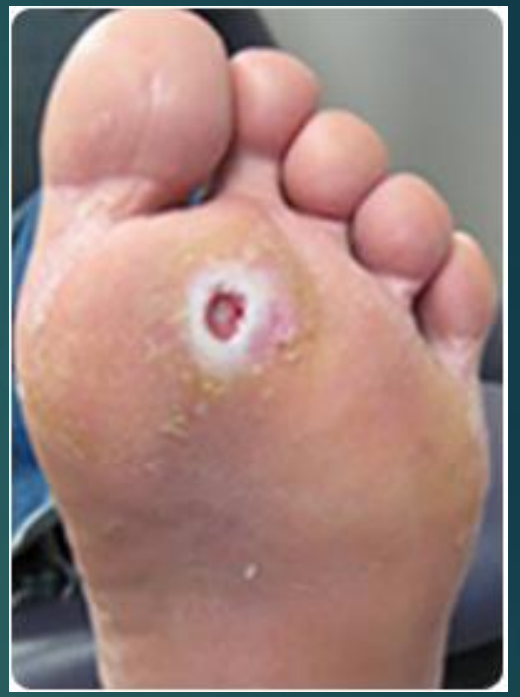
Lower Extremity Wound Management

AMANDA QUISNO, DPM, FACFAS

FOOT AND ANKLE SPECIALISTS OF CENTRAL OHIO

Chronic Wounds

- Major strain and challenge in every health care setting
  - Multiply with aging and increasingly obese population
- Chronic wounds affect 6.5 million people every year
  - Billions of dollars of health care cost
- Chronic wounds become stagnant
  - Vicious cycle
    - Exacerbated by numerous comorbidities, mixed etiologies, intrinsic and extrinsic factors



By 2030, ***550 million people*** will have diabetes

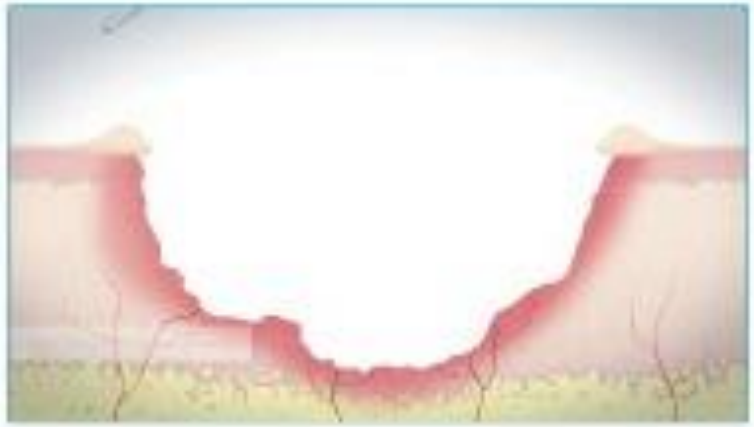
39-80% of patients die within 5 years following an amputation

Scary statistics…

- A foot ulcer is the initial event in more than ***85% of major amputations*** that are performed on people with diabetes.
- Throughout the world, it's estimated that ***every 30 seconds*** one leg is amputated due to diabetes.
- 10% of people with diabetes have a foot ulcer.
- Between 10-15% of diabetic foot ulcers ***do not heal***
  - ***25% of these will require amputation***
- In the United States, the cost to care for diabetic foot ulcers is about ***$11 billion per year***
- Approximately ***20% of hospital admissions*** in people with diabetes are due to foot ulcers

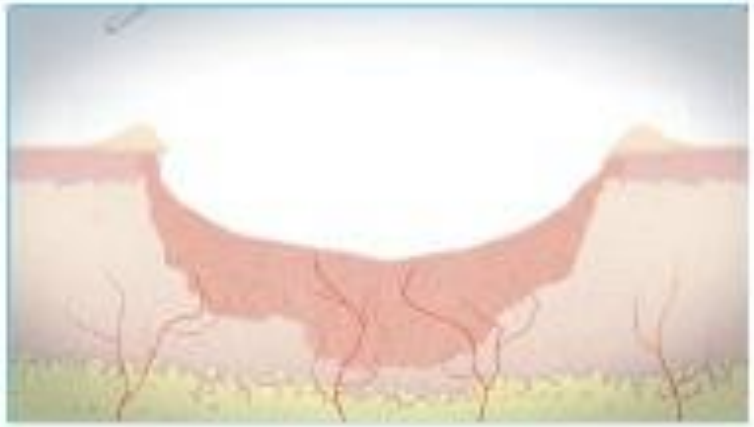
Figure 1 | Phases of wound healing

Inflammatory phase



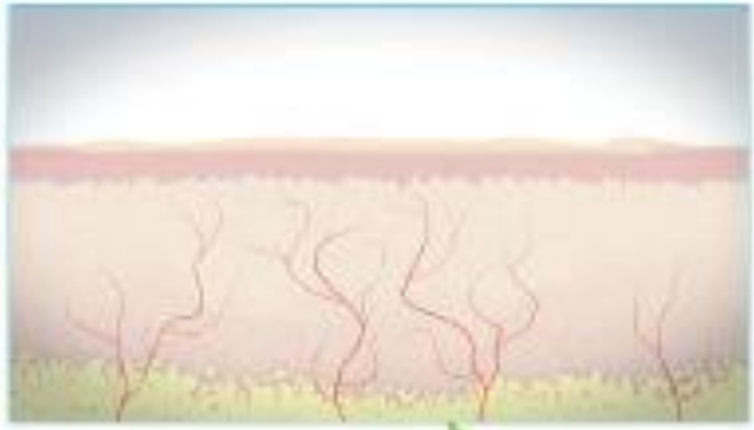
- Begins when the wound develops, lasts 4–6 days
- Marked by oedema, erythema, inflammation and pain
- Healing process triggered
- Immune system works to prevent microbial colonization

Proliferative phase



- Lasts another 4–24 days
- **Granulation tissue fills in the wound**
- **Fibroblasts lay collagen in the wound bed, strengthening new granulation tissue**
- Wound edges begin to contract
- Epithelial cells migrate from the wound margins

Maturation phase



- Can last 21 days–2 years
- **Length of time depends on patient- and wound-related complicating factors (e.g. duration of wound, patient comorbidities, wound** infection status)
- Filled-in wound is covered and strengthened
- Scar tissue forms

Simon et al. 2016

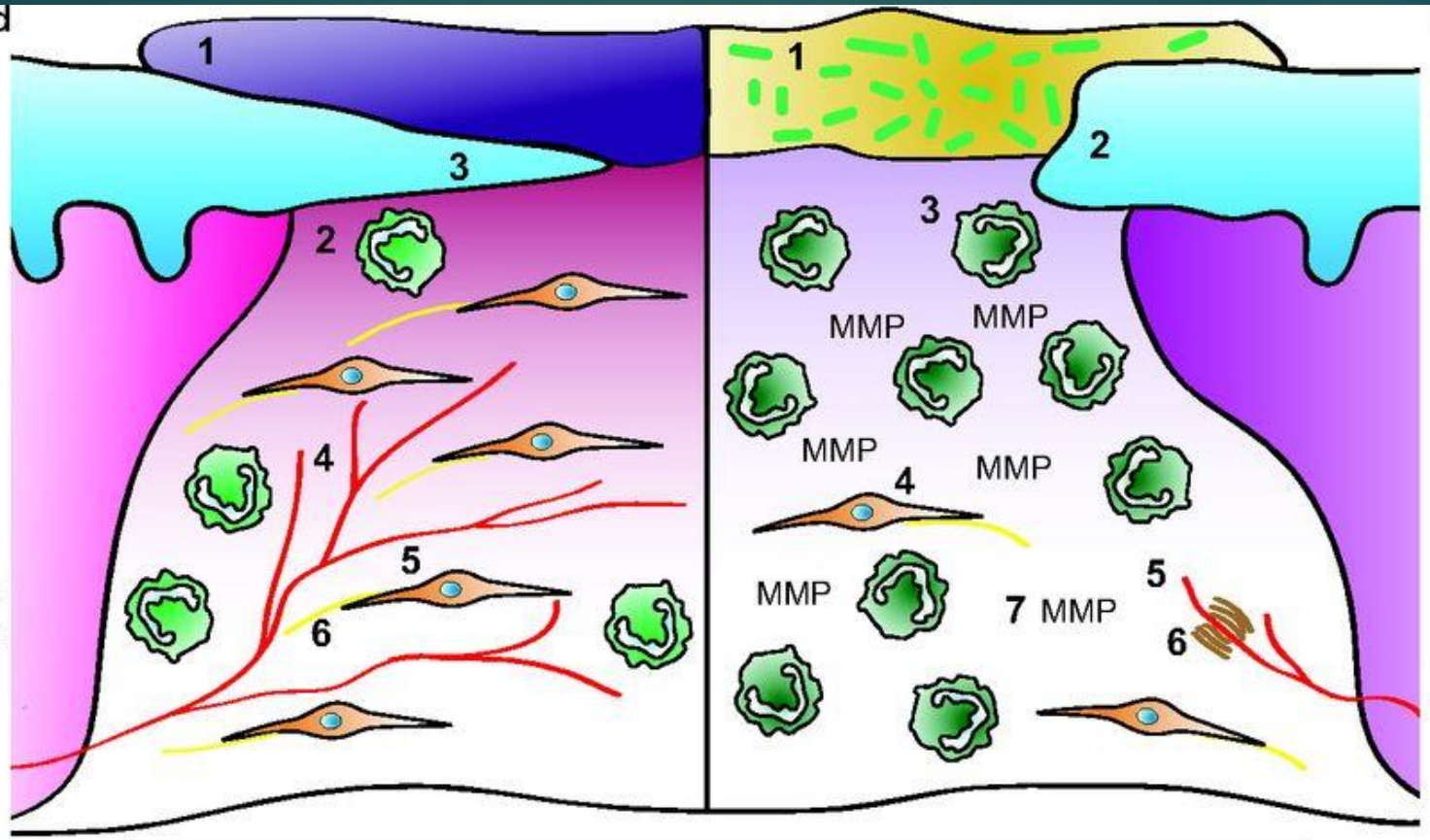
What goes wrong with chronic wounds?

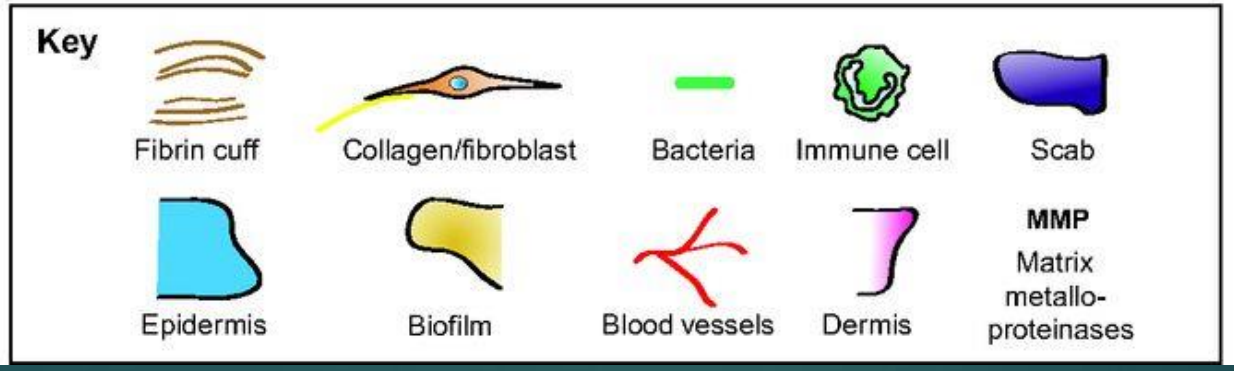
- Biology of chronic wounds (present >3 months) is different than that of acute wounds
- Hallmark → ***chronic, persistent inflammation***
  - Inflammatory phase typically resolves quickly in acute wounds
- Large influx of innate immune cells into chronic wounds
  - Inhibits many repair processes
- Build up of chronic necrotic debris at wound edge
  - Result of reduced phagocytic capacity of immune cells at a chronic wound
    - Why routine DEBRIDEMENT is an essential part of treatment

Acute (healing) wound

Inital phase:
1. Scab formation
2. Immune cell infiltration

Healing phase:
3. Re-epithelialisation
4. Angiogenesis
5. Fibroblast migration
6. Collagen deposition

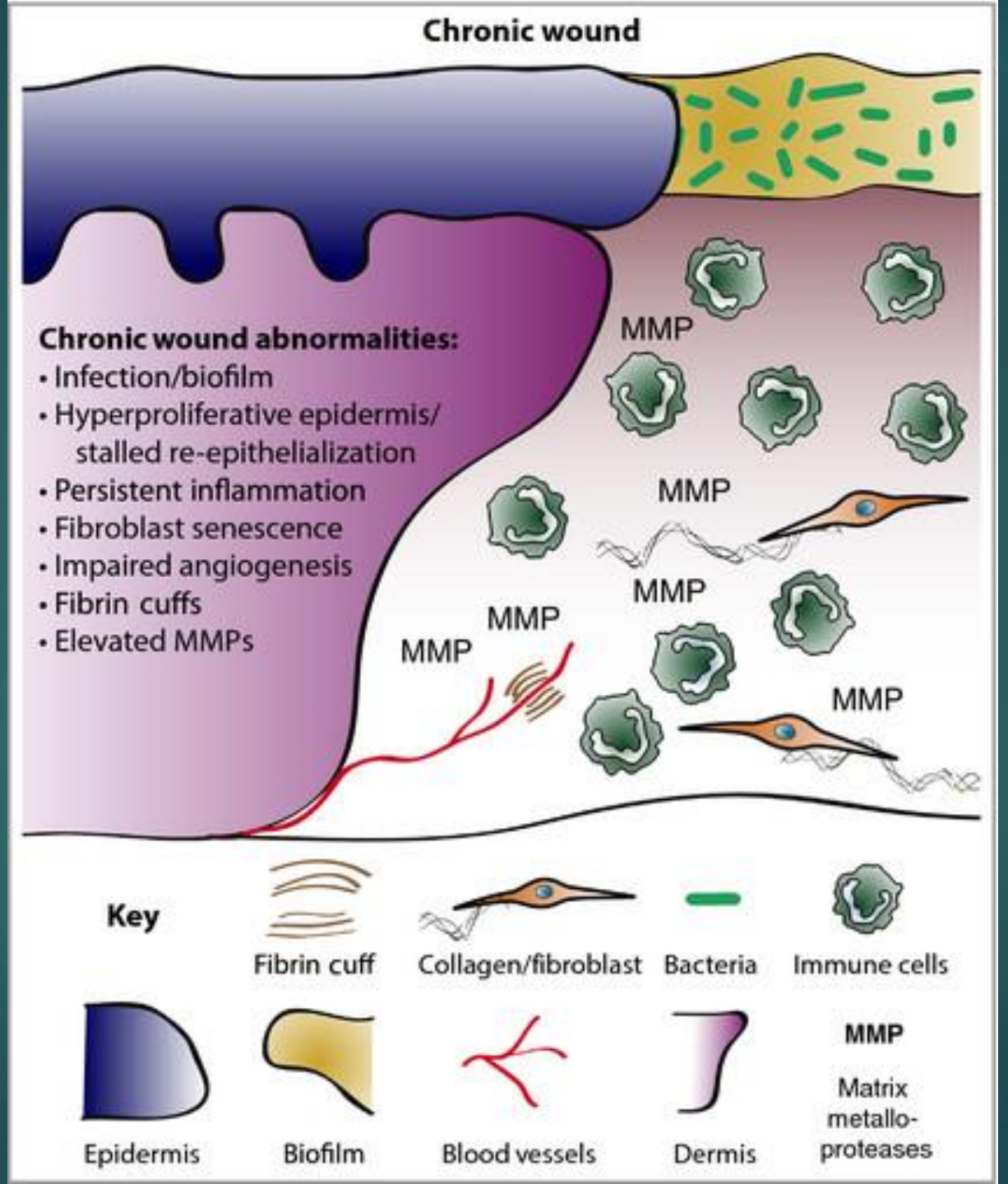




Chronic (non-healing) wound

Chronic wound abnormalities:
1. Infection/biofilm
2. Hyperproliferative epidermis/ stalled re-epithelialisation
3. Persistent inflammation
4. Fibroblast senescence
5. Impaired angiogenesis
6. Fibrin cuffs (barrier to oxygen)
7. Elevated MMPs

Build up of tissue degrading MMPs


Chronic wound
Chronic wound abnormalities:
• Infection/biofilm
• Hyperproliferative epidermis/ stalled re-epithelialization
• Persistent inflammation
• Fibroblast senescence
• Impaired angiogenesis
• Fibrin cuffs
• Elevated MMPs
MMP
MMP
MMP
MMP
MMP
MMP
Key
Fibrin cuff
Collagen/fibroblast
Bacteria
Immune cells
Epidermis
Biofilm
Blood vessels
Dermis
MMP
Matrix metallo-proteases

