

# Intraoperative Use of The Optical Tissue Imaging System (OTIS) for Oral Cavity and Oropharyngeal Tissue: Evaluation of Microstructure Using Wide-Field Optical Coherence Tomography (WF-OCT)



Arvind Badhey, MD<sup>1</sup>; Julia Schwarz BS<sup>2</sup>; Benjamin Laitman, MD,PhD<sup>2</sup>; Brandon Veremis, MD<sup>2</sup>; William Westra<sup>2</sup>; Mike Yao<sup>3</sup>, Marita Teng<sup>2</sup>, Eric Genden<sup>2</sup>, Brett Miles<sup>4</sup>

<sup>1</sup>University of Cincinnati. <sup>2</sup>Icahn School of Medicine at Mount Sinai. <sup>3</sup>Westchester Medical Center. <sup>4</sup>Northwell Health.

## Background

- Wide-Field Optical Coherence Tomography (WF-OCT)
- Analogous to laser optical ultrasound
- Identifies microarchitecture



## Objective

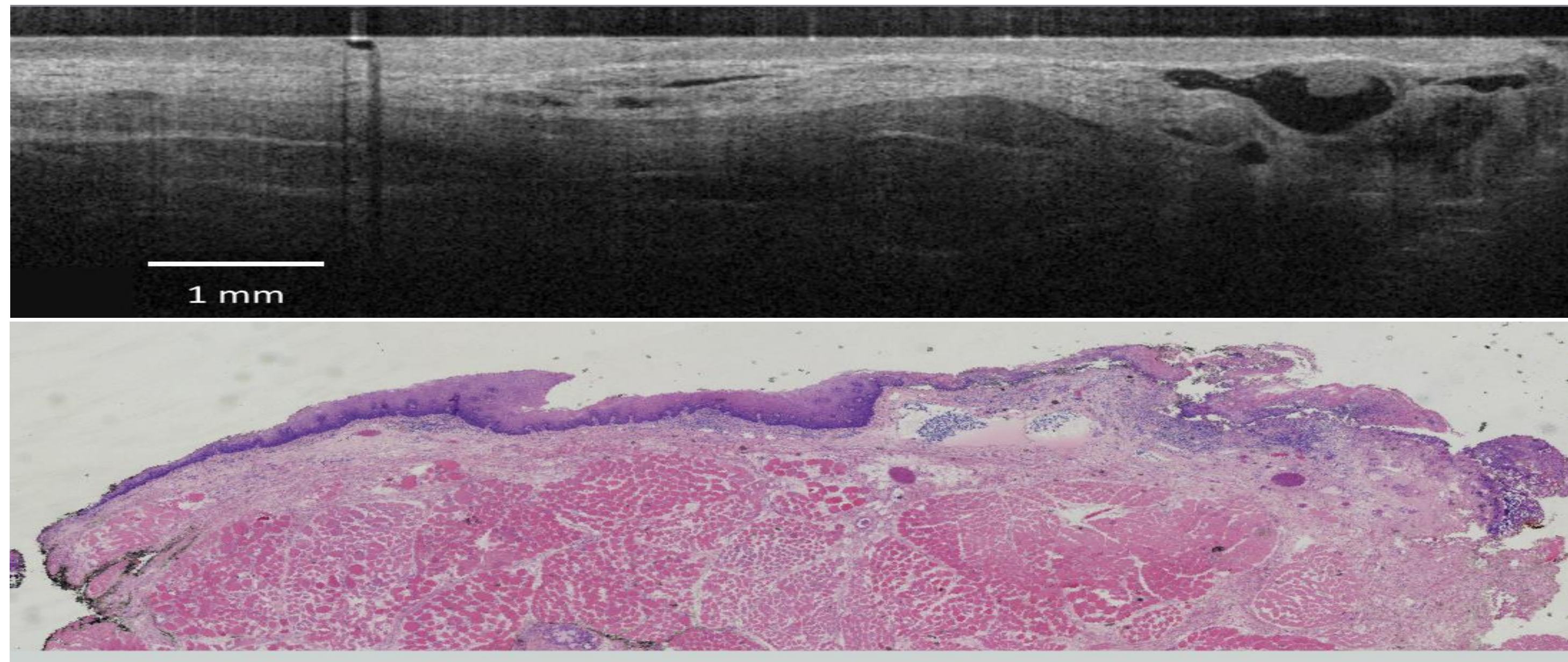
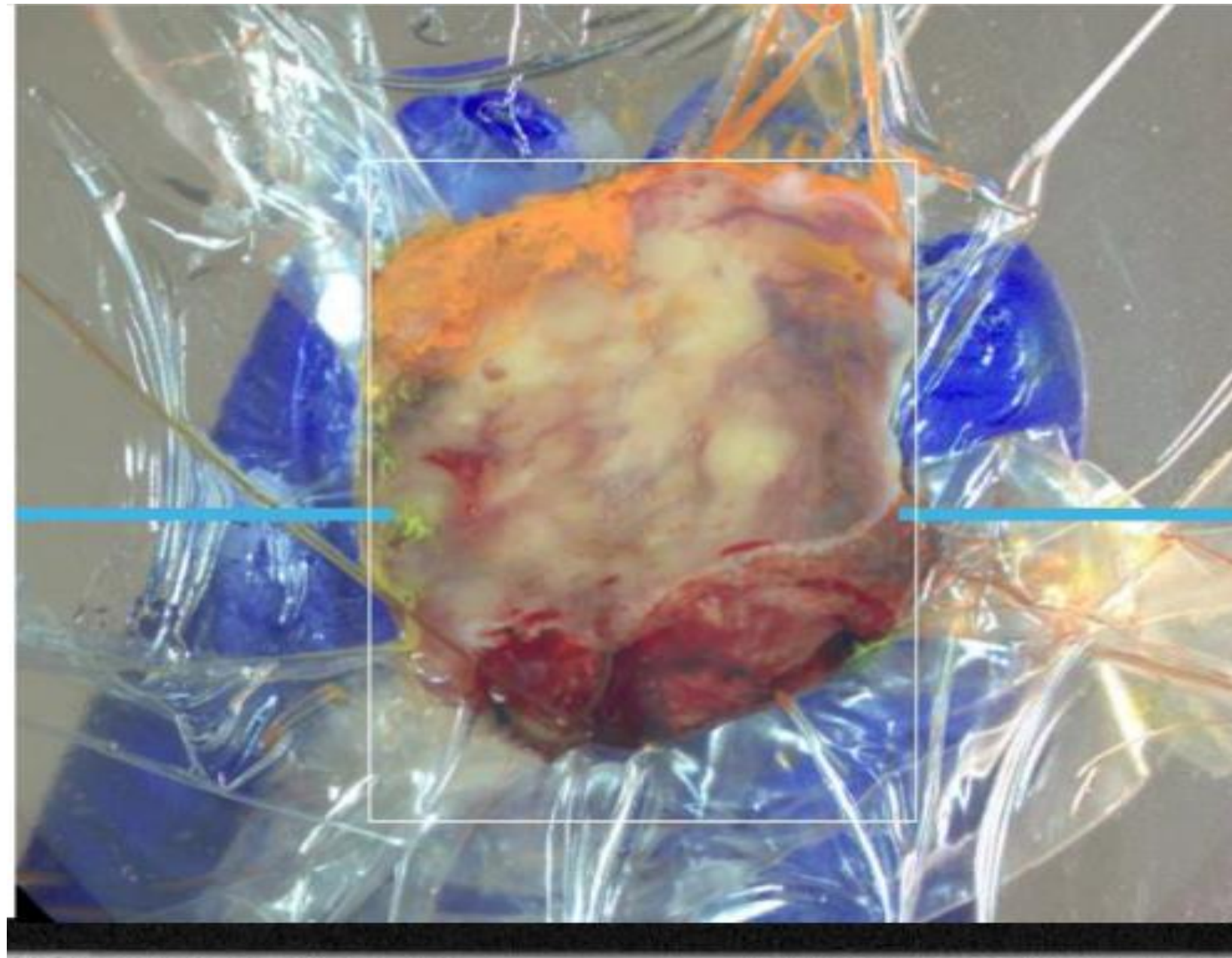
- Obtain WF-OCT Images that visualize microarchitecture within head and neck specimens
- Correlate WF-OCT image findings with gold standard of final histopathology slides

## Design

- Prospective, single-center
- Oral cavity or oropharynx specimens
- Target of 100 specimens

