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# Chronic Single-Neuron Recordings from the Cuneate Nucleus: Surgical Methodology

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## Introduction

Despite the role of the cuneate nucleus (CN) in transmitting all somatosensory input to the cerebrum, the responses of single neurons in CN have never been recorded in an awake animal. As a consequence, little is known about how sensory information is processed in this structure. A major challenge is the limited accessibility of the CN, located in the dorsal brainstem. While multi-electrode arrays (MEAs) have been used to record from cortex for decades, CN requires innovative surgical approaches. We report a novel surgical technique for the chronic implantation of MEAs in the CN of rhesus macaques.

## Methods

We implanted MEAs in ten monkeys, progressively modifying the approach to address recurrent lead failure and spontaneous explantation. Monkeys were placed in a stereotaxic frame with their neck flexed at 30 degrees to facilitate access to the dorsal medulla. We exposed the foramen magnum and performed a wide craniectomy. We then inserted an MEA with either a high-speed, pneumatic inserter (for "Utah" arrays) or slowly, with a stereotaxic instrument (for FMAs), and fixed the MEA to the brainstem using cyanoacrylate. Finally, we closed dura with attention to minimizing strain on the leads and fixed the pedestal, which receives the leads, to the skull using titanium screws.

## Learning Objectives

1. Understand challenges in implanting MEA into non-human primate (NHP) CN

2. Understand the purpose of research using CN recordings in awake behaving NHP

3. Understand innovations in surgical technique that allow long-term recording of single cells in NHP CN.

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## Results

The first few arrays either did not record any single units or failed within 2 weeks of implantation. With several technical modifications, a recent array has lasted over nine months with stable recording quality (Figure I). Using this technology, we have been able to obtain, for the first time, single-neuron recordings from the CN while an animal performs a behavioral task (Figure II).

## Conclusions

Our innovative surgical technique has allowed us to record both tactile and proprioceptive signals chronically from the CN in awake, behaving animals. This preparation is now poised to yield invaluable insights into the role of CN in tactile and proprioceptive processing.