Setting up a routine audit protocol to review on-treatment radiotherapy verification

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Introduction

Radiotherapy delivers regular high radiation dose to cancerous lesions over separate treatments, which can last up to six weeks. Dose to surrounding healthy organs and tissue is minimised to mitigate against toxicity. At the point of delivery it is recommended that a delivered dose assessment is made [1]. This confirms that the linear accelerator used for radiation delivery was operating as expected and that the patient shape and position still correlates to the treatment plan.

A novel solution for this measurement was implemented using the linear accelerator's portal imager, often used for patient setup images [2]. The software system, SunCheck Patient (Sun Nuclear), uses images taken during a patient's treatment and compares it to an expected image. Commissioning for this system started in Sept 2020. An annual audit protocol has been devised and implemented to review the tolerances used to identify errors in the system and during treatment, as well as to review innovative changes to treatment delivery care paths.

Methodology

A single comparison metric between the predicted and measured acquired image is used to verify treatment delivery. This global gamma absolute difference is used in collaboration with local tolerance levels to investigate out of action measurements.

Using a Structured Query Language script, data from 11450 treatment beams performed at the Royal Surrey from Jan-Apr 2022 was pulled from the SunCheck database. An analysis method was set up using pivot tables along with the slicer tool in Excel, as seen in Fig 1, to sort the data into usable sections.

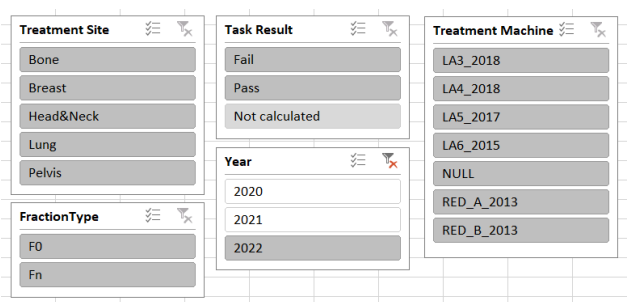

Figure 1. Screenshot of the slicers used in Excel to quickly and easily sort the large data sets between five categories: treatment site, fraction type, task result, treatment year, and treatment machine.

A review of the cause of common failures on each treatment machine used in the department was made, as can be seen in Fig 2. An annual audit schedule has been created to routinely review treatment site and machine results with respect to SunCheck result metrics.

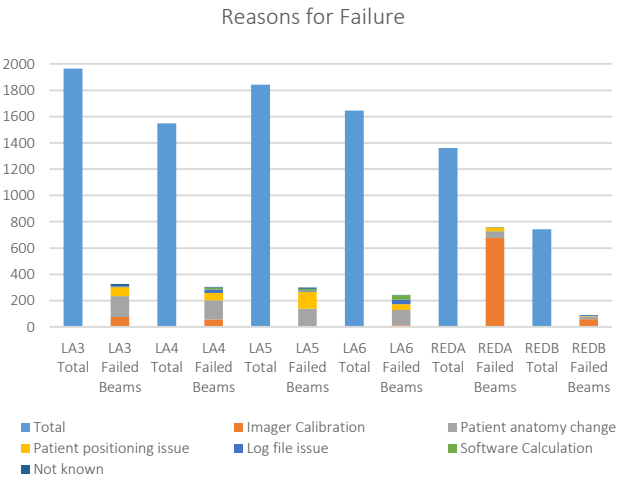

Figure 2. Number of failed measurements per treatment machine divided into five categories of causes of failure: software calculation issue, log file issue, patient positioning issue, patient anatomy changes, and imager calibration issues.

Results

The expected percentage of failure measurements was found to be 16.2%.Of these, patient anatomy (46.0%), patient positioning (24.1%) and imager calibration issues (16.2%) were found to be significant contributions. Indeed a repeated issue with the imager calibration on treatment machine 'REDA' was seen. A review of this imager and subsequent repair is set to improve measurement success rate and this should be seen in the results of future audit.

This information will be used to review subsequent audits and assess changes in treatment care paths. The current audit workflow has also been adapted to include set comments for common failures to streamline the audit process and a protocol of this system has been written up with plans of rolling it out to the whole department for routine audit.

Conclusions

Routine audit of an integrated delivery verification software is able to give greater confidence in results and provide a way to feedback into current treatment pathways. This leads to increased safe and accurate radiotherapy treatments.

References

[1]The Royal College of Radiologists. Towards Safer Radiotherapy. London: 2008.
[2]Bresciani S, Poli M, Miranti A, Maggio A, Di Dia A, Bracco C, et al. Comparison of two different EPID-based solutions performing pretreatment quality assurance: 2D portal dosimetry versus 3D forward projection method. Phys Medica 2018;52:65–71. https://doi.org/10.1016/j.ejmp.2018.06.005.

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