Therefore, chronic wound management should aim to…

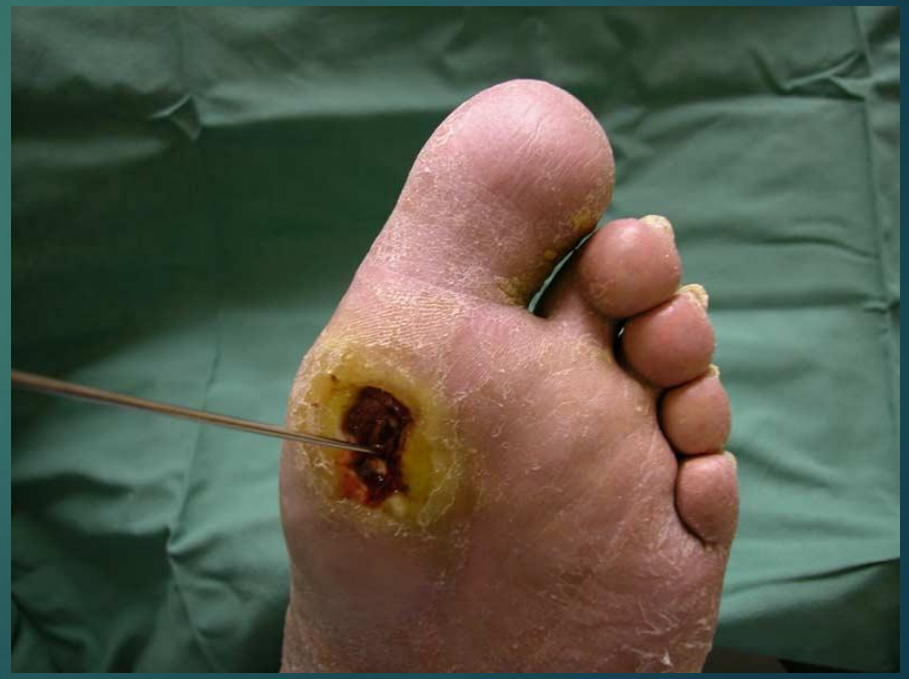
- Control biofilm
  - Treat infection
- Routinely remove accumulated debris
- Control patient comorbidities which contribute to stalled wound healing

Wounds by Etiology

- Diabetic foot ulcers / neuropathic wounds ★
- Venous Leg Ulcers
- Arterial Ulcers
- Pressure Ulcers
- Traumatic/Surgical wounds

Diabetic Foot Ulcers (DFUs)

- 15% of all individuals with DM will be affected by a foot ulcer
  - Recurrence rate of 70% within 5 years (Reiber et al. 1998)
- 85% of diabetic limb amputations are preceded by an ulcer (Pecoraro et al. 1990).
- Multifactorial in etiology:
  - Ischemia
  - Bony abnormalities
  - Neuropathy
  - Systemic barriers to wound healing
  - Infection



Wagner Classification

Grade 0 :

Fig. 7.3: No ulceration in a high-risk foot

Grade 1 :

Fig. 7.4: Superficial ulceration

Grade 2 :

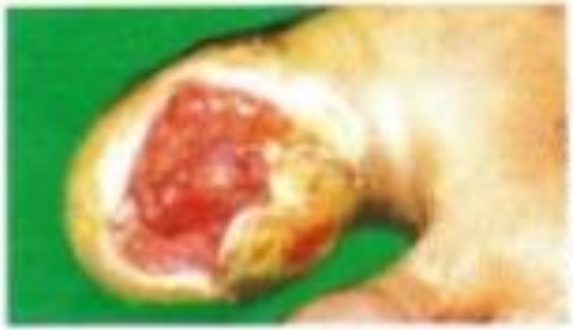


Fig. 7.5: Deep ulceration that penetrates to the tendon, bone or joint

Grade 3 :

Fig. 7.6: Osteomyelitis or a deep abscess

Grade 4 :

Fig. 7.7: Localized gangrene

Grade 5 :

Fig. 7.8: Extensive gangrene requiring a major amputation

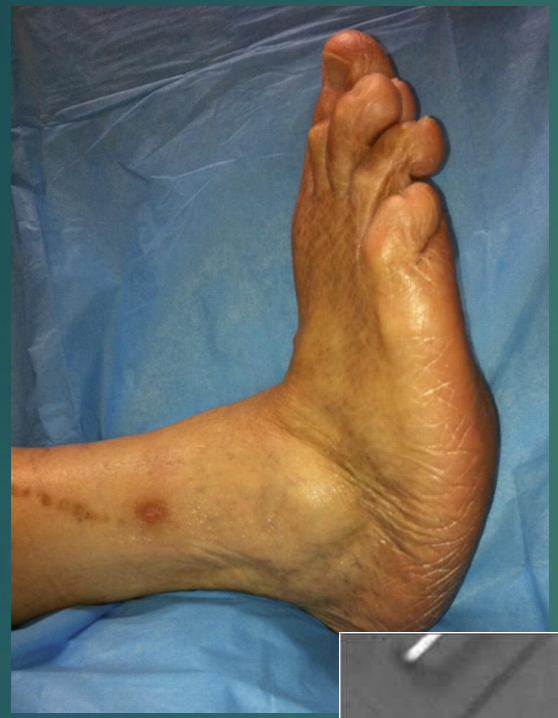
Treatment

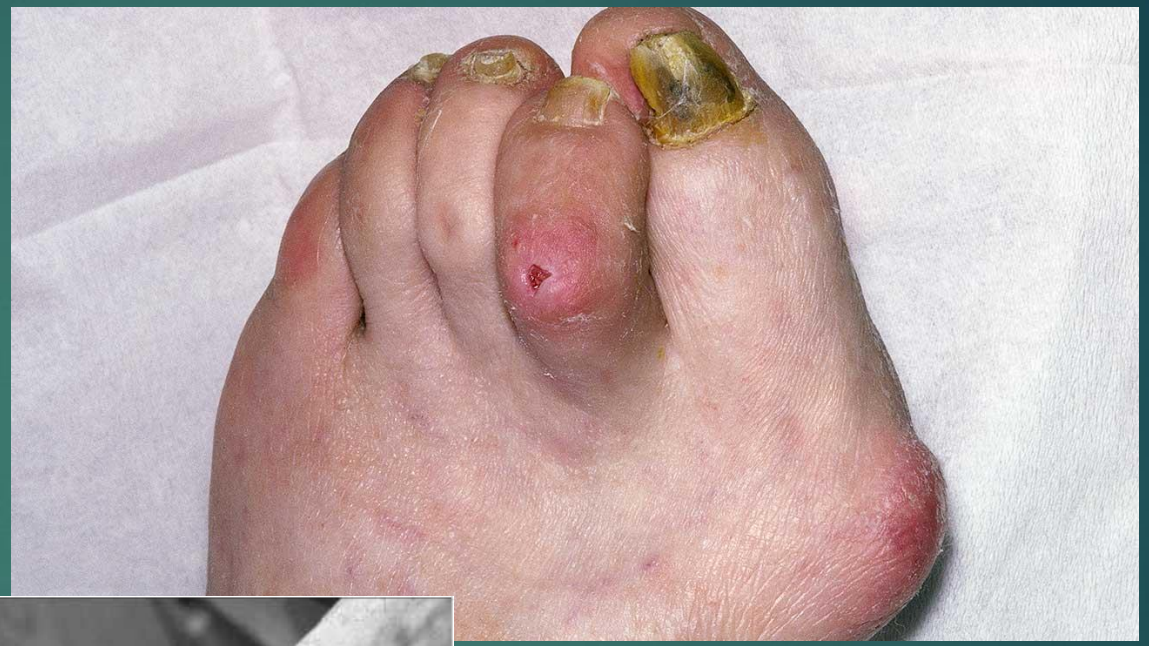
1. Offloading / Compression
2. Appropriate Dressings
3. Debridement
4. Antibiotics
5. Control of blood glucose
6. Evaluation and correction of arterial insufficiency

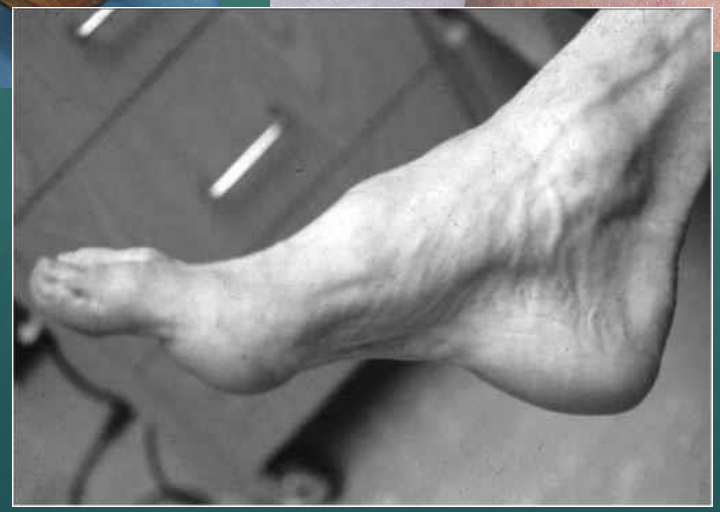
Offloading

- Loss of protective sensation → lack of awareness of developing or actual ulceration
- Motor neuropathy → affects muscles required for normal foot movement
  - Alters distribution of forces during walking
  - Callous formation in areas of increased pressure
- Ischemic necrosis of tissue beneath callous leads to breakdown of skin and SubQ
  - Neuropathic ulcer with "punched out" appearance

Offloading







Offloading

DIABETES/METABOLISM RESEARCH AND REVIEWS
Diabetes Metab Res Rev 2016; 32(Suppl. 1): 25–36.
Published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/dmrr.2697

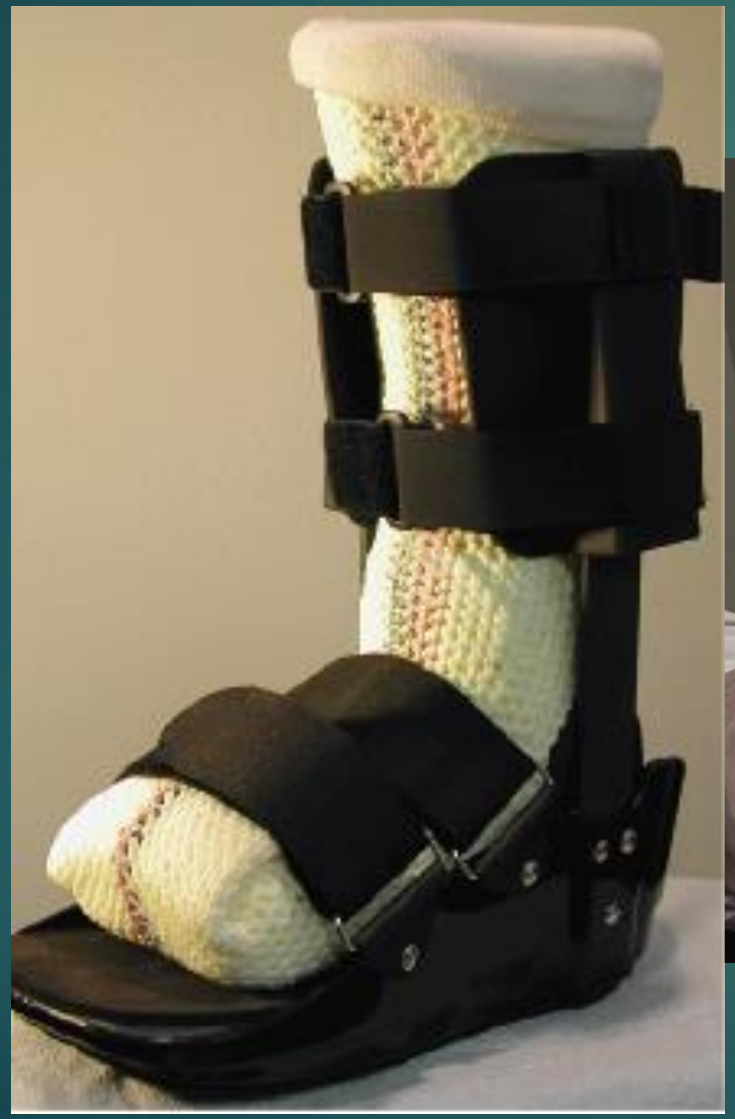
SUPPLEMENT ARTICLE

IWGDF guidance on footwear and offloading interventions to prevent and heal foot ulcers in patients with diabetes

Offloading

- Noninfected, nonischemic neuropathic plantar forefoot ulcers should heal in 6 to 8 weeks ***with adequate offloading.***
- Lots of options for offloading…what's best?
  - Recent meta analysis and systemic reviews show that ***nonremovable knee-high deveices are most effective.***
    - Removes the temptation of non-compliance
- What about removable cast walkers (RCW)?
  - May actually be more efficient at offloading (Bristol et al)
  - However, issues is compliance
  - Can be made non-removable

Non-removable devices



RCW rendered non-removable

Pre-fabricated removable walkers that are rendered "irremovable" have been shown to be as effective as the TCC (Bus et al, 2016)

New gold standard?

When a non-removable device is contraindicated…

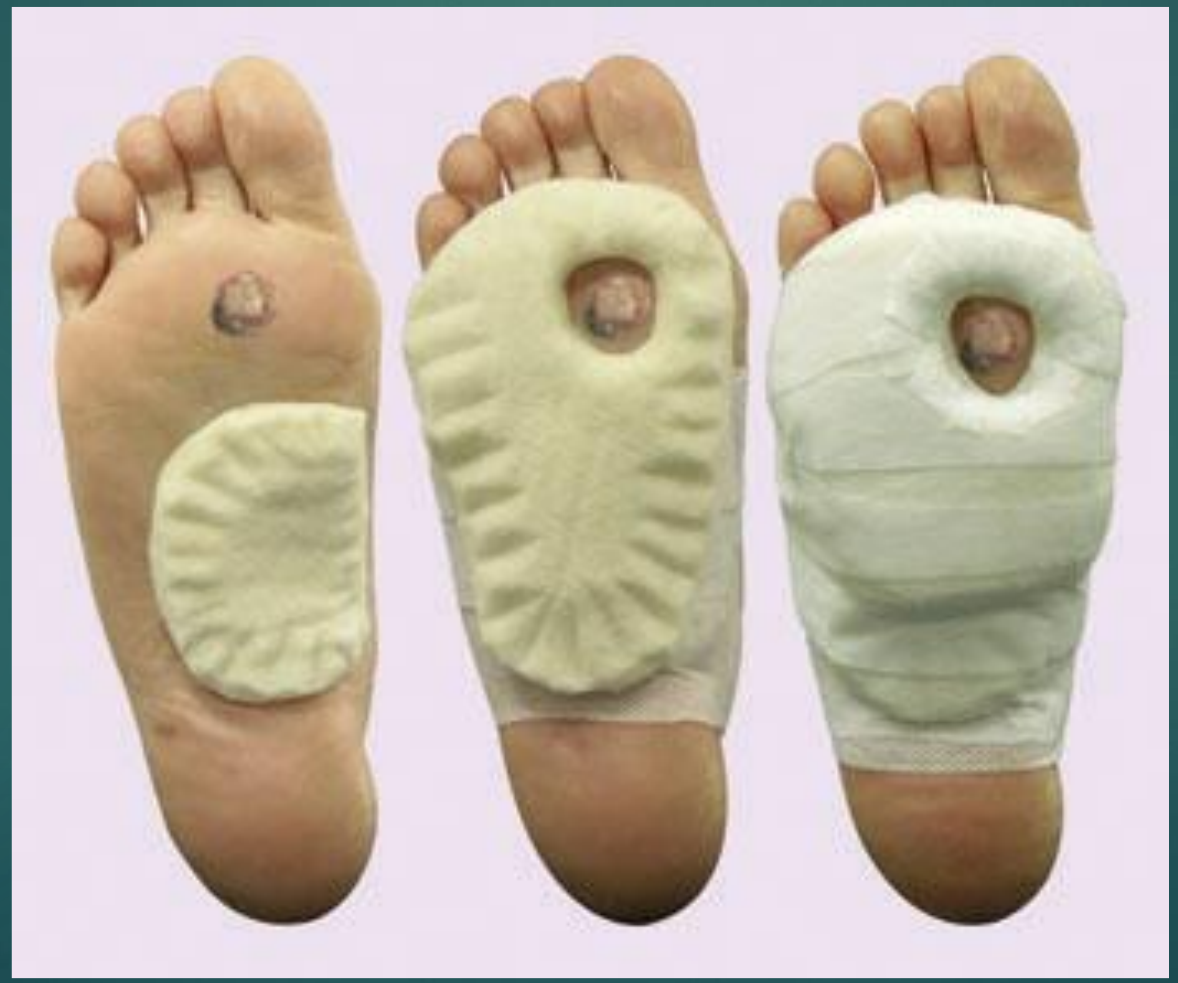
- Heavily exudating plantar foot ulcers
- Active mild infection not yet under control
- Plantar foot ulcers with mild/moderate PAD
  - Concern for iatrogenic wounds
- If this is the case…
  - Consider offloading with a forefoot offloading shoe, cast shoe, custom-made temporary shoe

