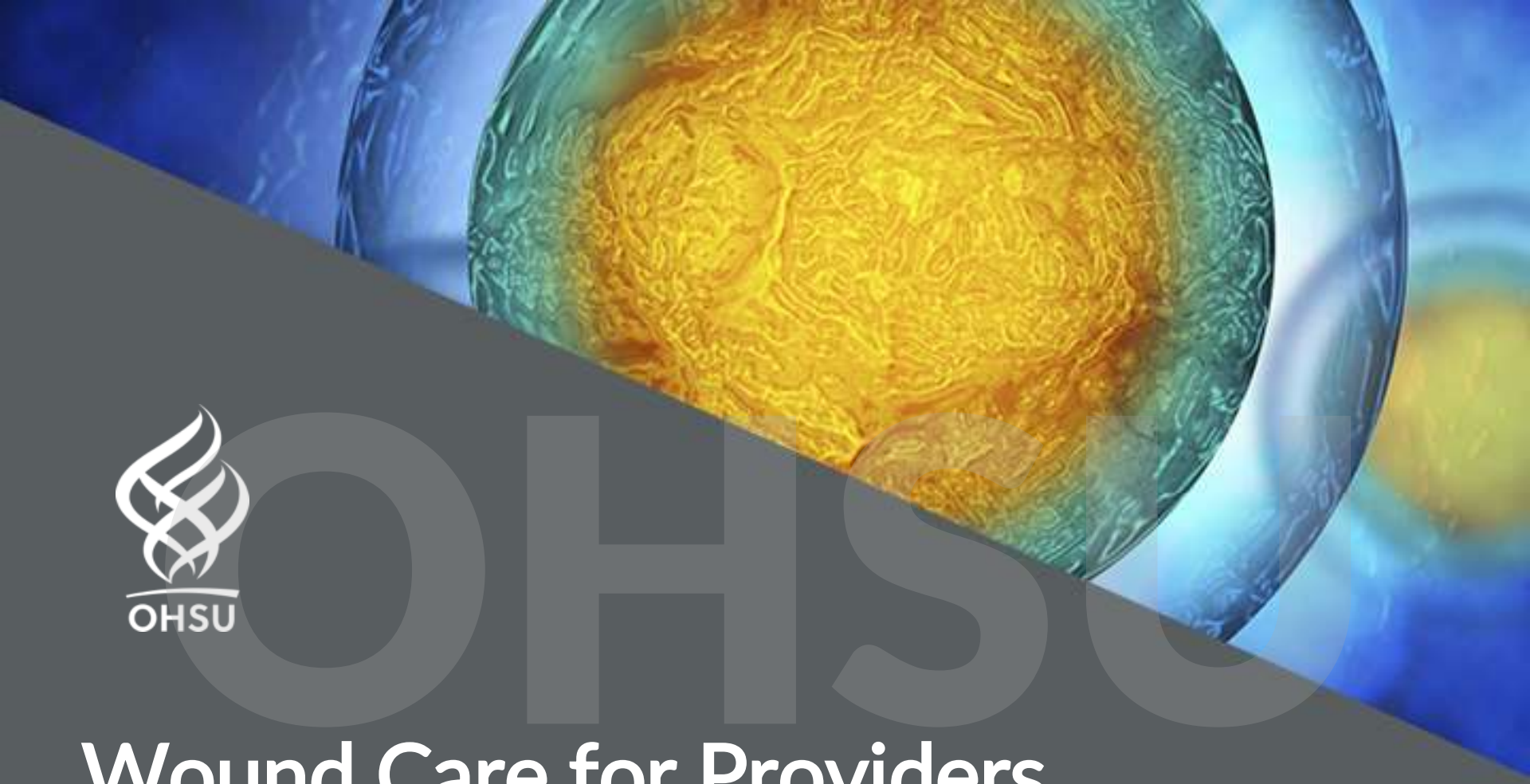


Wound Care for Providers

Brenda LaVigne, PA-C
Wound and Hyperbaric Medicine
Faculty OHSU School of Medicine - Dept. of Vascular Surgery

Objectives

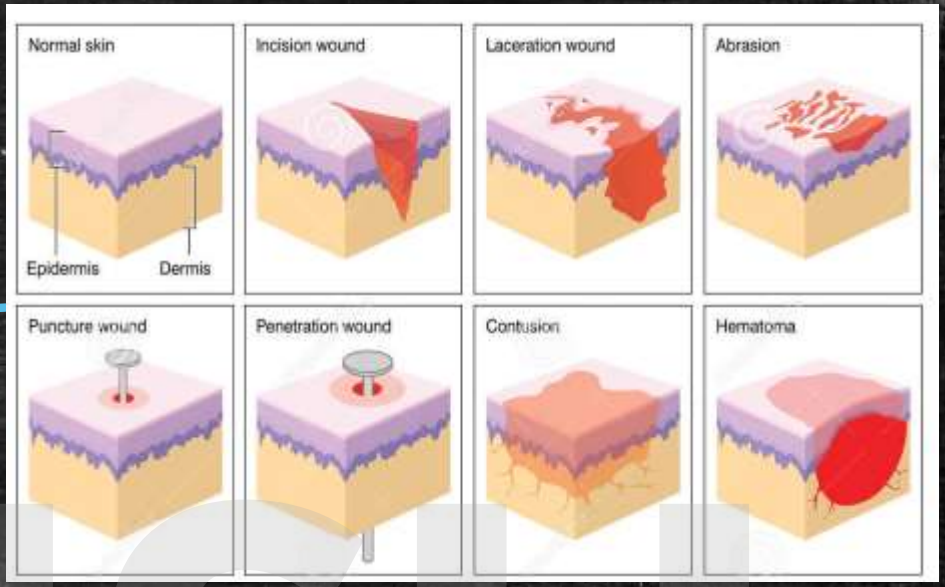
WARNING: Graphic Images

1. Review Phases of Normal Wound Healing

2. Review Principles and Management of Wound Healing

3. Discuss Wound Development/Advanced Treatment Options

How Wounds Develop:

