Device for Neurochemical Sample Collection of Freely Moving Monkeys

Mark Reagan, Anika Lohrentz, Alison Boumeester, David Leinweber
Advisor: Dr. Naomi Chesler, Client: Dr. Ei Terasawa

Abstract

Timing of pubertal onset can impact development, but its trigger is as yet unknown. Dr. Terasawa, who works in the Primate Research Center, collects neurochemicals of Rhesus monkeys using a cannula that is inserted from the top of the monkey's head to the thalamus. During the 12 hours of experimental collection, the monkeys are confined to a chair so that they do not tamper with the microdrive. To avoid complications with the anesthesia, Dr. Terasawa wishes to allow the monkeys to move freely in a cage. To do so, a protective device must be constructed so that the collection probe is not bumped. The solution is a reverse cone shell, similar to those seen on dogs when they are injured. Although more work is needed, preliminary testing shows that the device will be successful.

Background

•The objective of Dr. Terasawa's research is to determine the triggers of puberty. Timing of the onset of puberty is crucial to the health of an individual, such that earlier onsets can stunt growth and development.

•Current research suggests that there is a correlation between concentrations of neurochemicals such as Gonadotropin Releasing Hormone (GnRH) around the pituitary gland and onset of puberty .

•To collect samples a cannula is inserted from the top of the monkey's head to the thalamus(Figure 1). The cannula serves as a probe that neurotransmitters can diffuse into. The cannula is then connected to a microdrive which is in turn connected to a pedestal that sits on the top of the head.

•During the 12 hours of experimental collection, the monkeys are confined to a chair so that they do not tamper with the microdrive.

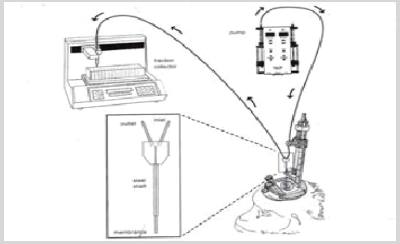

Figure 1: Schematic for neurochemical collection showing the cannula and pedestal.[1]

Motivation

•Sitting in a chair is not a normal environment for a monkey. Distress caused by the chair can alter the neurochemicals present . Thus, the researchers would like to allow free movement of the monkeys during the experiment.

•In order to allow free movement, a protective device must be made for the microdrive so the monkeys cannot tamper with it.

Figure 2: Rhesus monkey confined to a chair during sampling.[2]

Client Requirements

Weight- Needs to weigh less than 480 grams, and if possible, bring the weight of the load closer to the shoulders and center of the body

Ease of Use- The device needs to be easily secured onto the monkey while under anesthesia.

Reproducibility- Multiple copies of the device need to be made for differently sized monkeys.

Comfort- The device will be worn for 48-72 hours. Also, a chin strap should not be used due to the possibility of causing discomfort to the monkey's neck.

Safety- Based on the ability of the design to protect and not interfere with the microdrive.

Previous Semesters Work

Figure 3: Metal Design.
Failed because it was Heavy.

Figure 4: Plastic Cone Design.
Failed because of Weak Strap.

OVERALL: TOO MUCH PRESSURE ON HEAD

Final Prototype: Process

•Three Final Prototype Designs were chosen for consideration (Bone Screws, Ski-Mask, and Reverse Cone). The Reverse Cone was chosen based on the design matrix shown in Figure 5.

Category	Weight	Bone Screws	Ski Mask	Reverse Cone
Safety	40	30	25	**35**
Ease of Implementation	30	10	25	**28**
Practicality of Production	20	15	10	**18**
Comfort	10	5	7	**8**
Total		60	67	**89**

Figure 5: Design Matrix. Reverse Cone Design was chosen.

•A cast (Figure 6) was made to create the shell that would be thermoformed out of High Impact Polystyrene.

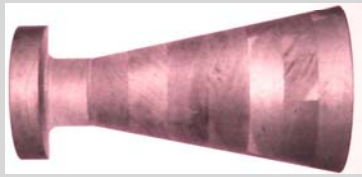

Figure 6: Cast used for thermoforming of final shell.

Final Design: Components and Implementation

Components

•Two High Impact Polystyrene (HIPS) Shells. Front shell Includes hole to accommodate monkey face (from neck to brow) lined with soft tape.

•Flange on shell bottom disperses load on shoulders. Includes foam to provide comfort.

Figure 7: Completed Prototype.

Implementation (Completed while monkey is anesthetized, after placement of microdrive)

1) Shell without face hole is placed on monkey.
2) Shell with face hole is fit to the head of the monkey.
3) Bungee cord is tightened and secured to the inside of the shell.

Final Design: Testing

Weight Testing

- With collar: 800g
- Without collar: 500g

Conclusion: Collar adds excessive weight.

Figure 8: Restraint Collar.

Monkey Mold Testing

- With reasonable movement of monkey head, microdrive maintained 3 cm buffer away from wall.

Conclusion: The microdrive will not be bumped with reasonable movement of the monkey head.

Future Work

- Test on a live monkey.
- Add polycarbonate visor to face section if needed.
- Incorporate a thinner shell to make device lighter.
- Implement clients' need for a hose from the microdrive which will attach to the jacket.
- Determine if there is a more efficient method to make multiple shells of various sizes.
- Determine the various sizes needed for the different monkey sizes.

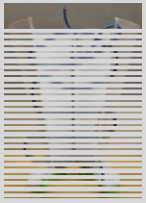

Figure 9: Side View of Completed Prototype.

Acknowledgements

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1. Forst SI, et al., Microdialysis methods for *in vivo* neropeptide measurement in the Stalk-median eminence in the Rhesus monkey, J Neurosci Methods (2007).
2. www.all-creatures.org/saen/res-fr.html