THREE-DIMENSIONAL RECONSTRUCTION OF HUMAN CORNEAS BY TISSUE ENGINEERING

Reporting

Project Information

CORNEA ENGINEERING

Grant agreement ID: 504017

Start date
1 January 2004

End date
31 December 2007

Funded under
FP6-NMP

Overall budget
€ 4 214 680

EU contribution
€ 2 558 797

Coordinated by
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE
France

This project is featured in...

Final Report Summary - CORNEA ENGINEERING (Three-

dimensional reconstruction of human corneas by tissue engineering)

Approximately 10 million people worldwide are blind as a result of corneal diseases. The only generally available treatment option at the time of writing was to replace corneas using donor tissue. In Europe, approximately 25 000 such operations are carried out each year. But there is an increasing risk of disease transmission from donor tissue and furthermore the growing use of laser corrective surgery renders corneas unsuitable for grafting.

These factors, together with the limited applications of synthetic polymer-based artificial corneas (keratoprosthesis), pointed to the urgent need to develop tissue engineered corneas for clinical applications. In addition, following recent European directives banning the use of animals for toxicity testing, there was an urgent requirement to develop in vitro alternatives to the widely used Draize eye test.

The overall aim of this project was to carry out research leading to the three-dimensional (3D) reconstruction of human corneas. In order to do so, part of the project was aimed at producing 3D cell scaffolds resembling - as closely as possible - the natural extracellular matrix (ECM). This required production of recombinant human ECM proteins and their processing enzymes, including functional studies on the roles of these enzymes and associated proteins.

In parallel with these studies, another goal was to isolate and characterise the different cell types and identify as far as possible corresponding adult stem cell sources. Part of this work included clinical trials using stem cell-derived epithelial cells.

Cell interactions with the ECM were the topic of a further area of research, such interactions being essential for optimal tissue reconstruction. For the tissue engineering, the first aim was to reconstruct a hemi-cornea (epithelium + stroma) as an in vitro alternative to animal toxicity testing. Subsequently, a variety of novel scaffolds and hemi-corneas were reconstructed for possible long-term clinical applications. Biocompatibility testing in animal models was begun. Finally, full depth corneas were reconstructed in vitro using all three cell layers.

The project was largely successful, having achieved most of the aims initially set out. Partners developed new protocols for the production of recombinant extracellular matrix proteins and gained new insights into the regulation of extracellular enzymes and the roles of cell-matrix interactions in corneal structure and repair. They also identified new molecular mechanisms controlling the phenotype of limbal stem cells and showed that keratocytes from different regions of the cornea vary in proliferative potential. Successful clinical trials on restoration of limbal stem cell deficiency were carried out. They developed a hemi-cornea using normal human cells for applications in pharmacotoxicity testing, undergoing validation at the time of writing. Finally, they devised new technologies for the construction of 3D scaffolds and shown these to be useful for corneal tissue engineering, including preclinical testing in animal models.

Related documents

Other documents

Three-Dimensional Reconstruction of Human Corneas by Tissue Engineering (CORNEA ENGINEERING) - Publishable Final Activity Report

Last update: 14 April 2011
Record number: 51651