Journal of Radiotherapy in Practice

cambridge.org/jrp

In this issue

Cite this article: Duxbury A. (2018) In this issue. *Journal of Radiotherapy in Practice* **17**: 257–260. doi: 10.1017/S1460396918000286

In this issue

I am pleased to introduce the 'in this issue' for the third issue of the *Journal of Radiotherapy in Practice* for Volume 17 published in September 2018. In this issue there are 12 original articles on a range of topics, a literature review on magnetic resonance imaging in radiotherapy treatment target volume definition for brain tumours, a technical note on the dosimetric evaluation of electron beams on scalp using EBT2 films and a Rando phantom and a case report on the external auditory meatus involvement in nasopharyngeal carcinoma.

In the first paper, Georgiou and Farmer present their research into estimating the risk of lung cancer and cardiac mortality from doses to the lung and heart from modern tangent-only breast radiotherapy. The Early Breast Cancer Trialists' Collaborative Group (EBCTCG) reported that the risks of breast cancer treatment in women smokers may outweigh the benefits. The data used doses from published reports using a variety of treatment techniques. In this study, the risks of lung cancer and heart disease were determined from a modern era tangential-only technique.

Doses to the lung and heart were obtained for tangential radiotherapy to the breast or chest wall. The risk of lung cancer incidence and cardiac mortality were calculated by taking the ratio of their doses to those published by the EBCTCG. A total of 77 women were identified who met inclusion criteria.

The authors conclude that tangential-only radiotherapy delivered substantially lower doses to the combined whole lung and whole heart than those reported by the EBCTCG. In this cohort, the risks of radiation-induced lung cancer and heart disease are outweighed by the benefits of radiotherapy even in smokers.

In the next paper, Sheazadi, Appleyard, Foley and Foran present their study to evaluate the extent to which intensity-modulated arc therapy (IMAT) for high-grade gliomas is comparable to three-dimensional conformal radiotherapy (3DCRT) in relation to the dose delivered to normal brain tissue, planning target volume (PTV) conformity and the dose delivered to brainstem and optic chiasma.

In total, 16 randomly selected 3DCRT treatment plans of grade 3 gliomas were re-planned using an IMAT planning technique and dose–volume histograms were compared. Primary outcomes were maximum, mean, 1/3 and 2/3 doses to normal brain tissue outside the PTV and maximum, mean, *D*50 and *D*20 doses to PTV. Secondary outcomes were maximum and mean doses to the brainstem and optic chiasm. The Wilcoxon signed-rank test was used to compare data.

The authors conclude that IMAT is at least comparable to 3DCRT in relation to minimising dose to normal brain tissue and ensuring good PTV conformity. Doses delivered to organs at risk using IMAT were also comparable to 3DCRT. This study supports the continued use of IMAT for the treatment of high-grade gliomas.

In the paper by Zhang, Liu, Lin, Lee, Tam and Wu, the authors compared the pattern of radiation-induced parotid changes between conventional (ConRT) and intensity-modulated radiotherapy (IMRT) in nasopharyngeal carcinoma patients (NPC).

A total of 56 adult NPC patients treated with IMRT ($n = 28$) and conventional radiotherapy ($n = 28$) were recruited. Computed tomography (CT) scans were acquired before radiotherapy, at 10^{th}, 20^{th} and 30^{th} fractions, and 3 months after treatment. The parotid gland was delineated in the corresponding CT slices and its mean dose was calculated. The volumetric and geometric changes of the parotid gland at various time intervals were compared against the pre-treatment structure set. The pattern of changes was compared between the two techniques.

The findings of the study reveal that similar parotid gland size and location changes were observed during the treatment course in both ConRT and IMRT. However, IMRT demonstrated better parotid volume recovery after treatment.

In the next paper by Acar, Caglar and Altinok, the authors investigate the accuracy of two calculation algorithms of the Varian Eclipse treatment planning system (TPS), the electron Monte-Carlo algorithm and general Gaussian pencil beam algorithm (GGPB) for calculating peripheral dose distribution of electron beams.

