AbstractID: 4805 Title: For small field Radiosurgery Intermediate Energy Photons (800kV) show superior dose distributions compared to megavoltage beams

Purpose: Beam penumbra is significant when using stereotactic radiosurgery to treat small volumes with limited microscopic extensions. It is challenging to irradiate these lesions if a highly critical structure is in close contact with the target. Previous Monte Carlo simulation has demonstrated that using Intermediate Energy Photons (IEP, above orthovoltage and below megavoltage) dramatically reduces the radiological penumbra for small field size radiosurgery (2 x $2cm^2$) when compared to a standard 6 MV beam. This study aims at evaluating the dosimetric benefit of IEP.

Methods: A virtual IEP unit based on an 800 kV beam spectrum was described in the $Pinnacle^3$ TPS including an extended kernel library to the kilovoltage range. A head phantom with a 1cm diameter target volume situated in the middle of the brain and at 1mm from a critical structure was used to assess the dosimetric advantage of IEP compared to 6MV beam. An 11 beam non-coplanar arrangement was used to cover the GTV without margin and a dose of 1000cGy was prescribed. Cumulative DVHs were generated for both energies and for the target, the critical structure and the entire brain. Optimal dosing percentages were chosen for dose normalization to ensure comparable target coverage.

Results: The 800 kV and 6MV beams were dosed to 92% and 78% isodose lines respectively. DVHs demonstrate that the volume of critical structure that received 40% of the given dose was 5.5 % versus 10 %, and the maximum dose received by the target was 110% and 127% for the 800 kV and 6MV beams respectively. The increase in integral dose to the brain for the 800 kV beam is negligible.

Conclusions: An 800 kV beam shows improvements in dose distribution conformality, homogeneity, and critical structure sparing compared to a standard 6MV beam.