years, including EPID-based Winston Lutz tests, table rotation inaccuracy measurements, leaf and jaw position accuracies and KV-MV isocenter measurements.

Results: Table 1 summarizes the precision of the separate elements in our intracranial SRS treatment chain. The largest inaccuracies of about a mm are found for imaging, delineation and treatment planning. Image registration, machine QA and patient setup show high sub mm accuracy. Resulting accuracies are in compliance with the SRS tolerances as mentioned in international and national guidelines (AAPM TG 142, NCS 22 and 24). The TPS dose grid will be adjusted to 2 mm (recommendation by AAPM TG 101). Furthermore, setup and image registration data are in good agreement with literature [1]. In addition to the upper tolerance limits from guidelines, this table provides detailed reference material regarding realistic machine and treatment accuracies for frameless, linac-based intracranial SRS.

Conclusion: This method to comprehensively map and evaluate SRS treatment accuracy has allowed us to identify the most relevant sources of treatment delivery uncertainties and indicate items that require further investigation. Currently, relevant treatment uncertainties are further investigated and an end-to-end test is developed to further define and improve our accuracy. This approach can be extended to other stereotactic sites and techniques as well as to other institutes. We believe that comparing this kind of comprehensive data over institutes will also help to improve evaluation of treatment outcome as the actually delivered dose highly depends on the treatment accuracy.


PO-0949
Automated approval of a pre trial benchmark RTTQA case. The ARISTOTLE experience.
L.N. Sweeney1, E. Spezi2, N. Cole1, D. Sebag-Montifiore3, R.A. Adams3
1Velindre Cancer Centre, Clinical Oncology, Cardiff, United Kingdom
2Velindre Cancer Centre, Medical Physics, Cardiff, United Kingdom
3St James Institute of Oncology, Clinical Oncology, Leeds, United Kingdom

Purpose or Objective: To demonstrate the feasibility of using a statistical algorithm, MDC-OVER-UNDER, as an automated assessment tool of a test case for radiotherapy outlining. If feasible, this efficient technique could be used to screen submissions for significant errors in outlining a radiotherapy quality assurance (RTTQA) pre-trial test case.

Material and Methods: UK centres submitted a neoadjuvant radiotherapy rectal cancer test case, prior to recruitment to the phase III ARISTOTLE trial. CERR (a computational environment for radiotherapy research) software platform was used for assessment. Previous pilot work using conformity indices to evaluate target volume delineation (TVD) in this trial had limitations. An MDC value of +/- 0.2mm from a single line reference volume calculated from ROC curve analysis, gave high sensitivity and specificity for slices which were over/under outlined. We were unable to satisfactorily validate this system owing to areas of “accepted” discrepancy from the reference standard (RS). In this work, a RS (non-margin generated) CTV with a minimum and maximum extent was created by two clinicians involved in the RTTQA process (fig 1). This was based on previous single line RS and iterative review of submissions from several centres. MDC-OVER-UNDER on a slice by slice basis, applied to the slice-based CTV, was applied to the individual institution submitted CTV. For any slice of the volume to pass the automated assessment, both following criteria had to be met. NB. An outline difference of 0.1mm is visually perfect.

1) For CTV MAX extent: MDC Over (mm) - 0.1mm = ≤ 0mm 2) For CTV MIN extent: MDC Under (mm) + 0.1mm = ≥0mm.

Results: We analysed 16 submissions from 10 centres. Data was saved in CERR format with uniform naming convention. The RS CTV ranged from maximum extent slices 30-53 (24 slices); minimum extent slices 31-52 (22 slices). Assessment of a submission was complete within seconds. The algorithm identified and quantified deviation for every outlined slice as expected. There was a quantifiable improvement in TV delineation in 75% of centres who had more than one submission, post feedback. Extra/missing slices were always associated with an MDC value greater than +/- 0.5mm respectively. Superior and inferior portions of the volume showed most discordance as reflected in the MDC values, with a tendency to outline superiorly. Discarded and extreme slices were always associated with a higher MDC value, for example 0.6mm.

