

Monkey Restraint Group



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Client: B'Ann Gabelt

Thursday, October 02, 2003

Abstract

Accuracy is an important aspect of nearly all scientific experiments and procedures. When administering eye drops to primates, accuracy is almost impossible. A struggling monkey is nearly as strong as a full grown human and delivering accurate amounts of medicine proves to be quite a battle. A description of various methods of restraining the primate is presented, with a proposed design following.

Problem Definition

To develop a method of effectively restraining a monkey's head in conjunction with the existing monkey restraint device. To find a way to effectively stabilize monkey transportation cages when delivering a monkey to its permanent cage.

Introduction

When attempting to cure or learn more about many of the most deadly disease faced by humans, researchers and scientist are stalled by the fact that any procedure with a scintilla of risk cannot be performed on any human subject. The solution to this problem



Figure 1: Rhesus Monkey

lies in the genetically similar nonhuman primates (NHP). Pictured (Figure 1) is a commonly studied NHP, the rhesus monkey.

Primate research has proven extremely beneficial to the advancement in treatment of many human diseases. Progress has been made in the fight against cancer, AIDS,

Alzheimer's disease, Parkinson's disease, leprosy, hemorrhagic shock, and cardiovascular diseases (1).

Our client, B'Ann Gabelt, is a researcher at the Wisconsin National Primate Research Center. B'Ann and her team are investigating the effects of a new glaucoma treatment. Jenny Seeman, a member of the Gabelt research team, we will not need any sort of "real" approval from a committee to test our device on the monkeys. Jenny will have to look at the manual device we make before using it on the monkeys.

There are three studies for which our head/chin restraint device will be used. All these studies also involve returning conscious monkeys to their cages, which is where the lift device is needed.

The first study involves looking at how aqueous humor formation and drainage can be altered to lower intraocular pressure, which is the main risk factor for the development of glaucoma in humans that results in blindness. Often the monkeys are treated for several days with topical eye drops containing the drug under investigation. Then the intraocular pressure response is measured along with mechanistic studies to determine how the drug lowers pressure.

In the second study, monkeys are made glaucomatous by a laser so one of the outflow pathways of the eye obstructs the aqueous humor outflow thereby increasing the intraocular pressure. Neuroprotective agents can be administered before and during the pressure elevation to try to prevent damage to the retinal ganglion cells. Success with any of these types of treatments has direct relevance to the treatment of human glaucoma. Often our client needs to keep the intraocular pressure within a certain range of values, therefore, these animals also get treated in the restraint device with current

glaucoma medications that are use in humans.

In the third type of study, our client is trying to determine the mechanism by which humans lose their ability to focus their eyes, as they get older. Monkeys also undergo these changes, as do humans. The movement of the various structures involved in focusing and what happens when parts of the mechanism are disrupted are studied. For this study also, the restraint device will be used.

The treatment requires the scientists to administer a series of eye drops to a large study group of rhesus monkeys daily. Treatment would be trivial if the option to put the monkeys under during the procedure was available. The problem lies in the fact that continually putting a monkey under eventually drains the subject and the subject begins to quit eating, along with other behavior changes that may affect the health of the monkey.

Since the monkeys are completely coherent during treatment, they do everything in their power to resist and prevent the administration of the drops. This creates a struggle, to open the eye lids of the monkey between the scientist and the monkey, which is not easily won by the scientist. The monkeys' current restraint permits for head and arm movement, and restricts the mobility of the scientist, putting the scientist at a clear disadvantage against the larger monkeys.

Our client has asked us to make a device that will restrain monkey's head or neck while it is being treated with eye drops. Moreover, she has asked us to modify the transport-cage, so the monkeys can be easily transferred from the transport cage to the storage cage, where they are housed. Lastly, our client would like us to modify the door

on the transport-cage, so it stays in place while the monkey is being moved from transport cage to the treatment-cage.

While we hope to solve all of the problems she has presented, we have decided to take an incremental approach and devote our total attention and skills to one problem at a time.

The device we are focusing on first is the head/neck restraint, so the treatment process becomes easy. The monkey moves around while in the treatment-cage, so it becomes very difficult to keep the monkey in one place and treat it at the same time. Our device will hopefully reduce the hardships currently faced by the monkey-handler and decrease the treatment time. The device will restrain the monkey's upper region, so the handler can treat the monkey easily and without the help of another person.

