



Matriderm vs Integradermal Regeneration Template Single Layer as a Dermal Substitute for Synchronous Autologous Skin Grafting in Necrotising Fasciitis – a Case Study

Pennyloise Hever* and Naveen Cavale

Department of Plastic & Reconstructive Surgery, Kings College Hospital, London, United Kingdom.

Summary

Artificial dermal matrices (ADMs) have been developed to serve as a template for dermal repair and improved healing in full thickness wounds. They provide a natural structure to foster immediate in growth of cells and more rapid revascularization, thereby increasing the elasticity and pliability of the reconstructed skin. They help to overcome the drawbacks of the natural wound healing process of contracture and scar formation, optimizing quality of the grafted area.

We report a case study designed to compare the wound healing properties of two different ADMs- MatriDerm®(MedSkin Solutions Dr. Suwelack AG, Billerbeck, Germany) and Integra®Dermal Regeneration Template Single Layer(IRDT-SL)(Integra Life Sciences Corp., NJ, USA). when used as dermal substitutes for synchronous autologous split-thickness skin grafting (STSG) in a case of severe necrotising fasciitis of the arm. We demonstrate MatriDerm to produce superior graft quality when compared to IntegraDermal Regeneration Template Single Layer. Though an isolated case report, we propose MatriDerm to be considered as the preferred dermal substitute in synchronous autologous skin grafting. We could not find any other cases reporting the use of ADMs for synchronous skin grafting in necrotising fasciitis.

Keywords: *Artificial Dermal Matrices ADM; Dermal Substitute; Autologous Skin Graft; Necrotising Fasciitis; Matriderm; Integra Dermal Regeneration Template Single Layer*

Background

Dermal substitutes are a group of materials that aid wound healing in full thickness wounds by mimicking the form and restorative functions of the dermal and epidermal layers of the skin. These can be broadly classified as temporary or permanent, and synthetic or biological both MatriDerm and Integra Dermal Regeneration Template Single Layerserving as examples of permanent and synthetic dermal substitutes [1]. Both of these are based on an engineered collagen scaffold.

The synchronous use of dermal substitutes for split-thickness skin grafting (STSG) reduces the morbidity associated with full thickness wounds by replacing lost skin layers, thereby providing a superior template for reconstruction of the skin, and avoiding complications of STSG such as hypertrophic scarring and contracture formation. A recent series, for example, demonstrated good results with the synchronous use of epidermal grafting and a dermal substitute for keloid lesion excision, with scars remaining flat with no growth

beyond their borders, and no evidence of contracture [2]. Pascone et al. reported similar outcomes in terms of scarring response when using this technique in oncological wounds [3]. In addition, donor-site morbidity is reduced, with a smaller surface area of autologous meshed skin required to achieve full coverage of the wound bed. Infection rates are lower compared with the use of STSG alone, with the dermal substitute providing an immediate barrier to bacteria and pathogens.

Case report

A 35 year old male presented to the emergency department with severe necrotising fasciitis of the arm following an isolated puncture wound to the elbow. He presented in septic shock with a lactate of 4.3, an acute kidney injury (AKI) with a creatinine of 266 and CK of 923, and acute respiratory distress syndrome (ARDS) requiring ITU admission for intubation and ventilation. On examination large blisters were evident at the olecranon process of the left arm, associated with swelling from the elbow to the wrist [Figure 1]. A clinical diagnosis of necrotising fasciitis of the arm with a septic arthritis of the elbow was made, and the patient received STAT doses of Meropenem, Clindamycin and Gentamic in as guided by microbiology advice before being taken to theatre for debridement and washout by the orthopaedic team [Figure 2]. Following debridement, the patient was referred to plastics for skin and soft tissue closure.

*Address for Correspondence: Pennyloise Hever, Department of Plastic & Reconstructive Surgery, Kings College Hospital, London, United Kingdom, Tel: 07966069819; E-mail: phever@nhs.net

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Figure 1: Elbow at presentation



Figure 2: Elbow at presentation

Matriderm and Integra were compared in a single-stage procedure involving simultaneous transplantation of either Matriderm or IRDT-SL with STSG, and STSG alone. The biceps muscle belly was utilized for its large surface area, allowing for the effective comparison of the three grafted areas. STSG were taken from both thighs. The dermal substitute was applied to the prepared wound bed, and soaked in a 0.9% saline solution before the autologous meshed skin graft was grafted over the top. The graft was then fixed in place with staples. At the end of the procedure a negative pressure wound therapy system was applied to minimize tissue oedema and prevent seroma formation. This was removed on the 5th post-operative day.

Outcome and follow-up

The grafted areas were assessed and compared for graft survival repeatedly in the post-operative period [Figure 3a-c]. Efficiency and quality of each matrix was expressed by take-rate of the epidermis, and pliability of the grafted area. By the end of the follow-up period we had observed complete take of all grafted areas. We found auto graft survival to be improved however by the simultaneous application of a dermal substitute compared with STSG alone. Matriderm yielded better results in terms of skin elasticity and pliability when subjectively compared to IRDT-SL, though pliability was greater with IRDT-SL compared to STSG alone. The skin graft settled quicker with a quicker take-rate and a better final result with Matriderm compared to IRDT-SL or STSG alone.

The patient was discharged home 3 weeks after admission, and was followed-up in our outpatient clinic over a 6-month period. At 8 weeks post discharge, he represented with extensive scarring and an elbow contracture in the area of the Integra graft. He underwent surgery for contracture release, and the area was regrafted

with Matriderm. The grafted area then did better, and the patient required no further surgery.

