Clean, Cover, and Close Approach to Chronic Wounds

Integrating Patient-Centric Care and Reimbursement

Supported by an educational grant from Smith & Nephew

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- **Rodney Lindsay, MD, CWS-P**
  Advisory Board, Consultant, Speakers Bureau: Smith & Nephew

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Learning Objectives

- Investigate the potential of collagenase in enhancing the pro-ECM response in chronic wounds through macrophage conversion to a fibroblast-like state
- Evaluate the impact of advanced therapies utilizing placental allografts on health outcomes for chronic wounds, supported by recent big data research findings and optimal reimbursement strategies
- Analyze the mechanism of action and clinical applications of single-use negative pressure wound therapy (sNPWT) across the continuum and transitions of care
- Explore illustrative case studies leveraging a clean, cover, and close method integrating advanced therapies for optimal healing outcomes

ECM = extracellular matrix; sNPWT = single-use negative pressure wound therapy.

The State of Chronic Wounds

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Medical Director
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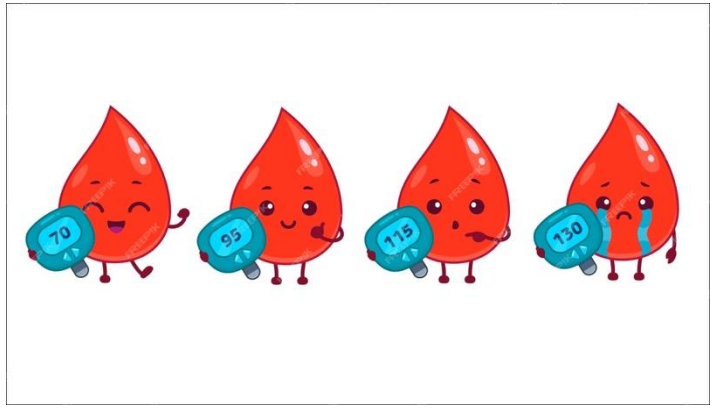
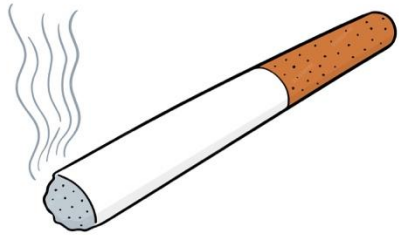
Risk Factors for Stalled/Chronic Wounds

- 10.5 million patients in the U.S. are affected by chronic wounds
- Chronic wounds — often referred to as *stalled* — are characterized by a failure to reduce in size by 40%–50% in 30 days
- Comorbidities such as diabetes, obesity, smoking, cardiovascular disease, immunodeficiency, age, and nutrition are risk factors that contribute significantly to the development of stalled, chronic, non-healing wounds





Sen CK. *Adv Wound Care*. 2023;12(12):657-670. Guo S, Dipietro L.A. *J Dental Res*. 2010; 89(3):219–229. Pocock ES, et al. *Vasc Cell.* 2014;6(1):24. Strbo N, et al. Adv Wound Care. 2014;3(7):492–501. Atkin L, et al. J Wound Care. 2019;23:S1-S52.

Predictors of Healing

- Benchmark: Wounds that show a 50% or more reduction in wound size after 4 wks of treatment are more likely to be completely healed at wk 12 than wounds that show a reduction in size of less than 50% at wk 4, as demonstrated in a study of diabetic foot ulcers (DFUs)[1]

DFU = diabetic foot ulcer.

Sheehan PJ, et al. *Diabetes Care*. 2003;26(6):1879-1882.

Management of Chronic Wounds

- Comprehensive patient assessment
- Diagnostic testing
- Development of initial plan

Chronic Wounds

There is a cycle of recurring inflammation and tissue damage which prevents progression to healing.

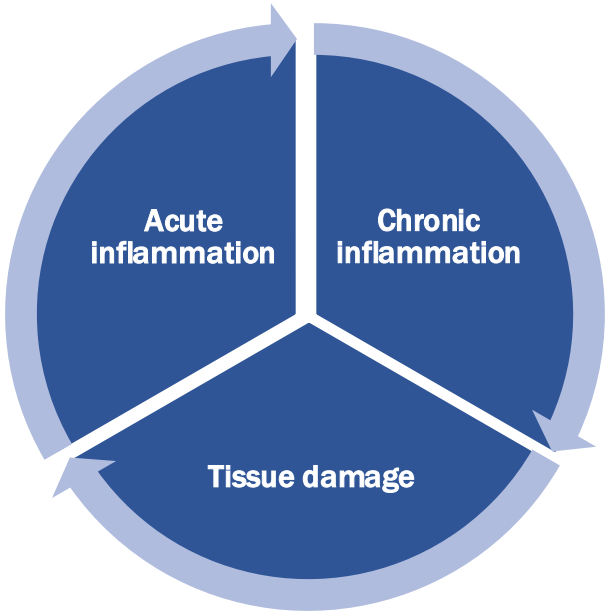
Injury

Hemostasis phase

Bacteria + Comorbidities + Environment

Inflammatory phase

Increased bacterial bioburden can inhibit wound progression toward healing due to induction of chronic inflammation



~~Proliferative phase~~

~~Closure~~

~~Epithelialization phase~~

Diegelmann RF, Evans MC. *Front Biosci.* 2004;1:283–289. Menke NB, et al. *Clin Dermatol.* 2007;25:19–25.

The Cycle of Inflammation

Chronic wound
(wound presents visible necrotic tissue)

Initial debridement
(usually sharp)

Inflammatory process ignited

Wound stalls
(sub-clinical necrotic tissue accumulates; wound fails to progress)

Inflammatory process ignited

Debris accumulation
(continues to accumulate and becomes visible)

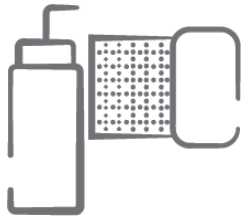
Breaking the cycle of inflammation

Remove necrotic tissue; preserve granulating tissue; progress through the normal phases of wound healing

Velnar T, et al. *J Int Med Res.* 2009;37:1528-1542. Enoch S, et al. *Wounds.* 2003;15:213-229. Sen CK, et al. *Wound Repair Regen.* 2009;17:763-771.

Common Wound Debridement Methods

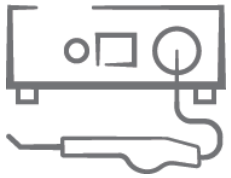
Sharp



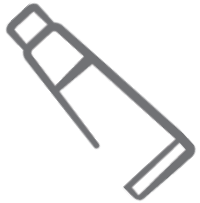
Autolytic

Mechanical

Biosurgical
(maggot therapy)



Hydrosurgical



Enzymatic

Enoch S, et al. *Wounds*. 2003;15:213-229. Vowden K, et al. *Wounds UK* [serial online]. 2011;7:1-4. Available at: http://www.wounds-uk.com/pdf/content_10133.pdf.

Collagenase Ointment selectively digests collagen

- Incomplete debridement may stall wounds in the inflammatory phase of healing
- Wounds stalled in the inflammatory phase continue to generate debris that is anchored to the wound bed by collagen strands

Clostridial Collagenase Cleaves Denatured Collagen at 7 Sites vs 1

Works faster than passive autolytic support as shown in multiple clinical studies

Cleaves necrotic tissue at **7 specific sites** along the triple-helix collagen strand

Breaks and unwinds denatured collagen while preserving healthy granulation tissue

Through its specific enzymatic debridement process, unique collagen fragments are created that **recruit cells that contribute to the formation of granulation tissue and microvasculature**

Exogenous debridement with collagenase ointment

VS

Endogenous debridement with honey, hydrogels, hydrocolloids, and transparent films

French M, et al. *J Protein Chem*. 1992;11:83-95. Kim M, et al. *Biochim Biophys Acta*. 2007;1770:1627-1635. Shi, et al. *Int Wound J*. 2010;7:87-95. Sheets, et al. *PLoS ONE*. 2016;11(7):e0159598.

Products Utilized on the Market

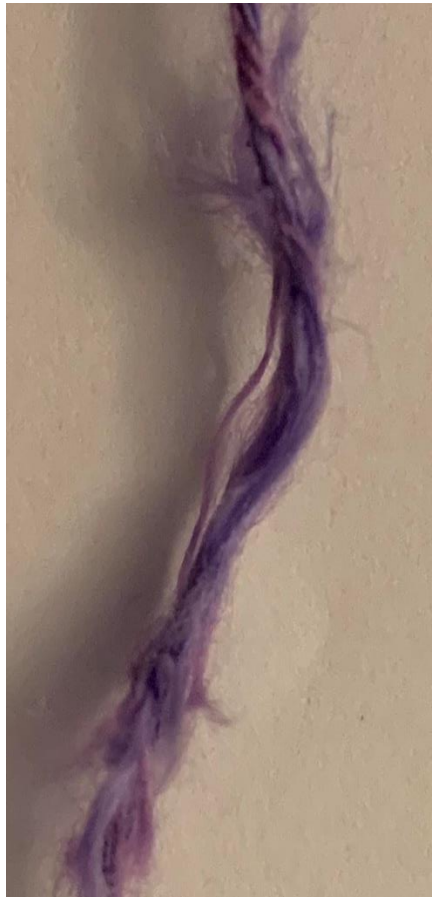
Endogenous debridement methods	Exogenous debridement methods
Hydrogels	Collagenase ointment
Honey	
Hydrofibers	
Topical antibiotics	

Collagen Breakdown

What happens to the collagen fragments?

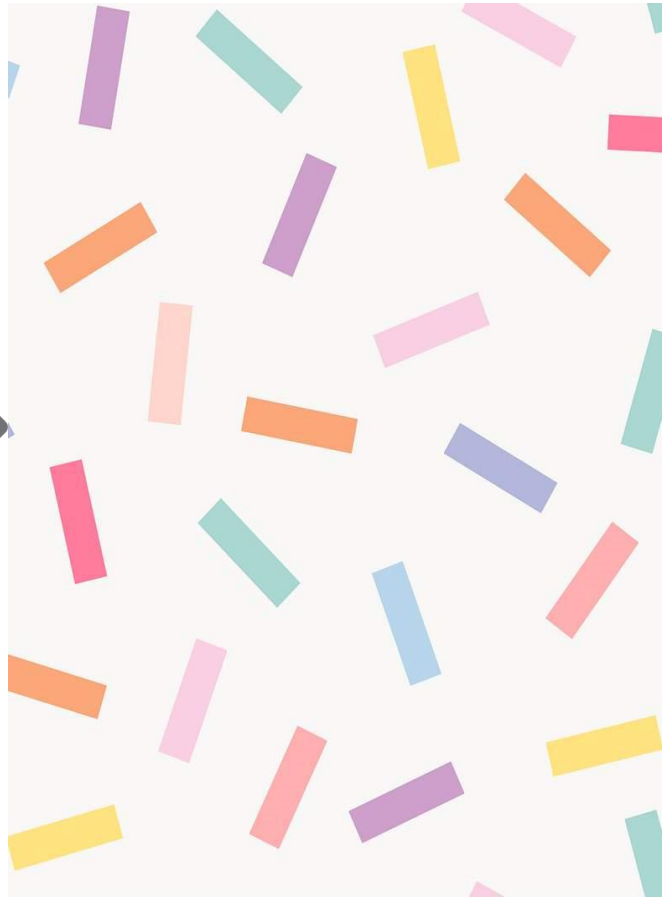
Native Collagen
(Intact)

Denaturation



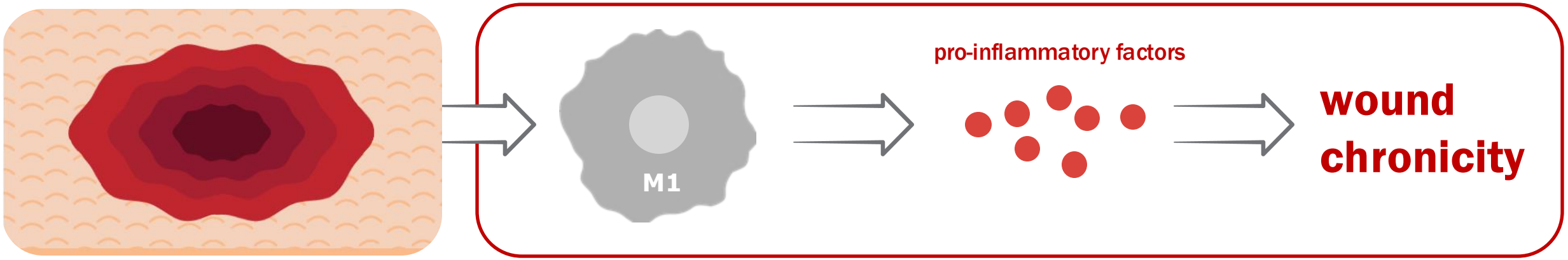
Denatured Collagen
(Unwound)

Enzymatic cleavage



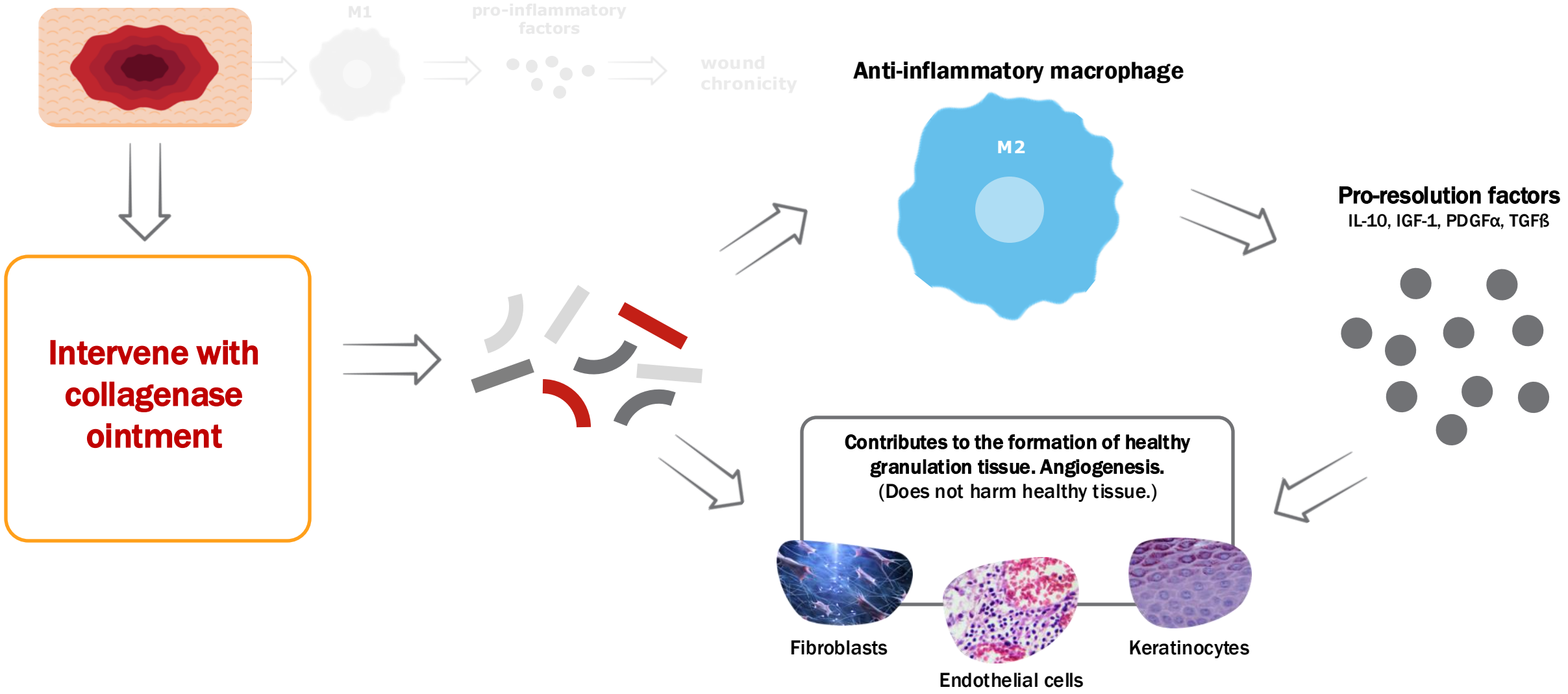
Digested Collagen
(Broken Down)

The Cellular Cascade



Das A, et al. *Am J Pathol*. 2015;185:2596-2606.

