

Supplementary Information

Supplementary Note 1

Field Effect Transistor Equations

The following details are not required to understand the main manuscript but are provided to assist in replicating our results. In the manuscript, we define the drain current of a field effect transistor (FET) in saturation, I_D , with κ , a device specific constant. We chose this representation because it is accurate for both JFETs and MOSFETs. Although our circuit implementation used JFETs, either FET can be used in this circuit. In the case of a JFET,

$$\kappa = \frac{I_{DSS}}{V_p^2} \quad (1)$$

where I_{DSS} is the drain current at gate-source voltage of 0 V, and $V_p = V_{th}$ which is the pinch-off voltage. In the case of the MOSFET,

$$\kappa = \frac{1}{2} \mu C_{ox} \frac{W}{L} \quad (2)$$

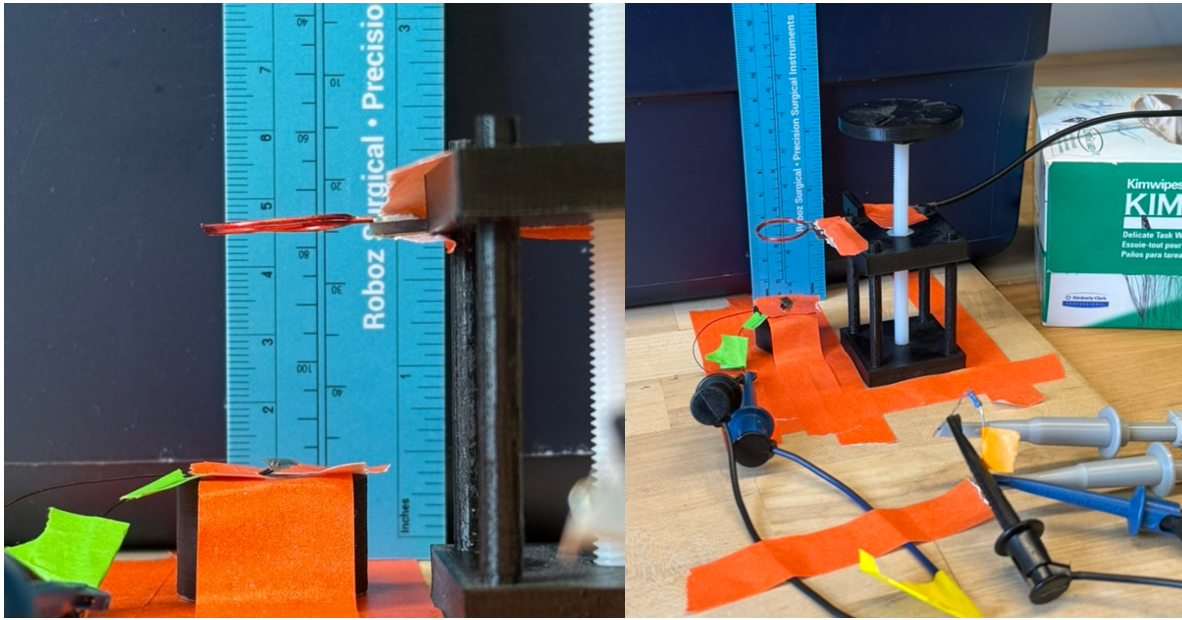
where μ is the carrier mobility, C_{ox} is the gate capacitance per unit area, and $\frac{W}{L}$ is the width-to-length aspect ratio of the MOSFET. To define the current-limiting circuits in Figure 2a,b, we substituted the corresponding κ into the relevant equations to calculate the current limit.