Table 1. Precision of the separate elements in our intracranial SRS chain. EFFECT SPECIFIES WHETHER THE INACCURACY RESULTS IN + Or - Of The Calculated Dose Distribution. It Is Important To Note That The Summed Value Of These Separate Inaccuracies Does Not Correctly Represent The Total Uncertainty In Treatment Delivery, But Will Give An Approximation If Values Are Combined Or Maximum Values And In The Total Treatment Chain Errors Cannot Be Computed As One Anomaly.

Dose grid resolution
Benefit for acute small fields [V100%

QA-machine
MDC Over (mm) - 0.1mm = ≤ 0mm
MDC Under (mm) + 0.1mm = ≥0mm.

Clinically applicable MDC (V100%) 2.0 2.0 2.0

Fig 1: CERR Blue = Minimal extent of RS volume. Red = Maximal extent of RS volume. Orange = Submitted volume from centre D. MDC Over = +0.6mm.
PO-0950

QA and dummy-run results of the TRENDY randomized trial on SBRT vs. chemoembolization for HCC


1Erasmus MC - Cancer Institute, Radiotherapy - Physics and Instrumentation, Rotterdam, The Netherlands
2MAASTRO Clinic, Department of Radiation Oncology, Maastricht, The Netherlands
3VU University Medical Center, Radiation Oncology, Amsterdam, The Netherlands
4Academic Medical Center, Radiotherapy, Amsterdam, The Netherlands
5University Medical Center Utrecht, Department of Radiotherapy, Utrecht, The Netherlands
6Radboud University Medical Center, Radiation Oncology, Nijmegen, The Netherlands
7Oscar Lambret Comprehensive Cancer Center, Academic Radiation Therapy Department, Lille, France
8GZA Sint-Augustinus, Radiotherapy, Wilrijk, Belgium
9University Hospital Zürich, Department of Radiation Oncology, Zürich, Switzerland
10University Hospital Gasthuisberg, Radiation Oncology, Leuven, Belgium

Purpose or Objective: The TRENDY trial is an international multi-center phase II study in which patients with hepatocellular carcinoma (HCC) are randomized between transarterial chemoembolization in the standard arm and stereotactic body radiation therapy (SBRT) in the experimental arm. SBRT is delivered in six fractions with a total target dose of 48-54 Gy. Since the treatment is technologically challenging, an extensive quality assurance (QA) program has been established. The main goal is to ensure high quality treatments in order to achieve an optimal clinical outcome.

Material and Methods: QA guidelines and recommendations are outlined in a separate QA protocol, which also defines minor and major protocol deviations. Treatment is not allowed with a major deviation. If possible minor deviations must be avoided. Centers can only enter patients with a successfully completed external dosimetry audit. Prior to patient inclusion, a QA questionnaire should be filled out with regards to imaging modalities, treatment planning, patient setup, margins, breathing-motion management and treatment delivery. Besides that, centers are requested to complete a dummy run, including contouring and treatment planning. Contours are evaluated by comparison with golden contours, based on consensus within an expert panel. Treatment plans are evaluated using the constraints and objectives outlined in the treatment protocol, including an NTCP for the healthy liver. During patient accrual, the QA protocol accommodates prospective feedback for the first patients from each center.

Results: Ten participating institutes completed and submitted the dummy-run. All contours were considered acceptable, although variation in both liver and GTV contours was substantial as shown in the figures below. Both individual feedback and general recommendations regarding delineations have been provided. The results of the treatment planning round are summarized in the table below. Two centers (III and VII) did not meet the NTCP constraint initially and re-planned the dummy-run patient after feedback had been provided. Dose homogeneity and conformity vary substantially, with some institutes aiming at a high target dose allowing for large dose gradients in the GTV-PTV margin, and others optimizing for a smoother, more homogeneous, dose distribution.

Above: Axial slices with liver (left) and GTV (right) contours of the participating institutes. Below: Protocol requirements and planning dummy-run results. Roman numbers (I, II, ...) refer to the institutes and replannings are indicated with an asterisk (*).

Conclusion: As part of the TRENDY randomized trial, an extensive QA program has been implemented including a dummy run. Individual feedback and general recommendations have been provided to the participating centers, and will continue to be provided while patients are included.