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A MINIMALLY-INVASIVE APPROACH TO THE CHALLENGE OF ORAL NEOPLASIA

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Background: Despite significant advancements in the treatment of oral cancer, it still results in 10,000 U.S. deaths annually. Squamous cell carcinomas (SCC) account for 96% of oral cancers and are usually preceded by dysplasia. Current techniques require surgical biopsy of oral lesions, which are often benign and detect malignant changes too late for optimal treatment. A non-invasive capability for early detection of oral dysplasia is required for patient survival. In this study we aim to develop a fiber coupled miniature probe suitable for examination of oral cavity. The probe includes coherent Raman scattering (CRS) along with two-photon excited florescence (TPEF) imaging capabilities.
Study: The probe design includes optimized objective lens, efficient light delivery and collection through optical fiber, real time fiber scanning capabilities and home build photodetector. Each of these parts is individually optimized for improved performance. For preliminary experiments we imaged SCC excised tissue.

Results: We have designed and constructed a miniature lens assembly with achromatic performance, numerical aperture of 0.5 and lateral resolution of 1 μm. We incorporated a fiber tip scanner, including a piezo-electric actuator and fiber cantilever. The fiber tip spiral scans at the rate of 20 Hz, resulting in faster imaging of field of view of 100 100 mm2. All components are enclosed in a compact probe of 10.5 mm diameter and length of 38 mm, suitable for imaging of oral cavity. A SCC sample imaged with TPEF/CRS clearly separates the nuclei from the cytosolic cell content and shows similarities to hemotoxylin/eosin (H&E) stained images in the epidermal layers.
Conclusion: Advances made in this work enables discrimination of the cell cytoplasm and nucleus similar to conventional H&E staining contrast, using CRS imaging. The improved imaging resolution of TPEF/CRS probe makes it possible to visualize cell nuclei and cell boundaries, without the need of histopathology of biopsy, crucial for diagnostic of oral cancer.
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