



INTERSTITIAL OPTICAL PROBE

MICHAEL SIMONSON, SAM LINES, MATT BOYER, TOMMY ZIPP
CLIENT: DR. MICHAEL KISSICK
ADVISOR: DR. PAUL THOMPSON



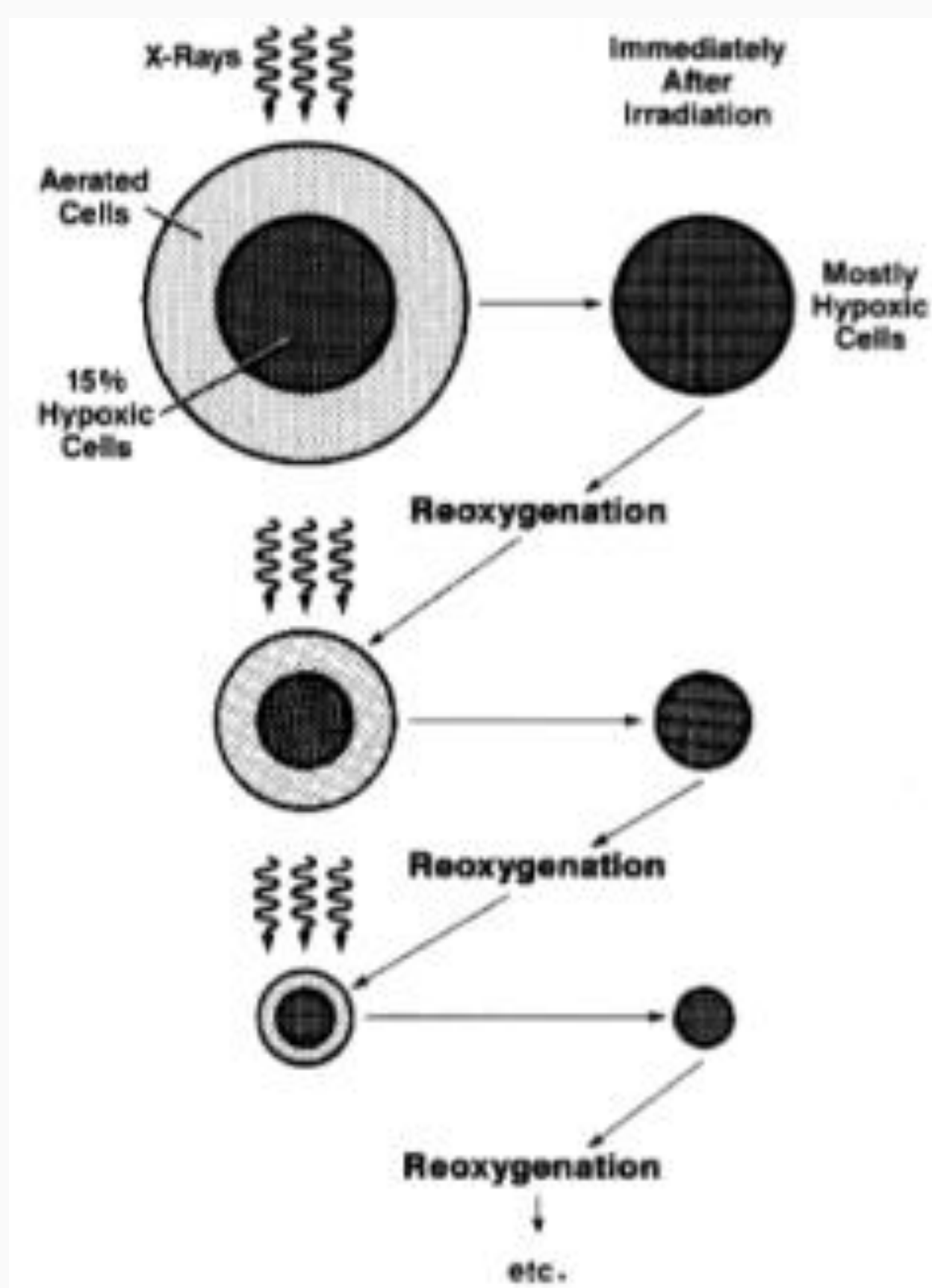
ABSTRACT

- Nearly two-thirds of all cancer patients experience radiation therapy, as it is a diverse and capable “drug” (1)
- Tracking the effectiveness of radiation therapy is critical towards applying a biologically meaningful dose
- Our probe allows our client to observe and analyze hemoglobin-oxygen saturation, a main indicator of tumor development in mouse tumors.
- By using this probe, we can track how tumors respond to treatment, and change treatment plans accordingly.

