

ROLLERBALL MICROENDOSCOPE FOR MOSAICKING IN HIGH-RESOLUTION ORAL IMAGING

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Only 40% of oral cancers are diagnosed at an early, localized stage, when treatment is most effective [1]. Thus, implementing diagnostic imaging tools for early detection of high-grade dysplasia and cancer may help improve the survival rate of oral cancer patients [2]. The high-resolution microendoscope (HRME) is a compact, portable, fiber-based imaging device that can image cell nuclei in tissue labeled with the fluorescent contrast agent proflavine [3]. The HRME allows clinicians to non-invasively image the size, shape and distribution of epithelial cell nuclei in vivo, enabling real-time evaluation of potentially neoplastic lesions [3]. The primary limitation of the HRME is the small field of view of its fiber probe (720 μm), which makes it time-consuming to examine large areas of tissue. Mosaicking algorithms have previously been implemented to allow real-time generation of image mosaics during HRME imaging, thus interrogating a larger field of view than the fiber probe's diameter [4]. However, this approach has had limited success in vivo due to the practical difficulty of translating the fiber probe across the tissue in a smooth, controlled manner in order for the mosaicking software to function properly. Here we report the construction and initial testing of a rollerball HRME probe that permits smooth, rolling translation across the tissue surface while maintaining image quality with subcellular resolution. The rollerball HRME consists of a standard HRME probe interfaced with a rollerball mechanism. The mechanism is composed of two 5mm sapphire ball lenses enclosed within a 3D printed pen-like casing. The ball lenses serve as an optical relay, while the distal ball lens also serves as a rolling contact point with the tissue surface. Figure 1 shows the use of the rollerball HRME to generate a real-time mosaic of a calibration target (field finder slide) as it rolls across the surface of the target. Figure 2 shows the use of the rollerball HRME to generate a real-time mosaic showing cell nuclei on the lateral tongue of a healthy volunteer as it rolls across the tissue surface. The rollerball HRME will allow clinicians to more rapidly examine large areas of tissue with subcellular resolution, potentially aiding in the early detection of high-grade oral dysplasia and cancer.

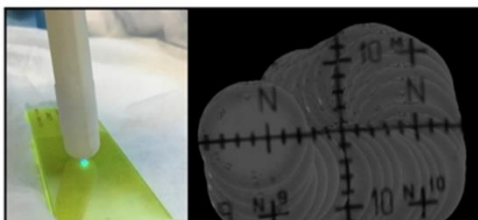


Figure 1 – Rollerball HRME mosaicking using a calibration target. Instantaneous field of view (individual circular field) is 720 μm in diameter. Mosaic shown is approximately 1.7 mm x 1.3 mm in size. Scale bar: 100 μm .

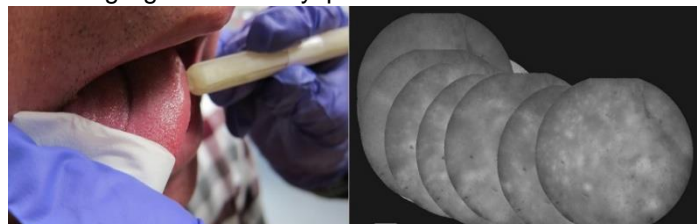


Figure 2 – Rollerball HRME mosaicking to image epithelial cell nuclei on the lateral tongue of a volunteer. Instantaneous field of view is 720 μm in diameter. Mosaic is approximately 1.8 mm x 0.72 mm. Cell nuclei appear as bright dots. Contrast & brightness adjusted +20%. Scale bar: 100 μm .

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