Development and Pilot Testing of a Task Trainer for Tonsillectomy Simulation: A Feasible, Cost-Effective, and Re-Usable Model.

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ABSTRACT

Objective: **:**

1) To develop a novel low cost task trainer which appropriately simulates the basic steps involved in a tonsillectomy procedure for the novice trainee

2) To assess this task trainer for feasibility, face validity, usability, and content validity using a group of expert surgeons

Subject Area: Simulation Training

Participants: Attending and fellow level pediatric otolaryngologists

IRB: Exempt, Study ID 2011-1485

Main Outcome Measure: Post-course participant surveys

Methods: The task trainer was developed to reproduce all steps of the tonsillectomy procedure using pieces of steak with adherent connective tissue to simulate the tonsil for electrocautery dissection. Pediatric otolaryngology attendings and fellows were surveyed using a 5-point Likert scale to assess ease of use, realism, and perceived utility.

Results: The model consists of a Styrofoam head with cut-out oropharynx and steak pieces suspended by metal clips and wired to an electrocautery unit. Surgeons use a headlight, grasp the muscle, and electro-dissect it away from the fat. Cost of the model was twenty US dollars. Ten attending pediatric otolaryngologists and 4 pediatric otolaryngology fellows completed simulated tonsillectomies and surveys. Participants rated a median realism score of 4 out of 5 (very realistic) and ease of use a median 5 out of 5 (simple and intuitive). All participants agreed residents would be better prepared for real tonsillectomies after using the model.

Conclusions: Production and use of a tonsillectomy task trainer is a feasible and inexpensive endeavor for training programs and may provide appropriate usability and fidelity in simulating tonsillectomy for trainees. Face and content validity were confirmed by expert observers. Further study will assess validity and effectiveness for teaching and assessment.

Keywords: Computer/technology, general otolaryngology, and residents.

INTRODUCTION

All surgical procedures require a certain level of technical skill and a basic familiarity with steps, instrumentation and the overall flow of the operation. Few novice residents have had significant exposure to the most basic of surgical procedures performed by otolaryngologists. A steep learning curve exists for these individuals once entering the operating suite.[1]

Concern for patient safety and the efficiency of operating room time as well as decreasing time available for residents to spend in the hospital has been a driving force in recent years for increased use of simulation to aid in resident preparation for real patient interaction.[1]

Simulation has been extensively utilized in the past decade to allow novice learners to become familiar with the essential steps and equipment used for a variety of common procedures in surgical training. General surgeons have used simulation training in laparoscopic skill development and these skills have been shown to be transferrable to the operating suite.[2-3] Otolaryngology has adopted sinus surgery trainers and temporal bone simulators with strong transfer of skills as demonstrated by several authors.[4-8] Tonsillectomy is one of the most common major surgeries performed in the United States, yet to our knowledge no tonsillectomy simulator model exists in the English language literature.

We sought to develop, produce, and evaluate a novel tonsillectomy task trainer model for otolaryngology junior residents at a single institution, with the aim of establishing feasibility, face and content validity, and usability utilizing expert exposure.

MATERIALS AND METHODS

Supplies List

- One Male Styrofoam Mannequin Head ($3.99 from displayimporter.com)
- Two Silicone Blocks (~$3 at hardware store or casted from clear silicone caulk)
- Four Electrical Alligator Clips (~$5 at hardware store)
- Two Electrocautery Grounding Cords (Unused OR supply)
- One Electrocautery Handpiece with Tip (Unused OR supply)
- Soldering Iron and Solder
- Electrical Tape
- Two 50 Ohm Resistors and 8 Feet of Wire (~$3 at electronics store)
- Tonsillectomy Tray (or unused instruments) and Electrocautery Unit (borrowed from OR)
- Two 1x3cm pieces of strip steak with attached connective tissue (~$5 for approximately 8 tonsillectomies)

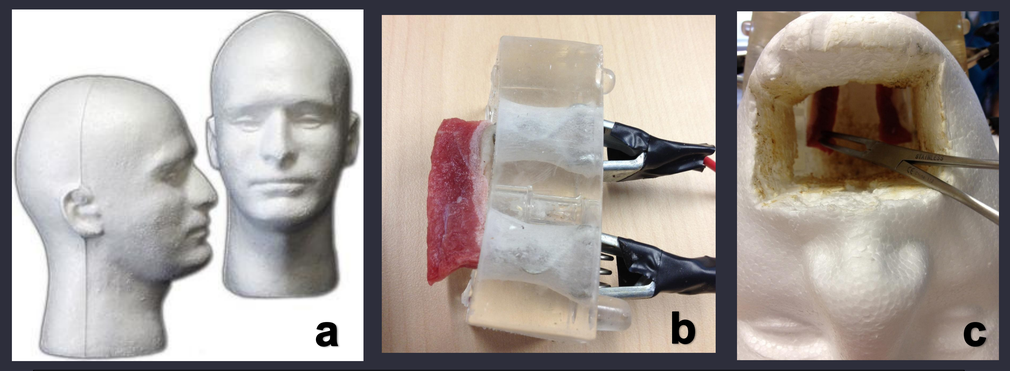

Figure 1a-c. Male Styrofoam mannequin head as sold (a). Silicone block with alligator clips inserted and attached to steak and electrocautery grounding wires (b). Styrofoam head with silicone blocks and steak in surgical position (c)