INTRODUCTION

Radiation Therapy and Cancer

- Current methods focus on controlled, uniform dose (illustrated)
- Our clients method attacks tumor as it changes throughout treatment



Hypoxia as Dominant Factor

- Tissue damage from radiation comes largely from secondary oxygen free-radicals (3)
- Tracking oxygen levels indicates where radiation will be more or less damaging.
- More oxygenated parts of the tumor will be more affected as a result of the increase in radical formation.

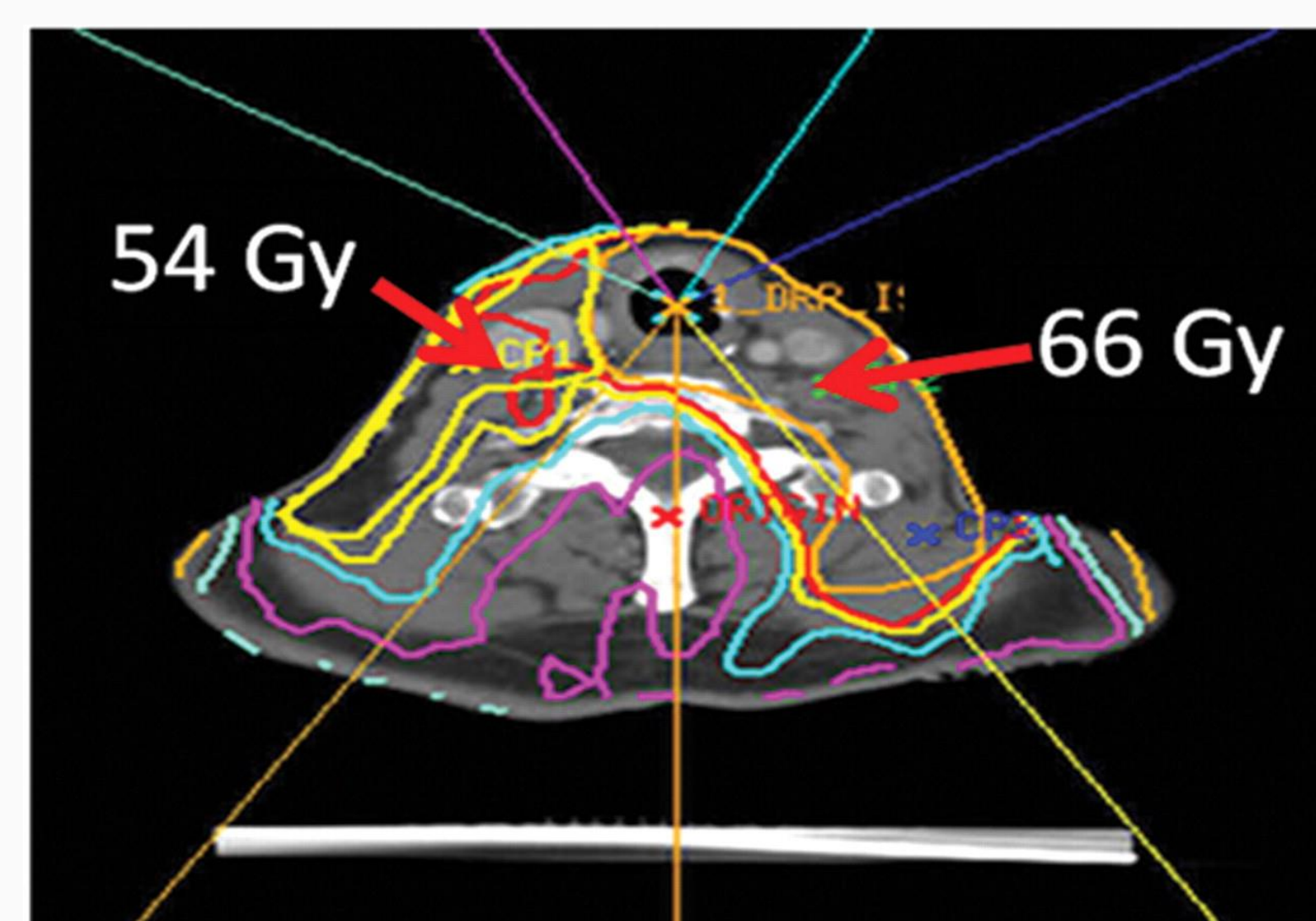


Fig. 1: Idealized Tumor Regrowth Models (2)

Future State

- The future of dose-application will be at least in part towards non-uniform dose (4)
- This demands a probe that allows for inexpensive and fast analysis of treatment progress.

DESIGN CRITERIA

A successful device will hold two optical probes so that they can be prepared and inserted in a cancerous tumor. This device should have the following characteristics:

