Comparing Results From a Single Vendor's Patient QA Solutions

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PURPOSE

To investigate results from initial usage of DoseCHECK, PerFRACTION and ArcCHECK patient QA products from Sun Nuclear Corporation (SNC).

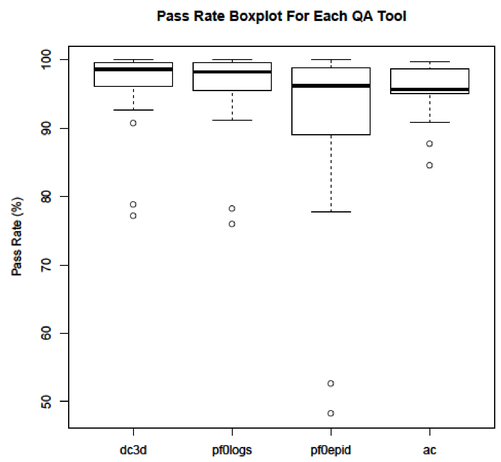
METHODS

At a new clinic, the first twenty-three VMAT patient plans (RayStation TPS and Elekta Infinity linear accelerator) were selected for analysis of pass-rate consistency amongst multiple patient pre-treatment QA products offered by SNC. For each patient, gamma analysis criteria across products were consistent (typically a 3%/3mm/10% threshold). Reference dose for analysis was either the TPS dose on the patient CT (for [dc3d], [pf0logs], [pf0epid]) or TPS dose on the ArcCHECK phantom (for [ac]). The investigated products were:

- **[dc3d]** *DoseCHECK.* (3D dose calculation engine using the patient CT, RT Structure Set and RT Plan from the TPS)
- **[pf0logs]** *PerFRACTION 3D with logs only.* (3D dose calculation engine using the patient CT, RT Structure Set, RT Plan in conjunction with log files created using an iCom-Vx interface to the linac during delivery)
- **[pf0epid]** *PerFRACTION 3D with EPID.* (CT, RT Structure Set, RT Plan, logs and EPID images captured by the Elekta iView panel to verify actual MLC position)
- **[ac]** *ArcCHECK.* Cylindrical diode array.

RESULTS

I. A simple visual of pass rate results. A boxplot is shown below illustrating the pass-rate results (%) for the sample of twenty-three plans utilizing the four QA tools.

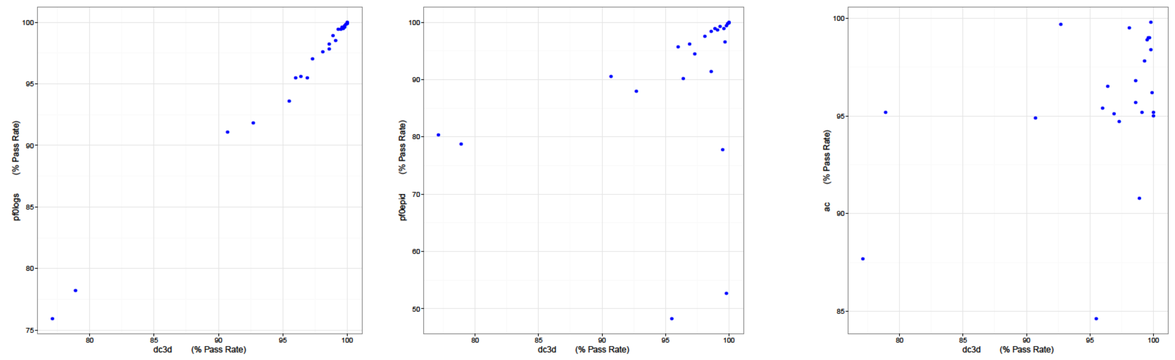


II. Matched pair examination of QA tools. To examine the relationship between these four pre-treatment QA methods as applied to the sample, a non-parametrical statistical (Friedman rank sum) test was chosen. As expected from the boxplot above, a difference between the collective results from the four QA tools was indicated. To further understand the inter-relationship of the four QA tools, two tools were recursively selected and correspondence of the pass-rate relationship was visualized for each of the 23 plans in the matched pair sample.

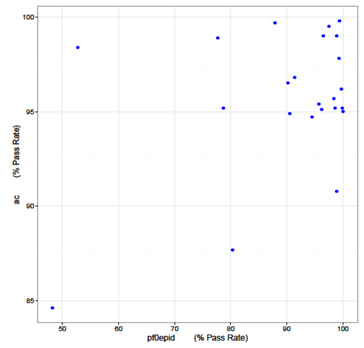
RESULTS (CONTINUED)

II A. [pf0logs] vs [dc3d] The linear correlation ($R^2 = 0.994$) between these two tools (both of which use the same dose engine calculation on the patient CT and differ substantially only in the usage of delivery parameters as represented in the DICOM RT object from the TPS [dc3d] vs delivery parameters as recorded from an iCOM-Vx connection to the linac [pf0logs]) indicated that Elekta's linac controller (Integrity) had machine parameters which match well those planned by the TPS.

II B. [pf0epid] vs [dc3d] and **[ac] vs [dc3d]** The introduction of measurement of leaf position (either via EPID in [pf0epid] or via cylindrical diode array [ac]) resulted in loss of relationship to [dc3d].



II C. [ac] vs [pf0epid] If the actual MLC positioning was the singular issue then one might expect an agreement between [ac] and [pf0epid], both of which incorporate information from actual leaf positioning. However, there was a lack of linear relationship.



CONCLUSIONS

- EPID image usage introduced a marked PerFRACTION performance difference from that obtained using log files only. EPID fault was not suspected as it yielded excellent results for absolute dose calibration of the panel (PerFRACTION FZAD) for 6X and 10X.
- ArcCHECK performance was uncorrelated to PerFRACTION 3D regardless of EPID image usage.
- Future work will investigate performance of a 2D tool (PerFRACTION 2D) using an absolute dose calibrated panel and calibration technique influence upon ArcCHECK.

CONTACT

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