Editorial

Introduction to the Special Issue on the Technology of Radiotherapy

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In his October 1981 Presidential Address to the American Society of Therapeutic Radiologists [1], Herman Suit challenged the radiotherapy community to increase the doses given in radical radiotherapy treatments to improve local control while avoiding normal tissue complications. It was not until the development of multileaf collimator technology 10 years later that the concept of minimising the amount of normal tissue irradiated so that an increase in tumour dose could be safely achieved became readily achievable. A further 10 years elapsed before the possibilities of moving the multileaf collimator during the radiation delivery led to the widespread use of intensity-modulated radiotherapy (IMRT) to improve the conformation of the high-dose distribution to the target volume further. This special issue looks at some of the issues relating to this technology.

In 2007, the National Radiotherapy Advisory Group (NRAG) report [2,3] recommended that IMRT should become the standard of care between 2012 and 2017. In order to implement the recommendations of NRAG, a successor group—the National Radiotherapy Implementation Group—was created and the paper by Williams et al. [4] describes the work this group has done to establish widespread use of IMRT in the UK. The professional bodies involved in radiotherapy were also encouraged to provide advice on technical and scientific aspects of IMRT and in order to fulfil this role the Royal College of Radiologists together with the Society and College of Radiographers, the Institute of Physics and Engineering in Medicine, the Academic Clinical Oncology Radiotherapy Research Network, the National Cancer Research Institute and NRAG set up a Radiotherapy Development Board, on which each of these groups was represented. The Board set up a number of workstreams, including an evaluation of the current state of implementation of IMRT, education and training requirements for IMRT, establishing quality standards and assessing the evidence for the use of IMRT. The results of their deliberations form a significant part of this special issue. The need to improve the volume and quality of radiotherapy research in the UK has also been recognised and the National Cancer Research Institute has established the Clinical and Translational Radiotherapy Research Working Group. The work of this group is also described.

Four separate papers giving examples of the practical implementation of the new technology in the clinic are also included. Two clinical papers provide examples of the development of IMRT techniques in a clinical department and of the use of image-guided radiotherapy (IGRT), which is an important part of the process of improving the accuracy of radiotherapy. Two technical papers look at different aspects of the infrastructure necessary for advanced radiotherapy. As image data are an increasingly essential part of both planning and treatment, the first of these papers looks at how the Digital Imaging and Communications in Medicine (DICOM) standard can be used to integrate radiotherapy into the Picture Archiving and Communication Systems (PACS) that have become the de facto standard for storage and transfer of diagnostic image data. It is perhaps unfortunate that in the period when PACS were being specified, the radiotherapy community was not sufficiently active in encouraging the integration of radiotherapy data into the specifications for the national systems. It is increasingly becoming common practice to use the diagnostic information from multiple imaging modalities when defining treatment volumes. Although modern image registration algorithms are increasingly successful, the opportunities later in the process for verification of the accuracy of coregistration of two data sets are limited and it is important that planning staff are aware of some of the potential pitfalls.

It is generally agreed that the quality assurance burden associated with IMRT is a major limiting factor in increasing the number of IMRT treatments. The results of quality assurance assessments by the RPC in the US [5] and recent publicity relating to serious errors in stereotactic
radiotherapy draw attention to the need for caution in implementing IMRT and other advanced radiotherapy techniques. Ibbott et al. [5] describe the errors they detected in very general terms, but from their description one can conclude that almost all of them were associated with inappropriate commissioning. This is the justification for the recommendation that is made by the Radiotherapy Development Board [6] that the necessity to carry out individual patient measurements can be reviewed after 10 similar patient plans have been verified. Recent IMRT calculation algorithms have become increasingly accurate and as very few, if any, of these individual patient measurements have led to a change in the patient’s plan, reducing the number of individual patient measurements seems a sensible way forward. If this option is taken, it is clearly essential that it is replaced by routine IMRT-specific quality assurance checks of the equipment (which are probably more informative anyway) and an independent dose calculation. Also, the fact that small systematic errors only become apparent when a systematic offset has reached statistical significance requires that a regular formal review of results is carried out. However, identifying the need or otherwise for individual patient measurements would be on a sounder footing if there were more publications like that of Ibbott et al. that detailed the causes that had been identified for unsatisfactory dose measurements.

It is also important in the present climate that the additional costs of IMRT are not inflated. With arc therapy techniques, the time taken for treatment delivery is actually reduced. Equipment for quality assurance is becoming increasingly efficient to use. With the Electronic Portal Imaging Device (EPID) quality assurance techniques now commercially available, checks could be carried out by radiographers if there is a gap between patients waiting for treatment. Also, with electronic test devices, batching of patient checks enables a number of patient checks to be carried out in a relatively short time. This leaves the intractable problem of the increased amount of time required for volume definition and it is perhaps unlikely that this will be reduced in the near future. However, as clinicians become more practiced and perhaps hand over some of the outlining to other staff groups, even this may be less of an obstacle. If the cost per quality-adjusted life year were reduced to little more than standard conformal treatment, there is little doubt that IMRT would be the recommended form of treatment for many sites. Perhaps we can indeed look forward to the day in the not too distant future when IMRT can be offered to the many patients who would benefit from it.

References