

Surgical Innovations in Vision Restoration: Leveraging Cochlear Implant Success for Subretinal Implant Placement

Santana Karbe*

Klinikum Stuttgart-Olga hospital, ORL-Department, Pediatric Otorhinolaryngology and Otology, Germany

Abstract

Photoreceptors degrade rapidly in hereditary retinal disorders, often resulting in blindness in the absence of treatment. Photoreceptor functions can be replaced by newly created subretinal implants. Retina implant extraocular surgical procedure is heavily reliant on cochlear-implant expertise. However, a whole new surgical approach for handling the photosensor array safely has to be established. Through a sub periosteal tunnel above the zygoma using a specially built trocar. In all patients, the implant housing was secured in a bone bed within a tight subperiosteal pocket. The primary outcomes were patient safety and effectiveness in the short term. In the first phase of the multicenter experiment, nine patients received the subretinal visual implant in one eye. Microphotodiode array pull-through and steady placement were possible in all circumstances without impacting device function.

Keywords: Cochlear-implant expertise; Zygoma; Photoreceptor; Microphotodiode array; Photosensor array

Introduction

Significant progress has been achieved in the field of neuroprosthetics in recent years, particularly in the creation of subretinal implants for blind patients. These implants show considerable potential for recovering eyesight in those with retinal degenerative illnesses including retinitis pigmentosa. Extraocular surgical approaches have evolved as a promising way for effectively implanting these devices, using lessons from the field of cochlear implants. The lessons learnt from cochlear implants and how they opened the path for the development of extraocular surgical methods for subretinal implants are discussed in this article [1].

Cochlear implants restore hearing by replacing the peripheral acoustic receptor with an electronic device. Thus, a number of groups have been pursuing the possibility of restoring vision to blind patients by replacing the photoreceptive function with technical devices since the early 1990s. Most inherited retinal illnesses cause progressive degeneration of photoreceptors, often resulting in blindness in the patient's middle age with no treatment available. The remaining visual pathway is still mostly functional.

Several types of electronic retinal implants are either commercially available or under development for the treatment of inherited retinal degenerations. All of these implants have a light-capture unit as well as an electrode array for stimulating retinal neurons, primarily those in the inner retina [2].

While other groups prefer an epiretinal approach with a camera on the outside, our aim was to restore vision by implanting a microelectronic light sensitive device in the subretinal space that can transform light after amplification into electrical signals for stimulating bipolar cells. This method makes use of natural eye movement, which leads to more natural visual perception. However, the insertion approach looks to be more difficult because to the specific placement in the subretinal area, which is not a standard ophthalmological surgical operation. Furthermore, the energy supply and parameter settings are communicated from a small external portable unit to an implant housing, which is similar to cochlear implants placed in the retroauricular area, via a receiver coil and electronic circuits. As a result, the retina implant extraocular surgical approach is heavily reliant on CI know-how but had to be designed from scratch because the power and signal supply cables had to be brought forward to the orbital area rather than the cochlea.

The success of cochlear implants

Cochlear implants, which stimulate the auditory nerve directly, have revolutionized the treatment of profound hearing loss. Internally, an electrode array is introduced into the cochlea, bypassing the damaged hair cells and providing electrical stimulation to the auditory nerve. Researchers have been inspired by the success of cochlear implants in recovering hearing ability to investigate similar approaches for vision restoration [3, 4].

The concept of subretinal implants

Subretinal implants attempt to restore vision in people with retinal degenerative disorders by directly stimulating the remaining functional retinal cells. Subretinal implants, unlike cochlear implants, are meant to communicate with the remaining healthy retinal cells, such as bipolar and ganglion cells, to convey visual information to the optic nerve. A microelectrode array is surgically implanted beneath the retina in these implants [5].

Adapting the cochlear implant approach

Extraocular surgery for subretinal implants is based on the lessons acquired from cochlear implants. Both types of implants necessitate precise and sensitive surgical procedures to provide the best possible results. Surgeons have used their cochlear implant surgery capabilities, such as precision manipulation of delicate structures, to undertake subretinal implant procedures.

*Corresponding author: Santana Karbe, Klinikum Stuttgart-Olgahospital, ORL-Department, Pediatric Otorhinolaryngology and Otology, Germany, E-mail: santana.karbe@gmail.com

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Surgical techniques

Making a tiny incision in the sclera and producing a retinotomy for implant implantation is the extraocular surgical method. This approach improves access to the subretinal area, lowering the danger of injuring the eye's fragile tissues. The subretinal implant's electrode array is carefully introduced through the retinotomy and positioned beneath the retina to ensure optimal contact with the remaining functional retinal cells. After the implant is in place, the incision is closed, and the patient begins postoperative care and therapy [6, 7].

Clinical outcomes and future directions

Preliminary research on subretinal implants using an extraocular surgical technique has yielded promising results. Patients have reported better visual perception, as well as the capacity to perceive light and simple forms. There are still obstacles to solve, such as optimising the electrode array design, improving vision acuity, and strengthening long-term biocompatibility.

The knowledge gained from cochlear implants has proved essential in the advancement of subretinal implants. Researchers and surgeons are constantly fine-tuning surgical techniques, implant designs, and rehabilitation regimens in order to enhance outcomes and broaden the possible applications of these devices [8].

Discussion

The surgical approach proposed for this investigation is, in our opinion, possible for the implantation of a retinal prosthesis with an extraocular implant retroauricular ceramic housing for power supply and control signals. The surgeries were all uneventful and resulted in the implant being stable throughout the study period. For cochlear implants, the technique of placing the device in a periost pocket under the temporalis muscle is widely recognised. Because the retina implant was placed beneath the pinna, a less invasive method was used. The pinna helix, the ear canal, and the zygomatic process allowed anticipation of the linea temporalis as a caudal extension of the temporalis muscle. Due to the limited surgical access, the diameter of the subperiosteal pocket matched the implant body exactly and allowed for very tight closure by suturing the periost without extra fixation over the implant housing [9].

The intraoperative treatment of the implant's delicate structures appears to be critical. Because the intra- and extraocular components of the implant are created as a single unit, the device had to be placed as a whole through the postauricular incision. The photosensitive chip was then dragged through the narrow subperiosteal channel in a posterior-anterior manner and secured to the orbital rim. This second point of fixation was created as an indentation that matched the exact size of the implant cable. This enables for tiny motions while preventing Page 2 of 2

extrusion. A similar fixation method is frequently utilised for CI-cable at the mastoid border [10].

Conclusion

The success of cochlear implants impacted the extraocular surgical method for subretinal implants, which represents a big step forward in the field of vision restoration for blind individuals. Researchers and clinicians have made significant progress in creating viable strategies for subretinal implant implantation by leveraging surgical techniques and ideas from the cochlear implant sector. Although problems persist, the lessons learnt from cochlear implants provide a solid foundation for future developments in the field, bringing hope to people suffering by retinal degenerative disorders and paving the path for a future in which the blind's vision can be restored.

Conflicts of Interest

None

Acknowledgment

None

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