



TEP Insufflator

*Computer Integrated Surgery II
Spring, 2014*

Rahul Modi under the mentorship of Dr. Jeremy Richmon

Introduction

Laryngectomy is the removal of the larynx in patients suffering from laryngeal cancer, certain types of head and neck cancer, or severe swallowing problems. Each year, over 3,000 patients undergo laryngectomy.

As the larynx, commonly known as the voice box, is removed during laryngectomy, patients are unable to speak post-surgery without a voice-prosthesis. Placed in the tracheo-esophageal puncture by the surgeon, the one-way valve allows air to pass from the lungs to the esophagus. When the patient covers his/her stoma, the air vibrates the esophageal tissue, producing sound. This sound is then turned into speech through mouth and tongue movements.

The Problem

For the air to pass from the lungs to the esophagus, the patient must cover his/her stoma, an opening in the lower neck. However, this poses numerous problems:

- The physical covering/uncovering can become inconvenient and tiring for the patient
- An uncovered stoma can result in social stigma and unwanted attention

Patients desire a better solution to restoring voice functions after laryngectomy. By creating a method that would prevent the patient from needing to cover his/her stoma, we eliminate all of the problems listed above.



Fig. 1: Image of an uncovered stoma in a patient

The Solution

We developed an insufflator that would enable the patient constant air to his/her tracheo-esophageal puncture at his/her discretion. To do this, we made use of a CPAP (Continuous Positive Airway Pressure). The CPAP machine connects to a suction catheter via a custom made attachment. The suction catheter then connects to the patient's voice prosthesis.

By introducing a valve, the patient is able to turn airflow on/off at the flick of his/her thumb and does not need to turn the CPAP device off. An image of the attachment that connects to the CPAP device can be seen in Fig. 2.



Fig. 2: Image of valve attachment that connects to CPAP machines

Outcomes and Results

We are currently in the process of testing this idea with a high-pressure CPAP machine. In prior tests, it was determined that a 20cmH₂O pressure was too low to help generate voice in the patient. We are currently awaiting IRB approval to test with a 30cmH₂O pressure CPAP machine. An image of this CPAP device can be seen in Fig. 3.



Fig. 3: 30cmH₂O CPAP Device

Future Work

- IRB submission and patent on idea
- Our goal is to market this idea to medical device companies who will manufacture and sell the product to hospitals and patients

Lessons Learned

- PTC Creo and 3D modeling used for mock-up designs
- Use of machining tools such as band saws, bores, and mills

Credits

- Rahul Modi, inventor
- Dr. Jeremy Richmon, mentor

Publications

A provisional patent has been filed for this project. The project is currently IRB approval on a new CPAP machine and the only thing pending is a proof of concept.

Support by and Acknowledgements

Thank you to Dr. Richmon for mentoring this project and providing me with the opportunity. Thank you to Dr. Taylor for his continued support and feedback. Thank you to Nishikant for his helpful feedback and advice