## Summary

- High resolution images for head and neck tissue specimens
- Able to integrate OTIS imaging within surgical workflow for surgically resected specimens
- Scans a specimen within minutes without altering or denaturing tissue
- Tissue goes through standard pathology workflow for frozen and then permanent section

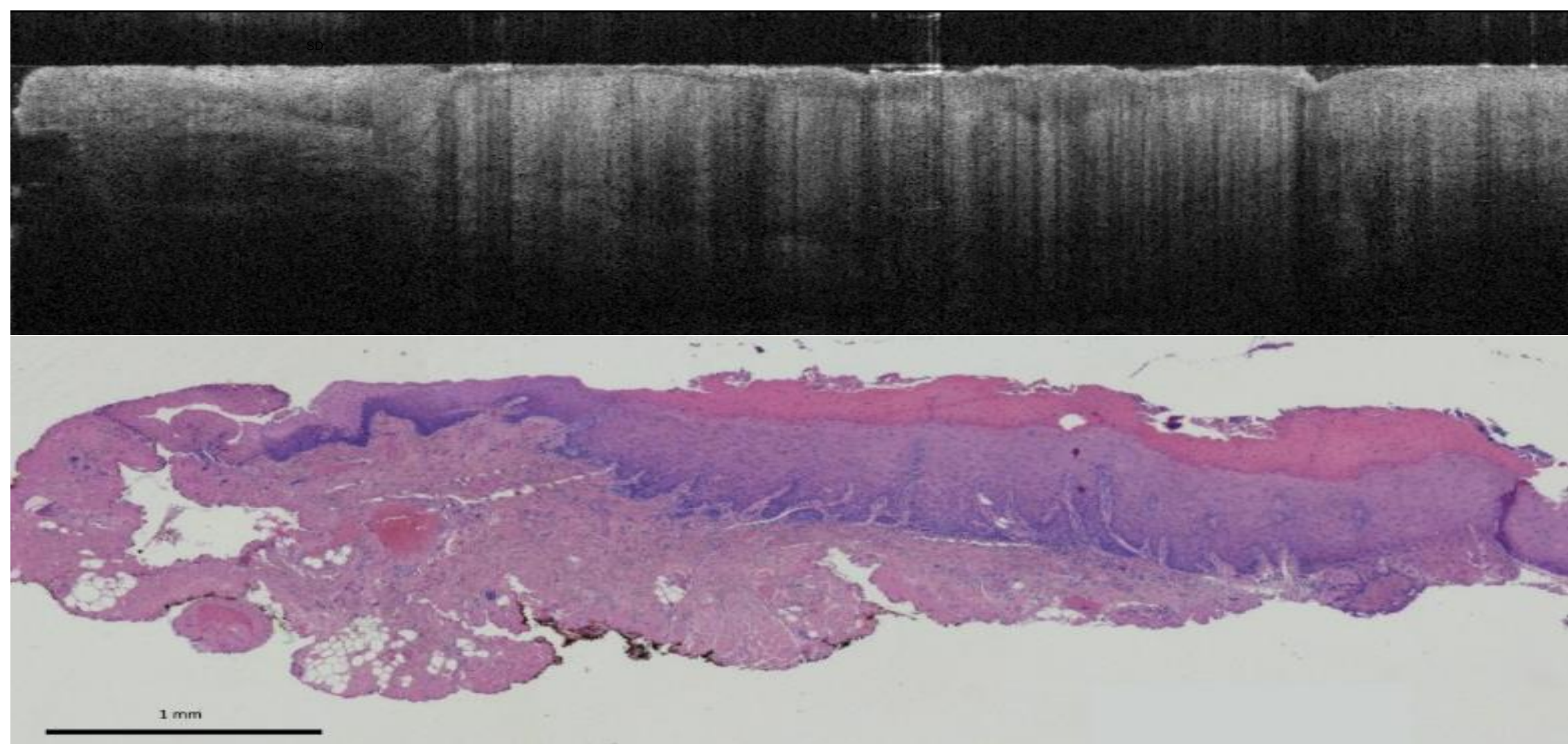
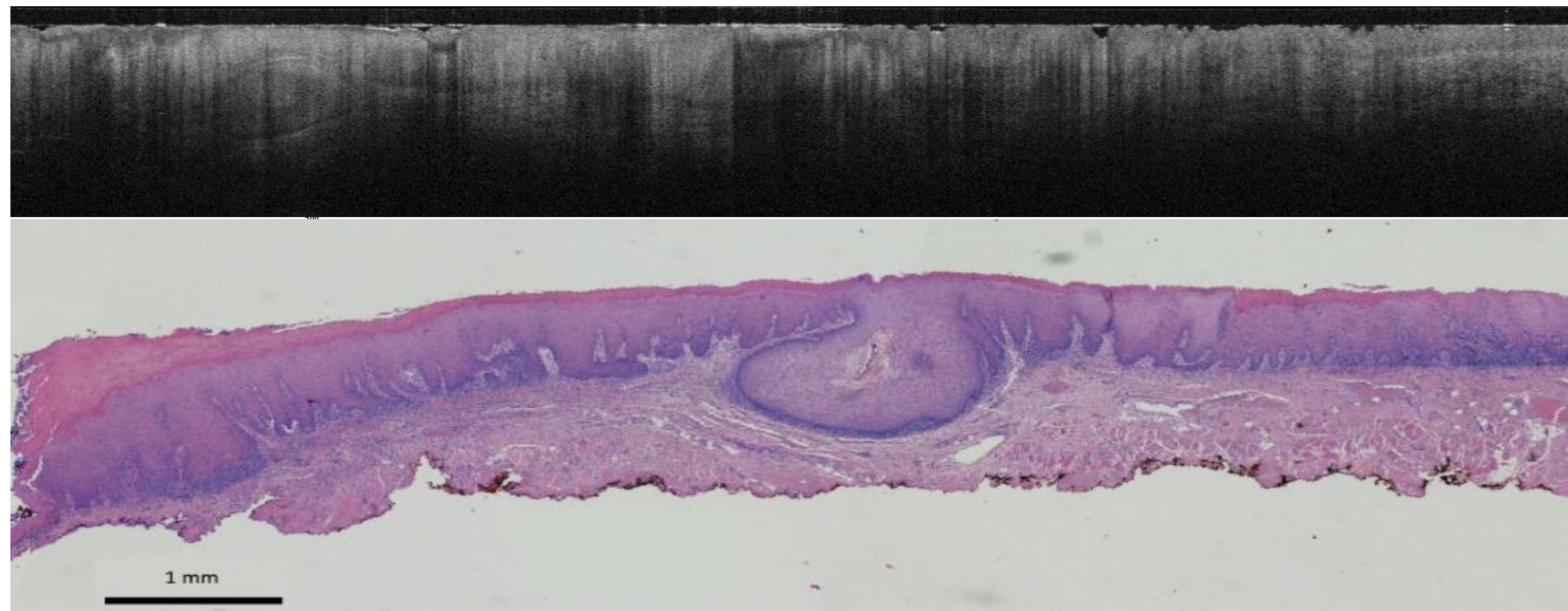


## Future Directions & Limitations

- Compare to frozen section analysis
- Long Term: Clinical trial to determine if WF-OCT can impact surgical outcomes
- The preparation of the surgical specimen and slicing of the tissue must be in the same plane as the OTIS imaging to allow for correlative histopathology slides that match OTIS images.
- Cautery artifact distorts OTIS Images

## Results

| Specimens          |     |        |        |           | Tissue Type | Microstructures                                                                                                                                                                                                                                                          |
|--------------------|-----|--------|--------|-----------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Patients Scanned   | 35  |        |        |           |             |                                                                                                                                                                                                                                                                          |
| Specimens Scanned  | 48  |        |        |           |             |                                                                                                                                                                                                                                                                          |
| Pathology Reviewed | 29  |        |        |           |             |                                                                                                                                                                                                                                                                          |
| Tonsil             | BOT | Buccal | Palate | Composite |             |                                                                                                                                                                                                                                                                          |
| 28                 | 9   | 3      | 1      | 3         | Tonsil      | <ul style="list-style-type: none"><li>• Epithelium</li><li>• Submucosa</li><li>• Blood vessels</li><li>• Adipose &amp; connective tissue</li><li>• Skeletal muscle</li><li>• Lymphoid tissue</li><li>• Crypts</li><li>• Cyst</li><li>• Squamous cell carcinoma</li></ul> |
|                    |     |        |        |           | Tongue      | <ul style="list-style-type: none"><li>• Squamous metaplasia</li><li>• Squamous dysplasia</li></ul>                                                                                                                                                                       |
|                    |     |        |        |           | Buccal      | <ul style="list-style-type: none"><li>• Minor Salivary Gland</li><li>• Salivary duct</li></ul>                                                                                                                                                                           |



