Visual Prosthesis to Assist Natural Healing

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A visual prosthesis is an artificial organ to restore vision in blind patients by applying electrical stimulation to the visual nervous system. For years, our research group has been studying "biohybrid implants", which combine the characteristics of regenerative medicine and visual prostheses. They require the implantation of not only the MEMS (microelectromechanical system), but also the transplantation of nerve cells. It has been shown that when nerve cells and Schwann cells are together, irrespective of their origin, the visual cortex or periphery, the lengthening of nerve fibers is promoted by factors produced by Schwann cells, and myelin sheath formation occurs. Hence, the biohybrid implants require the ocular implantation of the MEMS with nerve cells for transplantation attached to the surface of an electrode array. Using a peripheral nerve graft or an artificial optic nerve prepared from Schwann cells (a semipermeable membrane tube filled with cultured Schwann cells, extracellular matrix, and neurotrophic factors), the axons of these nerve cells are guided to the higher visual cortex, connecting the MEMS with the visual cortex. That is the nerve cells are used as a "living electrical cable." Once the connection is complete, it is considered that nerve cells transmit signals to the visual cortex in response to electrical pulses provided by the electrode array. Because nerve cells are transplanted as part of the process of fitting this visual prosthesis, a biohybrid implant is appropriate for blind patients whose optic nerves and/or retinal ganglion cells are NOT intact such as glaucoma and diabetic retinopathy patients.

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