Otology and Neurotology Paper

Goal: outline the design of the instrument and how design decisions were made.

Reference: “Lowering the Barrier of Surgical Endoscopy With a Novel Articulating Retractor”

**Abstract:**

*Background:*

*Clinical Motivation:*

* TEES is a minimally invasive surgical technique – list benefits
* One-handed surgery
* Tools for TEES (such as...) are being developed but according to Needs Analysis study they are still not sufficient to facilitate the technique
* Need: a tool to reach structures visualized by the endoscope and suction (as per Needs analysis paper) -> nitinol notched tube compliant joints that can accomplish this

*Design Constraints:*

* Current tools used: incorporate suction with dissector tip, round knife, but their tip geometry doesn’t enable reach in hard to reach hidden recesses within the middle ear where cholesteatoma is usually found (sinus tympani and attic) – need to reach areas visualized by the endoscope (as per needs paper)
* Size constraints:
  + Size required: 2.7 mm endoscope + tool inside of 5mm average diameter ear canal
  + Average ear canal diameter
  + Size of current instruments that have suction
  + These yielded the current tube diameter (OD, ID)
* reach required (as per needs analysis)
  + include picture of 3D model with endoscope and current tools (double bend Thomassin and show that it is unable to reach and barely fits within the ear canal with its double bend)
  + needs to reach hard to reach areas that are visualized by the endoscope (using patient CT scans as a guide to design the curvature of the tip in order to reach
* Suction and Dissection (as per needs analysis)
* Tip forces required (middle ear surgery forces paper)

**Overview of Instrument Design:**

<Figure (picture and CAD?) of instrument with tip and handle labeled – see Kyle’s thesis chapter 6>

*Tool Operation:*

* Use figures to describe how the thumb wheel maps to bending the tool
* Laser and suction

*Tip Design:*

* OD/ID for suction
* size to fit alongside endoscope in ear canal
* bending angle to reach boundary of endoscopic viewing field
  + patient CT scans generated the surgical workspace (Bennett paper as a reference of what is visible by the endoscope 1)
  + experienced otologists identified hard to reach regions (sinus tympani, boundaries of the antrum)
  + Matlab used to generate the curvature of the tip to reach – read: 2 and 3
* material NiTi for superelastic property and biocompatibility
* length is same as current instrument – Rosen Needle
* can withstand tissue forces during dissection or (suction or laser)
* laser cut – reference ASME contact aided compliant joint paper that describes this joint design

*Handle Design:*

* single-handed operation
* ergonomically comfortable handle held like a pen in order to perform precise microscopic movements and so it is used similar to other instruments in ear surgery

*Fabrication Methods:*

* laser cutting nitinol tube
* 3D printing parts (list them)
* milling parts (list them)

**Methods**: outline testing methods to validate the tool:

*Functional tool validation inside a 3D printed bone model*

* 3D printed bone model with highlighted regions that are hard to reach areas during TEES
* compare this tool (with different arc lengths and bending angles) with Rosen, Panetti instruments

Discussion:

* Limitations of the design, and areas of improvement
* Test results
* Innovation

Conclusion: