Purpose: Radiotherapy techniques for sparing the hippocampus during cranial irradiation are emerging. This work is to study dose-painting with volumetric modulated arc therapy (VMAT) in the setting of oligo brain metastases and the clinically relevant dose QA.

Methods: A patient having 3 brain metastases was re-planned using 2-arc 6 MV photons with in-house VMAT treatment planning system (TPS). The clinical goal is to dose paint the whole brain and brain metastases to 32 Gy and 63 Gy in 15 fractions, respectively while keeping the mean dose to the hippocampus less than 6 Gy. The VMAT dose QA was carried out using ArcCHECK (AC) and 3DVH (Sun Nuclear Corp) on a Varian Trilogy LINAC. The AC Planned-Dose-Perturbation (ACPDP) algorithm was employed to estimate the actual patient dose distribution, at the same grid resolution as that from the TPS calculation. The patientâ€™s DICOM RT dose/plan/structures/CT images were loaded into the software. The measured doses and TPS calculated doses for relevant structures were compared. Their differences represented systematic errors induced from the combination of TPS dose calculation algorithm and beam-delivery.

Results: Clinical planning criteria were all satisfied. A 99.5% 3D matching rate for 2%/2mm DD/DTA was observed between the ACPDP reconstruction and TPS-calculated dose. Despite the excellent agreement, the relative dose differences for patientâ€™s critical structures between measurements and TPS are: 0.8%, mean brain lesions; 0.7%, mean whole brain; 9% (<3% of prescription), mean L_hippocampus; 9% (<3% of prescription), mean R_hippocampus; 0.1%, max cord; 1.8%, max chiasm; 3.7%, max brainstem; 0.5%, max L_OpticN; 1.9%, max R_OpticN, 0.2%.

Conclusions: For the application of dose painting VMAT planning for patients with oligo brain metastases, the patient relevant dose QA result has demonstrated the capability and the accuracy of our VMAT technique, allowing for 3-level dose-painting to spare critical structures with acceptable target coverage and homogeneity.