MULTIMODAL OPTICAL IMAGING PLATFORM FOR THE EARLY DIAGNOSIS OF ORAL NEOPLASIA

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Key Words: autofluorescence imaging, oral cancer, user interface, image registration, microendoscopy

Early diagnosis is critical to reducing the global burden of oral cancer. In the US, 65% of oral cancer patients are
diagnosed after regional metastasis; these patients have a 50% five-year mortality compared to 17% for those
with localized disease. A major reason for late diagnosis is that clinicians are unable to accurately distinguish
neoplastic lesions, which require treatment, from benign lesions. Furthermore, clinicians are unable to
accurately select to biopsy the site with the worst diagnosis within a larger lesion. Many diagnostic adjuncts
to address early detection have been explored without strong evidence for clinical benefit. Recently,
autofluorescence imaging (AFI) has gained popularity as the basis of the commercially available VELscope
device (LED Dental, Inc.). AFI has high sensitivity for neoplasia but suffers from limited specificity, likely due to
inflammatory benign lesions. Our group has developed an inexpensive, portable fluorescence microscope
coupled to a coherent optical fiber called the high-resolution microendoscope (HRME) that could boost the
specificity of AFI by directly imaging nuclei with the topical contrast agent proflavine. We have previously shown
that combining automated features calculated from AFI and HRME images improves diagnostic accuracy for
neoplasia compared to either modality alone. Here, we introduce a user interface that quickly walks the user
through a novel imaging procedure that takes advantage of the strengths of each modality to 1) identify high-risk
areas within a single lesion, then 2) predict the diagnosis at the areas and potentially recommend biopsy. First,
the user acquires an autofluorescence image of the lesion plus a corresponding reference white-light image and
identifies high-risk regions with high sensitivity based on an autofluorescence-based risk heat map overlay. The
high-risk regions are then used as a guide to select HRME imaging sites. Finally, the coordinates of the HRME
sites on the autofluorescence image are determined, and imaging features from both modalities are combined
for a diagnostic prediction. This process is known as multimodal imaging. To address the challenge of correlating
specific tissue locations in vivo to their locations on the autofluorescence image, a custom image registration
algorithm based on mutual information was developed and assessed. The algorithm registers the
autofluorescence image with the reference white-light image so that the clinician may interact with the white-light
image, which resembles the tissue’s appearance to the naked eye. We report initial in vivo results of the
multimodal imaging system on patients with oral lesions. Future work will focus on assessing the ability of
multimodal imaging to guide biopsy location and diagnose tissue sites in a larger group of patients.