# Determination of acceptable air gap differences from the treatment plan for the Mevion S250i Hyperscan system

M. Newpower [1], Z. Richards[1], S. Ahmad[1] and H. Jin[1]

1 University of Oklahoma Health Sciences Center, Oklahoma City, OK

## INTRODUCTION

- In proton therapy, the air gap is defined as the distance between the end of the snout and the surface of the patient.
- Due to patient anatomy changes over the course of treatment, the air gap changes from its planned value, usually increasing.
- If the difference between the planned air gap and actual air gap is too large, the dose modelling in the patient may become inaccurate
- Our therapists need a guideline of what an acceptable air gap difference is

## PURPOSE

- To determine what an acceptable air gap difference is for the Mevion S250i Hyperscan proton pencil beam scanning system.

## METHODS

- We selected four patient plans: the IROC spine, a neck, a prostate and a brain, created QA plans for each, and then delivered one beam from each plan into our QA phantom setup.
- Dose distributions at isocenter were measured with the Octavius 729 XDR. For each QA plan, we irradiated the phantom with the snout at the planned extension and then at various retracted distances, from 0.5 cm to 3.0 cm, to simulated an increased air gap.
- Dose distributions between the planned and retracted extensions were compared using gamma analysis.

## RESULTS

- In Figure 1, the gamma pass rate as a function of Δ, or the air gap difference between the planned beam and delivered beam, is plotted.
- Gamma passing rates for Δ=1 cm were 100% with 2%/2 mm criteria. At Δ =1.5 cm, dose distribution comparisons passed at 65-88% and decreased with increasing Δ.
- Plans with large planned air gaps such as prostate cases, showed less sensitivity to Δ than the brain and neck plans with smaller air gaps.
- In Figure 2, an example of the gamma analysis on the IROC spine phantom with snout retracted 3.0 cm is shown.

**Figure 1:** Δ is defined as the difference between the planned air gap and the actual air gap during patient treatment. As expected, increasing Δ results in changes to the dose distribution as analyzed by gamma analysis.

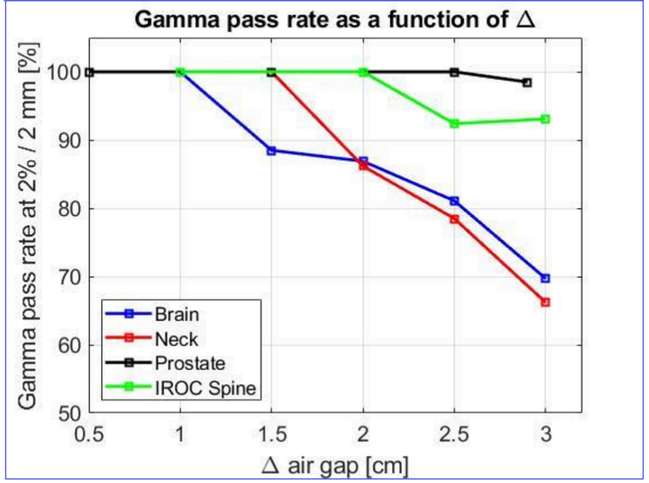
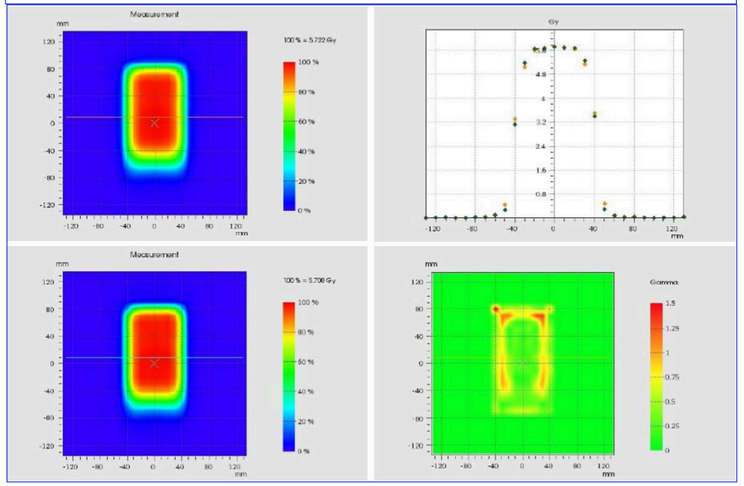



**Figure 2:** Analysis of the IROC spine phantom irradiation with snout retracted 3.0 cm. 93.1 % of points passed the gamma test with 2% / 2mm criteria. Anecdotally, as the air gap difference increased, the dose distributions in high gradient regions tended to fail gamma analysis.



## CONCLUSIONS

- We determined that a snout extension difference of up to 1 cm would be acceptable for patient treatment.
- Plans with large air gaps show less sensitivity to changes in air gaps than plans with small air gaps.

## CONTACT INFORMATION

Email Mark Newpower: mark.newpower@gmail.com