

Development of restraint for non human primates during inhalation dosing

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Inhalation masks

Our first design (Figure 1) that we used was one that was available off the shelf which needed to be secured using Velcro® straps around the sides and over the top of the head of the primate.



Figure 1. Primate inhalation mask.

Production of this mask has since stopped, resulting in the need for us to source a new mask. This pushed us to design and make one ourselves which we knew would meet our requirements.

The triangular shape from the original mask (Figure 1) was used as the basis for our new design (Figure 2). The main change was the addition of dual ports for both the inlet and extract. The Velcro strap secured the mask around the sides and over the head.

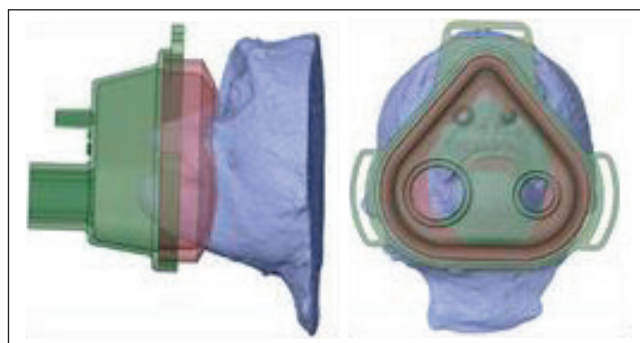


Figure 2. New design of mask.

Whilst using this design, Animal Technicians realised that the mask had a pinch point in the top of the triangle which resulted in abrasions on the bridge of the primate's nose due to where the silicone seal rubbed. Another observation was the triangular design with the Velcro strap over the top of the head reduced the primate's vision.

The following design of face masks (Figures 3 and 4) moved away from triangular to a circular one which



Figure 3. Face mask.



Figure 4. Face mask.

reduced pinching with the silicone on the bridge of the nose. This design improved the primate's ability to see due to less eye obstruction and did not have a strap going over the top of the head, but instead had two straps going around the sides of the head providing differing size configurations to ensure a better fit for primates with a range of different sized faces. This gave a better seal, less escape from test material and less rubbing on their face due to movement.

The future

Our future design (Figure 5) for the mask involves moving away from the use of Velcro and substituting a silicone strap with holes at different increments to hold the mask in place. The use of our new Einscan® scanning device and 3D printing allows us to scan faces of the primates. This allows us to create masks that fit the primates' faces much better and that can be modified for a variety of facial sizes.

Chair restraint

The first chair (Figure 6) was designed to meet our requirements and was a basic model consisting of a seat platform above a bar for the legs.



Figure 6. First chair.



Figure 5.

Two plates secured around the abdomen and two plates secured around the neck gave primates sufficient room to move but were unable to get out of the chair. The height of each section could be adjusted to the size of the primate being restrained.

Due to the size of the plates, primates could reach up to remove their inhalation mask which then meant their arms may be restrained using Velcro to prevent this from occurring. Depending on the primate's behaviour, legs could also be restrained to the leg bar at the bottom using Velcro.

The second type (Figure 7) of chair allowed us to push through the ideas from the original design.