Assembly

- Carve Styrofoam head utilizing the specifications below (Figure 2b)
- Drill silicone to accommodate two electrical alligator clips through each side (4 total)
- Solder 50 ohm resistors to grounding pad wires and to alligator clip wires in parallel with tonsil tissue to simulate human tissue resistance (Figure 2a)
- Cut strip steak into 1x3cm pieces and firmly grasp the connective tissue on each side with alligator clips (Figure 1b)
- Insert loaded silicone blocks into side ports of mannequin head (Figure 1c)
- Electrocautery used on 20 watts to perform "tonsillectomy" dissecting between connective tissue and meat

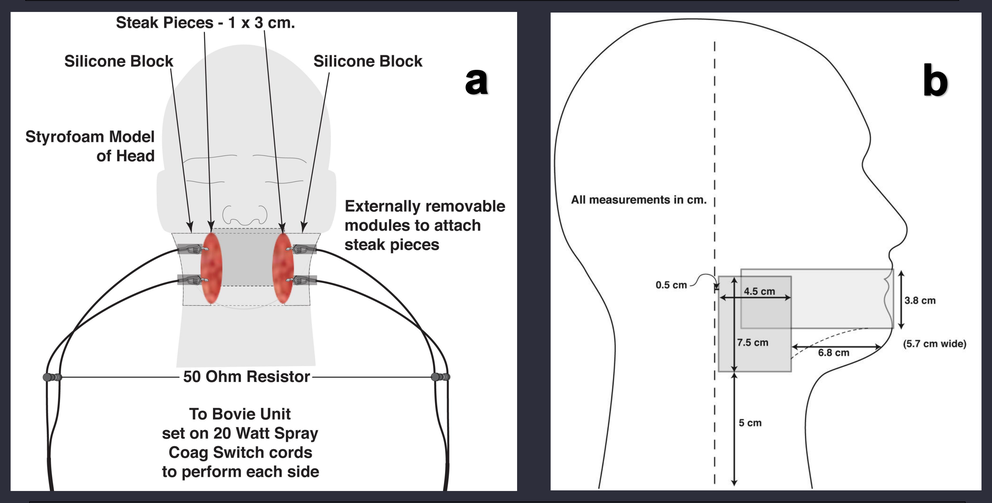

Figure 2a-b. Trainer setup with 50 ohm resistor to simulate human tissue resistance for the electrocautery unit (a). Diagram with dimensions of Styrofoam trainer head housing the pieces of strip steak (b).

- "Tonsillectomies" performed by fourteen expert surgeons
- Connective tissue dissected from its connective tissue in a similar fashion to actual tonsillectomy procedures using an Allis clamp, headlight, and electrocautery
- Post-participation survey completed evaluating the ease of use and realism of the task trainer as well as the potential impact on novice resident education and readiness for actual patient tonsillectomies
- All responses based on a five point Likert scale with 1 being cumbersome and/or unrealistic up to 5 being effortless and/or exceptional realism for ease of use and realism, respectively
- Finally, a cost analysis was performed to determine total cost of each unit

RESULTS

- All fourteen expert surgeons completed post-participation surveys
- None of the participants had prior experience with simulators
- Median score for ease of use was 5 (effortless to use)
- Median score for realism was 4 (quite realistic)
- Median score for expected increase in resident performance was 5 (strongly agree)
- Ten out of fourteen "strongly agree" that this task trainer would better prepare residents for the operating room with the remaining four "agree" with the statement (median 5, see Figure 3)
- Cost of the model was approximately 20 US dollars

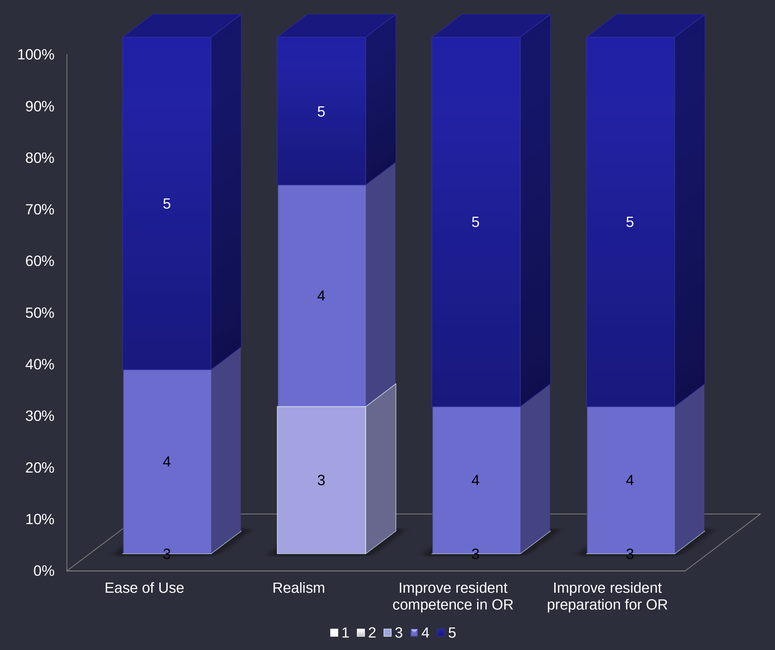

Figure 3. Data showing expert opinion following initial exposure to tonsillectomy task trainer. A score of 1 generally means the simulator was unrealistic or cumbersome and 5 was designated as exceptionally realistic/easy to use and indispensible to medical education.

CONCLUSIONS

Production and use of a tonsillectomy task trainer is a feasible and inexpensive endeavor for otolaryngology training programs and may provide appropriate usability and fidelity in simulating tonsillectomy for the novice user. Face and content validity were confirmed by expert observers. Further study will assess validity and effectiveness for teaching and assessment. Use of this task trainer is expected to economically allow for improvement of resident skill and comfort prior to real patient tonsillectomies.

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