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PERSONAL INFORMATION

Your name and address e-mail :

Naïg Chenais

email: naig.chenais@epfl.ch

Your affiliation :

EPFL
IBI-STI -Center for Neuroprosthetics
LNE (Medtronic Chair in Neuroengineering)

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ABSTRACT

TITLE: Photovoltaic stimulation of retinal ganglion cells with wide-field epiretinal prosthesis

AUTHORS: Naïg Chenais [1], Marta Airaghi Leccardi [1], Laura Ferlauto [1], Kevin Sivula [2] and Diego Ghezzi [1]

e-mail address of the contact author : naig.chenais@epfl.ch, diego.ghezzi@epfl.ch

AFFILIATIONS:

1. Medtronic Chair in Neuroengineering, EPFL STI IBI-STI LNE, 1015 Lausanne, Switzerland
2. Laboratory for Molecular Engineering of Optoelectronic Nanomaterials, EPFL SB ISIC LIMNO, 1015 Lausanne, Switzerland

ABSTRACT (limit of 2500 characters):

Retinal prostheses have become in the past decade a promising and realistic technology to restore vision. Nonetheless, sight restoration with retinal prostheses in a clinically relevant perspective requires resolution and implantation challenges not yet achieved. Our goal is the development of a foldable and wide field-retinal prosthesis capable of achieving a wireless photovoltaic stimulation of retinal ganglion cells and restore at least 40° of visual field, though being injectable trough minimal incision. The 2345 organic photovoltaic stimulating pixels of our retina prosthesis are distributed into biomimetic pattern within an active area of 13 mm (44° of visual field) and the light-triggered current profile generated by those pixels shows a reproducible ability to elicit activity in explanted rodents' retinas mimicking human retina dystrophies.

Extracellular recordings of prosthetic-evoked spiking activity of retinal ganglion cells reveal both direct and network-mediated stimulation when the degenerating retina circuit is explanted on top of the stimulating device, while when retinas are layered on bare PDMS substrates, any light-evoked pattern of response can be detected among retina spontaneous activity.
Screening of different conditions of illumination (pulse duration and intensity) with Rd10 retinas explanted on our prosthesis shows a direct activation from the minimal radiant exposure tested - that is 7 times smaller than the maximum permissible retinal irradiance allowed for ophthalmic applications in this case- while network-mediated activation requires higher light exposure and can be supressed using synaptic blockers.

The clinical compliance of the so-designed prosthesis and those preliminary results on explanted retinas represent a step forward in building wide-field photovoltaic retinal prostheses.