The standard treatment for locally advanced cancer of the cervix is external beam radiotherapy (EBRT) with concomitant cisplatin chemotherapy followed by brachytherapy. Over the past two decades, there have been major advances in the planning, prescription and delivery of EBRT. The use of cross-sectional imaging and three-dimensional (3D) conformal treatment planning has resulted in improved coverage of tumour target while reducing dose to organs at risk (OAR).

In contrast, the planning and prescription of cervix cancer brachytherapy has remained virtually unchanged since the 1930s with standard doses prescribed to a fixed point, regardless of tumour topography and doses to OAR, and the use of plain x-ray imaging for treatment planning. This is because the opportunity for dose optimisation has been limited with traditional low dose rate (LDR) machines and conventional metal brachytherapy applicators have not been suitable for use with computed tomography (CT) or magnetic resonance imaging (MRI). With the advent of modern brachytherapy machines with the flexibility to adjust source dwell positions and dwell times – high dose rate (HDR) and pulsed dose rate (PDR) – and new artefact-free applicators, image-guided 3D dose optimisation for brachytherapy treatments has become possible.

In 2005, the Groupe Européen de Curiethérapie European Society for Therapeutic Radiology and Oncology (GEC-ESTRO) published recommendations on contouring of tumour target and OAR and reporting of dose volume parameters for image-guided brachytherapy (IGBT) for locally advanced cervix cancer.4 The major advantage of the technique is the possibility to conform the dose to the anatomy of each patient to take into account tumour volume and topography, and the position of OAR (figure 1). In the seminal paper on the clinical impact of IGBT published by the Vienna group in 2007, Pötter et al5 reported a three-year pelvic control rate of 96% for small tumours (2-5cm in diameter) and 90% for larger tumours (>5cm in diameter). At the same time, the rate of Grade 3-4 bowel and urinary toxicity was reduced to only 2%. Since then, other groups have reported that both CT and MRI-based IGBT result in an improvement in local control of around 20%, with or without a concomitant reduction in serious late toxicity. The GEC-ESTRO guidelines are now universally accepted as the new international standard for cervix cancer brachytherapy.

In July 2008, the Royal College of Radiologists (RCR) set up a working party to facilitate the implementation of IGBT for cervix cancer in the UK. The aims of the working party were to recommend minimum standards for a cervix cancer brachytherapy service in the UK which are in keeping with international recommendations, and to provide national guidance on equipment, dose prescription (including dose fractionation schedules, dose specification and reporting, and dose targets and constraints) and techniques (including imaging modality and applicator designs). The definitive document was published in April, 2009.6

A report of the progress in implementing IGBT for cervix cancer in the UK has recently been published7 based on questionnaire surveys carried out in September 2008 and March 2011. The results show that considerable progress in implementing IGBT for cervix cancer has been made in the UK since the publication of the RCR guidance document in 2009. The number of UK centres offering IGBT for cervix cancer has increased from 12/45 (26%) in 2008 to 32/45 (71%) in 2011. The number of centres offering MRI-based IGBT has increased from two (4%) in 2008 to nine (20%) in 2011. This is important as MRI-based IGBT allows greater opportunity for dose optimisation and/or dose escalation compared to CT, and consequently superior local control rates for large tumours and lower toxicity rates. Other changes recommended in the RCR document have also been implemented, including change to 3D conformal planning for EBRT (eight centres = 18%), dose escalation (nine centres = 20%), and addition of interstitial needles (one centre) which further improves tumour coverage for patients with insufficient response and/or unfavourable topography after EBRT while limiting the dose to OAR (figure 2). Overall, 32 of the 45 centres (71%) in the UK have implemented one or more changes over the past two years to improve the outcome of radiotherapy treatment for cervix cancer.

The impressive progress with implementing IGBT for cervix cancer highlights the value of national guidance in facilitating the implementation of advanced radiotherapy techniques in the UK. The role of the professional bodies and the National Radiotherapy Implementation Group (NRIIG) in producing such documents is crucial. However, it is necessary to recognise that when implementing any complex new technique, there is inevitably a learning curve involved with the potential for inadvertent detrimental consequences due to inexperience or incomplete understanding of the concepts involved. IGBT for cervix cancer incorporates several new concepts in target volume delineation, applicator reconstruction, and dose prescription, optimisation and modification. There have been anecdotal reports of unexpected local recurrences in low bulk tumours which have been attributed to inadvertent dose reduction due to over-optimisation or changes in method of prescription (figure 3).

In recognition of this important issue, the RCR in partnership with the Institute of Physics and Engineering in Medicine (IPEM), the Society and College of Radiographers (SCoR) and Department of Health e-Learning for Healthcare (e-LfH) have produced an e-learning programme to support the implementation of IGBT for cervix cancer (www.e-lfh.org.uk/radiotherapy-e). The programme offers multi-professional learning resources for the trained workforce involved in the delivery of radiotherapy, including oncologists, physicists, radiographers and dosimetrists. All aspects of the IGBT process are covered, including terms and definitions, techniques, equipment and protocols, dose targets and OAR constraints, target volume and OAR contouring, applicator reconstruction, dose prescription, optimisation and modification, commissioning and quality assurance, logistics and patient care. A number of customised tools have been specially developed to allow users to practise some of the practical skills required for IGBT cervix including a contouring tool, an image registration tool and...
spreadsheets for calculating biologically equivalent doses. The emphasis is to share the lessons learned through experience of the practical aspects of implementing IGBT for cervix cancer, including shortcuts, pitfalls and topics of uncertainty. It is hoped that the programme will shorten the learning curve for new users of the technique and facilitate the safe transition from standard x-ray-based point dosimetry to individualised volume-based image-guided dosimetry.

**Note**
The e-learning content of Radiotherap-e is free to all relevant healthcare professionals within the NHS. For non-NHS workers or those who do not work in the UK, access is available by payment. For more information, visit www.e-lfh.org.uk/radiotherap-e.

**References**