MP 6.01.48
Positional Magnetic Resonance Imaging

DISCLAIMER
Our medical policies are designed for informational purposes only and are not an authorization, explanation of benefits or a contract. Receipt of benefits is subject to satisfaction of all terms and conditions of the coverage. Medical technology is constantly changing, and we reserve the right to review and update our policies periodically.

POLICY
Positional (non-recumbent) magnetic resonance imaging is considered investigational, including its use in the evaluation of patients with cervical, thoracic, or lumbosacral back pain.

POLICY GUIDELINES
Currently, there is no way to signify with coding that a magnetic resonance imaging (MRI) is open or positional. The service would be coded using the CPT code for the MRI scan (e.g., codes 72141-72158 for MRI of the spine, codes 73221-73223 for any joint of the upper extremity).

BENEFIT APPLICATION
BLUECARD/NATIONAL ACCOUNT ISSUES
State or federal mandates (e.g., FEP) may dictate that certain U.S. Food and Drug Administration–approved devices, drugs, or biologics may not be considered investigational, and thus these devices may be assessed only on the basis of their medical necessity.

BACKGROUND
Determining the cause of back pain is a complex task. In some patients, extensive evaluation with various imaging modalities does not lead to a definitive diagnosis. Some recent studies have suggested that imaging the body in various positions with “loading” of the spine may lead to more accurate diagnoses. This loading can be accomplished by having the patient sit or stand upright. Also, imaging can be completed with the patient in the position that causes the symptom(s). This theory is being evaluated in suspected nerve root compression and in some cases of spondylolisthesis.

An open magnetic resonance imaging (MRI) system has been developed that allows imaging of a patient in various positions. Imaging can be conducted with partial or full weight-bearing. Dynamic-kinetic imaging (images obtained during movement) can also be obtained with this system. Conventional MRI of the spine is typically completed with a patient in a recumbent position. Weight bearing can be simulated by imaging in the supine position with a special axial loading device.

One concern with positional MRI is the field strength of the scanners. Today’s clinical MRI scanners may...
operate at a field strength between 0.1 to 3 Tesla (T), and are classified as either low-field (<0.5 T), mid-field (0.5-1.0 T), or high-field (>1.0 T). Low-field MRI is typically used in open scanners. Open scanners are designed for use during interventional or intraoperative procedures, when a conventional design is contraindicated (e.g., an obese or claustrophobic patient), or for changes in patient positioning.

In general, higher field strength results in an increase in signal-to-noise ratio, spatial resolution, contrast, and speed. Thus, low-field scanners produce poorer quality images compared with high-field scanners, and longer acquisition times with low-field scanners increases the possibility of image degradation due to patient movement. However, field strength has less of an effect on the contrast-to-noise ratio, which determines the extent to which adjacent structures can be distinguished from one another.

REGULATORY STATUS
Several magnetic resonance imaging (MRI) systems have been cleared for marketing by the U.S. Food and Drug Administration (FDA) through the 510(k) process as open or total body systems for positional imaging. One such system is FONAR’s Upright® MRI. FDA product code: LNH.

RATIONALE
This evidence review was created in February 2007 and has been updated regularly with searches of the MEDLINE database. The most recent literature update was performed through January 25, 2017.

POSITIONAL MAGNETIC RESONANCE IMAGING

Clinical Context and Test Purpose
The purpose of positional magnetic resonance imaging (MRI) in patients with position-dependent back or neck pain is to inform a decision whether the pain can be attributed to changes in the spinal canal. For example, pressure on the spinal cord from a herniated disc may be increased with sitting when compared to standing.

The question addressed in this evidence review is: Does use of positional MRI improve health outcomes in patients who have position-dependent back or neck pain?

The following PICOTS were used to select literature relevant to the review.

Patients
The population of interest is patients who are being evaluated for position-dependent back or neck pain.

Interventions
The intervention is positional MRI using seated or standing positions in neutral, extension, and flexion.

Comparators
The reference standard is conventional supine MRI. Studies comparing positional MRI to loaded supine MRI are also of interest.

Outcomes
In evaluating this approach to imaging, it is important to determine whether MRI results in additional diagnostic information. However, it is also important to determine whether treatment of these additional findings results in improved outcomes. This additional step is important given the previously described false-positive findings with MRI of the spine. For example, Jarvik et al (2001) reported that many MRI findings have a high prevalence in subjects without low back pain, and that findings such as bulging discs and disc protrusion are of limited diagnostic use. They also reported that the less common findings of moderate or severe central stenosis, root compression, and disc extrusion were more likely
to be clinically relevant.¹ The health outcomes of interest include symptoms (eg, pain), self-reported functional outcomes, and quality of life measures.

**Timing**
The optimum time interval to examine health outcomes would be after healing of a surgical intervention, typically at 3 to 12 months postprocedure.