Supplementary Note 2

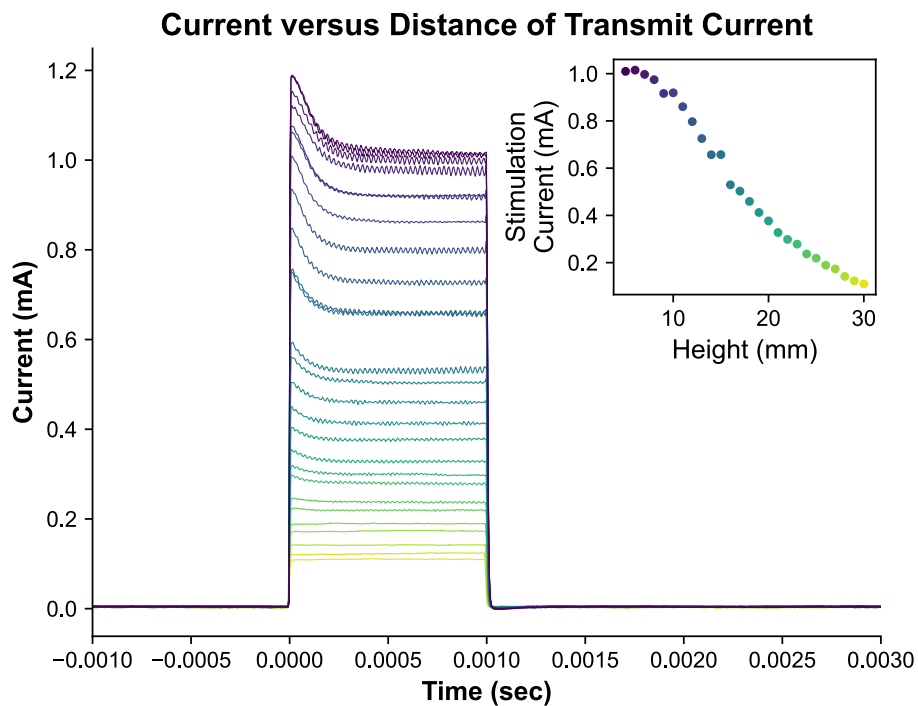
Device Operation Distance

We measured device output current across a 1.002 k Ω load while varying the distance from the transmit coil to the device. The setup for this test is shown in Supplementary Figure 1, with the transmit coil on a plastic rig (so as not to affect the wireless link) with a screw mechanism that allowed us to carefully adjust the distance from the device. We tested every millimeter from 5 mm to 30 mm from the device. The output waveform was a 27.12 MHz sine wave that was pulse modulated at 5 Hz with 1 ms of “on time” to get the monophasic square pulse shown in Supplementary Figure 2. This over-the-air measurement serves as a proxy for wireless power transfer efficiency, calculated as:

$$\frac{I * V}{1 \text{ W}} = \frac{I^2 R}{1 \text{ W}} = \frac{(0.001 \text{ A})^2 * 1002 \Omega}{1 \text{ W}} = \frac{0.001 \text{ W}}{1 \text{ W}} * 100 = 0.1\%$$

