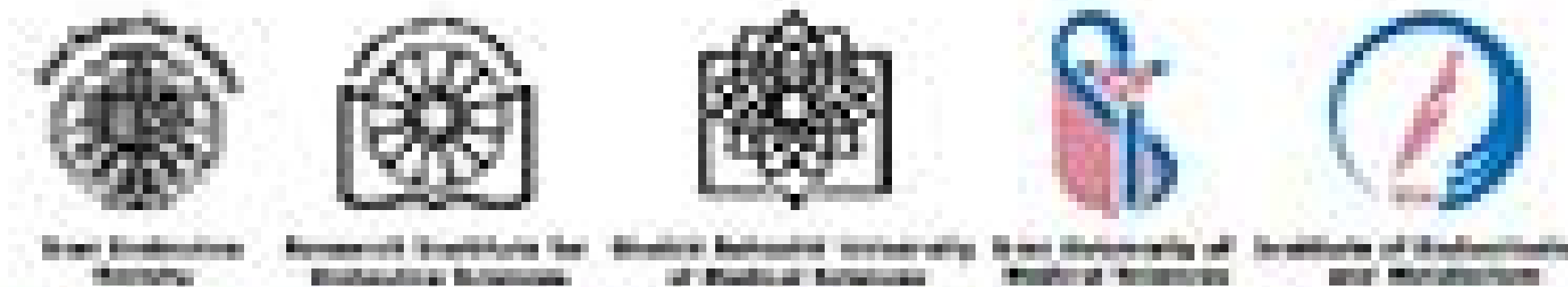


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# **Complicated Diabetic Foot Ulcer**

## **(Clinical Case Discussion)**

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**Diabetic Foot Research Group**

**EMRI-TUMS**



# CLINICAL CASE



- A **61 year-old** male patient was diagnosed with DM2 **14 years** ago.
- This diagnosis was initially accompanied by sensory and motor **peripheral neuropathy** and **metatarsophalangeal arthropathy** with no signs of **osteomyelitis**.





# History

- The patient had presented ulcers in both his feet for **ten years** now, in the metatarsophalangeal area.





# History

- Ulcers had never **completely healed** in this period.
- He did not present partial or total **amputations**.
- He had needed **several admissions** in hospital due to recurrent infections.
- He had needed **debridement** and **IV antibiotics** in multiple occasions.



# History

- He does **not smoke** and has never smoked.
- He has an **appropriate metabolic control** of his disease with **7.4%** glycated hemoglobin values.



# Medical Treatment

- **Lantus<sup>®</sup>** insulin(Glargine) : 28 units once a day in the morning
- **Atorvastatin<sup>®</sup>** 10mg: once a day
- **ASA<sup>®</sup>**100mg: once a day
- **Vitamin (B1-B6-B12)**: once a day





# Ulcer Treatment

- Cures with **therapeutic honey** and cleaning with **soft soap**.
- Offloading with 1cm-thick **pads** as a foot insole.
- He uses a **stick (same as a cane)** to avoid weight bearing.
- Use **Skin Care Oil** (Hyperoxygenated fatty acid compounds)
- **Dressing** to support the pad.







# Physical Exam

- The patient presented sole ulcers on both feet.
- (**2x3 cm** wide on the right foot and **4x3 cm** wide on the left foot)
- Hyperkeratosis, swollen borders with exudation and bad smell.
- The areas between the fingers were **moist** and also **bad smell**.



# Physical Exam

- Dorsal pedal and posterior tibial **pulses** in the right foot are **very weak**.
- **Onychomycosis** is present in all **nails**.
- The patient reports **cramps** in both **feet**.
- **Intermittent claudication** of less than **150** meters.
- **Itching** of the malleolar & anterior tibial regions, mostly in the left foot.



# Physical Exam

- He presents **nighttime pain** that subsides with the change of position.
- left leg : a **dark brown pigmentation** of the skin in the malleolar region with **two areas of blisters** with no further ulceration and **no-pitting edema** in the tibial region.



# Physical Exam

- He presents **dermatitis** in the base of the toes with no external signs of varicose veins.
- He has moderate **Charcot arthropathy** in his left foot.
- The patient is **independent for activities** of daily living.







# Physical Exam

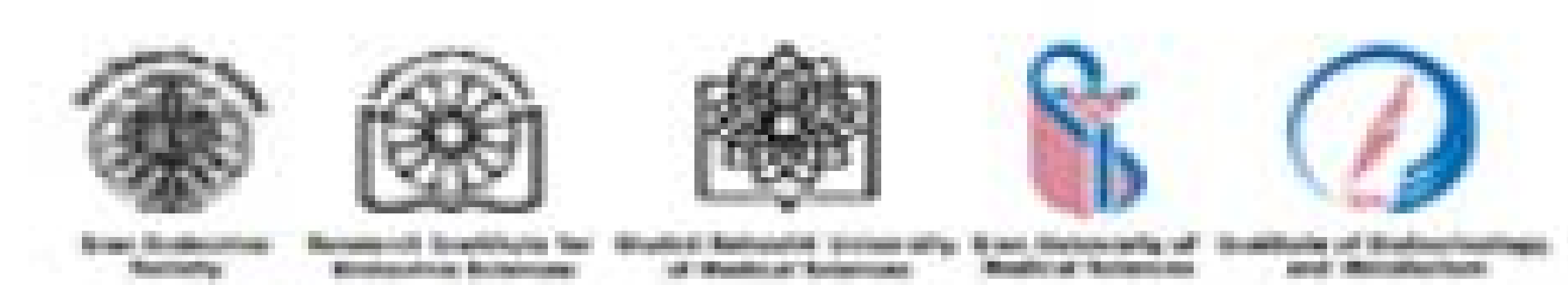
- The probing to bone test: **negative**

The ankle-brachial index (ABI):

the right foot = **1.2**

the left foot = **1.3**

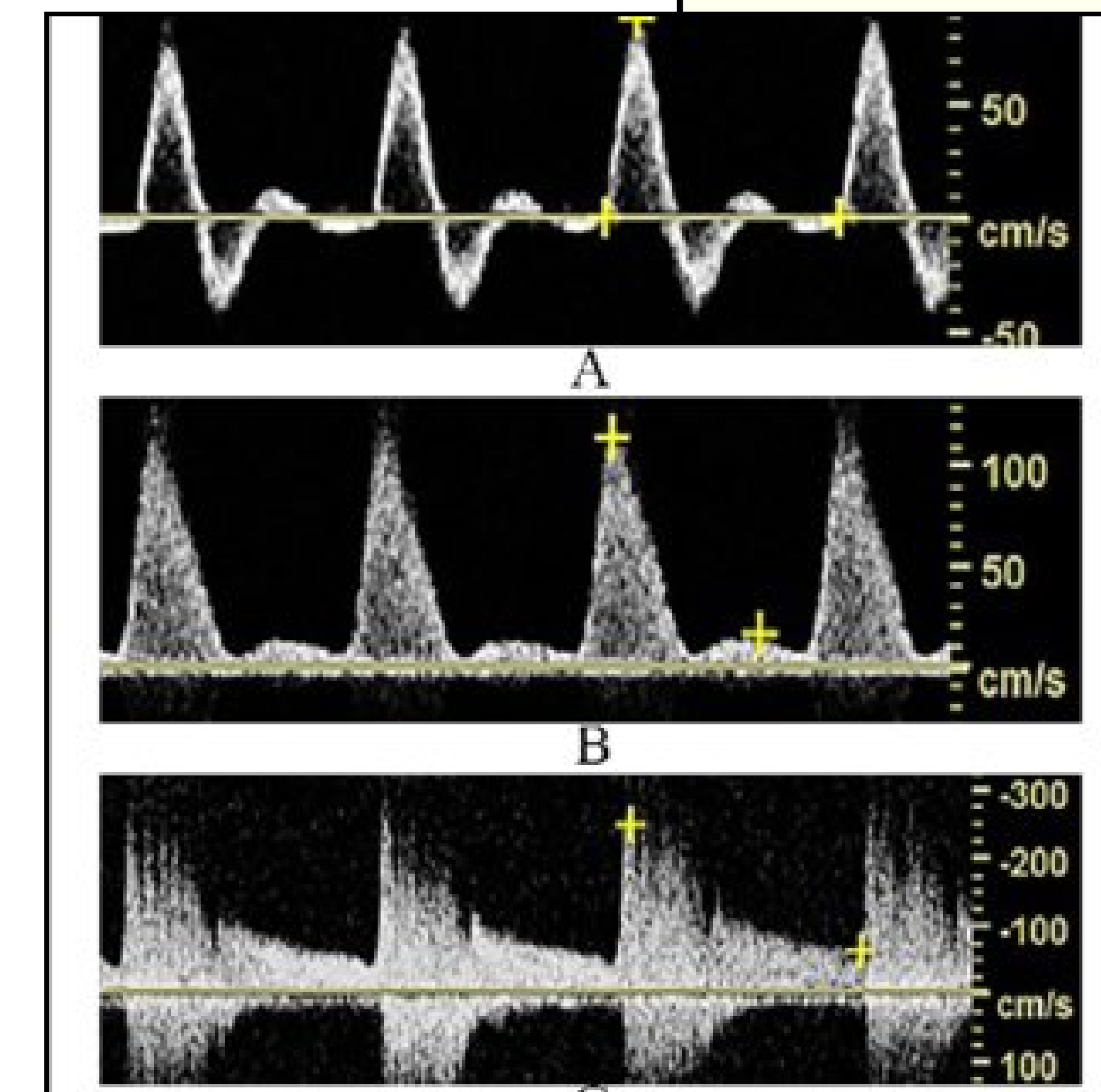
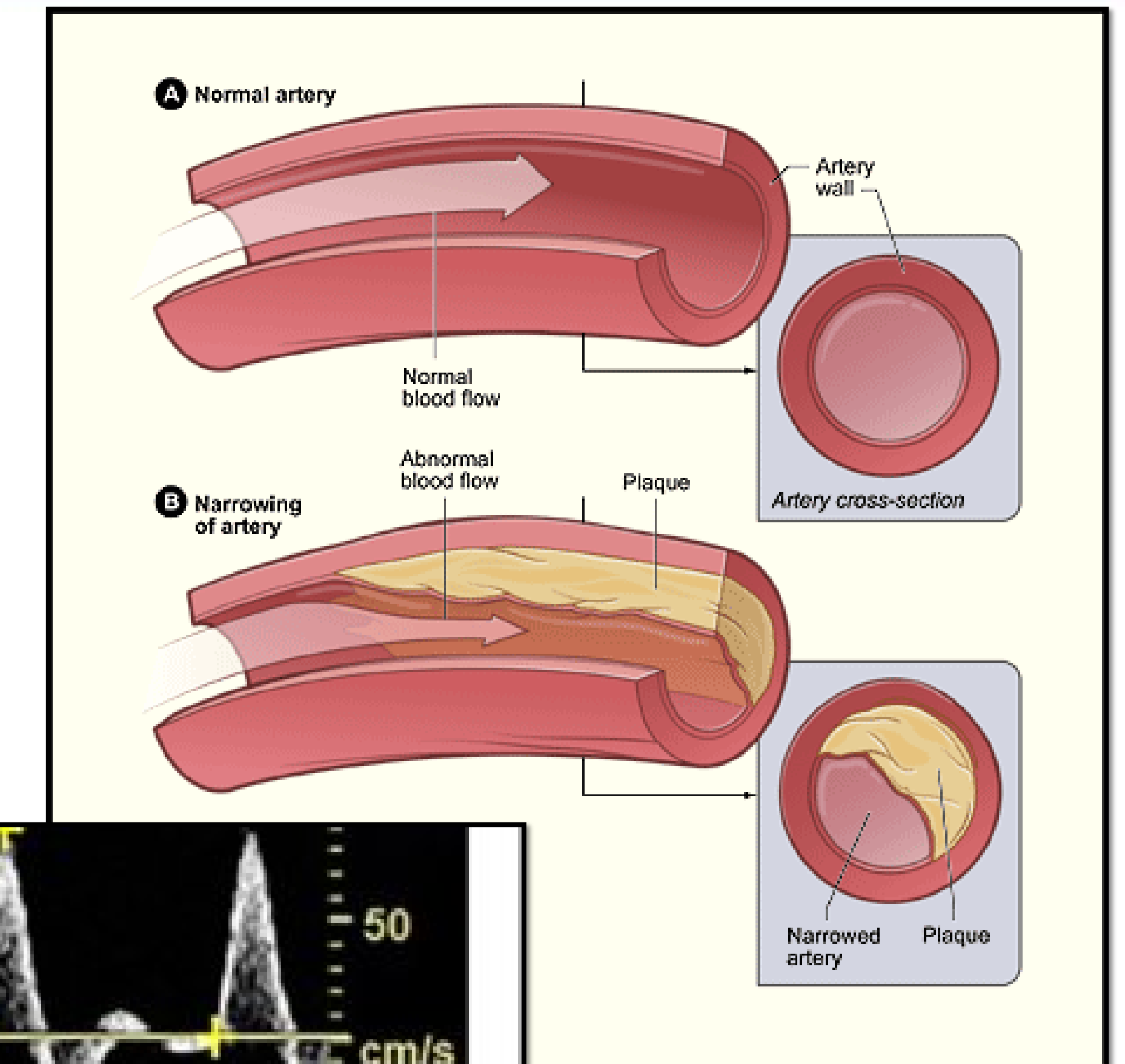


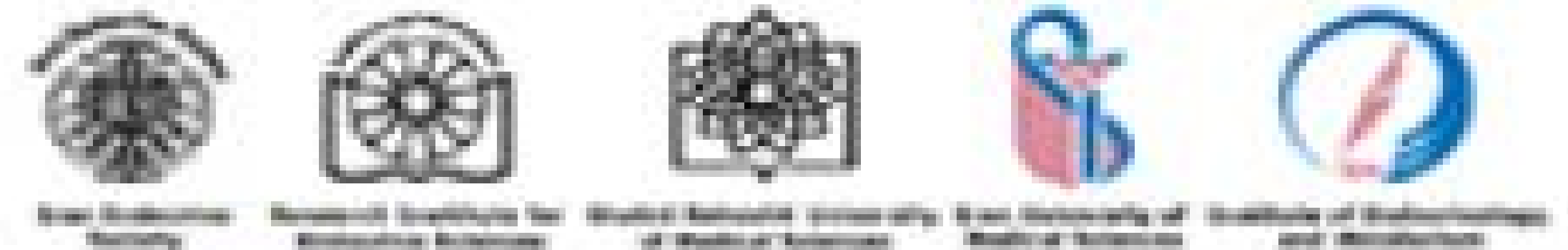


# Physical Exam

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- **Doppler Ultra Sonography :**
- calcified laminar atherosclerotic **plaques** mainly in distal territories, **biphasic flow** due to impaired vascular elasticity, in the posterior retro-malleolar territories of the **pedal and tibial arteries.**





