Journal of Radiotherapy in Practice

cambridge.org/jrp

In this issue

Cite this article: Duxbury A. (2021) In this issue. *Journal of Radiotherapy in Practice* **20**: 1–3.
doi: 10.1017/S1460396920000941

In this issue

I am pleased to introduce the first issue of the *Journal of Radiotherapy in Practice* for Volume 20 published in March 2021. In this issue, there are 13 original articles on a range of topics and a literature review on the patient preparation strategies to manage internal organ motion during radiotherapy to the pelvis. The educational note is an overview of the management of breast cancer. In addition, there are two technical notes, the first on the commissioning experience of the X-ray volume imaging system of an image-guided radiotherapy capable linear accelerator and the second is an evaluation of the planning target volume (PTV) margins in intensity-modulated radiotherapy (IMRT) treatment for head and neck and prostate cancer. The case study in this issue is a rare case of bilateral optic nerve glioma treated with IMRT.

In the first original article, Flinton explores the subject of how professional groups view themselves and its importance in promoting effective work practices. This study primarily aims to identify how student radiographers view their own and other professions.

A survey was undertaken using the Student Stereotypes Rating Questionnaire with all radiographic training sites in England. The questionnaire asked radiography students training as either Diagnostic Radiographers or Therapeutic Radiographers to rate four professions; Doctors, Diagnostic Radiographers, Therapeutic Radiographers and Nurses on nine characteristics.

The study concluded that students have a preconceived positive stereotype of their own profession and a more negative stereotype of the other radiography profession that appears relatively stable during their training period and was unaffected by interprofessional education.

In the paper by Chetverkov, Vassiliev, Yang, Wang, Liu, Liao and Mohan, the aim of the study was to investigate the impact of intra-fractional motion on dose distribution in patients treated with IMRT for lung cancer

Twenty patients who had undergone IMRT for non-small-cell lung cancer were selected for this retrospective study. For each patient, a four-dimensional computed tomography (CT) image set was acquired and clinical treatment plans were developed using the average CT. Dose distributions were then recalculated for each of the 10 phases of respiratory cycle and combined using deformable image registration to produce cumulative dose distributions that were compared with the clinical treatment plans.

Findings of the study indicate that intra-fractional anatomical changes reduce the PTV coverage compared to the coverage predicted by clinical treatment planning systems that use the average CT for dose calculation. Doses to organs at risk were mostly over predicted.

In the paper by Siow and Lim, the authors present their paper on the correlation of lung tumour location and motion with respiration using 4D CT scans. Lung tumours, especially those in the lower lobes, can move considerably during respiration; this motion needs to be accounted for during radiotherapy treatment.

All cases of lung tumours treated with stereotactic ablative radiotherapy between 2012 and 2016 were identified retrospectively, and the 4D CT scan data was analysed. These tumours were grouped into the following locations: upper zone, middle zone and lower zone. The treatment planning system was used to generate the displacements of the centre of mass of the tumours in the Right–Left, Anterior–Posterior and Superior–Inferior axes; these were compared with the current generic margins. Median displacements were calculated for each axis in each location. New PTV margins were derived by summing the median displacement, median absolute displacement and 0·5 cm (for setup error).

Findings of the study are that current generic margins are inadequate for the majority of cases. Tumour motion is greatest in the lower zone in the Superior–Inferior axis. Motion mitigation strategies are essential for large lower zone tumours.

In the next paper, Koo, Darko and Osei undertake a retrospective analysis of portal dosimetry (PD) pre-treatment quality assurance (QA) of hybrid IMRT breast treatment plans. The purpose of this study is to evaluate the effectiveness and sensitivity of the Varian PD system as a QA tool for breast IMRT treatment plans.

Four-hundred portal dose images from 200 breast cancer patient IMRT treatment plans were analysed. The images were obtained using Varian Portal Vision EPIDs on Varian TrueBeam Linacs. Three patient plans were selected, and the MLC positions were randomly altered by a mean of 0·5, 1, 1·5 and 2 mm with a standard deviation (SD) of 0·1 mm on 50%, 75% and 100% of the control points. Using the improved/global gamma calculation algorithm with a low-dose threshold of 10% in the EPID, the change in gamma passing rates for 3%/3 mm, 2%/2 mm and 1%/1 mm criterion were analysed as a function of the introduced error. The changes in the dose distributions of CTV and OAR due to MLC positioning errors were also analysed.

