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Using A Mobile Device Application for Checks of CyberKnife Daily Quality Assurance

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ABSTRACT

Purpose: Daily Quality Assurance (QA) is critical to ascertain regular checks upon radiation therapy treatment machines and maintain quality of treatment plan delivery for patients. A point of interest is to improve the workflow and ease of use of the devices and checks used during these daily QAs. The purpose of this study is to do a comparative analysis of an in-house application created to perform Accuray CyberKnife AQA tests using a mobile device's camera to promote alternative methods of verification.
Methods: This retrospective study includes seventeen morning AQA GAFchromic film analyzed using the Accuray AQA software to determine radial error in a 3-dimensional perspective. The films that were analyzed include the following three types of apertures: Fixed, Iris, and MLC. A clinic approved Epson scanner was used to scan the films and processed through the Accuray software. Films were processed using a mobile device, Apple iPhone, capable of 42-megapixel quality images to analyze within an in-house application housing the AQA analysis program.
Results: Analysis of the current sample size suggest that the Epson scanner and native to PC Accuray AQA software perform with greater consistency when compared to the setup using the application and mobile device.
Conclusion: Under the current processing framework and mobile device operating system, the in-house mobile app rendition is comparable in results but demonstrates greater variability. With further development, a one-to-one or improved setup over the original can be created and adapted to multiple types of mobile devices, demonstrating a promising future for this application and brings consideration to expand upon its use in the clinic.

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INTRODUCTION

Cyberknife delivers highly conformal, non-isocentric radiation through many small, non-coplanar beams delivered by the robotic arm. The uniqueness of this delivery system demands an exceptional geometric accuracy, due the nature of even submillimeter errors in beam targeting can compromise the steep dose gradients that make the radiosurgery effective and safe for nearby and adjacent healthy tissue.

One of the ways to ensure the maintenance of this demanding technique is Daily Quality Assurance, which is one of the cornerstones for safe and accurate radiosurgery delivery, for which Gafchromic film plays an indispensable role. This routine test verifies the submillimeter accuracy of the robotic arm and target precision.

This process, irradiating tungsten spheres within a holder cornered by two films orthogonal to each other, involves the use of color flatbed scanners that require their own setup and testing to ensure the quality of the system to be used for Daily quality assurance, demanding space, time, and maintenance in the clinic.

With current advances in technology, a now common household and personal device with high quality image scan potential, cellphones, have a potential to supplement and support clinic use to ease the process of morning quality assurance by means of serving as the scanner itself, by means of an in-house app to run the AQA test entirely localized within the portable device.

METHODS AND MATERIALS

Gafchromic EBT-XD films from Daily QA for the CyberKnife were acquired after being analyzed for in-department daily quality assurance totaling to 51 sample data points including film irradiated using the Fixed, Iris, and MLC aperture.

Ensuring typical imaging conditions by means of static source of light available in a typical clinic or office setup, support stand for holding mobile device, and a white background from use of paper for good contrast, pictures of the film were taken, ensuring that the whole film was captured by the phone's camera with cropping of image to focus on the film.

Phone was set to capture photo quality with the files set to RAW formatting and 48-megapixel quality to avoid OS based alterations.

Without any further processing of the data beyond any internal processes forced upon by the iOS and application, the images were then uploaded to the mobile app from which it was analyzed.

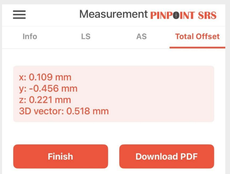

Figure 1. Sample Total Offset calculated by application

RESULTS

The data reveals a significant deviation from a normal distribution of the differences between the Scanner and Mobile device leading to a $W = 0.71$ and $p < 0.001$ from the Shapiro-Wilke test.

The appropriate test, the non-parametric Wilcoxon Signed-rank test determines that there is a significant difference between the two data sets, resulting in a rank $W = 0$ and a $p < 0.001$ representing that the scanner outperforms the mobile device and application setup.

