

Custom 3D-printed covers for enhanced aseptic technique in stereotactic surgery for rodents

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Introduction

Using an aseptic technique when performing animal surgery under the Animals (Scientific Procedures) Act is mandatory. Certain surgical procedures, especially when performed single-handedly in small rodents such as mice present a special challenge concerning the maintenance of asepsis. One such procedure is experimental stereotactic surgery.

During this type of surgery, the surgeon needs to touch many items of equipment such as microscope handles, stereotactic frame dials, controls and anaesthetic vaporisers which are not amenable to sterilisation (Figure 1). To minimise contamination of the surgeon's gloves when touching these items, current recommendations include wrapping such items with sterile foil, food-safe plastics or swabs.^{1,2}

Goals

Our institution has used sterile aluminium foil and food-safe plastics (Press'n Seal, GLAD™) to cover these items. Still, surgeons found them cumbersome and difficult to work with, especially when manipulating the dials of the stereotactic frame. The latter requires very precise turning motions and the operator needs to visualise the markings below the turning part. Wrapping them with transparent sterile Press'n Seal plastic was not ideal because the plastic often obscured the readings and tended to break up with repeated turning motions. This also did not provide the surgeon with a precise tactile feel for the minor adjustments required.

Hence, we set out to use 3D printing to produce tailor-made covers with the following aims:

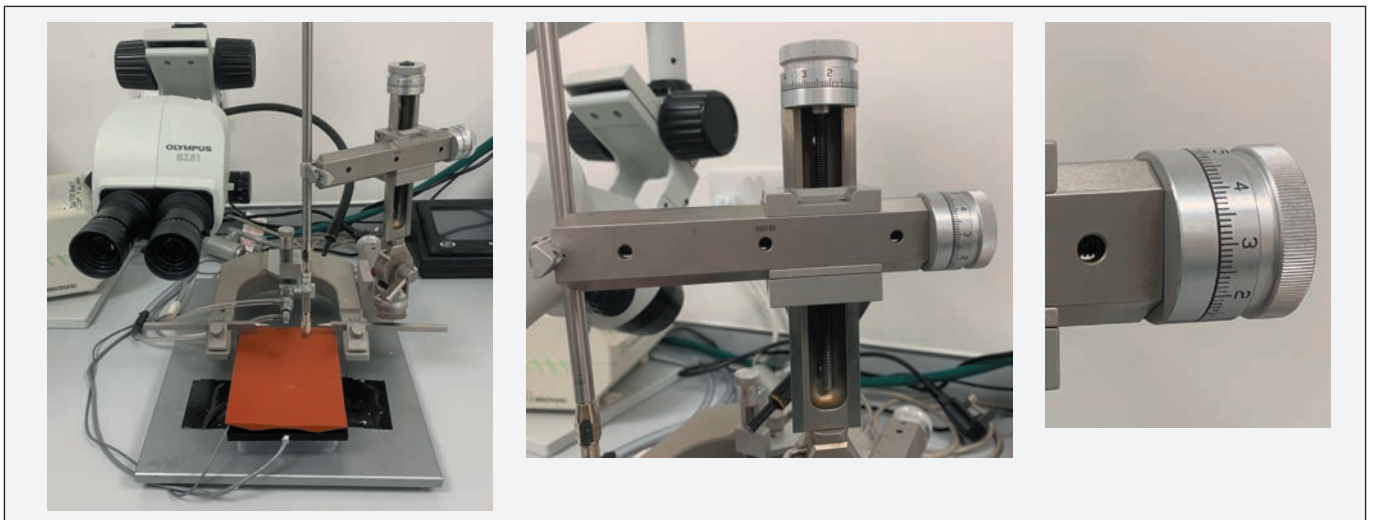


Figure 1. Kopf stereotactic apparatus showing the x-z manipulator and dials which need to be manipulated during surgery.



Figure 2. 3D printer, 3D models and prototypes.

- Maintain asepsis: Develop autoclave-safe 3D-printed covers to ensure sterile handling during stereotactic surgeries.
- Improve precision: Design covers that allow precise equipment control without losing tactile feedback or visibility.
- Enhance usability: Create durable, autoclavable covers that streamline surgery and improve user experience.

Method

Our institute's workshop has a multipurpose 3D printer (Makerbot replicator 2X prototyping 3D printer) plus in-house expertise in its use (Figure 2).

The challenges of keeping an aseptic technique during stereotactic surgery were discussed with the workshop team, who examined all the equipment *in situ*. They obtained detailed measurements of microscope handles and frame dials and set out to produce model prototypes that could be tested in terms of withstanding autoclaving, ease of use/correct sizing and matching users' expectations. The prototypes were produced using NinjaFlex TPU (thermoplastic polyurethane) 3D printing filament. The total print time for a stereotactic frame dial cover set was approximately 3 to 4 hours; the total print time for one microscope dial cover was approximately 5 to 6 hours. The development was an iterative process with initial prints true to the measured size. However because some covers fitted and some did not, measurements were tweaked on 3D CAD and some covers were re-printed

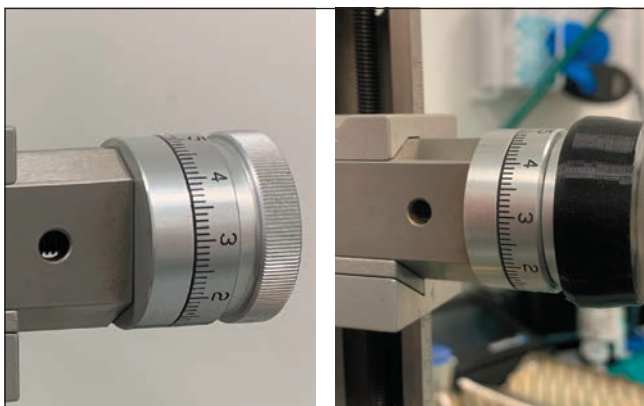


Figure 3. Close up of frame dial, before and after placing the 3D printed cover.

(Figure 2). They were autoclaved using an LTE touchlave system autoclave on a 121°C sterilisation cycle for 20 minutes. The covers were then re-tested on the stereotactic frame and microscope to confirm that the effects of autoclaving had not altered their shape. They were then handed over to the surgeons.

Results

One of the surgeons trialled the prototypes without performing surgery, just to see how well (or not) they fitted handles/dials and how easy it was to use them (Figure 3). The results were very satisfactory and the workshop then produced two sets of 3D-printed covers for trialling in actual surgeries. Covers were sterilised before surgery using a Tuttnauer benchtop autoclave-steam steriliser (model 2340EAD).

The results of this trial were once again very satisfactory, with surgeons commenting on the ease of placing the covers over the respective handles/dials and manipulating them, including the ease of visualising markings and performing delicate rotation movements.

The surgical team have now been using the 3D-printed covers for over 30 surgeries without any issues.

Conclusion

Maintaining aseptic technique when doing experimental stereotactic surgery in rodents can be challenging. Various solutions for preventing the surgeon from touching non-sterile microscope handles and stereotactic frame dials, such as using pieces of sterile aluminium foil, swabs or food-safe semi-adhesive plastic were not ideal. The manufacturing of 3D-printed, made-to-measure plastic covers that could withstand autoclaving and fit every handle and dial was found to offer a superior solution and facilitate the maintenance of the aseptic technique.

References

- 1 **Chris Barkus et al.** "Refinements to rodent head fixation and fluid/food control for neuroscience". In: *Journal of neuroscience methods* 381 (2022), p. 109705.
- 2 **Amanda Novak.** Refining rodent stereotactic surgeries. Video: NC3Rs Webinar, 3Rs Resource Library. 2021.