2015-910 Design and Fabrication of an Array for Transcutaneous Spinal Cord Stimulation

Published date: Aug. 28, 2019

Technology description

UCLA researchers in the Department of Bioengineering developed a novel transcutaneous spinal cord stimulation device that employs microneedles to continuously deliver effective and uniform electrical current to spinal cords. The device does not irritate tissues and uses much lower electrical power than conventional devices.

Approximately 1.3 million people in the United States suffer from serious spinal cord injuries. This number increases roughly by 12-15,000 per year. About 50% of these injuries result in total loss of motor function below the level of injury sites. However, certain motor tasks can be enabled by epidural electrical stimulation of the brainstem and the lower back region of the spinal cord. Existing technologies that provide such stimulations utilize large area skin contact to administer transcutaneous electrical neural stimulation (TENS). Nevertheless, skin is not an efficient conductive material due to its high impedance.

Typical TENS uses high voltage that could induce irritation and produce excess heat. The cooling conductive gel used on the skin is only a temporary solution for heat dissipation and lowering impedance. The impedance gradually goes up as the gel dries up. The efficacy is further comprised due to stimulation edge effect that leads to accumulation of high current near the edge of the skin contact area, causing further irritation. These devices are not made to be worn by patients over a long period of time.

An array of microneedles for transcutaneous spinal cord stimulation is developed to address the aforementioned problems with existing technologies. These hollow solid needles have conformal electrical field distribution. Their micro size allows them to penetrate the top layer of dead skin cells to reach a less electrically impeding tissue layer, but not into the subcutaneous tissue, hence no pain or bleeding. With less impedance, the electrical power administered is reduced by almost 6 times. The distribution of microneedle electrodes can be fine-tuned to reach specific stimulation level and areas. Individual needle can also be controlled to empathize stimulation in targeted areas. These needles are fabricated in a 3D printed mold to allow uniformity. They are also attached to a flexible polymer backing to allow complete conformity to a patient’ s back. With these innovative designs, this stimulation system can continuously deliver highly effective electrical stimulation to spinal cords without irritation, excess heat or tissue damage.

Application area

Transcutaneous electrical spinal cord stimulation
Transcutaneous electrical stimulation
Transcranial direct current stimulation
All kinds of electrical stimulation applied from outer skin layer

Advantages

Complete physiological conformity
No edge effects
Increased efficiency and efficacy
Can be worn for a long period of time
Lower tissue damage and irritation
Lower power

Institution

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