The Cellular Cascade



Das A, et al. *Am J Pathol*. 2015;185:2596-2606.

Case Study: Enzymatic Debridement
Oct. 5 – Nov. 27

Case Study: Enzymatic Debridement
Feb. 2 – March 1

Case Study: Enzymatic Debridement
May 9 – July 1

Clinical Pearls

Enzymatic Debridement

Collagenase ointment 250 units/gram

- Indicated for debriding both chronic dermal ulcers and severely burned areas
- Contributes to formation of granulation tissue and subsequent epithelialization of dermal ulcers and severely burned areas
- Removes necrotic tissue and preserves healthy granulation tissue – selective and active
- Faster debridement than passive autolytic support

Placental Allografts: Supporting Data and Clinical Effectiveness

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Medical Director, Wound Care, Fairfield Region, St. Vincent's Medical Center
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Comparative Effectiveness of Placental Allografts in the Treatment of Lower Extremity Diabetic Ulcers (LEDUs) and Venous Leg Ulcers (VLUs) in U.S. Medicare Beneficiaries (2016-2020)

A Retrospective Observational Cohort Study Using Real-World Evidence

Comparative Effectiveness Research with Big Data: LEDU and VLU Outcomes with Skin Substitutes

rapid communication

DISCOVERY EXPRESS

WHS Wound Healing Society

Comparative Effectiveness of Placental Allografts in the Treatment of Diabetic Lower Extremity Ulcers and Venous Leg Ulcers in U.S. Medicare Beneficiaries: A Retrospective Observational Cohort Study Using Real-World Evidence

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[2]The Leonard D. Schaeffer Center for Health Policy & Economics, University of Southern California, Los Angeles, California, USA.
[3]Stage Analytics, Suwanee, Georgia, USA.
[4]Rogan Consulting, Sacramento, California, USA.
[5]Southwestern Academic Limb Salvage Alliance (SALSA), Department of Surgery, Keck School of Medicine of University of Southern California, Los Angeles, California, USA.

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Objective: To compare the effectiveness of cellular tissue products (CTP) versus standard care in U.S. Medicare beneficiaries with diabetic lower extremity ulcers (DLEUs) or venous leg ulcers (VLUs).
Approach: We performed a retrospective cohort study using real-world evidence from U.S. Medicare claims for DLEUs or VLUs between 2016 and 2020. There were three cohorts evaluated: viable cryopreserved placental membrane (vCPM) or viable lyopreserved placental membrane (vLPM); other CTP; and standard care. Claims were collapsed into episodes of care. Univariate and bivariate statistics were used to examine the frequency distribution of demographics and clinical variables. Multivariable zero-inflated binomial regressions were used to evaluate mortality and recurrence trends. Logistic regression compared three adverse outcomes (AOs): amputation; 1-year mortality; and wound recurrence.
Results: There were 333,362 DLEU episodes among 261,101 beneficiaries, and 122,012 VLU episodes among 80,415 beneficiaries. DLEU treatment with vLPM was associated with reduced 1-year mortality (−26%), reduced recurrence (−91%), and reduced AOs (−71%). VLU treatment with vCPM or vLPM was associated with reduced 1-year mortality (−23%), reduced recurrence (−80%), and 66.77% reduction in AOs. These allografts were also associated with a 49% and 73% reduced risk of recurrence in DLEU and VLU, respectively, compared with other CTPs. Finally, vCPM or vLPM were associated with noninferior prevention of AOs related to amputation, mortality, and recurrence (95% CI: 0.69–1.14).
Conclusions: DLEUs and VLUs treated with vCPM and vLPM allografts are associated with lowered 1-year mortality, wound recurrence, and AOs in DLEUs and VLUs compared with standard care. Decision makers weighing coverage of placental allografts should consider these added short- and long-term clinical benefits relative to costly management and high mortality of Medicare's most frequent wounds.

Keywords: cellular tissue products, diabetic lower extremity ulcer, diabetic foot ulcer, chronic wound, venous leg ulcer, comparative effectiveness research

DOI: 10.1089/wound.2023.0143

- Compare the clinical effectiveness of skin substitutes for treating lower extremity diabetic ulcers (LEDUs) and venous leg ulcers (VLUs)
- Analyze long-term health outcomes associated with skin substitute utilization
- Using placental allograft-based cellular tissue products (CTPs)
  - *vCPM: viable cryopreserved placental membrane*
  - *vLPM: viable lyopreserved placental membrane*
- CTPs are a rich source of different cell types, such as fibroblast, epithelial cells, and stem cells, along with collagen matrix and growth factors

LEDU = lower extremity diabetic ulcer; VLU = venous leg ulcer; CTP = cellular tissue product; vCPM = viable cryopreserved placental membrane; vLPM = viable lyopreserved placental membrane.

Study Design

- Retrospective observation cohort
- 2 cohorts
  1. LEDU
  2. VLU
- Medicare Limited Dataset (LDS), 2016-2020
  - Inpatient
  - Outpatient
  - Skilled nursing facility (SNF)

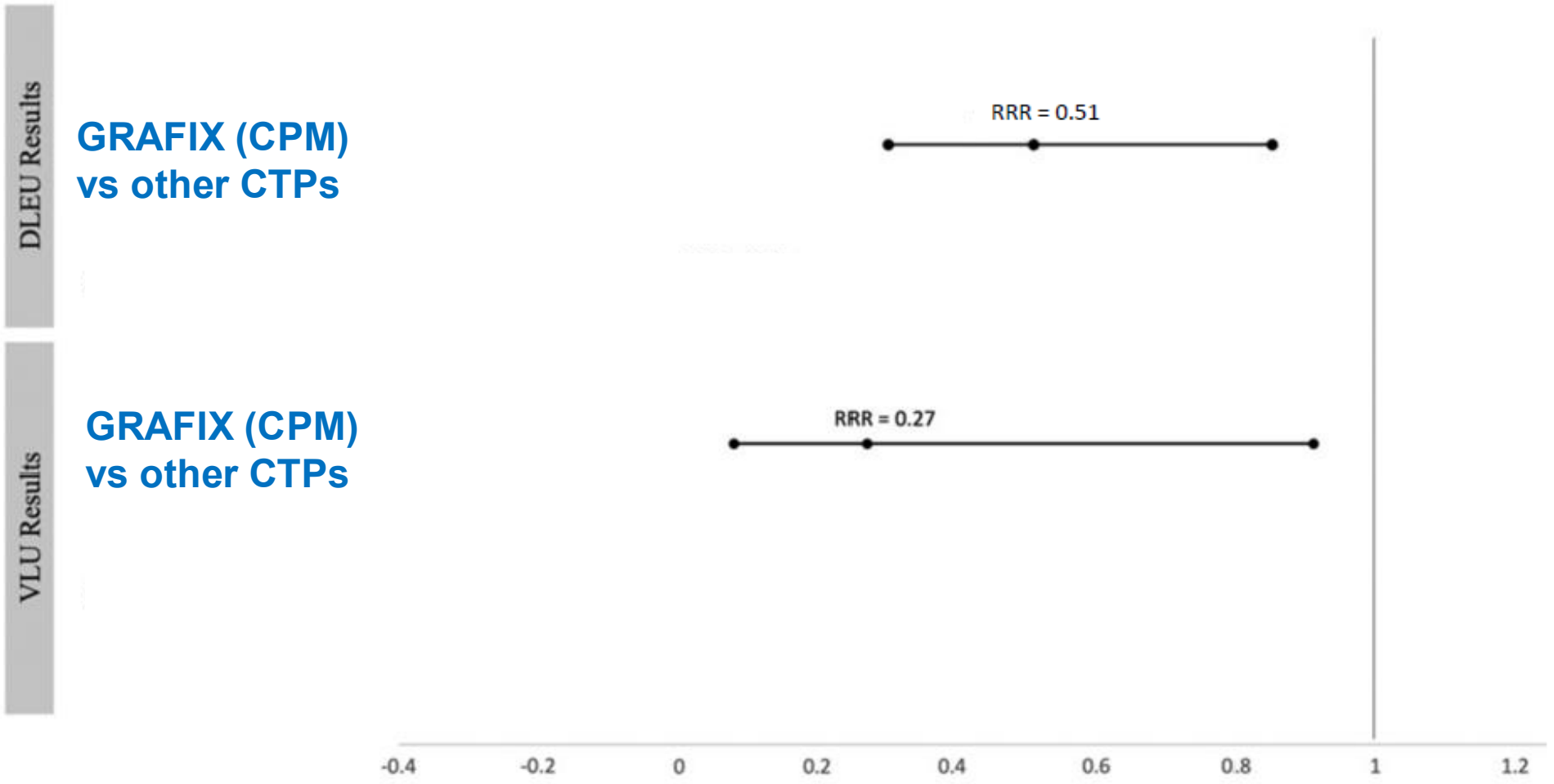
LDS = limited dataset; SNF = skilled nursing facility.

Key Findings

- vLPM and vCPM are alternatives to standard of care (SOC), such as compression therapy and other CTPs, in the treatment of LEDUs and VLUs for Medicare patients
- Compared with SOC and other CTPs, vLPM and vCPM are associated with superior wound recurrence for LEDUs and VLUs in the Medicare population
- Compared with SOC, vLPM and vCPM are associated with long-term reductions in 1-yr mortality, amputation, and composite rates of AOs

SOC = standard of care; AO = adverse outcomes.

A Retrospective Analysis of Medicare Claims (2016-2020) Showed 49% and 73% Reduced Risk of Recurrence in LEDU and VLU, Respectively, Compared to Other CTPs



CPM = cryopreserved placental membrane.

Padula WV, et al. *Adv Wound Care (New Rochelle).* 2024;13(7):350-362.

ORIGINAL RESEARCH OPEN ACCESS

A Multicenter, Randomized, Controlled, Clinical Trial Evaluating a Lyopreserved Amniotic Membrane in the Treatment of Venous Leg Ulcers

Yadwinder Dhillon[1] | Lena Levine[2] | Gregory Tovmassian[3] | Alexander Reyzelman[4] | Francisco Perez-Clavijo[5] | Francis Wodie[6] | Shawn Cazzell[7] | Allan Grossman[8] | Lesly Robinson[9] | Felix Sigal[10] | Robert S Kirsner[11] | Mher Vartivarian[12] | Molly Saunders[13] | Jaideep Banerjee[14]

[1]Titan Clinical Solutions, Phoenix, Arizona, USA | [2]Acclaim Bone & Joint Institute, Fort Worth, Texas, USA | [3]Center for Clinical Research, Carmichael, California, USA | [4]Center for Clinical Research, Castro Valley, California, USA | [5]Integral Clinical Trials Solutions, Doral, Florida, USA | [6]Integral Clinical Trials Solutions, Homestead, Florida, USA | [7]Limb Preservation Platform, Fresno, California, USA | [8]Harrisburg Foot and Ankle Center, Harrisburg, Pennsylvania, USA | [9]Temple University School of Podiatric Medicine, Philadelphia, Pennsylvania, USA | [10]LA Foot Pain and Ankle Clinic, Los Angeles, California, USA | [11]University of Miami, Miami, Florida, USA | [12]Center for Clinical Research, San Francisco, California, USA | [13]Osiris Therapeutics, Columbia, Maryland, USA | [14]Smith & Nephew Inc., Fortworth, Texas, USA

Dhillon Y, et al. *Health Science Reports*. 2025.

- 200 patients randomized to lyopreserved cellular placental membrane (LPM) vs SOC
- 72% higher probability of wound closure with LPM+SOC
- Larger wounds fared better with LPM
- Quality of life improvements shown

LPM = lyopreserved cellular placenta membrane.
Dhillon Y. *et al. Health Sci Rep. 2025;*8(5):e70819.

Dhillon Y, et al. *Health Science Reports*. 2025

- LPM and SOC significantly closed more VLUs – and faster – than SOC alone and improved the quality of life for patients, suggesting that the use of aseptically processed LPM is a safe and effective treatment option in the healing of chronic VLUs

Dhillon Y, et al. *Health Sci Rep. 2025;*8(5):e70819.

Case Reports

Case Study: Sacral Pressure Injury

- 71y Female first presented 8/3/20 with GI bleeding and alcoholic encephalopathy; a stage 4 sacral decubitus wound was present on admission
- She recovered from the bleed but had complications of her right knee replacement becoming infected; over the next year, the knee was removed, further complicating her mobility
- She continued to have an open sacral ulcer throughout this time
- Presentation to our wound center 3/1/22
- Continued problems with drainage and maceration

Case Study: Sacral Pressure Injury, 3/1/22

Initial presentation to wound center

Case Study: Sacral Pressure Injury

9 months later
12/27/22

Case Study: Sacral Pressure Injury

4/25/23

Case Study: Sacral Pressure Injury, 6/15/23

- Patient sent for second opinion as she has now had the wound for roughly 3 yrs and has been coming to our wound center for 15 months
- Her knee had been explanted with a spacer placed, and the surgeons wanted the sacral wound closed before they would replace the knee
- She had countless outpatient debridements and several skin substitute applications before seeing me

