Laboratory-grown human retinas for personalized medicine

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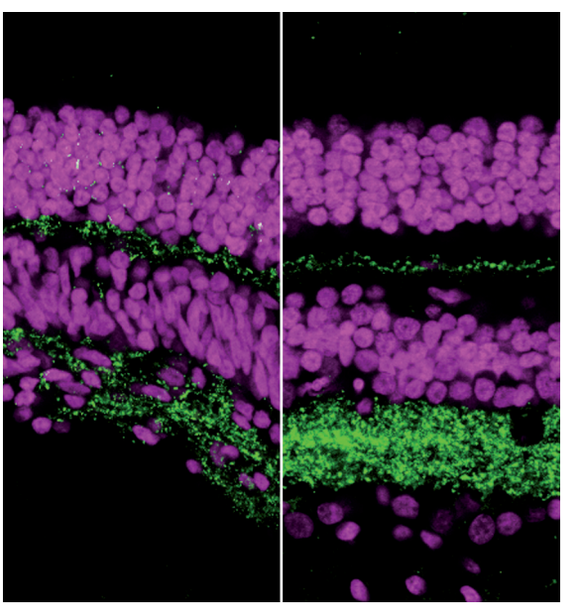
Scientists at IOB have generated highly organized human retinas from human skin cells *in vitro*.

These so-called retinal organoids can be the starting point for developing personalized treatments for patients.

Vision is a key sense in humans and losing eyesight has been regarded as the condition with the greatest effect on day-to-day life. Most visual diseases originate in the retina, a biological image processor built from many different cell types organized in five retinal layers. Scientists have so far relied on animal models to study retinal function and disease; however, it is often difficult to translate findings in animal models to humans. This may be due to structural differences and/or to species-specific differences in gene expression. A model system consisting of human retinal cell types would be highly beneficial to the study of human disease and the development of new therapies.



200-day human retinal organoid (left) and a human donor retina (right)

Synaptic layers

Nuclear layers

Scientists at the IOB have succeeded in generating highly organized human retinal organoids in culture. Skin fibroblasts were used that can be programmed into pluripotent stem cells. These pluripotent cells can be induced to differentiate into most cell types of the human body. Following a specific culture protocol, IOB scientists induced a process very similar to human eye development. Over a period of several months, tissues formed that are strikingly similar to the human retina. Their work allowed the generation of a large number of retinal organoids from stem cells, that not only contain all major cell types of the human retina, but are also arranged into five layers. Moreover, the photoreceptor cells of the organoids possess a highly developed outer segment consisting of the light sensors that are often damaged in human disease.

Retinal organoids can also be generated from skin fibroblasts of patients suffering from specific genetic diseases. Thus, the effects of mutations on retinal cells can be directly studied in a culture dish. Furthermore, different therapies could be tested specifically on a patient's own retinal organoids.