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Submitted

on December 04, 01:55 PM

for arvo2014

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CONTROL ID: 1913146

TITLE: A polymer-based interface restores light sensitivity in blind rats

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Commercial Relationships Disclosure (Abstract): Diego Ghezzi: Commercial Relationship: Code N (No Commercial Relationship) | Maria Rosa Antognazza: Commercial Relationship: Code N (No Commercial Relationship) | Mattia Di Paolo: Commercial Relationship: Code N (No Commercial Relationship) | Maurizio Mete: Commercial Relationship: Code N (No Commercial Relationship) | Rita Maccarone: Commercial Relationship: Code N (No Commercial Relationship) | Silvia Bisti: Commercial Relationship: Code N (No Commercial Relationship) | Grazia Pertile: Commercial Relationship: Code N (No Commercial Relationship) | Guglielmo Lanzani: Commercial Relationship: Code N (No Commercial Relationship) | Fabio Benfenati: Commercial Relationship: Code N (No Commercial Relationship)

Study Group:

ABSTRACT BODY:
Purpose: Sight restoration is one of the new frontiers for prosthetic devices that enable the electrical stimulation of neurons. In particular, diseases affecting the retinal pigment epithelium and photoreceptors but preserve the inner retinal layers are preferential targets for implantation of visual prostheses. We recently discovered that primary neurons can be successfully grown onto a photovoltaic organic polymer and electrically stimulated by light. This result was confirmed by restoring light sensitivity in retinas explanted from albino rats with light-induced degeneration of the photoreceptor layer. After implantation of the interface in Royal College of Surgeons rats, we are now evaluating the efficacy of the implant in restoring light sensitivity in-vivo.

Methods: Experiments were performed on Royal College of Surgeons (RCS) rats and the non-dystrophic congenic animals (RCS-rdy). 2-3 months old animals were implanted with the prosthesis and let to recover for at least 3 weeks before experimentation. Pupillary light reflex, electroretinogram, visually evoked field potentials, and behavioral tests were performed in both implanted and not implanted rats (either RCS or RCS-rdy). Optical coherence tomography and immunofluorescence assays were performed to verify the correct positioning of the prosthesis after the surgery and its long-term tolerability.

Results: We demonstrated the long-term tolerability (up to 5 months) of the organic prosthesis by monitoring the expression of inflammatory markers on retinas from RCS (GFAP) and RCS-rdy animals (FGF and GFAP) after implantation; Electroretinogram in implanted RCS-rdy animals confirmed that the prosthesis is not altering the functioning of healthy retinas. Moreover, electrophysiological and behavioral techniques on RCS rats suggest the possibility to partially restore light sensitivity in-vivo. We found: a statistically significant improvement in the pupillary light reflex (in 54% of the tested animals), the recovery of the visually evoked field potentials (in 50% of the tested animals), and a behavior in the Dark/Light test statistically comparable with the non-dystrophic animals (in 59% of the tested animals).

Conclusions: In conclusion, our in-vitro and in-vivo results demonstrate the potential application of an optoelectronic polymer as substrate for the generation of a photovoltaic retinal prosthesis.

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PRESENTATION TYPE: #1 Paper, #2 Poster : Travel Award Applicant
CURRENT * REVIEWING CODE: 1270 artificial vision, nanobiodevices, manipulation and engineering - NT
CURRENT * SECTION: Nanotechnology and Regenerative Medicine

KEYWORDS: 508 electrophysiology: non-clinical, 607 nanotechnology, 688 retina.

Clinical Trial Registration: No
Other Registry Site:
Registration Number:
Date Trial was Registered (MM/DD/YYYY) :
Date Trial Began (MM/DD/YYYY):

TRAVEL GRANTS and AWARDS APPLICATIONS
AWARDS: ARVO and ARVO Foundation Travel Grants
Grant Support: Yes
Grant Support:
Support Detail: Telethon Italy GGP12033A
Support Detail: