

ABSTRACT

A Comparison of Filmless QA Technologies for Variable-Aperture Collimators in Robotic Radiosurgery

Jacob A. Gersh^{1,2}, Jesse D. McKay³, and Regina K. Fulkerson⁴

¹Gibbs Cancer Center and Research Institute, Greer, SC

²Spectrum Medical Physics LLC, Greenville, SC

³Erlanger Health System, Chattanooga, TN

⁴Standard Imaging Inc., Middleton, WI

PURPOSE:

The Iris Variable-Aperture Collimator, available for CyberKnife (Accuray Inc., Sunnyvale, CA), provides an automated, efficient, and accurate means of collimation. Though efficient with respect to patient treatment, this technology requires time-consuming QA. Although Accuray provides a film-based QA method, several commercially-available technologies have been developed to reduce uncertainty and inefficiency inherent with film. This study compares the results for Iris QA metrics obtained with film to those obtained with the QA StereoChecker (Standard Imaging Inc., Middleton, WI), the SRS Profiler (Sun Nuclear Corp, Melbourne, FL), and the IBAC (Logos Systems International, Scotts Valley, CA).

METHODS:

During a single day, all techniques were used to evaluate Iris; reducing the impact of machine variability. Except the QASC, QA was performed following attachment of the device/phantom to the collimator and delivered in a physics/service mode. QA using the QASC was performed in a clinical mode with the device placed on the couch and aligned using automated fiducial tracking.

RESULTS:

Results acquired using the QASC, IBAC, and SRS-PRO matched those acquired using film. One exception is that the SRS-PRO over-estimated the field size for small fields. The major difference between the techniques is the efficiency in performance. Being automated and delivered in a clinical mode, the QASC required 7 minutes, including setup, acquisition, analysis, reporting, and break-down. The film-based method required 60 minutes while the IBAC and SRS-PRO systems both required 30 minutes.

CONCLUSION:

The devices investigated provided similar results as with the vendor-provided method, with the exception of the small-field size inaccuracy observed with the SRS-PRO. The main difference between the devices and film-based method is the efficiency. The clinically-automated setup of the QASC allows for daily performance assessment of the Iris, allowing for trending of QA metrics, which can aid in a proactive approach to addressing issues with the Iris.

