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Advancing foot and ankle medicine and surgery

THE DIABETIC FOOT

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Risk factors

- Vascular status
- Neurologic changes
- Infection
- Protein deficiency/Nutrition
- Musculoskeletal deformities
- Biomechanical challenges

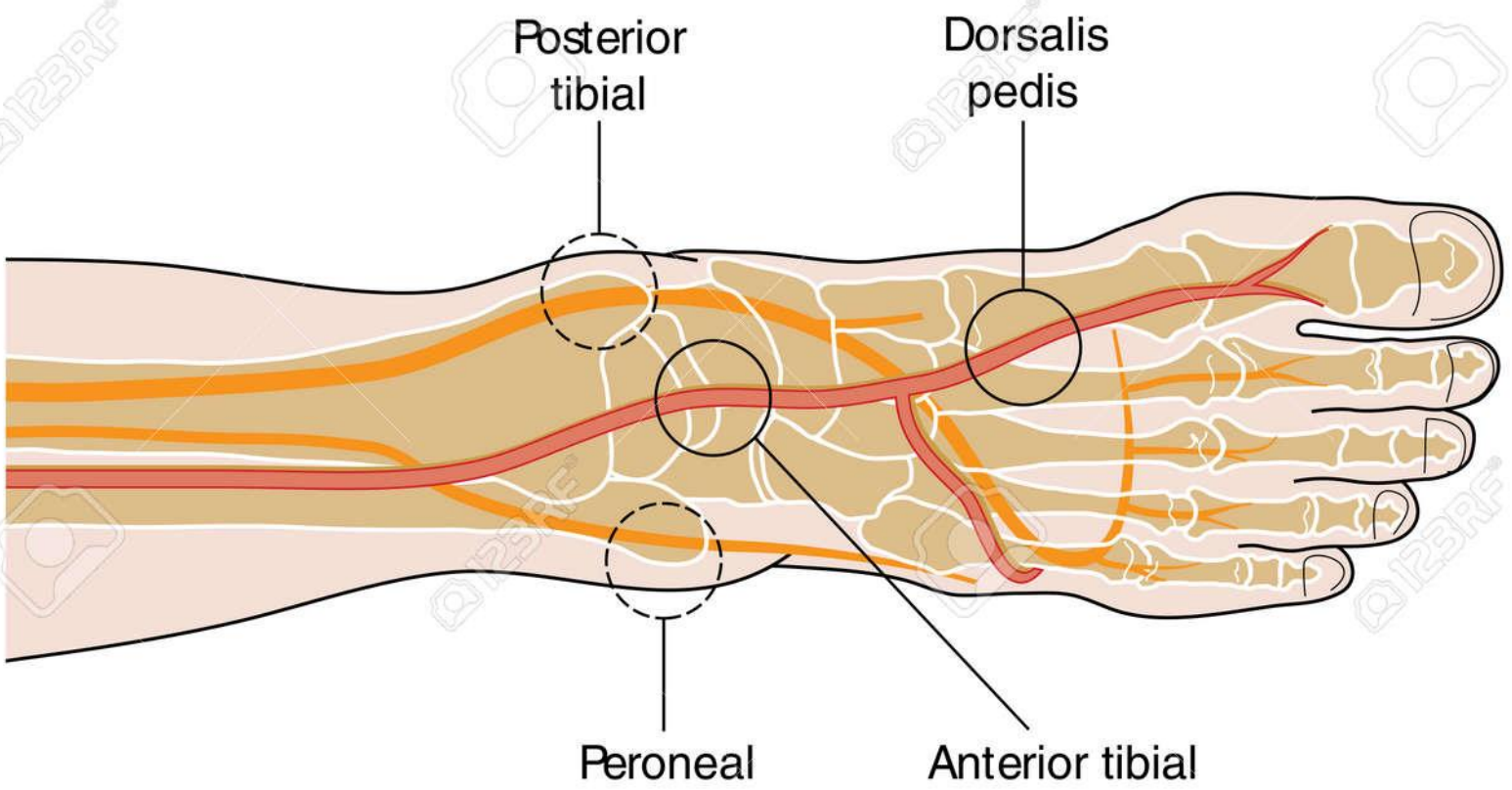
Vascular risks

- **Peripheral arterial disease**
  - **-Affects over 12 million people in the US**
  - **-increased risk with diabetes and smoking**
  - **-African Americans and Hispanics with diabetes are at higher risk.**
  - **-Smokers tend to have more proximal disease**
  - **-Diabetics have distal disease (below the knee)**
  - **-In a recent study 29% of Diabetics patients >50 have PAD.**

Studies

- Palpate pulses, Capillary fill time
- Doppler
- ABI
- Segmental Pressures
- CT angiogram

Vessels of the foot



Is palpation good enough?

