The future of retinal and retinal pigment epithelial (RPE) cell transplantation lies in refinements in retinal and embryonic stem cell (ESC) transplantation. This pathway appears to offer much greater potential to return retinal function back to normal, in comparison to technology driven artificial vision. Initially, autologous RPE cells were harvested from the peripheral retina, and implanted into the macular subretinal space. Bruch’s membrane, choriocapillaris, and the RPE have been rotated beneath the macula, and free RPE-choroidal grafts have been placed in the submacular space in humans. Studies with up to seven years of follow-up have shown varying degrees of maintenance of retinal function with these techniques (1). Retinal stem cells within the pigmented ciliary epithelium (CE) have been shown to differentiate into all neural retinal subtypes and RPE cells as well. More recently, pluripotent embryonic stem cells (ESC) have been transformed into viable RPE cells. Studies have shown that these ESC assimilate and integrate into host retina in mouse retinitis pigmentosa (RP) models. Long-term survival of cells has been documented, SD-OCT has shown precise placement of cells in the rat subretinal space, and ERG recordings have demonstrated improved visual function (2).

Getting the cells to grow in a monolayer, and integrate into the visual pathway does remain a challenge however. In numerous disease states, including age-related macular degeneration (AMD), Stargardts’ disease, and RP, a healthier Bruch’s membrane is needed, and synthetic polymers (parylene substrates and polytetrafluoroethylene) have been developed to serve as a scaffold for monolayer cellular growth. Fetal derived sheets of retinal progenitor cells have been implanted in the subretinal space of rats and humans, and in humans, improvement of visual function has now been documented. While immunosuppression was initially felt to be necessary to keep these cell lines intact, more recent studies have shown that this is most likely not necessary. Human ESCs have been implanted into the subretinal space in humans, and after four months of observation, there were no signs of hyperproliferation, tumorigenicity, ectopic tissue formation, or rejection of the tissue. Visual acuity improved slightly from HM to 20/400 (3).

In summary, autologous RPE grafts and even more likely, pluripotent ESC appear to be the future of retina and RPE transplantation. A number of human studies have shown viable submacular implantation techniques, with maintenance of graft function, integration into the host tissues, and stabilization of vision. It is only a matter of time until such treatment is shown to not only preserve, though actually help to restore visual function, in a variety of degenerative retinal conditions.

References: