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Abstract

Transcanal (or totally) endoscopic ear surgery (TEES) is a minimally invasive ear surgery technique that employs an endoscope through the ear canal, avoiding an external skin incision. This new and growing technique reduces patient morbidity and length of hospital stay and resources, compared to traditional, invasive microscopic ear surgery. Despite its benefits, the principal challenge is the one-handed surgical technique required as the non-dominant hand holds the endoscope for visualization. Due to this challenge, the learning curve is steep and thus TEES has a low adoption rate among surgeons. The objectives of this project are to: identify the main challenges experienced by surgeons during TEES, design and prototype a surgical instrument to address these challenges and test the instrument to validate that it can facilitate TEES. A survey of experienced TEES surgeons revealed that the main challenge is reaching structures visualized by the endoscope and many surgeons favoured an instrument that performed suction along with another function. An instrument with a suction-enabled steerable tip was designed and prototyped to address these challenges. The steerable tip allows the initially straight instrument to be fed through the narrow ear canal and bend into a range of angles to reach structures visualized by the endoscope. The tool was tested inside 3D printed ear models to validate that the tip could reach hard to reach areas and was also tested by surgeons inside cadaver ears during an endoscopic ear surgery course in Toronto.