THE UNIVERSITY OF MEMPHIS | Office of Technology Transfer

Novel Material Improves and Streamlines Repair of Peripheral Nerves

Every year in the U.S. several hundred thousand people suffer traumatic nerve injuries or have surgical procedures which damage peripheral nerves. Repairing these requires significant additional time in surgery and delivers only modest chances of functional recovery. A novel product platform developed at the University of Memphis has significant potential to improve the outcomes for these patients as well as reduce the surgical time required to achieve these benefits.

Current nerve repair procedures are limited to single nerve pathways and involve suturing and grafting. These increase the incidence of misfire and neuropathy due to misalignments and tissue trauma. ***A significant alternative to suturing peripheral nerve injuries****, an aerogel-based implant uniquely and* ***specifically guides nerve terminals along a precise pathway in order to reestablish functional nerve communication (tracks) for branched nerves.*** *The implant material establishes a multi-channel map, by means of targeted signal conduction and biological attachment factors, to direct nerve terminals to a preprogrammed destination.*

> *"It is my opinion that the development of the multidimensional aerogel based nerve repair device that Dr. Sabri and her team are developing can be an attractive alternative to existing nerve repair devices.* ***The future of neurosurgery and nerve repair approaches could be significantly impacted if multidimensional suture-free devices such as the one under development by F. Sabri are available for usage by the medical professionals.*** *Even if the device is only successful in two of the three areas, it will still be superior to currently practiced techniques, or the least, an attractive alternative."*
> *– Surgeon and Professor, UT Department of Otolaryngology, Head & Neck Surgery*

Inspired by research with electrical circuit boards, an aerogel-based peripheral nerve repair approach applies the functionality of a circuit board to molecular nerve biology, thereby enhancing reconnection of damaged peripheral nerve terminals severed by trauma or surgery. An aerogel-based device is lightweight and porous, yet mechanically robust, and reinforces an appropriate track for nerve stimulation to intentionally map growth pathways that lead to better patient recovery and regaining control of various muscle groups otherwise compromised.

This novel approach provides distinct yet simultaneous guidance for multiple severed nerve terminals by aligning electrical signals and attachment factors along a conducting channel imbedded within an aerogel-based, mechanically strong, porous substrate.

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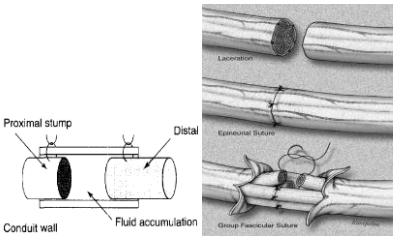
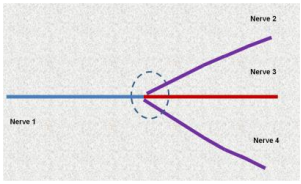


Current techniques for nerve repair: Suture required, maximum repair gap 3 cm, limited to one nerve repair only, once conduit inserted external evaluation of implant cannot be performed.



Aerogel-based technique features: No suture required, multiple nerves repaired simultaneously, long gap repair possible since material is light weight yet mechanically robust, shorter surgery time, provide tracks for electrical stimulation and propagation of action potential. Implant detectable through acoustical means.

This implantable material provides precision communication for multiple severed nerve terminals through a permeable and lightweight biomedical material. The unique aerogel material, attachment stimulating factors, and localized signal technology promote the body's natural healing process by means of:

- **Precise Pathway Mapping:** The unique substrate defines a precise conduction and growth pathway, enhancing both directional and electrical signaling for biological growth.
- **Sutureless Repair:** A biocompatible channel device supports the natural osmotic environment for nerve repair. With no need for sutures or subsequent removal, the aerogel-based device decreases surgery time and eliminates hemorrhaging, thereby contributing to better functional recovery.
- **Acoustical Monitoring:** Detection through acoustical means allows for imaging of both device placement as well as revascularization of healthy tissue.
- **Functionality:** A specific nerve channel and adhesion technology minimizes mismatches and misfiring of nerve signals.

Short and long term in vivo studies have demonstrated no toxicity or pathology resulting from implants of the aerogel material, thus far. In vitro studies have shown that confining of nerve cells on aerogel substrates is possible and more importantly, neuronal communication on a microscopic scale is abundant. Additionally, in a study directly comparing functional recovery resulting from repair of surgically-severed sciatic nerve, the aerogel-based technology performed very close to the more labor-intensive suturing technique. The prototype device also contains color coding identification mechanism that has been tested for toxicity and stability under various physiological conditions and proven to be inert. Currently, the University of Memphis seeks an experienced biomedical executive to assist with the development of an early-stage commercialization plan.

Dr. Firouzeh Sabri received her Ph.D. in Semiconductor Physics and Microelectronics from Cavendish Laboratory, University of Cambridge, United Kingdom. After completing her Ph.D. she joined the biophysics group at NIH-NIDCD and conducted research on the biomechanics of cochlear outer hair cells. She then joined the University of Florida Chemistry Department for further work on silicone-based polymers, both for medical and for NASA space exploratory applications. In August 2007, Dr. Sabri joined the Physics Department at University of Memphis. She is currently working on establishing the Materials Science Laboratory and has several materials-related projects ongoing. Dr. Sabri has won several awards during her years in Physics to include the ORS award, Nuffield Foundation award, and APS Hildred Blewett award.