



MRI Guided Radiotherapy (MR-guided RT)

What is the evidence for MRI guided Radiotherapy?



Summary

Magnetic resonance imaging (MRI) has been used for over a decade to define and direct radiotherapy volumes in many cancer sites – largely limited to the initial radiation planning stages before treatment begins. MRI devices merged with radiation delivery devices provide an ability to do an MRI immediately before, during or after the patient is treated with the patient in the same treatment position.

The potential benefits include improvements in soft-tissue imaging during treatment that leads to real-time treatment adaptation; reductions in high doses to normal organs; reduction in treatment volumes and better detection of radiation responses of a tumour and the surrounding organs. The limitations include the expense; the risks and complexity with the use of MRI, novel effects on radiation dose distributions, the training requirements and the changes to workflows. Use requires additional staff including a radiation oncologist, medical physicist and radiation therapist at the machine to adapt treatment delivery on an ongoing basis.



Currently only a small number of radiotherapy centres have the equipment which offers MR-guided RT. However, The Society and College of Radiographers reports, in [recent guidance](#), that this is likely to increase.

The current evidence reflects the need for innovative clinical trials identifying the patient groups, the levels of personalisation and adaptation of MR-guided RT that identify the clinical conditions where it is cost effective.

Conclusion

MR-guided RT is currently unproven (Amber AXA Health Patient Safety Rating), meaning further research is required.

Technological development in targeting cancer therapies will transform current care pathways and several studies are underway that might confirm MR-guided RT's effectiveness in cancer patients. This summary should therefore be kept under review in the light of the emerging evidence for this technology.



Patient
safety
rating:
amber



MR-guided RT

Evidence: systematic/non-systematic reviews

Canadian Agency for Drugs and Technologies in Health (CADTH) published Magnetic Resonance Imaging-Guided Radiotherapy Delivery Systems for Cancer Treatment: A Review of Clinical Effectiveness, Cost Effectiveness and Guidelines in 2019. They concluded:

“Given the limited availability and low quality of evidence, the effectiveness and utility of MRgRT delivery systems for the treatment of patients with cancer requiring radiotherapy remains uncertain.”

Given the comprehensiveness of the CADTH review we have looked for systematic reviews published from 2019 and found none. However, we have located some non-systematic reviews. Given the non-systematic nature we are highlighting them for interest only:

Details	Conclusion/snippet
The transformation of radiation oncology using real-time magnetic resonance guidance: A review (2019) Eur J Cancer	The direct integration of magnetic resonance imaging (MRI) with linear accelerators represents an exciting development with the potential to dramatically impact cancer research and treatment.
MR-guidance in clinical reality: current treatment challenges and future perspectives (2019) Radiation Oncology	Due to its continuous technological improvement and rapid clinical large-scale application in several anatomical settings, further studies may confirm the potential disruptive role of MRgRT in the evolving oncological environment.
Realizing the potential of magnetic resonance image guided radiotherapy in gynaecological and rectal cancer (2019) Br J Radiol	This review describes the application of MRI guided radiotherapy in two pelvic tumour sites likely to benefit from this approach.
Online adaptive magnetic resonance guided radiotherapy for pancreatic cancer: state of the art, pearls and pitfalls (2019) Radiation Oncology	Aim of this study is to present and discuss the state of the art, the main pitfalls and the innovative opportunities offered by online adaptive MRgRT in pancreatic cancer treatment.
MRI-guided adaptive radiotherapy for liver tumours: visualising the future (2020) Lancet Oncol	This Review outlines the current and future applications for MRI-guided radiotherapy with respect to metastatic and primary liver cancers.
Optimizing MR-Guided Radiotherapy for Breast Cancer Patients (2020) Front Oncol	In this position paper, we discuss MR guidance in relation to each step of the breast RT planning and treatment pathway, focusing on the application of MR-guided RT to neoadjuvant PBI.
Image guidance in radiation therapy for better cure of cancer (2020) Mol Oncol	IGRT is the most convincing success story of radiation oncology over the last decades, and it remains a major driving force of innovation, contributing to the development of personalised oncology, for example, through the use of real-time imaging biomarkers for individualised dose delivery.
A review of the role of MRI in diagnosis and treatment of early stage lung cancer (2020) CTRO	Despite challenges for MRgRT in early stage lung cancer radiotherapy, early data utilising MR-linacs shows potential for the treatment of early lung cancer. In both diagnosis and treatment, MRI is a promising modality for imaging early lung cancer.



Health

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MR-guided RT

Evidence: Randomised Controlled Trials (RCTs)

We could find no recent RCTs.

Evidence: ongoing trials

A search on [ClinicalTrials.gov](https://clinicaltrials.gov) finds 32 registered studies, of which two are randomised:

[Trial of Magnetic Resonance Imaging Guided Radiotherapy Dose Adaptation in Human Papilloma Virus Positive Oropharyngeal Cancer](#) (Estimated Study Completion Date: January 2026)

[Hypofractionated Expedited Radiotherapy for Men With localisEd proState Cancer \(HERMES\)](#) (Estimated Study Completion Date: April 30, 2028)

Three UK studies are currently underway at the [Royal Marsden Hospital](#), the site of the first scanner in the UK in Nov 2017.

- [The MOMENTUM Study: The Multiple Outcome Evaluation of Radiation Therapy Using the MR-Linac Study \(MOMENTUM\)](#) Estimated Study Completion Date: February 1, 2024
- [Prostate Radiotherapy Integrated With Simultaneous MRI \(The PRISM Study\) \(PRISM\)](#) Estimated Study Completion Date: August 2023
- [Prospective Evaluation of Radiotherapy Using Magnetic Resonance Image Guided Treatment \(PERMIT\)](#) Estimated Study Completion Date: November 2025