**Setting**
The setting is referral to a spine specialist for the evaluation of back and neck pain.

**Imaging under Loading Stress**
In 2011, the Agency for Healthcare Research and Quality (AHRQ) published a systematic review on emerging MRI technologies for musculoskeletal imaging under loading stress.² Included were 36 studies that used positional weight-bearing MRI in patients with musculoskeletal conditions. Also included were studies evaluating axial compression devices. Most studies were cross-sectional or had case-control designs. The most commonly imaged body region was the lumbar spine. Four identified studies of lumbar spine imaging compared positional weight-bearing MRI with conventional MRI, myelography, or non-weight-bearing imaging in the same MRI device; however, these studies did not report the effect of the technology on patient outcomes. Two studies of foot imaging that compared weight-bearing MRI with MRI in the supine position with the same MRI device found that the 2 techniques provided similar information. Two studies of knee joint imaging found differences between weight-bearing MRI and non-weight-bearing MRI using the same device; no functional outcomes were reported. The potential effect on image quality of low magnetic field strengths (≤0.6 Tesla [T]) in weight-bearing MRI scanners was not assessed. The systematic review concluded that, despite the large number of available studies, considerable uncertainty remained about the utility of this technique for the clinical management of musculoskeletal conditions. Key studies not included in the systematic review are described next.

**Comparison of Positional MRI in Neutral, Flexion, and Extension (Kinetic MRI)**
Systematic reviews published in 2014 have indicated that the literature on positional (kinetic) MRI consists primarily of examining anatomic changes in neutral, flexion, extension, and axial rotation.³,⁴ For example, kinetic MRI studies in healthy and symptomatic individuals have identified changes in neuroforaminal size, cord compression, cord length, cross-sectional area, ligamentum flavum thickness, and motion at the index and adjacent levels. Evidence for the clinical utility of kinetic MRI is needed.

**Comparison Between Seated and Supine MRI**
In 2007, Ferreiro Perez et al compared recumbent and upright-sitting positions in 89 patients with disc herniation or spondylolisthesis (cervical or lumbar spine).⁵ Using a 0.6-T Upright MRI system for both positions, pathology (disc herniation or spondylolisthesis) was identified in 68 (76%) patients. Images from 18 (20%) patients were not interpretable due to motion artifact. Pathologic features were better identified (ie, either only evident or seen to be enlarged) in 52 (76%) of the 68 patients when in the sitting position; 10 of these were only observed in the sitting position. Pathologic features were better identified in the recumbent position in 11 (16%) of the 68 patients. The overall underestimation rate was calculated to be 62% for patients in the recumbent position and 16% for those in the upright-seated position. This research suggests that there may be advantages when the position during imaging is matched with the positional symptoms of the patient. However, a more appropriate comparison group would be a standard recumbent clinical MRI system (eg, field strength >0.6 T). In addition, technical problems with motion artifact were due to poor stabilization in an upright sitting position.
Comparison between Standing and Supine MRI

In a 2013 study by Tarantino et al, 57 patients with low back pain when standing (50% also had back pain in the supine position) received an MRI in both upright and recumbent positions using a 0.25-T tilting system. A table tilt of 82° was used to reproduce the orthostatic position without the patient instability associated with standing at 90°. Compared with the supine position, there was a significant decrease in intervertebral disc thickness (11.2 mm vs 12.9 mm) along with changes in other measures and a qualitative increase in the volume of disc protrusions and/or spondylolisthesis in the upright position.

Comparison between Standing and Axial Loaded Supine MRI

A 2008 study compared vertical (standing) MRI and recumbent MRI with axial loading in patients with lumbar spinal stenosis. Sixteen patients with neurogenic claudication experienced mainly during walking or in an erect position, were recruited for this phase of the study. Each patient underwent 4 scans with a 0.6-T Upright MRI system, consisting of vertical, horizontal with compression at a load of 40% of body weight, horizontal with no load, and horizontal with a 50% axial load. All horizontal scans were conducted with a cushion placed below the lower back to induce extension of the lumbar spine. Results showed similar dural sac cross-sectional area between the 2 positions, suggesting that the standing position may be adequately simulated while recumbent by axial loading and lordosis. Results were not correlated with patient symptoms in this study.

SUMMARY OF EVIDENCE

For individuals who have position-dependent back or neck pain who receive positional magnetic resonance imaging (MRI), the evidence includes comparative studies. Relevant outcomes are test accuracy, symptoms, functional outcomes, and quality of life. Comparisons of results from positional MRI with results from supine MRI or standing x-ray have indicated that positional MRI provides additional diagnostic data. However, we found no studies describing clinical outcomes of patients whose treatments were selected based on these new data. The clinical benefit of basing treatment decisions, including surgery, on these additional findings needs to be established. The evidence is insufficient to determine the effects of the technology on health outcomes.

SUPPLEMENTAL INFORMATION

CLINICAL INPUT FROM PHYSICIAN SPECIALTY SOCIETIES AND ACADEMIC MEDICAL CENTERS

While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process, through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted.

In response to the requests, input was received from 1 physician specialty society and 1 academic medical center while the policy was under review in 2008. Both reviewers agreed that positional magnetic resonance imaging is considered investigational.

PRACTICE GUIDELINES AND POSITION STATEMENTS

No guidelines or statements were identified.

U.S. PREVENTIVE SERVICES TASK FORCE RECOMMENDATIONS

Not applicable.
MEDICARE NATIONAL COVERAGE
There is no national coverage determination (NCD). In the absence of an NCD, coverage decisions are left to the discretion of local Medicare carriers.

ONGOING AND UNPUBLISHED CLINICAL TRIALS
A search of ClinicalTrials.gov in February 2017 did not identify any ongoing or unpublished trials that would likely influence this review.

REFERENCES

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**Positional Magnetic Resonance Imaging**

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**POLICY HISTORY**

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