Hands-On Workshop: Integrating the Use of Negative Pressure Wound Therapy and Meshed Bilayer Wound Matrix

Supported by educational grants from 3M Health Care, Medical Solutions Division and Integra LifeSciences

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Faculty Disclosures

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Disclosures and Disclaimer

The faculty have been informed of their responsibility to disclose to the audience if they will be discussing off-label or investigational use(s) of drugs, products, and/or devices (any use not approved by the US Food and Drug Administration).

- Applicable CME staff have no relationships to disclose relating to the subject matter of this activity
- This activity has been independently reviewed for balance

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Learning Objectives

- Review best practices for wound bed preparation prior to application of advanced therapies
- Examine the role and landscape of dermal substitutes in wound repair and reconstruction
- Highlight the landscape of negative pressure wound therapy (NPWT) technologies, including NPWT with instillation (NPWTi) and incisional NPWT (iNPWT)
- Explore an algorithmic approach to the application of NPWT in combination with meshed bilayer wound matrix
- Participate in hands-on application of NPWT in combination with meshed bilayer wound matrix

NPWT = negative pressure wound therapy; NPWTi = negative pressure wound therapy with instillation; iNPWT = incisional negative pressure wound therapy.

Best Practices for Wound Bed Preparation

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Professor, Dept of Plastic Surgery, Dept of Orthopedic Surgery
Medical Director, Wound Program
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The Wound Equation

$$\text{Healing Potential} = \frac{1}{\text{Bacteria} \times \text{Perfusion} \times \text{Tissue Mechanics}}{(\text{Host})^{x}}$$

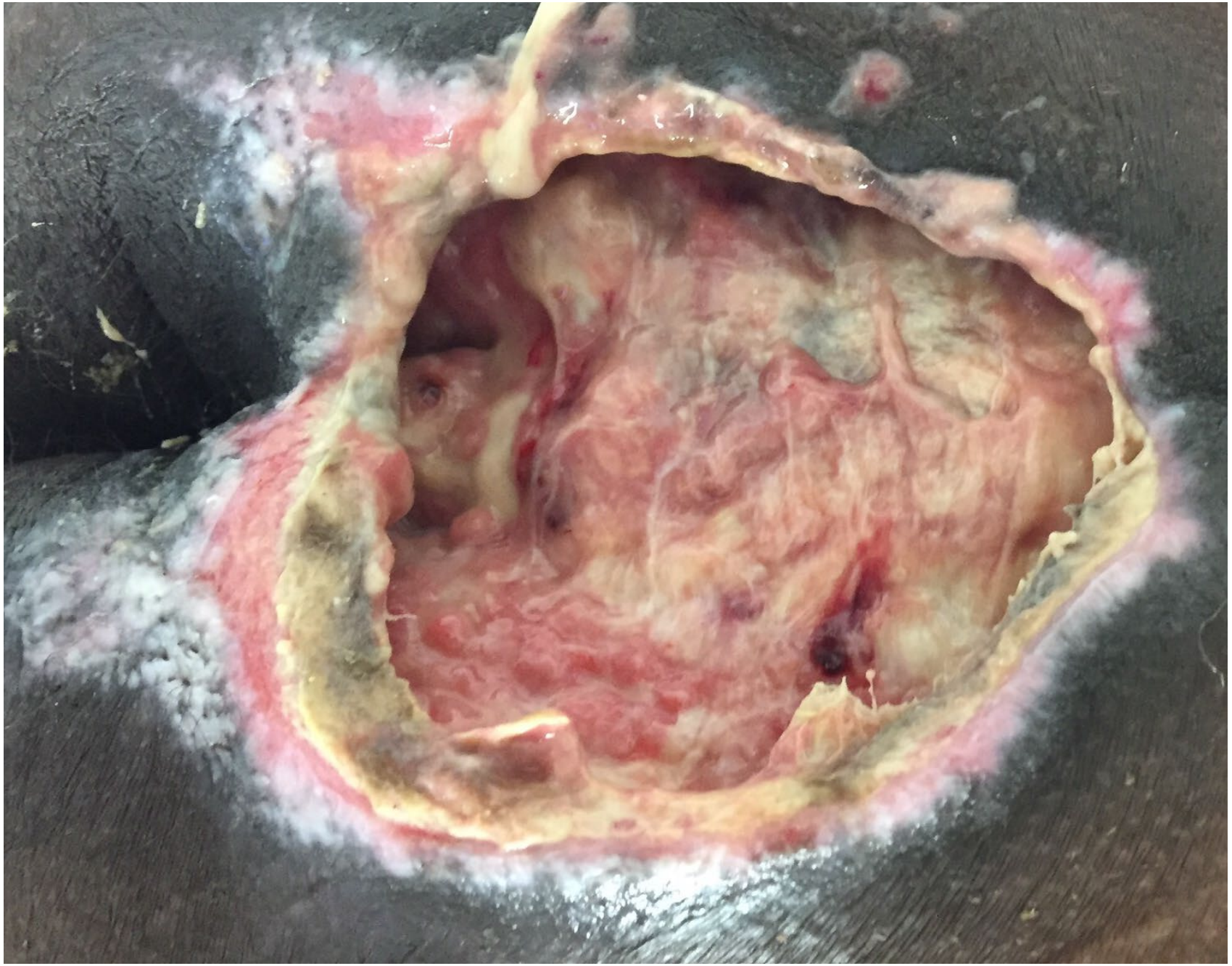
X=Unknown

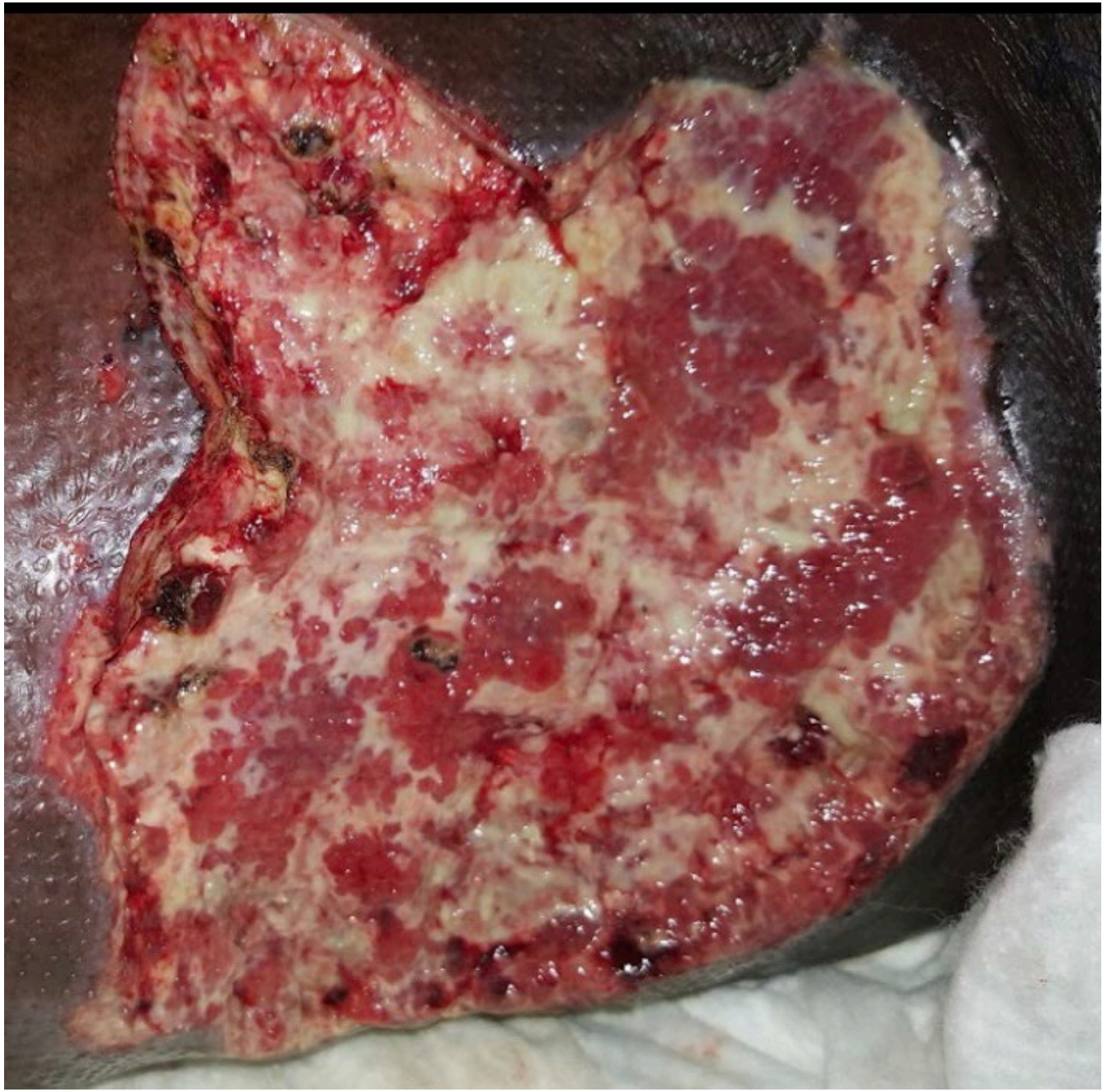
Kim PJ. *Clin Podiatr Med Surg.* 2019;36(3):xiii-xiv.

Key Signs of Wound Bed Preparation

- No signs of infection (erythema, edema, purulent drainage, odor, pain)
- Granulation tissue present
- Minimal fibrotic tissue

Wound Bed Prepared or Not Prepared to Heal?





Conclusions

- Close inspection is necessary to determine that the wound is ready for healing
  - Medical history and wound history and trajectory
  - Physical exam
  - Labs, radiology
  - Host factors
  - Your intuition
- Always address
  - Perfusion
  - Infection/biofilm
  - Tissue mechanics

The Role of Meshed Bilayer Wound Matrix In Wound Repair and Reconstruction

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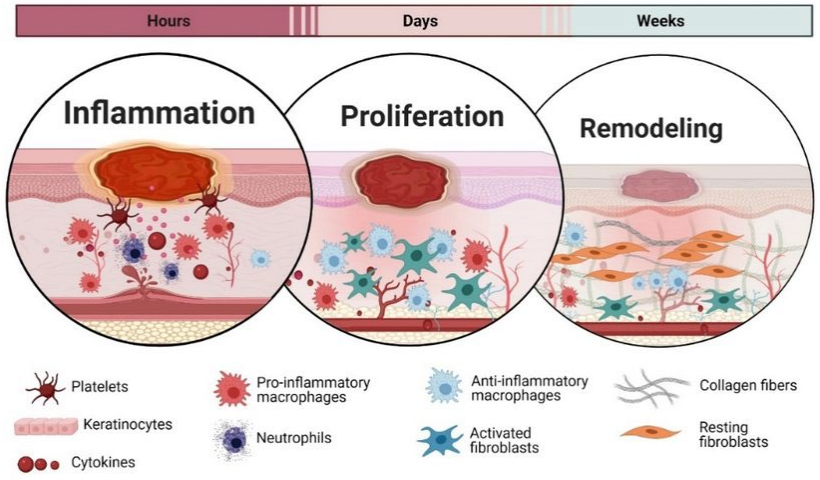
Learning Objectives

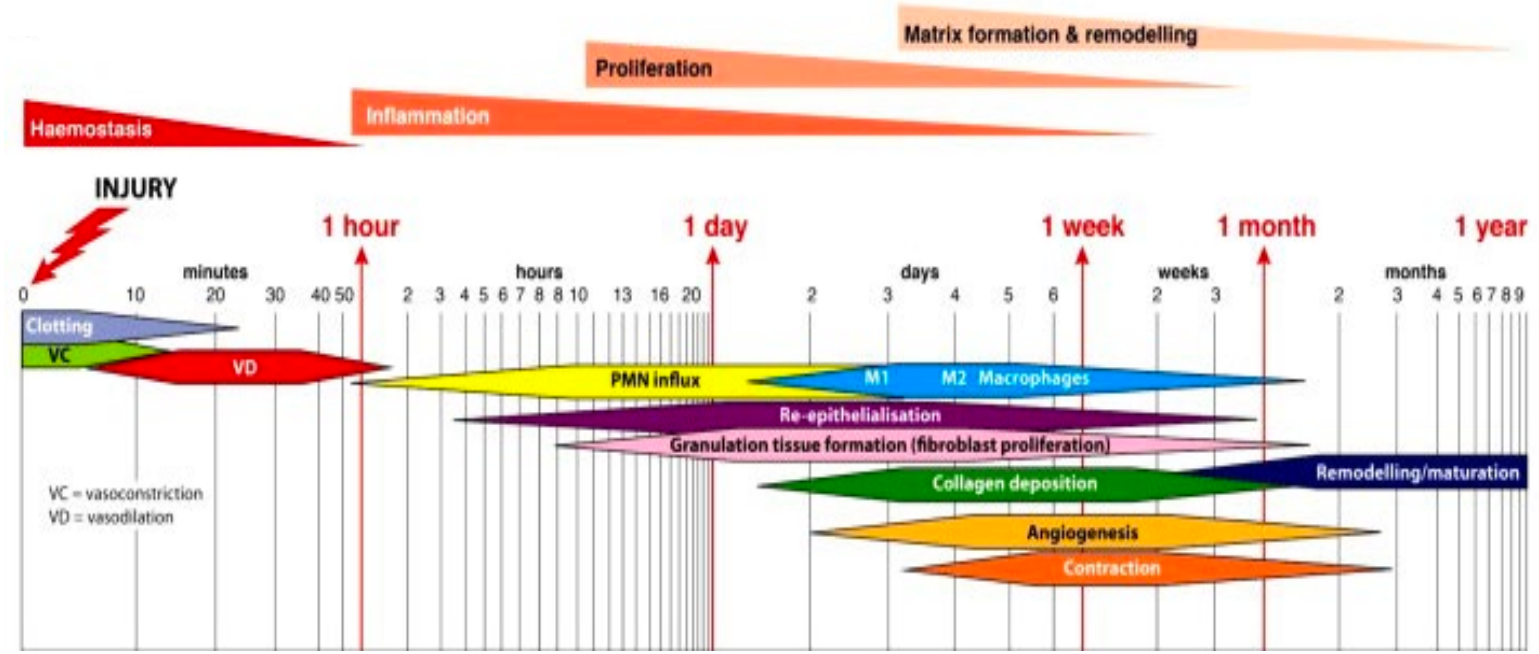
- What purpose do the extracellular matrix (ECM) and angiogenesis serve for acute and chronic wound healing?
- How to use skin substitutes when the wound is not amendable for split-thickness skin autografts (STSGs)?
- Identify how chronic wound treatment differs from acute wound care.
- How does NPWT contribute to wound healing?
- Review case studies where NPWT was used in combination with acellular, extracellular matrixes

ECM = extracellular matrix; STSG = split-thickness skin graft.

Wound Healing: A Progression

- Progression of cellular events divided into 4 overlapping phases consisting of hemostasis, inflammation, proliferation, and maturation
- During proliferation, fibroplasia and angiogenesis are co-dependent processes with the goal of ECM and granulation tissue formation

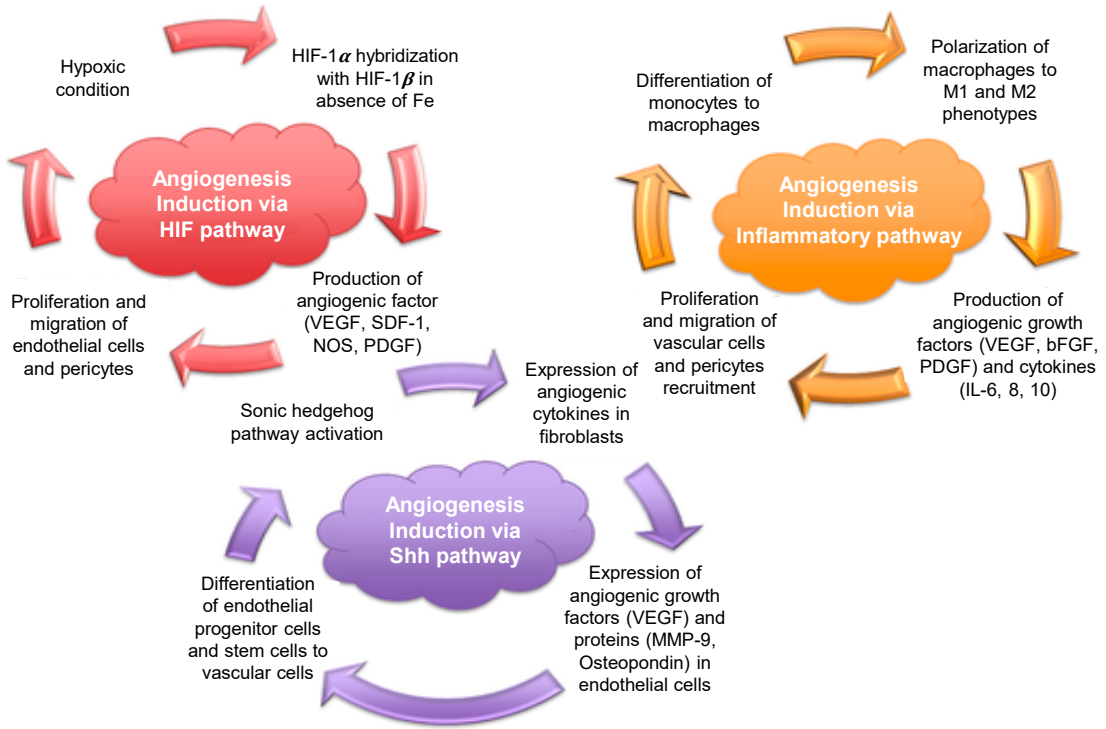




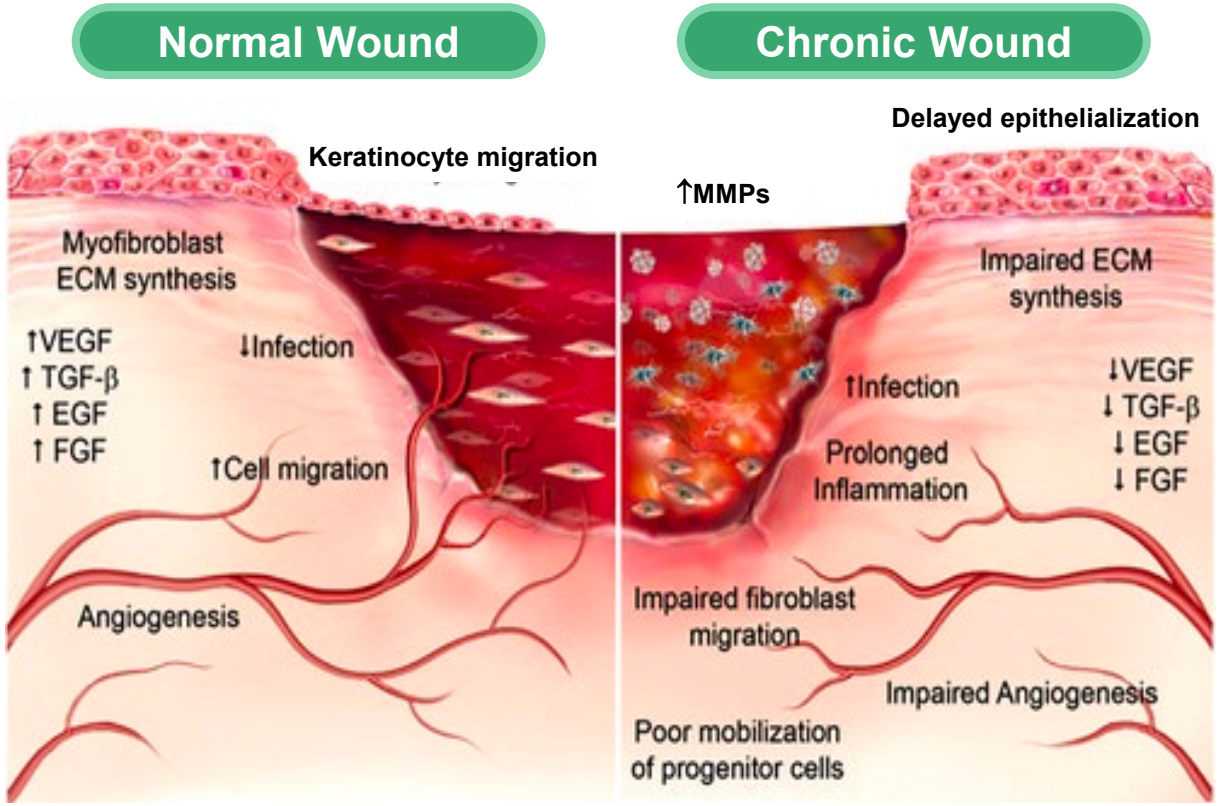
Greaves NS, et al. *J Dermatol Sci.* 2013;72(3):206–217.

Angiogenesis Is Key to Tissue Repair

- These signaling pathways prepare for angiogenesis, controlling the migration of growth factors, arteriogenesis, and transition of small arteries to large ones to improve blood circulation around chronic wounds



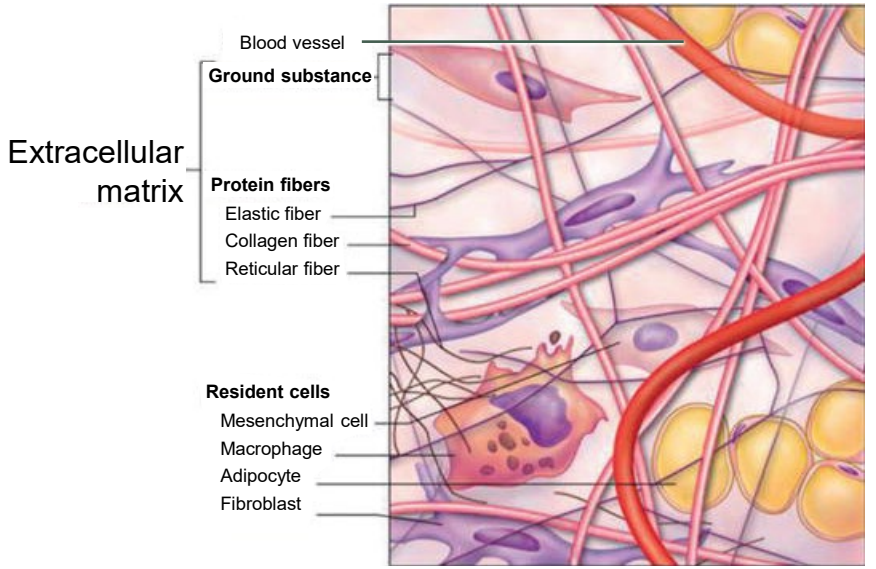
- Persistent edema— a continuative inflammatory phase — and impaired angiogenesis are significant in chronic wounds

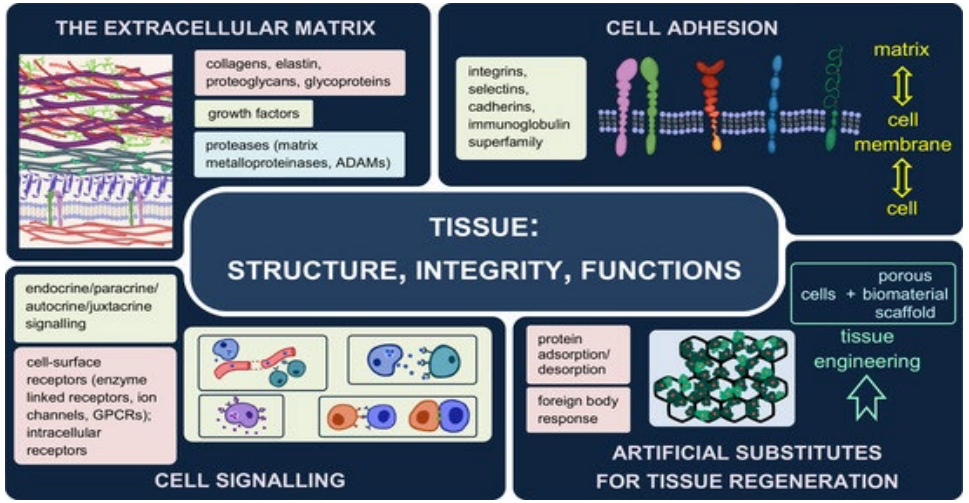


Nour S, et al. *J Biomed Mater Res A*. 2021;109(4):453-478.

Uses of ECM in the Stages of Healing

- In hemostasis, the fibrin, fibronectin, and collagen are essential in clot formation
- In inflammation, ECM directs the inflammatory cell migration and controls state of activation
- In proliferation, cells bind to the ECM to stimulate cell replication in conjunction with growth factors
- In re-epithelialization, the dermal ECM — especially type I collagen — guides wound closure
- In remodeling, the short-term ECM is replaced with fibrillar collagen (leads to scar formation, which is necessary in moderation)
- All chronic wounds are missing ECM





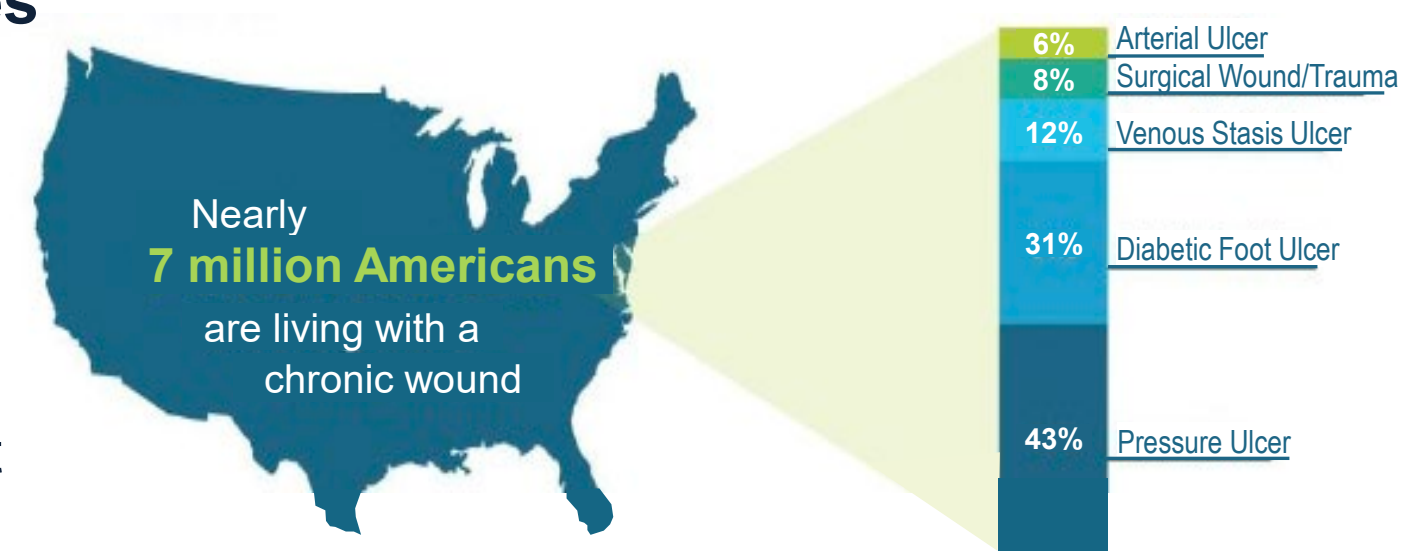
Kusidarta DL, et al. InTech. Updated Jan 31, 2018. Accessed Oct 18, 2023. https://www.intechopen.com/chapters/60312. Bandzerewicz A, et al. *Cells*. 2022;11(5):914. Arnold, Peter. (2023). SAWC Spring.

Chronic Wounds I

- Patients with chronic wounds experience loss of function, wound recurrence, and significant morbidity
- Chronic wounds include pressure injury (PI), diabetic foot ulcer (DFU), peripheral arterial disease (PAD), and venous leg ulcer (VLU)

Standard of care regimen includes

1. Weekly to monthly wound assessments
2. Infection control
3. Debridement
4. Dressings that maintain a moist wound environment



PI = pressure injury; DFU = diabetic foot ulcer; PAD = peripheral arterial disease; VLU = venous leg ulcer.

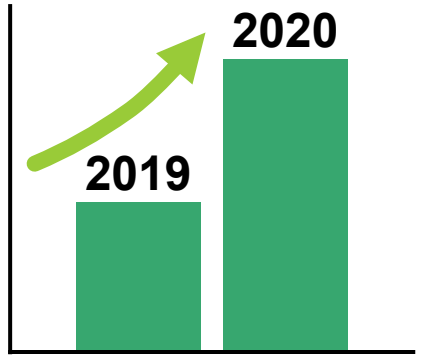
Han G, et al. *Adv Ther.* 2017;34(3):599-610. Agency for Healthcare Research and Quality. (2020). Updated Nov. 27, 2018. Accessed Oct. 18, 2023. https://effectivehealthcare.ahrq.gov/products/skin-substitutes/protocol

Chronic Wounds II

- Adjunctive therapy may include
  1. NPWT
  2. Hyperbaric oxygen therapy (HBOT) or
  3. Biologics, such as bioengineered cellular therapies, ECM products, and amniotic membrane products
- Skin substitutes are intended to stimulate the host to regenerate lost tissue and replace the wound with functional skin

The rate of amputations has increased during COVID-19

Up to **50% increase in amputations** was observed when comparing equal time frames in 2020 vs 2019



25%

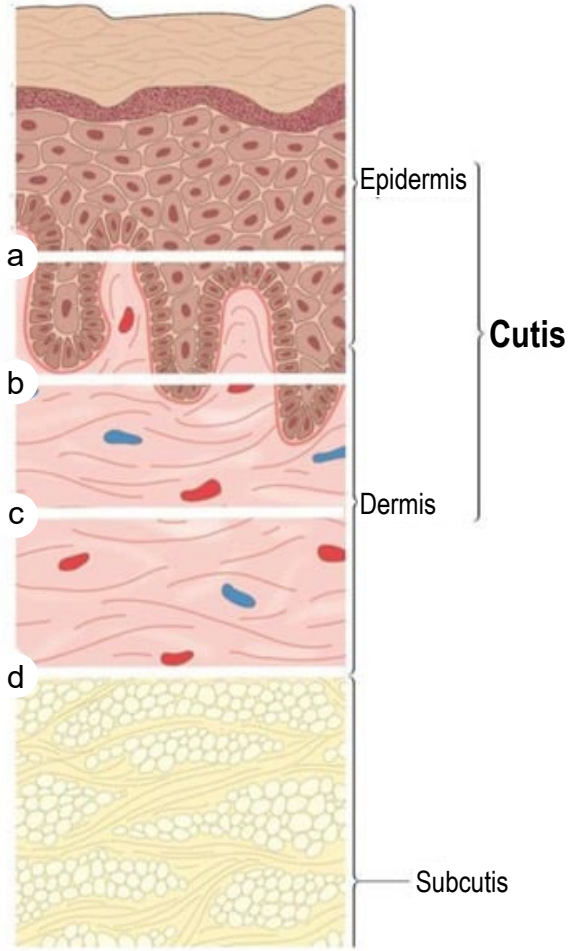
of people with advanced PAD may require an amputation within 1 yr due to a non-healing wound

HBOT = hyperbaric oxygen therapy.

Han G, et al. *Adv Ther.* 2017;34(3):599-610. Agency for Healthcare Research and Quality. (2020). Updated Nov. 27, 2018. Accessed Oct. 18, 2023. https://effectivehealthcare.ahrq.gov/products/skin-substitutes/protocol

Wound Repair and Tissue Reconstruction

- Thin split-thickness skin autografts (STSGs) provide a source of epithelium for both acute and chronic wounds
- What are alternative options to STSG in environments not ideal for graft take?
- An ideal dermal substitute should provide
  1. Template with appropriate 3D porous structure
  2. Mechanical support to guide cell migration, ECM deposition, and angiogenesis
- The combined application of NPWT and dermal substitutes improve graft take



STSG = split-thickness skin graft.

Kohlhauser M, et al. *Medicina*. 2021;57(4):348. Zhang L, et al. *BioMed Res Int.* 2020:8824737.

The Wound Nurse with a Wound

Negative Pressure Wound Therapy (NPWT)

- NPWT reduces the time required for vascular ingrowth into the dermal substitute and improves graft take
- Vacuum-assisted closure (VAC) therapy results in increased growth of granulation tissue, increased blood flow, diminution of the wound area, and regulation of inflammatory response
- Acute traumatic wounds do best at 125 mm Hg; chronic non-healing venous ulcers do best at 50 mm Hg at intermittent cycles
- Angiogenesis and local vasodilatation occurs during the “suction off” periods of VAC therapy leading to the recommendation of intermittent mode
- Rate of granulation tissue formation is 103% with intermittent vs 63% with continuous

*Two NPWT changes

VAC = vacuum-assisted closure.

Agarwal P, et al. *J Clin Ortho Trauma.* 2019;10(5):845-848.

