



# Evaluation of a novel-integrated quality assurance phantom for Winston-Lutz test

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## INTRODUCTION

The myQA SRS is a novel 2D digital detector array for patient specific quality assurance (QA) and commissioning of stereotactic radiosurgery (SRS). The myQA SRS system includes the detector array, 3D phantom, and various inserts for film and ion chamber measurements.

A new Winston-Lutz insert was recently developed for the myQA SRS system. The new insert is made from water equivalent acrylonitrile butadiene styrene (230mm x 155mm x 40mm) with a ceramic ball 5mm in diameter as shown in Figure 1.

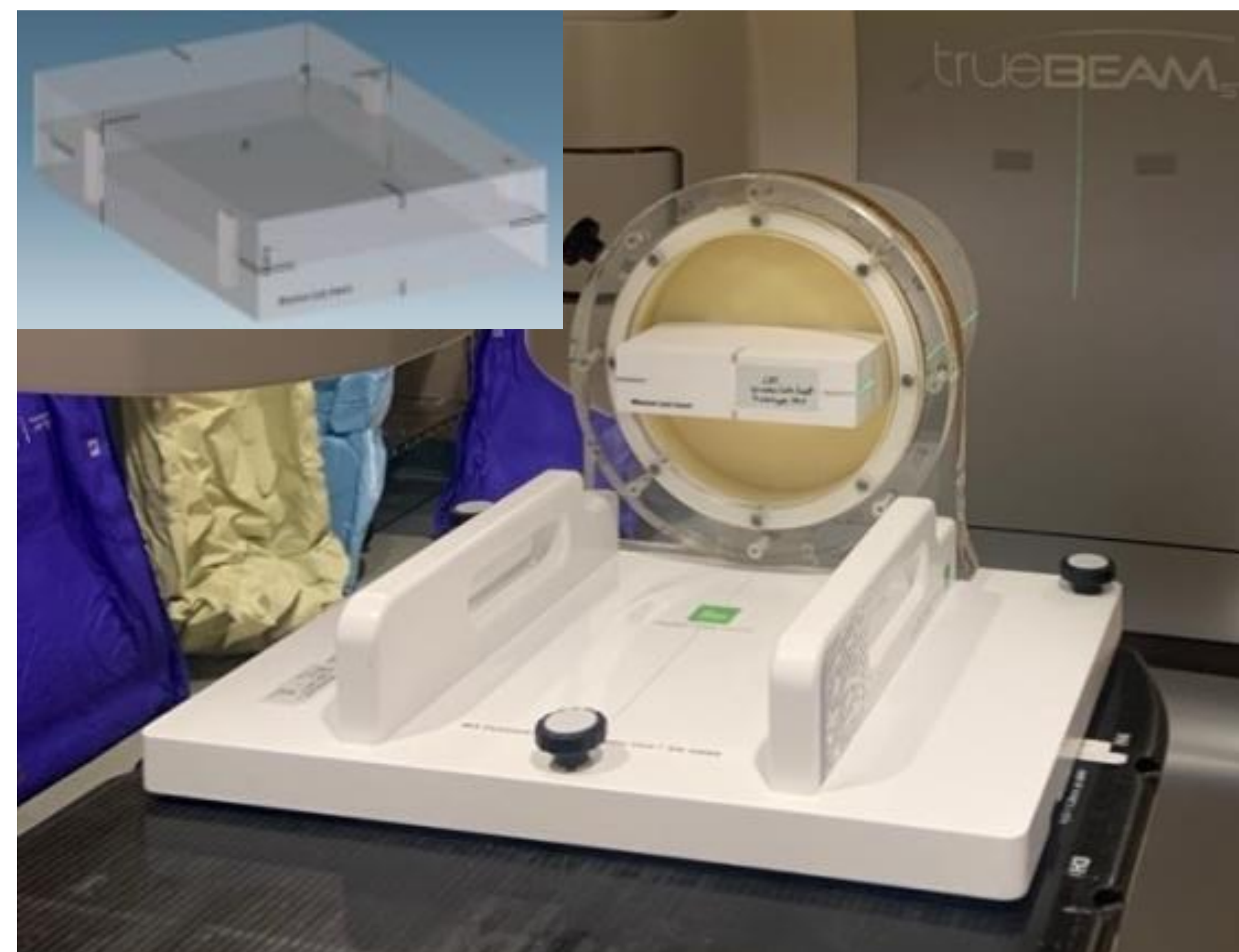


Figure 1. A novel Winston Lutz insert within the myQA SRS 3D phantom.

