Wound Progression and Healing in Non-surgically Debrided Directed Energy Wounds

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Defense Health Agency
RESEARCH & DEVELOPMENT

Disclaimer/ Animal Statement

The views, opinions and/or findings contained in this presentation are those of the author and do not necessarily reflect the views of the Department of War and should not be construed as an official DoW/Army position, policy or decision unless so designated by other documentation. No official endorsement should be made. Reference herein to any specific commercial products, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government.

Research was conducted in compliance with the Animal Welfare Act, the implementing Animal Welfare regulations, and the principles of the Guide for the Care and Use of Laboratory Animals. The facility's Institutional Animal Care and Use Committee approved all research conducted in this study. The facility where this research was conducted is fully accredited by the AAALAC International. Prior to any injury, animals were anesthetized with Telazol and provided analgesia with buprenorphine SR.

Our Mission & Vision

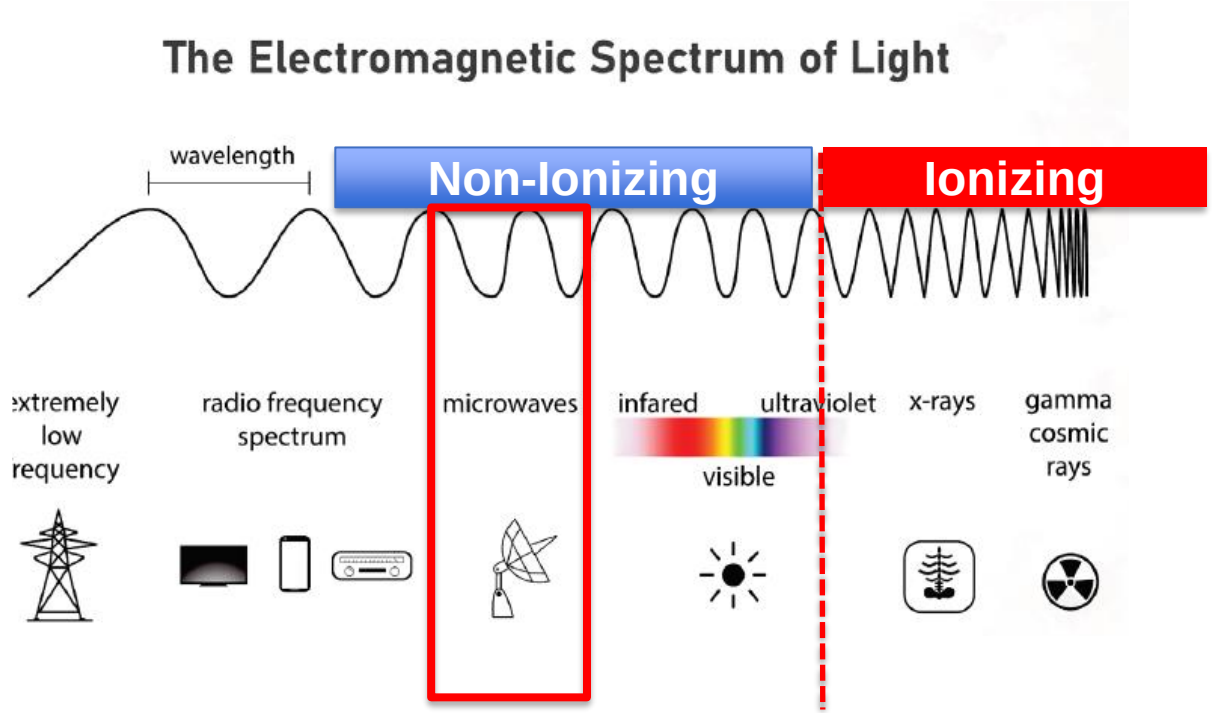
Mission

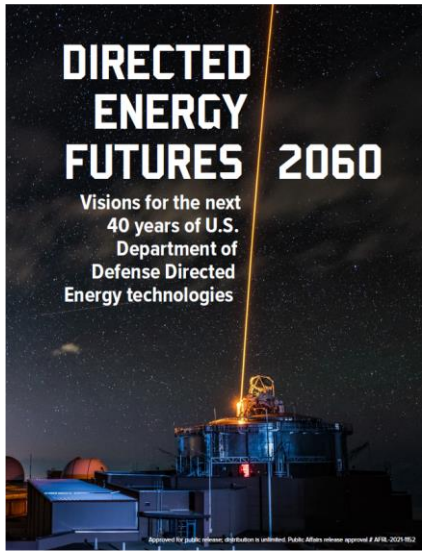
Responsively and responsibly create, develop, acquire and deliver medical capabilities for the warfighter.

Vision

Lead the advancement of military medicine.

What is Directed Energy (DE)?

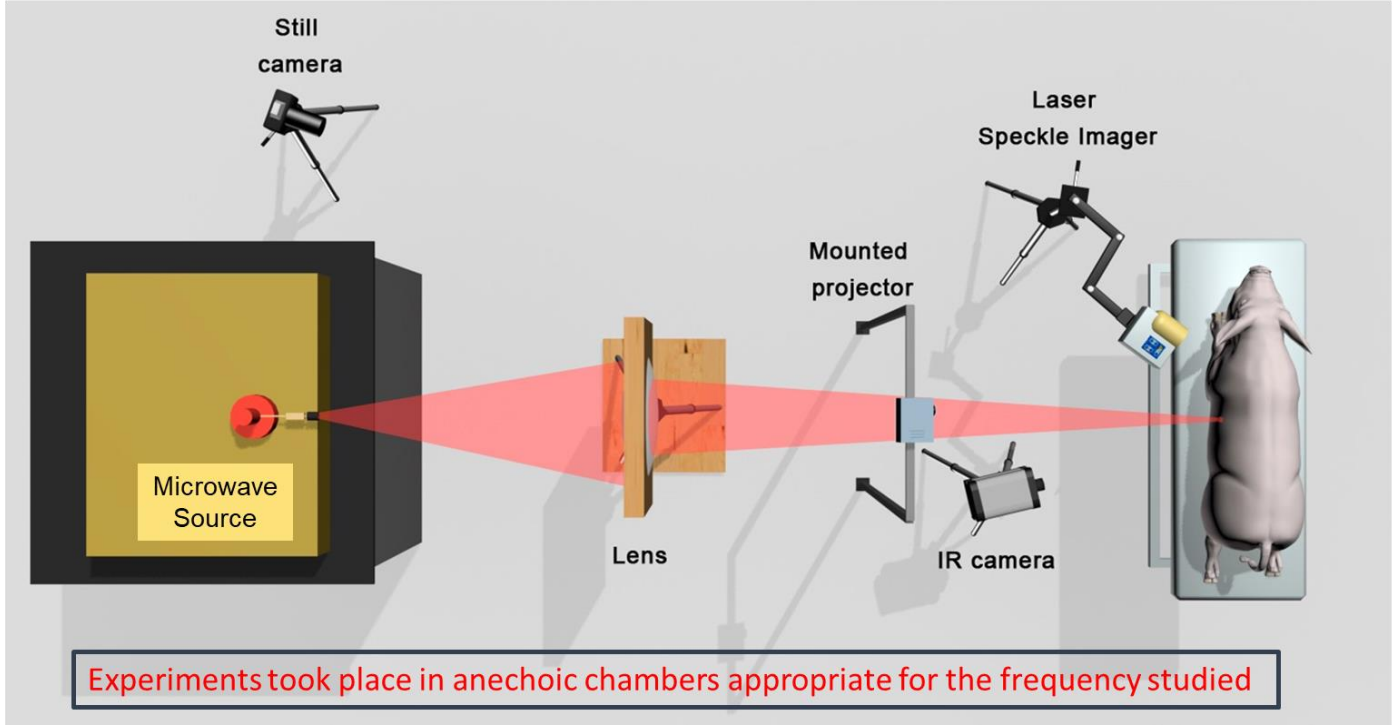




- » *Defined (for military applications) as* "the ability to project electromagnetic energy either broadly to provide information probing of the battlespace, or in a focused manner sufficient to produce a **defensive** or **offensive effect** at militarily relevant distances within the battlespace"
- » DoD is actively engaged in developing and employing Directed Energy (DE) technology for use in the global support of U.S. and allied forces

