





Physical Therapist: Practitioner of Choice for Wound Care

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Objectives

- The participant will have a basic understanding of the skin and its functions.
- The participant will be able to distinguish the etiology of a wound.
- The participant will have an understanding of dressing classes.
- The participant will be able to verbalize 3 modalities that are appropriate for application by the physical therapist or physical therapist assistant for wound healing.
- Participants will be able to utilize research to support the role of physical therapy in wound management.

Role of Wound specialization in Health Care



- Physicians, podiatrists, nurses, physical therapists, and physical therapy assistants all are contributors to wound management in United States and global health care systems
- Certified Wound Specialist (CWS®): American Academy of Wound Management
- Wound Care Certified (WCC®): National Alliance of Wound Care
 - <http://www.nawccb.org/library/documents/wound%20care%20certification%20comparison.pdf> Comparison document of qualifications and ongoing maintenance requirement of all certifications.
- Certified Wound, Ostomy and Continence Nurse (COWCN®): Wound, Ostomy and Continence Nursing Certification Board

Vision 2020



- **APTA Vision Sentence for Physical Therapy 2020**
- *“By 2020, physical therapy will be provided by physical therapists who are doctors of physical therapy, recognized by consumers and other health care professionals as the practitioners of choice to whom consumers have direct access for the diagnosis of, interventions for, and prevention of impairments, functional limitations, and disabilities related to movement, function, and health”*

www.apta.org

APTA Vision 2020 and Wound Management

- “Practitioner of choice”
 - Physical Therapist skilled to diagnose, refer/order diagnostic testing, deliver skilled interventions for complete wound management
- Procedural intervention specific to PT:
 - “Integumentary repair and protections techniques: The application of therapeutic procedures and modalities that are intended to enhance wound perfusion, manage scar, promote an optimal wound environment, remove excess exudate from a wound complex, and eliminate non-viable tissue from a wound bed.” *Guide to Physical Therapist Practice, 2nd ed. 2003*





Physical Therapy Evidence for Wound Management

“The results of this study suggest that many PTs do not practice wound care (32% of survey respondents), that variations in wound evaluation and treatment modalities observed among other disciplines are also common among PTs, and that these variations are related to clinical experience and continuing education.”

“The low percentages reported with evaluation techniques (Doppler: Mean = 1.27. ABI: Mean = 1.49, Venous Filling Time: Mean = 1.83) suggest a need for clinical practice pattern development to move toward outcome-based research and justification of wound care interventions.”

Meier, K.M. and Dockter, M. A survey of current physical therapy practices in wound care. *Ostomy Wound Management* 48(2).





PTA Role in Wound Management

- Should be included in the continuum of care, can implement-
 - Modalities
 - Compression
 - Advanced dressings
 - Therapeutic exercise
 - Gait/Offloading



Quiz Time



- #1- Describe the wound type.



http://www.skinsight.com/images/dx/webAdult/pressureUlcerDecubitusUlcer_1350_lg.jpg



- #2- Describe the wound type.



<http://lifeinthefastlane.com/wp-content/uploads/2010/06/partial-thick.png>



- #3- Describe the wound type.



<http://www.podiatrytoday.com/files/photos/pt0307cc3.jpg>



- #4- Describe the wound type.



TMC TRUMAN MEDICAL CENTERS **Define this:**

- #5- Epiboly
- #6- Hemosiderin staining
- #7- Stage 2 pressure ulcer
- #8- Senescent cells
- #9- Apoptosis
- #10- Collagen

TMC TRUMAN MEDICAL CENTERS


TMC TRUMAN MEDICAL CENTERS

How did you do?

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TMC TRUMAN MEDICAL CENTERS **Skin**

- Does your skin look like this?



http://upload.wikimedia.org/wikipedia/commons/a/ac/Elephant_Skin.jpg

TMC TRUMAN MEDICAL CENTERS

TMC TRUMAN MEDICAL CENTERS

- Or like this?



http://www.davidtomo.com/MacTex_Uploads/Skin001.jpg

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TMC TRUMAN MEDICAL CENTERS **Skin Function**

- Thermoregulation
- Sensation
- Metabolism of vitamin D
- Protection from Shear
- Protection from Water Loss

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TMC TRUMAN MEDICAL CENTERS **Effects of Aging**

- Decreases:
 - Dermal thickness
 - Fatty layer
 - Collagen and elastin
 - Sensation and metabolism
 - Sweat glands
 - Circulation
 - Epidermal regeneration

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Skin

3 Main Layers

- Epidermis
- Dermis
- Subcutaneous/endodermis/hypodermis

<http://www.osovo.com/diagram/skin.jpg>

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Skin Layers

- Epidermal functions
 - Protective layer to the more fragile dermis and its structures
 - Prevents water loss (90% keratinocytes)
 - Synthesizes vitamin D
 - Provides pigmentation (melanocytes),
 - Protect from shear, friction and toxic irritants

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Skin Layers

- Dermal Functions
 - Houses sensory organs and vasculature
 - Thickest layer of skin 2-4cm
 - Responsible for giving skin its bulkiness (turgor)
 - Provides structure (collagen) and elasticity (elastin) to the skin

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Subcutaneous/Endodermal Layer

- Superficial fascia
- Contains deep blood vessels and nerve endings
- Provides insulation, reserve of energy, cushion (fatty layer)

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When good skin turns bad....

<http://www.lib.uiowa.edu/hardin/mDui/trav/skincancer21.html>

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Wound Types

- Arterial
- Venous
- Diabetic
- Pressure Ulcers
- Burns
- Other Wound Types

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Arterial

Result of complete or partial arterial blockage limiting perfusion causing tissue necrosis/ ulceration.



Associated Illnesses

- Coronary disease
- CHF
- COPD
- Hypertension
- Diabetes mellitus
- End-stage renal disease
- Hypercholesterolemia



Arterial

- Wounds between toes, on tips of toes, plantar aspect of foot, over phalangeal heads, adjacent to lateral malleolous/ tibia or where subject to trauma , such as shin, distal calf
- Dry wounds with black/gray necrotic tissue & erythematous halo
- Thin dry skin, absence of hair, shiny, smooth, cool
- Well defined borders "punched out" smooth edges



Arterial

- Painful
- Dry gangrene
- Elevational pallor, dependent rubor
Pulses absent or diminished
- Decreased pain in the dependent position, increased with elevation, exercise (claudication)



Diagnostics

- ABI
- Toe Brachial index
- TCPO2



Ankle Brachial Index (ABI)

- Compares Brachial BP with LE BP's at different levels to determine quality of blood flow.
- Does not take into account collateral circulation
- Not effective if vessels are calcified (common in diabetics)
- Important and non-invasive technique to determine if adequate blood flow is available



