Coverage of Deep Cutaneous Wounds Using Dermal Template in Combination with Negative-pressure Therapy and Subsequent Skin Graft

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Background: We consider the use of dermal matrix associated with a skin graft to cover deep wounds in the extremities when tendon and bone are exposed. The objective of this article was to evaluate the efficacy of covering acute deep wounds through the use of a dermal regeneration template (Integra) associated with vacuum therapy and subsequent skin grafting.

Methods: Twenty patients were evaluated prospectively. All of them had acute (up to 3 weeks) deep wounds in the limbs. We consider a deep wound to be that with exposure of bone, tendon, or joint.

Results: The average area of integration of the dermal regeneration template was 86.5%. There was complete integration of the skin graft over the dermal matrix in 14 patients (70%), partial integration in 5 patients (25%), and total loss in 1 case (5%). The wound has completely closed in 95% of patients.

Conclusions: The use of Integra dermal template associated with negative-pressure therapy and skin grafting showed an adequate rate of resolution of deep wounds with low morbidity. (Plast Reconstr Surg Glob Open 2014;2:e170; doi: 10.1097/GOX.0000000000000108; Published online 16 June 2014.)

Skin substitutes currently comprise a large number of organic products and synthetic materials used to replace the skin in cases of extensive loss. Such cases include burns and trauma, particularly when an autogenous skin graft is needed.1 Skin substitutes that may replace the lost dermis are called dermal templates and require a skin grafting to reconstruct the epidermis. Burn patients, either in acute or late burn treatments (sequels), use dermal regeneration templates more frequently.2-7

In this study, we considered the use of a dermal matrix associated with a later skin graft to cover deep wounds in the extremities when there was exposure of tendon or bone. This procedure may be beneficial in reducing surgical morbidity, especially in more severe cases and in debilitated patients. It could also prevent the need for major surgeries or even amputation of an affected limb.

The association between dermal regenerate templates and negative-pressure therapy has been proved to be effective as this promotes a faster integration of dermal matrix and fewer complications such as accumulation of fluids and infection.8-10

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The objective of this article was to evaluate the efficacy of covering acute deep wounds through the use of a dermal regeneration template (Integra) associated with vacuum therapy and subsequent skin grafting.

**PATIENTS AND METHODS**

Twenty patients were followed prospectively. All of them presented acute (up to 3 weeks) deep wounds in the limbs. They were admitted to an emergency unit and agreed to participate in this research after receiving proper guidance and signing the consent form.

The essential condition for the indication of the matrix was the presence of a clean wound (no necrotic tissue) and no bleeding on the wound bed. Table 1 shows the inclusion criteria. Table 2 shows the exclusion criteria of the study.

Table 3 lists the epidemiological data assessed.

The following parameters were evaluated:

- Percentage of dermal regeneration template and integration of skin graft (evaluation by digital image software)\(^1\)
- Resolution of the wound (complete coverage of bone and tendon);
- Duration of treatment up to final wound closure.

### RESULTS

The integration of the dermal regeneration template was on average 86.5% of wound area. Complete integration of the skin graft over the dermal matrix was achieved in 14 patients (70%), partial integration in 5 patients (25%), and total loss in just 1 case (5%). The wound has completely closed in 95% of patients. Only one patient had a failure and needed an additional skin graft. When there was partial integration of the graft (loss of up to 20%), the remaining wound was closed through dressing care on an outpatient basis.

The average time of treatment from the first attendance until discharge was 31.8 days. The mean follow-up was 10.6 months (minimum: 6 months/maximum: 24 months).

### DISCUSSION

Reports\(^{12-14}\) of coverage of deep wounds with dermal matrices, especially with exposure of tendon and bone, show that usually these structures require surgical flaps to cover them and that is not appropriate to use skin grafts. In such cases, one might need to use a distant flap, a surgical procedure with longer duration and higher morbidity, requiring specialized equipment and trained microsurgery staff, which are not always available. Thus, dermal templates may be indicated to cover deep wounds in limbs to reduce the surgical morbidity, some especially in debilitated patients with no clinical conditions to undergo a long-duration procedure.

