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Purpose/Objective: Inhomogeneities around lung tumours may reduce the accuracy of dose calculation by the planning system. The use of IMRT or VMAT can include small field segments which exacerbate these issues. *Isotoxic IMRT* is a multi-centre non-randomised feasibility study of isotoxic dose escalation using IMRT, for stage III non-small cell lung cancer patients. As part of the pre-trial QA, a dosimetry audit was undertaken to verify accurate delivery of the planning benchmark case.

Materials and Methods: An ArcCheck diode array (Sun Nuclear) was used to measure fluences from the treatment delivery, and apply standard gamma analysis. Half of the Multiplug central insert was replaced by lung equivalent material (St. Bartholomew's Hospital, London, UK) to simulate an inhomogeneous environment. Point and planar dose readings near the interface were acquired using a 0.125cc ion chamber (PTW Semiflex), and GafChromic EBT3 film (ISP) (Figure 1).

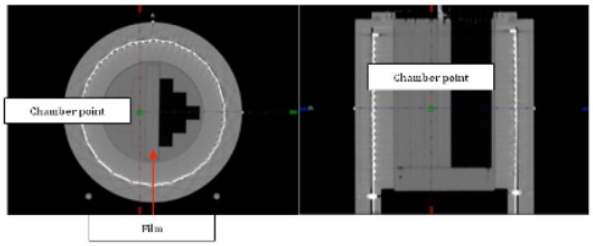

Figure 1. Cross-section through ArcCheck, showing position of chamber point and film plane.

Results: 2 pilot centres and 7 trial centres were visited, a total of 14 distinct combinations of planning and delivery system. Gamma analysis of the entry and exit dose fluence showed good agreement, with mean pass rates of 100% (range 98-100%) and 99% (97-100%) for tolerances of 4%/3mm and 3%/3mm respectively. Central point doses all agreed within ±2.4%. Film gamma analysis gave mean pass rates of 96% (88-100%) and 92% (78-99%) for tolerances of 4%/3mm and 3%/3mm respectively. These are lower than for the array fluences because of proximity to the low density interface.

Conclusions: This multi-centre audit of complex IMRT delivery provides confidence in the accuracy of a range of planning and delivery systems in an inhomogeneous environment. Along with other aspects of trial QA, it assures that trial outcomes will not be undermined by unintended variations in delivered doses.

PO-0986

Can radiotherapy dose distribution be related to outcome? An analysis of the SCOPE 1 oesophageal cancer trial data

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Purpose/Objective: By applying the Mean Distance to Conformity (MDC) index proposed by Jena et al (1) to the dose distribution of a radiotherapy plan, the conformity of the 95% isodose line to the Planning Treatment Volume (PTV) can be measured, allowing both overdosing of normal tissue and underdosing of the target volume to be measured by the OverMDC and UnderMDC respectively. The aim of this study was therefore to analyse this aspect of treatment planning, in addition to volume of PTV and the treatment delivery method (3D conformal or Intensity Modulated Radiotherapy), and relate to patient outcome.

Materials and Methods: The OverMDC and UnderMDC of the 95% isodose line ($V_{95\%}$ for 50Gy prescribed dose) to the PTV was calculated using a Matlab script based in CERR (2) for 97 patients from the SCOPE 1 trial (a National Cancer Research Institute (NCRI) and Cancer Research UK (CRUK) funded Phase II/III two arm trial of definitive chemoradiotherapy (dCRT) in oesophageal cancer) (3). Kaplan-Meier and multivariate analysis was undertaken in EUCLID (4) with further tests in Microsoft Excel and IBM's SPSS.

Results: A statistically significant breakpoint in the overall survival data, independent of cetuximab, was found according to OverMDC metric (0.44cm, $p<0.05$). This was not the case with UnderMDC. There was a statistically significant difference in PTV volume either side of the OverMDC breakpoint (Mann Whitney $p<0.001$). There was a statistically significant difference in OverMDC value dependent on the treatment delivery method (mean IMRT=0.21cm, mean 3D-CRT=0.41cm Mann Whitney $p<0.001$). OverMDC did not remain significant in a multivariate analysis that included age, sex, staging, tumour type, position, PTV volume and GTV length.

Conclusions: We have shown in univariate analysis that a patient's OverMDC has a significant correlation with overall survival, independent of Cetuximab. OverMDC is strongly related to IMRT and to a lesser extent with PTV volume. We recommend careful attention to all aspects of plan quality, not just adequate coverage of the PTV.

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PO-0987

Ultrasound image guided radiotherapy for prostate cancer using a transperineal probe

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Purpose/Objective: Pre-treatment imaging based on ultrasound (US) images was first developed using transabdominal probes but several issues linked to image quality and probe pressure[1] were reported. The aim of this work was to evaluate a non-invasive transperineal (TP) US probe comparing its registration results with cone beam CT (CBCT) on patients treated for a prostate cancer, with prostate in situ or after prostatectomy.

Materials and Methods: 10 prostate patients (cohort A) and 14 post-prostatectomy patients (cohort B) were imaged with the TP probe (Clarity, Elekta), which acquires 3D images using an automated motorized sweep. During the planning CT session, a reference US (US_{ref}) image was acquired with the patient in the same position as that of the CT acquisition. A reference positioning volume (RPV) was delineated on the US_{ref} image (Figure 1). For each treatment session, a daily US (US_{day}) image was acquired and manually registered on the US_{ref} image using a RPV projection. A CBCT image was acquired right after and registered on the reference CT. The differences between CBCT and TP-US shifts were analysed on 320 and 453 paired US_{day}/US_{ref} and CBCT/CT images for the cohorts A and B, respectively. Finally, the systematic difference found between CBCT and US shifts was retrospectively calculated on the first 5 sessions and applied to the US shifts of the following sessions.

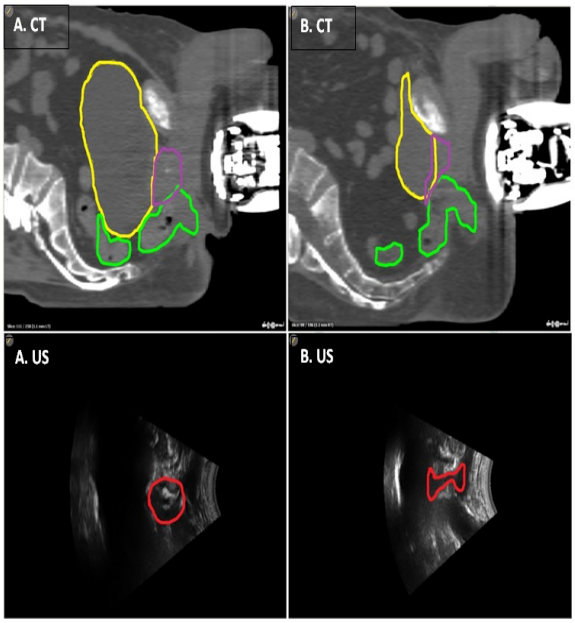

Figure 1: CT and US images of patients treated with in situ prostate (A), and after a prostatectomy (B). Volumes: purple: CTV; red: RPV; yellow: bladder; green: rectum. The RPV corresponds to the prostate volume, for patient A and to the bladder neck plus the urethra, for patient B.

Results: The US system was well tolerated by the patients. All images were of good quality for the registration of the two cohorts. On the raw data, shifts agreements at ± 5 mm were above 80 %, with the best agreement obtained in the lateral direction for both localizations (≥ 97.6 %). Average differences between the 2 modalities were 2.2 ± 3.2 mm, -0.2 ± 2.5 mm and -0.3 ± 2.7 mm for the cohort A, and 1.5 ± 2.6 mm, -1.6 ± 3.2 mm and -0.5 ± 2.3 mm for the cohort B, in the axial, longitudinal and lateral directions respectively. These results were comparable to other inter modalities, e.g., CBCT soft tissue registration versus fiducial markers with MV-EPI registration[2]. Correcting the systematic shifts between the 2 image modalities on the base of the first 5 fractions enabled the percentage of agreement to be greater than 93 % for all directions and localizations and the average differences to be close to 0 mm (≤ 0.3 mm whatever the direction or localization). Therefore, correcting systematic shifts drastically improved the results.

Conclusions: TP-US based localization of the prostate or the prostate bed is a feasible method to ensure accurate delivery of treatment plans. This device represents an attractive alternative to invasive and/or irradiating imaging modalities.

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PO-0988

Beam delivery time reduction in breath-hold treatments for left-sided breast cancer using FFF technique

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