

# From Sea to Skin: Acellular Fish Skin Matrix for a Complex Anterior Ankle Wound in a Patient with Diabetes & Multiple Comorbidities: A Case Report

## CASE REPORT

**38-year-old male:** Type 1 diabetes (A1c 13%), CKD stage 3, neuropathy, retinopathy, erectile dysfunction, prior amputations, CVA.

**Wound:** Chronic >2 years, anterior ankle, exposed tibialis anterior tendon, rolled edges, necrosis.

**Procedure:** OR debridement → fragmented AFSM into cavity → sheet graft (7 × 10 cm) stapled over bed.

**Week 7:** Second AFSM sheet applied to augment granulation/epithelialization.

**Outcome:** Complete healing in <4 months (serial images). The patient has remained ambulatory with durable wound closure and no subsequent breakdown.

## Barriers to Healing

Exposed tendon/bone → poor vascularity, infection risk [1,2].

Necrotic tissue → barrier to healing [3].

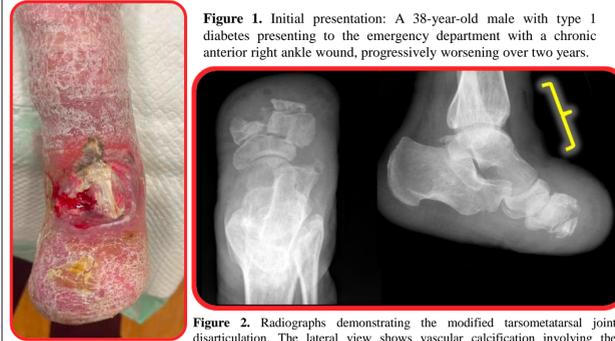
Inflammation/edema → impaired perfusion [5].

Anterior ankle → high shear/mobility [6].

Severe systemic comorbidities: uncontrolled diabetes, neuropathy, CKD, erectile dysfunction, retinopathy, prior amputations, CVA.

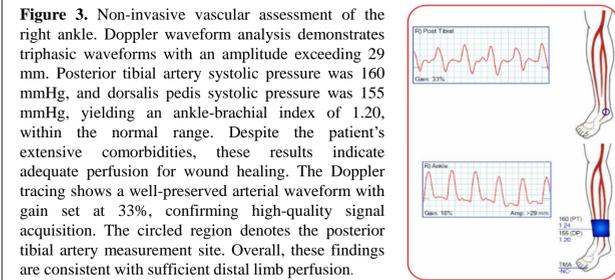
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### INITIAL PRESENTATION

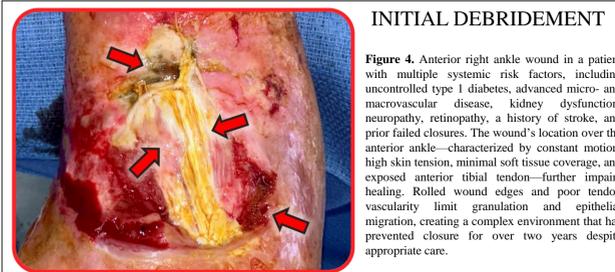
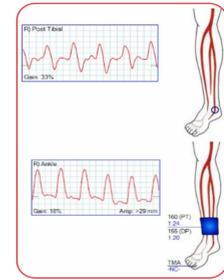


**Figure 1.** Initial presentation: A 38-year-old male with type 1 diabetes presenting to the emergency department with a chronic anterior right ankle wound, progressively worsening over two years.

**Figure 2.** Radiographs demonstrating the modified tarsometatarsal joint disarticulation. The lateral view shows vascular calcification involving the anterior tibial and posterior tibial arteries. Correlation of radiographs with the wound location revealed no evidence of underlying bony involvement.



**Figure 3.** Non-invasive vascular assessment of the right ankle. Doppler waveform analysis demonstrates triphasic waveforms with an amplitude exceeding 29 mm. Posterior tibial artery systolic pressure was 160 mmHg, and dorsalis pedis systolic pressure was 155 mmHg, yielding an ankle-brachial index of 1.20, within the normal range. Despite the patient's extensive comorbidities, these results indicate adequate perfusion for wound healing. The Doppler tracing shows a well-preserved arterial waveform with gain set at 33%, confirming high-quality signal acquisition. The circled region denotes the posterior tibial artery measurement site. Overall, these findings are consistent with sufficient distal limb perfusion.