Basic comparison by mean and standard deviation further support this.

	Analysis (Scanner File)		Analysis (Mobile Device)		Comparing
	Radial Error		Radial Error		Mean
Aperture	Mean	STD	Mean	STD	% Difference
Fixed	0.444	0.207	1.837	1.237	61.064
Iris	0.347	0.144	1.176	0.525	54.416
MLC	0.337	0.103	1.408	0.387	61.334

Table 1. Analysis of film denoting radial error for each type of aperture in millimeters

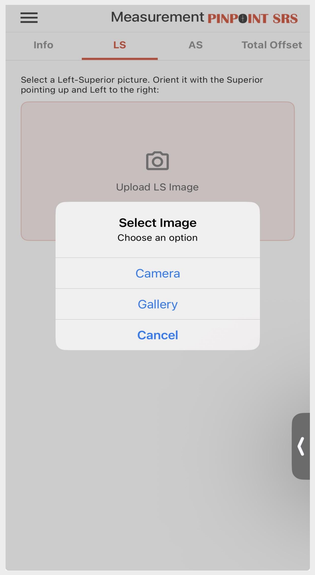

Figure 2. Step 1 of processing through application, instructing on orientation and offering camera access in application or gallery access are options given.

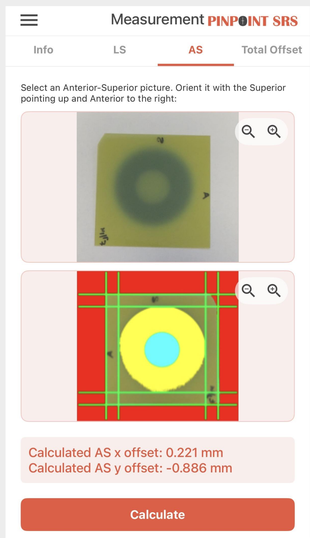

Figure 3. Step 2 of in-app processing, showing representation of edge and centroid detection of film

DISCUSSION

Considerations such as the specific screenshot angle, distance to the film, reflection caught on the film, and quality of the scanner image versus that of the camera of the cell phone are known to influence this difference in the outcome by means of increased offsets calculated as can be seen from the variance where some of the specific offsets ranged from near matching to thrice the clinical setup.

This indicates a rather pertinent focus on setup conditions for when taking the image of the film that motivates further looking into reasonable setup conditions that aren't limiting.

The application itself houses an equivalent if not identical processing of the image files as the AQA software, which was done to ensure that there was no confounding variable beyond the known image creation itself, leading to a good understanding that the inflated differences are occurring from the image creation and formatting of the files prior to analysis.

Further testing with cellular devices of varying ranges of quality in this clinical setting with various Operating systems (OS), such as other similar devices like the iPad's iPadOS, is ideal for future implementations to help create a potential profile style system to help compensate for the capacity differences of the mobile devices that your everyday clinical worker may have or interact with to push beyond a minimum device requirement and allow for further adoption.

CONCLUSIONS

Due to potential variability in setup and the processing of the cellphone device in its operating system for the image formatting, a greater variability was found when compared to the use of the Epson scanner and the typical setup conditions used currently in most clinics.

The reveal of the regions of potential improvement when it comes to the analysis shows the capacity of the in-house app to simplify workflow for the daily AQA process by means of reducing the equipment need, setup, and time to process when equivalency is reached.

Addition of further data will further improve upon the accuracy of the application with further studying allowing better understanding of the differences between the prior shown Android results to the Apple results.

REFERENCES

1. Niroomand-Rad, A., Chiu-Tsao, S.-T., Grams, M.P., Lewis, D.F., Soares, C.G., Van Battum, L.J., Das, I.J., Trichter, S., Kissick, M.W., Massillon-JL, G., Alvarez, P.E. and Chan, M.F. (2020), Report of AAPM Task Group 235 Radiochromic Film Dosimetry: An Update to TG-55. Med. Phys., 47: 5986-6025.

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