- I offered her a surgical option

Case Study: Sacral Pressure Injury

Examine the wound under anesthesia – define the extent, and make a plan

7/17/23

Case Study:
Sacral Pressure Injury

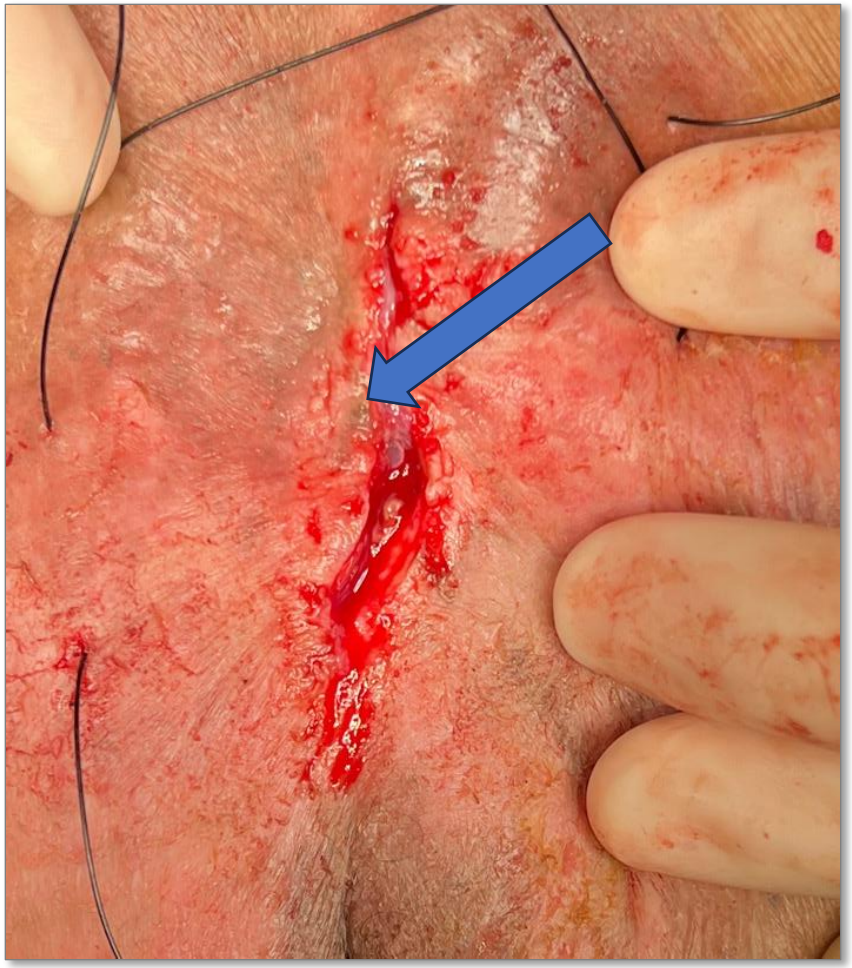
Case Study: Sacral Pressure Injury

Retention suture closure technique –

Helps to offload the wound and prevent tension on the skin edges

Case Study: Sacral Pressure Injury

Wound closure over cryopreserved placental membrane graft

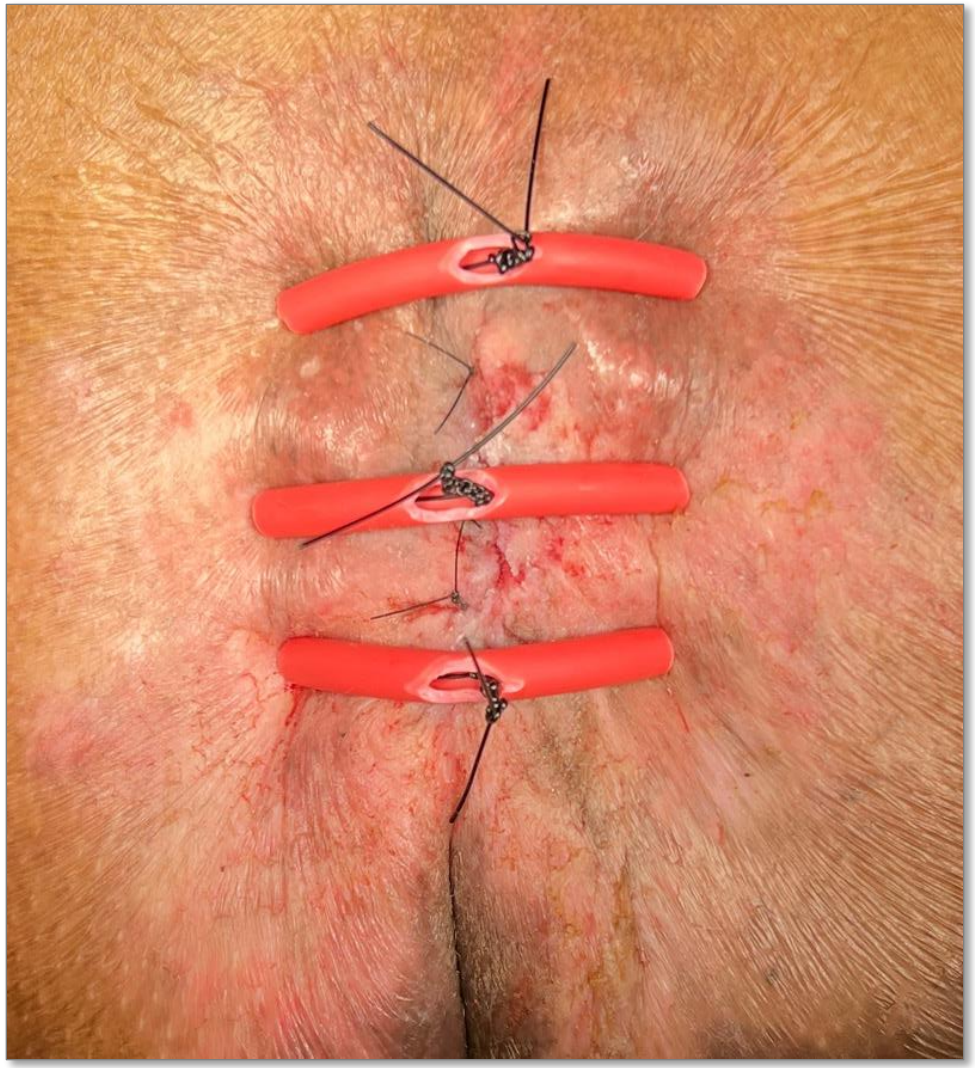


Case Study: Sacral Pressure Injury

Cryopreserved placental membrane graft

Retention closure over biologic glue

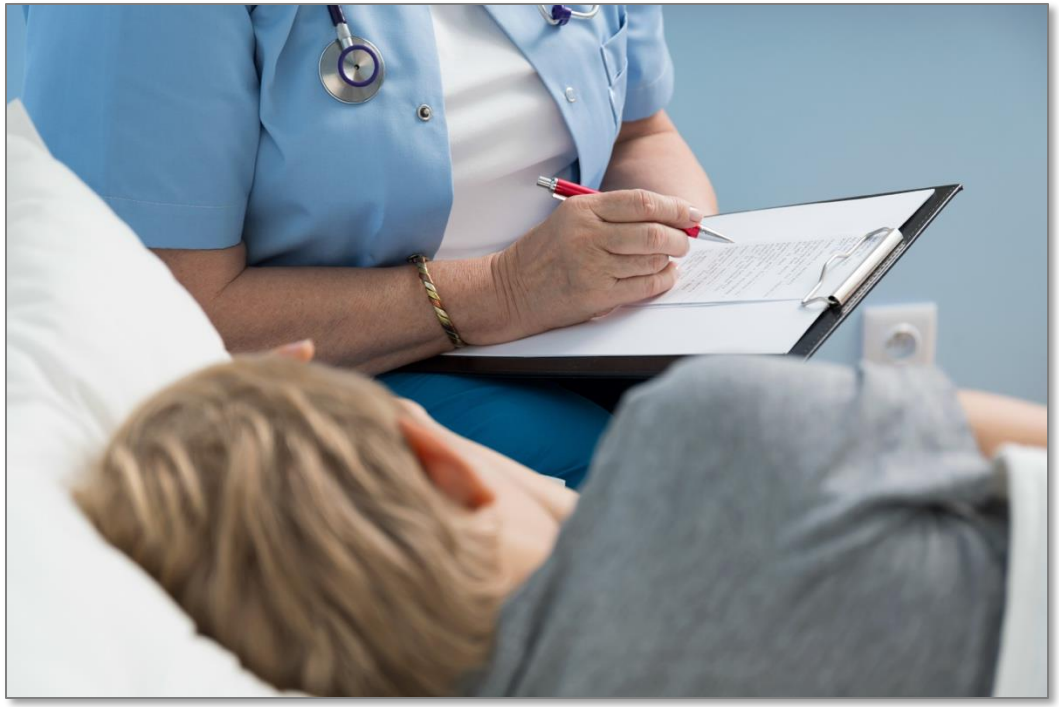
7/17/23



Insights

Surgical closure or revision of chronic wounds

- Need to remove all inflamed, hypergranulated, chronically colonized, epithelialized tissues
- **Offloading and pressure relief is the single most important key to success and must be established preoperatively**
- Nutrition must be assessed preoperatively
- Converting the wound to an acute, healthy surgical wound and supplementing closure with cryopreserved placental membrane graft helped heal this patient



Case Study: Sacral Pressure Injury

POD 10, 7/27/23
Sutures removed

Case Study: Sacral Pressure Injury

POD 17, 8/3/23
Discharged

Patient has since had her knee replaced

Management of large problem wounds with cellular, acellular, and matrix-like products (CAMPs)

Presentation

- 70y Female with PMH significant for morbid obesity, s/p gastric sleeve (10/13) and then gastric bypass (4/18)
- 2016: Bilateral thigh lipodystrophy resection due to excess skin around legs and recurrent knee arthroplasty infections, eventually with a functioning R knee and fused left knee (12 surgeries)
- Seen by lymphedema clinic for decongestive therapy in 2023

Lymphedema presentation 4/23

↑ 3/2024

11/2024
→

11/2024

Panniculectomy, umbilical transposition, rectus plication

3/21/25

Bilateral thigh lift and liposuction

POD 5

POD 6

POD 9

POD 10: Return to OR for Debridement

- Bilateral thigh debridement in OR
- Large volume debridement with suture reinforcement of dehiscence
- Dressed with petrolatum gauze dressing, ABD pads, elastic compression bandage

POD 14

POD 18: Dr. Goldstein Consulted

- I first saw these wounds bedside with virtually no dressings in place, large amounts of slough, drainage, odor, and debris
- Initial recommendations
  - IV antibiotics
  - Nutrition supplements
  - Urinary diversion
  - Offloading bed to prevent pressure injury (PI)
  - Operative exam and treatment

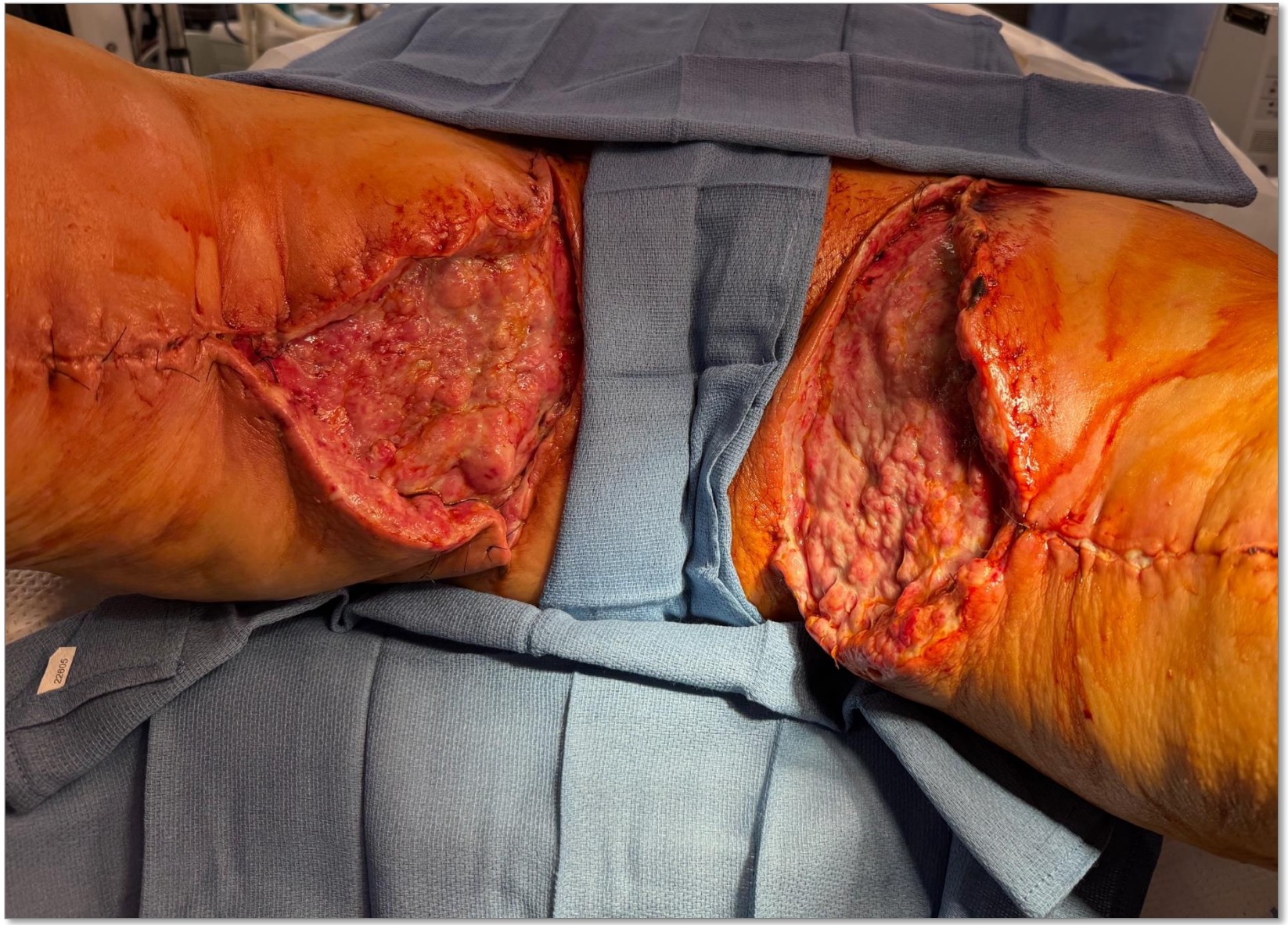
PI = pressure injury.

Challenges

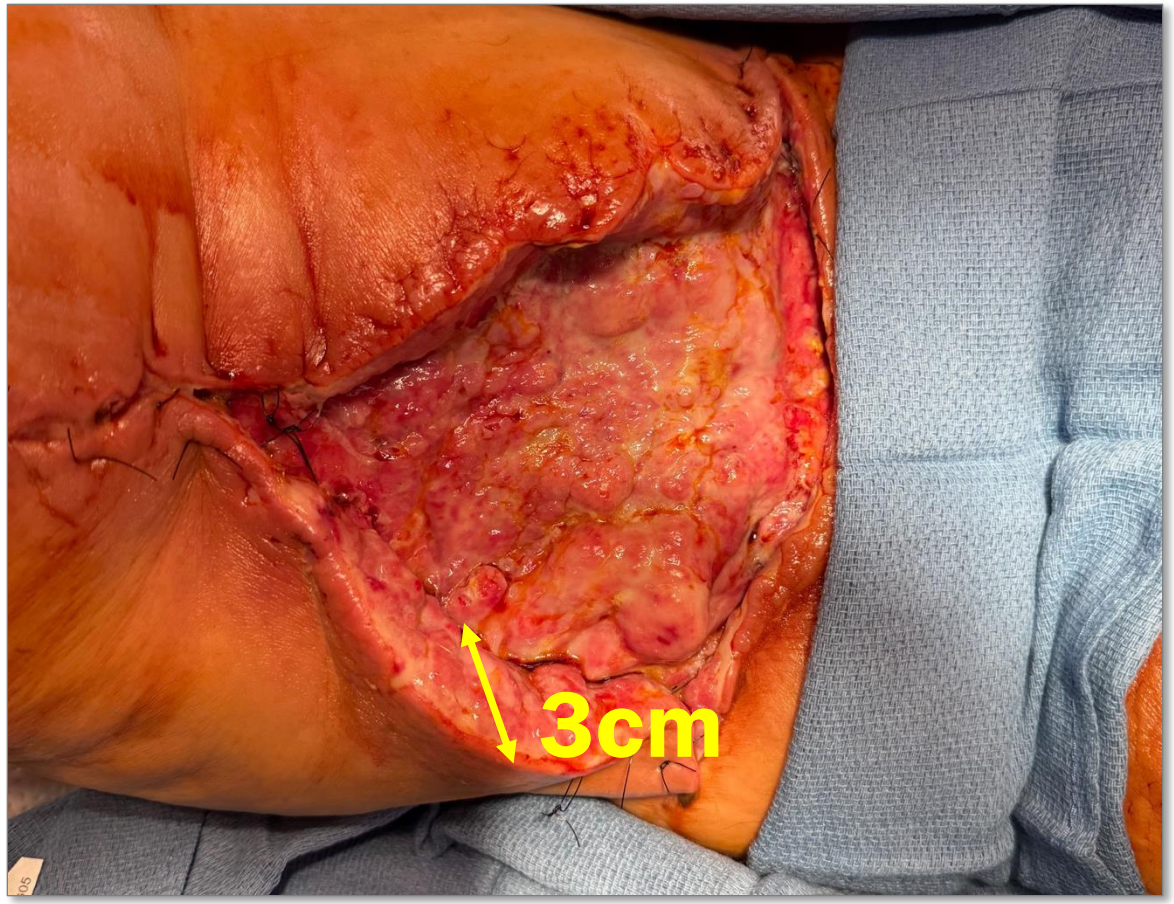
- Obese patient with mobility issues, fused left knee
- Clinical infection
- Recurrent fecal and urinary soilage
- Risk of PI
- Difficult local wound care and dressing management
- Pain
- Deconditioning
  - Approaching 3 wks in the hospital when we met
- Exposure
  - Plan ahead for the OR – I chose lithotomy