# Physical Exam

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## Leriche-Fontaine classification: **stage IV**

Stage I	Asymptomatic
Stage II	Intermittent claudication, no rest pain
IIa	When walking a distance of greater than 200 m
IIb	When walking a distance of less than 200 m
Stage III	Nocturnal pain and/or pain at rest
Stage IV	Tissue loss: ischaemic ulcers and/or gangrene

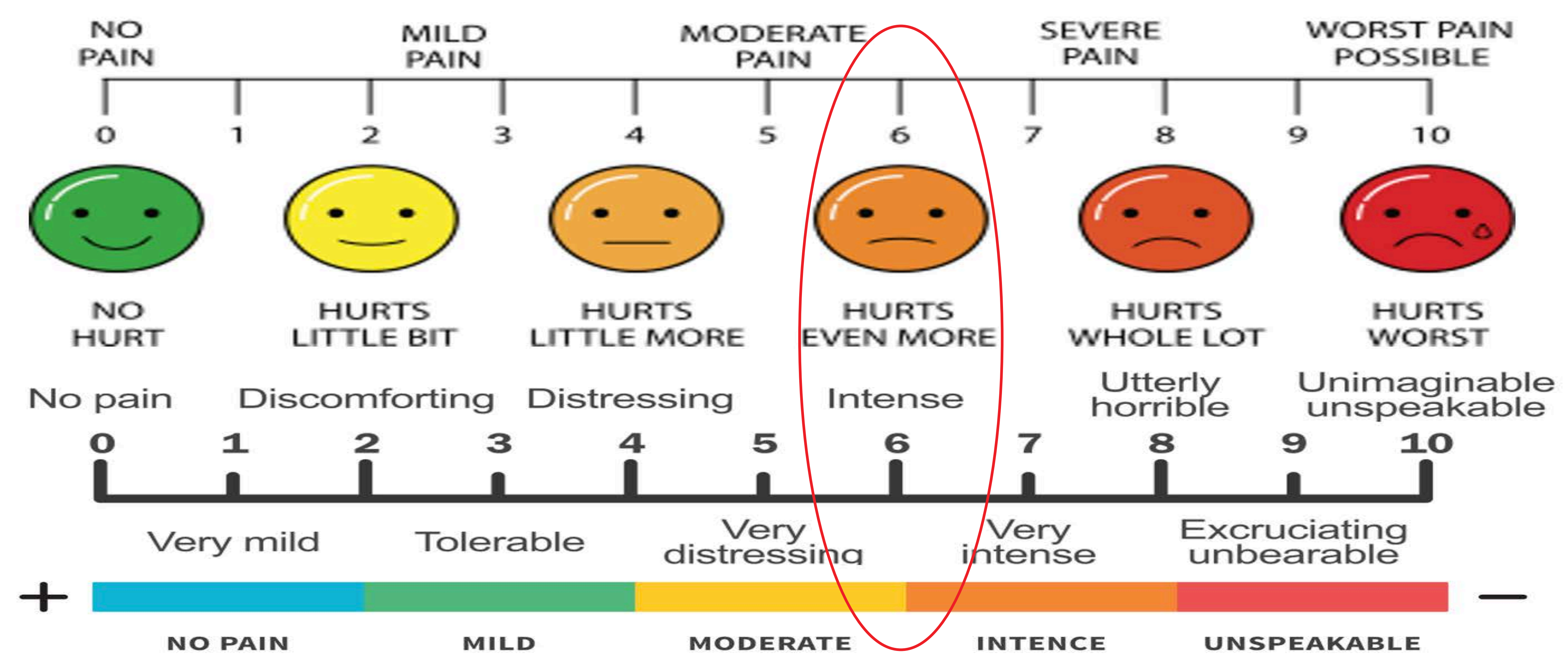




# Physical Exam

## Visual Analogue Scale (VAS): 6

- The **pain** usually had nighttime predominance which forced him to wake up and move his legs







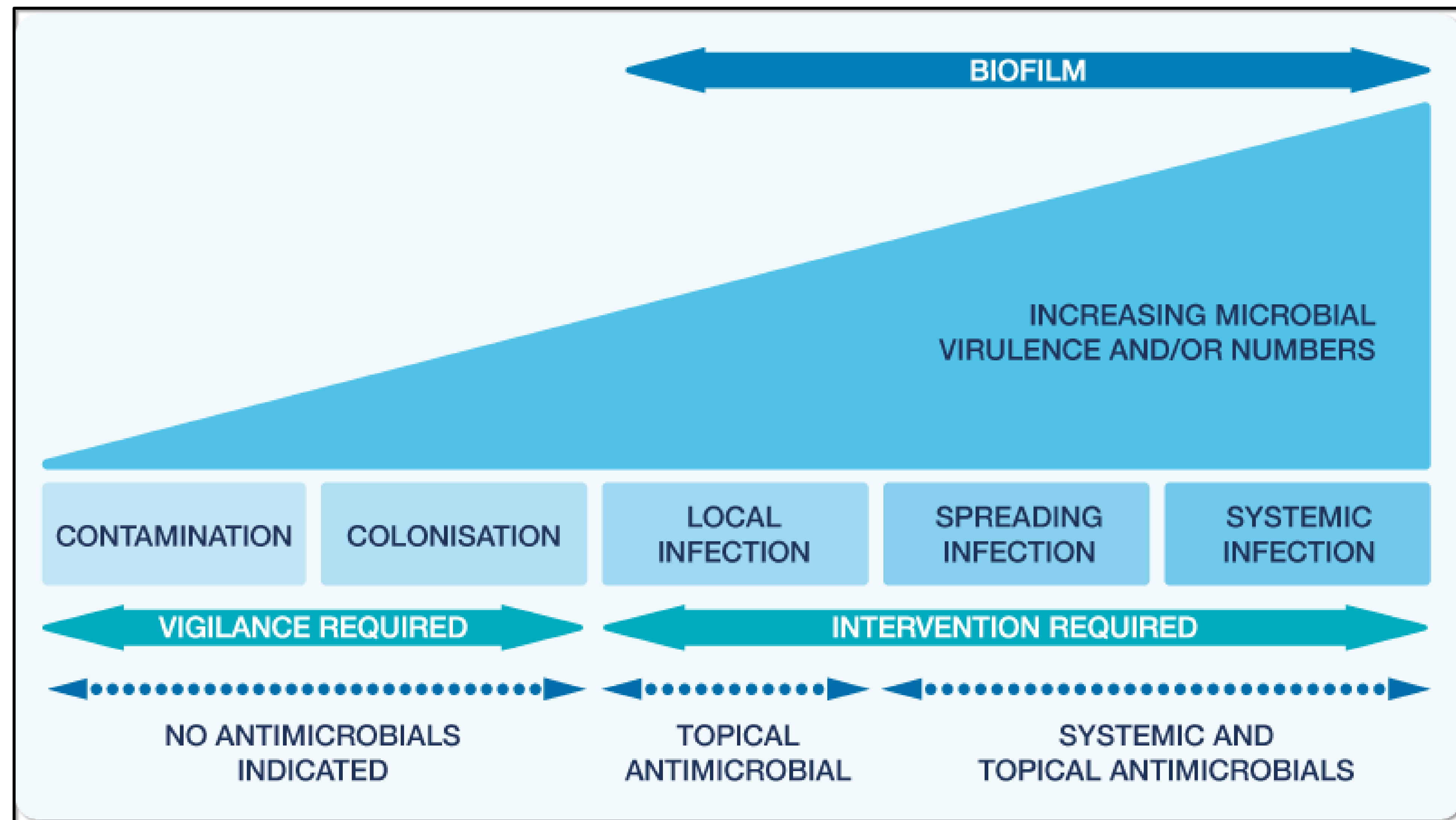
# Physical Exam

**Blood pressure (BP):** 102/63 (Normal)

**Body mass index (BMI):** 21.6 (Normal)

**Culture of wound:**

**Staphylococcus aureus**

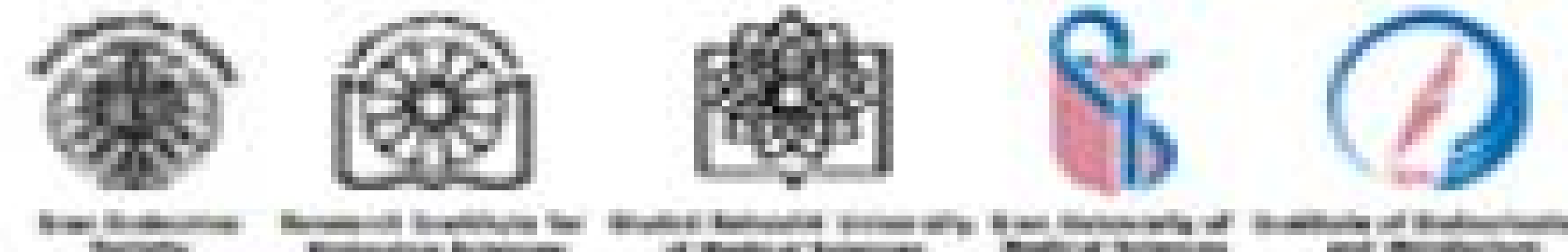




# Diagnosis

- A **neuropathic ulcer** with a moderate **ischemic component** and **venous insufficiency** of the most affected limb which impairs treatment.