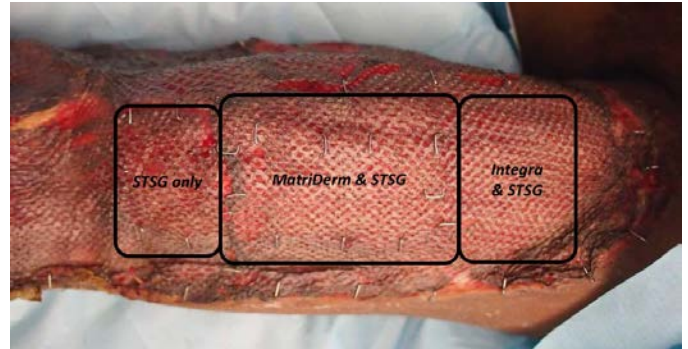


Figure 3(a): Grafting of the biceps muscle belly with areas of Matriderm & STSG, IDRT-SL and STSG, and STSG alone.

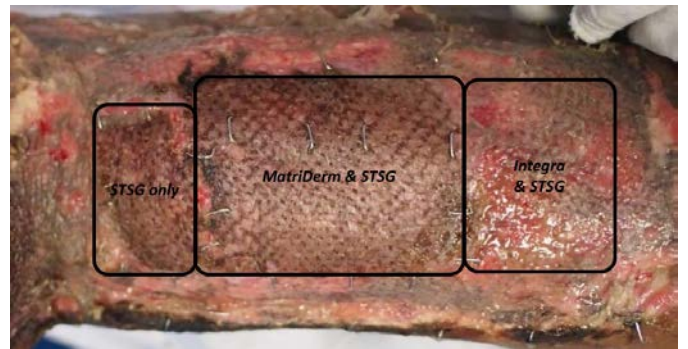


Figure 3(b): Appearance of grafted areas 12 days post-op

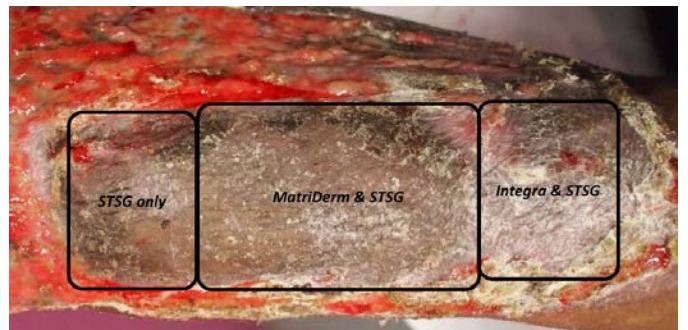


Figure 3(c): Appearance 28 days post-op

At follow-up 6months post-initial presentation to the emergency department the patient had experienced a return to normal level of functionality with full use of his arm, and was able to return to work. He reported high levels of satisfaction with aesthetic outcome. Figure 4 demonstrates the final postoperative result.

Discussion

Simultaneous use of a dermal substitute has been shown to improve wound healing potential in STSG in full thickness wounds of various etiologies [4-6]. In our case report, both Matriderm and Integra were used in a single-stage procedure. Matriderm produced superior graft quality when compared to IRDT-SL, demonstrating better engraftment rates and skin pliability. This is in contrast to

to previous experimental studies comparing MatriDerm and Integra, which have not revealed any major differences between the two dermal substitutes in terms of neodermis formation or vascularization [7-8]. Both of these studies, however, utilised rat models. We could not find any studies comparing the results of these two grafts in man.



4(a)



4(b)

Figure: 4 a & b Result at 6-months post presentation

When trying to evaluate reasons for the differences we observed, it is important to break the two templates down to their components. MatriDerm is an acellular lyophilized collagen and elastin based biomatrix of 1mm thickness, while IDRT-SL is an acellular, permanently cross-linked collagen and glycosaminoglycan based biomatrix of 1.3mm thickness. As elastin plays a major role in providing elasticity and resilience to the skin, it may be that the lack of elastin in the IDRT-SL template could provide one contributing factor for the difference in pliability of the two grafted areas observed in our case study. The difference in take rate could also tenuously be explained by the difference in thickness of the two templates, or, more likely by the fact that MatriDerm may degrade more quickly than IRDT-SL owing to the lack of cross-linking between the collagen components – cross linking proven to reinforce matrix stability and make it less susceptible to degeneration [9]. This is all very hypothetical, however, and requires further detailed experimental studies to properly evaluate,

with more detailed experimental analysis of outcomes than aesthetic and functional outcomes alone.

In summary, based on our experiences the first reported case study comparing MatriDerm and IRDT-SL as a single-stage procedure in man, we propose MatriDerm as the preferred dermal substitute in synchronous STSG for full thickness wounds with superior functional and aesthetic outcomes demonstrated. This proposal is supported by a review of the literature, with several authors reporting good outcomes with the simultaneous use of MatriDerm in autologous skin grafting in a broad range of indications [10-13], with only one publication describing the successful use of IRDT-SL in man in the reconstruction of deep facial defects [14]. It is important to mention however that Integra has only recently become available as a single layer, and therefore clinical studies for the use of Integra in a one-stage procedure in man are lacking. This should therefore be a focus of future research, in order to disprove or corroborate our findings.

Financial Disclosure

MatriDerm and Integra Dermal Regeneration Template Single Layer samples were donated free of charge by respective UK companies. The authors received no financial incentives for the reporting of this case.

Conflict of interest statement

The authors declare no conflict of interest.

Informed consent

The patient consented to participation in this case study, and to the use of images for the purpose of this report.

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