

Wound Care

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Disclosure slide

- I have no financial disclosures.
- I will be talking about particular products that we happen to currently have on formulary at UAB. Use of name brands is not intended to insinuate that I am promoting that particular brand product over another, nor does it mean that UAB is promoting that particular brand.
- All pictures of patients obtained with permission.

Everything you need to know about Wound Care

- Wet to Dry
 - For patients who were going to heal anyway
- Wound VacTM
 - For covering up a wound you want to ignore

What does your body do to heal?

What are we really trying to do with Wound Care?

- Stop bleeding
- Fight infection
- Get rid of slough & necrotic tissue
- Promote granulation tissue growth

Stop the bleeding

- Your body does NOT want you to bleed to death
- Pressure
- Oxidized Regenerated Cellulose (ORC)



Fight infection

- All wounds have bacteria
 - Colonized
 - Critical Colonization
 - Infection
- Biofilm
- Topical swab cultures often not helpful
 - Does not differentiate between colonization and infection
- Not everything that is red is infected



Fight infection

- Lots of options
- Wound Cleansers
 - Sodium hypochlorite
 - Hypochlorous acid
 - With or without surfactant
- Silver containing dressings
 - Provides sustained antimicrobial coverage for 7 days
 - Inhibits bacterial cell division which prevents development of resistance
- Methylene blue / gentian violet
- Bacterial binding dressings



Fighting Infection: Dakin's

- Dakin's is a broad spectrum antimicrobial. It is also helpful in management of wound odor.
- Quarter Strength = 0.125%
 - Dakin's 0.125% is bactericidal while still being minimally toxic for good cells/fibroblasts.
- Di-Dak-Sol= 0.0125%
 - Dakin's 0.0125% is bactericidal while being very safe to fibroblasts.



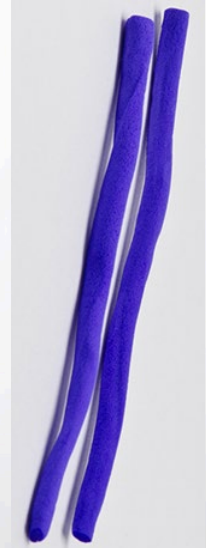
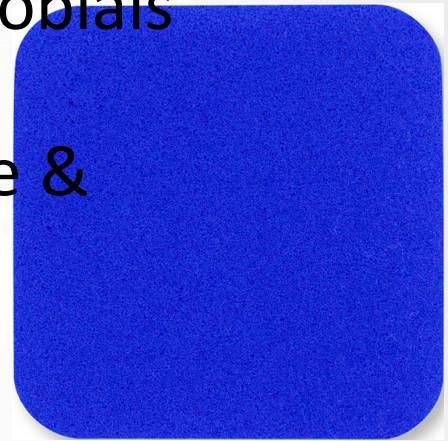
Fighting Infection: Foam dressing with silver

- Silicone adhesive foam with Silver
- Can be on for 3 days at a time
- Foam can absorb fluid



Fighting Infection: Foam with other antimicrobials

- Antimicrobial foam - utilizes methylene blue & gentian violet to manage bioburden
- Kills bacteria within the foam
- Foam aids in maintaining moist wound environment
- Classic variety helps treat epibole
- Classic variety promotes autolytic debridement



Fighting Infection: Case

- 34 year old homeless paraplegic with multiple pressure ulcers and wounds to dorsal foot from dragging under wheelchair. Had a skin graft that failed to Right dorsal foot. Started HFB Ready Transfer 6/7/19, Results after one week

June 7, 2019



June 13, 2019

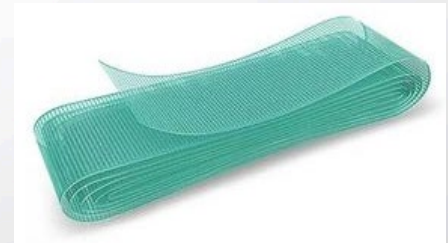
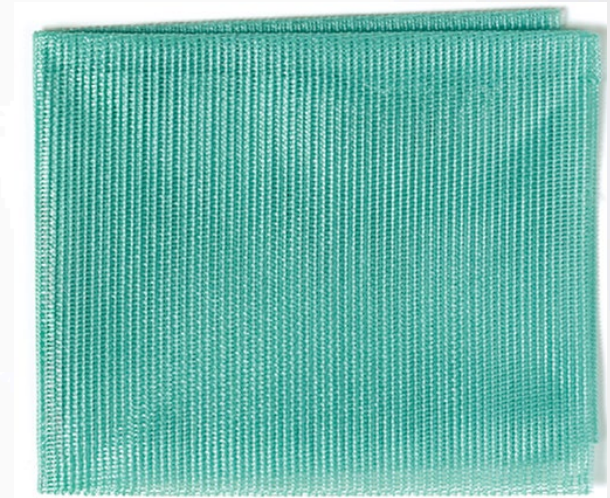


