AN INTERCOMPARISON OF AMORPHOUS SILICON EPIDS OF DIFFERENT TYPE: IMPLICATIONS FOR MEGAVOLTAGE PORTAL IMAGING AND DOSE TO PATIENT

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Introduction

The complete characterisation of MV Electronic Portal Imaging Devices (EPIDs) is now paramount, as it is gradually becoming a necessary tool on the linear accelerator (LinAc) for a combination of purposes including patient position verification, portal dosimetry and LinAc QA. Recently, two different amorphous silicon (*a*-Si) EPIDs, namely Varian PortalVision (PV) (aS500-II: IAS3; IDU20) and Elekta *i*ViewGT (PSP Solution; XRD1640 AL5) were introduced into routine clinical use at the Dorset Cancer Centre (DCC). This work compares image quality and patient dose reduction methods for each EPID type. An optimum strategy is required such that the concomitant dose is justified as being low as reasonably practicable (ALARP) (IR(MER) 2000; Medical and Dental Guidance Notes, 2002)).

Method & Materials

A standardised method was adopted to test a number of key factors such as dose (MU), doserate, energy, detector distance, number of frame averages, and various acquisition techniques. A commercial test phantom, QC-3V (Standard Imaging, Inc) was used for the measurements and the images were analysed objectively using the PIPSpro Version 4.1 software (Standard Imaging, Inc) for three fundamental image quality parameters: spatial resolution, contrast and noise.

Results & Discussion

Images were acquired from each EPID over several months using 6 MV, 50 MU and 400 MU.min^{-1} resulting in mean spatial resolution's (f_{50}) 0.412 ± 0.005 lp.mm^{-1} and 0.429 ± 0.005 lp.mm^{-1}, mean contrast-to-noise ratio's (CNR's) 860 ± 50 and 445 ± 50, and noise levels 0.62 ± 0.03 and 32 ± 3 respectively. This showed that images acquired using the PV EPID had very low noise levels and almost twice the CNR whilst the *i*ViewGT EPID had comparatively better spatial resolution for clinical 'during treatment' exposure settings. Images were acquired with both EPIDs using 6 MV, 100 MU and 400 MU.min^{-1} resulting in CNR's 1123 ± 50 and 951 ± 50, spatial resolution's 0.413 ± 0.005 lp.mm^{-1} and 0.415 ± 0.005 lp.mm^{-1} and noise levels of 0.487 and 0.763. The marked improvement in the CNR of images acquired using the *i*ViewGT system can be attributed to reducing the pixel format from 1024 to 512 or applying software noise filters to raw images and also by optimising the window width. Images were acquired using low MU from each EPID at 6 MV, 100 MU.min^{-1}

using 1 MU (RadMode technique) and 3 MU (Synchronous technique), resulting in CNR's 100 ± 15 and 100 ± 30 respectively. This showed that for equivalent CNR, the PV EPID is capable of a dose saving to patient of approximately 2 cGy for each clinical pre-treatment exposure image. The RadMode technique was optimised by using 50 cMU pulses per frame over a single frame thus requiring ~0.5 cGy for each pre-treatment acquisition image on the PV EPID.

Conclusions

The improved performance of the PV EPID can be attributed to both hardware features (e.g. number of readout channels per ADC; frame rate; gating interface) and software algorithms (e.g. acquisition technique and post processing of raw images). It is evident from the assessment carried out in this work that the PV EPID is capable of minimising concomitant radiation doses to patient, whilst also providing equivalently acceptable clinical images.

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