The authors conclude stricter pre-treatment QA action levels can be established for breast IMRT plans utilising EPID. For improved sensitivity, a multigamma criteria approach is

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recommended. The PD tool is sensitive enough to detect MLC positioning errors that contribute to even insignificant dose changes.

In the next paper by Maiti, Meyur, Mandal, Shenoy, Biswas and Basu, the authors undertake a comparison of conventional and hypofractionated radiotherapy after mastectomy in locally advanced breast cancer. Although hypofractionated radiotherapy has been standardised in early breast cancer, even in post-mastectomy, no such consensus has been developed for locally advanced breast cancer, probably due to complex planning and field matching. This study is directed towards dosimetric evaluation and comparison of toxicity, response and disease-free survival comparison between hypofractionation and conventional radiotherapy in post-mastectomy locally advanced breast cancer

Two-hundred and twenty-two female breast cancer patients were randomly assigned to be treated with either hypofractionated radiotherapy ($n = 120$) delivering 40 Gy in 15 fractions over 3 weeks or conventional radiotherapy ($n = 102$) with 50 Gy in 25 fractions over 5 weeks after modified radical mastectomy along with neoadjuvant and/or adjuvant chemotherapy. All patients were planned with treatment planning software and assessed regularly during and after treatment.

Authors conclude that even though biologically effective dose in hypofractionation is lower than that of conventional fractionation, there are indistinguishable toxicity, loco-regional recurrence, distant failure rate and disease-free survival between the two modalities.

The next paper is a qualitative study exploring men's experience of sexual dysfunction as a result of radiotherapy and androgen deprivation therapy (ADT) to treat prostate cancer, by the authors Kinnaird and Stewart-Lord. Sexual dysfunction is a common side effect of external beam radiotherapy (EBRT) and ADT to treat prostate cancer. Men are likely to experience erectile dysfunction, low libido, ejaculatory problems and penile shortening. This qualitative study explored men's perceptions of sexual dysfunction including factors such as self-perception, relationships and information and support needs.

Semi-structured interviews were carried out with $n = 8$ men living 18–30 months after EBRT ± ADT. The interviews were transcribed and thematic analysis was carried out.

The findings indicate that men undergoing EBRT/ADT for prostate cancer may be affected by post-treatment changes in sexual function in a range of ways. This study suggests they would benefit from early and wide-ranging information and support on sexual dysfunction, even if they do not consider it a priority. Candid discussions about self-perception and relationships, as well as physical changes, may equip them to cope with post-treatment changes.

In the next paper, Sarwar, Altaf, Khan, Buzdar and Iqbal study three ways of dose verification of prostate patients treated by RAPIDARC with the aim to find alternative dose verification and QA methods RAPIDARC treatment plans of 35 prostate patients, planned on Eclipse treatment planning system (Aria 15) were included in this study. Dose verification was carried using statistical analysis by computing homogeneity index, radical and median homogeneity index, coverage and uniformity index. Dose–volume histograms (DVH), PD by gamma analysis using 3% 3 mm gamma criteria, SD and mean SD error were also calculated and analysed.

Results of the dosimetric analysis found that all parameters were within acceptable limits. RAPIDARC possesses the unique feature of delivering the whole treatment with only two rotations of the gantry and has an improved efficiency of delivery with equivalent dosimetric quality.

In the study by Marvi, Gholami, Baroug, Hosseini, Nabavi, Jabery and Mohammadkarim, the aim was to evaluate the application of the exit skin dose (ESD) in verifying the accuracy of intra-cavitary brachytherapy treatments performed by the BEBIG 60 Co machine using thermoluminescent dosimeters (TLD).

Eleven patients who were treated for gynaecological malignancy using a high-dose rate (HDR) brachytherapy machine have been included in this study. A combination of tandem, cylinder and interstitial needles were applied for eight patients and tandem ovoid applicators was used for three patients. In order to measure the ESD, TLD dosimetry was performed for each patient. TLDs were placed precisely on the patient's skin along the symphysis pubis bone (anterior) and left and right sides of her pelvic. Positioning of the dosimeter was accurately determined using fiducial markers in CT scan imaging, prior to the treatment. Finally, a comparison was made between the calculated dose from the treatment planning system and the dose measured by TLDs.

