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Using the Spincare® System in Hard to Heal Burns

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Personalized burn treatment: bedside electrospun nanofiber scaffold with cultured autologous keratinocytes: a case study

Introduction

Grafting healthy autologous skin from a donor site to the damaged areas remains the gold standard treatment for extensive burn wounds, nearly four decades after cultured epidermal autografts (CEA) were initially used. Furthermore, the clinical use of current skin substitutes is constrained. Spincare®, a portable wound care system, involves direct on-site application of an electrospun polymer nanofibrous matrix. The innovative method mimics epidermal-dermal connective tissue structure, promoting cellular regeneration and enhancing wound healing. Additionally, a personalized treatment strategy is suggested for hard-to-heal regions, involving not only CEA, but also the direct application of suspended autologous keratinocytes integrated with in situ Spincare matrix onto the wound bed, allowing for larger wound coverage than CEA.


practice

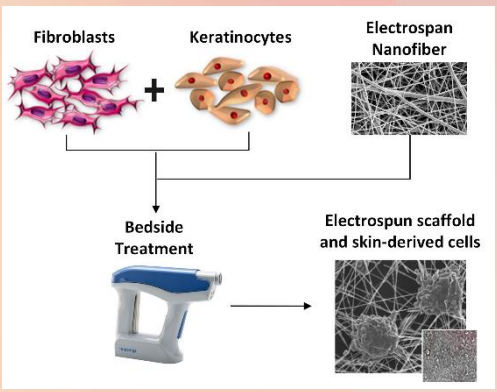
Personalised burn treatment: bedside electrospun nanofibre scaffold with cultured autologous keratinocytes: a case study

Abstract: Nearly four decades after cultured epidermal autografts (CEA) were first used for the treatment of extensive burn wounds, the current gold standard treatment remains grafting healthy autologous skin from a donor site to the damaged areas, with current skin substitutes limited in their clinical use. We propose a novel treatment approach, using electrospun polymer nanofibrous matrix (EPNM) applied on-site directly on the CEA-grafted areas. In addition, we propose a personalised treatment, on hard-to-heal areas, in which we spray suspended autologous keratinocytes integrated with 3D EPNM applied on-site, directly onto the wound bed. This method enables the coverage of larger wound areas than possible with CEA. We present the case of a 26-year-old male patient with full-thickness burns covering 98% of his total body surface area (TBSA). We were able to show that this treatment approach resulted in good re-epithelialisation, seen as early as seven days post CEA grafting, with complete wound closure within three weeks, and to a lesser extent in areas treated with cell spraying. Moreover, in vitro experiments confirmed the feasibility of using keratinocytes embedded within the EPNM: cell and culture viability, identity, purity and potency were determined. These experiments show that the skin cells are viable and can proliferate within the EPNM. The results presented are of a promising novel strategy for the development of personalised wound treatment, integrating on-the-spot 'printed' EPNM with autologous skin cells, which will be applied at the bedside, over deep dermal wounds, to accelerate healing time and wound closure.
Declaration of interest: JH is a member of the Scientific Board of Nanomedic Technologies Ltd and CMB is the Chief Technology Officer for Nanomedic Technologies Ltd, advising and consulting in the use of the device, including the in vitro studies. The authors have no other conflicts of interest to declare. The opinions, interpretations and conclusions are those of the authors and are not necessarily endorsed by the sponsors of this study.

autografts • burns • nanofibres • polymers • skin transplantation • wound • wound care • wound dressing • wound healing

Case report & methods

A 26-year-old male patient was treated, with extensive deep-dermal to full-thickness burns covering 98% of his total body surface area (TBSA). The treatment approach involved a combination of widely expanded Meek grafts taken from his secondarily healed scalp and over 500 CEA grafts, produced from two 2cm^2 biopsies taken from his foot and applied over the burn wounds in 17 sequential transplantations. These CEAs were grafted onto autografts and dermis-free areas, replacing Vaseline gauze or other secondary dressing with Spincare matrix before placing the secondary Jelonet gauze for 7 days. Additionally, a novel application technique was employed, spraying isolated keratinocytes integrated with Spincare matrix over debrided, deep dermal wounds that had previously failed with CEA or upon which other grafts had failed to take.



Results

The innovative treatment approach led to significant re-epithelialization within seven days of CEA grafting. Complete wound closure was achieved within three weeks, while lesser extent was observed in areas treated with cell spraying. In vitro experiments validated the feasibility of utilizing keratinocytes within Spincare matrix, confirming cell viability, identity, purity, and potency. Moreover, control cells grew in a typical monolayer structure, whereas cells grown on Spincare matrix displayed a more multi-dimensional configuration. Spincare matrix's resemblance to the 3D structure of the ECM potentially enables cell infiltration into the matrix and promoting growth in a 3D manner. These experiments highlight the viability and proliferative capacity of skin cells within the Spincare matrix environment.

Conclusions

A promising novel approach combines on-the-spot 'printed' Spincare matrix with autologous skin cells for accelerated healing of deep dermal wounds. Spincare matrix proves beneficial for temporal epidermal layer directly applied on large superficial wounds and on donor site areas. Application of Spincare matrix on CEA-grafted regions enhances the graft take and accelerates re-epithelialization, resulting in quicker wound healing without infections. The portable Spincare matrix, as opposed to other non-portable electrospinning technologies, enables personalized anatomical wound coverage and provides a suitable scaffold for tissue integration and regeneration. This innovation holds the potential to enhance patients' quality of life and improve functionality.

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