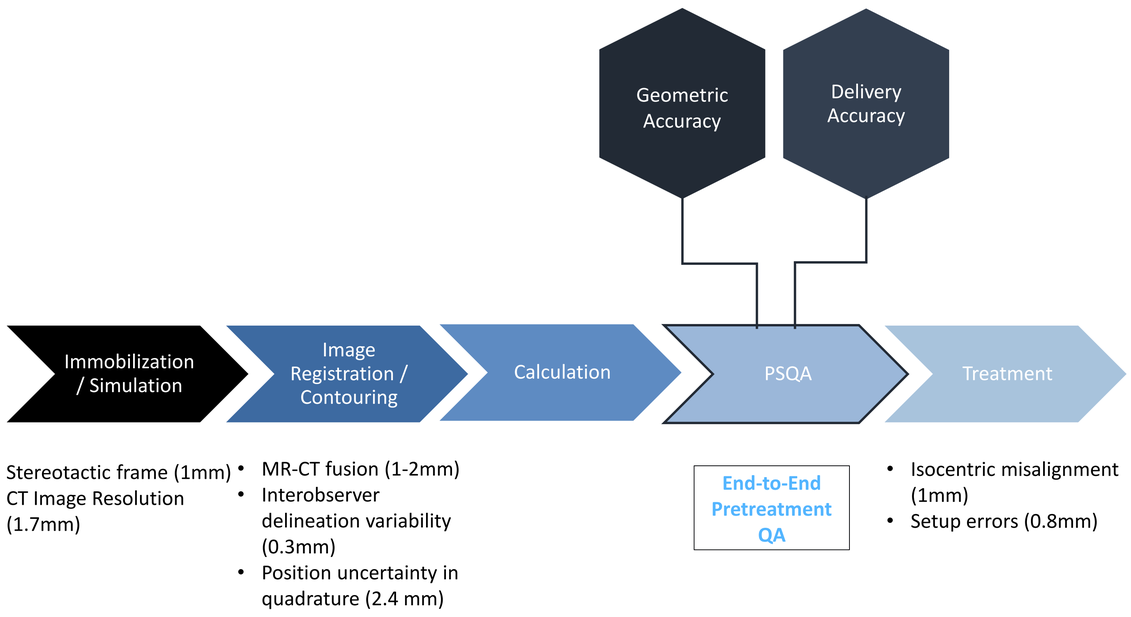
Assessment of Surface Guided Radiotherapy system for utilization in SRS treatments using a TG-302 compliant anthropomorphic head phantom

D. STASINOU, M. PSARRAS, E. ZOROS, T. STROUMPINIS, N. PAPANIKOLAOU, K. PLATONI, E. PAPPAS

INTRODUCTION

Single isocenter stereotactic radiosurgery (SI-SRS) is an efficient approach for dose delivery to multiple brain metastases since the treatment duration is considerably reduced, compared to the standard method of the isocenter placement at each tumor center. However, the complexity of this technique results in increased sensitivity to geometric and dosimetric uncertainties during plan delivery, thus demanding patient-specific quality assurance (PSQA) procedures of high accuracy. With the implementation of advanced new techniques in the treatment workflow, such as **Surface Guidance (SGRT)**, the need for the adjustment of the QA process occurs.



OBJECTIVES

In this study we aimed to:

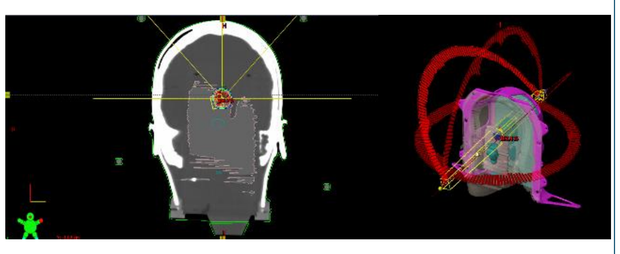
- Construct a TG-302 compliant anthropomorphic phantom.
- Perform a dosimetric end-to-end (E2E) test for the commissioning of an SGRT system for SI-SRS treatments.

MATERIALS & METHODS

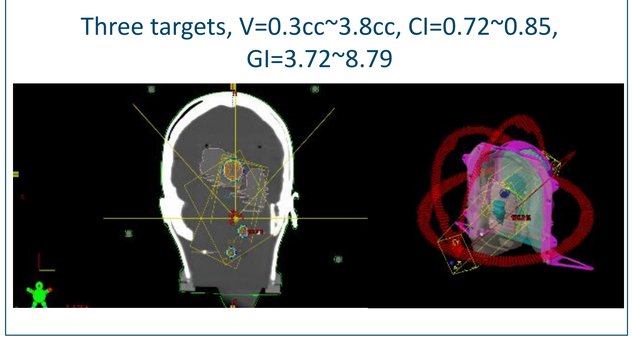
Two SI-SRS plans were generated with HyperArc algorithm for Varian TrueBeam Edge linac.

