University of Zurich[UZH]

Zurich Integrative Rodent Physiology (ZIRP)

3D-printed Mouse Tail Models

to promote the 3Rs in i.v. injection training

Felix Gantenbein[1], Fabian Eggimann[2], Petra Seebeck[1]

[1]Zurich Integrative Rodent Physiology, University of Zurich, [2] AMF, Department of Biochemistry, University of Zurich

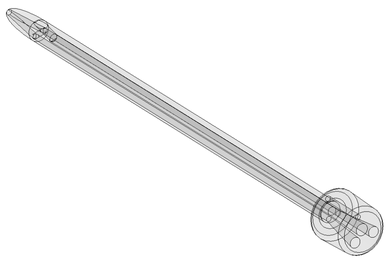
Contact details:

1. Abstract

Intravenous (i.v.) injections are a very common experimental procedure in mice to deliver substances. Successful delivery, however, is highly dependent on the operator's skill. It is therefore common (and necessary) to undergo extensive training on live animals before. Novice personnel tend to require many mice for training to get used to tail- and syringe handling before being able to fully concentrate on the injections themselves. Training these first steps on artificial mouse tail models could not only prepare trainees better for injections on live mice in terms of handling and speed but ultimately also bear the potential of reducing the number of animals required for training overall. Currently available animal training models have proven to be unsatisfactory in regards of anatomical accuracy and feel. Hence, a collaboration between animal research scientists and mechanical/electrical engineers proficient in various 3D-printing technologies spawned a newly designed mouse tail that combines anatomical accuracy with more realistic tactile feedback.

2. Methods

- CAD (computer assisted design) modeling on the PC
- Prototyping and testing various materials, colors and textures
- 3D printing in batches with DLP (digital light processing) technology
- Manual quality control important



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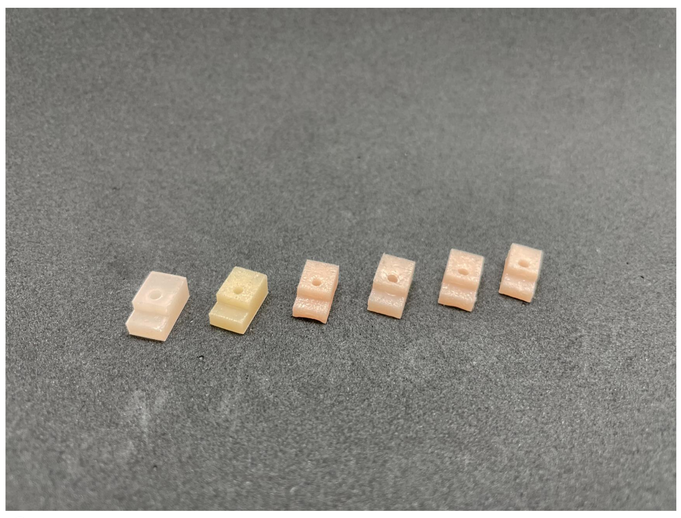

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Figures: **1** CAD modeling, **2** Early prototype with central wire («tail bone») visible, **3** Testing different colors and textures in small material samples, **4** & **5** Printing and finishing a prototype

3. Results

- High anatomical accuracy and realistic feel
- Very durable and often re-usable
- Effective to practice first steps in i.v. Injection training
- Positive feedback from users

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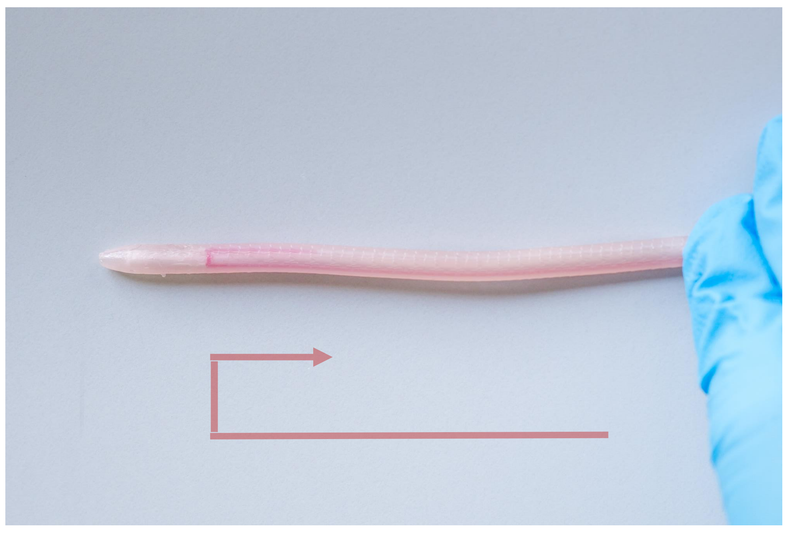

