Evaluation of Contrast Phantom Images Obtained From Laser-based and Conventional X-ray Sources.

Laser-based x-ray sources have a number of advantages over conventional electron impact sources. One advantage is the ease of changing target material to tailor the spectrum to a particular imaging task. In this study, we have produced images of acrylic contrast-detail phantoms using various concentrations of Iodine in wells. All images were obtained using a standard diagnostic film-screen system and processing. A table top terawatt laser (10^{19} Wcm^{-2}, 159 or 450 fs pulse length) impinging thin La or BaF_2 targets was used for the laser-based source with conventional x-ray images produced at 80 kVp, 3 phase, ~3 mm Al added filtration and at 45 kVp, single phase, no added filtration. Image contrast (C) was determined by measuring the optical density of the images at the position of the iodine wells and adjacent acrylic, where: $C = D_1 - D_2/D_1$. The laser-based x-ray images resulted in significantly greater image contrast compared to the conventional images. For example, at an Iodine value of 10 mg/cm^2, contrast values of 10%, 40% and 60% were obtained, respectively, for 80 kVp, 45 kVp and laser-based images. Laser-based x-ray sources appear to have significant potential in diagnostic x-ray imaging.