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Novel device shows potential in better detecting oral cancer

Researchers supported by the National Institute of Dental and Craniofacial Research, part of the National Institutes of Health, report today their initial success using a customized optical device that allows dentists to visualize in a completely new way whether a patient might have a developing oral cancer.

Called a Visually Enhanced Lesion Scope (VELScope), this simple, hand-held device emits a cone of blue light into the mouth that excites various molecules within our cells, causing them to absorb the light energy and re-emit it as visible fluorescence. Remove the light, and the fluorescence of the tissue is no longer visible.

Because changes in the natural fluorescence of healthy tissue generally reflect light-scattering biochemical or structural changes indicative of developing tumor cells, the VELScope allows dentists to shine a light onto a suspicious sore in the mouth, look through an attached eyepiece, and watch directly for changes in color. Normal oral tissue emits a pale green fluorescence, while potentially early tumor, or dysplastic, cells appear dark green to black.

Testing the device in 44 people, the results of which are published online in the Journal of Biomedical Optics, the scientists found they could distinguish correctly in all but one instance between normal and abnormal tissue. Their diagnoses were confirmed to be correct by biopsy and standard pathology.

"The natural fluorescence of the mouth is invisible to the naked eye," said Dr. Miriam Rosin, a senior author on the paper and a cancer biologist at the British Columbia Cancer Research Center in Vancouver, Canada. "The VELScope literally brings this natural fluorescence to light, helping dentists to answer in a more informed way a common question in daily practices: To biopsy or not to biopsy."

Because developing tumors in the mouth are often easily visible, public health officials have long advocated early detection of oral cancer. But determining whether a

suspicious sore is benign or potentially cancerous has remained scientifically problematic. "A major reason is looks alone can be deceiving," said Rosin, referring to the common practice of diagnosing cancer based on the general appearance and staining patterns of tissue biopsy. "What's been badly needed in screening for oral cancer is a way to visualize the biological information within and let it tell you whether or not a lesion is likely to become cancerous."

Rosin said the VELScope goes a long way toward answering this unmet need. "Historically, the problem in developing a fluorescence-reading instrument has been largely organizational," said Rosin, a leader of the British Columbia Oral Cancer Prevention Program. "No one scientific discipline possesses sufficient expertise to build such a sophisticated imaging device, and the needed interdisciplinary groups weren't forming to tackle the problem."

This lack of communication changed a few years ago when Rosin broached the subject to Dr. Calum MacAulay, the head of the British Columbia Cancer Research Center's cancer imaging program and who has extensive training in physics, pathology, and engineering imaging devices. Based on these discussions, MacAulay and post-doctoral fellow Pierre Lane agreed to begin the technologically challenging process of designing a hand-held device that also would be user friendly in the dentist's office.

Starting with a crude, light-emitting box and a pair of goggles that their group had previously cobbled together to visualize skin cancer, Lane and MacAulay gradually progressed to the one-step device reported today. "We essentially refined and integrated the box-and-goggles concept into one device," said MacAulay, who also works closely with a corporate partner that would like to commercialize the VELScope. "The box was molded into the lightweight, hand-held structure, a flexible cord attaches the examination light, and the goggles became the view finder that allows dentists to directly evaluate lesions in real time."

In their study, the scientists evaluated 50 tissue sites from 44 people. All sites were biopsied, and pathologists classified seven as normal, 11 had severe dysplasia, and 33 biopsies were oral squamous cell carcinoma. Reading the fluorescence patterns of the 50 sites, the group correctly identified all of the normal biopsies, 10 of the severe dysplasias, and all of the cancers. These numbers translated to 100 percent specificity and 98 percent sensitivity. Specificity refers to how well a test correctly identifies people

who have a disease, while sensitivity characterizes the ability of a test to correctly identify those who are well.

Rosin said her group is now engaged in a larger follow-up study in Vancouver that will further evaluate the VELScope. "Laboratories are developing similar devices to detect lung and cervical cancer," said Rosin. "That means that the same basic technology is now being used to evaluate three tumor sites, and we can begin hopefully to pool our data and fine tune the characteristics and meaning of the changes in fluorescence."

The American Cancer Society (ACS) estimated last year that about 20,000 Americans were diagnosed with various oral cancers. The ACS also estimated that just over 5,000 Americans died from these cancers in 2005.

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