Creation of an Interventional Neck Ultrasound Phantom

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Introduction

- Currently, surgeons in the UK, get very little formal training with ultrasound imaging and therefore many have little experience of performing ultrasound guided procedures.
- There is a clear need to upskill surgeons in the use of ultrasound imaging and the need for accessible simulation training phantoms.
- To date, there is a lack of readily available and economical training phantoms for interventional applications.
- Our aim was to produce a simple, cost effective and reproduceable neck phantoms with anatomical features important to head and neck surgeons carrying out ultrasound guided aspirations and biopsies.


Methods

- CAD and a 3D printer were used to create moulds of the neck phantom structure.
- The base of the phantom was made using Agar based tissue mimicking materials (Teirlinck et al, 1998) with differing concentrations of scattering agents (Table 1).
- A top layer of ADAMgel (Willers et al, 2015) was added to improve the feel and texture of the phantom whilst scanning.
- Clinicians were asked to trial the phantom and fill a questionnaire on its performance.
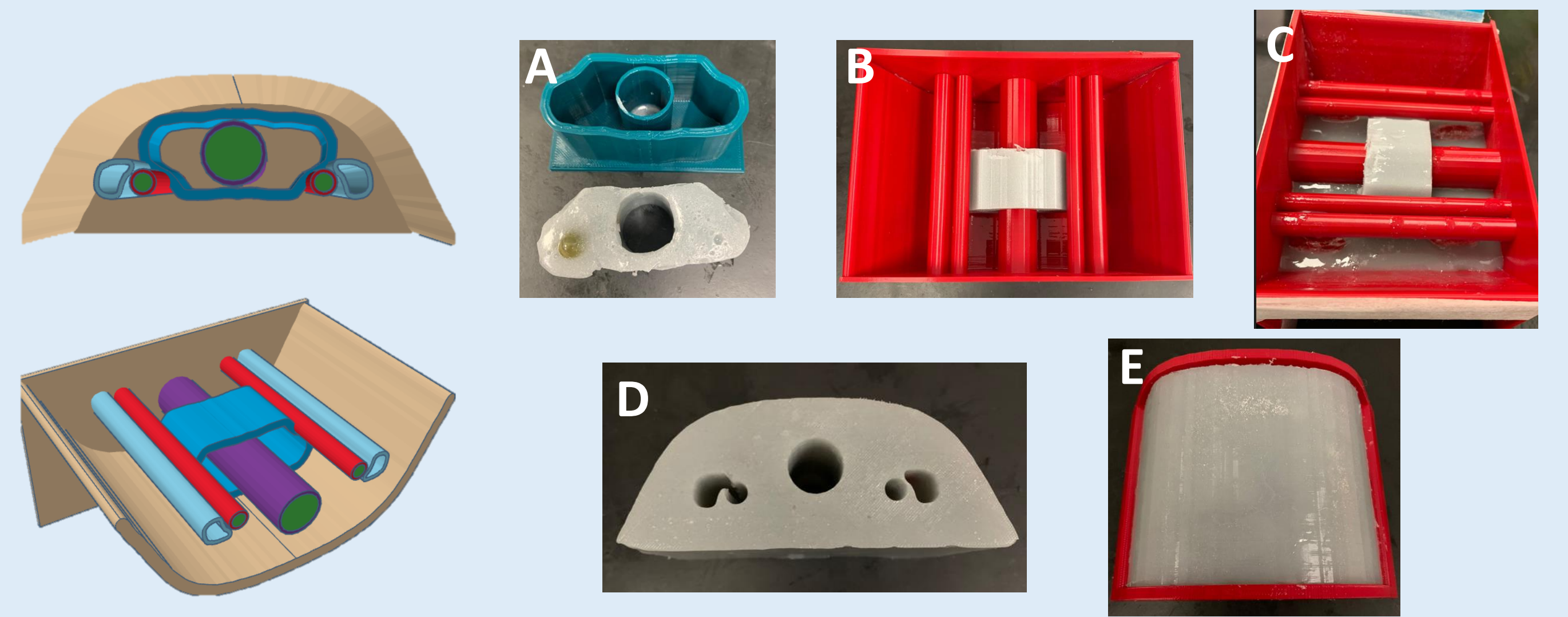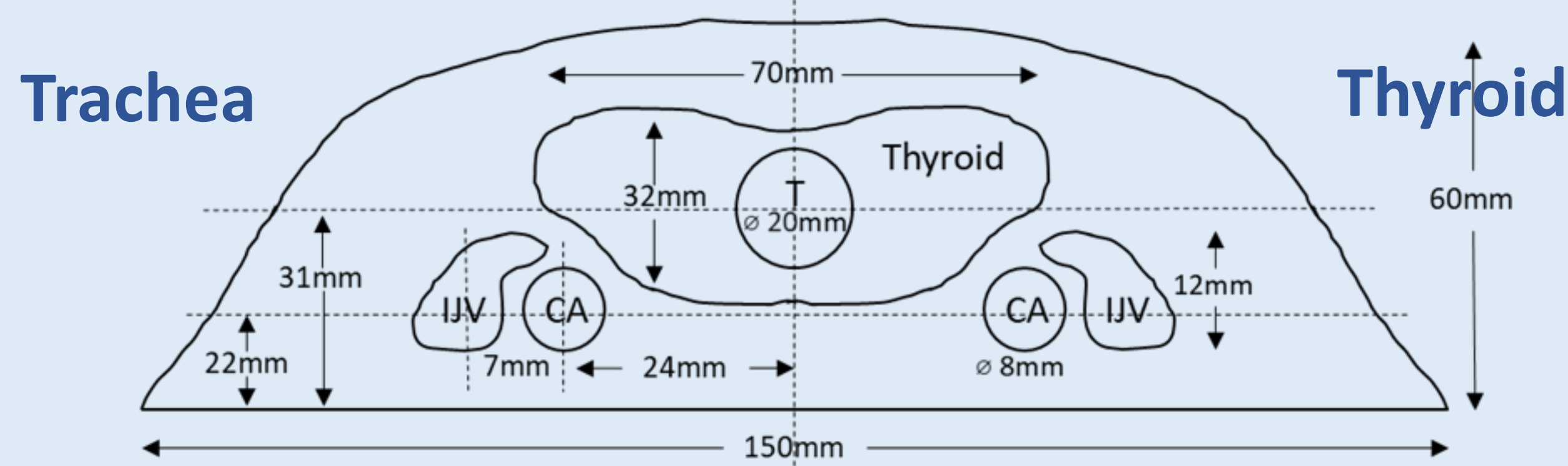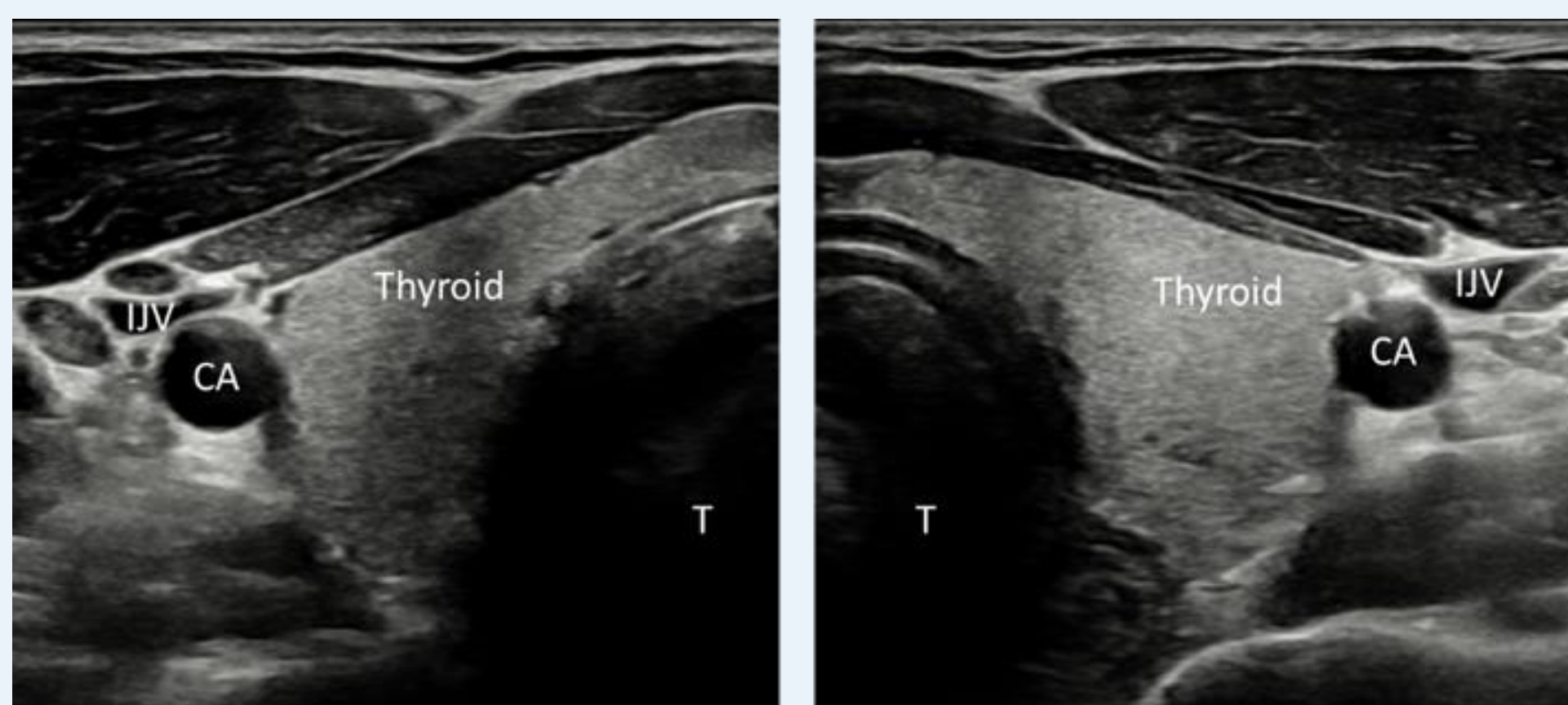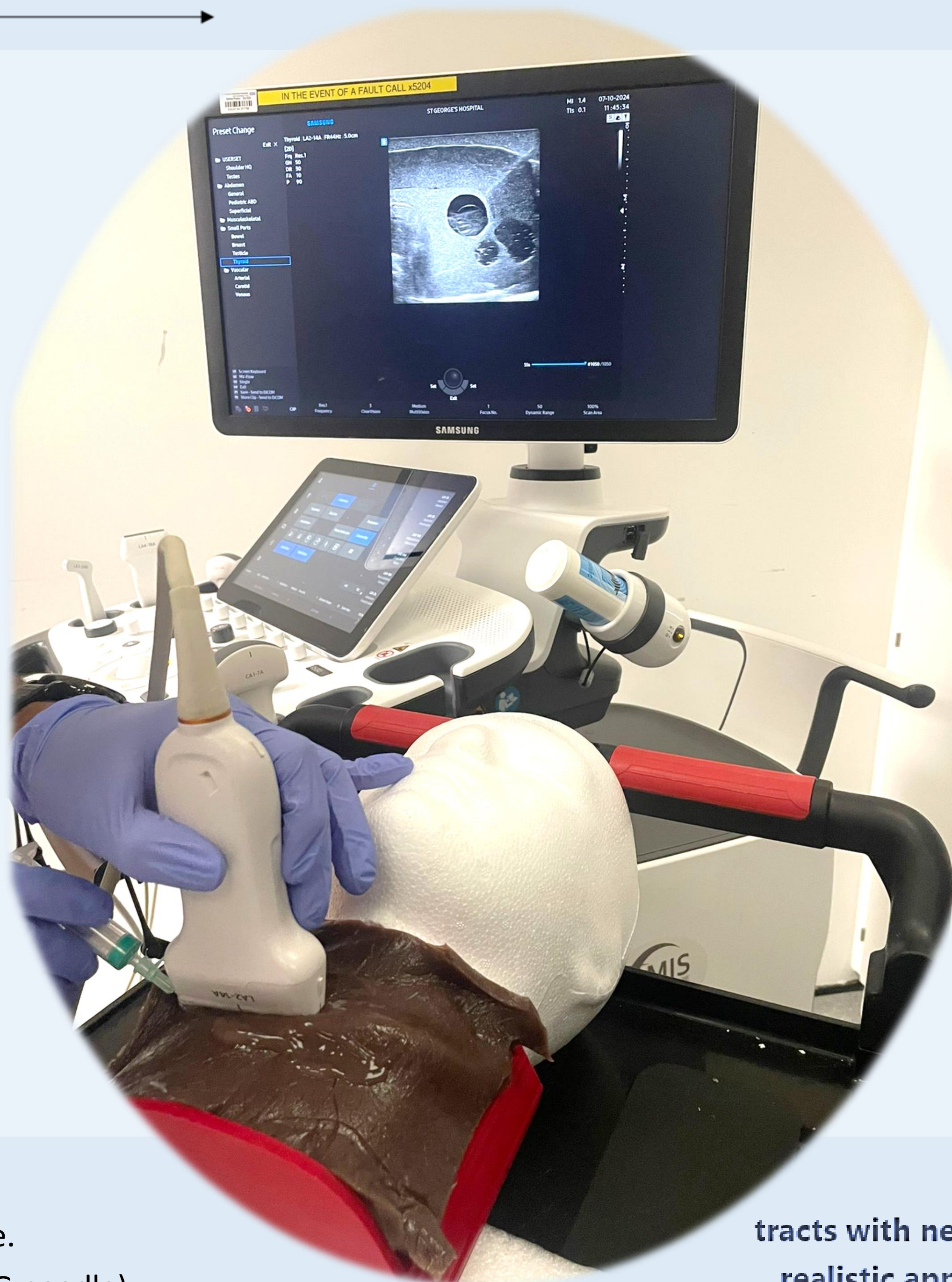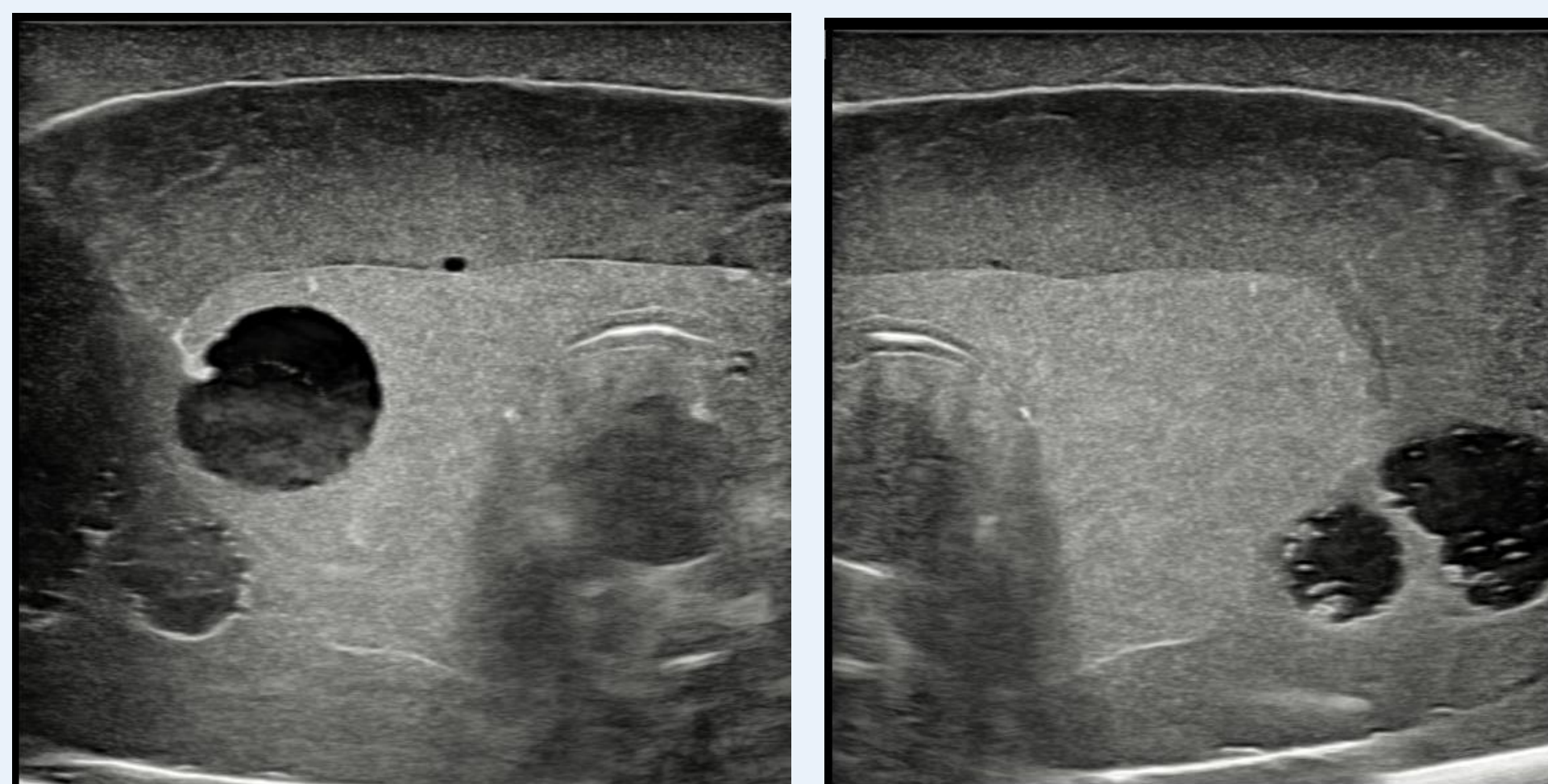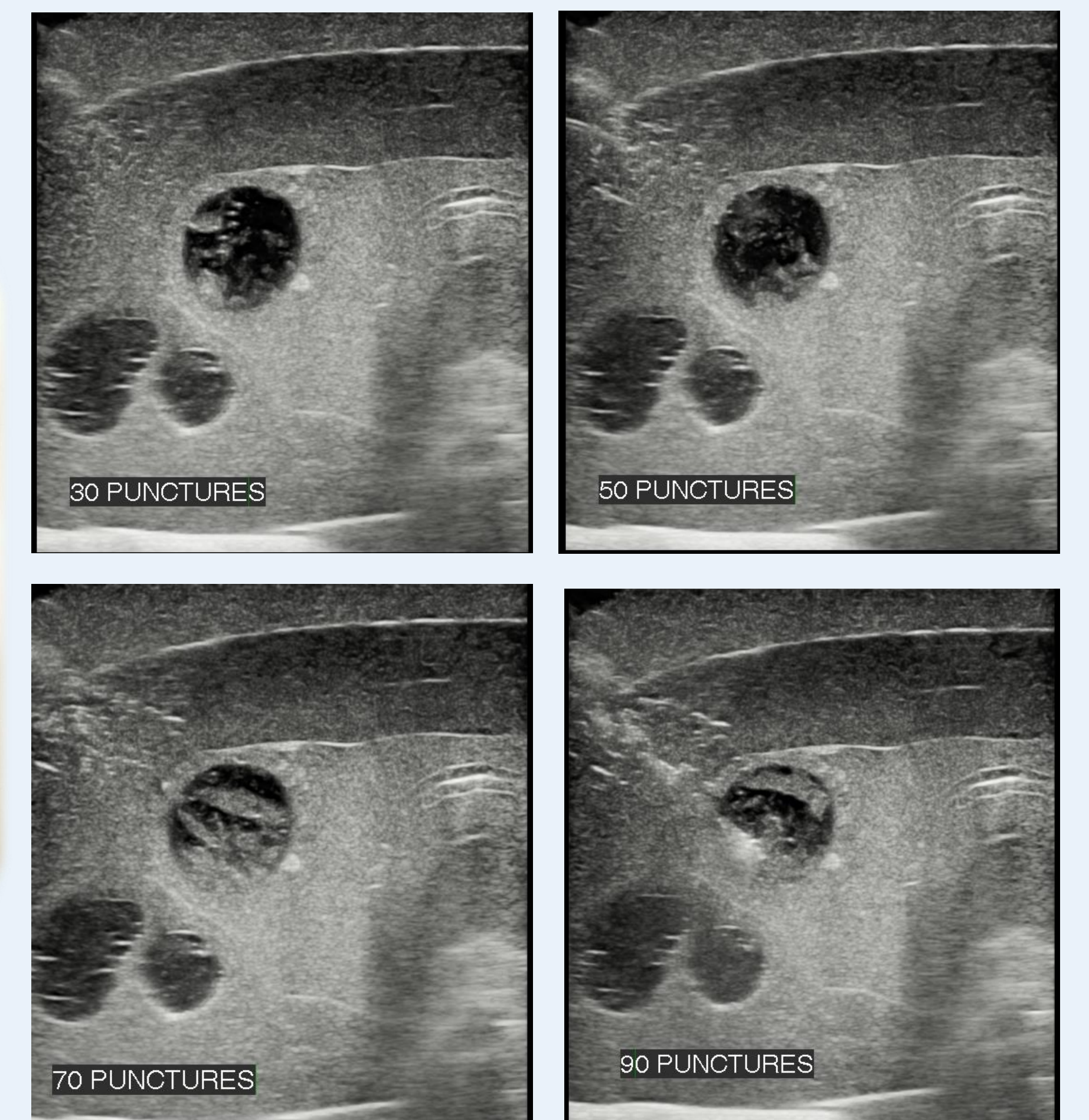

