
Monitoring of prostate cancer with a transperineal ultrasound probe: impact on treatment margins

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Résumé

Purpose/Objective: To achieve a better accuracy in dose delivering in prostate cancer treatment a real-time prostate monitoring system for correcting inter and intrafraction motion, such as the intramodality transperineal ultrasound device (TP-US) (Clarity®, Elekta, Sweden) is required. Previous studies had shown a good correlation between Cone beam CT (CBCT) without fiducial markers (FM) and TP-US [1]. However important differences remained in the antero-posterior direction (shift agreement at 5mm: 82.6%) probably because of the low soft-tissue contrast of CBCT acquisitions. The first goal of this study was to compare pre-treatment registration results obtained with CBCT imaging with FM (CBCT+FM) to TP-US for prostate cancer treatment. Finally treatment margins were calculated for 4 treatment protocols: CT/CBCT+FM (1), CT/CBCT+FM followed by intra-fraction monitoring (IFM) (2), TP-US/TP-US + IFM (3) and TP-US/TP-US registration corrected by CT/CBCT+FM for the first 5 sessions + IFM (4).

Materials/Methods: 16 prostate patients were involved in this study. Pre-treatment positioning was first performed with TP-US/TP-US registration then corrected by CT/CBCT+FM registration as it was considered as the "gold standard". The shifts detected during CBCT imaging and treatment were collected. After 5 sessions the mean of the differences between CBCT+FM and TP-US was calculated and applied to subsequent TP-US registrations to correct for the systematic differences observed between the 2 modalities. The differences between TP-US/TP-US and CBCT/CT registrations were analyzed on 255 sessions. Finally treatment margins considering inter-fraction motion, IFM and inter-operator variability as sources of uncertainties were calculated using van Herk formula [2].

Results: CBCT+FM and TP-US shift agreements at ± 5 mm were 91.8%, 92.2%, 95.3% in the left-right (LR), anterior-posterior (AP) and superior-inferior (SI) direction, respectively. Treatment margins were smaller using CT/CBCT+FM as a reference modality for pretreatment registration (Table 1). The main differences between CBCT and TP-US protocols came from the uncertainties of inter-fraction motion, which were not considered in CBCT protocols, as it was the "gold standard". The use of the IFM (2) as well as correction of systematic shifts for TP-US registrations (4) enabled to considerably reduce margins compared to (1) and (3), respectively.

*Intervenant

Conclusion: A strong correlation was found between TP-US and CBCT+FM registrations. The use of IFM enabled to considerably reduce treatment margins. Further investigations are in progress to assess the robustness of CBCT+FM registrations notably in case of prostate rotations.

Fargier-Voiron et al, *Physica Medica* 2016

van Herk, *Seminars in Radiation Oncology* 2004

Mots-Clés: Monitoring, marge de traitements, prostate, sonde échographique transpérinéale