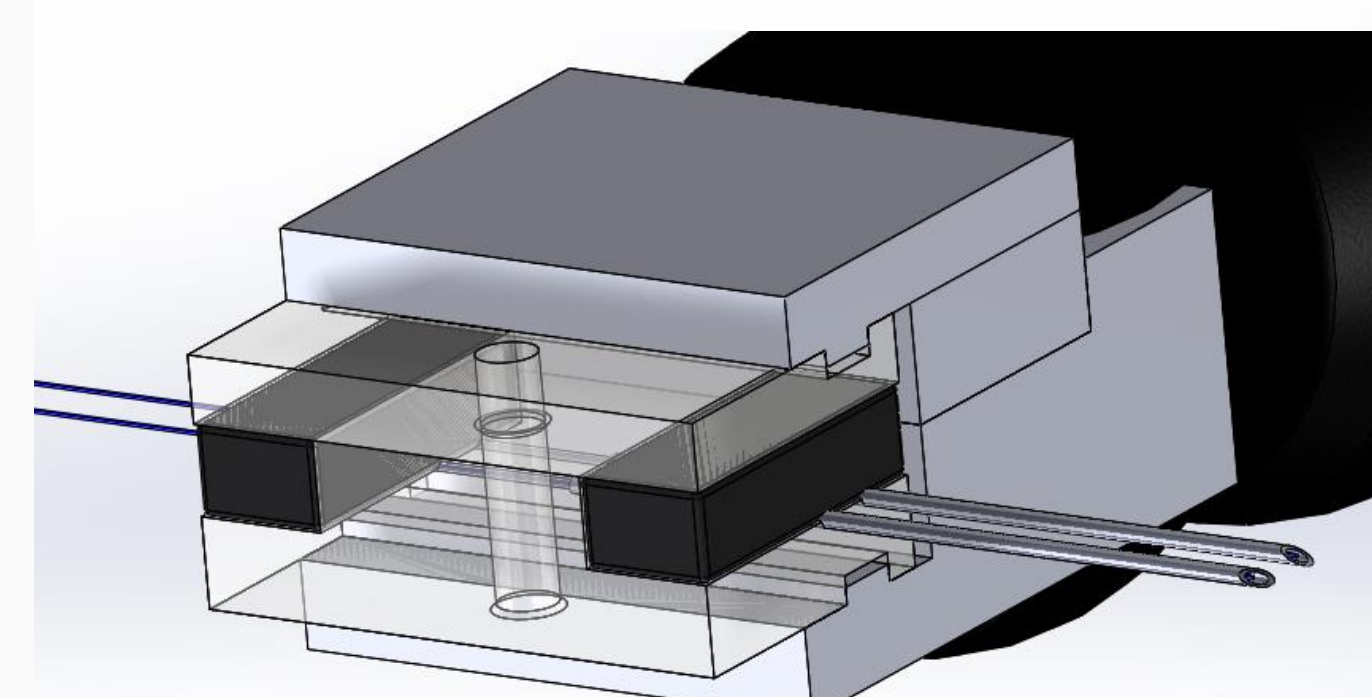
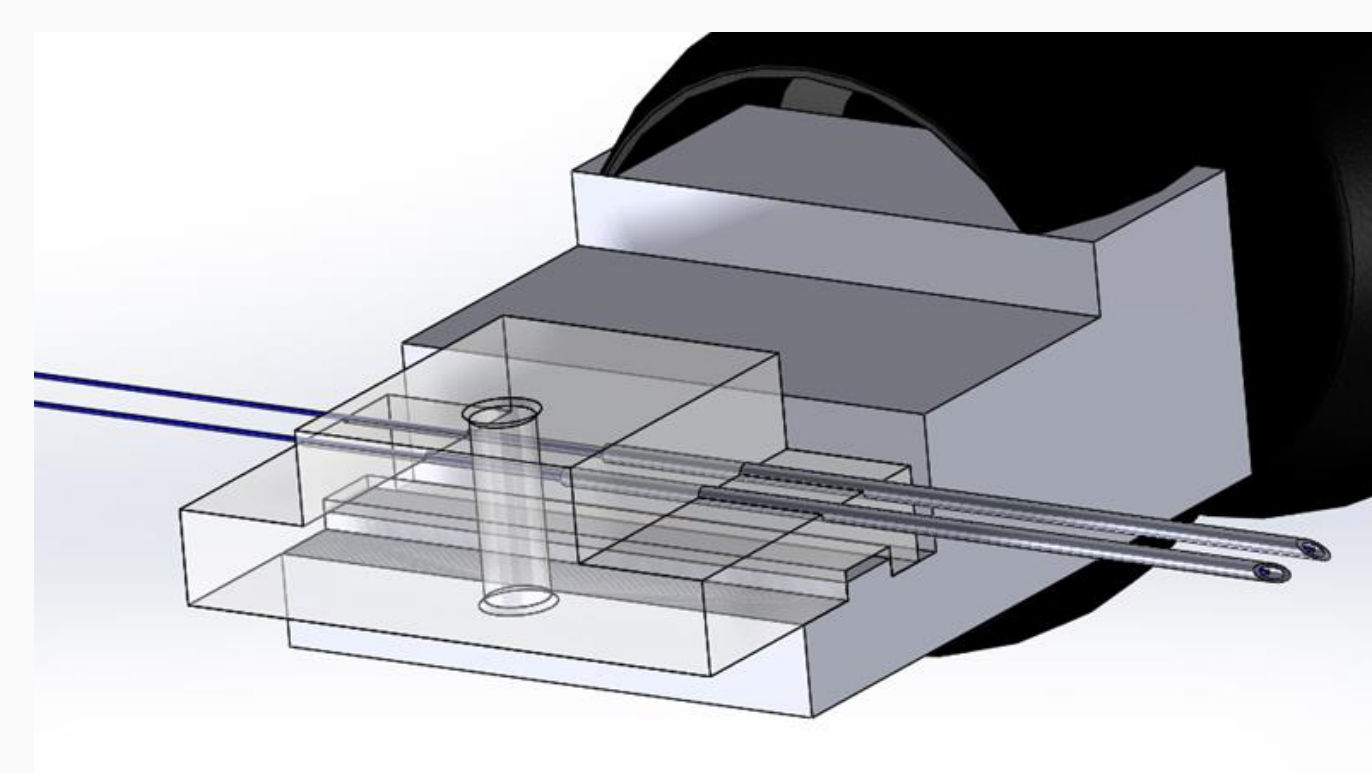
