Capstone Design
College of Engineering
UNIVERSITY OF GEORGIA

Capstone Design Project Abstract

Project Title: Mouse Mounting Device & Training Model
Partner/ Client: Dr. Marie Lacour, University of Georgia Department of Veterinary Medicine
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Project Supervisor: Dr. Cheryl Gomillion
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High-precision surgical procedures in mice, such as adeno-associated virus (AAV) injections and fiber optic implantations, are critical for neuroscience and gene therapy studies. At the UGA School of Veterinary Medicine, Dr. Marie Lacour's research team conducts these procedures, which require absolute immobilization of the mouse head to ensure accurate targeting of brain structures. The facility currently employs a mounting bar system that places metal pins to the bone located above the eardrum in the mouse's skull as a method of internal fixation to stabilize the head (**Figure 1**). However, this system has proven problematic as it produces inconsistent outcomes and risks animal welfare.

The primary challenge lies in the device's steep learning curve. Proper use demands simultaneous coordination: aligning the mouse's ears with skull landmarks, supporting the mouse's body, and securing bilateral pins. Inexperienced users frequently misalign the pins, apply uneven pressure, or compress the skull excessively. This leads to skull fractures, brain trauma, or fatal hemorrhages. Such errors cause euthanasia, with the facility reporting a notable proportion of animal losses attributed to mounting failures. Furthermore, the device's design exacerbates these risks. The internal fixation pins concentrate pressure on a small surface area of the skull, increasing localized stress. At the same time, the non-adjustable surface forces users to manually lift and stabilize the mouse's body during pin placement, complicating alignment and prolonging procedure times. Compounding these issues, training new personnel—a process that currently relies on live animals—extends learning timelines and perpetuates avoidable animal harm.

To address these multifaceted challenges, the MiniMed Innovations team proposes a comprehensive redesign of the mounting system paired with an innovative training protocol. First, the mounting device is redesigned with two key modifications: a stationary base plate and external fixation hemispheres. The base plate enables the proper vertical height to align the mouse's body ergonomically (**Figure 2**), eliminating the need for manual stabilization and freeing a hand for pin placement. As a replacement for the internal pins, the external fixation hemispheres (**Figure 3**) are flexible, ergonomically shaped thermoplastic polyurethane (TPU) that will allow for a higher distribution of pressure. The hemispheres conform to the skull's curvature, distributing the pressure circumferentially rather than at discrete points.

Additionally, we developed a 3D-printed synthetic training model replicating the mouse skull's anatomical features, including temporal bone landmarks, ear alignment points, and simulated tissue resistance (**Figure 4**). The model integrates LED sensors to provide real-time feedback on location applications, enabling trainees to refine techniques without using live animals. Replaceable skull modules mimic accurate skull size and curvature variations, ensuring adaptability across common laboratory strains. Various sized training models have been curated to allow users of wide-ranging experience levels to practice and develop their mounting skills before conducting a live mounting.

Future steps include refining hemisphere material properties for optimal shape and biocompatibility, integrating the base plate with existing surgical stations, and validating the training model's efficacy in a controlled study. Long-term implementation aims to reduce euthanasia rates by 25%, lower procedural variability in data collection, and enhance compliance with animal welfare regulations. Merging ergonomic design innovation with ethical training practices ensures the facility remains at the forefront of translational neuroscience and veterinary medicine.

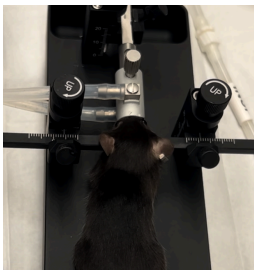
Figure 1: Mounting Device

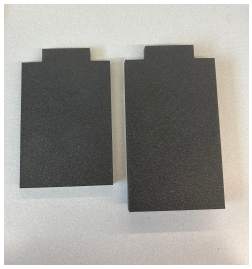
Figure 2: Base Plates


Figure 3: Hemispheres


Figure 4: Training Model