

Magnetic Resonance Imaging (MRI) Scan basic level

Overview

This is a noninvasive diagnostic test that gives a detailed view of the soft tissues of your spine or brain. Unlike X-rays or CT, images are created by using a magnetic field, radio waves, and a computer. It allows your doctor to view your spine or brain in slices, as if it were sliced layer-by-layer and a picture taken of each slice. The pictures can be taken from the side, from the front, or from the bottom as cross-sections. This test is most often used to help your doctor diagnose tumors, strokes, and disc herniations.

What is a Magnetic Resonance Imaging (MRI) scan?

An MRI scan uses a powerful magnet to take pictures of the inside of your body. This is an excellent test because it allows your doctor to see your body in narrow slices, each about one quarter of an inch thick. For example, imagine that you are slicing a loaf of bread and taking a picture of each slice. It can view slices from the bottom (axial), front (coronal), or sides (sagittal), depending on what your doctor needs to see.

MRI can also be used to view veins and arteries, called magnetic resonance angio-graphy (MRA). Standard MRI can't see fluid that is moving, such as blood in an artery, and this creates "flow voids" that appear as black holes on the image. The MRA uses a contrast dye (gadolinium) injected into the patient's vein to help the computer "see" the arteries and veins. The contrast is also used to view tumors and arteriovenous malformations (AVMs).

How does it work?

The scan works by using a magnet, radio waves, and a computer to create detailed images. Your body is made up of millions of hydrogen atoms (the human body is 80% water), which are magnetic. When your body is placed in the magnetic field, these atoms line up with the field, much like a compass points to the North Pole. A radio wave "knocks down" the atoms and disrupts their polarity. The time it takes for the atoms to return to their original alignment is picked up by the sensor. This information in essence measures the water content (or fluid characteristics) of different tissues and is processed by the computer to create a black

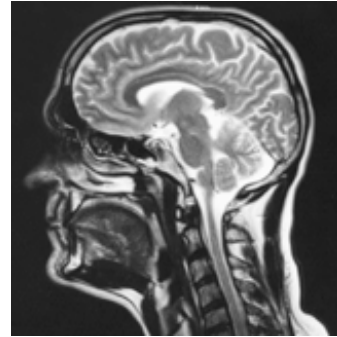


Figure 1: Head and neck

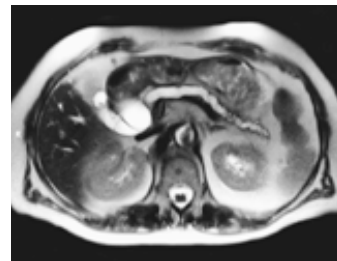


Figure 2: Body



Figure 3: Bones and joints

and white image. The image is highly detailed and can show even the smallest abnormality.

What does an MRI show?

Head and Neck (Fig. 1)

MRI gives very detailed pictures of the brain and spine. Air and hard bone do not give an MRI signal so these areas appear black. Bone marrow, spinal fluid, blood and soft tissues like the brain vary in intensity from black to white, depending on the amount of fat and water present in each tissue and

the machine settings used for the scan. The radiologist compares the size and distributions of these bright and dark areas to determine whether a tissue is healthy.

Body (Fig. 2)

Nearly every part of the body may be studied with MRI. Organs within the chest and abdomen, such as the heart, liver, bladder and kidneys can easily be seen. The image at right gives a very detailed view of the abdominal vessels.

Bones and joints (Fig. 3)

MRI is very sensitive to changes in cartilage and bone structure resulting from injury, disease or aging. Clear pictures often provide information not available through other medical testing and may actually eliminate the need for exploratory surgery.

Types of MRI scanners

- **Standard MRI:** this machine looks like a long cylinder with a narrow tube in the center. You lay on a moveable bed and your whole body slides inside the tube. Even though this machine can be confining to some people, it produces the best-looking images.
- **Short-bore MRI:** this machine is similar to the standard, but it's about half the length. If you are having pictures taken of your head, then your feet will stick out one end of the tube; if your back is being imaged, then your head will stick out. You may find this option more tolerable if tight spaces make you anxious (Fig. 4).
- **Open MRI:** this machine is designed more like a bagel sliced in half rather than a donut hole. It is a good choice for large or claustrophobic patients because there is much more room inside the machine. The only disadvantage is that the images it produces are not as detailed as those made by the standard or short-bore MRI scanners (Fig. 5).

