ELECTRICALLY CONDUCTIVE BIOMATERIALS FOR THE PRESERVATION AND REGENERATION OF SOFT TISSUE.

Pomfret, L.[a,b,c,d*], Cheneler, D.[b,c], Mort, R.M.[c] Hardy, J.G.[a,b,*]

[a] Department of Chemistry, Lancaster University, Lancaster, LA1 4YB, UK. [b] Materials Science Lancaster, Lancaster University, Lancaster, LA1 4YB, UK. [c] Division of Biomedical and Life Sciences, Lancaster University, Lancaster, LA1 4YQ, UK. [d] School of Engineering, Lancaster University, Lancaster, LA1 4YW, UK. * Corresponding author e-mail: l.pomfret@lancaster.ac.uk and j.g.hardy@lancaster.ac.uk

Introduction

Combat trauma results in severe, complex injuries involving multiple tissue types. There is growing evidence that an electrical stimulus applied to a wound can enhance tissue regeneration. Therefore, in early wound management it is important to optimise endogenous responses including the bioelectric current.

Materials and methods

In order to fabricate electroactive wound dressings, we have incorporated a network of the conductive polymer polypyrrole (Ppy) into non-biodegradable wound care products. We are also developing electrically controlled delivery methods using conductive polymers incorporated in the wound dressings for therapeutic use that enhance tissue preservation. In parallel we are investigating the migratory and proliferative properties of skin cell types and their response to electrical stimulation.

Results

Comparison of pristine wound dressings to Ppy coated wound dressing shows that foam, alginate and aquafiber based dressings are electrically conductive. Preliminary data shows that drug can be electrochemically loaded into the wound dressings and released upon electrical stimulation. We have also developed an electrical stimulation paradigm by performing wound healing experiments on indium tin oxide coated glass and applying an electrical stimulus. Fibroblasts demonstrate enhanced wound healing at 50mV/mm DC electrical stimulation.

Discussion

The conductive wound dressings will allow direct electrical stimulation of the wound to achieve pro-regenerative activity. Combined with a drug delivery system, this will allow localised drug release to the wound to stimulate wound healing. The wound dressings will also provide a direct electrical stimulation to the wound. Overall, we aim to aid the healing of complex wounds by enhancing the endogenous regenerative response of cells in the skin and therefore decrease the recovery period.

Acknowledgements

For financial support we thank DSTL and Advanced Medical Solutions.