AbstractID: 8178 Title: Potential application of 3D thermal tomography in radiation therapy

Purpose:
Radiation-induced skin toxicity is a common and potentially serious treatment complication for patients receiving radiotherapy. A non-invasive method for predicting skin reaction, particularly moist desquamation, could allow for treatment modifications that may improve treatment outcome and quality of life.

Method and Materials:
3D thermal tomography (3DTT) is a new image-modality that displays the 3D distribution of thermal effusivity under the imaged surface. The 3DTT system utilizes one or more photographic flash lamps and an infrared camera containing a focal-plane array of infrared sensors. The flash lamps provide a thermal impulse (a few ms in duration) on the sample surface, and the infrared camera monitors the immediate rise and gradual decay of surface temperature due to conduction of surface heat into the interior of the sample. Because heat transfer from the surface to the interior depends on a material's thermal properties, pulsed thermal imaging data can be used to determine the thermal property distribution below the surface. As a feasibility study, we used 3DTT to obtain effusivity-based cross-sectional images for a ceramic composite plate with embedded holes ranging from 1-7.5mm in diameter at various depths and a stock of pig's knee joint. We also measured the degree of maximum temperature rise at the back of a hand to assure the safety of the procedure.

Results:
Thermal effusivity tomography images from 0.3-5mm depth were successfully obtained from both ceramic and pig joint phantoms. The images showed excellent details of the phantoms, with better resolution toward the surface. The temperature rise at the back surface of a hand was no more 5ºC, confirming the safety of the 3DTT procedure.

Conclusion:
It is feasible to produce 3DTT images under the surface of phantoms. These results warrant further exploration of using 3DTT as patient specific biomarker to predict the development of radiation-induced skin injuries.