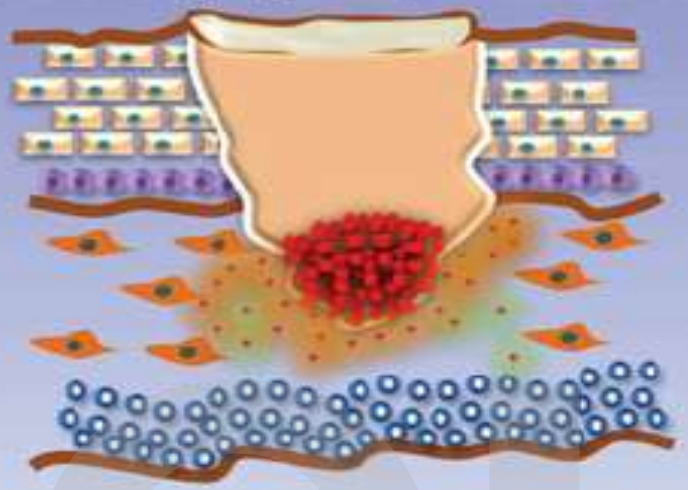


- Trauma/Surgical Complications
- Edema/Vascular compromise
- Infection
- Diabetes/Neuropathy
- Atypical (CA, Autoimmune, Allergies/Rash)

Hemostasis

Seconds to Hours

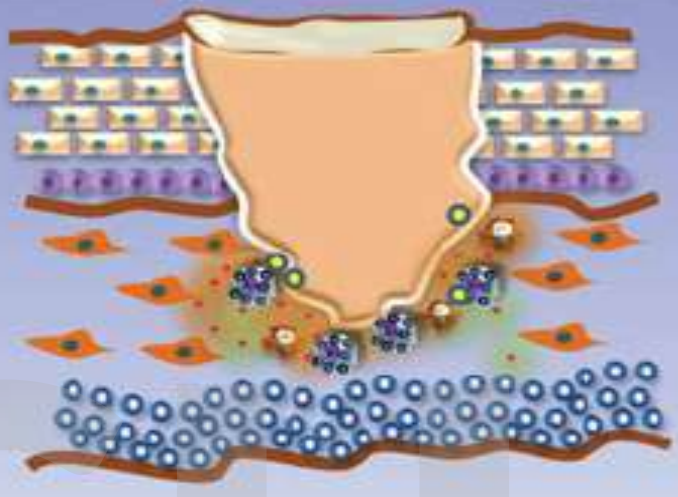
Platelets aggregation prevent blood loss



Inflammation Substrate

Hours to Days

Inflammatory cells cleanse the wound



Proliferation

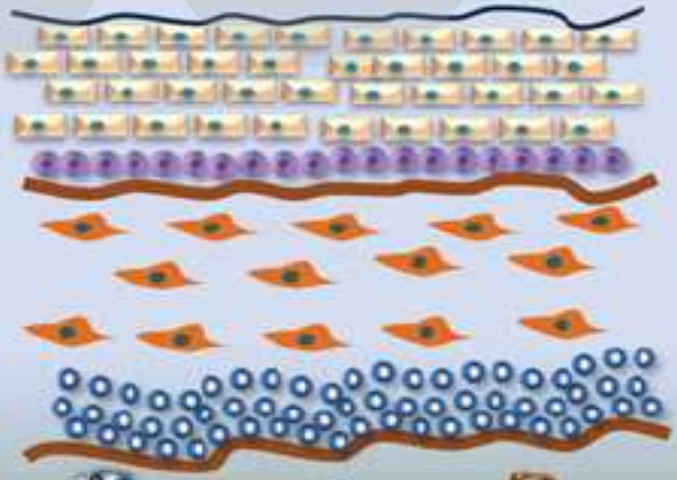
Angiogenesis and re-epithelialization takes place

Days - Weeks

Remodeling Maturation

Wound remodeling restores mechanical strength to the healed tissue

Weeks to Years



Keratinocytes Fibroblasts Adipocytes Platelets Neutrophils Lymphocytes Phagocytes

Normal Wound Healing Process

- Healthy population
- Size decreases at least 50% by 4 weeks
- Typically does not re-occur

3 Types of Wound Healing

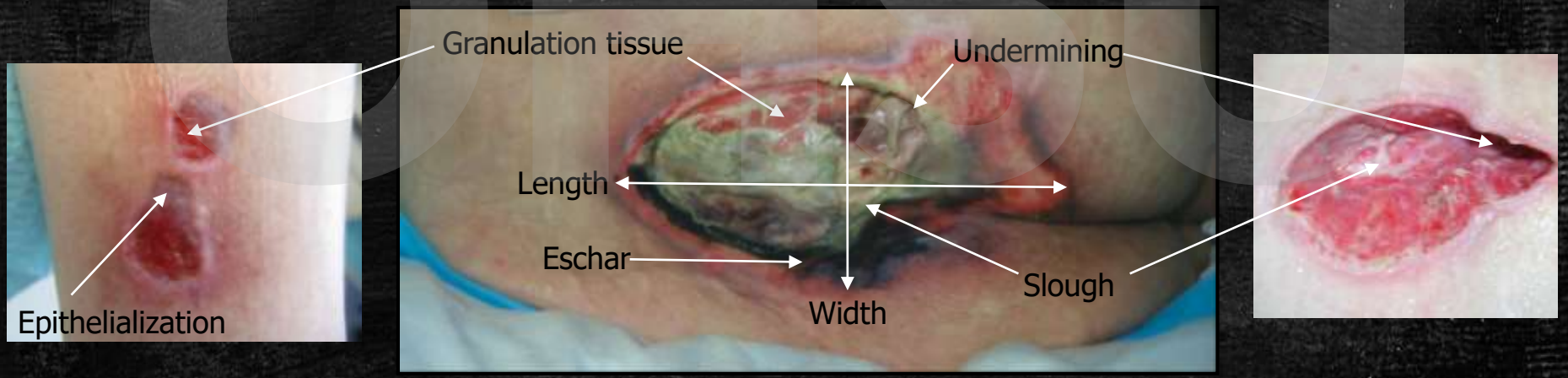
1. First Intention "Primary Intention/Primary Union":
   - Tissue surfaces are approximated (sutures, glue, staples, steristrip/tape, closure devices)
     - Ex: Surgical incisions, lacerations, superficial injuries
2. Secondary Intention:
   - Tissue damage is extensive and wound edges cannot be approximated (wound must heal from bottom up)
     - Ex: Pressure ulcers, abscesses, avulsions
3. Tertiary Intention "Delayed Primary Closure" or "Secondary Closure":
   - Wound edges could be approximated, but there is reason to delay closure after debridement (such as concern of retained foreign body, infection, poor circulation, unhealthy wound base)
     - Ex: Dog bites/infected wounds/Road rash, pending flap or revascularization.