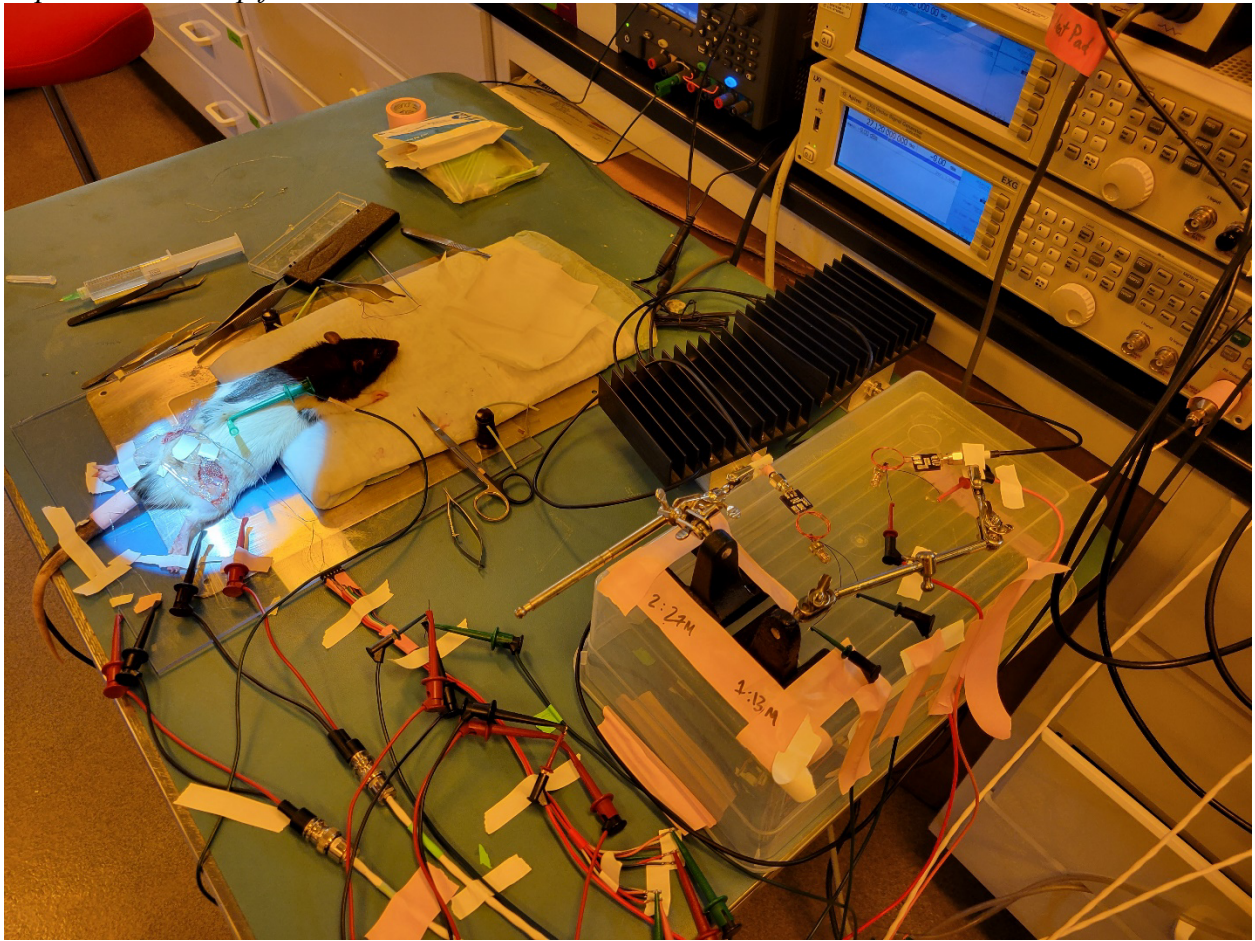


Supplementary Figure 1 | Experimental setup for device current as a function of distance between the transmit coil and the device (Supplementary Figure 2).



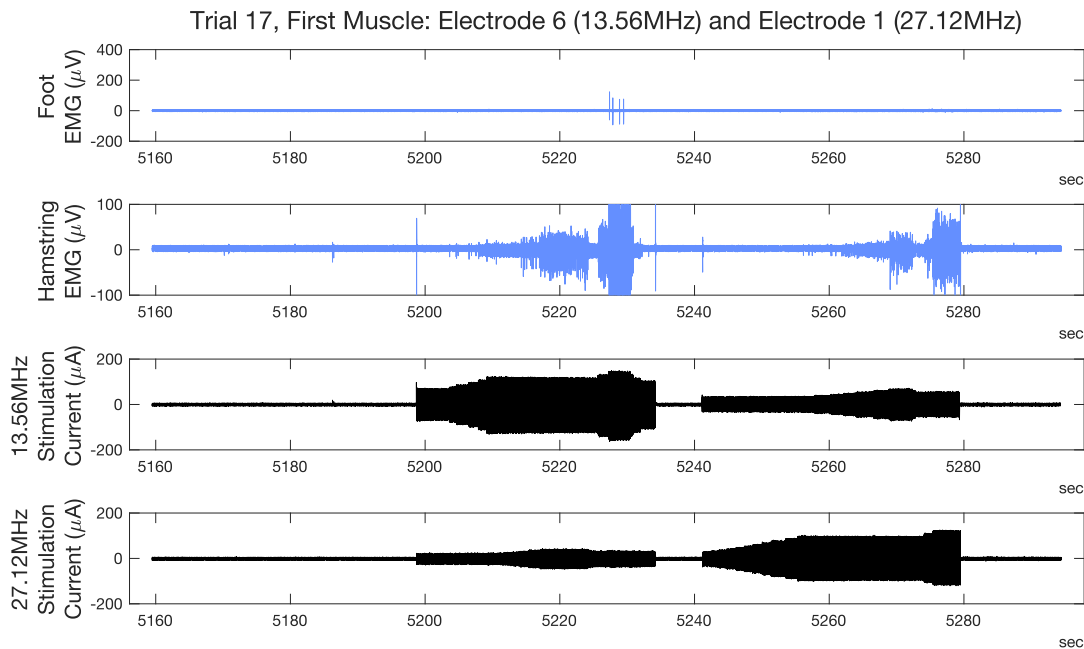
Supplementary Figure 2 | Device current across a 1.002 k Ω load as a function of distance between the transmit coil and the device. The inset shows the steady-state stimulation current we measured at each distance. Current limiting at ~1 mA becomes apparent as the distance decreases.

