Uterine Manipulator Incorporating Non-Local Controls & Lateral Motion

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Abstract

This device provides a convenient means for a gynecologist to remotely position a patient's uterus, without the need for an assistant to hold a manipulator throughout the procedure. The end effector is cable-driven with a non-local control handle that may be positioned wherever convenient for the clinician. Uterine orientation is permitted about two degrees of freedom, vertical and lateral, the latter which is not available in any other device.

Background

- 600,000 hysterectomies per year – second most common procedure undergone by US women[1]
- Many more exploratory procedures also require use of manipulator

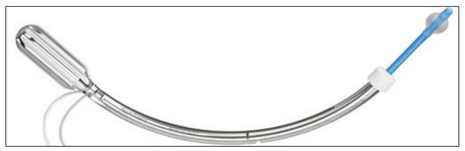
Problem

- No commercially available devices provide lateral motion – they must be manually forced sideways to achieve limited lateral displacement
- Manipulators usually require an assistant to hold the device throughout the procedure

Prior Art

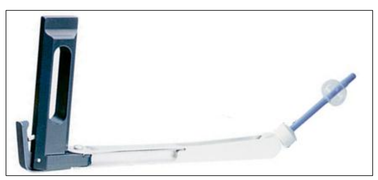
V-Care[2] - ConMed Endosurgery

- Allocable for hysterectomies only
- Semi-rigid structure with anteversion & retroversion achieved through flexing
- No mechanical actuation



RUMI[3] - Cooper Surgical

- Multifunctional manipulator
- Actuated via linkages
- 90° anteversion & 50° retroversion



Acknowledgements

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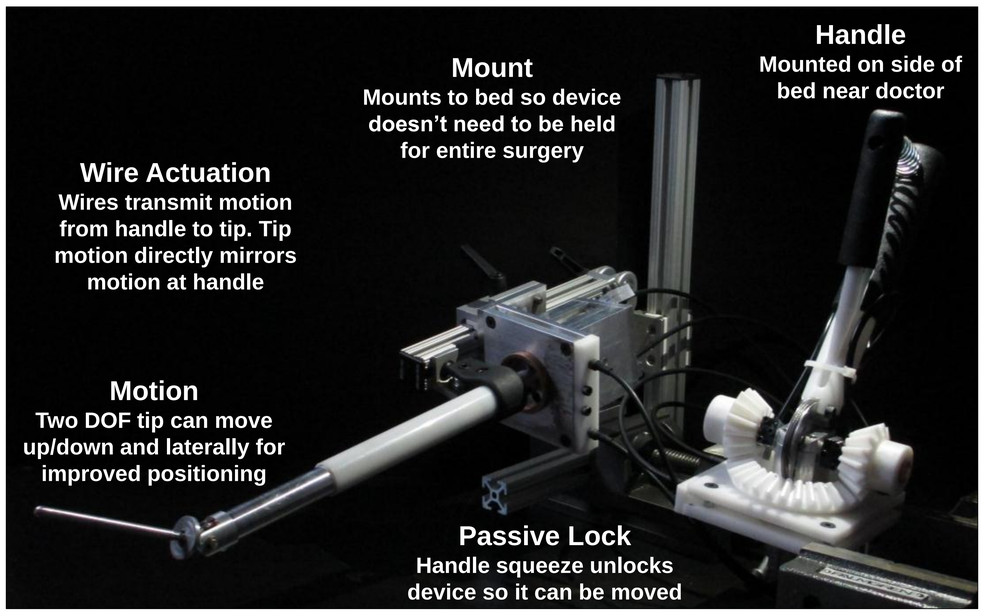
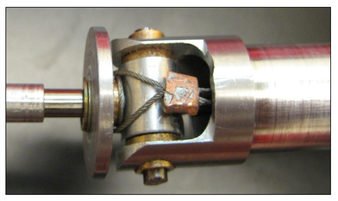
Functional Requirements

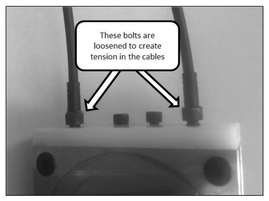
- Vertical *and* lateral motion
- Controlled by doctor at bedside
- Large enough for all patients
- Easy for doctor to use
- No assistant required
- Compatible with hysterectomy cups, dye tubes, and different size tips

