402 - Excellence - 21 - Hindlimb Stimulator - Executive Summary
Shake it For Me!

Peripheral nerve injuries are common, debilitating, and costly. According to the Centers for Disease Control, approximately 2.8% - 5% of all trauma patients in the U.S. sustain such an injury. 100,000 peripheral nerve repairs are performed annually, costing approximately 150 billion dollars. The most important clinical outcome following nerve repair is functional ability. Despite advances in microsurgical technique, poor functional outcomes are frequent. Unfortunately, the cause for outcome variability is unknown and functional outcome is difficult to assess and measure experimentally. Therefore, a device facilitating the assessment and analysis of nerve repair in animal models would be of great scientific value.

We have created a novel design which can provide somatosensory stimulation (vibration) to the hindlimb of a rodent in order to assess nerve regeneration. Rodents are trained to distinctly respond to varied vibrotactile stimulation of their hind limbs. After training is complete, their sciatic nerve is insulted and repaired using surgical techniques and various pre-, peri-, and post-operative care plans. After a recovery period, the animals can be assessed on the duration until baseline response is attained.

Currently, there is no device which uses vibrotactile stimulation to assess the recovery following nerve repair in rodents. Additionally, there is extremely limited data on the vibrational frequency ranges rodents can perceive via their hindlimbs. Therefore, this device has potential to contribute to the body of scientific knowledge.

What makes this device unique is that devices small enough to reliably deliver the desired vibrations are not commercially available. Common vibratory motors of this size are limited in the frequency and amplitude of their vibrations and, therefore, provide little scientific value. Additionally, most vibrational motors have their output amplitude coupled with output frequency, making it difficult to vary one parameter without influencing the other. In contrast, our device can precisely and independently vary amplitude and frequency.

The device itself relies on transducers, a small motor capable of producing precise mechanical vibrations, to reliably and accurately deliver vibrations at varying frequencies and amplitudes. During the design process we exhaustively researched all possible commercially available methods of vibrotactile stimulation and concluded that transducers are the best option for our design. The rodent is trained to stand within an enclosure in a manner such that each hindlimb is centered on its own platform, to which a separate transducer is attached. Experiments can then be conducted varying stimulation parameters, as well as the timing and target of stimulation.

Testing is currently being finalized with promising results. The frequency of vibration as well as amplitude can be independently controlled, giving the researcher access to a large parameter space. This device has the potential to lead to novel findings in nerve repair and regeneration. The implications of these results will be applicable for a variety of research topics in the future, ranging from anesthesiology to muscle and tissue repair.