Collaboration with Air Force 711th HPW, Radio Frequency Bioeffects Branch

Lab Setup

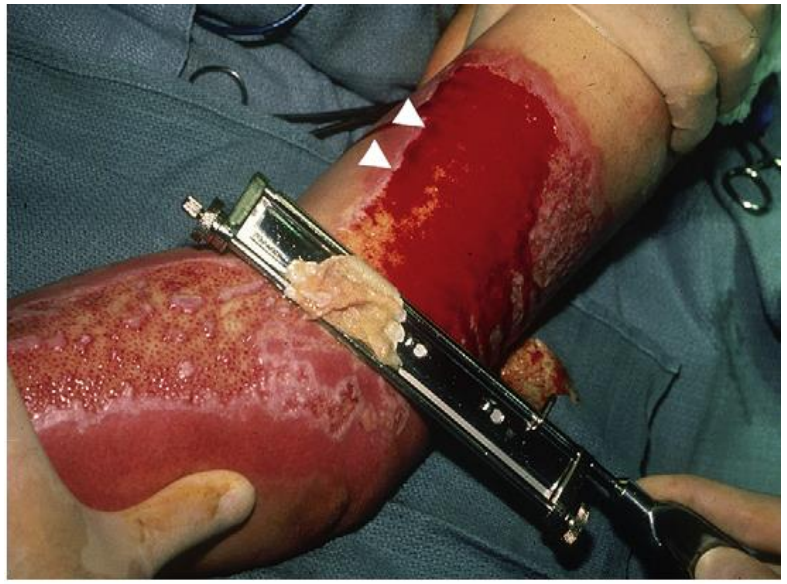


Initial 711th studies assessed:

1. The effect of carrier frequency
2. The effect of dose
3. Compare DE wounds to thermal contact burns
4. Efficacy of mathematical models

Burn Debridement

Surgical Theatre
Tangential excision



- Sufficient to remove eschar
- Painful
- Excessive bleeding
- Excessive Tissue removal

Field Care
Wet-to-dry debridement

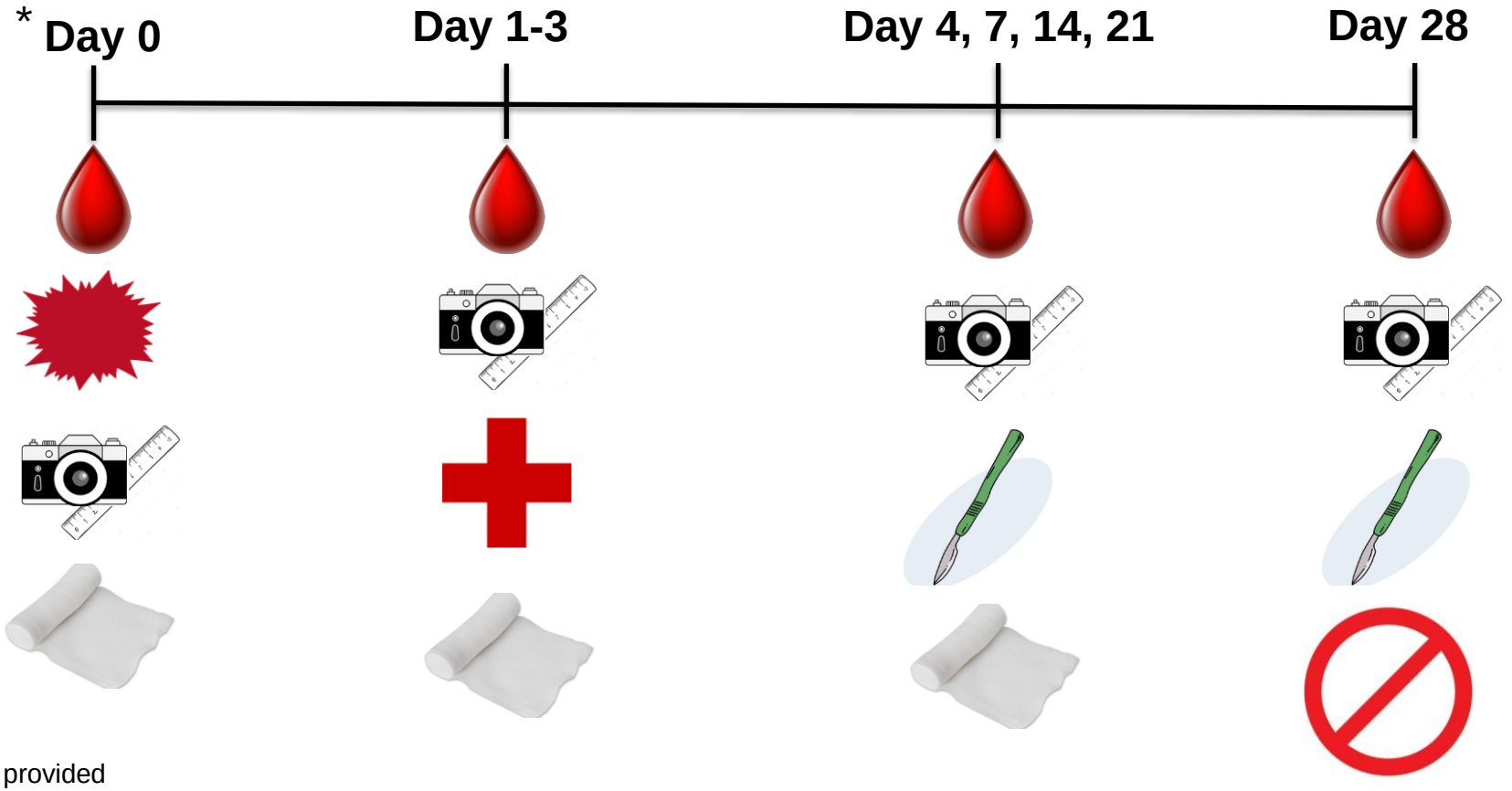
- Best practice for field care
- Little debridement efficacy
- Excess moisture may contribute to bacterial motility