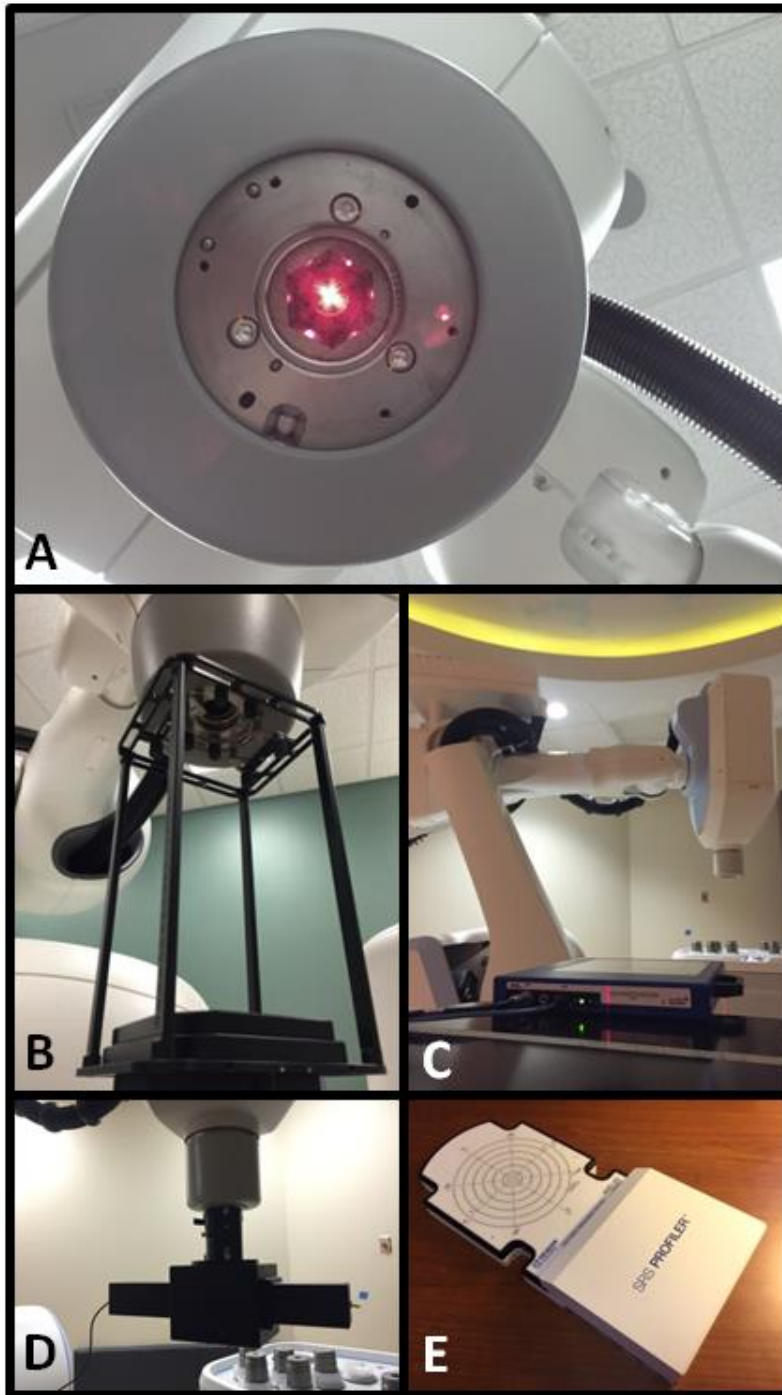


FIGURE 1: A. The Iris Variable-Aperture Beam Collimation System. B. The vendor-provide beam IrisQA phantom attached to the Bird Cage fixture. C. The Standard Imaging QA StereoChecker. D. The LOGOS IBAC System attached to the Iris Collimator. E. The Sun Nuclear SRS Profiler.

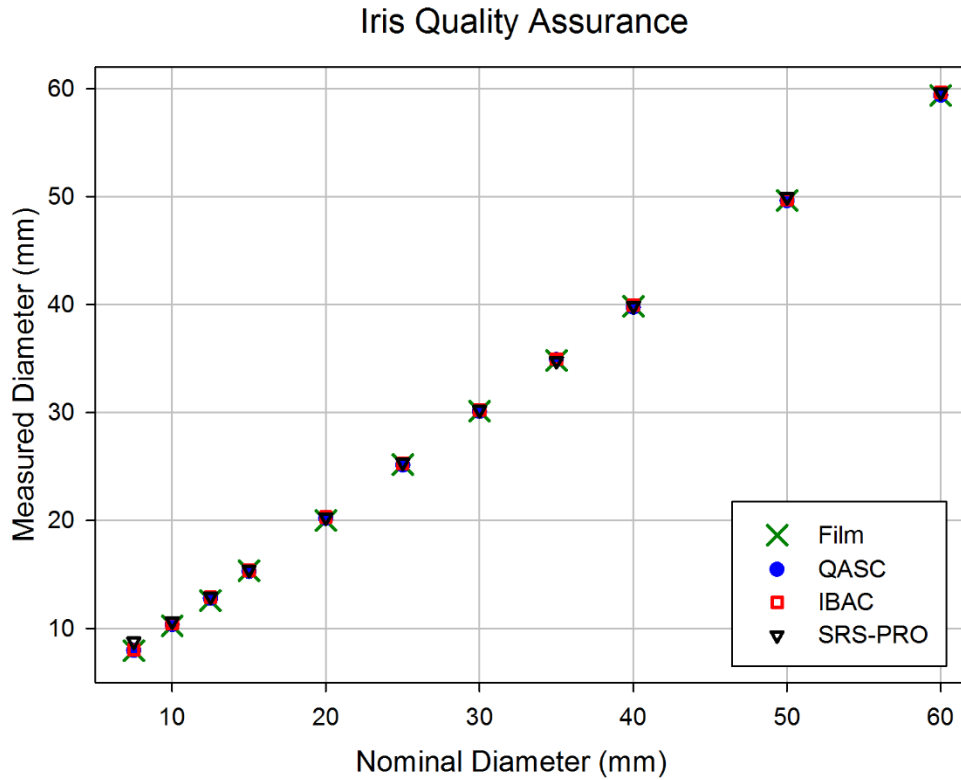


FIGURE 2: Plot of the measured beam diameter as a function of the nominal beam diameter. Representative of data contained in Table 1.