## AIM

The new Winston-Lutz insert integrates with the myQA SRS system and streamlines commissioning, end to end test, and patient specific QA for SRS. The goal of this study is to investigate the feasibility of using this novel Winston-Lutz insert to evaluate Linac isocenter accuracy.

## METHODS

Winston-Lutz tests were performed on two Varian TrueBeam Linacs, with 2.5MV and 6MV imaging energy respectively. During the Winston-Lutz tests, the new insert was placed inside the myQA 3D phantom and initially aligned to the isocenter by taking two orthogonal MV images as shown in Figure 2. AP MV image was used to adjust Left/Right direction and Lateral MV image was used to adjust Inferior/Superior direction, etc.

A MLC field size of 20mm x 20mm was used for all the measurements. For each Winston-Lutz measurement, eight MV images were acquired with Couch=0° (Gantry=270°, 0°, 90°, 180°) and Gantry=0° (Couch=270°, 315°, 45°, 90°). The maximum distance between the ceramic ball and isocenter was analyzed with both IBA myQA machine and SNC machine software.

Measurements were performed with 2.5MV and 6MV to evaluate the imaging quality. For comparison purpose, Winston-Lutz tests were also performed for the Brainlab Winston-Lutz device.

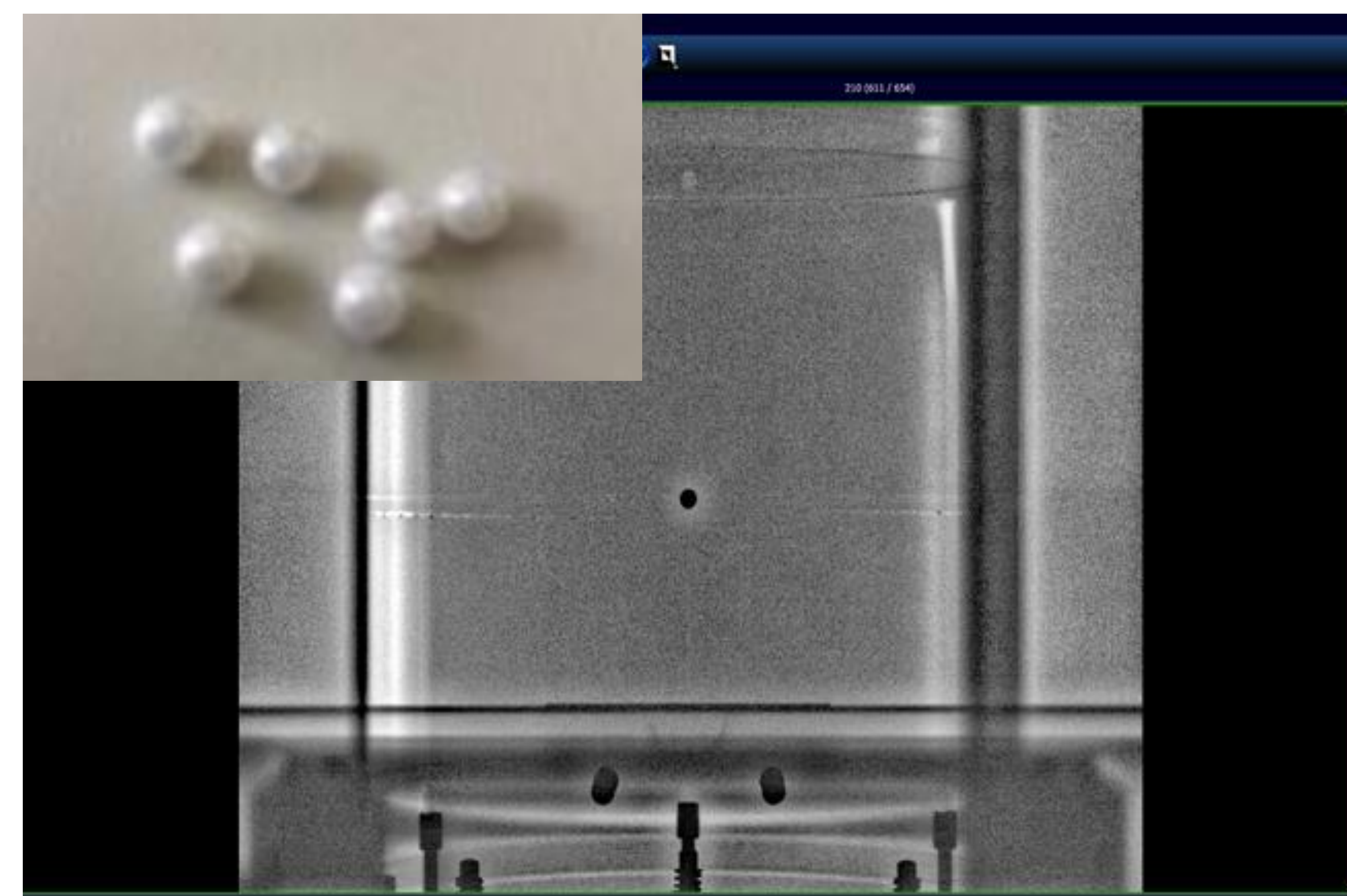


Figure 2. An example of AP image of the Winston-Lutz insert inside the myQA SRS 3D phantom for 6MV.

## RESULTS

The ceramic ball was made from ZrO<sub>2</sub> and was radiopaque under both 2.5MV and 6MV images as shown in Figure 2. The ceramic ball can be detected virtually for both 2.5MV and 6MV images. Manually adjustment of windows level was needed to virtualize the ceramic ball for 6MV images, while the default content windows level provided reasonable contrast for the 2.5MV images as shown in Figure 3.

