

Exposure technique factors in digital X-ray imaging systems: Demonstrating the effect of mAs

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Why was the idea necessary?

Digital X-ray imaging systems have a wide, dynamic exposure latitude that allows almost 500 times the exposure necessary to produce optimal diagnostic images.^[1,2] Consequentially, patients may receive more exposure to ionising radiation than necessary to produce an image of optimal diagnostic quality. A recent study showed that ~54% of radiographers understood and used indicators of exposure in digital X-ray imaging systems.^[3] With just more than half of radiographers understanding and using indicators of exposure in digital X-ray imaging systems, enhancing radiographers' understanding of exposure technique factors (kilovoltage peak (kVp), milliampere and the exposure time (mAs)) in digital X-ray imaging systems is needed to curtail unnecessary exposure to ionising radiation.

Ethical approval for the study was obtained from the Faculty of Health Sciences Research Ethics Committee, University of Johannesburg (ref. no. REC-234-2019).

What was tried?

A structured tutorial demonstrating the effect of mAs on image quality in digital X-ray imaging systems was tried. Four radiographs were taken of a hand phantom, using a constant kVp, focal film distance (FFD), focal spot size, 4-sided collimation and the same computed radiography (CR) (a type of digital X-ray imaging system) cassette. Only the mAs changed for each exposure (exposure refers to each time the radiograph is taken and the phantom hand is 'exposed' to ionising radiation) (Fig. 1A-D). Before the tutorial, students needed to predict the image quality for each exposure. After the tutorial, students compared their predicted outcomes with the actual outcomes. Dose area products (DAPs), exposure indicators (EIs) and image quality for each exposure without any image post-processing were tabulated. Students then evaluated and reported the effect of mAs. The resultant images and exposure technique factors are indicated in Fig. 1.

The effect of mAs on image quality in digital X-ray imaging systems was observed. It was noticeable that at higher than standard optimum mAs, the image quality was preserved (acceptable mAs for a posteroanterior (PA) projection of a hand for the X-ray unit used in the tutorial was 2.5 mAs (Fig. 1B)). However, with higher mAs, there was a congruent increase in the dose to the phantom (DAP). Students predicted that for the exposure technique factors used in Fig. 1C and Fig. 1D, they would not be able to observe an image, but acceptable images were obtained. Students predicted a contrary outcome, despite learning the theory of the wide dynamic exposure latitude of digital X-ray imaging systems and seeing images similar to those in Fig. 1 in the literature. Therefore, using a blended teaching approach provided an opportunity for students to experiment with varied mAs to enhance their understanding of the effect of mAs on image quality in digital X-ray imaging systems.

Declaration. None.

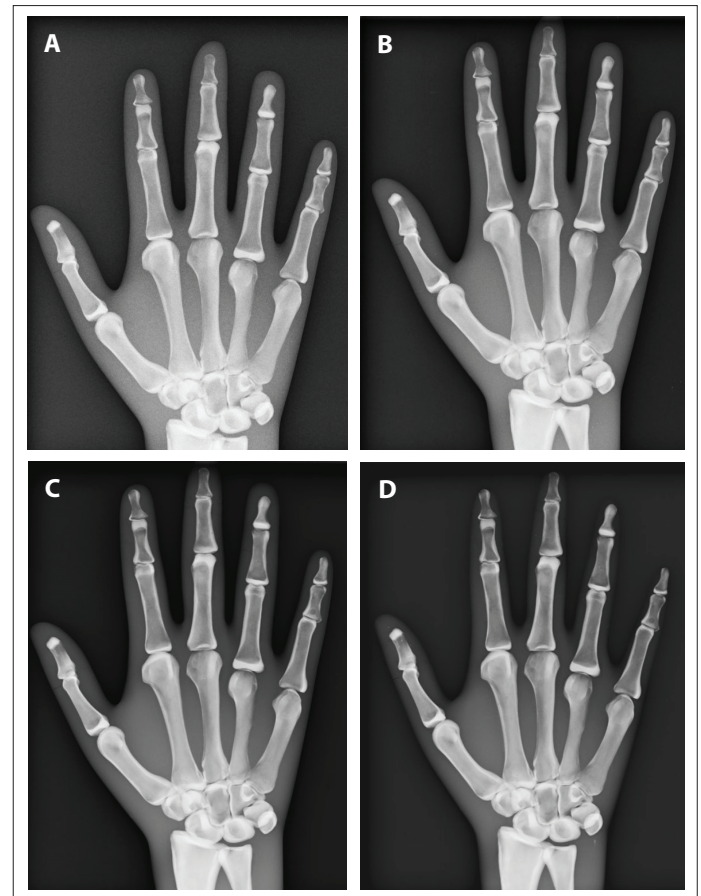


Fig. 1. Images from the demonstration: (A) 45 kVp/0.5 mAs. (B) 45 kVp/2.5 mAs. (C) 45 kVp/200 mAs. (D) 45 kVp/400 mAs.

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Conflicts of interest. The author lectures the students who participated in the tutorial.

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