2-Step Reconstruction Procedures with NPWT

- Revascularization is necessary for graft take, and large burns may require allografting (cadaver, xenograft or fish skin) prior to autografting
- In Molnar et al. (2004), NPWT was combined with a dermal substitute for treatment of complex tissue defects. The dermal substitute take rate was 96%, and STSG grafting was performed at 4-11 days, with a 93% take rate, indicating that NPWT improved the take rate and time to vascularization of the dermal substitute
- A prospective study conducted by Moiemen et al. (2010) showed that the NPWT application to meshed bilayer wound matrix reduces shearing forces, restricts seroma and hematoma formation, simplifies wound care, and improves patient tolerance
- The NPWT group had significantly shorter intervals between the 2 operations (24 days vs 10 days) and a significantly higher skin graft survival rate (78% vs 98%)

Zhang L, et al. *BioMed Res Int.* 2020:8824737. Stone R II, et al. *Pharmacol*. 2018;9:672.

Burns and Acellular Dermal Substitutes

- Early excision of burn wound eschar and subsequent coverage prevents fluid and protein loss, hypothermia, and the risk of infection
- Goals of skin substitutes are to reduce infection, graft rejection, and hypertrophic scarring

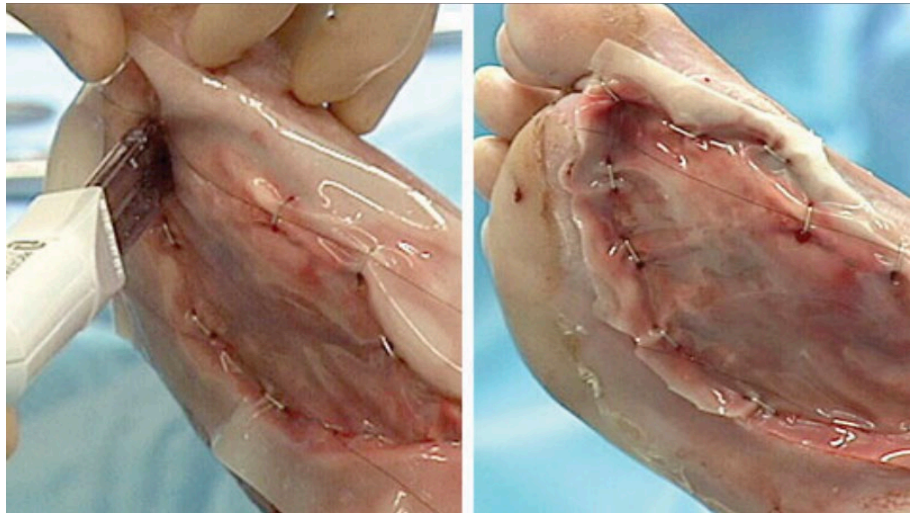
Engineered Skin Substitutes

Model	Description	Indications
ACELLULAR		
Biobrane® (Tissue-engineered skin)	Very thin semipermeable silicone membrane bonded to nylon fabric	Temporary adherent wound covering for partial-thickness excised burns and donor sites
Integra™ (Meshed bilayer matrix)	Bilayer structure; biodegradable dermal layer made of porous bovine collagen-chondroitin-6-sulfate matrix; temporary epidermal layer made of synthetic silicone polymer	Grafting of deep partial- or full-thickness burns; epidermal layer removed when donor sites available for autografting
Alloderm® (Human dermal matrix)	Structurally intact allogenic acellular dermis; freeze-dried after cells were removed with detergent treatment; rehydrated before grafting	Dermal template for grafting to burns and other wounds; repair of soft tissue defects
Matriderm® (Bovine dermal matrix)	Non-cross linked bovine collagen and elastin matrix that allows cellular ingrowth and neovascularization	Template for dermal reconstruction in the treatment of full-thickness burns

Jeschke MG, et al. *J Burn Care Res.* 2013;34(6):612-620.

Bilayer Matrix Wound Dressing

- Biological matrix composed of cross-linked bovine tendon collagen and glycosaminoglycan scaffold that assimilates into wounds and stimulates vascularization and dermal regeneration
- The semi-permeable silicone membrane controls water vapor loss and provides a flexible adherent covering that resists tear
- The collagen-glycosaminoglycan biodegradable matrix provides a scaffold for cellular invasion and capillary growth
- FDA approved for burns, burn scars, and DFUs



Silicone is typically ready for removal around POD 21 (possibly sooner with use of NPWT).

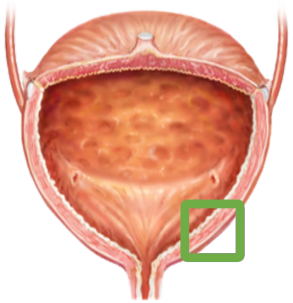
Paronychial Infection and Debridement

- Full-thickness dorsal hand defect measured 120 cm^2 with exposed extensor tendons
- Application of meshed bilayer wound matrix, STSG, and NPWT
- Occupational therapy worked with patient and after epithelization, full range of motion was achieved

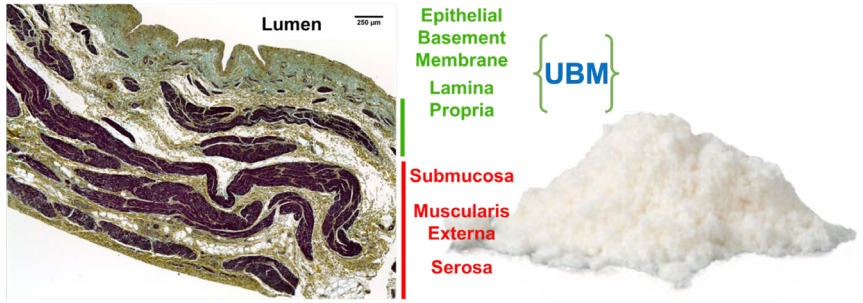
Lyons M, et al. (2016). *Eplasty*. 2016;16:ic23.

Urinary Bladder Matrix (UBM)

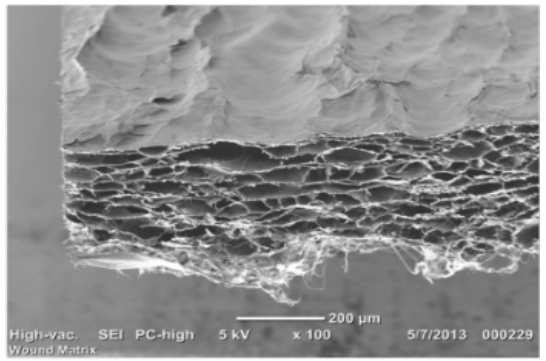
- UBM contains proteins, glycosaminoglycans, and other biological molecules in normal concentrations and distributions
- Induces bioactive growth factors that support angiogenesis and facilitate proliferation of connective tissues
- The **intact basement membrane** is conducive to epithelial and endothelial cell proliferation
- The lamina propria is composed of connective tissue that induces wound bed neovascularization



Porcine Bladder



Cross-section of bladder wall

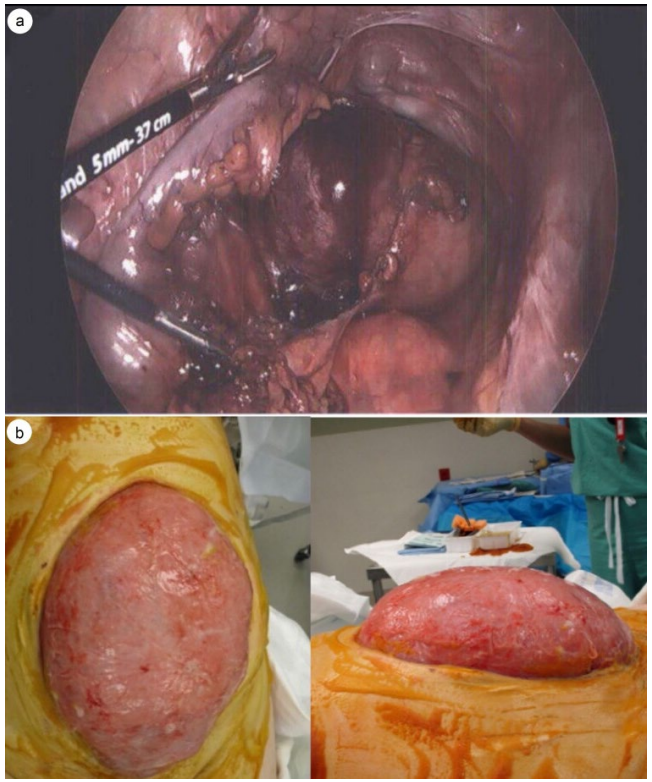


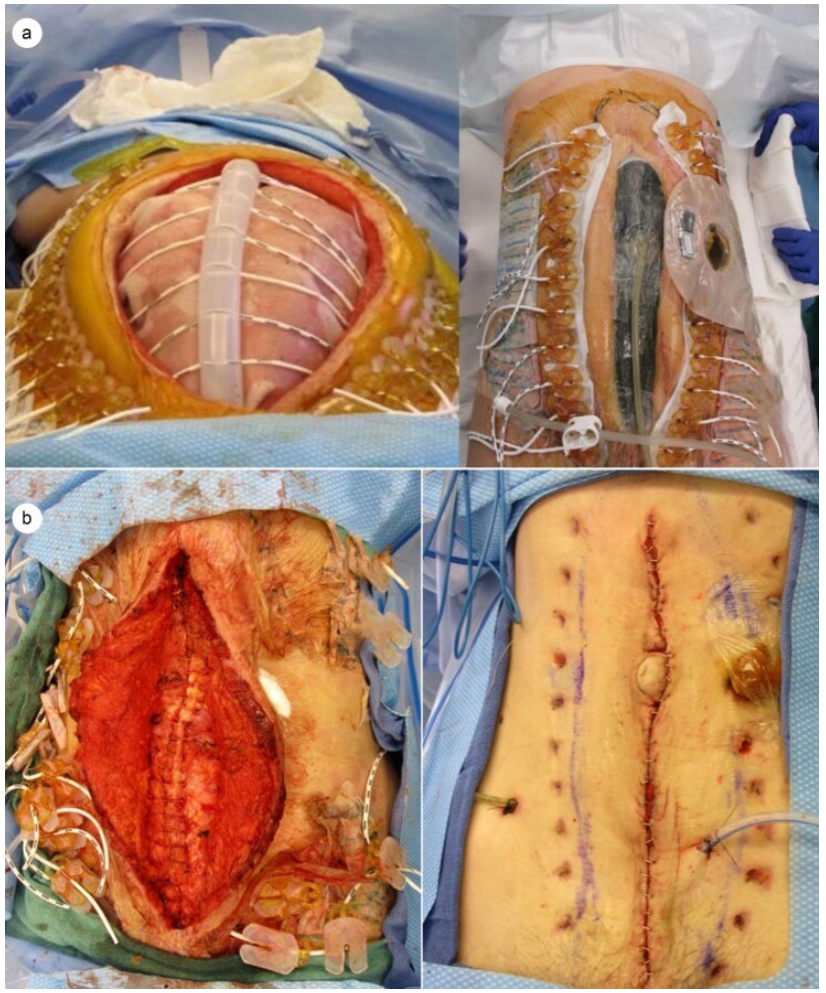
UBM = urinary bladder matrix.

Lanteri Parcells A, et al. *Wounds*. 2014;26(7):189-196. Zhang W, et al. *Cell Biosci.* 2021;11:65.

Acute Open Abdomen (AOA) with Loss of Domain (LOD)

- Primary myofascial closure (PMC) was achieved with abdominal dynamic tissue system (DTS) and porcine urinary bladder matrix (PUBM) xenografts
- Installation of abdominal dynamic tissue system and NPWT use (31 days)
- Successful primary myofascial closure and completion of skin closure (6 wks)





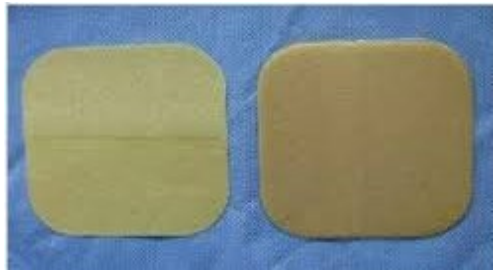
AOA= acute open abdomen; LOD = loss of domain; PMC = primary myofascial closure; DTS = dynamic tissue system; PUBM = porcine urinary bladder matrix.

Zhu C, et al. *Proceedings* (Baylor University Medical Center). 2022;35(6):876-878.

Use of Accessory Items

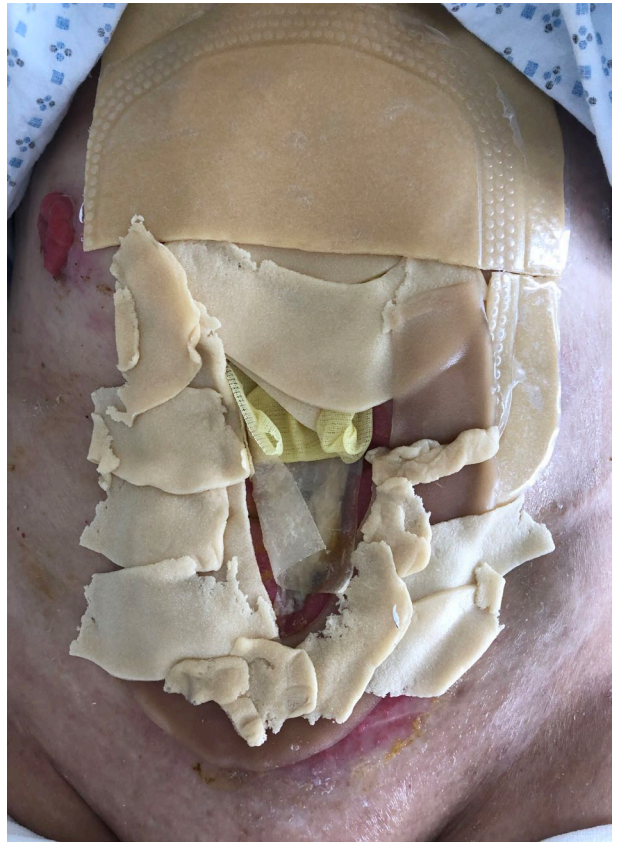
- Products like skin barrier films, pastes, barrier rings, adhesive removers, and hydrocolloids help keep dressings intact
- Use in combination in areas where creasing occurs, at joints, or when attempting to isolate areas such as the sacrum
- Non-adherent dressings allow for protection of dermal matrices and ECM products

Hydrocolloids



Ostomy rings

Non-adherent dressings



Isolating a fistula with ECM in use

Case Study 1: Unstageable Pressure Injury

- Debridement and initiation of NPWT
- On 4/26, wound measurements of 6 cm x 5.6 cm x 1.8 cm with tunnel measuring 2.6 cm; 1,000 mg UBM powder and 2 UBM 2-layer sheets were applied at bedside, NPWT continued

2/9

4/20

4/26

4/30

Transition to Home

- Client discharged home on May 17 with measurements of 5.4 x 5.8 x 2.1 cm; undermining seen from 2-3 o'clock measuring 1.3 cm
- Client was seen 1 month after discharge in the outpatient clinic

5/7

5/17

6/25

Outpatient Wound Healing

- Client received follow-up in outpatient clinic with no further wound management application required
- 10/3: Wound measured 3.5 cm x 2.4 cm x 0 cm
- 1/21: Wound measured 0.3 cm x 1 cm x 0.4 cm

7/16

10/3

1/21

Case Study 2: Deep Tissue Injury (DTI)

2/13

2/14

DTI = deep tissue injury.

Progression of the Sacral Pressure Injury

Reassessed 3/6

Post debridement
and after NPWT placement

NPWT Application Technique

NPWT initiated for 2 wks
Twice weekly changes

After 1 application
of UBM

Case Study 3: Hidradenitis Suppurativa (HS)

- Debridement with plastics; surgical sacral wound measured 28 cm x 17 cm x 2 cm at greatest depth
- UBM applied with NPWT

10/10

HS = hidradenitis suppurativa.

Acute Bleed – Pause on NPWT

- RN noticed blood in VAC canister
- Dressing removed, oxidized regenerated cellulose placed, and active bleed was stitched

NPWT Resumed

10/18

UBM + NPWT Application

- Wound management solution and NPWT dressing with non-adherent under black foam and use of hydrocolloid and barrier ring

Accelerated Tissue Growth

- Tissue growth through non-absorbable, nonadherent dressing

Saline to Remove

- No active bleeding after dressing removal, and NPWT was continued

Graft and Epithelialization

11/8

January – Outpatient Clinic

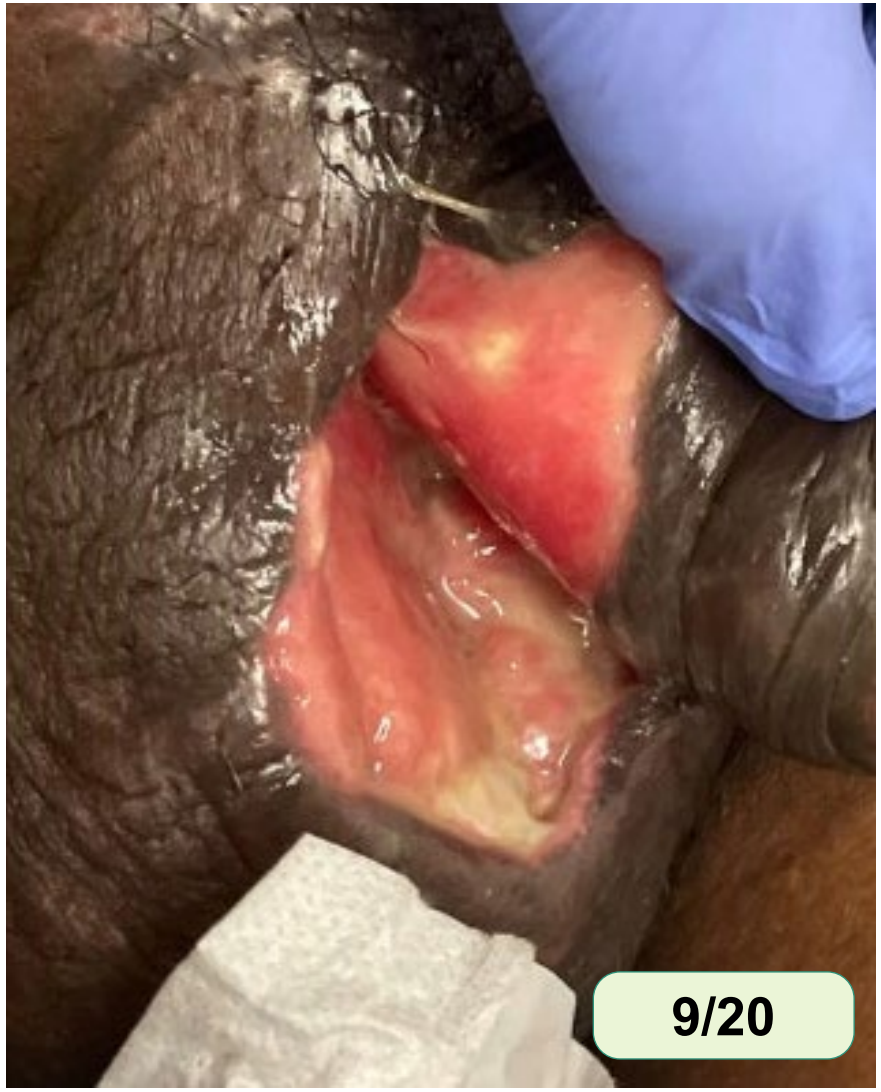
Case Study 4: Fournier Gangrene

- Debridement and application of UBM and NPWT

9/1

Discharge and Outpatient Follow-up

- NPWT changed twice weekly; client seen in outpatient and NPWT continued



Clinical Pearls

- All chronic wounds are missing ECM
- Moist wound healing is always recommended
- Goal of skin substitutes is to stimulate the host to regenerate lost tissue and replace the wound with functional skin
- Skin substitutes can reduce infection, graft rejection, and hypertrophic scarring
- The combined application of NPWT and dermal substitutes improves graft take
- Wounds heal with 2X the rate of granulation tissue formation with intermittent negative pressure compared with continuous negative pressure

Clinical Pearls

- Air leaks should be avoided, as they lead to continual flow of air over the wound surface leading to desiccation of tissue and formation of eschar
- 2-3 sessions of NPWT should be planned to avoid rebound phenomenon
- Accessory items will help keep a dressing intact and allow patients to ambulate
- Non-adherent dressings protect the ECM and skin substitutes from accidental removal during dressing changes

The Role of Meshed Bilayer Wound Matrix In Wound Repair and Reconstruction

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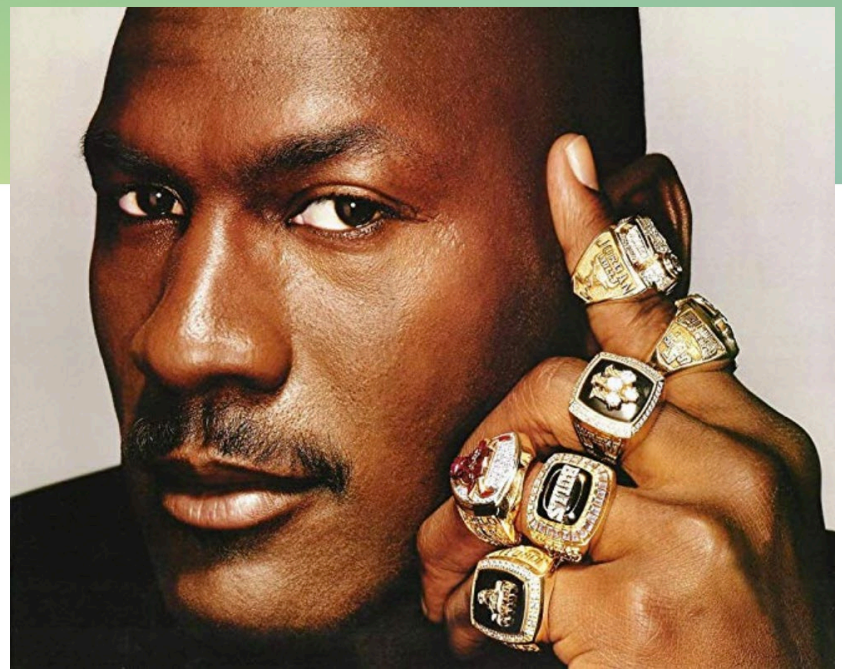
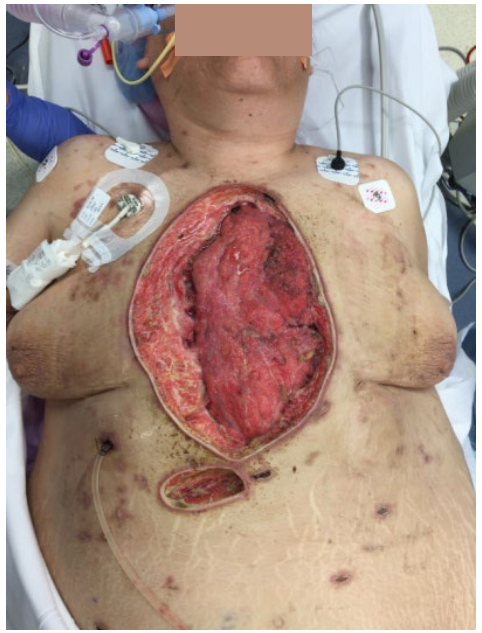
Associate Professor, Plastic, Reconstructive and Cosmetic Surgery
University of Illinois, Chicago
Chicago, IL

Introduction

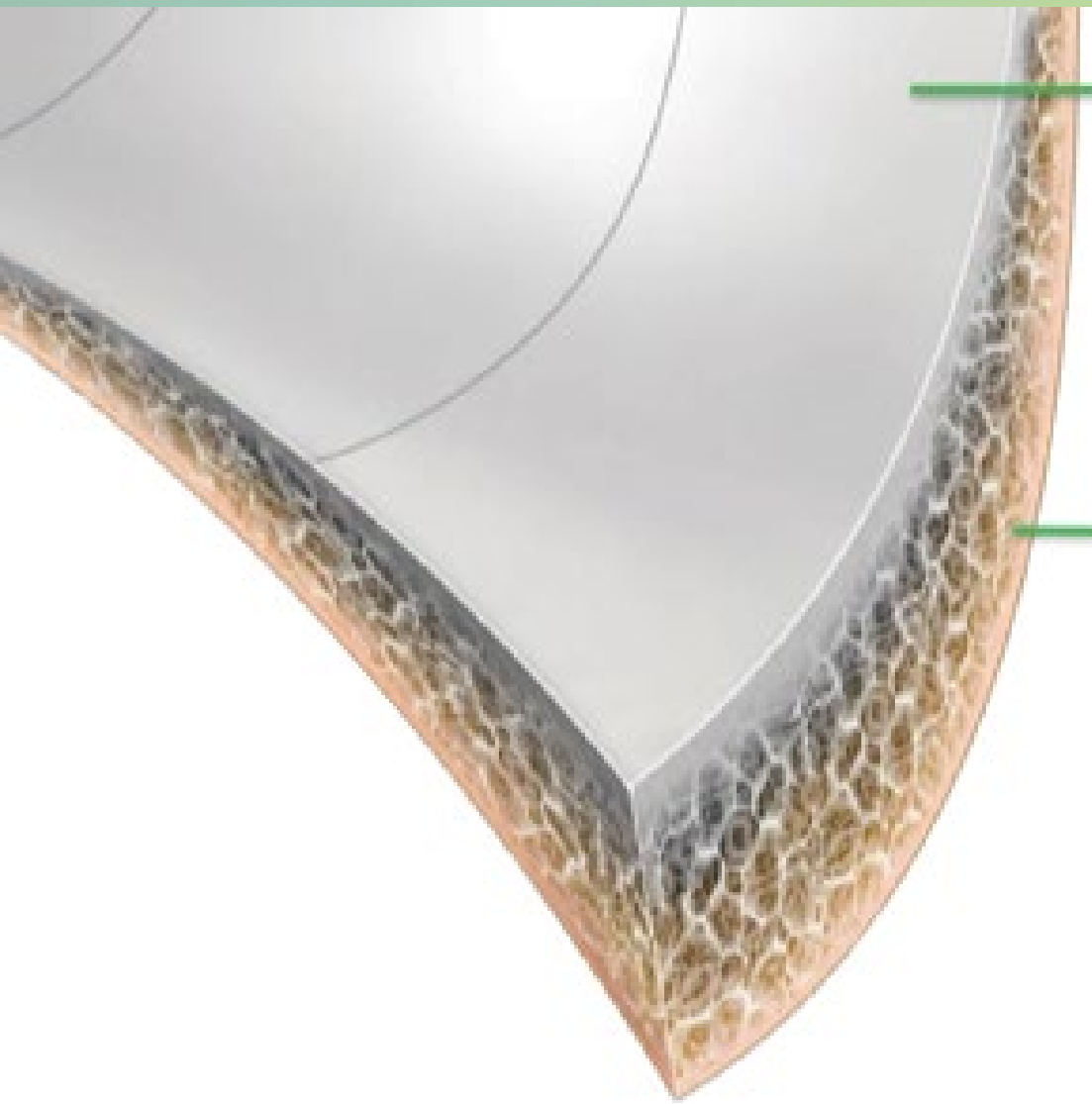
- Born and raised city of Chicago
- Loyola University, Chicago
- Rush Medical College
- University of Illinois, Chicago
- University of Louisville



Plastic Surgery



Dermal Substitute Composition



Silicone Layer

- Temporary epidermal layer
- Provides immediate coverage to the wound
- Typically removed between 14-21 days

Collagen/Chondroitin Sulfate Layer

- Dermal replacement layer
- Bioengineered scaffold built to promote dermal regeneration
- Designed with controlled porosity and defined degradation rate

Dermal Substitute Design Parameters

- Pore size
- Pore volume (porosity)
- Cross-linked collagen/GAG
- Matrix degradation rate

GAG = glycosaminoglycans.

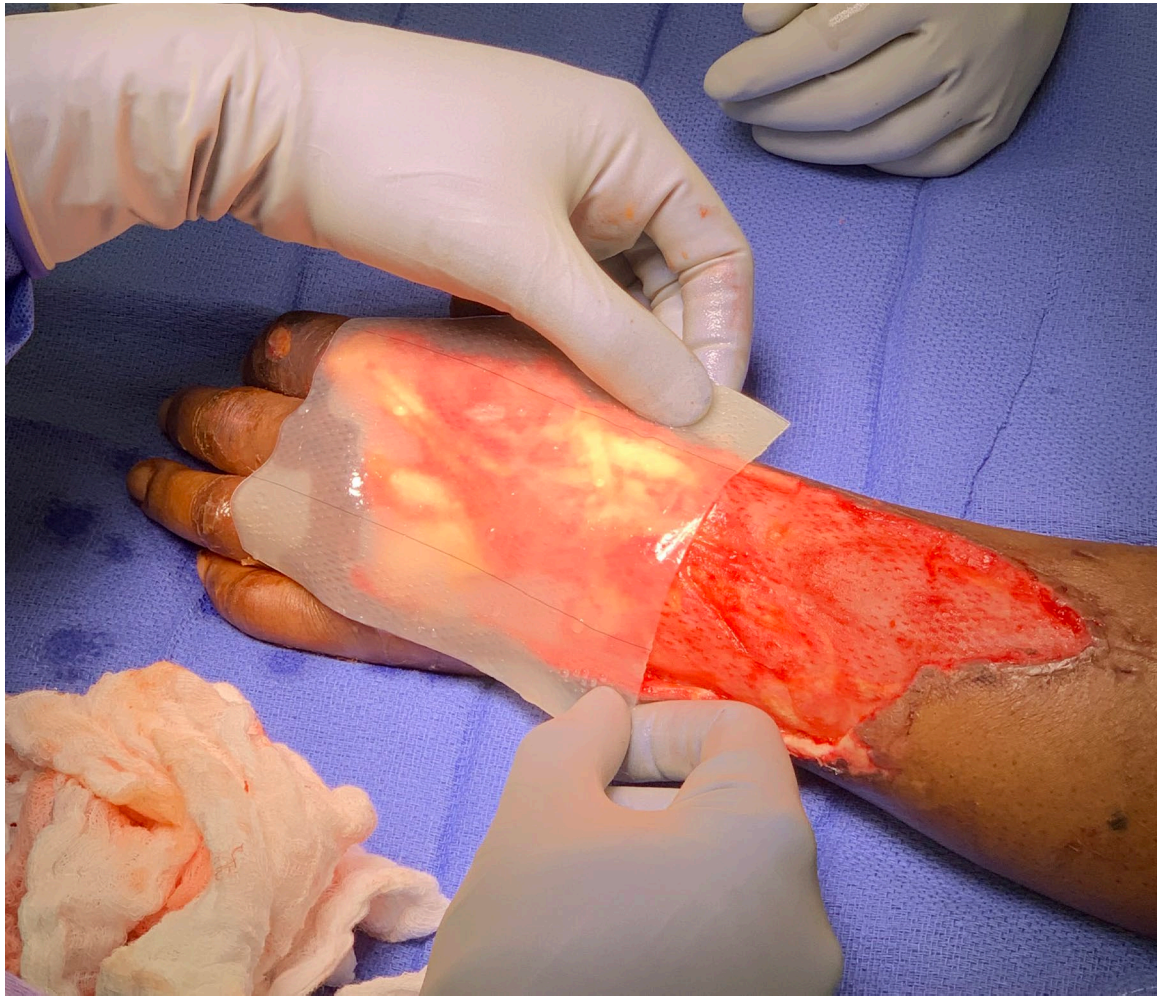
Case 1: Soft Tissue Crush Injuries

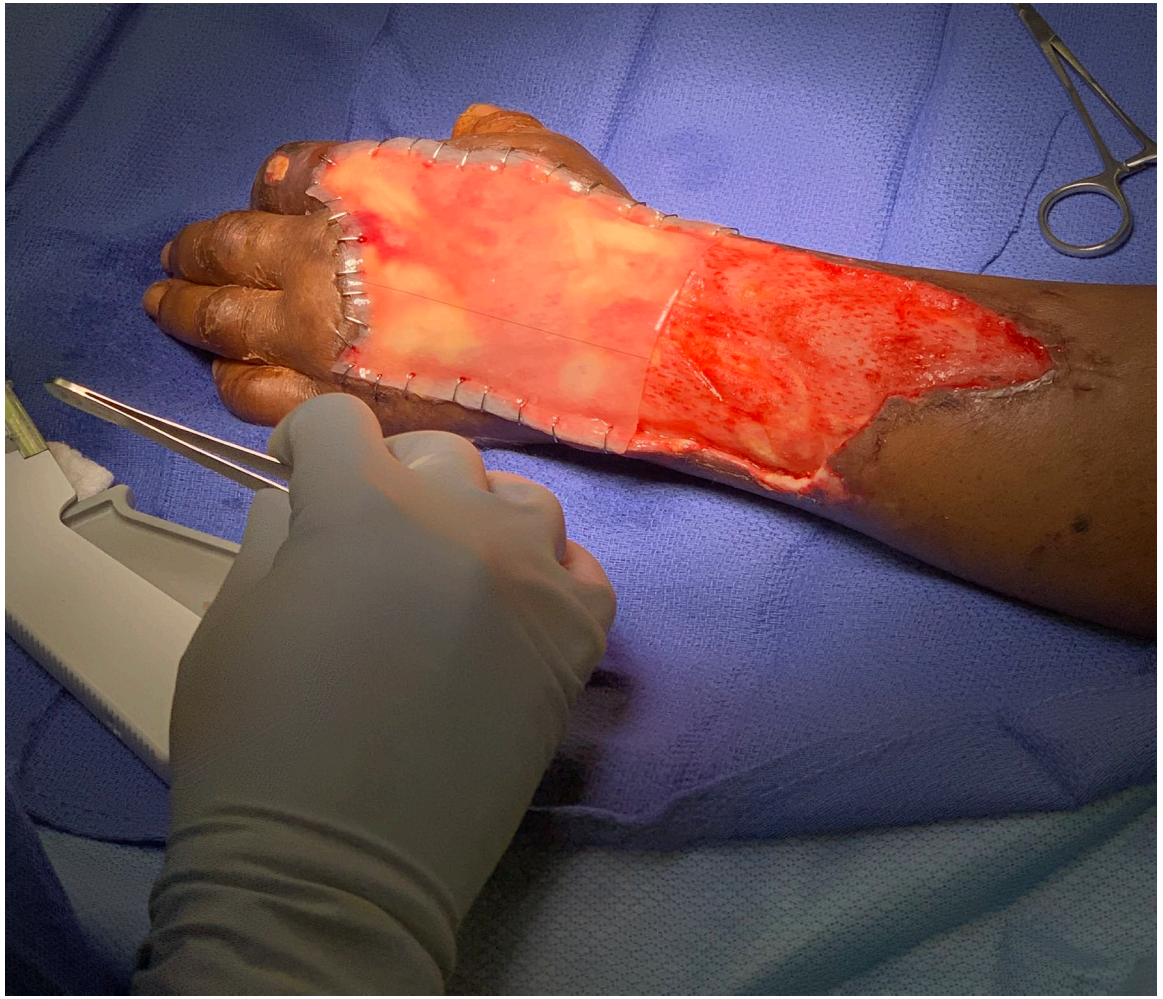
- 28 y/o male had his left leg slammed in a truck door at work
- Soft tissue crush injuries
- Significant edema with resultant loss of domain and exposed tendon and fascia
- Application of bilayer wound matrix
- Subsequent STSG

Case 2: Soft Tissue Infection of Forearm and Hand

- 77 y/o female with multiple medical problems, including HTN, brittle DM, HL, PVD, previous MI and TIA
- Soft tissue infection of forearm and hand
- Serially debrided
- Resultant deficit with exposed extensor tendons of right forearm and hand
- Serially debrided and NPWT
- Application of meshed bilayer wound matrix x2
- STSG

HTN = hypertension; DM = diabetes mellitus; HL = hyperlipidemia; PVD = peripheral vascular disease; MI = myocardial infarction; TIA = transient ischemic attack.