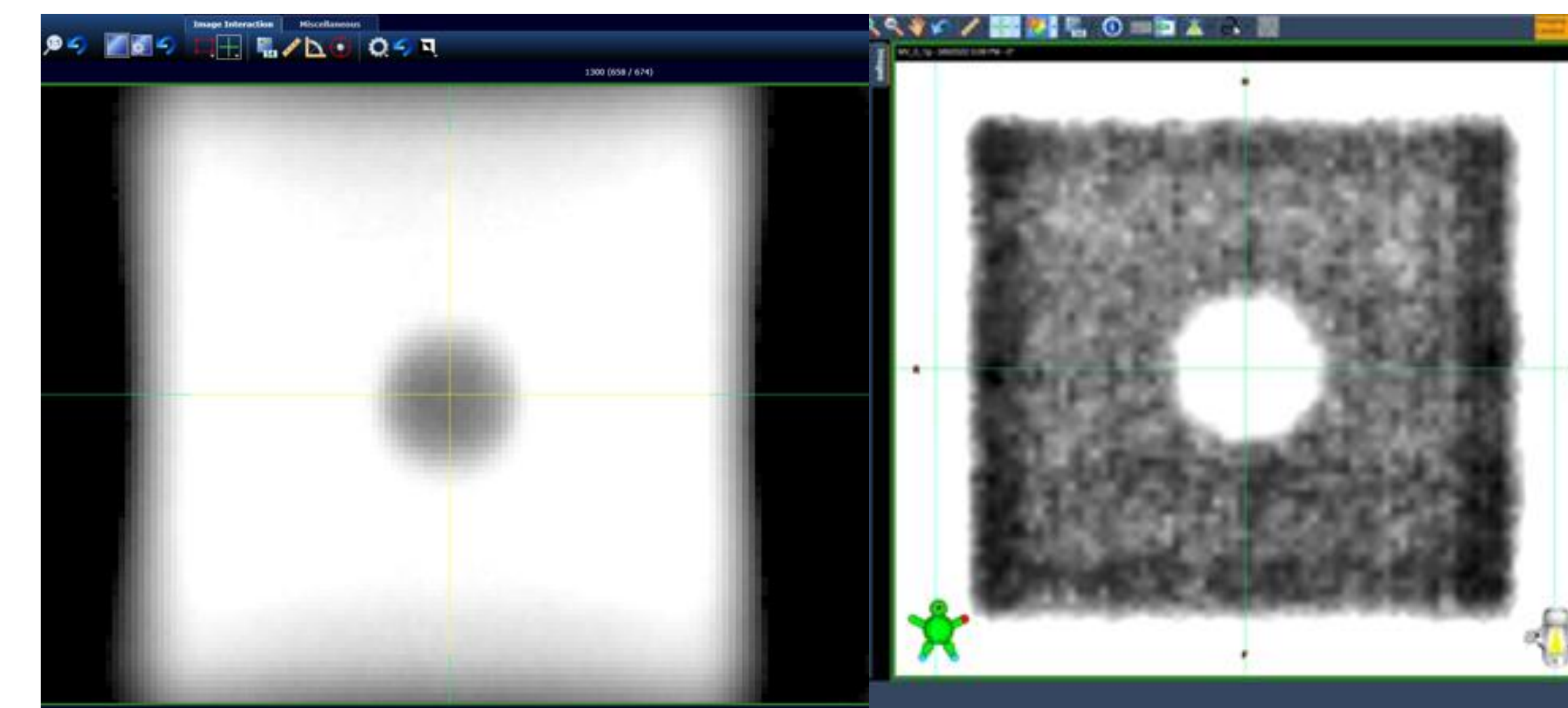


Figure 3. The 2.5MV (Left) and 6MV (Right) with default content and manually adjusted windows level respectively.

The ceramic ball can be detected automatically by both IBA and SNC software. The maximum 2D deviation from IBA myQA machine software was 0.80mm (Figure 4), compared to 0.77mm from SNC machine software, for the same set of measurements with IBA device,

Image	DPI	SDD[mm]	SAD[mm]	Gantry[°]	Coll[°]	Couch[°]	Dv[mm]	Status
MV_27...	32.40	1500.0	1000.0	270.0	360.0	360.0	0.8	Passed
MV_90...	32.40	1500.0	1000.0	90.0	360.0	360.0	0.8	Passed
MV_0_1e	32.40	1500.0	1000.0	0.0	360.0	360.0	0.0	Passed
MV_18...	32.40	1500.0	1000.0	180.0	360.0	360.0	0.8	Passed
MV_0_1a	32.40	1500.0	1000.0	360.0	360.0	270.0	0.6	Passed
MV_0_1a	32.40	1500.0	1000.0	360.0	360.0	90.0	0.6	Passed
MV_0_1a	32.40	1500.0	1000.0	360.0	360.0	45.0	0.8	Passed
MV_0_1a	32.40	1500.0	1000.0	360.0	360.0	315.0	0.3	Passed

Figure 4. An example of Winston-Lutz results for the myQA SRS insert with 2.5MV and analyzed with IBA myQA machine software.

## RESULTS

At the meantime, equivalent results were observed between the IBA phantom and the Brainlab phantom. The maximum 2D and 3D deviations were 0.77mm and 0.89mm for IBA device and 0.74mm and 0.91mm for Brainlab device when measured on the same linac and analyzed with SNC software.