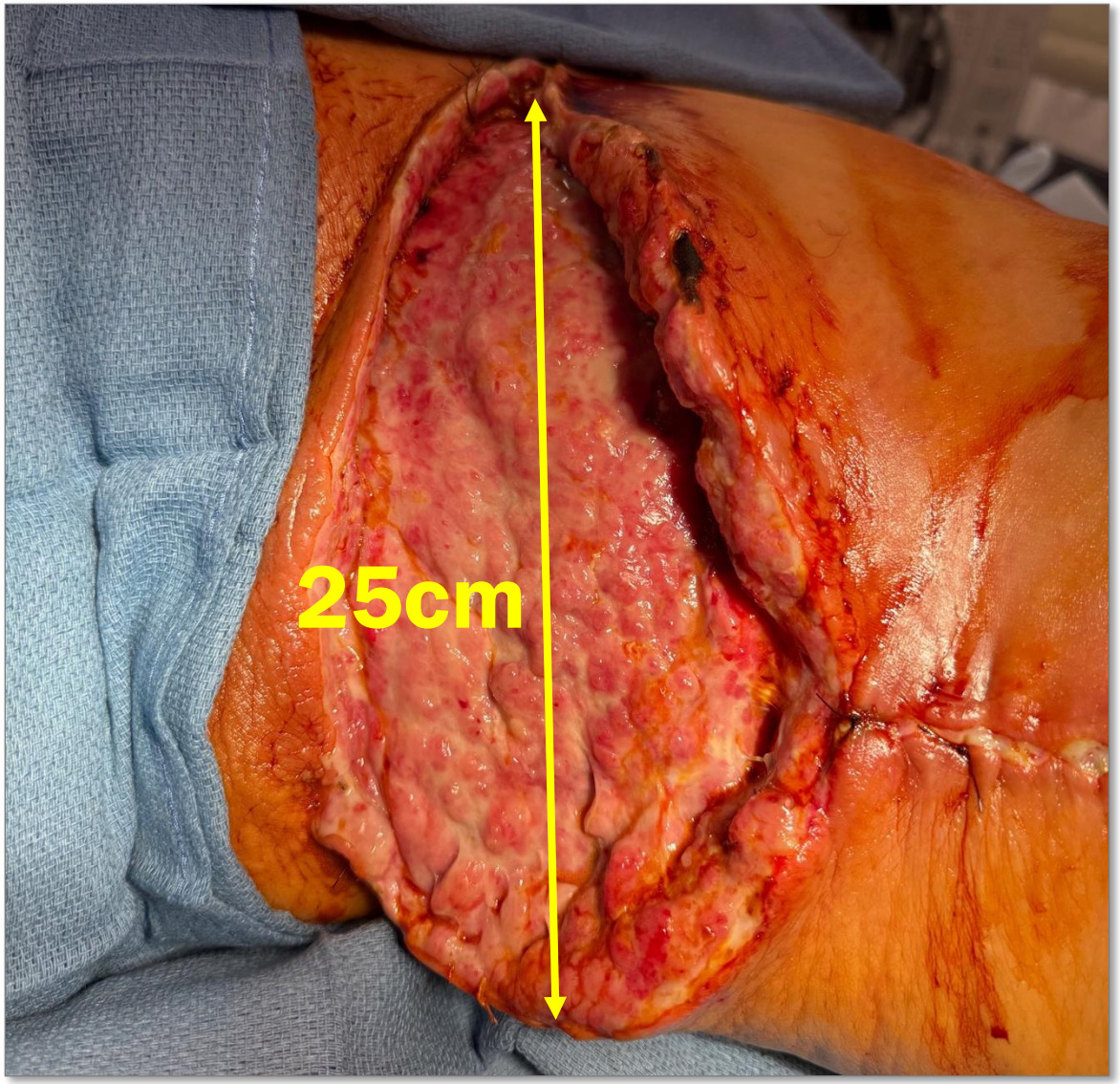
POD 21/0

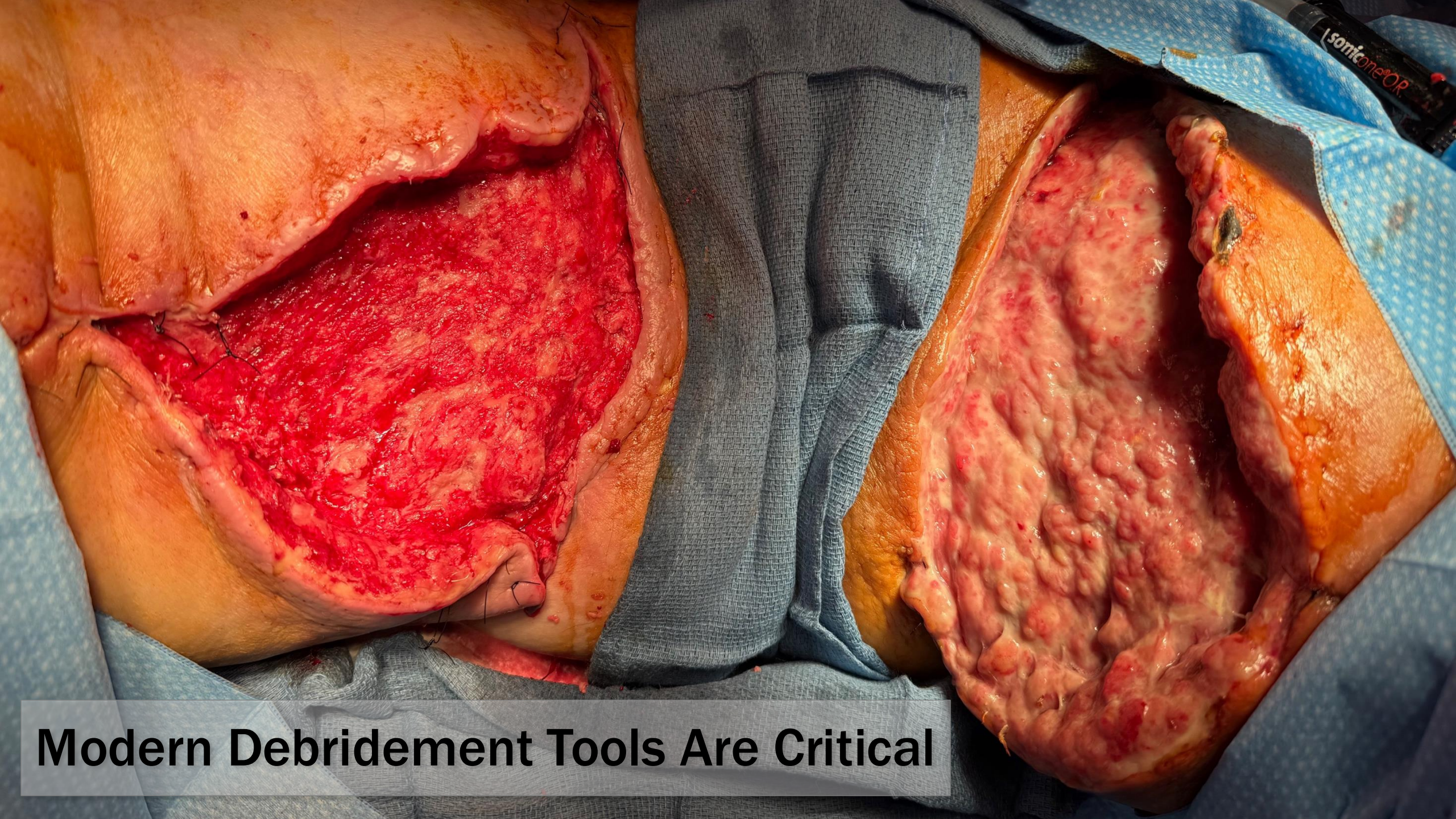
Operative management



Thoughts?





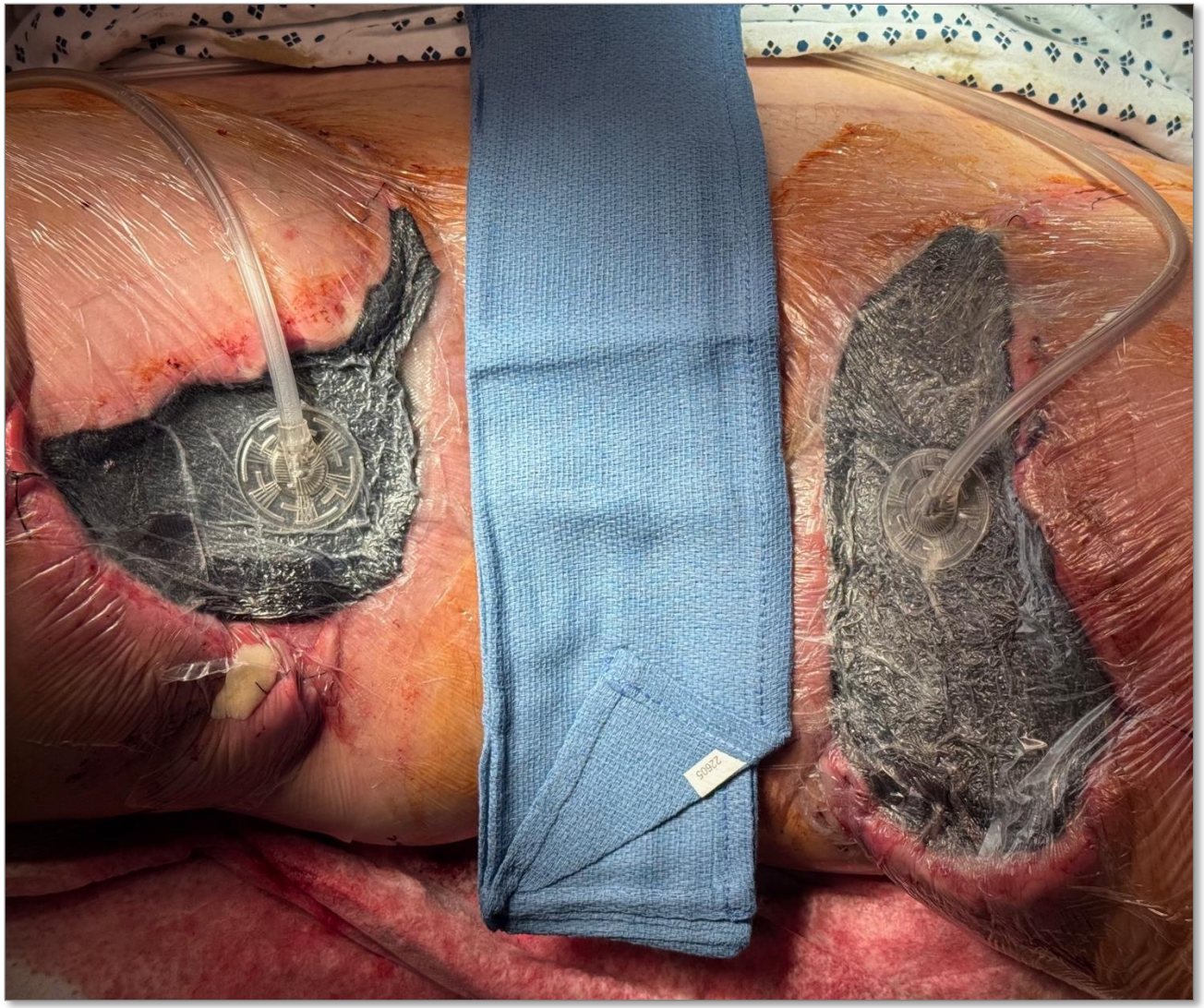


Modern Debridement Tools Are Critical

POD 21/POD 0

Bilateral wound ultrasonic debridement, grafting with (3) cryopreserved placental membrane 7.5x15

Wounds dressed with low-adherent wound contact dressing, negative pressure wound therapy (NPWT)



NPWT = negative pressure wound therapy.

Operative Cultures: ESBL E. Coli

Specimen Information: Leg, Upper left; Swab, Wound
Specimen Comment: Swab, Wound

0 Result Notes

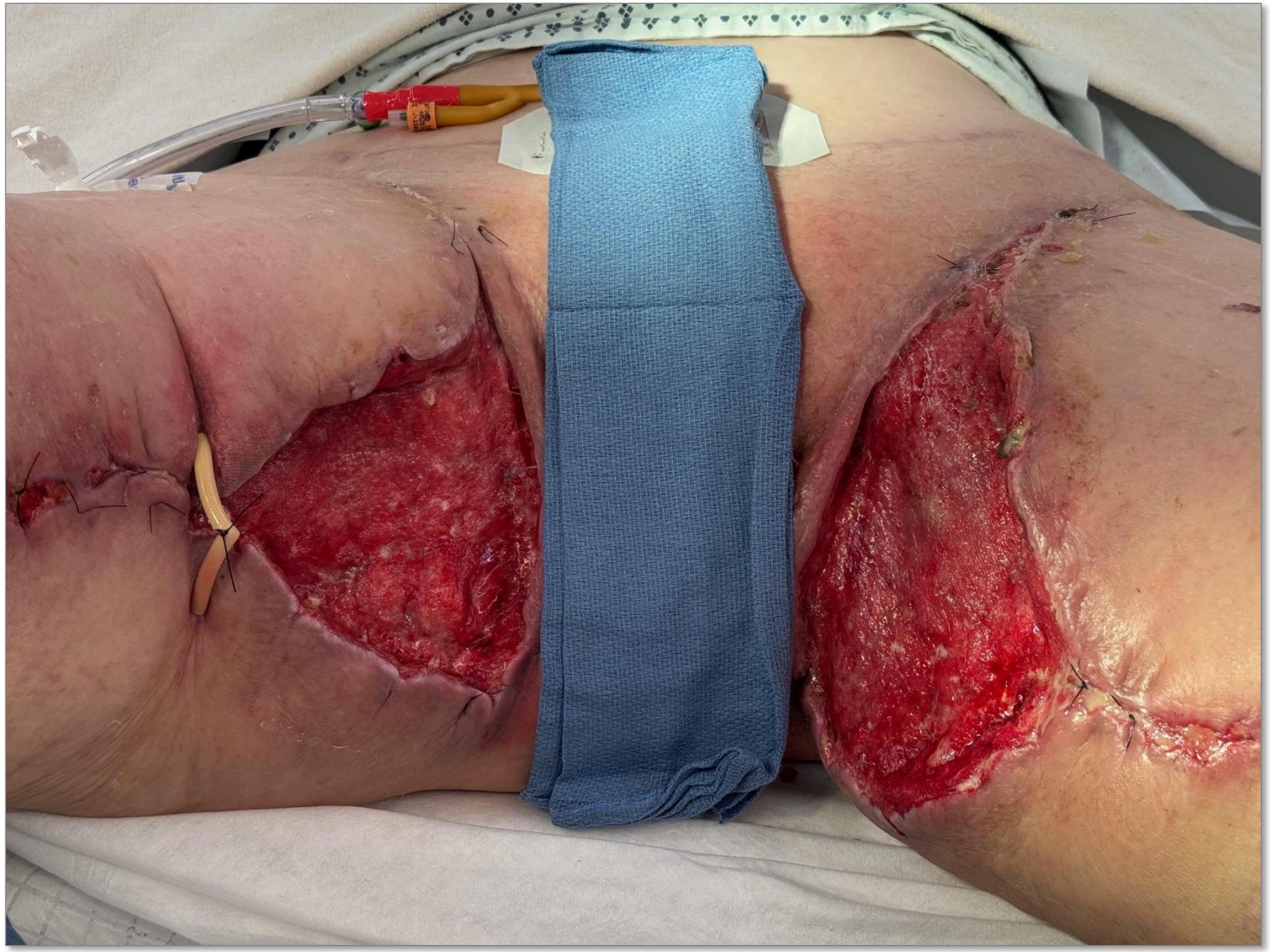
Component	
Gram stain suggestive of	Few neutrophils No squamous cells Red blood cells No organisms seen
Culture	E.coli ESBL producer !