June 19, 2019



Fighting Infection: Binding agents

- Irreversibly binds to microorganisms which are then physically removed with each dressing change
- Bind to bacteria and fungi through hydrophobic interaction
- No bacterial resistance
- Does not kill bacteria, thus there are no bacterial endotoxins released from dead bacteria.
- Non cytotoxic
- No risk of allergies
- No contraindications – safe for use during pregnancy, while breast feeding, and on children.



Fighting Infection: Hypochlorous Acid

- Cleansing agent which can be used instead of normal saline in wet-to-dry dressings
- Cleanses and debrides
- Non Cytotoxic, Non Sensitizing, Non Irritating, No Oral Toxicity, No Clinical Contraindications
- Cleansing Contact time 3-5 minutes

Fight Infection

- Cytotoxicity
- Hydrogen peroxide
- Alcohol
- Topical antibiotics

Hydrogen Peroxide

- Hydrogen peroxide is a “household cleaner” ... used for cleansing surfaces, instruments (trach care).
- Cytotoxic and will impair wound healing
- Pseudomonas has developed resistance
- Disrupts granulation tissue growth



Get rid of necrotic tissue: Five ways to debride

- Necrotic tissue increases inflammation
- Sharp
 - Make a chronic wound acute
- Chemical
 - Wound cleansers
- Enzymatic
 - Santyl
 - Maggots





Get rid of necrotic tissue: Collagenase

- The only enzymatic debrider on the market
- Used on slough or eschar
- Cost is ~\$200 for a “travel toothpaste” size tube
- Apply nickel thick
- Must have a source of moisture to activate



Get rid of necrotic tissue: Five ways to debride

- Autolytic
 - Moist wound environment
 - Alginates
 - Honey
- Mechanical
 - Wet to dry
 - Nonspecific debridement
 - Instillation therapy



Get rid of necrotic tissue: Five ways to debride

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Get rid of necrotic tissue: Alginates

- Silver, Alginate, and Maltodextrin
- Promotes autolytic debridement
- Decreases wound odor

Promote granulation tissue growth: Making a nice wound environment

- Moist wound environment is optimal for healing
- Promotes autolytic debridement
- Promotes granulation tissue growth
- Wet to moist means at least BID
- Honey / Salves
- Gelling fibers, alginates, foams
- Collagen
- Wound vac
 - Not for infected wounds
 - Not for wounds with >20% slough/necrotic tissue



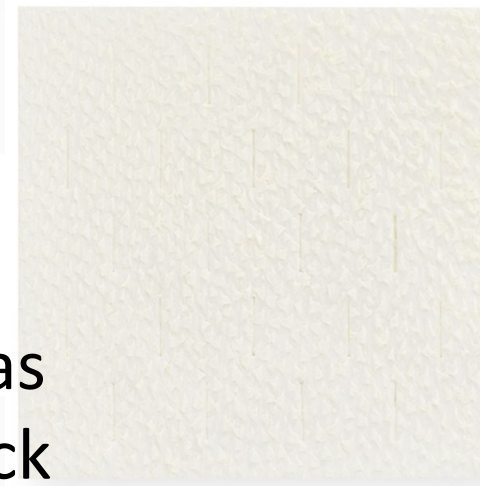
Promote tissue growth: Gelling fiber

- Gelling dressing
 - Conforms to wound bed to reduce dead space in which microorganisms can grow.
 - Locks in exudate to minimize maceration
 - Locks in bacteria to minimize cross infection
 - Promotes a moist wound healing environment
 - Helps decrease pain with dressing changes.



