Purpose:
To evaluate the dosimetric effect of spine hardware on intensity modulated spinal sterotactic radiosurgery (IMSRT) treatment planning in Pinnacle.

Methods:
Monte Carlo (MC) modeling of a clinical 6 MV photon beam was validated with measured Percentage depth dose (PDD) and cross profile for various field sizes. Once validated, MC simulation was used to study the dosimetric effect of a 5-mm diameter Titanium rod in water for field sizes 2x2, 3x3 and 5x5 cm2. We used MC results to benchmark the Pinnacle treatment planning system on heterogeneity calculations for Titanium rods by overriding the titanium density (4.5 g/cm3) from the default CT-Density LUT value of 1.75 g/cm3. Finally, Pinnacle was used to study the dosimetric effect of metal implant in IMSRT plan by evaluating the DVH difference between a hardware density of 1.75 and 4.5. In the study, spine hardware was auto contoured and verified with DCR in multiple beam angles.

Results:
Pinnacle's heterogeneity calculation for titanium rods are accurate when relative electronic density of 4.5 is used based on our benchmark tests using MC simulations. Overriding the hardware density from 1.75 to 4.5 decreases the dose to the part of the target that is blocked by the hardware, which reduces the target volume that receives the prescribed dose. For the 7 cases we evaluated, the reduction of target volume receiving the prescription dose can be as high as 15% with most cases around 4%. The dosimetric effect of the hardware on critical structures, such as cord, is minimal.

Conclusions:
Our results showed metal implants can cause significant dose perturbations in spine SBRT. Beam angle selection should minimize the presence of the metal hardware in the beam path. Appropriate density values should be used for the hardware to improve the dose calculation accuracy.