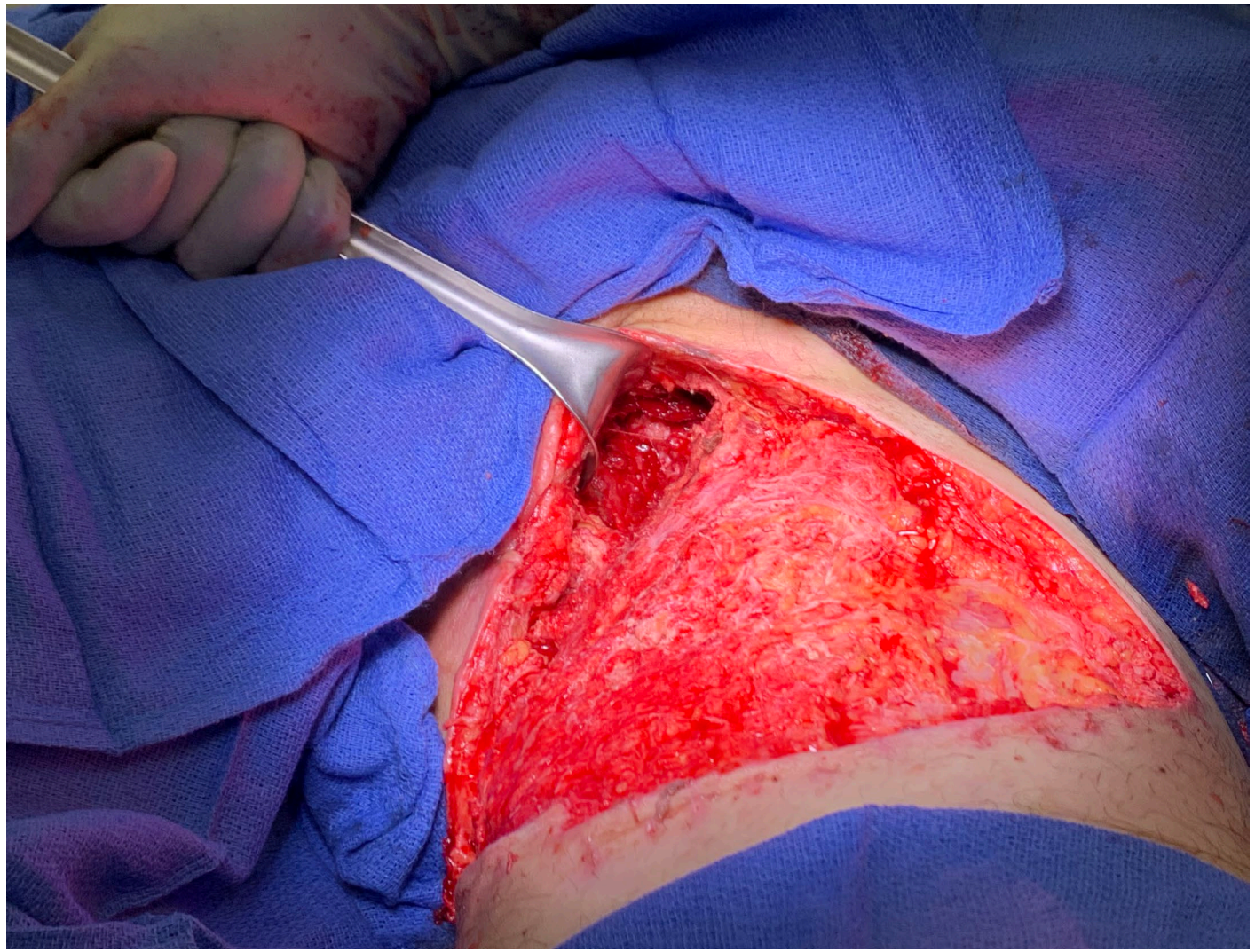


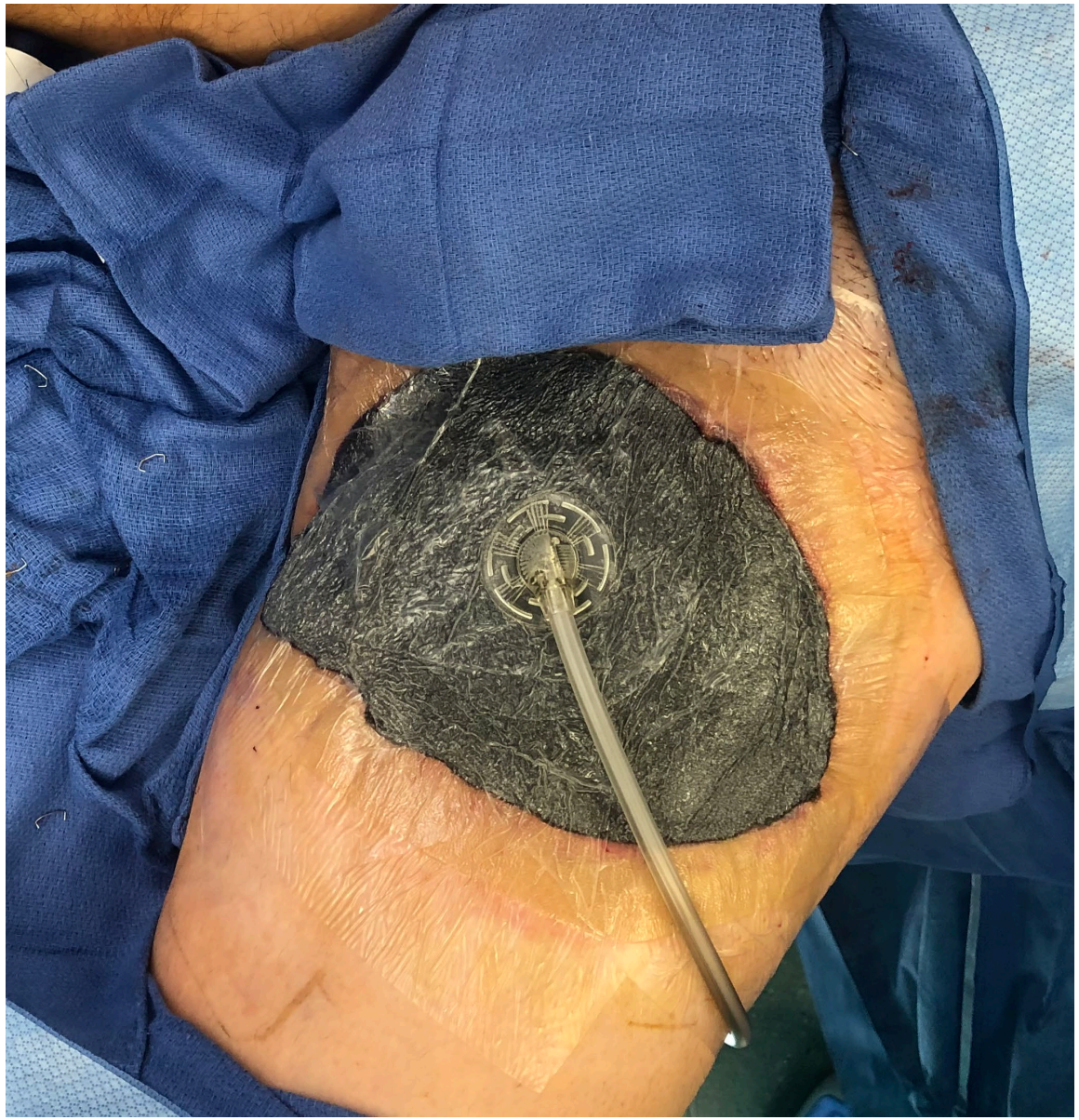


Case 3: Open Pelvis Fracture, Intra-abdominal Injuries

- 54 y/o male with HTN, smoker
- Motorcycle accident with open pelvis fracture, and hemorrhage with intra-abdominal injuries; s/p IR embolization of pelvic vessels and exploratory laparatomy
- Large groin wound with exposed pelvis
- Serially debrided and NPWT
- Application of bilayer wound matrix and STSG

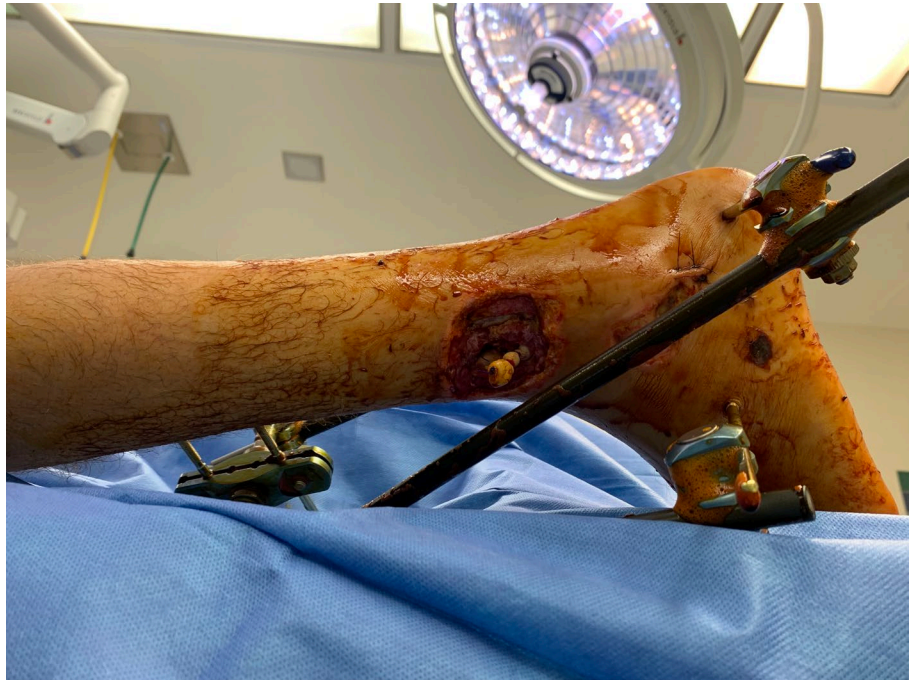
IR = interventional radiology.

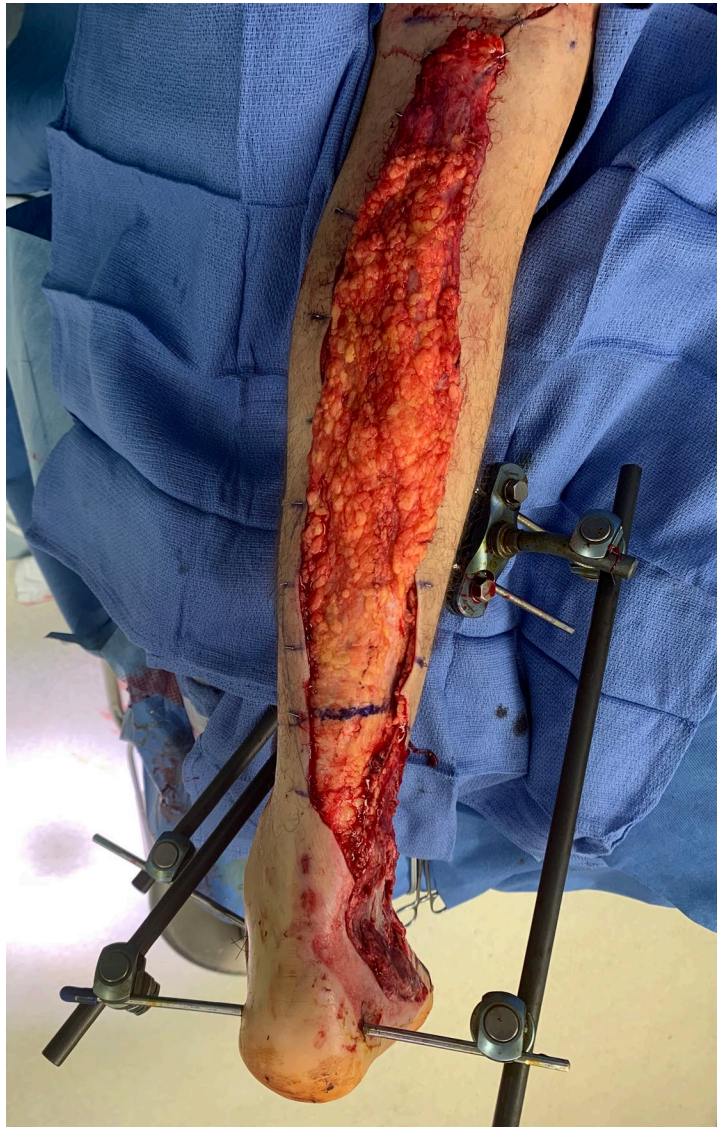




Case 4: Mangled Lower Extremity

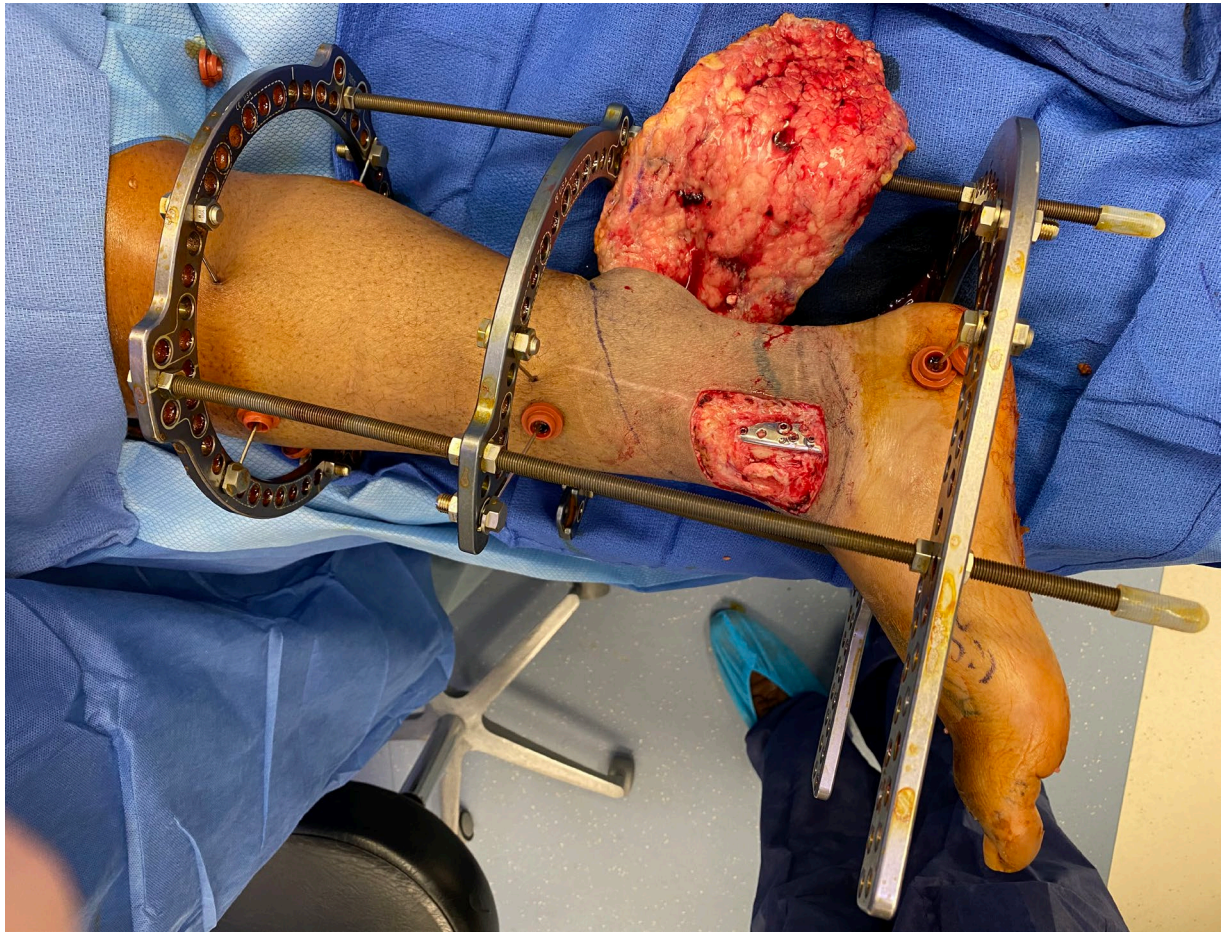
- 24 y/o male at work on a farm got his left foot trapped in a grain mill
- Mangled lower extremity
- Medially exposed vessels, tendon, bone
- Laterally exposed bone and tendon
- Serially debrided
- Autologous tissue reconstruction of medial wound
- Meshed bilayer wound matrix and STSG for lateral wounds

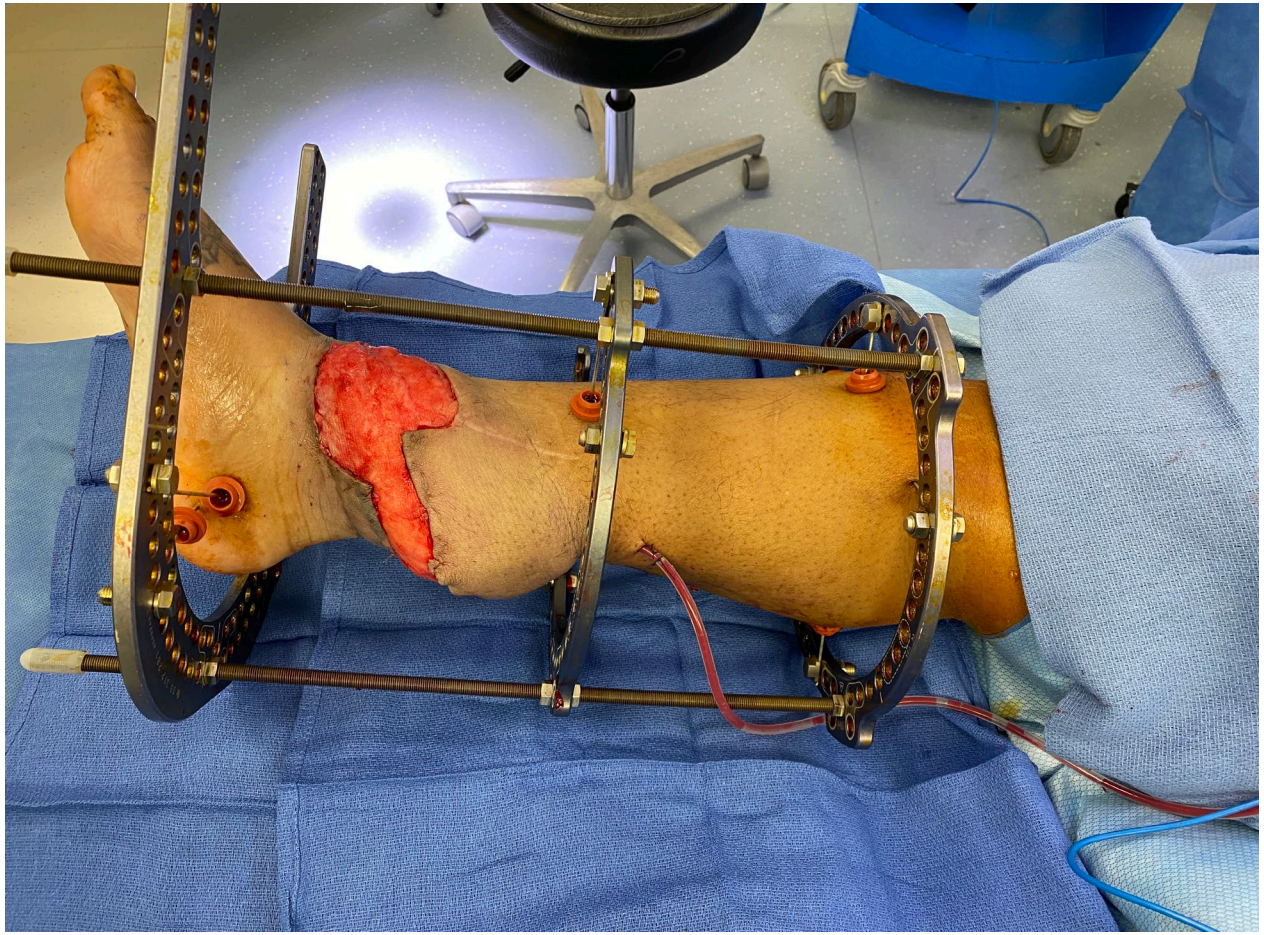


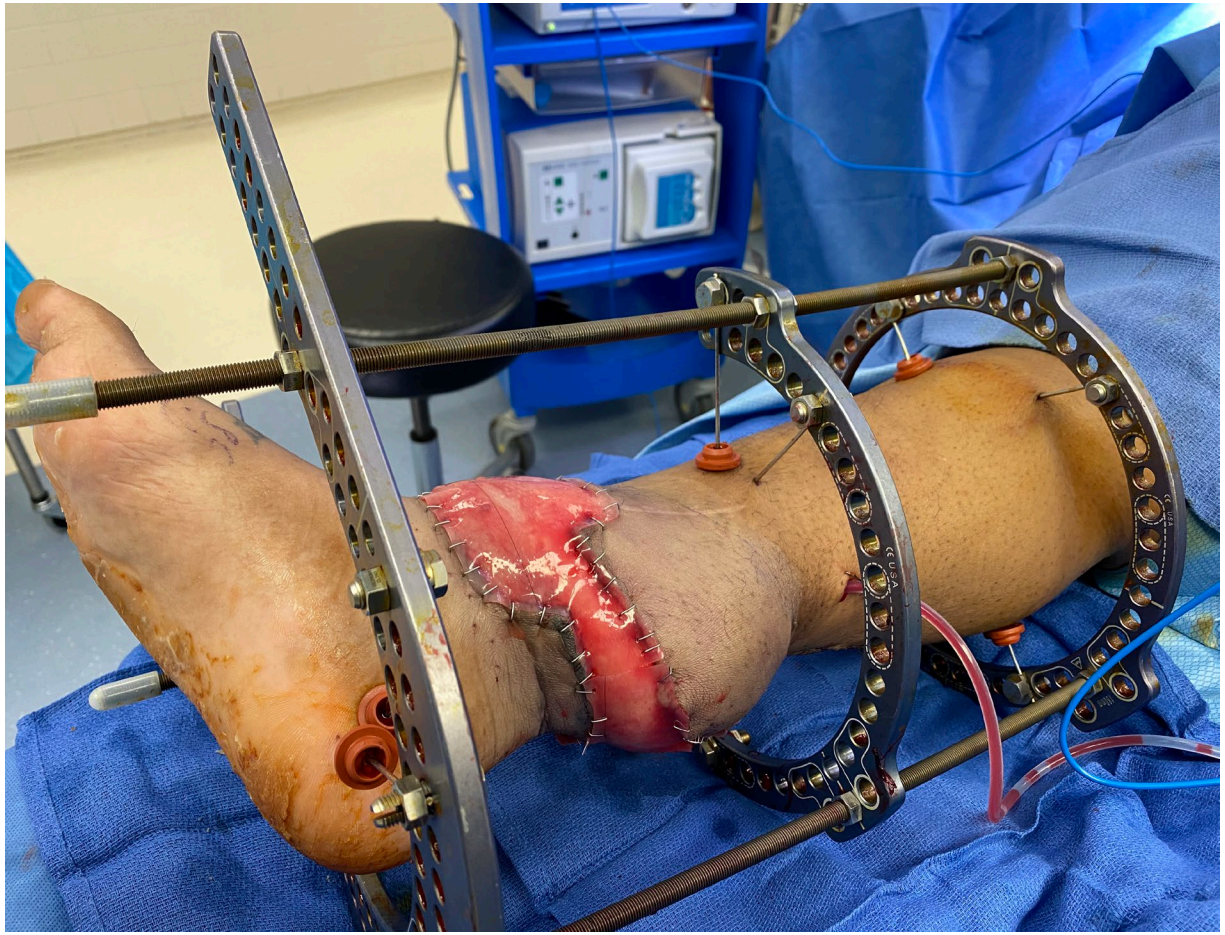


Case 5: Open Fracture, Right Lower Extremity

- 35 y/o female involved in high-speed motor vehicle accident
- Right lower extremity open fracture
- Exposed tendon, bone, fracture, and hardware
- Serially debrided
- Reverse sural, bilayer wound matrix, STSG







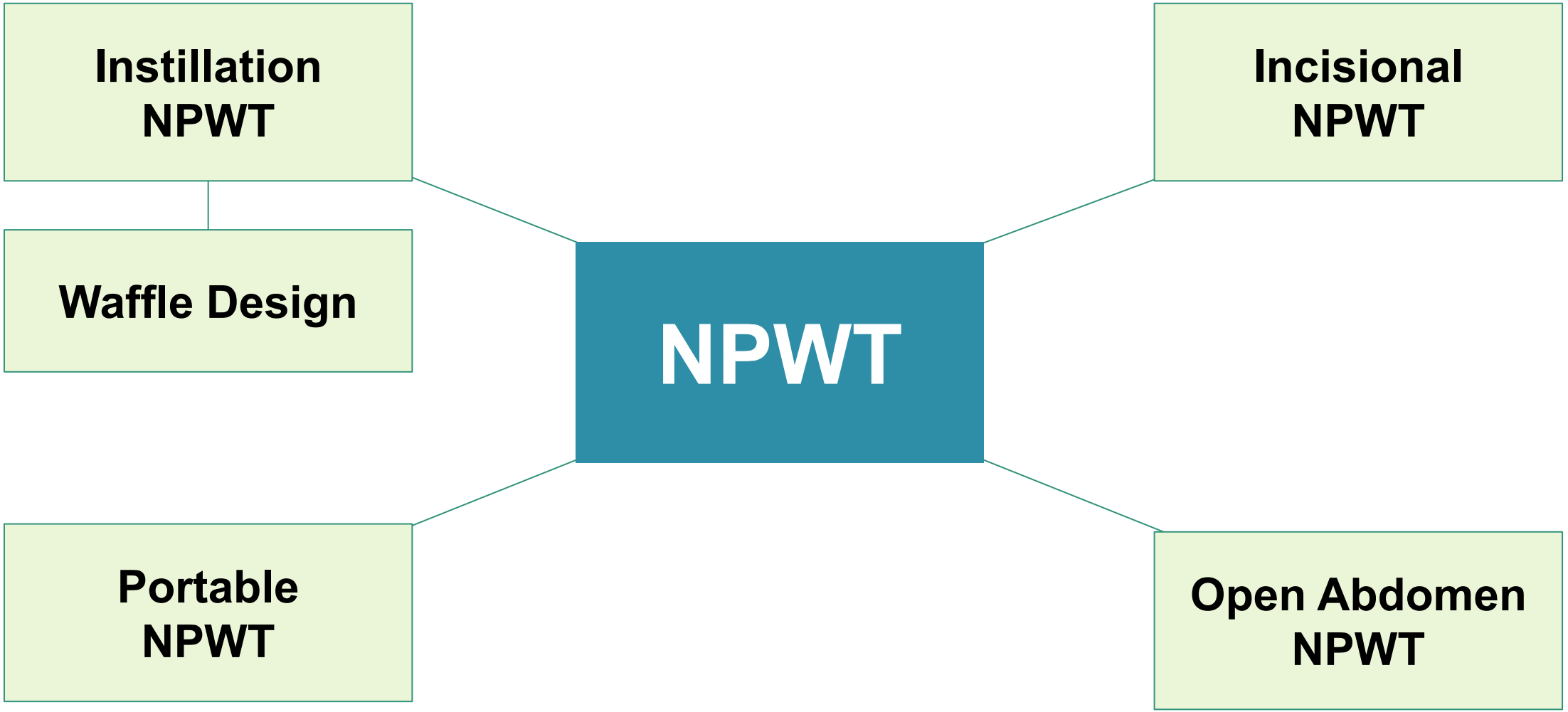
Thoughts…

- Where regenerative dermal matrix fits into my practice
  - Prepare a wound bed
  - Consider future contracture potential
  - Comorbid patients
  - Coverage over structures
    - Bone, tendon, fascia, fat
  - Alter wound characteristics
    - Dimensions, depth, tissue quality leads to alternate (simpler) reconstructive plan
- Adjunctive
  - Replacement for vascularized soft tissue? I still do a lot of flaps!
  - Additional tool (powerful) in the toolbox

Mechanism of Action of Negative Pressure Wound Therapy

Paul J. Kim, DPM, MS, FACFAS
Professor, Dept of Plastic Surgery, Dept of Orthopedic Surgery
Medical Director, Wound Program
University of Texas Southwestern
Dallas, TX

Treatment and Prevention



Traditional
Negative Pressure Wound Therapy

Negative Pressure Wound Therapy

Healed Wound

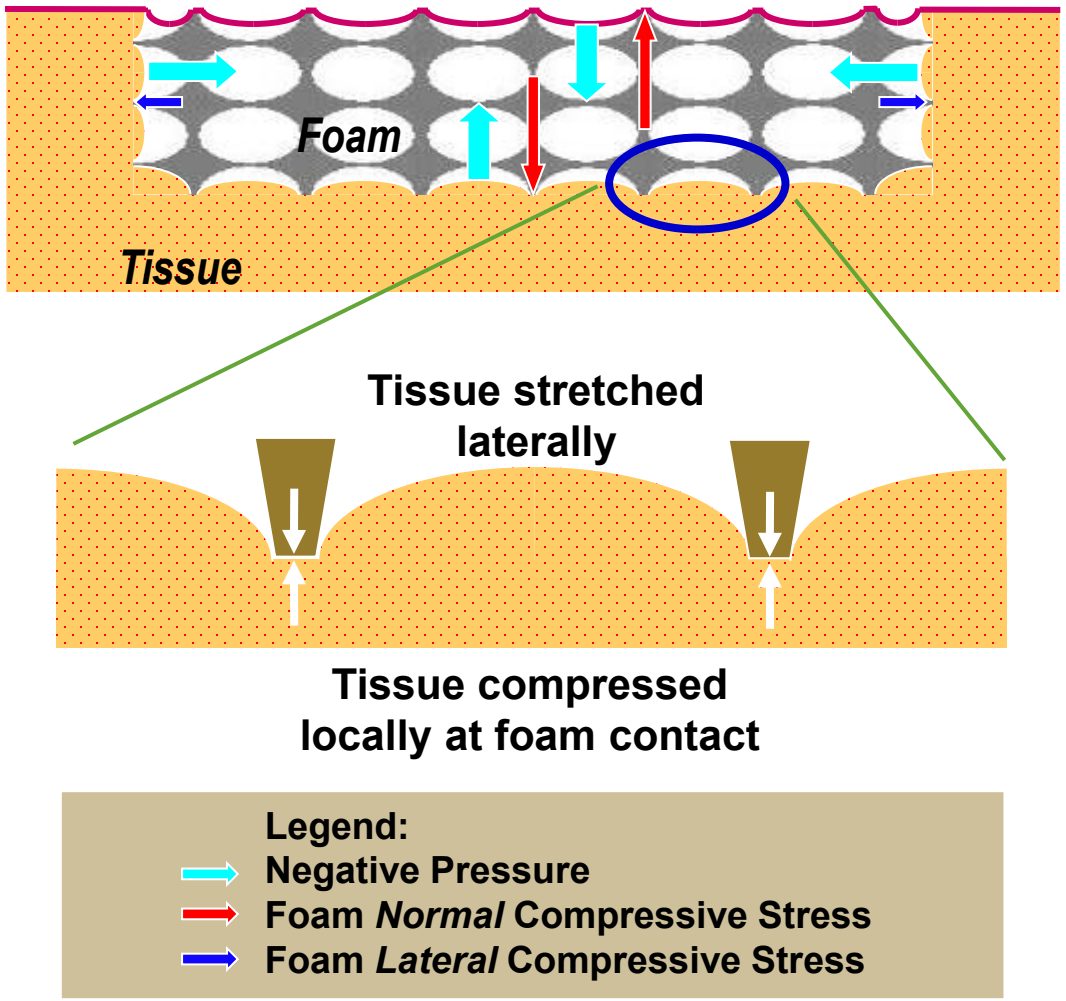
Promotion of Granular Bed

Adjunct Therapy with BATs

Terminal Epithelialization

BAT = bioengineered alternative tissues.

Foam-Tissue Interface



Macrostrain

- Visible alteration of form or shape
- When negative pressure contracts the foam, it draws the wound edges together and removes fluid

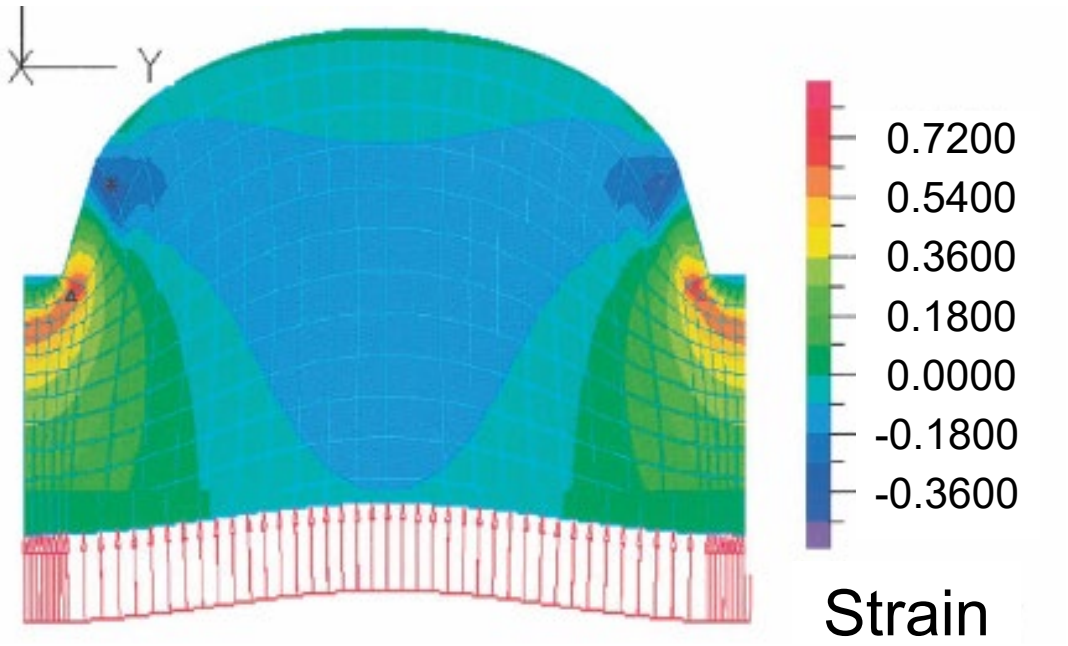
Microstrain

- Induces tissue deformation at a cellular level leading to cell stretch
- Induces cell proliferation and angiogenesis, which is thought to promote wound healing

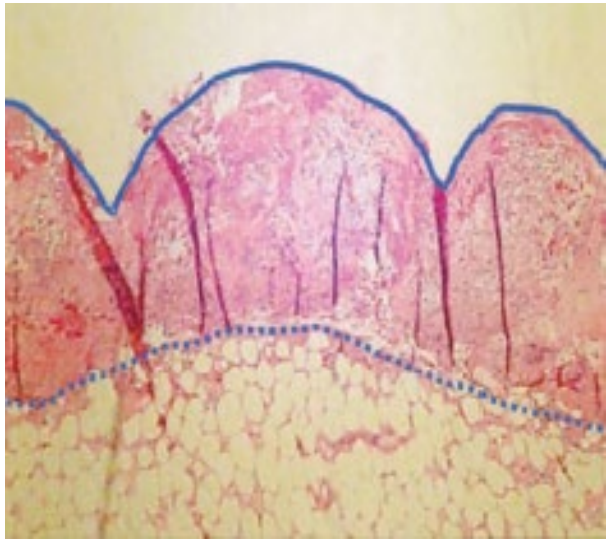
Huang S, et al. *Mol Biol Cell*. 1998;9:3179. Chen CS, et al. *Science*. 1997;276:1425.

Granulation Tissue Formation

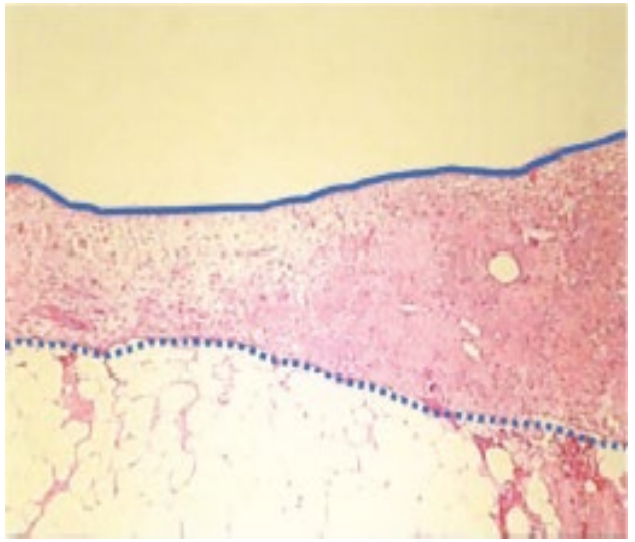
Finite element analysis predicts the effects of the reticulated open-cell foam as demonstrated by granulation tissue formation



NPWT Treated Tissue



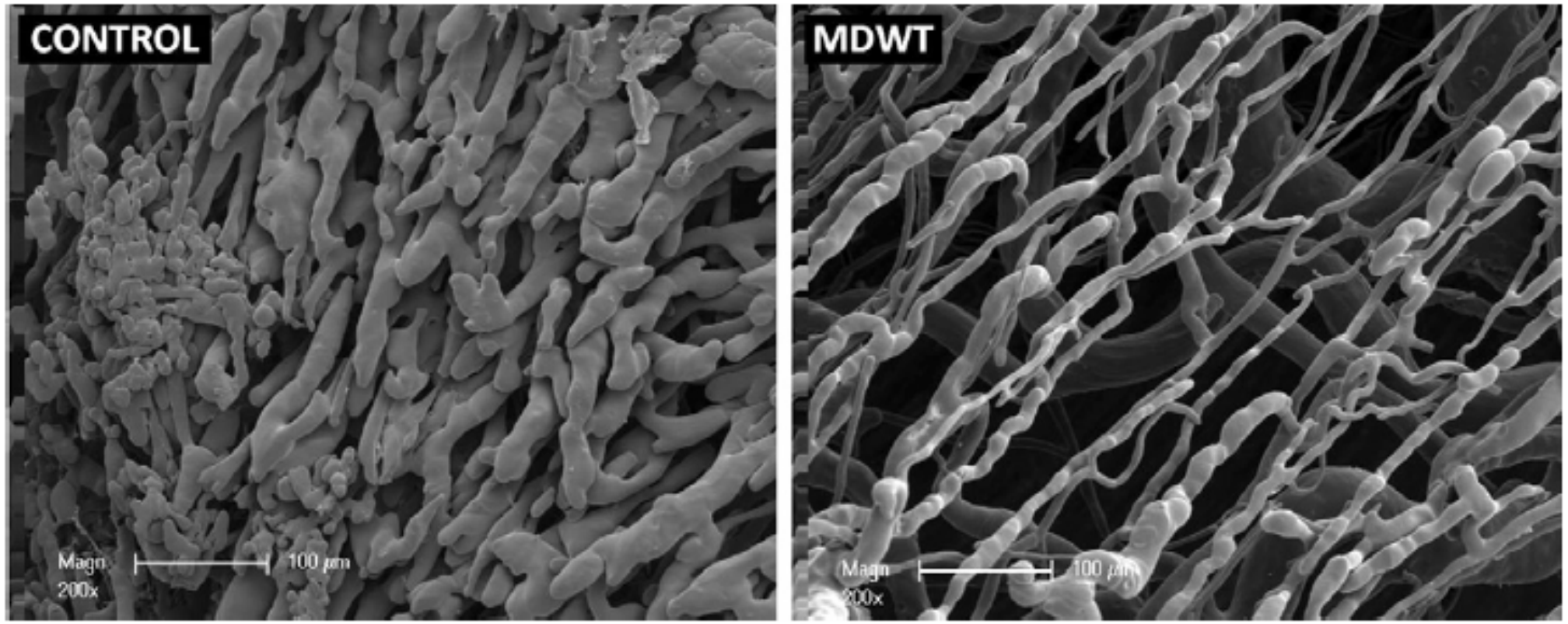
Untreated Tissue



Saxena V, et al. *Plast Reconstr Surg.* 2004;114(5):1086-1096.

Vascular Organization

Organized, physiologic configuration of small vessels

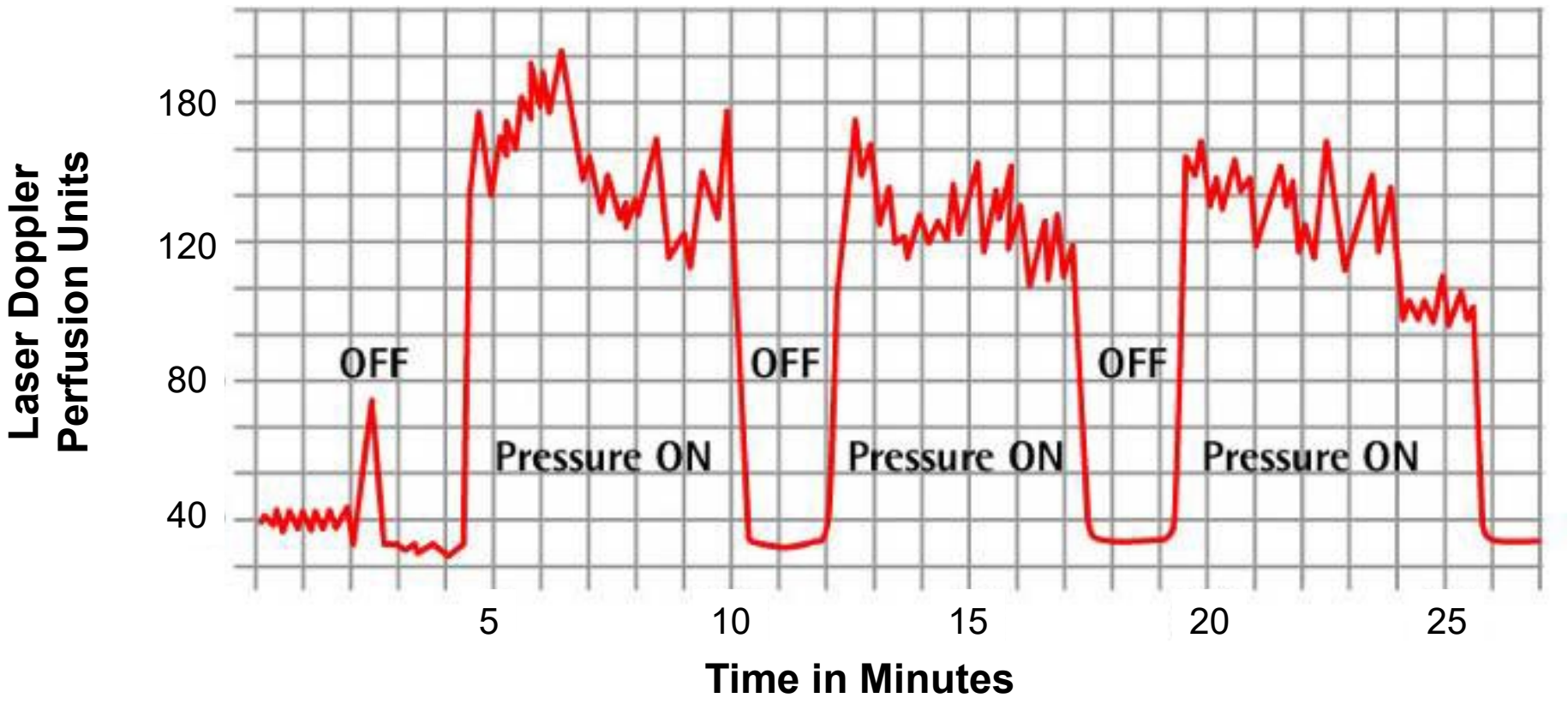


MDWT = microdeformational wound therapy.

Erba P, et al. *Ann Surg.* 2011;253:402-409.

Vascular Function

Blood flow at 125 mm Hg in porcine model



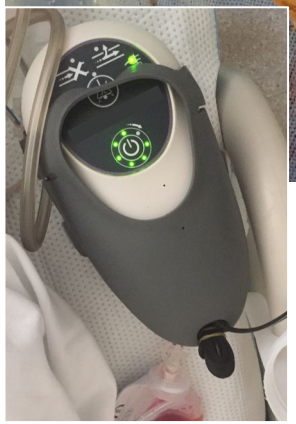
Morykwas MJ, et al. *Ann Plast Surg.* 1997;38(6):556-557.

Summary of Clinical Impact

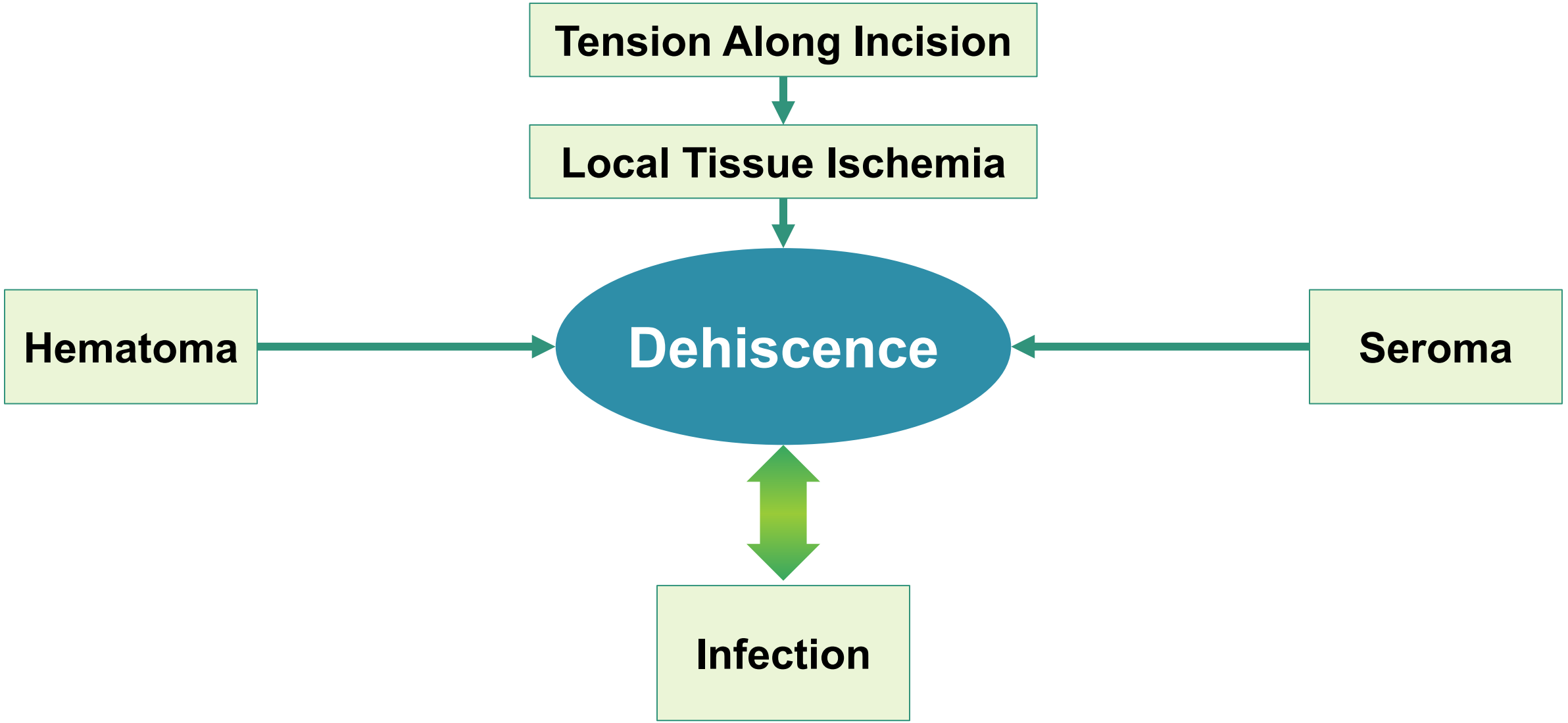
Goals of Wound Healing	What NPWT Does
• Remove exudate	• Remove exudate
• Promote granulation tissue	• Promote granulation tissue
• Increase local perfusion	• Increase local perfusion
• Decrease bacteria and contamination	• Decrease bacteria and contamination

Well Aligned

Incisional
Negative Pressure Wound Therapy

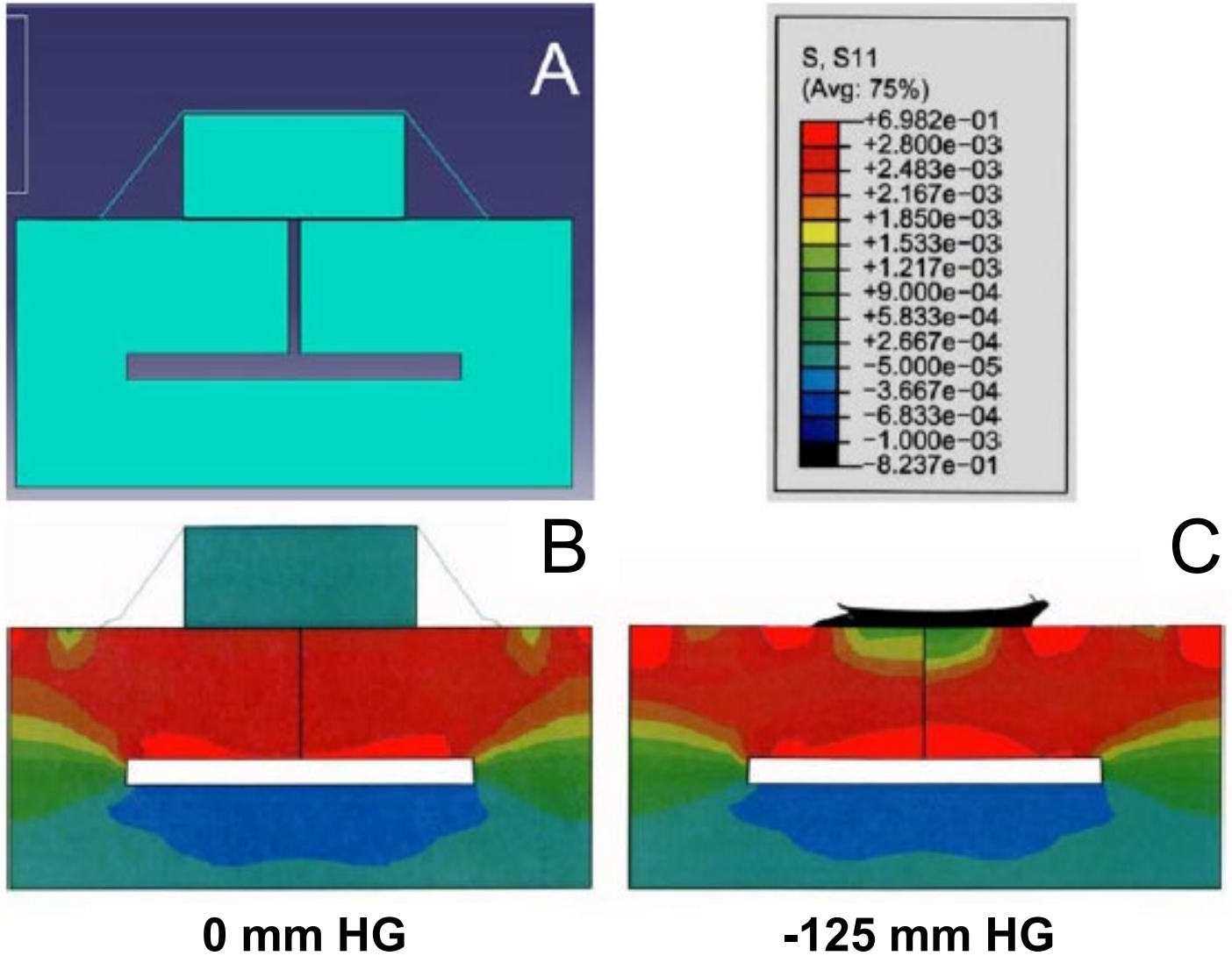


Pathomechanism of a Surgical Incision

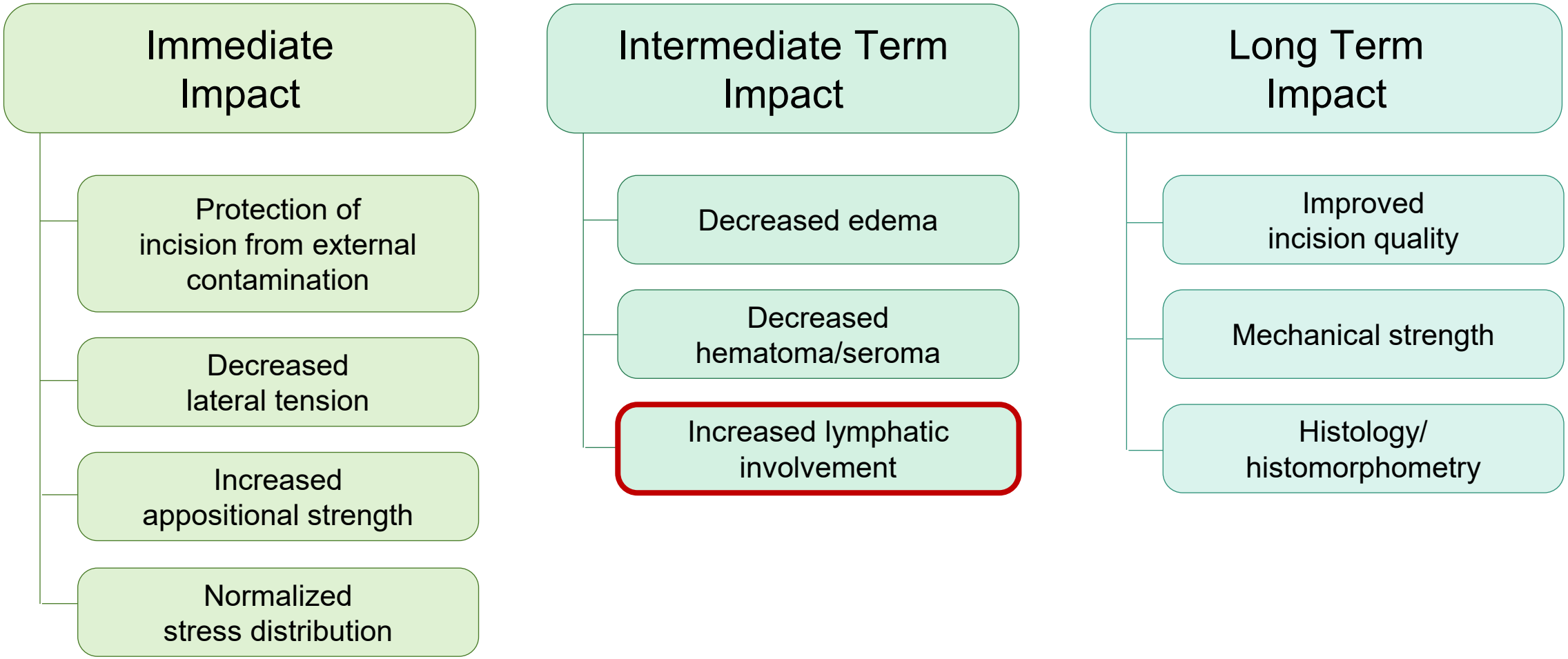


Computer Model

Finite element analysis-I: A 2-mm wide incision cuts from the skin surface to the void (A). The incision is joined by sutures (B) and lateral stress develops (color contours, MPa) negative pressure (-125 mm Hg) is applied to the dressing (C), and lateral stresses become more compressive



Summary of Clinical Impact



Negative Pressure Wound Therapy with Instillation

Disruptive Innovation

Negative Pressure Wound Therapy
1994

NPWT with Instillation

2013

Novel Foam

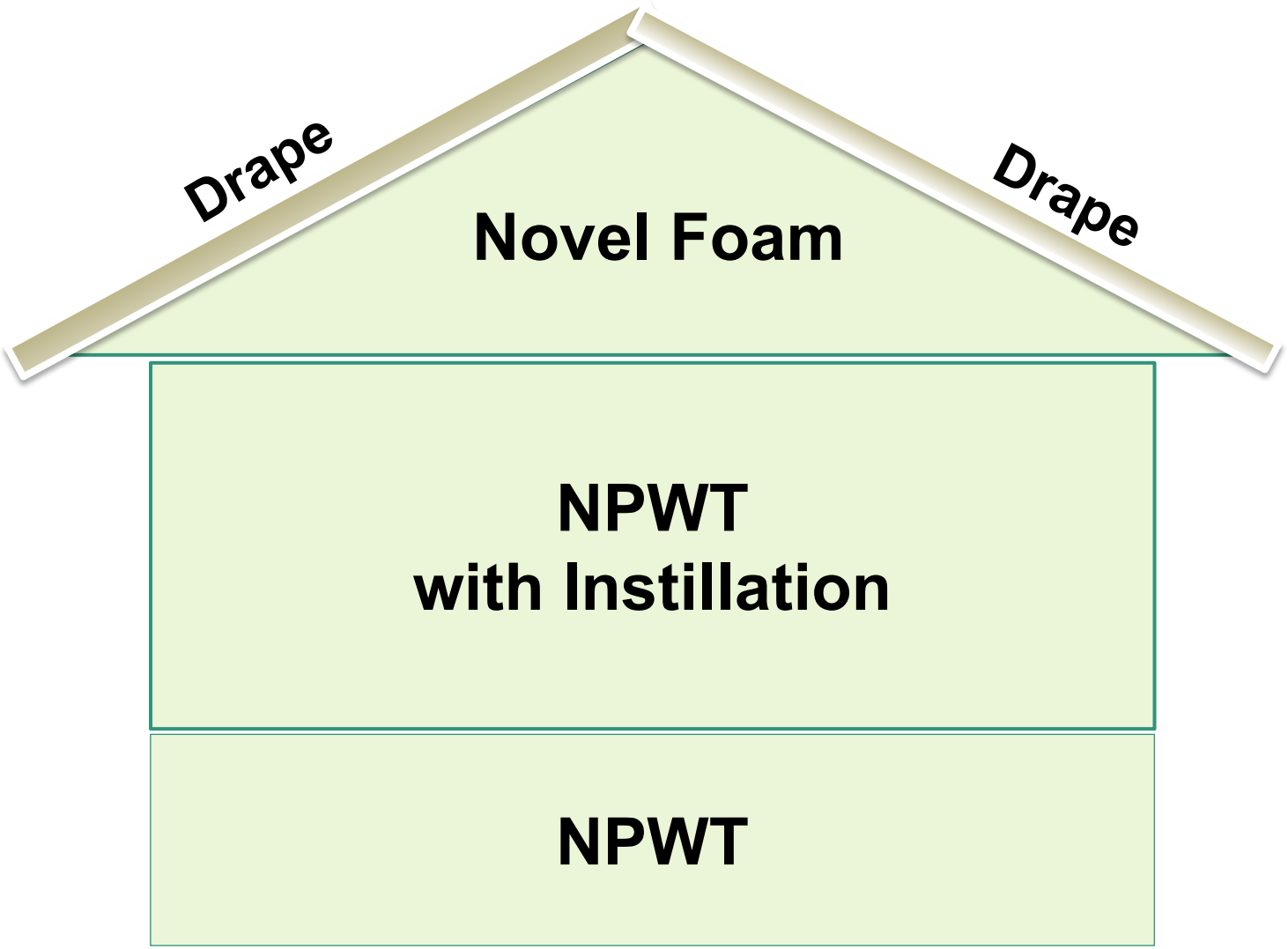
2017

Automated Volume Estimator

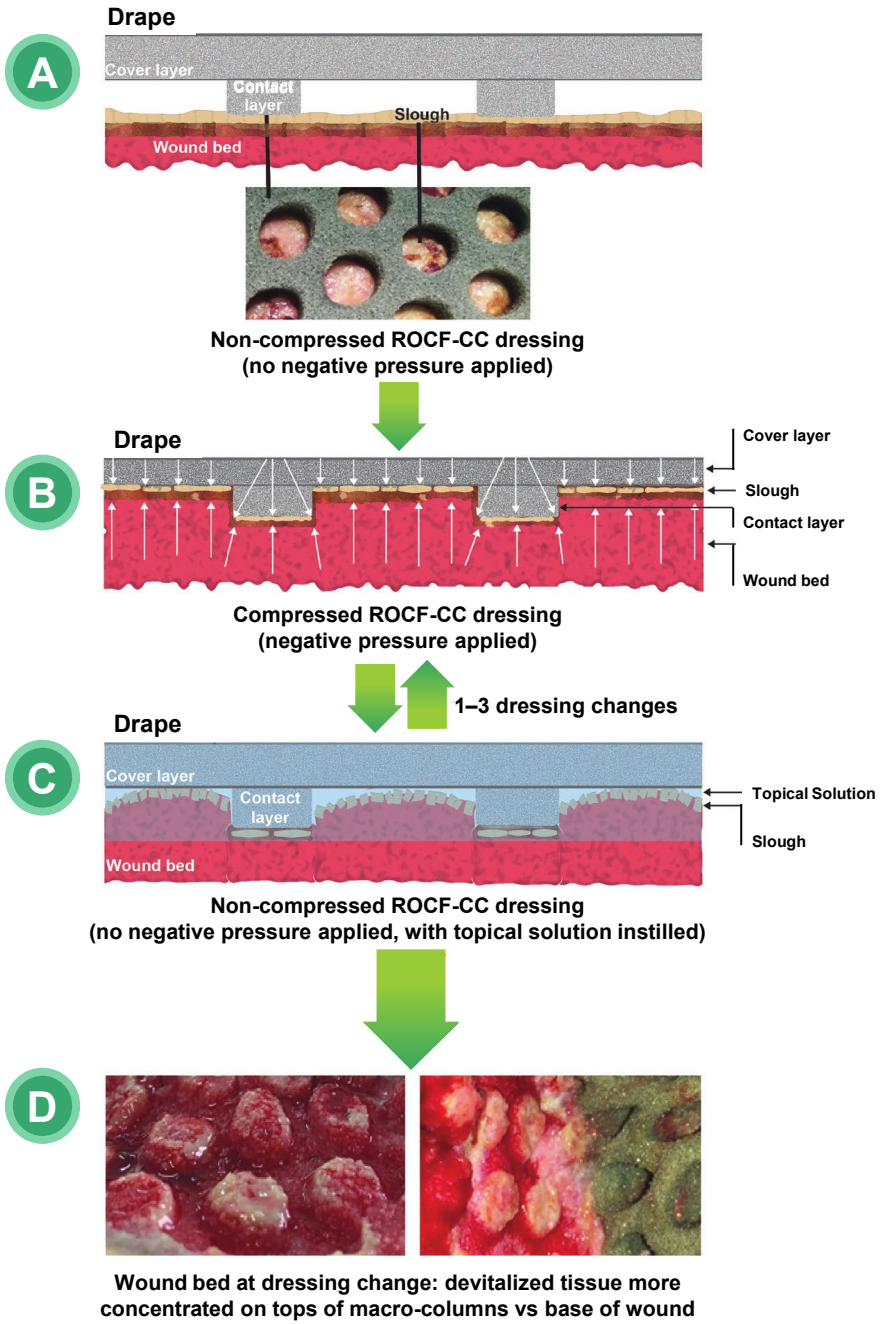
2022




Negative Pressure Wound Therapy with Instillation



The Solution to Pollution is Dilution



Vertical and Horizontal Forces (Macrodeformation)

