Purpose:
- The delivery of robotic-based SBRT for prostate cancer requires fiducial marker implantation.
- In order to take into account intrafraction rotation, a minimal spacing of 1.8cm must be achieved between implanted markers.
  - This is frequently accomplished with double-loaded needles with spacers present or rigidly attached to the markers.
- This study explores fiducial migration and base vs. apex motion in this cohort.

Materials/Methods:
- From March 30, 2015 to February 6, 2017, 259 consecutive patients with prostate adenocarcinoma were treated with robotic-based SBRT.
- Patients had transperineal implantation of 4 fiducial markers a median of 8 days (5-103) prior to simulation.
- A median of 20 days (4-49) lapsed between simulation and first fraction.
- The median prescription was 3500cGy (3500-3625), delivered over 5 days (5-12), with 5 fractions delivered.
- The daily position of a total of 5180 fiducials was tracked over the 1295 patient treatments.
- Based on NCCN risk categories, 23.0% had low risk, 57.2% had intermediate risk, and 19.8% had high risk disease.
- The median age was 67 years (42-93) and the mean CTV and simulated bladder volumes were 70.5cc's (20.5-215.2) and 125.9cc's (28.4-515.4), respectively.
- 61 (23.6%) of patient received Androgen Deprivation Therapy (ADT).

Results:
- 54 (20.8%) of patients were treated with all 4 fiducials localized for each fraction and all treatments had at least 3 fiducials registered, to allow prostatic intrafraction rotation correction.
- 109 (42.1%) patients had the same fiducial off for each of their 5 fractions, suggesting post-simulation migration.
- Predictors of treatment with all 4 fiducials for each fraction included
  - use of needles without rigid spacer attachment to fiducials (28.6% vs. 15.0%, p=.008)
  - age >60 (23.7% vs. 12.3%, p=.05)
  - time between simulation and first fraction <20 days (26.4% vs. 15.7%, p=.034).
- On MVA, the use of needles without rigid spacer attachment was the only statistical predictor (OR 2.15, CI 1.16-4.00, p=.015).
- For CTV's <35cc, a higher percentage of migrated fiducials occur in the apex compared to the base (54.8% vs. 45.2%, p=.046).
- Patients with high risk disease had a greater likelihood of errant apex and base fiducials--as opposed to one or the other--during treatment.
- Compared to those with low risk disease (50% vs. 33.3%, =.012).

Conclusions:
- Despite a minimum spacing threshold for intrafraction rotation correction, patients can consistently achieve the required 3 fiducial localization for robotic-based SBRT.
- Waiting roughly 1 week between fiducial implantation and simulation and 2-3 weeks between simulation and first fraction is adequate for consistent fiducial reproducibility.
- A minority of patients achieve all 4 fiducials localized for each fraction, with the only predictor being use of non-rigidly attached spacers in double-loaded needles.
- Smaller glands tend to have a higher rate of apex migration.
- There was no relationship between fiducial motion and ADT use or simulated bladder volume during treatment.