To conclude, the ESD measurement method is a suitable approach for verifying the accuracy of gynaecological HDR treatment delivery.

In the next paper, Uday Krishna, Naveen, Vani Santosh, Arivazhagah, Lokesh present their study on the subgroup stratification of adult diffuse gliomas and outcomes. The updated World Health Organization 2016 classification of central nervous system tumours recommends the addition of molecular parameters to the histological diagnosis. In a resource-constrained setting, molecular testing such as gene sequencing and fluorescent in situ hybridisation are not feasible for all the patients. The authors assessed the utility of immunohistochemistry (IHC) for isocitrate dehydrogenase (IDH1/R132H) gene, and alpha-thalassemia/mental retardation syndrome X-linked gene (ATRX) to stratify adult diffuse gliomas into subgroups and analysed the outcomes.

Fifty-eight patients with grades III/IV astrocytic gliomas were tested by IHC for IDH1/R132H and ATRX mutation as per the standard protocol and were later stratified into three subgroups based on IHC. IDH1/R132H positive/ATRX retained gliomas were stratified as group 1 (G1), IDH1/R132H positive/ATRX lost were grouped as G2 and IDH1/R132H negative (with or without ATRX loss) as G3. All patients underwent adjuvant therapy as per Stupp's regimen. Outcomes and survival were analysed by Kaplan–Meier analysis using SPSS 21.v.

Findings indicate that subgroup stratification of adult diffuse gliomas based on IHC for IDH/R132H and ATRX demonstrates that group 1 was the most favourable prognostic factor. In a resource-constrained environment, IHC alone may guide appropriate management decisions for the majority of adult diffuse gliomas, gene sequencing reserved for IDH1/R132H negative glioblastoma in patients less than 45 years of age.

In the paper by Mamballikalam, Senthilkumar, Jaon bos, Basith and Jayadevan, the objective of this study was to evaluate the dosimetric efficacy of VMAT in comparison to dynamic conformal arc therapy (DCAT) and 3D conformal radiotherapy (3D CRT) for very small volume (≤1cc) and small volume (≤3cc) tumours for flattened (FF) and unflattened (FFF) 6MV beams

A total of 21 patients who were treated with single-fraction stereotactic radiosurgery, using VMAT, DCAT or 3DCRT were included in this study.

This study establishes the equivalence between the flattened and unflattened beam models and different delivery techniques for stereotactic radiosurgery in small tumour volumes in the range of ≤1 cc–≤3 cc. Dose conformity, heterogeneity, dose fall-off characteristics and organs at risk doses show no or very little variation. FFF offered only a limited time advantage due to excess dose rate over a flattened beam.

https://doi.org/10.1017/S1460396920000941 Published online by Cambridge University Press

In the next paper, Hoseinnezhad, Geraily, Esfahani, Farzin and Gholami undertake a comparison of calculated and measured basic dosimetric parameters for total body irradiation (TBI) with 6-MV and 18-MV photon beams. In TBI, large field sizes and extended source skin distances (SSD) are applied to deliver a therapeutic dose to the whole body. As measurements in such situations are not common and have more uncertainties in comparison to standard dosimetry situations, it is more precise if calculated beam data can be used instead of measurements taken under TBI situations. The aim of this study was to compare calculated beam data; percentage depth dose (PDD) and dose rate with those obtained from simulated treatment measurements.

PDD and dose rates were measured for the 6-MV and 18-MV photon beams under TBI and standard conditions using a 9,000 cm^3 water phantom and ion chambers (Markus and Farmer). The results were then compared with the calculated PDD and dose rate data. The beam flatness was also measured under TBI and standard conditions for both 6-MV and 18-MV photon beams and the results were then compared.

According to the results, due to a high error level in dose rate and PDD calculations, these parameters must be directly measured under TBI conditions; however, regarding the obtained results, direct measurement is not necessary for the 18-MV photon beam.

In the paper by Das, Lahiri, Dam, Maji, Roy, Ray and Mandal, the authors present their study on definitive concurrent chemoradiation (CCRT) versus laryngectomy and post-operative radiation using IMRT, in locally advanced laryngeal cancer. For patients with locally advanced laryngeal cancer, the two main treatment options are either total laryngectomy (TL) followed by post-operative adjuvant radiation therapy (RT) or definitive CCRT with surgery retained as salvage. The objectives were to study the feasibility of CCRT using IMRT in locally advanced laryngeal cancer with respect to response, toxicities and quality of life (QoL) and comparison with other modality of TL with post-operative RT.