Experimental Setup for Fiber-Selective TIS

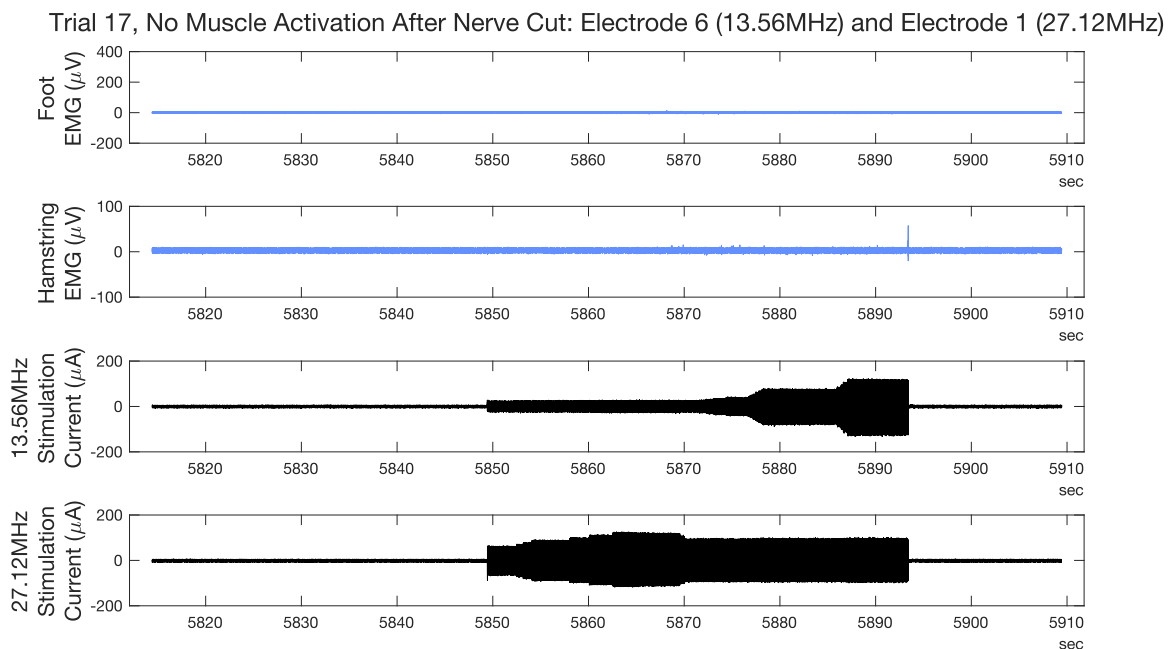


Supplementary Figure 3 | Experimental setup for Figure 5. We wirelessly powered two devices connected to electrodes in a 12-electrode cuff implanted around the sciatic nerve to deliver stimulation. The devices were tuned to resonate at 13.56 MHz and 27.12 MHz, respectively. We connected each device to different electrode contacts to map the fascicular nerve and determined the firing threshold for the plantar and hamstring muscles via EMG. We then applied TIS to preferentially stimulate the hamstring or plantar muscles.