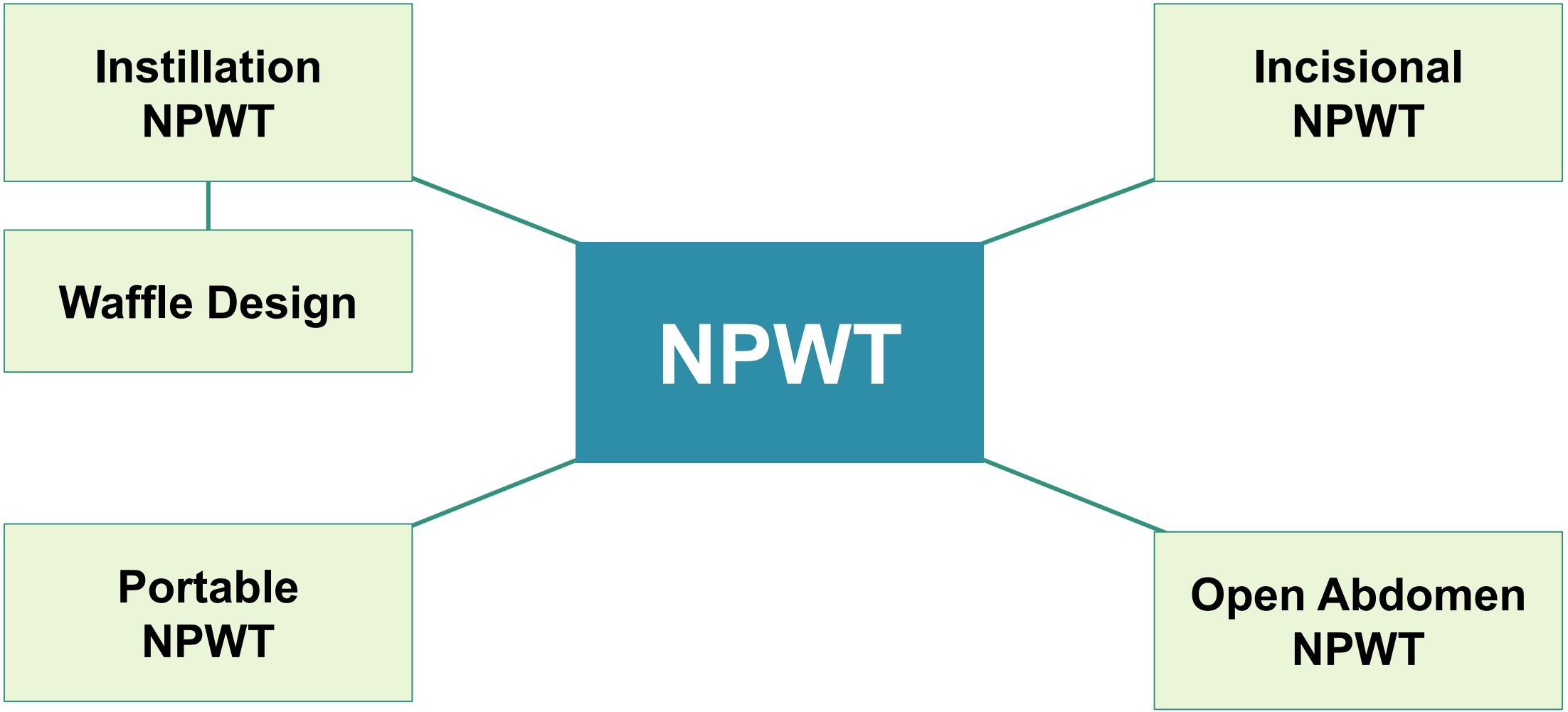
+

Acting on a Solubilized Wound Bed

+

Removal Through a Fluid Medium

Pick the Right Tool for the Job



Negative Pressure Wound Therapy Tips and Techniques

Mary Anne Obst, BSN, RN, CWON, CWS
Complex Wounds Specialist
Regions Hospital
St Paul, MN

Trouble-Free Instillation NPWT Dressings

Pain and Anxiety – Patient and Provider

ABA GUIDELINES

American Burn Association Guidelines on the Management of Acute Pain in the Adult Burn Patient: A Review of the Literature, a Compilation of Expert Opinion, and Next Steps

Kathleen S. Romanowski, MD,[*,] Joshua Carson, MD,[†,] Kate Pape, PharmD, BCPS, BCCCP,[‡] Eileen Bernal, MD,[||] Sam Sharar, MD,[$] Shelley Wiechman, PhD, ABPP,[$] Damien Carter, MD,[¶] Yuk Ming Liu, MD,[**] Stephanie Nitzschke, MD,[††] Paul Bhalla, MBChB,[$] Jeffrey Litt, DO,[‡‡] Rene Przkora, MD, PhD,[||||] Bruce Friedman, MD,[$$] Stephanie Popiak, BA, PharmD,[¶¶] James Jeng, MD,[***] Colleen M. Ryan, MD,[†††] and Victor Joe, MD,[‡‡‡] on behalf of the American Burn Association Committee for the Organization and Delivery of Burn Care

Romanowski KS, et al. *J Burn Care Res.* 2020;41(6):1129-1151.

Technique Tips

Strive for perfect edging

- Clean, dry skin
- Work top down
- Lower section bib

Port application

- On flat surface
- Stay away from seams
- Extra foam, if needed

Start pump in NPWT phase

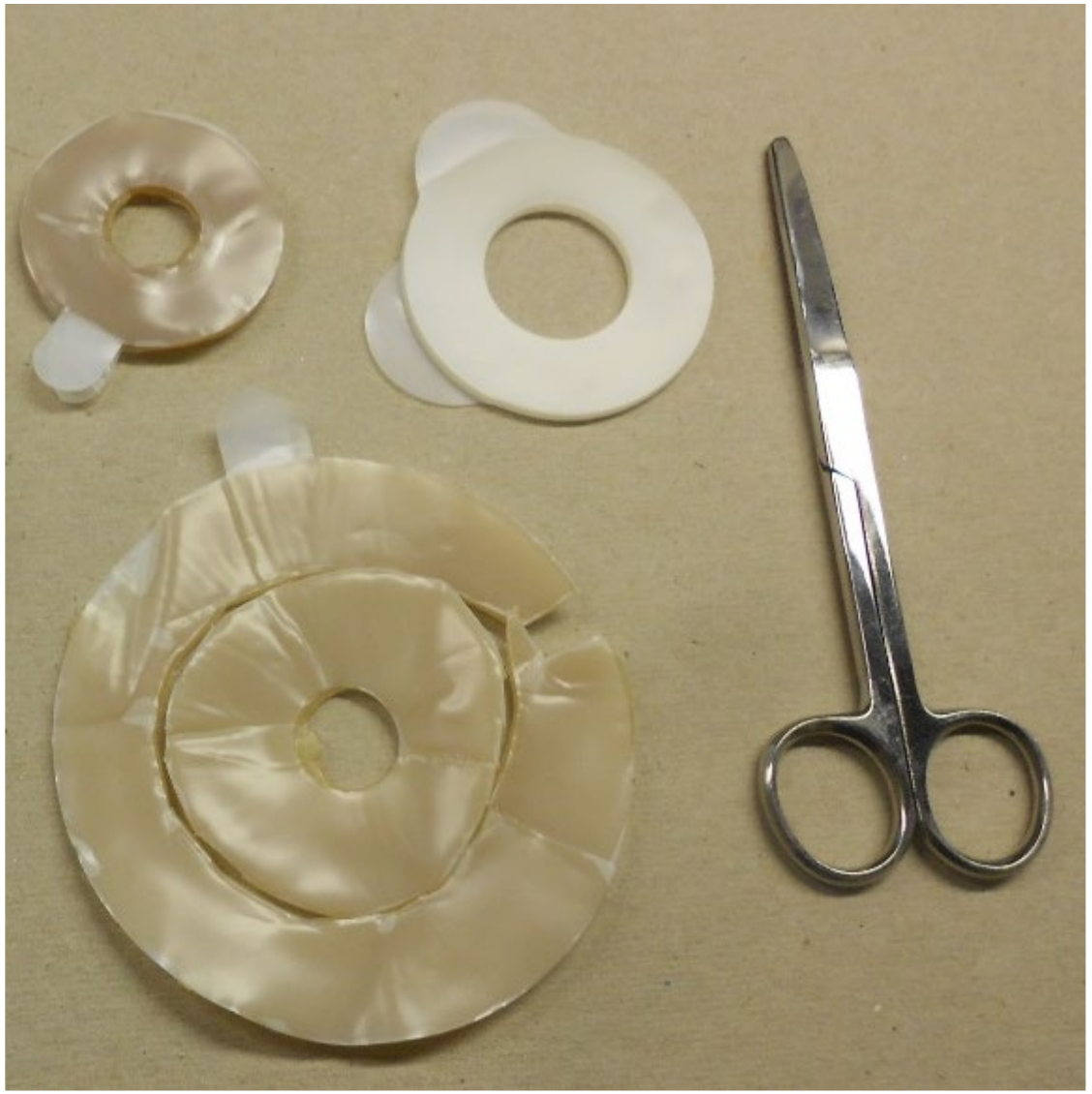
- Longer timeframe for dressing to adhere and blend together
- Movement after dressing placement

If “non” debrided

- More frequent soak cycles
- Plan to move ports
  - 2 methods: new and refurbished

