Purpose: In particle therapy inter-fractional motions cause dose inhomogeneities in the target region. An adaptive strategy which not only takes target position variation but also organ deformation into account is proposed, and its feasibility is tested.

Methods: The suggested adaptive workflow starts with generation of an original treatment plan that is included in a patient specific plan library. During the first fraction, a daily CT is taken for position verification, and the original plan is applied to the patient. From the daily CT, a new plan is generated off-line after treatment, and added into the plan library. For the following fractions, the adaptive process is repeated: the plan, of which the associated planning CT represents the best for the daily anatomy according to similarity comparison with the daily image, is chosen from the expanding treatment plan library on-line and applied to the patient; off-line, a new plan is generated from the daily CT, and added into the plan library. This adaptive method is tested in a retrospective planning study based on CT serials of two prostate cancer patients with 7 and 6 CT data sets. The simulated treatment courses with adaptation are compared with applying the original plans for each fraction, regarding V95 of the target.

Results: V95 values for treatment fractions with the proposed adaptive method are always higher than or similar as those without adaptation, with the maximum improvements of 8.6% and 7.3% for the two patients, respectively. Planned without additional margin outside the CTV, the accumulated V95 values for the treatment course applying the original plans are 90% and 88% respectively, while the values increase to 94% and 93% respectively when the adaptation is applied.

Conclusions: The effectiveness of the proposed adaptive strategy is proven. The expanding treatment plan library facilitates motion mitigation through the treatment course.

Funding Support, Disclosures, and Conflict of Interest:

The research leading to these results has received funding from the European Community's Seventh Framework Programme 2007-2013 under grant agreement n° 215840-2.