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In this issue

I am pleased to introduce the September 2017 issue of the *Journal of Radiotherapy in Practice*. In this issue there are 11 original articles, two literature reviews, a technical note and a book review.

In the first article, authors Rozanec, Smith, Wells, Moyo, Zychla and Harnett explore patient satisfaction with a clinical specialist radiation therapist (CSRT) in a palliative radiotherapy clinical environment. A one-point dissemination design captured satisfaction scores from patients who did ($n = 19$) and did not ($n = 14$) receive palliative care from the CSRT. The 'Patient Satisfaction Questionnaire' was modified, including six common questions and four additional questions for patients seen by a CSRT. *t*-Tests compared results from common questions and mean values, standard deviations were also calculated. The results of the study found that patients receiving care from the CSRT had better understanding of treatment and an excellent experience with the CSRT. This interaction provided more opportunities to address patient questions/concerns, thus alleviating patient anxiety, increasing satisfaction with care, and demonstrating how new roles can develop new models of care within the current healthcare system.

In the next article, Claxton and Appleyard present their study to investigate the use of an ultrasound bladder volume scanner (Bio-Con 700; Mcube) to see if this can improve bladder reproducibility when used during an active volume correction protocol, during intensity-modulated radiotherapy for cancer of the cervix/endometrium. During this method-comparison study, patients were prospectively recruited ($n = 20$) and followed a fluid loading protocol to achieve acceptable bladder volume. Bladder ultrasound was performed daily to verify planned volume, with patients actively correcting volumes outside a planned range up to a maximum of three times. Using the Bland–Altman method, we compared mean ultrasound readings (USMean) with mean cone-beam computed tomography volumes (CBCTMean). We also conducted staff focus groups exploring issues encountered during implementation of bladder scanning.

Comparing USMean with CBCTMean produced a mean of the differences -10 ± 49.92 mL (1 SD), demonstrating that bladder volume scanning is equivalent to our standard measure for the stated confidence levels. The cohort mean bladder volume decrease from week 1–5 was only 8.4%. Mean USMean was 323 mL, mean CBCTMean was 313 mL. Staff experience with the scanner overall was positive.

Authors conclude that the Bio-Con 700 is suitable for the purpose of daily pre-treatment volume verification, facilitating daily assessment and modification of bladder volume, resulting in reproducible treatment volumes.

In the next paper, Bongkot Jia-Mahasap undertakes a dosimetric comparison of helical tomotherapy (HT) using different techniques, simultaneous-integrated boost (SIB) and sequential boost (Sq) for craniospinal irradiation (CSI). CSI has become an important and challenging radiation technique for radiation oncologists. HT seems to have dosimetric advantage for CSI compared with other radiation modalities. The purpose of this study was to compare dosimetric data between two different HT plans; SIB and Sq. In total, 12 treatment plans, previously used to treat 12 patients with CSI using a SIB technique, were selected and re-planned. Dosimetric comparative parameters of targets were conformity index and homogeneity index. For organ at risk (OAR), the mean dose of

parallel organs, D2% of serial organs and whole body integral dose were also investigated. The author concludes that CSI treatment using HT, SIB technique was feasible and had more target coverage while minimising the radiation dose to healthy tissues.

In the next paper, authors Welgemoed, Rogers, McNaught, Cleator, Riddle and Gujral examine the efficacy of the Elekta Active Breathing Coordinator (ABC), a deep inspiration breath-holding method, in reducing heart dose in left-sided breast radiotherapy.

In total, 12 patients receiving radiotherapy to the left breast were planned for treatment with both a free-breathing (FB) and an ABC scan. The dose–volume histogram data for the plans were analysed with respect to heart V13, V5 Gy, mean heart dose and ipsilateral lung V18 Gy. Tumour bed D98%, threshold lung volume in breath hold (BH) and the maximum BH time for each patient was also measured. Patients then received their radiotherapy treatment using the ABC plan and the systematic error in the cranio-caudal, lateral and vertical axes was assessed using orthogonal imaging.

Authors conclude that ABC represents a good method of reducing radiation dose to the heart while not compromising on dose to the tumour bed, and it has a clear advantage over FB radiotherapy in reducing the risk of cardiac toxicity. It is tolerated well by patients and does not produce any difficulties in patient positioning.

In the next paper, Giri and Pradhan present their study to establish inherent uncertainty in the shift determination by X-ray volumetric imaging (XVI) and calculating margins due to this inherent uncertainty using van Herk formula.