Comparison of Anatomy Appearance

Cyst Appearance after FNAs

Results

- Each phantom cost approx. £15.00 and took 2.5 hours to make.
- Each cyst target was able to withstand up to 90 punctures (21G needle).
- Each phantom is stable at room temperature for at least 8 weeks.
- The phantom was tested by 22 clinicians with varied levels of USG FNA experience.

How would you rate your training experience with this phantom?

Very Poor ① ② ③ ④ ⑤ Very Good
0% 0% 0% 27% 72%

How would you rate the feel and texture of the phantom?

Not Realistic ① ② ③ ④ ⑤ Very Realistic
0% 4% 9% 50% 36%

How would you rate the appearance of the internal structures?

Not Realistic ① ② ③ ④ ⑤ Very Realistic
0% 0% 4% 31% 63%
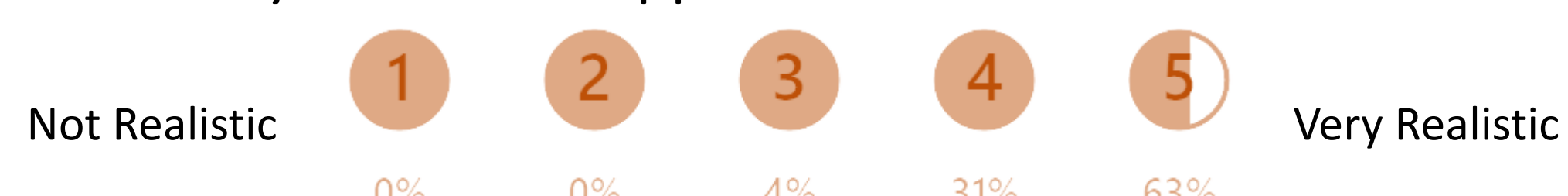
How valuable is this training phantom for your work?

Not Valuable ① ② ③ ④ ⑤ Extremely Valuable
0% 0% 9% 13% 77%
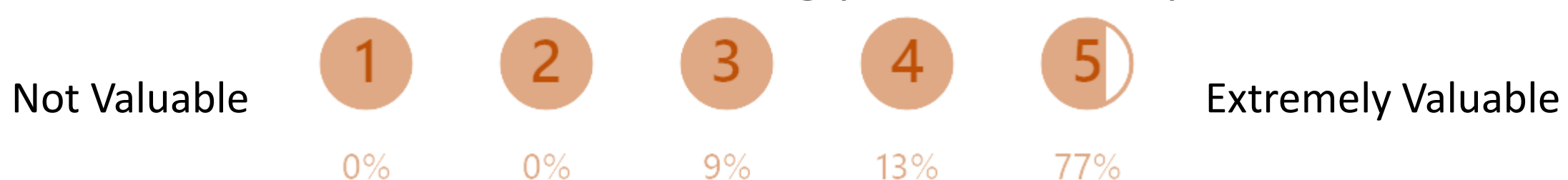
How likely are you to recommend the training phantom to a colleague?

