

## One-Stage Closure of Venous Ulcers with Matriderm and Split-Thickness Skin Grafts

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## 1. Abstract

Venous ulcers are important cause of chronic wounds with high hospitalization costs associated. Compression therapy alone, as the mainstay treatment, often fails to completely close large ulcers which require surgery. Bi-layered constructs of dermal matrix and split-thickness skin-graft are already widely used in burns, scar resurfacing, traumatic wounds and diabetic ulcer, but rarely in venous ulcers and only in a two-stage procedure. We report two cases of large venous ulcers treated with Matriderm and split-thickness skin grafts in a one stage procedure, associated with compression therapy. Graft take at day 5 was 100%. Follow-ups were performed at 2 weeks, 1 month, 3 months and 6 months and showed no signs of recurrence. The observational data obtained suggest that Matriderm can be successfully used in a one-stage procedure to close large venous ulcers with reduced hospitalization costs.

## 2. Introduction

Venous ulcers, as a severe manifestation of chronic venous insufficiency, represent a rising cause of chronic wounds in the aging population. It is estimated that venous ulcers account for about 70% of chronic ulcers of the lower limb, with a recurrence rate ranging from 54% to 78% and high hospitalization costs [1].

Damage to the superficial/deep vein valves impair venous return which leads to increased venous pressure, compromising the oxygen supply and resulting ultimately in an ulcer. The venous ulcer

abounds in proteases which destroy the extracellular matrix impeding cellular adhesion and angiogenesis. As a consequence, the ulcer remains in the inflammatory phase of wound healing.

Clinically, the ulcer is accompanied by edema, exudate, pain and bad smell which may have a negative impact on the patient's quality of life, limiting mobility and causing personal hygiene problems and psychological issues. Poor prognostic factors include besides large ulcers (>10 cm<sup>2</sup>), tissue fibrosis, peripheral arterial disease, duration longer than 12 weeks, high body mass index and advanced age [2].

The treatment options available are various, with different level of evidence: compression therapy (level A), pentoxifiline associated with compression therapy (level A), calf muscle exercise (level B), electrical stimulation therapy (level B), venous surgery (level B), limb elevation (level C), hyperbaric oxygen (level C), sclerotherapy (level D), protein nutritional supplementation with protein (level E) and skin grafts (level E).

Although skin grafts do not have a high level of evidence in the treatment of venous ulcers, often compression therapy (the first line treatment) and local wound care cannot close completely some ulcers, especially those associated with poor prognostic factors.

In such cases, skin grafting is required in order to achieve wound closure and since there is a deficiency of extracellular matrix, artificial acellular dermal matrix might be beneficial. There are many

types of acellular dermal matrix commercially available. The main differences between them are the origin (human/animal) and the possibility to apply the skin graft at the same time.

Matriderm is a bovine-derived acellular dermal matrix which consists of 3D pore structure naturally cross-linked, with a pore size that encourages cell migration. Guided regeneration is supported by the bovine collagen whereas early elastin synthesis and neoangiogenesis is stimulated by the solubilized elastin. All the components of the extracellular matrix (collagen, elastin and hyaluronic acid) are produced by the fibroblasts activated inside the matrix. Their activity is modulated by Matriderm, the elastin synthesis being up-regulated while the collagen synthesis slows down. Also, elastin stimulates the angiogenic phenotype of the endothelial cells which start to build up new capillaries. Moreover, due to its hemostatic properties, Matriderm reduces the risk of hematoma and it can be used in a single or double stage procedure.

### 3. Case Report

The authors report two cases of recurrent venous ulcers treated successfully with acellular dermal matrix (Matriderm) and split-thickness skin graft in a one stage procedure. Research ethics board of our institution approved the protocol of the study. The informed consents of the patients were obtained to publish the case details and associated images and the anonymity of the patients was respected.

The first patient was a 70-year old male admitted to our clinic with a large venous ulcer which appeared 5 months before. He also suffered from stage V venous insufficiency, ischemic cardiomyopathy, high blood pressure, atrial fibrillation, mitral regurgitation, heart failure and had a BMI of 32. The physical examination revealed an ulcer on the lateral aspect of the left calf of 150 cm<sup>2</sup>, with full thickness skin loss without bone/tendon exposure, malodorous, covered with fibrotic and necrotic debris. Swab culture was obtained which showed *Proteus* spp and *Pseudomonas* spp infection which were treated according to the antibiogramme.

The second patient was a 45-year old male admitted to our clinic with a large venous ulcer which appeared 3 months before. He had also stage V venous insufficiency, type II diabetes managed with oral medication and a BMI of 36. The physical examination shows an ulcer of 100 cm<sup>2</sup> on the lateral aspect of the left calf, with full thickness skin loss without bone/tendon exposure (Figure 1). The swab culture performed showed infection with *Proteus* spp and *Klebsiella* spp, both treated according with the antibiogramme.

Initially, the ulcers were treated with advanced dressings and fibrinolytic ointments and the comorbidities of the patients were addressed. Afterwards, surgery was scheduled.

In both cases the authors performed surgical debridement under

regional anesthesia. After meticulous hemostasis, a 1 mm sheet of Matriderm was hydrated and applied on the wound bed. Air bubbles were carefully removed by pricking it with an 18 gauge needle, which also prevented seroma formation. Thin split-thickness skin grafts were harvested using the electrical dermatome from the lateral aspect of the ipsilateral thighs and applied on top of Matriderm. This bi-layered construct was fixed with staples (Figure 2); paraffin gauze and compressive dressing was applied which was removed in 5 days [3].

At day 5, graft take was 100% in both cases. Patients were discharged at day 7 and compression therapy was continued. Complete wound closure was obtained at 14 days in both cases. Follow-up visits were performed at two weeks, 1 month, 3 months and 6 months. Clinical signs of inflammation, infection and reulceration were observed.

At 6 months there were no signs of recurrence with an obvious improvement of the skin texture (Figure 3).



**Figure 1:** Infected venous ulcer



**Figure 2:** Intraoperative aspect of the bi-layered construct



**Figure 3:** Clinical aspect at 6 months

#### 4. Discussion and Conclusion

Although acellular dermal matrix has been already widely used in burns, burn scar resurfacing, traumatic full-thickness wounds, donor sites or diabetic ulcers, it has not been commonly employed in the treatment of venous ulcers, since surgical wound closure is not a first-line treatment. However, extracellular matrix technologies have been used as topical wound treatment with satisfactory results.

De Angelis [3] used Nevelia, a bi-layered dermal matrix made of a 2 mm porous dermal matrix and a 2 mm silicon sheet reinforced with polyester fabric, in a two stage-procedure with good results. Nonetheless, wound closure was obtained in 94% of the patients in 56 days, since Nevelia required two surgeries.

Matriderm of 1mm can be used in a single stage procedure reducing thus considerably hospitalization costs and improving patient's satisfaction rate. In both cases, the patients required only one surgery, one regional anesthesia and were discharged 7 days postoperatively without any complications. Both patients were satisfied with the results.

However, there are some limitations of this observational study. The authors report only two cases; large cohorts will be needed in the future, with control groups.

In conclusion, Matriderm with split-thickness skin grafts as a bi-layered construct may represent a good option to close large venous ulcers, especially in patients with poor prognostic factors. Wound closure surgery, regardless of the type, should also be associated with compression therapy and a good management of comorbidities.

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