Assessing Patients With Wounds:

- History: How long have they had the wound? Initial cause? What do they do for it at home? Improving/Worse? Previous/similar ulcers, if so what helped? Relevant co-morbidities? Daily Activities/offloading? Diet? Smoking/Drugs/ETOH?
- Physical Exam: Overall appearance, Pulses/Cap refill, edema, evidence of infection, sensation, pressure
- Labs: Culture, albumin, pre-albumin, Hgb A1c, CBC w/diff, ESR/CRP
- Imaging/Diagnostics: X-ray, MRI, CT, US/Vascular studies, Pathology

Wound Assessment

- **Measure**: L x W x D in cm. Probe & measure tunnels and undermining (Box/Clock method – 12 @ patient head)
- Images helpful to monitor progress (Consistent angle/distance for comparison)
- **Wound Edges**: Adhered or undermined, epibole, scar, macerated, exudate, callus, firm, epithelialization
- **Wound Bed**: Exposed structures, necrotic tissue, granulation tissue, fibrin, slough, exudate, odor, drainage, tenderness
- **Periwound skin**: color, moisture, induration, erythema



Wound Descriptors:

Granulation

Hypergranulation

No Granulation

Induration

Crust (Scab)

Eschar

Excoriated

Maceration

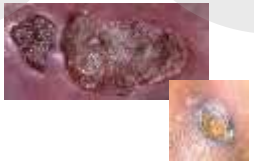
Slough

"Unable to visualize" Unstagable/ Suspected Deep Tissue Injury

Ecchymosis

Closed/Epithelialized

Denuded



Punched out

Pre-Ulcerative Callus

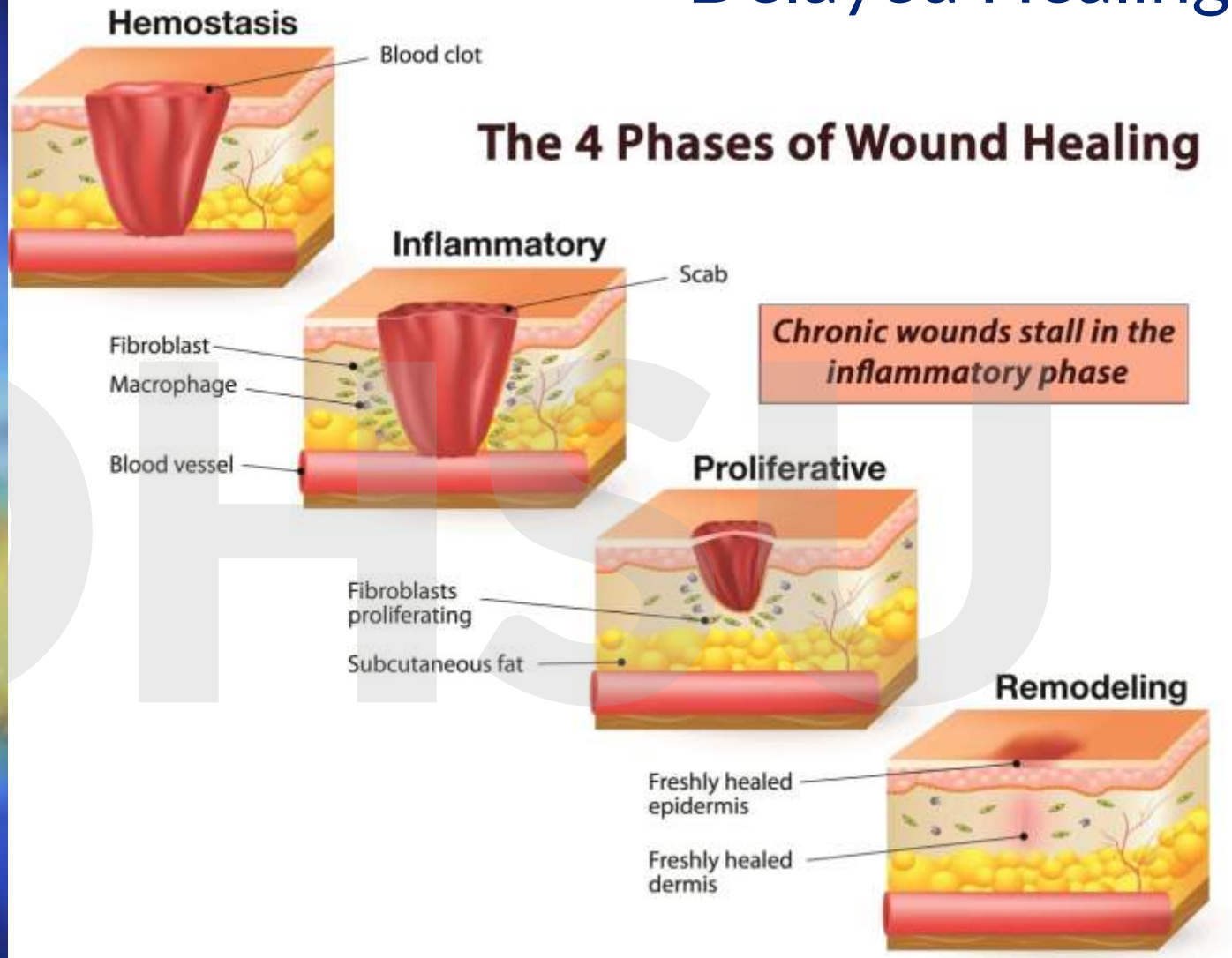
Why Won't This Wound Heal?

