AbstractID: 8915 Title: Effect of titanium implants on therapeutic proton dose delivered to patients

Purpose: To assess the accuracy of proton beam dose calculation in Eclipse treatment planning system (TPS) in the presence of Titanium rods in the path of the beam.
Materials and methods: All measurements and computations were performed for a phantom consisting of slabs of acrylic with known water equivalent thickness (WET). One of the slabs supported two cylindrical rods of Titanium, similar to the ones used in spine cages, each of 5 cm in length and 0.5 cm in diameter. A treatment plan was then created using the CT scan of the phantom including the rods. EBT films were placed at various depths in the phantom and were irradiated with the proton beam used in the planning. Specifically, a 225 MeV proton beam impinging the phantom surface was modulated to achieve a 16 cm wide spread out Bragg peak (SOBP) inside the phantom. Percentage depth-dose (PDD) and profiles from Eclipse plan and film dosimetry at different depths in the phantom were compared.
Results: The PDD at depths below the Titanium rods from film dosimetry and Eclipse TPS agree within 3% inside the width of the SOBP. A more significant difference (5% to 20%) is seen at depths beyond the distal 90% dose region with high dose gradients, and can be attributed to the uncertainties in the determination of WET of the phantom materials from CT numbers. Lateral profiles, both in the transversal and longitudinal directions along the Titanium rods, from Eclipse and film dosimetry agree reasonably well with each other including in the regions close to the Titanium-acrylic interface.
Conclusion: Eclipse TPS dose calculation in the presence of Titanium implants is found to be moderately accurate, within the experimental uncertainties. The differences are explainable by the limitation of the analytical pencil beam model for proton dose calculations.