Myringotomy and Tymanostomy Tube Insertion Training Device: A Surgical Simulator

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Objectives
1. Develop a task simulator for myringotomy and pressure equalizing tube insertion.
2. Develop a simulator that can be used to hone a participant's micro surgical skills.

Introduction
The use of simulators have started to become available and the need for such devices in surgical training has been recognized including in Otolaryngology. The use of such simulators allows trainees to have a relatively unpressured and relaxed environment to perform surgical tasks. Decreased errors, decreased operative time and in general a safer procedure for patients are cited results. Simulators are such vital tools that allow for safe repetition of techniques to train the minds and hands of surgeons how to operate. 1

Myringotomy and insertion of pressure equalizing tube is one of the most basic and common procedures done by an Otolaryngologist. These perhaps are the reasons why simulators for this procedure was among the first to emerge in the field of Otolaryngology.

The earliest attempt at making a simulator for myringotomy was in 1969 which was composed of an acrylic external ear with a bronze base and used tracing paper as the simulated tympanic membrane. 2

In the past also, there have been other simulators emerging from the relatively cheap construct of tubing sealed on the distal end with either a rubber or plastic. Differences for these simulators have been seen in the type of tubing used to represent the external auditory canal and the material used to simulate the tympanic membrane. 3, 4, 5 More recently, virtual imaged and computer based simulators have been seen. 6

It has been proven that simulation has a significant effect on operative time and task performance, and yet wide spread use of surgical simulation is still to be seen. 7 With this device, we try to offer a relatively cheap and high fidelity simulator for myringotomy and tympanostomy tube insertion.

Methods and Materials
The conceptualization, design, and prerequisites of the Myringotomy and Tube Insertion Simulator was conducted by a team of Otolaryngologists.

The concept for the simulator was to be able to come up with a life size human head with anatomically correct pinnae and external auditory canal. There should be a way to easily place and remove in the model an artificial tympanic membrane and middle ear fluid. The maneuvers involved during procedures like manipulating the pinna and having to deal with the isthmus and curvature of the canal should be available in the simulator.

With the basic concept for the simulator in mind, a design for a model head with a core made up of wood and polyester body filling was made. The external facial features were replicated with the use of molded clay.

The pinna and the external auditory canal were then made from carved wood. Rubber fittings were used to attach the pinna to the lateral aspects of the head in order to allow some degree of mobility to the pinnae.

In order to simulate the tympanic membrane and middle ear cavity, a solution bottle’s cap was used. This cap served as the tympanic membrane cartridge. A thin single sheet of polyethylene film (Glad Cling Wrap) was used to simulate the tympanic membrane. 8 Sealing off the open end of the cap with the cling wrap, an enclosed cavity was made within the cap acting as the middle ear cavity. A stainless steel hose ring was used to secure the cling wrap to the cartridge. Different consistencies of fluid were placed with in the supposed middle ear space to check if it can be held with in the cavity.

A port on the occipital portion of the model head was made that would accommodate the tympanic membrane cartridge. The port was made in such a way that the cap when inserted would fall exactly at the medial end of the external auditory canal. Thus, completing the representation of external and middle ear structures.

Several trial runs of myringotomy, suctioning of middle ear fluid, and tube insertion was done on the simulator by the authors.

Results
We were able to construct a simulator for doing myringotomy, evacuation of middle ear fluid, and tympanostomy tube insertion. The simulator when tested proved to be sturdy, easy to use, and economical. Fidelity with actual performance of these procedures also seems to be a quality of this simulator.

Discussion
Simulators and task trainers are becoming an important aspect of training residents. It allows physicians to be exposed to relatively unfamiliar tasks and procedures in a safe manner.

This simulator has the potential to help train residents and students in the proper instrumentation when it comes to doing myringotomy and tube insertion. It also provides a safe environment to develop dexterity, familiarity, and confidence in doing the aforementioned procedures.

There are several things that can be done in order to validate the efficiency and reliability of the simulator.

Several participants can be asked to rate the simulator with the use of grading scale. The scores can then be averaged and analyzed to have a statistical measure of how the simulator is rated in the hands of novice and expert surgeons.

A construct validity of this simulator can also be undertaken in the future.

Doing a CT-scan of the model may be beneficial in seeing how closely the model approximate actual human dimensions.

Conclusions
Surgery is performance of a set of tasks that would eventually, lead to improvement if not cure of a patient. There is no question that whatever operation is to be performed on a human being, it places some degree of pressure on the surgeon as there are a myriad of complications that can happen. Performance of such tasks often requires quick and deliberate actions. Employing finesse and coordinated movements and constant presence of mind.

We have started to shy away from the traditional way of surgical training where in a resident learns by performance of procedures on actual patients under the supervision of more experienced surgeons.

The benefits of surgical simulation have been proven. With the presence of simulators, constant practice and objective evaluation of skill can be done without added risks to the patient under the hands of a surgeon still on the learning curve.

The creation of this simulator is a step towards the improvement of surgical training, evaluation of residents, better health economics, and patient safety.

References

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