## References

1. Jesse RH, Sugarbaker EV. Squamous cell carcinoma of the oropharynx: why we fail. *Am J Surg.* 1976;132(4):435-438.
2. Jackel MC, Ambrosio P, Martin A, Steiner W. Impact of re-resection for inadequate margins on the prognosis of upper aerodigestive tract cancer treated by laser microsurgery. *Laryngoscope.* 2007;117(2):350-356.
3. Kurita K, Nakashima Y, Nishizawa R, et al. Impact of different surgical margin conditions on local recurrence of oral squamous cell carcinoma. *Oral Oncol.* 2010;46(11):814-817.
4. Slootweg RJ, Hardijk GJ, Schade V, van Es RJ, Kooze H. Treatment failure and margin status in head and neck cancer: A critical view on the potential value of molecular pathology. *Oral Oncol.* 2002;38(5):500-503.
5. Nabelek M, Hassler P, Marging MB, et al. Clinical Impact of Intraoperative Optical Assessment of Bone Resection Margins in Patients with Head and Neck Carcinoma. *Annals of surgical oncology.* 2016;23(11):3579-3586.
6. Tanveeryanon T, Padhya T, McCaffrey J, et al. Postoperative concurrent chemotherapy and radiotherapy for high-risk cutaneous squamous cell carcinoma of the head and neck. *Head Neck.* 2015;37(6):840-845.
7. Hinni ML, Ferillo A, Branstetter-Gardner MS, et al. Surgical margins in head and neck cancer: a contemporary review. *Head Neck.* 2012;35(9):1262-1270.
8. Wodjat A, Triantafyllou A. A histopathological appraisal of surgical margins in oral and oropharyngeal cancer resection specimens. *Oral Oncol.* 2005;41(10):1034-1043.
9. Getzler M, Doreffler S, Turner M, et al. Transoral robotic surgery for management of cervical unknown primary squamous cell carcinoma: Updates on efficacy, surgical technique and margin status. *Oral Oncol.* 2017;66:9-13.
10. Nguyen TT, Zuck AM, Chaney EL, et al. Intraoperative evaluation of breast tumor margins with optical coherence tomography. *Cancer Res.* 2009;69(22):8790-8796.
11. Erickson-Shatt SJ, Nolan PM, Shemanski ND, et al. Real-time imaging of the Resection Bed Using a Handheld Probe to Reduce Incidence of Microscopic Positive Margins in Cancer Surgery. *Cancer Res.* 2015;75(18):3706-3712.
12. Kraft MC, Chini K, van Gersich W, Willeke H, Lubetzkowski H, Arens C. Clinical value of optical coherence tomography in laryngology. *Head Neck.* 2008;30(12):1638-1645.
13. Bus MT, Muller BG, de Bruin DM, et al. Volumetric in vivo visualization of upper urinary tract tumors using optical coherence tomography: a pilot study. *J Urol.* 2013;190(6):2236-2242.
14. Huang D, Swanson EA, Lin CP, et al. Optical coherence tomography. *Science.* 1991;254(5081):1178-1181.
15. Hinni ML, Zarka MA, Hovvorth JM. Margin mapping in transoral surgery for head and neck cancer. *Laryngoscope.* 2013;123(5):1190-1198.
16. Hamdoun Z, Jesse W, McKenzie G, Jay A, Hopper C. Optical coherence tomography in the assessment of oral squamous cell carcinoma resection margins. *Photodiagnosis Photodyn Ther.* 2016;13:211-217.
17. Wang T, Brewer AS, Zhu C. An overview of optical coherence tomography for ovarian tissue imaging and characterization. *Wiley Interdiscip Rev Nanomed Nanobiotechnol.* 2012;7(1):1-16.
18. Miles B. (2016). How Close Are We to Real Time Optical Margin Control in Head and Neck Oncologic Surgery? *Cancer Cell & Microenvironment.* 3(e1305).