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Optical technologies for detection and diagnosis of oral neoplasia

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The goal of our research is to develop an approach to early detection and diagnosis of oral neoplasia using optical-based technologies such as fluorescence spectroscopy and imaging, high-resolution microendoscopy and molecularly-targeted optical contrast agents. Although patients with early disease have better chances for cure and functional outcome, most patients present with advanced tumours when treatment is less successful and often causes severe deficits in speech, swallowing, facial appearance and quality of life. To improve outcomes we must improve detection and diagnosis of early neoplastic changes. Changes in tissue architecture, morphology, and molecular composition that occur during carcinogenesis also produce changes in the optical properties of tissue. These changes can be detected non-invasively, in vivo, and in near real-time using optical spectroscopy and imaging. Our research group has developed multi-spectral imaging devices for wide field visualization of early changes in oral mucosa. We are investigating whether these devices can improve the clinician's ability 1) to improve visualization of early neoplastic changes in oral mucosa that can be difficult to see using normal white light examination in community settings, 2) to choose optimal sites within lesions to perform biopsies, and 3) to visualize the peripheral margins of disease. We have also shown that using computer algorithms and disease probability maps, optical imaging and spectroscopy can provide objective discrimination between normal and abnormal oral mucosa with good sensitivity and specificity – similar to that of oral cancer specialists. We are now developing simplified optical devices to use in screening and diagnosis in community settings.

In addition, we are evaluating the use of molecularly targeted optical contrast agents for non-invasive diagnosis and molecular characterization of oral mucosal lesions. These contrast agents can potentially be used in conjunction with portable microendoscopes and confocal microscopes that have sufficient resolution to visualize cellular features in vivo, to provide non-invasive "optical biopsies" of suspicious areas.