Susceptibility

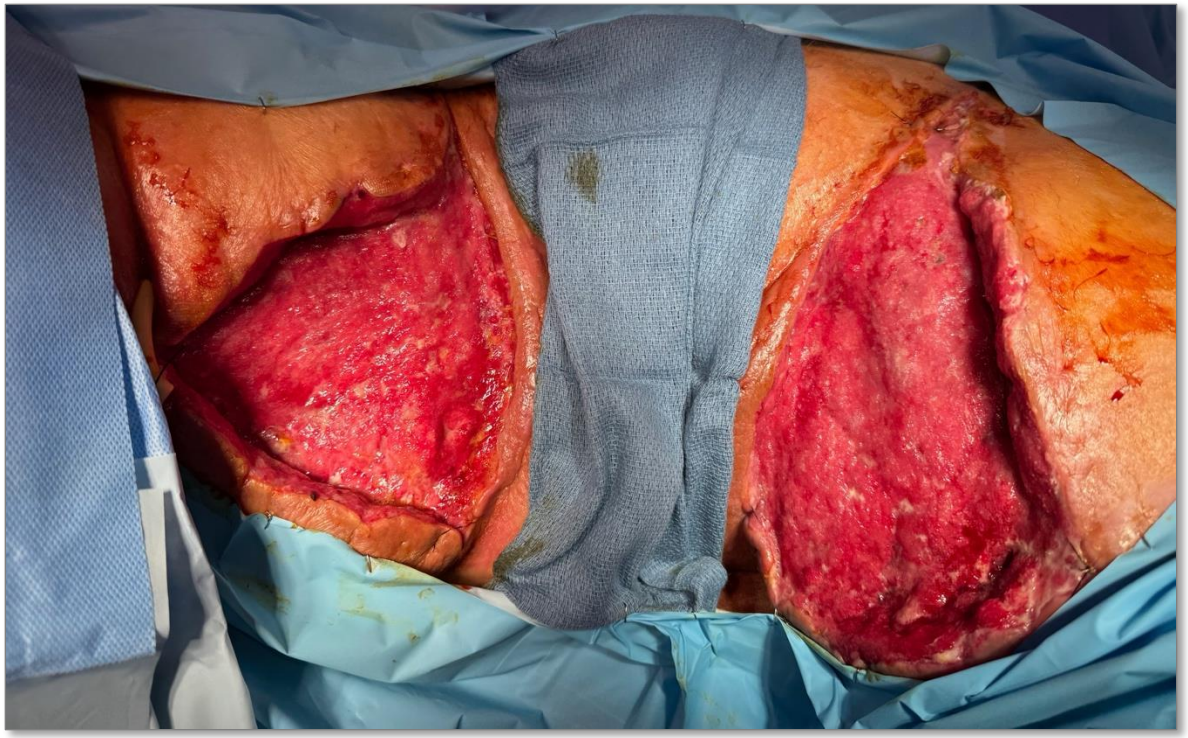
	E.coli ESBL producer (REPORT) BACTERIAL MIC AND INTERPRETATION (MCG/ML)
Ampicillin	Resistant
Ampicillin/Sulbactam	Susceptible
Cefazolin	Resistant
Cefepime	Susceptible dose dependent [1]
Ceftazidime	Intermediate
Ceftriaxone	Resistant
Ciprofloxacin	Susceptible
Ertapenem	Susceptible
Gentamicin	Susceptible
Levofloxacin	Susceptible
Meropenem	Susceptible
Tetracycline	Resistant
Tobramycin	Susceptible
Trimethoprim/Sulfamethoxazole	Susceptible

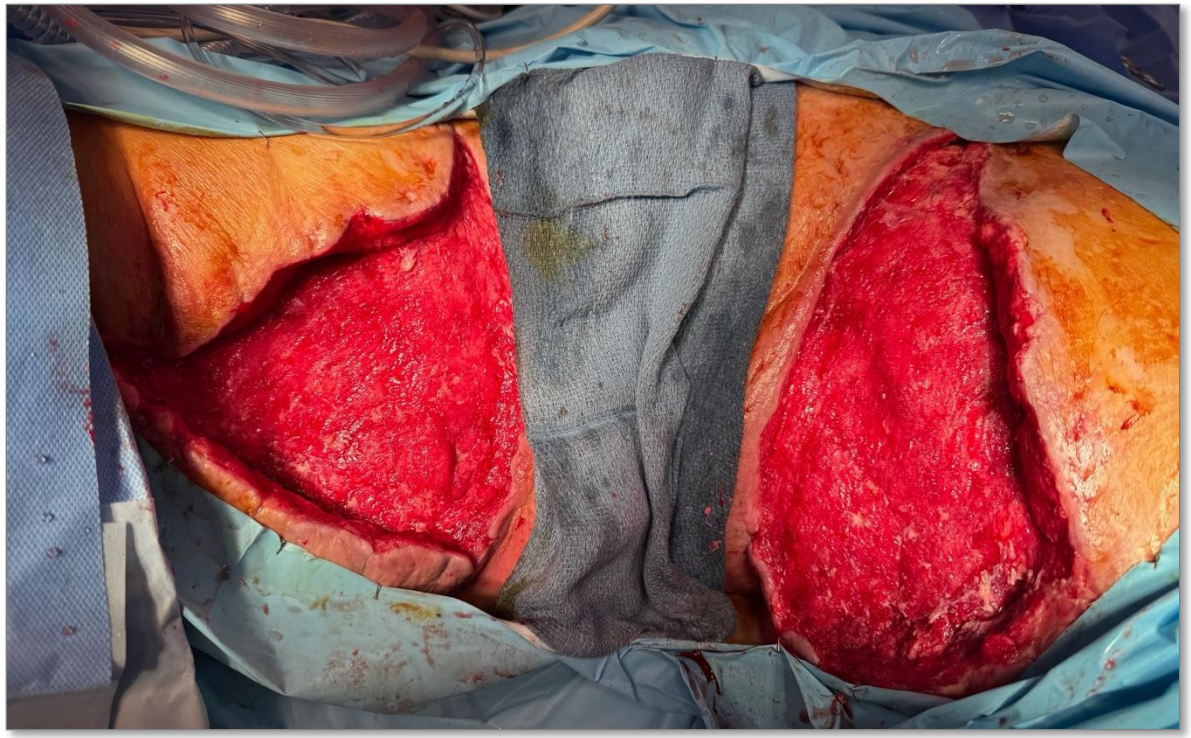
- Patient followed by infectious disease (ID)
- IV antibiotics instituted
- Diarrhea from anti-microbial therapy continues to be a problem
- Dislodgement and soilage of NPWT requires nearly daily dressing changes and reinforcement
- Patient cannot leave hospital

POD 28/7/0
Return to OR



Debridement, Grafting, Cultures, NPWT





Cryopreserved Placental Membrane Graft

(3) Cryopreserved placental membrane graft 7.5 x 15cm

NPWT over low-adherent wound contact dressing

Operative Cultures

Component		Resulting Agency
Gram stain suggestive of	Many neutrophils No squamous cells Red blood cells No organisms seen	ST.VINCENT'S MEDICAL CENTER
Culture	Staphylococcus epidermidis !	HARTFORD HOSPITAL ANCILLARY LABORATORY

Susceptibility

	Staphylococcus epidermidis (REPORT) BACTERIAL MIC AND INTERPRETATION (MCG/ML)	
Ampicillin/Sulbactam	**Resistant**	
Cefazolin	**Resistant**	
Cefoxitin	**Resistant** [1]	
Clindamycin	**Resistant** [2]	
Erythromycin	**Resistant**	
Minocycline	**Intermediate**	
Oxacillin	**Resistant**	
Tetracycline	**Resistant**	
Trimethoprim/Sulfamethoxazole	**Resistant** [3]	
Vancomycin	**Susceptible**	

POD 38/17/10
Remove non-adherent layer under foam

POD 46/25/18/0

Return to OR

Cryopreserved Placental Membrane Graft

Debridement, split-thickness skin grafting (STSG), cryopreserved placental membrane graft application, NPWT

(2) Cryopreserved placental membrane grafts

STSG = split-thickness skin graft.

Debridement, STSG, Cryopreserved Placental Membrane Graft Application, NPWT

POD 56/35/28/10

POD 61/40/33/15

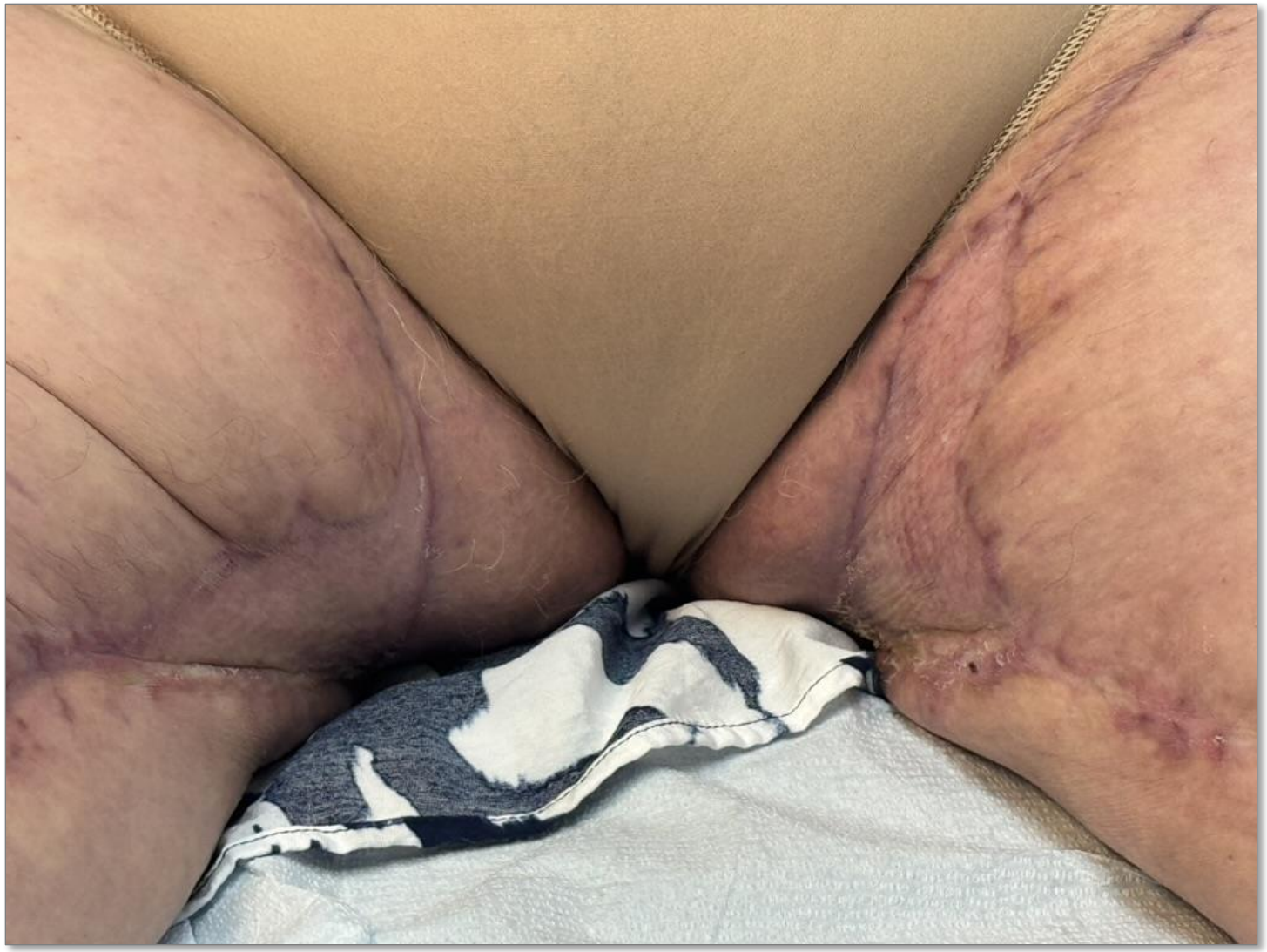
Hydrofera Blue® (antibacterial foam wound dressing) started with alginates and Allevyn◊ (hydrocellular foam wound dressing)

POD 74/53/46/28

POD 81/60/53/35

POD 88/67/60/42

POD 109/88/81/63



Reimbursement

Reimbursement: Skin Substitutes Are Coded Based on Size and Location

- Location
  - Trunk, arms, legs
  - Face, scalp, eyelids, mouth, neck, ears, orbits, genitalia, hands, feet
- Size
  - <100 cm^2
  - >100 cm^2

