Open Magnetic Resonance Imaging (MRI) Scanning Commissioning Policy

1. Background

MRI is a widely used diagnostic imaging technology and is particularly useful in detecting soft tissue damage and disease. The patient undergoing imaging is placed in a gradient magnetic field delivering radiofrequency pulses to the patient and processing the electromagnetic signals emitted from the region being examined.\(^1\) (CADTH) The standard (Closed/high-field) method of MRI requires the patient to be horizontal and stationary.

Magnetic resonance imaging (MRI) uses a strong magnetic field and radio waves to produce detailed, usually 2-D, images of the inside of the body. MRI scans can show muscles, joints, bone marrow, blood vessels, nerves and other structures within the body and are commonly used to examine the brain, spine, abdomen and pelvis.

There are two main types of MRI. Open (or low-field) MRI has a typical magnetic field strength of around 1.0 tesla (T), while Closed (or high-field) MRI is the more powerful at around 1.5 or even 3T.

A Closed MRI scan often involves a cylinder-shaped scanner that is uncomfortable for larger patients and leaves some patients claustrophobic. For many patients Open MRI minimizes anxiety and claustrophobia because its ‘C’ shaped design offers a spacious environment in which patients lie between two plates. They are also used for intraoperative imaging or image-guided interventions where easy access to the patient is required.\(^1\)

The main drawbacks of Open MRI are that the sequences needed (length of time to get an image) are longer, the signal-to-noise ratio is lower, and the spatial resolution is poorer. Consequently, for the analysis of small structures such as joints (wrists, fingers and toes), Closed MRI is always recommended because the quality and detail of the image will be superior. Also, the field strength of open magnets is significantly reduced and may be inadequate for some scanning purposes.

While it may have apparent limitations in terms of indications, there are situations that call for Open MRI, which as its name suggests is not reliant on having the patient lie in a long narrow tube. Open MRI can be used where there is the problem of claustrophobia, which affects about 10% of the population (Anxiety UK).

Furthermore, the increasing number of overweight and obese patients produces more problems for high-field MRI units. A third advantage of low-field MRI is that the images obtained are affected to a much lesser degree by metallic structures that may be present in the body such as pins in the spine, implants or even shrapnel.
2. The Technology

The quality of MRI images is partly dependent on the field strength of the magnet which is measured in tesla (above 1 Tesla (T) is considered high). Closed MRIs have magnet field strengths of >1.5 tesla whereas Open MRIs have medium strengths magnets of 0.5-1.0T. The lower field strength of Open MRIs results in poorer quality images in comparison to Closed MRIs, with lower signal-to-noise ratios and more motion artefacts. The length of time required to obtain an image is also longer.\(^1\)

Generally low field strength is below 0.5T, mid-field strength is 0.5 T, up to 0.9 T or 1 T; and high-field strength is at/and or above 1 T.\(^2\) High-field devices are usually closed-bore magnets because the stronger magnetic fields (1–3 T) require more robust shielding and gradient structure to maintain field homogeneity. The open magnet's field strength usually varies from 0.2–1.0 T.

3. Commissioning Policy

Referral for open MRI scanning of greater than 0.5T as an alternative to conventional MRI in secondary care is commissioned only for:

- patients who suffer from claustrophobia where an oral prescription sedative has not been effective (flexibility in the route of sedative administration may be required in paediatric patients as oral prescription may not be appropriate)

OR

- patients who are obese or cannot fit comfortably in conventional MRI scanners

Standing, upright, weight-bearing or positional MRI will not be commissioned.

4. Rationale for the decision

MRI studies reported in the literature are generally based on intermediate- or high-field MRI. There is insufficient evidence in the published peer-reviewed literature to support the use of low-field strength MRI for any diagnostic indication.\(^3,4,5,6,7,8,9,10,11,12,13\)

An evidence review performed by the Canadian Agency for Drugs and Technologies in Health (CADTH)\(^1\) found several non-randomised trials which compared high and low field MRIs.

- In a prospective study comparing a 0.2 T open scanner and a 1.5 T high-field system were used to examine 401 patients.\(^14\) There was no significant difference in the diagnostic accuracy of the two types of scanners in examinations for patients with diseases of the kidney (n=78), shoulder (n=122), or spine (n=105), using surgical or clinical follow-up as the reference finding. In cerebral examinations (n=96),
the high-field system had a statistically significant advantage in accuracy (p=0.01). The authors suggest that limitations due to field strength are relevant only in a small number of cases that warrant high-field examination.

- In a study on MRI arthrography of the shoulder, a 0.2 T Open MRI and a 1.5 T high-field system were used to examine 38 patients. Correlation of surgical and MRI findings was available for 27 patients (71%). The high-field MRI produced better image quality and fewer motion artefacts than the open low-field MRI, but diagnostic accuracy in the cases with surgical correlation was the same for both systems. The authors conclude that low-field MRI compares favourably to high-field MRI in detecting major abnormalities of the shoulder, but has disadvantages because of the duration of the examination, and the increased risk of reduced image quality due to motion artefacts.15

- Michel et al.16 compared patients' acceptance of MRI pelvimetry that was done using Open 0.5 T and Closed 1.5 T systems. Of 30 women referred for pelvimetry, 60% preferred the Open system, 7% the Closed system, and 33% had no preference. The image quality was adequate in both systems. In a British study, 47 of 50 patients (94%) who had failed to complete a scan in a conventional machine underwent successful MRI in a 0.5 T open system.17

Standing, Weight-Bearing, Positional, or Upright MRI

Washington State published a Health Technology Assessment on Standing, Weight-Bearing, Positional, or Upright MRI (2006). Conclusions included that:18

- there is limited scientific data available on the accuracy and diagnostic utility of standing, upright, weight-bearing or positional MRI

- there is no evidence from well-designed clinical trials demonstrating the accuracy or effectiveness of weight-bearing MRI for specific conditions or patient populations

- due to the lack of evidence addressing diagnostic accuracy or diagnostic utility, standing, weight-bearing, positional MRI is considered investigational and experimental

Open-design

Open MRI allows for imaging without the patient being placed within an enclosed space. Open MRI has become the standard of care when conventional design is contraindicated. Specifically, this includes patients who would require sedation for a conventional MRI such as severely claustrophobic or paediatric patients.
5. Exceptionality

Patients who are not eligible for treatment under this policy may be considered for exceptionality on an individual basis.

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| Policy to be reviewed | In two years or sooner if national or further guidance becomes available.  

References

2 CIGNA. Magnetic Resonance Imaging- low field. CIGNA coverage policy 0444
18 Washington State Department of Labor and Industries, Office of the Medical Director. Standing, weight-bearing, positional or upright MRI. Health Technology Assessment. Olympia Washington State Department of Labor and Industries; May 31 2006