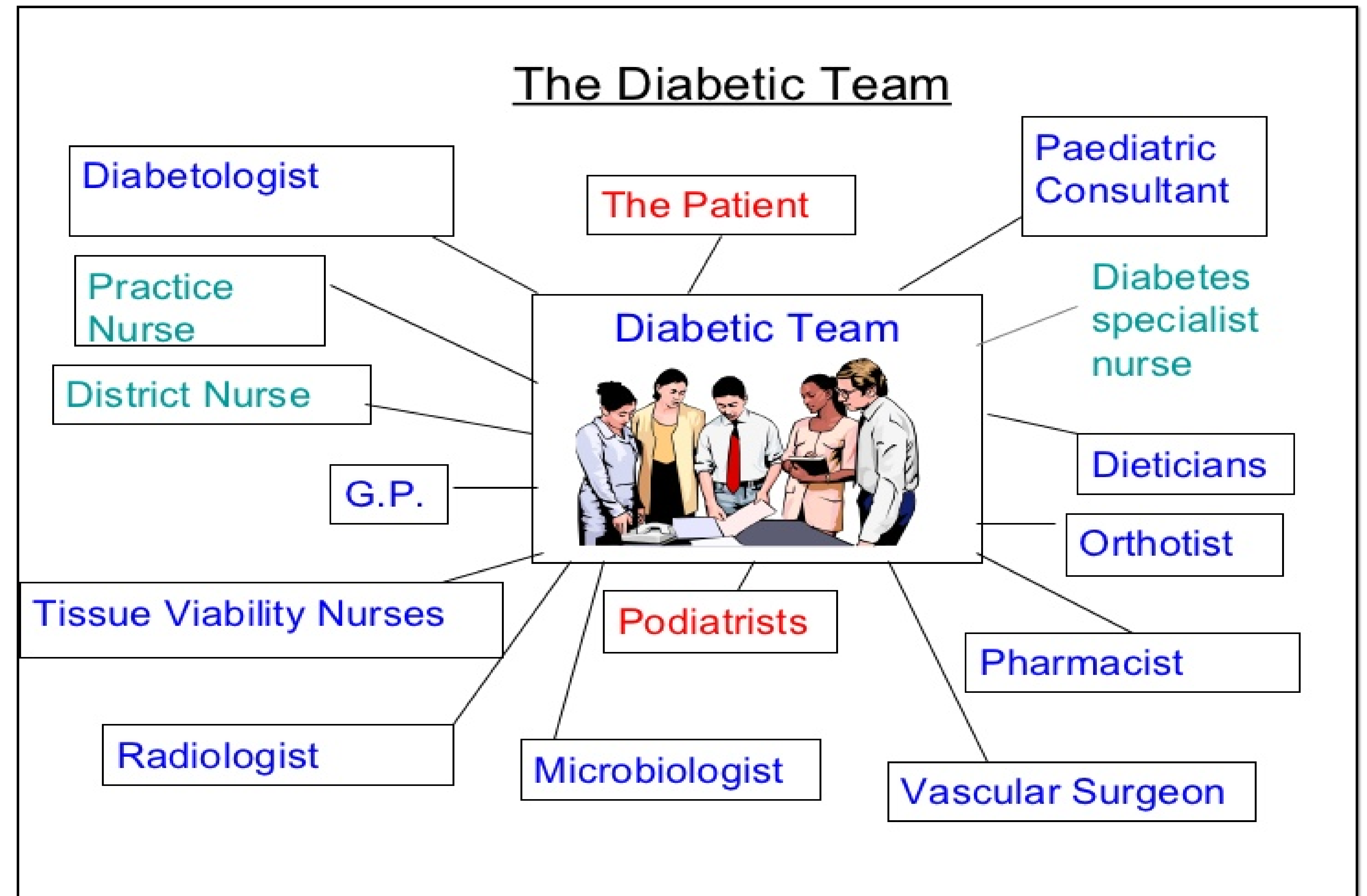


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# Diabetic Foot Management

# Multidisciplinary DF Management

- Multidisciplinary foot care team
- Foot protection team



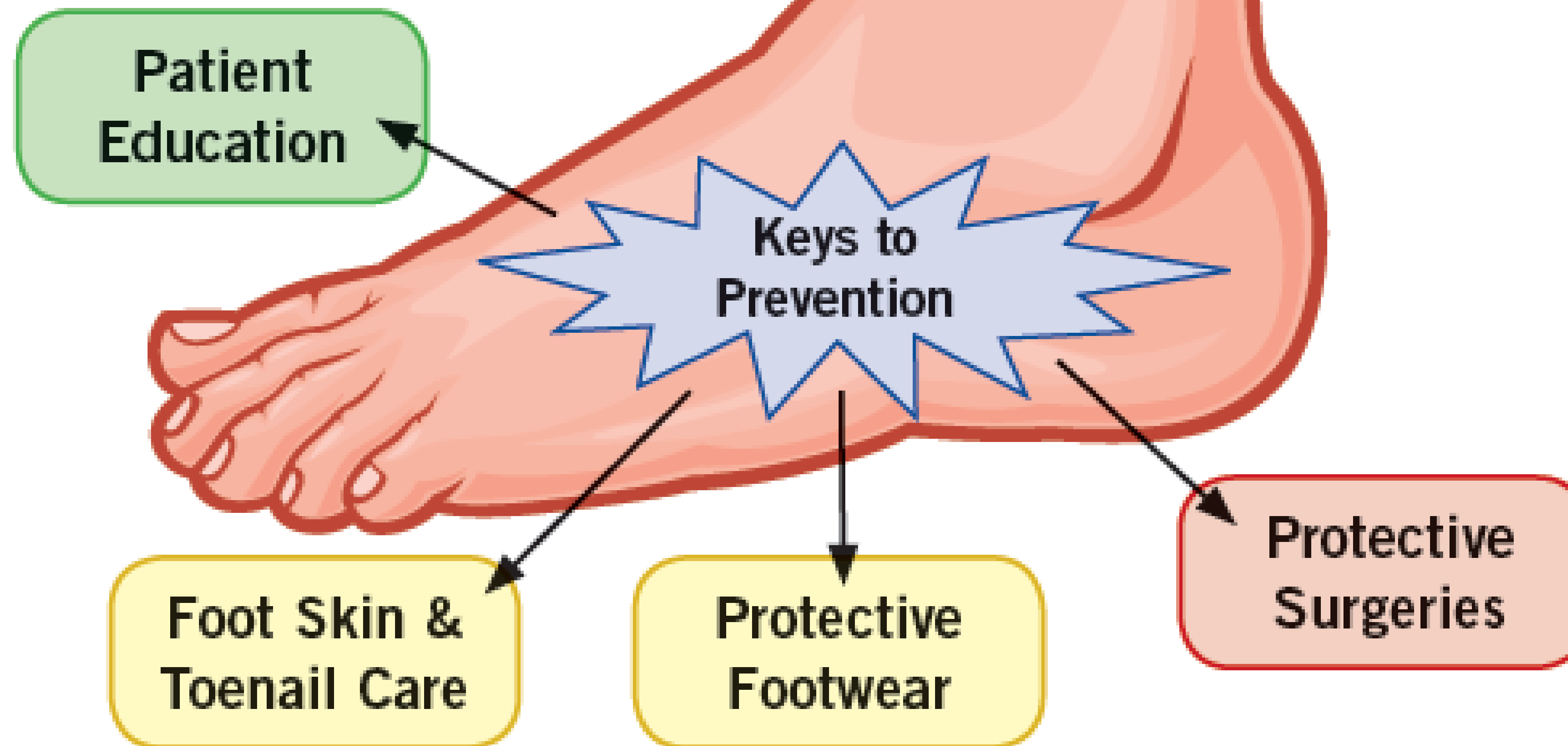


# DFU Principle of Treatment

- 1. Educational Control**
- 2. Metabolic Control**
- 3. Wound Control : Debridement & Dressing**
- 4. Infection Control**
- 5. Mechanical Control : Offloading**
- 6. Vascular Control: Revascularization**

# **Educational Control**

## The 4 Essentials for Preventing DFU



# Metabolic Control



# **Metabolic Control in T2DM for DFU Prevention & Management**

- **To assess patients' achievement of ADA guideline recommendations**
- **Glycosylated hemoglobin**
- **Lipid profile, and blood pressure in T2DM**

# Wound Control

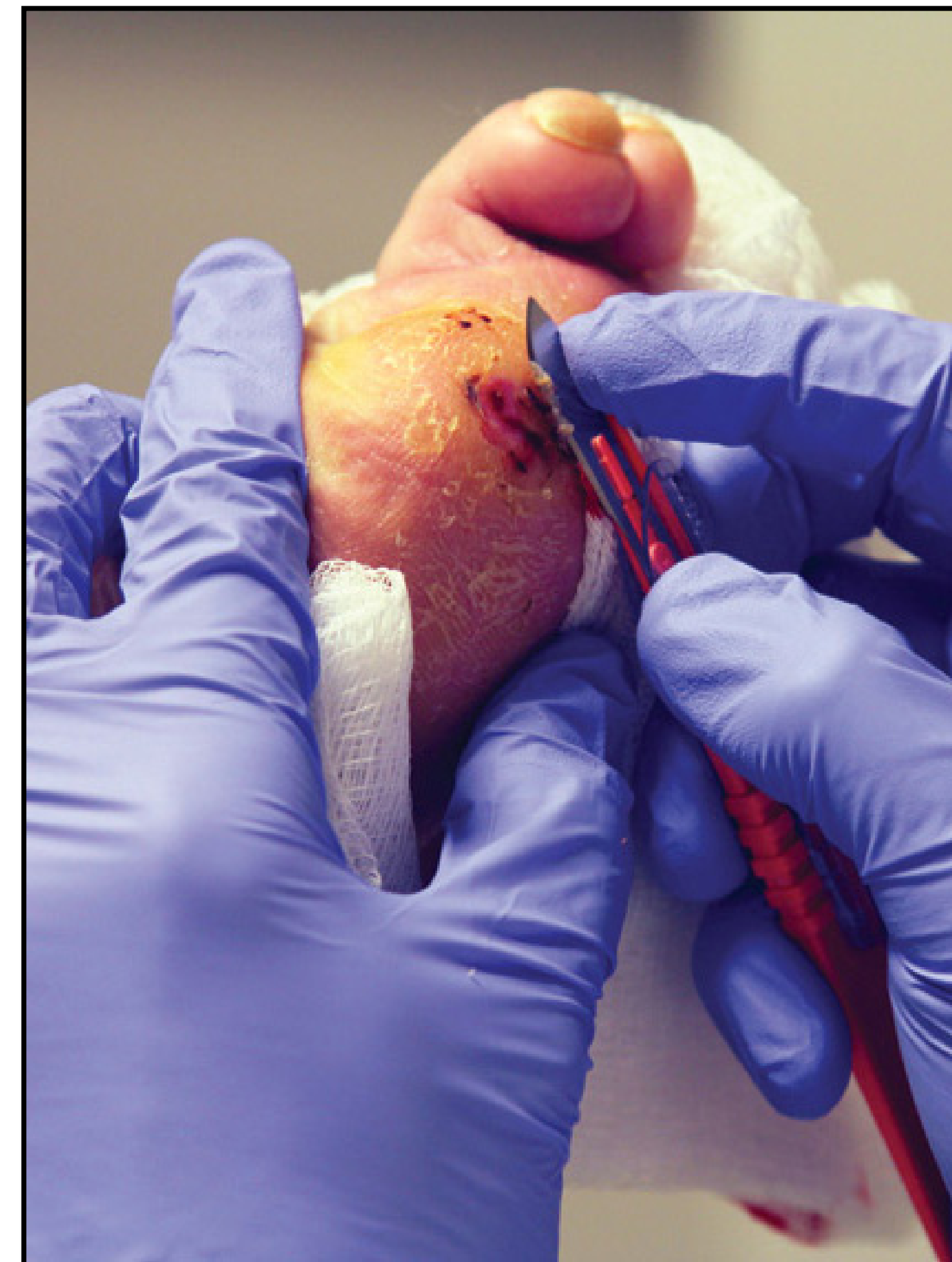
# Debridement

## Definition:

Debridement is the process of removing nonliving tissue from pressure ulcers, burns, and other wounds.

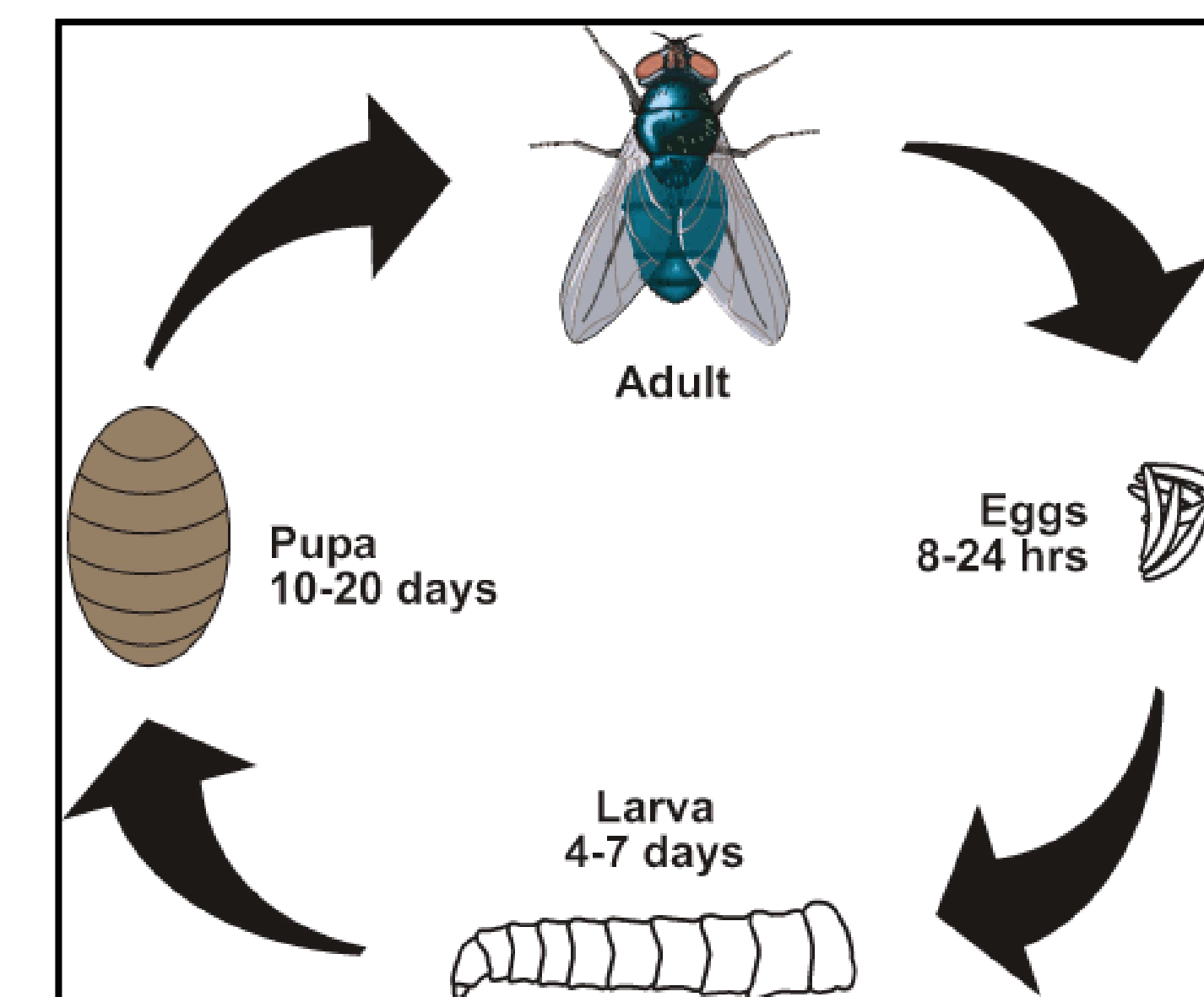
## Types:

- Autolytic
- Mechanical
- Biological
- Ultrasonic
- Hydrosurgical
- Sharp
- Surgical



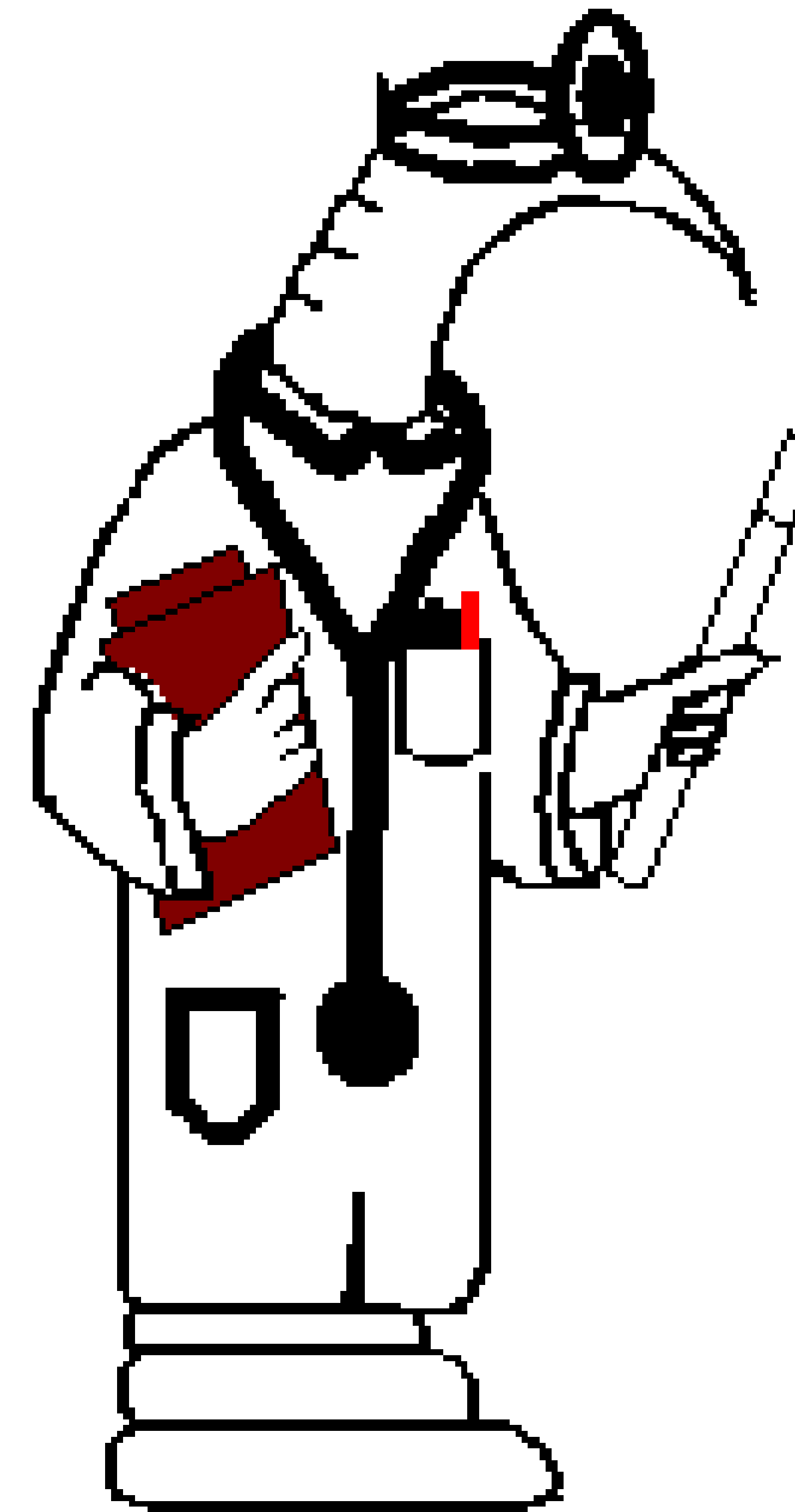
# Maggots (larva-therapy)

- The larvae of the green bottle fly used to debride ulcers, especially in the neuro-ischaemic foot.
- Sterile maggots obtained from a medical maggot farm.
- Larvae produce secretions with antimicrobial activity against Gram-positive cocci, including Methicillin-Resistant Staphylococcus Aureus (MRSA).