Peripheral dose measurements were carried out for 6, 9, 12, 15, 18 and 22 MeV electron beams using a parallel plate ionisation chamber and EBT3 film in the slab phantom. Measurements were performed for 6×6, 10×10 and 25×25 cm^2 cone sizes at d_{max} of each energy up to 20 cm beyond the field edges. The measured and TPS calculated data were compared.

Authors found the use of GGPB for planning large field treatments with 6 MeV could lead to inaccuracies of clinical significance.

In the paper by Shamsi, Buzdar, Atiq, Atiq, Altaf and Iqbal, the authors measured tissue maximum ratios (TMRs) in smaller fields through a CC01 detector and compared CC01-measured TMRs with Pinnacle TPS calculated TMRs.

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A CC01 compact chamber detector was used to measure TMR in a water phantom for 6 and 18 MV beams delivered from a Varian linear accelerator. Pinnacle TPS was employed in this study to calculate TMR from the measured percentage depth dose (PDD) data. CC01-measured TMR data was compared with the calculated TMR data at depths from 5 to 20 cm for field sizes varying from 1 to 10 cm^2.

The authors found that for both 6 and 18 MV beams there was good agreement between CC01-measured and Pinnacle-calculated TMRs for the field sizes ranging from 1 to 10 cm^2. This exploration can be extended to the determination of other dosimetric parameters such as TARs and TPRs in small fields.

In the next paper, Shamsi, Buzdar, Altaf, Atiq, Atiq and Iqbal determine the total scatter factor (TSF) measuring properties of CC01 and CC04 detectors for field sizes ranging from sub-centimetre to the centimetre fields. Small field dosimetry is complicated and accuracy in the measurement of TSF is crucial for dosimetric calculations, in making optimum IMRT plans for treating small target volumes.

CC01 and CC04 chamber detectors were used to measure TSF for 6 and 18 MV photon beam delivered from a linear accelerator, through small fields in a water phantom. Small fields were created by collimator jaws and multi-leaf collimators separately, with field sizes ranging from 0·6 to 10 cm^2 and 0·5 to 20 cm^2, respectively.

Authors found CC01 was shown to be effective for measurement of TSF in sub-centimetre field sizes. CC01 can be employed to measure other dosimetric quantities in small fields using different energy beams.

In the next paper, Farhat, Fourati, Mnajja and Daoud present their retrospective study to evaluate the efficacy and safety of routine use of the electronic portal imaging device (EPID) in intensity-modulated radiation therapy for localised prostate cancer.

Data from 20 patients with localised prostate cancer treated by radical radiotherapy using intensity-modulated technique were analysed to define the action levels for pre-treatment planer dose distribution of 100 treatment fields and the setup errors of 418 portal imaging. Pre-treatment planar dose distribution was measured with the EPID. The additional dose from repeated portal imaging was determined using a TPS.

Authors conclude that the electronic portal imaging device is a useful tool to verify pre-treatment dose distribution and to assess the correct field position without a significant increase in the absorbed dose due to the repetition of portal imaging.

In the next paper, Davoudi, Shabestani Monfared and Rahgoshay undertake a comparison between 6 MV Primus LINAC simulation output with commissioning data using EGSnrc and build a Monte-Carlo geometry of 6 MV Primus LINAC, as realistically as possible. The BEAMnrc and DOSXYZnrc (EGSnrc package) Monte-Carlo model of the LINAC head was used as a benchmark.

First, the BEAMnrc was used for the design of the LINAC treatment head. Second, dose calculation and for the design of a 3D dose file were produced by DOSXYZnrc. The simulated PDD and beam profile obtained were compared with that calculated using commissioning data. Good agreement was found between calculated PDD (1·1%) and beam profile using Monte-Carlo simulation and commissioning data. After validation, TPR20, 10, TMR and Sp values were calculated in five different fields.