Promote tissue growth: Collagens

- MMPs attack and break down collagen in the wound bed.
- Collagen dressings act as sacrificial lamb as an alternate source for the MMPs to attack



Promote tissue growth:

Negative Pressure Wound Therapy

- Mechanisms of action:

- Removes exudate which reduces cytokines, bacteria, and MMPs within wound bed
- Reduces edema thereby improving perfusion to the wound bed
- Promotes overall wound contraction
- Promotes mechanical stretch at the cellular level which is believed to stimulate cell division, proliferation, and angiogenesis
- Promotes granulation tissue formation

Promote tissue growth:

Negative Pressure Wound Therapy

- Indications:
 - Deep wounds with large amounts of exudate
 - Wounds that are pale/slow to granulate
 - Flaps – preop, post op, and donor sites
 - Orthopedics



Promote tissue growth: Negative Pressure Wound Therapy

- **Contraindications:**

- >20% necrotic tissue
- Malignancy

- **Cautions:**

- Infected wounds or those with Osteomyelitis – okay to use after starting antibiotics
- Exposed vessels/organs close to the surface –use with protective measures and close monitoring
- Conditions with increased risk of hemorrhage

Moist Wound Environment is good- But don't make it too wet!

- Moisture can cause skin breakdown
- Diaper technology has come a long way
 - Gauze & ABD pads cheap option but holds moisture against the skin
 - Great options available as primary or secondary dressing that pulls fluid up & out
 - Drawtex, foam, Xtra-sorb, biotin



Moisture Control: Foam dressing

- A silicone adhesive foam dressing that is thin and conformable
- Maintains moist wound environment but also absorbs fluid
- Also used for pressure ulcer prevention



Moisture Control

- Moves exudate and debris into the porous material of the dressing against the force of gravity.
- Draws out a large amount of exudate, devitalized tissue, and bacteria
- Actively draws fluid away from the wound
- Draws out adherent fibrin and slough, while leaving healthy granulation tissue in place.

What does your body do to heal?

What are we really trying to do with Wound Care?

- Stop bleeding
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The wound won't heal, so now what do we do?

- There's always a reason a wound won't heal
- Concentrate on WHY the wound is there
- Then determine WHAT to put on the wound
- (Feel free to get help)



Wound Healing Requires:

- Signal to heal
 - Inflammation (but not too much)
- Building Blocks
 - Protein
- Energy (oxygen)
 - Perfusion
- Proper environment
 - Moist wound free of infection, necrotic tissue, and edema




Impaired Wound Healing

- Chronic wounds often start as a minor injury
- Failure to heal because one or more of the requirements for healing is not met
- To convert a chronic wound to a healing wound:
 - Identify the cause and correct it
 - (Not always easy)

Clinical Approach

- Identify the primary etiology
- Identify secondary complicating factors
 - Local
 - Systemic
- Pick modes of therapy to specifically treat the obstacles of healing



Identify Primary Etiology

- Arterial Ulcer
- Venous Ulcer
- Pressure Ulcer
- Neuropathic Ulcer (Diabetic)
- Moisture Associated Skin Damage
- Traumatic Wound
- Many have mixed etiology

Primary Etiology: Arterial Insufficiency

- History of CAD, CVA, DM, dyslipidemia, HTN, CKD, advanced age, tobacco use
- Intermittent Claudication, Pain with leg elevation
- 6 Ps of acute limb-threatening occlusion: pulselessness, pain, pallor, paresthesia, paralysis and polar
- Physical finding: diminished pulses, skin cool to touch, rubor in dependent position

Assessing Arterial Flow

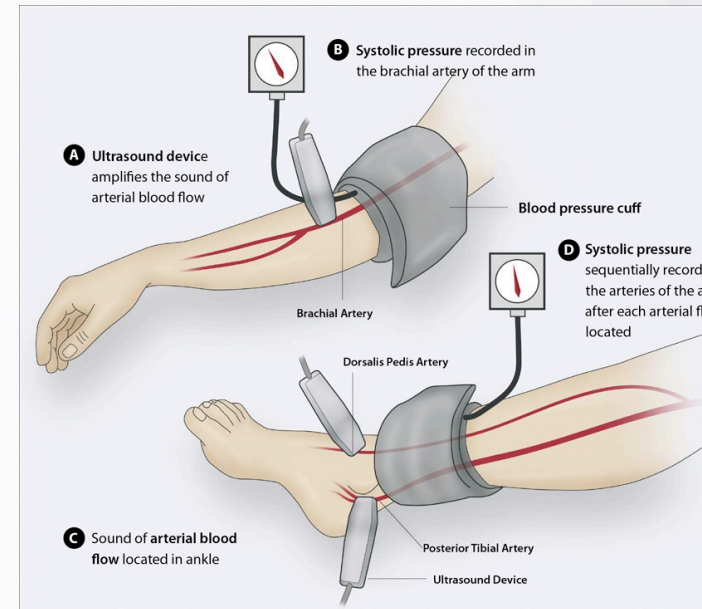
- Non-Invasive Modalities
 - Ankle Brachial Index
 - Pulse Volume Recordings
 - Transcutaneous oximetry
- Advanced Vascular Studies
 - Conventional Angiography
 - CT Angiogram
 - MR Angiography



