Purpose: To compare dosimetric results of VMAT and Tomotherapy dose painting techniques with hippocampus sparing in brain metastases.

Methods: A patient with multiple brain metastases was entered into this dosimetry study. Pinnacle VMAT SmartArc™ plan was executed in version 9.2 while setting the same dose constraints in Tomotherapy planning version 4.04. The clinical goal is to perform simultaneous in-field boost (SIB) with whole brain for 32.5 Gy while delivery extra dose per fraction to the brain metastatic sites to 63 Gy. The mean dose to each of the hippocampus was prescribed to less than 6 Gy. Dosimetric analysis was performed on the 3DVH modules by Sun Nuclear Corp™. The ArcCheck™ platform was also utilized to measure the 3%/3mm gamma passing rate.

Results: Clinical planning criteria for GTV coverage were all satisfied, while Tomotherapy presents better hippocampus sparing compared both to the VMAT technique (mean: 5.29/10.05 Gy on left and 5.18/9.90 Gy on right, max: 7.19/17.82 Gy on left and 7.58/20.79 Gy on right). Tomotherapy has inferior chiasm sparing with mean 32.26 Gy compared to VMAT planning 29.16 Gy. However, the dose uniformity of Tomotherapy has proven to be superior in all lesions with average mean dose 63.63 Gy with respect to 64.33 Gy; max dose of 102.2% on Tomotherapy and 105.3% on VMAT planning. ArcCheck passing rate for Tomotherapy is 98.9% with 3%/3mm gamma settings.

Conclusions: Tomotherapy planning is considered a gold standard for arc-based treatment. From the planning comparison, with VMAT delivery, achieving 6Gy dose sparing to the hippocampus presents great challenge compared to the Tomotherapy planning and delivery. One major reason is that the VMAT MLC speed cannot generate enough fluence patterns to produce the extremely high dose gradient. ArcCheck measurements for VMAT and Tomotherapy represented errors induced from the combination of TPS dose calculation algorithm and beam-delivery inaccuracy.