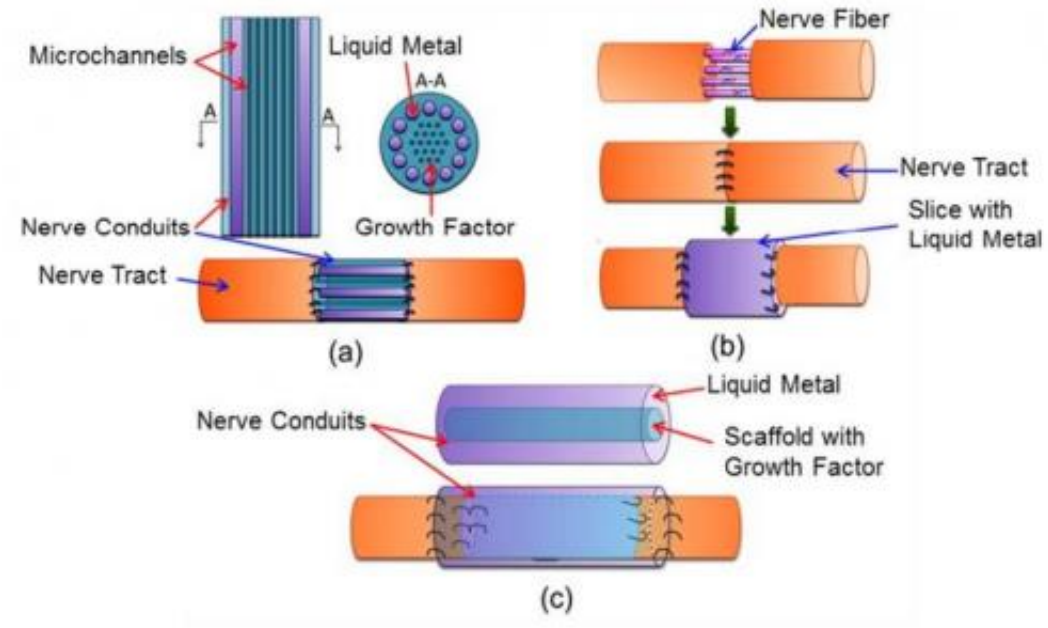
Beijing researchers explore liquid metal to reconnect nerves

April 29 2014, by Nancy Owano



Three kinds of nerve conduits to repair the injured peripheral nerve. (a) Nerve conduit with microchannels. (b) Nerve conduit with a shape of thin slice. (c) Nerve conduit with concentric tubes. Credit: arXiv:1404.5931 [physics.med-ph]

(Medical Xpress)—What is the most effective way to reconnect severed nerves? After years of research, scientists are still exploring, aware of the risks of long-term disability. Techniques used include sewing ends back together or grafting nerves into the gap, but it takes a long time, sometimes years, for the nerve ends to grow back and knit together, and during that time the muscles can degrade beyond repair. Researchers

look for a way to keep muscles active during regrowth and there is news that Chinese biomedical engineers may be on to something important.

MIT Technology Review said Monday that a team of scientists from the department of biomedical engineering at Tsinghua University in China have used liquid metal to transmit electrical signals across the gap in severed sciatic nerves, raising hopes of a potential new treatment for nerve injuries. Is it possible that liquid metal could turn out to be a valuable component in treating nerve injuries?

Earlier this month, Jie Zhang, Lei Sheng, Chao Jin, and Jing Liu submitted their paper , "Liquid Metal as Connecting or Functional Recovery Channel for the Transected Sciatic Nerve" to *arXiv*. The paper details their study in reconnecting severed nerves using liquid metal, exploring the viability of such a technique. This was the "first ever experiment," they wrote, "to demonstrate that liquid metal GaInSn alloy could efficiently reconnect the transected sciatic nerve invitro and conduct the electroneurographic signals." A significant feature about their work is that they found that the metal's electrical properties could help preserve the function of nerves while they regenerate. They used sciatic nerves connected to a calf muscle taken from bullfrogs.

The authors noted that since liquid metal clearly shows up in x-rays, it can be easily removed from the body with a micro-syringe when no longer needed. The authors said that "visibility under the plain radiographs and fluidity could make it convenient to suck up the liquid metal via a micro-syringe. To investigate the visibility under the plain radiographs, the liquid metal was injected into the bullfrog's leg where it was close to the sciatic nerve, and then the plain radiograph was acquired by X-ray under the dosage of 100V and 1mAs. After that, the liquid metal was sucked up by a micro-syringe, and the plain radiograph was acquired once again."

Assessing their results, the authors find the use of liquid metal encouraging. "The unique diverse favorable properties of the GaInSn guarantee it an advantageous material for future clinical practices. Besides, the applied liquid metal could represent with similar electrical properties of the nerve. It is expected that such kind of materials could open a promising way for nerve functional recovery during the regeneration process and reduce the probability of functional impairment."

According to *MIT Technology Review*, the questions to be examined are legion. "How much of the muscle function can be preserved in this way? Could the liquid metal somehow interfere with or prevent regeneration? And how safe is liquid metal inside the body, particularly if it leaks?" The review said the researchers will hope to answer such questions in the near future, "with animal models at first and possibly later with humans."

More information: Liquid Metal as Connecting or Functional Recovery Channel for the Transected Sciatic Nerve, arXiv:1404.5931 [physics.med-ph] arxiv.org/abs/1404.5931

Abstract
In this article, the liquid metal GaInSn alloy (67% Ga, 20.5% In, and 12.5% Sn by volume) is proposed for the first time to repair the peripheral neurotmesis as connecting or functional recovery channel. Such material owns a group of unique merits in many aspects, such as favorable fluidity, super compliance, high electrical conductivity, which are rather beneficial for conducting the excited signal of nerve during the regeneration process in vivo. It was found that the measured electroneurographic signal from the transected bullfrog sciatic nerve reconnected by the liquid metal after the electrical stimulation was close to that from the intact sciatic nerve. The control experiments through replacement of GaInSn with the conventionally used Riger Solution revealed that Riger Solution could not be competitive with the liquid

metal in the performance as functional recovery channel. In addition, through evaluation of the basic electrical property, the material GaInSn works more suitable for the conduction of the weak electroneurographic signal as its impedance was several orders lower than that of the well-known Riger Solution. Further, the visibility under the plain radiograph of such material revealed the high convenience in performing secondary surgery. This new generation nerve connecting material is expected to be important for the functional recovery during regeneration of the injured peripheral nerve and the optimization of neurosurgery in the near future.