Not good!

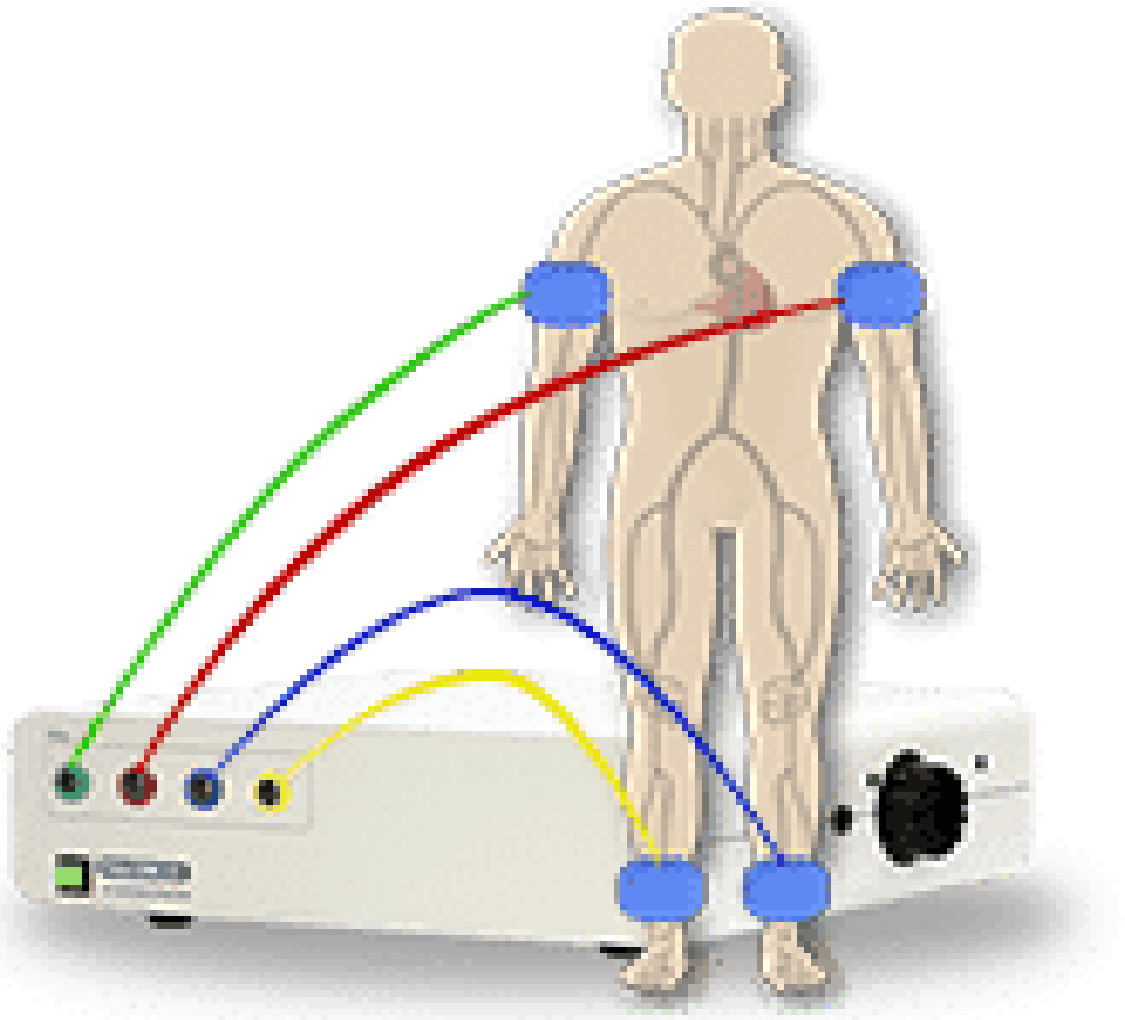
Also not good!

Duplex Doppler

What should I be listening for?

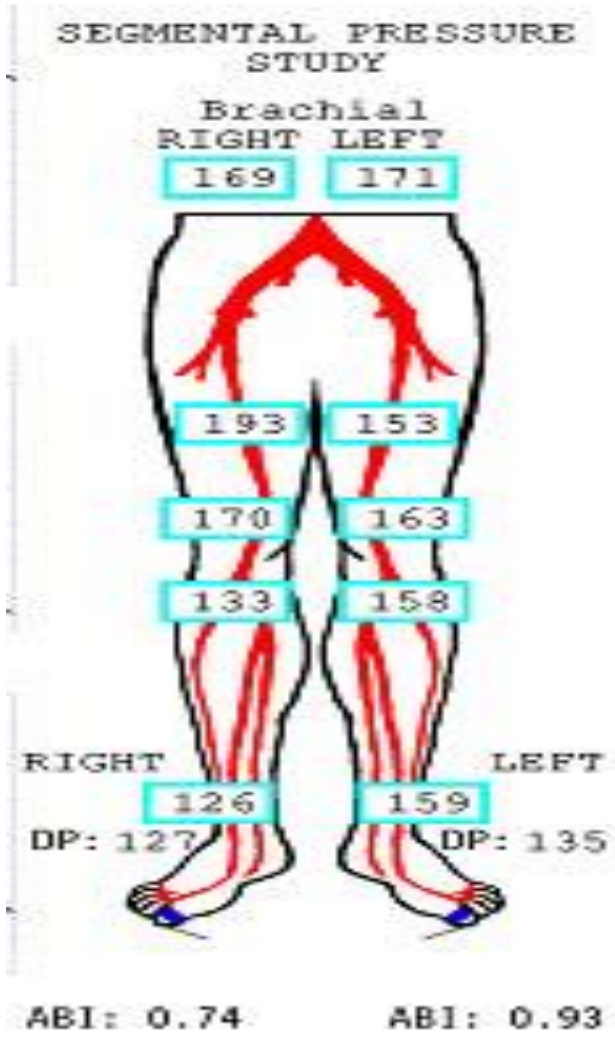
- High pitched triphasic vessel sounds are the norm
- Biphasic sounds are indicative of mild disease
- Low pitched monophasic vessels indicate moderate disease at some level
- Absent sounds are ominous