In deep wounds on the dorsum of the hand or on fingers or foot where the flaps have a coarser contour (even cutaneous flaps), the use of a dermal template provides adequate coverage with a more delicate contour and in maintaining the anatomical characteristics of the area\(^{15}\) (Fig. 1).
Another attractive option for dermal template in complex wounds is as a rescue procedure in loss of free flaps, allowing the resolution of the wound by using the matrix associated with skin grafting. In this series, 3 wounds had been covered primarily with free flaps that had a total loss (Fig. 2).

Negative-pressure devices were used over the dermal template to obtain a faster maturation (approximately 1–2 weeks) and a higher quality of integration. This association keeps the matrix immobilized, leaves the wound bed moist and free of debris, prevents the accumulation of fluid collections, and reduces bacterial colonization of the wound. All these factors favor a faster maturation of the dermal regeneration template.

The 86.5% area of integration rate of the matrix and the 70% of cases of total integration of skin graft were considered suitable because the treated wounds

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Fig. 1. A female patient, 63 years old, with chemotherapy extravasation in bilateral dorsal hands and wrists. A, Fresh wound after debridement. B, Vascularized dermal template (12 days postoperative). C, Silicone removal and dermal template integrated. D, Meshed thin skin graft. E, Result at 12 months postoperatively. F, Comparison between the right (cutaneous flap) and left (template + graft) at 12 months postoperatively.

Fig. 2. A male patient, 19 years old, with crushing and degloving injury on left leg. A, Deep fresh clean wound with bone exposure. B, Dermal regeneration template in place (Integra). C, Negative-pressure wound therapy over dermal matrix. D, Meshed partial thickness skin graft over mature dermal template (18 days postoperative). E and F, Long-term results with adequate stable coverture (2 years postoperative).
were complex injuries and only the skin graft alone would not solve the problem. In the presented cases, 95% of wounds resolved with no need for additional procedures (flaps). Helgeson et al.\textsuperscript{12} in a retrospective study, evaluated the Integra dermal matrix associated with negative-pressure therapy in 16 patients suffering from war trauma with exposed bone or tendon. They reported success in 83% of patients. The success rate presented here was 95%. We had 1 case failure probably due to inadequate skin graft taking (a too thick skin grafting). This case needed a thin skin regrafting over the dermal template for resolution.

TARAS et al.\textsuperscript{18} in a prospective study with application of Integra in 17 digital trauma patients with exposure of deep structures, showed a successful full-thickness skin grafting in 20 digits after 21 days of maturation. They reported partial loss of 15–25% and no total losses. In our study, we used partial skin grafting after an average maturity period of 12.6 days, and we had total integration in 70%, partial integration in 25% (loss of up to 20% of the grafted area), and total loss in 5% of patients. Most authors recommend performing a partial skin graft on the matrix to avoid loss as its vascularization is still incipient by 3 weeks.

Weigert et al\textsuperscript{19} retrospectively studied 15 patients with severe trauma on their hands and exposure of tendon or bone. The average area of the wound was 62 cm\textsuperscript{2}, the preparation time up to the placement of the dermal template was 26 days, the maturation time of the dermal template was 26 days, and the resolution of the wound was 87%. In our study, the average area of the wound was 87.2 cm\textsuperscript{2}, the average preparation time up to the dermal template was 13.2 days, the maturation time of the template was 12.6 days, and the resolution of the wound was 95% of cases. These favorable results are probably due to the use of negative-pressure therapy.

**CONCLUSIONS**

In short, the use of the Integra dermal template together with the negative-pressure therapy and skin grafting as a subsequent treatment showed adequate rate of resolution of deep wounds with low morbidity.

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