Combining Electronic Portal Imaging Device (EPID) based transit in-vivo dosimetry and kV-CBCT information for *a posteriori* 3D dose calculation and delivered dose reporting

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Purpose: The aim of this study is to assess a robust dose reporting by sharing information using 2 major footprints of each fraction of the treatment: simultaneous 2D EPID-based transit dosimetry and a posteriori 3D dose calculation with anatomical information provided by the kV-CBCT to trigger relevant differences between planned and delivered dose.

Material and methods: kV-CBCT were acquired before each fraction and EPID images during dose delivery in transit condition for five prostate plans and 2 breast plans (Varian Eclipse TPS, 6MV, VMAT, Truebeam^{TM}). Dose from the 2D-EPID images were back projected in the planning CT (pCT) and a posteriori 3D dose calculation was computed using Eclipse on the pCT corrected with kV-CBCT body information. DVH and gamma index evaluation were compared with the planned dose to conduct the report of the delivered dose.

Results: On patient study errors such as wrong positioning or anatomical and morphological modifications were well detected by transit dosimetry and *a posteriori* DVH calculation identified dose discrepancies. Transit dosimetry alerts on dose or volume deviation with a threshold of 5% tolerance criterion. The *a posteriori* 3D dose calculation using the "patient of the day" allows re-computing dose in the actual condition given by the kV-CBCT and EPID images.

Conclusion: This approach of fraction dose reconstruction demonstrates that using 2D dose EPID image and a back-projection algorithm in the pCT can be used to flag unexpected discrepancies about dose and volume prescription. The *a posteriori* 3D dose calculation refines dose evaluation according to the TPS accuracy. Combining 2D and 3D information as major treatment footprints reduces uncertainties on reconstructed delivered dose values and may contribute to robust actual dose reporting needed for patient specific quality assurance and allows adaptive radiotherapy.