

Spot-Scanning Proton Arc Therapy (SPArc) versus Intensity Modulated Proton Therapy (IMPT) for Parotid Sparing in Unilateral Tonsil Cancer

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INTRODUCTION

Lateralized tonsil cancer is a common head and neck cancer that is often irradiated to only one side of the neck. IMPT can help spare midline organs such as the brainstem and larynx from exit dose, but it is difficult to spare the ipsilateral parotid gland from entrance dose. This is the first known study of unilateral neck irradiation to evaluate potential dosimetric improvements beyond IMPT using SPArc.

MATERIALS AND METHODS

Five patients undergoing high dose (66-70 GyE) IMPT using single-field uniform-dose (SFO) optimization to tonsil cancer and the unilateral neck were re-planned using SPArc in RayStation ver. 6.2. The same worst-case-scenario robust optimization parameters were used (3.5% range and 3 mm setup uncertainties with total 21 scenarios). Clinical IMPT plans using 2 to 3 fields were compared to SPArc plans utilizing one partial arc with 2.5 degree arc sampling frequency.

RESULTS

Mean dose levels (in GyE) for organs at risk were as follows with IMPT versus SPArc, respectively: Parotid Gland 54.8 vs. 21.8, Pharyngeal Constrictors 43.4 vs. 33.6, Larynx 23.8 vs. 14, Ipsilateral Cochlea 11.6 vs. 2.4, Esophagus 19.5 vs. 12, and Oral Cavity 19.5 vs. 17.1. Similarly, the average Brainstem maximum was reduced from 25.8 to 15.1 GyE with SPArc. Differences were statistically significant ($p < 0.05$) for brainstem, larynx, pharyngeal constrictors and parotid.

CONCLUSIONS

For tonsil cancers requiring unilateral high-dose irradiation, SPArc significantly reduced dose levels to larynx, brainstem and pharyngeal constrictors by nearly 10 Gray beyond clinical IMPT plans. SPArc provided new and clinically meaningful parotid sparing (mean dose 21.8 GyE), thus reducing risks of symptomatic xerostomia.

Table 1	SFO Dose (GyE)	SPArc Dose (GyE)	Percent Reduction	p-value
Pharynx Mean	43.4	33.6	23%	0.02
Larynx Mean	23.8	14	42%	0.005
Brainstem Max	25.8	15.1	41%	0.03
Parotid Mean	54.8	21.8	60%	0.0005

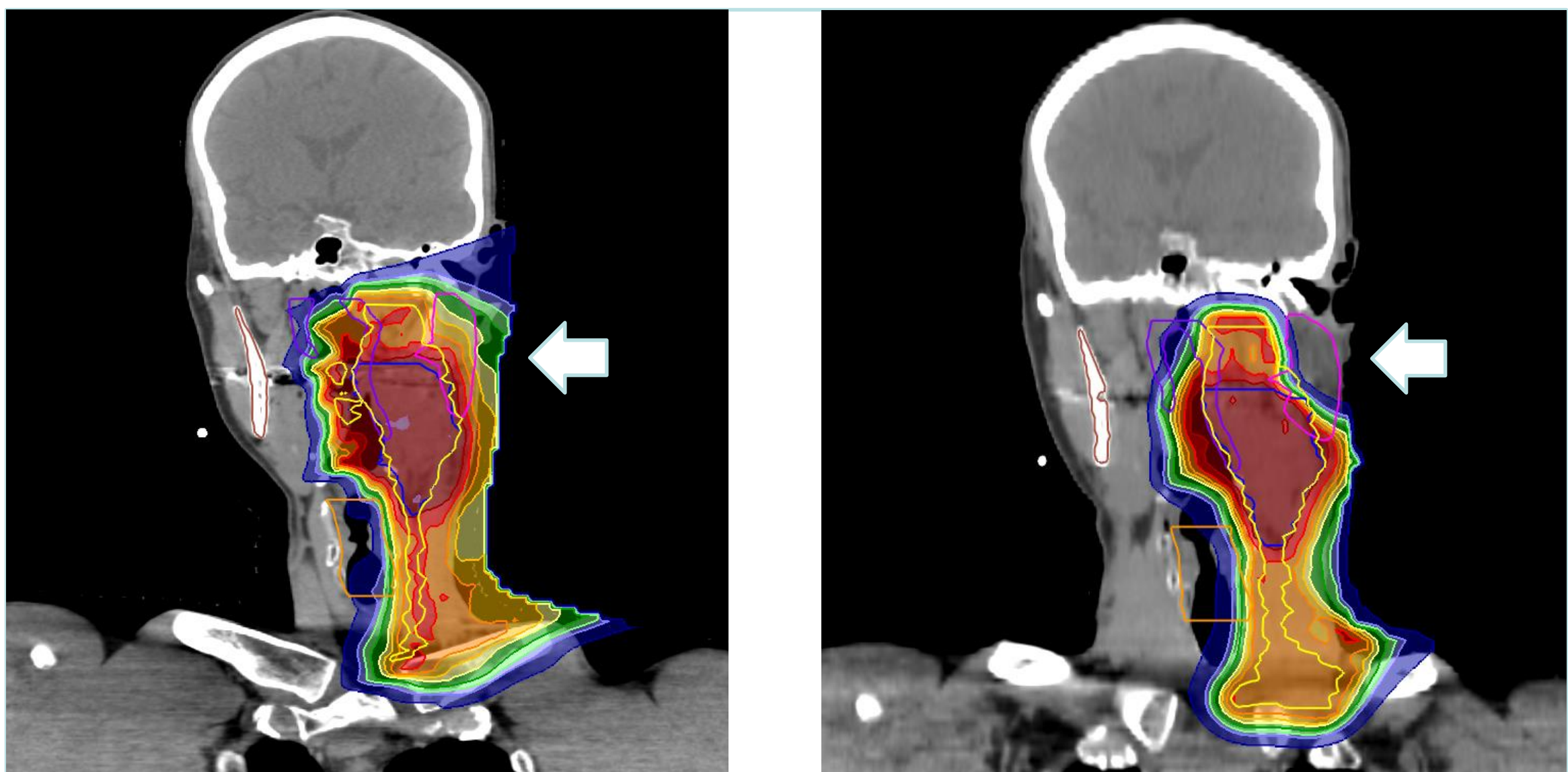


FIGURE 1: SFO-IMPT Plan (Left) Parotid Mean = 61.9 GyE, vs SPArc Plan (Right) Parotid Mean = 24.2 GyE, or 61% less.