EP-1918

Radiotherapy quality assurance in the TREC trial

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Purpose or Objective: Transanal Endoscopic Microsurgery (TEM) and Radiotherapy in Early Rectal Cancer (TREC) [1][2] is a randomised phase II feasibility study to compare radical TEM surgery versus short course pre-operative radiotherapy (25Gy in 5 fractions over 5 days) with delayed local excision for treatment of early rectal cancer.
The QA programme for TREC is co-ordinated by the UK Radiotherapy Trials Quality Assurance (RTTQA) group [3][4]. We describe the development of a standardised analysis pipeline and the results of this analysis.

Material and Methods: To ensure consistency and therefore comparability between radiotherapy centres involved in TREC, a detailed radiotherapy protocol was developed. To assess the quality of the plans, 3 (PTVmin, PTVmax, ICRUmax) quantities were measured and recorded. Further investigation was carried out if the relevant objective was not met.
TEMS patients in TREC were treated across 18 UK centres. Radiotherapy plan data was submitted for each of the 87 TEM patients in DICOM format and processed with the Computational Environment for Radiotherapy Research (CERR) software [5]. This enabled i) outlining of target and organ-at-risk structures, ii) dose distribution and dose volume histograms to be assessed (independently) and iii) data format standardisation and automated analysis.

Results:

ROI Objective	Definition
PTV min	D99% ≥ 95% (23.75 Gy)
PTV max	D5% < 105% (26.25 Gy) D2% < 110% (27.5 Gy)
ICRU max	D1.8cc < 110% (27.5 Gy) Lateral patient dose distant from PTV <80% to 85%

Table 1: Summary of quantities assessed during review of radiotherapy plans

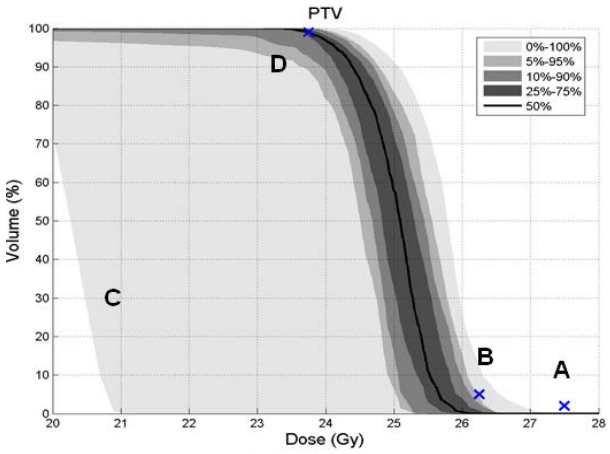

Figure 1: Distribution of PTV coverage

Table 1 shows the ROI objectives outlined in the TREC protocol. Figure 1 shows the distribution of PTV coverage for the 87 TEM patients analysed. All plans achieved D2%<110% (Figure 1, marker A) and 95% of plans achieved D5%<105% (B). Cases of poor coverage (C) were investigated and in 4 cases it was found that the outlined PTV extended beyond the patient surface. In these cases PTV was retracted to within the patient surface and coverage was recalculated.

Conclusion: Deviation from the clinical trial protocol has the potential to confound the study question and quality assurance is therefore essential when comparing different treatments. A high level of conformance was found across the 18 treating centres, with 95% of plans achieving both the minimum and maximum PTV objectives. Our analysis of the radiotherapy plans demonstrates good understanding and adherence to the TREC protocol.
STAR-TREC is an upcoming trial that will amend and extend the TREC pilot. RTTQA findings from TREC will be used to strengthen and improve the STAR-TREC protocol, for example, use of standardised structure names and use of plan-optimisation PTVs to assess target coverage.

References:

[1] Cancer Research UK, "TREC trial protocol," 15 09 2010. [Online]. Available: http://www.birmingham.ac.uk/Documents/college-mds/trials/bctu/trec/TREC-protocol-v1.pdf.

[2] Cancer Research UK, "A study looking at a possible new way to treat cancer of the back passage (TREC)," 13 03 2015. [Online]. Available: http://www.cancerresearchuk.org/about-cancer/find-a-clinical-trial/a-study-looking-possible-new-way-treat-cancer-back-passage-trec.

[3] "RTTQA group," [Online]. Available: http://www.rttrialsqa.org.uk/rttqa/.

[4] C. M. Evans, N. G. Burnet, E. Hall, R. A. Huddart, C. M. Nutting and C. E. Coles, "The Radiotherapy Clinical Trial Research Landscape in the UK Between 2004 and 2013: A Cross-sectional Analysis," *Clinical Oncology*, vol. 27, pp. 491-494, 2015.

[5] "A Computational Environment For Radiotherapy Research, CERR," [Online]. Available: http://www.cerr.info/about.php.

EP-1919

A cost-effective and fast end-to-end test for treatment accuracy evaluation

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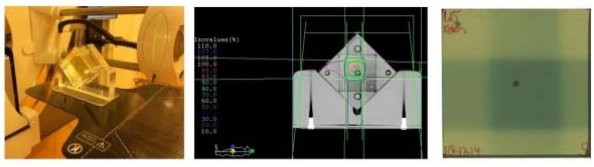
Purpose or Objective: End-to-end tests are used to measure the overall accuracy of the radiation therapy chain, excluding patient specific factors. An end-to-end test is a prerequisite to the overall success of any IGRT program. In this work the performance of a cost-effective and fast end-to-end test to assess the geometrical accuracy of the radiotherapy workflow is described.