# Maggot Therapy

- Diversity of wound types
- Remove necrotic flesh
- Antimicrobial properties (MRSA)
- Promote Wound Healing





# Soring



## Low-Frequency Ultrasound Debridement in Patients with Diabetic Foot Ulcers and Osteomyelitis

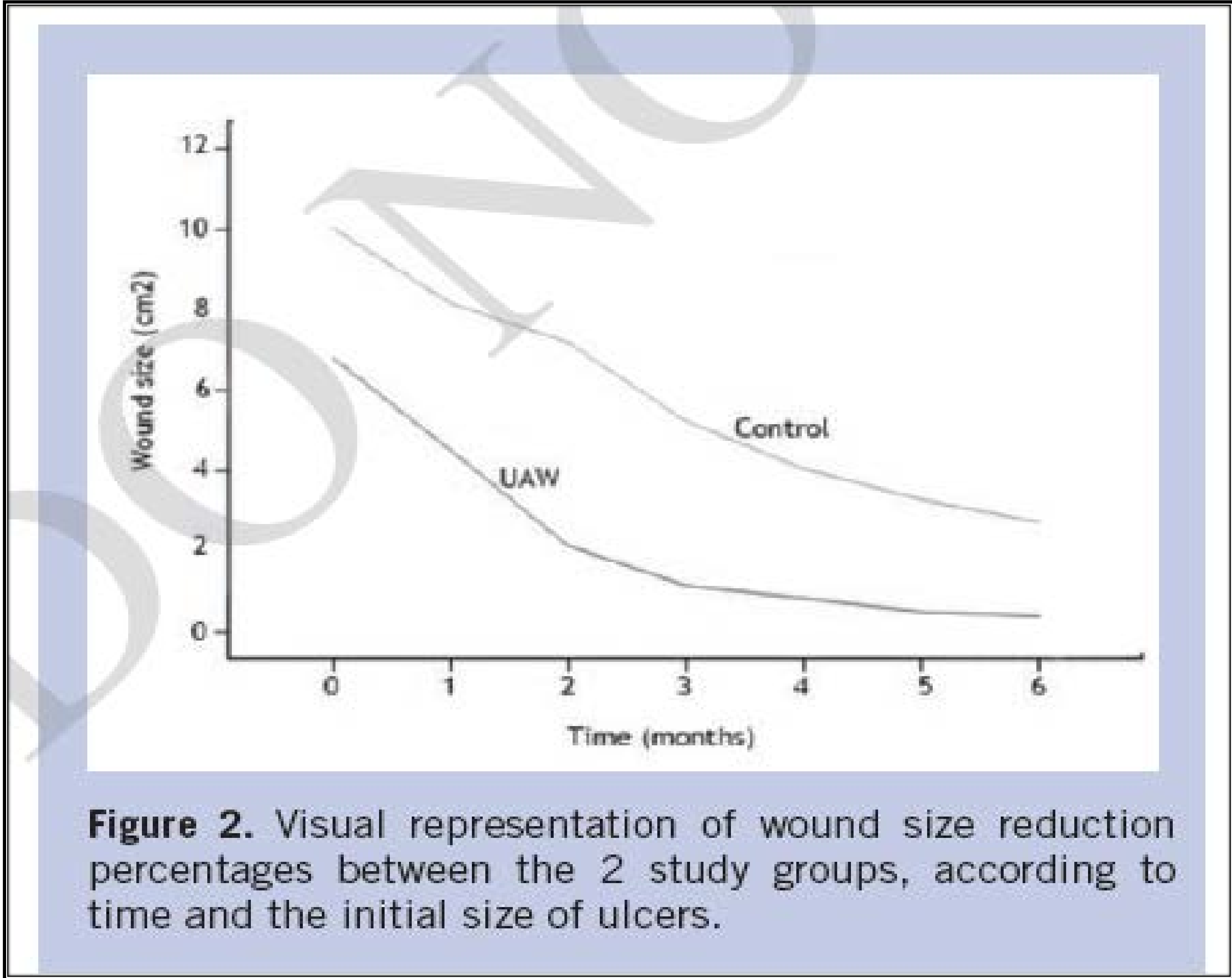
*Sareh Amtini, MD<sup>1</sup>; Abolfazl SbojaeeFard, MD<sup>2</sup>; Zobreh Annabestani, MD<sup>1</sup>; Mobsen Rezale Hammami, MD<sup>1</sup>; Zabra Sbatganmebr, BS<sup>1</sup>; Bagher Larijani, MD<sup>1</sup>; Shabrizad Mobseni, MD<sup>1</sup>; Hamid Reza Afsbani, MD<sup>3</sup>; Maryam Aboee Rad, BS<sup>1</sup>; Mohammad Reza Mohajeri-Tebrani, MD<sup>1</sup>*

WOUNDS 2013;25(7):193-198

*From the <sup>1</sup>Endocrinology and Metabolism Research Center, Endocrinology and Metabolism Research Institute, Tehran University of Medical Sciences, Tehran, Iran, <sup>2</sup>General and Vascular Surgery Ward, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran, <sup>3</sup>Iran Endocrine Society, Tehran, Iran*

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5th Floor-Shariati Hospital

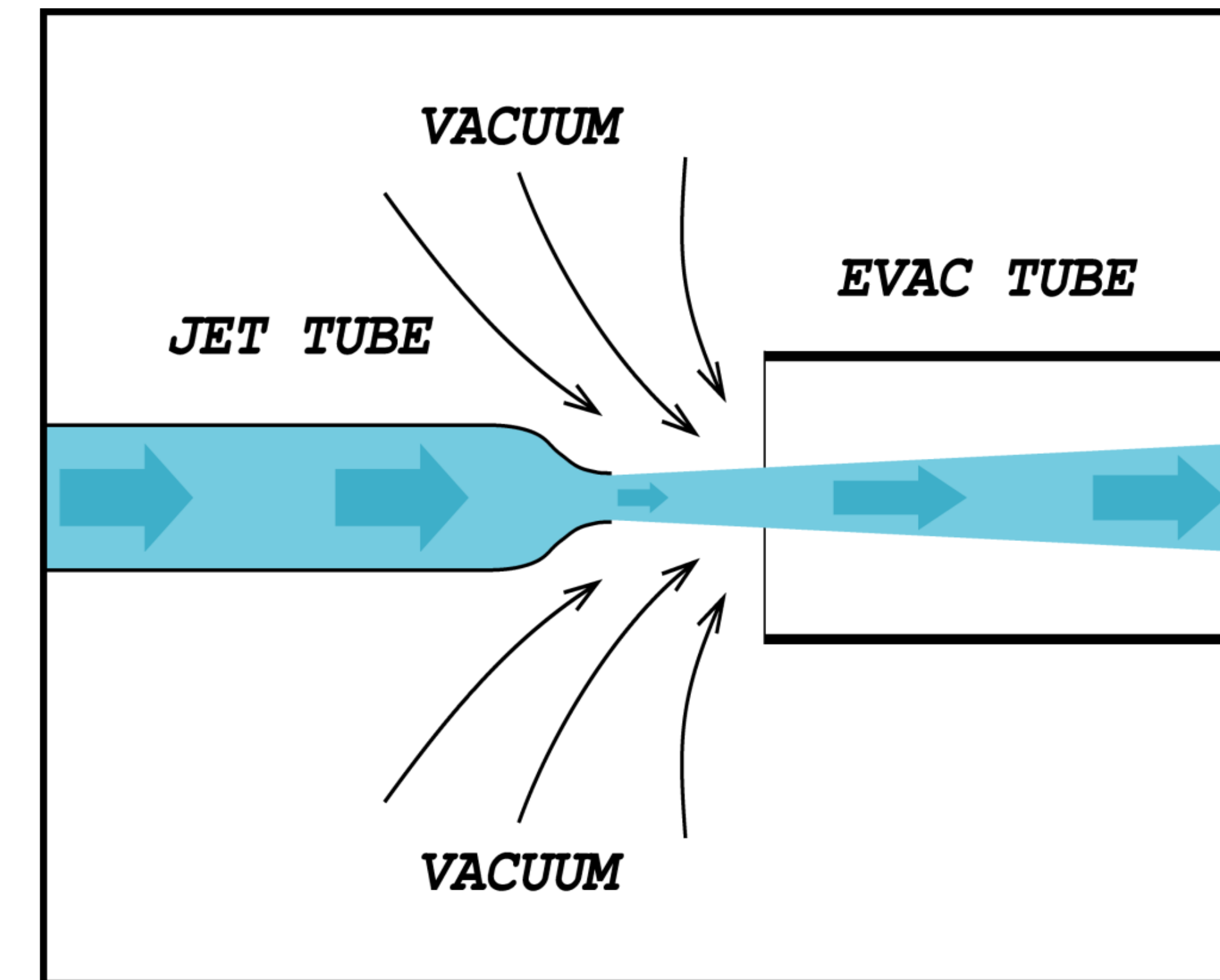
**Abstract:** *Background.* Although debridement plays a significant role in the healing of diabetic foot ulcers, it may delay the healing process by damaging the granulation tissue. In this study, the efficacy of low-frequency ultrasound (LFU) in chronic wound healing in diabetic foot ulcers in patients with osteomyelitis was evaluated. *Methods.* This randomized clinical trial was conducted on 40 patients with diabetes recruited from the Diabetic Foot Ulcer Clinic of the Endocrinology and Metabolism Research Center of Tehran University of Medical Sciences, Tehran, Iran. All patients with a grade 3 ulcer (Wagner Classification) with  $0.6 \leq$  ankle brachial index  $\leq 1.2$ , were included. Patients were divided into 2 groups; 1 group received ultrasound-assisted wound therapy (UAW) in conjunction with standard wound care ( $n = 20$ ) and the control group received only standard wound care. Patients were followed for 6 months. *Re-*



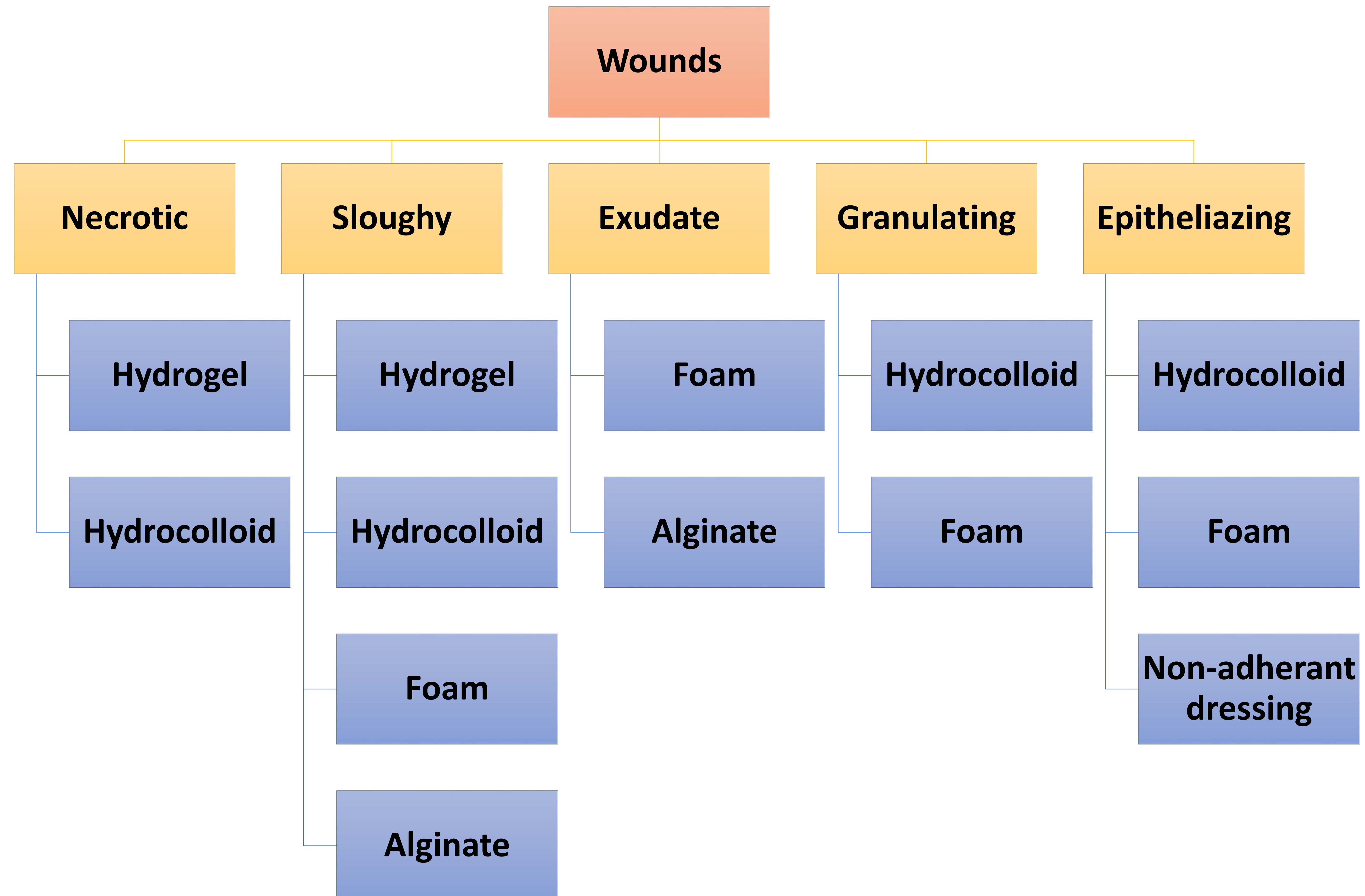


# Hydro-surgery VersaJet

- To debride wounds using a high velocity stream of sterile saline.
- The Venturi effect creates a localized vacuum across the operating window cuts and removes tissue, while aspirating debris from the operating site.