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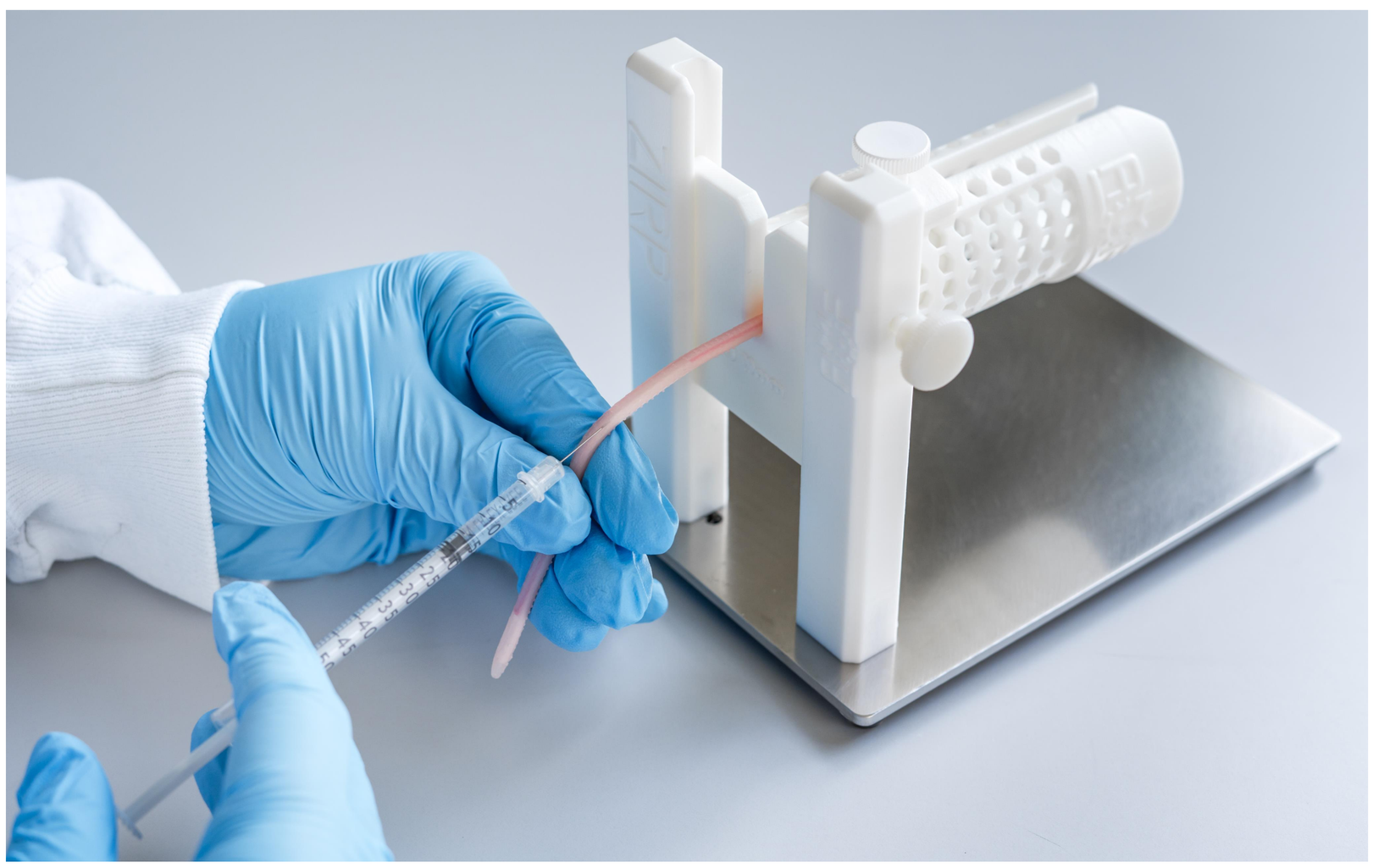

