IMPROVING EXTRACELLULAR RECORDING TECHNOLOGY WITH SUCTION ELECTRODES

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INTRODUCTION

Extracellular recording of nerve activities using suction electrodes is an easy yet powerful tool in characterizing neural activities in physiology and pathological conditions.

Key factors that determine the quality of suction electrode recording has not been fully investigated.

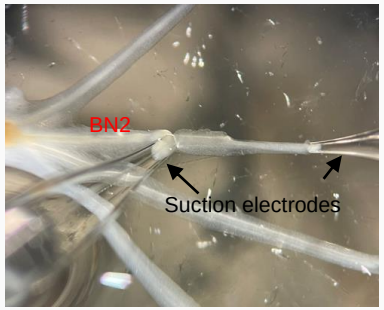
Here, we modeled the biophysical mechanisms underlying suction technology, and found that both the recording site and the integrity of the neural tissue impact the shape of the recorded activity. The model also suggests, quantitatively, the importance of a tight suction for high-quality recording. Using nerves from the model system, *Aplysia californica*, we tested the model predictions.

METHODS

- Biophysics modeling.
- Extracellular recording from buccal nerve 2 (BN2) axons.
- Shape analysis.

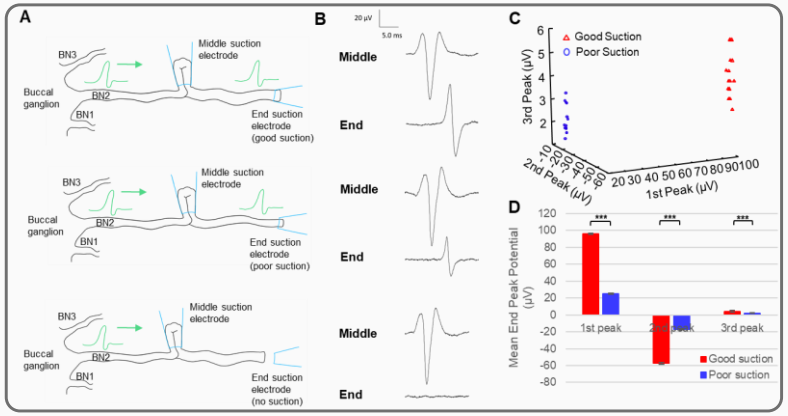
Aplysia californica

Buccal ganglion



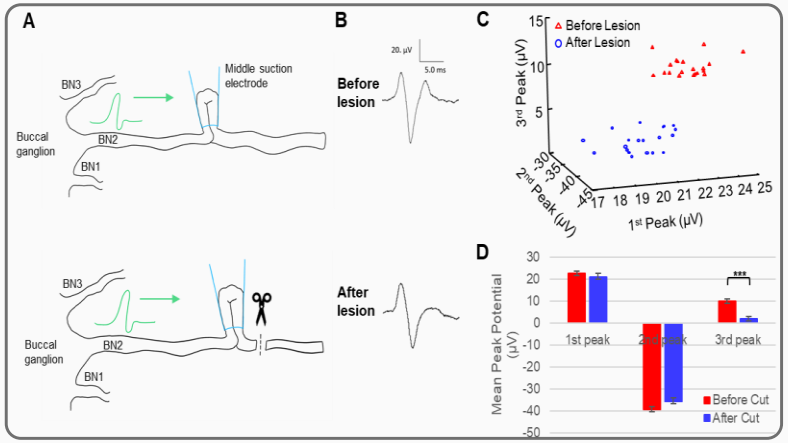
RESULTS

Suction quality affects quality/magnitude of waveform recording.



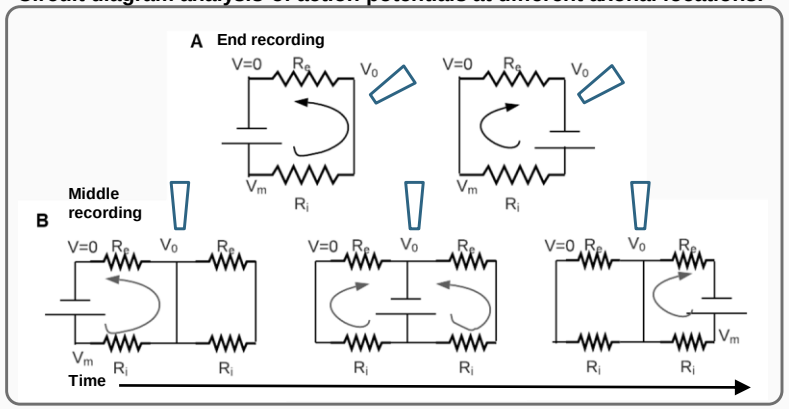
A Drawings of electrode placement on the BN2 and suction quality. **B** Comparison between middle and end waveform for varying suction qualities. **C** Drawing of the BN2 before and after cut. **C** 3D scatterplot comparing peak values of varying suction qualities. **D** Bar graph comparing average peak potentials (μV) for varying suction qualities.

Lesioning of BN2 changes the shape of the extracellular nerve recording.



A Drawing of the BN2 before and after cut. **B** Difference in waveform shape before and after severing BN2. Loss of third peak after cut. **C** 3D scatterplot comparing peak values before and after cut. **D** Bar graph comparing average peak potentials (μV) between peaks before and after the cut.

Circuit diagram analysis of action potentials at different axonal locations.



Shape and circuit analysis for nerve pulses recorded from the end of the nerve using extracellular suction electrode. Model prediction: **A** *End-of-axon extracellular recording:* A bi-phasic shape shall be recorded. **B** *Middle-of-axon extracellular recording:* Size of the action potential should depend on the quality of suction.

DISCUSSION

The work will provide guidance for researchers to acquire high-quality extracellular nerve recording using the suction technology. It will also improve researcher capabilities in interpreting extracellular recording data. Specifically, the shape analysis of the nerve pulses can used to be deduce the location of the electrode and potential neural damage.

The work can be extended to clinical neural recording using other types of extracellular technology, to guide the accurate positioning of the electrode and evaluate the potential neural damage.

REFERENCES

[1]Buzsáki, G., et al, . Nat Rev Neurosci 13, 407–420 (2012).

[2]Heinricher, M.. “2 Principles of Extracellular Single-Unit Recording.” (2004).

[3]Johnson, Bruce R et al., Journal of undergraduate neuroscience education : JUNE : a publication of FUN, Faculty for Undergraduate Neuroscience vol. 6,1 (2007): A21-6.