SCoR
THE SOCIETY & COLLEGE OF RADIOGRAPHERS

MRI Guided Radiotherapy

First edition
February 2020
ISBN: 978-1-909802-48-3
Review Date September 2021

Quartz House
207 Providence Square
Mill Street
London SE1 2EW

020 7740 7200
info@sor.org

www.sor.org

Contents

The Society and College of Radiographers (SCoR) publishes this guidance document for the therapeutic radiography profession and education providers with an overview of the educational and professional requirements for the profession to support safe, effective use of magnetic resonance imaging (MRI) in radiotherapy for the purposes of simulation (MRSim) or on-board radiotherapy guidance (MR-RT).

1. Introduction

The potential benefits of integrating MRI into the radiotherapy pathway (superior soft tissue characterisation compared to CT, multi-planar and multi-parametric capabilities, absence of ionising radiation and the capacity for non-invasive functional imaging) have been well reported[1,2]. In fact, the earliest report of MRI in radiotherapy planning was published in 1986[3]. In light of recent technological advances in dedicated MR Oncology Systems and MR-RT hybrid systems, the implementation of MR-guided radiotherapy is on the rise. It is therefore important to address the educational and training needs of radiographers (both diagnostic and therapeutic) working in MR for RT.

This guidance focuses on the areas of radiographic practice: MRSim and MR-RT. Much of the foundational knowledge, skills and competence overlap between these two areas, and it is these that this document aims to address. The training and educational needs for advanced clinical practice in relation to MR-adaptive radiotherapy will be included within the updated guidance Image Guided Radiotherapy, from the UK Radiotherapy Board.

MRI will become increasingly embedded within the radiotherapy patient pathway, an exciting development and change. We should take this opportunity to work towards a more collegiate model and joined-up approach, though still with clear lines of responsibility, as we bring together clinical experts, researchers, educators and patients as this clinical pathway moves from novel to routine. Developing a competency framework and pathway where tasks can be shared across professions will result in a more resilient and cost-effective service for patients.

2. Aim of the document

The aim of this guidance document is to present education providers and the radiography profession with an overview of the educational and professional requirements for the safe, effective use of MRI in radiotherapy within these two domains (MRSim and MR-RT). This guidance is consistent with the following documents:

- The Education and Career Framework: covering outcomes for all levels of practice, including entry level as a practitioner and at higher levels of practice; advanced and consultant-level practitioners; and the indicative pre-registration curriculum;[4]
- The Scope of Professional Practice: detailing actions for individuals defining their scope of practice;[5]
- SCoR response to recommendations of the Francis Report in relation to the maintenance of practitioner competence;[6]
- Magnetic Resonance Imaging (MRI) Equipment, Operations and Planning in the NHS;[7]
- MHRA Safety guidelines for magnetic resonance imaging equipment in clinical use;[8]
- Safety in Magnetic Resonance Imaging – SCoR;[9]
- Image guided radiotherapy (IGRT) clinical support programme in England 2012–2013;[10]
- The continuing professional development requirements of the Health and Care Professions Council;[11]
- e-Learning for Healthcare MRI Safety.[12]

3. Integration with career and professional development frameworks

Both the SCoR and the British Association of MR Radiographers (BAMRR) recommend that all workforce working in a clinical or clinical support role in MR units should have as a minimum:

- Knowledge and understanding of the threats posed by the static magnetic field;
- Understanding of the MR controlled access area and MR environment;
- Awareness of MR authorised personnel;
- Understanding of the screening process and access rights;
- Knowledge of emergency procedures within the MR environment;
- Understanding of the nature of a magnet quench and when a system may need to be quenched by the operator;
- Understanding of the labelling system for MR equipment;
- Understanding of the requirement for hearing protection and correct positioning;
- Understanding of the correct use and positioning of the coils and cables and ancillary equipment.

Radiographers acting as MRI operators should have further post-registration knowledge and understanding of MRI in the following areas:

- Bio-effects of the static magnetic field, time-varying gradient magnetic fields and radio-frequency (RF) radiation;
- Projectile and attractive forces;
- Recommended exposure value limits;
- Sequence selection and parameter manipulation to minimise all of the above;
- Conditional implants and devices;
- Medicines used in MRI.

