

Introduction

This case study looks at two IMS systems naming MIM Maestro and RADformation ClearCheck for SRS plan dosimetry review. The reason for conducting this study is because while reviewing clinical trial dosimetry for stereotactic radiosurgery (SRS) plans, the Imaging and Radiation Oncology Core (IROC) Houston notices dosimetry parameter, D99 (dose to 99% of target volume) of small target volume $\leq 0.5\text{cc}$ extracted from MIM system is slightly to grossly difference compared to the same plan from its TPS system

Methods

A total of 10 SRS plans were imported into MIM Maestro and RADformation ClearCheck. A total of 68 GTVs with volumes of less than or equal 0.5cc from 10 SRS plans (linac based) were reviewed. First, each SRS plan is imported into MIM Maestro and RADformation ClearCheck. Next step is to assess dosimetry D99 (Gy) and total volume (cc) for each GTV (gross tumor volume). The last step is to compile the extracted dosimetry parameters using Excel spreadsheet and to compare these values between MIM Maestro vs. TPS and RADformation ClearCheck vs. TPS.

Results

1. D99 MIM Maestro vs. TPS Ratio

- 20.5% (14 GTVs) has 100% agreement between the two systems
- 36.8% (25 GTVs) in agreement within $\pm 1\%$ (99% - 101%)
- 58.8% (40 GTVs) in agreement within $\pm 2\%$ (98% - 102%)
- 70.6% (48 GTVs) in agreement within $\pm 3\%$ (97% - 103%)
- 79% (54 GTVs) in agreement within $\pm 4\%$ (96% - 104%)
- 82% (56 GTVs) in agreement within $\pm 5\%$ (95% - 105%)

The largest D99 dose discrepancy between MIM Maestro and TPS value is -13% (MIM D99 is 13% lower compared to TPS value).

Results (cont'd)

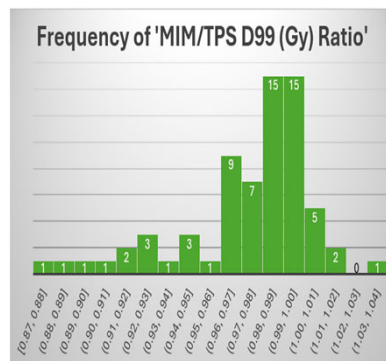


Fig.1 MIM vs. TPS D99 Ratio: Raw Data (Total GTVs = 68)

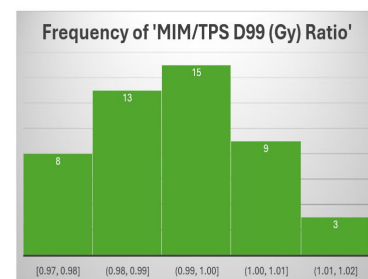


Fig 2. MIM vs. TPS D99 Ratio: $\pm 3\%$

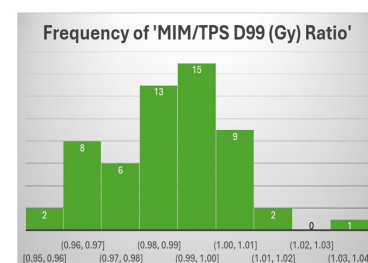


Fig 3. MIM vs. TPS D99 Ratio: $\pm 5\%$

Results (cont'd)

2. D99 Radformation ClearCheck vs. TPS Ratio

- 26.5% (18 GTVs) has 100% agreement between the two systems
- 48.5% (33 GTVs) in agreement within $\pm 1\%$ (99% - 101%)
- 79.4% (54 GTVs) in agreement within $\pm 2\%$ (98% - 102%)
- 91.2% (62 GTVs) in agreement within $\pm 3\%$ (97% - 103%)
- 97% (66 GTVs) in agreement within $\pm 4\%$ (96% - 104%)
- 97% (66 GTVs) in agreement within $\pm 5\%$ (95% - 105%)

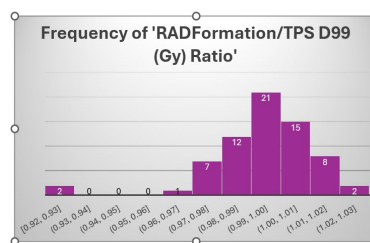


Fig.4 RADformation vs. TPS D99 Ratio Raw Data (Total GTVs = 68)

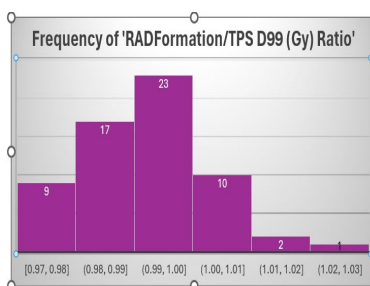


Fig. 5 RADformation vs. TPS D99 Ratio: $\pm 3\%$

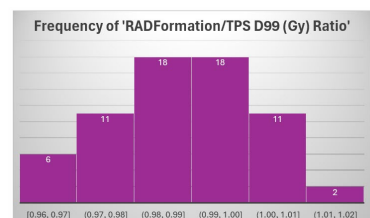


Fig 6. RADformation vs. TPS D99 Ratio: $\pm 5\%$

Discussions

RADformation shows better agreement with TPS reported values for D99 and GTV total volume compared to MIM Maestro for the same dosimetry parameters. This might be because most of these SRS plans were done with Varian Eclipse TPS system which RADformation Clearcheck also utilizes Eclipse Scripting API to extract data from active plans.

In addition, MIM Maestro used four decimal point for GTV extracted volume compared to two decimal point was used in RADformation and reported TPS values. This might explain better correlation of RADformation ClearCheck and TPS in both D99 and GTV total volume.

80% or 55 GTVs has the volume of less than or equal 0.2cc this seem to be very a very small volume for dose extraction by an independent IMS system and to have 100% dose agreement.

Limitations

Cyberknife and Gammaknife plans were not included in this study due to limitation of RADformation ClearCheck at the time of this study (it did not support Cyberknife and Gammaknife plans).

Conclusions

Collected data shows both IMS systems seem to detect:

- Lower GTV D99 dose compared to reported value from TPS
- Larger volume compared to TPS systems for the same GTV.
- RADformation has better agreement for D99 with TPS reported dose, especially for the $\pm 3\%$, $\pm 4\%$ and $\pm 5\%$. However, extracted data method from both IMS systems is different which could influence the result outcomes.
- Additional study is needed for further evaluation.