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The impact of new clinical indicators (delivered dose and patient positioning) based on transit in vivo dosimetry using Electronic Portal Imaging Device (EPID) for adaptive radiotherapy.

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In vivo dosimetry consists in measuring in real time, during one or several treatment sessions, the dose actually received by the patient1Many researchers in the past year have improved methods to verify the correct dose delivery in the patient1. A simple method to determineIn the last 10 years the dose received by the patient during his treatment is to usehas been measured by an Electronic Portqal Imaging Device (EPID) already integrated to the treatment machine and placed below the patient during the fraction. The accuracy and the efficiency of the EPID has been discuss in the literature for many years.2
By comparing the dose predicted by the treatment planning system (TPS) to the dose received by the EPID – after conversion, we can evaluate the dose received by the patient at each fraction. There are many ways of comparing both transit dose. The first one Two main approaches are possible: i)is to predict an image from the patient planning Computed Tomography scan data (pCT) and to compare the acquired image during the fraction;. ii)Another way, -used in this PhD thesis, is to reconstruct the dose using back projection, from the EPID image. Both mentioned method use tolerance threshold to accept or reject the control. The first step is to give a quick and reliable statistical analysis to answer if the fraction was in or out the tolerance. In case of the latest a deeper analysis has to be done using dose/volume relation to find the root cause of this deviation. Transit dose analysis cannot inform of the "real"clinical impact of the deviation and the information of the "patient of the day"are required. Kilovoltage cone beam computed tomography (CBCT) produces volumetric images (with just one rotation of the x-ray source-detector pair)3 of the patient at the time of his fraction. An elastic registration from pCT to CBCT for the volume of interest, an –as much as possible- accurate conversion curve Hounsfield units (HU) to electronic density (deED) for both pCT and CBCT and "true"treatment machine information can inform of the clinical impact of the discrepancy.
The last part of this decision making tool is the need of correction of the treatment plan (Adaptive Radiotherapy –clinical decision making).

Watching the dosimetry of each fraction of the treatment should help to quantify and to check the delivered dose to the patient and then to be an indicator of the quality of the delivered treatment, concerning:

- the accuracy of patient (re-)positioning;
- the anatomical reproducibility and patient morphology;
- the constancy of the treatment machine and its accessories.

It should be easier to:

- Compare delivered/predicted and fraction to fraction,
- Cumulate real delivered dose, be alerted and then modify initial treatment plan,
- Enhance patient's treatment quality within the department

Key words: External Radiotherapy, in vivo transit dosimetry, dosimetric quantification, Adaptive Radiotherapy

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