**Biosynthetic corneal endothelial graft functions in a rabbit model of corneal endothelial damage**

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**Purpose**: Corneal endothelial dysfunction leads to visual impairment and a requirement for corneal endothelial transplant. There is a worldwide donor cornea shortage, so biosynthetic graft alternatives are being developed using in vitro expanded corneal endothelial cells. Our poly-ε-lysine (pεK) hydrogel is highly tunable and its properties can be controlled by the nature and percentage of the cross-links and the density of the peptide to produce a panel of hydrogels with different properties. We have chosen a hydrogel with excellent optical and mechanical properties for this application and here we investigate the functionality of the biosynthetic graft using porcine corneal endothelial cells in a rabbit model of endothelial damage.

**Methods**: Hydrogels were synthesised from pεK crosslinked 60% with nonanedioic acid and then punched into 8mm circles. Gels were seeded with primary porcine corneal endothelial cells at a density of 1x105cells/gel and cultured for 3 weeks. Immunocytochemical staining (ZO-1 and Na+K+ATPase) was performed to assess the phenotype of cells on gels. PεK hydrogels (+ and – cells) were transplanted into the right eyes of New Zealand white rabbits with Descemet’s membrane and endothelial layer removed. A group with no gel acted as control. Optical coherence tomography (OCT) imaging and pachymetry was used to measure corneal thickness for the experimental period (3 weeks). Photographs of rabbit corneas were taken to assess corneal clarity and eyes were dissected for histological analysis.

**Results**: Porcine corneal endothelial cells adhered to the pεK hydrogels and formed monolayers expressing ZO-1 and Na+K+ATPase. OCT imaging showed control unoperated corneas had a mean thickness of 399.5mm (SD27.6) and the corneas with Descemet’s membrane and endothelial layer removed (no gel) had a mean thickness of 1052mm (SD77.1). Corneas with attached gels (no cells) were 583.5mm (SD 251.0) and attached gels with cells were 451mm (SD37.4).

**Conclusions**: Cellular pεK grafts show good cell compatibility, handleability and are able to function to thin the cornea to near control levels after 3 weeks in a rabbit in vivo model of endothelial damage.