Types of offloading

- Surgical shoe

Types of offloading

- Felted foam

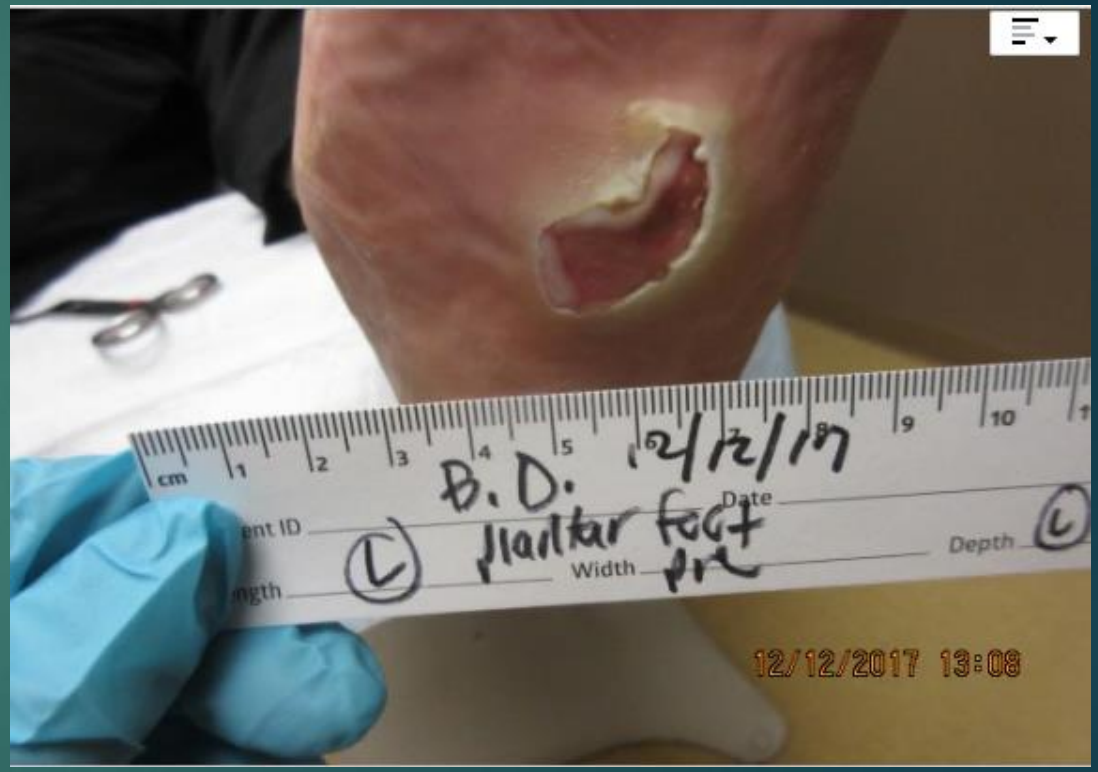


Surgical offloading

- Achilles tendon lengthening
- Joint arthroplasty
- Single or pan metatarsal head resection
- Osteotomy

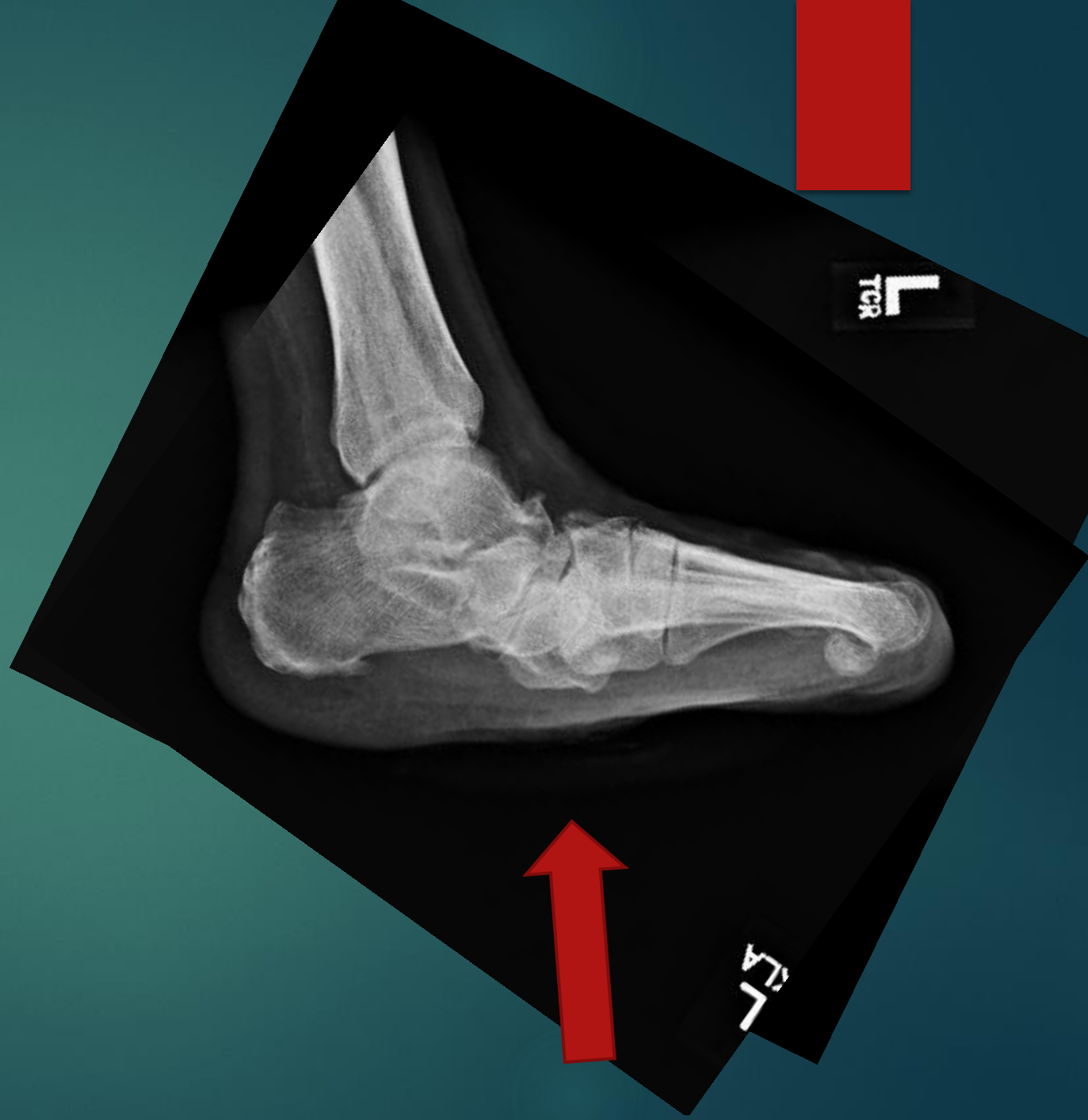
Surgical offloading

- 56 y/o DM male
- Hx of Charcot/midfoot deformity
- Chronic recurrent plantar midfoot ulceration
  - TCC, custom footwear, good glycemic control
- Opted to attempt surgical correction of deformity prevent reoccurence



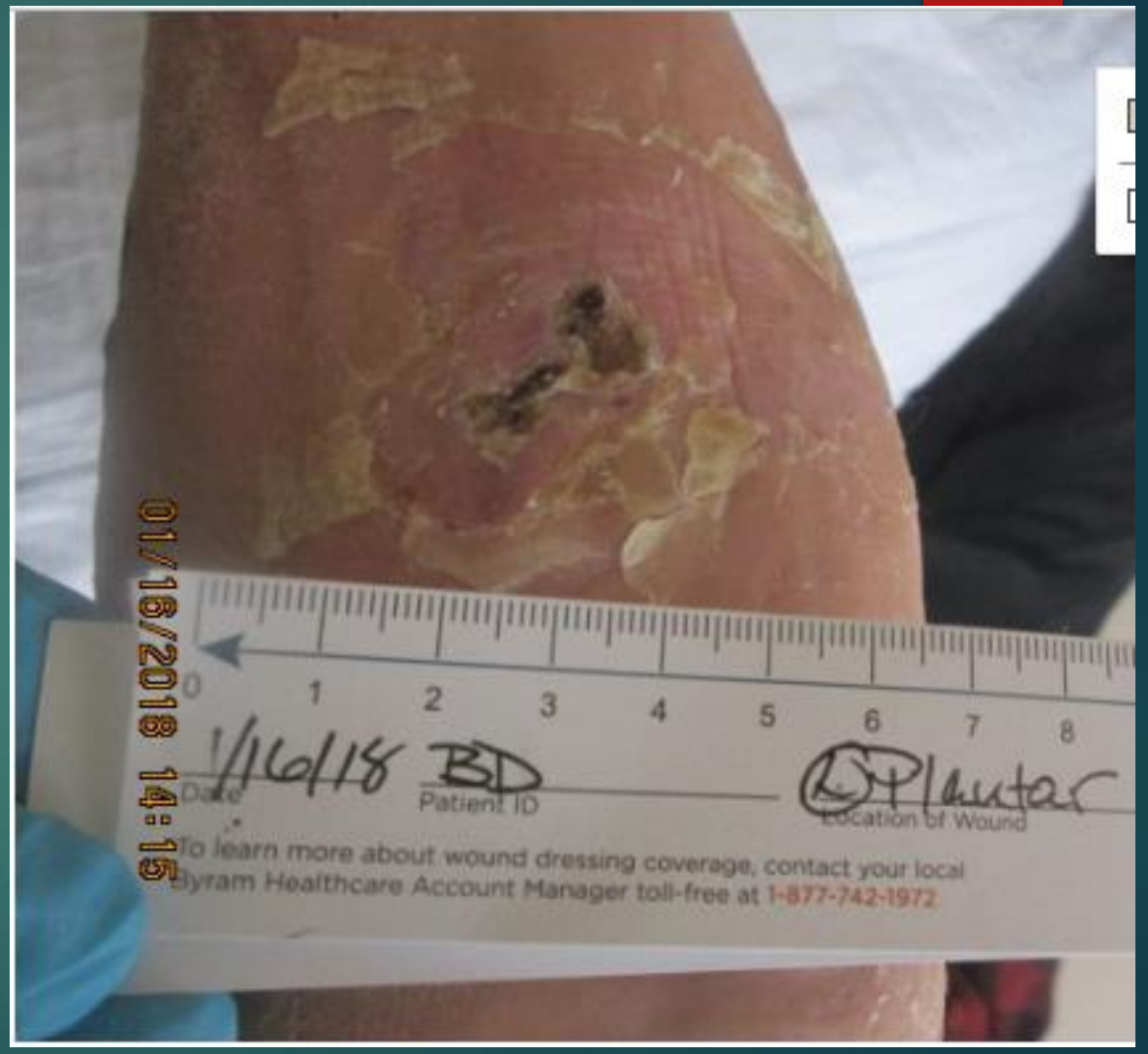
Surgical offloading

- Underwent plantar exostecomy with Achilles tendon lengthening for surgical offloading



Surgical offloading

- 6 weeks post-op
- Remains healed >1 year from surgery



Dressings

- Many different choices
- Different dressing types indicated for different wound types based on etiology, stage, presence/absence of infection, amount of drainage, etc.
- Overwhelming amount of choices
  - Try to keep it as simple as possible
  - Use wound clinic for assistance with dressings for patients who have difficulty with compliance

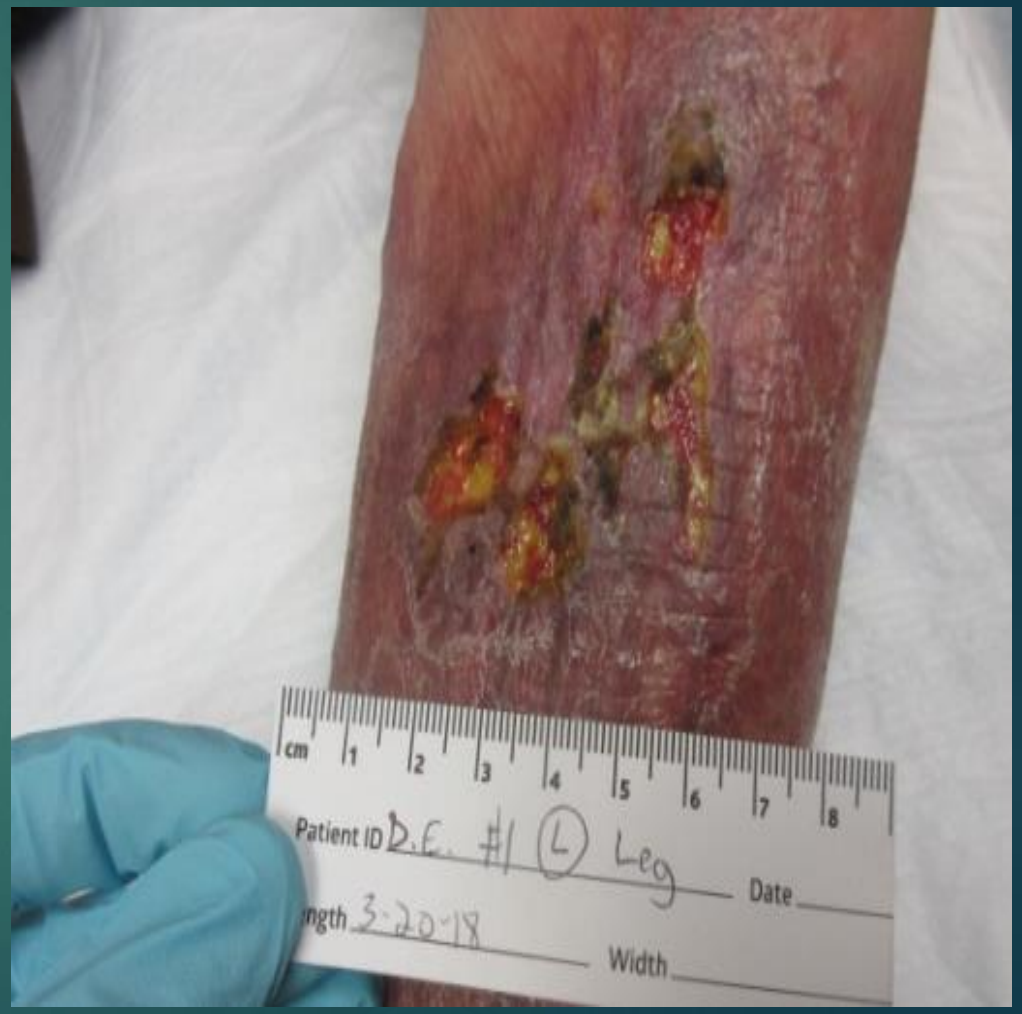
Wet-to-dry gauze

- Benefits: readily available, inexpensive, simple application increases compliance, mechanical debridement
- Downfalls: bandage trauma, no anti-microbial properties, does create ideal wound healing environment, often not adequate for highly exudative/draining wounds

- Outdated!

