Feasibility of the DP-850 Phantom as an Annual End-to-End Testing Device

L. Helinski, MS

Radiological Technologies University – VT

OMPC Therapy, LLC

Purpose

The DP-850 phantom as a multi-performance tool was used in the end-to-end testing process to evaluate image quality, treatment planning systems (TPS) accuracy and dose delivery accuracy. This study evaluated the consistency of the phantom across multiple clinical sites to determine that the facilities can accurately model, calculate, and deliver a treatment plan utilizing the DP-850 phantom.

The assessment was conducted at nine radiotherapy departments, utilizing five separate linear accelerators (Varian TrueBeam, Varian iX, Varian Triolgy, Varian Edge, and Elekta VersaHD) and two different calculation algorithms, Phillips Pinnacle (version 9.1 and 9.8) and/or Eclipse (version 8.9, 9.1, and 11.031).

Methods

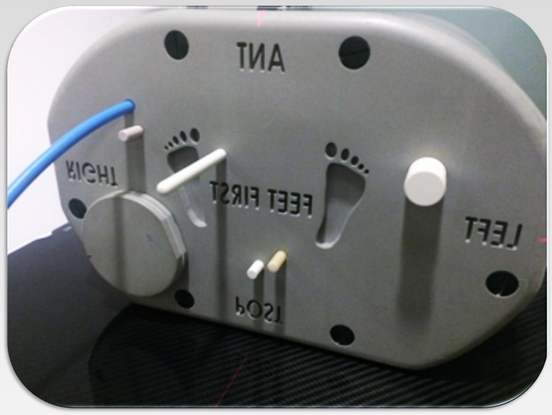
The end-to-end test was completed in the following steps:

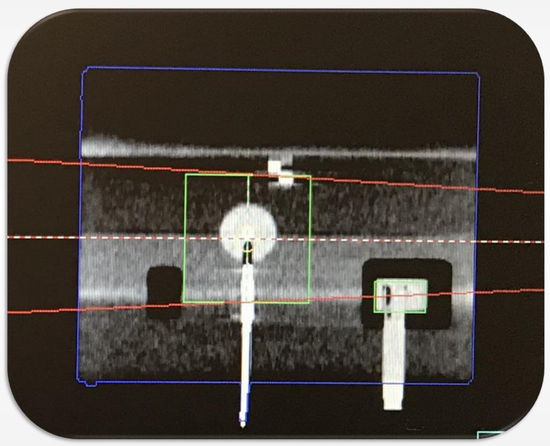
1. The DP-850 was scanned in the "head first supine" position, with the ion chamber in the center position, on the CT table.
2. The image quality and geometric accuracy analysis was performed at the CT console on the completed scan. Some examples are: contrast resolution, field uniformity and spatial resolution.
3. The known structures were contoured using the CT simulation tool and the completed scan was then sent to the TPS.
4. On the TPS, the image quality, geometric accuracy analysis test, and contouring known structures were repeated on the imported images.
5. Typical patient treatment plans were then created and exported for delivery on the DP-850 phantom.
6. The geometric accuracy was recorded of the structures using OBI console and dose delivered to the target (ion chamber) structure (calculated mean dose to chamber volume compared).
7. All the data was verified to be accurate in the record and verify system.