Necrotizing Soft Tissue Injury

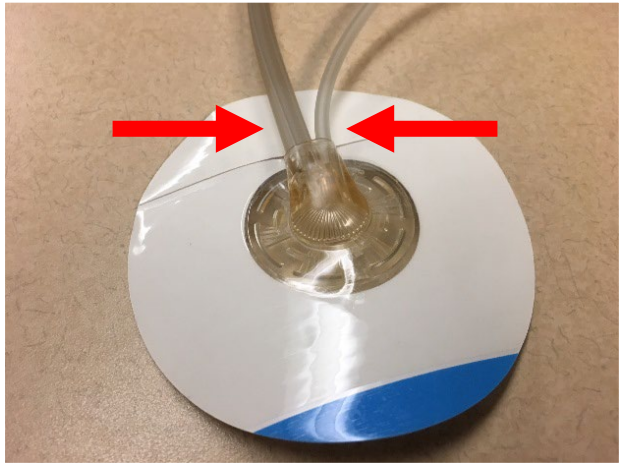
Secret Sauce



NPWT only

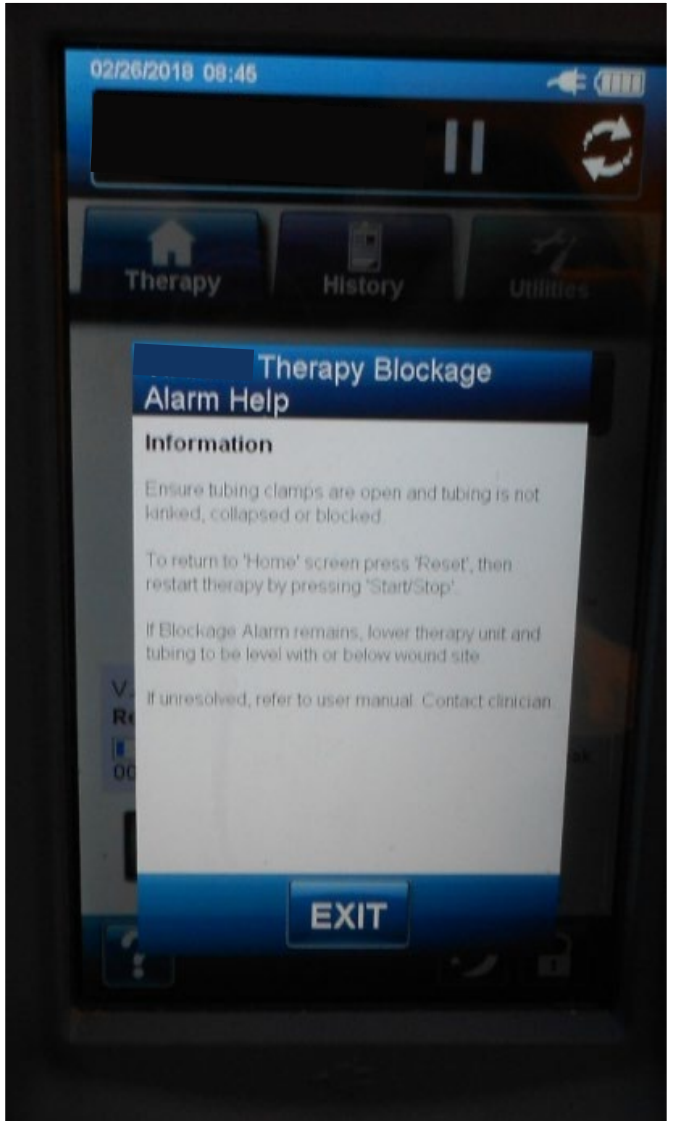
LARGE
dressing kit

MEDIUM
dressing kit

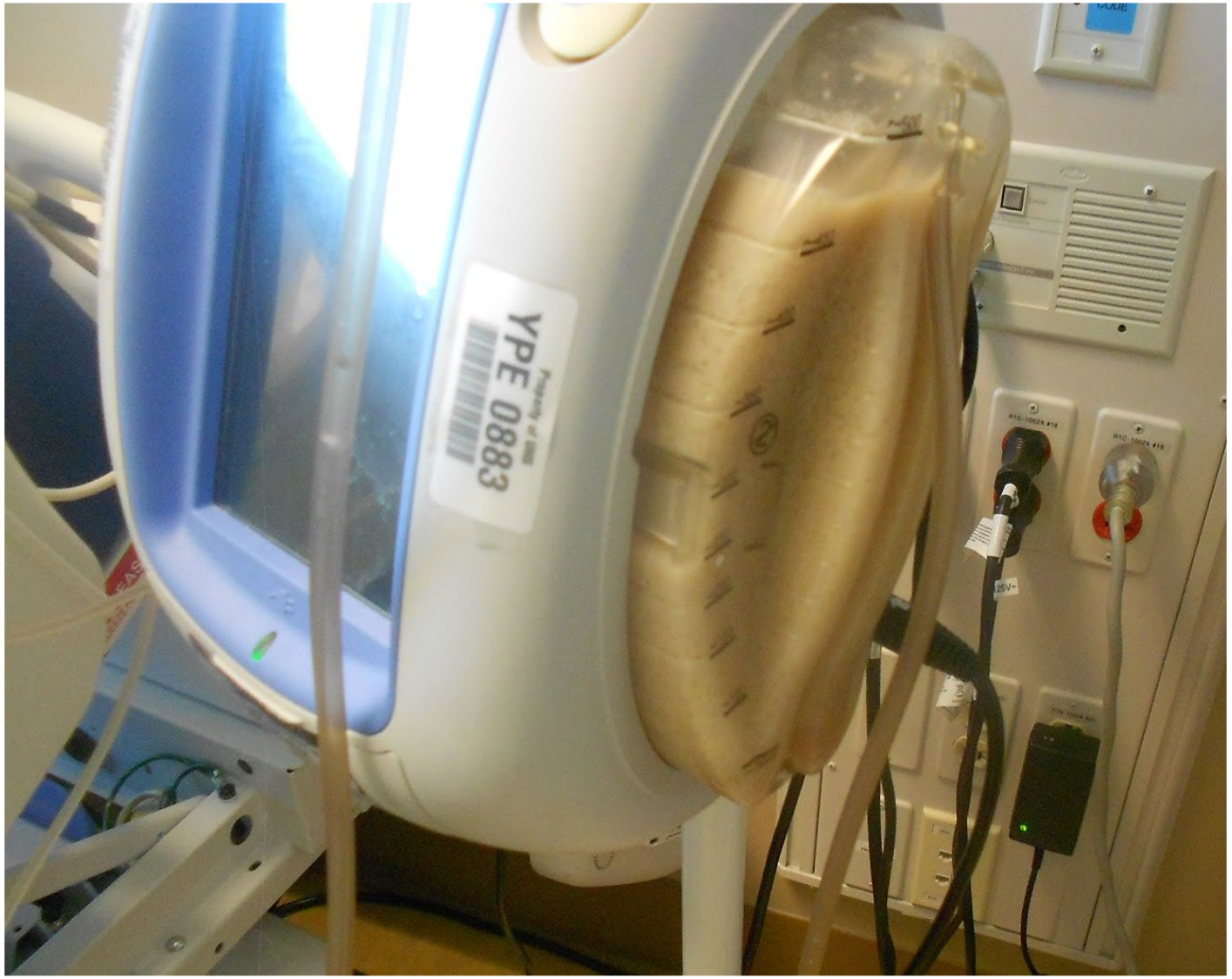


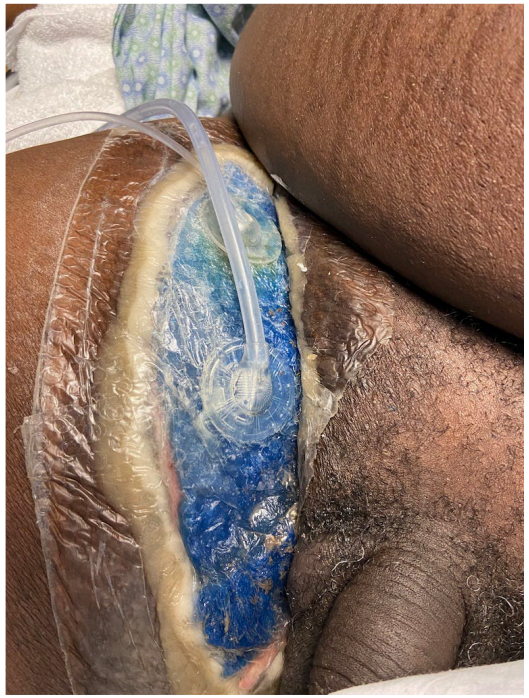
Sold Separately Without Foam

Software on Pump

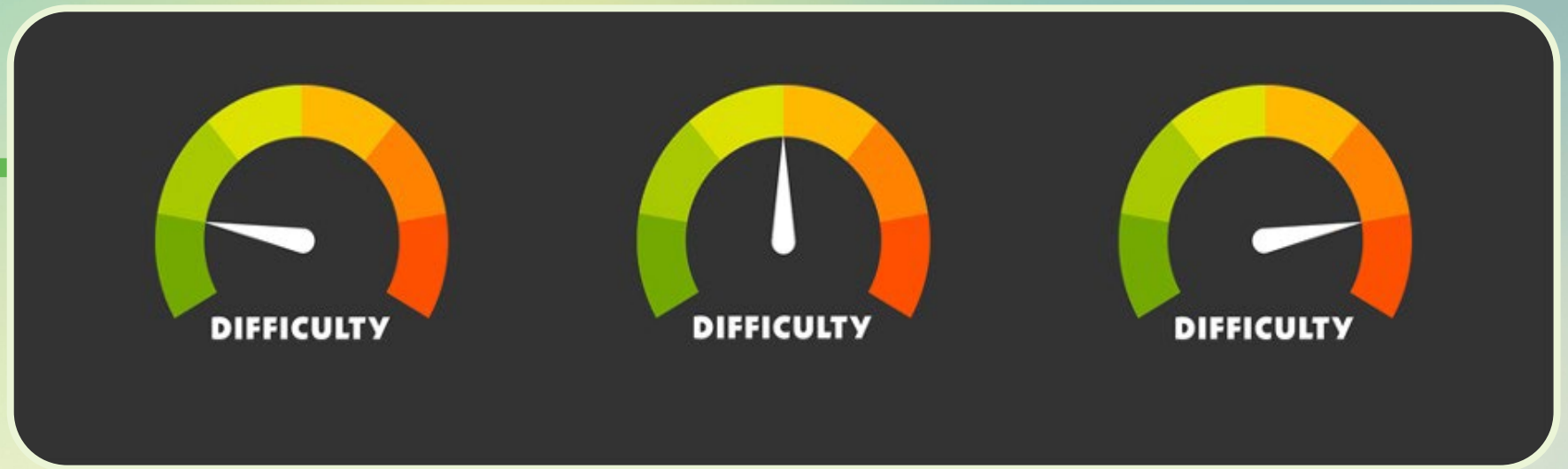


Canister Diagnosis

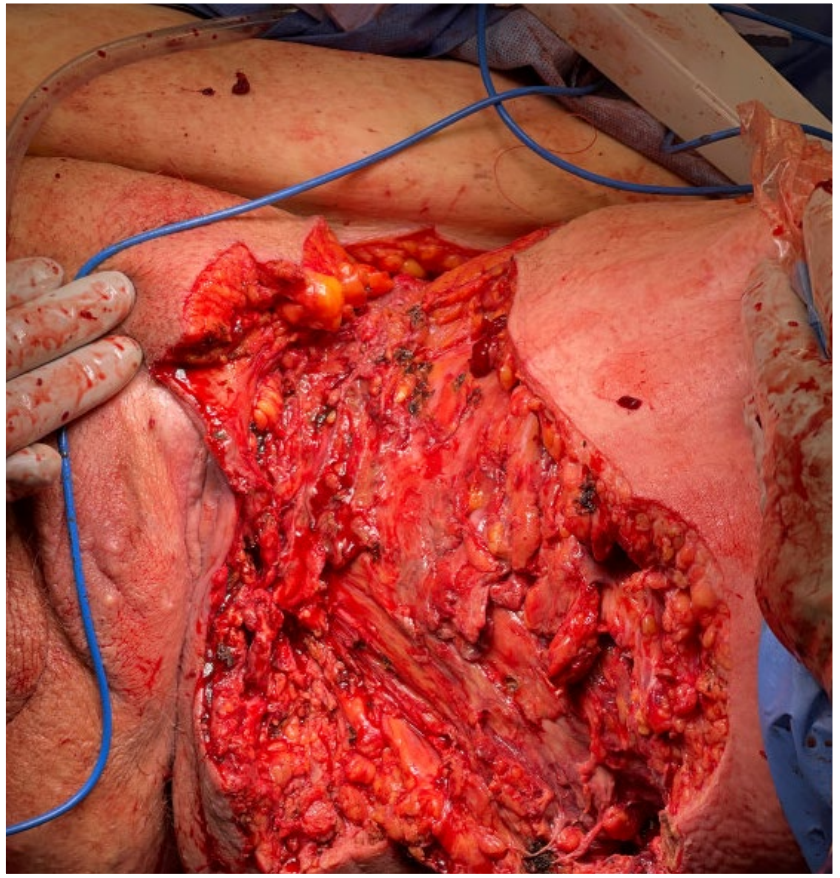


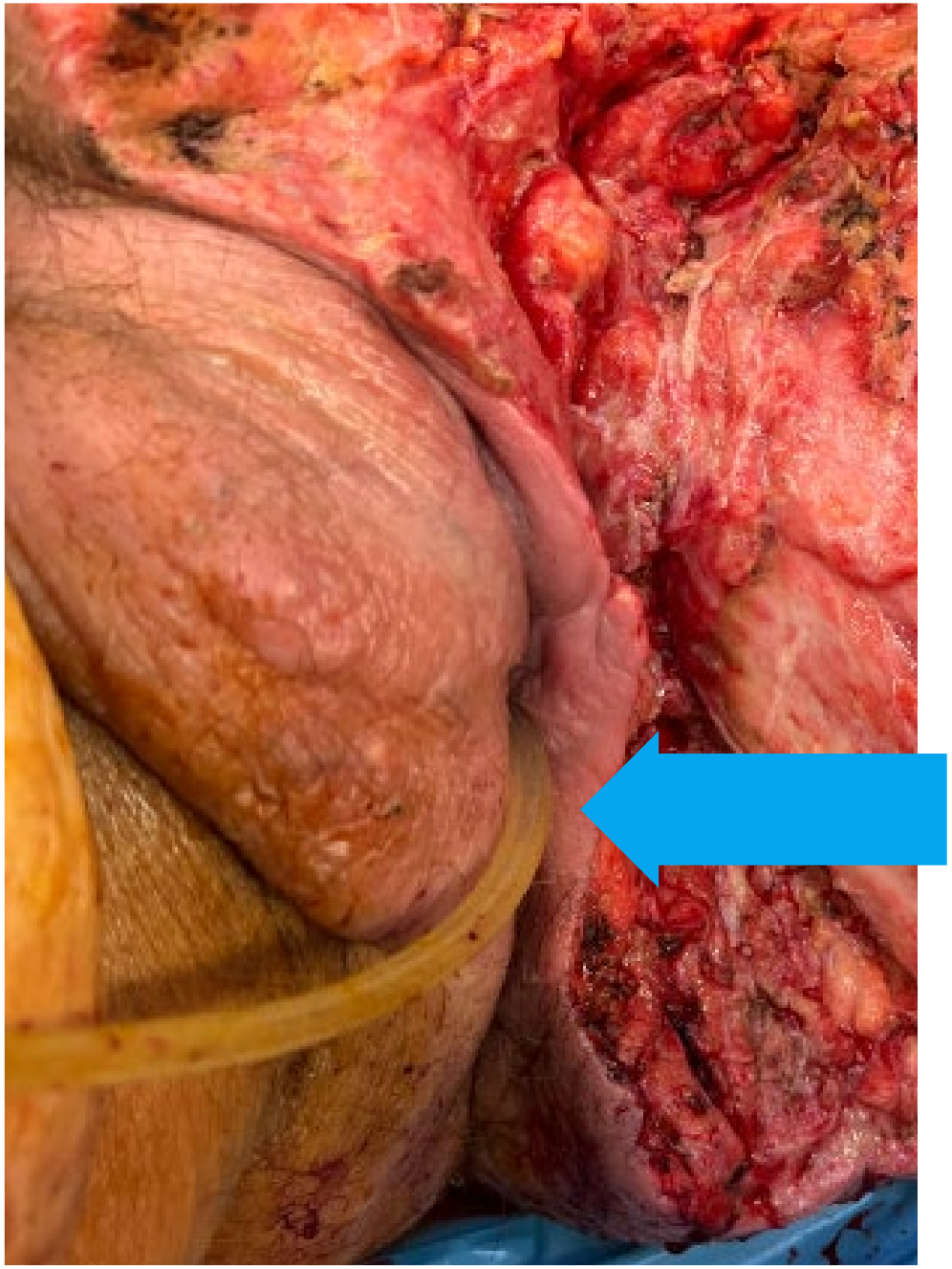


Groin

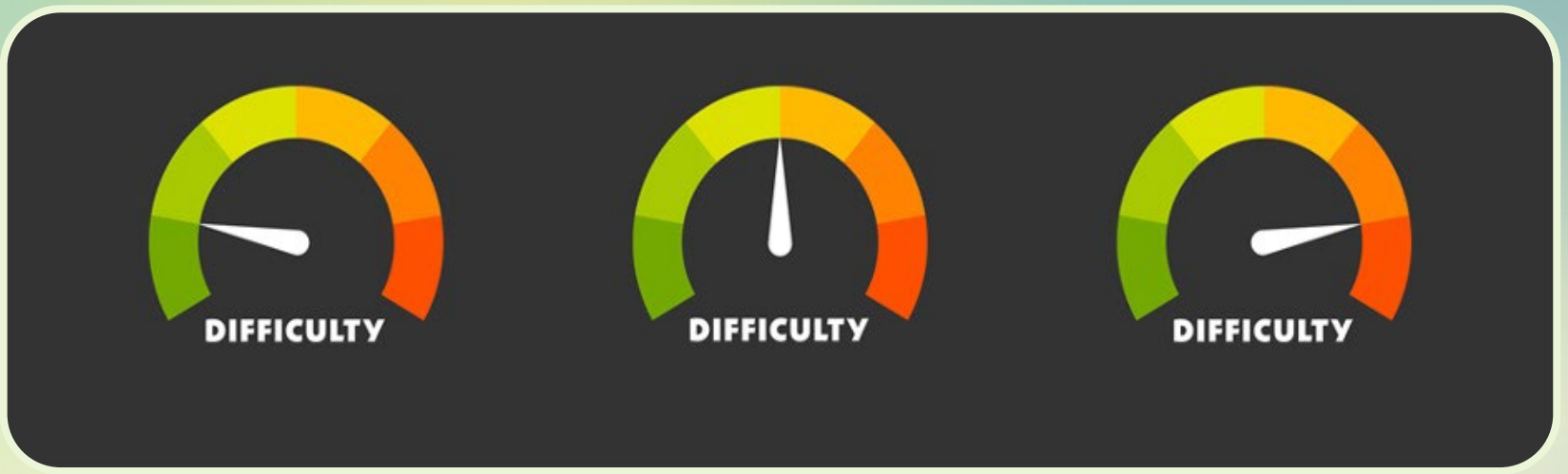


Necrotizing Soft Tissue Infection in the Groin





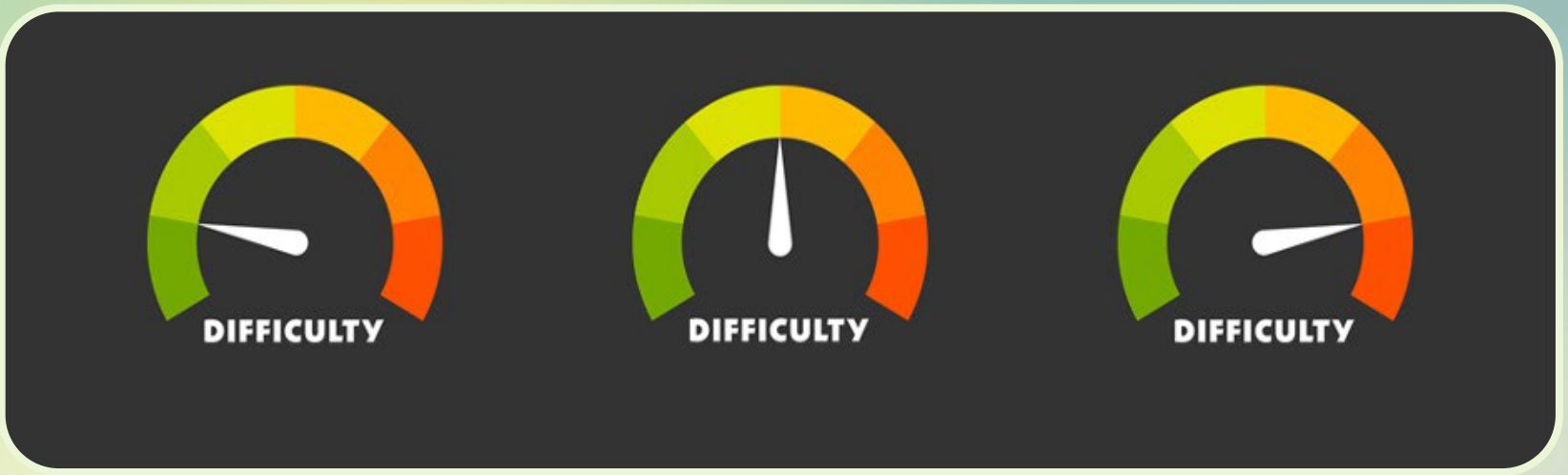
Skin Graft



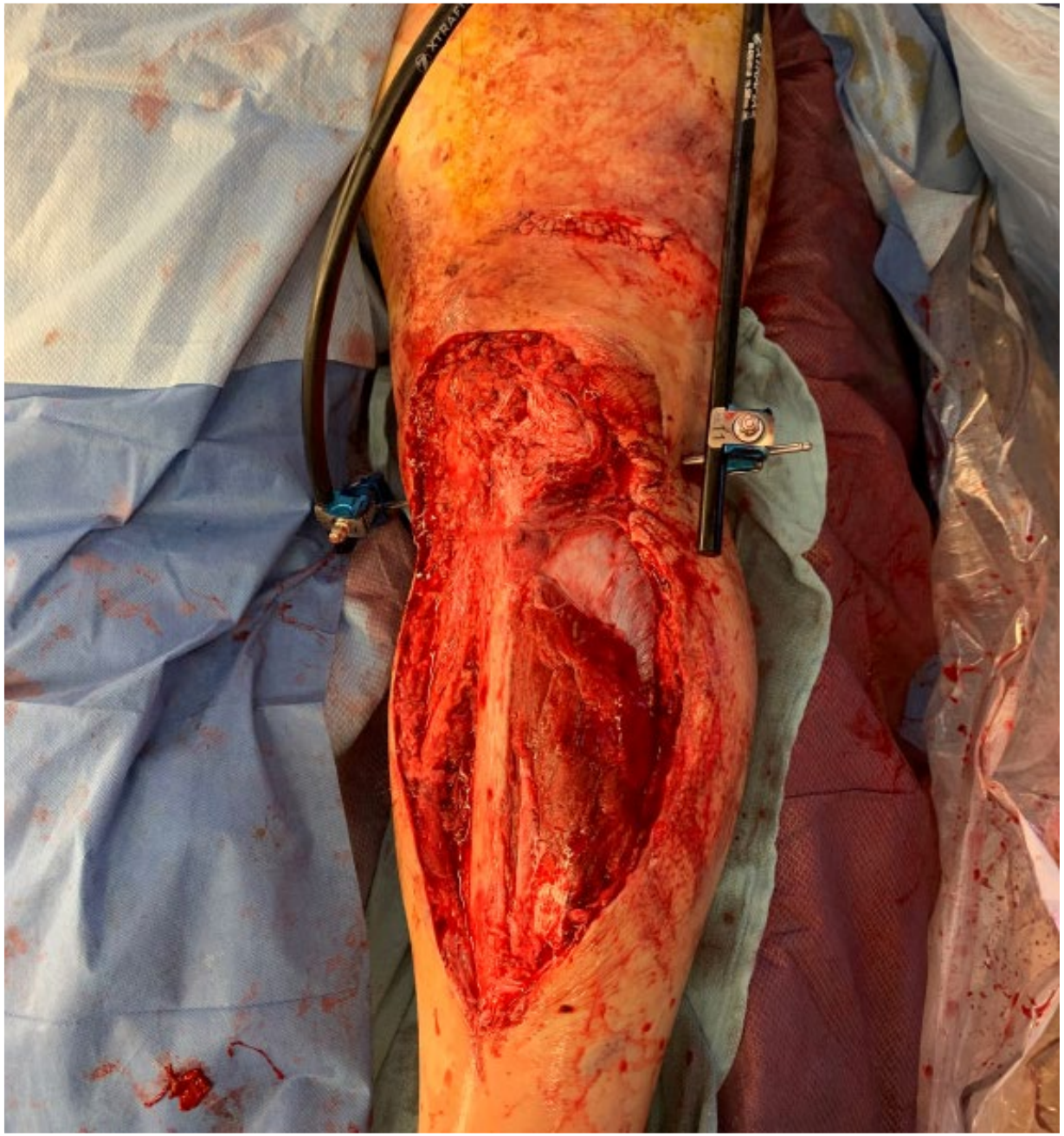

Rw
Picc
Picc

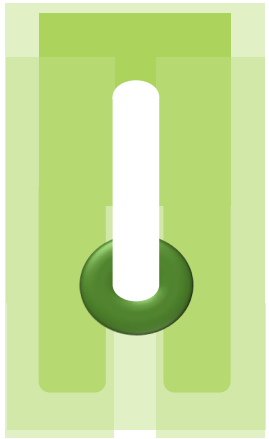

Rw

Orthopedic



Motorcycle Crash

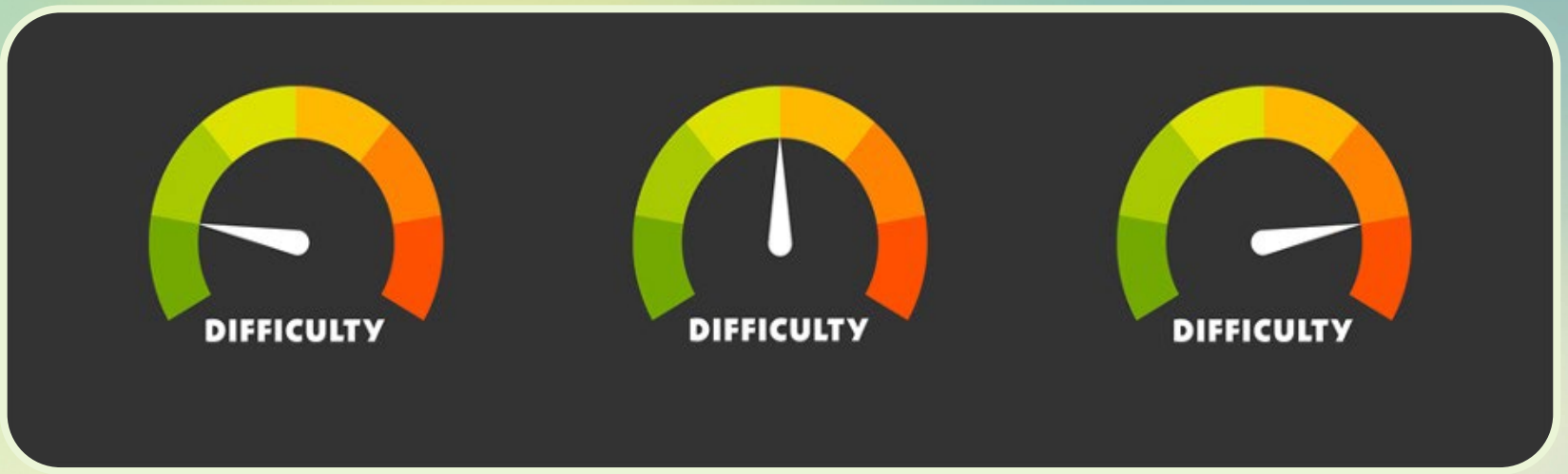




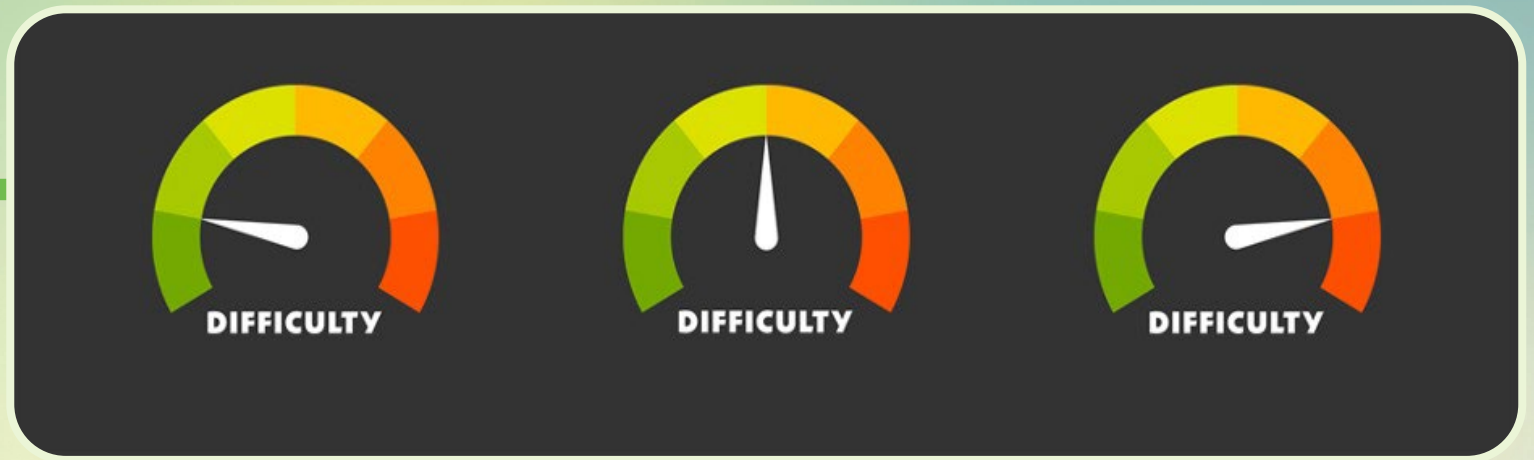
1) Drape “pants” on skin
2) Foam “pants”
3) Drape “pants”
4) Ostomy barrier ring

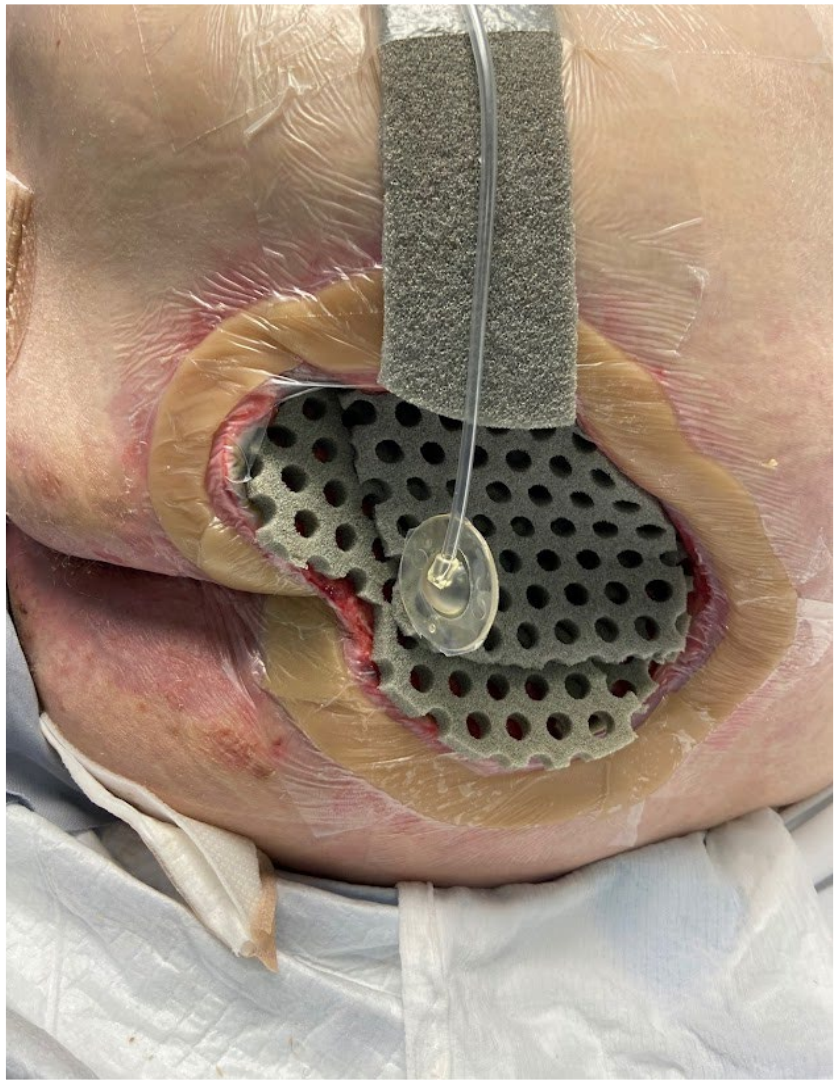
Include pin sites

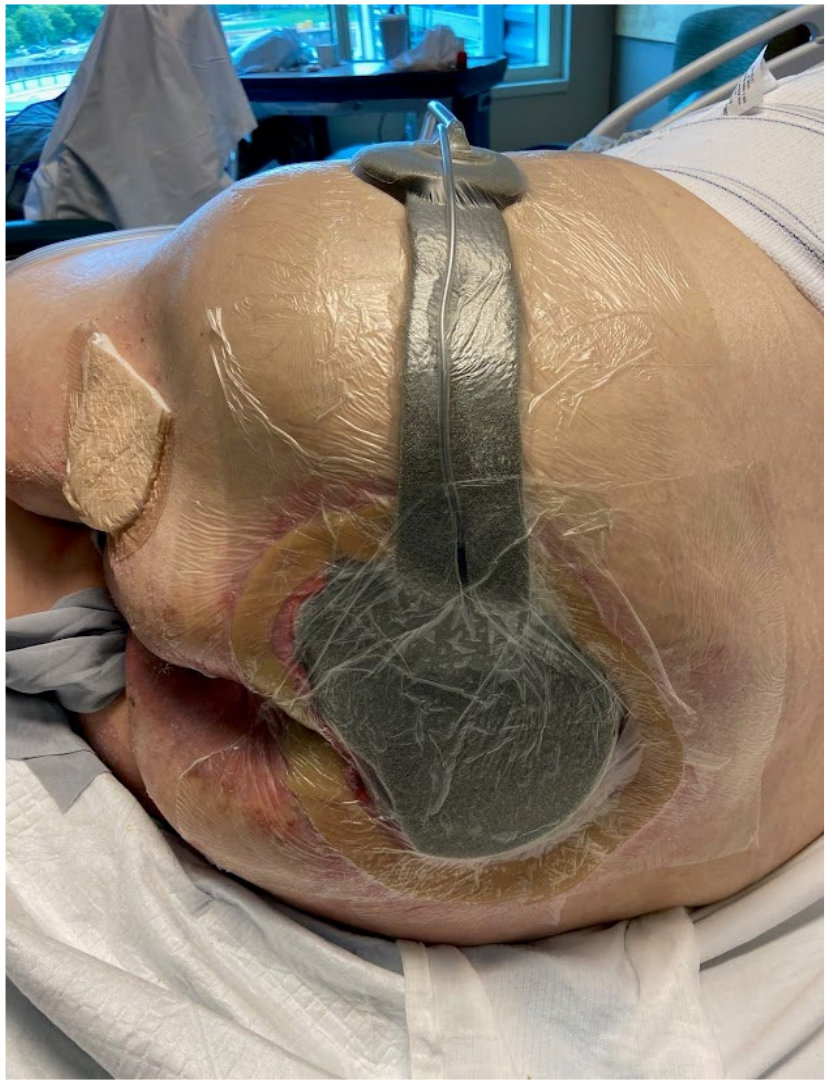
Ostomy

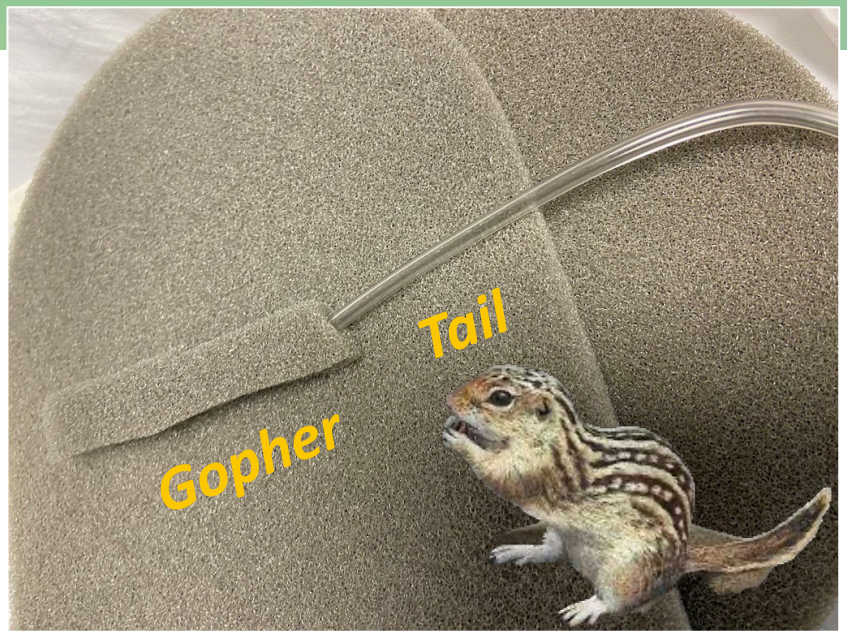


Posterior





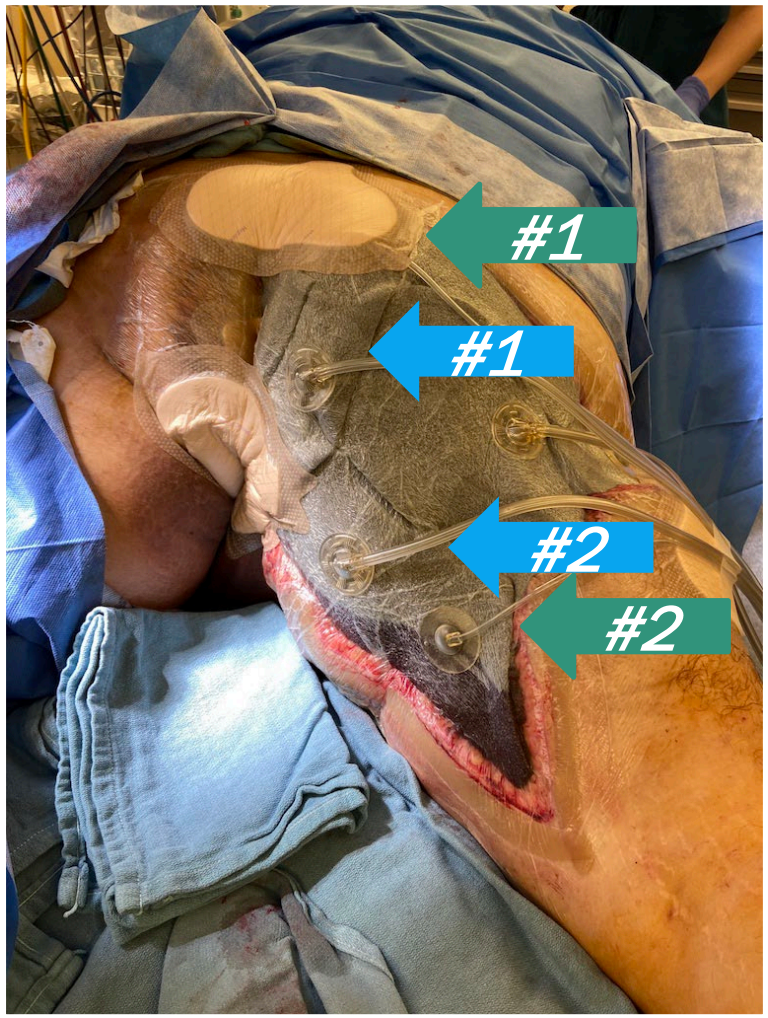




POD 51

Multiple Pumps

POD 4



3 Pumps

3 Instill

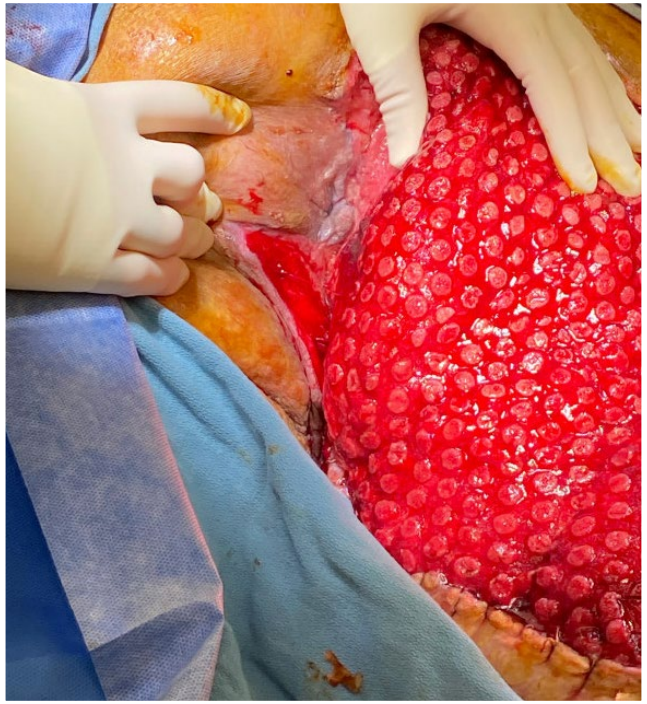
3 NPWT

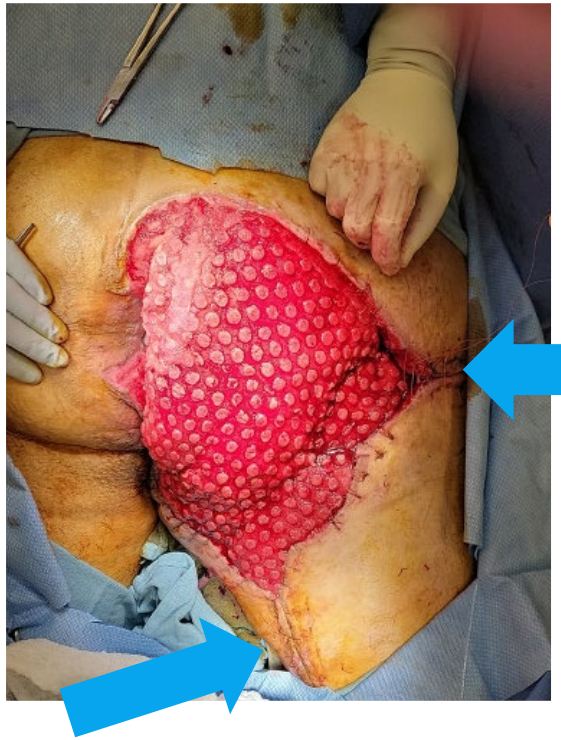
60 mL each

2 hrs NPWT cycle

5 min soak

-125 mm Hg





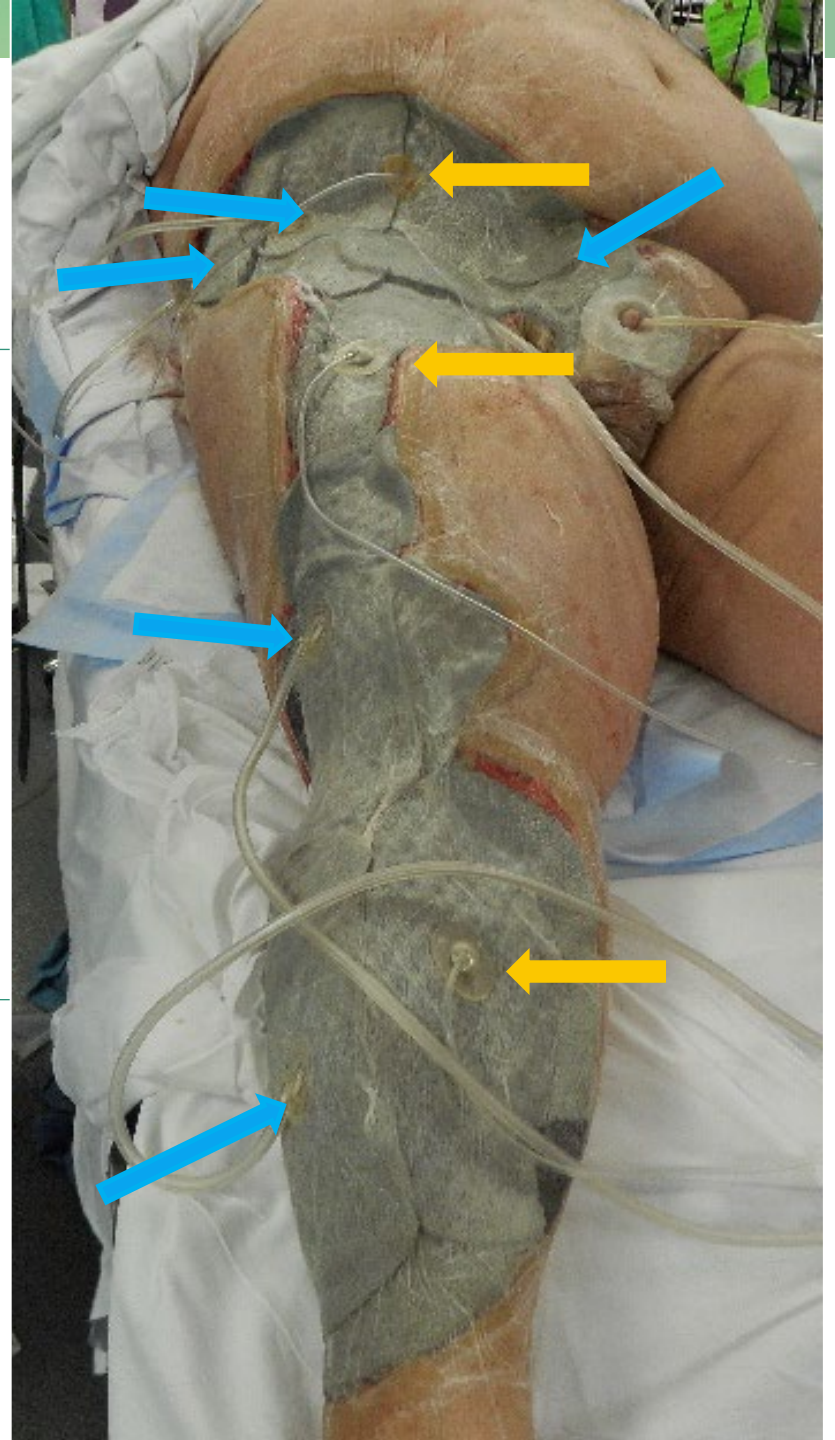
Last photo before skin graft

POD # 58

Arrow key

Yellow – Instillation

Blue – NPWT

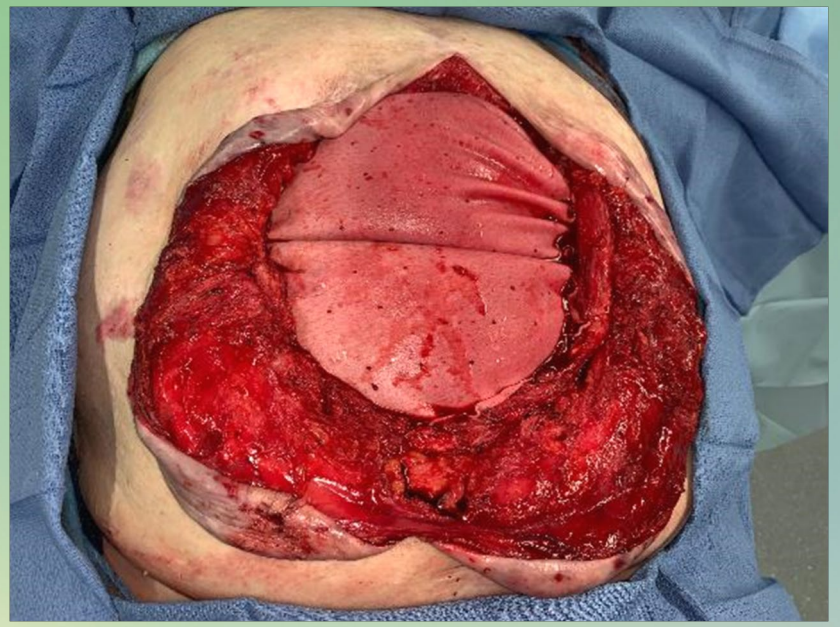


Algorithmic Approach to Application of NPWT In Combination with Dermal Substitutes

Michael N. Desvigne, MD, FACS, CWS, FACCWS

Plastic & Reconstructive Surgery
Wound Care & Hyperbaric Medicine
Abrazo Arrowhead Hospital
Glendale, AZ








Consider:

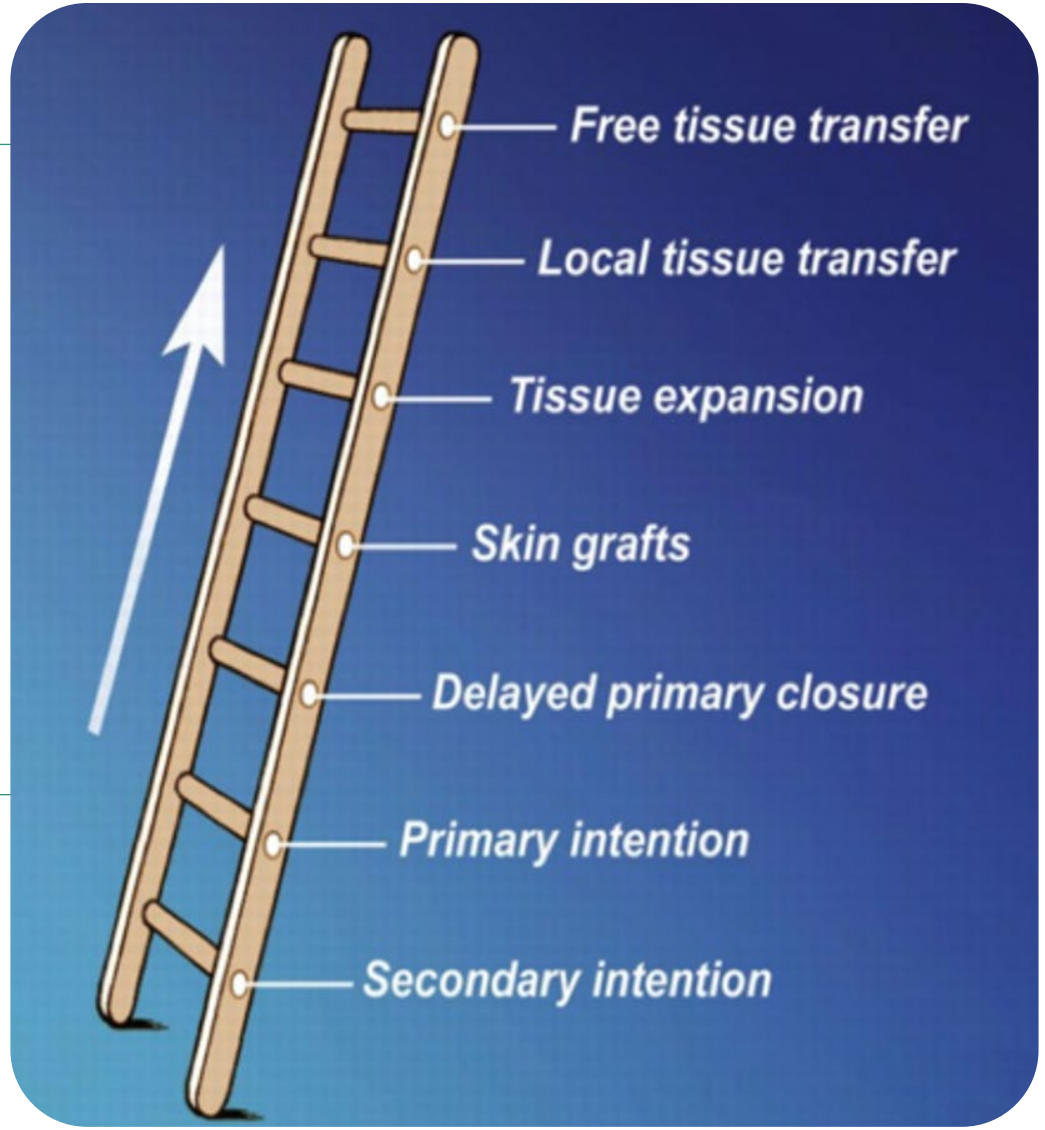
What is the “problem”?

What is the “solution”?

Is that solution the best “solution” for this patient?

