deviation vector ranged from 0.34 mm to 0.82 mm with an average of 0.58 mm and a SD of 0.16 mm. Using the new method of calibration, the 3D deviation vector between the ET X-ray isocenter and the LIS isocenter was on average reduced threefold.

Conclusion

Using an in-house made software, a new user independent method of co-calibrating the X-ray isocenter of the ET system with the LIS isocenter was developed. The new method reduced the deviation between the two isocenters threefold and brought them into alignment within one tenth of a millimetre. This may be of clinical relevance in radiotherapy operating with small margins and steep dose gradients i.e. as used in stereotactic radiotherapy.

EP-1747 From pre-treatment verification towards in-vivo dosimetry in TomoTherapy

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Purpose or Objective

Dosimetry Check software (DC) has been under commissioning to be used as a patient specific delivery quality assurance (DQA) tool in the TomoTherapy machine recently installed at our institution. The purpose of this work is to present the workflow from pre-treatment verification with DC comparing it with the standard film dosimetry towards in-vivo patient dosimetry having transit dosimetry with a homogeneous phantom as an intermediate step.

Material and Methods

The retrospective study used MVCT detector sinograms of 23 randomly selected clinical cases to perform i) pre-treatment verifications, with the table out of the bore, ii) transit dosimetry for DQA verification plans calculated in a Cheese Virtual Water™ phantom and iii) in-vivo dosimetry using the sinogram of the first treatment fraction for each of the 23 patients. The 3D dose distribution in the phantom/patient CT images was reconstructed in Dosimetry Check v.4, Release 10 (Math Resolutions, LLC) using a Pencil Beam (PB) algorithm. In the pre-treatment mode, Gamma passing rate acceptance limit was 95% using a 3%/3mm criterion. The results have been correlated with the standard film based pre-treatment verification methodology, using Gafchromic EBT3 film with triple channel correction.
In transit mode, with the Cheese Phantom, two groups were identified: one with clinical cases in which the longitudinal treatment extension exceeded the phantom limits (group I) and another one with cases where the whole treated volume was inside the phantom (group II). In this mode, a 5%/3mm criterion was used in Gamma analysis. The acceptance limit was again 95%. This was also the criterion for in-vivo dosimetry in the first fraction of each of the 23 patients.

Results

There was a good agreement between planned and measured doses when using both pre-treatment and transit mode. In the pre-treatment approach the mean and standard deviation Gamma passing rates were 98.3±1.2% for 3%/3mm criterion correlating well with the results in film. Concerning transit analysis in Cheese phantom, 8 out of 23 cases – group I – presented poor Gamma passing rates of 93.8±2.2% (1SD) on average for 5%/3mm. This was caused by partial volume effect at the edges of the phantom as the longitudinal treatment extension exceeded its limits. Considering the other 15 cases – group II – the global Gamma passing rates were significantly better 99.5±0.7% (1SD), 5%/3mm. Using the sinogram from the first fraction delivered to each patient, the passing rates were 98.7±1.4% (1SD), on average.

Conclusion

The presented results indicate that Dosimetry Check software using either pre-treatment or transit mode is a reliable tool for patient specific DQA in TomoTherapy easily integrable in the routine workflow and without major time allocation requirements. Further investigation needs to be done on DC ability to detect discrepancies during the treatment course, namely if it will be able to alert for re-planning need.

EP-1748 Mesorectal-only irradiation for early stage rectal cancer: Target volumes and dose to organs at risk

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Purpose or Objective

There is increasing interest in radiotherapy (RT)-based organ preservation strategies for early stage rectal cancer. However, standard RT for locally advanced rectal cancer uses a large pelvic target volume, which may represent overtreatment of early cancers with a low risk of nodal involvement and could cause significant morbidity. Thus the international, multi-centre phase II/III STAR-TReC trial, aiming at organ preservation, will use a mesorectal-only irradiation approach for early rectal cancer. Furthermore, in order to limit normal tissue toxicity risk, IMRT or VMAT may be used. We explored the advantages in terms of clinical target volume and organ at risk (OAR) doses of a mesorectal-only target volume compared to a standard target volume for short-course RT, and compared VMAT and 3D-conformal radiotherapy (3D-CRT) for mesorectal-only irradiation. We also aimed at establishing optimal planning objectives for mesorectal-only short-course VMAT.

Material and Methods

We conducted a retrospective planning study of 20 patients with early rectal cancer: 15 men, 5 women; 1 high, 10 mid, 9 low tumours; 4 T1, 13 T2, 3 T3a; all N0; 13 treated prone, 7 supine. **Standard** CTV encompassed the mesorectum, obturator lymph nodes, internal iliac nodes and pre-sacral nodes cranio-caudally from puborectalis to the S2-3 vertebral junction (as per the UK phase III Aristotle trial). The **mesorectal-only** CTV included the mesorectum only from 2cm caudal of the tumour up to the S2-3 vertebral junction. VMAT plans (6MV FFF, single arc) delivering 5x5Gy to the mesorectal PTV were optimized using a Monte Carlo-based treatment planning system. They were compared to 5x5Gy three-field 3D-CRT plans, for standard and mesorectal targets. We considered target coverage, plan conformity (CI), and doses to bowel cavity, bladder and femoral heads. Metrics were compared using the Wilcoxon signed rank test. VMAT optimization objectives for OAR were established by determining dose metric objectives achievable for ≥90% (bowel cavity) and ≥95% (bladder and femoral heads) of patients.