ABI Testing

http://www.nhlbi.nih.gov/health/doi/images/pad_abi.jpg

ABI Report

<http://www.qualityvascular.com/images/microemboli%20PVR.jpg>

ABI Results

- > 1- Calcified vessels if diabetic- requires further evaluation. Do not exceed 250 mmHg, is non-compressible and may damage artery.
- <.9-.95- Arterial Disease
- .95-.8- Mild disease- Compression with caution
- .8-.5- claudication- compression contraindicated (usually symptomatic with claudication @ .7)
- <.6 debridement contraindicated by ANY means. Inadequate circulation, exposing debrided tissue to infection(Can be double-checked with TCPO2 to determine collateral circulation.)
- <.5 compression contraindicated –resting pain .5-.4
- ≤.3- tissue loss

TBI- Toe Brachial index

- Represents drop in BP in smaller digital vessels
- If ABI normal, may indicate small vessel disease
- normal $\geq .75$ (.7-9)
- <.5-.6 do not debride

TBI- Toe Brachial Index

<http://sydney.edu.au/medicine/diabetes/foot/IMAGES/toepressure.jpg>

Transcutaneous Oxygen Measurement

- Measurement of O₂ diffusing across the skin from the capillary beds. May indicate better perfusion than ABI due to collateral circulation.
- <20mmHg will not heal
- >30mmHg will heal/ debridement safe
- Not reliable in patients with swelling/infection



Transcutaneous Oxygen Measurement



- http://spanish.chandlerregional.org/stellent/groups/public/@xinter_net_con_com/documents/webcontent/chandler100.jpg



Intervention Goals

- Protect
 - Use foam dressings to pad area
 - non-adherent dressing to reduce trauma with dressing changes
 - no sharp debridement
 - often will need revascularization to achieve healing
- Promote circulation
 - Warmth
 - No compression
 - Modalities



Venous

Impaired venous return > increased hydrostatic pressure > Stasis hypertension > dermal ulceration.



Venous

- Hyperpigmentation
- Eschar or slough, wet, yellow fibrous
- Irregular wound edges
- Tortuous veins
- Superior to Malleoli, usually medial
- Edematous leg
- Pulses present
- Hemosiderin staining
- Shallow wounds
- Surrounding skin dry and scaly
- Moderate to heavy exudate



Venous

- Pain in dependent position, decreased with elevation, usually minimal dull ache or heaviness
- Caused by valvular incompetence, obstruction of deep venous system, or congenital absence or malformation of venous valves
- Foot warm, ABI > .8



Recent Evidence regarding Venous Ulcers

-Patients > 60 years old, with history of blindness, cataracts, renal insufficiency, or a history of pressure ulcers were twice as likely to develop venous ulcer

-Individual venous ulcers can cost from \$1100-\$2800

Takahashi P Y, et al. A Predictive Model for Venous Ulceration in Older Adults: Results of a Retrospective Cohort Study. *Ostomy Wound Management* 2010;56(4):60-66

-10-35% US Adult population has CVI, 1-4% active or healed ulceration
-up to 80% ulcers may heal with compression therapy only, similar to surgery

-reduction in reoccurrence rate at 4 year follow up from study (one group vein ablation vs. compression only) were 31% reoccur in surgery group, compared to 55% in compression group

Marocco CJ, Atkins MD, Bohannon WT, Warren TR, Buckley CJ, Bush RL. Endovenous ablation for the treatment of chronic venous insufficiency and venous ulcerations. *World J Surg.* 2010 Oct;34(10):2299-304





Intervention Goals

- Compression to promote venous return- 4-layer wraps, short stretch wraps, compression stockings
- Non adherent dressings to protect delicate skin
- Elevation
- Gentle debridement- enzymatic or autolytic due to severe tenderness
- Exercise to promote venous return



Diabetic



- http://www.2curediabeticwound.com/2curediabeticwound.com/images/ROGA_YAHIS_20KHAMIS_before%20treatment.JPG
- <http://www.pediatrytoday.com/files/photos/pt0307cc3.jpg>



Diabetic

- Usually on tips of toes, lateral aspect of foot dorsum of foot, metatarsal heads especially 1st and 5th, heels, midfoot and at location of orthopedic deformity
- 60% to 70% of diabetic ulcers are neuropathic foot ulcers
- 15-20% of diabetic ulcers are from PVD
- 15-20% are mixed cause
- If to bone 90% have osteomyelitis



Diabetic

- All wounds have delayed in healing
- Skin changes: Cracking; callous formation
- Inhibited fibroblast activity
- Inhibited endothelial cell activity
- Decreased collagen deposition
- Delayed re-epithelialization
- Decreased re-endothelialization of microarterial anastomoses



Diabetic Labs

- Optimal Glucose < 150
>180 inhibits neutrophil activity
- Glycosolated hemoglobin A1C- Provides aggregate glucose level over past 2-3 months.
Normal 4 to 6.1 %



Diabetic Neuropathies

- Sensory neuropathy-
 - the most common type of diabetic neuropathy
 - causes pain or loss of feeling in the toes, feet, legs, hands, and arms.
- Autonomic neuropathy
 - causes changes in digestion, bowel and bladder function, sexual response, and perspiration
 - Can affect the nerves that serve the heart and control blood pressure, as well as nerves in the lungs and eyes.
- Motor neuropathy
 - Results in muscle atrophy and weakness



TMC TRUMAN MEDICAL CENTERS **Neuropathic Pressure Ulcers**

Peripheral neuropathy alters sensation so pressure related trauma goes unnoticed as ulcer forms



TMC TRUMAN MEDICAL CENTERS **Neuropathic Pressure Ulcers**

- Occurs on weight bearing surface
- Calloused edges
- Peripheral neuropathy- decreased sensation –unaware of pressure
- Foot deformities caused increased risk due to abnormal pressure
 - Hammer toe/claw toe
 - Charcot foot-Autonomic neuropathy causes increased blood flow resulting in osteolysis, osteopenia

TMC TRUMAN MEDICAL CENTERS **Intervention Goals**

- Tight blood glucose control
- Off-loading
- Aggressive debridement if arterial supply intact to decrease microbial load and remove senescent cells/biofilm
- Removal of callous and irregular wound edges to allow healing from borders
- Silver dressings to help with bacterial load
- Collagen to provide wound matrix/scaffold
- Enzymatic debriders

TMC TRUMAN MEDICAL CENTERS **Recent Evidence regarding DFU**

- Suggests hydrogels with debridement improvement (autolytic) over standard debridement
- Surgical debridement no significant benefit

Edwards J, Stapley S. Debridement of diabetic foot ulcers. *Cochrane Database of Systematic Reviews* 2010, Issue 1. Art. No.:CD003556. DOI: 1002/14651858.CD003556.pub2

TMC TRUMAN MEDICAL CENTERS **Pressure Ulcer**

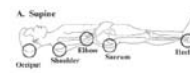
A pressure ulcer is localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear and/or friction.



