IADR INTERNATIONAL ASSOCIATION FOR DENTAL, ORAL, AND CRANIOFACIAL RESEARCH

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Machine Learning And Digital Biopsies For Oral Cancer Detection

Alexandria, VA, USA – A study evaluating segmentation and classification approaches in machine learning analysis of fluorescence *in vivo* confocal microscopy images was presented at the 103rd General Session of the IADR, which was held in conjunction with the IADR/Pan European Regional Congress on June 25-28, 2025 in Barcelona, Spain.

Artificial intelligence is transforming the field of oral cancer detection with the innovations brought about by machine learning (ML). This technology, coupled with 'digital biopsies' in the form of non-invasive intra-oral confocal microscopy, could enhance diagnostic precision. This study evaluated segmentation and classification approaches in ML analysis of fluorescence *in vivo* confocal microscopy images of four diagnostic categories: normal tissue, lichenoid lesions, low-risk lesions, and high-risk lesions on the oral mucosa.

Images from 59 participants with oral mucosal abnormalities were captured using an *in vivo* fluorescence confocal micro endoscope with fluorescein and acriflavine as contrast agents. For the segmentation approach, StarDist 2D models with ImageJ were trained using the ZeroCostDL4Mic online framework to identify and measure the size and shape of cell nuclei. This tool learned to locate and separated the nuclei from the background of the image before measuring them. These measurements were used as features to train four types of ML models: logistic regression, support vector machines, random forests, and XGBoost. The classification approach involved developing convolutional neural networks (CNN) in the PyTorch framework using the Python programming language to directly classify the images into the diagnostic categories.

The best segmentation model was random forest, with a moderate to high accuracy for normal (70.2%), lichenoid (63.2%), and low-risk (84.2%) images, being most accurate with high-risk images (91.2%). The best classification approach CNN model outperformed the segmentation model by having high accuracy of normal (86.4%), lichenoid lesions (91.2%), low-risk lesions (89.6%), and high-risk lesions (94.4%). Evaluation of entire image using a CNN machine learning model provided highly accurate identification of oral epithelial dysplasia and oral cancer compared to isolating and measuring cell nuclei in the segmentation approach.

The abstract, "Machine Learning And Digital Biopsies For Oral Cancer Detection" was presented by Rishi Ramani of the University of Melbourne, Australia during the "Oral

Medicine and Pathology IV" Poster Session that took place on June 27, 2025 at 3:45 p.m. CEST (UTC+2).

About IADR

The International Association for Dental, Oral, and Craniofacial Research (IADR) is a nonprofit organization with a mission to drive dental, oral, and craniofacial research for health and well-being worldwide. IADR represents the individual scientists, clinician-scientists, dental professionals, and students based in academic, government, non-profit, and private-sector institutions who share our mission. Learn more at www.iadr.org.