Non-surgical Debridement Strategies

	Dry Gauze (Standard of Care)	Wet-to-Dry Debridement	Debrisoft	SN514
				
Compact	✓	✓	✓	✓
Shelf-stable	✓	✓	✓	✓
Minimal Scrubbing	✓			✓
Debridement Efficacy		✓	✓	✓
Prolonged Activity				✓

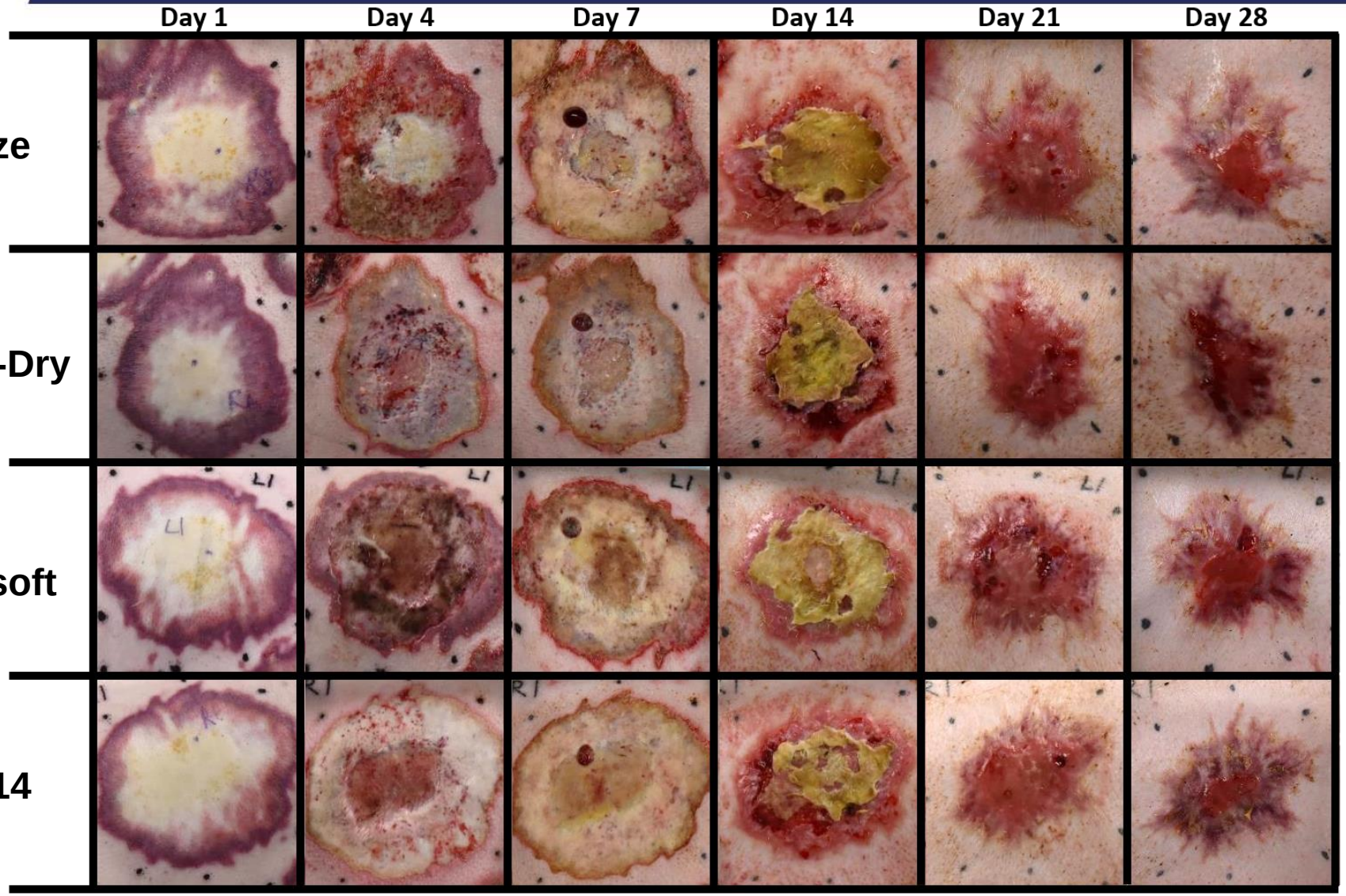
Methods

Hypothesis: DE induced partial-thickness burn injuries (8.2 GHz, 20 W/cm^2 for 5 s) will heal (re-epithelialize; wound closure) within the clinical threshold of three weeks post-injury (on par with contact burns), when using nonsurgical debridement treatments.



*Prior to injury, animals were anesthetized with Telazol and provided analgesia with buprenorphine SR.

Gross Image Assessment

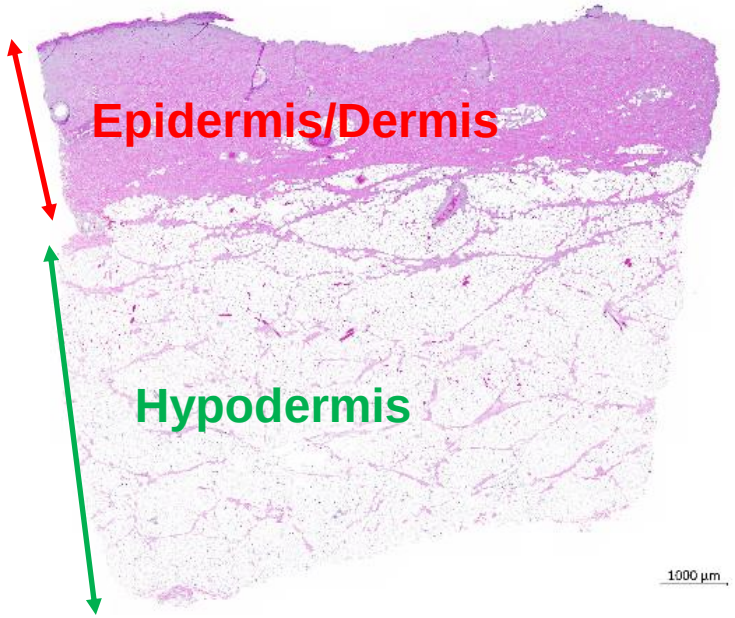


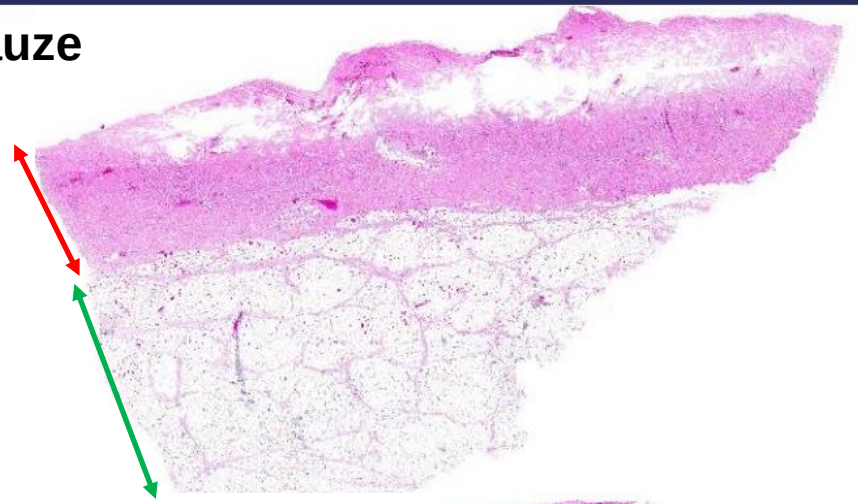
Histological Evaluation of Debridement Efficiency