Alginate Dressings

- High absorptive, non-occlusive
- Made of soft, non-woven calcium alginate fibers
- Pad or rope form
- Gel on contact with wound exudate
  - Allows for a moist wound environment, autolytic debridement
- INDICATIONS
  - Moderate to heavy drainage
  - Infection (if impregnated with silver)
- CONTRAINDICATIONS
  - Dry eschar
  - Third-degree burns
  - Heavy bleeding



Antimicrobial dressings

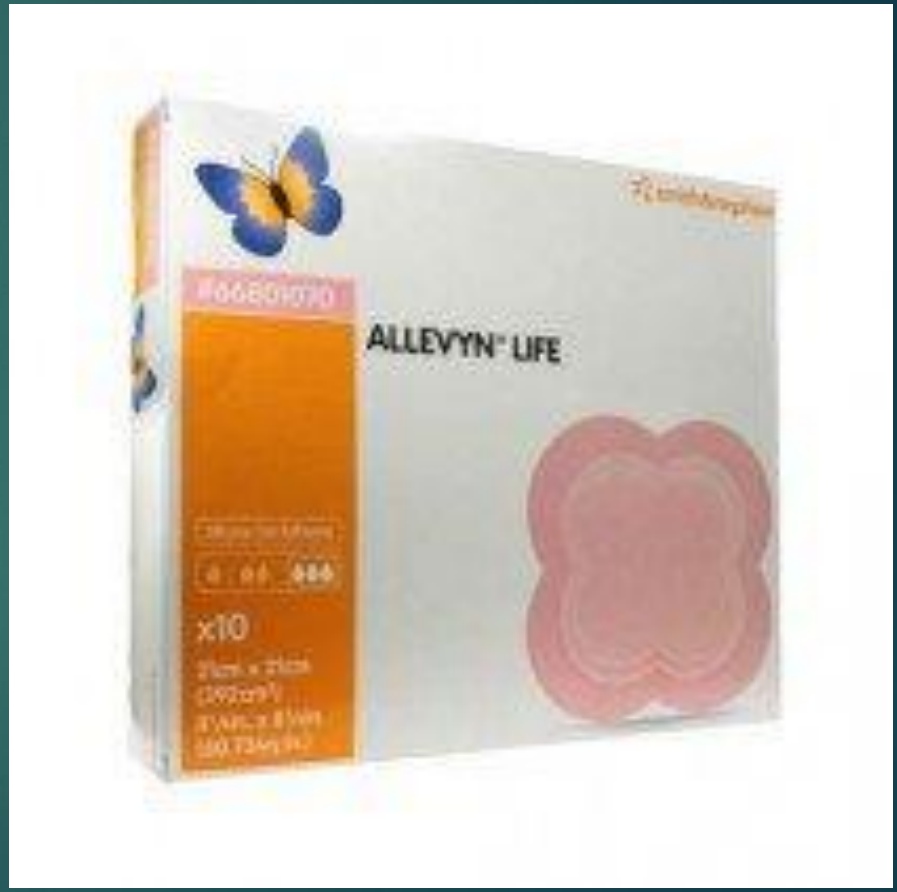
- Deliver sustained release of anti-microbial agents
- Silver, iodine, PHMB, chlorohexidine
- Silver dressings available in multiple forms
  - Hydrocolloids, foam, alginates, gelling fiber
- Indications
  - Draining, infected, surgical, diabetic foot ulcers, pressure ulcers, vascular ulcers
- Contraindications
  - Silver dressings should not be worn during MRI
  - Patients with known sensitivies

Collagen dressings

- Sheets, pads, particles, powders, and gels derived from bovine, equine, porcine, or avian sources
- Encourage deposition and organization of newly formed fibers and granulation tissue in wound bed
- Indications
  - Partial- and full-thickness wounds such as skin grafts, donor sites, surgical wounds, tunneling wounds, minimal to heavy drainage
- Contraindications
  - Dry wounds, third-degree burns

Foam Dressings

- Polymer solutions in sheets capable of holding fluids
- Can be impregnated with other materials
- Non-adherent
- Available in sheets, pads, strips, and cavity dressing
- Indication
  - Minimal- to heavily-exudating wounds
  - Protect intact skin over bony prominences
- Warnings
  - Can cause maceration if dressing is saturated
  - Not effective on dry eschar



Hydrocolloid Dressings

- Occlusive or semi-occlusive
- Paste, powder, gel, sheet
- Gel on contact with wound exudate
- Lightly to moderately exudating wounds
- Contraindicated in burns and dry wounds, wounds with heavy exudate, tunneling, infection, exposed tenson or bone

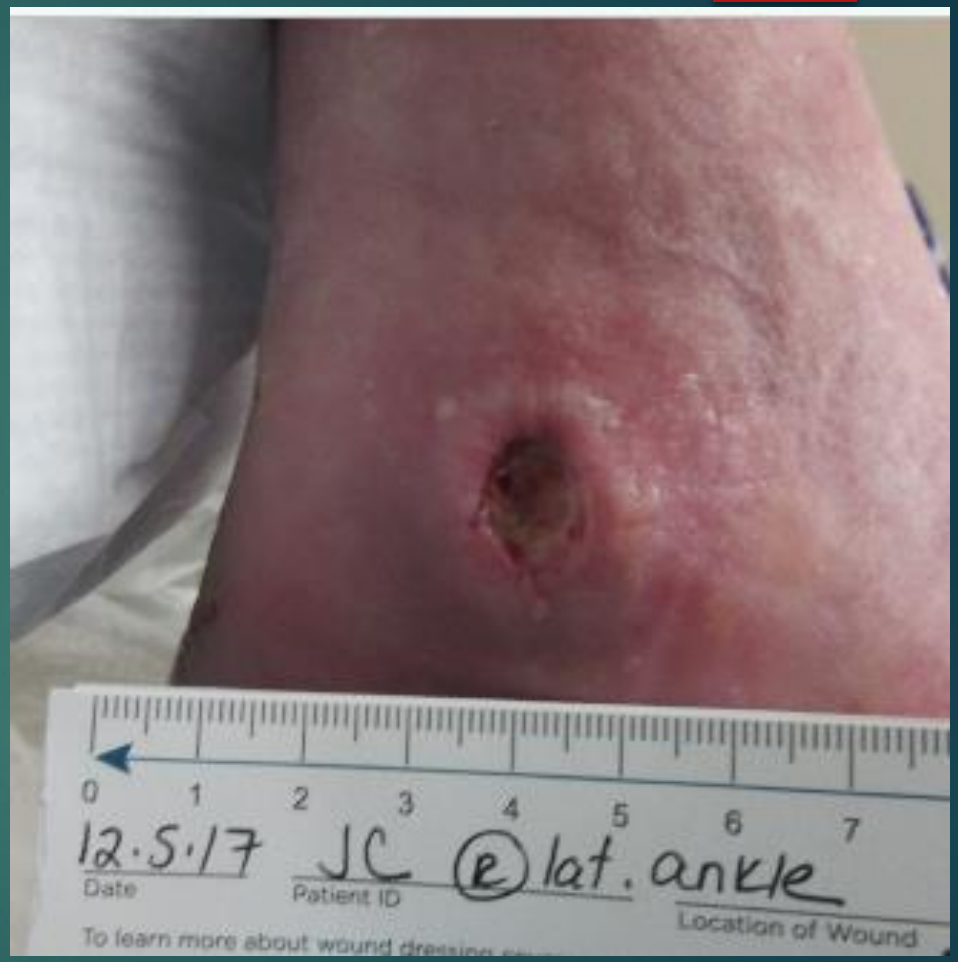
Medical Grade Honey

- Active *Leptospermum* honey or Manuka honey as main component
- Promote optimal healing by reducing edema, lowering wound pH, and promoting autolytic debridement of slough and eschar
- Indications:
  - Partial and full thickness wounds of multiple etiology

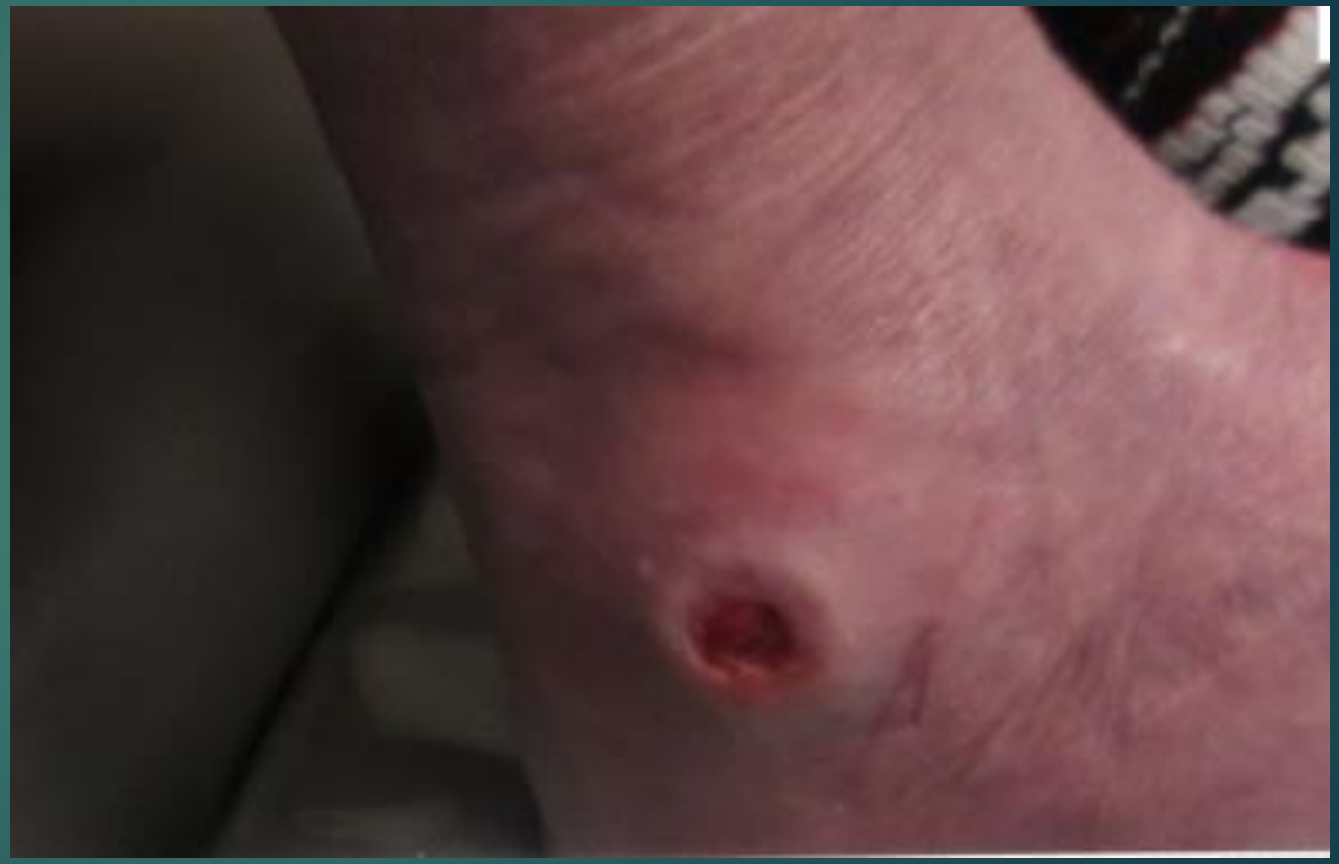
Advanced dressings

- Collagenases (Santyl)
  - Allows for maintenance debridement
  - General painless
  - Great for patients with fibrous or escharotic wounds which cannot tolerate debridement
- Growth factors (PRP, Regranex)
  - Expensive, not easily accesible

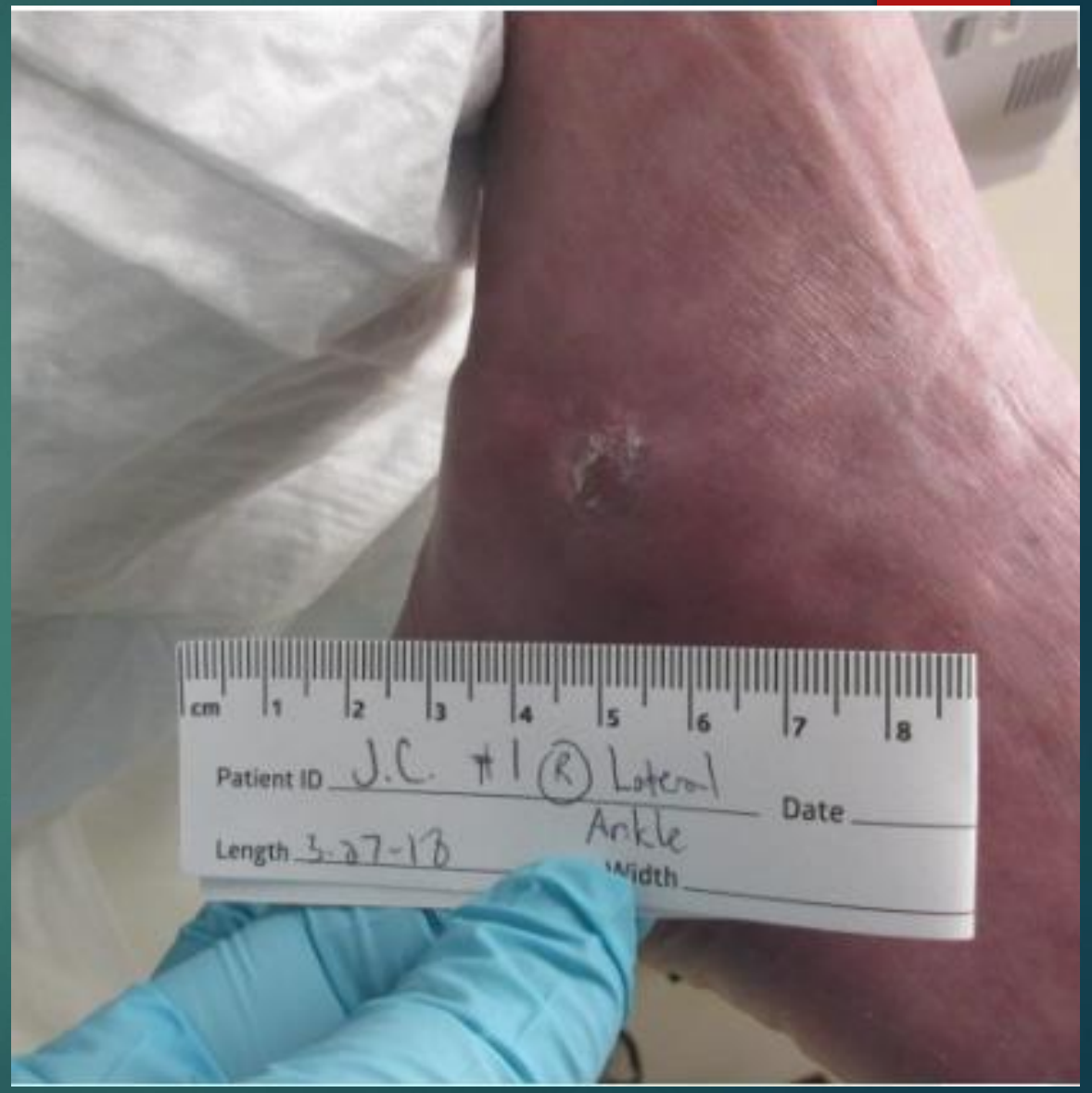
- 74 y/o F
- Stage III pressure ulceration
- Painful, doesn't tolerate debridement well



- 6 weeks into use
- Granular wound base
- Transitioned to collagen dressing



- Healed ~ 2 months later
- Need to reassess wounds frequently and adjust as necessary



Advanced dressings

- Skin substitutes
- Split thickness skin grafting
- Flaps and plastic surgery
- Negative pressure wound therapy

In my practice…

- At initial treatment, generally use:
  - 1. Silver alginate: highly draining, venous wounds
  - 2. Prisma: granular, superficial, non-infected
  - 3. Gentamycin or similar abx cream: partial thickness, superficial wounds. Unable to afford advanced wound products.
  - 4. Betadine/iodine: dry gangrene, grossly infected wounds in the hospital setting
  - 5. Santyl: fibrotic wounds non-tolerant to debridement
  - 6. Advanced wound dressings: once wounds have failed a reasonable trial of alternatives.

