Development of Very Large Array Structures for Retina Stimulation (VLARS)

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Today's retinal implant prototypes consist of small multi-electrode-arrays (MEAs), which are mounted near the *fovea centralis* on or under the surface of the retina. Clinical studies show that basic visual perception is partly restored in the central field of vision by electrical stimulation. The stimulation of peripheral areas cannot be achieved up to now. However the peripheral functionality of the retina is essential to be able to orient oneself in space.

Within the VLARS-project the goal is to develop a MEA, which allows the stimulation of very large areas of the retina to restore also the peripheral field of vision. The structures are subject to some conditions, for example operability and bio-compatibility.

At present there are different groups who develop implants to restore vision of patients with hereditary or acquired degeneration of the retina. These implants consist of stimulation-electrodes mounted on a flexible substrate along with the necessary electronics providing signals an power. Typically the electrodes are mounted on the backside (sub-retinal) or on the surface (epi-retinal) of the *macula*. The stimulating electrodes are covering a retinal surface area of a few mm² (compare figure 1). The systems were implanted and tested on blind patients in clinical studies. However these patients reported only very rudimentary visual perception. Depending on stimulation, the patients reported seeing dots, lines, arcs or circles in different colors. [2]

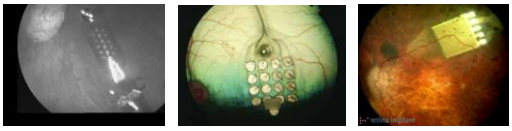

figure 1. retina stimulators: *left*: EPIRET III [4], *middle*: Argus I [1], *right*: Retina Implant AG [2]

At the IWE1 and the UK-Aachen the groups of Prof. Dr. rer. nat. Mokwa and Prof. Dr. med. Walter have been working on an epiretinal prosthesis for a couple of years now. Six devices were successfully tested in humans [3]. In order to enlarge the visual field of this implant within the VLARS project we want to create a MEA on a flexible polyimide foil which covers about 100mm² of the retina, and which carries a total of several hundred stimulation electrodes [5]. This increase in both area and resolution should give patients a much better perception of their environment. Especially the visual capabilities of patients with *retinitis pigmentosa* whose retina degenerates first in the peripheral areas could be extended.

The goal of the VLARS-project is to develop a polyimide structure which is able to cover a large area of the retina and carry a large number of electrodes, while being implantable through a very small opening of a few mm in the eye-ball [6]. We are also investigating techniques to give the implant an inherent curvature which leads to a perfect adaption to the spherical shape of the retina.

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