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Background

- Microlaryngoscopy presents a unique challenge for residents: single operator, reduced visualization in a narrow cylindrical field, use of operating microscope and long fulcrum instruments.
- In a survey of 191 US and Canadian residents, only 21.6% felt “very” comfortable performing removal of a vocal fold lesion and 87.4% felt their comfort level would increase with access to laboratory-based training.¹
- The objectives of this study were to (1) develop a combined animal-bench model device for the realistic simulation of microlaryngoscopy and laryngeal tumor resection, and (2) improve surgical proficiency, patient safety, and surgical outcomes.

Materials and Methods

Simulator Design

- Laryngoscope: 3D printed standard stainless-steel laryngoscope channel design, plastic cassette modules to mount larynges, adjustable mounts.
- Porcine larynges: prepared by removing excess tissues, median posterior section performed to allow access to vocal cords for injection.
- Synthetic larynx model: CT images used to create a computer model of human true vocal folds, negative mold printed in thermoplastic polyurethane (TPU), mold filled with EcoFlex curable silicone.
- Tumor phantom: soy protein isolate with 10% gelatin by weight (SG-10), mixed with SilcPig (red silicone-based pigment), injected into both porcine and synthetic larynges.

Materials and Methods Cont.

Simulator Validation

- Simulator evaluated for face and content validity by 18 participants from the LSU Department of Otolaryngology.
- Participants performed microlaryngoscopy with laser resection on porcine larynges and cold resection on synthetic larynges.
- 17-question Likert scale survey.

Design

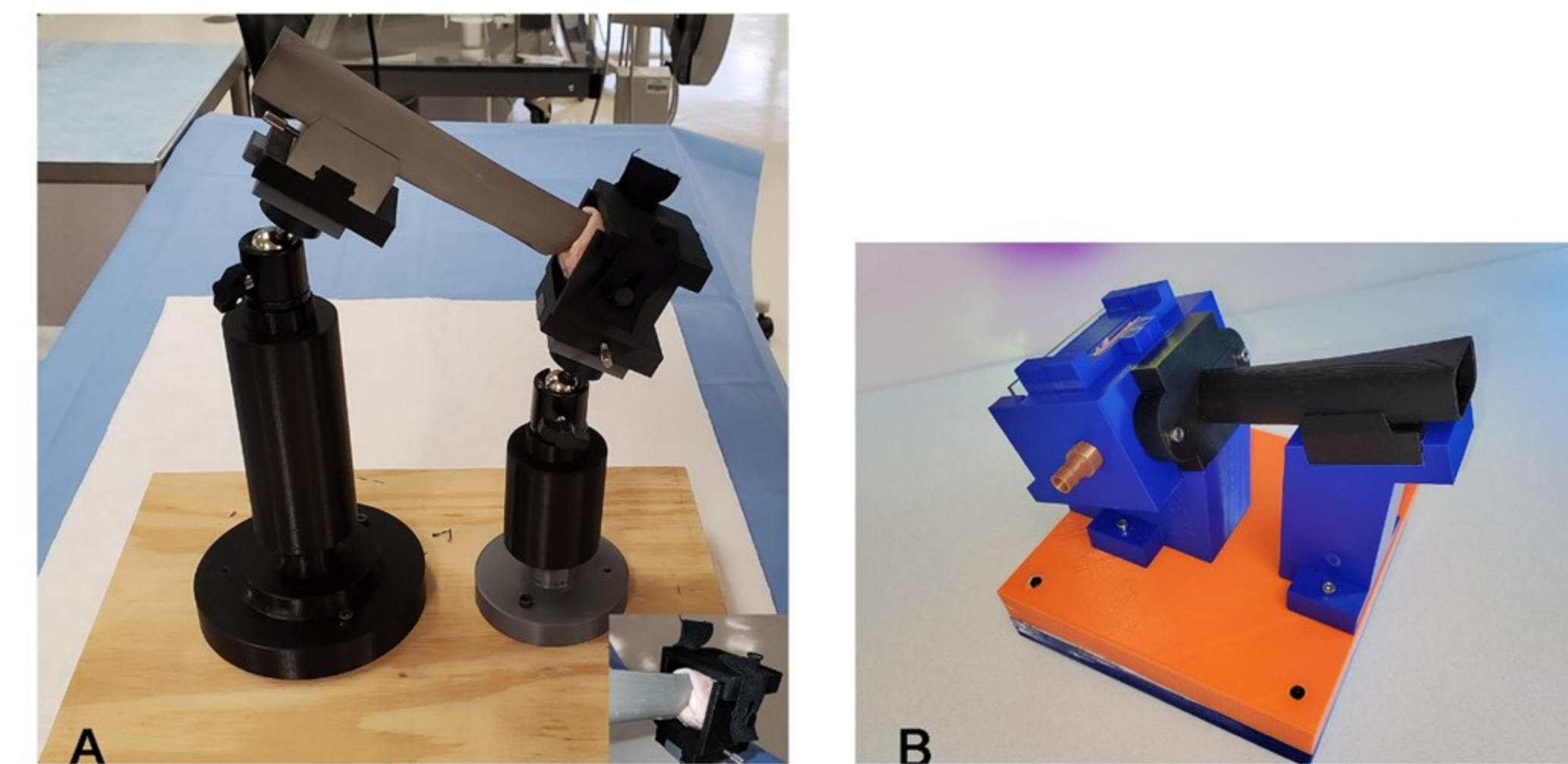


Figure 1: Microlaryngoscopy simulator. (A) Final design with stainless-steel laryngoscope and adjustable mounts; (B) Original prototype.