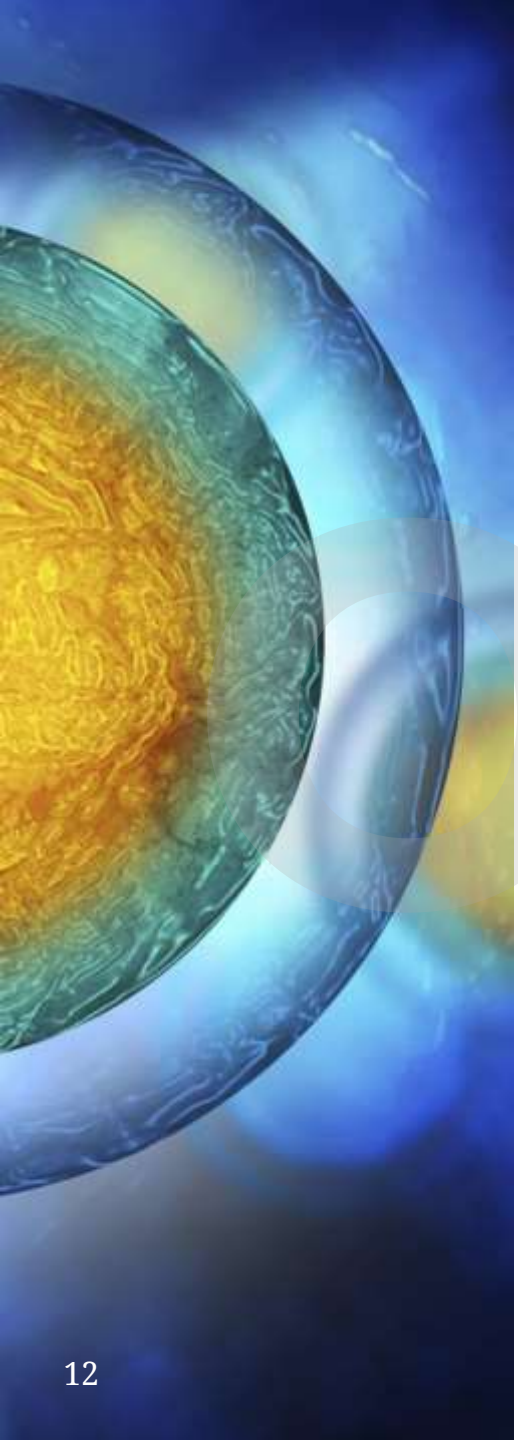
- Chronic inflammation
- Pressure/Inadequate offloading
- Poor blood supply
- Inadequate edema control
- Infection/Colonization/Poor bioburden control
- Cancer
- Immune deficiency
- Comorbidities not well manged

Delayed Healing

- Comorbidities
- Does not heal as expected
- Re-occurs
- Re-opens
- Complications

* Goal of 50% closure within 4 weeks

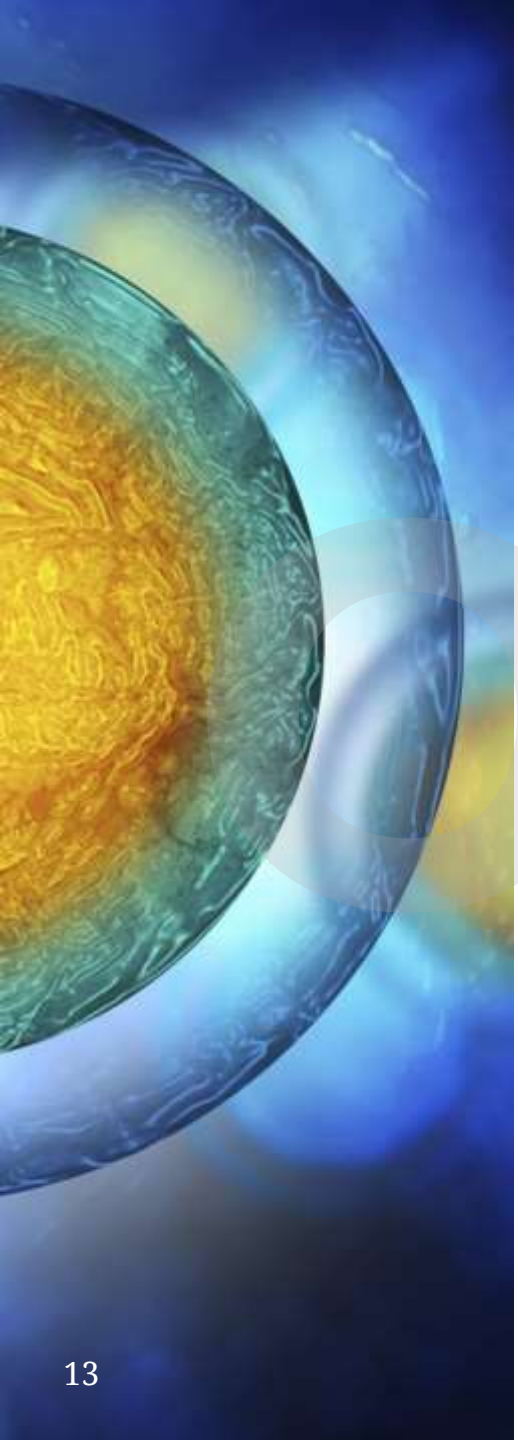




Wound Care

1. Assess perfusion

- **Arterial:** Hx of claudication/rest pain, PAD/CAD/CVA, Pulses, cap refill, temp of toes, color, pallor on elevation or dependent rubor.
  - ***ABI***
  - ***ArtDup***
  - ***Consult Vascular***
- **Venous:** LE edema, hemosiderin staining, varicosities, weeping/blistering of LE's.
  - ***Elevate***
  - ***Graduated compression***
  - ***Consult Vascular***



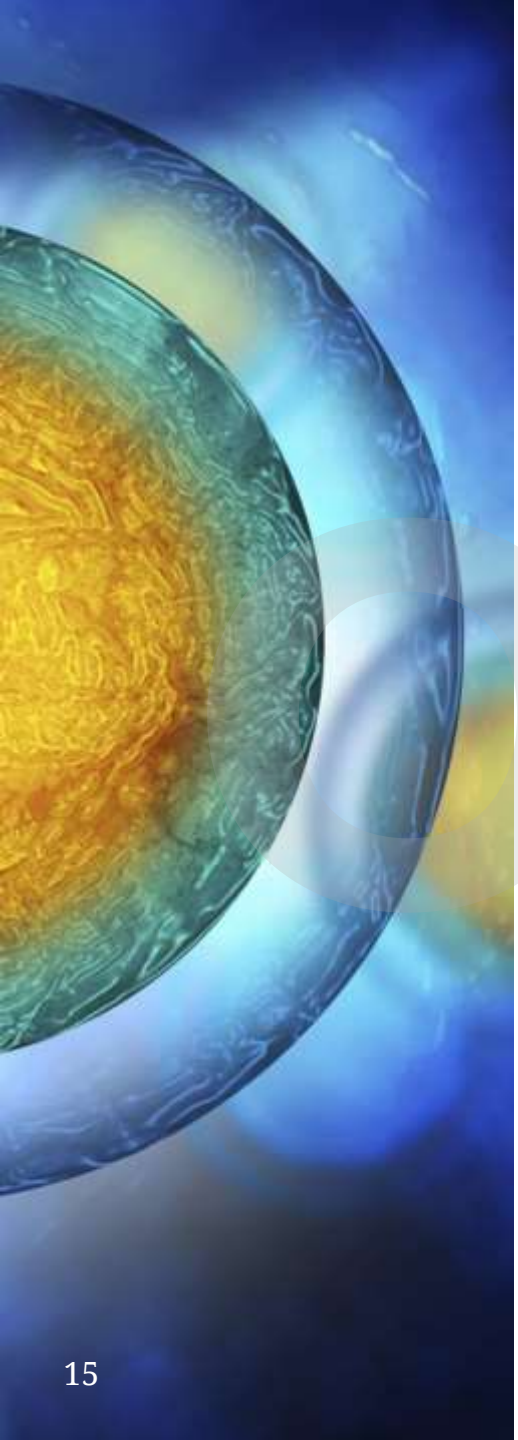
Wound Care

2. Removal of Non-viable tissue

- **Debridement**
  - May refer to OP wound clinic
  - Consider Surgical consult (plastics, vascular, podiatry/foot and ankle, ortho if osteomyelitis)

