**Online Image-Guidance for Prostate SBRT: Dosimetric Benefits and Margin Analysis**

**Introduction:** Intra-fractional target motion during prostate radiation is particularly important for prostate stereotactic body radiation therapy (SBRT) due to its considerably large fractional dose (7.4Gy). This study tries to quantify the frequency, magnitude and dosimetric impact of intra-fractional target movement in an IRB approved clinical trial on prostate SBRT.

**Clinical data and simulated treatment:** Our prostate SBRT clinical trial has so far treated 28 patients in 2 years using a regimen of 37Gy in 5 fractions. During treatment, online dynamic tracking and correction was performed to ensure delivery accuracy. To evaluate the benefit of the online tracking and correction, one needs to compare the delivered dose with such corrections to that without correction. Figure 1 and its caption illustrate detailed process on how the cumulative dose w/o correction is simulated.

![Figure 1](image)

- **Figure 1** Illustration on the process of generating cumulative doses w/ and w/o couch correction. Dashed lines indicate simulated process. In treatment, before each beam-on, couch is shifted based on measured target shift from electromagnetic/imaging devices, such that the isocenter of each beam is aligned with the actual target position (indicated by black arrow). In simulation, such couch corrections are omitted by shifting each beam by the opposite vector to its online correction (indicated by red arrow) and return to the planned isocenter, as if no correction were made.

- **Representative Case:** Figure 2 shows a representative case that has the largest difference when couch correction is omitted during treatment. This large difference was due to consistent target shifts in the same direction (+Y and -Z) in multiple fractions (Figure 2 Right).

![Figure 2](image)

- **Figure 2** DVH of the case with largest difference between w/ and w/o correction (Left), and its couch shift analysis (Right).

**Margin Calculation:** The margin calculation in this study followed the margin recipe by Van Herk et al:\(^1\): \(2.5 \Sigma + 0.7 \sigma\).