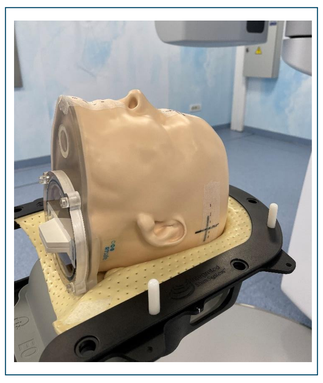
The first plan included a single target, while the second had two additional targets with volumes ranging from 0.3 to 3.8cc at a maximum dista of 8cm. The targets were irradiated to a prescribed dose of 8Gy in a single fraction using three noncoplanar arcs and one coplanar, with the isocenter placed at the center of their mass.

Single target, V=3.8cc, CI=0.90, GI=2.93



Three targets, V=0.3cc~3.8cc, CI=0.72~0.85, GI=3.72~8.79





The plans were calculated for a specially modified Rtsafe Prime phantom equipped with a film insert. The phantom follows the recommended features according to AAPM TG-302:

> sufficiently detectable topography

> non-reflective surface with human-like skin color

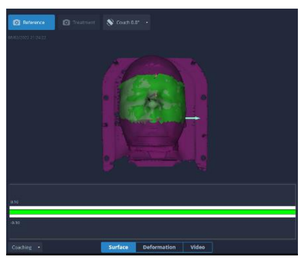
> external fiducials

The phantom was positioned according to the AlignRT (VisionRT) SGRT system and was immobilized with an open-face mask. Positioning was verified with Cone Beam Computed Tomography (CBCT) and corresponding couch shifts were applied. Calibrated EBT3 film pieces were used for absolute dosimetric measurements. Dose read-out of the films was performed using a flatbed scanner (150 dpi, positive 48-bit, Tiff format) and implementing a single channel film dosimetry protocol.

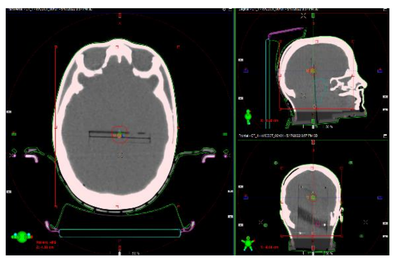
RESULTS

- In both treatment plans, the highest differences between the different setup methodologies were not bigger than 0.9 mm for the translational shifts and not higher than 0.3° for the rotational shifts.
- Gamma analysis of 3%/1mm and a low dose cut-off of 1Gy resulted in 96.9% and 98.27% passing rates for one- and three-target plans, respectively.

SGRT



CBCT



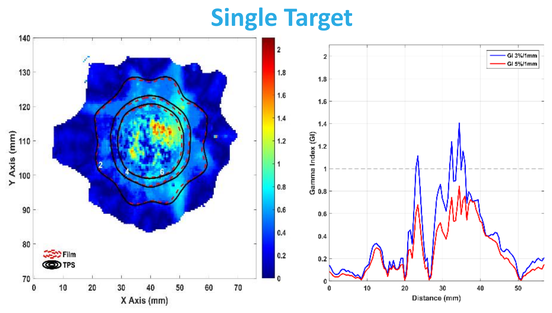
Single Target

Orientations	Shifts		Deviations
	SGRT	CBCT	
VRT (cm)	0.01	+0.07	0.06
LNG (cm)	0.00	+0.04	0.04
LAT (cm)	0.00	-0.05	0.05
YAW (°)	-0.3	-0.3	0
PITCH (°)	-0.4	-0.1	0.3
ROLL (°)	-0.3	-0.2	0.1

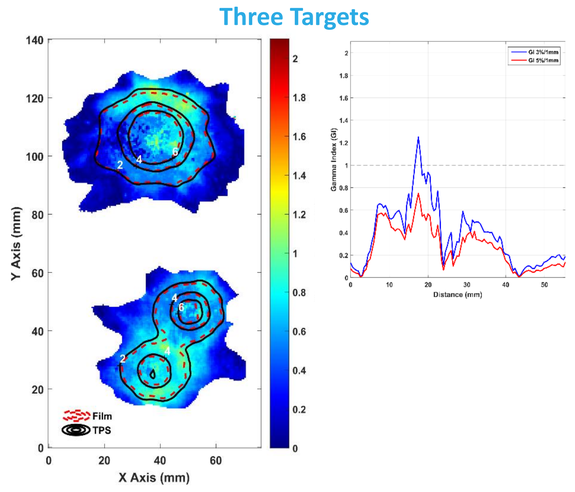
Three Targets

Orientations	Shifts		Deviations
	SGRT	CBCT	
VRT (cm)	-0.01	+0.08	0.09
LNG (cm)	-0.02	-0.01	0.01
LAT (cm)	-0.01	-0.04	0.03
YAW (°)	-0.2	-0.2	0
PITCH (°)	-0.2	0	0.2
ROLL (°)	-0.2	-0.1	0.1

Single Target



Three Targets



CONCLUSIONS

- The deviations between the setup shifts indicated by SGRT in comparison to the ones indicated by CBCT imaging were smaller than 1mm and 1°, proving that the SGRT system allows positioning with the required accuracy for SRS treatments.
- The modified Prime phantom is compatible with the SGRT system, making it ideal for E2E tests that encompass all the stages of SI-SRS treatments, when the workflow includes the use of surface guidance.

CONTACT INFORMATION

Despoina Stasinou, Medical Physicist, Center of Radiation Oncology and Stereotactic Radiosurgery, Mediterraneo Hospital, Athens Greece

Email: despoinast95@gmail.com