ABI



ABI exam ankle portion

Segmental pressures



exam

CT angiogram

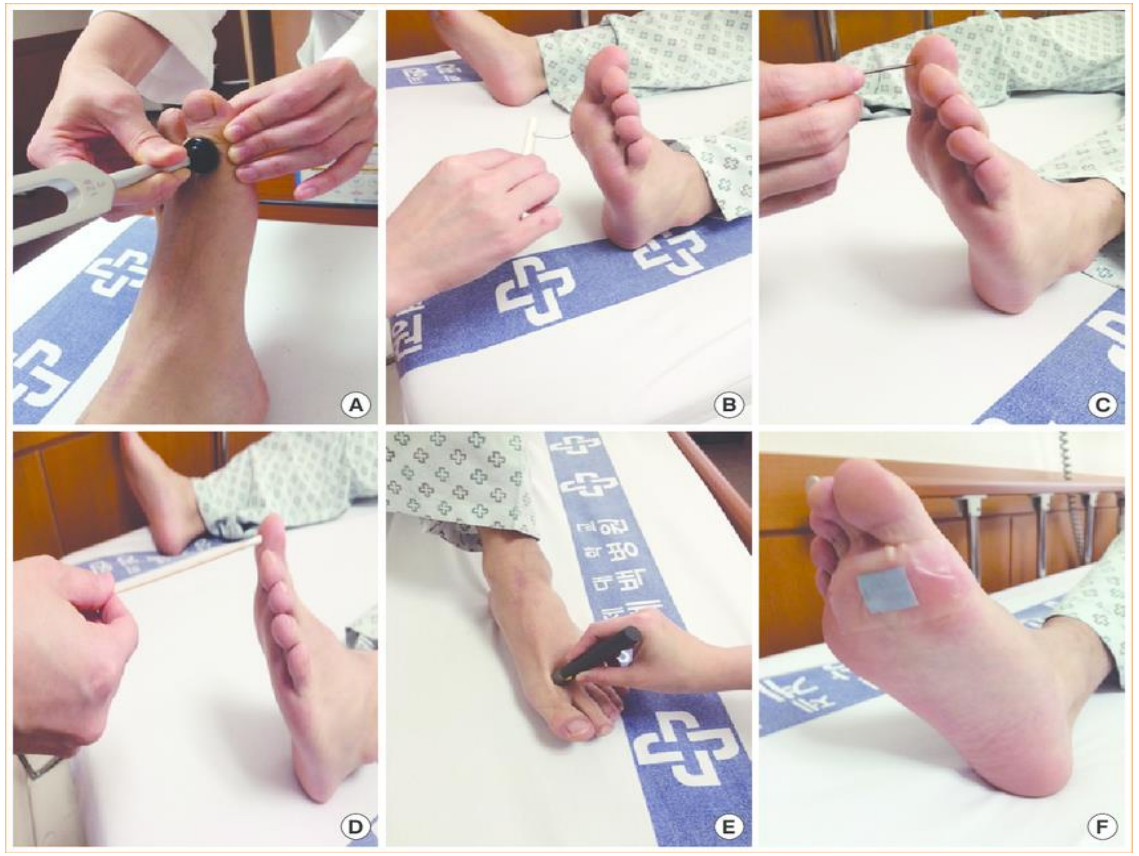
Grandch

Neurologic exam

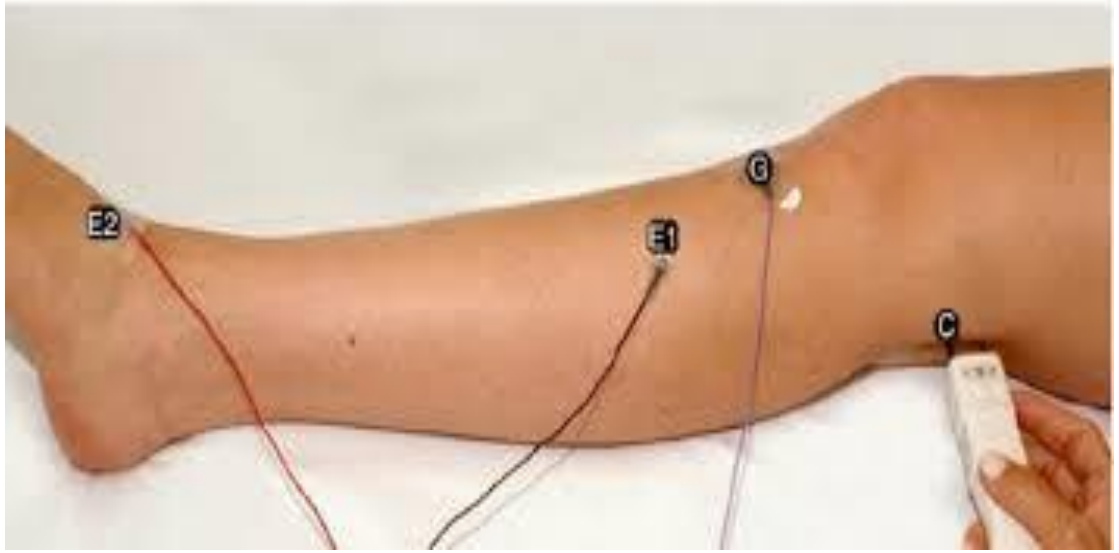
- 5.07 semmes Weinstein
- Vibratory
- Sharp/dull
- Hot/cold
- Reflexes
- NCS
- Biopsy

