

Session 3-D: Cataract/Refractive: Presbyopia—Multifocal IOLs, New Techniques

Title: Implantation of Subepithelial Lenticules in the Cornea for Refractive Correction

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Purpose: To test the feasibility of using tissue engineered extracellular matrix (ECM) substitutes as implantable lenticules for refractive correction.

Methods: ECM substitutes comprising collagen, with or without additional proteoglycans, were fabricated into lenticules (6 mm diameter, 70 μ m thickness at the centre) using either EDC/NHS or poly(N-isopropylacrylamide-co-acrylic acid-co-acryloxysuccinimide) as crosslinkers. Lenticules were characterized in vitro for physical properties (mechanical strength, optical clarity) and biocompatibility. They were then implanted sub-epithelially within one cornea of mini-pigs, with contralateral corneas serving as controls. Clinical examination including in vivo confocal microscopy and topography was performed pre-and post-operatively. Implanted corneas were recovered at 3 weeks post-operative and processed for histology.

Results: Both crosslinkers resulted in fully biocompatible lenticules that showed smooth host-implant integration. Slit lamp examination showed that corneas with implants were optically clear, with no vascular infiltration. The epithelium adhered well to all lenticules, and expressed Keratin 3 and E-cadherin at levels comparable to untreated controls. Staining for α 6 integrin, which mediates adhesion of epithelial cells to the basement membrane showed localization in the basal epithelial cells in both operated and untreated controls. However, type VII collagen staining for anchoring fibres within the basement membrane complex showed weaker staining in treated corneas. Treated corneas were touch sensitive by aesthesiometry, and contained neurofilament positive nerves. Topographical analysis showed a change of about 50 μ m in thickness in central corneal elevation.

Conclusions: The collagen-based lenticules were able to integrate functionally within host corneas. There is potential for such lenticules to be useful, future supplements for, or alternatives to laser-based refractive corrections.