

Validation of a Commercially Available, aSi QA Device for the Verification of Aperture Size in the CyberKnife Iris Collimation System

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Purpose: The QA of the CyberKnife Iris aperture is currently a time-consuming task requiring irradiating and analyzing film for each of the eleven aperture sizes. The purpose of this study is to validate and benchmark the detection resolution of the QA StereoChecker, a novel high resolution (aSi) dosimeter, relative to radiochromic film. Additionally, a secondary objective is to quantify any time savings with the QASC.

Methods: The procedure for measuring the aperture sizes of Iris was followed per recommendations of the vendor. The QASC (*Standard Imaging, Middleton, WI*) was aligned to a reference location and irradiated using six of the available eleven Iris aperture sizes. Images were recorded and analyzed by Standard Imaging proprietary software. After each aperture size was measured, a piece of EBT2 Gafchromic film was set on top within a Baby Blue phantom's film tray with 1.5 cm of buildup and then irradiated. After curing for at least 24 hours, the film was then analyzed using the proprietary Accuray software, Iris QA.

Results: Overall, both dosimeters yielded acceptable results with the exception of the smallest aperture size with film. The percent differences from the expected aperture widths were within 1.0% except for the 7.5 mm and 10 mm field sizes. By contrast, the QASC had percent differences $< 0.3\%$ for all evaluated field sizes.

Conclusion: The QASC was shown to be a stable platform on which Iris aperture size verification can be performed in a significantly more efficient manner—approximately 2 hours for film versus 20 minutes for the QASC.

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TABLE 1: Comparison of the expected and measured field sizes for five Iris apertures using EBT2 film. Triplicate measurements were taken on different days.

Iris Aperture Measured with Film				
Nominal Diameter (mm)	Expected Width (mm)	Mean Measured Width (mm)	Standard Deviation (mm)	Percent Difference (%)
7.5	7.08	7.45	0.03	-5.23
10	9.44	9.69	0.03	-2.65
15	14.16	14.19	0.04	-0.21
30	28.31	28.13	0.05	0.64
60	56.63	56.11	0.06	0.92

TABLE 2: Comparison of the expected and measured field sizes for five Iris apertures using the QA StereoChecker (QASC). Triplicate measurements were taken on different days.

Iris Aperture Measured with QASC				
Nominal Diameter (mm)	Baseline Width (mm)	Mean Measured Width (mm)	Standard Deviation	Percent Difference (%)
7.5	8.02	8.00	0.03	0.26
10	10.41	10.40	0.01	0.12
15	15.20	15.19	0.02	0.08
30	29.84	29.82	0.03	0.08
60	59.41	59.40	0.04	0.01

QAStereoChecker Automated IrisQA

Nominal Diameter	Baseline Image	Select Baseline	Pass/Fail
<input type="radio"/> 07.5 mm	Baseline_07_5_20170215	Select	Pass
<input type="radio"/> 10.0 mm	Baseline_10_0_20170215	Select	Pass
<input type="radio"/> 12.5 mm	Baseline_12_5_20170215	Select	Pass
<input type="radio"/> 15.0 mm	Baseline_15_0_20170215	Select	Pass
<input type="radio"/> 20.0 mm	Baseline_20_0_20170215	Select	Pass
<input type="radio"/> 25.0 mm	Baseline_25_0_20170215	Select	Pass
<input type="radio"/> 30.0 mm	Baseline_30_0_20170215	Select	Pass
<input type="radio"/> 35.0 mm	Baseline_35_0_20170215	Select	Pass
<input type="radio"/> 40.0 mm	Baseline_40_0_20170215	Select	Pass
<input type="radio"/> 50.0 mm	Baseline_50_0_20170215	Select	Pass
<input checked="" type="radio"/> 60.0 mm	Baseline_60_0_20170215	Select	Pass

FIG. 1: Quick QA results within the QASC software after measurements of the Iris apertures. On the right is an image of the 60 mm aperture baseline. The images of the other aperture sizes are also made available by the software for easy viewing.

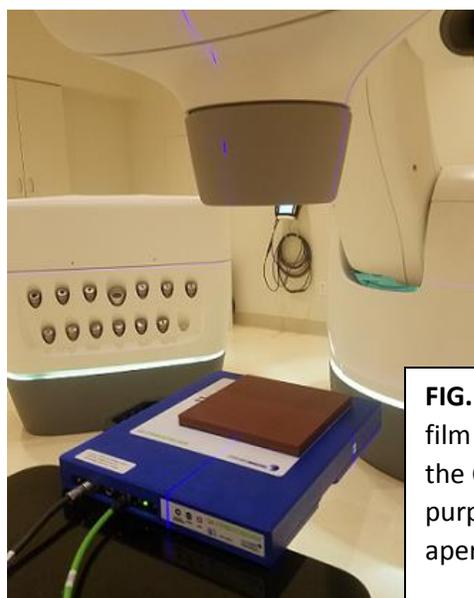
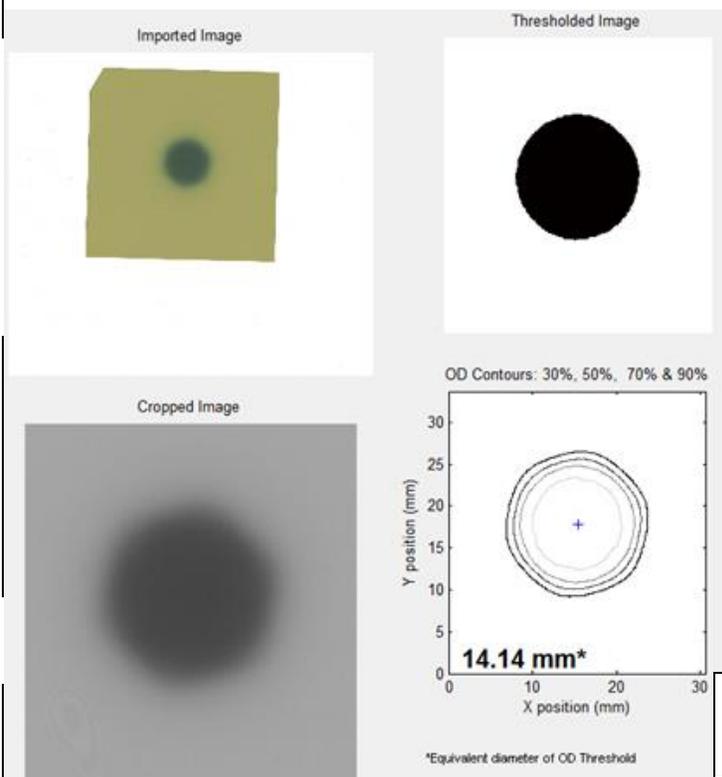
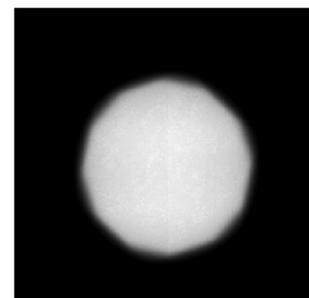


FIG. 2: Picture of the QASC-film exposure setup inside the CyberKnife vault for the purpose of verifying the Iris aperture size.

FIG. 3: Film analysis of the 15 mm aperture of the CyberKnife Iris collimation system within the Accuray Iris QA software.