<http://27.photobucket.com/albums/c192/Sekhauil420/decub2bmg.jpg>

TMC TRUMAN MEDICAL CENTERS **Pressure Ulcers: Common Sites**

- Ischial tuberosities
- Greater trochanters
- Sacrum/ Coccyx
- Lateral malleoli
- Heels
- Olecranon
- Medial femoral condyles
- Occiput



<http://img167.imageshack.us/img167/1677/taale111fu7.jpg>

TMC TRUMAN MEDICAL CENTERS **Ulcer Staging**

Stage 1 Stage 2
 Skin layers—
 Subcutaneous
 soft tissue—
 Bone—
 Stage 3 Stage 4

- <http://weblink.saintlukeshealthsystem.org/library/healthguide/en-us/images/media/medical/hw/nr55551996.jpg>

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TMC TRUMAN MEDICAL CENTERS **STAGE 1**

Intact skin with non-blanchable redness of a localized area usually over a bony prominence. Darkly pigmented skin may not have visible blanching; its color may differ from the surrounding area.

<http://www.snjourney.com/images/poststage1.gif>

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TMC TRUMAN MEDICAL CENTERS **STAGE II**

Partial thickness loss of dermis presenting as a shallow open ulcer with a red pink wound bed, without slough. May also present as an intact or open/ruptured serum-filled blister.

http://www.skinsight.com/images/dx/webAdult/pressureUlcerDecubitusUlcer_1350_lg.jpg

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TMC TRUMAN MEDICAL CENTERS **STAGE III**

Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon or muscle are not exposed. Slough may be present but does not obscure the depth of tissue loss. May include undermining and tunneling.

<http://www.ruralfamilymedicine.org/educationalstrategies/stage%203.jpg>

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TMC TRUMAN MEDICAL CENTERS **STAGE IV**

Full thickness tissue loss with exposed bone, tendon or muscle. Slough or eschar may be present on some parts of the wound bed. Often include undermining and tunneling.

http://www.eczema-answers.com/images/bed_sores2.jpg

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TMC TRUMAN MEDICAL CENTERS **UNSTAGEABLE**

Full thickness tissue loss in which the base of the ulcer is covered by slough (yellow, tan, gray, green or brown) and/or eschar (tan, brown or black) in the wound bed.

<http://www.ouhsc.edu/geriatricmedicine/Education/pu/image13.jpg>

TMC TRUMAN MEDICAL CENTERS

TMC TRUMAN MEDICAL CENTERS **DEEP TISSUE INJURY**

Purple or maroon localized area of discolored intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear. The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer or cooler as compared to adjacent tissue.



<http://woundeducators.com/wordpress/wp-content/uploads/2008/09/12-calcanus-ischemic-bulla.jpg>

TMC TRUMAN MEDICAL CENTERS **Intervention Goals**

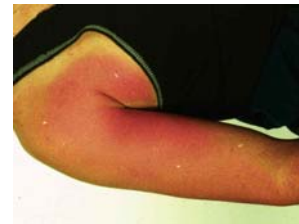
- Off loading
- Fill dead space
- Control exudate- alginates
- Decrease microbial load- silver dressings
- Stage 1 and 2 film dressings to prevent shear allow oxygen to get to area, but block bacteria/contaminants, autolytic debridement

TMC TRUMAN MEDICAL CENTERS **Burns**

Burns

TMC TRUMAN MEDICAL CENTERS **Superficial (epidermal layer)**

- Erythema, significant pain, lack of blisters, sunburn



<http://mhhs.com.au/slides/burns.2.jpg>

TMC TRUMAN MEDICAL CENTERS **Partial thickness/superficial (papillary dermal layer)-**

- Blistered injury site which may heal spontaneously after blister fluid has been removed, painful, clear fluid



<http://www.freewebs.com/woodthornterprises/2nd%20dec%20burn.jpg>

TMC TRUMAN MEDICAL CENTERS **Partial thickness/deep (reticular dermal layer)**

- Whiter appearance or fixed red staining (no blanching), reduced sensation



<http://lifeinthefastlane.com/wp-content/uploads/2010/06/partial-thick.png>

Full thickness

- Epidermis, Dermis, and complete destruction to subcutaneous fat, eschar formation and minimal pain, requires skin grafts, Charred or leathery, thrombosed blood vessels, insensate



<http://www.colinaschools.org/sci/images/Eve%20Injury%20Pics/m-60.gif>

Intervention Goals

- Superficial wounds heal spontaneously within the first 2 weeks with pain management and topical dressings to prevent infection
- Deeper wounds take longer than 2 weeks to heal and may require surgical intervention.
- Need to prevent infection- topical antibiotic creams, Vaseline gauze to prevent trauma to tissue
After initial injury, cooling of burn site important

Other Wound Types

- Traumatic wounds
- Abscesses
- Atypical wounds

Traumatic wounds



<http://www.podiatrytoday.com/article/7899>

Abscesses



<http://missinglink.ucsf.edu/Im/DermatologyGlossary/img/Dermatology%20Glossary/Glossary%20Clinical%20Images/Abscess.jpg>

Abscesses



Atypical wounds

- Pyoderma Gangrenosum
- Cancerous lesions
- Psoriasis
- Discoid lesions
- Fungal infections
- Hydradenitis Suppurativa
- Yeast infections
- Peau d'orange

Pyoderma Gangrenosum

- Uncommon ulcerative cutaneous condition of uncertain etiology
- Diagnosis of exclusion
- Immune system dysfunction
- Deep ulceration with a violaceous border that overhangs the ulcer bed



<http://emedicine.medscape.com/article/1123821-overview>
http://en.wikipedia.org/wiki/File:Chronic_Pyoderma_gangrenosum.jpg

Keratoacanthoma

A skin disruption that does not fit the typical categories and does not respond to conventional treatment should be biopsied to determine if it is a cancerous lesion



<http://www.lib.uiowa.edu/hardin/mD/ui/trav/skincancer21.html>

Psoriasis

- a chronic, autoimmune disease that appears on the skin
- five types of psoriasis: plaque, guttate, inverse, pustular and erythrodermic
- plaque psoriasis, the most common form, appears as raised, red patches or lesions covered with a silvery white buildup of dead skin cells, called scale



<http://www.psoriasis.org/netcommunity/learn/about-psoriasis>
<http://www.lib.uiowa.edu/hardin/mD/ui/trav/skincancer21.html>

Lupus Erythematosus

“One type of SCLÉ looks like psoriasis and has red scaly patches on the arms, shoulders, neck, and trunk, with fewer patches on the face. The other type has red ring-shaped areas with a slight scale on the edges. Natural sunlight, as well as tanning beds, worsens both forms. The lesions of SCLÉ are not particularly itchy, and may heal with light or dark marks. Discoid lesions and lesions associated with ACLE can appear in SCLÉ patients”



http://www.aad.org/public/publications/pamphlets/common_lupus.html
<http://www.lib.uiowa.edu/hardin/mD/ui/trav/skincancer21.html>

