

Purpose: It is investigated how portal images from IMRT beams can be used to estimate intrafraction prostate motion when fiducial markers are implanted in the prostate and how these estimates can be used in adaptive radiation therapy.

Method and Materials: The software framework ORBIT⁴ART has been used to simulate intrafraction motion, marker positions and portal images (PI). The target motion is governed by a rigid body transformation. The following procedure estimates the position of the target before the delivery of each treatment beam. An image of the largest segment is recorded. The projection of transformed reference marker positions known from the planning CT are compared with the true marker positions in the PI. By minimizing the distance in the image plane between corresponding markers, the 3D rotation as well as the in-plane translation is estimated. ORBIT⁴ART has also been used to perform dose registration in deformable tissue and to evaluate the effect of patient positioning on the delivered dose. In the tests the patient was repositioned based on the target position estimate acquired before the delivery of each beam.

Results: The target registration error (TRE) is approximately as large as the unknown out-of-plane translation. If the target does not move between images the TRE is improved further since more information is added for every new PI. If couch corrections are made according to the estimates provided by the method, the delivered dose is in better agreement with the planned dose than if no such adjustments are made.

Conclusion: The algorithm can be used to monitor intrafraction target motion. Although the estimated target translation lacks the out-of-plane component, online couch translations reduces the discrepancy between delivered and planned dose.

Conflict of Interest: All authors are employees of the submitting company and own stocks or stock options.