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Interpretation of the ABI

RESTING ABI	SEVERITY
0.91 - 1.30	Normal
0.70 – 0.90	Mild Dis
0.40 – 0.69	Mod Dis
<0.40	Severe Dis

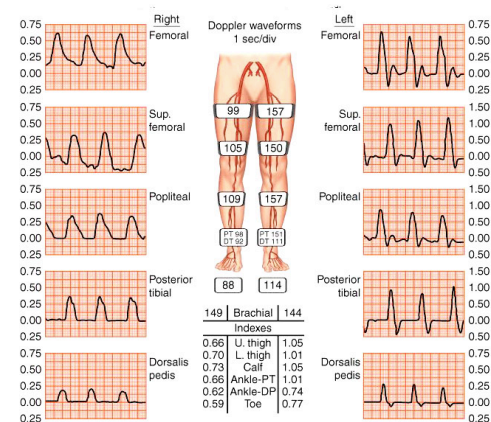


Pulse-Volume Recordings (PVRs)

- Valuable in patients with calcified vessels
- Pulses read as waveforms
- The shape of these waveforms help identify level of arterial disease
- Used as a guide for need for further evaluation or intervention



A



B

A. Pulse volume recording is done by connecting blood pressure cuffs and plethysmograph to various levels of the leg. B. Typical report of peripheral study with arterial segmental pressure measurement plus Doppler evaluation of the lower extremity.

Arterial Insufficiency Treatment

- Consult Vascular Surgery for open or endovascular revascularization
- Limit debridement while considering need for open necrotic tissue and wet gangrene
- Maintain clean wound environment
- Think more about infection prevention
- Stabilize dry gangrene with povidone

Primary Etiology: Venous Insufficiency

- Venous ulcer is most common lower extremity ulcer
- Valvular reflux and incompetence -> Venous HTN
- Can be clinically similar to lymphedema



Photos by Rajabrata Sarkar, MD, PhD



Venous Insufficiency Ulcer

- Venous hypertension leads to capillary bed congestion which leads to extravasation of intravascular fluid into tissue
- Edema leads to inflammatory and fibrotic changes. Skin susceptible to minor trauma.



Venous Insufficiency Ulcer

- Physical findings:
 - Edema, weeping, hemosiderin, warm feet
 - Venous dermatitis: itchy, hardened skin, scabbing, flaking
 - Shallow, exudative, ruddy red color, yellow film, seldom tunneling or undermining



Venous Ulcer Evaluation

- Send patient to Vein Clinic
- Venous duplex ultrasound
- Venous Plethysmography
- Other options: CT venography, MR venography, contrast venography, and intravascular ultrasound

Venous Insufficiency Treatment

- Get rid of edema
- Elevate
- Compressive dressings
 - Gold Standard of treatment
- Therapeutic level compression: 30–40mmHg
 - Contraindicated if pt has uncompensated heart failure or ABI <0.5
 - 20-30mmHg if ABI 0.5-0.7

Principles of Compression

- Graduated from base of toes to knee
- 30-40 mm Hg
 - Lower for mixed etiology
- Unna, 2/3/4 layer
- Compression stockings
- Put on before getting out of bed or after lying down 20-30 minutes



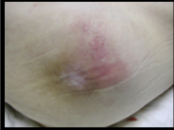

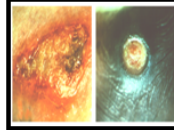


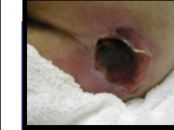






Venous Insufficiency Treatment

- Works through several mechanisms
- Reduce loss of exudate related protein
- Decrease activation of MMPs (unknown mechanism)
- Reduce formation of peri-capillary fibrinous cuffing
- Promotes fibrinolysis of excessive fibrin deposition
- Decreases diffusion gradient for O₂ and nutrients