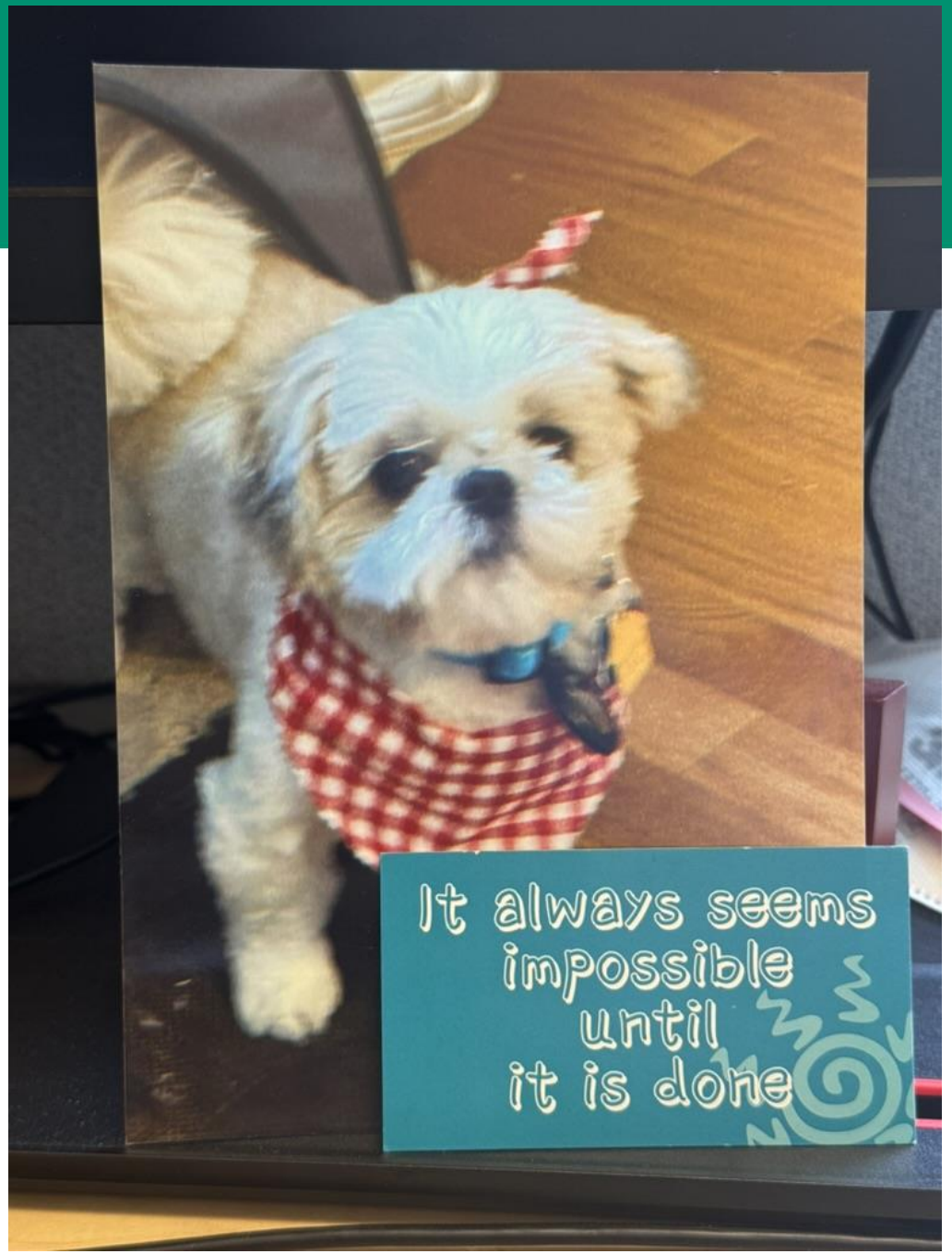
Reimbursement: Skin Substitutes Are Coded Based on Size and Location

- CPT Codes TRUNK, ARMS, LEGS
  - 15271 (<100 cm^2, first 25 cm^2)
  - 15272 (<100 cm^2, additional 25 cm^2)
  - 15273 (>100 cm^2, first 100 cm^2)
  - 15274 (>100 cm^2, additional 100 cm^2)
- CPT Codes FACE, SCALP, EYELIDS, MOUTH, NECK, EARS, ORBITS, GENITALIA, HANDS, FEET
  - 15275 (<100 cm^2, first 25 cm^2)
  - 15276 (<100 cm^2, additional 25 cm^2)
  - 15277 (>100 cm^2, first 100 cm^2)
  - 15278 (>100 cm^2, additional 100 cm^2)

Reimbursement

- Upcoming nationwide proposed LCD changes point towards a significant decrease in covered skin substitutes, with specific emphasis being placed on graft-specific supporting data
- New coverage will apply to skin substitutes used to treat VLUs and DFUs
- Tentatively planned to go into effect January 1, 2026

Healed!



“It always seems impossible until it is done.”

Clinical Pearls

- Viable lyopreserved and cryopreserved amniotic membrane grafts have increasing amounts of supporting clinical data, especially from large data sets
- Methods of preparation and production are graft-specific, so policy and coverage decisions should favor graft-specific data
- CAMPs can be valuable adjuncts in healing large, complicated, challenging wounds

Dhillon Y, et al. *Health Sci Rep*. 2025;8(5):e70819. Padula WV, et al. *Adv Wound Care (New Rochelle)*. 2024;13(7):350-362.

Mechanism of Action and Application of sNPWT

Erich S. Lemker, MD
Dual Board-Certified Plastic and Reconstructive Surgeon
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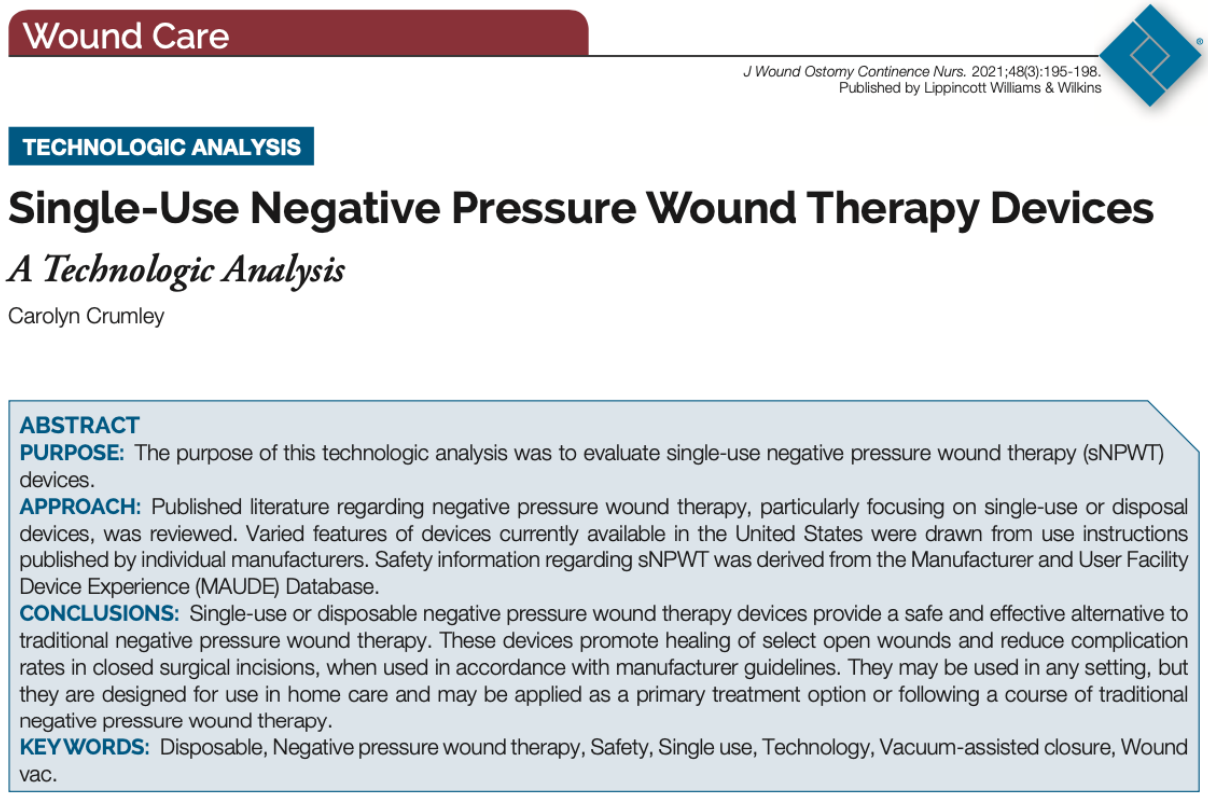
Commercially Available Products



Wound Care

J Wound Ostomy Continence Nurs. 2021;48(3):195-198.
Published by Lippincott Williams & Wilkins

TECHNOLOGIC ANALYSIS

Single-Use Negative Pressure Wound Therapy Devices

A Technologic Analysis

Carolyn Crumley

ABSTRACT

PURPOSE: The purpose of this technologic analysis was to evaluate single-use negative pressure wound therapy (sNPWT) devices.

APPROACH: Published literature regarding negative pressure wound therapy, particularly focusing on single-use or disposal devices, was reviewed. Varied features of devices currently available in the United States were drawn from use instructions published by individual manufacturers. Safety information regarding sNPWT was derived from the Manufacturer and User Facility Device Experience (MAUDE) Database.

CONCLUSIONS: Single-use or disposable negative pressure wound therapy devices provide a safe and effective alternative to traditional negative pressure wound therapy. These devices promote healing of select open wounds and reduce complication rates in closed surgical incisions, when used in accordance with manufacturer guidelines. They may be used in any setting, but they are designed for use in home care and may be applied as a primary treatment option or following a course of traditional negative pressure wound therapy.

KEYWORDS: Disposable, Negative pressure wound therapy, Safety, Single use, Technology, Vacuum-assisted closure, Wound vac.

- 2021 Review lists 9 distinct devices
- Several new devices since then

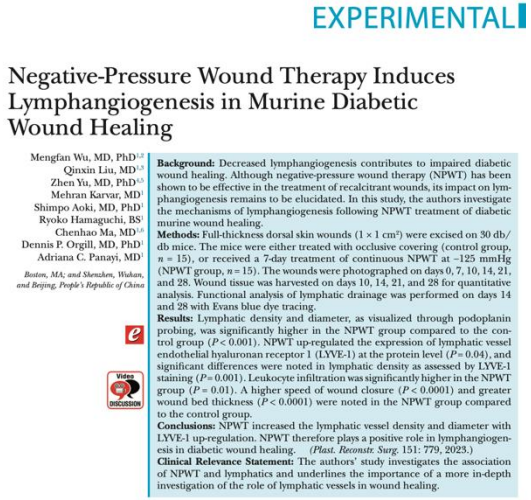
Crumley C. Single-Use Negative Pressure Wound Therapy Devices: *A Technologic Analysis. J Wound Ostomy Continence Nurs.* 2021;48(3):195-198

Commercially Available Products

Crumley C. *J Wound Ostomy Continence Nurs*. 2021;48(3):195-198.

Mechanism of Action: Traditional NPWT (tNPWT)

- Macrodeformation
- Microdeformation
- Fluid removal
- Alteration of wound environment
- Modulation of inflammation
- Cellular responses
  - Proliferation, migration, angiogenesis
- Alterations in bioburden
- Oxygen gradient
- Lymphatic clearance



EXPERIMENTAL

Negative-Pressure Wound Therapy Induces Lymphangiogenesis in Murine Diabetic Wound Healing

Mengfan Wu, MD, PhD[1,2]
Qinxin Liu, MD[1,3]
Zhen Yu, MD, PhD[4,5]
Mehran Karvar, MD[1]
Shimpo Aoki, MD, PhD[1]
Ryoko Hamaguchi, BS[1]
Chenhao Ma, MD[1,6]
Dennis P. Orgill, MD, PhD[1]
Adriana C. Panayi, MD[1]

Boston, MA; and Shenzhen, Wuhan, and Beijing, People's Republic of China

Background: Decreased lymphangiogenesis contributes to impaired diabetic wound healing. Although negative-pressure wound therapy (NPWT) has been shown to be effective in the treatment of recalcitrant wounds, its impact on lymphangiogenesis remains to be elucidated. In this study, the authors investigate the mechanisms of lymphangiogenesis following NPWT treatment of diabetic murine wound healing.

Methods: Full-thickness dorsal skin wounds (1×1 cm^2) were excised on 30 db/db mice. The mice were either treated with occlusive covering (control group, $n = 15$), or received a 7-day treatment of continuous NPWT at −125 mmHg (NPWT group, $n = 15$). The wounds were photographed on days 0, 7, 10, 14, 21, and 28. Wound tissue was harvested on days 10, 14, 21, and 28 for quantitative analysis. Functional analysis of lymphatic drainage was performed on days 14 and 28 with Evans blue dye tracing.

Results: Lymphatic density and diameter, as visualized through podoplanin probing, was significantly higher in the NPWT group compared to the control group ($P < 0.001$). NPWT up-regulated the expression of lymphatic vessel endothelial hyaluronan receptor 1 (LYVE-1) at the protein level ($P = 0.04$), and significant differences were noted in lymphatic density as assessed by LYVE-1 staining ($P = 0.001$). Leukocyte infiltration was significantly higher in the NPWT group ($P = 0.01$). A higher speed of wound closure ($P < 0.0001$) and greater wound bed thickness ($P < 0.0001$) were noted in the NPWT group compared to the control group.

Conclusions: NPWT increased the lymphatic vessel density and diameter with LYVE-1 up-regulation. NPWT therefore plays a positive role in lymphangiogenesis in diabetic wound healing. (*Plast. Reconstr. Surg.* 151: 779, 2023.)

Clinical Relevance Statement: The authors' study investigates the association of NPWT and lymphatics and underlines the importance of a more in-depth investigation of the role of lymphatic vessels in wound healing.

Contents lists available at ScienceDirect

Current Problems in Surgery

journal homepage: www.elsevier.com/locate/cpsurg

ELSEVIER

Effect of negative pressure wound therapy on wound healing

CrossMark

Contents lists available at ScienceDirect

Journal of Tissue Viability

journal homepage: www.elsevier.com/locate/jtv

ELSEVIER

Oxygen levels during negative pressure wound therapy

Niklas Biermann[a], Edward K. Geissler[b], Eva Brix[a], Daniel Schiltz[a], Lukas Prantl[a], Andreas Kehrer[a], Christian D. Taeger[a,*]

[a] Department of Plastic, Hand- and Reconstructive Surgery, University Hospital Regensburg, Germany
[b] Department of Surgery, University Hospital Regensburg, Germany

Wound Repair and Regeneration

Evaluation of closed incision management with negative pressure wound therapy (CIM): Hematoma/seroma and involvement of the lymphatic system

Deepak V. Kilpadi, PhD, MBA[1]; Mark R. Cunningham, PhD[2]

Huang C, et al. *Curr Probl Surg*. 2014;51(7):301-331. Biermann N, et al. *J Tissue Viabil*. 2019;28(4):223-226. Kilpadi DV, Cunningham MR. *Wound Repair Regen*. 2011;19(5):588-596. Nov;28(4):223-226. Wu M, et al. *Plast Reconstr Surg*. 2023;151(4):779-790.

Mechanism of Action: Single-Use NPWT (sNPWT)

- Macrodeformation
- Microdeformation
- Fluid removal
- Alteration of wound environment
- Modulation of inflammation
- Cellular responses
  - Proliferation, migration, angiogenesis
- Alterations in bioburden
- Oxygen gradient
- Lymphatic clearance

Huang C, et al. *Curr Probl Surg*. 2014;51(7):301-331. Biermann N, et al. *J Tissue Viabil*. 2019;28(4):223-226.