ALWAYS in the setting of appropriate offloading, compression, and vascular and medical optimization

Debridement

- "the process in which all materials incompatible with healing are removed from a wound"

Procedure	Benefits	Detractions	Time Frame	Types of Wounds
Sharp or surgical	Rapid, highly selective, may be used on all types of wounds	Requires skilled training; is painful, typically requires local or general anesthesia; possibility of removing viable tissue	Immediate	Useful for all types of wounds
Mechanical	Easy to perform, faster than autolytic debridement	Slow and may be painful	Days to weeks	Exudating and necrotic wounds
Enzymatic	Easy to perform, selective based on product, may be used in combination	Slow to moderate; surrounding tissue irritation; allergic reactions	Days to weeks	Exudating and necrotic wounds
Autolytic	Easy, readily available, minimal pain	Slow; requires compliance	Weeks to months	Well perfused wounds with minimal necrosis

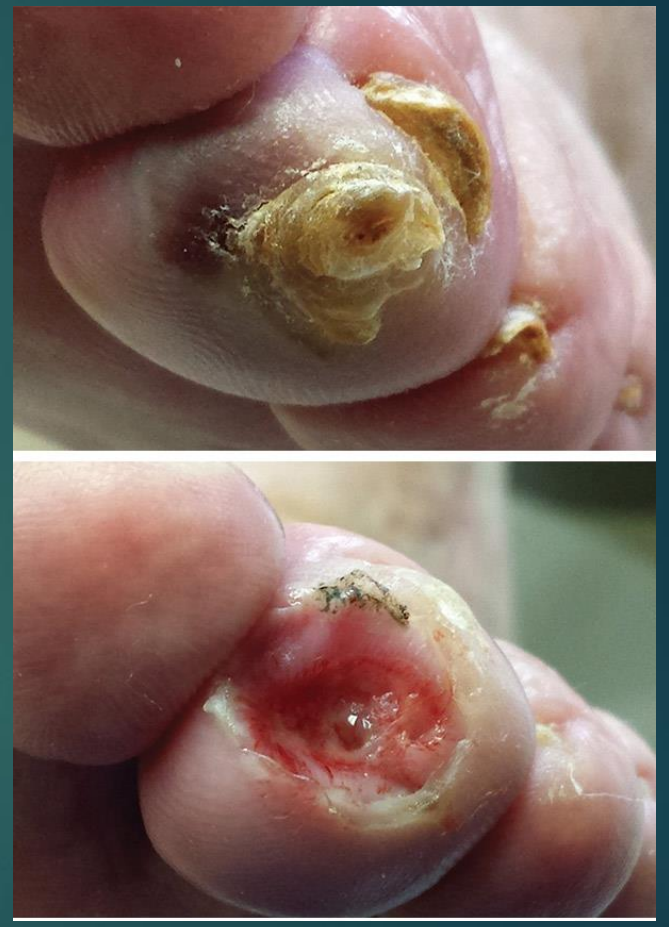
E. Espensen, *Podiatry Today*, 2007

Types

- Surgical/Sharp: use of a scalpel, scissors, or other instrumentation
  - In clinic or OR
- Mechanical: hydrotherapy, whirlpool, or wound irrigation
- Autolytic: use of hydrocolloids or hydrogels
- Enzymatic: exogenously derived proteolytic enzymes
- Biological: larval or maggot therapy
- Chemical: application of relatively caustic chemicals

Debridement

- Clinician cannot properly assess or document status of wound until all necrotic, hyperkeratotic, and devitalized tissue has been removed
- Dead tissue is a medium for bacterial growth
- Presence of foreign material provokes an inflammatory response
- Necrotic tissues slow wound contraction
- Surgical/sharp debridement has long been viewed as the "gold standard" for debridement
  - Often times practitioner choses method of debridement based on their level of comfort



Antibiotics

IDSA GUIDELINES

2012 Infectious Diseases Society of America Clinical Practice Guideline for the Diagnosis and Treatment of Diabetic Foot Infections[a]

Benjamin A. Lipsky,[1] Anthony R. Berendt,[2] Paul B. Cornia,[3] James C. Pile,[4] Edgar J. G. Peters,[5] David G. Armstrong,[6] H. Gunner Deery,[7] John M. Embil,[8] Warren S. Joseph,[9] Adolf W. Karchmer,[10] Michael S. Pinzur,[11] and Eric Senneville[12]

[1]Department of Medicine, University of Washington, Veterans Affairs Puget Sound Health Care System, Seattle; [2]Bone Infection Unit, Nuffield Orthopaedic Centre, Oxford University Hospitals NHS Trust, Oxford; [3]Department of Medicine, University of Washington, Veteran Affairs Puget Sound Health Care System, Seattle; [4]Divisions of Hospital Medicine and Infectious Diseases, MetroHealth Medical Center, Cleveland, Ohio; [5]Department of Internal Medicine, VU University Medical Center, Amsterdam, The Netherlands; [6]Southern Arizona Limb Salvage Alliance, Department of Surgery, University of Arizona, Tucson; [7]Northern Michigan Infectious Diseases, Petoskey; [8]Department of Medicine, University of Manitoba, Winnipeg, Canada; [9]Division of Podiatric Surgery, Department of Surgery, Roxborough Memorial Hospital, Philadelphia, Pennsylvania; [10]Department of Medicine, Division of Infectious Diseases, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts; [11]Department of Orthopaedic Surgery and Rehabilitation, Loyola University Medical Center, Maywood, Illinois; and [12]Department of Infectious Diseases, Dron Hospital, Tourcoing, France

Table 2. Infectious Diseases Society of America and International Working Group on the Diabetic Foot Classifications of Diabetic Foot Infection

Clinical Manifestation of Infection	PEDIS Grade	IDSA Infection Severity
No symptoms or signs of infection	1	Uninfected
Infection present, as defined by the presence of at least 2 of the following items: • Local swelling or induration • Erythema • Local tenderness or pain • Local warmth • Purulent discharge (thick, opaque to white or sanguineous secretion)		
Local infection involving only the skin and the subcutaneous tissue (without involvement of deeper tissues and without systemic signs as described below). If erythema, must be >0.5 cm to ≤2 cm around the ulcer. Exclude other causes of an inflammatory response of the skin (eg, trauma, gout, acute Charcot neuro-osteoarthropathy, fracture, thrombosis, venous stasis).	2	Mild
Local infection (as described above) with erythema > 2 cm, or involving structures deeper than skin and subcutaneous tissues (eg, abscess, osteomyelitis, septic arthritis, fasciitis), **and** No systemic inflammatory response signs (as described below)	3	Moderate
Local infection (as described above) with the signs of SIRS, as manifested by ≥2 of the following: • Temperature >38°C or <36°C • Heart rate >90 beats/min • Respiratory rate >20 breaths/min or $PaCO_2$ <32 mm Hg • White blood cell count >12 000 or <4000 cells/μL or ≥10% immature (band) forms	4	Severe[a]

Abbreviations: IDSA, Infectious Diseases Society of America; $PaCO_2$, partial pressure of arterial carbon dioxide; PEDIS, perfusion, extent/size, depth/tissue loss, infection, and sensation; SIRS, systemic inflammatory response syndrome.

[a] Ischemia may increase the severity of any infection, and the presence of critical ischemia often makes the infection severe. Systemic infection may sometimes manifest with other clinical findings, such as hypotension, confusion, vomiting, or evidence of metabolic disturbances, such as acidosis, severe hyperglycemia, and new-onset azotemia [29, 43, 44].

Treatment based on severity

- IDSA Classification has been prospectively validated as predicting the need for hospitalization
  - No infection = 0
  - Mild infection = 4%
  - Moderate infection = 52%
  - Severe infection = 70%

Appropriate cultures

- IDSA Guidelines
  - "For infected wounds, we recommend that clinicians send appropriately obtained specimens for culture PRIOR to starting empiric antibiotic therapy if necessary "
  - "We recommend sending a specimen for culture that is from DEEP TISSUE, obtained by biopsy or curettage AFTER the wound has been cleansed and debrided."
  - "We suggest AVOIDING swab specimens, especially of inadequately debrided wounds, as they provide less accurate results."

Appropriate cultures

- Surface swabs are bound to be a misrepresentation of actual pathogen and will be contaminated with surface bacteria and normal skin colonizers not contributing to infection
- Routine swabbing of wounds in the absence of clinical signs of infection is not recommended
  - Will likely result in a positive culture which physician is then obligated to treat
- ***Ideally, a deep tissue culture following debridement of necrotic/nonviable tissue and irrigation***
  - Not always practical or convenient
- ***If this is not possible, for a swab culture:***
- Following debridement:
  - 1. Irrigate the tissue with normal saline solution
  - 2. Moisten a swab with normal saline solution
  - Swab a 1 cm square are of viable tissue with enough force to produce exudate/bleeding

What antibiotics?

- Based on severity of infection
  - Mild-moderate: target aerobic GPC, usually oral
    - Some moderate my require parenteral therapy
  - Severe: broad spectrum parenteral therapy
    - Empiric therapy directed at Pseudomonas aeruginosa usually unnecessary EXCEPT for patients with risk factors for true infection with this organism
  - Continue therapy through resolution of signs of infection but not through wound healing

Table 6. Antibiotic Selection Overview: Questions a Clinician Should Consider

Is there clinical evidence of infection?
Do not treat clinically uninfected wounds with antibiotics
For clinically infected wounds consider the questions below:
- Is there high risk of MRSA?
Include anti-MRSA therapy in empiric regimen if the risk is high (see Table 7) or the infection is severe
- Has patient received antibiotics in the past month?
If so, include agents active against gram-negative bacilli in regimen If not, agents targeted against just aerobic gram-positive cocci may be sufficient
- Are there risk factors for *Pseudomonas* infection?[a]
If so, consider empiric antipseudomonal agent If not, empiric antipseudomonal treatment is rarely needed
- What is the infection severity status?
See Table 9 for suggested regimens for mild versus moderate/severe infections

Abbreviation: MRSA, methicillin-resistant *Staphylococcus aureus*.

[a] Such as high local prevalence of *Pseudomonas* infection, warm climate, frequent exposure of the foot to water.

Table 8. Suggested Empiric Antibiotic Regimens Based on Clinical Severity for Diabetic Foot Infections[a]

Infection Severity	Probable Pathogen(s)	Antibiotic Agent	Comments
Mild (usually treated with oral agent[s])	*Staphylococcus aureus* (MSSA); Streptococcus spp	Dicloxacillin	Requires QID dosing; narrow-spectrum; inexpensive
		Clindamycin[b]	Usually active against community-associated MRSA, but check macrolide sensitivity and consider ordering a "D-test" before using for MRSA. Inhibits protein synthesis of some bacterial toxins
		Cephalexin[b]	Requires QID dosing; inexpensive
		Levofloxacin[b]	Once-daily dosing; suboptimal against *S. aureus*
		Amoxicillin-clavulanate[b]	Relatively broad-spectrum oral agent that includes anaerobic coverage
	Methicillin-resistant *S. aureus* (MRSA)	Doxycycline	Active against many MRSA & some gram-negatives; uncertain against streptococcus species
		Trimethoprim/ sulfamethoxazole	Active against many MRSA & some gram-negatives; uncertain activity against streptococci

Moderate (may be treated with oral or initial parenteral agent[s]) or severe (usually treated with parenteral agent[s])	MSSA; *Streptococcus* spp; Enterobacteriaceae; obligate anaerobes	Levofloxacin[b]	Once-daily dosing; suboptimal against *S. aureus*
		Cefoxitin[b]	Second-generation cephalosporin with anaerobic coverage
		Ceftriaxone	Once-daily dosing, third-generation cephalosporin
		Ampicillin-sulbactam[b]	Adequate if low suspicion of *P. aeruginosa*
		Moxifloxacin[b]	Once-daily oral dosing. Relatively broad-spectrum, including most obligate anaerobic organisms
		Ertapenem[b]	Once-daily dosing. Relatively broad-spectrum including anaerobes, but not active against *P. aeruginosa*
		Tigecycline[b]	Active against MRSA. Spectrum may be excessively broad. High rates of nausea and vomiting and increased mortality warning. Nonequivalent to ertapenem + vancomycin in 1 randomized clinical trial
		Levofloxacin[b] or ciprofloxacin[b] with clindamycin[b]	Limited evidence supporting clindamycin for severe *S. aureus* infections; PO & IV formulations for both drugs
		Imipenem-cilastatin[b]	Very broad-spectrum (but not against MRSA); use only when this is required. Consider when ESBL-producing pathogens suspected

	MRSA	*Linezolid*[b]	Expensive; increased risk of toxicities when used >2 wk
		Daptomycin[b]	Once-daily dosing. Requires serial monitoring of CPK
		Vancomycin[b]	Vancomycin MICs for MRSA are gradually increasing
	Pseudomonas aeruginosa	***Piperacillin-tazobactam***[b]	TID/QID dosing. Useful for broad-spectrum coverage. *P. aeruginosa* is an uncommon pathogen in diabetic foot infections except in special circumstances (2)

Table 8 continued.

Infection Severity	Probable Pathogen(s)	Antibiotic Agent	Comments
	MRSA, Enterobacteriacae, *Pseudomonas*, and obligate anaerobes	Vancomycin[c] plus one of the following: ceftazidime, cefepime, *piperacillin-tazobactam*[b], aztreonam,[b] or a carbapenem[b]	Very broad-spectrum coverage; usually only used for empiric therapy of severe infection. Consider addition of obligate anaerobe coverage if ceftazidime, cefepime, or aztreonam selected

Table 11. Suggested Route, Setting, and Duration of Antibiotic Therapy, by Clinical Syndrome

Site of Infection, by Severity or Extent	Route of Administration	Setting	Duration of Therapy
Soft-tissue only			
Mild	Topical or oral	Outpatient	1–2 wk; may extend up to 4 wk if slow to resolve
Moderate	Oral (or initial parenteral)	Outpatient/ inpatient	1–3 wk
Severe	Initial parenteral, switch to oral when possible	Inpatient, then outpatient	2–4 wk

Glycemic Control

- Team approach to treatment
- Does glycemic control improve wound healing?
  - Recent systemic review (Patil et al., *Diabetes* 2018) showed a relationship between wound healing and improvement in glycemic control
  - Improvement in rates of healing of DFU previously resistant to conventional care after strictly controlling glycemia
  - Worsening glycemic control during DFU treatment significantly decreased odds of wound healing

Management of Arterial Insufficiency

- Team approach
- Rutherford classification
  - Classifies PAD
  - Useful in communication with your vascular surgeon
- Baseline vascular testing in ANY new patient with a wound

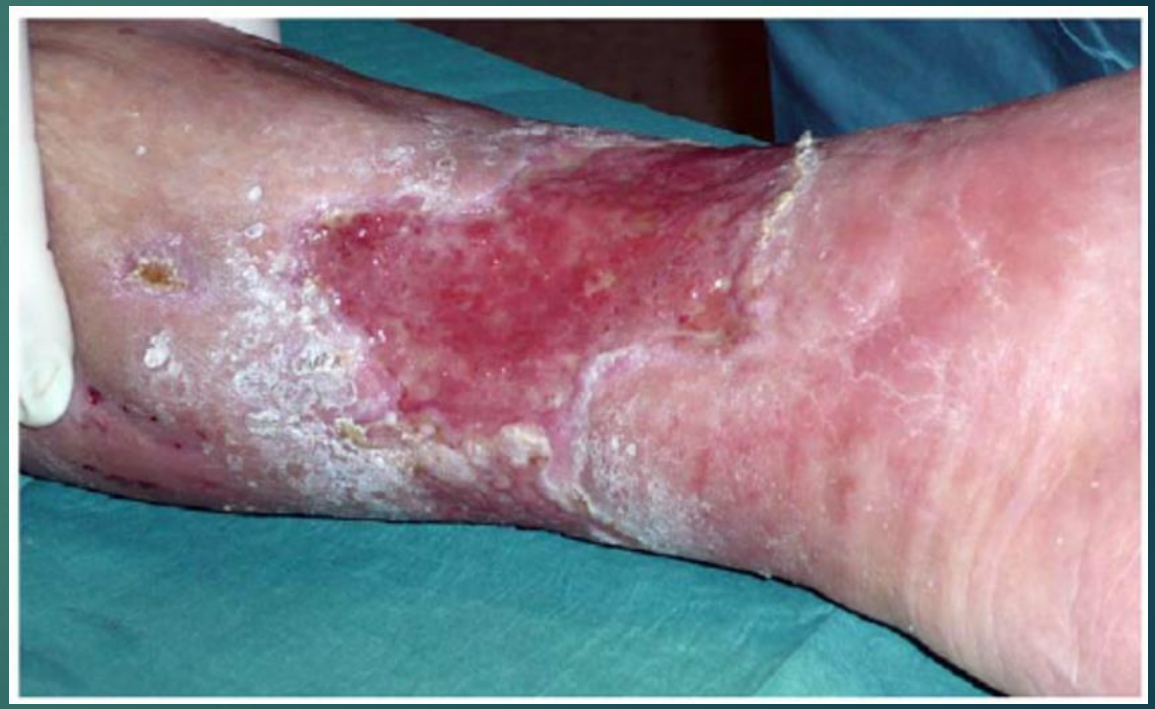
Grade	Category	Clinical description
0	0	Asymptomatic
I	1	Mild claudication
I	2	Moderate claudication
I	3	Severe claudication
II	4	Ischemic rest pain
III	5	Minor tissue loss – nonhealing ulcer, focal gangrene with diffuse pedal ischemia
III	6	Major tissue loss – extending above transmetatarsal level, frank gangrene

Arterial insufficiency

- Palpation of pulses
  - Absent pulses can be an indicator of no flow, but palpable pulses are never an indicator of sufficient flow
- ABI's
  - Widely endorsed, non-invasive
  - Can be unreliable
  - Compares pressures in brachial arteries to lower extremity pressures
  - However, MANY diabetic have calcified, non-compressible vessels leading to falsely elevated ABI's
  - Variation in administration of exam
- Duplex arterial ultrasound, pulse volume recordings, transcutaneous oximetry, skin perfusion pressures

Venous Leg Ulcers (VLU)

- AKA stasis ulcers
- Risk factors
  - Older age
  - Obesity
  - Previous leg injuries
  - DVT
  - Phlebitis
- Irregular, shallow, located over bony prominence
- Varicosities, edema, venous dermatitis
- Usually recurrent
- Can persist for weeks to years

