

Stem cells based retinal tissue engineering for curing visual impairment

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The eye is a sensitive organ that should be handled with precision as it is composed of many delicate mechanisms and functions. For centuries, humans have suffered from various conditions that have affected vision either by weakening it or by causing blindness. However, the recent advancements in stem cell therapy and tissue engineering have opened the way to derive retinal tissue from human embryonic stem cells (hESCs) to develop retinal epithelial cells. These cells have improved vision as observed in many tests and clinical trials. Developing retinal cells requires obtaining hESCs that can differentiate into primary human retinal epithelial cells. As these cells mature, they can produce photoreceptor segments which contain proteins that renew the cells responsible for visual phototransduction; the process in which visual pigments absorb light (photons) and transform it into chemical and electrical signals. hESC-derived retinal epithelial cells transplantation was successfully performed on rats and the aftermath showed no signs of inflammatory immune response or tumorigenesis. As for humans, clinical trials on cases of visual impairing diseases were performed and visual improvement was reported in ten eyes within approximately two years after transplantation. Furthermore, no severe complications including immune system rejection or cancer were detected. Despite the positive results, there are still many challenges and questions to be resolved in this field. For example, no current evidence suggests that hESC-derived retinal epithelial cells can restore fully damaged retinas in blind patients or cure cases of retinal detachment. This is because neurodegenerative damage is already beyond repair and it might cause the transplanted cells to die. Additionally, as stem cells resemble cancer cells in the way that they grow uncontrollably, the possibility of tumorigenesis still exists. Despite the various obstacles, research is moving rapidly in stem cell technology as clinical trials have shown significant positive results when it comes to actual application. Further research and studies will aid in improving the prospects of applying stem cell technology and tissue engineering in the treatment of retinal diseases.

Keywords: Stem cells, Tissue engineering, Human embryonic stem cells, Organ transplantation

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