

# Antimicrobial Native Collagen ECM

Real-World Case Studies in Acute Wounds

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# Faculty Disclosures

- **Dr. Cheng** has disclosed no relevant financial relationship with any ineligible company (commercial interest)
- **Dr. Kapp:** Speakers' Bureau—Organogenesis Inc.; Advisory Board—Arch Therapeutics
- **Dr. Koullias:** Speakers' Bureau—Organogenesis Inc.

# Program Information

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# Learning Objectives

- Examine the science and evidence for native cross-linked ECM + broad-spectrum PHMB antimicrobial
- Explore acute complex wound cases managed with native cross-linked ECM + broad-spectrum PHMB antimicrobial in a variety of acute care applications

# Native Extracellular Matrix with Antimicrobial: Exploring Technology, Clinical Application, and Results

**George Koullias, MD, PhD**

Associate Professor of Surgery

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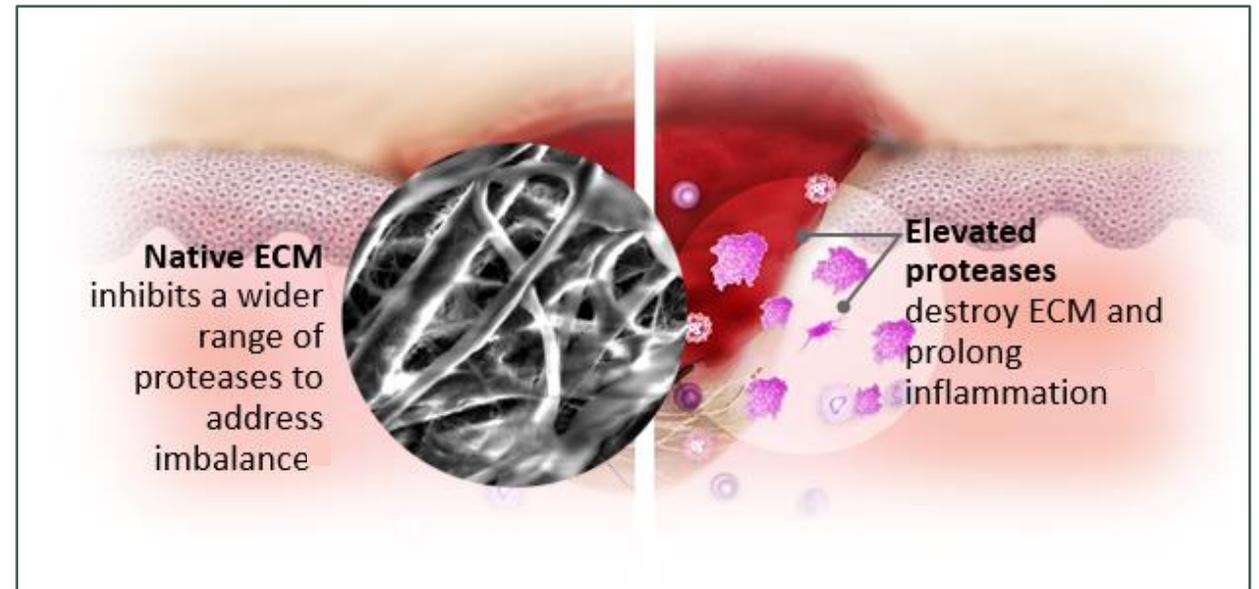
Stony Brook, New York

# Learning Objectives

- Review the properties of biofilm and the components of the effective management of biofilm
- Explore the mechanism of action of native collagen extracellular matrix with embedded antimicrobial in the effective management of biofilm
- Explore clinical cases illustrating effective biofilm management

# Retaining the Native ECM Inhibits a Wider Range of Proteases

- **Inflammatory phase:** MMPs and proteolytic enzymes stay elevated and break down the new collagen
- **Solution:** More collagen quenches the enzymes



MMP = matrix metalloproteinase.

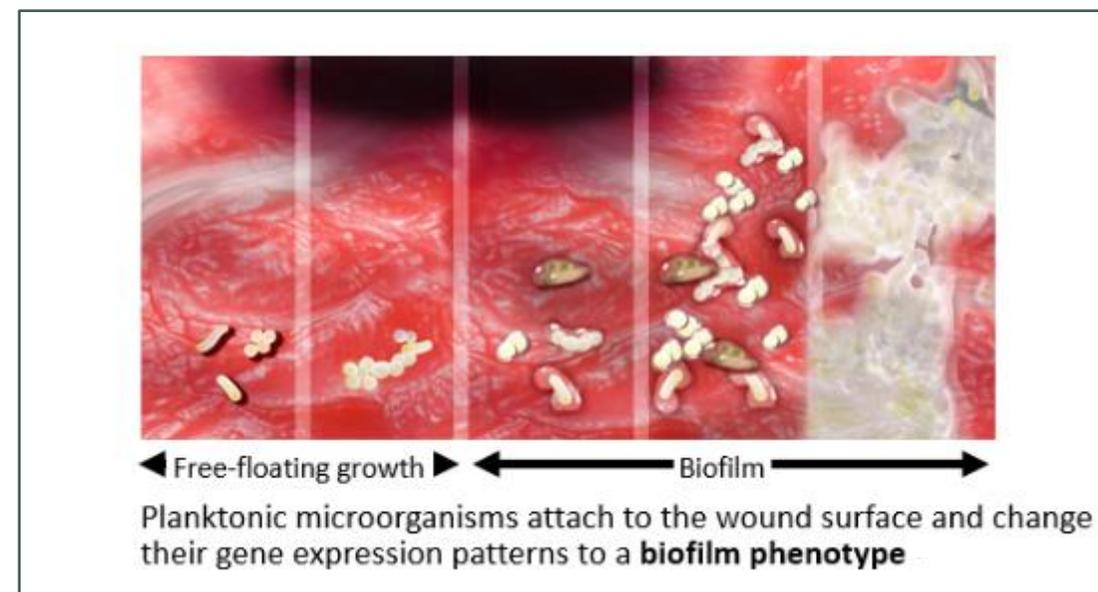
Negron L, et al. *Int Wound J.* 2014;11(4):392-397. Martin P, et al. *Br J Dermatol.* 2015;173(2):370-8. Clark RAF, et al. *J Invest Dermatol.* 2007;127(5):1018-1029.

# It's Not You; It's Them!

- **Inflammatory phase: Biofilm**

- All wounds contain bacteria, and bacteria can protect themselves with a biofilm
- Debridement removes biofilm and bacteria, but they completely regrow in 72 hours
  - Solution: Don't let bacteria regrow and form biofilm (Ag, PHMB, Dakin's, cadexomer iodine...?????)

## Virtually ALL Chronic Wounds Contain Biofilm



Ag = silver.

Philips PL, et al. *Wounds Int.* 2010;1(3):1-6. Carpenter S, et al. *Wounds.* 2016;28(6 Suppl):S1-S20. James GA, et al. *Wound Repair Regen.* 2008;16:37-44. Malone M, et al. *J Wound Care.* 2017;26(1):20-25. Schultz G, et al. *Wound Repair Regen.* 2017; 25(5):744-757. Donlan RM, et al. *Clin Microbiol Rev.* 2002;15(2):167-193.

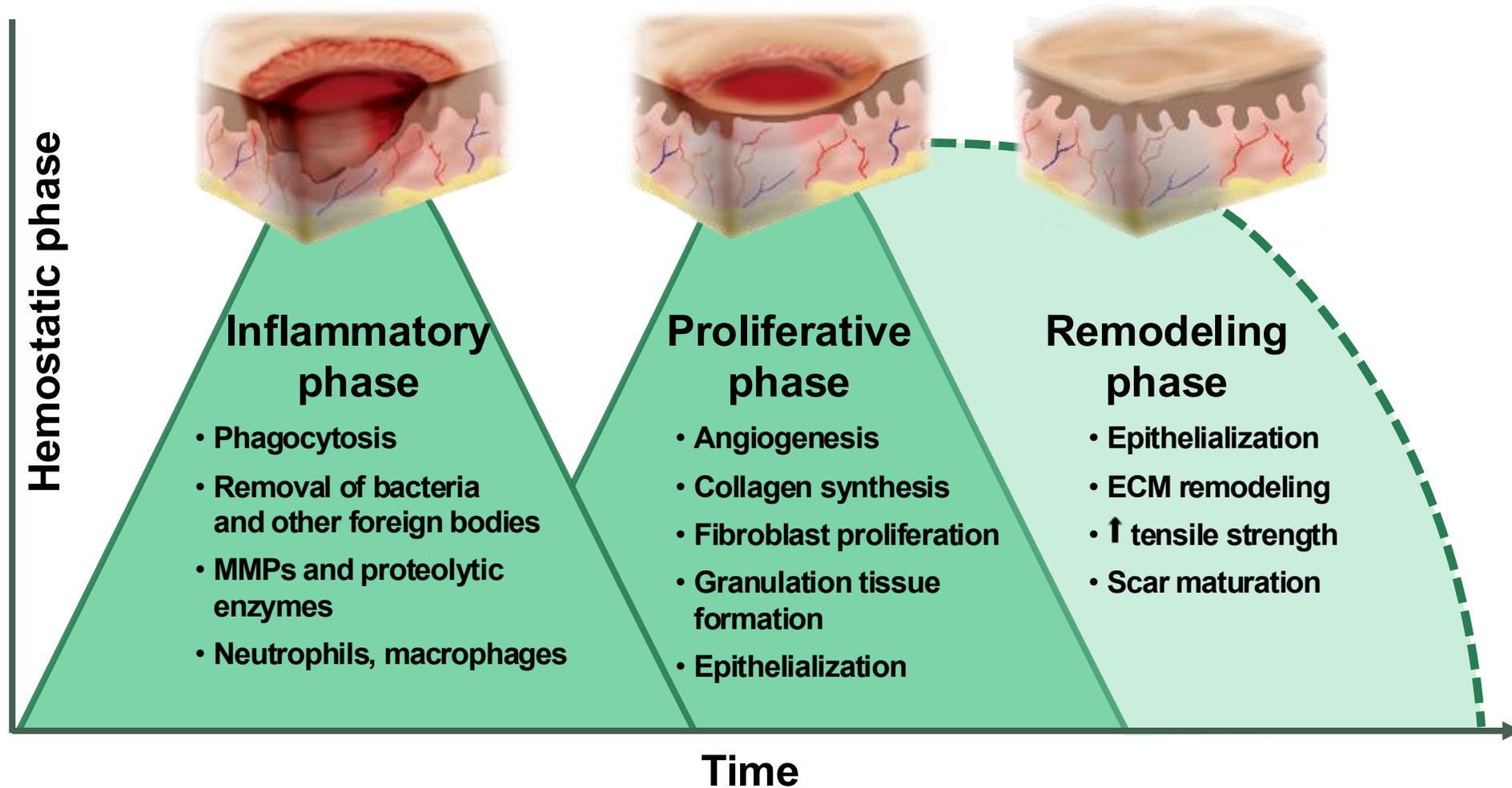
# Biofilm Resistance

- Biofilm becomes resistant to many therapeutic interventions between 48-96 hours
- Staph and *Pseudomonas* treated with gentamicin sulfate were less susceptible as soon as 6 hours and completely tolerant at 48-92 hours; hydrodebridement and reapplication showed continued tolerance immediately
- A second study was done with 100% bleach for *Pseudomonas*; 39% of the bacteria was tolerant by 48 hours
- Cadexomer iodine and PHMB have both been shown to limit biofilm reformation in published comparative analysis that included honey, silver dressings, topical antibiotics, etc.