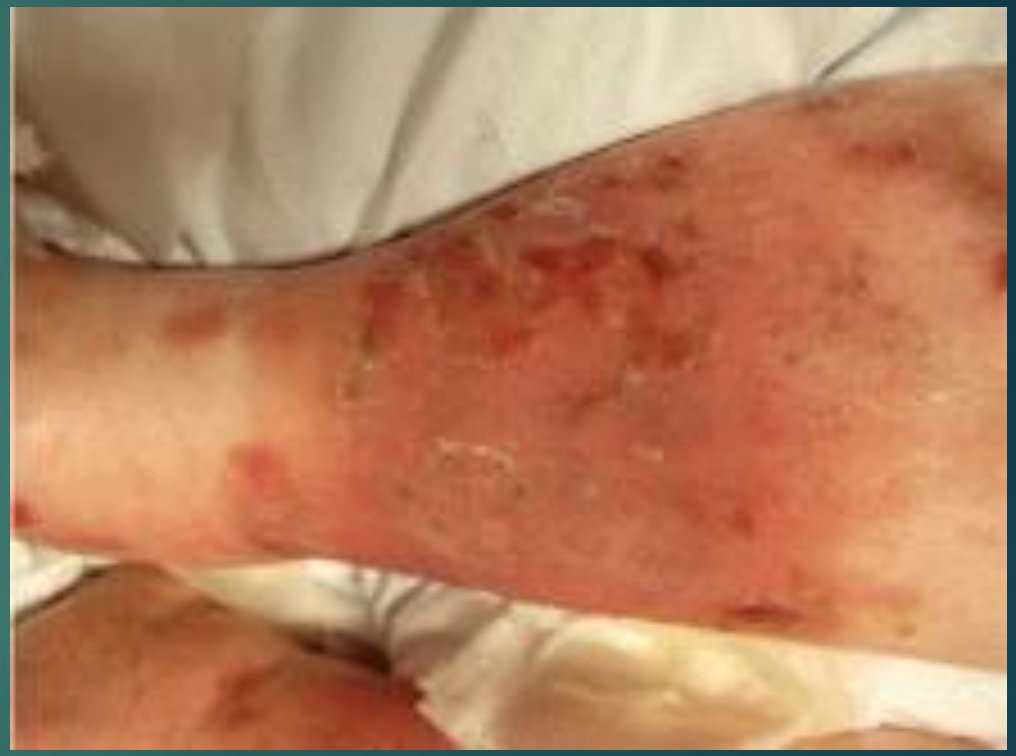


Distinguishing cellulitis vs. venous stasis

- More than 10% of patients labeled as having cellulitis do not have cellulitis
- Key characteristics:
  - Redness, warmth, tenderness, swelling
- Also…
  - Trauma
  - Pain
  - Leukocytosis
  - Underlying immunosuppression/comorbidities
  - Rapid progression
  - Previous episodes
- Long-standing, slowly progressive course and a history of unsuccessful treatment with abx are strong indicators of a condition OTHER than cellulitis

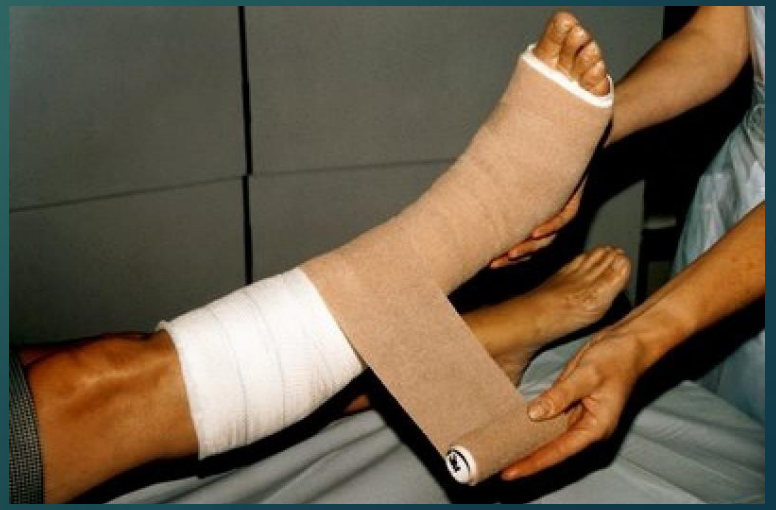
Stasis Dermatitis

- Most common mimic of cellulitis
  - Ill defined pitting edema of lower extremities
  - Erythema, hyperpigmentation, serous drainage, superficial desquamation
- Generally bilateral
- Ongoing for years
- Pitting edema
- Legs non-tender



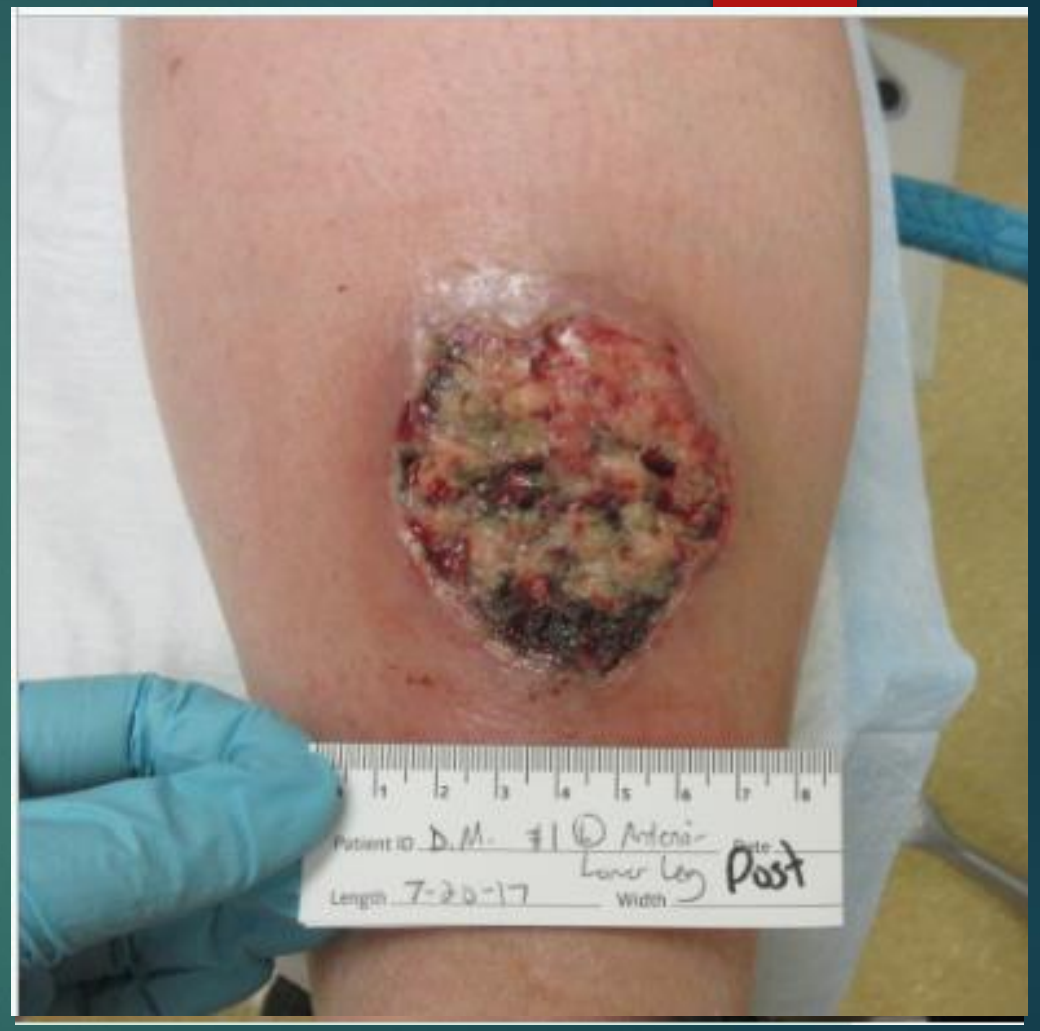
Venous wound management

- COMPRESSION THERAPY
  - Standard of care
  - Inelastic, elastic, and intermittent pneumatic compression
  - Reduces edema, improves venous reflux, enhances healing, and reduces pain
- After healing, lifelong maintenance of compression is necessary to prevent recurrence
- Success rates from 30-60% at 24 weeks, 70-85% at one year (Margolis et al, 2000)

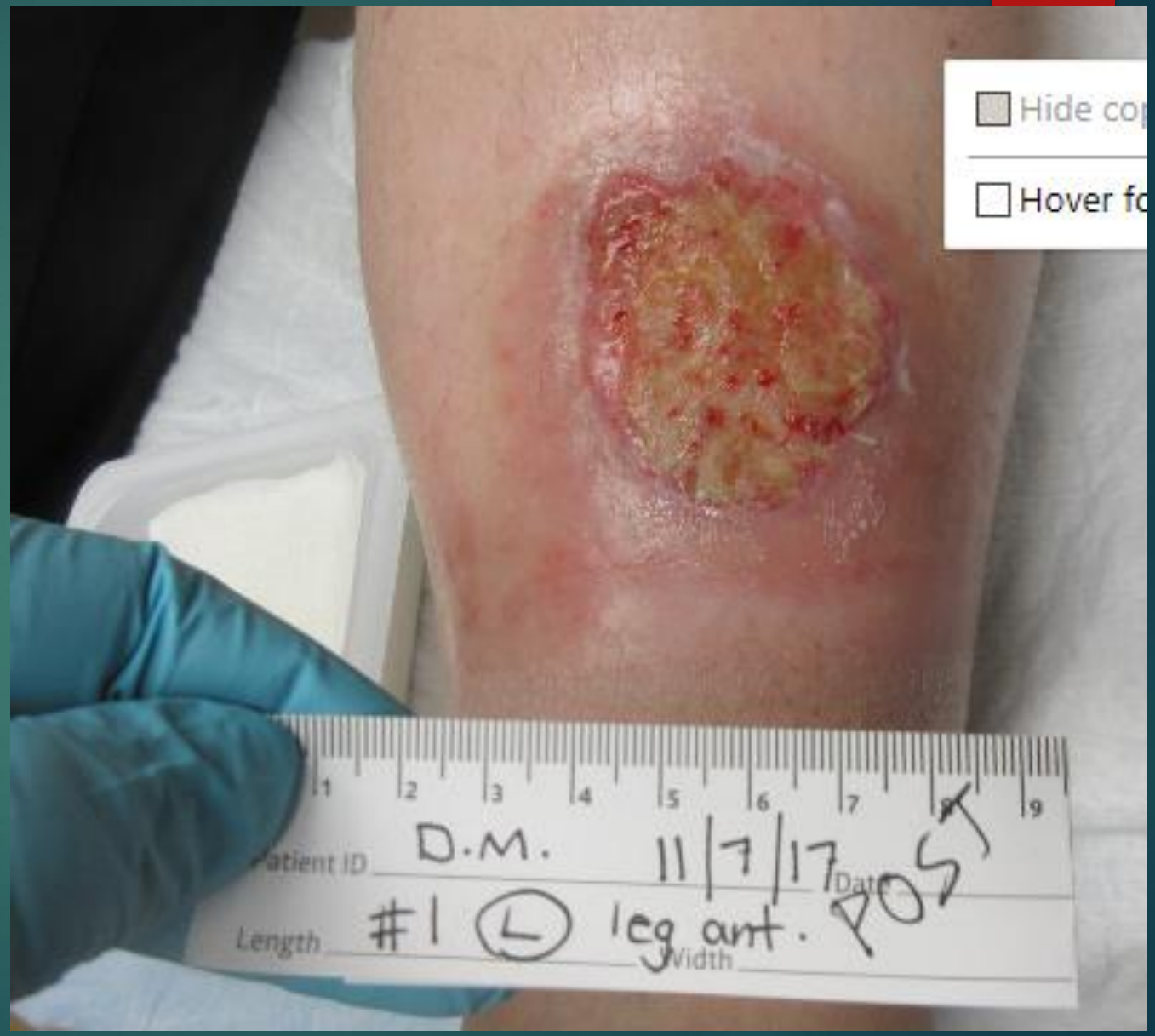


Venous Wounds

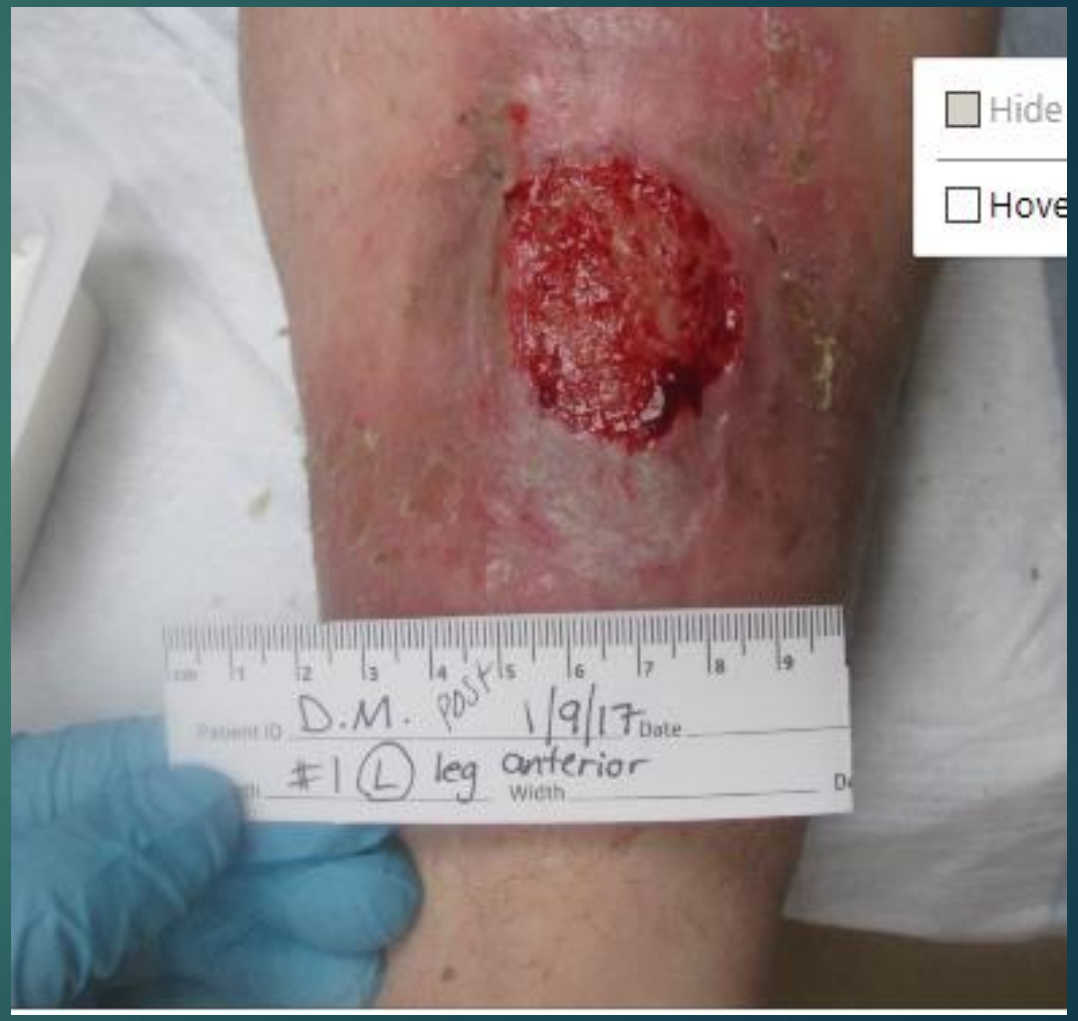
- 27 y/o DM female, A1c 6.4
- Inciting incident: trauma with fall
- Was placed on Bactrim by PCP, no cultures
- Physical exam: palpable pulses, significant edema, scattered minor varicosities
- Initial treatment: tissue culture following debridement, Santyl, serial follow-up with debridement