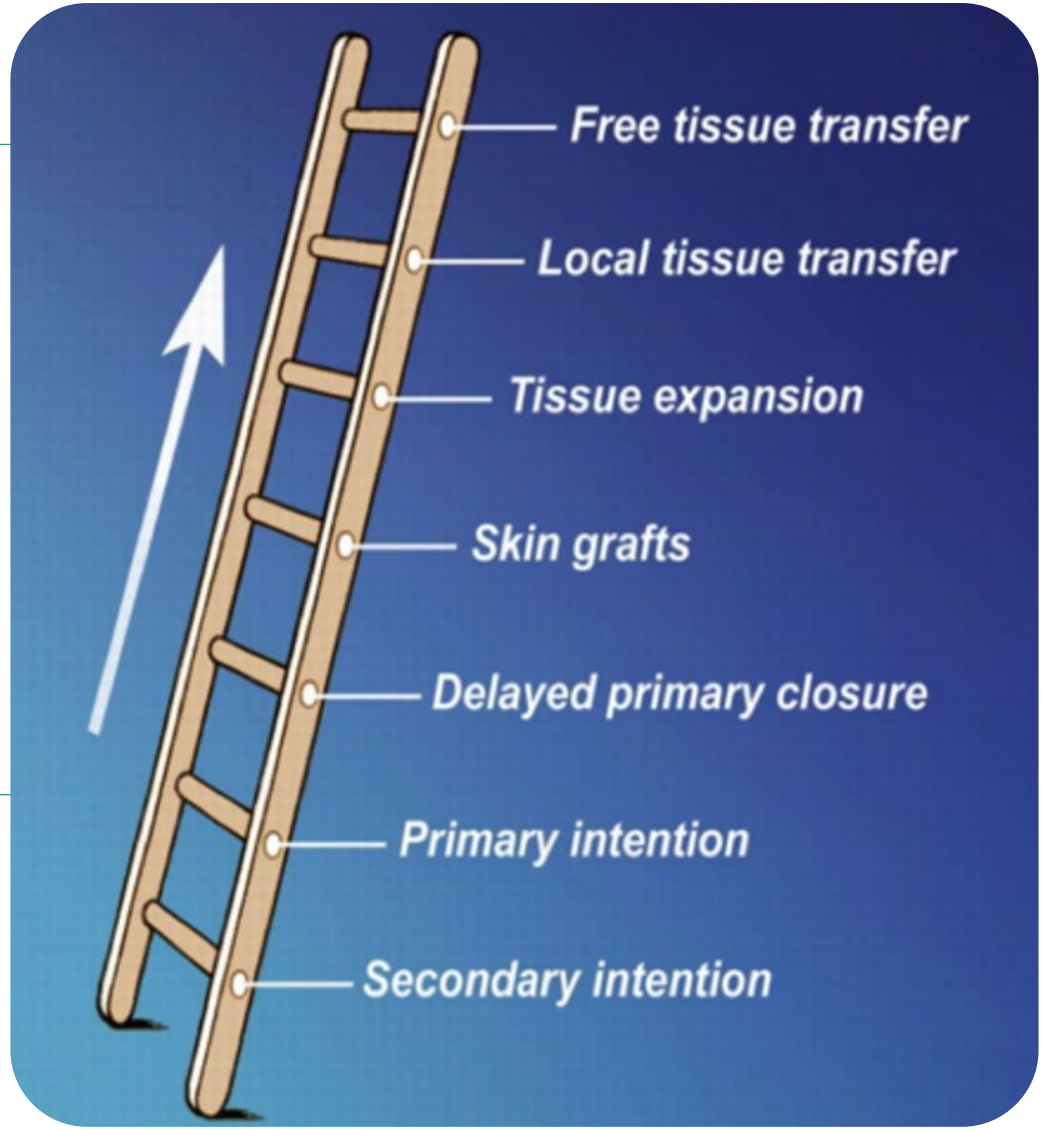
Plastic Surgery

The Reconstructive Ladder

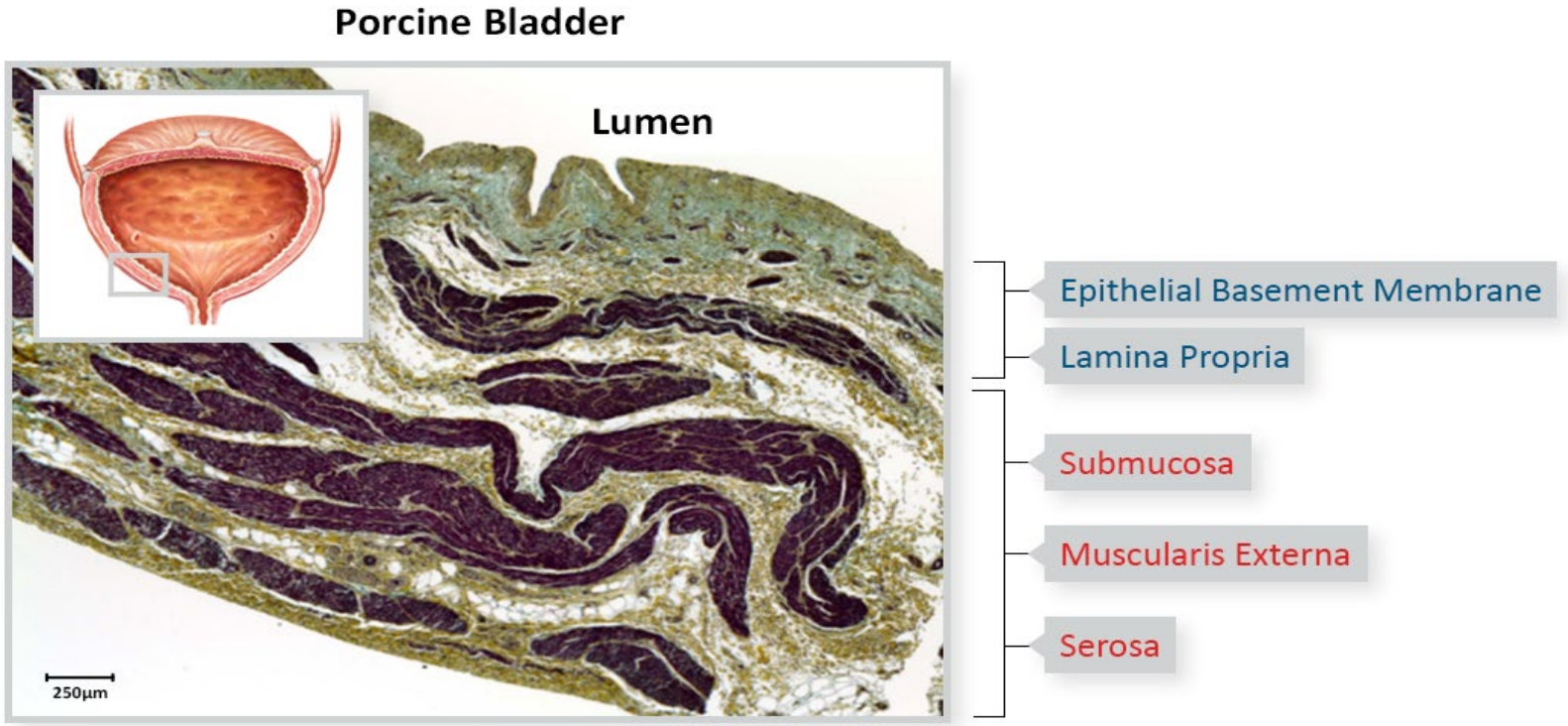


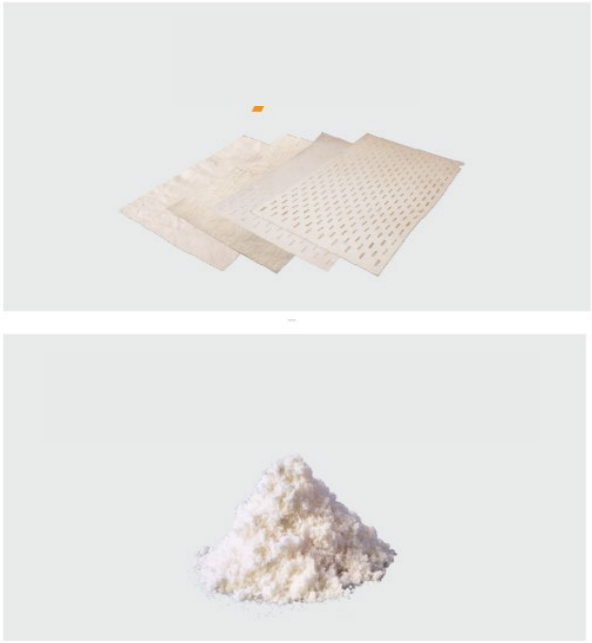
Plastic Surgery 2023

LESS is more…



Urinary Bladder Matrix (UBM)





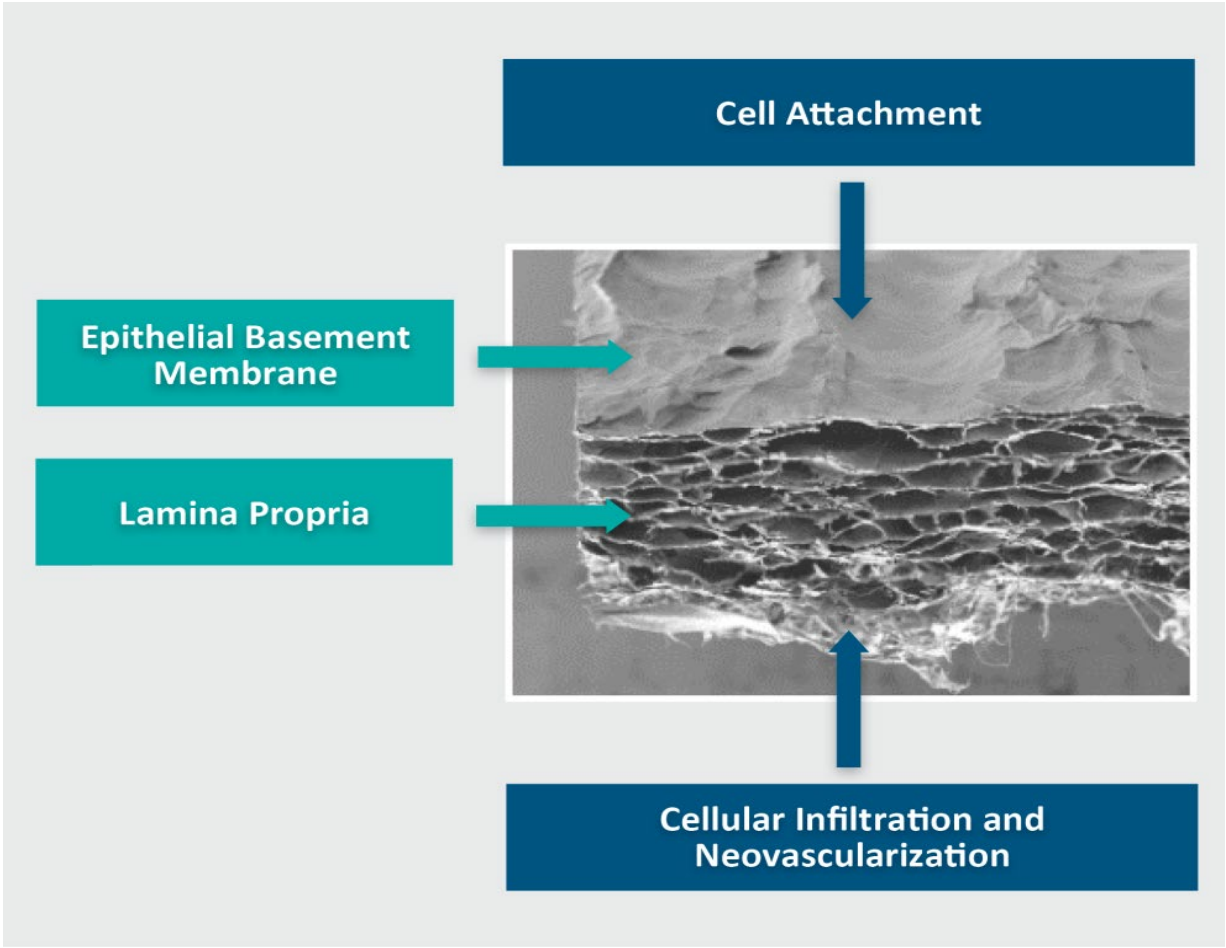
- Porcine bladders are processed in a controlled manufacturing environment
- The 3 outer layers of the bladder are mechanically removed
- UBM retains the epithelial basement membrane and lamina propria

UBM Composition

Bimodal scaffold composition

- **Epithelial Basement Membrane**
  - Provides a thin, dense collagen structure ideal for epithelial cell attachment
- **Lamina Propia**
  - Provides an open, porous structure ideal for cell infiltration and neovascularization

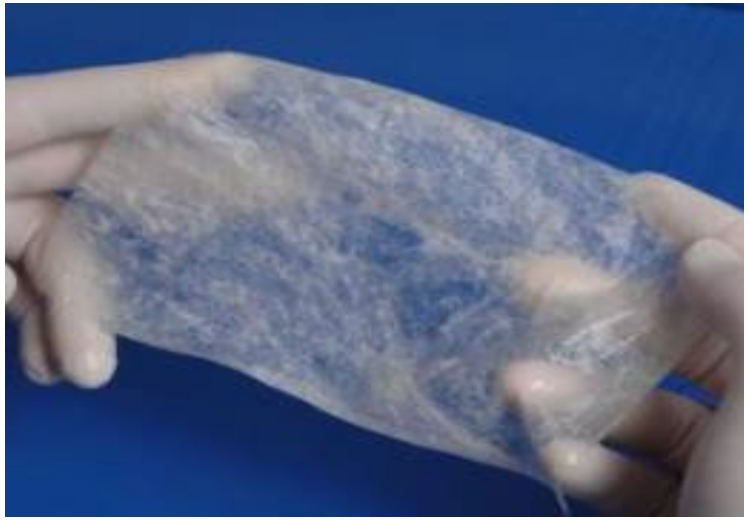
The presence of an intact epithelial basement membrane differentiates UBM from other extracellular matrix-based devices

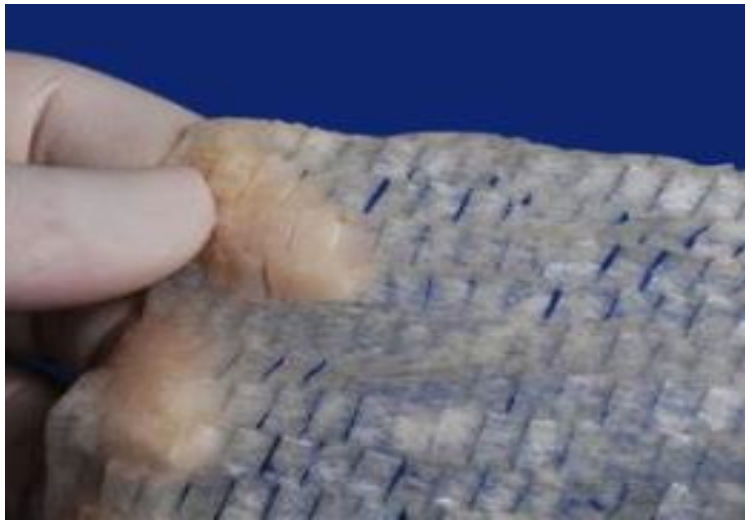


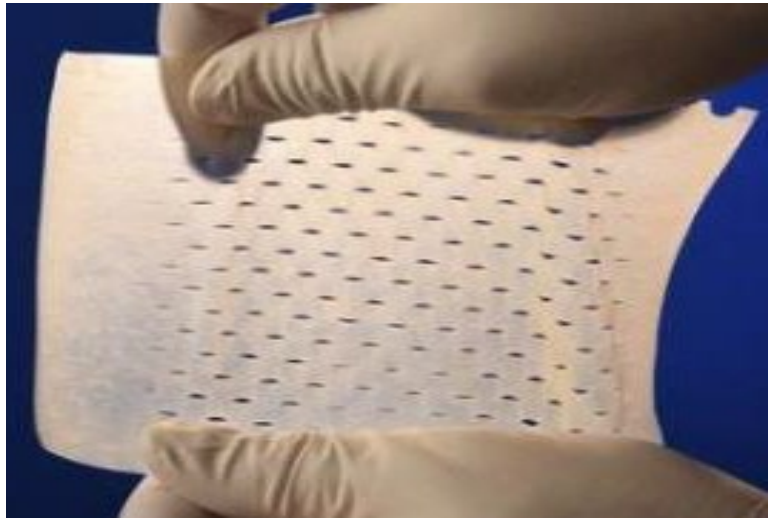
Brown AL, et al. *Biomaterials*. 2006;27(20):3825-3835.

Porcine Bladder Wound Matrix

- Porcine bladder wound matrix (1-layer, 2-layer, 3-layer, and 6-layer) and UBM burn matrix are for the management of wounds including partial and full-thickness wounds, pressure ulcers, venous ulcers, diabetic ulcers, chronic vascular ulcers, tunneled/ undermined wounds, surgical wounds (donor sites/grafts, post-Mohs surgery, post-laser surgery, podiatric, wound dehiscence), trauma wounds (abrasions, lacerations, second-degree burns, and skin tears), and draining wounds







Wound Management Solution

- Wound management solution for wounds including partial and full-thickness wounds, pressure ulcers, venous ulcers, diabetic ulcers, chronic vascular ulcers, tunneled/undermined wounds, surgical wounds (donor sites/grafts, post-Mohs surgery, post-laser surgery, podiatric, wound dehiscence), trauma wounds (abrasions, lacerations, second-degree burns, and skin tears), and draining wounds

Cases:
Porcine Urinary Bladder Matrix

Case Summary: Nonhealing DFU, Charcot Deformity

- 52 y/o female with obesity, DM, neuropathy, and Charcot deformity presents with foot ulcer and recent infection
- Medical history: Obesity, DM, peripheral neuropathy (PN), Charcot arthroscopies
- Treatment
  - Taken to OR by vascular surgeon with counter incision made to establish drainage, taken to OR for debridement
  - Taken to OR for repeat debridement with excision of nonhealing wound and extensive tunneling
  - **UBM sheet and micronized particulate used to "fill" tunneling defect**
  - NPWT initiated immediately following "closure"

PN = peripheral neuropathy.

DFU with Charcot Deformity (Day 1)

DFU with Charcot Deformity (Day 1)

DFU with Charcot Deformity (Day 1)

DFU with Charcot Deformity (Day 1)

DFU with Charcot Deformity (Day 1)

DFU with Charcot Deformity (Day 1)

DFU with Charcot Deformity (Day 3)

DFU with Charcot Deformity (Day 3)

DFU with Charcot Deformity (Day 10)

DFU with Charcot Deformity (Day 10)

DFU with Charcot Deformity (6 Weeks)

DFU with Charcot Deformity (8 Weeks)

Case Summary: Nonhealing Surgical Wound, LLE Previous Sarcoma, XRT

- 75 y/o female presents with nonhealing surgical wound s/p sarcoma resection, radiation therapy (XRT), and free tissue transfer
- Medical history: Multiple surgeries left lower extremity (LLE)
- Treatment
  - Taken to OR for drainage abscess knee and excision non-viable tissue
  - NPWTi-d initiated for wound bed preparation
  - Returned to OR for definitive closure
  - Placental particulate placed to optimize healing
  - **UBM micronized particulate used to “fill” tunneling defect**
  - NPWT initiated immediately following “closure”

LLE = left lower extremity; XRT = radiation therapy.

Nonhealing Surgical Wound Bone Exposed (Preop)

Nonhealing Surgical Wound Bone Exposed (Preop)

Nonhealing Surgical Wound Bone Exposed (Day 1)

Nonhealing Surgical Wound Bone Exposed (Day 1)

Nonhealing Surgical Wound Bone Exposed (Day 1)

Nonhealing Surgical Wound Bone Exposed (Day 1)

Nonhealing Surgical Wound Bone Exposed (Day 1)

Nonhealing Surgical Wound Bone Exposed (Day 3)

Nonhealing Surgical Wound Bone Exposed (Day 3)

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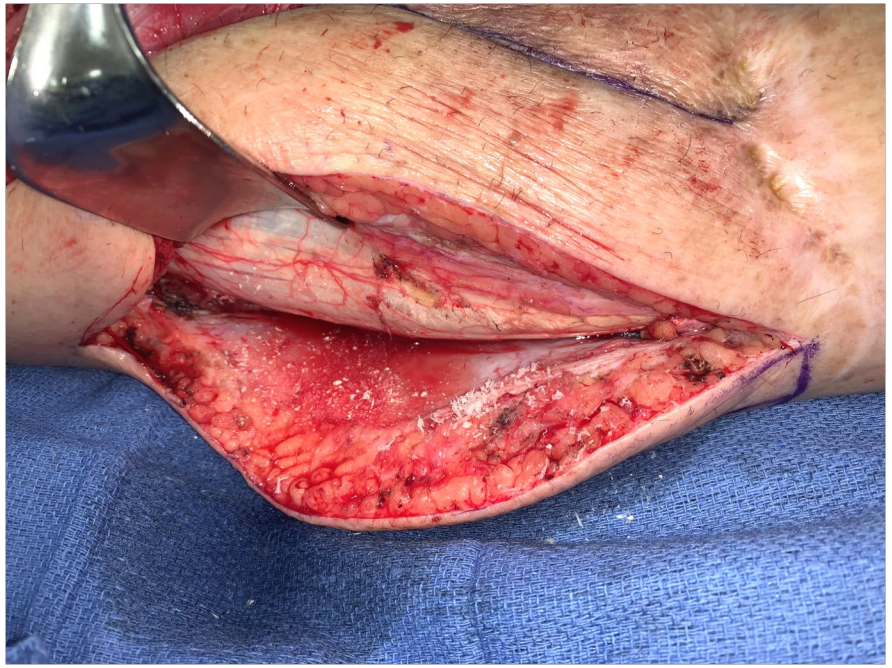
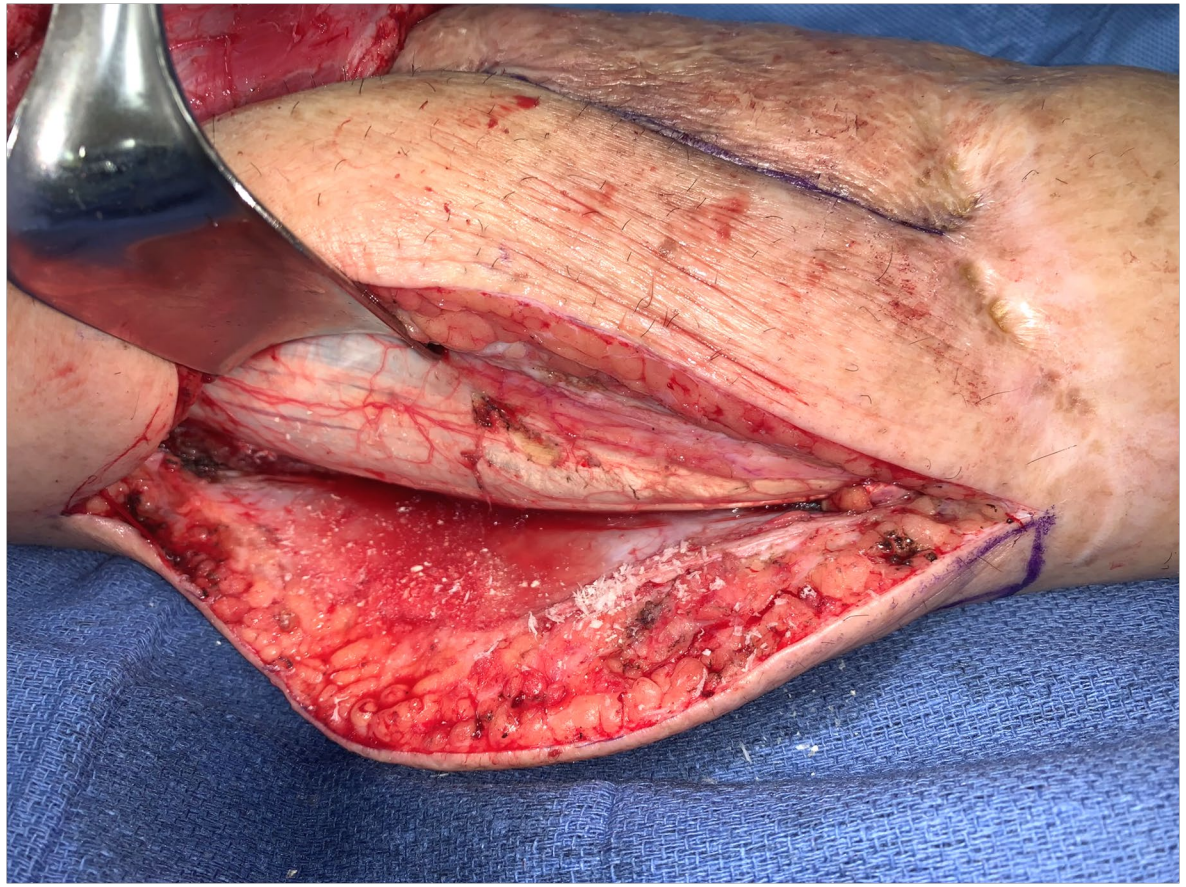
Nonhealing Surgical Wound Bone Exposed (Day 3)





Nonhealing Surgical Wound Bone Exposed (Day 3)

Nonhealing Surgical Wound Bone Exposed (Day 3)

Nonhealing Surgical Wound Bone Exposed (Day 3)

Nonhealing Surgical Wound Bone Exposed (Day 3)

Nonhealing Surgical Wound Bone Exposed (Day 10)

Nonhealing Surgical Wound Bone Exposed (Day 10)

Nonhealing Surgical Wound Bone Exposed (Day 17)

Nonhealing Surgical Wound Bone Exposed (Day 24)

Nonhealing Surgical Wound Bone Exposed (Day 24)

Nonhealing Surgical Wound Bone Exposed (4 Weeks)

Nonhealing Surgical Wound Bone Exposed (4 Weeks)

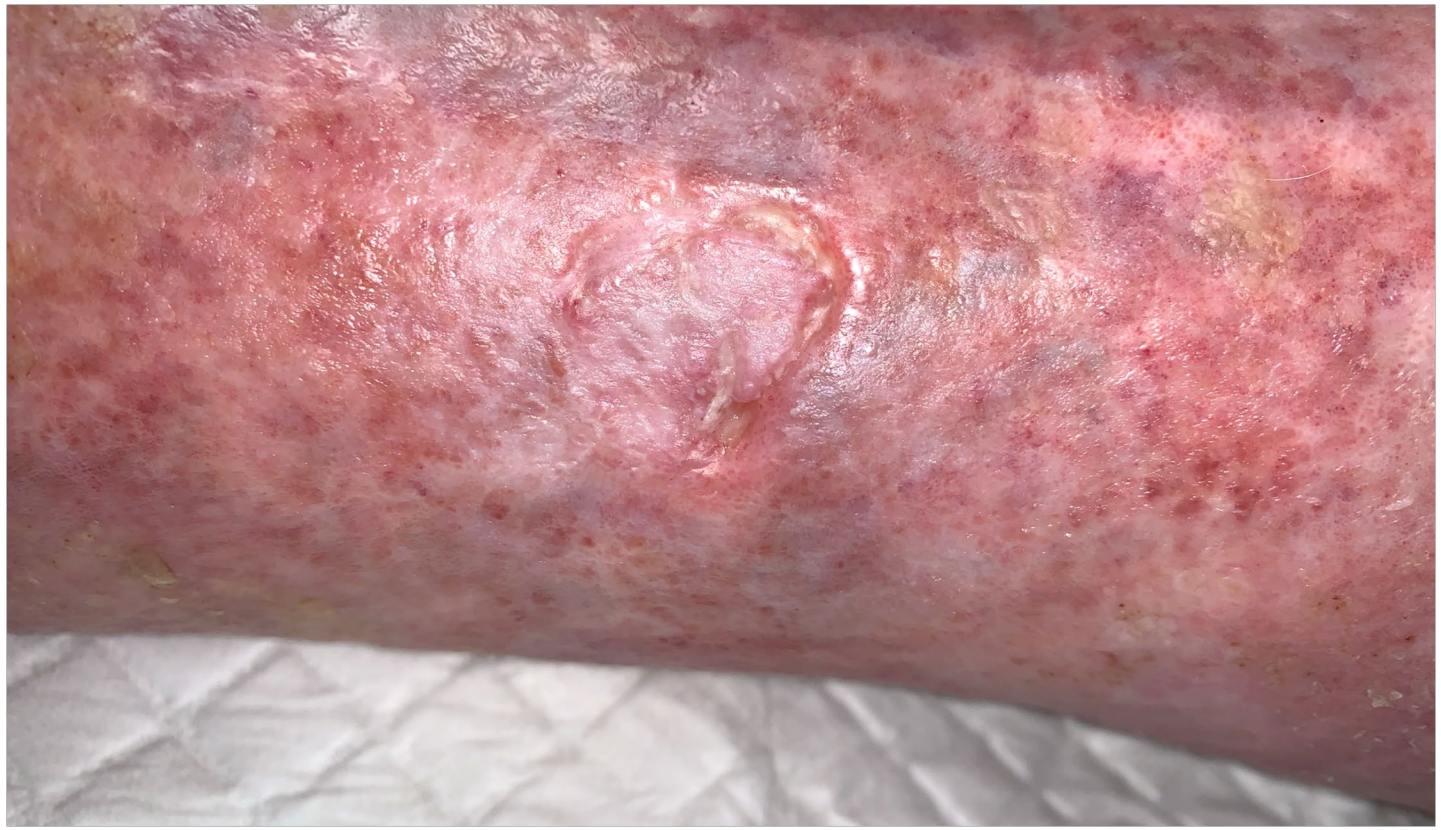
Nonhealing Surgical Wound Bone Exposed (8 Weeks)

Nonhealing Surgical Wound Bone Exposed (8 Weeks)

Nonhealing Surgical Wound Bone Exposed (12 Weeks)

Nonhealing Surgical Wound Bone Exposed (16 Weeks)

Nonhealing Surgical Wound Bone Exposed (16 Weeks)

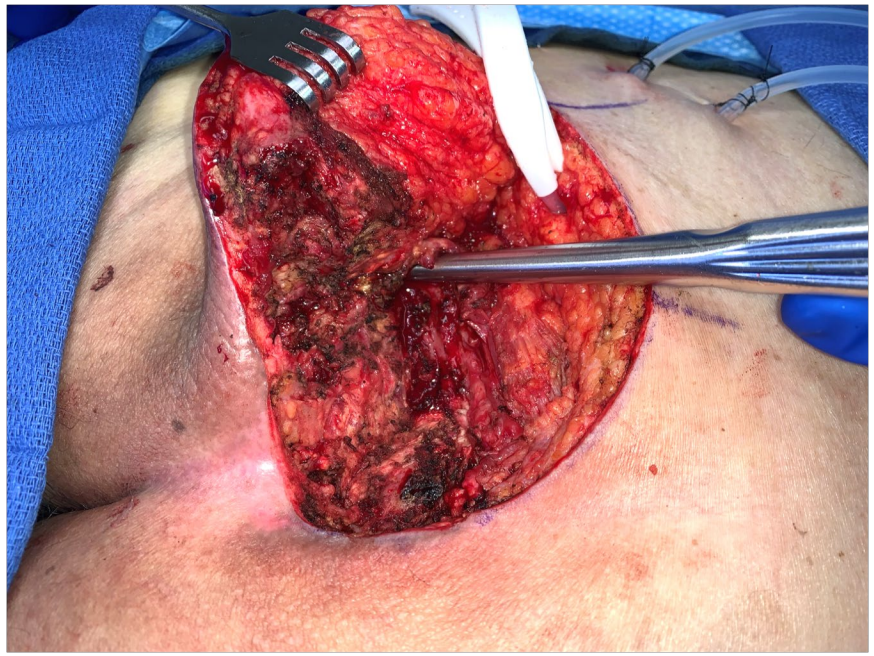


Case Summary: Sacral Ulcer with Tunnelling

- 70 y/o male presents with stage 4 sacral ulcer with extensive tunnelling following prolonged hospitalization following COVID-19
- Medical history: COVID-19 with respiratory failure
- Treatment
  - Taken to OR for excision ulcer with partial ostectomy
  - Extensive tunnelling noted
  - **UBM micronized particulate used to “fill” tunneling defect**
  - Placental particulate placed to optimize healing
  - NPWT initiated as incisional management immediately following closure

Sacral Ulcer with Tunneling (Day 1)

Sacral Ulcer with Tunneling (Day 1)



Sacral Ulcer with Tunneling (Day 1)

