Using a Novel Polylactic Acid Dermal Matrix for Achieving Closure and Limb Salvage in Hard-to-Heal Wounds

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Background

Objective:

- Here, we present **four cases of hard-to-heal wounds** where a synthetic **polylactic acid (PLA) closure matrix** led to restoring an appropriate healing environment, full wound closure, and **limb salvage**.

Background:

- The delicate interplay of cellular recruitment, extracellular matrix deposition, neo-angiogenesis, and the regulation of the immune environment governs wound healing.
- When these elements are disturbed, healing is arrested, and the wound becomes chronic.
- PLA has demonstrated excellent closure outcomes for patients with chronic wounds by **restoring the interplay of the key elements of wound healing**.
- This is achieved because the **lactate** released by the PLA matrix acts as a paracrine agent (lactormone) with potent signaling effects that include:
  - **Hypoxia mimicking** and triggering of **neo-angiogenesis**
  - **Cell survival and proliferation**
  - **Anti-inflammation**
  - **Wound pH acidification**

Modified from Calcif Tissue Int. 2022 Mar;110(3):349-366.

Application Protocol

- **Wound bed preparation:**
  - Excise devitalized tissue completely.
  - Bring to hemostasis.
- **PLA closure matrix application:**
  - Apply the matrix to cover wound surface, ensure intimate contact to wound bed.
  - Surgically fix with sutures, staples, or Steristrips.
- **Apply two more layers of dressings**
  - Apply a non-adherent separation layer to secure the matrix in place.
  - Apply gauze dressings, hydrogel pads or sponges as needed to create a protective barrier and for moisture control.
  - Apply gauze and elastic dressing as outer dressing.
- **Assess the healing process after 7-10 days**
  - Apply a new matrix to promote healing.
  - Graft tissue, if needed.

Case 1

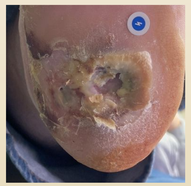
Initial Presentation
After a deep abscess drainage of the foot, systemic antibiotic therapy, and local use of antibiotic cement, this patient presented with a 25 cm^2 wound with extensive necrotic tissue. The devitalized tissue was excised and PLA matrices were applied to fill the defect.

Week 5
After 4 weekly applications, the wound bed presented granulation tissue that covered all previously exposed tendons. The wound size recorded was 9.51 cm^2, representing a 62% reduction in size. Note how the fourth toe has completely healed and its amputation avoided.

Week 12
After 10 weekly applications, the wound was completely healed. The patient regained full function, with adequate toe mobility and no pain on ambulation.

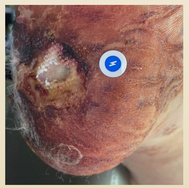
- Patient 1 was a 60-year-old male with diabetes, heart failure, peripheral arterial disease, and a 25.2 cm^2 foot ulcer secondary to abscess drainage.
- On initial presentation, bone and tendons were exposed, and necrotic tissue was present.
- After thorough debridement and antibiotic management, PLA matrices were applied weekly, leading to full closure after 12 weeks.
- No tendons were lost, and the foot regained full function.

Case 2

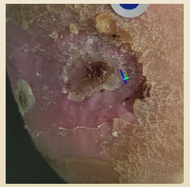


Initial Presentation
5.5 cm^2

Week 2
5.2 cm^2 after debridement



Week 5
1.3 cm^2 (77% reduction in size)

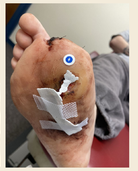


Week 7
Fully healed

- Patient 2 is a 47-year-old type 1 diabetic individual with an open heel ulcer for the past 2 years.
- The patient was diagnosed with osteomyelitis and underwent several antibiotic courses.
- After the last one, PLA matrices were applied to the wound bed, which was fully closed after 7 weeks.
- No further osteomyelitis episodes were documented.

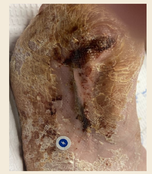
Case 3

Initial Presentation
15.0 cm^2



Initial Presentation
PLA application

Week 4
5.4 cm^2 (64% reduction)

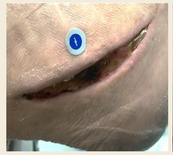


Week 7
1.7 cm^2 (88% reduction)

Week 9
Fully healed

- Patient 3 is a 35-year-old female with diabetes, obesity, and an acute plantar wound.
- Previous wounds on this patient led to non-healing and required amputations, so the decision was made to use PLA matrices immediately.
- Complete closure was obtained after 9 weeks of treatment without any complications.

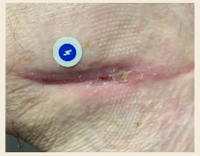
Case 4



Initial Presentation
3.1 cm^2

Initial Presentation
PLA application

Week 7
2.4 cm^2 (21% reduction)



Week 15
Fully healed

- Patient 4 is a 56-year-old male with a history of heavy smoking and Lyme disease who underwent a peroneal tendon repair.
- The post-surgical wound experienced dehiscence and tendon exposure.
- PLA matrices were used to protect the tendons and promote wound healing.
- After 15 weeks of treatment, the wound was completely healed, and the foot showed a normal range of motion.

Discussion

- PLA closure matrices induce a robust healing response in hard-to-heal wounds.
- Here we illustrate how these matrices can cover bone and tendon structures, maintaining tissue viability and promoting the deposition of granulation tissue on top of it.
- Furthermore, they can be introduced early in the wound care pathway. It will adapt a fibrous necrotic wound to a granular one that, in turn, can support re-epithelization. The pH modulation of the wound bed environment reduces bacterial load and may prevent infections.
- Together, PLA matrices helps preserve tissue integrity and avoid amputations.

References

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