DEBRIDEMENT

- Necrotic tissue provides ideal environment for bacterial growth increasing infection risk
- Debriding removes medium for bacterial growth and helps move wounds out of the inflammatory phase by triggering same release of chemicals from the brain during an acute wound, essentially starting the healing process over again.
- Encourages angiogenesis by minor trauma to exposed blood vessels.
- Multiple types (Surgical, Sharp excisional, Biologic, Autolytic, Mechanical, Chemical/enzymatic)



Wound Care

3. Infection Control

- **Wound culture**
  - Obtain after cleaning/debriding
  - Consider biopsy/tissue culture (more accurate than swab)
- **Imaging/labs** (Osteomyelitis/deep abscess/cellulitis/Necrotizing/Gas Gangrene)
  - CBC, ESR, CRP
  - X-Ray, MRI, CT
- **Antibiotics**
  - Topical (erythema local to wound bed)
  - PO (infection distal to wound)
  - IV (resistant/long-term/allergy/culture)

Wound Care

4. Edema Control

- **Venous HTN/Insufficiency:** Compression, consider Vascular referral
- **Lymphedema:** Compression, consider Lymphedema clinic referral






Wound Care

5. Optimal Wound Environment

- **Control Moisture**
  - ***Too Dry:*** physical barrier to wound contraction and keratinocyte proliferation.
  - ***Too Moist:*** maceration of periwound tissue, breeding ground for fungi/bacteria.
- **Dressing Adheres to wound/Pain with dressing changes**
  - If dressings cause trauma consider:
    - Vaseline impregnated/oil immersion contact layer (adaptic/curity/xeroform)
  - Can apply absorptive/cover layers over PRN
  - Rx for topical lidocaine
    - 2% mucosal jelly or 5% ointment

