An evaluation of a newly available portal dosimetry QA tool for SRS dynamic arc and VMAT

In our institute, all brain stereotactic radiosurgery cases are treated with Varian Novalis TX™ with the ExacTrac® system and 6X SRS beam with dose rate of 1000MU/min. About 60% of all the plans are delivered with dynamic conformal arc technique utilizing Varian’s 120-leaf HDMLC. Due to the high dose and precision of SRS treatments, we have been searching for the optimal pretreatment verification of fluence and MLC movement. Our current technique utilizes the MatriXX™ and MULTI Cube™ to be consistent with the procedures used for IMRT and VMAT QA. The space between two ion chambers on the MatriXX is 7.6mm, and the diameter for each chamber is 4.5mm. Considering the field sizes for SRS arcs are between 1.5cm and 4cm, partial volume effect is significant except at the center chambers. Figure 1 shows a typical report for our current QA technique. The dose difference limit is set to 8% of the calculated isocenter dose. The green profile is the calculated dose, and the red profile is the measured dose. The red area in the bottom of the figure is where the difference between measurement and calculation is higher than 8%. Thus, our current QA method has been, for the most part, a point dose check at isocenter with little regard given to fluence comparison due to the limited resolution of the MatriXX device.

Once the capability of performing portal dosimetry measurements for arc treatments became available in Eclipse™ Version 10, we began evaluating this method for SRS QA. For the SRS beam configuration, we followed the instructions in the Varian application tip. The standard Varian 5-bar pattern used to commission the portal dosimeter was converted to a 3-bar pattern due to the 15cm field size limit for SRS beams. This pattern was measured at an SID of 120cm and 150cm. Output factors were measured for a matrix of 9 different field sizes: 1cm, 3cm, 5cm, 7cm, 9cm, 10cm, 11cm, 13cm, 15cm. Figure 2 shows the predicted and measured portal doses of the 3-bar pattern. 99.5% of pixels have gamma <1 for 4mm and 4%, higher than the Varian recommended limit of 99%, leading us to consider our PDIP configuration successful.

Nine plans were delivered and QA performed using gamma analysis. The average area with gamma<1 was 98.4%. Figure 3 shows the resulting PD analysis for the same plan shown in Figure 1. Gamma passes at 100% and the percentage of area with dose difference higher than 5% is only 2.2%. From this data we conclude that PD is a robust and accurate QA method that outperforms our standard QA techniques.

Reference: (1) Varian Application Quick Tip: Configuring Portal Dosimetry for SRS mode