Purpose: To assess the geometrical uncertainty caused by the prostate rotational motion in radiotherapy and its' effect on the treatment margin calculation.

Method and Materials: Prostate rotation angle relative to the position in the planning CT is reported daily by the Calypso 4D Localization System (Calypso Medical, Seattle, WA) based on the detected transponders' locations. The contour for the clinical target volume (CTV) was obtained from the planning CT image and was smoothed first to remove the jitters caused by the uncertainty of the delineation. After the CTV contour was rotated by a Calypso system reported degree around the isocenter, distances from the points on the rotated contour to the original contour were then calculated. The prostate was treated as a rigid body in the calculation and thus the deformation was ignored. After the distances for all the points on the contour were calculated based on the rotation angles of ten treatment fractions for twenty patients, the statistical results of the geometrical uncertainty caused by rotation, such as the mean value and standard deviation of the systematic error and the standard deviation of the random error were then calculated.

Results: The prostate rotation detected at the setup time for the twenty prostate patients has a mean value of 6.4 degrees and a standard deviation of 4.4 degrees. The maximum rotation angle is 27 degree. The standard deviations for the systematic error and the random error of the geometrical uncertainty are about 1.3 mm and 1.7 mm, respectively. The mean value of the systematic errors is about zero.

Conclusions: Geometrical uncertainty caused by prostate rotational motion was estimated quantitatively based on the detected rotation angles. Its' effect on treatment margin calculation is significant.