Mediating Cell Delivery to a Diabetic Wound with the Use of a Collagen Scaffold
Aonghus O’Loughlin1, Mangesh Kulkarni2, John Ward2, Peter Dockery3 Abhay Pandit2, Timothy O’Brien1
Corresponding author: aonghus.oloughlin@nuigalway.ie

1Regenerative Medicine Institute, 2Network of Excellence for Functional Biomaterials, National Centre for Biomedical Engineering Science, NUIGalway, Ireland NUIGalway, Ireland, 3Department of Anatomy, NUIGalway, Ireland

Introduction
In humans, diabetic foot ulceration can result in amputation. Despite conventional treatment, there exists a high amputation rate. Peripheral vascular disease is present in 60% of diabetic foot ulcers contributing to non-healing and increased amputation rates. Type 1 collagen has a history of clinical use in wound repair. Peripheral blood mononuclear cells (PBMNCs) and circulating angiogenic cells (CACs) otherwise known as early endothelial progenitor cells (EPCs) promote angiogenesis. Cellular therapy by topically delivering these cells may provide a novel treatment method for diabetic foot ulceration.

Materials and Methods
EPCs were cultured from human peripheral blood and PBMNCs were isolated from rabbit blood. A collagen scaffold was formed from type 1 bovine collagen and cross-linked by freeze-drying. Cells were seeded into the scaffold by direct injection. Calcein AM and resazurin viability assays were performed 24 hours after seeding. Scanning electron and confocal microscopy images were obtained. Autologous topical treatment with EPCs seeded in a collagen scaffold was assessed in an animal model of diabetic wound healing. The treatment groups included 1.cells seeded in scaffold, 2. scaffold alone and 3. no treatment. The wounds were analysed using Mason’s Trichome and light microscopy.

Results
Human EPCs and rabbit PBMNCs retain metabolic activity 24 hours after seeding into a collagen scaffold (Figure 1). Confocal microscopy revealed viable cells distributed throughout the scaffold at 24 hours. Scanning electron microscopy revealed cell spreading between EPCs and scaffold at 24 hours. Preliminary results demonstrate improved wound healing in an animal model as evidenced by increased dense connective tissue formation over wounds in the cell treatment group.

Discussion and Conclusions
A type 1 collagen sponge is an effective scaffold that retains metabolic activity of PBMNCs and EPCs. This provides for potential topical therapies to diabetic cutaneous ulcers. In-vivo experiments show a trend towards improved wound healing after 1 week of treatment, with dense connective tissue formation on the wound surface in the cell treatment group. Autologous cell treatment of non-healing diabetic foot ulcers provides a new treatment modality to prevent lower extremity amputation.

References

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