Primary Etiology: Pressure

- Located over boney prominences or beneath devices
- Usually have round but not irregular wound edges, or match a device imprint

The "Fruits" of Pressure Ulcer Identification & Treatment

					
					
<p>Stage 1</p> <p>Think Tomato Doesn't blanch and return to original color. Has an unusual feel.</p> <p>Description: Red intact skin</p> <p>Management: *Initiate Nursing Skin Care protocol</p> <p>*Turn off affected area</p> <p>*Do not massage</p>	<p>Stage 2</p> <p>Think potato Top layer of skin gone, but not too deep.</p> <p>Description: Superficial skin loss</p> <p>Management: *Initiate Nursing Skin Care protocol</p> <p>*Turn off affected area</p> <p>*May cover with Mepilex (foam) dressing change every 3 days</p> <p>*If incontinent, apply skin barrier cream, DO NOT place Mepilex/occlusive dressing.</p>	<p>Stage 3</p> <p>Think apple Wound open down into fleshy part, but not to core.</p> <p>Description: Shallow crater/partial thickness tissue loss. Subcutaneous visible but bone, tendon or muscles are not exposed</p> <p>Management: *Initiate Nursing <u>Wound</u> Care protocol</p> <p>*Turn off affected area</p> <p>*Apply NS or Vashe moist gauze, cover with dry gauze/Abd pad. Change Q12hrs.</p> <p>*Consult WOCN</p>	<p>Stage 4</p> <p>Think peach Deep wound, open to core (bone, tendon).</p> <p>Description: Deep crater / Full thickness tissue loss, exposed bone, tendon or muscles</p> <p>Management: *Initiate Nursing Skin Care protocol</p> <p>*Turn off affected area</p> <p>*Apply apply NS or Vashe moist gauze, cover with dry gauze/Abd pad. Change Q12hrs.</p> <p>*Consult WOCN</p>	<p>Unstageable</p> <p>Think rotten peach You know it's probably bad very deep, but you can't see how deep or to where.</p> <p>Description: Yellow, brown, or black and you can't see the wound bed / the base of the ulcer is covered by slough and/or eschar</p> <p>Management: *Initiate Nursing Skin Care protocol</p> <p>*Turn off affected area</p> <p>*If yellow, brown, or black, apply NS or Vashe moist gauze, cover with dry gauze/Abd pad. Change Q12hrs.</p> <p>*Consult WOCN</p>	<p>Deep tissue injury</p> <p>Think eggplant People are not supposed to be purple or have a bruised appearance!</p> <p>Description: Deep tissue injury / purple – skin can be intact or broken. On patients with dark skin assess boney prominences closely! DTI may be darker color or warmer than surrounding skin.</p> <p>Management: *Initiate Nursing Skin Care protocol</p> <p>*Turn off affected area</p> <p>*If purple (doesn't matter if intact skin or not) begin Q12Hr Venelox for sites above knee, Betadine below knee</p> <p>*Consult WOCN</p>

Pressure Ulcer Treatment

- Reduce pressure
- Five layer foam dressing
- Deep Tissue Injuries:
 - Above the knee use balsam peru to increase blood flow
 - Below the knee paint with Betadine

Primary Etiology: Diabetic Foot Ulcer

- One of the most common complications
- Results from peripheral neuropathy complicated by deformity, callus, and trauma.
- Diabetics have small and large vessel arterial disease and frequently uncontrolled edema.