Verification of Neural Activation – Before and After Nerve Transection

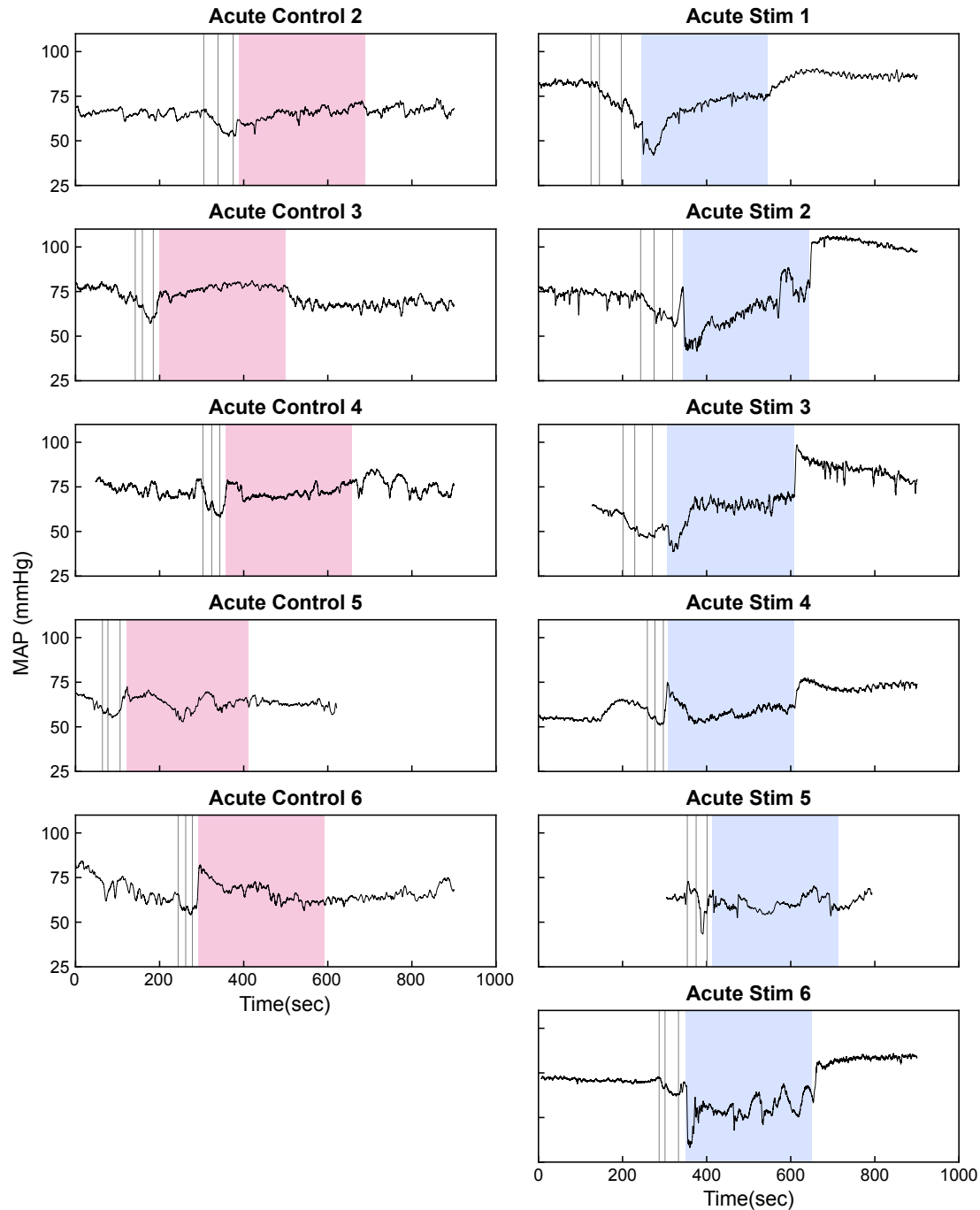


Supplementary Figure 4 | Foot (plantar) and hamstring EMG data following stimulation with electrodes 6 and 1 before nerve transection. Successful stimulation is shown in both the foot and hamstring (though in this configuration, the foot requires a high amplitude on electrode 6 to activate).