Candida Albicans

“Yeast infections of the skin are called cutaneous candidiasis and are caused by yeast-like fungi called candida. They occur when yeast on the skin grows more actively and causes a red, scaling, itchy rash on the skin. Yeast infections are not contagious.”



http://library.med.utah.edu/kw/derm/mml/derm_24850006.html

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Hydradenitis Suppurativa



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- http://www.mayoclinic.com/images/image_popup/ans7_hidradenitis.jpg
- <http://hidradenitisuppurativa.com/hidradenitis-suppurativa-pictures.html>

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Hidradenitis Suppurativa

- “Hidradenitis suppurativa (say: hi-dra-dun-i-tis sup-you-ra-ti-va) is a chronic disease that affects the apocrine glands. The apocrine glands are a type of sweat gland. Hidradenitis suppurativa is considered a severe form of acne. People who have hidradenitis suppurativa develop painful red bumps or sores in the armpits, groin and anal area. Women can also develop hidradenitis suppurativa under the breasts.”

<http://familydoctor.org/online/famdocen/home/common/skin/diseases/895.m/interview.html>

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Fungal infections

“Jock itch, also called tinea cruris, is a common skin infection that is caused by a type of fungus called tinea. The fungus thrives in warm, moist areas of the body and as a result, infection can affect the genitals, inner thighs, and buttocks. Infections occur more frequently in the summer or in warm, wet climates.”




<http://www.jockitchhelp.com/wp-content/gallery/jock-itch-1/jock-itch-picture-6.jpg>
<http://www.webmd.com/skin-problems-and-treatments/guide/fungal-infections-skin>

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Peau D'Orange

- a dimpling of the skin that gives it the appearance of the skin of an orange. Often due to lymphatic obstruction



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Key words

- Hemosiderin
 - “iron containing pigment derived from hemoglobin from disintegration of red-blood cells. It is one form in which iron is stored until it is needed for making hemoglobin.” *Tabor's Cyclopedic medical dictionary, 18th ed.*
- Hemosiderin staining
 - Pooling of blood in veins in lower leg due to chronic venous insufficiency, red blood cells are disintegrated and heme “stains” the skin. Characteristic darkening, can become woody texture, in gaiter area of lower leg.
- Papillary layer
 - Undulating portion of the dermis that connects with the dermis
 - Contains capillary loops that supply oxygen and nutrients to the epidermis
 - Reduces skin shear
 - Decreased height with age

Tabor's Cyclopedic medical dictionary, 18th ed.

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Phases of Wound Healing

- Phase 1: Hemostasis
- Phase 2: Inflammatory
- Phase 3: Proliferation/Epithelialization
- Phase 4: Remodeling

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Phase 1- Hemostasis

- Occurs immediately after injury
- Vasoconstriction
- Platelet aggregation
- Fibrin deposition, clot is end product



Phase 2-Inflammatory

- Clean wound site for tissue restoration. Vasodilation & phagocytosis.
- Signs: red, blue or purple skin, Temperature, Turgor (swelling), Sensation (pain)
- Starts at time of injury and Lasts 3-7 days
- Provides hemostasis- vasoconstriction, Platelet aggregation, Thromboplastin makes clot



Inflammatory Phase



- <http://www.podiatrytoday.com/files/photos/pt07bilayered1.jpg>



Phase 3-Proliferation

- Wound defect fills in with new tissue, skin integrity restored.
- Overlaps and follows the inflammatory phase beginning 3-5 days post-injury and continuing for 3 weeks in healing by primary intention.
- Angiogenesis
- Collagen synthesis by fibroblasts.
- Wound contraction occurs.



Proliferation Phase



- http://upload.wikimedia.org/wikipedia/commons/d/d4/Finger_wtih_granulation_tissue.jpg



Phase 3-Epithelialization

- Wound closure occurs.
- Starts immediately after trauma as protection from organisms
- Occurs concurrently with other phases, majority with Proliferation
- Epidermis and basement membrane must both be reestablished to maintain an impermeable barrier



Epithelialization

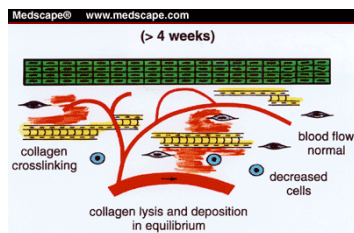


- http://cmr.medscape.com/viewarticle/418377_4
- http://2009.igem.org/wiki/images/5/5f/800px-Hand_Abrasion_-_17_days_11_hours_30_minutes_after_injury.jpg

Phase 4 -Remodeling

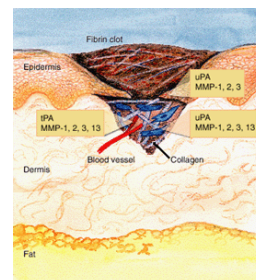
- Will not exceed 70-80% tensile strength of original.
- At closure tensile strength 15% normal
- Begins as Granulation tissue is formed. Predominately occurs approximately 21 to 28 days after injury. Can continue for 1-2 years post injury until it reaches maturation.
- Balance between collagen synthesis and lysis
- Chronic Remodeling- imbalance in collagen synthesis and lysis, dehiscence, keloids

Remodeling Phase



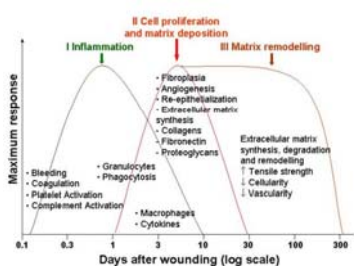
- http://cmr.medscape.com/viewarticle/418377_4

Remodeling



- http://www.mdsystems.com/mini_review_detail_objectname_MR02_CytokineWoundHealing.aspx

Overlap of Phases



<http://www.worldwidewounds.com/2004/august/Enoch/Pathophysiology-Of-Healing.html>

Key words

- Matrix Metalloproteinases (MMP's)
 - Proteolytic enzymes degrade proteins and ECM macromolecules. Benefit is in development and remodeling processes in healthy tissues.
- Angiogenesis
 - Capillary buds extend into the wound bed. Endothelial cells fill wound space creating capillaries with loose junctions and gaps in endothelial lining causing edematous look. Capillary loops look like small granules: **GRANULATION**.
- Collagen
 - Primary protein present in the skin, providing strength and structure

Sussman, C. & Bates-Jensen. *Wound Care: A Collaborative Practice Manual for Health Professionals*, 3rd ed. 2007
Patterson, G. Scarborough, P. Weir, D. *Wound Certification Prep Course: course manual*. 2005



Key Words

- Basement membrane
 - Thin layer of extracellular material found between layers of epithelia or between the epithelia and connective tissue. AKA *basal lamina*
- Senescent cells
 - Metabolically active, but nonproliferative or proliferating at greatly reduced rates. Unresponsive to chemical and physical stimuli, decreased migration rates, decreased production of matrix proteins and growth factors.
- Apoptosis
 - Mechanism for cell deletion in regulation of cell populations, as of B and T lymphocytes following cytokine depletion. "Programmed cell death"

Sussman, C. & Bates-Jensen. *Wound Care: A Collaborative Practice Manual for Health Professionals*, 3rd ed. 2007
Patterson, G, Scarborough, P, Weir, D. Wound Certification Prep Course: course manual. 2005



Name That Modality

- How many types of debridement can you name?
- How many modalities used for wound treatment can you name ?