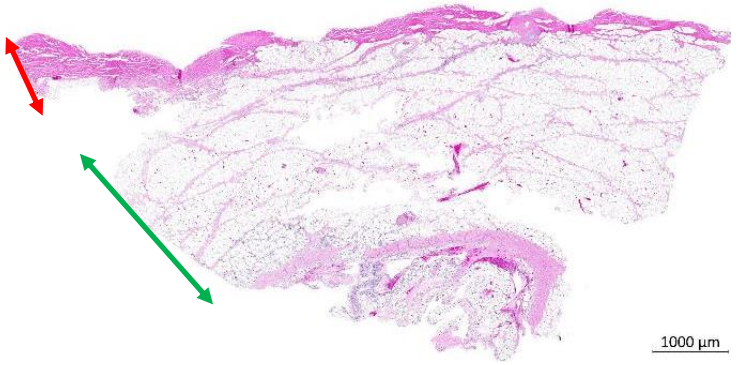
Gauze

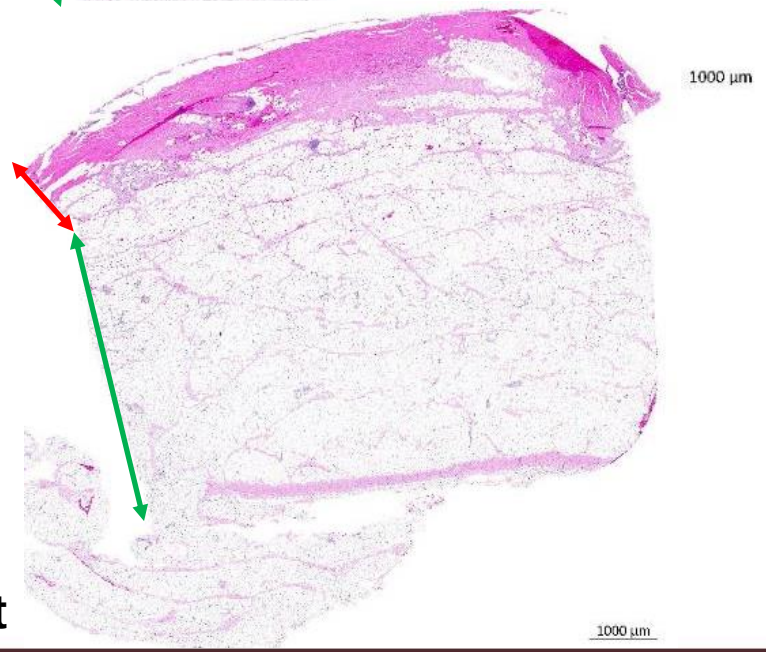
Wet-to-Dry

Untreated

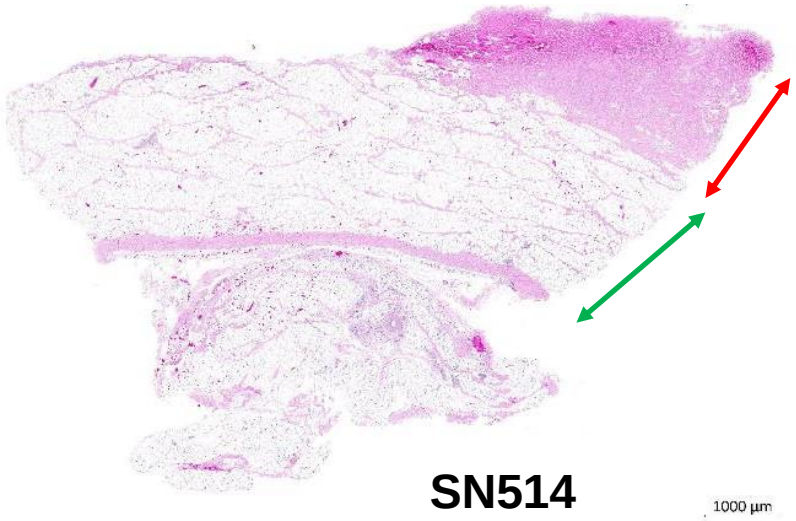






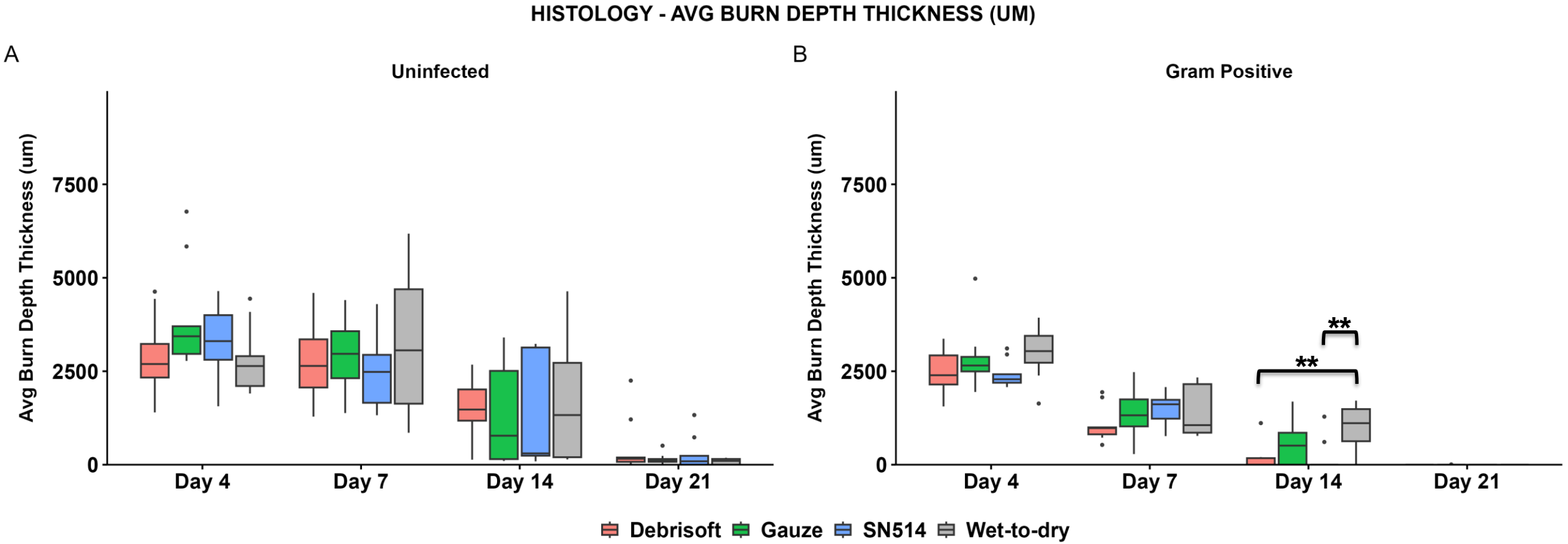


Debrisoft



SN514

Quantified Debridement Efficiency



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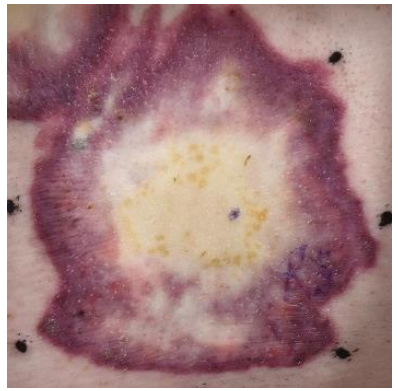
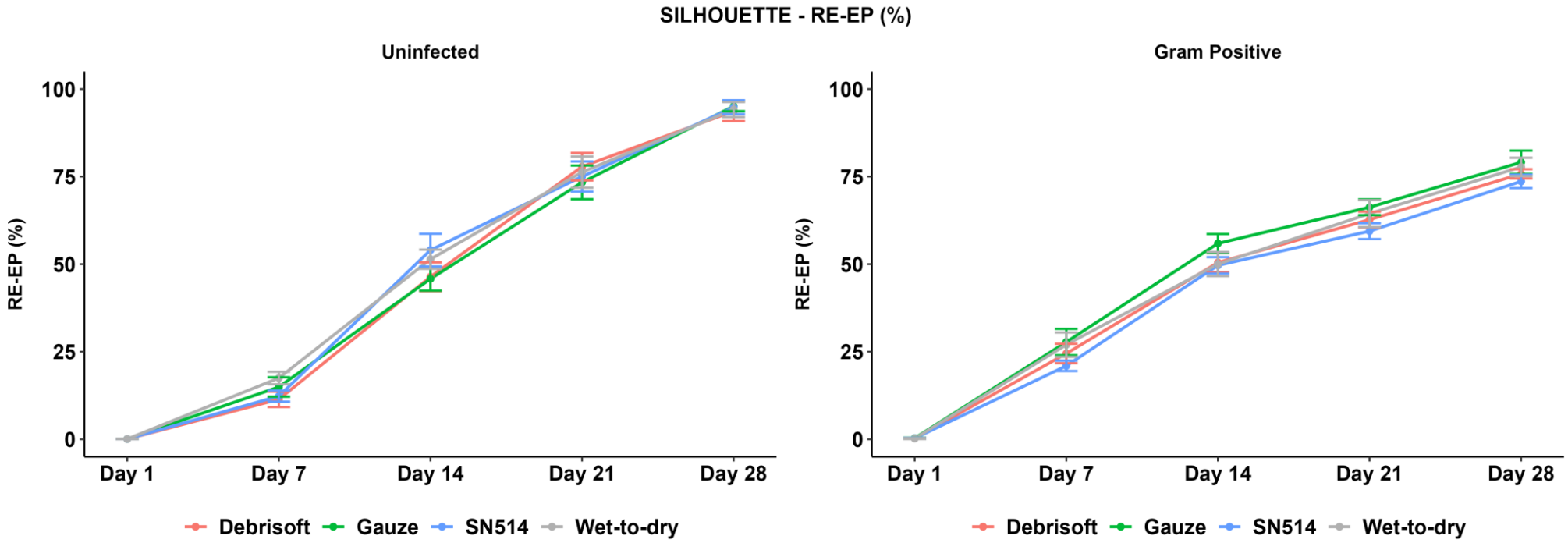
Wound Healing (Re-epithelialization)