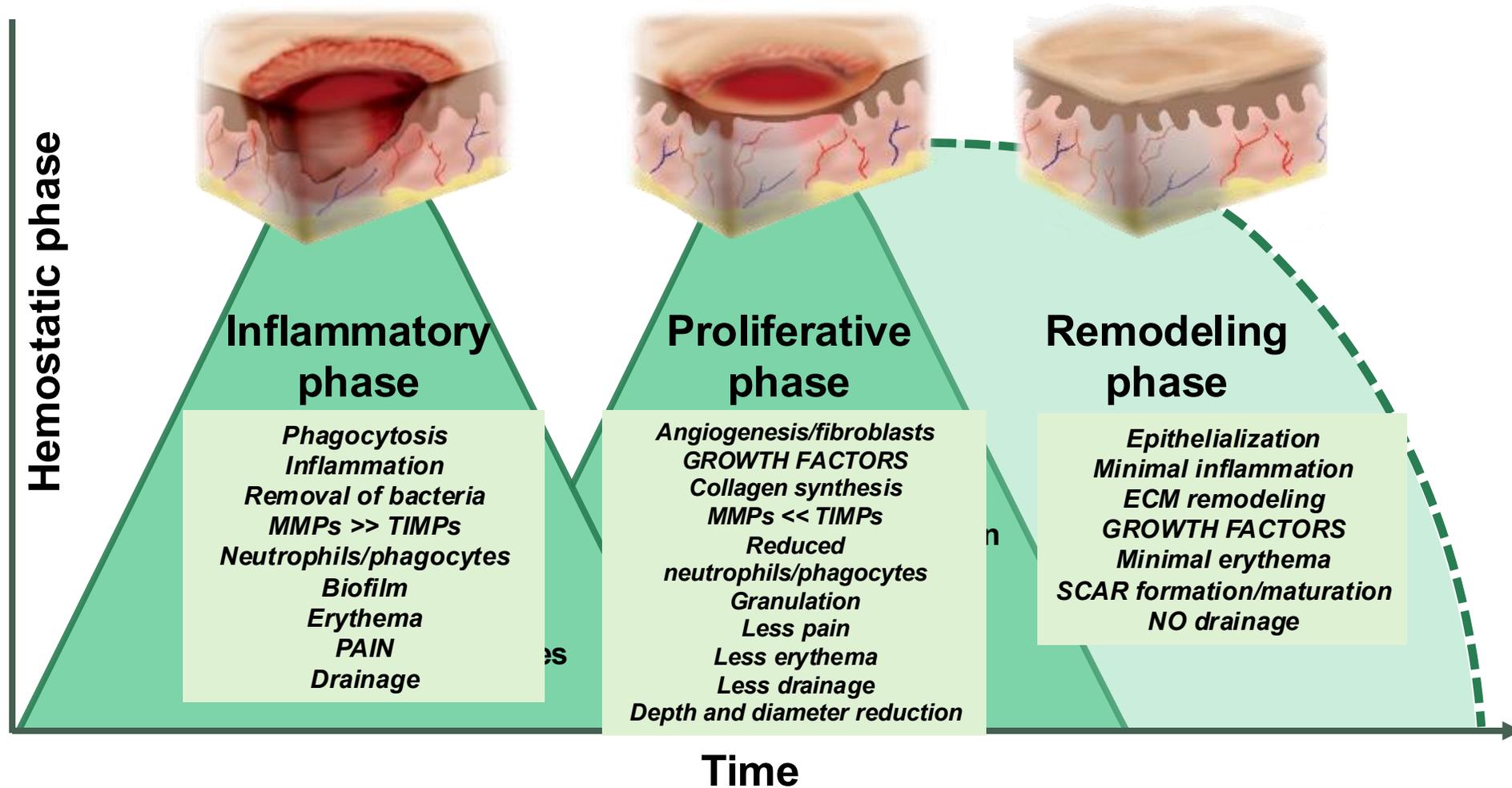
# Stuck in the Inflammatory Phase

- Virtually all wounds are stuck in the inflammatory phase on presentation
- Biofilm prolongs the inflammatory phase and keeps MMPs and proteolytic enzymes elevated
- Debridement of biofilm and initiating platelet degranulation creates an acute wound again
- Biofilm reforms in 72 hours if allowed
- Engineered tissue that contains collagen quenches MMPs and proteolytic enzymes; bactericidal chemicals help prevent reformation of biofilm

# The Acute Wound Healing Process Consists of Four Overlapping Phases

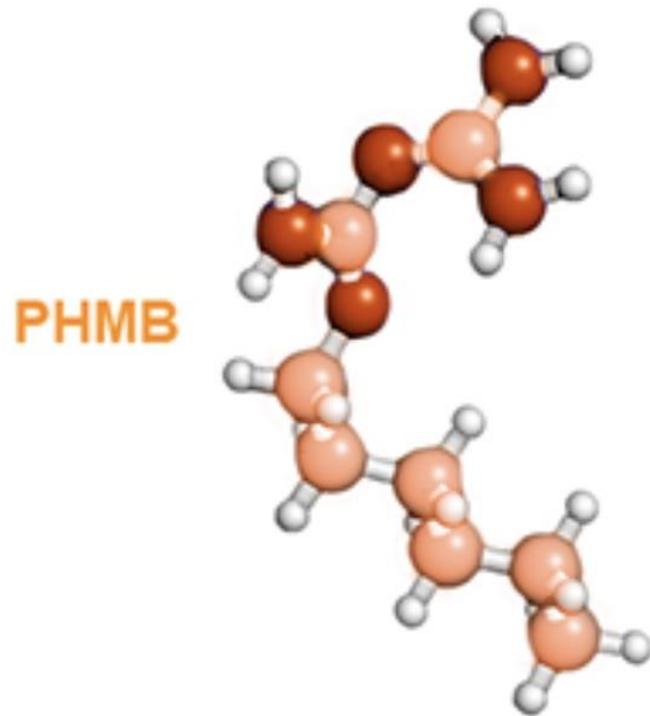


# The Acute Wound Healing Process Consists of Four Overlapping Phases



TIMP = tissue inhibitor of metalloproteinases.  
 Broughton G, et al. *Plast Reconstr Surg.* 2006;117(7 Suppl):12S-34S.

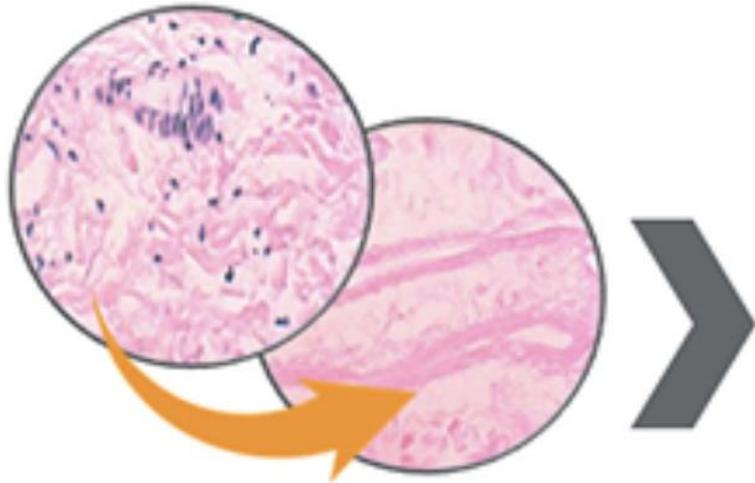
# Broad-Spectrum PHMB Proactively Disrupts Bioburden



## Positively-charged PHMB, unlike silver:

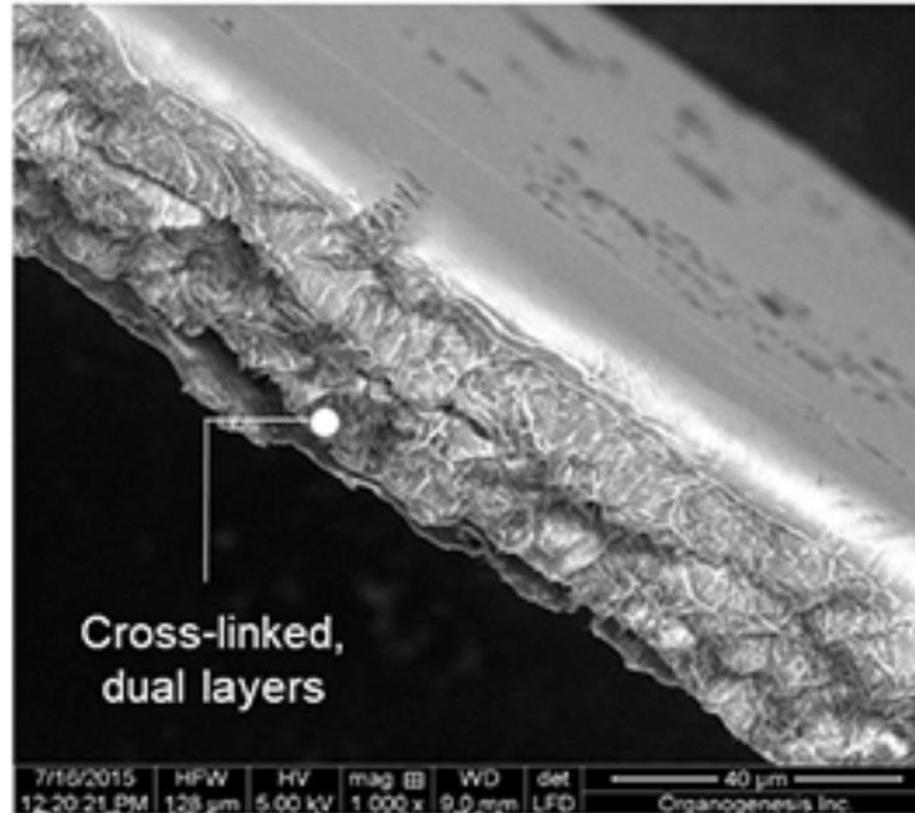
- Will not damage key cells (eg, fibroblasts) involved in wound healing
- High tissue compatibility and low cytotoxicity
- No known instances of bacteria acquiring resistance