Therapeutic Interventions

- Debridement
 - Removes necrotic tissue and purulent exudate to decrease bacterial load and remove senescent cells
- Modalities, Artificial skin grafts and Collagen
 - Promotes granulation, epithelialization
- Compression, elevation
 - Controls edema
- Off-loading/Pressure relief
 - Protects wound in healing phase



Debridement

- Autolytic
- Enzymatic
- Mechanical
- Sharp
- Surgical



Autolytic

- Body's own enzymes
- Stage III or IV wounds with light to moderate drainage
- Selective, only necrotic tissue is liquefied
- Painless
- Performed by occlusive or semi-occlusive dressings (hydrocolloids, hydrogels, or films) which keep wound fluid in contact with necrotic tissue
- Monitor closely for signs of infection (*Occlusive dressings can promote anaerobic growth*)
- *Slower than surgical debridement.*
- *May macerate surrounding tissue.*



Enzymatic

- Selectively digests protein, collagen, and fibrin.
- Minimal/ no damage to surrounding tissue
- Wounds with a large amount of necrotic debris or eschar formation
- Patient unable to tolerate sharp debridement
- *Expensive, requires prescription*
- *May cause inflammation or discomfort*
- *Slower process than sharp debridement*





Mechanical

- Moist to wet dressing removed causing non-selective debridement
- Hydrotherapy including Whirlpool, Pulsavac, jet-ox, US mist
- May also use wound cleanser or syringe irrigation which is less traumatic, but removes wound debris
- Wounds with moderate amount of necrotic debris
- Low cost
- *May traumatize healthy tissue*
- *Painful*



Whirlpool

- Nonspecific mechanical debridement
- Removes dirt and foreign contaminants
- Softens & rehydrates necrotic tissue
- Removes toxic residuals from topical agents
- 80°-90°F non-thermal, 92°-96°Neutral, 96°-104°Thermal
- *Dependent position may increase edema*
- *Drying of surrounding skin*



Whirlpool: Evidence For and Against?????????

- Additives may be cytotoxic?
- *Limited evidence shows if proper concentration not true*
- Force from jets may be traumatic?
- *Limited evidence indicates less force than pulsavac*



http://www.ncmedical.com/items/fullsize/2009_06_10_13_56_04_6_NC92603-B_LG.jpg



Pulsative Lavage

- Removes dirt and foreign contaminants
- Softens necrotic tissue
- Removes toxic residuals from topical agent
- Nonspecific mechanical debridement
- 4-15 PSI
- *Aerosolization of contaminants, requires clean room*
- *Contraindicated over granulation tissue*



<http://www.genesis-tech.ch/files/images/disposables/pistola3.jpg>



Jet-ox

- Mist of saline delivered by pressurized oxygen
- Gentle to wound
- Rehydrates necrotic tissue and gently debrides
- *Possible aerosolization of contaminants?*



http://www.lav-tech.com/images_ati/2d0a4d4d0ee8825810a9f2e5e6f6348.jpg



US Mist

- Mist created by US
- Rehydrates necrotic tissue and gently debrides
- May provide benefits of US for wound healing as well as debride
- *Possible aerosolization of contaminants?*
- 2001 evidence suggests no detectable production of aerosolized P aeruginosa.



<http://www.lrmchealth.org/mmc.nsf/0ebf6380021bca5b86256e7c005eede3aa72e5a78a9bafae85267574006878e1/Body/6.4B1E7OpenElement&FieldElemFormat=jpg>





Sharp

- Selective, necrotic tissue only
- Scalpel, scissors, forceps
- May also be used to correct improperly healing edges, epiboly
- Biofilm and Senescent Cells
- Performed by Physical Therapists, specially trained Nurses, and Physicians
- Silver nitrate as a debrider and a cauterizing agent



Surgical

- Selective
- Laser or scalpel under anesthesia is the fastest
- May be performed in OR or at bedside
- Large amount of necrotic tissue
- May involve removal of viable tissue
- Usually infected tissue
- *Painful*
- *Expensive*

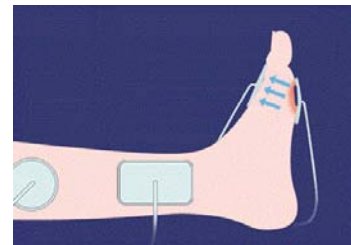


Modalities

- Electric stimulation
- Ultrasound
- Annodyne
- Wound vac
- Hyperbaric Oxygen



Electric Stimulation



<http://www.microvas.com/through.gif>



Electric Stimulation

- High volt pulsed current, monophasic (creates polarity)
- Effective independent of diagnosis and wound depth.
- Manages necrotic tissue, inflammation, & infection????
- Facilitates wound contraction and wound resurfacing
- Enhances lymphatic and venous drainage



Electric Stimulation: Evidence

- Contraindicated when cell proliferation is contraindicated i.e. malignancy, when there is evidence of osteomyelitis???? (could heal over infection and mask problem, but may be beneficial in healing osteomyelitis),
- Where there are potential for metal ions present in wound
- Where electrode placement is contraindicates i.e. reflex center, or where current could interfere with electric implant i.e. pacemaker





Application of Electric Stimulation

- Negative pole (cathode): Moves fluid from area, Dilates capillaries, Stimulates nerves, Retards microorganism growth (bactericidal), liquefies proteins, softens tissue, stimulates granulation, decreases edema, fibroblasts proliferate and make collagen, basic environment, promotes angiogenesis, attracts neutrophils when infection present, attracts fibroblasts
- Positive pole-(anode)- constricts capillaries, sedative to neurons, Facilitates healing, attracts macrophages, neutrophils, and epidermal endothelial cells, acidic environment, coagulates protein, hardens tissue
- Change polarity every 3 days