Mechanism of Action: tNPWT vs sNPWT

Wound Repair and Regeneration

ORIGINAL RESEARCH-CLINICAL SCIENCE

A prospective, randomized, controlled clinical trial on the efficacy of a single-use negative pressure wound therapy system, compared to traditional negative pressure wound therapy in the treatment of chronic ulcers of the lower extremities

Robert Kirsner, MD, PhD[1]; Cyaandi Dove, DPM[2]; Alex Reyzelman, DPM[3]; Dean Vayser, DPM, FACFAS[4]; Henry Jaimes, MD, PhD[5]

1. Chairman and Harvey Blank Professor, Dr. Phillip Frost Department of Dermatology and Cutaneous Surgery, University of Miami Miller School of Medicine, Miami, Florida,
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5. Global Senior Medical Director—Wounds Smith and Nephew, London, UK

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Manuscript received: July 12, 2018
Accepted in final form: May 9, 2019

DOI:10.1111/wrr.12727

ABSTRACT

Multicenter, phase-4, randomized, comparative-efficacy study in patients with VLUs or DFUs comparing for noninferiority the percentage change in target ulcer dimensions (area, depth, and volume) a single-use negative pressure wound therapy (s-NPWT) system versus traditional NPWT (t-NPWT) over a 12-week treatment period or up to confirmed healing. Baseline values were taken at the randomization visit. Randomized by wound type and size, 164 patients with non-infected DFUs and VLUs were included. The ITT population was composed of 161 patients (101 with VLUs, 60 with DFUs) and 115 patients completed follow-up (64 in the s-NPWT group and 51 in the t-NPWT group) (PP population). The average age for all patients was 61.5 years, 36.6% were women, and treatment groups were statistically similar at baseline. Primary endpoint analyses on wound area reduction demonstrated statistically significant reduction in favor of s-NPWT ($p = 0.003$) for the PP population and for the ITT population ($p < 0.001$). Changes in wound depth ($p = 0.018$) and volume ($p = 0.013$) were also better with s-NPWT. Faster wound closure was observed with s-NPWT (Cox Proportional Hazards ratio (0.493 (0.273, 0.891); $p = 0.019$) in the ITT population. Wound closure occurred in 45% of patients in the s-NPWT group vs. 22.2% of patients in the t-NPWT group ($p = 0.002$). Median estimate of the time to wound closure was 77 days for s-NPWT. No estimate could be provided for t-NPWT due to the low number of patients achieving wound closure. Device-related AEs were more frequent in the t-NPWT group (41 AEs from 29 patients) than in the s-NPWT group (16 AEs from 12 patients). The s-NPWT system met noninferiority and achieved statistical superiority vs. t-NPWT in terms of wound progression toward healing over the treatment period. When NPWT is being considered for the management of challenging VLUs and DFUs, s-NPWT should be considered a first choice over other types of NPWT.

INTRODUCTION

The most common types of chronic wounds worldwide are venous leg ulcers (VLUs), diabetic foot ulcers (DFUs), and pressure ulcers. More than 40 million new chronic wounds are reported annually.[1]

Most leg ulcers (at least 70%) are the result of chronic venous insufficiency[2] and others are due to mixed venous and arterial disease.[3] Estimated to occur in 1–2% of the population worldwide, the prevalence of leg ulcers may rise to

BWAT-m	modified Bates-Jensen Wound Assessment Tool
EQ-5D-5 L	EuroQoL 5 Dimensions, 5 Levels
MVTR	Moisture Vapor Transmission Rate
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Kirsner R, et al. *Wound Repair Regen.* 2019;27(5):519-529.

Mechanism of Action

tNPWT vs sNPWT in open wounds

Wound Repair and Regeneration

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Kirsner R, et al. *Wound Repair Regen.* 2019;27(5):519-529.

Mechanism of Action

tNPWT vs sNPWT in open wounds

tNPWT

- 58.6% Mean reduction in wound area
- 22% achieved wound closure

Wound Repair and Regeneration

ORIGINAL RESEARCH-CLINICAL SCIENCE

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Multicenter, phase-4, randomized, comparative-efficacy study in patients with VLUs or DFUs comparing for noninferiority the percentage change in target ulcer dimensions (area, depth, and volume) a single-use negative pressure wound therapy (s-NPWT) system versus traditional NPWT (t-NPWT) over a 12-week treatment period or up to confirmed healing. Baseline values were taken at the randomization visit. Randomized by wound type and size, 164 patients with non-infected DFUs and VLUs were included. The ITT population was composed of 161 patients (101 with VLUs, 60 with DFUs) and 115 patients completed follow-up (64 in the s-NPWT group and 51 in the t-NPWT group) (PP population). The average age for all patients was 61.5 years, 36.6% were women, and treatment groups were statistically similar at baseline. Primary endpoint analyses on wound area reduction demonstrated statistically significant reduction in favor of s-NPWT ($p = 0.003$) for the PP population and for the ITT population ($p < 0.001$). Changes in wound depth ($p = 0.018$) and volume ($p = 0.013$) were also better with s-NPWT. Faster wound closure was observed with s-NPWT (Cox Proportional Hazards ratio (0.493 (0.273, 0.891); $p = 0.019$) in the ITT population. Wound closure occurred in 45% of patients in the s-NPWT group vs. 22.2% of patients in the t-NPWT group ($p = 0.002$). Median estimate of the time to wound closure was 77 days for s-NPWT. No estimate could be provided for t-NPWT due to the low number of patients achieving wound closure. Device-related AEs were more frequent in the t-NPWT group (41 AEs from 29 patients) than in the s-NPWT group (16 AEs from 12 patients). The s-NPWT system met noninferiority and achieved statistical superiority vs. t-NPWT in terms of wound progression toward healing over the treatment period. When NPWT is being considered for the management of challenging VLUs and DFUs, s-NPWT should be considered a first choice over other types of NPWT.

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SSI	Surgical Site Infection
s-NPWT	Single-use Negative Pressure Wound Therapy
t-NPWT	Traditional Negative Pressure Wound Therapy

sNPWT

- 88.7% Mean reduction in wound area
- 45% achieved wound closure

Kirsner R, et al. *Wound Repair Regen.* 2019;27(5):519-529.

Mechanism of Action: sNPWT

Reduction of the force on sutures ~50%

Surgical Innovation
19(1) 67-75
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DOI: 10.1177/1553350611414920
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SAGE

Closed Incision Management With Negative Pressure Wound Therapy (CIM): Biomechanics

Robert Peyton Wilkes, MS[1], Deepak V. Kilpadi, PhD , MBA[1], Yabin Zhao, MS[1], Richard Kazala, BS[1], and Amy McNulty, PhD[1]

Abstract

A novel closed incision management with negative pressure wound therapy (CIM) has been developed for convenient use with closed incisions that has the potential to be beneficial for patients at risk for postoperative complications. Incisions are typically under lateral tension. This study explored the biomechanical mechanisms by which integrity of the incisional closure is enhanced by CIM. CIM was hypothesized to affect local stresses around closed incisions in a beneficial manner. Finite element analyses (FEA) indicated that application of CIM decreased the lateral stresses ~50% around the incision and changed the direction of the stresses to a distribution that is typical of intact tissue. Bench evaluations corroborated findings that CIM significantly increased the force required to disrupt the closed incision by ~50% as compared with closure alone. In conclusion, using 2 FEAs and bench modeling, CIM was shown to reduce and normalize tissue stresses and bolster appositional forces at the incision.

Keywords

biomedical engineering, hernias, orthopedic surgery, Cesarean section, dehiscence, finite element analysis, tissue mechanics, negative pressure wound therapy, CIM, modeling

Introduction

Underlying comorbidities such as obesity, diabetes, and poor vascular status as well as risk factors such as smoking, radiation therapy, chemotherapy, and use of steroids present potential challenges in maintaining incision closure after an open surgical procedure.[1-3] Closed incisions with a high risk of complications include those from hip and knee arthroplasty,[4] lower-extremity bypass,[5] abdominal laparotomies,[6,7] and cardiothoracic procedures.[8] These incisions have been traditionally closed by primary intention using sutures, staples, adhesive strips, or a combination thereof. In addition to the higher risk for surgical site complications in these procedure groups, the use of sutures and staples induce stress concentrations where they engage the tissue, and elevated stress concentrations can cause ischemia, fibrosis, or other tissue injury.

Negative pressure wound therapy (NPWT), as delivered by VAC Therapy (KCI USA, Inc, San Antonio, TX),[9-11] involves the controlled application of intermittent or continuous subatmospheric pressure to the wound bed typically via a pressure-manifolding dressing (eg, a reticulated, open-cell foam dressing). NPWT has been shown to have significant clinical success in the treatment of wounds that have a tissue deficit.[9-11] This success with open wounds has led some clinicians to use NPWT on closed surgical incisions using modifications of dressings that were designed for open wounds. In a randomized prospective clinical trial comparing NPWT to standard postoperative dressings used over closed incisions following high-energy trauma, Stannard et al[9,12] reported the incidence of dehiscence and infections to be lower in the NPWT-treated group. The authors recommend that NPWT be considered for high-risk wounds following severe skeletal trauma. A retrospective study by Atkins

[1]Kinetic Concepts, Inc, San Antonio, TX, USA

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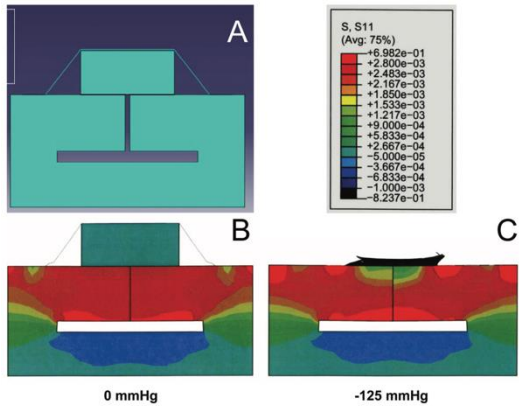
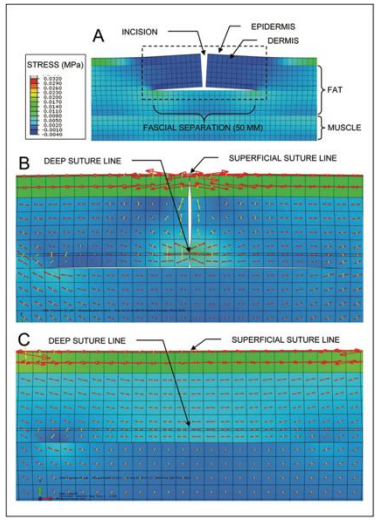
Robert Peyton Wilkes, Global Research and Development, Kinetic Concepts, Inc, 6203 Farinon Drive, San Antonio, TX 78249, USA
Email: robert.wilkes@kci1.com

Computer model and biomechanical studies





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Biomechanical Modeling of the Forces Applied to Closed Incisions During Single-Use Negative Pressure Wound Therapy

John Loveluck, PhD,[a] Tom Copeland, BSc,[a] Jason Hill, PhD,[b] Allan Hunt, MSc,[c] and Robin Martin, PhD[c]

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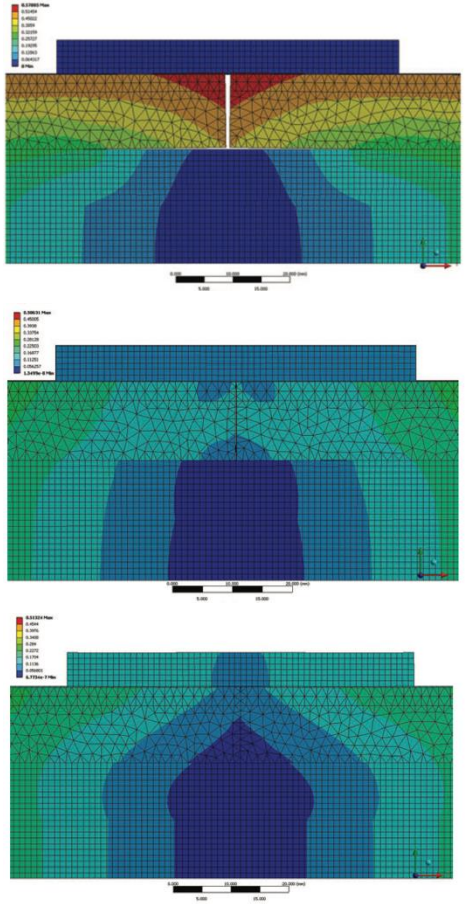
Keywords: negative pressure wound therapy (NPWT), closed incisions, surgical site complications, FEA, incisional NPWT

Published July 13, 2016

Objectives: The use of negative pressure wound therapy (NPWT) on closed surgical incisions is an emerging technology that may reduce the incidence of complications such as surgical site infections. One of the mechanisms through which incisional NPWT is thought to operate is the reduction of lateral tension across the wound. **Methods:** Finite element analysis computer modeling and biomechanical testing with Syndaver SynTissue™ synthetic skin were used to explore the biomechanical forces in the presence of the PICO® (Smith & Nephew Ltd, Hull, United Kingdom) negative pressure wound therapy system on a sutured incision. **Results:** Finite element analysis modeling showed that the force on an individual suture reduced to 43% of the force without negative pressure (from 1.31 to 0.56 N) at −40 mm Hg and to 31% (from 1.31 to 0.40 N) at −80 mm Hg. Biomechanical testing showed that at a pressure of −80 mm Hg, 55% more force is required for deformations in the tissue compared with the situation where no negative pressure wound therapy dressing is active. The force required for the same deformation at −120 mm Hg is only 10% greater than at −80 mm Hg, suggesting that most of the effect is achieved at −80 mm Hg. **Conclusions:** The results show that a canister-less single-use NPWT device is able to reduce the lateral tension across a closed incision, which may explain observed clinical reductions in surgical site complications with incisional NPWT.



Wilkes RP, et al. *Surg Innov*. 2012;19(1):67-75. Loveluck J, et al. *Eplasty*. 2016;13;16:e20.

Mechanism of Action: sNPWT

Computer model and biomechanical studies

Surgical Innovation
19(1) 67-75
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DOI: 10.1177/1553350611414920
http://sri.sagepub.com
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Closed Incision Management With Negative Pressure Wound Therapy (CIM): Biomechanics

Robert Peyton Wilkes, MS[1], Deepak V. Kilpadi, PhD , MBA[1], Yabin Zhao, MS[1], Richard Kazala, BS[1], and Amy McNulty, PhD[1]

Abstract

A novel closed incision management with negative pressure wound therapy (CIM) has been developed for convenient use with closed incisions that has the potential to be beneficial for patients at risk for postoperative complications. Incisions are typically under lateral tension. This study explored the biomechanical mechanisms by which integrity of the incisional closure is enhanced by CIM. CIM was hypothesized to affect local stresses around closed incisions in a beneficial manner. Finite element analyses (FEA) indicated that application of CIM decreased the lateral stresses ~50% around the incision and changed the direction of the stresses to a distribution that is typical of intact tissue. Bench evaluations corroborated findings that CIM significantly increased the force required to disrupt the closed incision by ~50% as compared with closure alone. In conclusion, using 2 FEAs and bench modeling, CIM was shown to reduce and normalize tissue stresses and bolster appositional forces at the incision.

Keywords

biomedical engineering, hernias, orthopedic surgery, Cesarean section, dehiscence, finite element analysis, tissue mechanics, negative pressure wound therapy, CIM, modeling

Introduction

Underlying comorbidities such as obesity, diabetes, and poor vascular status as well as risk factors such as smoking, radiation therapy, chemotherapy, and use of steroids present potential challenges in maintaining incision closure after an open surgical procedure.[1-3] Closed incisions with a high risk of complications include those from hip and knee arthroplasty,[4] lower-extremity bypass,[5] abdominal laparotomies,[6,7] and cardiothoracic procedures.[8] These incisions have been traditionally closed by primary intention using sutures, staples, adhesive strips, or a combination thereof. In addition to the higher risk for surgical site complications in these procedure groups, the use of sutures and staples induce stress concentrations where they engage the tissue, and elevated stress concentrations can cause ischemia, fibrosis, or other tissue injury.

