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ORIGINAL ARTICLE

PTW QUICKCHECK^{webline}: Daily quality assurance phantom comparison and overall performance

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Summary

Purpose: *The Daily QA^{TM}3 phantom from Sun Nuclear Corporation has been a popular daily quality assurance (QA) tool for many institutions. PTW has recently introduced the QUICKCHECK^{webline} phantom as an alternative. The goal of this study was to compare these two commercially available devices for daily quality assurance measurements of a linear accelerator and assess the overall performance of the new phantom.*

Methods: *Two daily QA phantoms (PTW QUICKCHECK^{webline} and Sun Nuclear Corporation Daily QA^{TM}3) were measured over a 4-month period using a 20x20cm^2 field size and delivering 150 MU. Photon energies of 6 and 18 MV were measured on a daily basis, and electron energies of 6, 9, 12, 15, and 18 MeV were measured weekly on a 23EX Varian Linear Accelerator. Consistency of the dose output, beam flatness, in-plane and cross-plane symmetry, and beam quality were evaluated.*

Results: *The QUICKCHECK^{webline} and Daily QA^{TM}3 performed with maximum percent differences from baseline of -0.97% and 1.12% for output, 1.36% and 0.82% for flatness, 0.86% and -1.36% for in-plane symmetry, -1.41% and 1.00% for cross-plane symmetry, and -0.91% and 1.29% for beam quality respectively over all energies.*

Conclusion: *Consistent and accurate measurements over a 4-month period, a user-friendly interface, and wireless features prove the QUICKCHECK^{webline} would be a suitable phantom for daily quality assurance use.*

Key words: *daily quality assurance, PTW Quick check*

Introduction

A radiation oncology clinic treating with medical linear accelerators should have a rigorous quality assurance (QA) program to ensure safe use of the equipment. In the United States, a common protocol to follow is from the American Association of Physicists in Medicine (AAPM) Task Group 142 (TG-142) [1]. This task group recommends a specific set of QA tests be performed on a daily, weekly, monthly, and annual basis and associated acceptable tolerances for each test. Recommended daily QA includes a series of tests for beam quality as well as mechanical and safety tests. To optimize time and reduce error, a single phantom is often used to perform several tests simultaneously or at minimum, using the same set-up. Two popular medical physics phantom and tool manufacturers are Sun Nuclear Corporation and PTW. Many facilities are very familiar with and make use of the Daily QA^{TM}3 (Sun Nuclear Corporation, Melbourne, FL, USA) device to perform daily QA tests, but recently PTW has introduced the QUICKCHECK^{webline} (PTW, Freiburg, Germany) phantom as an alternative [2,3]. The goal of this study was to determine if the QUICKCHECK^{webline} is a suitable alternative to the Daily QA^{TM}3.

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Figure 1. Output constancy results for each energy as a function of percentage difference from baseline.