# Dressing





# Managing Moisture Imbalance

None      Low      Moderate      Heavy

**Films**



**Hydrogel**



**Hydrocolloid**



**Alginate**



**Foams**



**Negative pressure rx**



# Infection Control

# Infection Control

## Microbial Evaluation: Principals of Wound Culture



# Microbial Evaluation

Plain radiograph of the right foot of last patient Osteomyelitis of the fifth metatarsal head and the proximal phalanx of the fifth toe, **subluxation of the metatarsophalangeal joint, calcification of the digital artery between the first two metatarsals and osteoarthritis of the first distal phalangophalangeal joint of the hallux .**



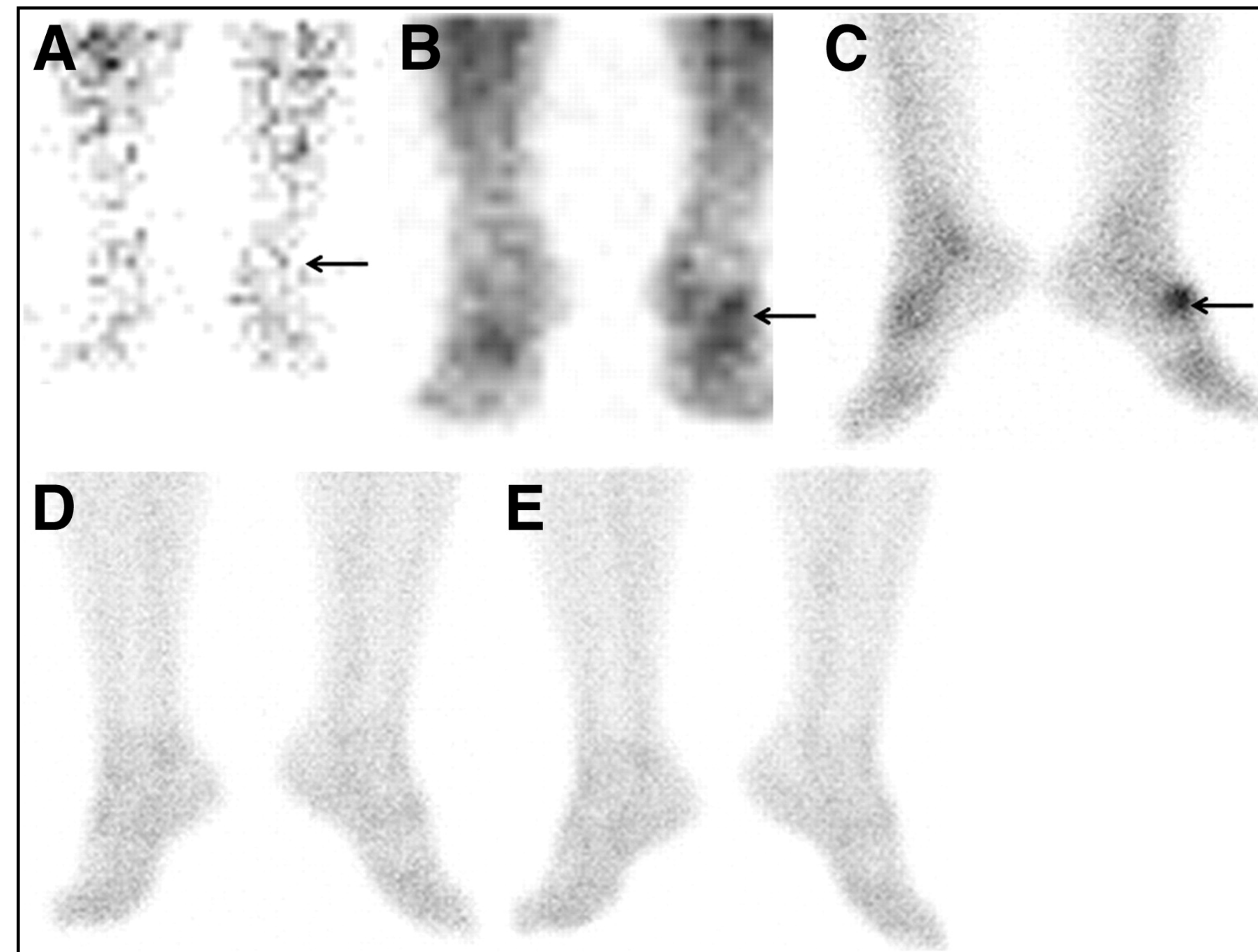
# Microbial Evaluation...

**Diabetic Foot MRI**



# Microbial Evaluation...

## Three phasic Scan



# Infection – Deep Compartment

- **Grossly visible bone or ability to probe to bone**
- **Ulcer size larger than 2 cm<sup>2</sup>**
- **Ulcer duration longer than one to two weeks**
- **Erythrocyte sedimentation rate (ESR) >70 mm/h**

# Infection – deep compartment...

## Oral agents for empiric treatment of mild to moderate diabetic foot infections

### **SINGLE-drug regimens with activity against streptococci and staphylococci (MSSA)**

Cephalexin **or**

Dicloxacillin **or**

Amoxicillin-clavulanate **or** clindamycin

### **TWO-drug regimens with activity against streptococci and MRSA**

Clindamycin\* **or**

Linezolid **or**

Penicillin **or** cephalexin **or** dicloxacillin

**PLUS**

Trimethoprim-sulfamethoxazole **or** doxycycline

# Infection – Deep Compartment...

**TWO-drug regimens with activity against streptococci, MRSA, aerobic gram-negative bacilli and anaerobes**

Trimethoprim-sulfamethoxazole

**PLUS**

Amoxicillin-clavulanate

**-OR-**

Clindamycin

**PLUS**

Ciprofloxacin **or** levofloxacin **or** moxifloxacin



# Mechanical Control

# Offloading Devices

- Casts
- Temporary shoes
- Felt padding
- Crutches
- Knee scooters
- Wheelchairs
- Zimmer frames
- Electric carts and buggies
- Insoles



# Total Contact Cast

- Efficient method to decrease forefoot plantar pressure by keeping the ankle at 90 degrees
- Can not be used in infected wounds!!



# Removable Cast Walker

- **Decreases forefoot plantar pressure by keeping the ankle at 90 degrees**
- **Can be used in infected wounds!!**
- **Acceptability is higher than TCC**





# Half Shoes

**Dissipates ground-reactive forces on the forefoot and heel by eliminating propulsive gait.**



# Felt Padding

- **Semi-compressed adhesive felt padding**
- **To divert pressures from ulcers**



# Knee Scooters

- An alternative to crutches
- Placing the weight of the body on the scooter's knee pad



# Wheelchairs

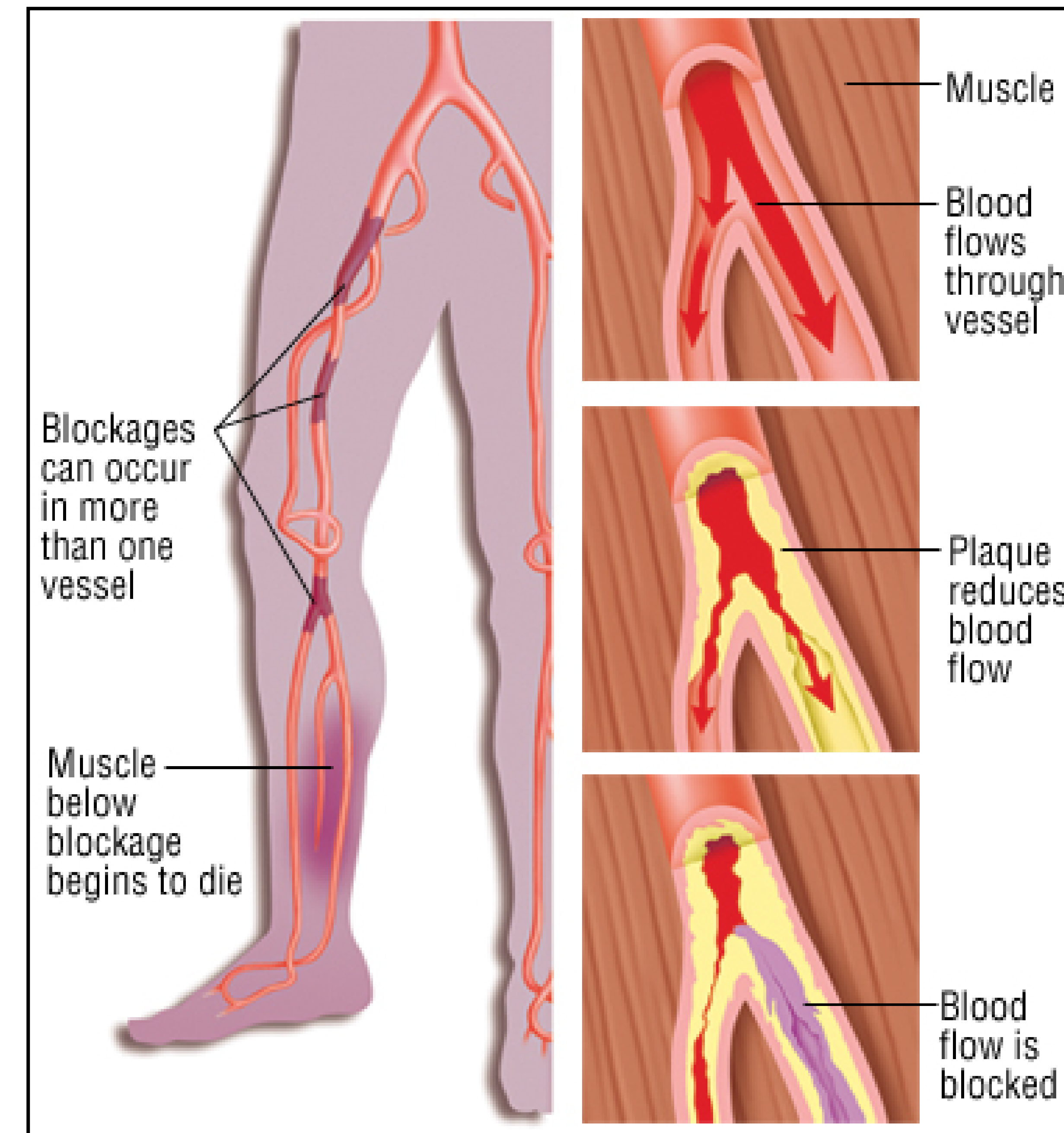
**A lightweight folding wheelchair can be of great help in achieving maximal off-loading**





