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A JOURNEY TO IN-VIVO PORTAL DOSIMETRY: CHARACTERIZATION AND QUALITY ASSURANCE OF AN ELECTRONIC PORTAL IMAGING DEVICE

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Introduction: In these days, medical linear accelerators (LINAC) are the most commonly used devices for external beam radiotherapy in cancer treatments. Electronic Portal Imaging Devices (EPIDs) are the standard option offered by manufacturers to be used in the patient's positioning. However, EPIDs have proven to be useful as dosimeters, either for patient-specific quality controls or in-vivo dosimetry. In this paper we present our first steps in the implementation of these devices as a dosimetric tool in our radiotherapy department.

Material and method: All our measurements were performed with 6 MV photon beams provided by Elekta Synergy and Synergy Platform linear accelerators. Both of these LINACs have an iViewGT EPID (Elekta) attached. This devices are based on amouphous silicon type detectors (PerkinElmer Optoelectronics) arranged in a two-dimensional photodiode array. This arrangement gives us an image of 1024×1024 pixels with a pitch of 0.4 mm. All the dose measurements were carried out using the XIS 3.0.1 software (PerkinElmer). Image calibration was also performed with the XIS software and consisted in offset, gain and dead pixels corrections. All the image processing and visualisation were implemented in a Python program. Finally, several characerization and quality assurance tests were performed.[1,2]

Results: By studying the offset images we were able to establish the warm-up time of the equipment at 2 hours. After this time the detector sensitivity was within 0.5%. Additionally, the temporal stability through several days and months was also less than 0.5%.

The characterization showed EPIDs behaviour to be linear with delivered dose (R^2=0.999996) and independent of dose rate within clinical range.

Ghosting phenomena was also studied as an increase of the signal due to a previous irradiation. When performing consecutive irradiations (~5 s) the signal was modificated up to a 4% compared to the case without previous irradiation. An example is shown in Figure 1.

Finally, quality assurance tests were made on the EPIDs. Both the uniformity and low contrast resolution results were higher than expected. Mechanical stability during gantry movement was found to be satisfactory for patient positioning but a minimal correction is necessary for dosimetric purposes.[1]

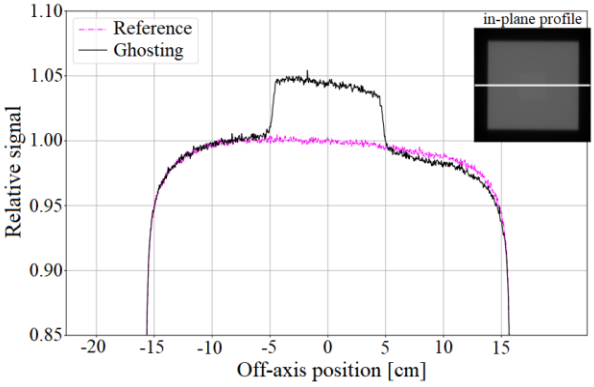

Figure 1: Beam profiles measured without a pre-irradiation (reference) and with a smaller field pre-irradiation (ghosting).

Conclusions: We have found that EPIDs are very stable devices in the short and medium term and need hardly any corrections to be usefull in dosimetry.

Ghosting is a key component of the signal and is caused by an increase in the material sensitivity due to a pre-irradiation. We have proposed different approaches to fight this effect, which we are studying further.

We are currently developing a dose reconstruction algorithm based in EPID images and different water phantoms.

References:

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