The guidance above applies to both the diagnostic and therapeutic radiography workforce.

3.1. Currently only a small number of radiotherapy centres have equipment which offers MR acquisition for radiotherapy. However, this is likely to increase, and therefore it is important for employers to support the development of the wider workforce.

Additionally, as MRSim or MR-RT units enter radiotherapy departments, it is essential that all staff have at least a core understanding of the hazards of MRI and who is responsible for MRI safety within the department. It is also essential that all members of the profession have an understanding of how MRI can be integrated into the radiotherapy pathway, and the possible indications for its use, to be able to advise both patients and other healthcare professionals accordingly. All referrals to the MRSim services or MR-RT should come from referrers understanding their responsibilities.

Therapeutic radiographers will need to discuss and provide clear information in a variety of forms to meet the individual patient needs about MR in RT to those patients and carers who are receiving photon and proton therapy, as this may or may not be part of their radiotherapy pathway. To support understanding and knowledge of MR in RT, an e-Learning for Health (e-LfH) programme, ‘MRI Safety’, has been developed jointly by the SCoR, the Royal College of Radiologists and the Institute of Physics and Engineering in Medicine.[12] It is strongly advised that all radiographers complete this programme and that this

be incorporated into pre-registration training. This programme is free to all staff working within the NHS and to students, and is available more widely through eIntegrity [https://www.eintegrity.org/] for those in the independent sector.

All radiographers working in MRSim and MR-RT should receive additional competency-based inductions and on-going training through locally based competency programmes. These can be developed with input from MR experts from within clinical imaging. The clinical environment, similar to x-ray-based imaging, will offer opportunities for therapeutic radiographers to develop advanced clinical practice roles, underpinned by College of Radiographers approved master's level education programmes. Many patients will be enrolled in clinical trials and there will be significant opportunities to engage in high-quality practice-related research activities across the patient pathway, during pre-treatment, treatment delivery and aftercare.[13]

This guidance is divided into two main sections:

- Recommendations to radiography educators for pre-registration education and training, either through the traditional higher education route or via an apprenticeship route;
- Recommendations to employers and radiography practitioners to support the education and training of the existing workforce, both those working within the MR-RT services and the wider workforce.

4. Learning and development for pre-registration students and therapeutic radiographers not directly engaged in MR in RT

The indicative curriculum set out in the Education and Career Framework[4] should be delivered through pre-registration education programmes.

With respect to MR in RT, pre-registration programmes approved by the College of Radiographers should include, as a minimum, up-to-date knowledge and understanding of:

- National guidance and recommendation for indications of MR-guided RT;
- Basic MRI physics;
- Potential side effects specific to the MR-RT environment;
- MRI scanners and hybrid MR-RT systems;
- Quality assurance protocols;
- Radiation protection;
- MRI safety;
- Uses and contra-indications for MRI-guided radiotherapy;
- Cross-sectional anatomy;
- Imaging and working with 2D and 3D, and aspiring to 4D;
- Functional imaging with PET and MR;
- Immobilisation techniques;
- Toxicity and symptom control.

5. Learning and development for therapeutic radiographers working in MRSim and MR-guided RT[14]

All radiographers working in MRSim or on-treatment MRI-guided radiotherapy will be required to meet indicative learning outcomes appropriate to their scope of practice. Radiographers should be able to:

- Provide site and MR-in-RT-specific information and support to patients and their carers;
- Plan and deliver safe, accurate MR-guided RT to patients within protocols, ensuring the radiation safety of all;
- Manage the care pathway for patients receiving MR-guided RT, including relationships with other departments (eg radiology).

5.1 In general

i MRI safety (recognition of environmental and physiologic safety considerations within an MRI or MR Linac suite);
ii. Competence in screening patients, staff, volunteers and visitors;
iii. Basic knowledge of MR image formation and ability to optimise acquisition for radiotherapy purposes;
iv. Knowledge of contrast media/muscle relaxants;
v. Ability to quickly and competently interpret multi-modal morphological and functional MRI images;
vi. Competence at multi-modality image registration (eg MRI-CT or fMRI-MRI);
vii. Knowledge of radiotherapy-specific imaging needs (eg geometric fidelity) and how to meet them;
viii. Ability to safely, comfortably and reproducibly position patients using MRI-safe positioning aids.

