A CASE SERIES OF A THREE-DIMENSIONAL WOUND MATRIX FOR DEEP UNDERMINING SPACES

Iris Brammer, B.A.[1,2]; David Rezko, B.S.[3]; Joshua Noonan, B.A.[3]; Kelsey Lloyd, M.D.[1]; Joseph Molnar, M.D., Ph.D.[1]

[1]Department of Plastic and Reconstructive Surgery, Atrium Health Wake Forest Baptist, Winston-Salem, N.C.; [2]George Washington University School of Medicine and Health Sciences, Washington, D.C.;
[3]Wake Forest University School of Medicine, Winston-Salem, N.C.

ABSTRACT

BACKGROUND: Tunneling wounds present a significant reconstructive challenge due to irregular geometry, high infection risk, and delayed healing. Traditional two-dimensional xenografts often fail to fill deep undermining spaces. In contrast, three-dimensional extracellular matrices (3D-ECM) provide a volumetric scaffold that may better support cellular infiltration. However, clinical evidence of its reconstructive efficacy remains limited. The purpose of this case series is to describe early clinical outcomes using a porcine liver-derived, decellularized 3D-ECM in the management of deep and tunneling wounds. **METHODS**: We report seven cases of complex wounds in patients aged 11 to 80 years, each with extensive undermining or tunneling. Management included debridement, trimming and placement of 3D-ECM within deep spaces, coverage with non-adherent petroleum dressing, and negative pressure wound therapy (NPWT). Interval in-office debridement was performed as indicated during follow-up. **RESULTS:** Indications included traumatic lower extremity injuries (n=2), full-thickness electrical burn of the hand (n=1), chronic soft-tissue necrosis following lumpectomy or mastectomy (n=2), diabetic foot ulcer with osteomyelitis and fifth ray amputation (n=1), and stage IV sacral pressure ulcer (n=1). Post-excisional wound depth ranged from 3-10 cm, though two cases were immeasurable due to multiple tunneling tracts and irregularity. All patients underwent serial debridement; two required planned split-thickness skin grafting. Complications included abscess, postoperative fevers, neuropathic pain, and scar contracture. One patient required re-exploration for fever on postoperative day 5, which revealed healthy granulation and resolved tunneling without evidence of infection. Another patient experienced bleeding into the NPWT, successfully managed with topical hemostatic agents. Overall, all patients demonstrated significant reduction in wound depth and tunneling (final depth 0.1-1.3cm), with three achieving complete closure. Follow-up ranged from 1 to 14 months; no patients were lost to follow-up. **CONCLUSION:** 3D-ECM was well-tolerated and facilitated partial or complete wound closure across diverse etiologies with minimal complications. These early outcomes support the utility of volumetric matrices as an adjunct in managing deep and tunneling wounds. However, further studies are warranted to assess long-term healing and establish standardized protocols for patient selection and integration into reconstructive algorithms.

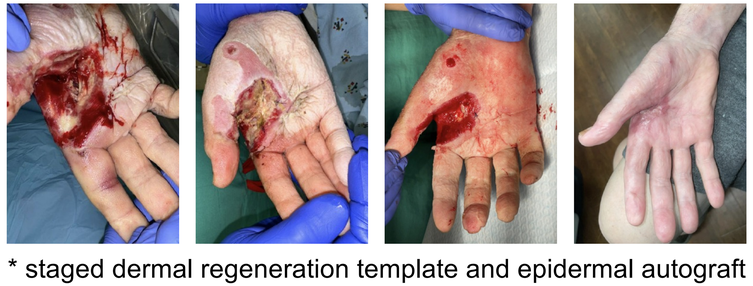
BACKGROUND

- 2D matrix fails to fill deep, irregular spaces
  → high infection risk, delayed healing
- 3D-ECM provides volumetric scaffold

Objective: describe outcomes of porcine liver-derived 3D-ECM use across diverse wounds

43 F with history of diabetes, hyperlipidemia, and tobacco use presented with limb-threatening left foot open fracture-dislocation and extensive soft-tissue loss following a motor vehicle accident

70 M with history of diabetes, hypertension, hyperlipidemia, myasthenia gravis on chronic prednisone, and tobacco use (former) presented with full-thickness electrical injury with muscle damage, creating a deep wound requiring 3D-ECM



* staged dermal regeneration template and epidermal autograft

- All patients received NPWT and non-adherent dressings
- Follow-up varied by wound severity (1-14 months)

Case Presentation		Initial[a]	Final[c]	Outcome
80F	Left breast *radiation-induced necrosis*	10 x 6 x 3	3.6 x 5.1 x 0.6	• Uncomplicated • Near complete healing
51M	Left foot *osteomyelitis, diabetic ulcer*	16 x 5.5 x 3.1	11.5 x 3.1 x 0.1	• Uncomplicated • Partial STSG take with healthy granulation
11M	Left buttock/ thigh *traumatic, boat propeller*	4 x 16 x 10	Healed	• POD5 fever, return to OR, healthy granulation • Complete healing
57M	Sacrum/ buttock *stage IV pressure ulcer*	3.8 x 4 x 6	1.4 x 0.8 x 0.5	• POD5 bleeding resolved with hemostatic agent • Near complete healing
70M	Right hand *electrical burn*	6 x 5.5 x NA	Healed	• Full STSG take • Scar release • Complete healing
43F	Left foot/ ankle *traumatic, motor vehicle accident*	12 x 6 x NA	Healed	• Uncomplicated • Mild plantar hypersensitivity • Complete healing
62F	Right flank *non-healing abscess, mastectomy and flap reconstruction*	26 x 10 x 5	5 x 12 x 1.3	• Much smaller wound, progressive healing • Lost to follow-up

[a] Post-debridement (cm); [b] months; [c] size at last follow-up (cm)
NA=Not available due to irregularity of undermining; STSG=split-thickness skin graft; POD=post-operative day; OR=operating room; FTSG=full-thickness skin graft

CONCLUSION

Porcine liver-derived, decellularized 3D-ECM demonstrated favorable healing across diverse cases, supporting its value as an adjunct for complex, deep and tunneling wounds.

- Future areas for research:
  → prospective trials with standardized outcomes
  → efficacy, utility, and cost of 2D and 3D matrices

Conflict of Interest: The authors declare no financial or non-financial conflicts of interest. No sponsorship was received from Miro3D or its manufacturer, Reprise Biomedical, Inc..