Abstract

Educational Objective: At the conclusion of this presentation, the participants should be able to construct and operate a low-cost, user-friendly laryngeal surgery training simulator.

Objectives: To describe a practical laryngeal surgery training simulator (LSTS) that is simple to construct, economical, and user-friendly. The simulator apparatus is used in conjunction with a cadaveric larynx to perform open and endoscopic laryngeal surgeries.

Study Design: Prototype design.

Methods: The LSTS was designed using widely accessible parts such that it can be easily constructed using basic tools. The model was developed to minimize cost, while utilizing durable and hygienic materials. A cadaveric porcine larynx was used to demonstrate the feasibility of the simulator for both open and endoscopic surgery.

Results: Using the design model, an individual with no machine shop experience was able to quickly construct the LSTS for under $100. All required parts were accessible from online retail vendors, as well as from local hardware stores. The versatility of this simple to use device enables participants to practice a wide range of laryngeal surgeries, including thyroplasty, arytenoid adduction, laser surgery, neurotoxin injection, and vocal fold augmentation.

Conclusions: The proposed LSTS is an inexpensive and easy-to-construct apparatus for practicing numerous types of laryngology procedures.

Methods and Materials

The base of the laryngeal surgery training simulator is composed of a high density polyethylene plastic square supported by four rubber legs (Figure 1). The larynx holder consists of a rubber stopper that is attached to an adjustable clamp (Figure 1, Label A). A cadaveric larynx can be secured to the larynx holder by using thumb tacks to pin the tracheal end over a rubber stopper. The adjustable clamp allows the larynx to be positioned for either endolaryngeal (Figure 2) or open (Figure 3) surgeries. A flexible snake arm is used to appropriately position a laryngoscope for endolaryngeal procedures (Figure 2, Label A). Any style of laryngoscope can be mounted to the snake arm using a snap-on saddle tee and a hose clamp. A single suture fastened to the superior aspect of the larynx is wrapped around the saddle tee to stabilize the larynx. The position of the laryngoscope and the larynx can be adjusted to create a wide array of angles, including those that mimic operating conditions.

When practicing open surgeries, the larynx is positioned horizontally with the posterior surface lying flat against the base (Figure 3). Three sutures provide added stabilization by applying tension to the larynx at various vectors. Each end of this suture is tied to the larynx, while the other end is wrapped around a bolt and fastened by tightening a wing nut.

Results

After the initial prototype was designed, the laryngeal surgery training simulator was able to be fabricated by an individual having no specialized machine shop experience. The optimized device is composed of commonly-available parts totaling less than $100. The parts are highly durable, and include high grade stainless steel and minimally porous plastics. All required parts are easily accessible from online retail vendors or local hardware stores. Construction only required basic tools, including a screwdriver, wrench, and drill. Both open and endoscopic procedures were able to be performed.

Discussion

The laryngeal surgery training simulator is based on a minimalist design, with each part selected for its high function to cost ratio. Previously described laryngeal surgery simulators have been cited to cost as much as $1000.6 Comparatively, the proposed simulator can be created for under $100. The cost of the device can be further be decreased by substituting various parts, without notably compromising durability and function. All parts can be purchased through online vendors or local hardware stores. Its easy constructability enables individuals with little-to-no machine shop experience to build the model in a short period of time.

The larynx holder is designed to be easily adjustable, enabling practice of both endolaryngeal and open surgeries. Also, the laryngoscope holder is compatible with any type of laryngoscope for performing endoscopic surgeries.

The versatility of this simple-to-use device enables participants to practice a broad range of laryngeal procedures, including thyroplasty, arytenoid adduction, laser surgery, neurotoxin injection, and vocal fold augmentation. Additionally, the flexibility of the laryngoscope holder and the laryngeal holder mimics in vivo surgical situations by accommodating variations in larynx size, endoscope angle, and operator height.

Conclusions

The proposed laryngeal surgery training simulator (LSTS) is an inexpensive and easy-to-construct apparatus for practicing numerous types of laryngology procedures. The device is straightforward and easy to use. Its low cost of under $100 makes it accessible to a wide population of practicing residents and physicians.

References


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