Regulation and characterisation of corneal stromal cell contraction

[Abstract]

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Regulation of genotype and phenotype of corneal stromal cells.

Control and maintenance of keratocyte phenotype is vital to developing in vitro tissue engineered strategies for corneal repair. In this study the influence of topographical and chemical cues on mechanical, phenotypical and genotypical behaviour of adult human derived corneal stromal (AHDCS) cells in three dimensional (3D) constructs are examined. Topographical cues are provided via multiple aligned electrospun nanofiber meshes and chemical cues are examined using different media supplements. A non-destructive indentation technique and optical coherence tomography are used to determine the elastic modulus and dimensional changes, respectively. qPCR analysis revealed that the shift between keratocyte and fibroblast marker expression could be adjusted by both chemical and topographical factors. The results demonstrate that changing the surrounding niche from 2D (TCP) to 3D (collagen hydrogel) conditions in serum-containing media increased keratocyte marker gene expression and decreased fibroblast marker expression which was further enhanced by removal of serum, media supplements and the presence of orientated nanofibers. There was a correlation between elastic modulus, contractile characteristics and gene expression. The combination of non-destructive monitoring techniques and analysis of gene expression provide important feedback for optimizing culture condition, which has not previously been shown in 3D corneal models.