Use of IMSure for MU Verification on RapidArc Plans

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Introduction:

RapidArc is a major advance in technology that improves dose conformity while significantly shortening treatment times. However, it posts challenges for medical physicists to re-evaluate the IMRT QA process to adapt to the era of rotational radiation delivery. This technical note is to share our experience on using the current version IMSure software from Standard Imaging to verify the mu calculations from Eclipse treatment planning system. Software verification is not meant for replacing rigorous measurement based QA process using either film dosimetry or detector arrays. But it provides dosimetrists an additional degree of safe guard against any gross error before the plan is approved for treatment.

Method:

With the current version of IMSure, we can only utilize an average depth from all gantry angles to calculate dose or monitor unit. There is only one difference between using IMSure for IMRT/3D vs. RapidArc - the calculation point must be placed at isocenter of RapidArc field, regardless where the target volume is. Otherwise, the calculation point will move within beam's eye of view when gantry rotates.

With a calculation point at isocenter, Eclipse plan report will show an Eq. Path Length which is an average effective depth with inhomogeneity correction applied.

Results:

The table below lists IMSure calculations for 11 arcs. The plan complexity ranges from simple prostate plan to complex abdomen plan. As showing in the table, our focus in the early stage of implementing RapidArc technology is on reducing treatment time for complex abdomen and pelvis IMRT treatments. These are the cases where we find RapidArc technology offer the most benefit. There is no H&N example because it often requires couch rotation to avoid shoulders. Our current version of Eclipse does not support couch rotation.

Our results shows that the difference between TPS calculated dose and IMSure calculated dose ranges from 1.1% to 8.7%, with an average of 2.5% discrepancy.

Site	Isocenter location	TPS Dose (cGy)	IMSure Dose (cGy)	Difference
Prostate	middle of Tx volume	204.1	215	-5.1%
Esophagus	middle of Tx volume	215.1	217.4	-1.1%
Abdomen	outside of Tx volume	98.7	97.5	1.2%
Abdomen	outside of Tx volume	114.6	110.2	4.0%
Abdomen	outside of Tx volume	91.5	96.9	-5.6%
Pelvis	middle of Tx volume	180	176.7	1.9%
Pelvis	middle of Tx volume	93.7	95.5	-1.9%
Pelvis	middle of Tx volume	93.7	97.1	-3.5%
Pelvis	middle of Tx volume	94.7	98.9	-4.2%
Pelvis	middle of Tx volume	94.7	103.7	-8.7%
Pelvis	outside of Tx volume	133.3	140.4	-5.1%

Discussion:

As expected, the difference between TPS calculated dose and IMSure calculated dose is larger than what we have seen for the plans with stationary gantry angle (IMRT or 3D). This is largely due to the approximation of using an average depth for all gantry angles. However, the magnitude of the discrepancies is relatively small that one can still use the current software to confirm that the treatment plan monitor units are within expected range. We use ± 10% as our tolerance for IMSure RapidArc validation.

One final note on the calculated dose at isocenter when the isocenter is outside of target volume: the total dose at calculation point is going to be much less than prescription dose in this case. Fortunately, Eclipse uses field normalization which also normalizes dose to isocenter. The plan coming out optimization process is too “hot”. What we have to do is to adjust plan normalization to a value > 100% to reduce the dose to target so that it receive prescribed dose. As a standard practice (for any types of plans), we multiply the calculated isocenter dose with plan normalization factor to see if this value is close to the prescription dose. This also applies to RapidArc cases.