Who performs the test?

A radiology technologist will perform the test in the MRI suite of the Radiology department of the hospital or at an outpatient imaging center.

How should I prepare for the test?

- Avoid caffeinated beverages.
- Wear comfortable clothes since you will be lying still for about 30 minutes.
- Avoid wearing jewelry and metal, and remove credit cards.
- Bring any relevant X-rays, CT scans or previous MRI exams.
- Bring your insurance identification card if you have one.

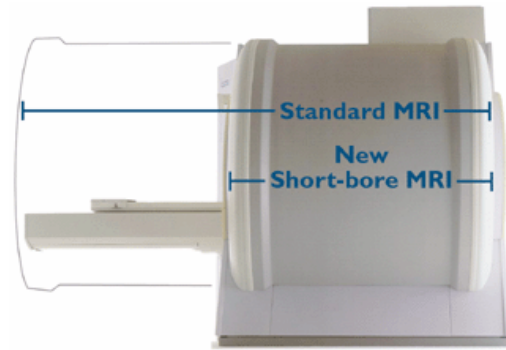


Figure 4: Viewed from the side, the short bore MRI is half the length of a standard MRI, which means your whole body does not have to be inside the scanner, just the area being imaged.



Figure 5: Viewed from the front, this open MRI resembles a bagel more than a donut, allowing the person being scanned more room.

What happens during the test?

You will lie on a moveable bed with your head cradled on a headrest and your arms at your sides. An antenna device called a "coil" will be placed over or around the area of the body to be imaged. It is specialized to produce the clearest picture of the area it is placed over. When you are comfortably positioned, the table will move into the magnetic field. The technologist will stay in constant contact with you. You can listen to music on a stereo system during your testing. As the exam proceeds, you will hear a muffled "thumping" sound for several minutes at a time. This is the sound of the pictures being taken. There will be no pain or discomfort associated with the sound or exam.

The exam usually takes 20 to 50 minutes. It is important that you relax and lie as still as possible. Any movement during this time will blur the picture. You may be given an injection of gadolinium, which is a contrast agent used to enhance the image.

What are the risks?

MRI is very safe. There are no known health risks associated with the magnetic field or the radio waves used by the machine. Sometimes a substance called a contrast agent is injected into your body to enhance the image. All contrast agents are FDA-approved and safe, though some people are especially sensitive to it.

Some special circumstances limit the use of a magnetic field, so it's important for you to tell your doctor if any of the following apply to you:

- cardiac pacemaker or artificial heart valve
- metal plate, pin or other metallic implant
- interuterine device, such as Copper-7 IUD
- insulin pump or other infusion pump
- aneurysm clips
- previous gunshot wound
- inner ear transplant
- been a metal worker (had metal in eye)
- permanent (tattoo) eye-liner

Any metallic substance on your body can affect the quality of the images. It can also cause discomfort or injury to you when placed in the magnetic field, and may exclude you from the exam.

Also, be sure to tell your doctor if you're pregnant. The American College of Radiology recommends that MRI scanning not be done in the first trimester of pregnancy. After the first trimester, there is no definitive research indicating that MRI is contraindicated in pregnancy. However, you will need to obtain a written order from your gynecologist for the test to be performed.

How do I get test results?

Once the examination is complete, you are free to go. The radiologist will promptly re-view your images and communicate directly with your referring doctor, who in turn will discuss the results with you. In some locations, test results and imaging studies can be securely transmitted digitally to the refer-ring doctor or hospital.

Sources & Links

If you have further questions about this diagnostic test, contact the doctor that ordered the test or visit:

www.radiologyinfo.org

www.nlm.nih.gov/medlineplus/diagnosticimaging.html

Glossary

contrast agent: a liquid (usually iodine or gadolinium) that is injected into your body to make certain tissues show up clearly during diagnostic imaging (angiography, CT, myelogram, MRI).

gadolinium: a type of contrast agent used during MRI.

radiofrequency: radiation used in MRI whose waves are in the frequency range of 300 MHz to 3 kHz.

radiologist: a doctor who specializes in reading X-rays and other diagnostic scans.

X-ray: electromagnetic radiation used in diagnostic imaging to view shadows of tissue density in the body, also called roentgenogram.

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