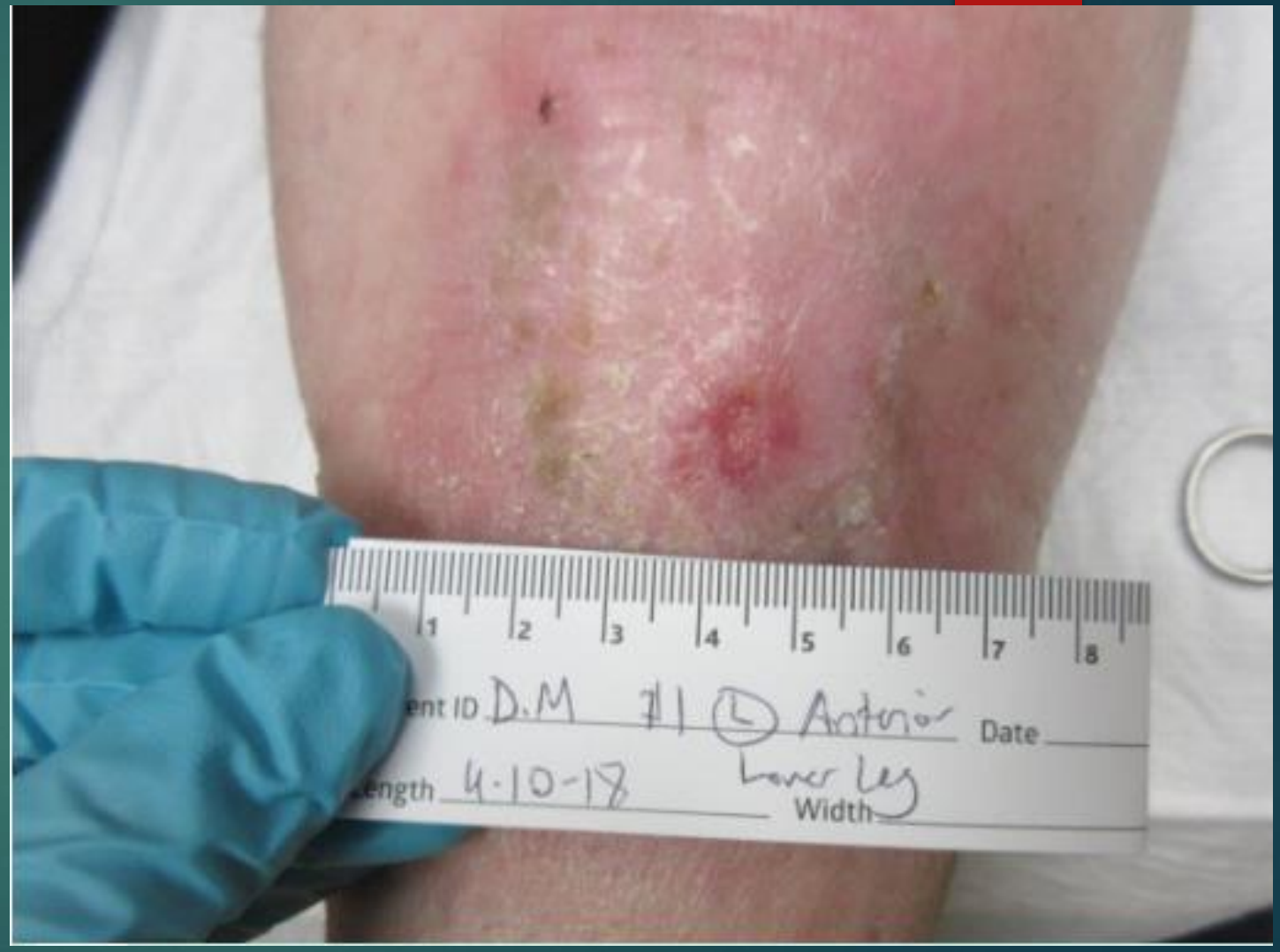
- 3 months into use of Santyl
- Sporadic f/u
- Venous function evaluated
  - Superficial reflux noted
- Transitioned to multi-layer compression wraps
  - Forced compliance!



- 6 months into initial treatment with compression therapy
- Aquacel Ag primary dressing
  - Highly exudative wound

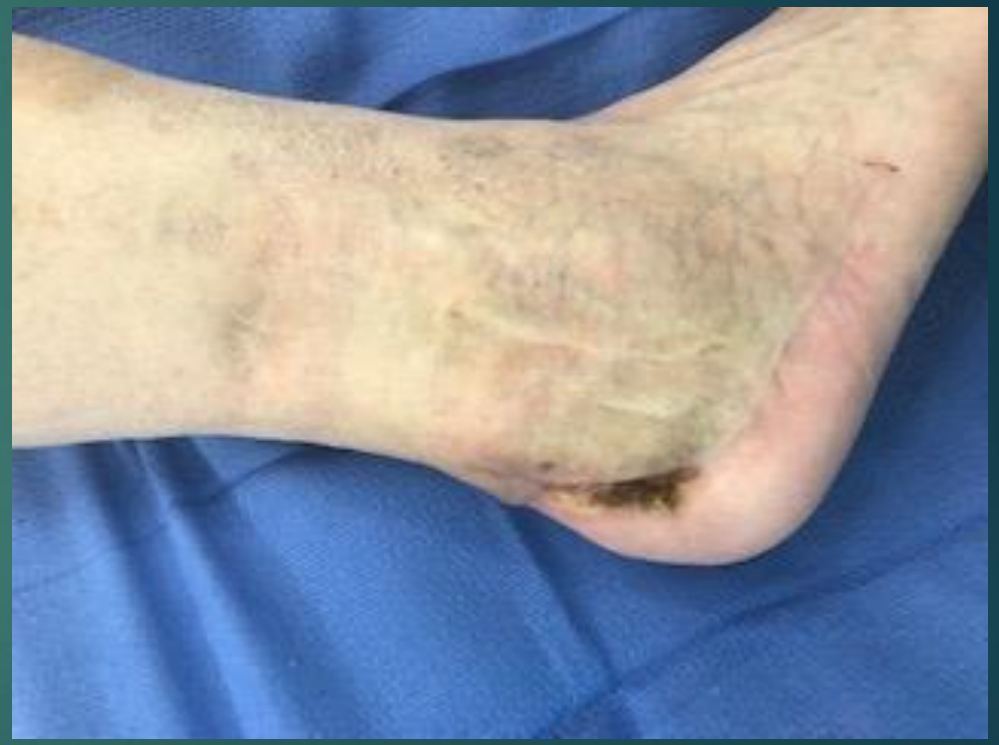


- Final f/u ~9 months from initial visit
- Transitioned to medical grade compression stocks
- No recurrence

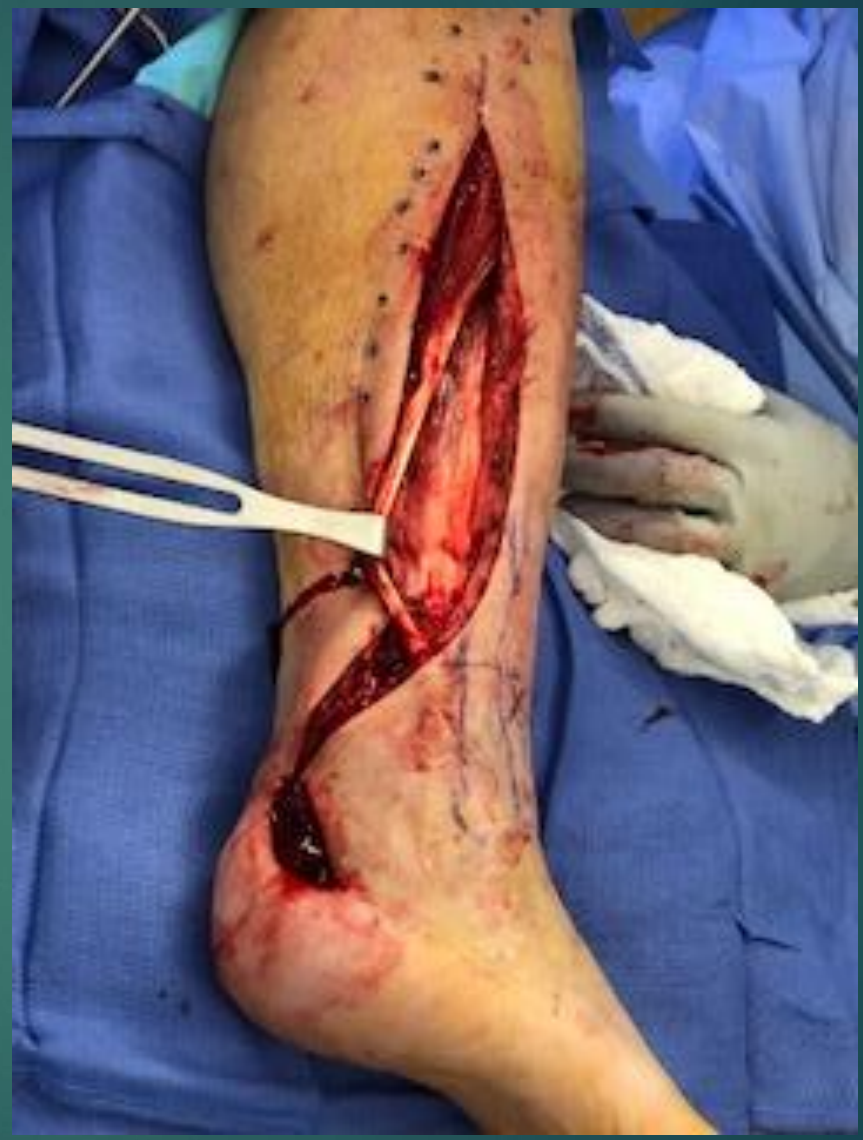


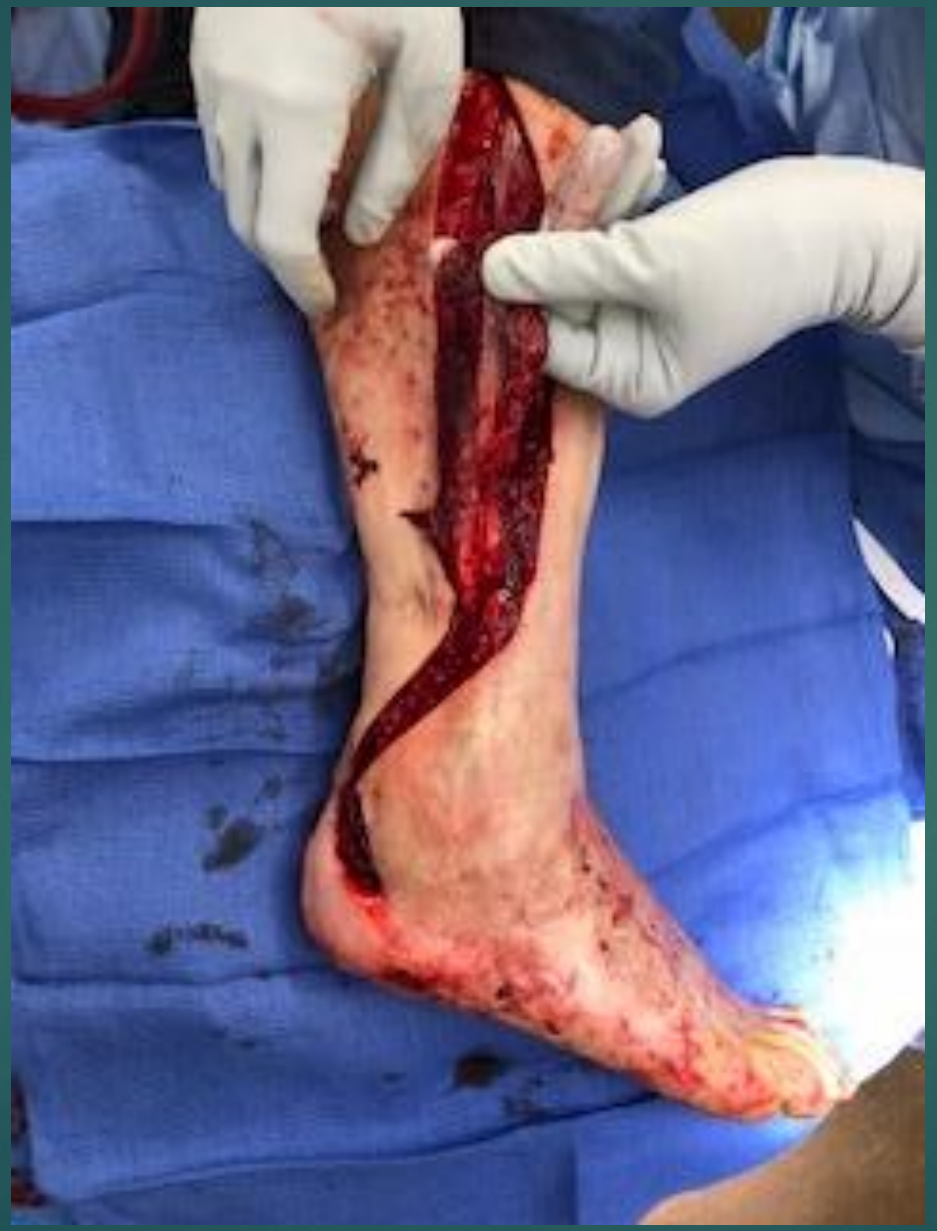
Advanced Wound Healing

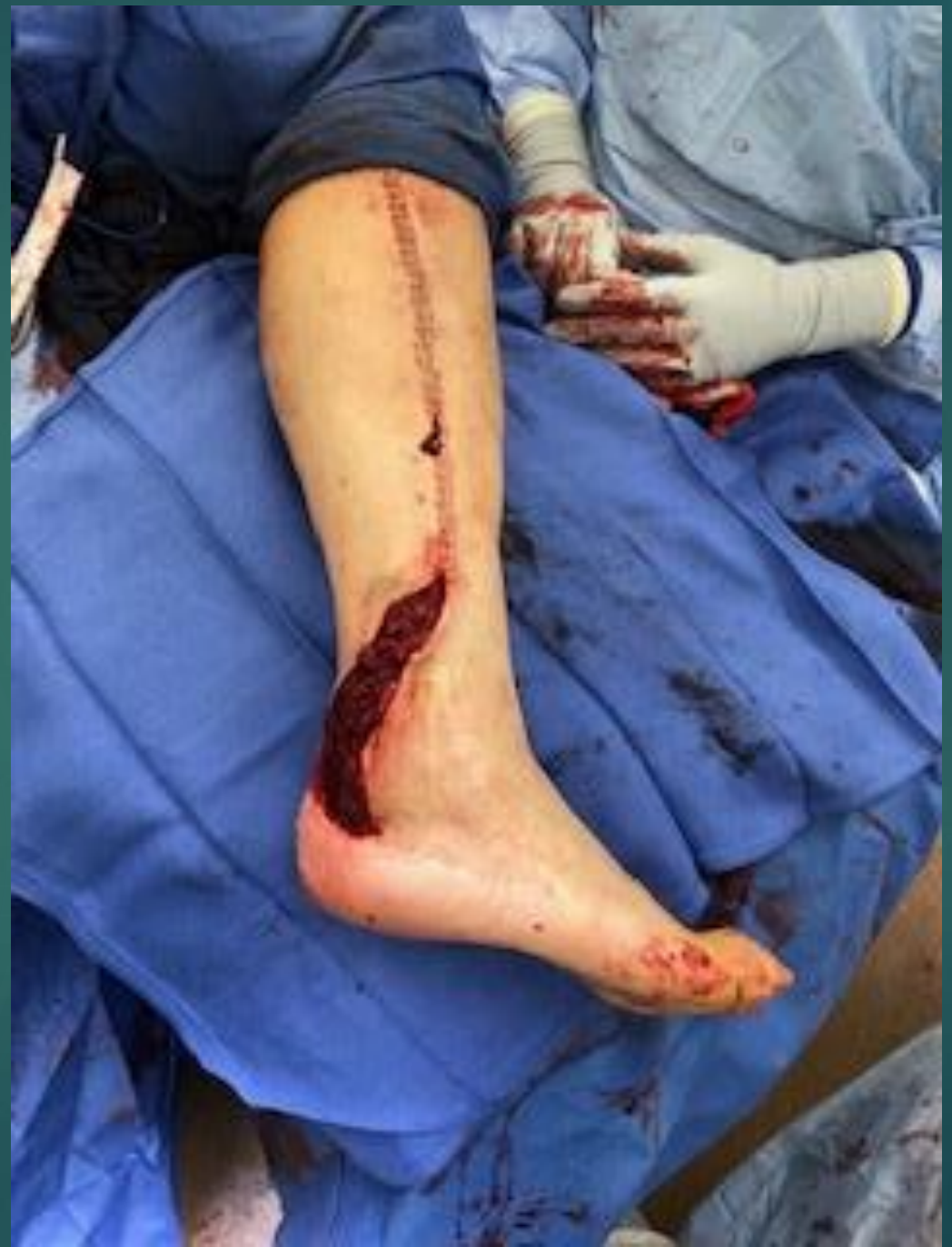
- 54 y/o DM male with hx of >20 year surgical wound with osteomyelitis to heal from old calcaneal fracture
- Underwent multiple debridements, bone biopsy, treatment of OM, local wound care
- Vascular intervention