DFU: Pathophysiology

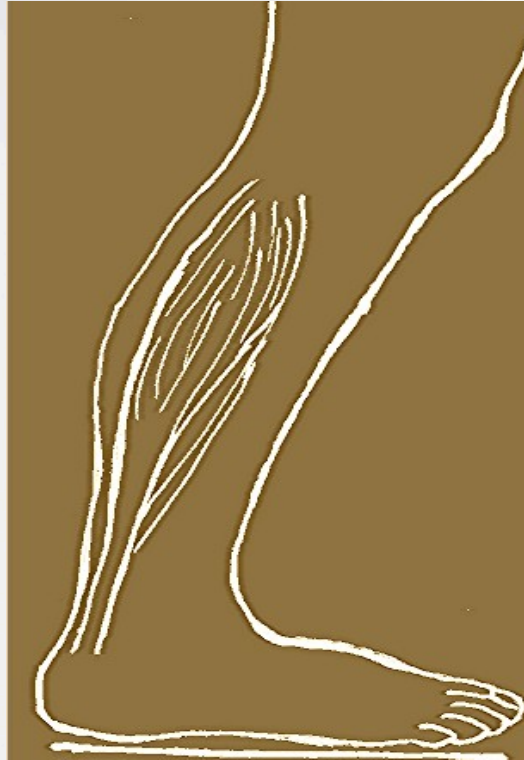
- Neuropathy Complications
- Loss of sweat & oil glands
- Dry skin that easily cracks
- Shunting of blood around the capillary bed
- Diminished neuro-inflammatory response to noxious stimuli



DFU: Pathophysiology

- Glycosylation of Collagen
 - Stiffens and thickens the tendons
- Decreased Flexibility
 - Makes self-inspection of the underside of feet difficult
- Achilles Tendon Stiffening
 - Leads to increased forefoot pressure and an increased likelihood of ulcer formation

