Face & Content Validity – Tympanostomy Tube Simulator with Variable Canal Sizes

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Introduction

Pressure equalization tube (PET) insertion is the most common pediatric otolaryngology procedure, leading to frequent exposure amongst junior residents.[1] While there are many PET simulators, few have varying levels of complexity for learners to practice these skills.[2-5] We have developed a novel low-cost, medium fidelity PET simulator that has different external auditory canal (EAC) sizes to adjust the level of complexity for trainees. This study aims to assess the face and content validity of the simulator.

Methods & Materials

A 3D-printed PET simulator with two interchangeable EACs of different diameters were created (Figure 1). The EACs were developed based on a CT temporal bone of a 5-year-old without abnormalities. EAC diameter was an average of 5.6mm. A separate EAC of 3.5mm was made to mimic a narrow (<4mm) EAC in children with Down Syndrome.[5]

Different materials were assessed to replicate the elastic modulus of the tympanic membrane (TM) – parafilm, pig intestine, latex gloves, tegaderm, wafer paper, and press'n seal.[6] While unable to get its elastic modulus, we selected press'n seal due to its accessibility, cost effectiveness, and tactilely similarity to a TM. The models were also mounted to a computer monitor to allow the user to move the ear/head as in real life. The total cost of the simulator was $70.10 (Figure 2).

Participants with experience in PET were recruited to complete PET insertion on both EACs of the simulator. A post-simulation questionnaire based on prior study (Huang et al.) was completed with questions assessing face and content validity.[2] This study was found to be IRB-exempt.

Figure 2. Breakdown of cost of the PET simulator

Item (Price - $)	
Computer monitor stand (29.99)	Press'n Seal (2.98)
6 pk Wood canvas boards (14.99)	5/16th short screw x 2 (1.62)
Corn hole sandbags (12.78)	5/16th long screw x 1(0.81)
Gorilla wood glue (5.97)	Winged nut x 2 (0.98)

***Total: $70.10**

*UNC School of Medicine provided 3D-printed skull at no charge. Access to power tools needed.

Figure 1. Images of the simulator with the computer monitor used (Top Left) the modular capability (Top Right), the mounted simulator (Lower Left), Normal EAC (Lower Middle), Narrow EAC (Lower Right)

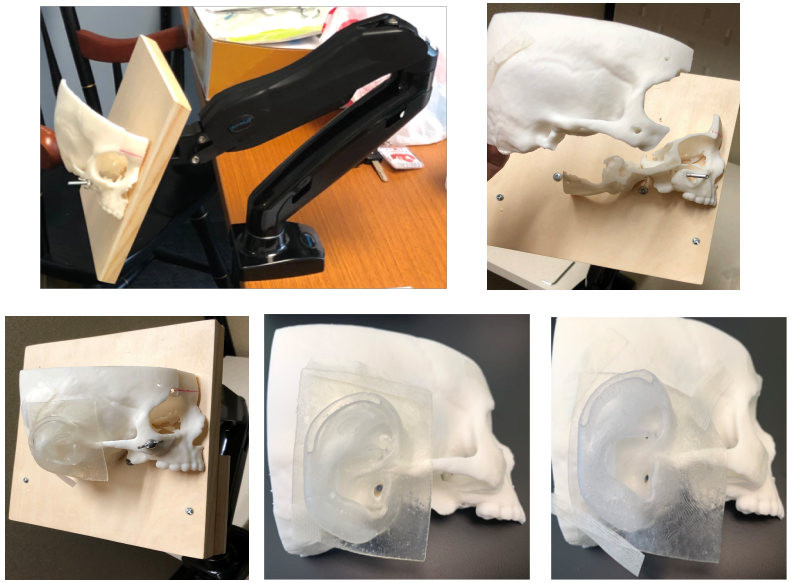
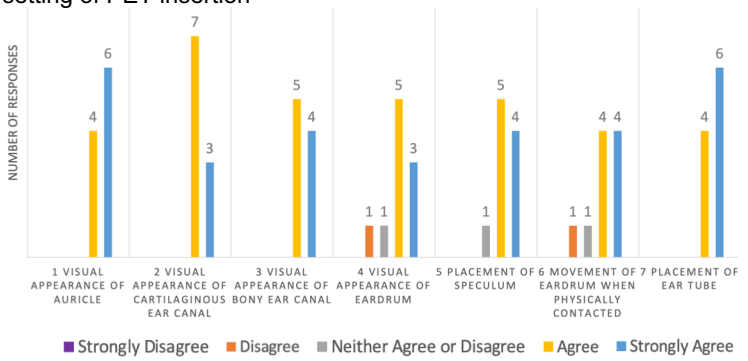


Figure 3. Rater responses for simulator's ability to mimic the true surgical setting of PET insertion



Results

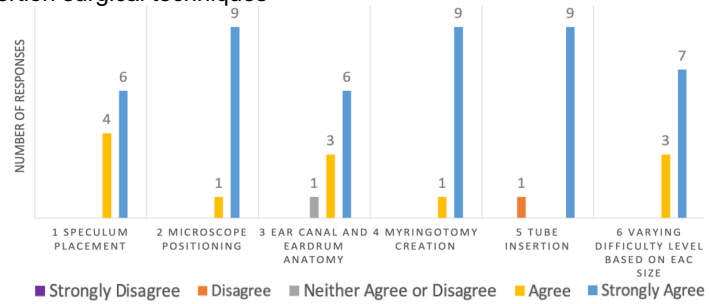
10 otolaryngologists were recruited. The majority of responders (80%) agreed that the simulator provided a realistic comparison of PET (Figure 3). 90% responded that the simulator would be useful in teaching residents different aspects of PET, including myringotomy creation and tube insertion (Figure 4).

Discussion

Responses suggest appropriate face and content validity for the simulator. Our simulator scored lower on factors related to TM realism as opposed to the model itself. It is possible that other materials have closer elastic properties to a real TM but this may lead to increase cost. Trying to mimic the properties of a TM has been challenging in many other simulators as well.[2-4] Another limitation of our study was the small sample size tested, though consistent with other PET simulators.[2-4]

Our model provides variable complexity and realistic positioning secondary to different EAC sizes and the highly maneuverable computer monitor stand, respectively. The least realistic portion of our simulator was the press'n seal TM, selected for its low cost and widespread availability.

Figure 4. Rater responses for simulator's utility in teaching residents PET insertion surgical techniques



Conclusion

Simulation plays an important role in preparing novice residents. Our simulator adds a new level of complexity. Though our study is small, it demonstrated our PET simulator of varying EAC sizes shows high face and content validity with the potential to provide a unique and valuable addition to PET training.

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