Restracomp – Research Proposal

Please complete these sections using language that would be understandable to a reader with doctoral-level scientific training but no specialist expertise in your field. References may be included on a second page.

Subject of proposed research – provide a brief overview of your proposed research project

Mminimally invasive surgery is beneficial to the patient and the hospital as it reduces trauma to the body, scarring, recovery time and length of hospital stay [1]. By employing an endoscope during middle ear surgery, the middle ear can be accessed through the ear canal without an external incision [2, 3]. As with open microscope-guided surgery, this transcanal endoscopic ear surgery (TEES) technique, allows the surgeon to perform procedures such as ear drum reconstruction, skin growth removal and hearing bone repair [2]. The principle challenge with TEES is that a one-handed surgical technique is required while the endoscope is held in the other hand. Otologic instruments were developed for two-handed microscope-guided surgery so they are not all well suited to TEES conditions [3]. These shortcomings have hindered the use of TEES and will be addressed by this project which will utilize mechanical engineering principles to develop specialized instruments for TEES [4, 3]. While previous instruments were developed by surgeons over decades through trial and error, modern engineering techniques provide the opportunity to rapidly design and produce ergonomic functional instruments optimised to facilitate this new branch of surgery.

Lab choice – explain why your (proposed) lab is the best place to pursue this research

The following labs will provide equipment and expertise to successfully complete the proposed project: Centre for Image Guided Innovation and Therapeutic Intervention (CIGITI) at SickKids, the Surgical Skills Centre (SCC) at Mount Sinai Hospital and the Institute of Biomaterial and Biomedical Engineering (IBBME). The labs are 3 minutes walking distance of each other and have been successfully used by the investigators to develop a functional initial prototype.
CIGITI is an open source medical device development facility. It will provide bench space, technical support and machines for 3D printing, metal milling and laser etching to manufacture prototypes. The IBBME will provide office desk space and computer software necessary for designing the instruments. The SSC will provide an instrument prototype testing environment using cadaveric temporal bone models, under the supervision of trained personnel.
The primary investigator will provide guidance on surgical ergonomics, functional requirements of instruments and feasibility of design proposals. He has previously developed instrumenation for minimally invasive cochlear implant surgery. Co-supervisor Dr. Andrysek has supervised multiple graduate students through MASc programs at IBBME and his experience with medical device design will provide technical engineering support for the project.

Outcomes and impacts – describe the expected outcomes and goals of your research, and what impacts might it have on your field/clinical practice/patients or other populations

The objective of the project is to develop and evaluate surgical instruments that facilitate one-handed surgery for TEES. First, a survey will be conducted to compile the needs of endoscopic ear surgery of various ENT surgeons. Tools will be designed to improve grip and manoeuvrability of synthetic grafts and enable accessibility in hard to reach places within the middle ear. Increasing functionality of surgical instruments using mechanical engineering design principles and input from endoscopic ear surgeons will increase control during TEES, replicating manoeuvres for which two hands are traditionally required. This project will demonstrate the feasibility of using CAD, modelling and printing technologies to expedite design of novel surgical instruments for new procedures. It is anticipated that new TEES instruments will increase the range of ear procedures that can be completed minimally invasively and increase the speed and effectiveness of surgery. This will be validated by having various ENT surgeons test the tool in cadaveric ear canal models. The design techniques and instruments created will also be applicable to other minimally invasive surgery in bony cavities such as sinus, nasal, spinal and arthroscopic surgery [5, 6, 7]. It could be envisaged that ultimately, virtual patient models could be used with rapid prototyping and fabrication to create patient specific specialist instruments.

Career aspirations – describe how Restracomp funding will help you achieve your research/career goals

As a biomedical engineer, I am very interested in developing surgical tools that are targeted to benefit the patient and satisfy the needs of the surgeons and nurses who handle the tools. Through this project, my goal is to refine my engineering design skills and follow through on the product life cycle, of the surgical tool by taking a prototype and developing it into a fully functional, sterilizable and manufacturable product. Upon completing this Master's Degree, I aspire to work at a start-up company that develops medical and surgical devices by collaborating with the end-users. Taking the lead on this project will have enabled me to enhance my leadership, communication and technical skills to enable me to take on the many different roles required at a start-up to successfully deliver functional products and exceed the expectations of the stakeholders.

Restracomp – Supervisor's Evaluation of Applicant

Use this space to speak to the applicant's potential for research performance under your supervision and the applicant's academic performance, publication activity, research/academic leadership, and personal characteristics/abilities.

Signature	Date

Supplementary Statement

Please use this space to complete the Letter of Intent and Statement of Hours (Category D), Statement of Research Goals (Category G), or description of special circumstances that qualify you for an extension to the eligibility timeline. Please see the Restracomp application instructions for descriptions of each document.