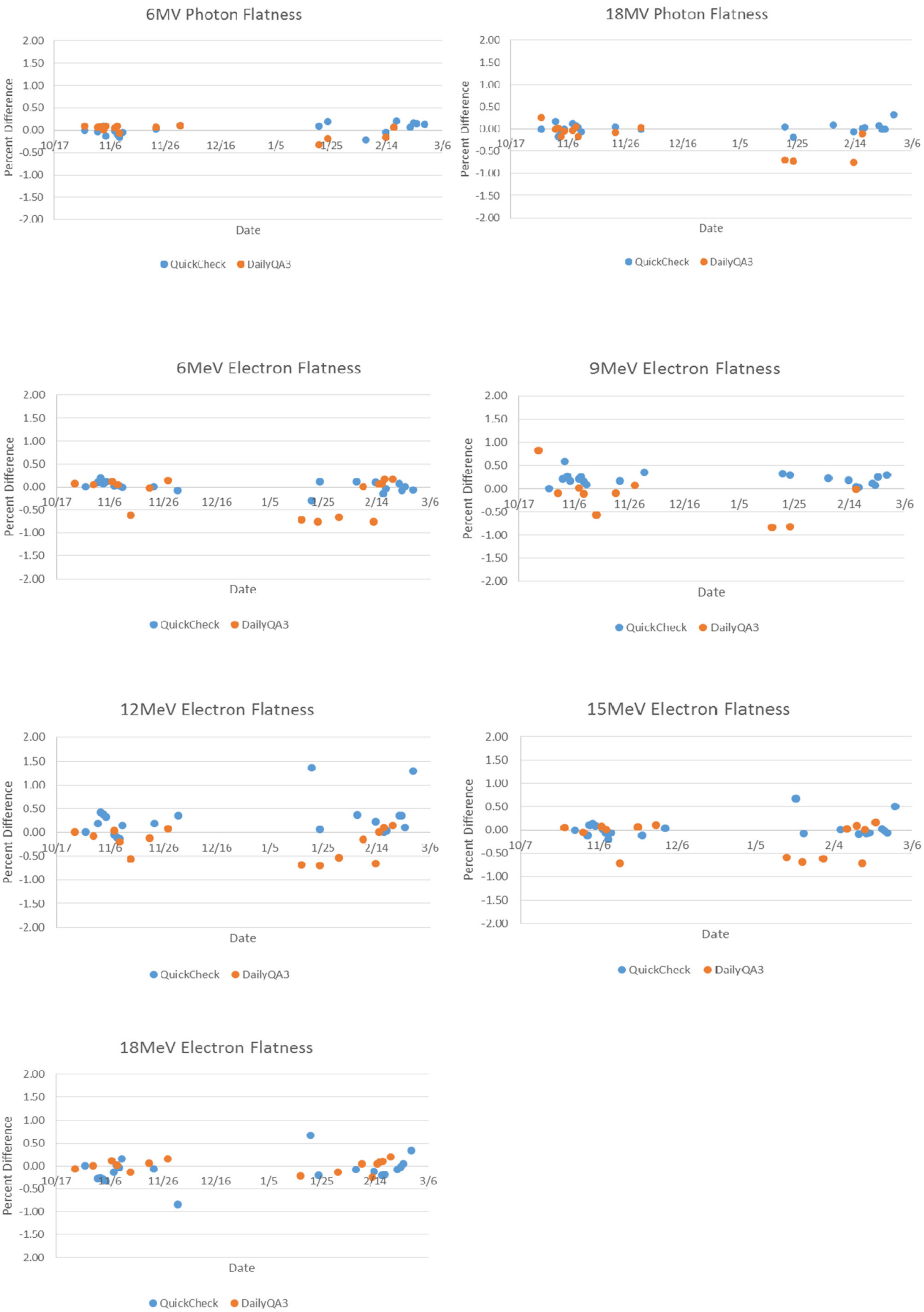

Figure 2. Flatness results as a function of percent difference from baseline for each energy.

Figure 3. In-plane symmetry results as a function of percent difference from baseline for each energy.