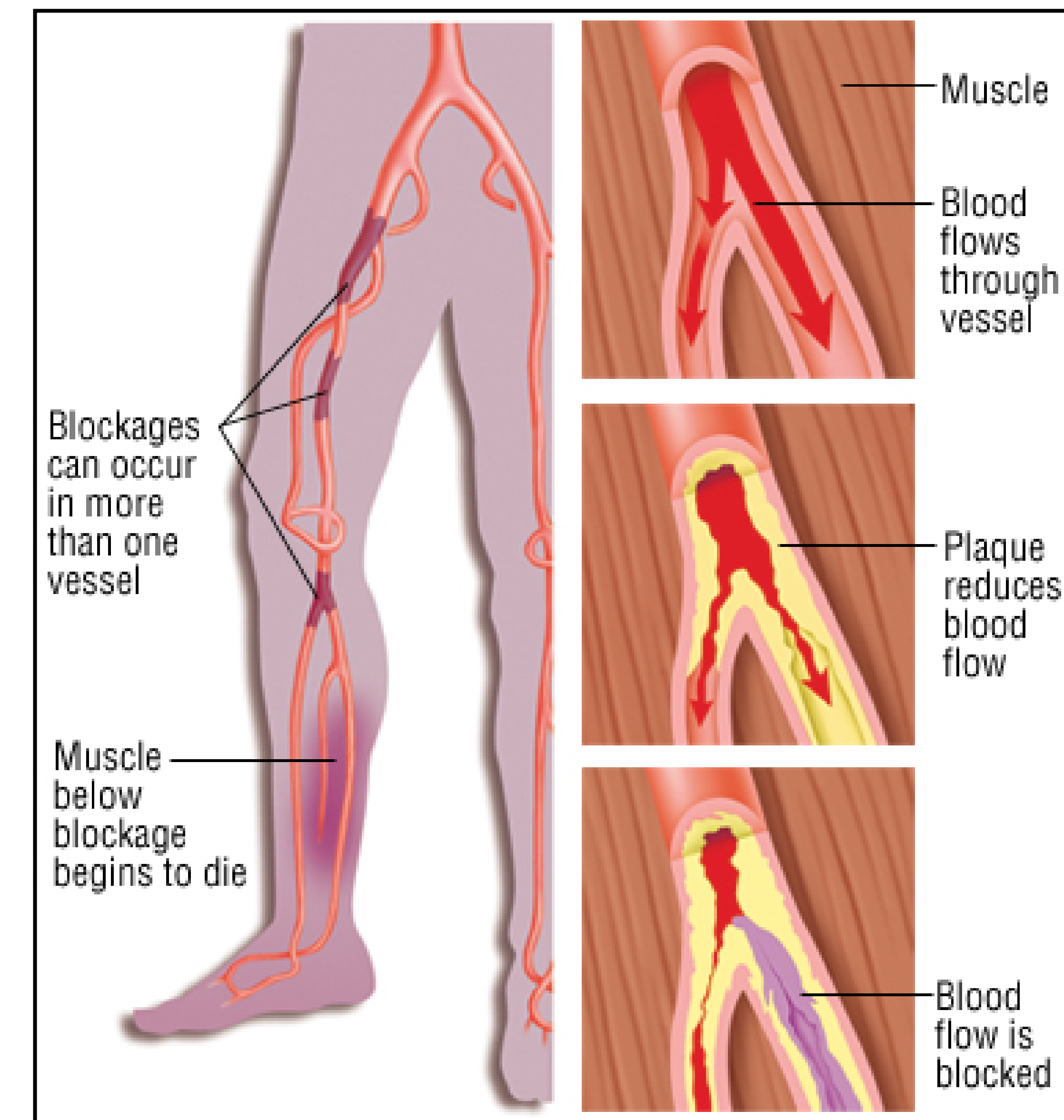
# Vascular Control

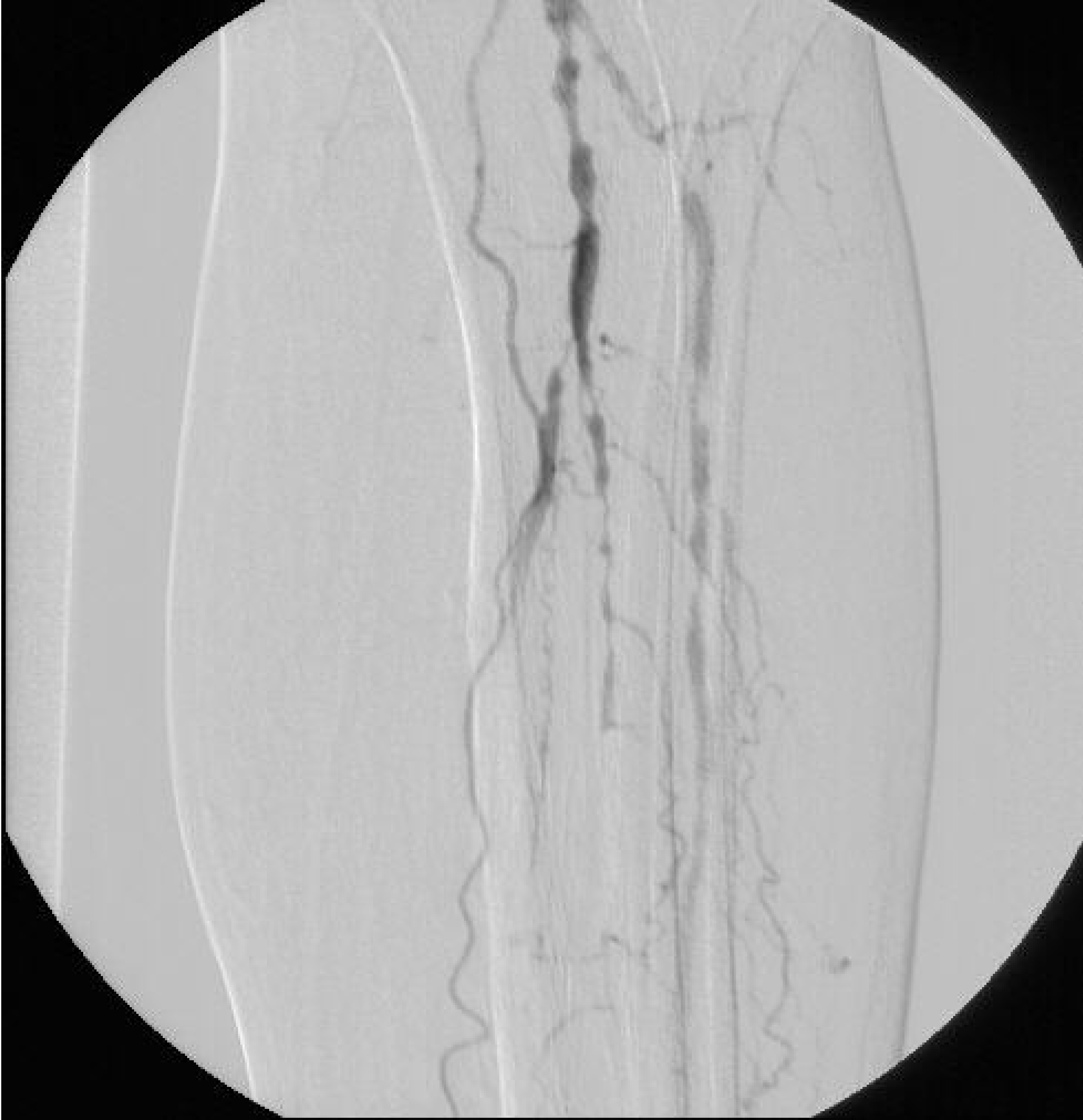
# Revascularization



# Revascularization

**Studies reported herein appear to demonstrate improved rates of limb salvage associated with revascularization compared with the results of non-revascularized patients with diabetes, PAD and ulceration**









# **Novel Treatments of Diabetic Foot**

# Novel Treatments

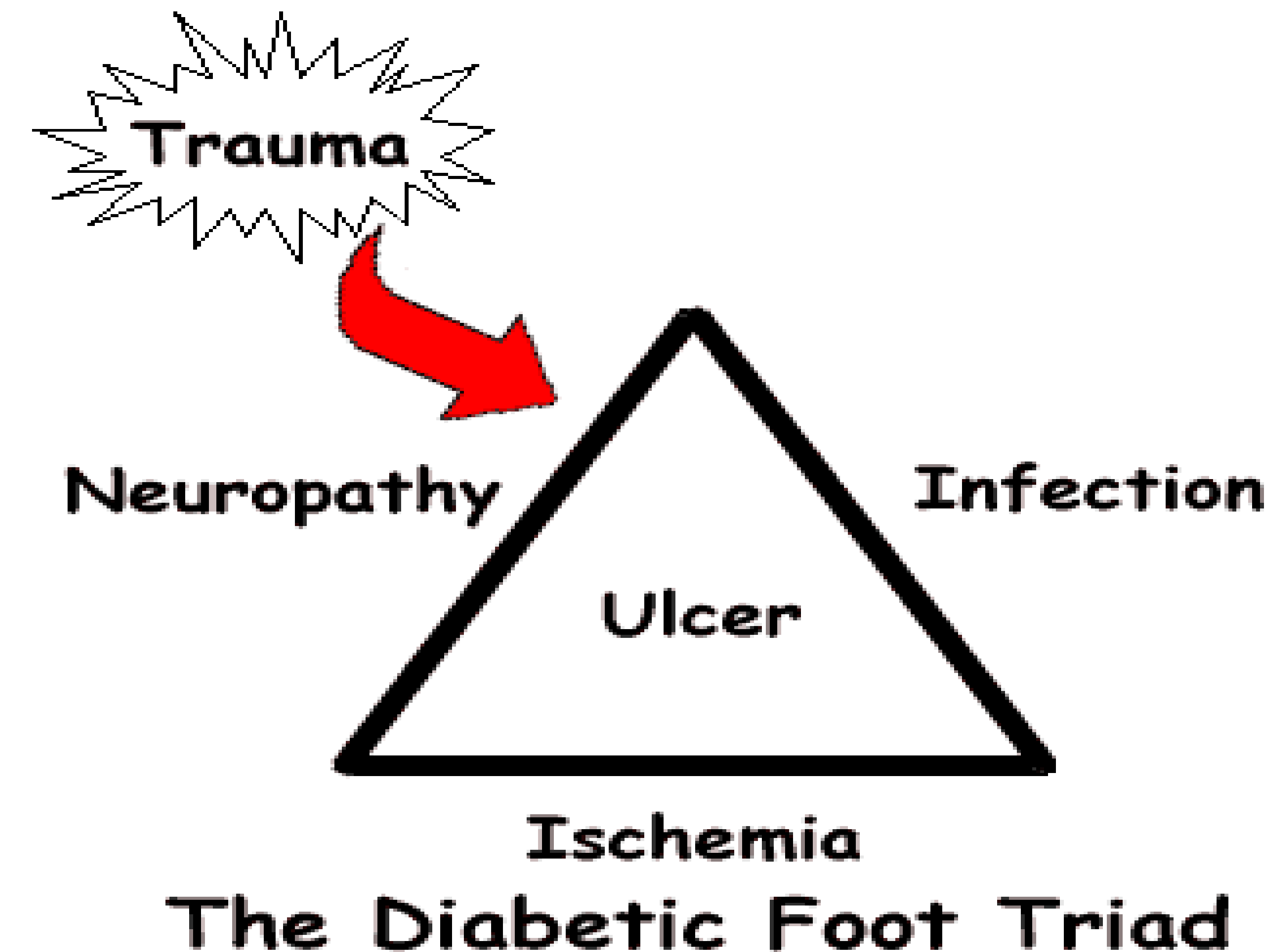
- **Hyperbaric Oxygen**
- **Ozone Therapy**
- **NPWT (Vacuum Therapy)**
- **Laser Therapy**
- **Shockwave Therapy**
- **Cold Plasma**
- **Skin Graft**
- **Bioimplant**
- **Plasma Rich Platelet (PRP)**
- **Stem Cell Therapy**
- **Herbal Therapy**



# Etiology

- DFUs usually result from two or more **risk factors** occurring together.

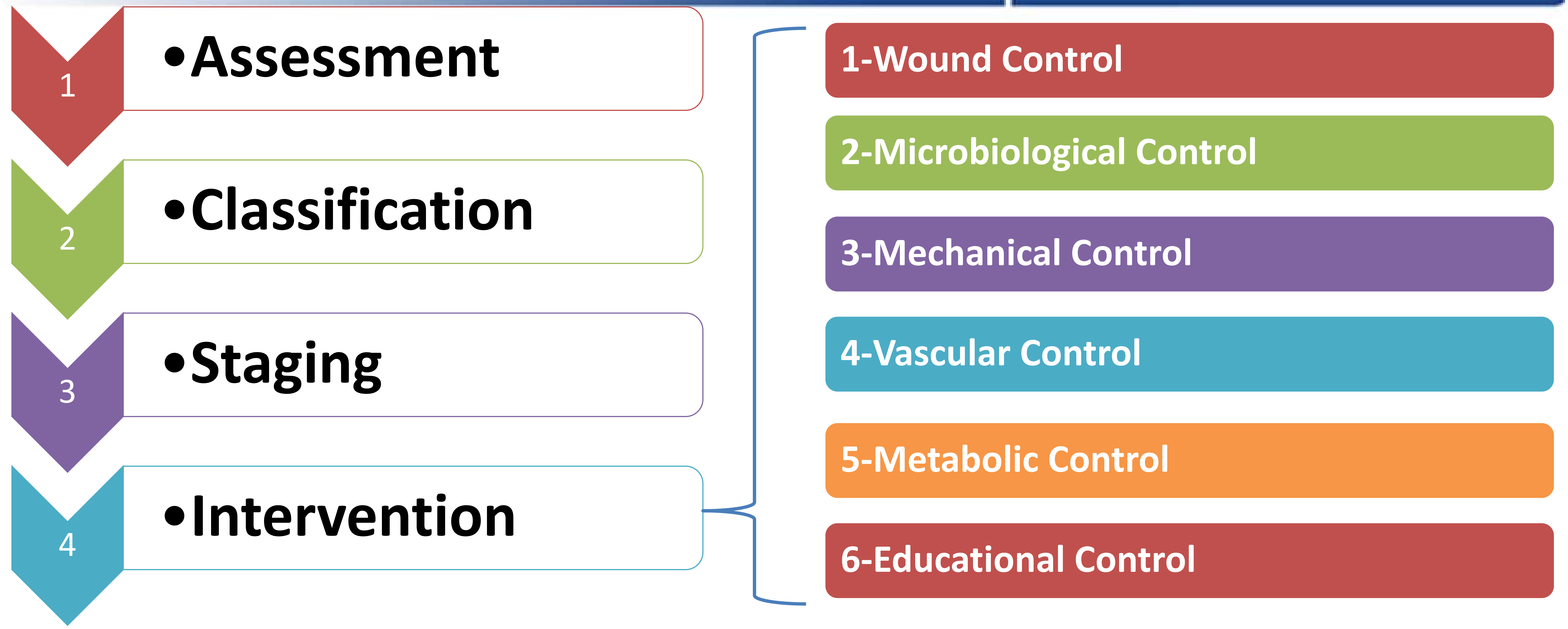
1. **Neuropathy**
2. **Ischemia**
3. **Infection**
4. **Trauma**
5. **Deformity**
6. **Callus**
7. **Edema**