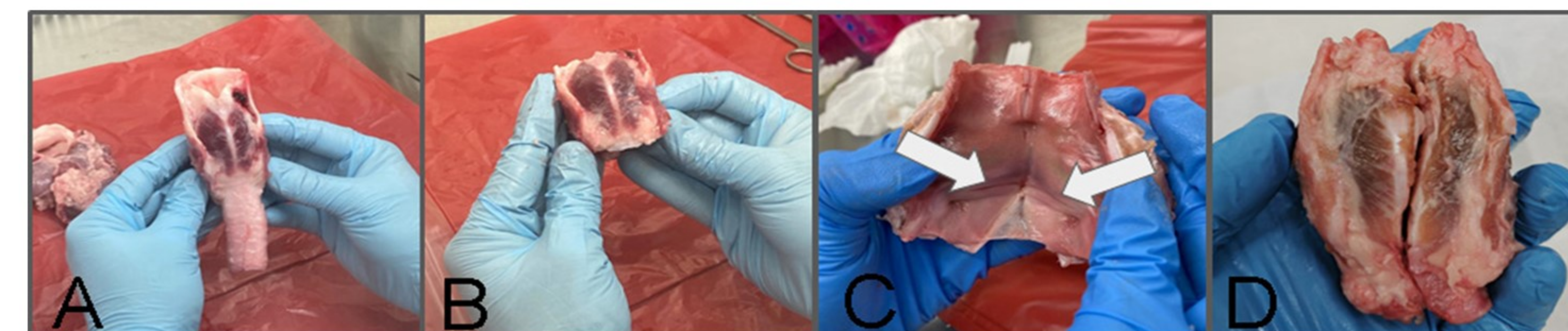


Figure 2: Preparation of porcine larynges.



Figure 3: Synthetic larynx model. (A) Negative TPU mold; (B) EcoFlex silicone vocal fold with tumor phantom.

Results

Table 1: Validation survey results.

Likert Scale Survey Results (1 = strongly disagree, 5 = strongly agree)		
	Average ± SD	% Agreement (Likert ≥ 4)
The transoral laser microsurgery simulator is a valuable training exercise	4.83 ± 0.14	100%
Portions of this model simulated an actual case start to finish.	4.11 ± 0.94	83.3%
The model is high fidelity and closely mimics actual laryngeal anatomy.	4.17 ± 0.76	88.9%
This model helps to develop skills needed for laryngeal exposure	4.19 ± 0.95	70.6%
This model helps to develop hand eye coordination needed for endoscopic laryngeal surgery	4.83 ± 0.37	100%
This model helps develop bimanual dexterity in endoscopic laryngeal surgery	5.0 ± 0	100%
The model correlates with essential skills needed for laryngeal surgery	4.88 ± 0.32	100%
This model helps to develop basic instrumentation skills for endoscopic laser surgery	4.83 ± 0.14	100%
This model helps to develop basic use of CO2 laser for excising lesions	4.89 ± 0.31	100%
This model helps to develop basic skills for removing a lesion en-bloc	4.56 ± 0.60	94.5%
This model helps develops basic use of the endoscopic instruments to mobilize a glottic tumor for excision	4.61 ± 0.59	94.5%
This model helps develop basic knowledge of evaluating tumor depth within the vocal folds	3.59 ± 0.97	47.1%
This model helps to develop skills for evaluating margins of a glottic cancer	3.41 ± 0.97	41.2%
This model allows for appropriate depth perception	3.88 ± 1.17	68.8%
Use of this model will increase resident competency when used to train residents prior to their first transoral laser microsurgery.	4.94 ± 0.23	100%
The model is an adequate training model for future surgeons.	4.78 ± 0.42	100%
I would be interested in using the model to train residents.	4.83 ± 0.50	100%

Discussion

- This simulator demonstrates an easy to construct, cost effective, and easily reproducible model for microlaryngeal surgery.
- Overall, participants felt this simulator was a valuable and realistic training exercise.
- Surgical simulation will play an important role in developing confidence, speed, skill, ability to recognize errors in the setting of stricter duty hour restrictions and potentially decreased operative time.
- Ultimately will improve patient safety and surgical outcomes.

References

1. Shah MD, Johns MM III, Statham M, et al. Assessment of phonosurgical training in otolaryngology residencies: a resident survey. *Laryngoscope* 2013; 123:1474-1477.