



Contribution ID: 330

Type: Poster

A simplified approach of measuring beam attenuation through treatment couch and immobilization devices using electronic portal imaging devices

Thursday, 22 June 2017 15:55 (5 minutes)

Introduction

With the increasing concern to measure beam attenuation caused by treatment couch and immobilization devices [1, 2], the objective of this study is to propose a simple and fast method to measure beam attenuation using the current generation of clinically available amorphous silicon electronic portal imaging device (a-Si EPID) without complex procedures to convert the signal to dose.

Method

An aS500 EPID attached to a Varian linear accelerator (21iX) was irradiated with 100 MU using 6 MV and 600 MU/min with a distance of 150 cm between source and EPID. Exact and IGRT Varian couches were positioned at source to surface distance (SSD) 110 cm. Integrated images without and with treatment couch, belly board, and head and neck board were acquired for jaw defined fields at gantry angles of 0, 30, 60°. In addition, attenuation measurements through the exact couch were examined with a presence of 20 cm solid water phantom. Attenuated 2D images were assessed as the percentage differences between images without and with attenuation. The percentage of attenuation at the centre, mean and maximum of attenuated image were reported. To validate the proposed method a comparison of measurements was conducted using an ionization chamber.

Results

Comparisons between beam attenuation measurements using an EPID and an ionization chamber agreed to within ± 0.1 to 1.4 (1 SD). Attenuation data are shown in Figure 1. The highest attenuation was observed with the combination of the couch and head and neck baseboard $9.8\% \pm 0.41$. The attenuation through the Exact couch was more angular dependent compared to the IGRT couch. Interestingly, the magnitude of attenuation was reduced with the addition of the phantom by approximately 1.2% for a large field size 15×15 cm², see Figure 2.

Conclusion

A simple tool that provides attenuation data for patient support and immobilisation devices has been demonstrated. Unlike the conventional approach, this approach is not time consuming and provides attenuation data in the center as well as the entire field. Data from this study characterised beam attenuation, and could also be useful to quantify the effect of attenuation when an EPID is used for transit dosimetry.

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Session Classification: Thursday afternoon - Poster Presentations - Screen5

Track Classification: Dosimetry