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Adaptive Proton Therapy for Head and Neck Cancer Using Intensity Modulated Proton Therapy: Frequency, Criteria and Practical Considerations

Yuanshui Zheng[*,1], Zuofeng Li[1], Taize Yuan[1], Shen Fu[1]

[*,1] Radiation Oncology, Guangzhou Concord Cancer Center, China

Objectives

Proton therapy of H&N cancer is associated with complex geometrical variations, such as tumor shrinkage and nasal cavity filling change, leading to potential range and dose variation. Therefore, plan adaptation is often needed to ensure optimal target coverage and normal tissue sparing due to proton. The purpose of this study is to present our findings in adaptive radiotherapy for H&N cancer using IMPT proton beams in terms of adaptation frequency, criteria for decision making, and practical considerations.

Methods

We analyzed H&N patients treated at our center since December 2024. Each patient was treated with IMPT proton beams using typically 3-5 fields. Physicians and/or physicists were notified of anatomical change during proton therapy, and a repeat CT was performed as necessary to evaluation the anatomical change and its effect on dosiemetric change. Plan adaptation was determined mutually by physicists and physicians based on anatomical variations and the resulting target coverage and normal tissue dose changes.

Results

Preliminary data were analyzed for the H&N proton therapy patients treated up to June 20, 2025. H&N patients underwent 1-2 adaptive plans on average during the course of proton therapy, ranged from 0 to 4 adaptive plans. The anatomy change leading to plan adaptation included tumor shrinkage, nasal cavity filling change, weight loss, and lack of patient positioning reproducibility. Repeat CT was performed every week initially, but changed to be performed per need based on ported anatomical change from daily imaging for better efficiency.

Conclusions

Adaptive planning is necessary for proton therapy treatment of H&N cancer to maintain prescribed dosimetric distribution when patient anatomy changes. To achieve best dose coverage and maintain high efficiency in proton therapy, we need to determine reasonable criteria for plan adaptation, optimize the adaptation workflow, and balance the benefit from the improved dosimetric distribution with the cost, available resource and potential risk associated with plan change.