Editorial

Image guided radiotherapy moving towards real time adaptive radiotherapy; global positioning system for radiotherapy?

Image guided radiotherapy (IGRT) has been defined as 'any imaging at the pre-treatment and treatment delivery stage that leads to an action that can improve or verify the accuracy of radiotherapy' [1]. During the last 30 years, imaging in radiotherapy has reflected the advances of technology in society. We have moved from 2D, film imaging, to digital camera imaging (electronic portal imaging), then to video recording, 3D technology (Computerised Tomography (CT) and Cone Beam CT(CBCT)), more recently the addition of 4D information with location finders, (4D CT, 4D CBCT), and now entering the world of real-time adaptive radiotherapy which promises to be a 'global positioning system (GPS) for radiotherapy'.

This special edition of Tipsro, focused on IGRT, demonstrates the developments in practice aiming to achieve greater accuracy in radiotherapy planning and delivery. The therapeutic radiographer/radiation therapist (TR/RTT's) role has evolved alongside technologic developments and we must ensure that our education and professional development keeps apace [2]. Role development and advanced practice will continue to transform as new skills become routine, and new techniques/technology emerge. It is important that we maintain education and competency to validate such skills.

To improve accuracy the first step in defining the target is crucially important. Good practice in diagnostic radiography can inform radiotherapy to optimise image quality [3]. The increased use of contrast and the implementation of multimodality imaging for example Magnetic Resonance Imaging (MRI) are both illustrated in this edition. CT scanners with high specification are now commonplace in radiotherapy departments enabling the application of 4D imaging and contrast in pre- treatment imaging use where appropriate. Skills such as cannulation and administering contrast can be acquired and maintained in line with the increase in use. The integration of MRI into radiotherapy planning varies internationally but the overall trend is increasing and it is recommended in many tumour sites particularly in those with solid tumours [4–6]. The recent introduction of MR Linac systems, combining MR imaging and a linear accelerator, further integrates MRI with radiotherapy. Knowledge of safety in MRI, MR image acquisition and optimisation will be required by TR/RTT's both pre and post registration [7].

Reproducible patient positioning throughout treatment must be investigated in parallel with developments in IGRT imaging. Breath hold is good example of a technique that is an effective method of reproducing the position of the target and becoming more widely used [8]. However it is imperative that the benefit and reproducibility of immobilisation techniques are investigated both generally and in each department when implemented.

Image verification has progressed from assessing bony anatomy, to the use of surrogates and/or soft tissue assessment. The role of the TR/RTT has become vital when implementing techniques such as stereo tactic body radiotherapy, where a high dose is delivered daily. To avoid the need for a clinician to be present at each fraction, training and competency programmes can be undertaken by the TR/RTTs [9]. The involvement of, and communication with, the multi-disciplinary team is essential when developing these programmes [10]. Audit is an important tool which can be used to assess the efficacy of such training programmes, the development of which can be iterative, and is nicely illustrated here.

Adaptive radiotherapy is the next evolution and encompasses, replanning off-line during the course of treatment, defining a library of plans for choice prior to treatment and real time on-line replanning [11]. Off-line planning requires definition of thresholds for re-planning to be identified and a process established. Although practical solutions have been presented [12], practice in department remains variable, as often the case with many new processes [13]. Hence this areas remains a topic of investigation and two papers in this edition investigate off-line adaptive radiotherapy which again highlights the importance of the TR/RTT in this process.

Real time on-line adaptive radiotherapy could be considered as GPS for radiotherapy; adapting the journey to reach the destination depending on the situation of the surroundings each day. It is only recently that this has been clinically possible with the introduction of the MR Linac, although treatments are lengthy and resource intensive [14,15] compared to conventional C-arm radiotherapy. However, with the treatment planning times becoming faster [16,17] and automation of aspects of planning eg contouring, it is possible that adaptive on-line treatments will be possible on C-arm Linacs. For an efficient workflow the role of each discipline, oncologist, physicists and TR/RTT, needs to be reviewed and established.

Radiographer/radiation therapists are the key professionals at the patient technology interface in the radiotherapy pathway and must continue to investigate and assess efficacy and efficient of new technologies.

Acknowledgments

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