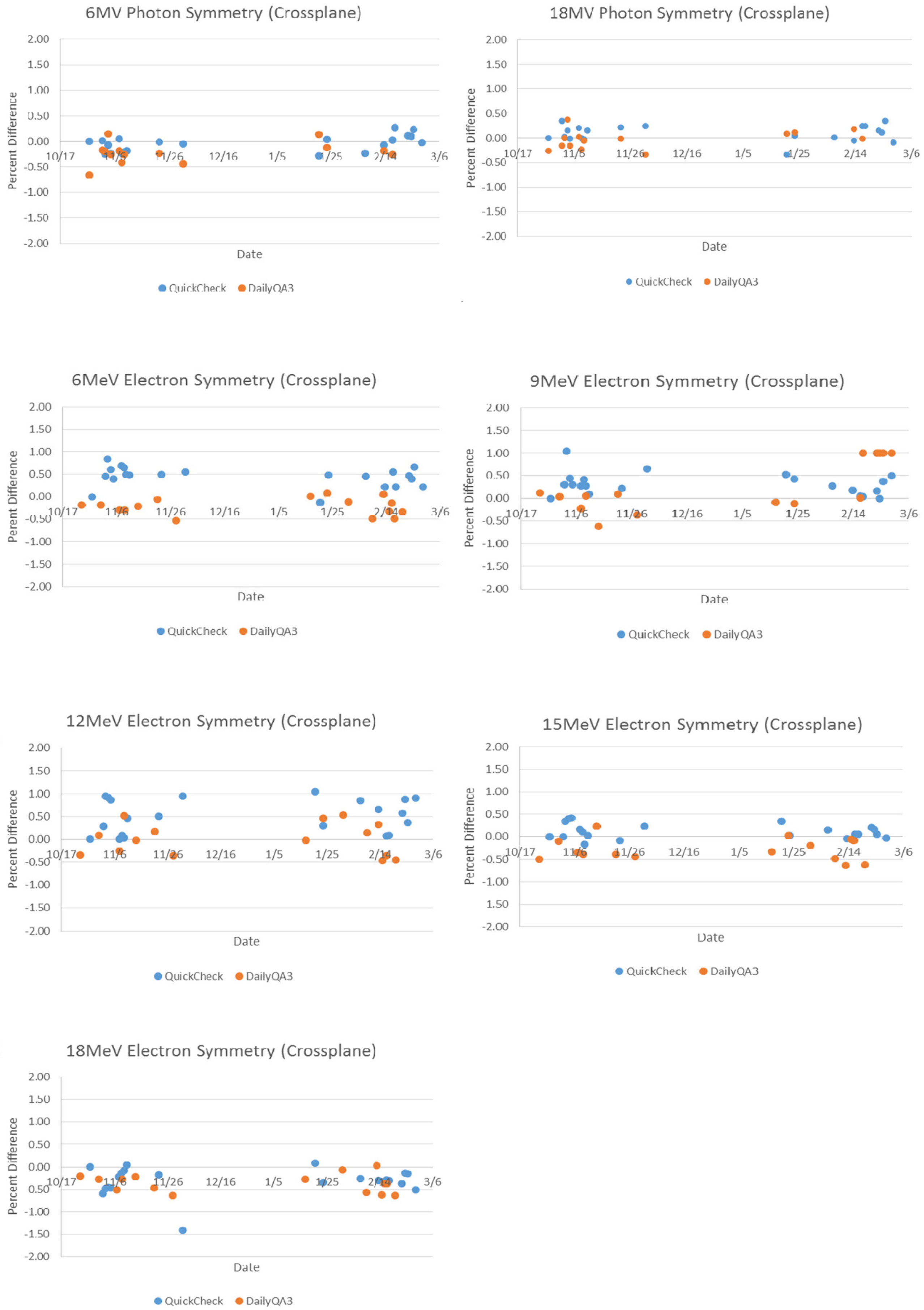

Figure 4. Cross-plane symmetry results as a function of percent difference from baseline for each energy.

Figure 5. Beam quality results as a function of percent difference from baseline for each energy.

Methods

The Daily QA™3 phantom by Sun Nuclear utilizes an array of 13 ion chambers to measure output, flatness, symmetry, and energy. The output is measured using an ion chamber located at the center of the array. There are 4 ion chambers located along the central axis at the borders of the field edge, and they are used to perform flatness and symmetry consistency tests. To measure the photon beam energy, there is an ion chamber located at each corner of the device, and electron beam energy is measured along the diagonal of the array but at a smaller field size. The device has a built-in temperature and pressure correction and associated software included for analysis including instant results for each test and trends [2].

The PTW QUICKCHECK^webline also utilizes 13 ion chambers for beam characteristic tests. Similar to the Daily QA™3, the QUICKCHECK^webline uses one ion chamber at the center of the device to measure output constancy, four chambers along the central axis at the borders of the device to measure flatness and symmetry, and the remaining chambers are used to measure the beam energy for the photons and electrons. The QUICKCHECK^webline also has the capability of built in temperature and pressure correction. A pass or fail will flash on the device itself after a beam is delivered and trends can be viewed in the software which is included with the device [3].

This study was performed using a 23EX Varian linear accelerator (Varian Medical Systems, Palo Alto, CA, USA) with photon energies of 6 and 18 MV as well as electron energies of 6, 9, 12, 15 and 18 MeV. Baseline output measurements were obtained during an annual QA test performed at our clinic for this linear accelerator using a PTW 0.3cc ion chamber, water phantom, and a PTW Webline electrometer. Both the QUICKCHECK^webline and the Daily QA™3 had measurements taken to be used as baselines for all other daily QA checks during this annual QA test. After the annual testing, the Daily QA™3 was used every morning as a part of our department QA program including photon measurements daily and electron measurements weekly. The device uses a set-up of 100 cm SSD, 150 MU, and a field size of 20×20 cm^2. The QUICKCHECK^webline was measured periodically over a four-month period. Each time all energies (photons and electrons) were measured using a set-up of 100 cm SAD, 150 MU, and a field size of 20×20 cm^2. Data was taken from each device as percent differences from their respective baselines.

Results

Output

Figure 1 shows the output comparison for each energy, as a function of percent difference from their respective baseline value. The 6 MV photons, 15 MeV electrons, and 18 MeV electrons were within 1.5% of baseline and the rest of the energies were within 1% of their respective baselines.

Beam flatness

Figure 2 shows the results for the flatness consistency of the beam for both devices. Both photon energies were within 1.0% of their baselines for each device. There was more variation in the flatness of the electron beams, but both devices were within 1.5% of their baselines.

Symmetry

Figure 3 shows the results for symmetry of the beam in the in-plane direction, and Figure 4 shows the cross-plane direction. The symmetry in both directions for all energies and devices was within 1.5% of the baseline.

Beam quality

The results for beam quality can be seen in Figure 5. All measurements were within 1.5% of the baseline for each energy and device.

Discussion

The purpose of this study was to determine if the PTW QUICKCHECK^webline would be a suitable daily QA tool by comparing it to a widely used device currently owned by many clinics. AAPM TG-142 recommends that the beam output for a linear accelerator remain within ±3% of baseline to be considered acceptable/passing each day. During our four-month study, all of the photon and electron outputs for our linear accelerator were within ±1.5% of the baseline as measured by each of the two devices studied. The remaining QA tests (flatness, in-plane and cross-plane symmetry, and quality) were also found to be within the clinical tolerance of ±2%. Using the results of this study, we found that the PTW QUICKCHECK^webline is a suitable tool for daily testing quantitatively, as well as a user-friendly and efficient solution qualitatively.

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Conflict of interests

The authors declare no conflict of interests.

References

1. Klein E, Hanley J, Bayouth J et al. Task Group 142 report: Quality assurance of medical accelerators. Med Phys 2009;36:4197-212.
2. Daily QA™3 & rf-Daily QA™3. Sunnuclear.com. https://www.sunnuclear.com/documents/datasheets/dailyqa3-rfdaily.pdf. Published 2015.
3. PTW QUICKCHECK[webline]. http://www.ptw.de/1847.html?&cId=4243. Published February 14, 2012.