Ultrasound

- During inflammatory phase stimulates release of growth factors from platelets, mast cells, and macrophages which are chemotactic to fibroblasts and endothelial cells. Accelerates inflammatory phase to speed proliferative phase. **US is most effective when initiated in this phase.**
- During proliferative phase stimulates fibroblast migration, endothelial cells and angiogenesis. May also facilitate wound contraction.
- During epithelialization phase stimulates release of growth factor necessary for regeneration of epithelial cells and promotes circulation.
- Remodeling Phase improves scar extensibility if initiated in the inflammatory phase
- *Contraindications: Infected wounds, osteomyelitis, DVT, Malignancy, Severe atherosclerosis*



US Protocol

- Acute wounds- initiate during the inflammatory phase to achieve benefit of increased tensile strength of scar by speeding proliferation. 1 minute/ cm² with maximum of 15 minutes three times per week. .5 watts/ cm² pulsed if impaired circulation.
- Chronic- initiate as soon as possible. 1 minute/ cm² with maximum of 15 minutes three times per week. Intensity .5-1 pulsed. Recommend initial treatment at 1.2 then decrease to lower range to stimulate inflammatory response. Can apply with hydro gel or film dressing and coupling gel or in a plastic basin of water. Limit to 14 treatments, improvement should be noticeable within 3-4 treatments



Annodyne



- <http://drobertlim.com/images/anodyne.jpg>
- <http://www.willowgrovept.com/img/Anodyne.jpg>



Infrared/Annodyne

- For seeping wounds that need drying
- Reduces pain and inflammation
- Synthesis and repair of DNA and RNA
- Expands collagen production
- Actuates neovascularization
- Releases/discharges lymphatic congestion
- Induces enzymatic reactions
- Diminishes scar tissue and adhesion formation



Vacuum Assisted Closure



- http://www.ucdmc.ucdavis.edu/cppn/resources/clinical_skills_refresher/wound_vac_dressing_change/images/01a.jpg
- http://www.ucdmc.ucdavis.edu/cppn/resources/clinical_skills_refresher/wound_vac_dressing_change/images/01b.jpg





Vacuum Assisted Closure

- Sub-atmospheric pressure (suction) applied to the wound via open celled foam sponge in the wound
- Beneficial heavily draining and cavernous wounds.
- Maintain negative pressure for 22 of 24 hours per day. If wound is infected change the dressing every 12-24 hours, 48 hours if not infected
- Decreases edema, increases blood supply, decreases bacterial colonization, promotes wound contraction, increases granulation, enhances epithelial migration



Vacuum Assisted Closure

- Precautions- active bleeding, anticoagulants
- Contraindicated in malignancy, untreated osteomyelitis, necrotic tissue with eschar present, and over exposed blood vessels or organs
- Physical Therapist can apply and charge



Hyperbaric Oxygen



- <http://www.aboutcancer.com/hyperbaric.jpg>



Hyperbaric Oxygen

- Treat air or gas embolism, decompression sickness, CO2 sickness.
- Adjunctive therapy for radiation tissue damage, gas gangrene, compromised skin grafts, crush injury, compartment syndrome, acute traumatic ischemia, necrotizing soft tissue infections, refractory osteomyelitis, problem non-healing wounds.
- Administered in an air filled chamber, patient breathes 100% O2 at 2-25 ATM for 90-120 minutes.
- Improve collagen deposition, angiogenesis, and decreases bacterial load in wounds by stimulating neutrophils



Key Words

- Epiboly-advancing keratinocytes at wound edges roll under. Migration stops due to keratinocytes touching each other
- Biofilm- a bacterial film present on most chronic wounds which blocks healing. can be removed by maintenance debridement
<http://www.medicalbiofilm.net/images/CaseHistories1.pdf>
- Chemotaxis-attraction of a cell in response to a chemical signal




Artificial Grafts



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Oasis

Submucosa of porcine small intestine



- <http://www.oasiswoundmatrix.com/about>

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Apligraf

artificial skin graft of neonatal foreskin keratinocytes and fibroblasts with bovine Type I collagen




- http://apligraf.com/patient/what_is_apligraf/what_is_apligraf.html

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Dermagraft-

cryopreserved human fibroblast-derived dermal substitute composed of fibroblasts, extracellular matrix, and a bioabsorbable scaffold derived from newborn foreskin tissue, does not contain macrophages, lymphocytes, blood vessels, or hair follicles.



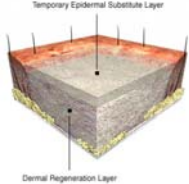
- <http://www.dermagraft.com/about/overview/>
- <http://www.hpnonline.com/inside/2008-03/0803/IC-AdvancedBioHealing-Derma.jpg>

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Integra Dermal Regenerative Template

Silicone provides a protective layer, 3 dimension matrix contains bovine tendon collagen and glycosaminoglycan



- http://www.integra-ls.com/PDFs/03.173_PHYSBRO_121003.pdf
- http://www.ilstraining.com/IDRT/idrt/brs_it_03.html

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Collagen

- Provide an extracellular framework for multi-cellular animals
- Primary protein present in the skin, providing strength and structure
- Present in the reticular layer of the dermis providing the skin with its strength, interwoven with elastin to provide flexibility

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Collagen Dressing

- Minimal exudates
- Can use on infected wounds
- Partial and full thickness
- Need to watch for allergic reaction
- Stimulates cells to proliferate
- Hemostatic
- Attracts fibroblasts and macrophages
- Increases tissue strength
- Decreases effect of MMP's
- Can be from any source

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Promogran Dressing

freeze dried composite of 45% oxidized regenerated cellulose (ORC) and 55% collagen




- <http://www.systagenix.com/usa/our-products/promogran/>

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Fibrocol Plus Dressing

90% collagen and 10% alginate




- <http://www.systagenix.com/usa/our-products/fibrocol-plus/>

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BIOSTEP

Collagen matrix dressing containing both type I and denatured (gelatin) porcine-derived collagen that attracts and serves as sacrificial substrates for MMPs. Also contains EDTA which deactivates excess MMPs.



- <http://global.smith-nephew.com/us/Product24241.htm>

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Compression

- Short stretch bandage
- Multi-Layer bandage
- Compression hose
- Long stretch bandage
- 4 layer bandage

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Short Stretch Compression Bandage

Graduated compression when applied with a spiral technique. When two bandages are applied one over another, the system will give a high level of sustained compression useable for the treatment of venous leg ulcers.




- <http://wound.smith-nephew.com/nz/node.asp?NodeId=727>

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Comprilan

- A short stretch, 100% cotton bandage used in compression therapy for edema, **lymphedema**, and venous insufficiency. Unlike long stretch elastic bandages, provides both compression and resistance to stretch thereby increasing venous and lymphatic return. Permeable to air and absorbs perspiration. Latex free and machine washable.