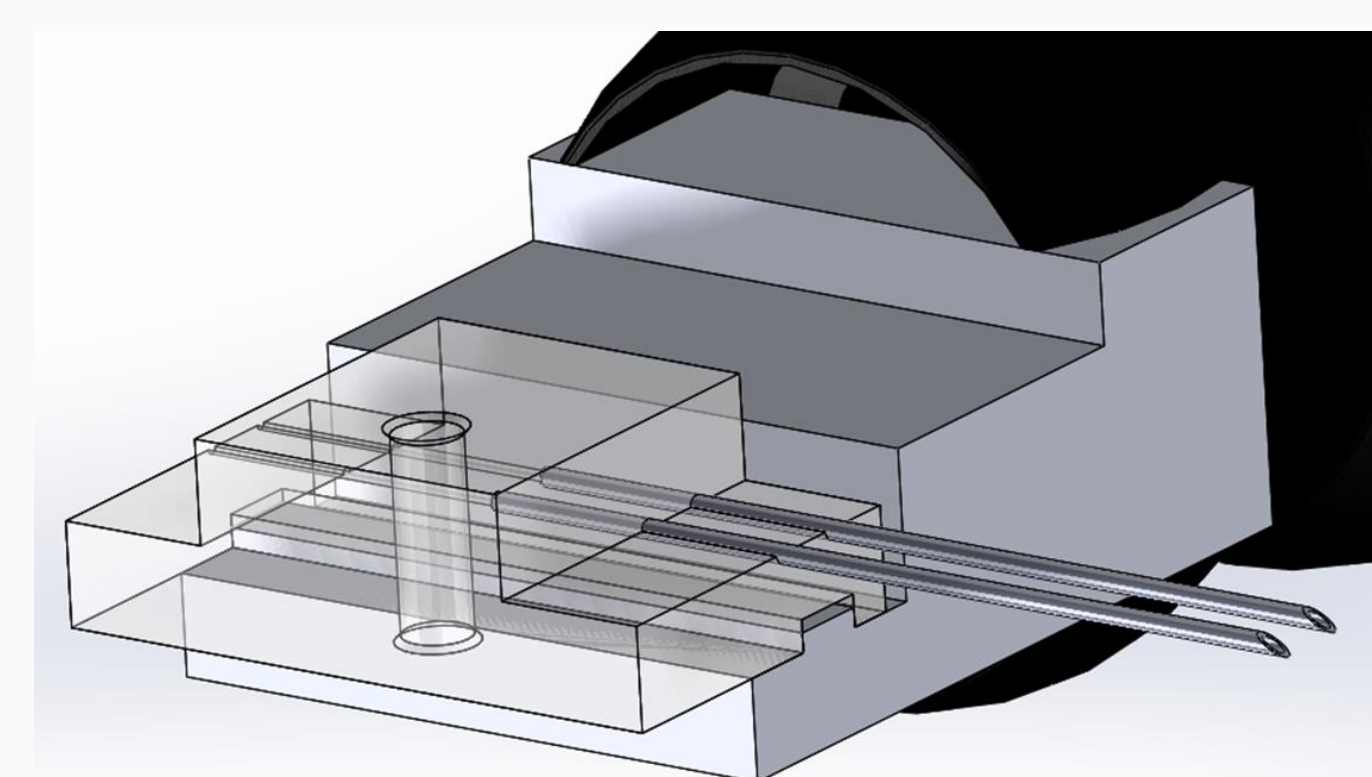
