

AbstractID: 2727 Title: Effects of Prepatient Filtration on Contrast, Scatter and Dose in CR Chest Exams: A Phantom Study

Purpose:

To establish a convenient method for objective comparison of the consequences of exposure conditions and filtration on image quality and patient dose in adult and pediatric thoracic computed radiography (CR) examinations.

Method and Materials:

Computer simulation (MATLAB) was utilized for approximating the x-ray spectrum and its modification by pre-patient filtration, predicting the attenuation by the phantom, predicting pixel values in the CR image, calculating expected contrast-to-noise ratio (CNR), and estimating patient dose. CDRH LucAl Chest and Pediatric phantoms with the Al quality insert were imaged at 125 kVp with beam filters ($Z=29, 57, 75$) with a grid and 75 kVp with beam filters ($Z=13, 29, 50$) tabletop, respectively. Entrance Skin Exposure (ESE) and detector exposure were measured. Fuji FCR 5000 CR images were developed with $L=4$ in fixed EDR Mode. Pixel ROI and SD were extracted from DICOM images. Doses were estimated by calculating absorption of the attenuated spectra in water of 20 cm (adult) and 10 cm (pediatric) thickness. Scatter-to-primary ratios (SPR) were estimated for each case using beam blocks.

Results:

Filtration increased half-value layer (HVL) reducing ESE and contrast. Contrast-to-Noise Ratio (CNR) can increase, depending on Z and the thickness of the filter. The same CNR produced by the unfiltered beam using Automatic Exposure Control (AEC) can be accomplished at 23% lower ESE. Even with a lower ESE, higher HVL increases exposure-to-dose conversion, resulting in higher dose absorbed by the patient to produce the same receptor exposure. No filtered case had CNR superior to the unfiltered case at the same patient dose. SPR also increased with filtration.

Conclusion:

LucAl Chest and Pediatric phantoms provide standardized platforms for investigating effects of exposure conditions on image quality and patient dose in digital chest radiography. Filtration can provide identical CNR at lower ESE, but may also deliver higher patient dose.