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In this issue

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I am pleased to introduce the third issue of the *Journal of Radiotherapy in Practice* for Volume 20 published in September 2021. In this issue, there are 15 original articles on a range of topics and a literature review on in vivo dosimetry in total skin electron therapy (TSET). There is an interesting technical note on the quantitative assessment of the production of radioactive materials by the Mevion S250i hyperscan proton therapy. To complete this issue, the case study is on a rare case of osteosarcoma arising in the sternum after radiotherapy for breast cancer in a patient with suspected hereditary cancer syndrome.

In the first article, Agnew et al. present their study with the aim to optimise patient dose and image quality of Varian TrueBeam cone beam computed tomography (CBCT) of pelvis, thorax and head and neck (H&N) images based on patient size.

An elliptical phantom of small, medium and large sizes was designed representative of a local population of pelvis, thorax and H&N patients. The phantom was used to establish the relationship between image noise, CT and CBCT exposure settings. Using this insight, the clinical images were optimised in phases and the image quality was graded qualitatively by radiographers. At each phase, the time required to match the images was recorded from the record and verify system.

From this study, quantitative phantom measurements provided insight into the magnitude of change to implement clinically. The final optimised exposure settings were determined from the radiographer qualitative image assessment.

In the next article, Chua et al. undertake a study to evaluate whether RapidPlan (RP) could generate clinically acceptable prostate volumetric-modulated arc therapy (VMAT) plans. The in-house RP model was used to generate VMAT plans for 50 previously treated prostate cancer patients, with no additional optimisation being performed. The VMAT plans that were generated using the RP model were compared with the patients' previous manually optimised clinical plans (MP), none of which had been used for the development of the in-house RP prostate model. Differences between RP and MP in planning target volume (PTV) doses, organs at risk (OAR) sparing, monitor units (MU) and planning time required to produce treatment plans were analysed. Assessment of PTV doses was based on the conformation number (CN), homogeneity index (HI), D2%, D99% and the mean dose of the PTV. The OAR doses evaluated were the rectal V50 Gy, V65 Gy, V70 Gy and mean dose, the bladder V65 Gy, V70 Gy and the mean dose and the mean dose to both femurs.

This study has demonstrated that VMAT plans generated using an in-house RP prostate model in a single optimisation for prostate patients were clinically acceptable with comparable or better plan quality compared to MP. RP can add value and improve treatment planning efficiency in a high-throughput radiotherapy department through reduced plan optimisation time while maintaining consistency in the plan quality.

In the paper by Ilamurugu and Chandrasekaran, the authors present their study on the rationale for MRI-only delineation and planning and retrospective CT-MR registration and target volume analysis for prostate radiotherapy. MRI is indispensable for treatment planning in prostate radiotherapy (PR). Registration of MRI, when compared to planning CT, is prone to uncertainty and this is rarely reported. In this study, a comparison has been undertaken for three different types of registration methods to justify the direct use of MRI in PR.

Thirty patients treated for PR were retrospectively selected for this study and all 33 underwent both CT and MRI. The MR scans were registered to the planning CT (pCT) using markers, focused and unfocussed methods and their registration are REGM, REGF and, REGNF respectively. Registration comparison is done using the translational differences of three axes from the centre-of-mass values of gross tumour volume generated using MRI.

The authors conclude that image registration uncertainty is unavoidable for a regular CT-MR workflow. Additional PTV margin ranging from 2 to 3mm could be voided if MR-only workflow is employed. This reduction in the margin is beneficial for small tumours treated with hypo-fractionation.

In the next article, Thongsuk et al. undertake an evaluation of daily dose accumulation with deformable image registration (DIR) method using helical tomotherapy (HT) images for nasopharyngeal carcinoma (NPC). These patients may have anatomical variations during their radiotherapy treatment course. In this study, the authors determined the daily accumulated dose by the DIR process for comparing with the planned dose and explore the number of fractions in which the daily accumulated dose significantly changed from the planned dose.

The validation of the DIR process in MIM software has been tested. One-hundred and sixty-five daily megavoltage computed tomography images of NPC patients who was treated by HT were exported to MIM software to determine the daily accumulated dose, and then was compared with the planned dose.

Findings of the study indicate that the inter-fractional anatomic changes cause the actual dose to be different from the planned dose. The dose differences and the number of fractions were varied in each target and OAR. The dose accumulation explored the necessary information for the radiation oncologist to consider adaptive treatment strategies to increase the efficiency of treatment.

In the next paper, Chiang et al. developed a Monte Carlo (MC) model for Mevion S250i with HYPERSCAN and Adaptive Aperture™ (AA) Pencil Beam Scanning (PBS) proton therapy system. As the number of proton therapy facilities has steadily increased, the need for the tool to provide precise dose simulation for complicated clinical and research scenarios also increases. In this study, the treatment head of Mevion HYPERSCAN PBS proton therapy system including energy modulation system (EMS) and AA was modelled using TOolkit for PArticle Simulation (TOPAS) MC code and was validated during the commissioning process.

The proton beam characteristics including integral depth doses of pristine Bragg peak and in-air beam spot sizes were simulated and compared with measured beam data. The lateral profiles, with and without AA, were also verified against calculation from the treatment planning system.