# Native, Cross-Linked ECM Helps Support Healing



## Proprietary process

- Preserves native ECM structure
- Removes cells and other non-collagen materials



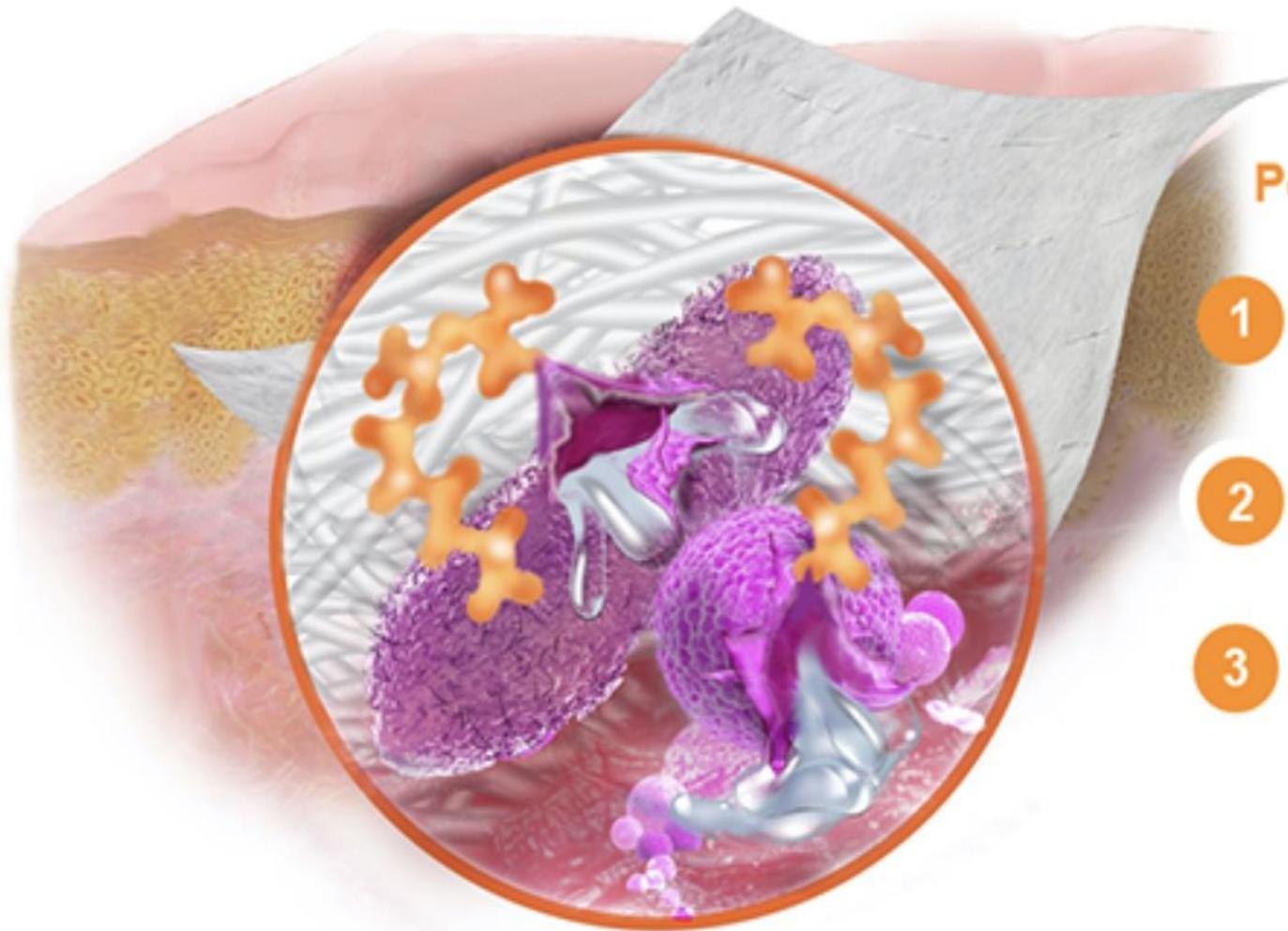
## PuraPly AM's\*\* cross-linked ECM, dual layers:

- Resist ECM degradation<sup>3\*</sup>
- Support persistence between debridements<sup>3\*</sup>
- Maximize surface area for PHMB saturation<sup>4<sup>±</sup></sup>

\* Data on file. PDR-0002. Organogenesis Inc. \*\* PuraPly AM = ECM plus PHMB

Oropallo AR. *Plast Reconstr Surg Glob Open*. 2019;7(1):e2047. Lintzeris D, et al. *Wounds*. 2018;30(3):72-78. Carpenter S, et al. *Wounds*. 2016;28(6 Suppl):S1-S20. PuraPly Antimicrobial package insert [www.puraplyam.com]. <https://puraplyam.com/pdf/PuraPly-Antimicrobial-Package-Insert.pdf>. Brantley J, et al. *Wounds Int*. 2016;7(3):40-45.

# Broad-Spectrum PHMB Proactively Disrupts Bioburden and Biofilm



## Positively-charged PHMB

- 1 **Binds** to negatively-charged bacterial cell membranes
- 2 **Disrupts** the cell membrane, inhibits metabolism, and leads to cell death
- 3 **Blocks** microbial attachment, helping to prevent biofilm re-formation

PuraPly Antimicrobial package insert [www.puraplyam.com]. <https://puraplyam.com/pdf/PuraPly-Antimicrobial-Package-Insert.pdf>. Brantley J, et al. *Wounds Int.* 2016;7(3):40-45. Gilbert P, et al. *J Appl Microbiol.* 2005;99(4):703-715. Hübner NO, et al. *Skin Pharmacol Physiol.* 2010;23(suppl):17-27. Gilliver S. *J Wound Care.* 2009;(Suppl):9-14. Wiegand C, et al. Poster presented at: European Wound Management Association Conference 2009; May 20-22, 2009; Helsinki, Finland. Abstract 13.

# Stony Brook Southampton Hospital Center for Advanced Wound Healing and Hyperbaric Medicine



- 64 yo female patient, with a history of chronic smoking (25p years), came with a 2-year history of a progressively enlarging, and extremely foul-smelling, necrotic, and draining, exophytic left neck mass; she was referred emergently to oncology, where she was discovered to have a locally advanced squamous cell carcinoma, with deep tissue penetration and invasion of the carotid sheath
- That last finding put this patient on imminent danger for carotid rupture
- Patient refused radiation therapy but consented on a triple chemotherapy regimen; after initiation of chemotherapy, she was sent back to the SBSHH wound care center for wound, odor, and drainage management; she was managed with debridements and active carbon dressings for odor control, highly absorbent foam for drainage control, and collagen dressing with PHMB to prevent biofilm reformation; collagen dressings with PHMB kept the wound bed clean and clearly helped elevate the wound bed. Due to the proximity of the bed of the wound to the lateral pharynx and esophagus, as well as the left common carotid artery, every effort was made to elevate the wound bed and heal the wound expeditiously; wound biopsies (during chemotherapy) were negative for malignancy; after initial necrotic debris and odor management, the wound was 78 cm<sup>2</sup>; the patient tolerated her chemotherapy well, but, on week 11, acquired bilateral pneumonia, and expired on week 12; by that point, the wound area was reduced by 90%, and the distance from the adventitia of the LCCA was 1cm

# Stony Brook Southampton Hospital Center for Advanced Wound Healing and Hyperbaric Medicine



- 80 yo female patient with a history of hypertension, hyperlipidemia, and also a history of multiple previous skin squamous carcinoma excisions, comes 1 month after a squamous carcinoma repeat excision, with a cellulitic infected, necrotic, dehisced flap at the excision site on the right calf; it produced a 45 cm<sup>2</sup> wound; the tumor excision was performed a month prior to her presentation at the wound care center
- She had serial wound debridements, followed by 6 weekly collagen dressings with PHMB applications and then 3 weekly placental allograft wound covering applications
- She healed completely by week 11

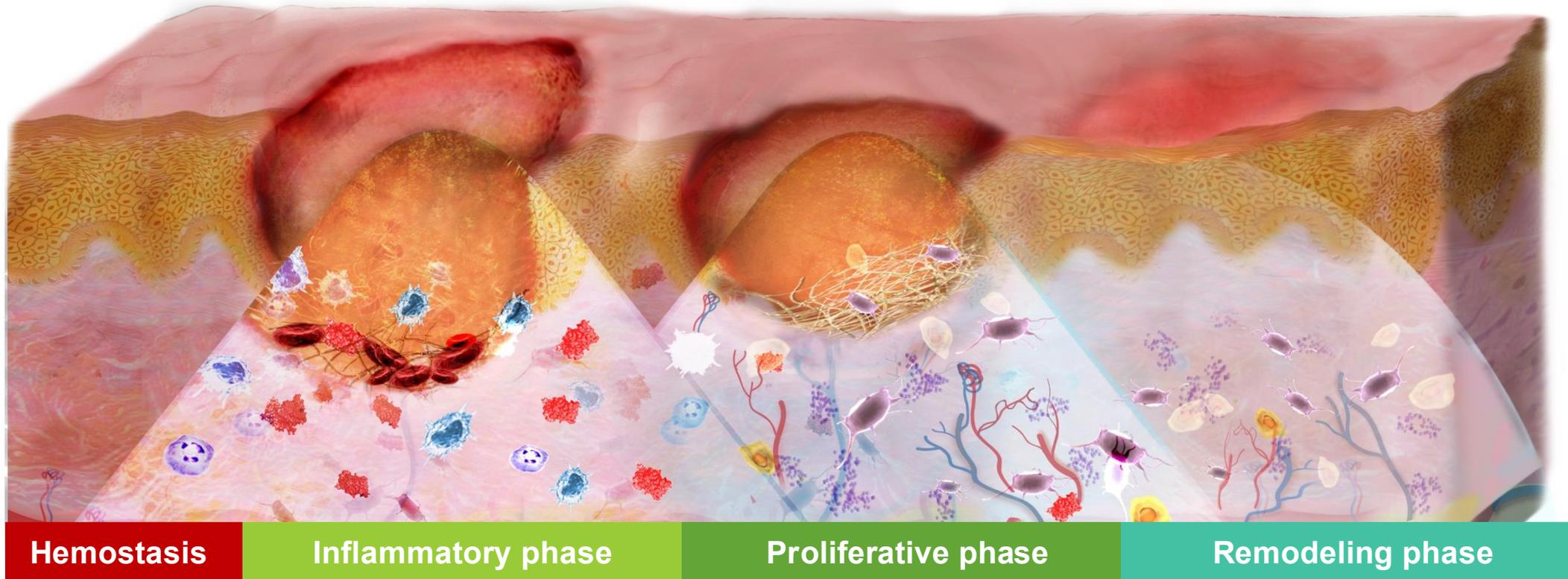
# Scientific and Clinical Evidence for Use of ECM