Tight



Normal

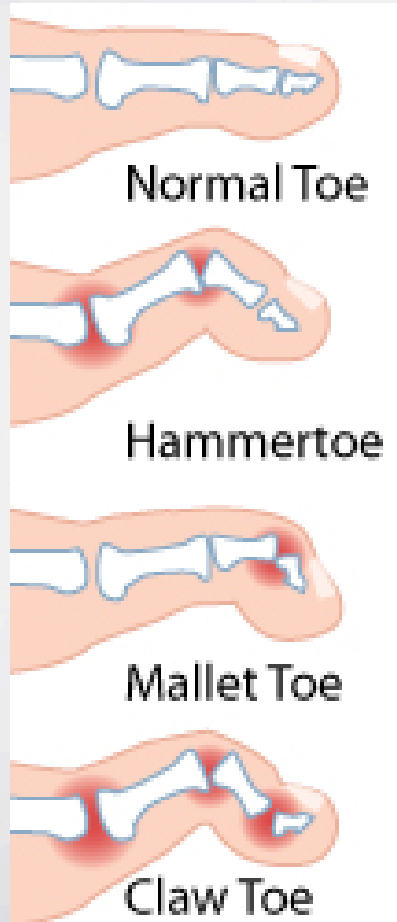


**Normal
Stress**

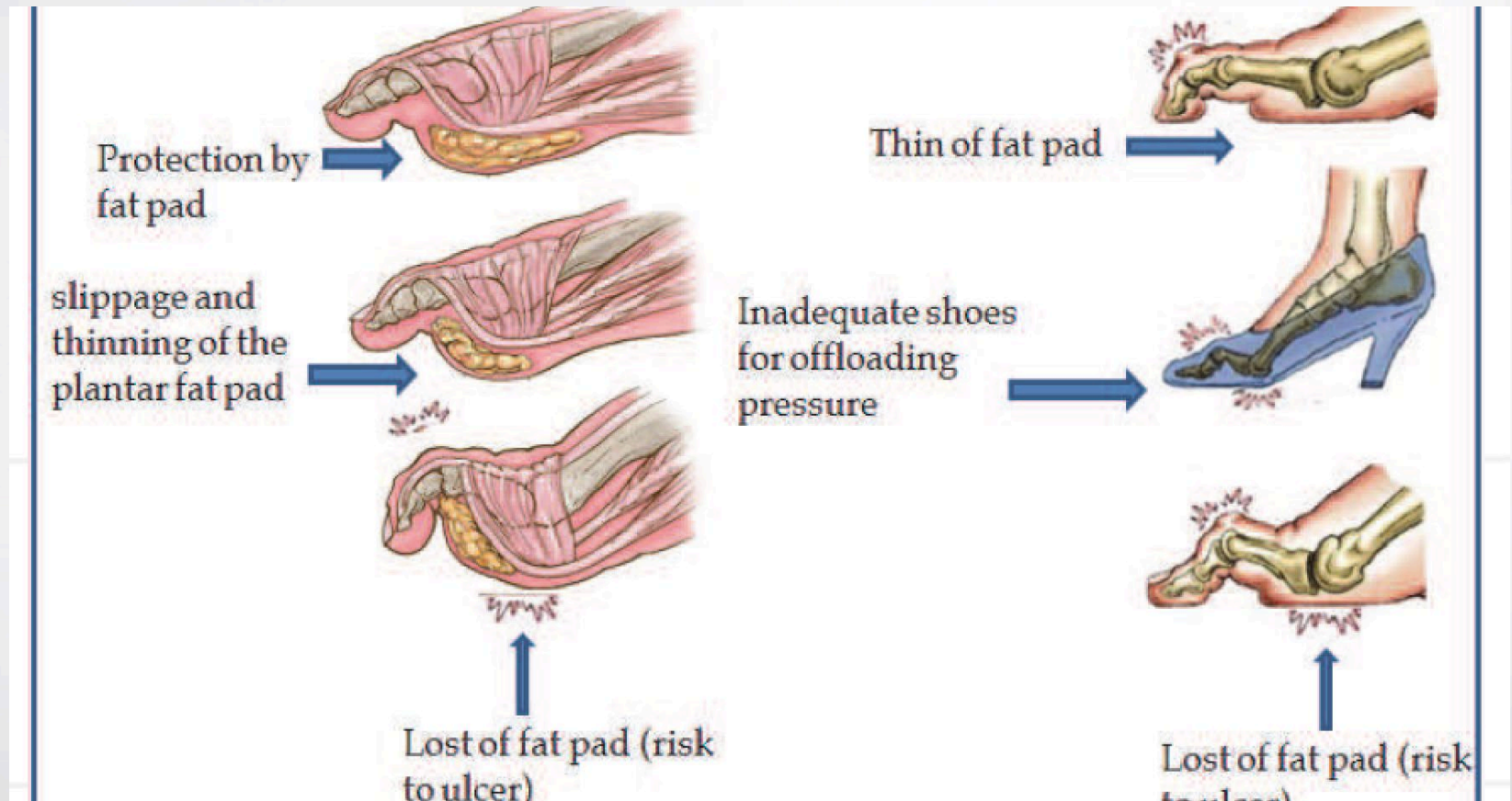


**High
Stress**

Hammer, Mallet, & Claw Toes



Hammer, Mallet, & Claw Toes



Charcot Foot



Charcot Foot

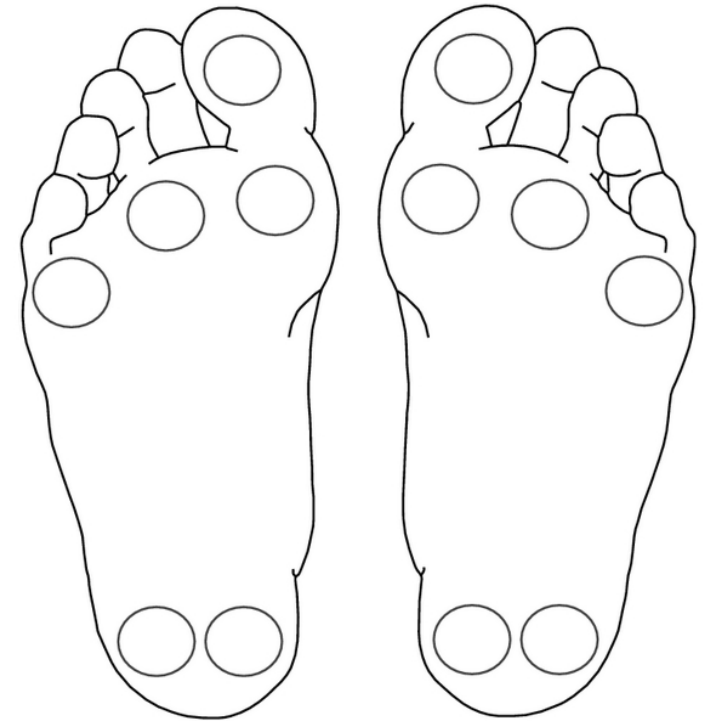


Neuropathy Testing

- Semmes Weinstein Monofilament Test
 - Monofilament is pressed against skin perpendicularly for 1 second after filament bends
- Vibration Test, such as with 128 Hz tuning fork
 - Held against IP joint of big toe
 - Loss of vibratory sense occurs before loss of light touch
- Ankle reflex
- Ipswich Touch Test
 - Lightly touch end of 1st, 3rd, and 5th toes
- 2-point Discrimination
- Nerve Conduction Study

