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PRESENTATION TITLE
Automatic Contour Propagation of Organs-at-Risk on Serial MRIs and Dosimetric Implications in Glioblastoma Patients Undergoing Chemo-Radiation

AUTHOR(S)
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ABSTRACT
Purpose: Changes in brain anatomy during cheemo-radiation (CRT) for glioblastoma (GBM) can be visualized with magnetic resonance imaging (MRI). The objective of this study is to investigate the anatomical changes that occur in organs-at-risk (OAR) on serial MRls during CRT for GBM patients, and to determine the feasibility of automatic OAR contour propagation for the purpose of an adaptive workflow in MR-guided radiotherapy.

Materials & Methods: 14 GBM patients treated with 60 Gy in 30 fractions of CRT underwent serial multiparametric MRIs on days 0, 10, 20 of treatment (D0, D10, and D20) and 1 month post last fraction (P1M). OARs including the brainstem, globes, lenses, optic nerves, and optic chiasm were manually contoured at each time point on the contrast-enhanced T1-weighted MRI and compared to propagated contours based on the STAPLE deformable image registration algorithm. The Dice similarity coefficient (DSC) was used to quantify changes in manual versus propagated contours. Dosimetric comparison between the manual and propagated contours with respect to maximum point doses (Dmax) of OARs was performed using the reference D0 treatment plan. Statistical differences were determined using the Wilcoxon signed-rank test.

Results: The mean DSC between the manual and propagated OAR contours varied from OAR to OAR (range 0.63 – 0.95) across all time points. The mean DSC +/- standard deviation (SD) across all patients and time points for the brainstem was 0.95 +/- 0.01. For the optic chiasm, the mean DSC +/- SD was 0.77 +/- 0.15. The mean difference in Dmax for each OAR, between the manual contours at each time point compared to the D0 manual contours, ranged from 5-375 cGy. For the brainstem, the differences were 45 +/- 114 (p=0.27), 32 +/- 113 (p=0.59), and 130 +/- 224 cGy (p=0.005) at D10, D20, and P1M, respectively. For the optic chiasm, the differences were 37 +/- 521 (p=1.00), 9 +/- 336, (p=0.86) and 38 +/- 573 cGy (p=0.29) at D10, D20, and P1M, respectively. The mean difference in Dmax for each OAR, between the manual and propagated contours, ranged from 0.3-704 cGy. For the brainstem, the differences were 53 +/- 143 (p=0.24), 3 +/- 50 (p=1.00), and 90 +/- 134 cGy
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(p=0.005) at D10, D20, and P1M, respectively. For the optic chiasm, the differences were 11 +/- 623 (p=0.63), 448 +/- 682, (p=0.005) and 320 +/- 651 cGy (p=0.026) at D10, D20, and P1M, respectively. **Conclusions:** Significant anatomical changes and resultant changes in OAR Dmax occur over the course of CRT for GBM. Automatic contour propagation using deformable image registration in an MR-guided radiotherapy workflow is feasible. The performance of contour propagation varies depending on the OAR and implications in dosimetric differences warrant further investigation.