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Chronic brain stimulation using Micro-ECoG devices

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ABSTRACT

Recording and stimulating brain activity has had great success both as a research tool and as a clinical technique. Neural prosthetics can replace limbs, restore hearing, and treat disorders like Parkinson's and epilepsy, but are relatively crude. Current neural prosthetic systems use penetrating electrodes to achieve high precision, but the invasive nature of these devices provoke a strong immune response that limits chronic use. (Polikov et al) In our study we evaluate micro-electrocortiographic (micro-ECoG) devices which sit under the skull and on the surface of the brain for stimulation over chronic timescales. We anticipate these devices with their less invasive placement will evoke less extreme immune responses compared to penetrating electrodes and allow for stable stimulation over long periods of time (months to years). These devices were developed by the NITRO Lab of University of Wisconsin. (Thongpang et al) In short, Sprague Dawley rats were implanted with micro-ECoG devices over either somatosensory or auditor cortex. They were stimulated electrically through these devices on a daily basis to evaluate their chronic performance *in vivo*. Sensitivity to stimulation was determined via an operant behavioral task and the implants' electrical properties were measured daily to monitor functionality and approximate of the immune response. After at least two months of implantation, animals were perfused and a histological analysis was performed to evaluate the chronic immune response. From preliminary results we expect to see that the micro-ECoG devices are capable of long term stimulation and evoke a smaller immune response from the brain than penetrating neural implants. In addition, we have found that removing the dura in rats for device implantation causes significant brain swelling, which indicates a strong immune response preventing effective stimulation. This research shows that micro-ECoG devices can chronically stimulate brain tissue and show great promise as a less invasive method of neural interfacing compared to traditional penetrating electrodes.

KEYWORDS

Micro ECoG, electrocortiography, neural implant, brain machine interface, chronic brain stimulation, immune response

REFERENCES

V.S. Polikov, P.A. Tresco, W.M. Reichert, “Response of brain tissue to chronically implanted neural electrodes,” Journal of Neuroscience Methods, vol. 148, pp 1-18, 2005

S. Thongpang, T. J. Richner, S. K. Brodnick, A. Schendel, J. Kim, J. A. Wilson, et al., "A micro-electrocorticography platform and deployment strategies for chronic BCI applications," *Clin EEG Neurosci*, vol. 42, pp. 259-65, Oct 2011.