Design Constraints

Our client has asked us to remain almost completely confidential about this project and the primates in Madison. It is our clients wish that we refrain from discussing the project with the general public. The device must be humane and by no means, harm the monkeys. The device should not strangle the monkeys when it is locked in it. The device must also be able to withstand monkey's force. As mentioned earlier, a large monkey has strength comparable to that of an adult human. Any unsecured piece of material will surely be broken off by the monkey. The device should be comfortable for the monkey, and it should not frighten the monkey. Monkeys are easily frightened by extremely bright and dark colors. The materials used to construct the device must not be abrasive or rough, they should comfortably fit anatomy of the monkey. Lastly, it needs to

be approved by the animal society before it can be tested. The device must be flexible and must fit into the existing treatment-cage easily. It must be easily operated by one person and must be stationary once it is in place.

Design Alternatives

Design #1

The first design is a device referred to as the U-CupPin. As the name implies, this device consists of a U-shaped cup that fits between the neck and jaw of the monkey (see notebook 1). The cup contains holes that the pin fits in. The pin can be placed at various increments to accommodate different sized subjects. The device is secured around the back of the monkey's head by a leather or rubber strap. The device should safely secure the monkey's head, as well as slightly tilt the head to make administering eye drops easier.

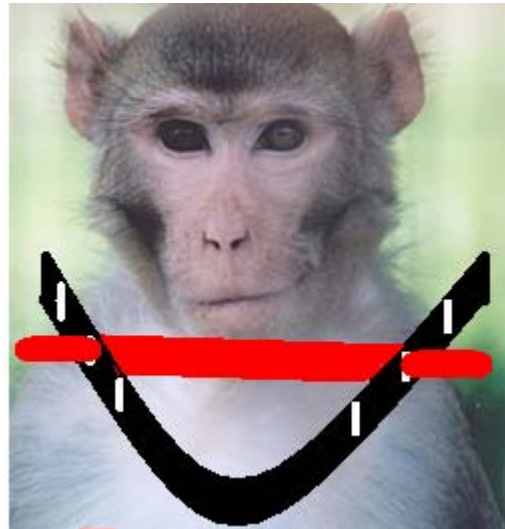
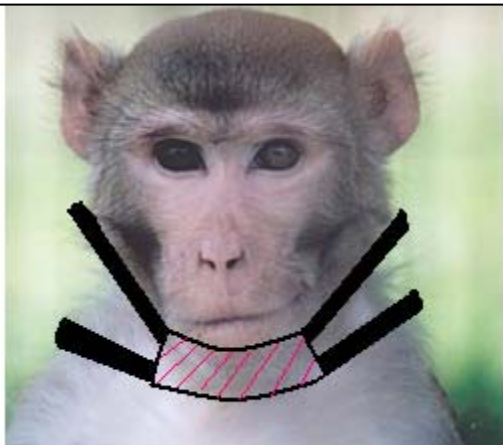


Figure 2: U-Shaped Cup Restraint

Figure 3: Chin Strap Restraint



Design #2

The second design is the Chin Strap Restraint. This device very closely resembles the chin straps used by football players. The difference lies in the material the device is fabricated with.

The monkey's chin strap will be made of a flexible, extremely durable material that can quickly mold around each monkey's unique jaw size. The top of the strap will rest near the lower lip, while the lower strap will fit against the union of the jaw and the neck. The device will be secured in a similar fashion as the device above. The advantages of this device are the ease of use and the ability of the device to secure the head of the monkey. The disadvantages of the device lie in the difficulty of finding the proper material and fitting for the monkey. If made with a substandard material, the monkey will easily either bite or tear the material.

Design #3

The third design acted at the forehead rather than the chin of the monkey. This design has a band that goes around the horizontal plane of the forehead and a second strap that runs vertically from behind the eye down around the jaw bone. The top headband is attached to snap wires such as those seen on snowboard bindings. So as the monkey struggles and moves the device gradually tightens until the monkey can no longer move. Problems could arise when securing the monkey in the device, but once in the device this should hold the monkey more comfortably, and more tightly than the other designs.

