Abstract ID: 16705 Title: Feasibility of a quantitative, patient-specific image planning system for radiation therapy

Purpose:
We studied the feasibility of developing an Image Planning System (IPS) for radiotherapy guidance that will allow clinicians to prospectively choose an imaging goal, for example, soft tissue contrast versus boney anatomy and predict the optimal imaging parameters. The IPS will allow ensure that imaging dose is appropriate for the imaging goal (neither over, nor under dose) and that imaging frequency (for example, real-time fluoroscopy) is applied with well-defined and predetermined patient doses.

Methods:
We characterized a commercial, linear-accelerator-mounted diagnostic x-ray imaging system with flat panel detector, in terms of low-contrast object detectability as a function of patient thickness and x-ray technique factors. A commercial contrast test object and homogeneous tissue equivalent phantom was used for this. The feasibility of predicting low contrast resolution analytically was tested using a clinical CT scan and a respiratory motion phantom. Optimal image-acquisition and display parameters where experimentally determined for an anthropomorphic phantom and using clinical images, thus assessing whether soft tissue contrast is a viable imaging goal. Contrast-noise ratio and low contrast detectability where used as metrics.

Results:
Characteristic curves of the response of the detector demonstrate a broad plateau over which image quality is relatively constant. All combinations of phantom thickness and technique parameters possessed both low-dose and high-dose reductions in low contrast quality. Analytical calculations of local soft tissue contrast predict superior low-contrast resolution using lower kVp settings (as expected) and are capable of resolving discrete objects.

Conclusions:
Optimal imaging techniques can be derived from these data in which the feasibility of the imaging goal is assessed, coupled with prospective calculation of technique factors that apply minimal patient dose and allow for maximum imaging repetition. Analytical, energy-dependent calculation models can be used to predict image contrast and plan optimal imaging dose.