

Dosimetric characterisation of continuous portal imaging for SBRT verification

Ana Rita Barbeiro¹, Laure Parent², Laure Vieillevigne^{1,2}, Régis Ferrand^{1,2}, Delphine Lazaro³, Jocelyne Mazurier⁴
and Xavier Franceries^{1,3}

¹CRCT, UMR 1037, INSERM, Université Toulouse III Paul Sabatier, Toulouse France.

²Dep. d'Ingénierie et de Physique Médicale, IUCT-Oncopole, 31100 Toulouse, France

³LIST, CEA, Gif-sur-Yvette, F91191 France

⁴Clinique Pasteur – Groupe Oncorad-Garonne, 31300 Toulouse, France

⁵Université Toulouse III-Paul Sabatier, Toulouse, France

Abstract

Purpose: Stereotactic radiation body therapy (SBRT) requires the implementation of robust treatment verification, to which electronic portal imaging device (EPID) offer an attractive solution. However the use of EPIDs in complex treatment delivery conditions, commonly present in SBRT, is still challenging and is not completely supported by commercial solutions for some EPID models [1]. Therefore, in this work we present the characterisation of an aSi-1000 EPID operating in continuous mode under these challenging conditions, for further 3D SBRT verifications. **Methods:** An aSi-1000 EPID installed on a Varian TrueBeamSTx was irradiated with 6 and 10 MV unflattened (FFF) and flattened photon beams in variable conditions using the maximum available dose rates, in order to study relevant dosimetric characteristics. Different EPID image sets were acquired in continuous mode (CM) and were also compared to the commonly used integrated mode (IM) to evaluate dose linearity, repeatability and reproducibility of EPID response, ghosting effect and field size dependence. Dynamic arc fields were also measured to study EPID dose response dependence, when subject to potential variations in dose rate and compared to the static irradiation. In-house Matlab software was implemented to automatically process all data, and handling different image formats. **Results:** Comparable dose response linearity was obtained for static and arc fields and in both acquisition modes, varying within 2.9% for low MU exposures (≤ 5 MU). Response repeatability was slightly better for IM, $\pm 0.6\%$ compared to $\pm 0.9\%$ (1SD) for CM, and improved with increased exposure time, due to dose rate stability. Reproducibility (over 7 months) was within 0.6% for both modes and all beam energies. Field size dependence of EPID response in both modes agreed within 1%. Signal increasing due to ghosting effect was within 1.2% for the configuration with the highest pre-irradiation, being comparable to the signal variations found between continuous acquisition frames ($\pm 1.1\%$, 1SD). **Conclusions:** The dosimetric response of aSi-1000 EPID in continuous mode with FFF beams and high dose rates showed comparable results to the commonly used integrated mode, and dosimetric properties similar to those of FF beams. These results are promising to perform 3D verifications of SBRT with dynamic techniques using continuous EPID imaging.

References

[1] Miri N, Legge K, Colyvas K, Lehmann J, Vial P, Moore A, et al. A remote EPID-based dosimetric TPS-planned audit of centers for clinical trials: outcomes and analysis of contributing factors. *Radiat Oncol* 13(178), 1:9, 2018.