


Researchers develop bioresorbable, implantable device to block pain signals from peripheral nerves

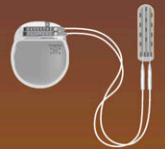
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Novel Implantable Devices for Pain Management via Peripheral Nerve Cooling

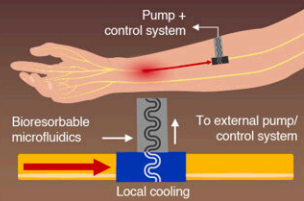
The use of opioids for pain management is strongly associated with opioid addiction and deaths due to overdose



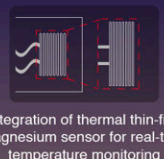
Implantable devices that eliminate pain signals can substitute opioids but are limited due to bulky forms and imprecise technology



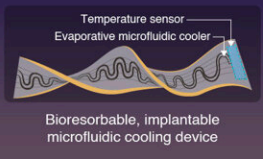
Can bioresorbable, implantable nerve-cooling devices offer local analgesia in a precise and stable manner?



Soft nerve cuff serpentine microfluidic channel carrying a bioinert cooler




Integration of thermal thin-film Magnesium sensor for real-time temperature monitoring

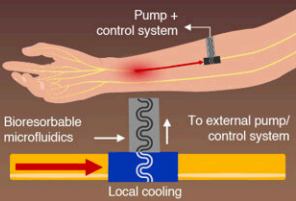


Temperature sensor—Evaporative microfluidic cooler
Bioresorbable, implantable microfluidic cooling device

Experiments on sciatic nerves in rat models for neuropathic pain control



Evaporative microfluid cooling approach



Pump + control system
Bioresorbable microfluidics
Local cooling
To external pump/control system

- Delivery of minimally invasive cooling power
- Precise and stable cooling for more than 15 minutes
- Localization of cooling effect

Advantages

- ✓ Dissolution to biocompatible end products
- ✓ Reversible elimination of local peripheral nerve activity
- ✓ On-demand analgesic ability

Soft, bioresorbable cooling devices have the potential to provide local analgesia for neuropathic pain in a rapid, precise, and stable manner

Soft, bioresorbable coolers for reversible conduction block of peripheral nerves
Reeder et al. (2022) | Science | DOI: 10.1126/science.abe18532

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PUSAN NATIONAL UNIVERSITY

A soft, bioresorbable, implantable device developed by researchers from Pusan National University provides a focused, reversible, and precise cooling effect to block pain signals from peripheral nerves. Credit: Pusan National University

Due to their high efficacy, opioids are used widely for the management of neuropathic pain, despite the increasing rates of opioid addiction and

deaths due to overdose. To avoid these side effects, there is an urgent need for pain management approaches that can substitute opioid use.

It is well known that [cold temperatures](#) numb the sensation in our nerves. Evidence suggests that cooling peripheral nerves can in fact reduce the velocity and amplitude of neural signals that cause [pain](#), leading to [pain relief](#). What's great about this approach is that if made possible, it will be completely reversible and non-addictive.

To this end, a team of researchers led by Professor Min-Ho Seo from Pusan National University developed a soft, bioresorbable, implantable [device](#) with the potential to cool peripheral nerves in a minimally invasive, focused manner. "Scientists already knew that low temperatures could numb the nerves in the body. But demonstrating this phenomenon with a small device at a clinical level was not an easy task," said Prof. Seo while discussing the study, which was published in *Science* on June 30, 2022.

To develop the device, the team designed a microfluidics system formed with a bioresorbable material—poly(octanediol citrate)—with interconnects carrying a liquid coolant to a serpentine chamber. To top it off, a Magnesium temperature sensor for real-time temperature monitoring was incorporated at its distal end. The intensity and localization of the cooling effect was regulated by perfluoro pentane (PFP) and dry nitrogen gas (N₂)—the two components of the liquid coolant, as well as the geometry of the serpentine chamber.

Next, the team tested the device by implanting it into the sciatic nerves of living rat models with neuropathic pain associated with spared nerve injury. After a three-week evaluation, the team found that the device successfully delivered cooling power to the [peripheral nerves](#) of the rats, which led to a reduction in their pain. Fortunately, the delivery of the cooling power occurred in a minimally invasive, stable, and precise

manner. Furthermore, this application was localized and reversible, and remained effective for almost 15 minutes during one session.

On being submerged in phosphate-buffered saline solution at 75°C, the device, which was made of bioresorbable materials, dissolved within 20 days and got eliminated in approximately 50 days. These findings imply that it has the potential to naturally degrade and get resorbed in the human body.

So, what are the future applications of this device? "The developed device can be used to treat pain after surgery. Since it is connected to an external source of fluid and power like a commercial intravenous (IV) device, it can easily be controlled by the patient. This way, our [implantable device](#) will be able to provide targeted and individualized relief without the drawbacks of the addictive pain medications," said Prof. Seo in response.

With such progress underway, patients with [neuropathic pain](#) will finally be able to receive safe and sustainable treatment, without the risk of adverse effects associated with opioid use.

More information: Jonathan T. Reeder et al, Soft, bioresorbable coolers for reversible conduction block of peripheral nerves, *Science* (2022). [DOI: 10.1126/science.abl8532](https://doi.org/10.1126/science.abl8532)

Provided by Pusan National University

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