Sensitivity of *myQA* SRS detector to intentional errors in HyperArc plans.

N. Cavalli[1], E. Bonanno[1], G. Borzì[1], A. D'Anna[2], M. Pace[1], G. Stella[2], L. Zirone[1], C. Marino[1]

[1] Humanitas -Istituto Clinico Catanese- Medical Physics Department;
[2] University of Catania, Physics and Astronomy E. Majorana, Catania, Italy

Purpose/Objective:

After a preliminary step of validation of IBA *myQA* SRS high resolution solid-state detector, we perform an evaluation in the context of the stereotactic Radiosurgery (SRS) HyperArc (HA) treatments.

In this study, we check the ability of the *myQA* system to detect intentional errors related to the High Definition (HD) MLC position.

Material/Methods:

Ten original SRS HA treatment plans (21Gy) and 30 plans with introduced delivery errors, for a total of 40 plans, were investigated. From the original plans, new plans with introduced errors of different magnitudes regarding the MLC were generated, using an "home-made" script. For each plan, MLC positioning errors were introduced, including widening of entire leaf bank A of 0.5 mm, 0.8 mm and 1 mm, respectively.

All plans were calculated on a TrueBeam machine equipped by HD MLC, using AcurosXB v.16.1 algorithm. Plans were delivered across *myQA* SRS detector, located inside *myQA* SRS phantom. The measurement sensors of *myQA* SRS are monolithic solid-state semiconductor sensors arranged in a 2D array and the detector is optimized to measure 2D dose maps of small fields with high resolution. The sensor layout is a grid of 300 x 350 pixels spaced of 400 μm in an area of 120 mm x 140 mm (active area).

The impact of the errors in the modified plans was assessed using *myQA* system's inherent gamma analysis with local 2%/2mm and local 2%/1mm (with 5% threshold dose) criteria.

To assess the *myQA* systems'ability to detect introduced errors, we evaluated the gamma passing rate between the original and modified measured dose distribution for each plan. Gamma analysis was performed for each single arc of plans and for the integrated total dose distribution of plans.

Reults:

Tab. I shows, for brevity, results in terms of gamma passing rate for the integrated total dose distribution of plans. Employing local gamma analysis with 2%-2mm criteria, a substantial gamma pass rate difference is evident for only one case concerning the MLC error positioning of 0.8 mm (total gamma pass rate: 91.9%); while for the error of 1 mm, the gamma pass rate decrease is observed for two plans (total gamma pass rate:86-95.4%).

Using the more restrictive local gamma analysis with 2%/1mm, MLC error positioning of 1 mm was detected for all plans (total gamma pass rate: 68.7-95.1%); the 0.8 mm error was detected for 7 plans (total gamma pass rate: 72-94.9%); the 0.5 mm error was detected for two plans (total gamma pass rate: 82.2-95.0%).

	Local Gamma Analysis_2%-2mm			Local Gamma Analysis_2%-1mm		
	Tot. Integrated γ passing rate			*Tot. Integrated γ passing rate*		
	0.5 mm MLC Error	0.8 mm MLC Error	1 mm MLC Error	0.5 mm MLC Error	0.8 mm MLC Error	1 mm MLC Error
Pt_1	99.0%	99.7%	99.3%	98.4%	97.7%	89.9%
Pt_2	99.2%	91.9%	86.0%	98.2%	82.2%	68.7%
Pt_3	99.8%	98.3%	96.0%	99.3%	93.8%	82.7%
Pt_4	99.9%	98.6%	97.1%	99.2%	92.3%	83.7%
Pt_5	99.5%	98.6%	97.5%	99.0%	97.6%	84.4%
Pt_6	99.8%	99.0%	98.6%	99.5%	97.6%	95.1%
Pt_7	99.8%	98.5%	97.0%	99.5%	94.9%	88.3%
Pt_8	98.0%	97.3%	97.3%	82.2%	72.0%	72.2%
Pt_9	97.6%	95.9%	95.6%	95.0%	92.3%	71.3%
Pt_10	98.9%	97.2%	95.4%	95.7%	93.6%	86.8%

Tab 1. Gamma pass rate (%) between original and modified measured distribution dose, for each patient(Pt) and for each magnitude of introduced error.

Conclusions:

myQA system seems to be a valid tool to detect MLC positioning errors for SRS HA treatments. Using the 2%-1mm gamma evaluation criteria, the system has been able to detect MLC bank offsets of 1 mm for all studied plans and, for 7/10 plans, the MLC error of 0.8mm. These results give confidence about the high accuracy of *myQA* system to detect relevant clinical errors for HA SRS treatments.