Results

Mesorectal-only CTVs were median 59% smaller than standard CTVs (interquartile range 58-63%, p<0.001). All VMAT and 3D-CRT plans had $V_{95\%}$=100% for the CTVs, while $V_{95\%}$ of the PTV was comparable for VMAT and 3D-CRT plans (median 99.4% vs 99.6%). Table 1 summarizes doses to OARs and CI. All OAR doses for mesorectal-only irradiation were significantly reduced with VMAT compared to 3D-CRT; p<0.001 for all metrics. Suggested optimization objectives for OAR for mesorectal-only VMAT were V_{10Gy}<200cm^3, V_{18Gy}<120cm^3, and V_{23Gy}<90cm^3 for bowel cavity; V_{21Gy}<15% for bladder; and $V_{12.5Gy}$<16% for femoral heads.

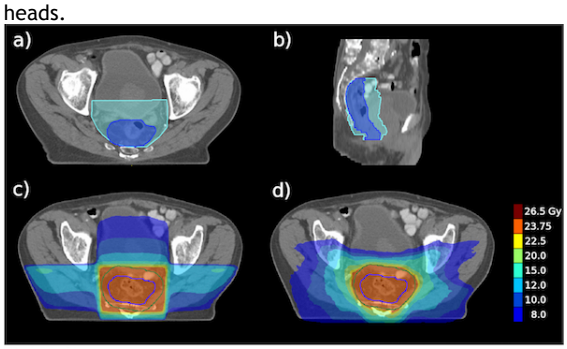

Figure 1:
a-b) Comparison of target volumes: UK standard CTV (light blue) and mesorectal-only CTV (dark blue)
c-d) Comparison of mesorectal plans: 3D-conformal (c) and VMAT (d)

	Standard target (3D-CRT)	Mesorectal-only (3D-CRT)	Mesorectal-only (VMAT)
CTV vol [cm^3]	542 (499 – 640)		233 (197 – 252)
CI	0.70 (0.69 – 0.72)	0.67 (0.66 – 0.70)	0.87 (0.87 – 0.88)
Bladder V_{21Gy} [%]	33.5 (22.0 – 43.3)	10.6 (6.4 – 18.1)	4.6 (2.9 – 10.9)
Bowel cavity V_{10Gy} [cm^3]	335 (231 – 393)	260 (197 – 311)	144 (117 – 187)
Bowel cavity V_{18Gy} [cm^3]	180 (144 – 217)	89 (73 – 111)	75 (65 – 104)
Bowel cavity V_{23Gy} [cm^3]	157 (93 – 184)	64 (55 – 90)	54 (46 – 74)
Femoral heads $V_{12.5Gy}$ [%]	65.2 (47.2 – 81.5)	43.8 (19.6 – 61.0)	3.9 (1.1 – 9.5)

Table 1: Volumes and dose metrics for the two target volumes: standard UK volumes (as per the UK phase III Aristotle trial) and mesorectal-only volumes. Conformity index (CI) was calculated as the absolute $V_{95\%}$ for the PTV relative to the absolute $V_{95\%}$ for the whole body outline. All values are medians, with interquartile ranges in parenthesis.

Conclusion

VMAT provides dosimetric advantages over 3D-CRT for mesorectal-only target volumes. The recommended OAR optimization objectives allow for clinical implementation of IMRT/VMAT with improved OAR sparing compared to 3D-CRT standard treatment. These objectives will, after independent validation, be used in the multi-centre STAR-TReC trial.

EP-1749 The IROC QA Center's Activities Supporting the NCI's National Clinical Trial Network

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Purpose or Objective

The Imaging and Radiation Oncology Core (IROC) Cooperative has been active for the past two years supporting the National Cancer Institute's (NCI) National Clinical Trial Network (NCTN), its clinical trials and the details of that support are reported in this work.

Material and Methods

There are six QA centers (Houston, Ohio, Philadelphia-RT, Philadelphia-DI, Rhode Island, St. Louis) providing an integrated radiation therapy (RT) and diagnostic imaging (DI) quality control program in support of the NCI's clinical trials. The former cooperative group QA centers brought their expertise and infrastructure together when IROC was formed in the new NCTN structure. The QA Center's efforts are focused on assuring high quality data for clinical trials designed to improve the clinical outcomes for cancer patients worldwide. This program is administered through five RT and DI core support services: site qualification, trial design support/assistance, credentialing, pre- and post-case review data management, and case review. IROC also provides educational efforts to improve the understanding of the protocols by participating institutions. IROC monitors over 2000 participating institutions that include nearly 100 participating institutions outside of North America.

Results

IROC currently provides core support for 172 NCTN trials with RT, DI and RT/DI components. Many of these trials were legacy trial from the previous cooperative group program. IROC monitors nearly 1800 RT photon and 20 proton institutions. Over 28,000 beams outputs were monitored with 8% of the sites requiring repeat audits due to beam out of criteria. As part of credentialing, 950 QA phantoms have been irradiated, 515 imaging modalities evaluated and almost 4000 credentialing letters have been issued. In just year 2, 5290 RT and 4934 DI patient datasets were received (many using TRIAD) by IROC QA Centers to be prepared for review. During the past 2 years, a total of 6300 RT cases and 19,000 DI image sets were reviewed by IROC technical staff. To date, IROC has published 36 manuscripts.

Conclusion

The QA services provided by IROC are numerous and are continually being evaluated for effectiveness, harmonized across all NCTN Groups and administered in an efficient and timely manner to enhance accurate and per protocol trial data submission. These efforts increase each NCTN Group's ability to derive meaningful outcomes from their clinical trials.

EP-1750 Enhanced radiotherapy by novel class of radiosensitizers based Bismuth and Gadolinium nanoparticles

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Purpose or Objective

Recently, the use of nanoparticles with a high atomic number as a new class of radiation sensitizers, to increase the tumor dose and sparing normal tissues has become a hot topic in radiotherapy treatments. Meanwhile, Bismuth and Gadolinium based nanoparticles, can not only be used