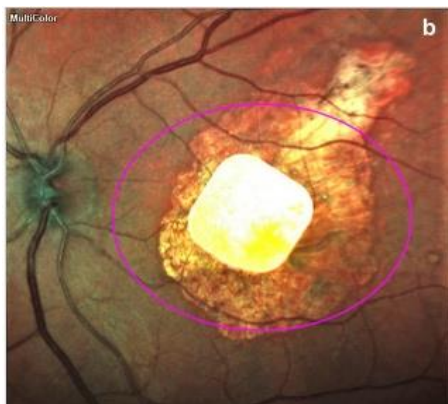


From blindness to bionic vision: The PRIMA Wireless Subretinal Prosthesis and the future of retinal rehabilitation

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INTRODUCTION

Retinal degenerative diseases such as age-related macular degeneration (AMD), Stargardt disease, and retinitis pigmentosa (RP) cause progressive loss of photoreceptors, leading to irreversible vision impairment. In advanced stages of these conditions, damage to the photoreceptor layer prevents the retina from converting light into neural signals, resulting in severe vision loss. Despite the loss of photoreceptors, many inner retinal neurons remain partially functional. Recent advances in retinal bioengineering have led to the development of retinal prostheses designed to bypass damaged photoreceptors and stimulate surviving retinal cells. The PRIMA wireless subretinal prosthesis is a new generation of photovoltaic retinal implant designed to restore visual perception.



Fundus photo showing a patient with the PRIMA implant located within the geographic atrophy (GA) region. The magenta oval indicates the retinal area covered by the projected beam (5.3 × 4.3 mm). (Palanker et al., 2022)

THE ROLE OF OPTOMETRISTS

Key responsibilities may include identifying potential candidates during routine retinal examinations, educating patients about emerging treatment options, and coordinating referrals to specialized clinics. Following implantation, optometrists may also contribute to ongoing visual rehabilitation, patient education, low-vision support, and monitoring ocular health.



MECHANISM

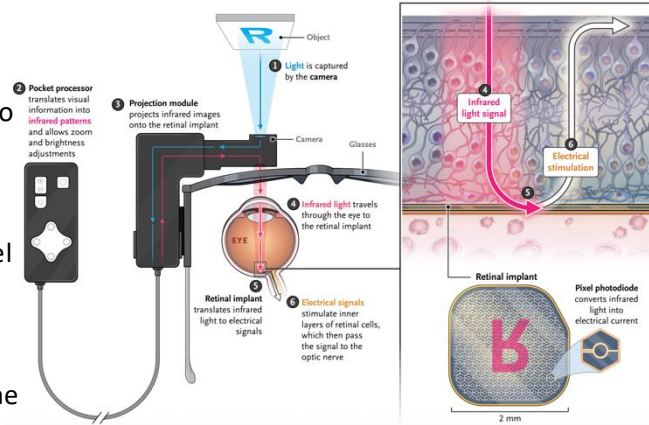
The PRIMA system is a wireless photovoltaic subretinal implant placed beneath the retina. The implant consists of a small microchip containing hundreds of photovoltaic pixels that convert light signals into electrical stimulation. The system works through three main components:

1. *External camera and augmented glasses* capture visual scenes.
2. *Image processing software* converts the visual information into near-infrared light patterns.
3. *The subretinal implant microchip* receives the projected near-infrared light and converts it into electrical stimulation that activates bipolar cells in the retina.

(Holz et al., 2026)

Because near-infrared light is used, the stimulation is invisible to the patient but can activate the implanted photovoltaic pixels. These signals then travel through the remaining retinal circuitry to the visual cortex, allowing the brain to interpret the visual information.

C Path of Visual Information through the PRIMA System



RESULTS

Early clinical studies have demonstrated positive outcomes for patients with advanced retinal degeneration, particularly those with GA. Patients implanted with the PRIMA device were able to perceive patterns, identify letters, and perform simple visual tasks using the prosthetic system.

In a first-in-human clinical trial, participants showed measurable improvements in prosthetic visual acuity and were able to recognize shapes and letters under controlled conditions (Palanker et al., 2022). Although the restored vision remains limited compared with natural vision, these results represent a significant step toward functional visual rehabilitation. Compared with earlier retinal implants, PRIMA offers several advantages, including wireless energy transmission, smaller implant size, and higher spatial resolution (Lorach et al., 2015). At 4 years follow up, PRIMA implantation was well tolerated, preserved peripheral vision, and enabled patients to recognize letters, with visual acuity improvements (Muqit et al., 2024)

LIMITATIONS

Current evidence for the PRIMA prosthesis remains limited, with small clinical cohorts and uncertain long-term outcomes. Hardware constraints such as limited pixel resolution and small visual field mean restored vision is still low resolution, allowing only basic shape or pattern recognition. In addition, implantation involves invasive subretinal surgery with potential surgical risks. Cost, accessibility, and long-term device stability are also important considerations (Ramirez et al., 2023)

CONCLUSION

Retinal prostheses such as PRIMA highlight the growing intersection between biomedical engineering and vision science. Ongoing research aims to improve spatial resolution, expand visual field, and optimize patient adaptation to prosthetic vision.

Although still in early stages of development, wireless subretinal implants represent a promising step toward restoring functional vision in patients previously considered untreatable. Continued innovation and collaboration between clinicians, engineers, and researchers will be essential in shaping the future of retinal rehabilitation.

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