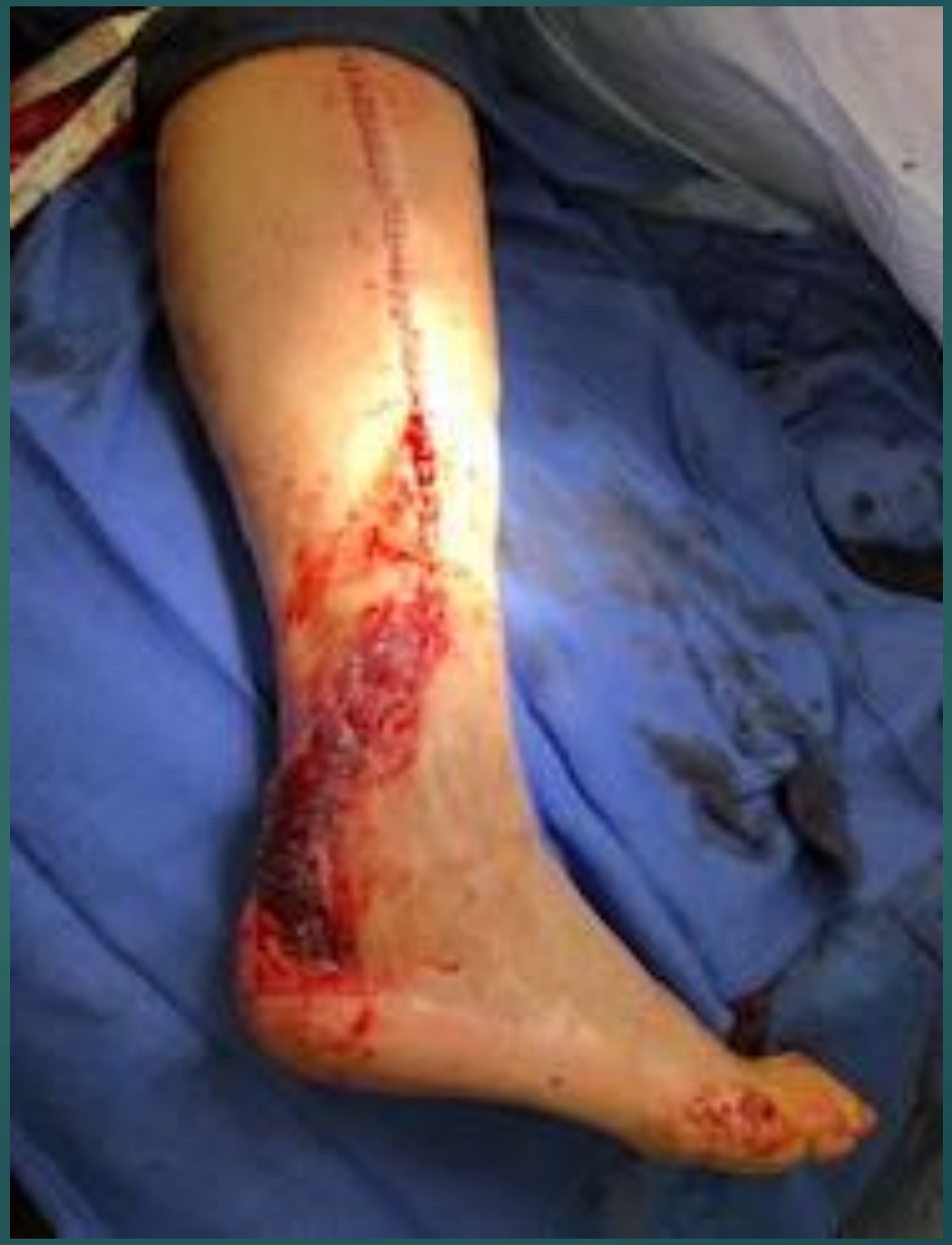


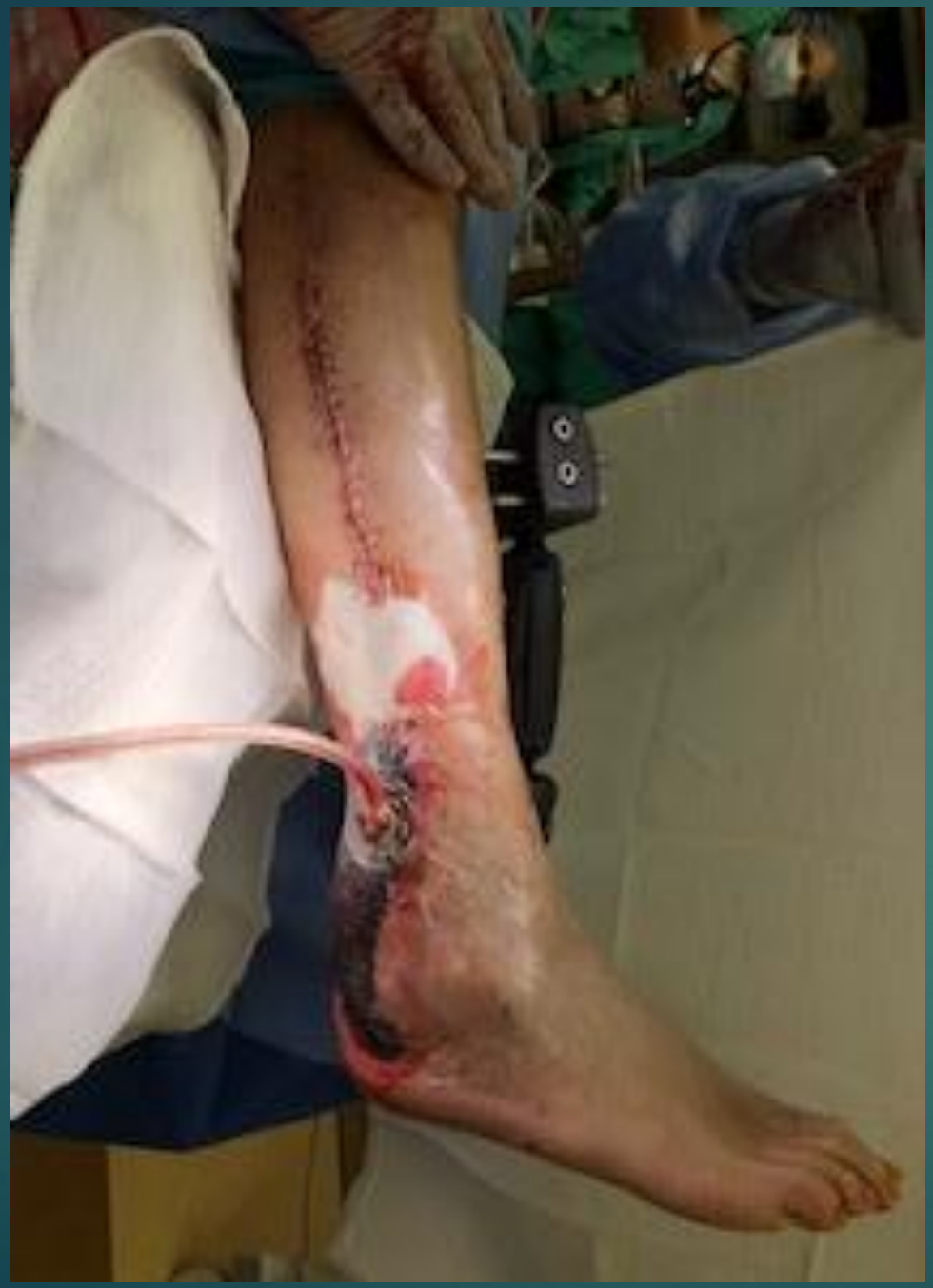
Peroneus brevis muscle flap

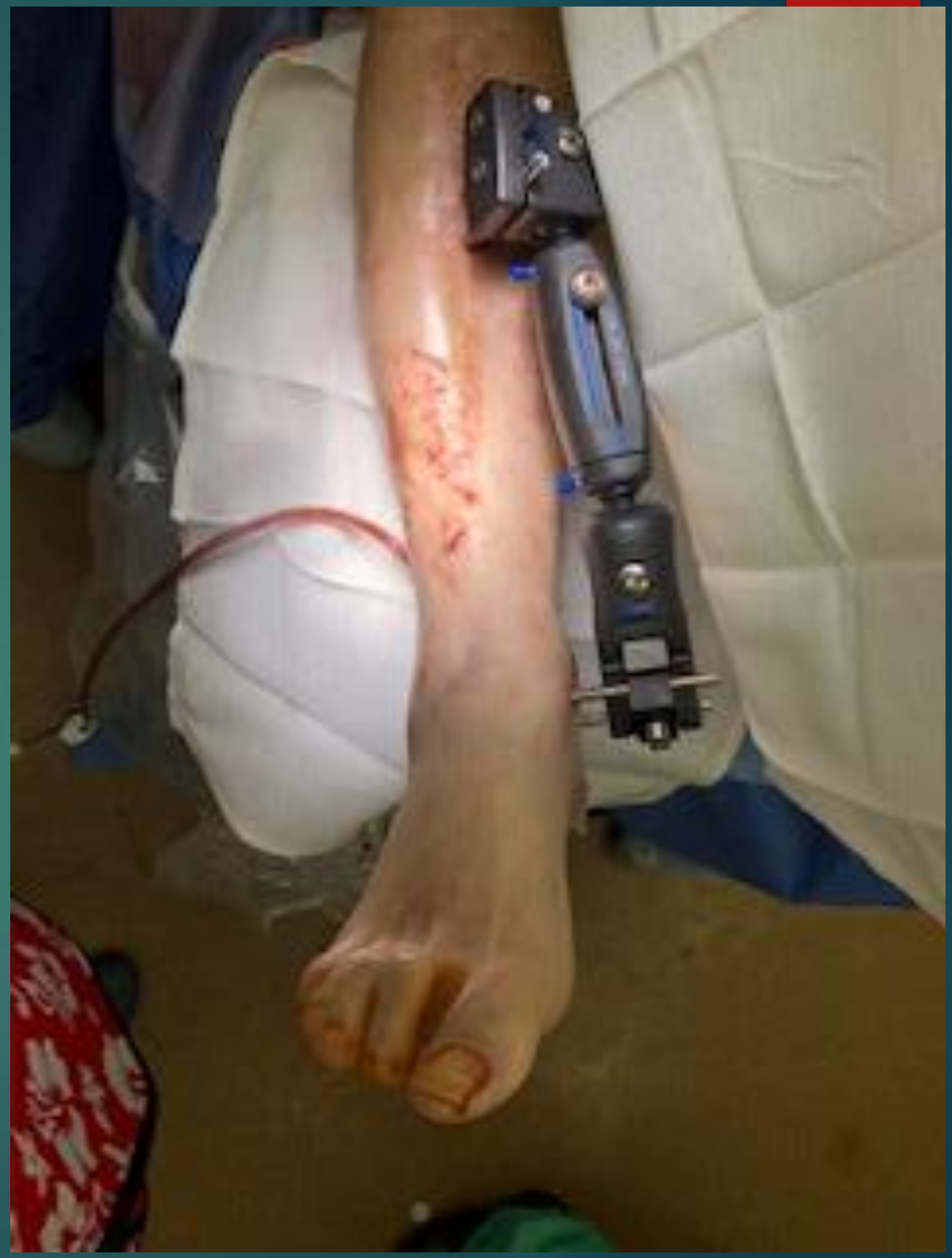


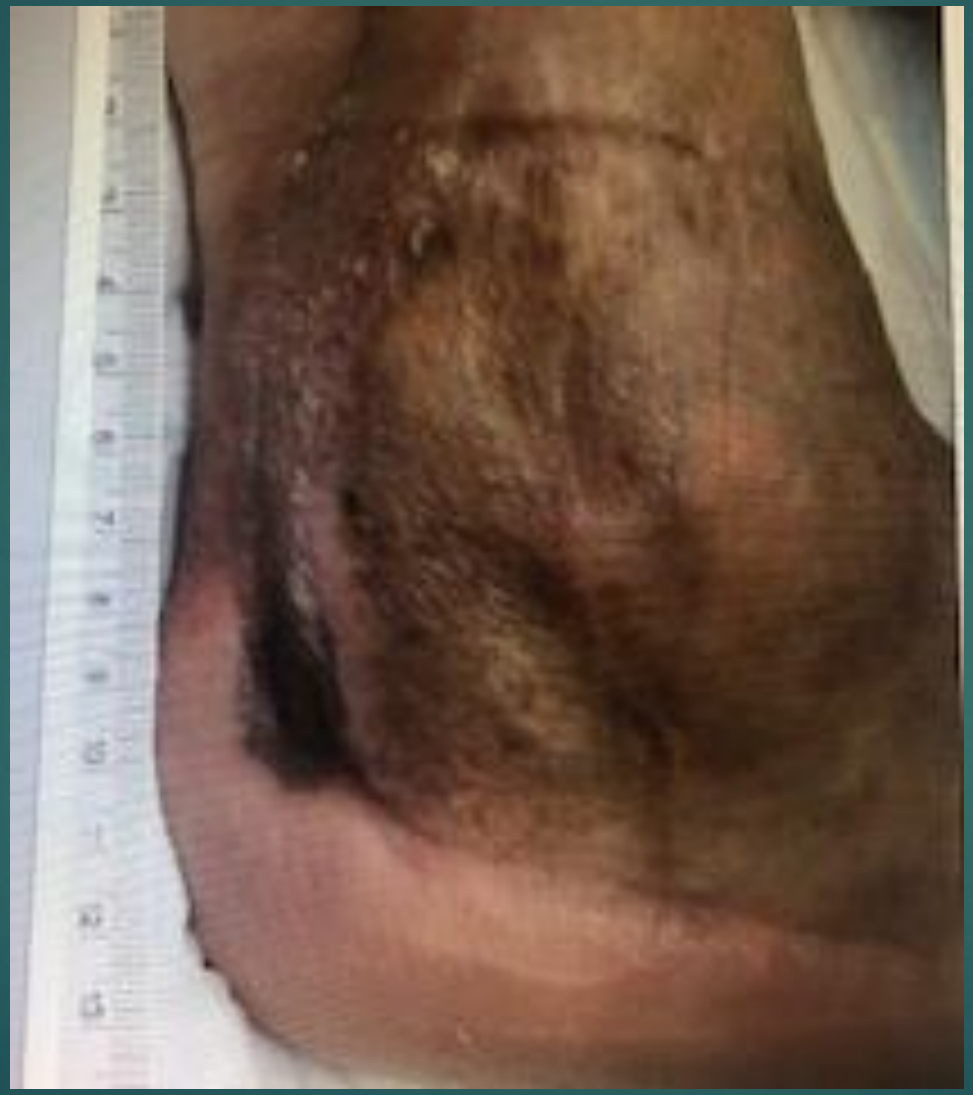












In Summary…

- Determining wound etiology can help guide treatment
- OFFLOADING and COMPRESSION
- Appropriate cultures and management of infection
  - Know when parental antibiotics are indicated
- Keep dressings simple
  - But avoid the standard "wet to dry"
- Wound healing is a TEAM APPROACH
  - Communication and appropriate referrals are key

Resources

Bus S. The Role of Pressure Offloading on Diabetic Foot Ulcer Healing and Prevention of Recurrence. Plast Reconstruct Surg. 2016 Sep;138(3 Suppl):179S-87S.

Collins L, Seraj S. Diagnosis and treatment of venous ulcers. Am Family Physician. 2010; 81(8): 989-996.

Donovan A, Schweitzer M. Use of MR Imaging in Diagnosing Diabetes Related Pedal Osteomyelitis. Radiographics. 2010; 30(3): 723-736.

Elraiyah T. et al. A systematic review and meta-analysis of off-loading methods for diabetic foot ulcers. J Vasc Surg. 2016 Feb;63(2 Suppl):59S-68S.e1-2. doi: 10.1016/j.jvs.2015.10.006.

Gutekunst D, Hastings M, Bohnert K, Strube M, Sinacore D. Removable cast walker boots yield greater forefoot off-loading than total contact casts. Clin Biomech. 2011 Jul; 26(6): 649-654

Keller E, Tomecki K, Alraies M. Distinguishing cellulitis from its mimics. Cleveland Clinic Journal of Medicine. 2012 August; 79(8):547-552

Lipsky B, Berend A, Cornia P, Pile J, Peters E, Armstrong D, Deery H, Embil J, Joseph W, Karchmer A. 2012 Infectious Diseases Society of America Clinical Practice Guidelines for Diagnosis and Treatment of Diabetic Foot Infections. Clin Infectious Diseases, 2012 June;54(12):e132-e173.

Pecoraro R, Reiber G, Burgess E. Pathways to diabetic limb amputation. Basis for prevention. Diabetes Care. 1990 May;13(5)513-521.

Reiber G, Lipsky B,Gibbons G. The Burden of Diabetic Foot Ulclers. Am J Surgery. 1998 August; 176(2):5s-10S.

Simon P. Skin wound healing. Medscape. 2016. http://emedicine.medscape.com/article/884594-overview

THANK YOU!