

Streamlined Quality Assurance Workflow for Linac-based SRS using an Elekta Versa 6FFF Beam

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PURPOSE

- Accurate and precise planning and delivery of linac-based stereotactic radiosurgery (SRS) can be challenging.
- Thus, it is important to develop a streamlined clinical workflow to increase efficiency, accuracy and precision of the treatment.

MATERIAL & METHODS

- An Elekta Versa HD linac equipped with 6 MV FFF beam, Agility MLC, and Hexapod couch was commissioned for SRS treatments.
- During commissioning, relative output factors (ROFs), PDDs and beam profiles were measured and cross validated using three different detectors. Agreement to the treatment planning system (TPS) was evaluated using 1mm/2% gamma analysis.



Figure 1. Detectors for linac based SRS commissioning

- KV-imaging isocenter was calibrated to coincide with the 6FFF radiation isocenter. The IROC SRS Anthropomorphic Phantom was irradiated for end-to-end testing. Prior to patient treatment, a mask fit, CT- and MR-simulation scans were acquired.
- A custom MIM workflow was developed to automatically standardize and register multiple MR sequences.
- Targets and OARs were delineated and transferred to the Monaco TPS for planning.
- A 1.5mm margin was selected for single iso treatment and 2mm margin for multitarget, multi-iso planning to account for treatment uncertainties.
- A dry run was scheduled to evaluate real-time patient monitoring using VisionRT and verify couch clearance. Patient-specific QA was performed using Sun Nuclear SRS-Mapcheck.
- Agreement between imaging- and radiation-isocenters was evaluated using a Sun Nuclear Multi-Met Winston-Lutz (MM_WL) cube.

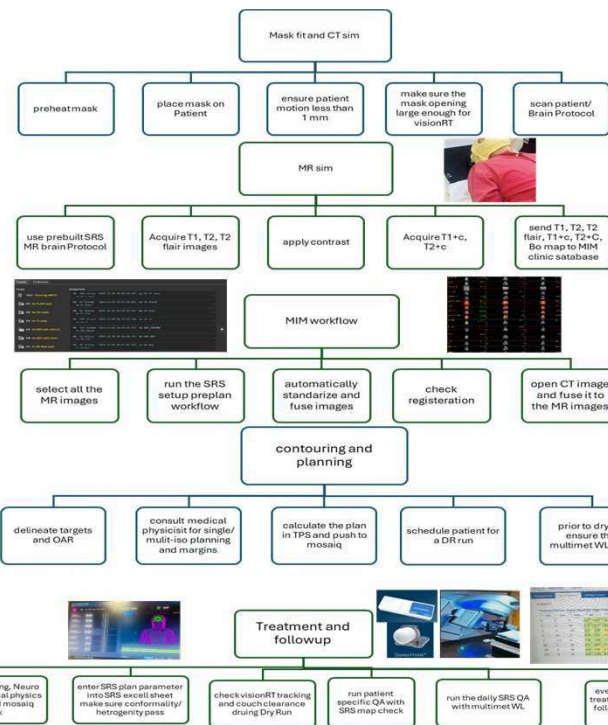


Figure 2. Linac based SRS workflow from imaging to treat



Figure 3. Example of SRS Map check (2.5 mm spatial resolution) setup showing perfect agreement between Monaco and SRS map check for 5cmx5cm

RESULTS

- Monaco TPS calculations demonstrated gamma passing rates >95% for field sizes as small as 0.6x0.6cm² compared to measured data.
- ROFs for all field sizes were within 2% of the TPS model. The WL-test confirmed field-target coincidence prior to patient treatment.
- Patient-specific QA measurements achieved gamma passing rates >95%.
- Implementation of the dry-run and MM_WL provided sufficient time to resolve issues related to gantry clearance, couch wobbling, or real-time monitoring prior to treatment.

Table 1. Scp measurements vs Monaco for 6FFF (output factors from 4 detectors agree within 3%)

FS	Film	Edge_corr	ST with CLR	A16V_corr
1 x 1	0.1%	-1.0%	0.1%	-3.0%
2 x 2	0.9%	1.4%	-1.3%	1.8%
3 x 3	0.1%	0.6%	-0.4%	1.3%
4 x 4	2.0%	0.3%	-0.1%	1.0%
5 x 5	2.5%	-0.2%	0.4%	0.3%

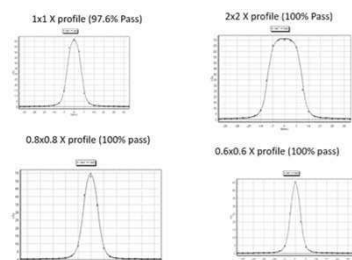


Figure 4. Gamma passing for different field sizes with 3%/1mm using SRS mapcheck

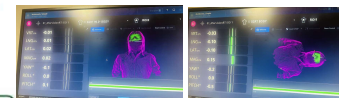


Figure 5. Example of Vision RT tracking

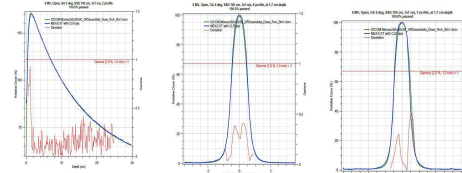


Figure 6. Example of water tank scan with W2 scintillator detector compared to Monaco with 1mm/2% criteria

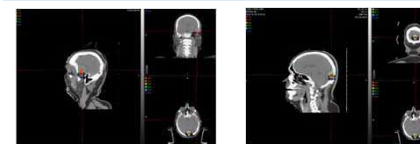


Figure 7. Example of SRS isodose distribution for brain met

CONCLUSIONS

- A streamlined workflow was developed to ensure precise, safe, and high-quality SRS delivery with an Elekta Versa 6FFF Beam

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