EPI-RET-3
A wireless retina implant system

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Retinitis Pigmentosa (RP) is a congenital retinal disease which leads to a gradually degeneration of the light sensitive cells of the retina, causing a narrowing of the visual field of the affected patients and in most cases leading to totally blindness. Although major progress has been achieved in the treatment of retinal disorders in the last years, Retinitis Pigmentosa is still incurable. The EPI-RET-3 wireless retina implant system is an epiretinal prosthesis, capable of stimulating the retinal ganglion cells, which are located on the surface of the retina and whose axons form the visual nerve. Thus evoking visual sensations in blind RP patients is possible.

As shown in Figure 1 the system consists of an extraocular and an intraocular part. The extraocular part includes a portable computer system, a transmitter unit and a transmitter coil attached to a special holder similar to an eyeglass frame. The intraocular part, also called the implant, is based on a flexible micro cable with an integrated receiver coil, stimulation electrodes, a receiver chip and a stimulation chip. All electronic components are located in an artificial lens in the posterior chamber of the eye. The electrode array is placed directly onto the retina and fixed with retinal tacks. Energy and data are transmitted to the implant via inductive RF coupling. In contrast to other partially wire-driven systems, the EPI-RET-3 system is completely implanted into the interior of the eye with no cable crossing the wall of the eye. This prevents intraocular infections, mechanical stress over the long term and reduces the surgery time and thereby the exposure for the patient.

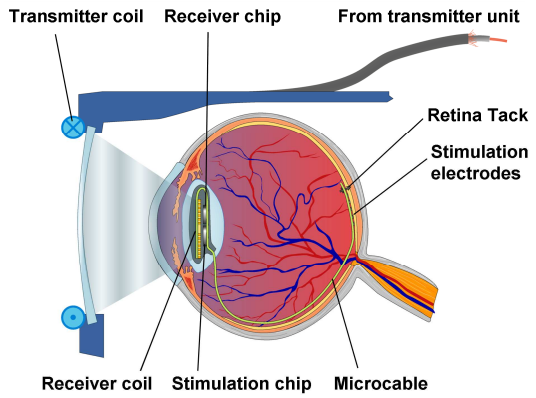

FIG. 1: *Concept of the EPI-RET-3 wireless retina implant system*

The EPI-RET-3 implant consists of a two layer polyimide foil with an embedded gold wiring layer. A second gold layer on top of the foil forms the planar microcoil, the electrodes and the contact pads. The three-dimensional stimulation electrodes with a diameter of 100 µm and a height of 25 µm are coated with iridium oxide to achieve a large charge-delivery-capacitance. The top of the implant is Parylene C covered with openings for the electrodes and the contact pads. A chip-scale rectifier diode and the SMD buffering capacitor are attached to the implant foil by gluing and wire bonding, receiver and stimulator microchip were mounted using flip-chip technology. After assembly and testing the microcoil is folded over the electronic components building a compact receiving part. This part was then encapsulated into an artificial silicone lens. Figure 2 shows a prototype of the EPI-RET-3 implant.

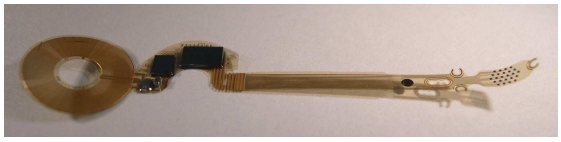

FIG. 2: *Prototype of the EPI-RET-3 wireless retina implant*

In-vivo and in-vitro tests have shown that the implant is fully functional up to a distance of 25 mm between transmitter and receiver coil even during eye movements. The EPI-RET-3 prostheses were implanted into the eyes of six legally blind patients. In each case the surgery was performed successfully and the implants were well-tolerated during the trial period. After four weeks, the implants were removed without any complications. During stimulation sessions all patients reported about visual sensations due to the applied stimulation pulses. Depending on stimulation, the patients reported seeing dots, lines, arcs or circles in different colors. When electrodes that define lines with different orientations on the electrode array were activated, the patient reported seeing different orientations.

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