In this study, the TOPAS MC simulation of the Mevion HYPERSCANPBS proton therapy system has been modelled and validated; it could be a viable tool for research and verification of proton treatment in the future.

In the next article presented by Kalyanasundaram and Vellaiyan, the aim of the study was to find the dosimetric impact of positron emission tomography (PET)-based gross target volume (GTV) delineation over CT-based GTV delineation for carcinoma oesophagus.

Fifteen patients with carcinoma oesophagus were retrospectively selected. Two sets of GTVs in CT plain images were generated, one with the help of intravenous and oral contrast (GTV-CT) and the other with only using PET uptake with the standardised uptake value (simple way of determining activity in PET) SUV >2.5 (GTV-PET). Corresponding PTV were generated, and for all the patients rapid arc plans were generated. Changes in target volumes and critical structure doses were evaluated. The Wilcoxon signed-rank test was used for statistical analysis and p-value.

The authors conclude that PET-based GTV contouring reduces the treatment volume and the critical structure doses significantly over CT-based GTV contouring for carcinoma oesophagus.

In the article by Akasaka et al., the authors aimed to modify the final dose delivered to superficial tissues and to modulate dose distribution near the irradiated surface using different types of boluses. The impact of the air gap under the bolus was evaluated in both HT and direct tomotherapy (DT) in a simulation study using the radiotherapy treatment planning system.

The authors conclude that the HT technique is a good choice, but the DT technique can be also used if the bolus position can be reproduced accurately. Thus, the reproducibility of the bolus position between planning and treatment is the most important factor.

In the article by Temelli et al., the purpose of the study was to compare hybrid (3DCRT-VMAT) and HT techniques in terms of both PTV and OAR in the plans produced for locally advanced non-small-cell lung cancer (NSCLC) patients.

Radiotherapy was planned for 15 locally advanced NSCLC patients with 2 different techniques. Patients presenting with large tumours with positive mediastinal lymph nodes were included. The prescription dose was determined as 60 Gy at 30 fractions.

The findings of the study indicate that acceptable dose coverage and OAR doses can be produced with both techniques. However, the opposite lung, heart and oesophagus doses can be kept lower with the hybrid plan, and has lower MU and a shorter beam-on time.

In the next article by Botwe et al., the study aimed at assessing the psychosocial impact of mastectomy on female breast cancer patients who was attending a radiotherapy centre in Ghana.

A cross-sectional design was used and a total of 80 female mastectomy breast cancer patients participated in this study. A semi-structured questionnaire was used for data collection over a 5-month period; January–May 2018. The data collected were analysed with Statistical Package for Social Science (SPSS) version 22.

The study revealed that mastectomy for breast cancer patients had a negative impact on their psychological, emotional and social wellbeing. The availability of affordable breast prostheses, involvement of clinical psychologists in the care of post-mastectomy women, provision of emotional, psychological and even financial support could alleviate the psychosocial impacts of affected women.

In the article by Nguyen et al., the authors investigate the effect of different energies on dose distribution in VMAT plans for H&N cancer.

Data from nine patients undergoing VMAT plans using 6 MV, 10 MV and dual-energy X-ray beams with the Pinnacle 3 V 9.10 treatment planning system (Philips Medical System, Fitchburg, WI, USA) were analysed for quality using the conformity index and homogeneity index for PTV, and for mean and maximum dose to the OAR: parotid glands, brainstem, spinal cord and optic nerves.

Compared with the 6 MV VMAT plan, the dual-energy VMAT plan slightly increased the coverage of the PTV with the prescribed dose, but did not decrease the dose to the OARs.

In the article by Mukhtar et al., a comparative study was performed on the plan parameters and quality indices between volumetric-modulated arc therapy (VMAT) and intensity-modulated radiotherapy (IMRT) for the treatment of high-risk prostate cancer patients. The aim of this retrospective study was to compare the two methods of external beam radiotherapy IMRT and VMAT in terms of plan quality and efficacy.

Fifteen high-risk prostate patients were planned for radiotherapy using 6MV photon. Three dose levels were contoured having Planning Tumour Volume 1 (PTV1 = 48 Gy), Planning Tumour Volume 2 (PTV2 = 57.6 Gy) and Planning Tumour Volume 3 (PTV3 = 60 Gy). Setup margins were given using the CHIP trial method. The prescribed PTV3 dose was 60 Gy in 20 fractions, which are biologically equivalent to 74 Gy in 37 fractions using $\alpha/\beta=3$. In case of IMRT, seven fixed beam angles 30, 60, 105, 180, 255, 300, 330 were used and the dose was optimised using the sliding window method. In the case of RapidArc technique, one or two full arcs were used for dose optimisation while keeping all the dose constraints and other planning parameters the same as used in IMRT. The plan evaluation parameters and OARs doses were calculated using a dose-volume histogram.