### INITIAL DEBRIDEMENT

**Figure 4.** Anterior right ankle wound in a patient with multiple systemic risk factors, including uncontrolled type 1 diabetes, advanced micro- and macrovascular disease, kidney dysfunction, neuropathy, retinopathy, a history of stroke, and prior failed closures. The wound's location over the anterior ankle—characterized by constant motion, high skin tension, minimal soft tissue coverage, and exposed anterior tibial tendon—further impairs healing. Rolled wound edges and poor tendon vascularity limit granulation and epithelial migration, creating a complex environment that has prevented closure for over two years despite appropriate care.



**Figure 5.** Operative management of the anterior ankle wound. Following debridement of necrotic tissue and exposed tendon, the wound cavity was filled with morselized acellular fish skin matrix and overlaid with a 7 × 10 cm sheet graft. The morselized matrix acted as a biologic scaffold, conforming to the wound bed and providing a foundation for cellular ingrowth. Saturation of the graft with the patient's blood transfused platelets, growth factors, and stem cells—pinned the wound or regeneration. This approach transforms a chronic, non-healing wound into a biologically active environment conducive to tissue repair.



**Figure 6.** The sheet graft was carefully positioned and secured over the wound bed with staples, ensuring full coverage of the morselized fish skin matrix and intimate contact with the underlying tissue to optimize healing.

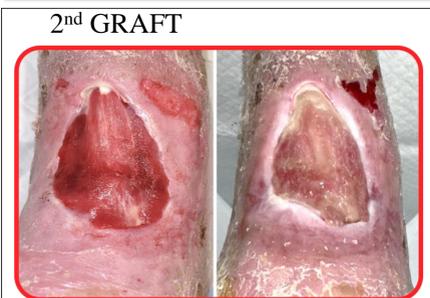


### 1<sup>ST</sup> POST OPERATIVE

**Figure 8.** Six weeks post-operatively, abundant granulation tissue fills the wound cavity and begins to envelop the previously exposed tendon, demonstrating progressive tissue regeneration. Prominent capillary networks are visible, highlighting the regenerative potential of the morselized biologic scaffold.



**Figure 9.** Six weeks post-operatively, the wound demonstrates uniform, vigorous granulation tissue over the previously exposed tendon and cavity, demonstrating progressive tissue regeneration. Notably, no skin graft or negative pressure wound therapy was used, highlighting the intrinsic regenerative potential of the morselized fish skin matrix when applied alone. This contrasts with most published reports, which combine the matrix with negative pressure therapy, underscoring the scaffold's ability to promote robust tissue regeneration independently.



### 2<sup>ND</sup> GRAFT



**Figure 12.** Two weeks following application of the second graft, the matrix is no longer visible, with only the staples remaining. The graft is fully incorporated, as host cells infiltrate, remodel, and replace it with the patient's own tissue, demonstrating the scaffold's ability to integrate and become part of the regenerating wound. With only the staples remaining visible, highlighting the graft's ability to transition from a foreign material to a living component of the regenerating wound.



**Figure 11.** Seven weeks post-operatively, with partial wound closure achieved, a second sheet of acellular fish skin matrix was applied. Saturation of the graft with the patient's blood facilitates uptake of platelets, growth factors, and stem cells, enhancing the regenerative potential of the scaffold.



**Figure 13.** Six weeks following the second graft application, the wound demonstrates significant contraction, complete coverage of the previously exposed tendon, and a healthy granulation base. Complete epithelialization of the anterior ankle was achieved in under four months, with full weightbearing and no wound breakdown. Notably, this outcome was achieved with standard dressing changes, without the use of negative pressure wound therapy, highlighting the regenerative potential of the acellular fish skin matrix alone.



**Figure 14.** Full healing was achieved in under four months despite numerous systemic and local barriers, using only simple dressing changes without negative pressure therapy. This outcome highlights both the potent regenerative effect and reproducibility of the morselized and sheet acellular fish skin matrix.



**Figure 15.** Notably, the tibialis anterior tendon maintained full sliding and gliding with minimal adhesions. Healing by secondary intention produced rapid epithelialization, restoring ankle motion and functional tendon mobility while achieving a favorable cosmetic outcome.

## DISCUSSION

- AFSM benefits: scaffold, angiogenesis, omega-3 anti-inflammatory effects, resorbable, resistant to bacteria.
- Limitations: cost, variable healing times, limited long-term data.
- Healing reflected combined approach: meticulous debridement + outpatient wound care + two AFSM applications.
- Obviously, further studies are needed with long term follow up.

## CONCLUSION

- AFSM is a promising adjunct in managing complex diabetic wounds with exposed tendon/bone.
- In this case, two applications over 7 weeks achieved closure in <4 months despite profound comorbidities.
- Larger studies needed to refine patient selection and cost-effectiveness.

Conflicts of Interest: No conflicts of interest or industry funding. References (condensed poster style)

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