Use of Octavius 4D for the Patient Specific Dose Validation of Single-Isocenter Multiple Brain Metastasis Stereotactic Radiosurgery

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INTRODUCTION

The purpose of this study was to assess the ability of the PTW Octavius 4D Modular Phantom (O4D) to perform quality assurance for single-isocenter multiple brain metastasis stereotactic radiosurgery and determine what fraction of lesions are measurable on the 11 x 11 PTW 1000 SRS detector array.

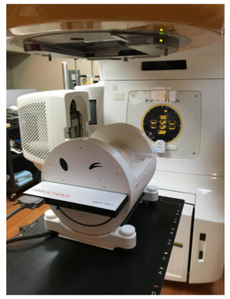

Figure 1: The Octavius 4D Modular Phantom set up for SRS patient specific QA

METHODS

The O4D is a water equivalent cylindrical phantom equipped with an insert for the 1000 SRS array. The array is composed of 977 liquid-filled ionization chambers that are spaced 2.5 mm apart in the inner 5.5 cm x 5.5 cm square and 5 mm apart in the outer 11 cm x 11 cm square. An inclinometer is placed on the gantry that allows for the O4D to rotate in synchronization with the gantry. All QA plans were delivered at a couch angle of 0 degrees.

15 SRS patient plans with multiple targets (2 – 11) created with Brainlab Elements Multiple Brain Metastases 2.0 were recalculated on the O4D and analyzed using Verisoft with a gamma criteria of 3%/1mm. Verisoft was given each beams intended table angle and a non-coplanar dose cloud was calculated. Lesions visible in the dose cloud were considered measurable.

RESULTS

Patient Number	Number of Targets	Number of measurable lesions	Gamma Passing Rate (3%/1mm)
1	5	4	99.4%
2	2	2	100%
3	5	3	99.4%
4	4	4	99.8%
5	3	1	99.9%
6	4	3	99.7%
7	11	8	98.9%
8	10	9	99.4%
9	3	3	99.5%
10	4	3	98.0%
11	5	5	98.2%
12	9	8	98.1%
13	3	3	100%
14	3	3	99.5%
15	3	2	99.7%

Table 1: Patient Demographics

Patient Number	Number of Targets	Average CI	Average GI	Prescription Volume
1	5	1.31	3.88	99.5%
2	2	1.21	2.93	99.5%
3	5	1.37	5.55	99.5%
4	4	1.55	4.12	99.5%
5	3	1.31	3.25	99.5%
6	4	1.71	3.93	99.5%
7	11	1.60	6.10	99.5%
8	10	1.63	6.01	99.5%
9	3	1.31	4.47	99.5%
10	4	1.39	4.97	99.5%
11	5	1.32	5.32	99.5%
12	9	1.61	6.89	99.5%
13	3	1.47	4.75	99.5%
14	3	1.33	3.54	99.5%
15	3	1.53	6.53	99.5%

Table 2: Individual results for each patient

Figure 2: The Octavius 4D Modular Phantom set up for SRS patient specific QA

Total Number of Targets	74
Total Number of Measurable Targets	61
Average Gamma Passing Rate (3%/1mm)	99.3%

Table 3: Summary of results

There were 74 targets amongst the 15 patients. 61 of these targets were visible in the measured dose clouds (82%). The average gamma passing rate was 99.3% with a sample standard deviation of 0.68%.

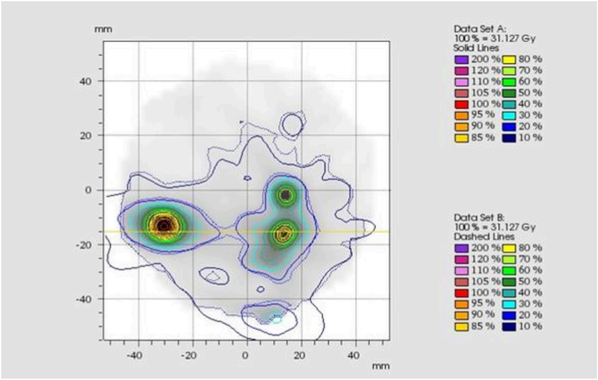

Figure 3: *Measured Dose from a single slice of the O4D phantom. The Dash lines show the calculated plan and the solid lines show the measured plan*

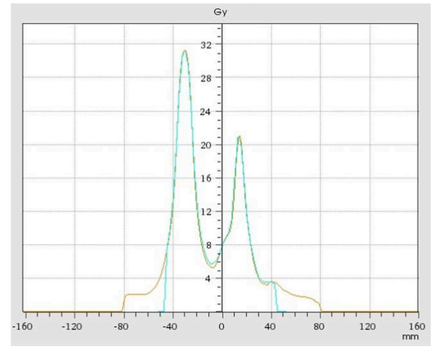

Figure 4: Measured dose profile (blue) vs calculated dose profile (orange)

CONCLUSIONS

The O4D is of a large enough size that a majority of targets can be QA'd for single-isocenter multiple brain metastasis stereotactic radiosurgery. The close detector spacing allows for very high resolution sufficient for patient-specific dose verification.

CONTACT INFORMATION

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