

## HowAccurateistheGoldSeeds-BasedIGRTinDetermining True ProstateShifts

**Objective:** To answer the important question of gold seeds -based IGRT for prostate cancer: what is the upper-bound accuracy in determining true prostate shifts?

**Materials and Methods:** A cylindrical phantom was constructed using tissue -equivalent plastic. Four pieces of circular bolus of 1 cm in thickness and 5 cm in diameter were stacked together and attached to a thin circular plastic plate inside the phantom to mimic the prostate gland. Three cylindrical gold seeds of 0.8x 3 mm were implanted at different locations. The phantom was scanned on a Brilliance Big Bore CT scanner with a slice thickness of 2 mm. The acquired CT images were transferred to an AQsim for treatment planning. Two pairs of orthogonal setup beams with gantry angles of 315°/45° and 0°/90° were created. Corresponding DCRs were reconstructed and transferred to Varian Varis for beam delivery. On a Varian 21EX CLINAC equipped with an *aSi500* portal imager, the phantom was set up to a LINAC ISO that has known shifts relative to the CT scan ISO. The portal images of the four setup beams were acquired using the standard clinical mode. The three shift sets relative to the CT scan ISO were then determined by manually registering the portal image with the corresponding DCR using Varian Vision. The same procedure was repeated at different dates.

**Results:** With theoretical shifts of 1, 0.9, and 1.4 cm in longitudinal, lateral, and vertical directions, respectively, the measured mean shifts were 0.994, 0.975, and 1.075 cm for 315°/45° setup beams and 1.00, 0.830, and 1.090 cm for 0°/90° setup beams.

**Conclusions:** Considering all other compounding factors *in vivo*, we believe that the accuracy in determining prostate shifts will not exceed  $\pm 0.2$ ,  $\pm 0.2$ , and  $\pm 0.5$  cm in longitudinal, lateral, and vertical directions, respectively.