- <http://www.bandagesplus.com/prd/51/599/Comprilan.html>

TMC TRUMAN MEDICAL CENTERS

TMC TRUMAN MEDICAL CENTERS **Rosidal K**

- *100% cotton* and specifically used for compression in the management of edema, lymphedema, and venous insufficiency.
- Provides both compression and resistance to stretch thereby increasing venous and lymphatic return.
- Especially well tolerated by the skin, permeable to air and absorbs perspiration.
- Latex free- and machine washable.



<http://www.bandagesplus.com/prd/51/598/Rosidal-K.htm>

TMC TRUMAN MEDICAL CENTERS

TMC TRUMAN MEDICAL CENTERS **Compression Hose**

Light support 8-14mmHg- edema prevention for extensive sitting and standing with minimal activity
 Antiembolism stockings-16-18mmHg- Deep vein prophylaxis, non-ambulatory patients with edema, includes TED hose
 Low compression 18-24mm Hg - Non-ambulatory patients with edema failing 16-18mmHg stockings, includes elastic wraps and paste bandages for clients with dependent edema
 Low to moderate compression- edema secondary to venous insufficiency, for clients able to participate in exercise, includes 4-layer wraps
 Moderate compression 30-40mmHg- Edema with or without ulceration, edema that persists despite lower level compression options, includes four layer bandage
 High compression 40-50mmHg-edema secondary to lymphedema

Sussman

TMC TRUMAN MEDICAL CENTERS

TMC TRUMAN MEDICAL CENTERS **Sigvaris**

- Designed with 25% Supima Cotton for optimum wearing comfort
- Cotton yarn on the interior is ideal for people with skin allergies or sensitive skin
- New integrated foot release zone with added length and reduced compression in foot area for improved comfort
- Contemporary ribbed design
- Unisex
- Latex



<http://www.compressionstockings.com/sigvaris-230-cotton-3040-mmhg-open-toe-calif-high-stylish-compression-stockings-p-222.html>

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TMC TRUMAN MEDICAL CENTERS **Jobst 30-40 mmHg**

Indications:

- Chronic venous insufficiency
- Deep vein thrombosis
- Post-thrombotic syndrome
- Severe varicose veins
- Severe edema
- Venous ulcer
- Lymphedema
- Orthostatic hypotension



<http://www.jobst-usa.com>
http://www.thefamilyrx.com/images/ig_jobst.jpg

TMC TRUMAN MEDICAL CENTERS

TMC TRUMAN MEDICAL CENTERS **4 layer bandage**

- A multi-layer compression bandaging system developed to apply sustained graduated compression for the management of venous leg ulcers and associated conditions
- Provides approximately 40mm Hg pressure at the ankle decreasing to 17mm Hg at the knee



<http://wound.smith-nephew.com/no/node.asp?Nodetd=4188>

TMC TRUMAN MEDICAL CENTERS


TMC TRUMAN MEDICAL CENTERS **Profore**



- <http://www.cardinal.com/us/en/distributedproducts/images/6/66000016.jpg>

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TMC TRUMAN MEDICAL CENTERS **FourFlex**



• <http://www.medicalsuppliesexpert.com/store/ris.aspx?path=/images/fourflex.jpg&tr=1&bw=250&bh=250>

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TMC TRUMAN MEDICAL CENTERS **Off-Loading**

- Avoidance of all mechanical stress on injured extremity, essential for healing
- Trauma causes most plantar wounds and ongoing trauma prevents healing

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TMC TRUMAN MEDICAL CENTERS **Off-loading/Pressure relief**

- Off-loading devices
 - Wedge shoes
 - Total contact casts
 - Prefabricated cast walker
 - Crutches, wheelchair
- Pressure relief
 - Orthotics
 - Cushions
 - Positioning

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TMC TRUMAN MEDICAL CENTERS **Wedge shoe**

- reduces weight bearing pressure on the forefoot which promotes faster healing after surgery, trauma or when forefoot wounds or ulcerations are present.




<http://www.darcointernational.com/orthowedge>

TMC TRUMAN MEDICAL CENTERS

TMC TRUMAN MEDICAL CENTERS **DARCO HeelWedge**

- off-loads pressure from the heel by shifting weight to the mid and forefoot to promote faster healing after surgery, trauma or when wounds or ulcerations are present on the heel.




<http://www.darcointernational.com/heelwedge>

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TMC TRUMAN MEDICAL CENTERS **Wound Care Shoe System**

- Deep rocker sole
- Four layers of differing density insoles that may be altered for off-loading
- Leather upper lined with Plastazote® material
- Sections may be removed from the leather upper without disturbing the liner to remove pressure

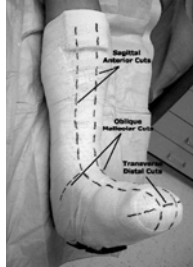


<http://www.biofeet.com/Darco-Healing-Shoe-pl/darco%20wound%20care%20shoe%20system.htm>

TMC TRUMAN MEDICAL CENTERS

Total contact cast

- Heals wounds by reducing weightbearing pressure and shear force to the plantar aspect of the foot
- Minimal padding
- Maintains "total contact" with the foot and lower leg.
- Closely molded



- <http://www.podiatrytoday.com/article/1853>
- <http://www.podiatrytoday.com/files/imagecache/normal/photos/tcc5.jpg>

Prefabricated cast walker

- Custom inflated aircells for individual fit and support
- Rocker bottom and rigid sole
- Allow forward progression in gait without transferring forces to the forefoot



- <http://www.donjoybraces.com/productcart/pe/AirCast-XP-Pneumatic-Walker-97p1817.htm>

Orthotics

Used to correct foot deformities and equalize pressure to prevent ulceration



- http://www.fashnfitshoes.com/images/orthosis_2.jpg

Dressings Goals

- Maintain moist wound bed
- Protect surrounding skin
- Control exudate
- Fill dead space
- Protect wound from environment
- Allow gas exchange so O₂, H₂O, CO₂ can pass through dressing
- Maintain normal thermia: By maintaining wound bed temperature at 98°F mytotic activity increases increasing the proliferative response up to 108%. When the wound bed is cool, cellular activity drops dramatically
- Impermeable to microorganisms
- Non-traumatic with removal
- Maintain correct ph

Classes

- Semipermeable Transparent Films
- Hydrogels
- Hydrocolloids
- Foams
- Absorptive Dressings/Alginates
- Gauze

Semipermeable Transparent Films

- Non- absorptive
- Permeable to moisture vapor and oxygen but not Bacteria
- Used on clean wounds
- Keeps wound moist
- Facilitates autolytic debridement
- Protects against shear
- May use as secondary dressing
- Waterproof, flexible, may leave in place > 1 week

Opsite



- http://www.caremedicalsource.com/tools_v2/resources/498d60b4e22c70e91315918b8ebc5040/upload_images/300-300:opsitetransparent.jpg