The findings are VMAT takes less dose delivery time and lesser number of monitoring units than IMRT; thus, it compensates the intra-fractional movements during dose delivery. The dose gradient index in VMAT was much better than IMRT. This indicates sharper dose fall off near the normal tissue. No other major differences were observed in terms of plan evaluation parameters between IMRT and VMAT techniques. So, we conclude that the VMAT technique is more efficient than IMRT in terms of plan quality and dose delivery.

In the next article by Mamballikalam et al., the aim of the study was to evaluate dosimetric parameters for percentage depth dose, dosimetric field size, depth of maximum dose (d max) surface dose, penumbra and output factors measured using IBA CC01 pinpoint chamber, IBA Stereotactic Field Diode (SFD), PTW microdiamond against MC simulation for 6MV flattening filter-free small fields.

The linear accelerator used in the study was a Varian TrueBeam® STx. All field sizes were defined by jaws. The required shift to the effective point of measurement was given for CC01, SFD and microdiamond for depth dose measurements. The output factor of a given field size was taken as the ratio of metre readings normalised to 10×10 cm^2 reference field size without applying any correction to account for changes in detector response. MC simulation was performed using PRIMO (PENELOPE-based program). The phase space files for MC simulation were adopted from the MyVarian website.

Conclusions drawn are for output factor measurement, TRS483 suggested correction factor needs to be applied to account for the difference in detector response. CC01 can be used for field sizes above 2×2 cm^2 and microdiamond detector is suitable for above 1×1 cm^2. Below these field sizes, perturbation corrections and volume averaging corrections need to be applied.

In the article by Khezerloo et al., the study aimed to optimise computed tomography simulation scan parameters by increasing the accuracy for gross tumour volume (GTV) identification in brain radiotherapy. For this purpose, high-contrast scan protocols were assessed.

A CT accreditation phantom (ACR Gammex 464) was used to optimise brain CT scan parameters on a Toshiba Alexion 16-row multislice CT scanner. Dose, tube voltage, tube current time and CT dose index were varied to create five image quality enhancement protocols. They were assessed in terms of contrast-to-noise ratio, signal-to-noise ratio and noise level and compared with a standard clinical protocol. Finally, the ability of the selected protocols to identify low-contrast objects was examined based on a subjective method.

Findings of the study indicate that CT image quality should be optimised using the high-dose parameters, which is created in this study to provide better soft-tissue contrast. This can lead to the accurate identification of GTV recognition in the planning of radiotherapy treatment.

In the next article, Goswami et al. undertake a comparison of the integral dose (ID) delivered to OAR, non-target body and target body by using different techniques of craniospinal irradiation (CSI) for medulloblastoma.

Ten CSI patients were already planned and treated either with linear accelerator three-dimensional conformal radiation therapy (Linac-3DCRT) technique or with linear accelerator RapidArc technique by Novalis Tx Linac machine have been analysed. Retrospectively, these patients are again planned on Radixact-X9 Linac with Helical, Direct-3DCRT and direct intensity-modulated radiation therapy (Direct-IMRT) techniques. The dose prescription to planning target volume brain (PTV-Brain) and PTV-Spine is 36 Gy in 20 fractions and is kept the same for all techniques. The target body, non-target body, OARs and total body dose are compared.

Findings indicate that RapidArc is a better alternative for the treatment of CSI. It provides better target coverage and better OARs sparing from any other treatment techniques.

In the next study by Shaiju et al., the authors investigate the central electrode artefact effect of different ion chambers in the verification phantom using the dose calculation algorithms Analytical Anisotropic Algorithm (AAA) and Acuros XB.

The dosimetric study was conducted using an in-house fabricated polymethyl methacrylate (PMMA) head phantom. The treatment planning system calculated doses in the phantom with detectors, and were compared against the dummy detector fillets using AAA and Acuros XB algorithm. The planned and measured doses were compared for the study.

The study confirmed that the CT set of the phantom with detectors (FC65 and CC13) gave more artefacts/heterogeneity, and caused a significant variation in dose calculation using Acuros XB. Therefore, the study suggests a method of using a phantom CT set with the dummy detector for mean dose calculation for the Acuros XB algorithm.

The next article is a review of the literature on in vivo dosimetry in TSET by Sundaramoorthy et al. TSET is a specialised radiotherapy technique to treat cutaneous T-cell lymphomas. The purpose of this article was to review different in vivo dosimetry techniques and to identify further research direction in TSET.

The review highlighted that the practice of using in vivo dosimetry is a superior way to treat TSET by ensuring the accuracy of dose delivery to the patients. Further, only limited studies are available for dosimetry with radiochromic films. With this observation, the authors have started exploring the use of radiochromic film for TSET dosimetry, and the results will be analysed to standardise the technique in future.

The technical note in this issue is on the quantitative assessment of the production of radioactive materials by the Mevion S250i hyperscan proton therapy system, by Chiang et al. This technical note describes a quantitative assessment of the production of radioactive materials during a year-long clinical operation of a Mevion S250i hyperscan proton therapy system. The production of accumulated radioactive materials plays an important role in determining radiation safety in and around the proton therapy facilities.

To complete this issue, the case study is presented by Trivedi et al., and is on a rare case of osteosarcoma arising in the sternum after radiotherapy for breast cancer in a patient with suspected hereditary cancer syndrome.

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