Vasculogenesis in Rapid Integration of a Synthetic Dermal Scaffold: Efficacy for Single-Stage Full Thickness Surgical Reconstruction

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Introduction

Large area burns wounds are prone to infection. A single-stage procedure of a dermal scaffold with an autologous split-thickness autograft (STSG) for dermal reconstruction offers expedient rapid closure. This is widely performed with Matriderm, but long term results are variable. A prototype pro-angiogenic ‘Smart Matrix’ fibrin-based scaffold was previously shown to support rapid and deeply penetrating cellular ingress and vasculogenesis in a porcine model. We now aim to optimise the matrix formulation and structure to support a single-stage reconstruction: dermal scaffold with immediately overlaid STSG.

Materials and Methods

The porcine full-thickness wound chamber model (six 4cm diameter dorsal excisions) with paravertebral region STSG donor sites was used. Full-thickness skin defects were reconstructed, comparing STSG (150um) alone, Matriderm (500um) + STSG , and Smart Matrix (1.5mm) + STSG. Dense or open pore versions of the Smart Matrix were also compared. Clinical appearance, photography, Laser Speckle assessment of microcirculation and punch biopsies for histological evaluation were collected for each wound at Days 0, 7, 14 & 21.

Results

Integration and neovascularisation of open pore Smart Matrix was faster than a dense pore structure (fig 1). Single-stage reconstruction was successful (n=5) in terms of (i) clinical examination; (ii) evidence of functional progressive neovascularisation (iii) histological graft integration (fig 2). Of note, the STSG on Smart Matrix did not contract up to day 21.

Fig 2. Single-stage SM/STSG skin reconstruction. A. cellular integration is complete at day 8. B. Detail of STSG/Smart Matrix interface showing closely adjacent capillary profiles (arrows). *Residual Smart Matrix scaffold (pink staining).

Discussion and Conclusions

The Smart Matrix differs from Matriderm in scaffold functionality and in vivo stability. Histological integration and vascularisation of the open-pore structure was fast enough to support allow a single stage process. Fine structural variations are critical for success or failure to support a split-thickness skin graft. Optimising the Smart Matrix scaffolds’ structure and thickness makes it viable for single-stage full-thickness skin reconstruction. The results suggest that scaffold functionality of Smart Matrix may support favourable long-term outcome, although further evidence is needed.

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