Purpose: Dermal side effects of breast cancer radiotherapy vary from minor erythema to moist desquamation, and are difficult to predict. While the worst skin reactions can necessitate treatment breaks thereby worsening treatment outcome, skin-sparing measures such as IMRT or topical treatments are widely considered too costly to distribute universally. We have previously presented a method of evaluating skin reactions shortly after exposure (3-5 days) with three-dimensional thermal tomography. The resultant thermal effusivity is a property which appears to be correlated to peak skin reaction at a later date. The analyzable depth was limited by assumptions that all heat from the flash prior to imaging is deposited on the surface. In this study we explore improvements to reconstruction method which models heat penetration.

Methods: Eleven hairless mice irradiated to a 40Gy regional skin dose in a single fraction were imaged daily by a 2.5 ms flash followed by ~6 s infrared image acquisition. Sequential infrared images were used to calculate the depth-effusivity distribution for each pixel using custom software. The relative mean effusivity within the treated area and the contralateral control were compared to the eventual severity of skin reaction.

Results: Modeling of the temperature penetration of the flash allowed calculation of effusivity at shallow depths, which were previously impossible. At depth, a drop in relative effusivity between the irradiated and control areas occurred earlier in mice which eventually developed moist desquamation (mean 1.7 days post irradiation) than those that did not (mean 4.4 days post irradiation). At newly viewable shallow depths, the relative effusivity rose shortly before erythema occurred.

Conclusion: In prior work, it was found that effusivity at depth 0.3-0.6 mm was predictive of clinical endpoint in hairless mice. We can now view shallow slices which are more sensitive to spatial variation and may yield stronger predictive power.

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