Harry Barberian Scholarship Application

March 3, 2017

Criteria:

* Originality of the research question and its importance
* Feasibility – do you have the skills and resources to carry out the study?
* Impact – long –term or short-term potential for application?

Applicant’s name: Arushri Swarup

Supervisor: Dr. Adrian James

Location of Laboratory or Institution: Hospital for Sick Children Toronto

Project Title:

Description: - in lay terms describe (500 words)

**Background:**

Transcanal endoscopic ear surgery (TEES) is a new and growing field that allows surgeons to perform common ear surgeries such as ear drum reconstruction, cholesteatoma (skin growth) removal and hearing bone repair through a natural body opening, the ear canal [1]. TEES is performed by feeding an endoscope and an instrument through the ear canal to visualize the surgical field and perform the surgery without a skin incision [1] [2]. As compared to traditional, invasive microscopic ear surgery, minimally invasive TEES allows for better visualization, more effective cholesteatoma removal and the preservation of the hearing bones while reducing the length of hospital stay, overall procedure cost and scarring [1] [3] [2]. Despite these benefits, the adoption rate of TEES is low and one possible explanation is that existing instruments are developed for two-handed microscope-guided surgery and are not optimized for one-handed TEES, making the surgery challenging [4]. The objective of this project is to evaluate and develop innovative surgical instruments for TEES. This project proposes the design of **novel instruments** to facilitate TEES and allow more surgeries to be completed minimally invasively which **benefits the patient and hospital.**

**Project Objective:** This project aims to understand the limitations of current TEES tools to develop design criteria to fabricate new, better surgical instruments to facilitate the use of TEES.

**Methodology:** The PI of the project is an experienced TEES surgeon at the Hospital for Sick Children in Toronto (SickKids) and is collaborating with an engineering Master’s student at SickKids’ CIGITI lab. This collaboration will provide the resources and expertise required for the successful completion of the project outlined below.

***Aim 1 (months 1-9):*** A needs assessment survey, sent to 100 otologists internationally, will follow a two-round Delphi method to identify trends and limitations for surgeon adoption of TEES. The questionnaire has been developed based on local otologists’ feedback on TEES and the results will be analyzed using non-parametric tests and ANOVA to develop a second survey to identify distinct criteria defining surgeons’ needs.

***Aim 2 (months 1-9):*** A time-flow study will record the duration of surgical steps for common TEES procedures. It will be conducted by observing a total of 50 surgeries performed by five surgeons at SickKids.

The results of these two studies aim to determine the desired functions of new tools and current inefficiencies of TEES. This will be used to develop design criteria for new tools. A Research Ethics Board (REB) application has been submitted to SickKids to conduct these studies.

***Aim 3 (months 3-5):*** CIGITI has developed successful surgical simulation models, both virtual and physical under close collaboration with surgeons; thus a virtual model of TEES. The model will integrate middle ear anatomy, an endoscope and an instrument. 3D middle ear models are rendered from CT scans of patients who are candidates for TEES surgery. This will develop a platform to design tool prototypes that can fit inside specific patient anatomy and perform the intended function efficiently. Tool prototypes will be tested in cadaver and 3D printed anatomical models by surgeons to obtain feedback to optimize the prototype so it can be further developed to be used by surgeons in patients during TEES. SickKids, CIGITI and Mount Sinai’s surgical skills centre will provide the otologists, 3D printing facilities and cadavers, respectively. Thus this project will present the unique method of developing patient-specific tools, advancing the capabilities of minimally invasive tools.

**Feasibility and Impact:** SickKids remains one of the very few centres in North America where a surgeon completes the majority of middle ear procedures using TEES. As well, the CIGITI lab at SickKids has successfully manufactured medical-grade tools for endoscopic neurosurgery and has developed brain surgery virtual models. Thus, SickKids and the University of Toronto provide the resources and skills to advance the technology available to facilitate TEES and **inspire future innovation of minimally invasive tools**, aiming to increase the use of minimally invasive surgery and **send patients home sooner and safer.**

CIGITI has done surveys and has close collaboration with surgeons. Projects that have made surgical simulation models and surgical tools have undergone testing and surveys to evaluate their efficacy and so the lab will provide the appropriate resources to make the model and conduct/analyze the survey results as per scientific protocol.

Detailed Budget