defined and a dose plan was created. Plan was delivered with two films positioned between two different slabs of phantom, at reciprocal distance of 2 cm, orientated perpendicularly to the source axis.

Results: PDDs show a maximum difference of 4.7% (average 2.2%). At 5 mm and at 15 mm, the gamma pass rate is 100% with tolerance 3%/2mm DTA. Results of films placed intra-slabs show a high pass rate (>96%) with tolerances of 2% dose and 1mm DTA.

Conclusion: 3D material investigated is water equivalent at Ir-192 energies and is suitable for superficial brachytherapy.

Superficial X-ray therapy beam measurements using a liquid-filled chamber array

Keith Davey [a], Margaret Moore [b], Sinéad Cleary [b]

[a] *School of Physics, National University of Ireland, Galway, Ireland*
[b] *Radiotherapy Department, University Hospital Galway, Ireland*

Superficial treatment from units such as the Gulmay D3300 investigated in this study are usually measured using a single ionization chamber at the central axis. Dose falls off from the central axis towards the periphery of the field. This falloff is asymmetrical in the anode-cathode axis due to the heel effect. Current clinical practice is to prescribe dose to the central axis, which neglects the varying dose across the treatment field. Therefore, it is important to formulate a methodology to quantify this. This study investigates the viability of the PTW LA-48 Linear Chamber Array with 100 and 140 kVp beam energies with seven applicators by comparing measurements with GAFChromic EBT-3 Film measurements which is validated for use at those beam energies in previous studies. The PTW LA-48 Array has 47 isooctane-filled chambers in series allowing investigation of off-axis dose. Measurements were taken under 5 mm of liquid water using a PTW MP3 Water Tank. Film measurements were taken under 5 mm of solid water and analysed using FilmQA Pro. Both data sets were made relative to the measured central axis dose and compared. The average percentage difference between measurements for each applicator ranged between $-2 \pm 2\%$ and $1.5 \pm 0.5\%$ for 100 kVp and $-2 \pm 1\%$ to $2 \pm 3\%$ for 140 kVp, where the uncertainty is the standard error. These results show that the PTW LA-48 measurements were comparable to the EBT-3 Film measurements and highlight the potential for liquid-filled chamber arrays to be utilised to investigate off-axis dose for superficial X-ray therapy units.

Radiobiological modelling of clonogen distribution, hypoxic fraction and tumour size effects on local tumour control of non-small cell lung cancer

Mohammed Alaswad, Christoph Kleefeld, Mark Foley

National University of Ireland, Galway, Ireland

Published clinical data show that hypoxia in human lung tumours can impede the establishment of optimum local tumour control. However, the overall effect of hypoxia on the tumour control probability (TCP) model is not clear. The focus of this project was to assess the influence of radiobiological parameters (the number of clonogens and the hypoxic fraction), as well as some treatment parameters (i.e., the tumour size), on local tumour control of early stage non-small cell lung cancer (NSCLC). A TCP model, based on LQ cell survival concept combined with the Poisson statistic, was established to predict one, two and three years of local tumour control. This TCP model was created using data from seventeen publications of early-stage

NSCLC treated using one of the three radiotherapy modalities: three-dimensional conformal radiation therapy (3D-CRT), continuous hyperfractionated accelerated radiotherapy (CHART) or stereotactic ablative body radiotherapy (SABR). The variations in the TCP with the gross tumour volume (GTV) size, clonogen number and hypoxic fraction were then investigated. This issue was approached by varying the clonogen densities values (between 10^1 and 10^7 cm̂3), the GTV volume (20–140 cc) and the hypoxic fraction (20–90%). The optimum values used to compute the TCP model were a clonogen density of 10^7 cm̂3 and a hypoxic fraction of 20%, which were consistent with the clinical outcome values reported in the literature for NSCLC. This radiobiological model has demonstrated the proof of concept that poor local tumour control is strongly associated with the hypoxic fraction and large tumours.

Testing of auto segmentation to improve the workflow for stereotactic radiosurgery

Gordon Sands, Clare Tunstall, Charlotte Hector, Claire Hobbs

Oxford University Hospitals NHS Foundation Trust, United States

Auto segmentation (contouring) is used to improve the efficiency of the radiotherapy workflow. Stereotactic Radiosurgery (SRS) patients often require short patient pathways. The aim of this study was to compare 3 different commercial auto segmentation software packages for SRS. The first software package uses a single contour set from a previous patients CT. The second uses an atlas built from a selection of previous patients CT. The final uses a generic model of a patient and utilises MRI and CT images. These 3 auto segmented datasets, and the original contours that were used during treatment, were assessed by 1 consultant clinical oncologist and 3 medical physicists from the SRS team. 12 contours, across two patients were analysed and ranked on a 3-step scoring system; 1-clinically acceptable, 2-needs small amendments, 3-needs large amendments. DICE coefficients were also performed. All auto generated contour sets required some amendments. Some of the original contours drawn by the physician were ranked as requiring amendments by all reviewers. Two of the auto segmentation tools had a median score of 2 across all the reviewed contours. For the contours that were originally physician approved, the median score was 1, although some of the contours were rated as 2. Statistical analysis indicated no significant difference between software packages 2 and 3 when comparing all contours that were included in both systems. This study demonstrated that our implementation of software packages 2 & 3 could be used to improve the workflow in the department by creating autogenerated structures.

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Energy and dose dependence of GafChromic EBT3-V3 film across a wide energy range

Sarah Bassi, Donal Cummins, Patrick McCavana

SLRON, Ireland

The purpose of this work is to determine the energy and dose dependence of GafChromic EBT3-V3 film over an energy range 0.2