Understanding the origin of visual percepts elicited by electrical stimulation of the human retina.

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Abstract

BACKGROUND: The success of a retinal prosthesis for patients with outer retinal degeneration (ORD) depends on the ability to electrically stimulate retinal cells other than photoreceptors. Experiments were undertaken in human volunteers to ascertain whether electrical stimulation of cells other than photoreceptors will result in the perception of light.

METHODS: In two subjects, two areas of laser damage (argon green and krypton red) were created in an eye scheduled for exenteration due to recurrent cancer near the eye. In the operating room prior to exenteration, under local anesthesia, a hand-held stimulating device was inserted via the pars plana and positioned over the damaged areas and normal retina. Subjects' psychophysical responses to electrical stimulation were recorded.

RESULTS: In both subjects, electrical stimulation produced the following perceptions. Normal retina: dark oval (subject 1), dark half-moon (subject 2); krypton red laser-treated retina: small, white light (both subjects); argon green laser treated retina: thin thread (subject 1), thin hook (subject 2). Histologic evaluation of the krypton red-treated retina showed damage confined to the outer retinal layers, while the argon green-treated area evinced damage to both the outer and the inner nuclear layers.

CONCLUSION: The perception produced by electrical stimulation was dependent on the retinal cells present. Electrical stimulation of the krypton red-ablated area best simulated the electrically elicited visual perceptions of our blind, ORD patients, suggesting that the site of stimulation in blind patients is the inner retinal neurons.

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