An Evaluation of SRS MapCHECK for the QA of stereotactic radiotherapy plans for patients with multiple metastasis and small targets

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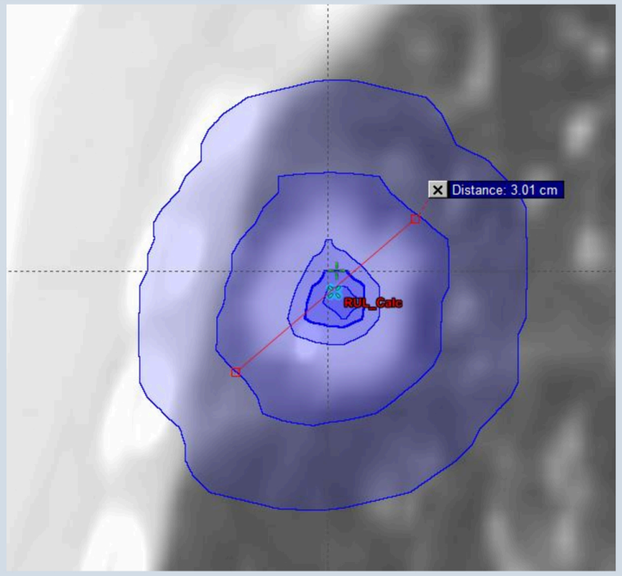
Purpose: In the Quality Assurance (QA) of stereotactic radiotherapy plans involving small targets, film dosimetry is suitable because of superior resolution but a filmless solution such as SRS MapCHECK (Sun Nuclear Corporation, Melbourne, FL) is attractive for expeditious results. In this work, we evaluated the suitability of SRS MapCHECK for patient-specific QA

Methods: First, we planned and delivered reference open square fields of sides 5cm, 3cm, 2cm, 1cm and 0.5cm. Next, starting with the planning target volume (PTV) of a previously treated lung cancer patient, we generated treatment plans and QA based on several derived targets with different PTV maximum diameters, named accordingly as PTV3mm, PTV6mm, PTV1cm, PTV3cm, and PTV5cm. Lastly, we performed QA on a complex case, namely a mono-isocentric multiple target (7) metastases planned with 5 non-coplanar beams. The volumes for PTVs1-7 were 1.4cc, 32.4cc, 1.2cc, 0.2cc, 27.1cc, 0.7cc, and 0.2cc. Three different QAs were developed to account for all targets grouped as QA1-PTV4,5,7; QA2-PTV1,3 and QA3-PTV2,6. Note that the QA plans were delivered with the actual planned couch angles



SRS MapCHECK in StereoPHAN properties:
2D array – 1013 diodes
2.47mm diode separation
Can rotate array to acquire in any oblique as well as coronal/saggital planes

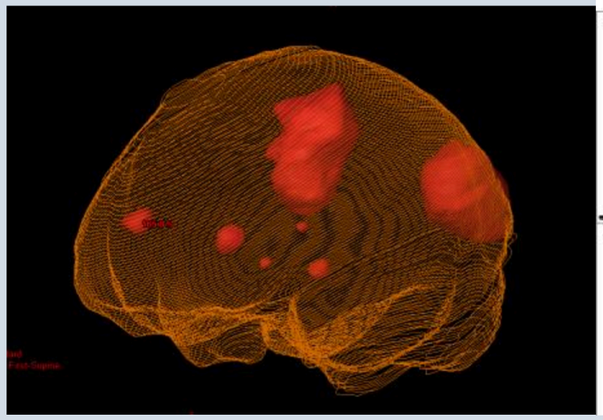
As shown above, starting with a PTV from a previously treated lung case, we generated 4 other PTVs

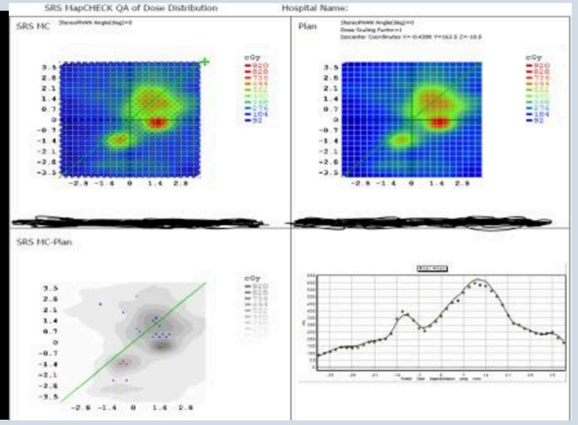
PTV5cm (72.3cc)
PTV3cm (13.8cc)
PTV1cm (0.7cc)
PTV6mm (0.2cc)
PTV3mm (0.03cc)

For the complex patient case studied, the PTV average distance from the monoIsocenter was 53.8 ± 15.9mm, range (26.4mm to 73.0mm)

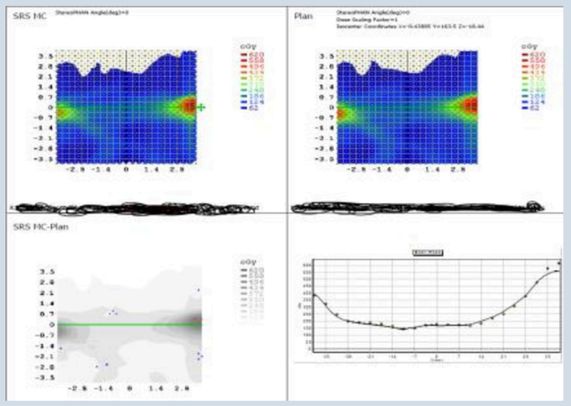
Results: Based on a 10% dose threshold, 2%/2mm criteria the gamma passing rate for the reference fields were 100%, 100%, 97.4%, 94.6% and 81.3% for the 5cm, 3cm, 2cm, 1cm and 0.5cm reference square fields respectively. Similar analysis showed a gamma passing rate of 100% (100%), 100% (99.6%), 100% (99.5%), 97.1% (99.1%), 100% (98.3%) respectively for the plans with PTV5cm, PTV3cm, PTV1cm, PTV6mm, PTV3mm when planned with the 6FFF (10FFF) energy.

For the complex case, the corresponding passing rates were 97.7%, 98.4%, and 98.3% respectively for the QA plans QA1-PTV4,5,7; QA2-PTV1,3 and QA3-PTV2,6.

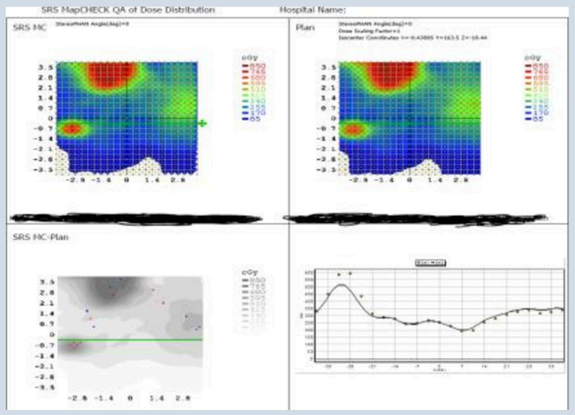




Previously treated patient with 7 metastases



QA2-PTV1,3 $\gamma = 98.4\%$



QA1-PTV4,5,7 $\gamma = 97.7\%$

QA3-PTV2,6 $\gamma = 98.3\%$

Conclusion: We have evaluated the SRS MapCHECK for suitability as a filmless solution for patient specific QA involving small targets and complex cases with multiple targets planned with single isocenter and non-coplanar fields.

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