5.2 Additional learning and development for on-treatment MR-guided RT

i. Understanding of potential side effects specific to the MR-RT environment (eg increased skin dose due to electron return effects);
ii. Ability to quickly and accurately contour/modify (at minimum) normal tissue contours for the purposes of adaptive radiotherapy; application of knowledge of the impact of dose on organs at risk;
iii. Understanding of adaptive radiotherapy strategies, and of how and when to apply them.

5.3 Learning and development for MRI radiographers working in MRSim

In addition to completing the e-Learning for Healthcare (e-LfH) programme accessible to all NHS staff, radiography staff will receive additional competency-based training within each centre that includes:

i. Understanding of the specific MR imaging needs for radiotherapy;
ii. Ability to acquire images with high geometric fidelity;
iii. Ability to position patients accurately and reproducibly in the treatment position using MRI-safe radiotherapy positioning aides, and awareness of local protocols on bladder filling, breath-hold, etc;
iv. Understanding of whether or not a deformation-free external body contour is required (in the case of MRI-only treatment planning), or a volume of interest required only for target/organ at risk delineation;
v. Knowledge of local nomenclature and data transfer protocols to ensure imaging is correctly labelled and transferred to treatment planning systems.

6. Conclusion

There is a role for the entire radiography workforce in radiotherapy as MR in RT services are integrated within radiotherapy nationally. Therapeutic radiographers directly involved in the use of MR in RT, and all members of the wider radiography workforce, should have the knowledge identified above, with a clear understanding of the eligibility criteria for treatment and referral mechanisms in place across the UK. Therapeutic radiography staff using MR in RT will need to develop further competencies to support patients through the pathway, to deliver treatment and integrate MR effectively into the patient pathway in order to support the goal of improved outcomes for patients, and to also ensure that therapeutic radiography workforce skills are effectively developed to enable full contribution to the care of patients within the full multi-disciplinary radiotherapy team.

Review date: September 2021

Works Cited

1. Torresin A, Brambilla MG, Monti AF, Moscato A, Brockmann MA, Schad L, Attenberger UI, Lohr F. Review of potential improvements using MRI in the radiotherapy workflow 3, 2015, Z Med Phys, Vol. 25, pp. 210-20.
2. Pollard JE, Wen Z, Sadagopan R, WAng J, Ibbott GS. The future of image-guided radiotherapy will be MR guided. 2017, Br J Radiol, p. 90(1073).
3. Curran WJ, Hackney DB, Blitzer PH and Bilaniuk L. The value of magnetic resonance imaging in treatment planning of nasophaaryngeal carcinoma.1986, Int. J. Radiat. Oncol, Vol. 12, pp. 2189-96.
4. The Society and College of Radiographers. Education and Career Framwork for the Radiotherapy Workforce. 2103.
5. The Society and College of Radiographers. The Scope of Practice. 2013.
6. The Society and College of Radiographers. The Joint Response of the Society of Radiographers and the College of Radiographers to the Final Report of the Independent Inquiry into Care provided by Mid-Staffordshire NHS Foundation Trust. 2013.
7. The Royal College of Radiolgoists. Magnetic Resonance Imaging (MRI) equipment, operations and planning in the NHS. London : s.n., 2017.
8. MHRA. Safety guidelines for magnetic resonance imaging equipment in clinical use. 2015.
9. Society and College of Radiographers. Safety in Magnetic Resonance Imaging. 2016.
10. Society of Radiographers. Image Guided Radiotherapy (IGRT) Clinical Support Programme in England 2012-2013. 2013.
11. Health and Care-Professions Council. Continuing professional develoment and your registration. 2017.
12. NHS Health Education England, e-Learning for Healthcare. MRI Safety.
13. The Society and College of Radiographers. Acheiving World-Class Cancer Outcomes: The Vision for Therapeutic Radiography. 2016.
14. Eccles CL, Campbell M. Keeping up with the Hybrid Magnetic Resonance Linear Accelerators: How do radiation therapists stay current in the era of hybrid technologies. 2019, JMIRS 50 (2) available online ahead of print DOI: https://doi.org/10.1016/j.jmir.2019.04.001

SCoR
THE SOCIETY & COLLEGE OF RADIOGRAPHERS