TITLE: Optical Imaging in Radiation Therapy & Molecular-Guided Surgery for Cancer Treatment

ABSTRACT:
Optical imaging is the largest economic sector of the medical imaging market, with endoscopy being the single largest modality utilized in medicine. While optical imaging has its core strengths in endoscopy, laparoscopy, ophthalmology, and pathology, there are still major innovations taking place, which provide the rationale for optical imaging in molecular guidance of procedures. The discovery of relevant imaging features to guide medical, surgical and radiological intervention is still undergoing substantial change. In this talk, examples of imaging molecular & cellular features of cancer are demonstrated in the context of macroscopic surgical guidance. Fluorescence imaging with molecular reporters and customized fluorescence imaging systems that work with room lights on will be demonstrated. This approach to imaging in surgery provides the surgeon with information which is not visible, and augments their guidance based upon white light imaging and touch.

Additionally, a fundamentally new way to visualize radiation dose delivery in real time is demonstrated with Cherenkov light imaging. The tools advanced in this area are being translated into a commercial application via a start-up company, making time-gated intensified CMOS cameras, that will change what is possible in terms of real time radiation delivery verification in radiation oncology. Examples of video capture of radiotherapy will be shown in total breast irradiation and total skin electron therapy, where dosimetry is challenging and inaccurate. In addition to this work, Cherenkov-based luminescence emission has been discovered, as a way to allow molecular imaging in tissue. The most advanced version of this uses radiation sheets to illuminate the tissue throughout, and scan the excitation volume, allowing super-resolution methods to be used. This Cherenkov-light sheet imaging provides the highest resolution possible in whole body molecular imaging today. Each of these examples are demonstrated with relevant clinical trials or biomedical disease models.