**Daniel Kapp, MD**

Division Director of Plastic Surgery  
and Past Chief of Surgery  
Palm Beach Gardens Medical Center  
Palm Beach, Florida

# The Acute Wound Healing Process Consists of Four Overlapping Phases

Normal wound healing is an orderly, sequential process



Time

# Uncontrolled Bioburden and Biofilm Trigger an Inflammatory Response and Delay Healing

## ***Bioburden and biofilm***

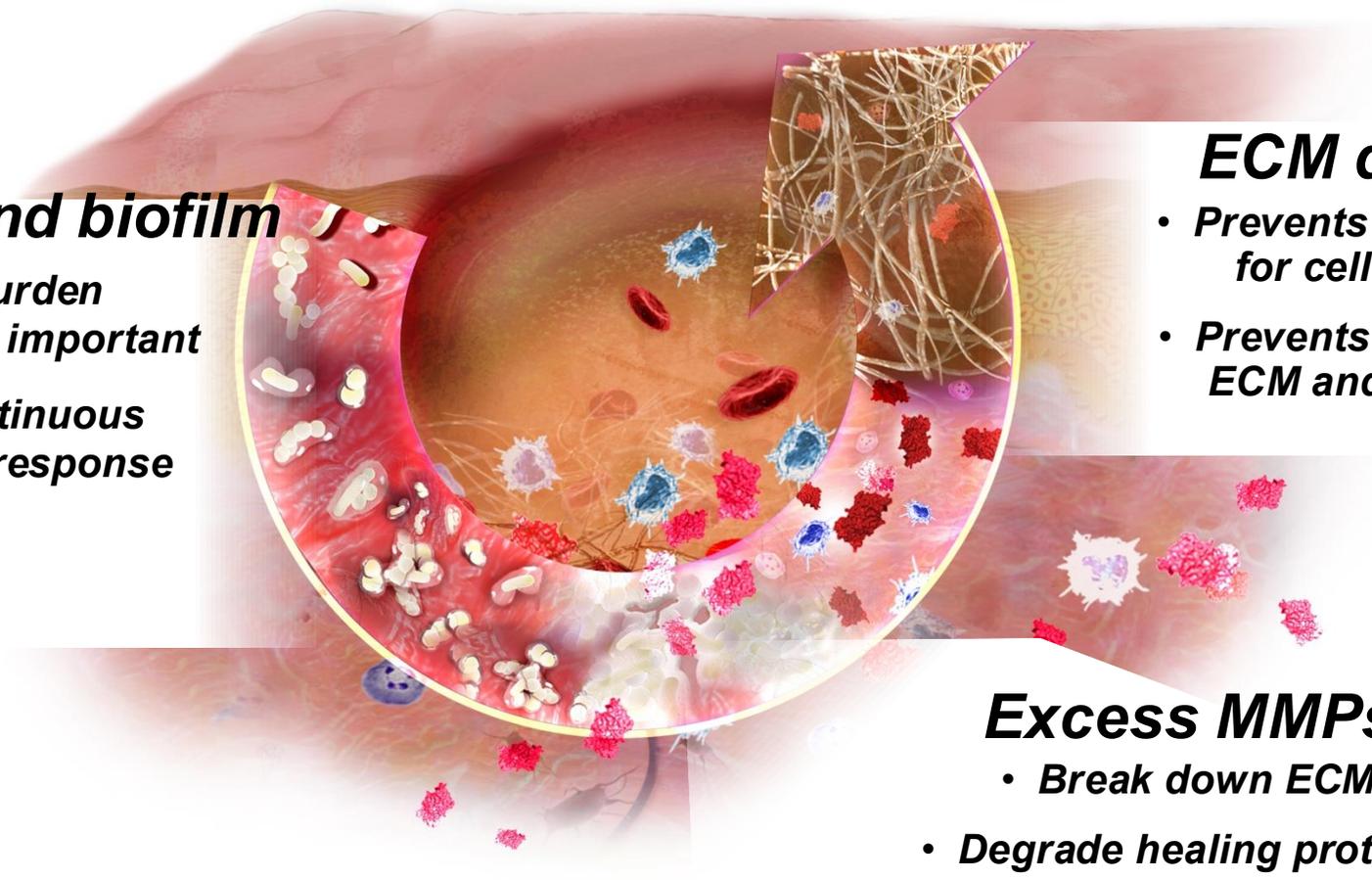
- *Early bioburden management is important*
- *Triggers continuous inflammatory response*

## ***ECM degradation***

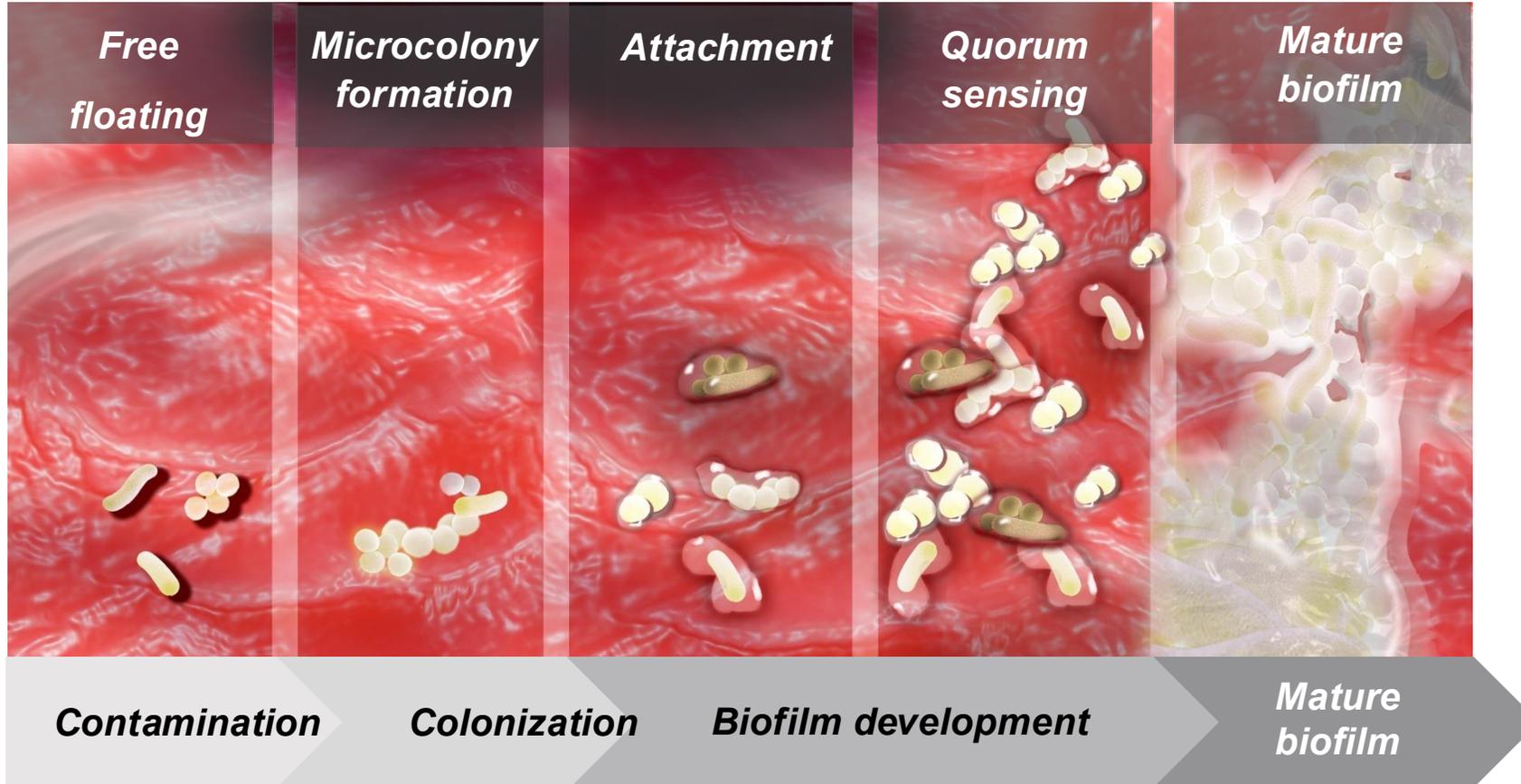
- *Prevents the scaffold needed for cell migration to form*
- *Prevents proper formation of ECM and granulation tissue*

## ***Excess MMPs***

- *Break down ECM*
- *Degrade healing proteins*
- *Prolong the inflammatory phase*



# The Continuum of Bioburden and Biofilm



**After  
debridement,  
biofilm can start  
to reform within  
24 hours and  
fully mature  
within 3 days**

# Native, Cross-Linked ECM Plus PHMB Antimicrobial Barrier (PCMP) Provides a Standard of Care for Local Wound Management to Control Bioburden