Parameter	Measurement	Baseline	Difference	Status	Tolerance
Maximum delta (2D) (mm)	0.71	0.69	-0.02	Passed	0.71
Maximum total delta (2D) (mm)	0.74	0.73	-0.01	Passed	0.74
Maximum Total Deviation (mm)	0.91	0.85	-0.07	Passed	0.91
Deviation from gantry isocenter (X) (mm)	0.07	0.04	-0.04	Passed	0.07
Deviation from gantry isocenter (Y) (mm)	0.36	0.42	0.05	Passed	0.36
Deviation from gantry isocenter (Z) (mm)	0.04	0.17	0.13	Passed	0.04
Deviation from gantry isocenter (R) (mm)	0.37	0.47	0.10	Passed	0.37
Table Misalignment (X) (mm)	-0.32	-0.21	0.11	Passed	0.32
Table Misalignment (Y) (mm)	0.36	0.34	-0.02	Passed	0.36

Figure 5. An example of Winston-Lutz results for Brainlab device analyzed with SNC machine software.

## CONCLUSION

A novel Winston-Lutz insert was developed and integrated with myQA SRS system. This new Winston-Lutz phantom provided equivalent results when analyzed with two different commercial software and compared to the Brainlab Winston-Lutz device.

## ACKNOWLEDGEMENTS

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## CONTACT INFORMATION

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