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Validation and implementation of a dedicated spine stereotactic radiosurgery treatment planning system

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the limited bone definition on MRI and limited soft tissue contrast on CBCT. Image quality and the region of interest (ROI) chosen during co-registration can impact the co-registration accuracy. A traditional CT scan can be used as an intermediate co-registration dataset, but this adds a potentially undesirable additional step in the workflow. The results reported suggest that both workflows produce similar results, and a traditional CT simulation scan is not necessary in the frameless LGK Icon workflow.

PO-GePV-T-415, Comparisons of the Dose Calculation Algorithms and the Dosimetric Impact of Titanium Implants in Spinal SBRT Using Three Commercial Treatment Planning Systems: C Liu*, A Magnelli, Y Cho, L Angelov, E Balagamwala, S Chao, P Xia, Cleveland Clinic, Cleveland, OH

Purpose: To compare four dose calculation algorithms and evaluate the dosimetric impact of the titanium implants in the spine for SBRT using three commercial treatment planning systems (TPSs). **Methods:** Twenty patients with titanium implants treated with spinal SBRT in 2019-2021 at our institution were selected. The clinical plan for each patient was created in Pinnacle and subsequently imported into Eclipse (AAA and Acuros) and Raystation (CCC) for dose re-calculation. For each dose algorithm, two plans with and without density override (DO) to the titanium implant (4.43 g/cm3) were created per patient. The plans with DO were set to have the same tumor dose coverage as the plans without DO. Dose metrics of PTV such as maximum dose to 0.03 cc (Dmax), dose to 99% (D99%) and 90% (D90%) and dose limits for the spinal cord such as Dmax and 10 Gy (V10Gy) were evaluated. **Results:** For the same algorithm, plans with and without DO had similar dose distributions. Differences in PTV metrics were <2% with slightly larger variations up to 5.58% in Acuros. Dmax of spinal cord for plans calculated with DO increased but the differences were insignificant for all algorithms (mean: 0.60%). Comparing to the clinical plans, the relative dose differences of PTV metrics between algorithms had an average of ~3% while two cases had the differences of >10%. Differences in Dmax of the spinal cord had an average of 4.1% while differences up to 11% were observed for smaller cord volumes. Due to the different partial volume interpretations, V10Gy (cc) of spinal cord were inconsistent among three TPSs depending on the spinal cord volume. **Conclusion:** For all algorithms, the presence of titanium implants in the spine had minimal impact on dose distributions with and without DO. The partial volume effect from different TPSs can impact on V10Gy (cc).

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PO-GePV-T-416, Validation and Implementation of a Dedicated Spine Stereotactic Radiosurgery Treatment Planning System: C Knill*, R Sandhu, B Loughery, L Lin, Z Seymour, P Chinnaiyan, T Quinn, M Almahariq, R Deraniyagala, Beaumont Health, Royal Oak, MI

Purpose: A dedicated spine stereotactic radiosurgery optimization algorithm was commissioned for 6FFF Versa HD deliveries. Plan comparisons with the existing clinical optimization algorithm along with the dosimetric validation of the deliveries were investigated. **Methods:** Nine stereotactic spine patients, previously treated with Pinnacle generated plans, were re-optimized using Brainlab's SRS spine planning Element. Three additional Elements plans were created for each patient: 1) initial optimization using a pencil beam calculation algorithm (PBC), 2) Monte Carlo (MC) re-calculation of the PBC plan, and 3) re-optimization of the PBC plan using Monte Carlo. Patient dose from PBC plans was compared to MC recalculated to evaluate dosimetric differences between Elements calculation models. MC re-optimized plans were compared to initial Pinnacle plans to evaluate optimization algorithms. Plans were compared using PTV percentage receiving prescription dose (PTV-V100%) and max spinal canal dose (Canal-DMAX). MC re-optimized plans were delivered to a microdiamond chamber and SRSMapcheck in the StereoPHAN phantom to verify deliverability. **Results:** Recalculating the Elements PBC plans with Elements MC reduced the PTV-V100 by -2.5%+/-3.28%, while increasing the Canal-DMAX by 1.14Gy+/-0.50Gy. Subsequent MC re-optimization led to similar Canal-DMAX doses as the PBC calculations, for the same target coverage [Wilcoxon Rank Sum alpha<0.05]. Elements MC re-optimized plans reduced the Canal-DMAX by 3.59Gy+/-2.13Gy, while maintain the same PTV coverage compared with Pinnacle. On average, microdiamond measured point doses were within –1.01%+/-2.18% and 0.311%+/-1.20% for targets and OARs, respectively. Average per-plan pass rates using a 2%/2mm/10% threshold relative gamma analysis were 99.1%+/-0.89%. **Conclusion:** Initial optimizations using PBC provided a fast method for exploring realizable optimization objectives that could be achieved with subsequent MC optimization. Brainlab's site-specific spine SRS optimizer was able to produce deliverable plans with lower spinal canal dose [Paired T-Test P<0.001] and similar target coverage to Pinnacle.

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