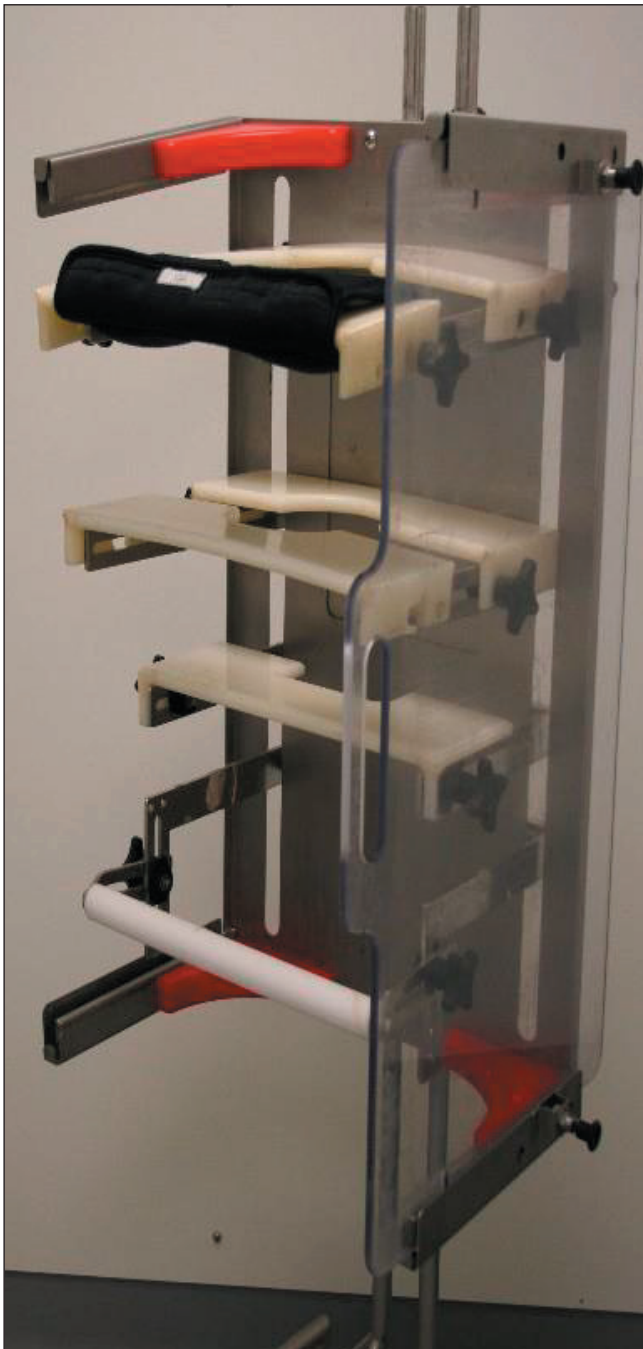


Figure 7. Second design.

The basic principle was the same with the technicians suggesting padding around the neck/head plate to improve the comfort of the primate. This was provided by using a padded cover of the plate that could be removed and washed.

The length of the neck plate was increased to reduce the ability of the primate to reach up and remove their mask. A Perspex® side plate was made to fit on both sides of the chair which prevented them from reaching up or grabbing items to the side of the chair. This allowed them to sit without their arms being restrained providing more comfort and freedom whilst sitting in the chair.

An additional refinement (Figure 8) that was suggested by technicians to enhance the inhalation use of the chair was to provide a way to direct the tubes and masks from above which prevents the mask from pulling the primate's head downward due to the additional weight of the tubes and mask.

This was achieved by using a frame which ran the pipes up and over the primate with the tubes being adjustable in length allowing the frame to hold the weight of the mask from above.



Figure 8. Third design.

The future

The newest design (Figures 9 and 10) that is being trialled has allowed us to keep the longer head plate and added built-in padding for the neck/head plate.

The sitting position has now completely changed with the primate sitting under/behind the cross-section. This allows them to either sit in a more natural position with the knees up in front or dangling. The part which holds the primate in a sitting position acts as a back support too and they have something to lean back onto. As with previous designs of chairs, the height is fully adjustable to each primate's needs. The design permits us to continue with the arm and leg restraint-free method, which should result in a calmer, less-stressed primate.

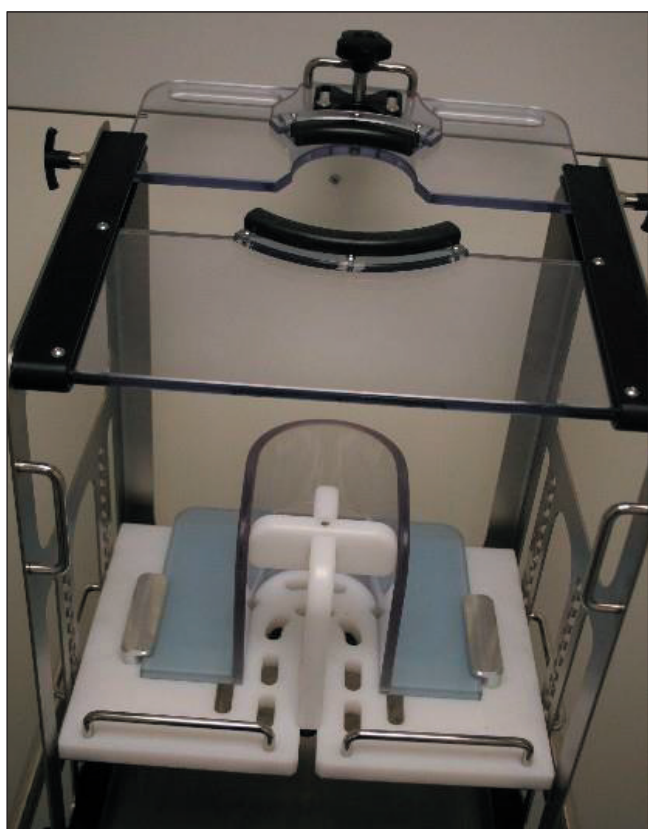


Figure 9.



Figure 10.