Alpha Prototype

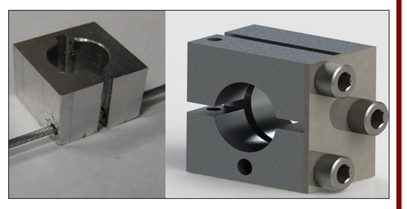




Tip Assembly

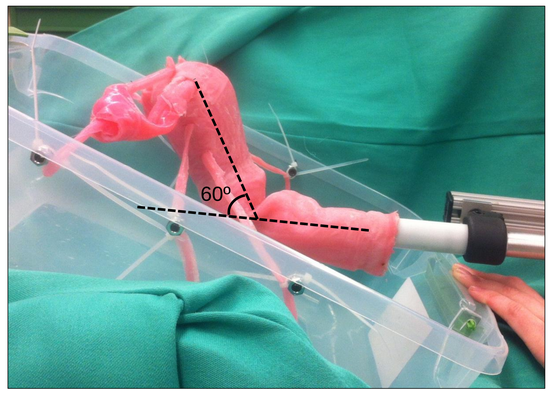


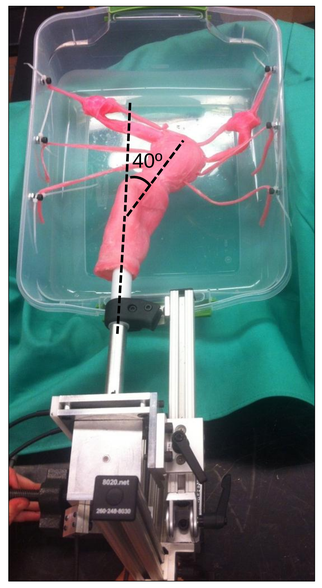
Cable Tensioning



Locking System

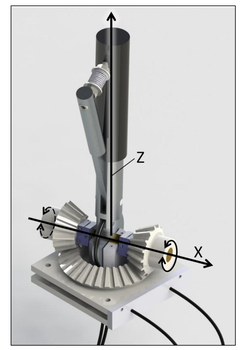
Synthetic Uterus Testing

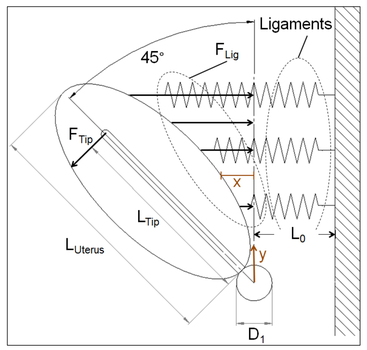




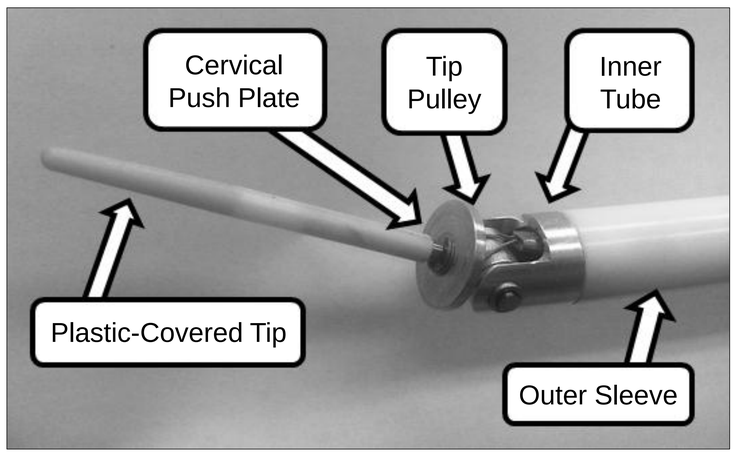
- Testing in synthetic uterus shows 120 degrees total up down motion and 80 degrees total lateral motion
- Further deflection constrained by ligament properties

Operation





- Handle motion about Z-axis rotates tip
- Handle motion about X-axis causes up / down motion of the tip
- Lateral motion achieved through rotation first, then moving the tip to the side
- Designed to resist 50N of force at tip



Future Work

- In / out sliding motion controlled with foot pedal
- Locking mechanism refinement
- Improved manipulator mount
- Device ergonomics
- Improved design for assembly

References

[1] "Women's Reproductive Health: Hysterectomy." Centers for Disease Control and Prevention, 07 2009. Web. 16 Dec 2012. http://www.cdc.gov/reproductivehealth/womensrh/Hysterectomy.htm

[2] http://www.conmed.com – V-Care

[3] http://www.coopersurgical.com – RUMI

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