Semmes Weinstein Monofilament Test

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Right foot

Left foot

Diabetic Foot Ulcers

- Osteomyelitis occurs in 15% of ulcer patients
- Amputations are required in 15% with osteomyelitis
- Ulcers precede approximately 85% of amputations
- Following a lower extremity amputation, the five year mortality is $\approx 74\%$



Primary Etiology: Moisture IAD & Yeast - Treatment

- Moisture Control
- IAD: Barrier Cream
 - Thick layer of Sensicare BID
 - No need to wipe down to skin after incontinence
- IAD & Yeast: Antifungal + Zinc oxide

Moisture Associated Skin Damage (MASD)

- Maceration because of fluid or within folds
- Skin breakdown, Fissures, and Yeast

MASD



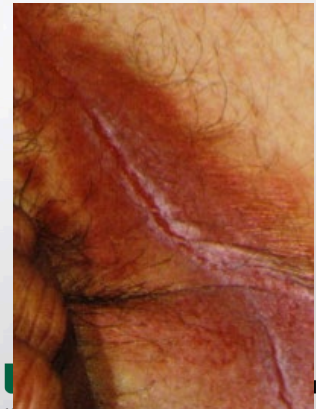
MASD with Maceration



MASD with Yeast



MASD with Fissure



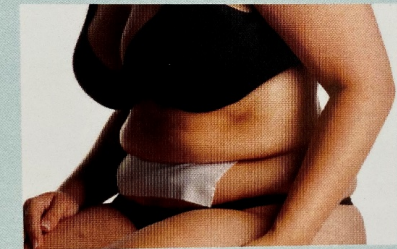
MASD Treatment

- Control moisture with wicking material
 - At least 2 inches of 1 layer of fabric is exposed beyond folds to wick moisture.
 - Do not use creams, powders, or ointments
- Yeast in fold: Interdry Ag
- Fissure in Intergluteal Cleft: Barrier Cream

SKIN-TO-SKIN



Under breasts



Abdomen



Between toes

Secondary Causes of Impaired Wound Healing

- Establish primary etiology of the wound, then identify secondary causes of impaired healing.
- Usually several
- These must be treated in order to successfully heal the wound.



Secondary Causes of Impaired Wound Healing

- Excess inflammation
 - Chronic infection, Biofilm
 - Ischemia / reperfusion
 - Foreign bodies
 - Pathologic inflammation from Primary Skin Disorder
- Inadequate inflammation
 - Steroids
 - Severe injury / illness

Infection & Biofilm

- A community of organisms located in a slime matrix
- Bacteria, fungi, and yeast can secrete a polysaccharide coat that encases the organisms and protects them from host defenses.
- Induces a prolonged inflammatory state stalling wounds

Biofilm Treatment

- Antibiotics - Topical/PO/IV
 - May need 1000-5000 increase in antibiotic concentration to eradicate the film
- Physical Contact
- Debridement
 - Sharp
 - Enzymatic
 - Biologic



Inflammation Causes

- Infection
- Wound bioburden
 - combination of organic and inorganic materials
- Necrotic debris, slough, senescent cells, bacteria, eschar, foreign bodies
- Inflammation increases metabolic stress load and decreases oxygen and nutrient content available to host cells in the wound.

Secondary Causes of Impaired Wound Healing

- Microvascular Insufficiency
 - Diabetes, Cigarette use
- Wound Hypoxia ($PO_2 < 40\text{mm Hg}$) impairs:
 - Ability to fight infection
 - Fibroplasia and collagen deposition
 - Angiogenesis
 - Epithelialization

Secondary Causes of Impaired Wound Healing

- Malnutrition
- Protein is the key
 - Required for collagen synthesis
 - Lost at a high rate from exudative wounds
- Vitamin C, Vitamin A, Zinc
- Sick patients are in catabolic state

Secondary Causes: Psychosocial Issues

- Often people do not understand the gravity of their disease
- Compliance is a large issue
- Travel for follow-up appointments is difficult
- Cost of appointments and dressings
- Finding people to help with dressing changes

What does your body do to heal?

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Questions?

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