5.07 Semmes Weinstein

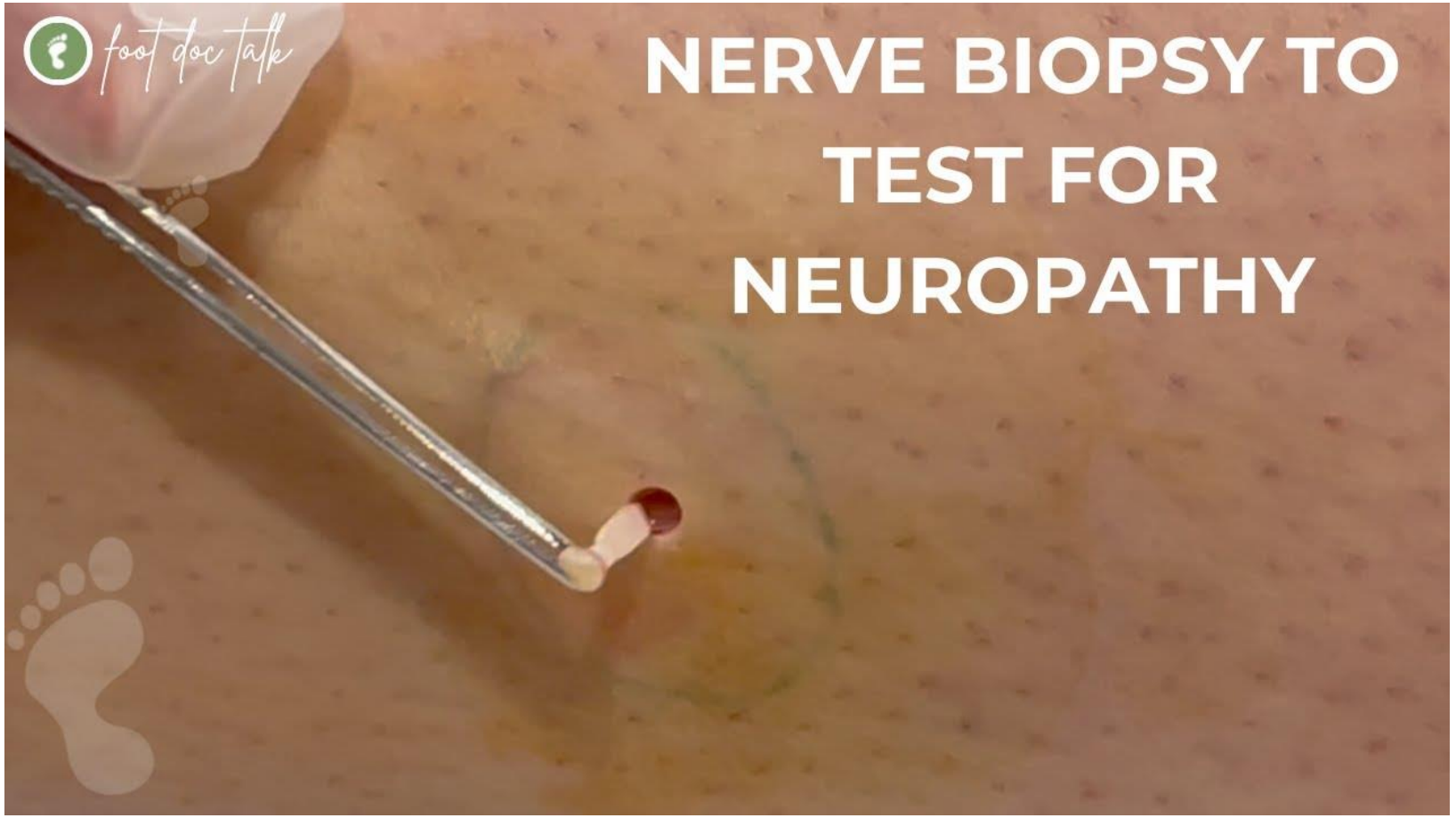
Vibratory testing, sharp/dull, hot/cold



Nerve conduction



Nerve biopsy



Why it matters

- **Diabetics with Peripheral Neuropathy will not have symptomatic Peripheral Arterial Disease. This leads to critical limb ischemia and a much higher risk of limb loss.**

Infection

- **Bacteria and/or fungal**
  - Aerobic
  - Anaerobic
  - Fungal
    - Deep wound cultures should be obtained.
    - Saline lavage the wound and then put the culture tip in the deepest part of the wound.
    - Consider acute or chronic osteomyelitis
      - X-rays
      - Bone biopsy
      - MRI