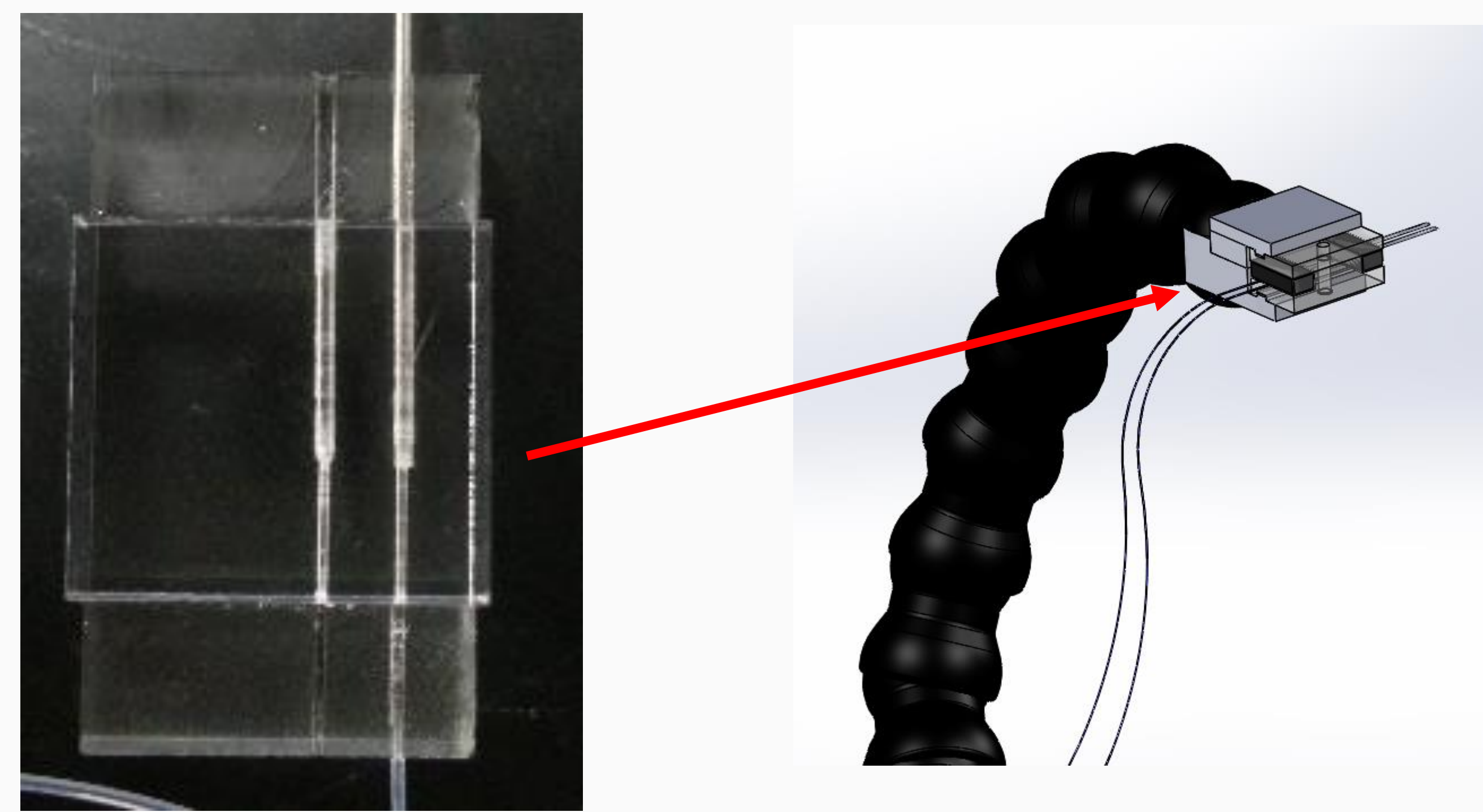
Physical/Operational Characteristics