In conclusion, the BEAMnrc and DOSXYZnrc codes package have very good accuracy in calculating dose distribution for 6 MV photon beam and it can be considered a promising method for patient dose calculations. The Monte-Carlo model of primus linear accelerator built in this study, meanwhile, can be used as a method of calculating the dose distribution for cancer patients.

In the next paper, Ansari, Satpathy, Ahmad, Singh, Lad, Thappa and Singh present a new index: the triple point conformity scale (CS3) and its implications for qualitative evaluation of the radiotherapy plan. Across the history of radiotherapy, with gradual technological progress and various methods of irradiation, the purpose has always been to deliver homogeneously 100% of the prescribed dose to 100% of the target volume containing the identifiable tumour and/or tumour cells potentially present while limiting the dose to adjacent normal tissues.

The formula for triple point conformity scale is $CS3 = (V95 + V100 + V105)/3VT$.

2(a) Lower limit determination: $CS3 = (VT + 0{\cdot}93\ VT + 0{\cdot}0)/3VT = 0{\cdot}643$

2(b) Upper limit determination: In order to find out an empirical relation in between V105 and VT, the authors studied over 593 cancer patients of various sites by taking PTV as target, and an empirical relation is derived out as: $V105/VT = 0{\cdot}0007$. Hence, $CS3 = (VT + VT + 0{\cdot}0007VT)/3VT = 0{\cdot}6667 \sim 0{\cdot}667$.

The authors conclude that the triple point conformity scale provides better qualitative information about the radiotherapy plan compared with other conformity indices. This study recommends the use of the CS3 scale to evaluate conformal radiotherapy plans which encompass a wide range of relevant clinical volumes, as it can extract qualitative dosimetric information.

Authors Varghese, Goudar, Abraham, Peace, Singh and Backianathan present their study which compares the dosimetric outcomes of linear accelerator-based stereotactic radiotherapy (SRT) techniques, Static Conformal Field (SCF), Static Conformal Arc (SCA) and Dynamic Conformal Arc (DCA), when treating pituitary adenomas and craniopharyngiomas.

Computer image sets of twenty patients with pituitary adenomas or craniopharyngiomas and treated with postoperative SRT were selected for this study. For each data set, three SRT plans with SCF, SCA and DCA techniques were generated using Brain LAB, iPlan RT V.4.5.3 and TPS software. The conformity index, homogeneity index, quality of coverage of the target, dose–volume histograms for the target and organs at risk (OAR) and the time taken to deliver treatment was compared across three sets of plans.

In conclusion, the LINAC-based SRT techniques SCF, SCA and DCA are efficient in delivering highly conformal and homogenous dose to the target in pituitary adenomas and craniopharyngiomas. Among these three techniques, SCF and DCA had acceptable quality of coverage. The dose received by OARs was the least in the SCF technique.

In the next paper, Khaledi, Sardari, Mohammadi, Ameri and Reynaert present a study that deals with the characteristics of simultaneous photon and electron beams in homogenous and inhomogeneous phantoms by experimental and Monte-Carlo dosimetry for therapeutic purposes.

Both 16 and 20 MeV high-energy electron beams were used as the original beam to strike perforated lead sheets to produce the mixed beam. The dosimetry results were achieved by measurement in an ion chamber in a water phantom and film dosimetry in a Perspex nasal phantom, and then compared with those calculated through a simulation approach. To evaluate two-dimensional dose distributions in the inhomogeneous medium, the dose-area histogram was obtained.

https://doi.org/10.1017/S1460396918000286 Published online by Cambridge University Press

The results present some dosimetric advantages that can make this study a platform for the production of simultaneous mixed beams in future LINACs, which through redesign of the LINAC head could lead to setup error reduction and a decrease of intra-fractional tumour cells repair.