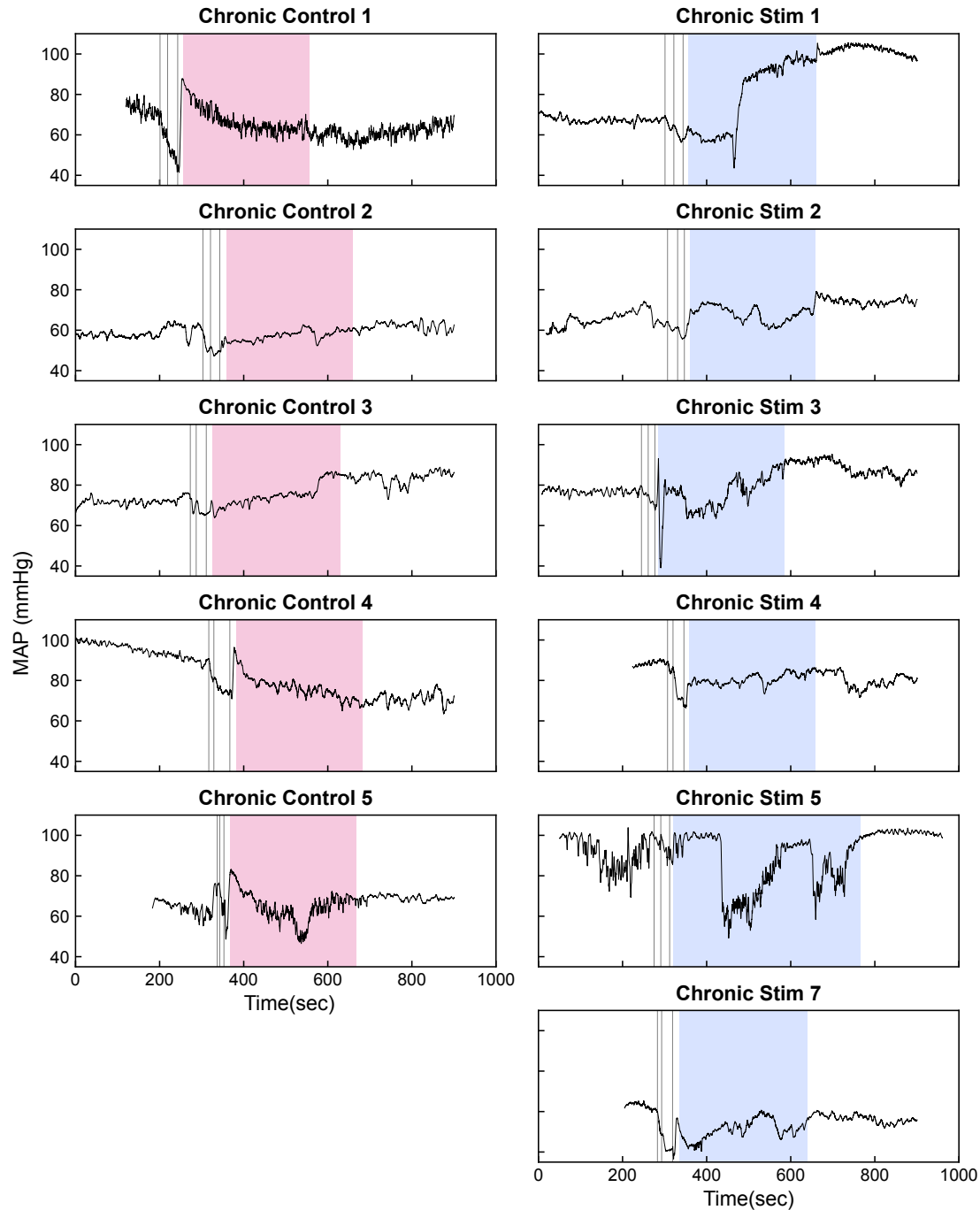
Supplementary Figure 5 | Foot (plantar) and hamstring EMG data following stimulation with electrodes 6 and 1 after nerve transection. No EMG signal was detected for the foot or hamstring.

