**Title:** Covalidation of the performances of a transperineal ultrasound probe and electromagnetic transmitter for monitoring prostate cancer motions in radiotherapy

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**Introduction:** Hypofractionated radiotherapy protocols in prostate cancer treatment require a better accuracy in dose delivery because of an increased risk of toxicity to the surrounding tissues. To achieve this goal a robust pre-treatment imaging device combined with a real-time prostate monitoring system for correcting inter and intrafraction motions is required. Two monitoring modalities are available in our department: intra-prostatic electromagnetic transmitter (RP) (RayPilot®, Micropos Medical, Sweden) and ultrasound imaging using transperineal probe (TP-US) (Clarity®, Elekta, Sweden). The first goal of this study was to assess the monitoring algorithm of the TP-US on prostate patients by comparing it to the RP system. Finally a retrospective study of intra-fraction motion observed during treatment with the TP-US has been done.

**Materials/Methods:** Four prostate patients were monitored using both monitoring devices simultaneously (80 treatment sessions). Intra-fraction motions collected with the TP-US were retrospectively analyzed for 23 prostate patients (730 sessions lasting 420s). Finally a simulation of the number of beam stops that would be required per session was done for different intervention thresholds (time/distance).

**Results:** A strong correlation was found between the 2 monitoring devices. Mean differences between the displacements observed were 0.03 ± 0.28 mm, 0.06 ± 0.39 mm , -0.11 ± 0.36 mm in the left-right (LR), anterior-posterior (AP) and superior-inferior (SI) direction, respectively. The differences were less than 1mm in 91 % of the time considering all the 3 directions. Larger differences were found in AP and SI directions (9 % and 7.7% of points were above 1mm, respectively). The retrospective analysis showed that mean motions observed were less than 2 mm in all directions (Table 1). A larger variability was found in SI and AP directions. Note that this was patient-dependent since some patients exhibited large movements whereas others did not move. By fixing action levels of 2mm and 3mm for at least 15s, the mean number of interruptions per session was 0.94 and 0.47, respectively, over all the patients. For patients exhibiting large movements the numbers of interventions reached 2.13 and 1.43, for action levels of 2mm and 3mm, respectively.

**Conclusion:** TP-US is a reliable technique for monitoring prostate during radiotherapy treatment. This device has the advantage to be non-invasive and non-ionizing. The magnitude of the motions observed over all patients is not important. However significant shifts are random and patient-dependent which requires prostate monitoring.

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|  | LR (mm) | SI (mm) | AP (mm) |
| Mean motion (+/- standard deviation) | 0.03 ± 0.78 | 1.11 ± 0.81 | -1.33 ± 1.16 |
| Range | [-1,63 ; 1,94] | [-0,39 ; 2,71] | [-5 ; 0,65] |

 Table 1: Prostate motions recorded by TP-US during 730 treatment sessions