## ***PCMP***

Sustained barrier effect\* \*\*

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### **PHMB**

Broad-spectrum antimicrobial with low cytotoxicity

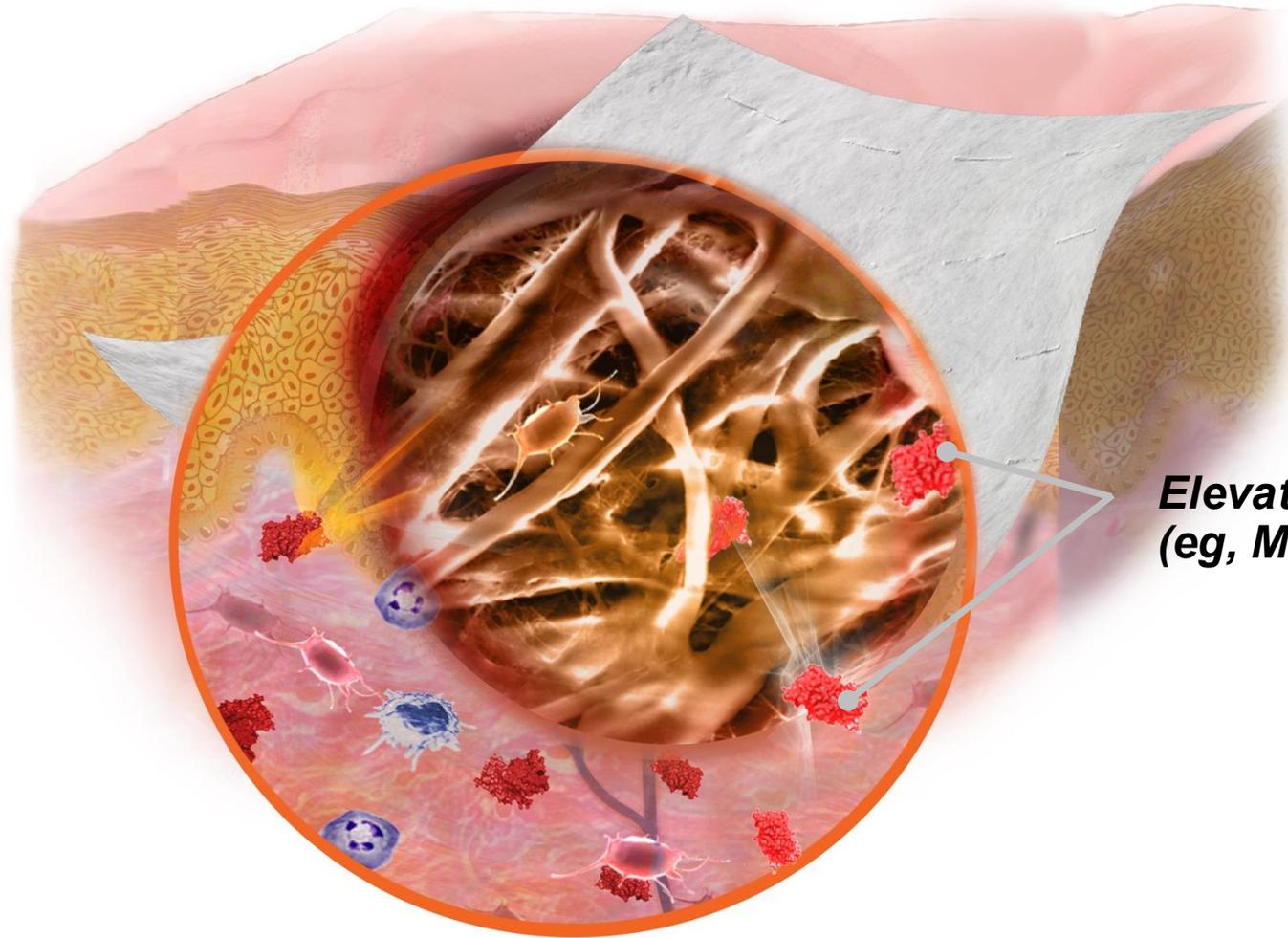
### **Native, cross-linked ECM**

Resists enzymatic degradation\*\*

\* Data on file. PDR-0001. Organogenesis Inc. \*\* Data on file. PDR-0002. Organogenesis Inc. Carpenter S, et al. *Wounds*. 2016;28(6 Suppl):S1-S20. 4. Gilbert P, et al. *J Appl Microbiol*. 2005;99(4):703-715. Hubner NO, et al. *Skin Pharmacol Physiol*. 2010;23(suppl):17-27. Sood A, et al. *Adv Wound Care*. 2014;3(8):511-529.

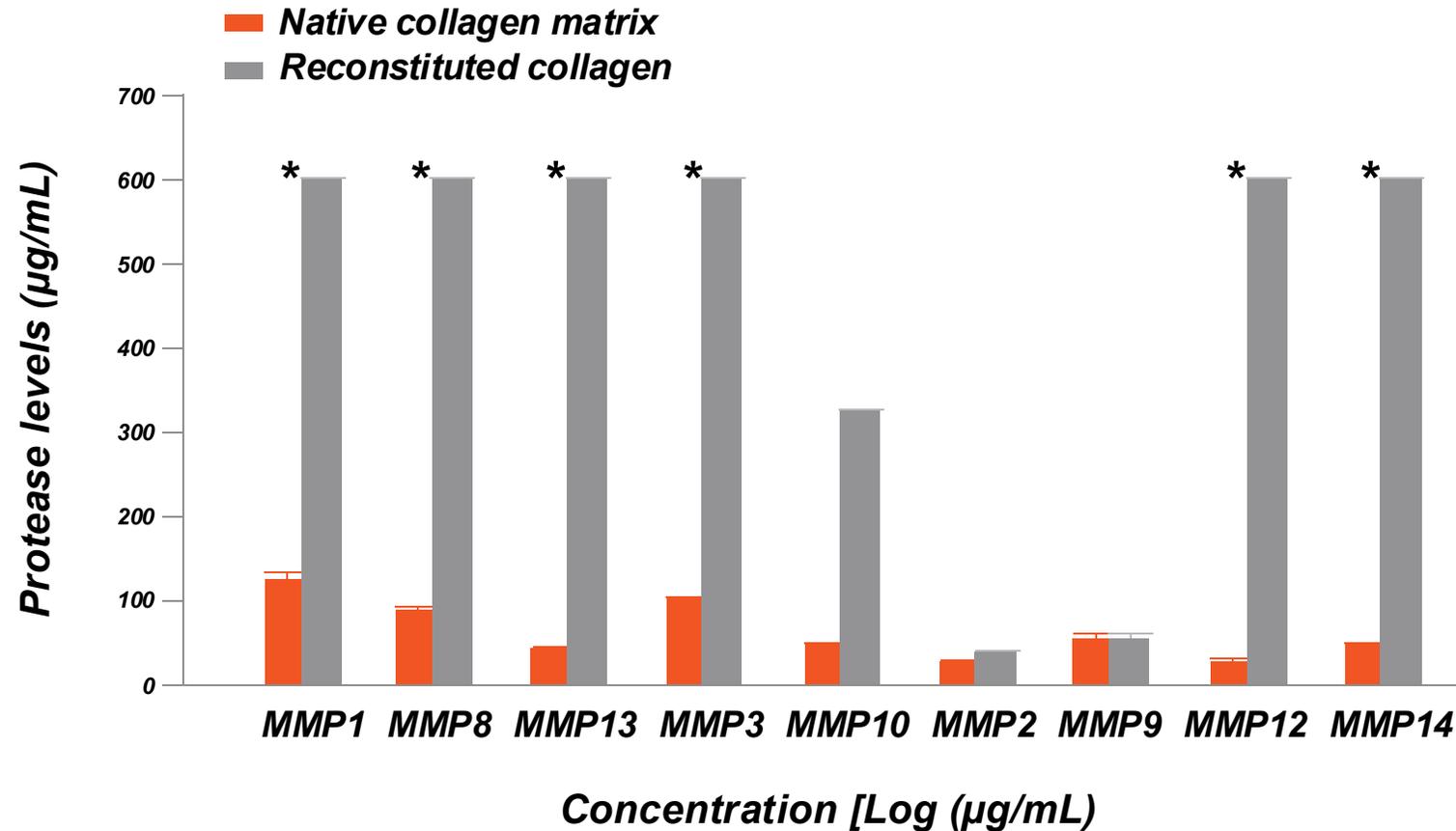
# Retaining the Native Collagen Matrix Inhibits a Wider Range of Proteases

***Intact collagen  
inhibits a wider  
range of proteases to  
address imbalance***



***Elevated proteases  
(eg, MMPs)***

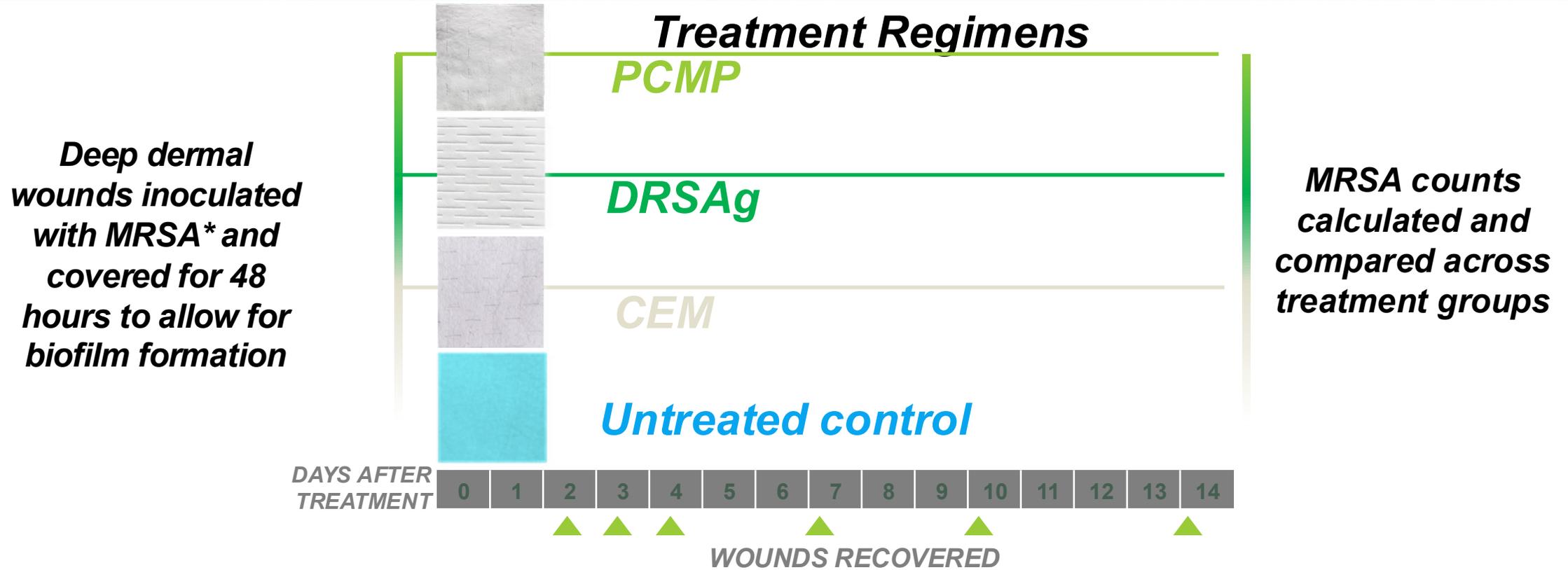
# Collagen That Retains Native Matrix Structure Is a More Potent Protease Inhibitor Than Reconstituted Collagen



\*Indicates samples where the IC<sub>50</sub> was estimated to be approximately 600 µg/ml or greater. Native collagen matrix: ovine forestomach matrix; reconstituted collagen: oxidized regenerated cellulose/collagen.  
Negron L, et al. *Int Wound J.* 2014;11(4):392-397.