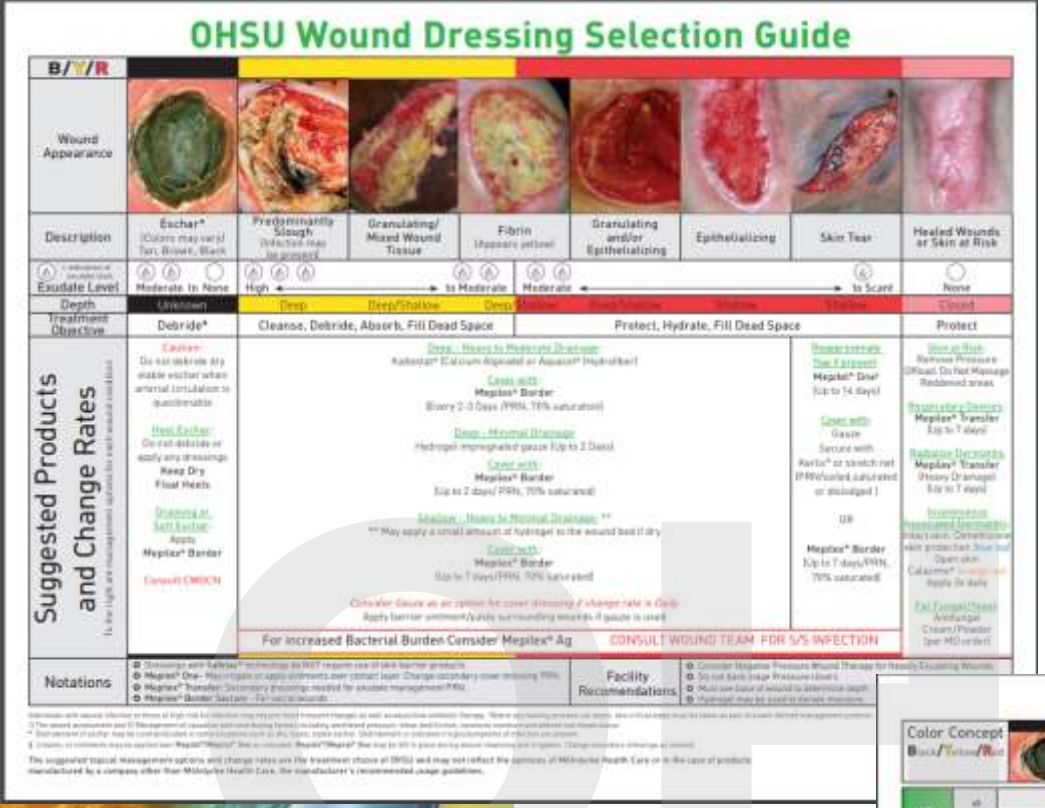
Moisture Balance

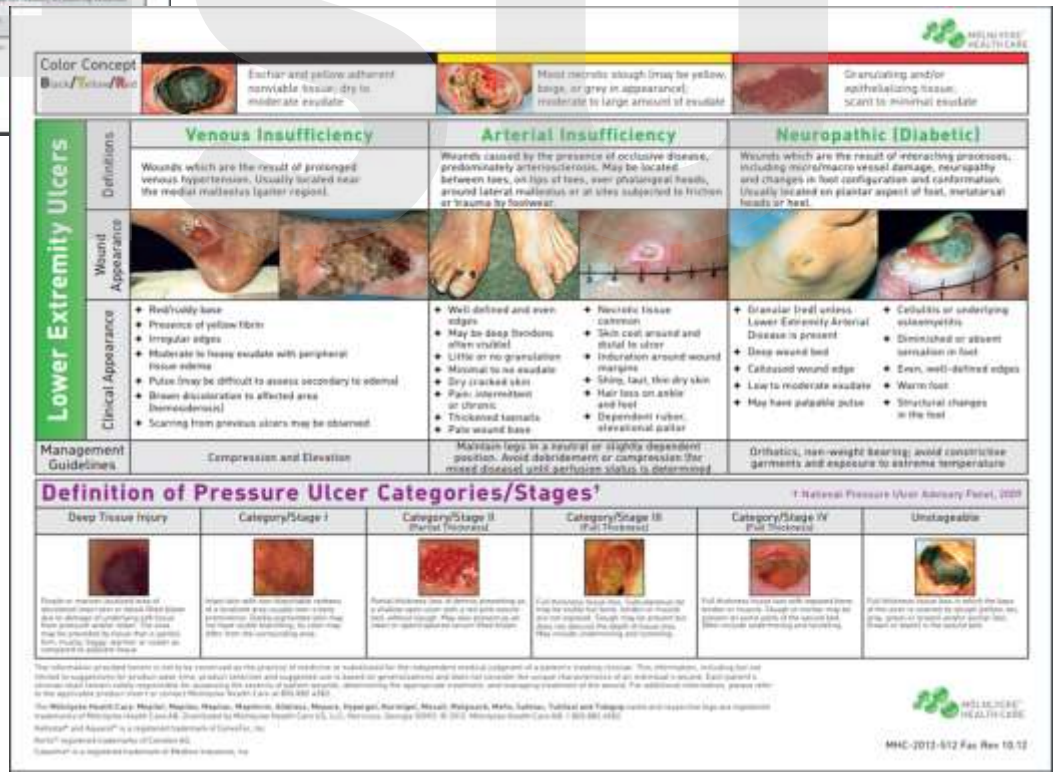
- **Dry Wound:** (e.g., wound with dry eschar): needs dressing that "traps" wound exudate or adds moisture to the wound. Changed less often – up to 1 week
  - Wound gel, A&D ointment/Vaseline, Medical/Manuka honey, cover with moisture retentive dressing (Oil Imersion: Xeroform, Adaptic, Curity), moistened Collagen. Occlusives (Tegaderm, Opsite) on a minimally exudative acute wound (Not typically used in chronic ulcers unless for showering or to keep water out temporarily)
- **Mild-Moderate Drainage:** (e.g., superficial or shallow ulcers):
  - Hydrocolloid dressings tend to absorb mild-moderate moisture and do not add moisture, Foam dressings, dry Collagen, Collagen/Alginate Combo (Fibracol).
- **Heavily Draining:** (e.g., Deep/heavily draining wounds): needs dressings that absorb moisture and likely more frequent dressing changes, BID-Biweekly.
  - Alginate, Hydrofiber, Exudry, Damp/dry gauze/kerlix, ABD, Super-absorbers

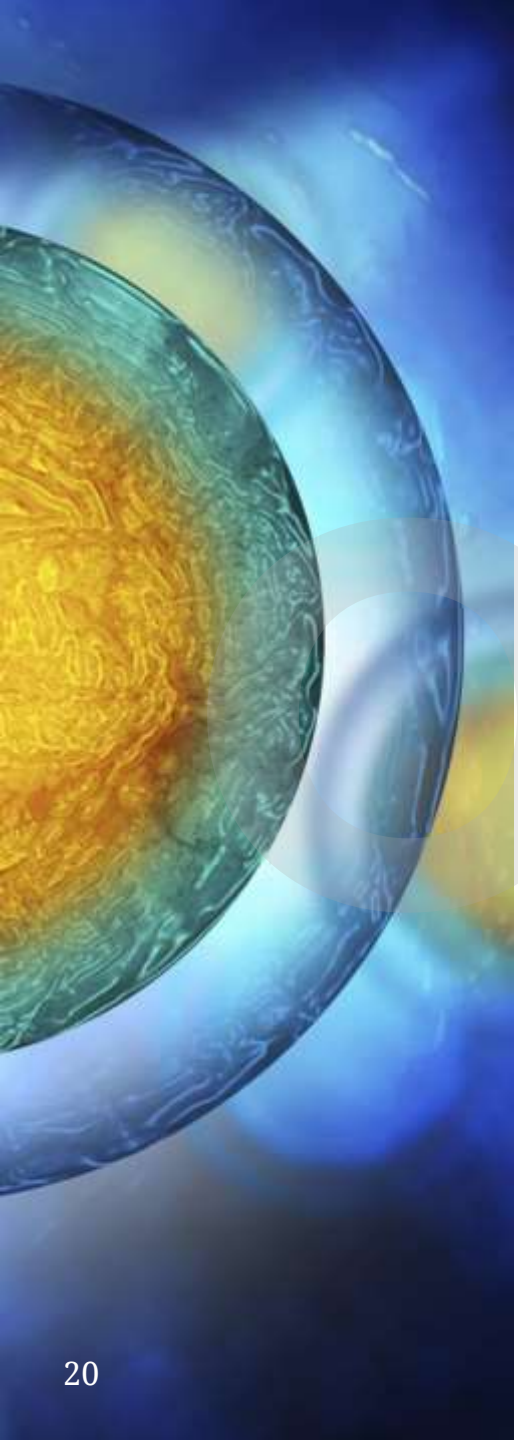
**Any wound product names are used as examples and no preference is given to specific brands, any product with comparable properties should be considered depending on patient tolerance and cost effectiveness.*

Dressing Selection

https://o2.ohsu.edu/nursing-portal/staff-tools-resources/tool-kits/wound-and-ostomy/upload/wound-dressing-selection.pdf