This study was performed on the X-ray volumetric Imaging (XVI; Elekta Oncology Systems, version 4.5) which is cone-beam computed tomography (CT) integrated with the Elekta Axesse™ linear accelerator machine having a six degrees of freedom enabled HexaPOD couch. A Penta-Guide phantom was used for inherent translational and rotational shift determination by repeated imaging. The process was repeated 20 times a day without moving the phantom for 30 consecutive working days. The measured shifts were used for margins calculation using Van Herk formula. The authors concluded that there was an inherent uncertainty associated with the XVI tools, on the basis of these six-dimensional shifts, margins were calculated and recorded as a baseline for the quality assurance (QA) programme for XVI imaging tools by checking its reproducibility once in a year or after any major maintenance in hardware or up gradation in software. Although, the shift determined was of the order of sub millimetre, still that shift had great significance for the image quality control of the XVI tools. Every departments practising quality radiotherapy with such imaging tools should establish their own baseline value of inherent shifts and margins during the commissioning process and must use an important QA protocol for the tools.

Authors Rozanec, Chan, Malam and Loudon present their work on the development of an auto-generated Patient Discharge Summary for all patients being treated in the radiation therapy department. This ensures information relevant to the care of the patient is communicated effectively during transitions of care following radiation treatment, and provides a record of the treatment site(s), dose delivered, start/completion dates and contact information for radiation oncologists. The eScribe feature in MosaiQ™ is utilised to auto-generate the patient discharge summary in less than 1 minute, and then printed and given to patients on the last day of treatment. This was piloted with palliative radiotherapy patients ($n = 22$), who also completed a telephone survey.

Overall, the patient discharge summary allows for a quick, automated and standardised approach for transfer of information during care transitions without significant impact to the radiation therapy departmental workflow.

In the next paper, Murphy and Drury-Smith, present their study to determine which concomitant boost technique is dosimetrically superior in the treatment of breast cancer; volumetric-modulated arc therapy (VMAT) or fixed-field intensity-modulated radiotherapy (ff-IMRT).

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In total, 30 breast patients were re-planned with both VMAT and fixed-field concomitant boost IMRT techniques. A hybrid technique was used delivering 80% of the dose through tangential beams and 20% through an integrated boost. A two-tailed *t*-test sample for means was used to compare the dosimetric differences between the techniques.

Authors conclude that VMAT and ff-IMRT techniques demonstrate excellent target coverage and OAR sparing facilitated by the hybrid planning technique and deep inspiration breath hold (DIBH). There is no obvious dosimetrically superior option between the two techniques. Reduced treatment times with VMAT make it more desirable to implement clinically.

In the next paper, Bridge, Fielding, Rowntree and Pullar present their study on a novel radiotherapy outlining application that uses a small number of user-assigned points across orthogonal planes to generate a mesh which is then edited across multiple slices using innovative three-dimensional (3D) sculpting tools. This paper presents the results of a bladder outlining study that compared times and volumes for the new tool with those of a conventional manual outlining tool.

All students undertaking their first University radiotherapy planning module were invited to participate. Following training, they performed a timed outlining of the same male bladder dataset and provided feedback on their preferred method.

The authors conclude that a minimal point 3D volumetric manual outlining tool utilising orthogonal CT planes demonstrated significant time saving for bladder segmentation compared with axial-based outlining within a group of novice outliners. Future work aims to establish the role of the 3D multi-slice sculpting tools in editing of auto-segmentation derived contour sets.

Authors Liu, Darko and Osei report on their investigation of preclinical studies for implementing field flattening filters (FFF) beams in hypofractionated VMAT for prostate cancer radiotherapy. VMAT has emerged as one of the most favourable techniques for radiotherapy treatment in recent years because of its conformal dose distribution to the planning target volume (PTV), lower doses to adjacent normal OARs and faster and easier dose delivery. A typical conventional VMAT protocol for low-intermediate risk prostate cancer uses a flattened 6 MV photon beam to deliver 78 Gy in 39 fractions; however, a recent Radiation Therapy Oncology Group study investigated prostate cancer radiotherapy with a hypofractionated dose scheme of 36.25 Gy in 5 fractions. One advantage of FFF beams in radiotherapy is the higher doses in the central region on the dose profile and much higher dose delivery rates.

In this study, all treatment planning were accomplished using Varian Eclipse™ treatment planning system version 11 and delivered on Varian Truebeam linear accelerators. The studies compared the biological-effective dose–volume histograms and dose–volume histograms of PTV and OARs for 20 patients using conventional and hypofractionated dose schemes. The study also evaluated using 6 and 10 MV FFF by comparing 6 and 10 MV VMAT plans with the FFF beams. The treatment time was investigated using plans with 6 MV beams and doses of 2, 4, 5, 6, 7.25 Gy/fraction and plans with 10 MV FFF with a dose of 7.25 Gy/fraction. Authors also investigated an angular monitor units quantity (MU/deg) and its threshold value for RapidArc™ plans, beyond which FFF beams can be considered superior to flattened beams in terms of treatment time increased caused by higher dose per fraction.

