ABSTRACT SUBMISSION FORM

5th MR in RT Symposium: Image->Innovate->Treat

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PRESENTATION TITLE

Online prostate plan adaptation for simulated volume changes on the 1.5T MR-Linac

AUTHOR(S)

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ABSTRACT

Purpose: On the MR-Linac (Elekta AB, Stockholm, Sweden) any change in patient set-up will be corrected for using a 'virtual couch shift', where the defined MLC aperture shifts, rather than the couch. Additionally, segment weights and shapes may be re-optimised to account for daily anatomical changes. This study investigates methods for re-optimisation of treatment plans for set-up and rectum volume changes for prostate patients.

Materials & Methods: Four prostate step and shoot IMRT plans, optimised to 60 Gy in 20 fractions, were created using an MR-Linac beam model on a research Monaco system (v5.19.02) (Elekta AB, Stockholm, Sweden). This allows the 1.5 T magnetic field to be included in the optimisation. To investigate adaptive workflows, the planning CT was re-imported into Monaco with two changes introduced; 1) either a 5mm or 10mm setup error in x, y or z, 2) rectal volume variation, ±20% uniform increase or decrease in volume, simulated by deforming the CT using ImSimQA.

To correct for translational and anatomical changes, three re-optimisation methods were tested: Shift-only (SO); Segment Weight Optimization (SWO); and Segment Weight and Shape Optimization (SSO). The time taken to re-optimise and the resulting DVH statistics were recorded, with the change in dose from the original plan calculated.

Results: Figure 1 shows box and whisker plots of the difference in D95% PTV coverage (top) and V40 Gy for the Rectum (bottom), from the original plan using the three re-optimisation methods. Figure 1 shows results with setup errors of 0.5 cm (left) and 1.0 cm (right), these are means over all the x, y and z shifts. For all rectal filling states the SO plan showed the largest difference with the original plan. The largest mean difference was ~4.2 Gy and ~14.0 Gy for SO with a decreased rectum with a set-up error of...
0.5 cm and 1.0 cm respectively. Using a SWO reduced these differences to -1.8 Gy and -6.1 Gy, with SSO reducing this further to -0.5 Gy and -0.6 Gy. The V40 for the rectum does not vary greatly between the three different re-optimisation methods with differences being due to the size of the rectum and magnitude of the set-up error.

The mean time taken to complete each of the 3 methods of plan re-optimisation were 61, 64 and 239 seconds for SO, SW and SSO respectively.

**Conclusions:** This preliminary study suggests available optimisation methods can be used for daily strategies. SO was not able to recover the PTV dose when translations of 1 cm were introduced. SSO was the optimal method for recovering the original PTV coverage whilst not adversely affecting the dose to the rectum. However, there was a mean time increase of 3 minutes between this and the other methods and set-up errors less than 5 mm could be recovered using SWO with little additional detriment to the rectal dose. However, further work is needed to determine which cases are best suited to each method.