

AbstractID: 11047 Title: Study of differences in lateral penumbra widths of passively scattered and spot scanned proton therapy beams

**Purpose:** To compare the lateral penumbra widths of passively scattered (PS) and spot scanned (SS) proton therapy beams.

**Method and Materials:** Lateral profiles of PS and SS proton therapy beams were measured using Gafchromic EBT films at different depths in plastic water phantom. The distal ranges of the beams, spread out Bragg peak (SOBP) widths, and field sizes are kept same both for the PS and SS beams. The SOBPs in the PS beam are generated by the use of appropriate range modulating wheels, and the field size is defined by apertures of appropriate size. The SOBPs and lateral extend of the radiation field for the SS beams are generated by the superposition of single spots with different energy or range positioned in the required open field area. The air gap between the aperture and the phantom surface for the PS beam was kept at a distance typically used for patient treatment. A calibration curve was used to convert film optical density to dose.

**Results:** The 80-20% penumbra widths for the SS beams were found to be substantially larger than those for the PS beams at all depths. The difference can be as much as 6 to 9 mm at shallow depths (< 20 cm). This difference may be attributed to the larger sizes of lower energy spots in the SS beams, which are responsible for the dose deposited at the shallower depths. It may not be possible to get sharp penumbras in SS beam like those in PS beams where the apertures are used for defining the open field area.

**Conclusion:** Spot scanning beams have larger penumbra widths due do the inherent limitations of the spot sizes. Use of field defining apertures like the ones used in PS beam will help in reducing the penumbra widths in SS beam.