Authors conclude that the 10 MV FFF beam is better for hypofractionated prostate cancer VMAT plan delivery. The threshold value of MU/deg is found to be 2.083 MU/deg based on our machine configurations.

In the next article, Fuse, Komatsu, Arakawa, Sakae, Fujisaki present their study on the evaluation of an infrared (IR) interactive patient position guidance and acquisition control system for use during radiotherapy treatment.

The control of patient position, posture and respiratory movements during radiotherapy is

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important for effective and specific treatment of malignancy. Authors have developed an IR interactive patient position guidance and acquisition control system for clinical use, comprising IR cameras, IR markers and dedicated software.

The system was evaluated with ten healthy volunteers and ten experienced operators. IR markers were placed on the body surface. Their positions were calculated using vectors of three translational and three rotational parameters, and the intra-fractional error for each marker was acquired with and without respiratory motion. The inclusion of multiple positioning markers allowed for real-time visualisation of the patient posture, with feedback on misalignment and required postural adjustments.

In conclusion, the IR interactive system was shown to be high utility and suitable for monitoring patient position, posture and respiratory movements during radiotherapy.

In the next article, Barrett, Taylor and Rock undertake an evaluation of a reproducible BH technique for stereotactic ablative body radiotherapy (SABR) treatment of lower lobe lung tumours.

DIBH is a method of motion management used in SABR for lung tumours. An external gating block marker can be used as a tumour motion surrogate; however, inter-fraction gross target volume (GTV) displacement within DIBH occurs. This study measured this displacement during a reproducible BH regime. In addition, factors such as position of the gating block marker were analysed. In total, 121 cone-beam computed tomography scans from 22 patients who received DIBH SABR were retrospectively evaluated and the magnitude of inter-fraction GTV displacement was calculated for each fraction. These data were analysed to assess if any correlation existed between tumour displacement and variation in the gating block marker position on the patient, the amplitude of BH at CT, the amplitude of BH at treatment and the tumour location. The measured tumour displacement was applied to the original planning CT to evaluate the dosimetric effect on surrounding OARs using cumulative dose–volume histograms.

The findings of the study, reproducible BH was achievable across a range of patients. Inter-fraction GTV displacement measured 0.41 ± 0.28 cm. Due to this low level of motion, the correction of soft tissue moves did not adversely affect OAR dose.

In the first literature review, Pugh, Lloyd and Collins ascertain whether it is feasible to improve bolus conformity within radiation therapy by using a 3D printer to fabricate bolus. A literature review was conducted that utilised Boolean terminology and included key words; ('3D' OR '3-dimensional' OR 'three dimensional') 'bolus' OR 'boli' conform* ('Radiation therapy' OR 'radiotherapy'), printing. Several key papers were identified and critically evaluated based on the title of the feasibility of improving bolus conformity with the used of 3D printing. Several fabrication material devices were explored.

The literature advocates that fused deposition modelling fabrication device clear-PLA material to be an adequate product to construct 3D printed bolus and conform to irregular surfaces. 3D bolus would prove advantageous for VMAT/IMRT techniques as literature has shown the presence of air gaps, small field sizes and large beam obliquity can result in a >10% dose reduction at skin surface.

In the second literature review, Montgomery and Collins, investigate the localisation and verification accuracy performance of ExacTrac (ET) and Novalis Tx System. A systematic review of the database Science Direct was carried out using search terms 'Stereotactic Radiotherapy' and 'ExacTrac'. All articles prior to 2000 were excluded. Only articles that involved intracranial lesions, with the exception of one article, were included in the final review.

The authors conclude that there is the need for regular calibration to prevent systematic errors and potential geographic miss. However, due to ET's additional benefits, including reduced

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concomitant dose and faster imaging time, ET is the superior image guidance modality for RS/SRT in the treatment of intracranial lesions.

The technical note in this issue is presented by authors Yuen, Au, Chan, Yiu, Law and Wong. The aim of this study was to compare the dosimetric parameters and effects of SIB and traditional sequential electron boost, after HT, because of the lack of studies in this field in the current literature.

The authors conclude that tomotherapy with SIB may be able to offer less OAR dose (except for the heart), while maintaining the ability to deliver adequate dose coverage.

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