Design of an Electrical Biopsy Tool for White Light Colonoscopy

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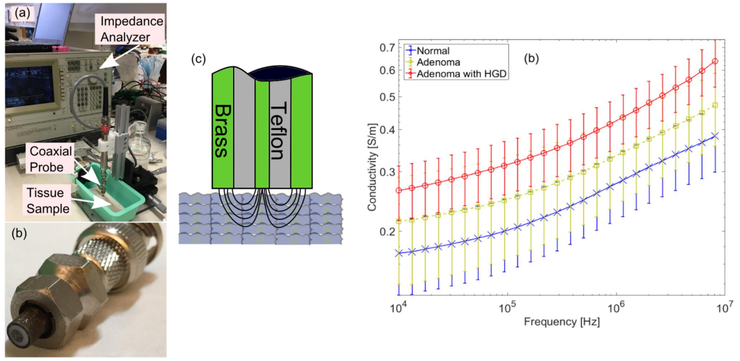
Abstract

Detection and identification of polyps during regular colonoscopy screening are crucial in the treatment and prevention of colorectal cancer. However, the current standard white light colonoscopy and biopsy have limitations in detecting and identifying polyps. It has been shown that the electrical impedance of polyps decreases as a function of neoplastic progression. The objective for this Major Qualifying Project is to develop a tool that can fit within an instrument channel of a conventional colonoscopy probe with embedded electrodes to enable electrical impedance measurements, enabling polyp identification in situ.

Colorectal Cancer (CRC) Background

1.85 million new cases annually, 8% of all cancer death

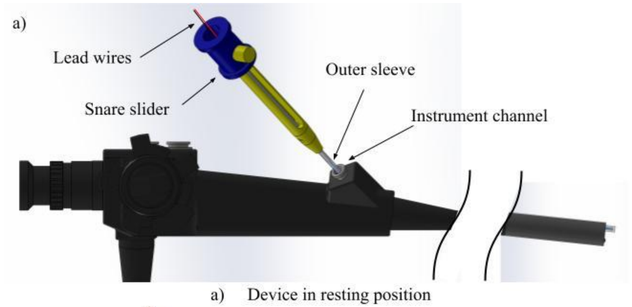


Coaxial Probe [1] Conductivity of tissue [1]

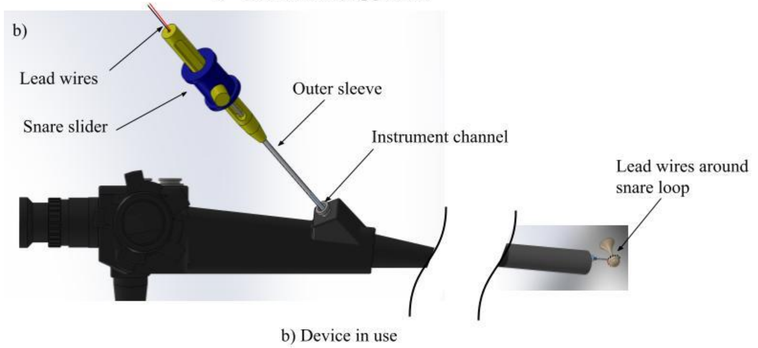
Project Goals

- Fits within instrument channel of colonoscopy probe
- Conforms to various polyp geometries
- Collects consistent electrical measurements
- Safe for patient
- Deployable with one hand
- Simple manufacturing

Design



a) Device in resting position



b) Device in use

Deployment mechanism

- Polylactic acid (PLA) body
- 2 mm hypodermic needle
- PLA Snare slider
- PLA Snare pin

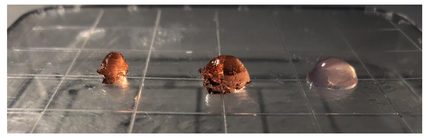
Electrical Component

- Expandable insulted wire loop
- Two 30AWG wires
- Plastic outer sleeve

Polyp Testing

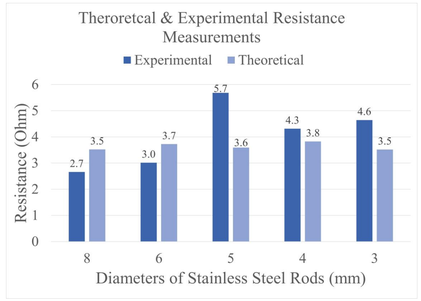
Carbon Fiber Polyps

Silver Polyps

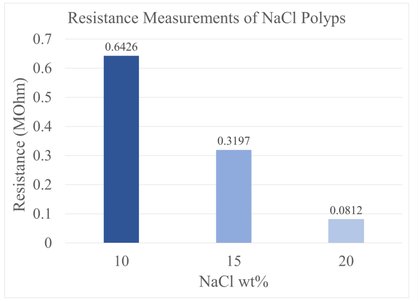


NaCl Hydrogel Polyps

Results



Measured resistance values using varying diameters of stainless-steel rods to determine validity of device



Measured resistance values from polyps varying in NaCl concentrations to assess differing conductivity levels

Conclusions

- Diameter less than 3 mm provides clearance within probe
- Snare loop encompasses diminutive polyp geometries
- Lead wires connected to bench top multimeter to collect impendence measurements
- Deployable with one hand
- Uses simple parts

Recommendations

- More permanent attachment methods
- Add suction component for stability
- Add actuating component to better maneuver to polyp geometries
- Snare loop made from shape-memory metal (ex. Nitinol)
- Sterile insulating material

References

1. Sabuncu AC, et al. Biomed Physics & Eng Express. 2018; 4(3):035003.