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Abstract

Conventionally Fractionated Large Volume Head and Neck Re-irradiation using Multileaf Collimator-Based Robotic Technique: A Feasibility Study

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Abstract

Objectives: To report on the feasibility and performance of conventionally fractionated multileaf collimator (MLC)-based robotic stereotactic body re-irradiation of the head and neck region using MLC-based Cyberknife (CK) technology. Methods: Patients treated for recurrent or second primary head and neck cancer with curative proton therapy to a target volume > 30 cm3 between 2011 and 2015 were included. MLC-based CK plans were generated using the CK M6 InCise2 MLC system. Dose statistics from the proton therapy and MLC-based CK plans were compared according to the following metrics: target coverage, target homogeneity index, gradient index, Paddick conformity index (CI), prescription isodose volume (PIV), delivery time (dTime) for one fraction as well as doses to organs at risk (OAR). Wilcoxon signed-rank test was used to compare dose metrics. Results: Eight patients were included; the recurrence sites included: salivary glands, pharynx (oropharynx, hypopharynx and retropharynx) and sinonasal cavities. Five of 8 patients were treated with multifield optimisation intensity modulated proton therapy, 3 were treated with passive scattering proton therapy. Median dose was 67 Gy (range 60-70) in 32 fractions (range 3035). The median high-dose planning target volume (PTV) was 45.4 cm3 (range 2.4 - 130.2 cm3) and the median elective PTV was 91.9 cm3 (range 61.2 - 269.7 cm3). Overall, the mean target coverage (mean 98.3% vs. 96.2% for MLC-based CK vs. proton therapy, respectively), maximum dose to PTV (mean 111% vs. 111%, p=0.2) and mean dose to PTV (mean 104% vs. 104%) were similar across modalities. Highly conformal plans were generated with both modalities, but mean CI was better with proton therapy (0.5 vs. 0.6 for MLC-based CK vs. proton therapy, p=0.04). Homogeneity and gradient indexes were similar between modalities; mean dTime with proton therapy and MLC-based CK was 17 vs. 18 minutes, respectively (p=0.2). Case-based study revealed that CK and protons plans allowed for excellent sparing of OAR, with some clinical scenarios associated with better performance of MLC-based CK while other scenarios had better performance of proton therapy. Conclusion: Our study has demonstrated the dosimetric performance of large volume head and neck re-irradiation using MLCbased CK in various clinical scenarios. While conformity was generally better achieved with proton therapy, MLC-based CK allowed for high dose gradient rapid drop off and sparing of OAR. Conventionally fractionated MLC-based CK could be a competitive alternative in large volume head and neck re-irradiation and should be investigated in the clinical setting.

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