Mean Arterial Pressure for Acute Animals



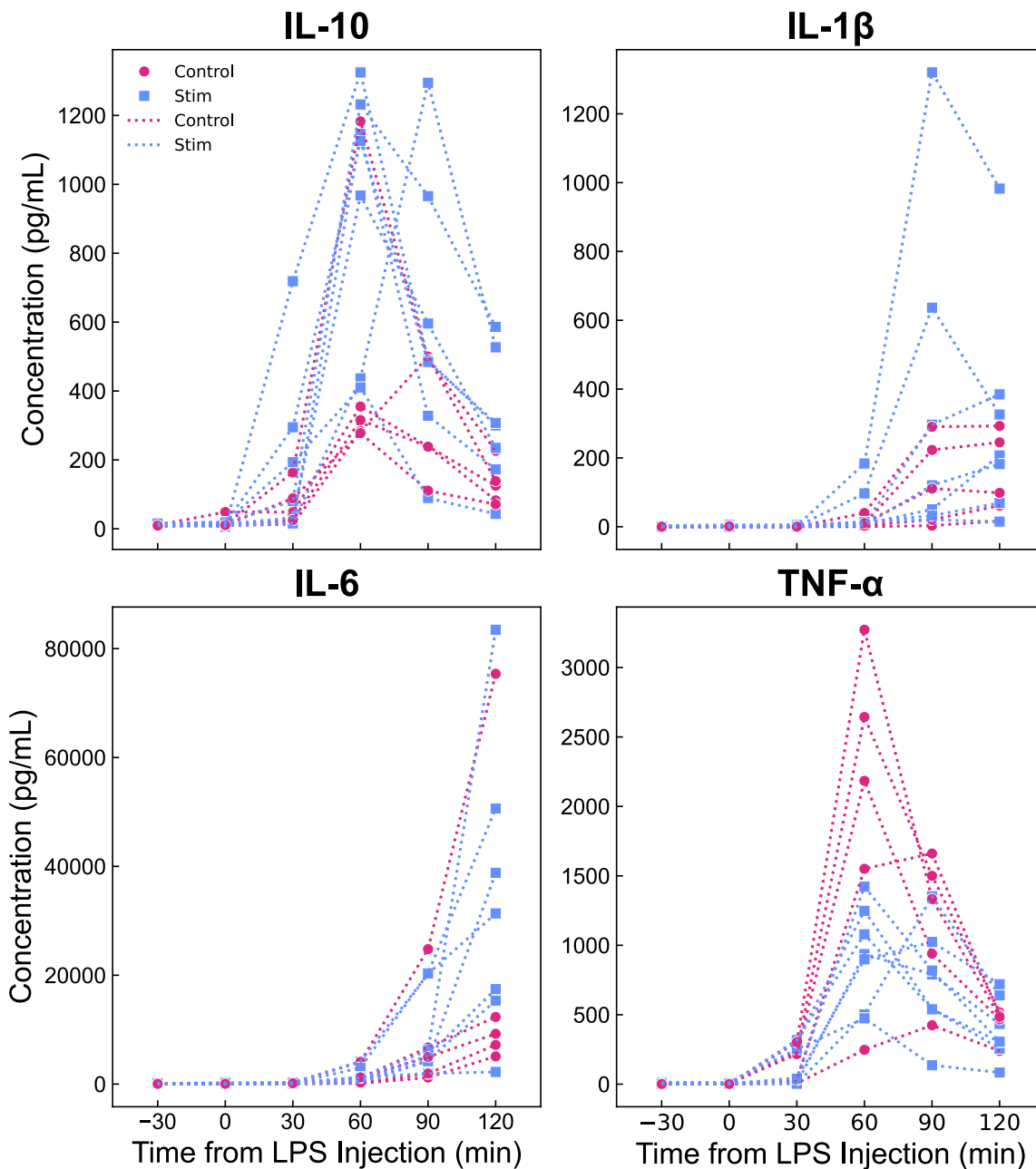
Supplementary Figure 6 | Mean arterial pressure (MAP) for acute animals. The three vertical lines indicate the timepoints for blood waste collection, blood sampling, and lactated Ringer's solution replacement. Shaded regions indicate periods of stimulation (blue for stimulation animals) or intended stimulation (red for control animals). Acute Control 1 is missing because the blood pressure recording for this animal was not taken at the right time and the times for the blood collection were not recorded. Acute Stim 5 was excluded during analysis due to poor data fidelity.

Mean Arterial Pressure for Chronic Animals



Supplementary Figure 7 | Mean arterial pressure (MAP) for chronic animals. The three vertical lines indicate the timepoints for blood waste collection, blood sampling, and lactated Ringer's solution replacement. Shaded regions indicate periods of stimulation (blue for stimulation animals) or intended stimulation (red for control animals). Chronic Control 6 is missing because the arterial catheter clogged during blood pressure recording so the signal could not be resolved.

Cytokine Concentrations for All Measured Cytokines



Supplementary Figure 8 | Serum cytokine concentrations for all measured cytokines as a function of time relative to LPS injection (t = 0 minutes) in chronic animals. Seven experimental animals (blue squares, dashed line) received VNS treatment (5 Hz, 5 minutes) delivered 30 minutes after LPS injection. Five control animals (red circles, dotted line) received no stimulation. Square and circle markers indicate measured data points; dashed and dotted lines connect consecutive points.