Wound Care

6. Optimize tissue growth

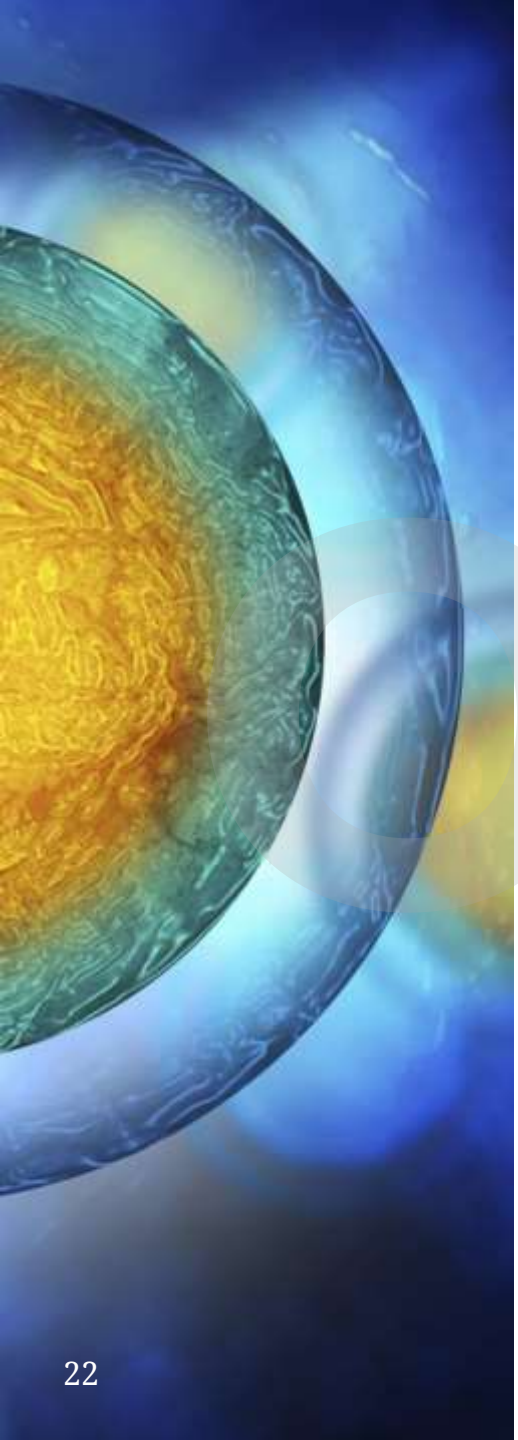
- **Large surface area**
  - Graft/flap (Allograft/Autograft)
  - Advanced cellular tissue based products CTBP (Scaffolding/ECM, Growth Factors)
- **Deep ulcer**
  - NPWT (Wound VAC)
  - “Packing” = Fill gently (plain/Iodoform)
  - “Wet to Dry” = Moist (+/- Daikens if infection)
  - Medihoney/Iodasorb (tunnel/undermining)

*Always protect exposed bone/tendons (adaptic/curity non-adherent/xeroform)

Wound Care

7. Offloading

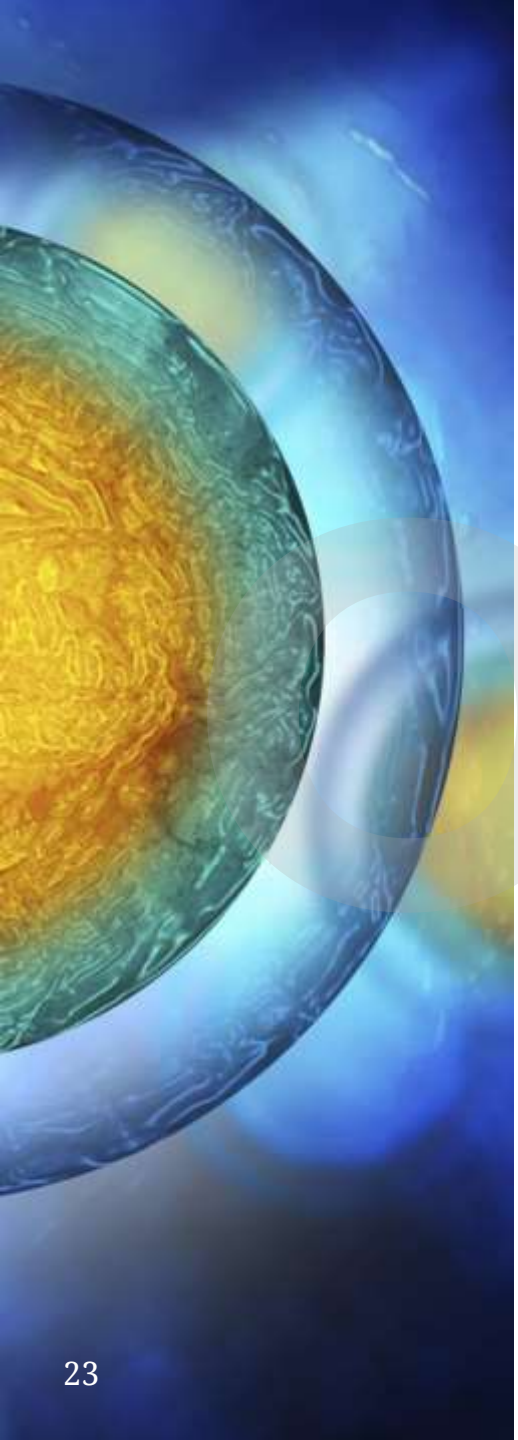
- **Avoid pressure** on the wound bed
  - ***Limit ambulation***
    - Walking Boot/Shoe, Orthotics
    - Felt/Foam cutout
    - TCC (Total contact cast) or Soft cast
    - Knee scooter/crutches/wheelchair
    - NWB status
  - ***Float heels/ulcer sites***
    - Foam/wedge
    - Pillows/rolled blankets/towels
    - Rooke boots



Wound Care

8. Pain Control

- Topical Lidocaine, injected Lidocaine/ Bupivocaine
  - 2-5% viscous lidocaine or ointment used topically is typically effective for most patients for debridement and dressing changes (check insurance coverage)
- OTC NSAIDs
- Rx PRN
  - PO or IV analgesics
- Consider referral to pain clinic
  - severe/refractory/long-term chronic pain



Wound Care

9. Host Factors Optimized

- **Comorbidities/Management**
  - ***Nutrition*** - Increase Protein/well balanced diet (adjust for comorbidities)
  - ***Diabetes*** – Blood sugar control, assess neuropathy and kidney function
  - ***HLD/CAD/PAD/CVA*** – Increased risk of arterial compromise
  - ***HTN/CHF/Arrhythmia*** – Adequate heart rate, BP and fluid/edema control
  - ***Cancer*** – Discussion about palliative vs. healing expectations
  - ***Sleep*** – Discuss good sleep hygiene, treat sleep apnea
  - ***Inflammation/Autoimmune*** – Immune modulation regulation (up/down depending on healing/overall health)

Chronic Ulcer/Comorbidity Types

Venous leg ulcer

- Common in elderly
- Result of chronic venous hypertension
- Persistent inflammation
- Hemosiderin deposits
- Lipodermatosclerosis

Arterial ulcer

- Reduced blood supply
- Ischemia, necrosis
- Little exudate
- Atrophic skin
- Common in diabetes
- Pain

Diabetic foot ulcer

- Common in diabetes
- Hyperglycemia
- Micro-/macroangiopathy
- Neuropathy
- Infection
- Foot deformities

Pressure sore

- Area of tissue necrosis
- Caused by prolonged soft tissue compression
- Local ischemia, moisture
- Multi-morbid and elderly