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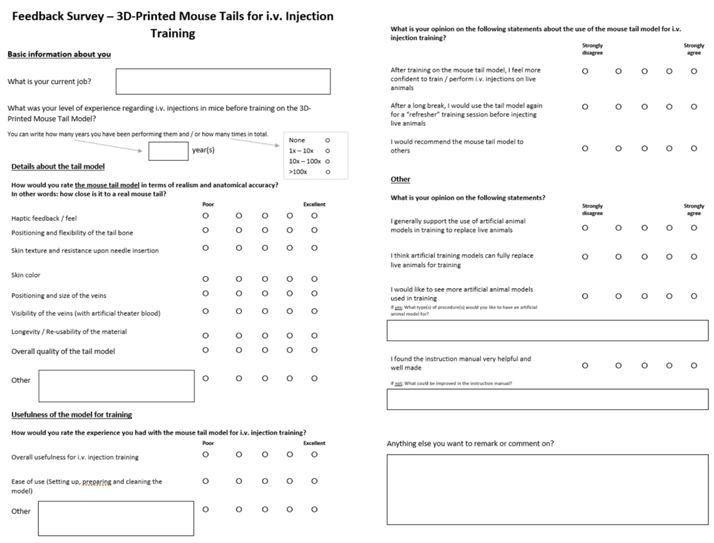
Figures: **6** & **7** Filling the tail model with artificial theater blood (the canals are connected at the distal end), **8** Injection training; the «blood» in the canals is replaced by the injected fluid just like in a real mouse tail (the tail model is held in place by our 3D-printed mouse restrainer), **9** Feedback survey (available in English, German and French, either online or printed out of paper)

Conclusion

The implementation of artificial mouse tail models in i.v. injection training proved to be very useful for beginners. Although the mouse tail model is meant only to facilitate the «first contact experience» for novice trainees, we see potential for a significant reduction in live animals needed for training. Furthermore, there seems to be a high demand of such training models (maybe training models in general) in an effort not only to maximize training efficacy, but also to contribute to the 3Rs.
A thorough feedback survey will shed more light on the participants' motivation to use training models, the model's effectiveness in training and also future viability.

4. Outlook

- Collect long-term user experiences through feedback survey
- Analyze feedback and publish results
- Continuous improvement of the mouse tail model
- Developing a reliable and highly functional product for further (commercial) distribution



Feedback Survey – 3D-Printed Mouse Tails for i.v. Injection Training

Basic information about you

What is your current job?

What was your level of experience regarding i.v. injections in mice before training on the 3D-Printed Mouse Tail Model?

You can write how many years you have been performing them and / or how many times in total.

year(s)

None ○
1x – 10x ○
10x – 100x ○
>100x ○

Details about the tail model

How would you rate the mouse tail model in terms of realism and anatomical accuracy? In other words: how close is it to a real mouse tail?

	Poor				Excellent
Haptic feedback / feel	○	○	○	○	○
Positioning and flexibility of the tail bone	○	○	○	○	○
Skin texture and resistance upon needle insertion	○	○	○	○	○
Skin color	○	○	○	○	○
Positioning and size of the veins	○	○	○	○	○
Visibility of the veins (with artificial theater blood)	○	○	○	○	○
Longevity / Re-usability of the material	○	○	○	○	○
Overall quality of the tail model	○	○	○	○	○
Other	○	○	○	○	○

Usefulness of the model for training

How would you rate the experience you had with the mouse tail model for i.v. injection training?

	Poor				Excellent
Overall usefulness for i.v. injection training	○	○	○	○	○
Ease of use (Setting up, preparing and cleaning the model)	○	○	○	○	○
Other	○	○	○	○	○

What is your opinion on the following statements about the use of the mouse tail model for i.v. injection training?

	Strongly disagree				Strongly agree
After training on the mouse tail model, I feel more confident to train / perform i.v. injections on live animals	○	○	○	○	○
After a long break, I would use the tail model again for a "refresher" training session before injecting live animals	○	○	○	○	○
I would recommend the mouse tail model to others	○	○	○	○	○

Other

What is your opinion on the following statements?

	Strongly disagree				Strongly agree
I generally support the use of artificial animal models in training to replace live animals	○	○	○	○	○
I think artificial training models can fully replace live animals for training	○	○	○	○	○
I would like to see more artificial animal models used in training	○	○	○	○	○

If yes: What type(s) of procedure(s) would you like to have an artificial animal model for?

I found the instruction manual very helpful and well made ○ ○ ○ ○ ○

If no: What could be improved in the instruction manual?

Anything else you want to remark or comment on?

Useful links

www.zirp.uzh.ch
www.amf.uzh.ch