**Developing a Platform to Improve Adoption of Endoscopic Ear Surgery**

**Background:** The Hospital for Sick Children (SickKids) in Toronto operates on 1 450 surgical ear, nose, throat (ENT) cases annually [1]. Transcanal endoscopic ear surgery (TEES) is a new and growing field that allows surgeons to perform common ear surgery procedures such as ear drum reconstruction, skin growth removal and hearing bone repair through a natural body opening, the ear canal [2]. Alternatively, traditional microscope-guided surgery is very invasive and requires a large skin incision behind the ear. By comparison, the endoscopic approach allows for better visualization, more effective growth removal and the preservation of the hearing bones. As well, TEES has significantly improved cosmesis which is very important to patients and has reduced length of hospital stay, reducing cost to the hospital [2]. However, with all of these benefits, a survey of 80 Canadian otologists (ear surgeons) reported the adoption rate of TEES as less than 10% [3]. To date, the literature has not yet reported specific reasons for this low adoption and there is little knowledge regarding how to improve its use.

**Objectives and Hypothesis:** To increase the use of TEES, the reasons why otologists have not adopted TEES and the limitations of existing tools will be investigated. This data will be used to develop criteria against which new instrumentation can be designed and tested. Since TEES has a low adoption rate by otologists, I **hypothesize** that a needs analysis survey, and a surgical time-flow analysis of expert otologists, will identify the one-handed surgical technique, that is required while using the endoscope, as a current limitation of TEES. To elaborate, existing otologic instruments are developed for two-handed microscope-guided surgery and are not optimized for TEES, making one-handed operation challenging. I aim to identify existing instrument limitations to motivate the endoscopic ear surgery community to fabricate and test new instruments to improve the adoption of TEES worldwide. This project aligns with CIHR’s mandate as TEES is a surgical technique being used internationally and the objective of the project is to encourage greater use of the technique, to facilitate safer and more effective middle ear surgery in Canada [2].

**Experimental Aims:** The following aims integrate both the Biomedical Engineering and Clinical Research pillars of CIHR. *Aim 1 (September – May):*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, using the SickKids RedCap research platform. A separate time-flow analysis study, recording the duration of surgical steps for TEES procedures conducted by surgeons at SickKids, will quantify the efficiency of current TEES tools. The results will be analyzed using descriptive statistics and disseminated through peer-reviewed otolaryngology journals to provide criteria for the development of novel, safe and efficient TEES instruments. An application has been submitted to the SickKids Research Ethics Board for approval of these studies. *Aim 2 (November – January):*A modular computer model, integrating ear anatomy, an endoscope and an instrument, will create a platform by which new tools’ shape, size and geometry can be designed to perform the desired functions. I have generated a 3D computer ear model using a head CT scan and will integrate the endoscope inside the ear canal. The project investigator, a TEES otologist at SickKids, will perform ear surgery maneuvers inside a physical 3D printed model of the ear canal, using an instrument with electromagnetic sensors. This will develop a workspace map of the tip of the tool, to be integrated into the platform. The desired functions will be those specified in the needs assessment and the inefficient steps identified by the time flow analysis.

**Significance:** Endoscopic ear surgeons continually design instruments to better facilitate TEES, and yet it still has a low adoption rate among otologists. This platform will be used as a base to develop tool designs in response to the needs assessment. This will be a modular platform, where more CT scans can be used to test the broad range of patient anatomy and different types of endoscopes. An initial, functional prototype instrument platform, based on new experimental instruments currently being designed for endoscopic neurosurgery, was designed and tested by the supervisor and student to facilitate ear drum reconstruction surgery. It will be modified to cater to the needs assessment, using the computer model. Thus, this project represents a valuable collaboration that will be applicable to other minimally invasive surgeries such as neuro, sinus, nasal, spinal and arthroscopic surgery. This technology will positively impact the healthcare system because TEES has already been demonstrated to reduce patient morbidity rates and length of hospital stay [4].

**References:**

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