Material and Methods: The in-house developed phantom for end-to-end testing is depicted in figure 1a. It consists of two Perspex slabs in which a piece of Gafchromic EBT3 film of 4x4cm2 can be placed in. Two notches tighten the film and determine the center and the orientation of the phantom/film respectively. The phantom can be positioned in such a way to have the film in the coronal and sagittal orientation. The total weight of the phantom is about 1kg. A high resolution computed tomography (CT) scan is made of the phantom and a treatment plan (figure 1b) including collimator, gantry and table rotations is computed on this CT. The treatment plan is sent to the linear accelerator. Simulating an actual patient treatment, the phantom is set up on the treatment table using the lasers. Then, cone beam CT guidance is used to adjust the phantom's position with respect to the planning CT. After applying the suggested table shift the plan is irradiated. The films are analyzed using an in-house written Excel macro. The shift required to align the film with the calculated dose plane represents the targeting error. The use of the described phantom for end-to-end testing was compared against two commercial available phantoms.



(a) (b) (c)

Figure 1 a. End-to-end phantom on the treatment table; b. dose distribution of the plan used for the test; c. corresponding film measurement.

Results: The phantom is light, easy to handle and to set up. Moreover, it is cheap compared to available commercial systems. The phantom allows to assess the overall geometrical accuracy of the treatment chain with sub mm

accuracy. The end-to-end test procedure requires on average 70 min preparation time, 30 min at the linear accelerator, 20 min analysis and administration. It allows end-to-end testing to be performed more frequently to assure the accuracy over time.

Conclusion: The developed end-to-end test is quick, cost-effective and easy to implement clinically. It allows to frequently highlight geometrical inaccuracies in an image-guided radiation therapy environment.

EP-1920

Harmonising the clinical trials QA group reports on phantom measurements around the globe

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Purpose or Objective: The Global Harmonisation Group was created in 2009 to harmonise and improve the quality assurance (QA) of radiation therapy implemented worldwide in multi-institutional clinical trials. The aim is to achieve a consistent platform to provide and share QA processes in clinical trials such that the workload for both the institutions and the QA groups is reduced and streamlined. As part of this aim, the group reviewed their reporting techniques to better understand each other's approaches and agree on core information which would be included as part of future creation of a standard template. This could potentially lead to the ability to use each other's reports in lieu of unnecessary duplication

Material and Methods: A survey was created to find a list of core information which could be included in future dosimetry credentialing reports. Answers were requested to give opinion from each group as to what should be included as a minimum in these reports. Some QA groups use site visits or postal phantoms, whereas some use a virtual phantom (i.e. local QA measurement) and others use both. The questions were divided to allow responses for both types. Questions were circulated amongst the groups beforehand and all comments and contributions were incorporated.

Results: All seven current member groups replied. Results were divided into three categories, 1)information which all groups agreed should be included 2)information which the majority use and the others often use which could be discussed as being agreed on inclusion and 3)information which was not used by all groups, but which could be used by those who did (see table 1).

Information which all groups agreed should be included in all reports	• dates of irradiation and report • name of organisation issuing report • overall pass/fail for the audit • planning system used, type of delivery (eg IMRT) • machine type used (eg linac, Tomo) • dose calculated by institution • dose measured by auditor • information on position of measurement
Information which the majority of groups agreed should be included in all reports	• named audit group personnel • named RT centre personnel • signature of responsible physicist • disclaimer about the scope of the audit • TPS algorithm used • energy used • phantom used (and description) • description of normalisation point
Information which was not used by all groups but which could be shared by those who did	• whether gantry angles were collapsed or not • gamma index software used • gamma index pass criteria • gamma index threshold used • calculations grid size used • whether local or global gamma calculation • correction for daily output dose • dose measured locally by institution (on local QA phantom)

Table 1 Agreed information in clinical trial QA group reports

Conclusion: The survey showed that that there is a wide variation in the information currently provided in the reports from the various QA organisations, which may hamper their mutual acceptance. Following discussion there were several pieces of information which were agreed should always be included and these constitute the beginning of an agreed list of included core information. There are several more pieces of information which the majority always include and the others use often or sometimes. These could be discussed to understand when and why they are not used and perhaps considered for inclusion. There are some others where not all members use the information because they do not use a gamma index analysis, however these could be included for those who do use the gamma index. There is also some information which sometimes included, but which is always included when needed. These cases will be discussed and decided if these should be included in specific cases, perhaps including a flowchart to aid standardisation. Some groups have already reviewed or are in the process of reviewing their reports to ensure inclusion of core information.

EP-1921

Novalis certification of stereotactic radiation therapy programs: methodology and current status

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Purpose or Objective: To present an overview and the current status of Novalis Certification, which provides a comprehensive and independent assessment of safety and quality in stereotactic radiosurgery (SRS) and stereotactic body radiation therapy (SBRT), ensuring the highest standards and consistency of practice.

Material and Methods: The Novalis Certification program includes a review of SRS/SBRT program structure, adequacy of personnel resources and training, appropriateness and use of technology, program quality management, patient-specific quality assurance and equipment quality control. Currently ten auditors support the program, with six in North America, three in Europe and one in Asia, each bringing a minimum of a decade of experience in stereotactic practice. Centres applying for Novalis Certification complete a self-study 30 days prior to a scheduled one-day site visit by one to two reviewers. Reviewers generate a descriptive 77-point report which is reviewed and voted on by a multidisciplinary expert panel of 3 medical physicists, 2 radiation oncologists and 2 neurosurgeons. Outcomes of reviews may include mandatory