CT-simulator phantom and analysis software for quality assurance

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Introduction

CT-simulation (CT-Sim) is a key part of the radiation treatment process. As such, bodies like the American Association of Physicists in Medicine (AAPM) have issued documents with quality assurance (QA) recommendations, such as the TG-66 report, to ensure the integrity of CT-Sim hardware and software. In Israel there are no official QA requirements on any part of the radiation treatment process, including the CT-Sim component. Thus CT-Sim QA is left to each institution's discretion.

Materials and Methods

We purchased a dedicated phantom (CT/SIM Check) and analysis software (IMT, Troy, NY) specifically for CT-Sim QA (Figure 1). The phantom is lightweight and user friendly, and the software analyzes most parameters required in the AAPM CT QA document. We performed a repeatability and reproducibility (R&R) study in order to evaluate the robustness of the QA process with this phantom in our clinic.

The steps involved are illustrated in Figure 2: positioning the phantom on the CT table, scanning with a prespecified protocol, performing a virtual simulation procedure wherein a plan is created in the treatment planning system and its isocenter is exported to the CT laser system, and exporting the images to the software for automatic pass/fail analysis. Four different staff members performed this procedure, once in the AM before clinical work began, and once in the PM, at day's end. The first test of the day was also recorded as our daily CT-Sim QA.

Results

Upon initiating this QA procedure we uncovered several issues that required correcting, such as a 1 mm misalignment of the longitudinal laser systems, and a mis-leveling of the CT table. The software provides a full report including all the parameters that are checked (Figure 3). The R&R analysis showed that the variation within and between users was on the order of 2 mm, which is the tolerance for most tests according to the AAPM guidelines, indicating the robustness and ease of use of both phantom and software.

Conclusions

Using the CT/SIM Check phantom and software we discovered several issues that required correction, underscoring the need for a simple, easy to use tool for CT-Sim QA. R&R analysis demonstrated that the QA process with these tools is robust and within AAPM guideline tolerances.