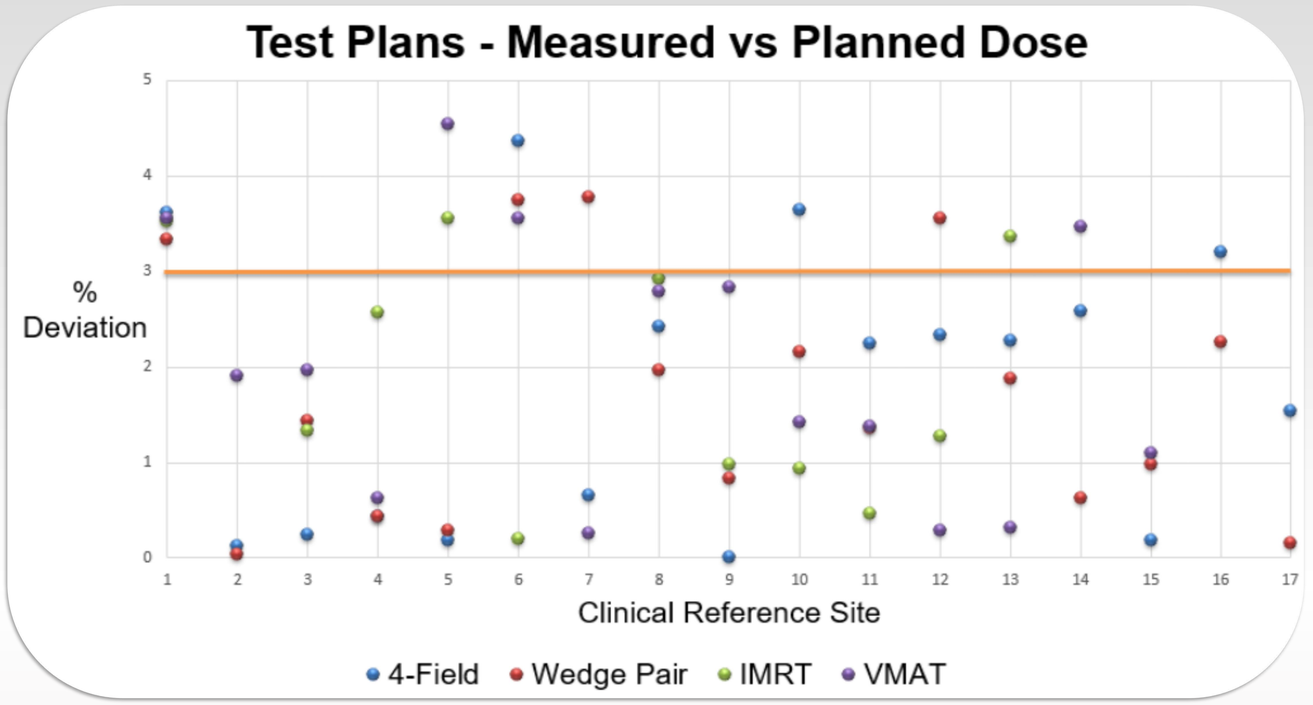
Results

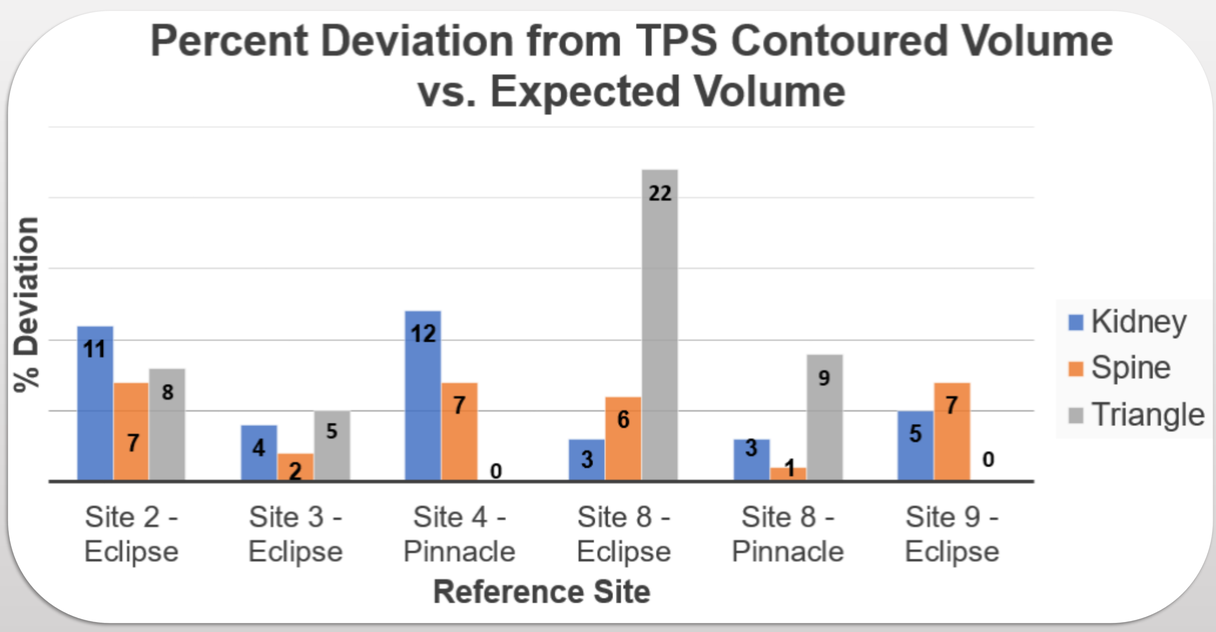
The images were successfully transferred from the CT simulators to the TPS with the correct orientation and image information. All the imaging QA was within acceptable limits, with no visible errors or degradation of the image quality. The treatment plans were prepared for delivery in the record and verify system and were confirmed to be accurate in the treatment delivery system. The image quality metrics remain unchanged from the CT simulator through the TPS to the treatment delivery system. The dose calculation accuracy of the TPS was confirmed acquiring ion chamber measurements performed with the DP-850 placed on the treatment couch.

The total dose for multiple fields is the appropriate comparison for plans and the results indicate that the TPS is capable of accurately determining the measured dose to within 3%, 75% of the time during assessment.









Conclusion

This retrospective study shows that the DP-850 phantom was found to be an acceptable method for all aspects of the annual end-to-end treatment planning process, across multiple facilities, utilizing different linear accelerators and treatment planning systems. This includes importing CT data sets, dose calculating, IMRT planning, and exporting patient treatment data.

In the future, further image quality analysis information could be available for comparison obtained from the CT scanner to the treatment delivery machine, following a standard protocol be set in place.