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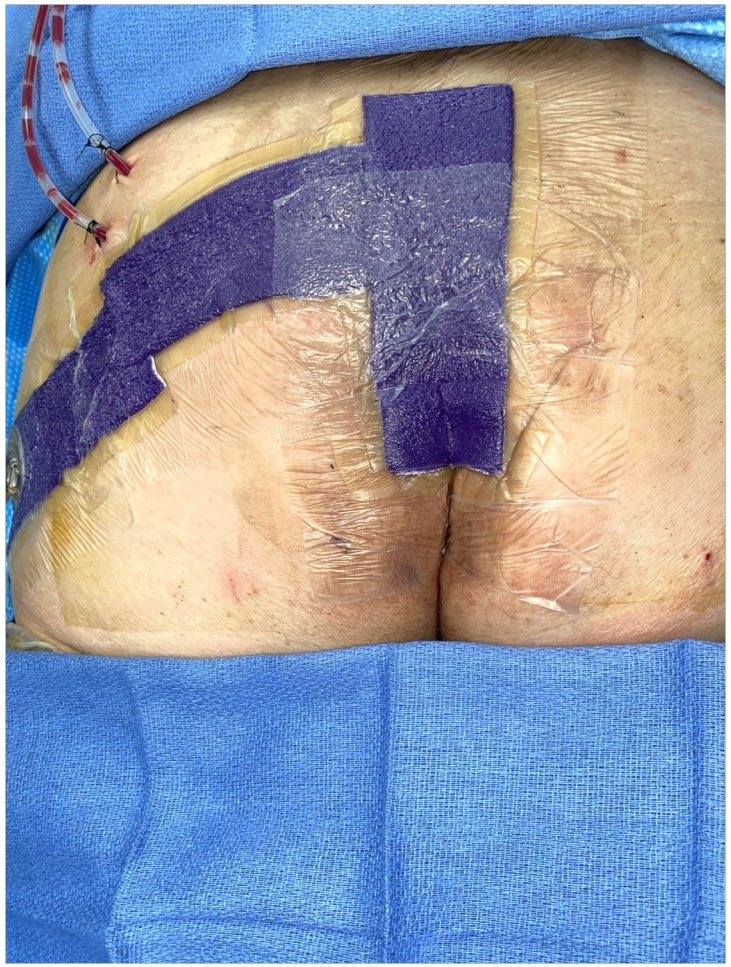
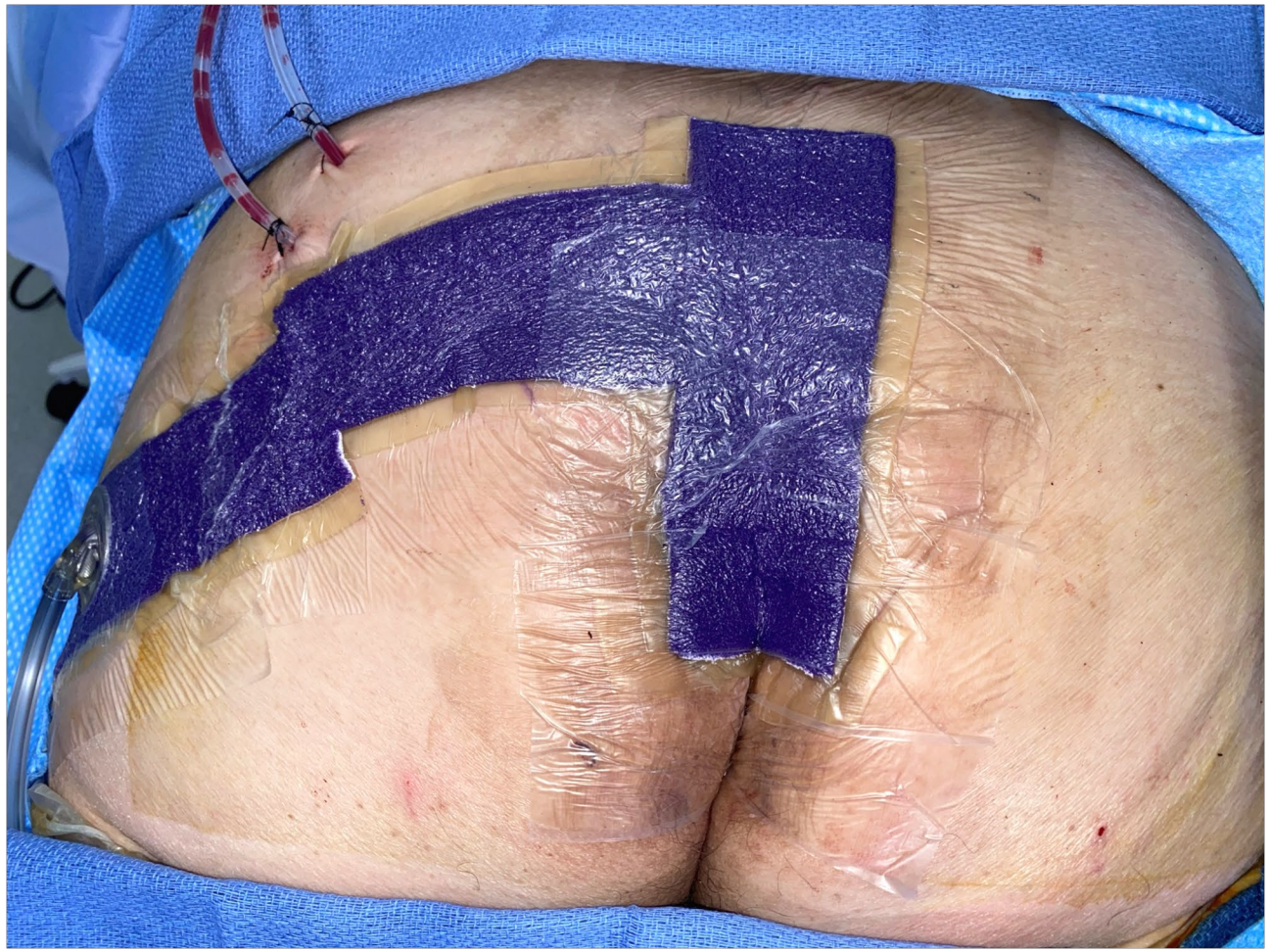
Sacral Ulcer with Tunneling (Day 1)





Sacral Ulcer with Tunneling (Day 10)

Sacral Ulcer with Tunneling (4 Weeks)

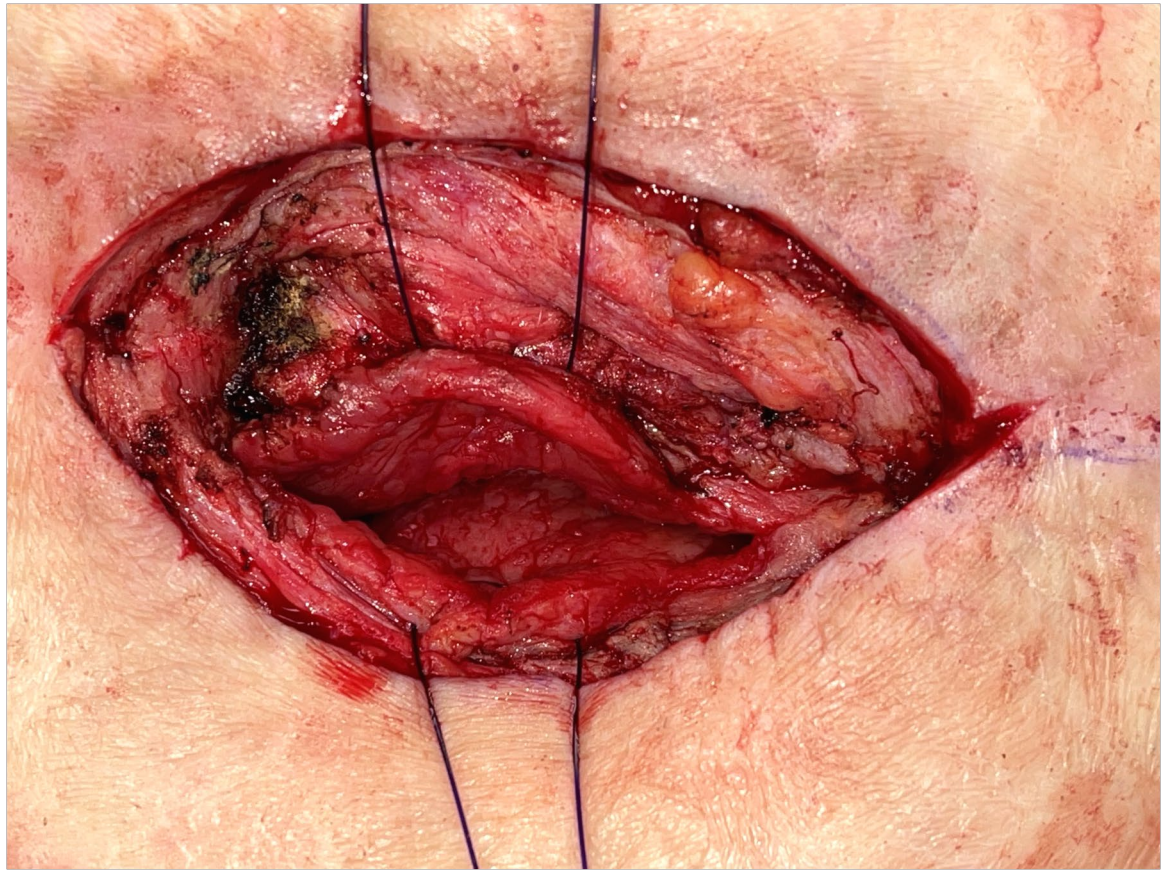
Case Summary: Nonhealing Wound, Left Hip with Tunnelling

- 58 y/o male presents with nonhealing surgical wound left hip present for 2 yrs; previous hip arthroplasty complicated by infection requiring explant
- Medical history: CHF, renal insufficiency, RA
- Treatment
  - Taken to OR for excision ulcer with flap closure
  - Extensive tunnelling noted
  - **UBM micronized particulate used to “fill” tunneling defect**
  - Placental particulate placed to optimize healing
  - NPWT initiated as incisional management immediately following flap closure

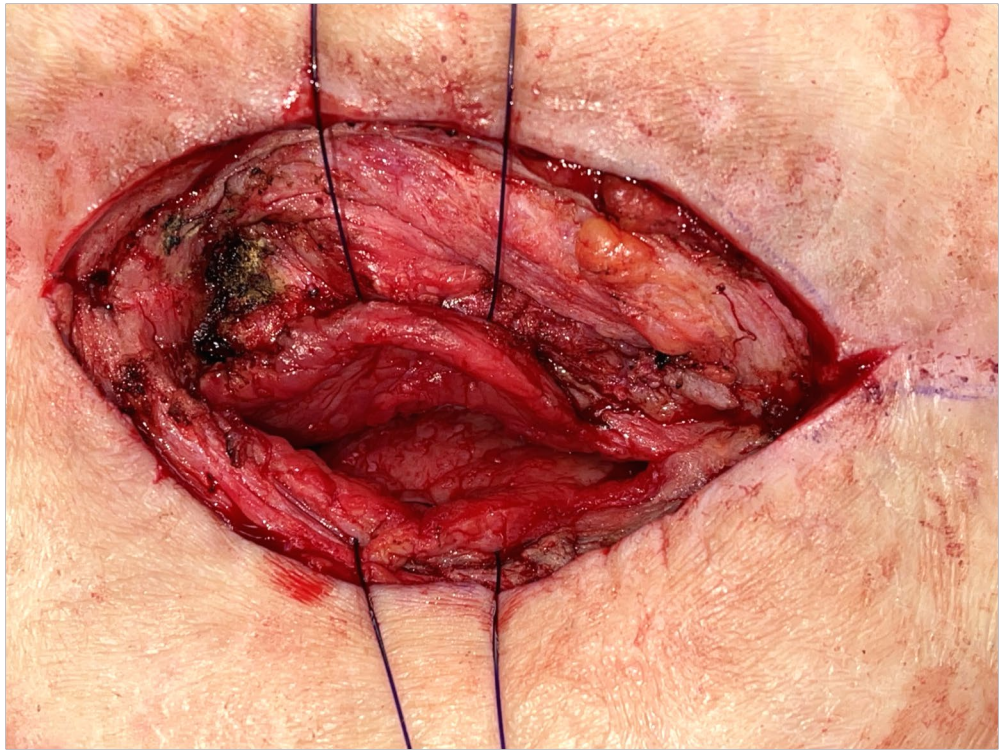
CHF = congestive heart failure; RA = rheumatoid arthritis.

Nonhealing Wound Left Hip with Tunneling (Day 1)

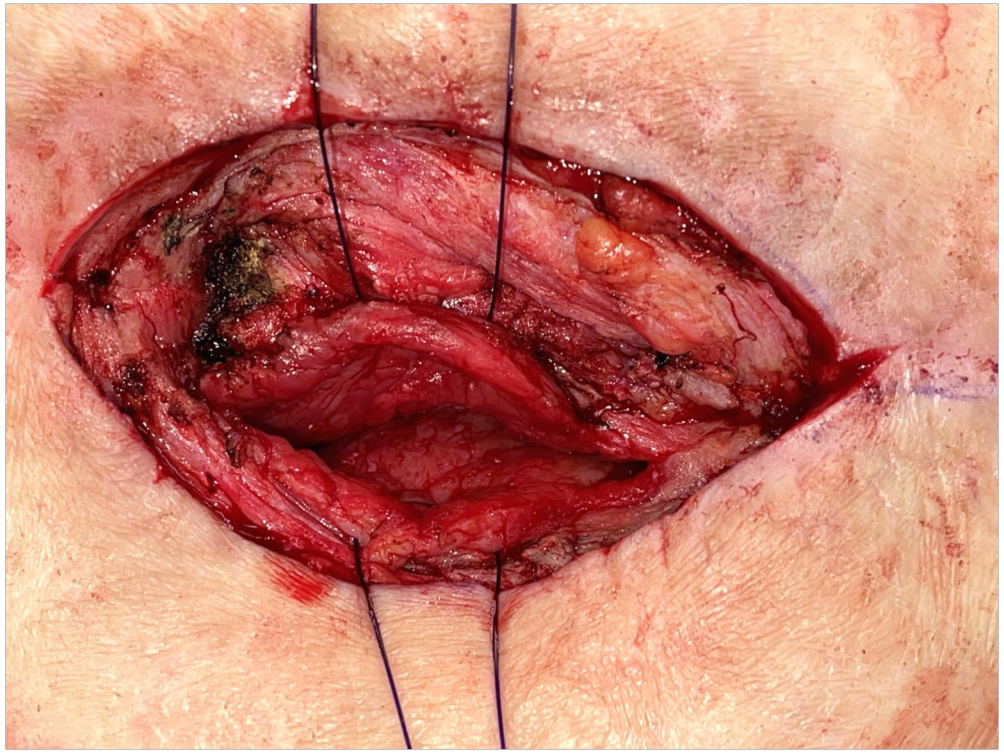
Nonhealing Wound Left Hip with Tunneling (Day 1)



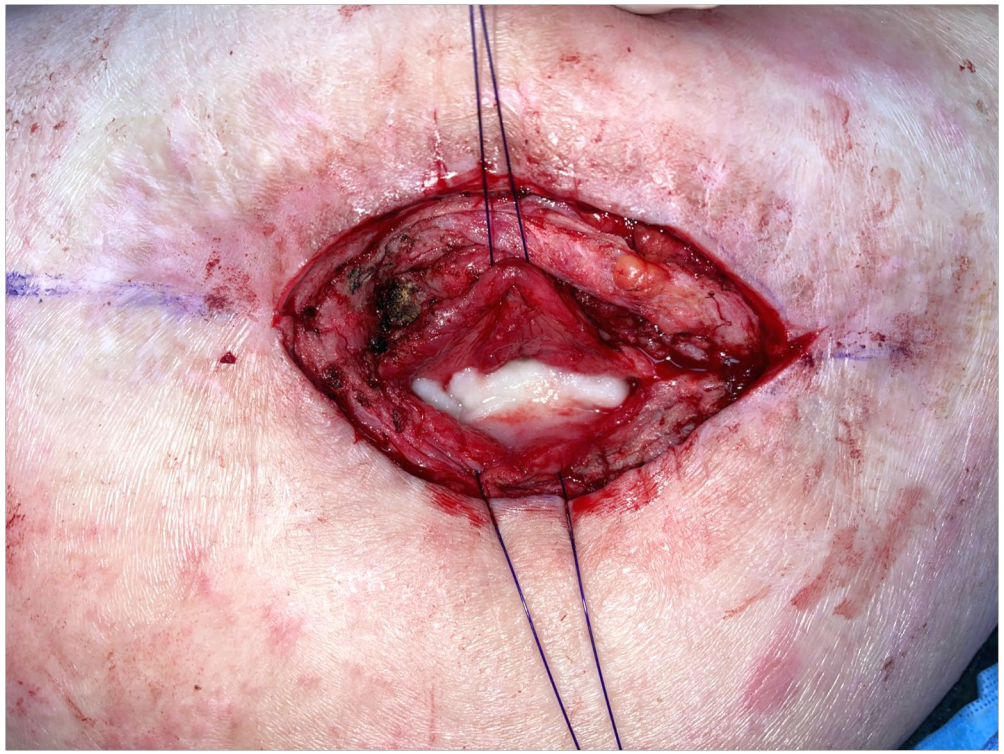
Nonhealing Wound Left Hip with Tunneling (Day 1)



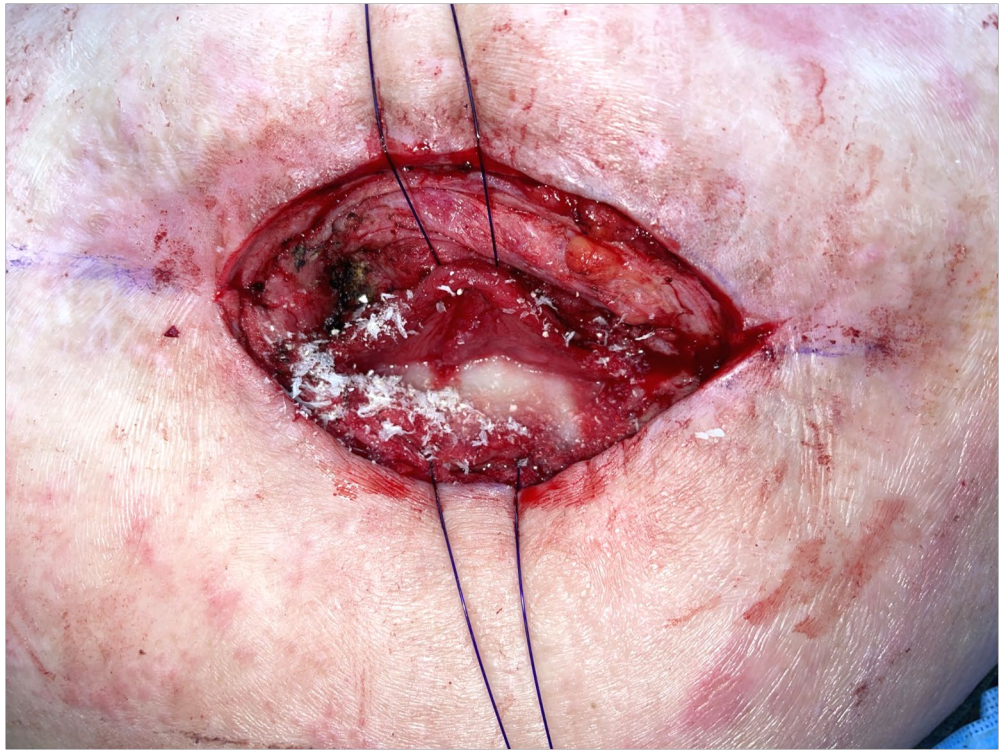
Nonhealing Wound Left Hip with Tunneling (Day 1)

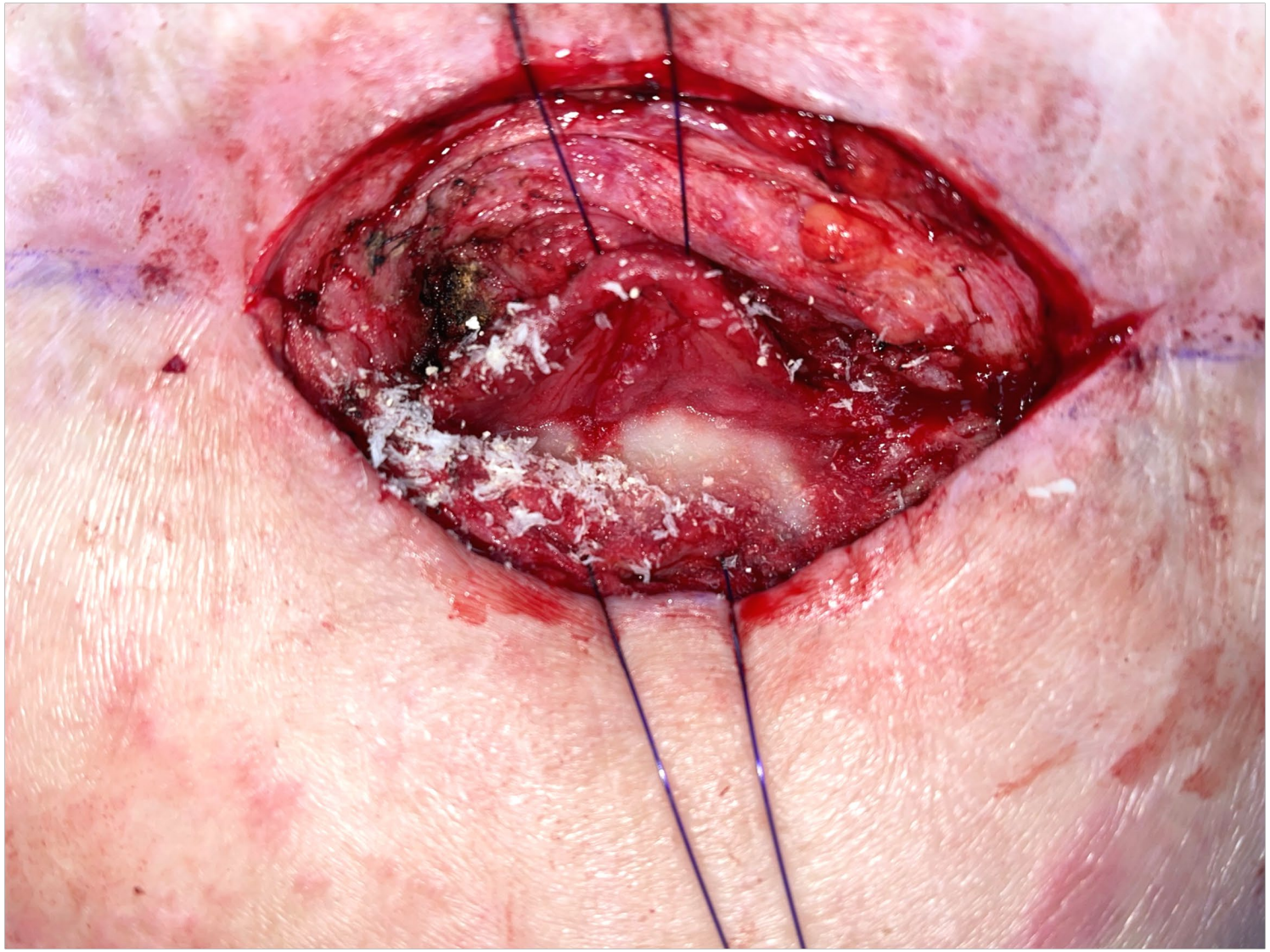


Nonhealing Wound Left Hip with Tunneling (Day 1)

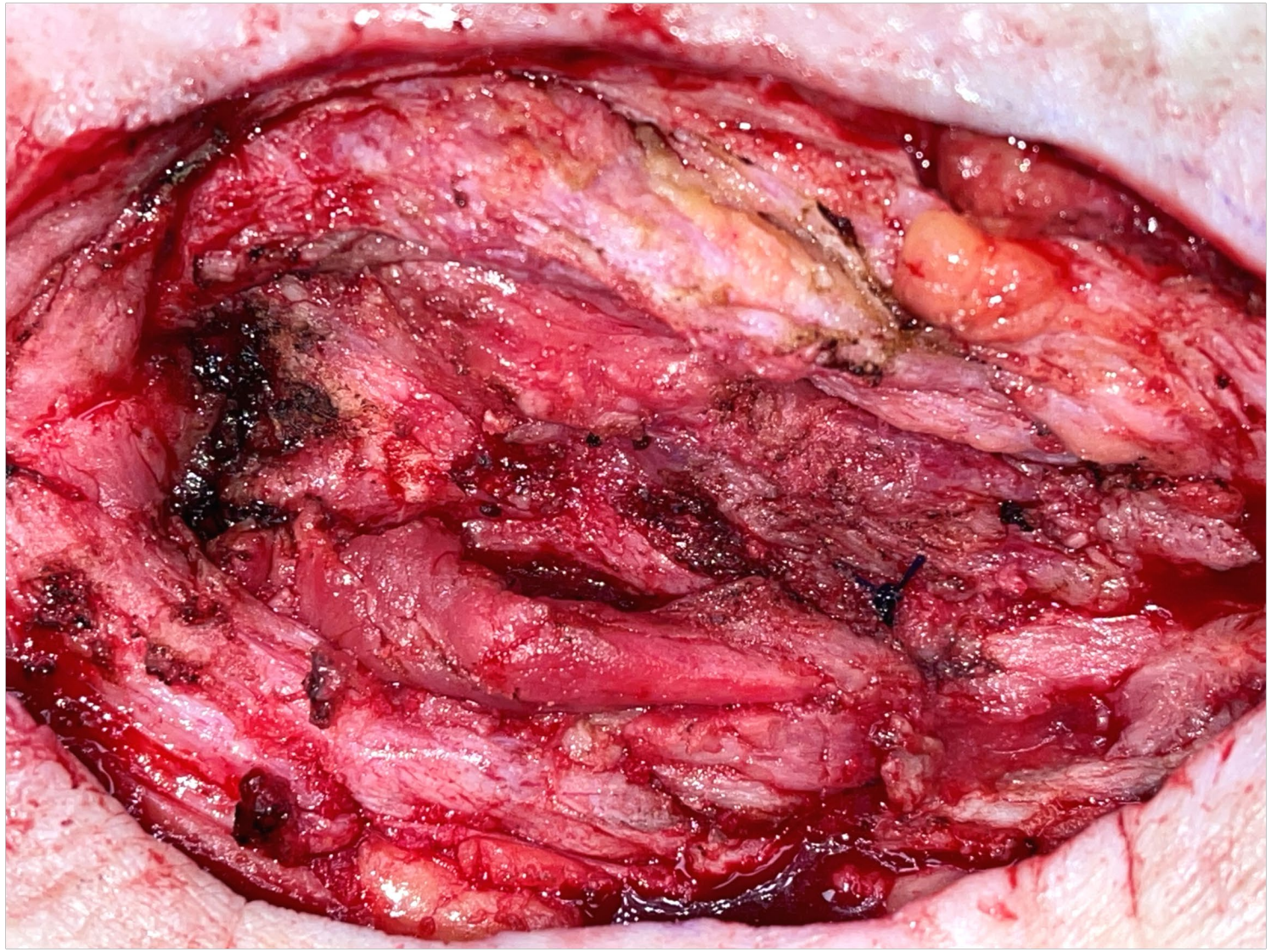


Nonhealing Wound Left Hip with Tunneling (Day 1)





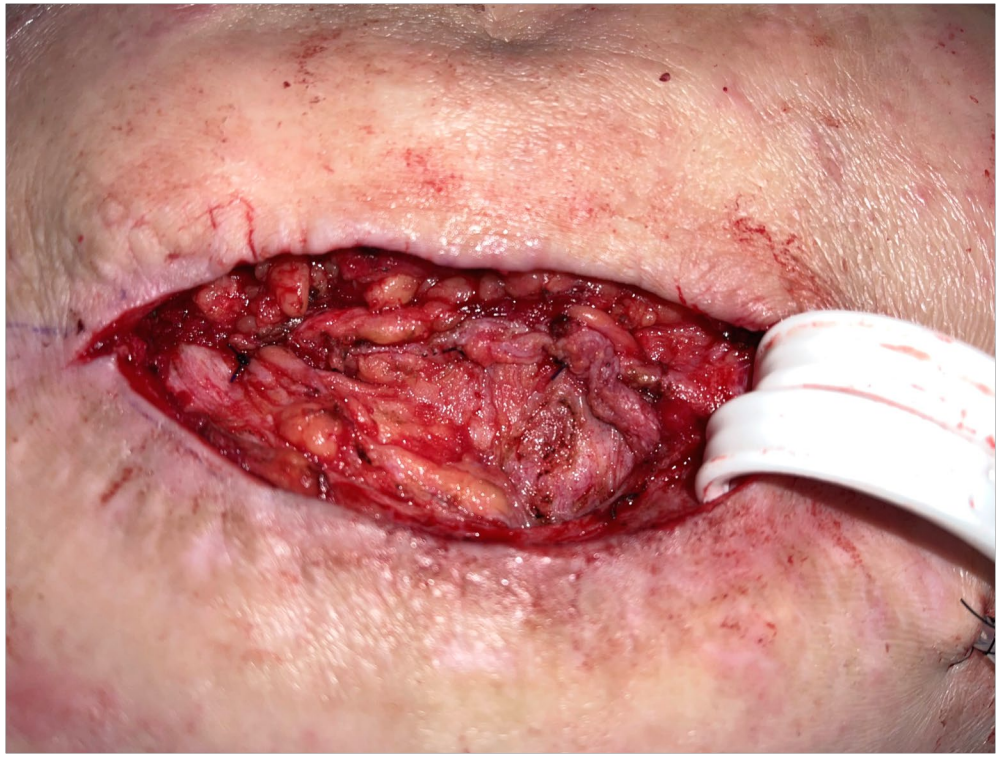
Nonhealing Wound Left Hip with Tunneling (Day 1)



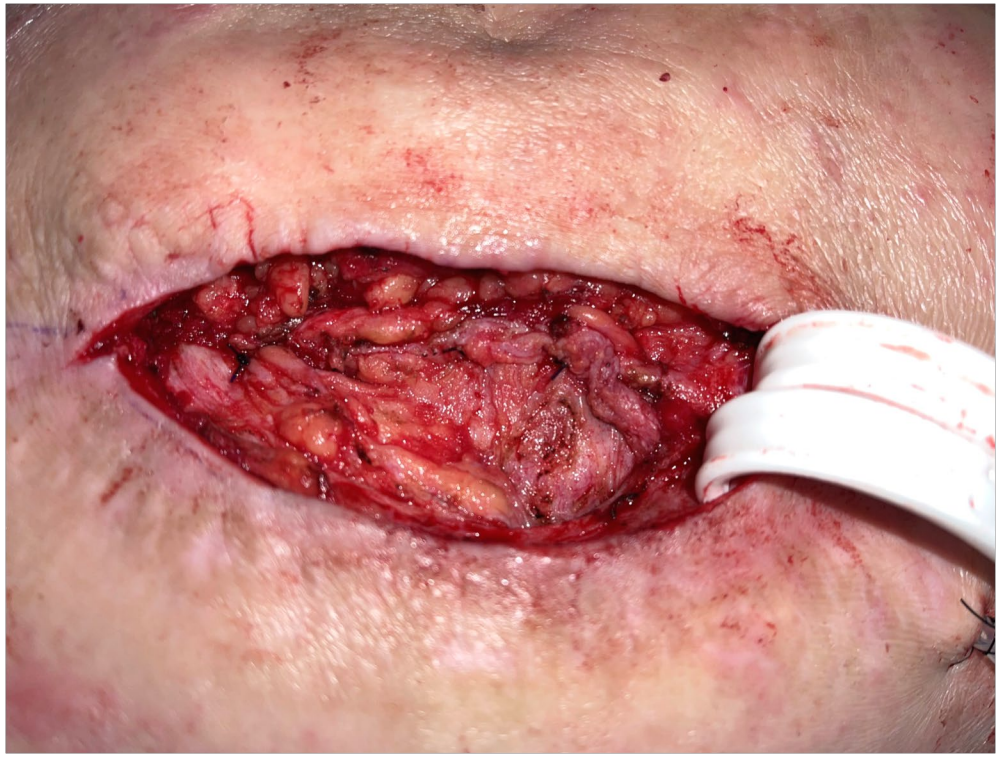
Nonhealing Wound Left Hip with Tunneling (Day 1)

Nonhealing Wound Left Hip with Tunneling (Day 1)

Nonhealing Wound Left Hip with Tunneling (Day 1)



Nonhealing Wound Left Hip with Tunneling (Day 1)



Nonhealing Wound Left Hip with Tunneling (Day 1)

Nonhealing Wound Left Hip with Tunneling (Day 1)

Nonhealing Wound Left Hip with Tunneling (1 Week)

Nonhealing Wound Left Hip with Tunneling (2 Weeks)

Nonhealing Wound Left Hip with Tunneling (6 Weeks)

Case Summary: Necrotizing Fasciitis

- 36 y/o female presents with acute necrotizing fasciitis right foot following acute trauma
- Medical history: Healthy
- Treatment
  - Taken to OR for initial debridement by Podiatry
  - **Secondary incision made lower extremity followed by dermal substitute placement and NPWT,** Plastic Surgery consulted for closure
  - NPWT continued as outpatient
  - STSG performed at 4 wks
  - Placental allograft placed to optimize healing
  - NPWT continued for 7 days to support STSG

Necrotizing Fasciitis (Day 1)

Necrotizing Fasciitis (Day 1)

Necrotizing Fasciitis (Day 1)

Necrotizing Fasciitis (Day 1)

Necrotizing Fasciitis (Day 1)

Necrotizing Fasciitis (Day 1)

Necrotizing Fasciitis (Day 1)

Necrotizing Fasciitis (Day 1)

Necrotizing Fasciitis (Day 7)

Necrotizing Fasciitis (Day 7)

Necrotizing Fasciitis (Day 14)

Necrotizing Fasciitis (Day 21)

Necrotizing Fasciitis (Day 28)

Necrotizing Fasciitis (Day 28)

Necrotizing Fasciitis (Day 28)

Necrotizing Fasciitis (5 Weeks)

Necrotizing Fasciitis (6 Weeks)

Necrotizing Fasciitis (7 Weeks)

Necrotizing Fasciitis (8 Weeks)




Fresh Baked
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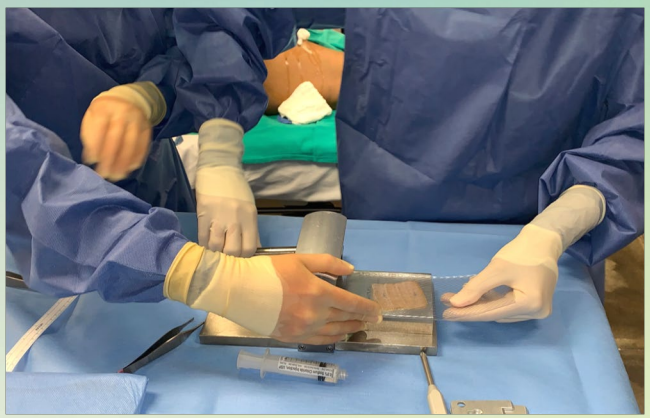








RN


“I’ve learned that people will forget what you said,
people will forget what you did,
but people will never forget how you made them feel…”

Maya Angelou

Questions?

Thank You!