# Scientific and Clinical Evidence

# Study Design: Effect of PCMP on MRSA Proliferation in Porcine Wound Model\*



MRSA = methicillin-resistant *Staphylococcus aureus*; DRSAg = dermal scaffold with silver; CEM = collagen extracellular matrix.  
Note: After treatment application, bacterial counts were assessed on days 2, 3, 4, 7, 10, and 14. This was a preliminary study with a small sample size, so these observational results are not statistically powered conclusions.  
\* Data on file. PDR-0001. Organogenesis Inc. \*\* Deep dermal porcine wound model that evaluated the ability of ECM plus PHMB to reduce MRSA (a biofilm-associated bacteria) compared to three other treatment groups.  
Davis SC, et al. Poster presented at: 9th Annual Symposium for Advanced Wound Care; October 20-22, 2017; Las Vegas, NV.  
Davis SC, et al. *Wound Repair Regen.* 2025;33(2):e70025.

# PCMP Substantially Reduced MRSA Counts\*\*

Largest reduction

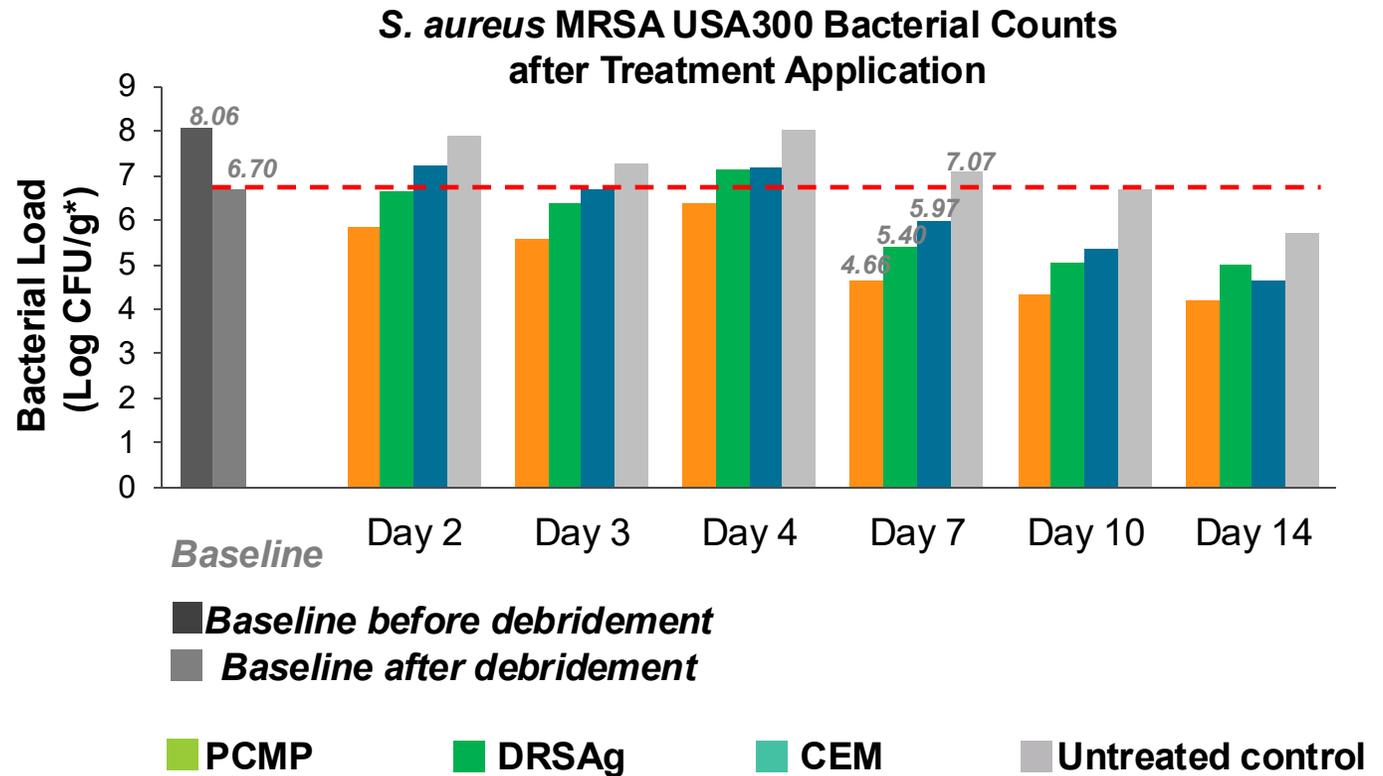
Only treatment

> 96% reduction

of MRSA counts vs any other treatment groups

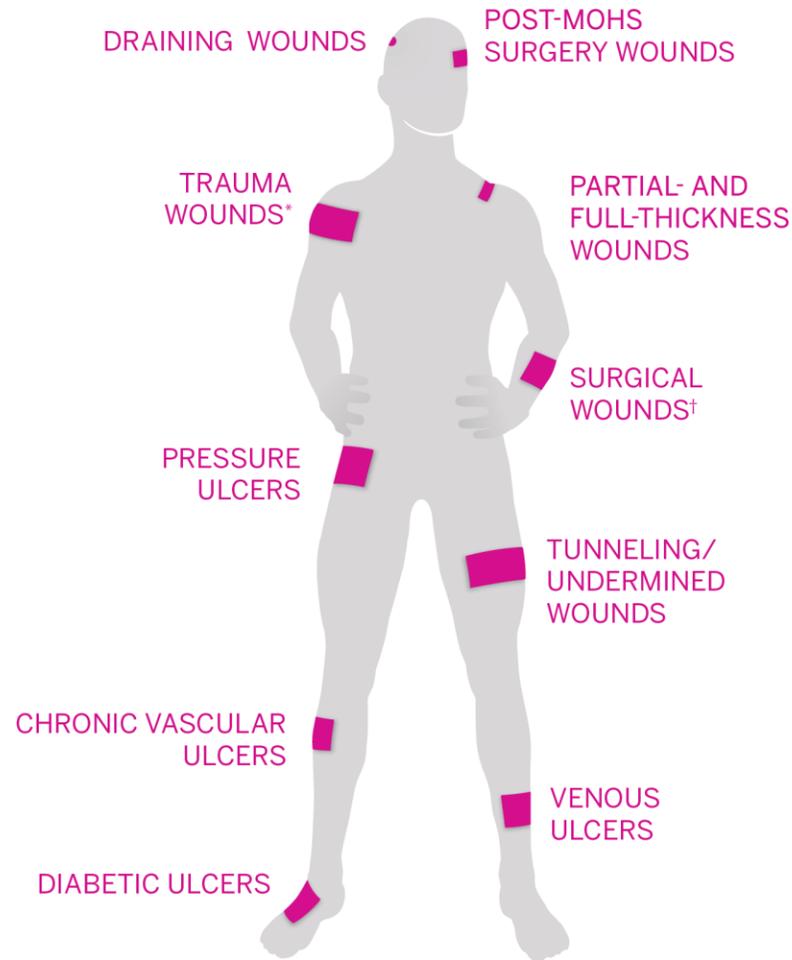
to substantially reduce MRSA within 2 days

of MRSA counts vs untreated control on all assessment days



\* Data based on colony forming units per gram (CFU/g) expressed using base 10 logarithm. \*\* Data on file. PDR-0001. Organogenesis Inc. Davis SC, et al. Poster presented at: 9th Annual Symposium for Advanced Wound Care; October 20-22, 2017; Las Vegas, NV. Davis SC, et al. *Wound Repair Regen.* 2025;33(2):e70025.

# PCMP Offers Multiple Sizes to Manage a Wide Variety of Wound Types



\* Abrasions, lacerations, second-degree burns, skin tears. † Donor sites/grfts, post-Mohs surgery, post-laser surgery, podiatric, wound dehiscence.

PuraPly Antimicrobial [package insert]. <https://puraplyam.com/pdf/PuraPly-Antimicrobial-Package-Insert.pdf>.