E. **Surgical Complication**

F. **Atypical Ulcer**

G. **Skin Tear**

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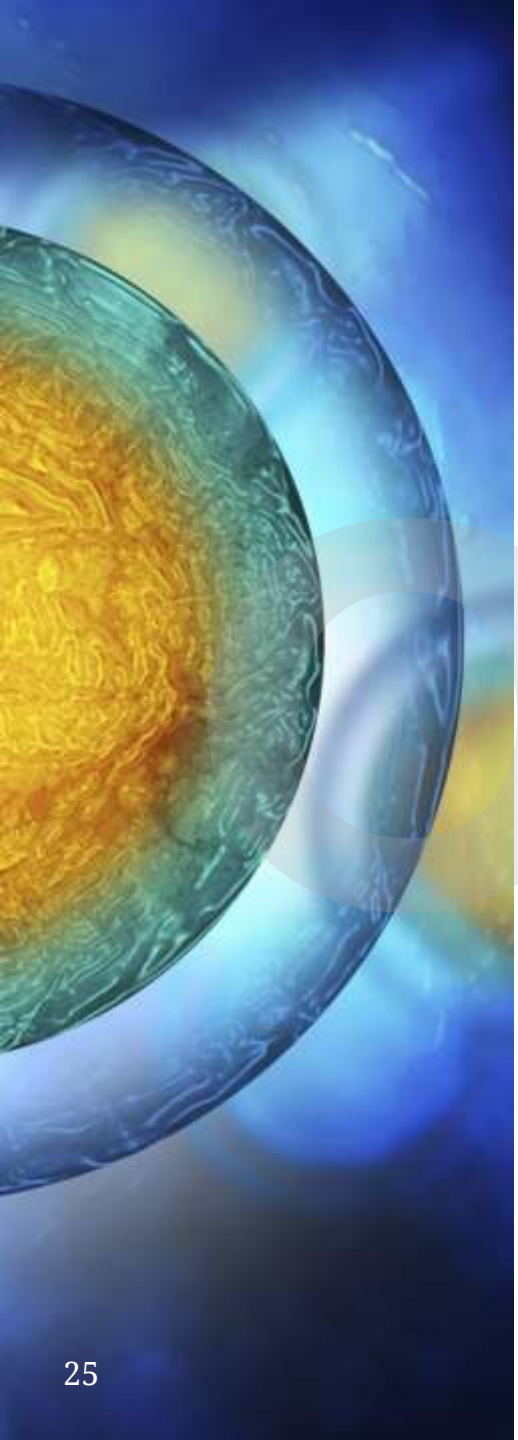
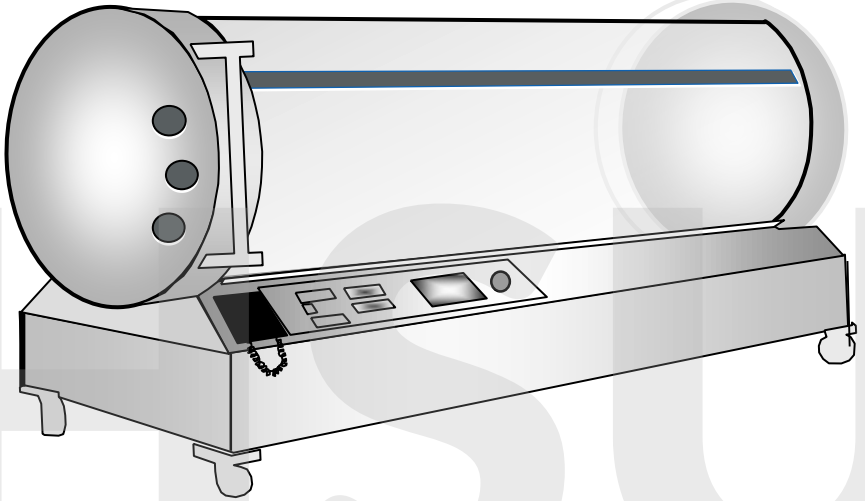


What is HBOT?
How does it work?



Patients are placed in an enclosed metal and acrylic chamber, which is filled with 100% oxygen, and pressurized (typically 2.5 atmospheres below sea level).

Nearly 17 x increase in the amount of oxygen dissolved in plasma and available to tissues

Hyperbaric Oxygen Consideration

Risks:

- Barotrauma
- Oxygen toxicity seizure
- Tension pneumothorax (if untreated pneumothorax)
- Temporary vision changes

Benefits

- Angiogenesis
- Decreased tissue hypoxia/increased perfusion and healing potential
- Decreased bacterial burden

- <u>Indications:</u>
  - Diabetic foot ulcers > 30 days with deep space/bone infection not reduced by 50% in 30 days despite advanced wound care.
  - Chronic Refractory Osteomyelitis > 60 days despite long term antibiotics/surgical debridement.
  - Radiation injury non-healing > 6 months post completion of RT
  - Severe Infections – Gas Gangrene, Nec. Fasc., Intracranial Abscess
  - Crush Injury/Compartment Syndrome/Amputation w/reattachment
  - Acute critical limb ischemia
  - Compromised Flap/Graft w/history of previous failure
- <u>Contraindications:</u>
  - Absolute = untreated pneumothorax
  - Relative = recent (< 6 half lives)/current treatment with bleomycin/cisplatin/disulfiram/doxorubicin/sulfamylon (active CA?), unstable seizures, recent/current URI/sinus/ear infection, implanted device not rated for chamber pressure, high fever, uncontrolled COPD/Asthma, congenital spherocytosis, or untreated claustrophobia/severe anxiety

Case Study Wagner III DFU

58 y/o M w/PmHx of DM w/chronic non-healing Wagner III DFU, tendon exposed.

- Treatment #7:
  - Healthy granulation tissue in wound base (Fig 2).
- Treatment #20:
  - Contracture of wound edges
  - Peripheral Epithelialization (Fig 3).

Post HBO Follow-ups:

Week 2 (Fig 4)

Week 6 (Fig 5)

*Patient discharged healed.

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QUESTIONS?

Appropriate Outpatient Wound and Hyperbaric Clinic referrals:

- Any patient w/wound > 30 days not responding as expected or with complications that is not under a 90 day global for surgery
- Any patient with an insurance covered diagnosis for hyperbaric oxygen therapy.

How to reach us:

1) Phone (503) 494-1624

2) OHSU Physician's Pavilion 4th Floor
3181 Sam Jackson Park Rd. (PPV 430)
Portland, OR 97239

Email: lavigne@ohsu.edu

Thank You!

And they all healed happily ever after!

☺

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