Day 1

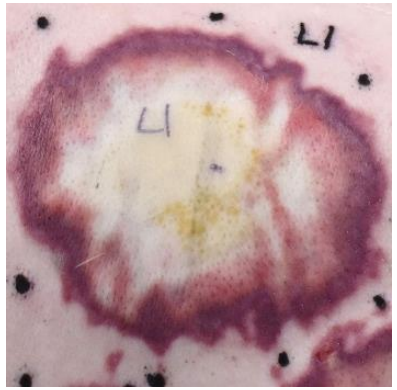


Day 28

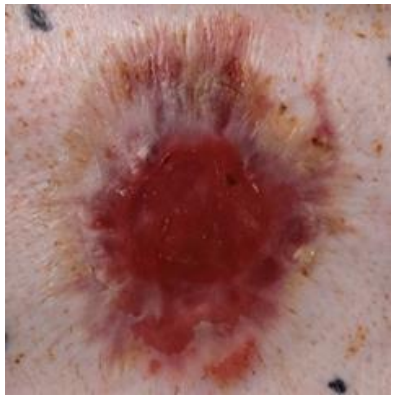


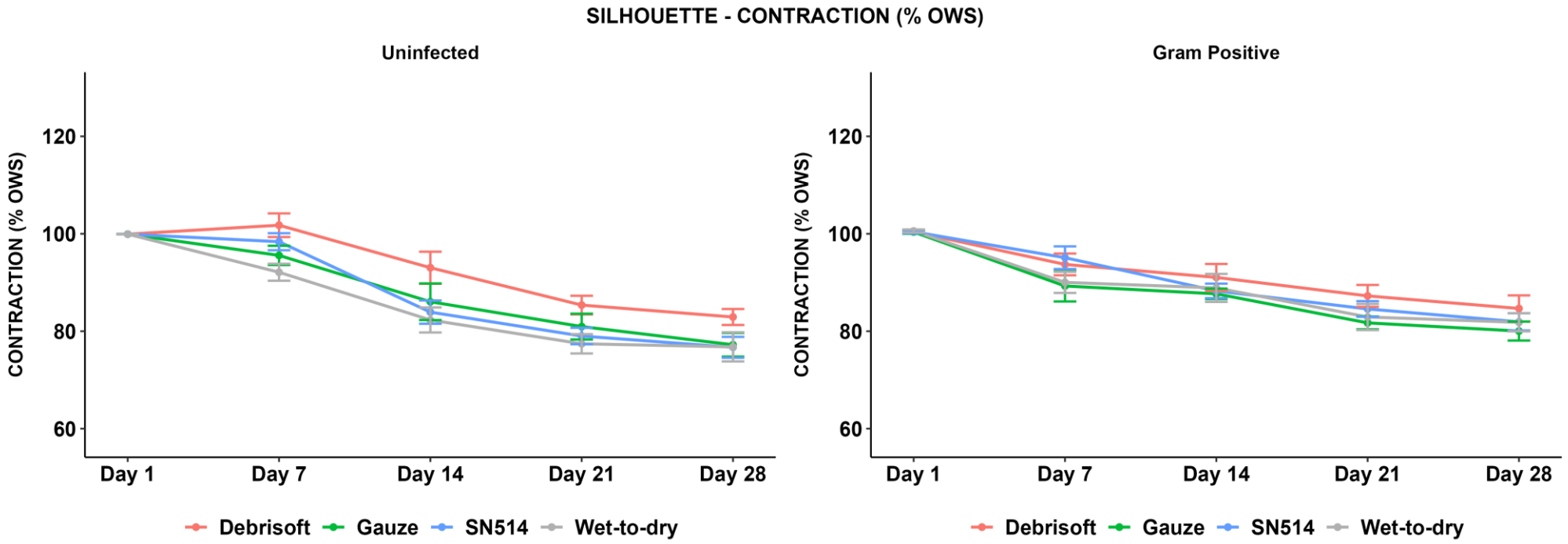
Wound Contracture

Day 1

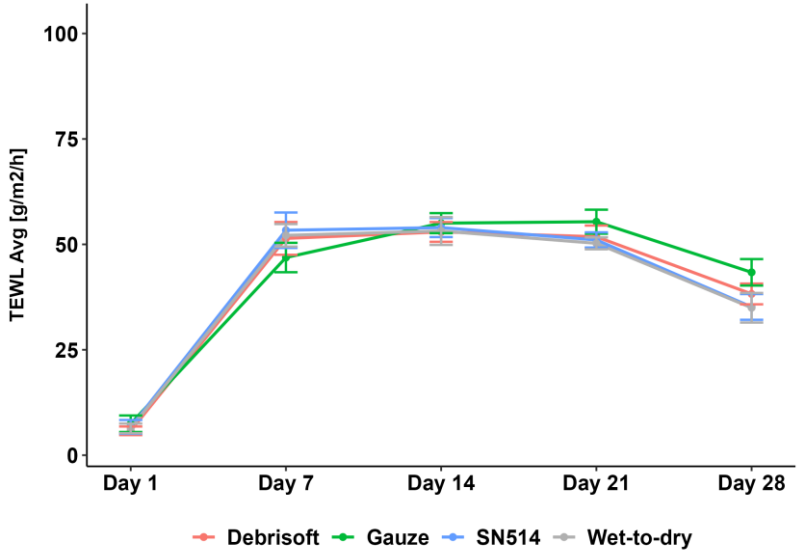


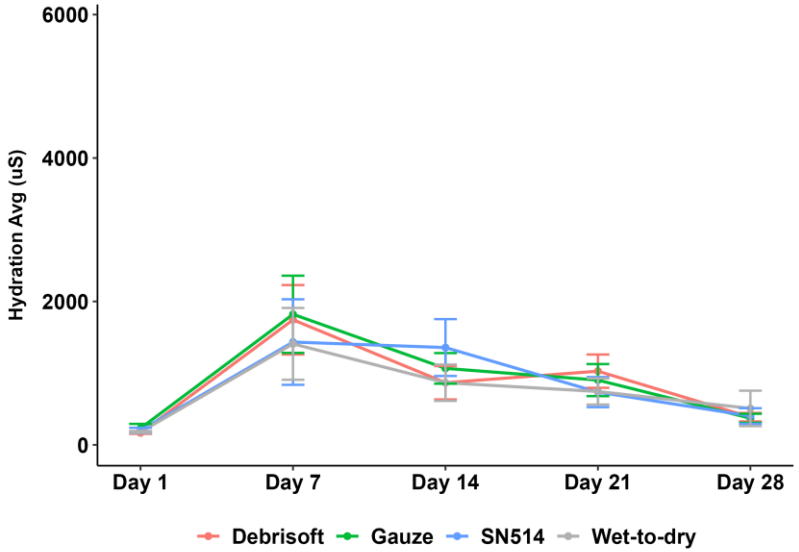
Day 28

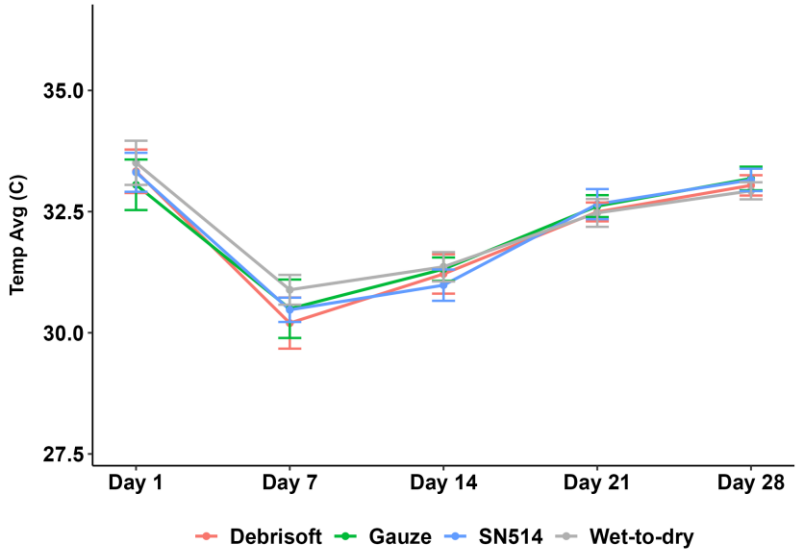




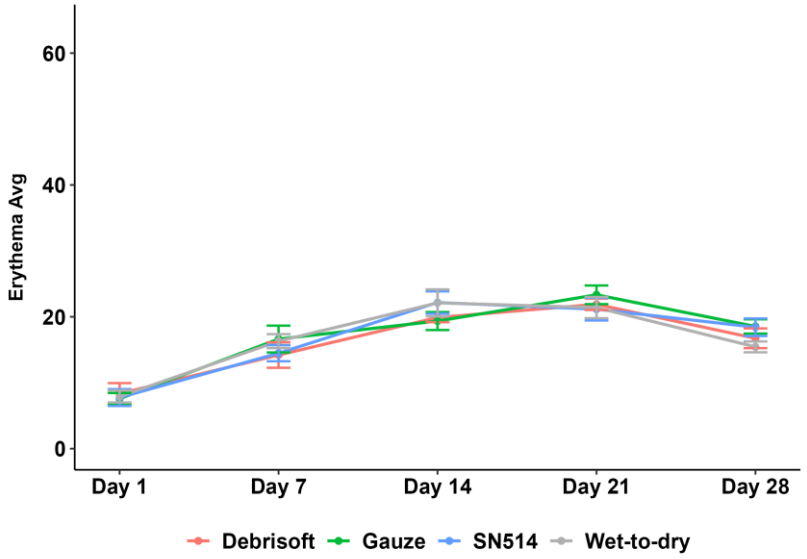
Skin Functional Assessments

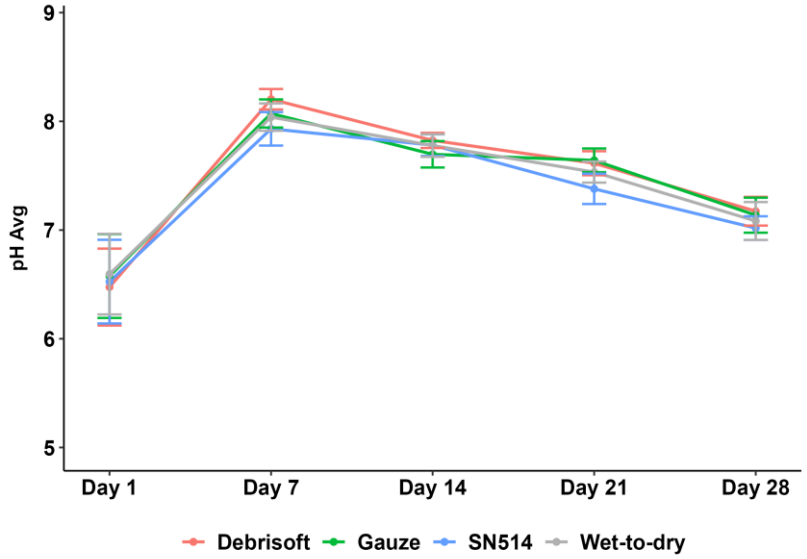


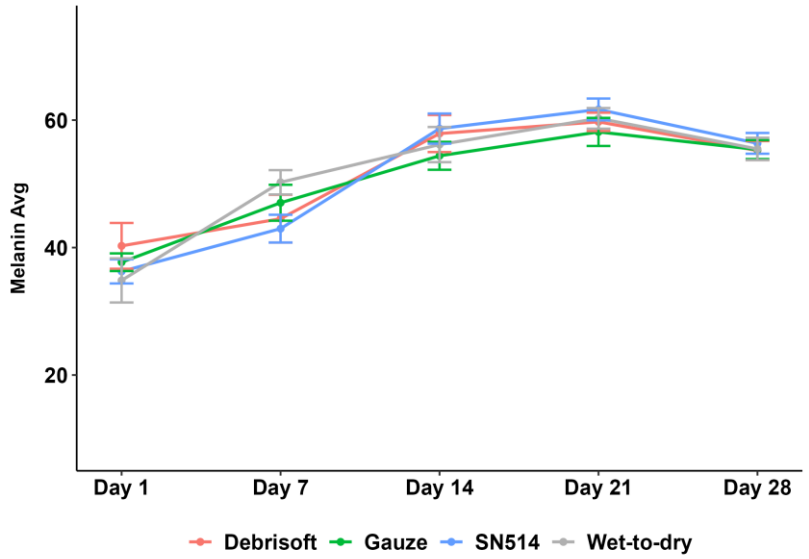




