Purpose: The volumetric modulated arc therapy (VMAT) plan need more control points than step&shoot IMRT, resulting more small MU/segments. The purpose of this study is to investigate the impact of small MU/segment and high dose rate for VMAT delivery.

Methods: Five patients for whole brain treatment with hippocampus sparing were selected for this study. For each patient, two VMAT plans were created using Pinnacle 9.0 with a maximum dose rate of 600 and 1000 MU/min for a prescription daily dose of 3 Gy. To evaluate the effect of small MU/segment at these planned dose rates, without altering the plan optimization, we also delivered two additional VMAT plans with the daily dose of 1 Gy and 1.5 Gy for each dose rate. For each of these plans, the histograms of the small MU/segment were compared. Using the delivered dose distributions of 3Gy VMAT plans as a benchmark, we compared the planar doses of these plans using three gamma index criteria.

Results: The average number of small MU/segment (≤1 MU)in 1Gy and 1.5Gy plans is 47±6 and 30±7. Compared to delivered 3Gy VMAT plans, at 600 MU/min, the delivered 1.5Gy plans were within 97.95±1.66 %, 99.95±0.04%, 99.99±0.01% agreement for 1%/1mm, 2%/2mm and 3%/3mm criteria, respectively. The delivered doses of 1Gy plans were within 80.84±2.60%, 98.77±0.85%, 99.92±0.08% agreement accordingly. At 1000 MU/min, the delivered 1.5 Gy plans were within 96.59±2.70%, 99.92±0.10%, 99.99±0.01%; the delivered 1 Gy plans were within 74.37±9.96%, 97.43±2.67%, 99.59±0.52%, respectively. At Ï=0.05, the variance between 1Gy plans and 1.5Gy plans was significantly different by T-test for both doserates. Same results for the variance between 600 MU/min and 1000MU/min at 1 Gy plans by T-test.

Conclusions: The number of small MU/segment (≤1 MU) in VMAT plan can significant impact the accuracy of the delivery dose. For small fraction dose, the use of very high dose rate should be cautioned.