The records of 48 patients with locally advanced laryngeal cancer (T3/T4aN0–2), registered between the years 2014 and 2017, treated with IMRT (definitive or adjuvant post-operative IMRT) were analysed from the hospital database. The patients received RT either as definitive CCRT or as adjuvant treatment after TL. RT in all patients was delivered with IMRT-Simultaneous Integrated Boost (SIB) technique and concurrent chemotherapy with weekly cisplatin. The response was assessed at 12 weeks. Toxicities and QoL were assessed and compared between patients receiving definitive CCRT and adjuvant RT.

Definitive CCRT using IMRT-SIB with weekly cisplatin is a feasible option for patients of locally advanced laryngeal cancer with an acceptable response rate. IMRT yields better toxicity outcomes with sparing of organs at risk. CCRT patients have a better QoL than laryngectomy patients in several parameters.

In the paper by Anushree, Shetty, Soans, Kuttappa, Shetty A, Shetty K and Nayak, the aim of the study was to evaluate the shear bond strength of metal brackets and adhesive properties of bonded irradiated and non-irradiated teeth.

Sixty-six extracted premolar samples were randomly divided into 3 groups – a control group consisting of 22 non-irradiated, non-aged teeth, a second group of 22 none irradiated, aged samples and a third group of 22 irradiated, aged teeth. Irradiation was done using gamma irradiation with a fractionated dose of 60 Gy for 5 consecutive days per week over 6 weeks. Metal brackets were bonded on all samples with light cure adhesive and subjected to a shear bond strength test using a universal testing machine. The samples were assessed under the scanning electron microscope to check for the adhesive remnant index and tag depth.

Findings indicate there is a statistically significant decrease in shear bond strength of irradiated enamel compared to that of non-irradiated teeth. However, the shear bond strength observed in the three groups was well above the ideal shear bond strength for orthodontic bonding, that is, 5·6–6·8 Mega Pascals. The adhesive remnant was found on all samples of the irradiated group. Deeper adhesive resin tags were found in the irradiated group in the resin–enamel interface.

The next paper is a literature review on the predictive, prognostic and diagnostic biomarkers for brain tumours by Osei, Walters, Masella, Fishwick, Tennant, Dadzie, Bhangu and Darko. Brain tumours are a relatively rare disease, but presents a large medical challenge as there is currently no method for early detection of the tumour and are typically not diagnosed until patients have progressed to symptomatic stage, which significantly decreases chances of survival and also minimises treatment efficacy. However, if brain cancers can be diagnosed at early stages and also if clinicians have the potential to prospectively identify patients likely to respond to specific treatments, then there is a very high potential to increase patients' treatment efficacy and survival.

This paper reports on a review of 21 current clinical and emerging biomarkers used in risk assessment, screening for early detection and diagnosis and monitoring the response of treatment of brain cancers.

The authors conclude that the future holds promise for the use of biomarker analysis as a major factor for personalised and targeted brain cancer treatment since biomarkers have the potential to measure early disease detection and diagnosis, the risk of disease development and progression, improved patient stratification for various treatment paradigms, provide accurate information of patient response to a specific treatment and inform clinicians about the likely outcome of a brain cancer diagnosis independent of the treatment received.

The educational note by McKittrick, Sheperd and Gilleece is an overview of the management of breast cancer for therapeutic radiographers. This paper outlines the management of patients with breast cancer and is designed to help therapeutic radiographers reflect on the current practices and to inspire them, where evidence dictates, to seize opportunities to explore improvement and enhance best practice.

There are two technical notes; the first is in on the commissioning experience of the X-ray volume imaging system of an image-guided radiotherapy capable linear accelerator by Raina and Sahoo. The second technical note is an evaluation of PTV margins in IMRT treatment for head and neck and prostate cancer by Youssoufi, Bougtib, Douama, Erraise, Abboud, Hassouni and Bentayeb.

To complete this issue, the case study is a rare case of bilateral optic nerve glioma treated with IMRT by Singh, Kumar, Tudu, Raina and Munda.

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https://doi.org/10.1017/S1460396920000941 Published online by Cambridge University Press