In the next paper, Mahmoud, Abdelgeleel and Mahmoud researches the impact of postoperative intravaginal brachytherapy on survival for patients with intermediate-risk cancer cervix. Cervical cancer is considered to be the fourth most frequent cancer among women in Egypt. Postoperative treatment is indicated depending on surgical findings and disease stage. The aim of this study was to assess the long-term outcomes of postoperative cancer cervix patients with intermediate risk factors who received pelvic external beam radiotherapy (EBRTH) with or without vaginal brachytherapy.

The records were collected for all patients with cancer cervix who received postoperative radiotherapy at the National Cancer Institute between the years 2008 and 2013. The endpoints of the study were local control, progression-free survival, overall survival and delayed complications.

Out of 248 patients, for patients who did not receive brachytherapy the median age was 53 years and 52 years among those who received brachytherapy. A statistically significant difference was found in overall survival, progression-free survival and recurrence-free survival for those who received brachytherapy with p value $< 0{\cdot}001$, $0{\cdot}01$, $0{\cdot}004$, respectively.

The author concludes that adding brachytherapy to postoperative EBRTH radiotherapy improves overall survival, progression-free survival and local control for patients with intermediate risk cancer cervix.

The next paper is a literature review on magnetic resonance imaging in radiotherapy treatment target volumes definition for brain tumours by Abubakar, Boujude, Usman, Garba, Obotiba, Barde, Miftaudeen and Abubakar. The aim of this study is to establish clinical evidence regarding the use of MRI in target volume definition for radiotherapy treatment planning of brain tumours.

Primary studies were systematically retrieved from six electronic databases and other sources. The only studies included were those which quantitatively compared CT and MRI in target volume definition for radiotherapy of brain tumours. Study characteristics and quality were assessed and the data was extracted from eligible studies. Effect estimates for each study was computed as mean percentage difference based on individual patient data where available. The included studies were then combined in meta-analysis using Review Manager (RevMan) software version 5.0.

The authors conclude that brain tumour volumes measured using the MRI-based method for radiotherapy treatment planning were larger compared to CT-defined volumes but the difference lacks statistical significance.

The technical note presented in this issue is on the dosimetric evaluation of electron beams on scalp using EBT2 films and Rando phantom, by authors Hasoomi, Naderi and Asl. In radiotherapy, electron beam irradiation is an effective modality for superficial tumours. Electron beams have good coverage of tumours which involve the skin; however, there is an issue about electron scattering and tissue heterogeneity. This subsequently demands dosimetric analysis of electron beam behaviour, particularly in the treatment of lesions on the scalp requiring the application of treatment to scalp curvatures. There are various methods which are used to treat scalp malignancies, including photons and electrons, but the latter needs precise dosimetry before each session of treatment. The purpose of the study was to undertake a detailed analysis of the dosimetry of electron beams when applied to the curved surface of the scalp using gafchromic EBT2 films.

A Rando phantom and gafchromic EBT2 films were used for dosimetric analysis. A Gafchromic calibration curve was plotted and an in-treatment beam dosimetric analysis was carried out using dosimetry films placed on the scalp. Electron behaviour was assessed by introducing five electron fields in particular curvature regions of the scalp.

Authors conclude that electrons are a good modality for treating one flat field, but in the special topography of the scalp, whole scalp treatment needs precise field matching and dosimetry.

To complete this issue, Lee and Ho present their case study on the external auditory meatus involvement in nasopharyngeal carcinoma. Nasopharyngeal carcinoma with local extension to the external auditory meatus is rarely reported. The authors present two cases of nasopharyngeal carcinoma with invasion to the external auditory meatus, the first case at initial presentation and the second at disease recurrence. Both patients presented with unilateral otologic symptoms corresponding to the affected site; as well as being heavily node positive. Otoscopic examination and 18F-fluorodeoxyglucose-positron emission topography demonstrated the involvement of external auditory meatus.

These two cases highlight the need for careful otoscopic examination and functional imaging to diagnose such cases.

Professor Angela Duxbury

https://doi.org/10.1017/S1460396918000286 Published online by Cambridge University Press