Negative pressure wound therapy (NPWT), as delivered by VAC Therapy (KCI USA, Inc, San Antonio, TX),[9-11] involves the controlled application of intermittent or continuous subatmospheric pressure to the wound bed typically via a pressure-manifolding dressing (eg, a reticulated, open-cell foam dressing). NPWT has been shown to have significant clinical success in the treatment of wounds that have a tissue deficit.[9-11] This success with open wounds has led some clinicians to use NPWT on closed surgical incisions using modifications of dressings that were designed for open wounds. In a randomized prospective clinical trial comparing NPWT to standard postoperative dressings used over closed incisions following high-energy trauma, Stannard et al[9,12] reported the incidence of dehiscence and infections to be lower in the NPWT-treated group. The authors recommend that NPWT be considered for high-risk wounds following severe skeletal trauma. A retrospective study by Atkins

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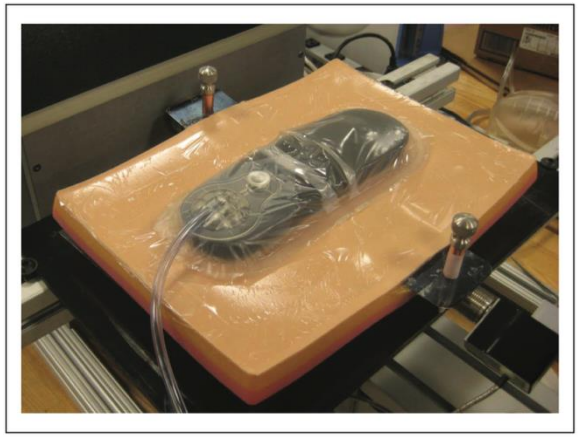

Force required for 10mm distraction increased 43% with sNPWT

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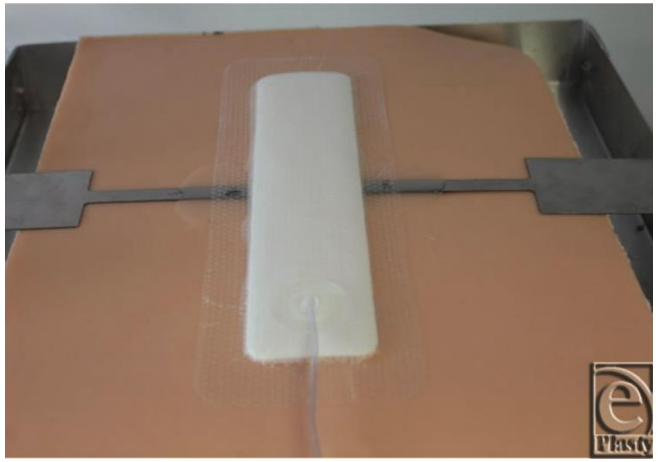
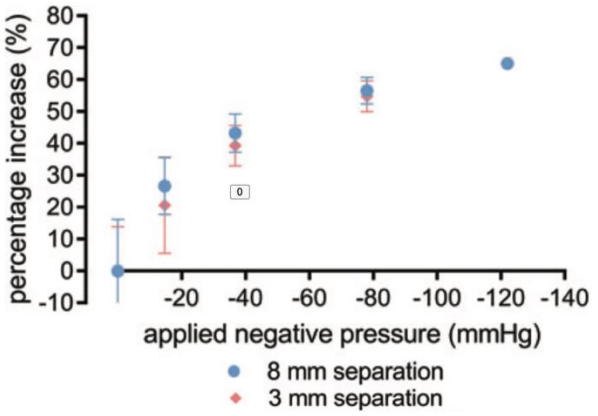




Mechanism of Action: sNPWT

Pre-Clinical Assessment of Single-Use Negative Pressure Wound Therapy During *In Vivo* Porcine Wound Healing

Varuni R. Brownhill,[1] Elizabeth Huddleston,[1] Andrea Bell,[2] Jeffrey Hart,[2] Iain Webster,[1] Matthew J. Hardman,[3,*] and Holly N. Wilkinson[3]

12-day study in porcine model with standardized wounds comparing tNPWT vs sNPWT

Evaluated at day 0, day 6, and day 12

- Faster wound closure (18.56% vs 33.36% area remaining)
  - Greater re-epithelialization
  - Faster wound contraction
- Reduced inflammation
- Granulation tissue maturation
- Higher total collagen deposition
- Reduced surrounding skin disruption and periwound inflammation

Brownville VR, et al. *Adv Wound Care (New Rochelle).* 2021;10(7):345-356.

Mechanism of Action: sNPWT

1. Tissue perfusion effects
2. Lateral tension and wound strength
3. Effects on edema
4. Reduction in hematoma and seroma

Karlakki S, et al. *Bone Joint Res*. 2013;2:276-284.

Mechanism of Action: sNPWT

"...incisional NPWT has developed so that there are now reasonable grounds for confidence that this approach is widely applicable to a range of indications...

...but we have little idea of precise mechanisms. "

Karlakki S, et al. *Bone Joint Res*. 2013;2:276-284.

Mechanism of Action: sNPWT

Mounting Evidence

- Orthopedic surgery
- Plastic and reconstructive surgery
- Cardiothoracic surgery
- Vascular surgery
- Colon and rectal surgery
- OB/Gynecology
- Breast surgery
- General surgery

Mechanism of Action: sNPWT

A randomized clinical trial evaluating negative pressure

Closed incision negative pressure wound t

Negative pressure wound therap

RESEARCH ARTICLE

Cost-effec

negative p

Original Article

Effectiveness of Specific Single-Use Incisional Negative Pressure Wound Therapy (PICO System) After Major Lower Extremity Amputation

The International Journal of Lower Extremity Wounds
2025, Vol. 24(1) 130–134

DOI: 10.1177/15347346231221116
journals.sagepub.com/home/ijl
Sage

ORIGINAL CONTRIBUTIONS: OUTCOMES

Cost-Effectiveness Analysis of Negative Pressure Wound Therapy to Prevent Surgical Site Infection After Elective Colorectal Surgery

Cheung, Douglas C. M.D., M.B.A.[1]; Muaddi, Hala M.D., M.Sc.[1]; de Almeida, John R. M.D., M.Sc.[1,2,4]; Finelli, Antonio M.D., F.R.C.S.C.[1,3]; Karanicolas, Paul M.D., Ph.D.[1,4,5]

Incisional Negative Pre

Postoperative Cardiothoracic Wound Infection

ainst

ound therapy *versus*
d surgical incisions:
l meta-analysis

Kaitlin A. Nguyen, BS,[a] George A. Taylor, MD, MS,[a] Theresa K. Webster, BS,[a] Rachel A. Jenkins, BS,[a] Nicklaus S. Houston, BS,[a] Dylan L. Kahler, MD,[a] Andrew A. Gassman, MD,[b] and Christine M. Jones, MD[a]

Kelly James [a], A

[a] *General Surgery, United St*
[b] *Global Clinical and Medic*

Correspondence to: Global Clinical Affairs, Smith+Nephew, 101 Hessle Road, Hull HU3 2BN, UK (e-mail: Christopher.Saunders@smith-nephew.com)

Presented to the 29th Conference of the European Wound Management Association, Gothenburg, Sweden, June 2019

Clinical Application of sNPWT Closed Incision

Single-use negative pressure wound therapy versus conventional dressings for the reduction of surgical site infections in closed surgical incisions: Systematic literature review and meta-analysis

Kelly James [a], Amy Glasswell [b], Ben Costa [b,*]

[a] *General Surgery, United Surgical Associates of Kansas City, Missouri, USA*
[b] *Global Clinical and Medical Affairs, Smith and Nephew, Hull, UK*

Single-use negative-pressure wound therapy *versus* conventional dressings for closed surgical incisions: systematic literature review and meta-analysis

C. Saunders [1,*], L. M. Nherera[2], A. Horner[1] and P. Trueman[2]

[1]Global Clinical Affairs, Smith+Nephew, Hull, UK
[2]Health Economics and Market Access, Smith+Nephew, Hull, UK

*Correspondence to: Global Clinical Affairs, Smith+Nephew, 101 Hessle Road, Hull HU3 2BN, UK (e-mail: Christopher.Saunders@smith-nephew.com)

Presented to the 29th Conference of the European Wound Management Association, Gothenburg, Sweden, June 2019

Saunders C, et al. *BJS Open*. 2021;5(1):zraa003. James K, et al. *Am J Surg*. 2024;228:70-77.

Clinical Application of sNPWT
Closed Incision

Initial Presentation

1-wk Postop

Clinical Application of sNPWT
Closed Incision

Initial Presentation

2-wk Postop

Clinical Application of sNPWT
Closed Incision

Initial Presentation

8-wk Postop

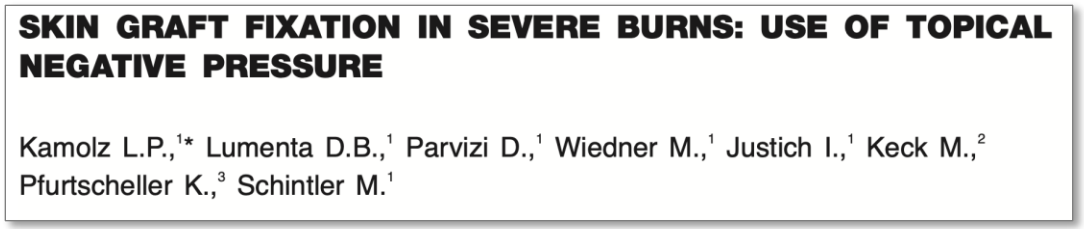
Application of sNPWT
Skin Graft Bolster

Safeguarding Skin Grafts

An Evidence-Based Summary of Fixation Techniques

Benjamin J. Patel, MRCS, Christian M. Asher, MRCS, Nicola Bystrzonowski, FRCS (Plast), and Ciaran Healy, FRCS (Plast)

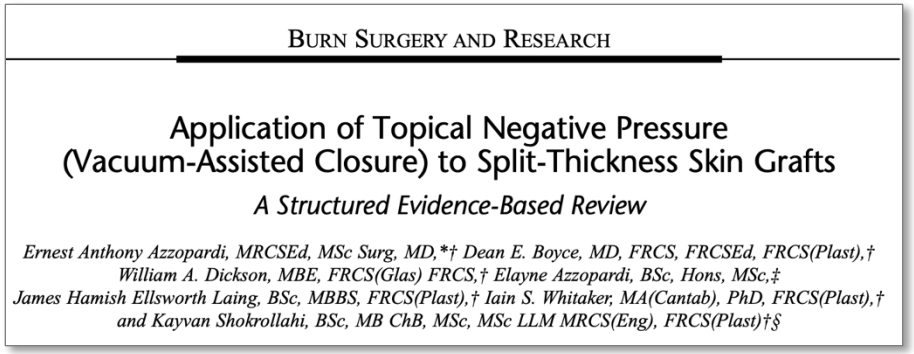
NPWT is associated with enhanced graft take compared with traditional techniques.



SKIN GRAFT FIXATION IN SEVERE BURNS: USE OF TOPICAL NEGATIVE PRESSURE

Kamolz L.P.,[1]* Lumenta D.B.,[1] Parvizi D.,[1] Wiedner M.,[1] Justich I.,[1] Keck M.,[2] Pfurtscheller K.,[3] Schintler M.[1]

An efficient method in major burns



BURN SURGERY AND RESEARCH

Application of Topical Negative Pressure (Vacuum-Assisted Closure) to Split-Thickness Skin Grafts

A Structured Evidence-Based Review

Ernest Anthony Azzopardi, MRCSEd, MSc Surg, MD,† Dean E. Boyce, MD, FRCS, FRCSEd, FRCS(Plast),† William A. Dickson, MBE, FRCS(Glas) FRCS,† Elayne Azzopardi, BSc, Hons, MSc,‡ James Hamish Ellsworth Laing, BSc, MBBS, FRCS(Plast),† Iain S. Whitaker, MA(Cantab), PhD, FRCS(Plast),† and Kayvan Shokrollahi, BSc, MB ChB, MSc, MSc LLM MRCS(Eng), FRCS(Plast)†§*

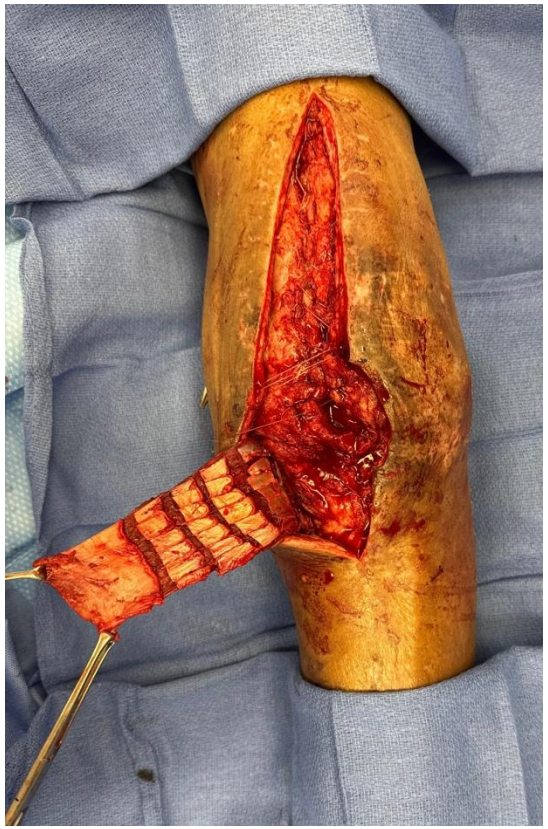
This systematic review suggests that it may impart a **considerable advantage** to split skin grafting over traditional dressings in quality and quantity of take.

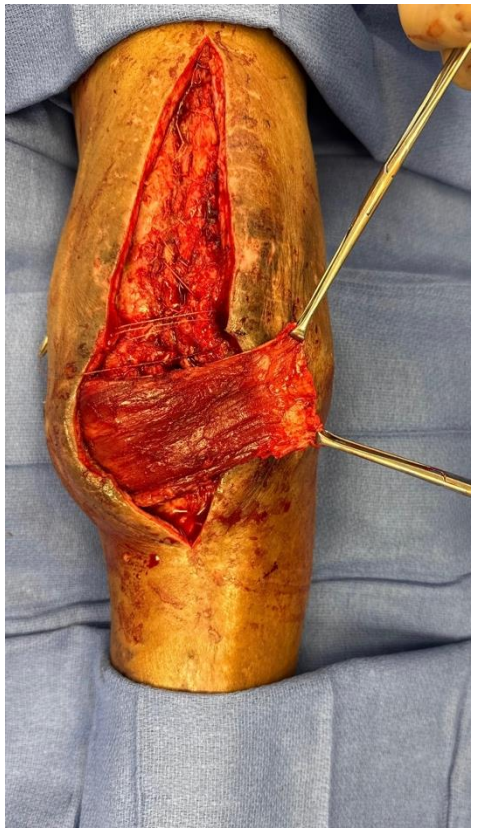
Azzopardi EA, et al. *Ann Plast Surg*. 2013;70(1):23-29. Patel BJ, et al. *Ann Plast Surg.* 2021;87(6):e180-e188. Kamolz LP, et al. *Ann Burns Fire Disasters*. 2014;27(3):141-145.

Application of sNPWT
Skin Graft Bolster

Initial Presentation

Intraoperative





POD 12

6 Wks Postop

Application of sNPWT
Open Wounds

"68% of wounds treated with tNPWT are amenable to and could be treated with sNPWT."

Lindsay R, et al. *Wounds*. 2025;37(3):125-133.

Application of sNPWT
Open Wounds

Start of Therapy | 4 Days | 1 Wk | 3 Wks | 4 Wks | 5 Wks

Clinical Pearls

Mechanism of action

All NPWT

- Macrodeformation
- Microdeformation
- Fluid removal
- Alteration of the wound environment
- Modulation of inflammation
- Cellular responses
- Oxygen gradient
- Lymphatic clearance

sNPWT

- Control of periwound edema
- Reduction in lateral tension
- Faster wound contraction and re-epithelialization
- Reduced injury to the periwound skin

Applications

- Open wounds
- Closed incisions
- Skin grafts

Thank You