- Fix two optical probe needles 3mm apart, tip-to-tip
- Allow for >2mm penetration of epidermis
- Maintain rotational/translational rigidity
- Minimize invasiveness
- Be reusable

Production Characteristics

- Allow for simple manufacturing
- Be manufactured within a budget of ~\$100

FINAL DESIGN



Clip Loading

- Clip design allows for the safe threading of optical fibers down the shaft of the needles

Three step process:

1. Manually load the gage 7 needles in the larger diameter channel
2. Using the smaller channel as guidance, insert optical fibers to the desired depth into the needles
3. Secure both the needles and optical fibers using the top plate with attached polymer padding

Fig. 3: Loading process of fibers and needles in the final prototype

TESTING

- Our design was tested to determine the force with which it could hold the needles both individually and with both needle in the device.
- These results were then compared to simulations of removal from real tissue



Trial	Single Needle Removal Force From Clip (N)	Double Needle Removal Force From Clip (N)	Chicken Breast Insertion Force (N)
1	2.09	3.17	0.19
2	2.01	3.56	0.20
3	2.05	3.09	0.18
4	2.02	3.91	0.20
5	2.06	2.98	0.22
Average and Standard Deviation	2.046 0.032	3.34 0.385	0.198 0.015

- Low clamping force is still much larger than the force needed to remove from flesh

FUTURE WORK

- In-mouse testing with Dr. Kissick and make any updates that are needed.
- Possible work on a device more suited for human testing.
- Human device would likely be smaller, more ergonomic, and biocompatible.
- Possible work on an updated device that is capable of having the needles removed for prolonged testing with the fibers.

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