

INTRODUCTION

CyberKnife is a robotic image-guided system for stereotactic dose delivery that requires specific QA including MLC, iris aperture and targeting tests. Machine QA is currently performed using Accuray procedures and Gafchromic films. Patient-specific QA is done using the SRS MapCheck digital detector (Sun Nuclear).

OBJECTIVE

The aim of this study was to characterize the performance of the SRS MapCheck for CyberKnife machine QA with the goal of replacing the use of film.

METHODS

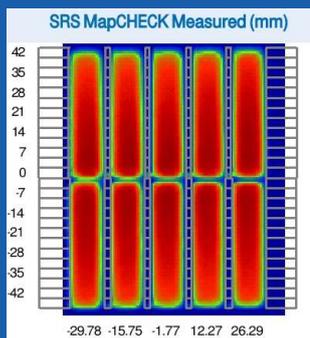
- **MLC Bayouth test:** reproducibility and sensitivity were evaluated. For the sensitivity tests, a leaf position error and an erroneous fully closed leaf were introduced.
- **Accuracy QA (AQA):** reproducibility was evaluated, and results compared to Gafchromic film (gold standard) for MLC, iris, and cones. Sensitivity was assessed for iris by introducing a known beam deviation in one direction.
- **Iris aperture QA:** reproducibility and sensitivity were evaluated by changing the source to detector distance. Results were compared to results from an in-house Python code.

For each test, Precision plans were prepared.



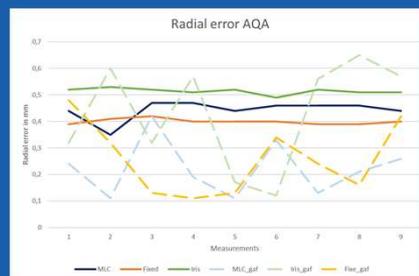
RESULTS

MLC Bayouth test



Leaf position deviation >0.5 mm was detected for the Bayouth test (manufacturer tolerance <0.51 mm position deviation). However, an unexpected fully closed leaf was not detected.

AQA



Mapcheck and film results within 1mm.

Deviation Y axis CK (mm)	AQA Radial error measured (mm)
0	0.58
0.5	1.11
1	1.49
1.5	2.14
2	2.89

Incremental Y axis beam deviation detected, from 0.5 mm.

Iris aperture QA

Repeatability and reproducibility σ was below 0.1 % (20 measurements).

Deviation (mm)	MapCheck software	Python in-house	Expected aperture
0	59.10	59.24	59.10
0.5	59.17	59.27	59.14
1	59.13	59.21	59.17
1.5	59.08	59.27	59.21
2	59.15	59.34	59.25
4	59.25	59.37	59.40
6	59.52	59.70	59.54

Aperture deviation ≥ 0.15 mm seems to be detectable (tolerance 0.2 mm). Further measurements are in progress.

CONCLUSION

The SRS MapCheck could be a reliable tool for daily constancy checks including MLC Bayouth (replacing Picket Fence and Garden Fence), and AQA. However, it cannot be used for all machine QA tests (insufficient resolution for the small iris aperture size). Further investigations are in progress; accuracy of the absolute diameter determination for iris aperture QA and deviation threshold for AQA. The advantages of using such a device are cost-saving (fewer films) and improved efficiency e.g. it takes 20 minutes to do the monthly iris aperture QA with the device, compared to 1 hour with film.