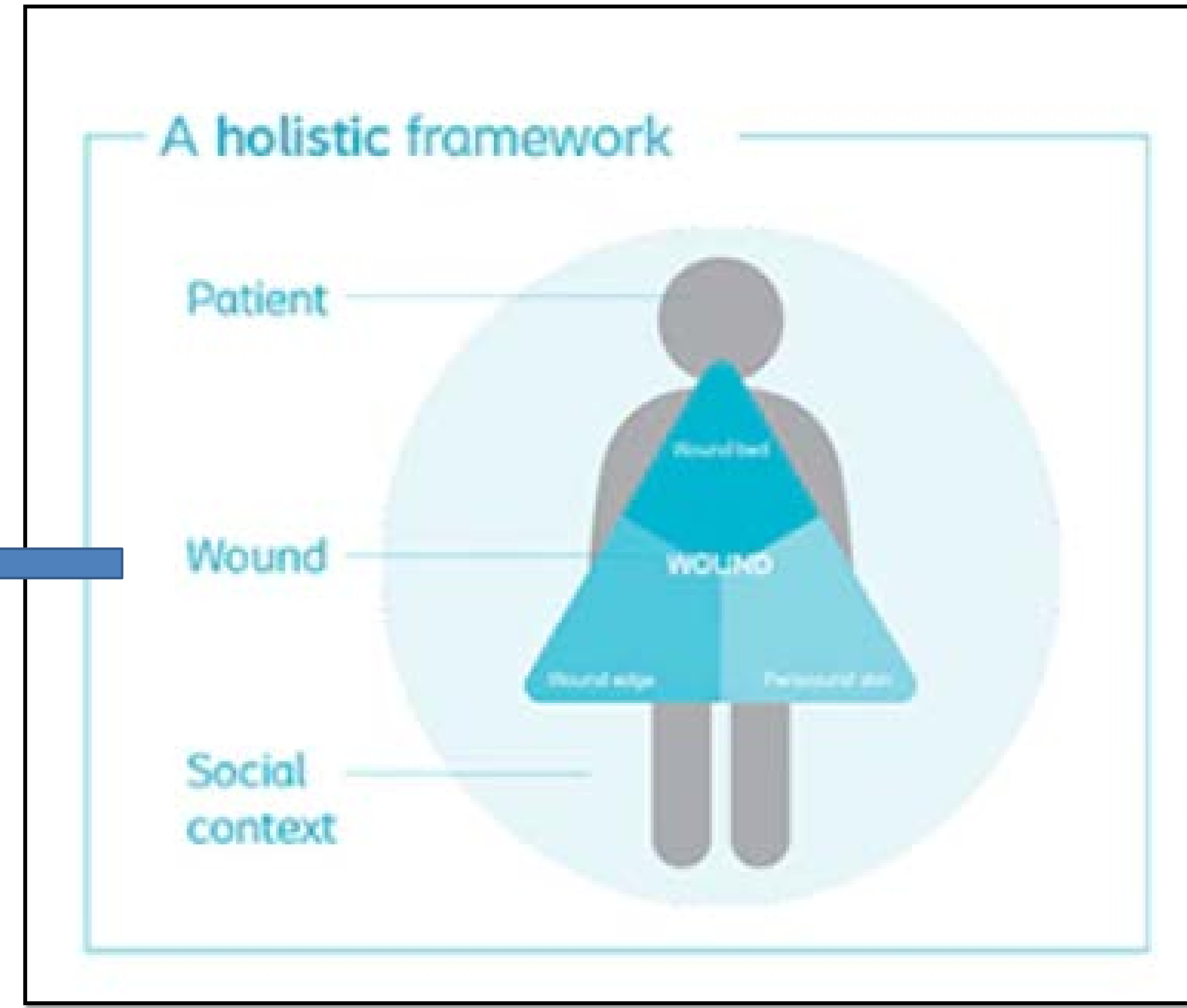
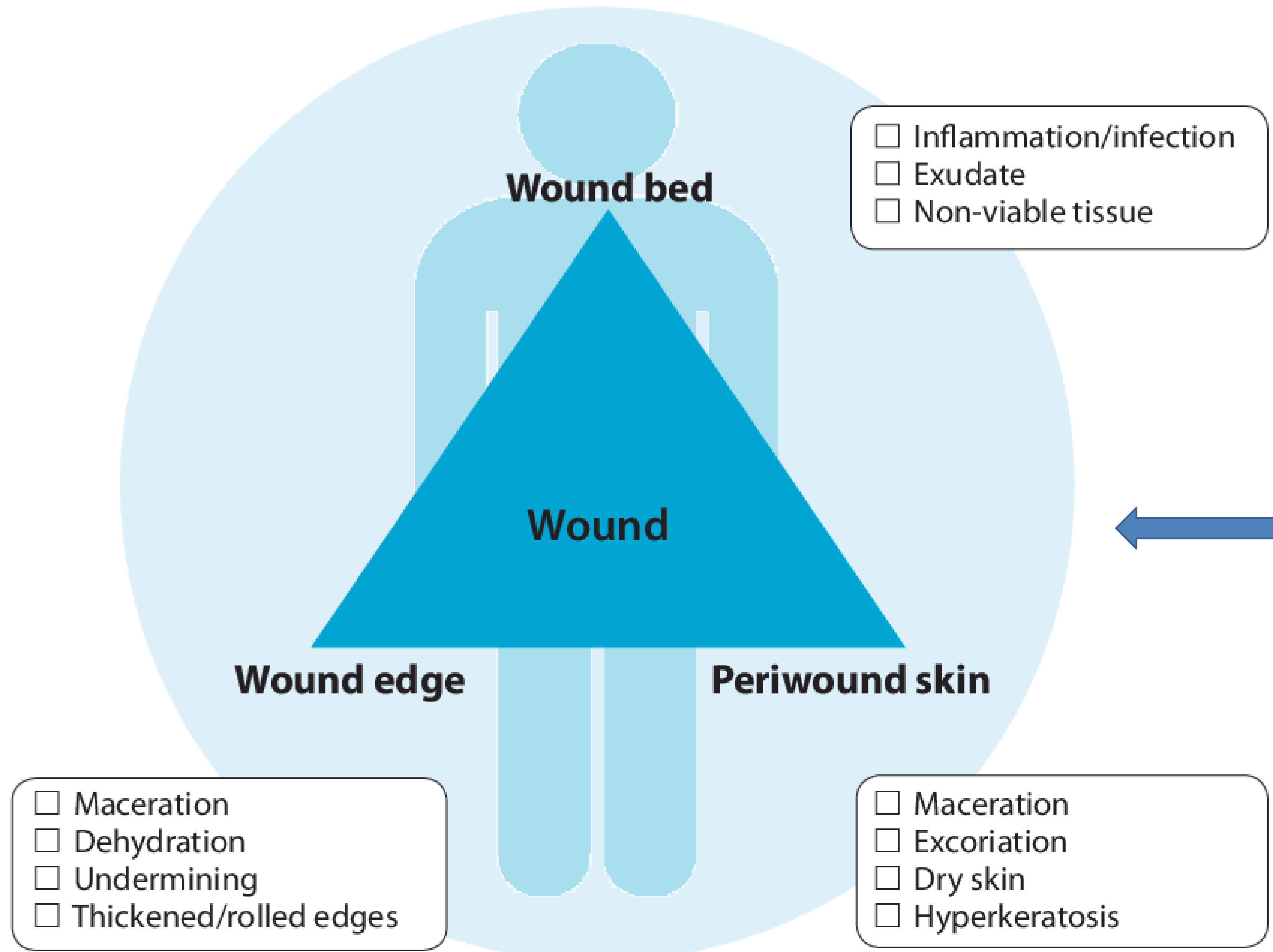


# Advanced Management of Diabetic Foot





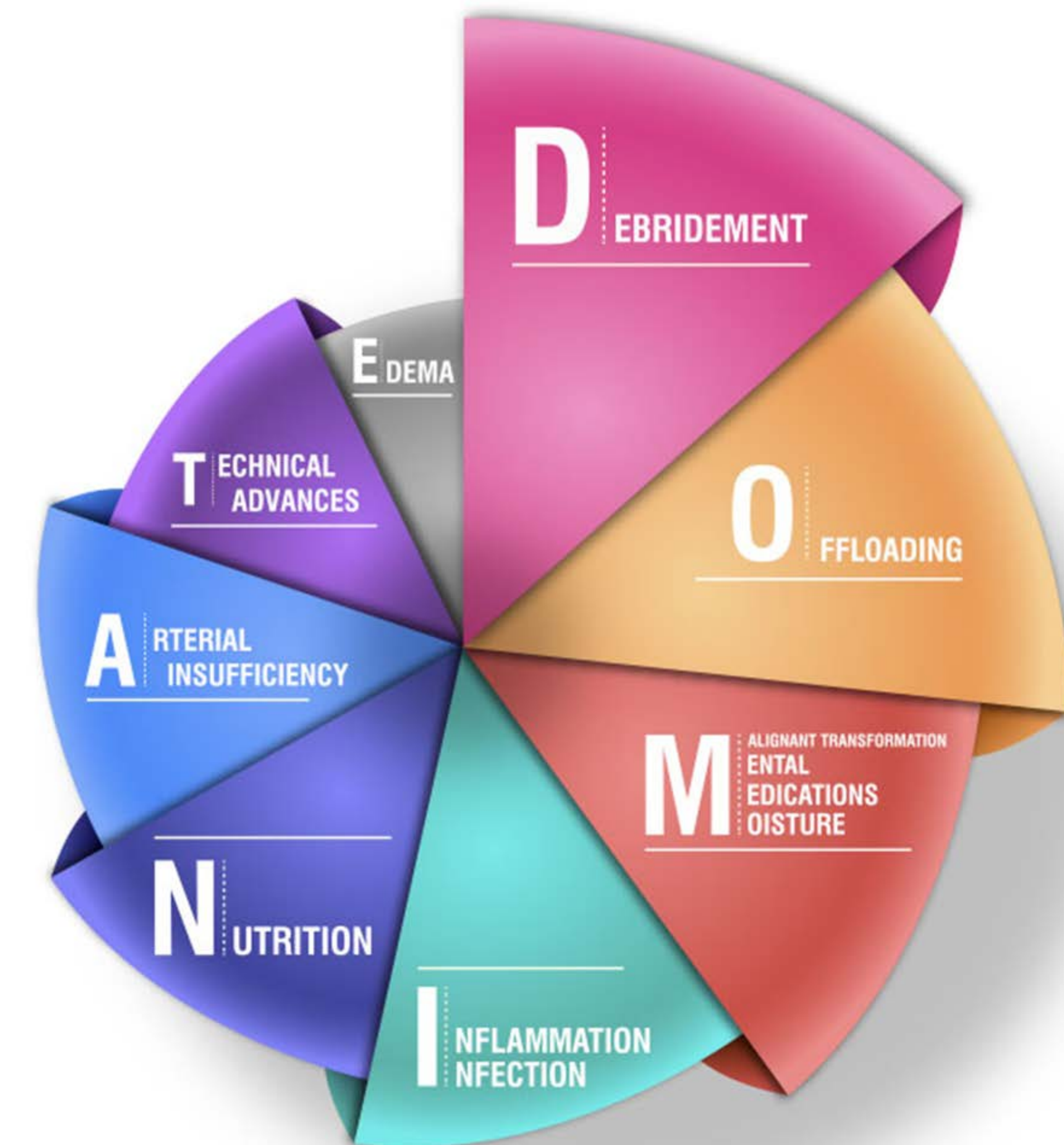
# Wound Control





# Care Plan

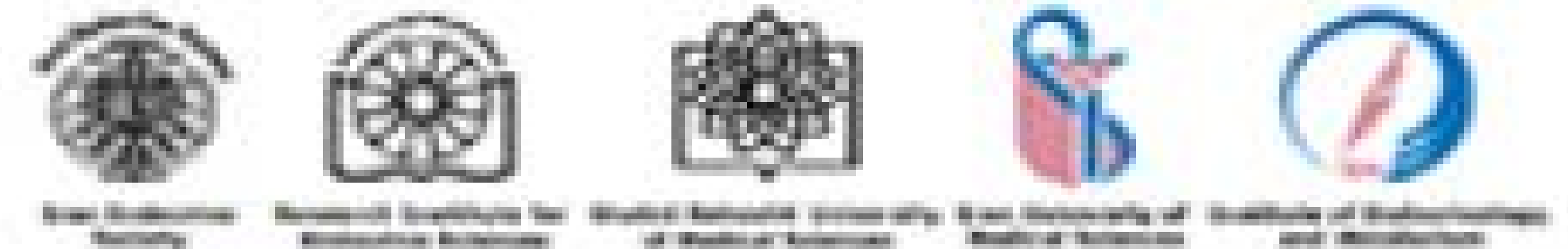
- The care plan is developed according to the **DOMINATE** management system.







# Debridement



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- Removal of nonviable tissue that impedes healing by means of mechanical and cleaning techniques.







# Offloading

- It eliminates wound stress and trauma which interfere with healing with a 1.5cm thick **pad** and **walking devices**.
- Appropriate **shoes** with anterior offload should be used.





# Moisture

- Control of chronic **exudates** by proper absorbent dressing.





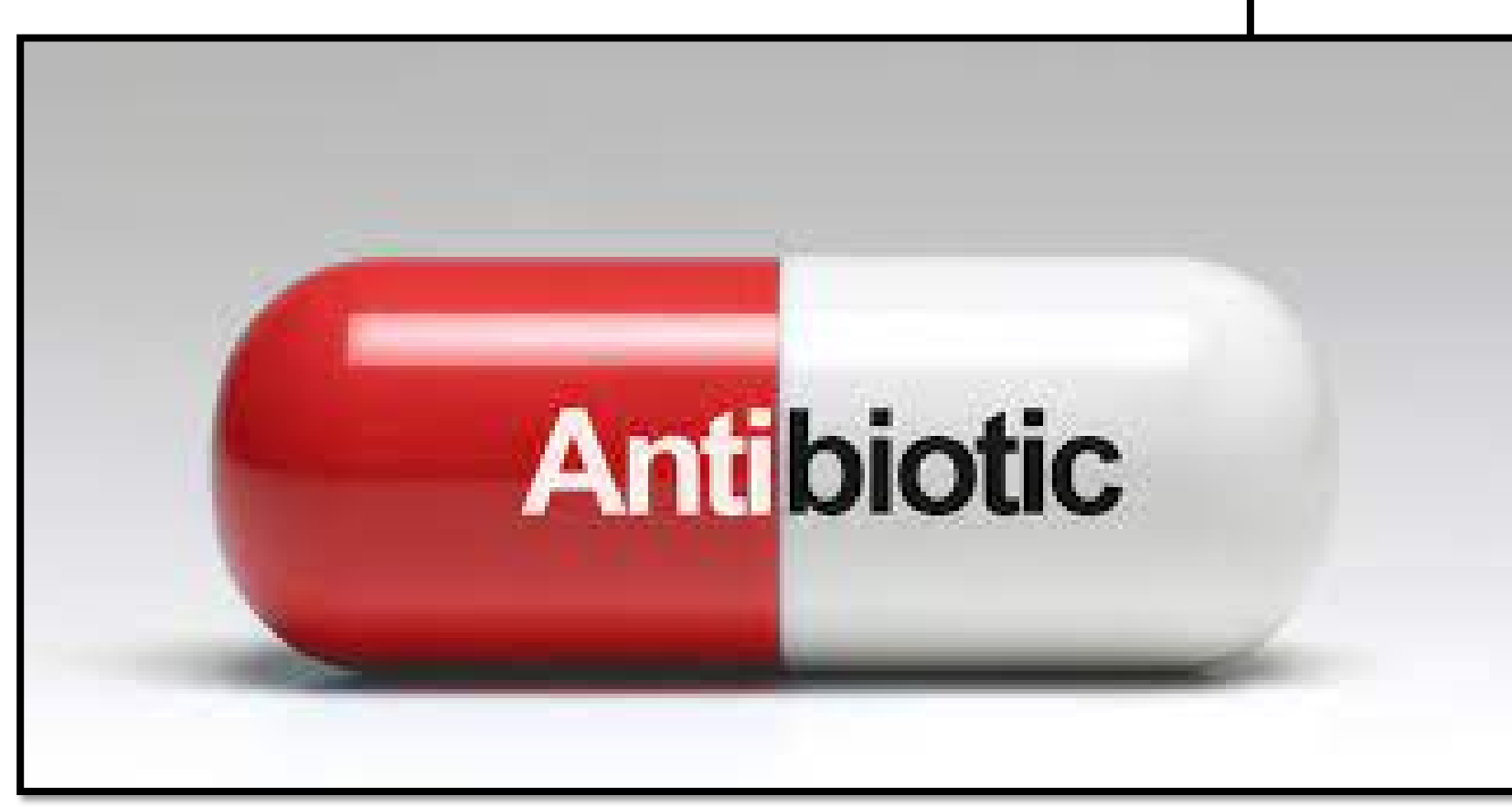


# Infection, inflammation

- Control of infection, identification of infection signs, antimicrobial therapy such as polyhexanide-betaine solution (**Prontosan**<sup>®</sup>), cadexomer iodine (**Iodosorb**<sup>®</sup>).