Tegaderm



- <http://www.safetynet.org/images/products/CompMedImg/133M1627.jpg>

Hydrogels

- Amorphous gel or sheet (Polymer gel with backing)
- 30-90% water, some have adhesive borders
- Gels are wound fillers and require secondary dressing
- Used to maintain adequate wound moisture
- Can absorb small amounts of exudate and facilitate autolytic debridement
- Non-adherent, reduces heat in burns, soothing
- Used over abrasions, donor sites, and partial thickness burns
- Can be used as coupling medium for US
- Lasts up to 3 days

Solosite



- http://www.caremedicalsource.com/tools_v2/resources/498d60b4e22c70e91315918b8ebc5040/upload_images/300-300:solosite_1.jpg

Elasto-Gel



- http://image.wisdomking.com/images/pictures/036/photo_114.jpg

Curasol



- http://image.wisdomking.com/images/pictures/280/photo_49.jpg

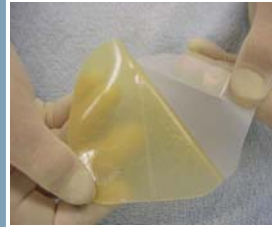


Hydrocolloids

- Colloidal Materials combined with elastomers and adhesives
- Usually have polyurethane film or foam to create a relatively occlusive dressing
- Some are semi permeable
- Hydrocolloids react with wound moisture to absorb or create a gel that maintains a moist wound bed
- Dressing residue may appear purulent and malodorous
- Adhesive may be traumatic if delicate peri-wound skin



Duoderm



<http://www.saddleback.edu/alfa/n170/images/Duoderm.jpg>
http://www.healthproductsforyou.com/ProductImages/largeimage/255200745194/03326_1.gif



Tegasorb



<http://www.safetynet.org/images/products/CompMedIm/13/3M90002.jpg>



Foams

- Semi permeable, usually polyurethane
- Moisture vapor transmissive unless film backing prevents
- Absorbent, conform to irregular surfaces, provide padding (protection), keeps wound warm & moist, non-adherent
- Not recommended for dry wounds or full thickness burns (may cause dehydration of wound base)
- Can last up to 7 days depending on exudate
- Allevyn, Lyofoam, Flexzan, Mitraflex, Synthaderm, Epilock



Allevyn



http://images.sabob.com/products/images/1/Allevyn_drs_fm_2x2_in_Allevyn_Polyurethane_Foam_Dressing.jpeg
http://shop.briggsco.com/ima_catalog/16-66000700_Lr.jpg




Lyofoam 'C' (charcoal)



<http://www.vitalitymedical.com/picxl/SQB164755.jpg>



TMC TRUMAN MEDICAL CENTERS **PolyMem**




http://www.medicalsupplycenter.com/products/polymem_quadrafoam_pack.html

TMC TRUMAN MEDICAL CENTERS **Absorptive dressings/alginate**

- Calcium alginate dressings are made from marine brown algae and giant kelp
- A chemical reaction between the dressing and wound exudate creates a gel that changes calcium alginate into sodium alginate and provides a moist wound bed
- Highly absorbent, used on highly exuding wounds
- Must use a secondary dressing
- Sorbsan, Kaltostat, Algisite, Duoderm paste and granules, Debrisan, Curasorb. Aquacel/hydrofibers are 30% more absorptive and non-wicking

TMC TRUMAN MEDICAL CENTERS **Aquacel**



http://www.walgreens.com/store/catalog/Wound-Care/Hydrofiber-Dressings/ID=prof3363337-product?V=G&ec=bz_&srccode=cii_10043468&cpncode=21-77197574-2

TMC TRUMAN MEDICAL CENTERS **Algisite**



- <http://www.cardinal.com/us/en/distributedproducts/images/5/59480100.jpg>

TMC TRUMAN MEDICAL CENTERS **Gauze**

- Standard
 - Air permeable, allows drying of wound (such as for wet to dry mechanical debridement)
 - Can be kept moist for less traumatic dressing & to keep wound bed moist
- Non-adherent and impregnated gauze
 - Telfa- (absorbs little exudate)
 - Vaseline gauze/Adaptic- non-adherent to protect granulation, can be used as a secondary dressing to increase occlusiveness.
 - Scarlet red, Xeroform- were thought to promote epithelialization, unsure if chemicals may actually impede healing. If they become dry can be traumatic to remove

TMC TRUMAN MEDICAL CENTERS **Adaptic**



http://www.media-med.pl/_img/produktv/ADAPTIC_3_D.jpg



Xeroform



- <http://www.safetynet.org/images/products/CompMedImg/21/SH84-433301.jpg>



Telfa



- <http://www.woundcareshop.com/images/categories/KendallTelfaOuchless.jpg>



Other Dressings

- Silver dressings- decreases microbial load against gram+ and gram-, antifungal, inactivates enzymatic debriders
- Mesalt- Heavily draining/infected wounds- by osmosis draws out exudate
- Hyaluronic acid -“natures moisturizer” enhances granulation
- Charcoal- Controls odor



Acticaot Silver



- http://www.medicalsupplycomer.com/feed_images/UNS20241.jpg



Mesalt



- <http://www.vitalitymedical.com/ssoot/Stores/VitalityMedical/piclg/MOL-285780.jpg>



Hyalofill-F



- <http://www.lincolnmembersupply.com/resource/products/Images/SOB401813.jpg>



TMC TRUMAN MEDICAL CENTERS **CarboFlex**



Odeur Control Dressing
 Pour soins aux ulcères et brûlures
 Apporte paix et confort instantanés
 Pour les ulcères et brûlures
 Pour les ulcères et brûlures
 Pour les ulcères et brûlures
 10
 4 in. x 4 in./10cm x 10cm

- http://www.vitalitymedical.com/isroot/Stores/VitalityMedical/nicxi/SOB40320_2.jpg

TMC TRUMAN MEDICAL CENTERS

TMC TRUMAN MEDICAL CENTERS **Website Resources**

- <http://www.thewoundinstitute.com/>
- <https://www.nursingquality.org/NDNQIPressureUlcerTraining/default.aspx>
- <http://www.medicaledu.com/>
- <http://www.aptasce-wm.org/>

-section for clinical electrophysiology and wound management (APTA)

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Let's try this again!

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- #1- Describe the wound type.



http://www.skinsight.com/images/dx/webAdult/pressureUlcerDecubitusUlcer_1350.jpg

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- #2- Describe the wound type.



<http://lifeinthefastlane.com/wp-content/uploads/2010/06/partial-thick.png>

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- #3- Describe the wound type.



<http://www.podiatrytoday.com/files/photos/p0307cc3.jpg>

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- #4- Describe the wound type.



Define this:

- #5- Epiboly
- #6- Hemosiderin staining
- #7- Stage 2 pressure ulcer
- #8- Senescent cells
- #9- Apoptosis
- #10- Collagen