We evaluated the feasibility of automated depth determination-based adaptive proton therapy to minimize the effect of inter-fractional movements of the prostate. Based on the center of mass method, using three fiducial gold markers in the prostate target volume, we determined the differences in prostate target location between the planning and treatment stages.

Thirty-eight images from 10 patients were used to assess the automated depth determination method, which was also compared with manually determined depth values. The mean differences in prostate target location for the left to right (LR) and superior to inferior (SI) directions were 0.9 mm and 2.3 mm, respectively, while the maximum discrepancies in location in individual patients were 3.3 mm and 7.2 mm, respectively. In the bilateral beam configuration, the difference in the LR direction represents the target depth changes, which was found to range from 0.7 mm to 3.3 mm in our study. We found that 42.1%, 26.3% and 2.6% of thirty-eight inspections showed greater than 1 mm, 2 mm and 3 mm depth differences, respectively, between the planning and treatment stages.

Adaptive planning based on automated depth determination may be a solution for inter-fractional movements of the prostate in proton therapy since small depth changes of the target can significantly reduce target dose during proton treatment of prostate cancer patients.