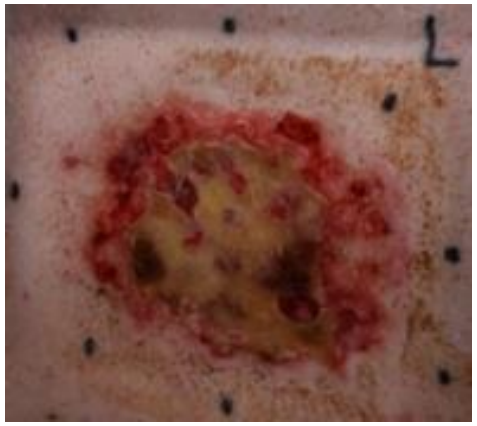
Skin Functional Assessments Cont'd

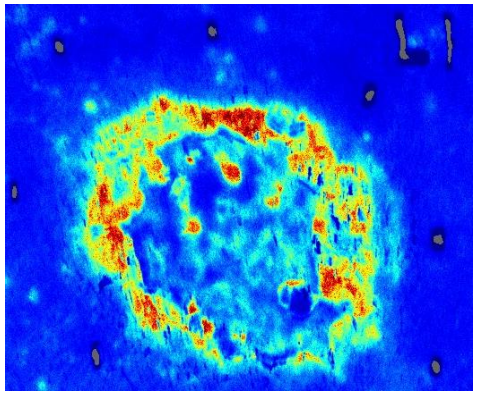


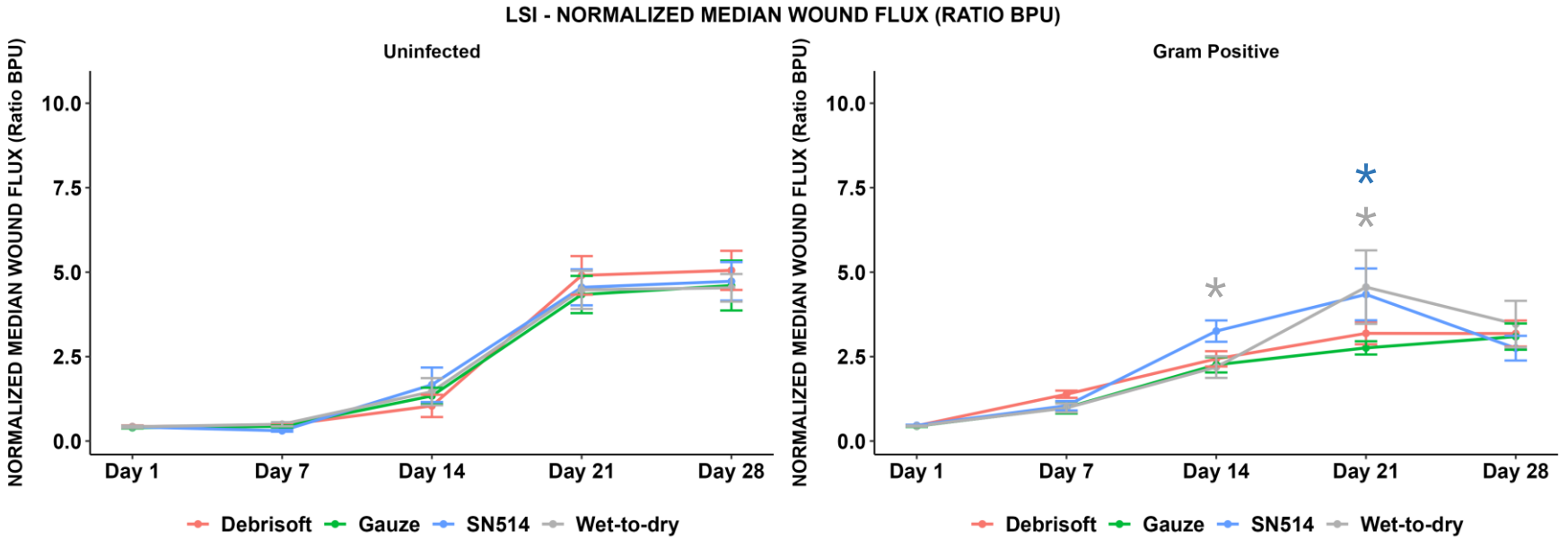




Wound Perfusion







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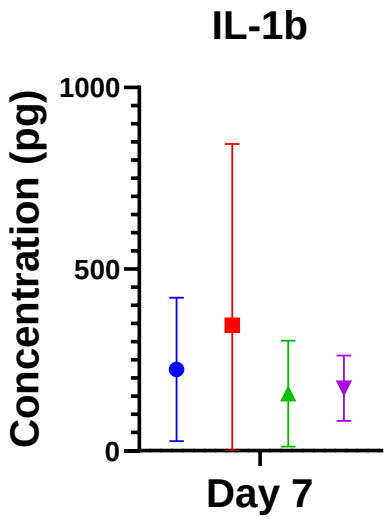
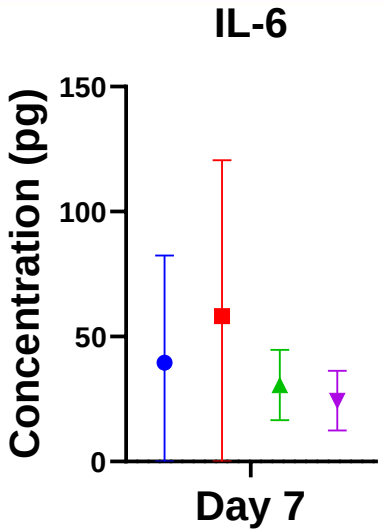
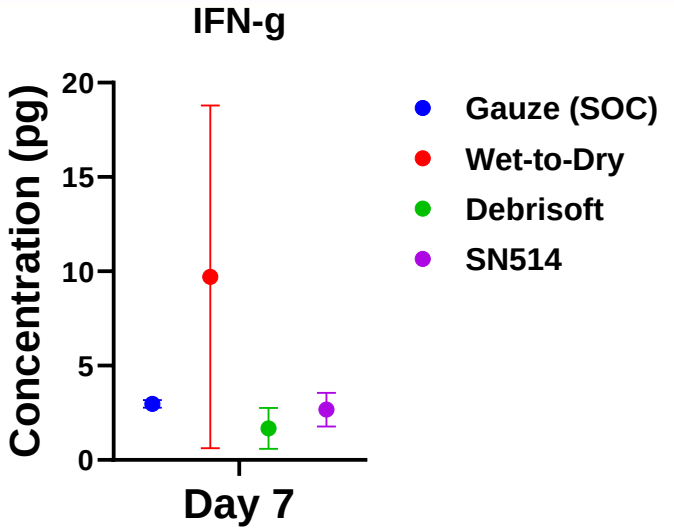
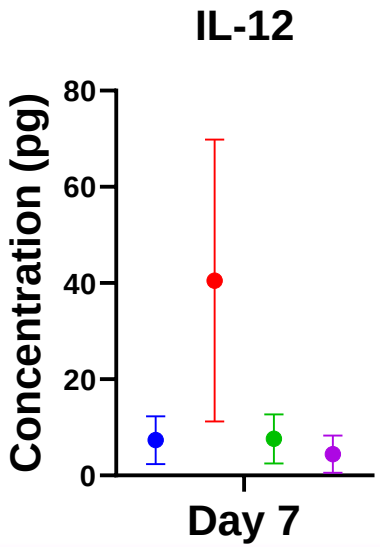
Statistical differences color coded and compared to Gauze

