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The latest innovative study in neurotechnology: A fully implantable external rechargeable and controlled neuroimplant system

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Abstract

Objective: One of the main problems for the bio-implants is the charge life of implant. International Neurotechnology Center is working to develop nerve stimulators and charge units for bio-implants.

Material and Methods: A general object of the present invention is to provide an improved method for transmission of stimulating signals to an electrode implanted in the body. The new neuro implant presented here is a fully implantable, externally rechargeable and controlled system.

Results: To overcome the problems encountered with the existing fully implantable neuro implants such as component failure, limited battery life, programming difficulties and high cost, a new system, that is based on fully implanted externally charged and controlled principles, has been developed.

Conclusion: The newly designed neuro implant system, which is patented and having full quality assurance certificates (CE, ISO9001 and ISO13485), appears to be competitive to the presently known neuro implants in terms of quality, safety, reliability, reduction in size and cost.

Key words: Vagal Nerve Stimulators; Fully implantable; External rechargeable; External controlled; neuro implant.

Introduction

Neuro implantation is a well-established surgical technic to apply neuro stimulation under the skin following operation. Neuro stimulation is a process, by which nerves partially losing their function as a result of disease or trauma, are stimulated using artificial electrical pulses for regeneration. Electrical signals used for this purpose must be consistent with the nature of human neurophysiology (1).

The application, started with epidural spinal cord stimulation to control chronic pain in 1967, nowadays has clinically been approved for other cases, e.g. peripheral nerve stimulation to control pain, vagus nerve stimulation for the management of epilepsy, depression and Alzheimer's disease, phrenic nerve stimulation for diaphragm pacing in breathing disorders, hypoglossal nerve stimulation to treat sleep apnea and snoring, deep brain stimulation for the management of Parkinson's disease (2-9).

Historically, implant technologies used were radio-frequency (RF) transmission, fully implantation, semi-implantation (the Tulgar neuro-implant system), system respectively (10).

Material and Methods

A general object of the present invention is to provide an improved method for transmission of stimulating signals to an electrode implanted in the body.

The new neuro implant presented here is a fully implantable, externally rechargeable and controlled system. The system includes both implanted and external parts.

The implanted parts are stimulator and electrode. Stimulator, that is housed in a medical grade titanium case Ti64 (grade 5, permanently implantable in human body) as shown in Figure 1, consists of a 3-fold sandwich, from bottom to up LFP rechargeable battery of 3.2V 120mAh, gold plated PCB mounted with the necessary electronic components and internal charging coil on the top. Implanted bipolar electrode is completely novel with a brand new designed easy-fit connector and cuff electrode that is not wrapped along the nerve thus enhancing the surgery (Figure 2a and b). External parts compose a specially designed Communicator with an external charging coil to awake the embedded circuit and to charge the implanted battery. The external Communicator also has a LCD display to show the status of battery, and to measure the tissue impedance during the operation. The software (treatment program) was optimized to allow the implanted battery lasts for at least 3 months. This user friendly systems allows to start or stop stimulation when needed, e.g. it is possible to start soon before feeling the aura in epileptic patients in case of VNS, vagus nerve stimulation; or to start just

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before going to sleep and to stop just after awaking, sleep apne patients in case of hypoglossal nerve stimulation; or to start anytime when pain is felt in case of peripheral nerve stimulation. In addition, the treatment program is consistent with the body's own language as scientifically approved by our previous study (11).

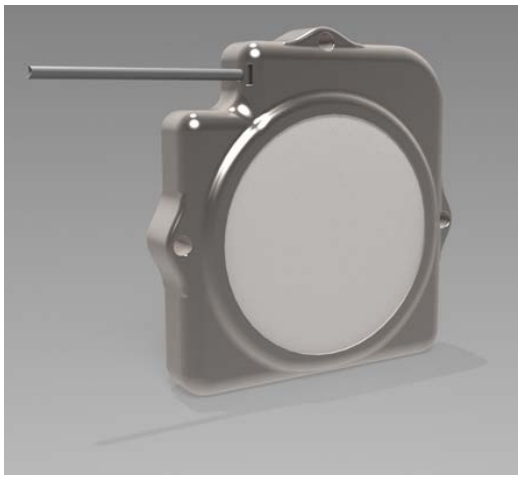

Figure 1: Titanium housing.

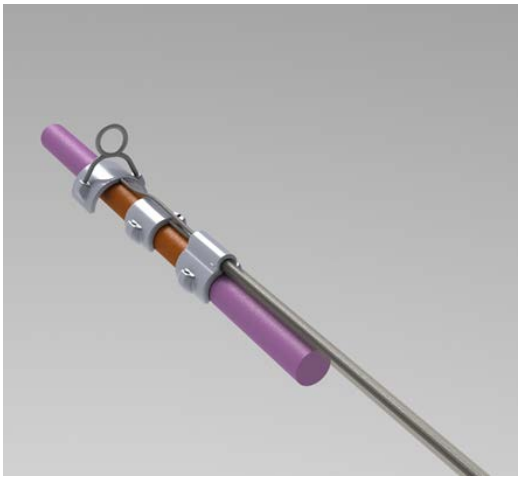

Figure 2A: Implanted bipolar electrode. user friendly cuff contacts (not wrapped around the nerve)

Figure 2B: Implanted bipolar electrode. easy-fit connector

Results and Discussion

Our latest innovative study, presented here, reports a fully implanted externally recharged and controlled neuro-implant model which is now ready to apply.

The newly designed neuro implant system, which is patented and having full quality assurance certificates (CE, ISO9001 and ISO13485), appears to be competitive to the presently known neuro implants in terms of quality, safety, reliability, reduction in size and cost.

Conflict of Interest: The authors declare that there are no conflicts of interest.

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