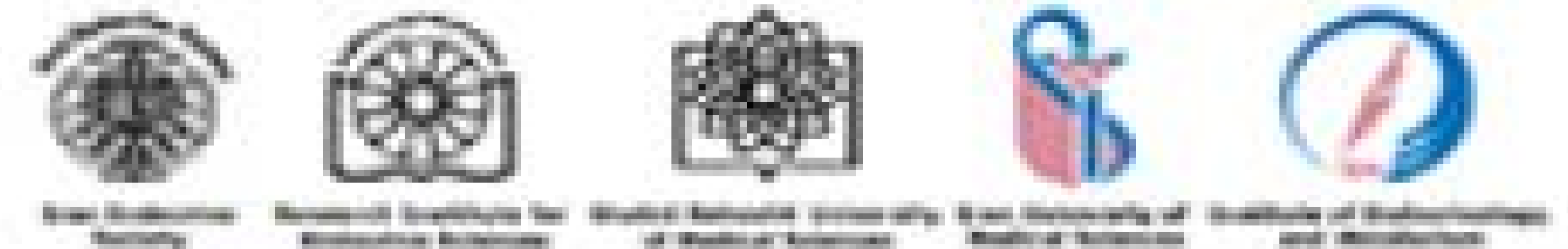


- Wound culture and **systemic antibiotics** under medical prescription



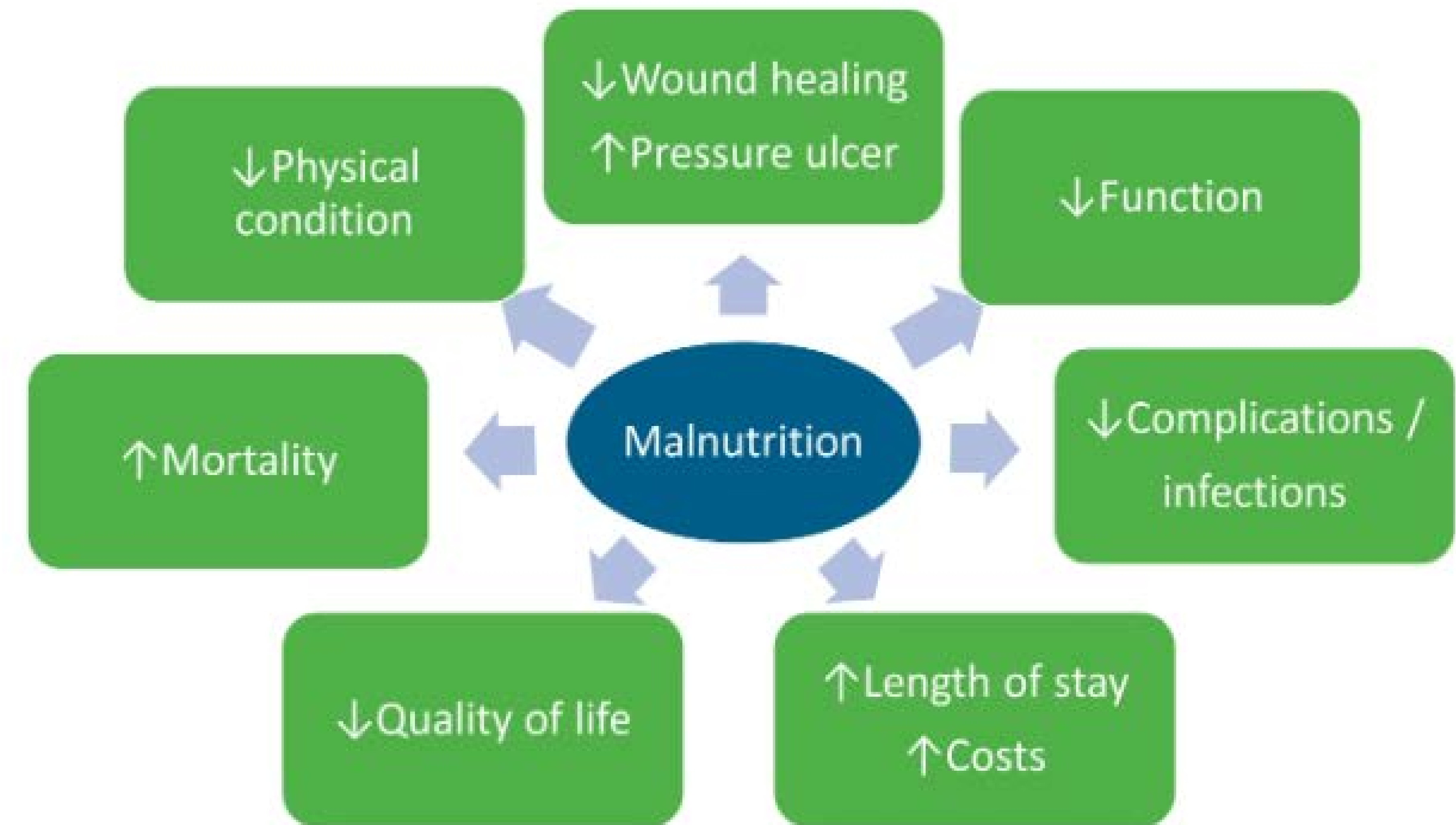


# Nutrition



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- Identification of **malnutrition**, correction of deficits and early referral to dietitians.

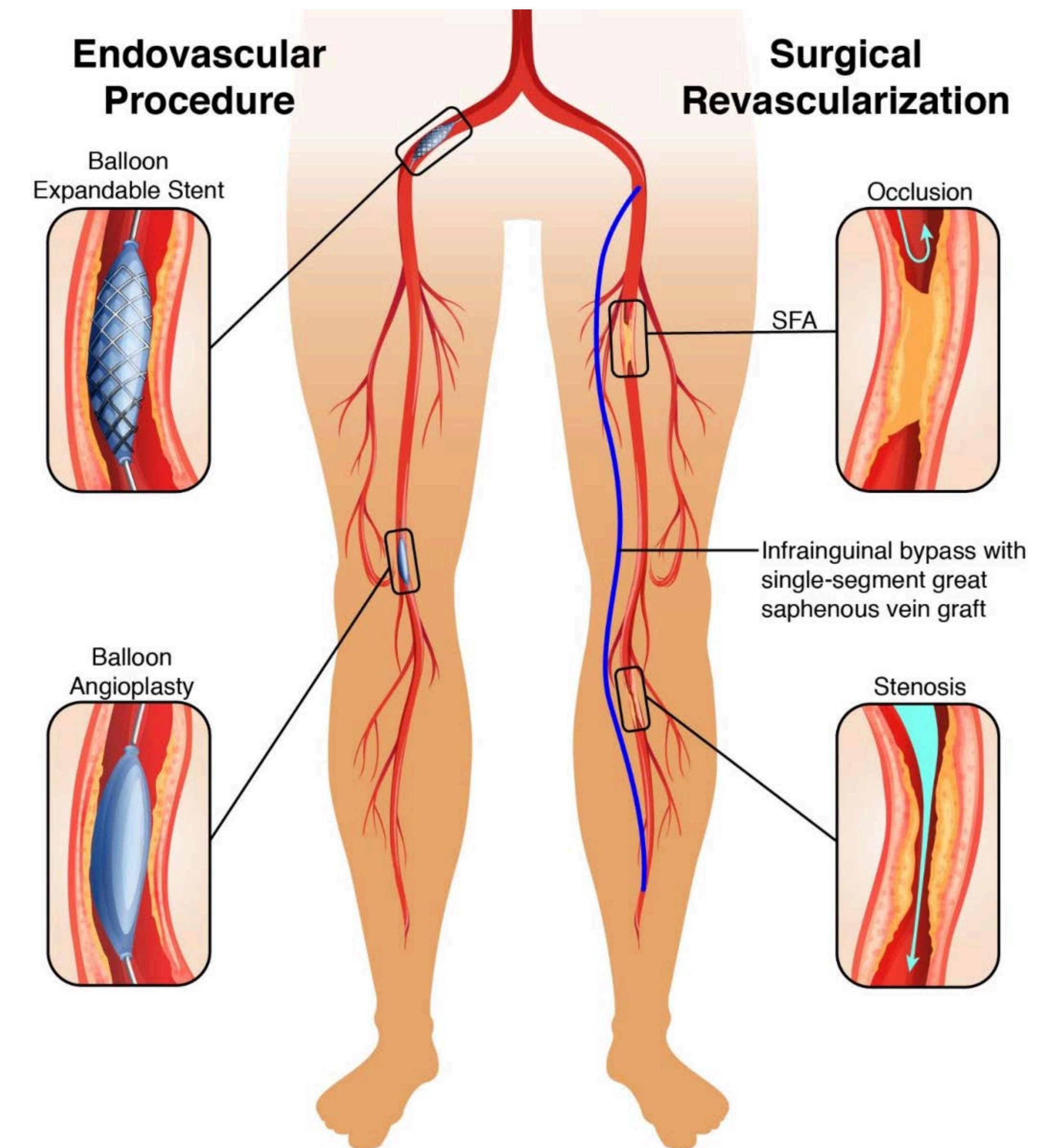






# Arterial insufficiency

- weak pedal and posterior tibial pulses in the right foot and absent in the left foot.
- Referral to specialist (vascular surgeon) to assess potential **revascularization**.

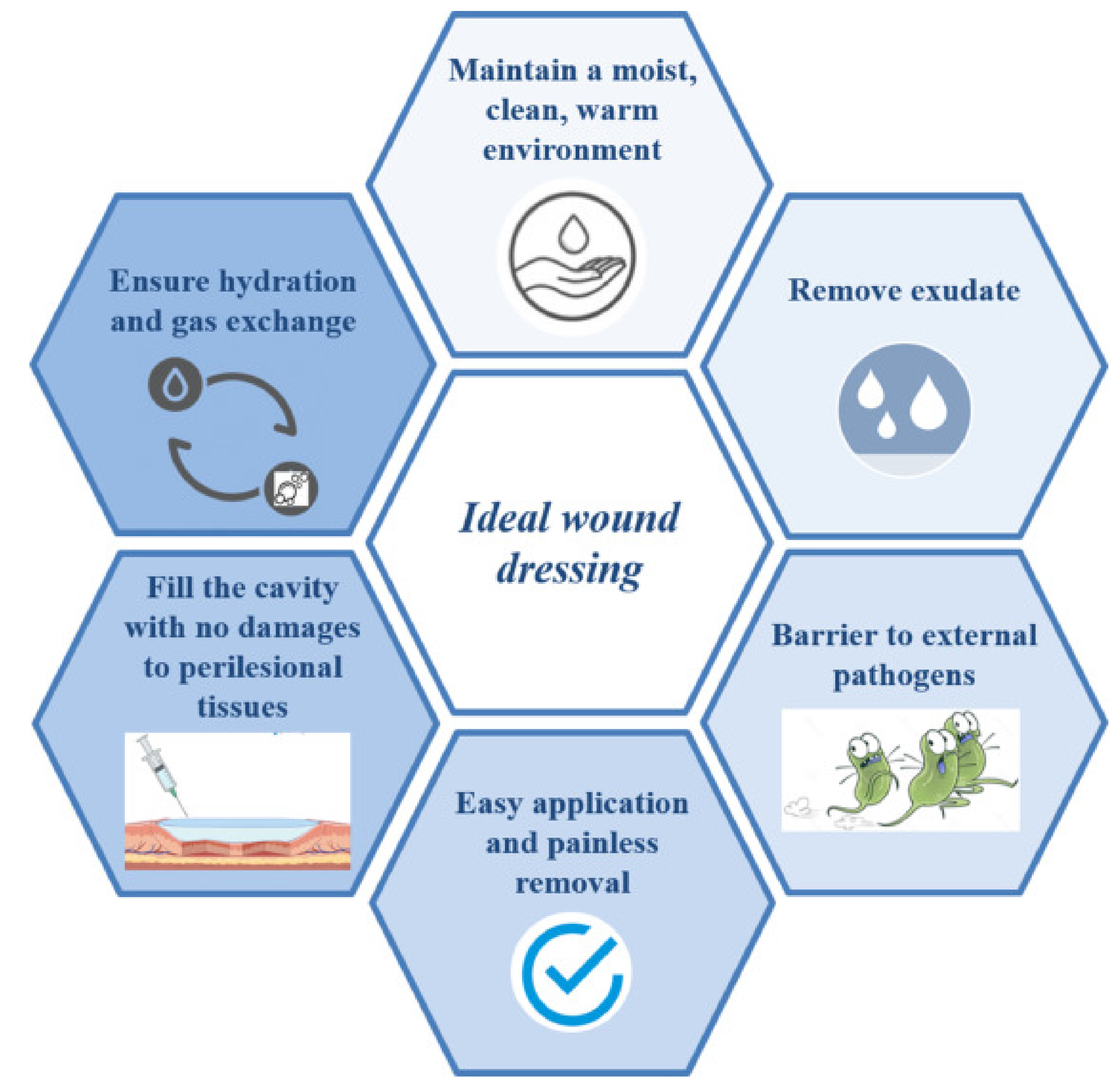






# Technical advances

- **Moist control** with daily cures and moist-free products.





# Edema, Education, Empowerment

- **Control of edema.** The patient will exercise his lower limbs while avoiding weight bearing (cycling, strengthening lower limb muscles), low-elasticity multi-layer bandage.
- **Education:** on his disease
- **Empowerment:** He is notified that without his cooperation good results are difficult to achieve.





# Care Plan

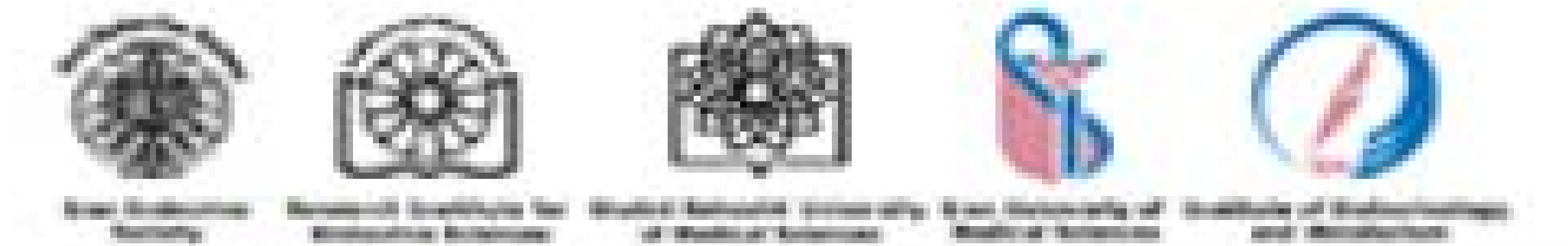
- **Venous hypertension** : The main basis of treatment is control of Venous hypertension should be treated with **compression** by means of a low-elasticity **multilayer bandage**.







# Result



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**Right foot:** four months after treatment initiation



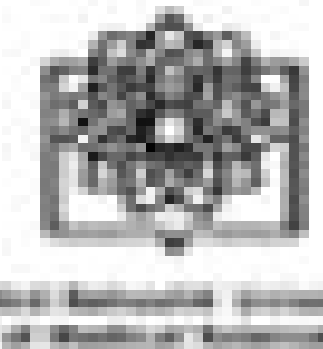
**Left foot:** four months after treatment initiation



# Summary

1. The main purpose of presenting this clinical case is to show the importance of **etiological diagnosis** and taking into account **all factors** within a diabetic foot ulcer.
2. A **delayed etiological diagnosis** can lead to chronic ulcers with a **potential risk for both the limb and the patient.**





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**Thank  
You**