Foot Deformities

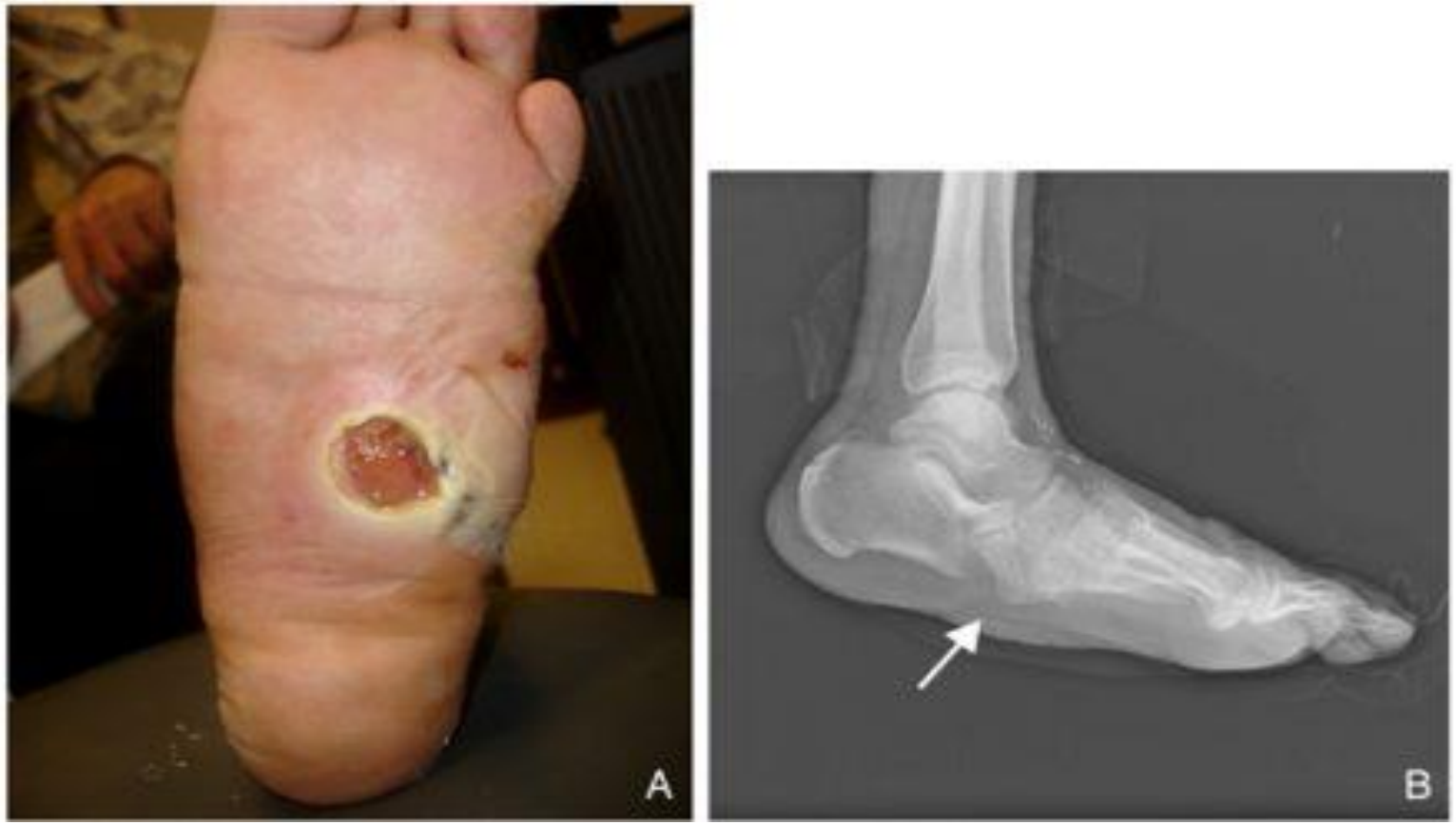
- Hammertoes
- Bunions
- Cavus
- Planus
- Equinus
- Hallux Rigidus

Hallux Valgus

Cavus foot

Pes planus

Charcot



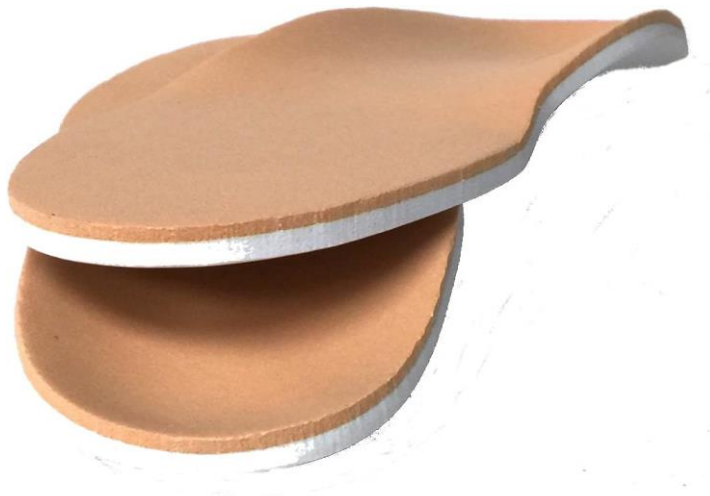
Hallux hammertoe

Diabetic Ulcer

- **Diabetic ulcer**
  - An open sore or wound that most commonly occurs on the foot
- **Causes**
  - Elevated blood glucose
  - Neuropathy
  - Uncontrolled blood pressure
  - Poor nutrition
  - Prolonged pressure
  - Friction

TMA with abnormal forefoot pressure

Diabetic shoes with MD insoles



Vascular/Gangrene

- Gangrene occurs when tissue dies (necrosis) because its blood supply is interrupted.
- Gangrene may be caused by an infection or injury or be a complication of a long-term condition that restricts blood circulation.

