ABSTRACT 6

A NOVEL CONCENTRIC TUBE ROBOTIC PLATFORM FOR TRANSURETHAL PROSTATE SURGERY

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Introduction: While many consider transurethral resection of the prostate (TURP) the gold standard treatment for benign prostate hyperplasia (BPH), recent evidence has shown that holmium laser enucleation of the prostate (HoLEP) is at least as effective as TURP, with less perioperative morbidity including shorter length of catheter use, lower transfusion rates, and shorter hospital stay. Despite the advantages of HoLEP, there has been reluctance of the urologic community to adopt the procedure, primarily as a result of a perceived steep learning curve. Thus, we sought to design and develop a novel transurethral endoscopic robotic platform for HoLEP.

Methods: An intensive clinical collaboration between Vanderbilt engineers and urologists was undertaken to develop a handheld robot that passes through a standard endoscope with the specific goal of improving the ease with which HoLEP is able to be performed.

Results: The robotic system design consists of 3 main modules: the user interface, the transmission, and the endoscope (Figure 1). The user interface consists of 2 handles, each with an embedded joystick and trigger which are linked to motors responsible for driving the concentric tube manipulators. The transmission section converts the motion of the motors into translation and rotation of the tubes. The endoscope contains optics, inflow/outflow channels, and a 5mm working channel through which 2 concentric tube robots are passed. Each concentric tube consists of a straight outer tube and superelastic nitinol inner tube that is pre-shaped into a curved configuration. When these tubes are translated and rotated, their elastic interaction creates a "tentacle-like" motion. The entire hand-held robot is mounted on a counterbalanced arm to allow for manual manipulation and positioning of the entire robot by the surgeon.

Conclusions: We have developed a concentric tube robotic platform passed through a standard endoscope capable of producing complex movements of the end effectors. Through these motions, it possible to retract tissue with one arm and aim a laser with the other, thus alleviating one of the major challenges encountered during HoLEP.