Dosimetry Comparison of VMAT and Tomotherapy Plans with Dose Painting in Brain Metastases

Innovation/Impact: This test case presents a systematic comparison for clinical implementation of the challenging VMAT technique for the dose painting scenario. The whole brain RT with hippocampus sparing and simultaneous boost to those brain metastases presents great challenge in both planning and dosimetry validation. This is the pre-commissioning work performed for both ArcCheck and VMAT techniques.

Fig. 1a-e displays the DVH from both the Pinnacle VMAT and Tomotherapy plans. ArcCheck (4D cylindrical detector array) and 3DVH were used for this VMAT and Tomotherapy QA study. Fig. 1a is for the GTVs comparison, Fig. 1b is for chiasm comparison, Fig. 1c and 1d are for both the left and right hippocampus. Fig. 1e is the numerical summary for both planning statistics from VMAT and Tomotherapy.

Fig. 2a displays the voxel dose differences in 3D, with the hippocampus sparing, which is noticeable for VMAT planning. Fig. 2b is from Tomotherapy planning. The lesions are covered by 63 Gy, with whole brain RT at 32.5 Gy, while hippocampi are kept in the low mean dose around 6 Gy (blue area). Compared to Tomotherapy, VMAT is a very promising choice. However, its dose verification process is tedious. Conventional pre-treatment patient QA tools with 2D detector arrays may not be sensitive and specific enough to detect clinically relevant dose error. Fig. 2c shows the comparison of ArcCheck testing results with Tomotherapy and comparable results were also acquired for VMAT delivery.