# Case Presentations

# Case Study: Surgical Dehiscence of the Lower Pole of the Sternum

- 84 y/o male
- S/p aortic valve replacement
- Referred by his cardiac surgeon for advanced wound care
- Received 6 applications of PCMP-XT\*
- Achieved complete wound closure after 9 weeks of advanced wound care



***Pre-debridement***



***Post-debridement***

# Case Study: Surgical Dehiscence



***PCMP-XT application***

# Case Study: Surgical Dehiscence

**Pre-debridement**



**Post-debridement**



# Case Study: Surgical Dehiscence

**Pre-debridement**



**Post-debridement**



**Wound closure**

# Case Study: Surgical Wound from Melanoma Excision

- 79-year-old female s/p excision of melanoma in situ and full-thickness graft 10/27/20
- Patient was referred for advanced wound care secondary to failed full-thickness graft
- Patient received 5 applications of PCMP-XT
- Patient's wound resolved in 6 weeks

# Case Study: Surgical Wound from Melanoma Excision



**12/2/20—Initial visit**



**12/9/20—PCMP-XT #1**

# Case Study: Surgical Wound from Melanoma Excision



**12/16/20—PCMP-XT #2**



**12/23/21—PCMP-XT #3**



**12/30/20—PCMP-XT #4**

# Case Study: Surgical Wound from Melanoma Excision



**Pre-debridement**



**Post-debridement**

**PCMP-XT #5**



**1/13/21—Discharged**

# Case Study: Post-Mohs Defect of Scalp

- 80 yo male, status post-Mohs resection of high-grade squamous cell carcinoma of scalp
- Serial application of PCHB collagen matrix



# Case Study: Status Post-Melanoma Resection

- 86 yo male with history of prior skin graft
- Refused a skin graft after bad experience
- Desired nonsurgical management



# Case Studies

**Charlie Cheng, MD**

Vascular Surgeon

Department of Cardiovascular Surgery

DeBakey Heart and Vascular Center

Houston Methodist Hospital

Houston, Texas

# Case Study 1

- This is a 60 yo male patient who presented with PAD and non-healing left foot wound
- Jan. 2020, he underwent stenting of popliteal artery to TP trunk, and angioplasty of the peroneal artery (only runoff)
- March 2020, he developed severe stenosis at the distal end of the stent and underwent stent extension into the peroneal artery
- June 2021, thrombosed stents and worsening wound; he underwent thrombolytic therapy, re-stenting, and wound debridement with decellularized dermal allograft coverage

# Case Study 1

- Aug. 2021, he presented with acute limb ischemia and foot numbness; he had infusion catheter placement for overnight thrombolytic therapy
- Next day, he underwent mechanical thrombectomy (pharmacomechanical peripheral thrombectomy device), angioplasty, and lower leg fasciotomy







# First Application



- Top foot: Dry with non-viable tissue over the wound
- At lateral fasciotomy wound, the muscles in the anterior compartment are not viable

# First Application



- After wound debridement
  - Lateral: 20 cm x 12 cm, 3 cm deep after removal of muscles in anterior compartment
  - Medial: 9 cm x 4 cm
  - Foot: 12 cm x 9 cm

# Second Application



- After wound debridement
  - Lateral: 19 cm x 7 cm
  - Medial: 8 cm x 3 cm
  - Foot: 12 cm x 9 cm

# Second Application



- Lateral wound: Defect in anterior compartment is almost filled in

# Third Application



- After wound debridement
  - Lateral: 19 cm x 6 cm
  - Medial: 7 cm x 2 cm
  - Foot: 12 cm x 9 cm

# Third Application



- Both the lateral and foot wounds with good granulation tissue

# Fourth Application



- After wound debridement
  - Lateral: 19 cm x 4.5 cm
  - Medial: 5.5 cm x 1.5 cm
  - Foot: 13 cm x 7 cm

# Fourth Application



- Wound appeared dusky on 10/14/2022
- Arteriogram planned for next OR

# Fifth Application



- After wound debridement
  - Lateral: 19 cm x 3.5 cm
  - Medial: Closed
  - Foot: 12.5 cm x 7 cm

# Fifth Application



- Arteriogram and stenting of peroneal artery on 10/22/2022
- Decided to apply decellularized dermal allograft (instead of ECM plus PHMB)

# Sixth Application



- After wound debridement
  - Lateral: 13 cm x 2 cm
  - Medial: Closed
  - Foot: 9 cm x 6.5 cm

# Sixth Application



- Another view of the lateral wound
- The decellularized dermal allograft did not take
- Reapplication of ECM plus PHMB

# Sixth Application



- Foot wound now perfused after revascularization

# Seventh Application



- After wound debridement
  - Lateral: Healed
  - Medial: Healed
  - Foot: 7.5 cm x 6 cm
- Decided to leave the scab on

# Seventh Application



- Wound healing nicely

# Eighth Application



- After wound debridement
  - Lateral: Healed
  - Medial: Healed
  - Foot: 7 cm x 5 cm

# Eighth Application



# Eighth Application



1/22/2022 (in Office)



2/3/2022 (in Office)



2/24/2022 (in Office)



3/10/2022 (in Office)



# Case Study 1

- End of March 2022, he underwent popliteal stenting for in-stent restenosis







4/27/2022 (in Office)



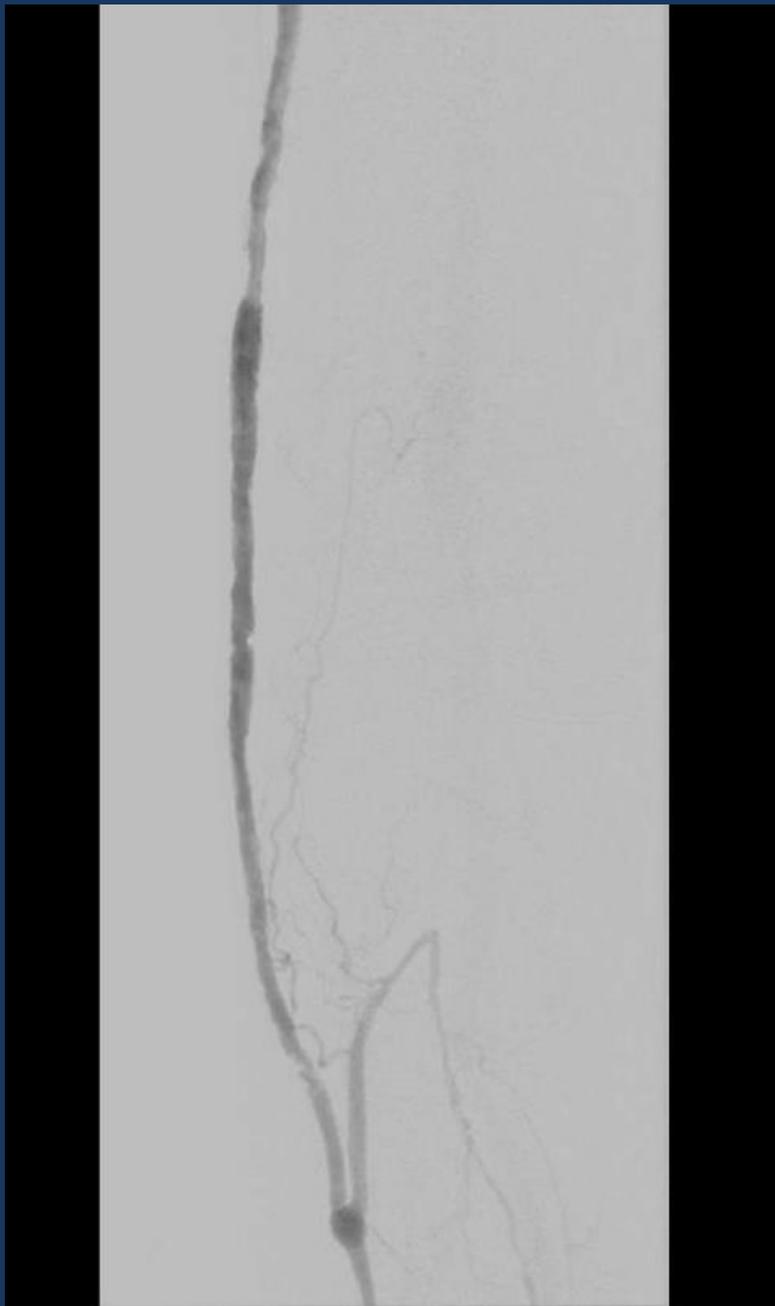
6/1/2022 (in Office)



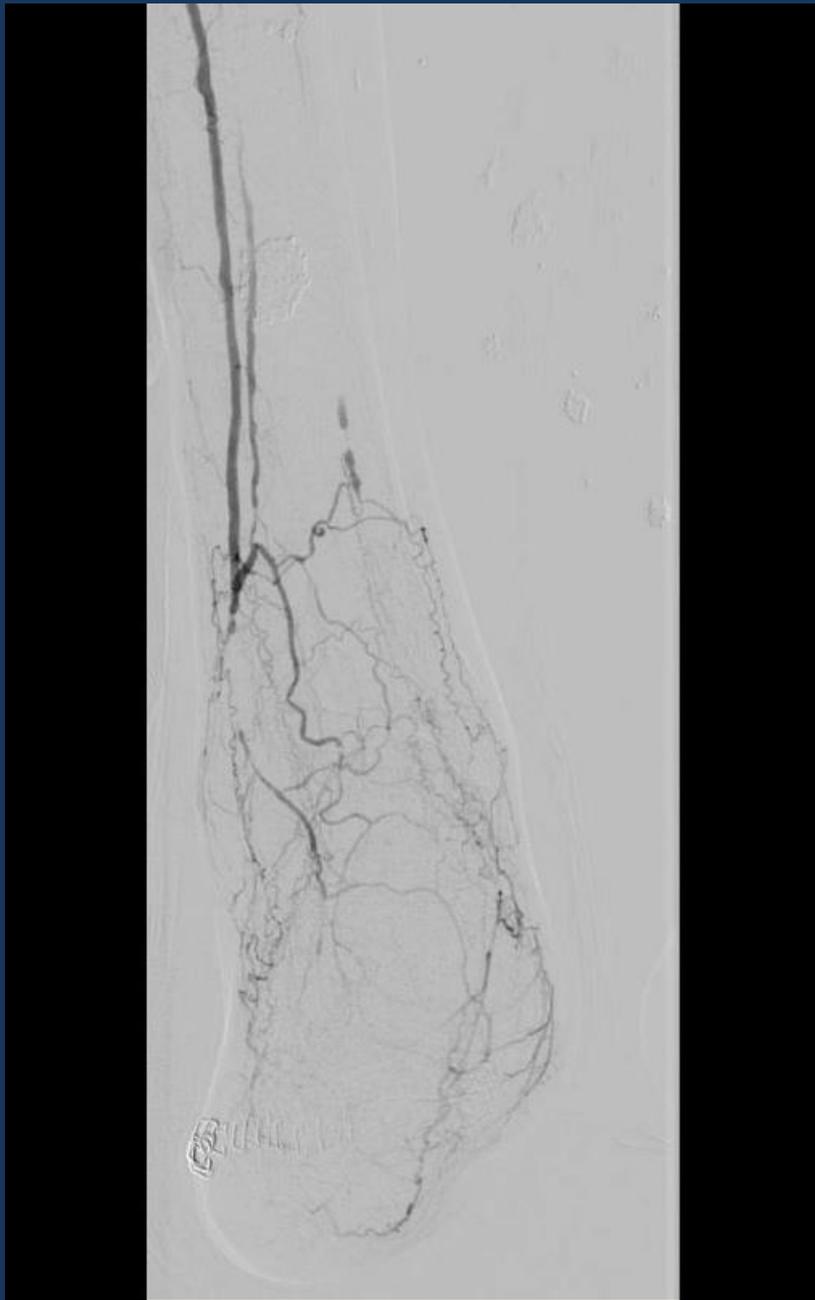
# Case Study 2

- This is a 72 yo male patient who presented with PAD and history of right leg bypass done > 10 years ago in California.
- In 2018, he presented with clotted bypass graft and underwent open thrombectomy
- In Dec 2021, he was admitted with toe gangrene and exposed metal plate from a toe surgery done in Sept 2021
- Podiatrist performed transmetatarsal amputation (TMA)
- Incision looked dusky, and performed arteriogram a week later







