Characterisation of a Novel Supermacroporous Cryogel for Skin Substitution
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Introduction
The application of autologous split-thickness skin grafts is the current method of choice for full-thickness burns treatment. However, skin cover in extensive deep burns is a challenge because of very limited autograft donor sites. The use of tissue engineered skin bioconstructs can be an alternative live-saving approach to treat such wounds. Various skin substitutes for epidermal and dermal replacement are available to the surgeon and have been described and extensively reviewed. However, these products are not used extensively in clinic, mainly due to their low efficiency or high cost. To address these limitations we have produced a supermacroporous gelatin cryogel scaffold by a novel process, with a highly sophisticated hierarchical pore structure. The material was characterized and assessed in vitro for its skin substitution potential.

Materials and Methods
The produced cryogel was characterized morphologically by assessing porosity and pore distribution in 3D images obtained with the help of confocal laser scanning microscopy (CLSM). The mechanical properties of the material were calculated by assessing dynamic elasticity and viscosity. The biocompatibility of the biomaterial was assessed in vitro by seeding it with primary normal human fibroblasts either by direct cellular inoculation with a cell suspension or by active cellular migration off the tissue culture plastic. The rates of cellular migration, proliferation and protein deposition within bioengineered scaffold samples were assessed over a 28 day period using immunohistological staining viewed by CLSM. The performance of a gelatin cryogel biomaterial was compared with a commercially available dermal regeneration template. Statistical significance was determined by ANOVA or t-test as appropriate.

Results
The morphological assessment of the gelatin cryogel scaffold demonstrated a supermacroporous, highly sophisticated, hierarchical pore structure. Its mechanical properties were similar to those of the commercially available dermal substitute. The gelatin cryogel material was found to be biocompatible, bioconductive and non-toxic to cells in vitro. The tissue engineered scaffold was able to support cellular migration and active cell proliferation when seeded both by direct cellular inoculation or active cellular migration. Over the 28 day period the cells populated the biomaterial exhibiting an even distribution across the entire thickness of the cryogel scaffold.

Discussion and Conclusions
The large size of interconnected hierarchical pores, biocompatibility and relatively small production costs of gelatin cryogels make these a promising material for tissue engineering and regenerative medicine with the potential application to treat burns and chronic wounds.

References

Acknowledgments
The work presented here is the contribution by the University of Brighton group to a collaborative project funded by MARIE CURIE TOK FP6 MTKI-CT-2006–42768 grant. Additional members of the group are Protista AG and University of Lund (Sweden); StratiCELL and University of Namur (Belgium); MAST Carbon Ltd., CliniMed Ltd. and Queen Victoria Hospital (UK), Special thanks to A. Ivanov (Protista AG).

Disclosures
There is no commercial conflict of interest and authors have nothing to disclose.