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Photovoltaic Restoration of Central Vision in Atrophic Age-Related Macular Degeneration.

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PURPOSE: Loss of photoreceptors in atrophic age-related macular degeneration results in severe visual impairment, although some peripheral vision is retained. To restore central vision without compromising the residual peripheral field, we developed a wireless photovoltaic retinal implant (PRIMA; Pixium Vision, Paris, France) in which pixels convert images projected from video glasses using near-infrared light into electric current to stimulate the nearby inner retinal neurons.

DESIGN: We carried out a first-in-human clinical trial to test the safety and efficacy of the prosthesis in patients with geographic atrophy (ClinicalTrials.gov identifier, NCT03333954).

PARTICIPANTS: Five patients with geographic atrophy zone of at least 3 optic disc diameters, no foveal light perception, and best-corrected visual acuity of 20/400 to 20/1000 in the worse-seeing study eye.

METHODS: The 2-mm wide, 30- μ m thick chip, containing 378 pixels (each 100 μ m in diameter), was implanted subretinally in the area of atrophy (absolute scotoma).

MAIN OUTCOME MEASURES: Anatomic outcomes were assessed with fundus photography and OCT for up to 12 months of follow-up. Prosthetic vision was assessed by mapping light perception, bar orientation, letter recognition, and Landolt C acuity.

RESULTS: In all patients, the prosthesis was implanted successfully under the macula, although in 2 patients, it was implanted in unintended locations: within the choroid and off center by 2 mm. All 5 patients could perceive white-yellow prosthetic visual patterns with adjustable brightness in the previous scotomata. The 3 with optimal placement of the implant demonstrated prosthetic acuity of 20/460 to 20/550, and the patient with the off-center implant demonstrated 20/800 acuity. Residual natural acuity did not decrease after implantation in any patient.

CONCLUSIONS: Implantation of the PRIMA did not decrease the residual natural acuity, and it restored visual sensitivity in the former scotoma in each of the 5 patients. In 3 patients with the proper placement of the chip, prosthetic visual acuity was only 10% to 30% less than the level expected from the pixel pitch (20/420). Therefore, the use of optical or electronic magnification in the glasses as well as smaller pixels in future implants may improve visual acuity even further.

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