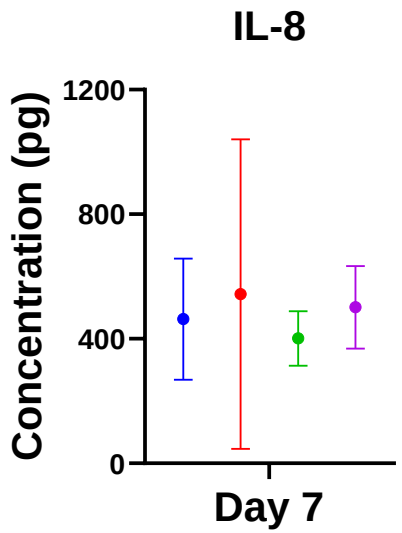
Wound Inflammatory Profile



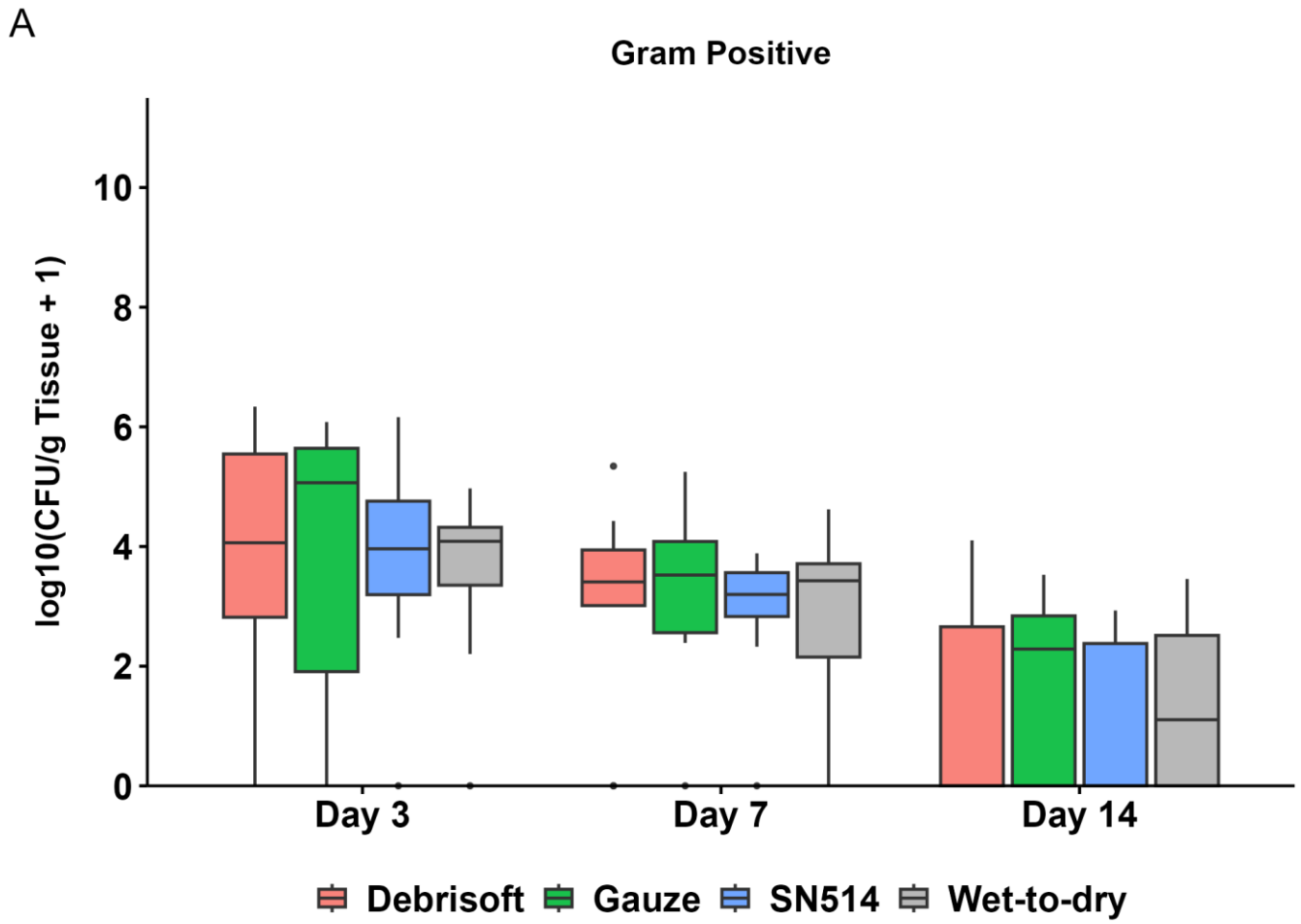








Bacterial Enumeration



Conclusions and Future Work

Conclusions:

- *Current CPG debridement as well as novel experimental debridement therapies support wound closure out to 21 days (SOC treatments are comparable).*
- *Debridement strategies improve critical facets that support wound healing (removal of necrotic tissue), leading to incremental improvements in wound closure rates.*
- *Some debridement strategies (SN514) limit excessive scrubbing/disruption of healthy tissue and may reduce the inflammatory response by using a more passive debridement process.*

Future Work:

- *More robust debridement strategies to mitigate delayed or incomplete healing due to DE burn infection.*

Acknowledgements

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