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.

https://doi.org/10.1016/j.ejmp.2019.09.183

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.

https://doi.org/10.1016/j.ejmp.2019.09.184

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 $1\hat{0}1$ and $1\hat{0}7$ $c\hat{m}3$), 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 $1\hat{0}7$ $c\hat{m}3$ 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.

https://doi.org/10.1016/j.ejmp.2019.09.185

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.

https://doi.org/10.1016/j.ejmp.2019.09.186

Imaging Equipment Limited Bursary Competition 14:45 – 15:20

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

mm Al HVL to 6 MV. Films have been irradiated at increasing dose with three different beams: 6MV beam, TPR(10,20) = 0.684±0.01; HVL = 2.00±0.01 mm Al and HVL = 0.20±0.01 mm Al, a very-low-energy beam. The dose output for each beam was determined with an appropriate calibrated ionization chamber, following IPEM and DIN6809-4 standard recommendations. Calibration curves were generated using the same dose range (0 cGy to 850 cGy) for the three energies. Using the 6MV calibration curve as reference, the film response in terms of net optical density was evaluated. The difference in the calibration curve obtained by irradiating the film with 6MV and 2mmAl HVL energy beams is less than 3%, within the calibration uncertainty, in the dose range 400–850cGy. The maximum difference is 4.1% at 150cGy. The optical density of EBT3-V3 film is significantly lower at 0.2 mmAl HVL compared to 6MV, showing differences up to 25%, with a minimum of 16% at 850 cGy. Conclusion: when the EBT3-V3 film is irradiated at doses higher than 400 cGy, the calibration curve for the 2 mmAl beam agrees with the reference beam (6MV) within 3%. A significant under-response (by up to 25%) was seen at 0.2mmAL HVL. EBT3-V3 films are suitable dose detectors when the dose response curve is measured within the range 6MV and 2 mm Al HVL. 6MV calibration curve could be used within this range, with 3% uncertainty.

https://doi.org/10.1016/j.ejmp.2019.09.187

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±2% to 1.5±0.5% for 100 kVp and −2±1% to 2±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.

https://doi.org/10.1016/j.ejmp.2019.09.188

Commissioning process for high dose rate prostate brachytherapy

Sarah Larkin, Sarah Leonard, Anysja Zuchora

National Radiation Oncology Physics Residency Programme (NROPRP), Ireland
NUI Galway – MSc Medical Physics, Ireland
University Hospital Galway, Ireland

The aim of this study was to outline and examine the commissioning process of a treatment planning system (TPS) dedicated to high dose rate brachytherapy (HDR BT) prostate treatment and the associated equipment. HDR BT treatment facilitates dose escalation to the prostate and involved seminal vesicles in conjunction with external beam treatment while minimising the dose to the rectum, bladder and urethra. In comparison to low dose rate (LDR) BT, there is an increase in precision and control in source positioning and corresponding dose distribution which results in a high tumour control and low toxicity rates. Other advantages include no patient-specific radiation precautions, as patients are not radioactive following treatment, and decreased radiation exposure to clinical staff and the general public. Commissioning and implementation of a quality assurance program of HDR delivery system guarantees optimal treatment of patients. All aspects must be thoroughly tested prior to the delivery of the treatment to patients to ensure the safe delivery of the intended dose. Based on published guidelines developed by the American Association of Physicists in Medicine (AAPM) and the European Society for Radiotherapy and Oncology (ESTRO) all aspects of the treatment planning system software including the image acquisition, dose calculations and data transfer underwent the required acceptance and commissioning testing. The quality assurance testing of the equipment and the imaging system to be used was also carried out. This study provides a framework of the steps required for the commissioning of a HDR interstitial brachytherapy prostate treatment.

https://doi.org/10.1016/j.ejmp.2019.09.189

Relative response of eye dosimeters to variations in scattered X-ray energy spectra encountered in interventional radiology

Maeve Masterson [a], Seán Cournane [b], Nina McWilliams [b], Dani Maguire [b], Jackie McCavana [b], Julie Lucey [b]

[a] *Southend University Hospital, Ireland*
[b] *St Vincent's University Hospital, Ireland*

The most appropriate operational dose metric for monitoring radiation dose to the eye lens has been identified as the personal and directional dose equivalent at 3 mm depth, Hp(3). Other suggested methods include evaluating Hp(3) through Hp(10) or Hp (0.07), and using conversion factors. There are many uncertainties, however, associated with these dosimetry methods. In particular, the energy response for different dosimetry techniques may vary considerably depending on the incident x-ray energy spectrum. For Thermoluminescent Detectors (TLDs), Optical Stimulated Luminescence Detectors (OSLD) and Electronic Personal Dosimeters (EPD), the deviation of the energy response from unity is reported to vary by a factor of 0.9–2.8 across Hp(0.07) and Hp(10) measurements, with overestimations occurring in the 30-60kV range. This range coincides with scattered energy spectra encountered in both interventional radiology and cardiology. Establishing how dosimeter energy dependence affects dose measurement accuracy in the clini-