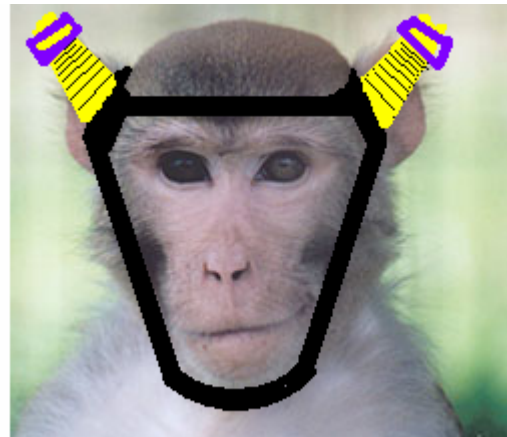


Figure 4: Headband Strap Restraint

Proposed Solution

The design that we propose is the U-Shaped Cup Restraint (Design 1). In order to come to this final decision, each design was evaluated using a decision matrix. We looked at the feasibility of producing, estimated cost, functionality, and ease of use. We felt that there are many more modifications that we can make to the U-Shaped Pin Restraint to improve its design. We think that it is a very sound, promising design that will be a starting block for the project.

Appendix 1

Product Design Specification

Function: To develop a method of modifying the existing monkey restraint device to effectively restrain a monkey's head or neck simplifying the eye drop administration process.

Client Requirement:

- Restrain the head of the monkey
- Must be compatible with existing restraint device
- Work with various sized monkeys
- Device should not harm the monkey physically
- It must be stationary and doesn't require one to hold it while giving treatment

Design Requirements:

1. Physical and Operational Characteristics

- a. **Performance Requirements:** It will be used at least 10 times a day for the whole year. The restrain device we'll design must be flexible; it should be able to hold and restrain monkeys of various sizes. The height of the monkeys can range anywhere from 2 ft to 3 ft and they can weigh anywhere from 8 to 25lbs. The device shouldn't hinder the treatment and should be small as possible. **Material should be resistant to monkey claws.**
- b. **Safety:** The device shouldn't be uncomfortable for the monkey or he/she may make the treatment process worse by reacting negatively to

the device. It should be gentle and provide a comfortable support. It should have no sharp edges that may cause harm to the monkey physically. The device should also be very strong and unbreakable. As witnessed, monkeys at times can be very aggressive and strong. If the device is fragile, it may break easily. This may lead to loss of monkey and may harm the monkey physically if the device breaks in small pieces. The device should follow the “animal humane” requirements and must not create a negative impact on the monkey.

- c. Accuracy and Reliability: Accuracy is not a necessity, but precision is. The device needs to be compatible with various monkeys, so it is very hard to make it accurate. It should, however, be adjustable for monkeys of various sizes (2-3 ft) and weights (8-20 lbs).
- d. Life in Service: The device will be used on a regular basis. It will be used daily for at least five hours a day and five days a week. It will be kept at one place, the treatment room.
- e. Shelf Life: The device must operate under extreme forces and loads. The monkeys may at times be aggressive, so it is imperative that the device is capable of withstanding monkey’s force. The device must also be durable. Since it will be used regularly, the device must be made of durable material.
- f. Operating Environment:
 - i. Temperature Range: 25 degrees Celsius
 - ii. Pressure Range: 4 GPM at 20 PSI

- iii. Dirt or Dust: very dirty environment.
- iv. User: Must be user friendly to people of all sizes and strengths.
- g. Ergonomics: The device must be very flexible. It should be compatible with monkeys of various sizes. The device must not need more than a one person to operate. It should be easily adjusted while wearing latex gloves.
- h. Size: The size of the product must correlate with the pre-existing monkey restraint device. Additionally, it should accommodate 8-25lb monkeys. The device must fit through the treatment cage and removed easily at the end of the treatment.
- i. Weight: It should not weigh more than three pounds.
- j. Materials: The materials used must be non-toxic, rigid (able to withstand strength of monkeys), tough (able to withstand scratching from monkeys), easily sanitized and nonabrasive.
- k. Aesthetics: No bright colors that will scare the monkey. Device must fit around the upper region of the monkey easily.

2. Production Characteristics

- a. Quantity: Only one unit is needed.
- b. Target Product Cost: The device must cost less than \$200.

3. Miscellaneous

- a. Standards and Specifications: Probably need some type of approval from the animal rights activists (RARC). Since the device is being used to restrain the monkeys, it must be checked to see whether it is humane or not.
- b. Customer: Because this monkey restraint device can be used only with the restraint used by our client, it would be impossible to market to other customers. However, the idea, if novel, could be patented.
- c. Patient-related concerns: Confidentiality of all processes occurring in Ophthalmology Department involving monkeys is extremely important to our client. The discussion of this device and the monkeys must be limited outside in the public.
- d. Competition: No current comparable product has been found or used.