Not Likely ① ② ③ ④ ⑤ Extremely Likely
0% 0% 0% 4% 95%
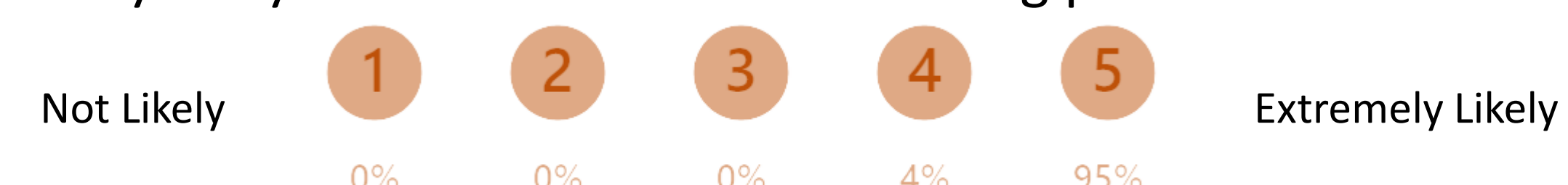
How does this phantom compare to others you may have used?
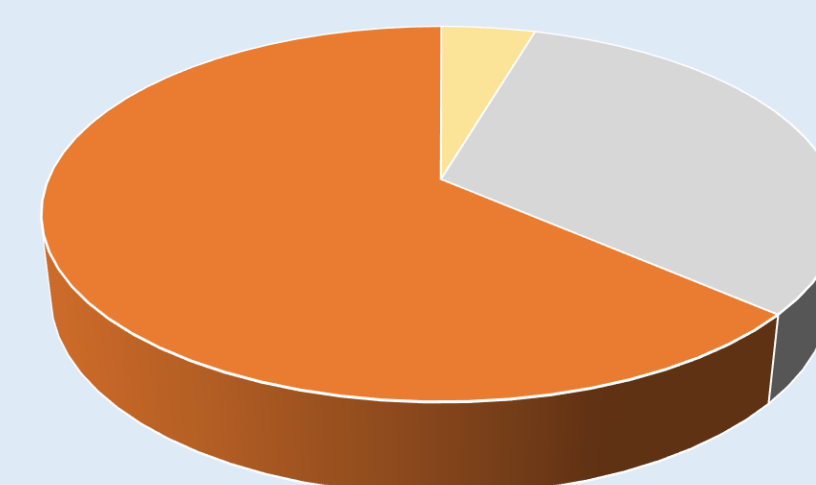
■ Better ■ Similar ■ Have not used another phantom ■ Worse

"Better than any other phantom training I had. Very helpful for a surgeon completing his competencies on US FNA"
Specialism- Surgery

"User friendly, realistic appearance. Minimal needle tracts with needle reflectivity approaching real life."
Specialism- Radiology

Conclusion

- We have produced an anatomical and cheap training phantom with fluid filled targets.
- The advantage of these phantoms over commercially available ones is primarily cost, however, they also have the advantage of being customisable and reproduceable should they be damaged.
- The use of CAD and a 3D printer made it possible to create realistic anatomical geometries.
- Further work is needed to increase the robustness and lifespan of the phantom material.

References

Teirlinck, Carolus JPM, et al. "Development of an example flow test object and comparison of five of these test objects, constructed in various laboratories." Ultrasonics 36.1-5 (1998): 653-660.

Willers, Josephine, et al. "Adamgel: An economical, easily prepared, versatile, selfrepairing and recyclable tissue analogue for procedural simulation training." BMJ Simulation and Technology Enhanced Learning. 1. A27.2-A27. (2015). 10.1136/bmjstel-2015-000075.66.