



# THREE-DIMENSIONAL RECONSTRUCTION OF HUMAN CORNEAS BY TISSUE ENGINEERING

## Results in Brief



## Engineering the human cornea

Currently available synthetic artificial corneas (keratoprotheses) present with severe limitations for cornea grafting. European scientists proposed an alternative in vitro system which is expected to revolutionise cornea transplantation.



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Diseases affecting the cornea are on the rise, with over 10 million people being affected worldwide. Current treatment approaches mainly involve transplantation of donor corneas. This is, however, hampered by the shortage of donors, the widespread use of corrective surgery, which renders corneas unsuitable for grafting, and the increasing risk of transmissible diseases.

Responding to the urgent need to develop new forms of corneal replacements, the EU-funded 'Three-dimensional reconstruction of human corneas by tissue engineering' (Cornea Engineering) project proposed to develop a human cornea in

vitro. This would serve for corneal grafting and as an alternative to animal models for cosmetics and pharmacotoxicity testing.

The innovation of the Cornea Engineering approach relied on the production of three-dimensional (3D) cell scaffolds resembling the natural extracellular matrix (ECM). To do so, scientists developed protocols for the use of recombinant human ECM proteins and their processing enzymes to support the growth of the different cell types found in the cornea. Implementation of the acquired knowledge led to the development of a hemi-cornea using human epithelial and stroma cells which would serve as an in vitro alternative to animal toxicity testing.

By studying the roles of extracellular enzymes and cell-matrix interactions in corneal structure and repair, partners succeeded in identifying new molecular mechanisms controlling the phenotype of stem cells. These findings enabled them to perform clinical trials using stem cell-derived epithelial cells.

The Cornea Engineering project succeeded in unravelling the matrix-cell interactions which are essential for optimal cornea tissue reconstruction, culminating in the development of full depth in vitro corneas. The reconstruction of the human cornea represents a real breakthrough, offering the opportunity for patients with diseased or damaged corneas to have them replaced by tissue-engineered human corneal equivalents.

#### Project Information

CORNEA ENGINEERING

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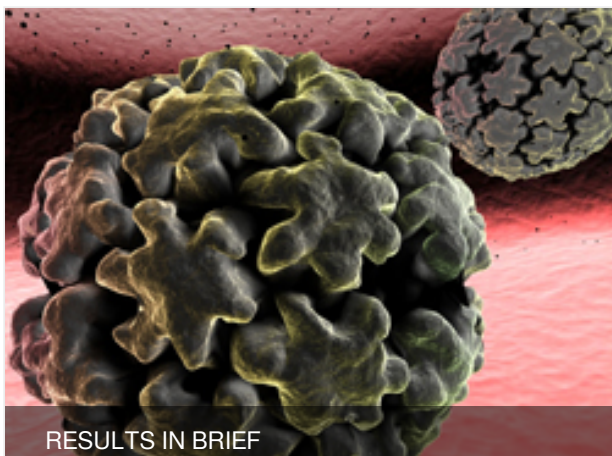
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