Measured Diameter (mm)

Nominal Diameter	IrisQA (Film)	QA StereoChecker	IBAC	SRS Profiler
7.5	7.95	7.97	8.02	8.80
10.0	10.25	10.37	10.48	10.68
12.5	12.60	12.80	12.90	12.98
15.0	15.37	15.29	15.40	15.46
20.0	20.02	20.21	20.34	20.30
25.0	25.19	25.14	25.28	25.38
30.0	30.15	30.11	30.24	30.25
35.0	34.83	34.91	34.98	34.80
40.0	39.84	39.75	39.94	39.90
50.0	49.65	49.62	49.74	49.95
60.0	59.37	59.39	59.66	59.65

TABLE 1: Measured beam diameters, presented in graphical form in Figure 2.

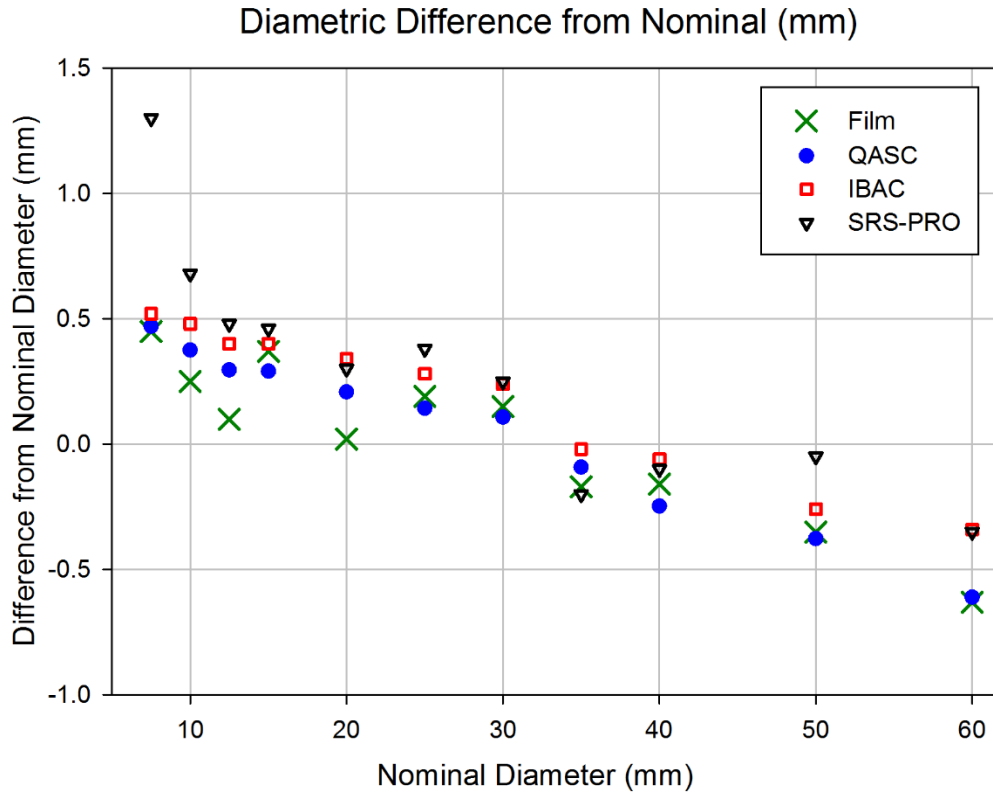


FIGURE 3: Plot of the difference in measured beam diameter and the nominal beam diameter, presented as a function of the nominal beam diameter. Representative of data contained in Table 2.

Diametric Difference from Nominal (mm)				
Nominal Diameter	IrisQA (Film)	QA StereoChecker	IBAC	SRS Profiler
7.5	0.45	0.47	0.52	1.30
10.0	0.25	0.37	0.48	0.68
12.5	0.10	0.30	0.40	0.48
15.0	0.37	0.29	0.40	0.46
20.0	0.02	0.21	0.34	0.30
25.0	0.19	0.14	0.28	0.38
30.0	0.15	0.11	0.24	0.25
35.0	-0.17	-0.09	-0.02	-0.20
40.0	-0.16	-0.25	-0.06	-0.10
50.0	-0.35	-0.38	-0.26	-0.05
60.0	-0.63	-0.61	-0.34	-0.35

TABLE 2: Difference in measured beam diameter and the nominal beam diameter, presented in graphical form in Figure 3.