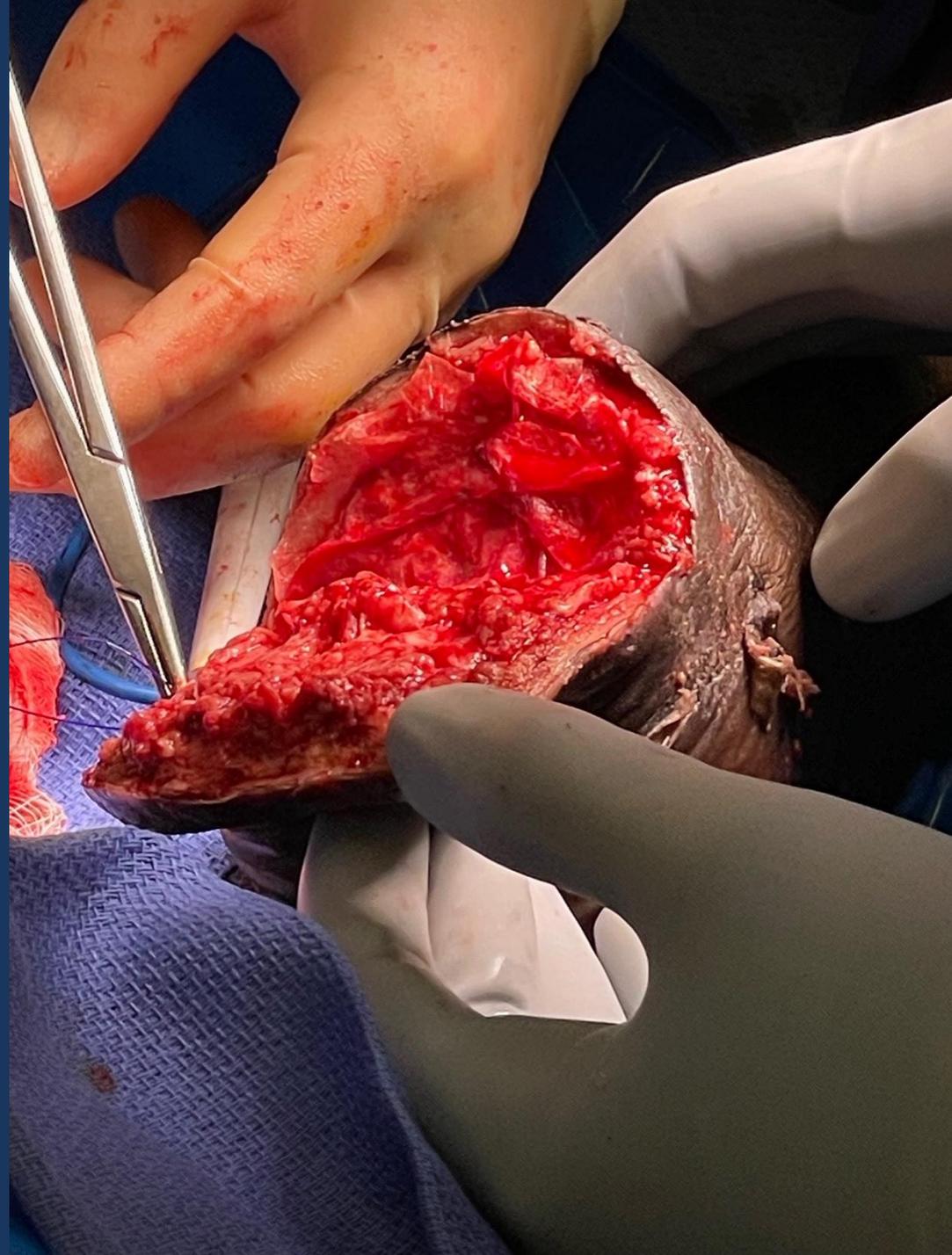


# Case Study 2

- It was noted that the TMA was not healing
- He was taken back for amputation revision 5 weeks after the first TMA









# Second Application

- 2 months later for 2<sup>nd</sup> application



METRIC  
INCHES

Devon®

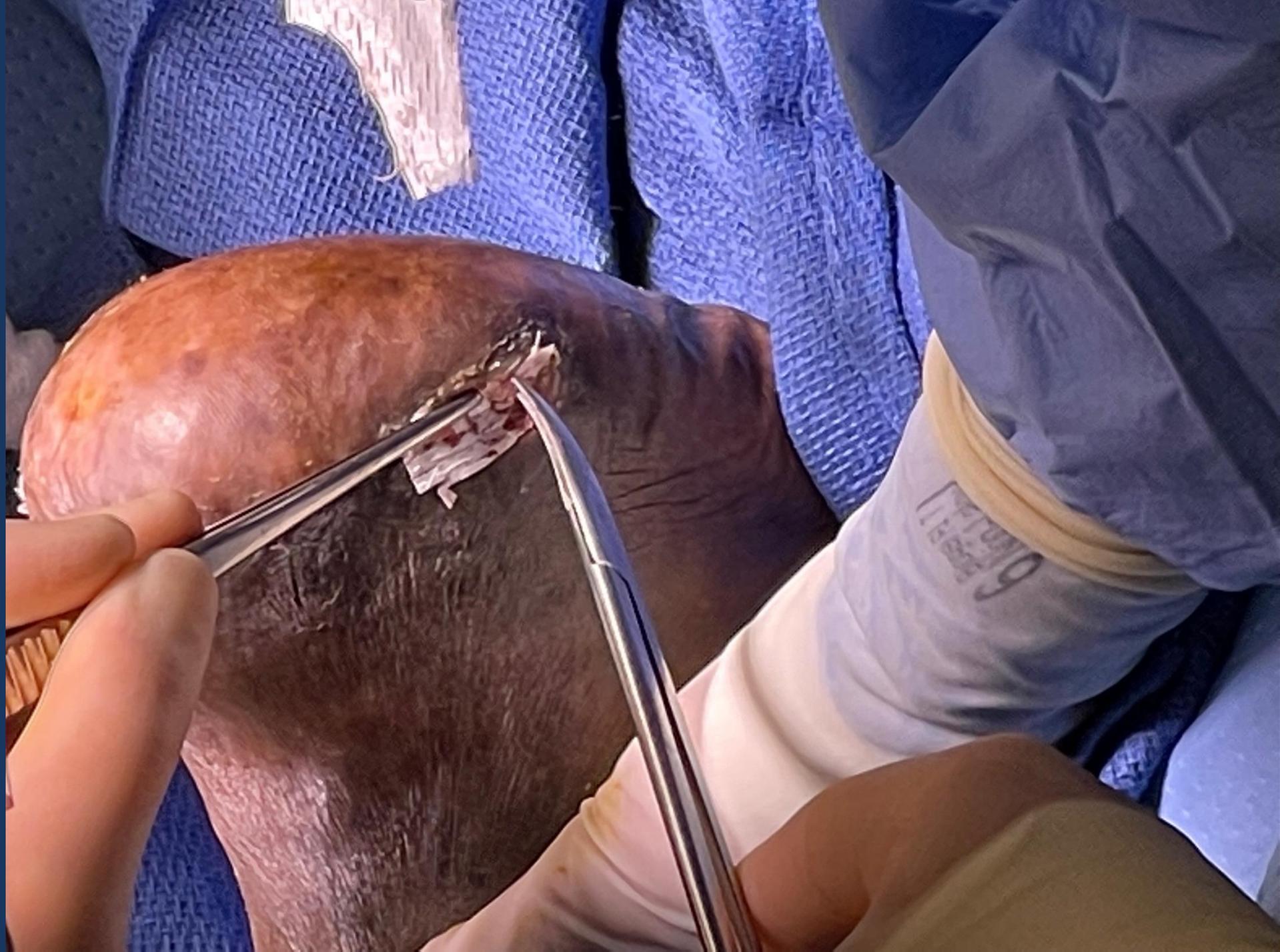
OR Product

Safety Solutions

Measurement device is not calibrated.







# Case Study 2

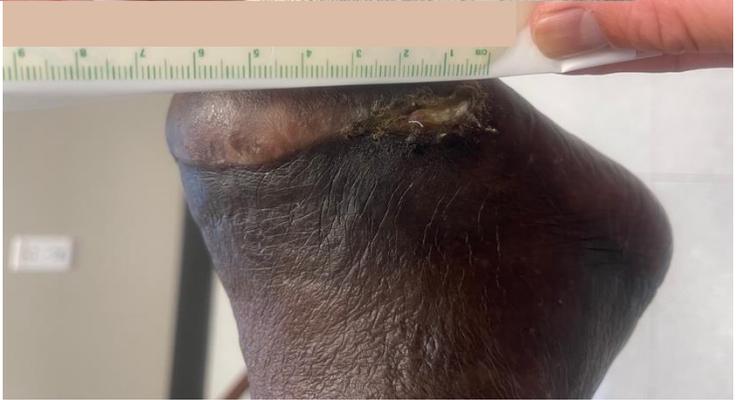
March in clinic



April in clinic



May in clinic





Date \_\_\_\_\_

Depth \_\_\_\_\_

Width \_\_\_\_\_

Wound Size: Length \_\_\_\_\_

Patient Name \_\_\_\_\_

# Case Study 2

- April in clinic



Patient Name \_\_\_\_\_

Wound Size: Length \_\_\_\_\_

Width \_\_\_\_\_



# Case Study 2

- May in clinic



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