Trauma (accident)

- High-velocity blunt trauma
- Low-velocity blunt trauma
- High-velocity penetrating trauma
- Low-velocity penetrating trauma
- Thermal/Chemical injuries

Treatment/Prevention

- Nutritional support
- Debridement
- Orthotic supports
- Off-loading
- Wound V.A.C. system
- Skin grafts (autografts and allografts)
- Flowable soft tissue scaffold
- Topical wound-healing agents

Nutritional Support–Protein

- Protein deficiency is a major factor in the healing of ulcers.
- Protein is necessary for fibroblast proliferation, new blood vessel formation, and collagen production.
- Depending on the severity of the wound, protein consumption should range from 0.55 to 0.84 grams per pound of body weight per day.
- Consult a nutritionist for the proper amount of protein consumption.

Nutritional Support (Vitamins/Minerals)

- **Vitamin A**
  - Increases collagen synthesis and wound tensile strength along with lymphocyte activation
- **Vitamin C**
  - Increases skin strength and fibroblastic content of scar tissues
- **Vitamin E**
  - Anti-inflammatory action decreases the production of prostaglandins
  - Enhances the immune response and breaking strength of post-operative wounds
- **Zinc**
  - Stimulates wound healing and increases collagen tensile strength

Debridement

- **Goals of debridement**
  - Remove potential pathogens
  - Remove necrotic and fibrous infiltrates

Debridement

- **Forms of Debridement**
  - "Cold steel"
    - Scalpel, curette, rongeur, tissue nippers
  - Mechanical
    - Wet to dry dressings, pulse lavage
  - Enzymatic debridement

Wound V.A.C. System

- **Goals of V.A.C. System**
  - Promote granulation and tissue perfusion
  - Remove infectious material
  - Draw wound edges together

- **Applications**
  - Diabetic wounds
  - Pressure ulcers
  - Skin grafts
  - Infected wounds

Skin Grafts–Autografts

- **Traditional Skin Graft**
  - Tissue usually removed from the thigh, leg, or buttocks on the same person
- **Glabrous Skin Graft**
  - Tissue usually removed from the medial arch of the foot
  - Replace “like” with “like”

Skin Grafts–Allografts

- Tissue removed from one person and transplanted to another person
- Closes a wound by providing a barrier against infection and fluid loss
- Reduces pain and promotes the healing of underlying tissues

Skin Grafts–Allografts

- **Dermagraft**
  - Dermal substitute
  - Utilization—promote granulation and the “filling” of the wound bed
  - Derived from fetal foreskin
- **Apligraft**
  - Epidermal/dermal bi-layer
  - Utilization—promote granulation and epithelialization
  - Derived from fetal foreskin
- **Epi-fix**
  - Harvested from umbilical cord
  - Growth factors
  - Utilization—promotes granulation and epithelialization

Dermal graft

Flowable Soft Tissue Scaffold

- Tissue scaffold is a soft tissue graft (reconstituted in the OR), which is comprised solely of human dermal tissue, including its native protein and collagen structure
- Provides rapid granular tissue formation to fill tunneling or undermining wounds

Topical Wound Healing Agents

- **Dressings (anti-microbial dressings)**
  - If it is dry, make it wet
  - If it is wet, make it dry
- **Gels/Ointments**
  - Provide a protective, hydrating, and lubricating layer over the wound that promotes healing

Topicals

- Ointment and creams are the best hydrating tools
- Betadine, collagen, foam, alginate are good for wicking/drying a wound bed
- It is a balancing act and you may go back and forth with the products.
- I tell patients it is like a garden where we want good things to grow.

Conclusion

- **Diabetic wounds are multifactorial**
- **Consider**
  - Vascular status
  - Neurologic status
  - Contamination of the wound
  - Patients nutrition
  - Deformities/function
  - Wound status (get good things to grow in the garden)

The crew