Multi-field optimization (MFO) compared to single-field optimization (SFO) for bilateral head and neck cancer

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Introduction

Multi-field optimization (MFO) offers dosimetric advantage for highly conformal plan compared to Single-field optimization (SFO) but is more susceptible to range and setup uncertainties, especially in bilateral head and neck cancer where target volumes are relatively complex surrounding with organs at risk (OARs). This study compares MFO with SFO and we report our findings.

Methods

Five patients previously treated with bilateral head and neck cancer with SFO and Monte Carlo dose calculation were retrospectively re-optimized with MFO. All patients were treated to a prescribed dose of 69.96 Gy(RBE) in 33 fractions with 3-4 dose levels to lower risk disease using a 3-field arrangement. All target volumes were optimized with 3mm geometric uncertainty to ensure plan robustness. Treatment plans were evaluated with 3% range uncertainty and 3mm geometrical shifts in each direction. Target coverage and dosage to OARs were compared between SFO and MFO technique.

Results

MFO generally yielded similar D98 and D2 values for target coverage against SFO with average difference of 0.45% and 0.82% respectively. Mean dose to OARs was between 2.67 and 8.05 Gy(RBE) lower with MFO. No significant difference in robustness analysis for target coverage was shown between SFO and MFO, with 1.01% and 1.68% higher in range and setup uncertainty respectively for MFO. Variations to dosage in OARs were comparable, with 3.23 Gy(RBE) higher in maximum dose to spinal cord in worst-case scenario.

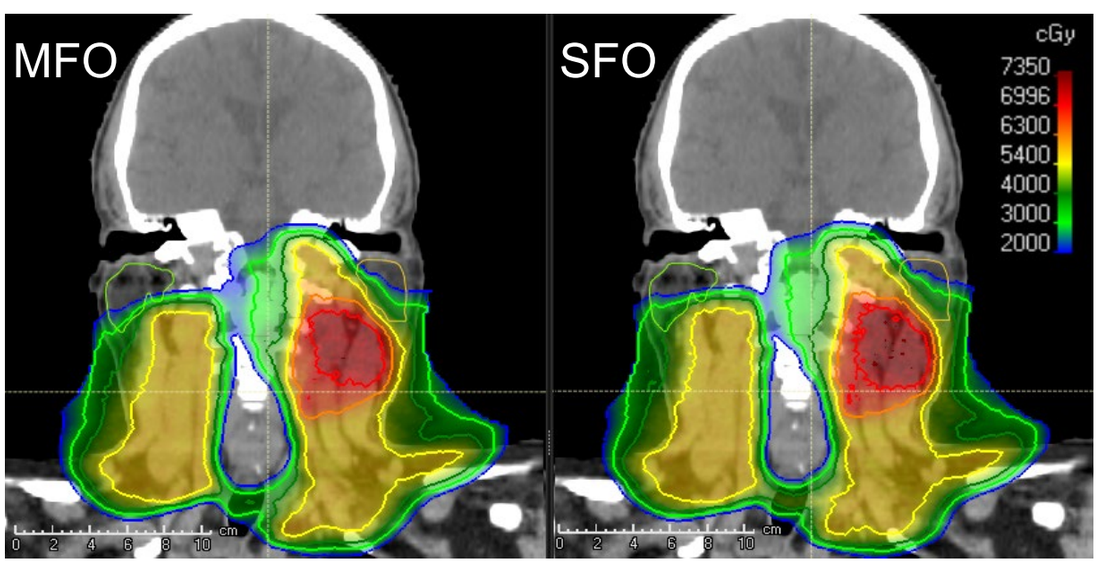

Figure 1. Treatment plan calculated with MFO - left and SFO - right.

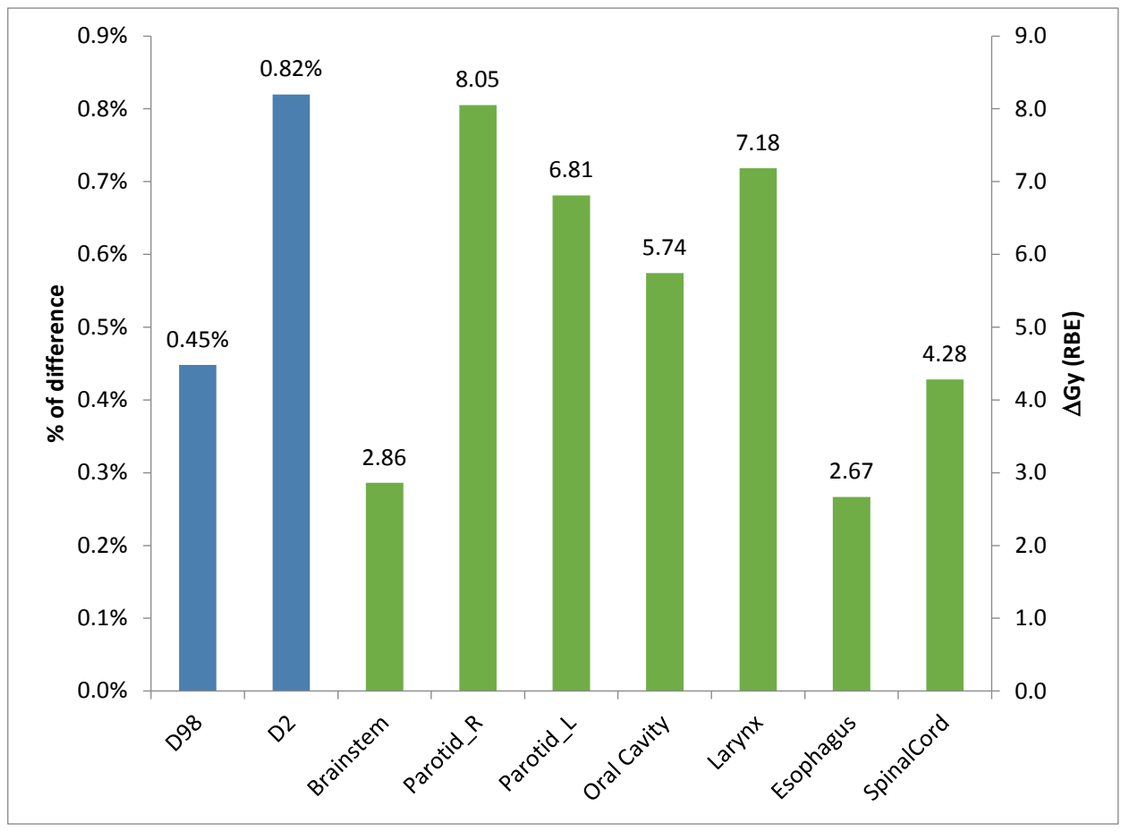

Figure 2. Blue - Average difference in target coverage between SFO and MFO. Green – Average difference in dosage for organs at risk.

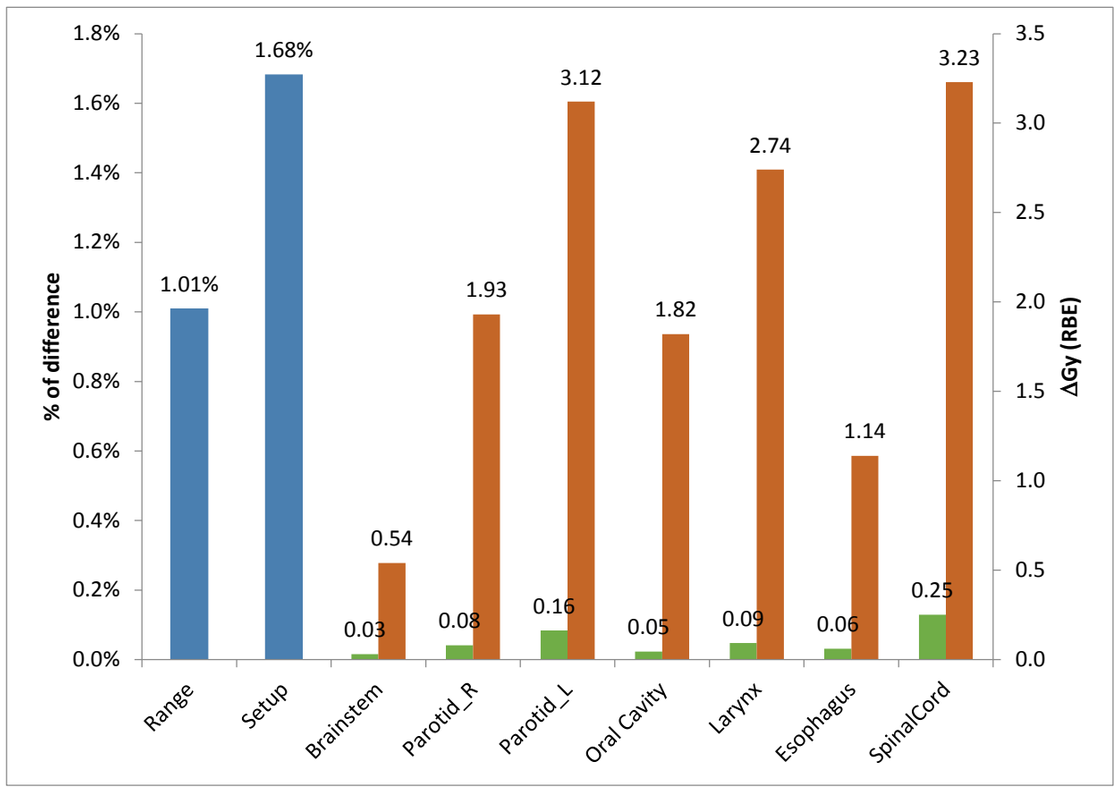

Figure 3. Robustness analysis for target coverage and organs at risk between SFO and MFO. Blue – Difference in average for target coverage with 3% range or 3mm setup uncertainty. Green – Average difference in dosage for organs at risk. Red – Dosage difference in worse-case scenario for organs at risk.

Conclusions

MFO with robustness improves dose distribution over SFO and is within acceptable plan robustness in bilateral head and neck cancer.