## Proffered Papers: RTT 6: Treatment planning and quality assurance

### OC-0615 Investigating online adaptive workflows for prostate patients on the MR-Linac: an in-silico study

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**Purpose or Objective**
On the MR-Linac system (Elekta Unity, 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 swift, dosimetrically acceptable processes for re-optimisation of treatment plans for set-up and rectum volume changes for prostate patients.
**Material and Methods**

4 prostate step and shoot IMRT plans, optimised to 60Gy in 20 fractions, were created using a MR Linac beam model on Monaco research TPS v5.19.02 (Elekta AB, Stockholm, Sweden). The 1.5T magnetic field was included in the optimisation. For investigating the adaptive workflows, the reference CT was re-imported into Monaco with two changes introduced. 1) a 5mm and 10mm setup error 2) rectal volume variation +/- 20% (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 values were recorded, with the change in dose from the original plan calculated.
**Results**

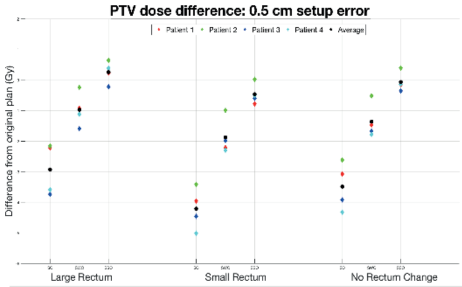


Figure 1. Difference in PTV D95% for re-optimised plans 0.5 cm setup error

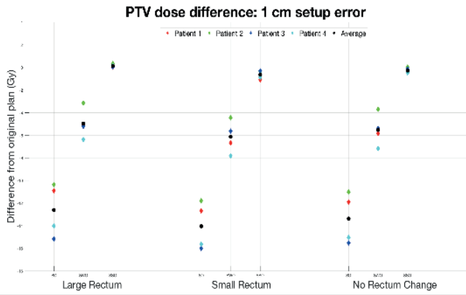


Figure 2. Difference in PTV D95% for re-optimised plan: 1 cm setup error

Figure 1 and 2 show individual and mean difference in PTV coverage (D95%) from the original plan using the 3 optimisation methods. With no change in the rectal size, mean difference in PTV dose for each optimisation method varied between 0.06-3.48Gy for 0.5cm setup error, and 0.25-13.4Gy for 1cm setup error. For small and large rectal changes, the mean change in dose varied between 0.26-4.21Gy for 0.5cm setup error and 0.15-14Gy for 1cm setup error. SSO optimisation produced the smallest difference in PTV dose for all setup conditions, whilst SO optimisation produced the largest. Overall, recovered plans had a lower maximum dose to 2cc of rectum. The mean difference for SO, SWO and SSO was 1.84Gy, 0.85Gy and 0.71Gy respectively.
The mean time taken to complete each of the 3 methods of plan re-optimisation are 61, 64 and 239 seconds for SO, SW and SSO respectively.
**Conclusion**
This preliminary study suggests available optimisation methods can be used for daily strategies. However, SO struggled to recover PTV dose when large translations of 1cm were introduced, this is unsurprising as the MR-Linac uses an unflattened beam. SSO was the optimal method for recovering the original parameters of the plan, however there was a mean time increase of 3 minutes between this and the other methods.
The efficiency of treatment speed and quality could therefore be assured by ensuring good immobilisation strategies in the pre-treatment stages. Given the time differential between optimisation strategies, further work is needed to determine which cases are best suited to each method.

### OC-0616 1.5T MRI-Linac treatment planning for multiple lymph node oligometastases in the pelvic area

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**Purpose or Objective**
Currently, in our center, patients with lymph node oligometastases are treated with SBRT on a conventional linac. About 35% of these patients present with multiple lesions which are treated simultaneously in one plan or two separate plans. PTV margins are partly based on the visibility on online cone-beam CT. MRI-Linac seems to be a promising treatment modality for lymph node oligometastases because of superior soft tissue contrast and online replanning possibilities to account for daily variations. The purpose of this study was to investigate the treatment plan quality of multiple lymph node oligometastases in the pelvic area for the 1.5T MRI-Linac accounting for magnetic field, a fixed isocenter and a non-rotating collimator.
**Material and Methods**
Ten patients with multiple lymph node oligometastases (2-3), only in the pelvic area were included. PTV margins were created using a 3mm margin, resulting in 2 PTVs per patient (mean PTV 8.7 cc; mean cranial-caudal distance 4.9 cm, Fig. 1). For each patient, one treatment plan was created including both PTVs. MRI-Linac treatment plans were generated using an IMRT-template with 7 or 9 beams of 7MV (Monaco Research version 5.19.03) with grid size of 0.2 cm and magnetic field. Organs at risk (OAR) within 5 mm of the PTV and a PTV ring structure of 2 cm were used to optimize the treatment plans. The prescription dose (PD) was 35 Gy in 5 fractions, $V_{100\%}$>95% and $D_{0.1cc}$ <135% of the PD. OARs dose constraints were based on the UK SABR consortium guidelines[1]. To quantify the treatment plan quality the procedure was used from the NRG-BR001 phase 1 trial[2]. In summary, the actual prescription dose (PD*) was given by $D_{95\%}$ of the PTV and must be ≥60% and ≤90% as a percentage of $D_{max}$. The conformity metrics $R_{100\%}$ (=$V_{PD^*}$/PTV), $R_{50\%}$ (=$V_{0.5xPD^*}$/PTV) and $D_{2cm}$ (max dose at 2 cm from PTV as % of PD*) were calculated and compared to the benchmark values[2].