**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 [1] [2] [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 [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. 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 Approach and Methods/Procedures:** 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. 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 workspace analysis to facilitate instrument design will be conducted. I will use a head CT scan to construct a 3D computer model of the ear, integrating the endoscope inside the ear canal. The project investigator, a TEES otologist, 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 computer model. This computer model, integrating the essentials of TEES: ear anatomy, endoscope and instrument, will create a platform by which new tools’ shape, size and geometry can be designed to perform the desired functions. The 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 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 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. The initial instrument was developed based on new experimental instruments currently being designed for endoscopic neurosurgery. Thus, this project represents a valuable collaboration that will be applicable to other minimally invasive surgeries in bony cavities such as sinus, nasal, spinal and arthroscopic surgery [4]-[6]. 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]. Additionally, endoscopic ear surgery has been shown to reduce rates of residual skin growth after surgery as the endoscope allows greater visualization in the previously hidden recesses within the middle ear [7].

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There are TEES surgeons who develop their own tools and have sold thyem for TEES but still there is not a very big adoption of TEES theredfore, conducting the needs analysis and time flow will help set the criteraia/requiremetnts against which surgoens could target more of an audience

Significance section: future work of the project is to develop the tools

There is a team of surgeons who believe in TEES and this is part of the team effort of IWGEES to increase adopition of TEES worldwide

We ;have created this modular platform that cvan be sused to cater the current prototype to satisfy the needs assessment and workspace criteria