INTRODUCTION

This is the first feasibility study to demonstrate that compared to traditional 3 filed RO-IMPT, utilizing the novel proton therapy technique – the spot-scanning proton arc (SPArc) therapy to treatment bilateral head and neck cancer (HNC) will bring significant clinical benefit, which include dosimetric improvement, delivery efficiency and plan robustness etc.

MATERIALS & METHODS

Ten bilateral HNC patients were retrospectively evaluated. Both SPArc and 3-field robust optimized Intensity Modulated Proton Therapy (RO-IMPT) plans were generated using the same robust optimization parameters (±3.5% range and 3mm setup uncertainties). The prescription dose was 7000cGy[RBE] for CTV_high and 6000cGy[RBE] for CTV_low. Clinically significant dosimetric parameters and potential clinical benefit for parotid glands were extracted and compared. Root-mean-square deviation dose (RMSDs) was used to evaluate the plan robustness. Total treatment delivery time was estimated based on a full gantry rotation with 1 rotation-per-min, 2ms spot switching time, 0.01 minimum spot monitor unit per spot, and energy-layer-switching-time (ELST) from 0.1 to 5 seconds.

RESULTS

The SPArc plan was able to provide equivalent or better robust target coverage while demonstrating significant dosimetric improvements over RO-IMPT in most of OARs sparing(Table1). More specifically SPArc reduced the mean dose of ipsilateral parotid(p<0.001), contralateral parotid(p<0.001), and oral cavity(p<0.001) by 27.1%, 28.1% and 32.6% respectively compared to RO-IMPT. The D1% of brain stem and cord were also reduced by 21.3%(p=0.003) and 6.2%(p=0.276) using SPArc, respectively. SPArc reduced the dose uncertainties in cord and ipsilateral parotid 119.6cGy[RBE] vs 91.3cGy[RBE] (p=0.017), 268.2cGy[RBE] vs 243.6cGy[RBE] (p=0.027) respectively(Fig1). Based on ELST of 0.1s, SPArc was comparable in average total estimated delivery time (284.0s vs 304.5s p=0.244). SPArc will decrease the mean probability of salivary flow dysfunction by 8.6%(p<0.001)(Fig2).

CONCLUSIONS

SPArc could significantly reduce the dose to OARs (parotids and oral cavity etc.) while providing a similar or better robust target coverage compared with RO-IMPT. SPArc could potentially achieve comparable treatment delivery time with ELST less than 1s.

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A patent related to the proton arc therapy is licensed to Ion Beaumont Application Inc.