

## Magnetic Resonance Imaging (MRI) - Breast

Magnetic resonance imaging (MRI) of the breast uses a powerful magnetic field, radio waves and a computer to produce detailed pictures of the structures within the breast. It is primarily used as a supplemental tool to breast screening with mammography or ultrasound. It may be used to screen women at high risk for breast cancer, evaluate the extent of cancer following diagnosis, or further evaluate abnormalities seen on mammography. Breast MRI does not use ionizing radiation, and it is the best method for determining whether silicone breast implants have ruptured.



Tell your doctor about any health problems, recent surgeries or allergies and whether there's a possibility you are pregnant. The magnetic field is not harmful, but it may cause some medical devices to malfunction. Most orthopedic implants pose no risk, but you should always tell the technologist if you have any devices or metal in your body. Guidelines about eating and drinking before your exam vary between facilities. Unless you are told otherwise, take your regular medications as usual. Leave jewelry at home and wear loose, comfortable clothing. You may be asked to wear a gown. If you have claustrophobia or anxiety, you may want to ask your doctor for a mild sedative prior to the exam.

### What is MRI of the Breast?

Magnetic resonance imaging (MRI) is a noninvasive test doctors use to diagnose medical conditions.

MRI uses a powerful magnetic field, radiofrequency pulses, and a computer to produce detailed pictures of internal body structures. MRI does not use radiation (x-rays).

Detailed MR images allow doctors to examine the body and detect disease.

MRI of the breast offers valuable information about many breast conditions that cannot be obtained by other imaging modalities, such as mammography or ultrasound.

### What are some common uses of the procedure?

MRI of the breast is not a replacement for mammography or ultrasound imaging but rather a supplemental tool that has many important uses, including:

- Screening in women at high risk for breast cancer

For women at high risk for breast cancer, typically because of a strong family history, MRI may be an appropriate tool to screen for breast cancer. A strong family history is usually a mother or sister who has had breast cancer before age 50. It can also be aunts or cousins, including those on your father's side. Relatives who have had ovarian cancer also increase your risk. Your radiologist or primary care doctor can look at your family history and determine if screening MRI may be appropriate for you. Depending on your family history, genetic counseling may also be recommended.

- Determining the extent of cancer after a new diagnosis of breast cancer

After being diagnosed with breast cancer, a breast MRI may be performed to determine:

- how large the cancer is and whether it involves the underlying muscle.
- if there are other cancers in the same breast and whether there is an unsuspected cancer in the opposite breast.
- if there are any abnormally large lymph nodes in the armpit, which can be a sign the cancer has spread to that site.

- Further evaluating hard-to-assess abnormalities seen on mammography

Sometimes an abnormality seen on a mammogram cannot be adequately evaluated by additional mammography and ultrasound alone. In these rare cases, MRI can be used to definitively determine if the abnormality needs biopsy or can safely be left alone.

- Evaluating lumpectomy sites in the years following breast cancer treatment

Scarring and recurrent cancer can look identical on mammography and ultrasound. If a change in a lumpectomy scar is detected by either mammography or a physical exam, MRI can help determine whether the change is normal maturation of the scar or a recurrence of the cancer.

- Following chemotherapy treatment in patients receiving neoadjuvant chemotherapy

In some cases, breast cancer will be treated with chemotherapy before it has been removed by surgery. This is called neoadjuvant chemotherapy. In these cases, MRI is often used to monitor how well the chemotherapy is working and to reevaluate the amount of tumor still present before the surgery is performed.

- Evaluating breast implants

MRI is the best test for determining whether silicone implants have ruptured.

## How should I prepare?

You will need to change into a hospital gown. This is to prevent artifacts appearing on the final images and to comply with safety regulations related to the strong magnetic field.

Guidelines about eating and drinking before an MRI vary between specific exams and facilities. Take food and medications as usual unless your doctor tells you otherwise.

Some MRI exams use an injection of contrast material. The doctor may ask if you have asthma or allergies to contrast material, drugs, food, or the environment. MRI exams commonly use a contrast material called gadolinium. Doctors can use gadolinium in patients who are allergic to iodine contrast. A patient is much less likely to be allergic to gadolinium than to iodine contrast. However, even if the patient has a known allergy to gadolinium, it may be possible to use it after appropriate pre-medication. *For more information on allergic reactions to gadolinium contrast, please consult the ACR Manual on Contrast Media (<https://www.acr.org/Clinical-Resources/Contrast-Manual>) .*

Tell the technologist or radiologist if you have any serious health problems or recent surgeries. Some conditions, such as severe kidney disease, may mean that you cannot safely receive gadolinium. You may need a blood test to confirm your kidneys are functioning normally.

Women should always tell their doctor and technologist if they are pregnant. MRI has been used since the 1980s with no reports of any ill effects on pregnant women or their unborn babies. However, the baby will be in a strong magnetic field. Therefore,

pregnant women should not have an MRI in the first trimester unless the benefit of the exam clearly outweighs any potential risks. Pregnant women should not receive gadolinium contrast unless absolutely necessary. *See the MRI Safety During Pregnancy* (<https://www.radiologyinfo.org/en/info/safety-mri-pregnancy>) page for more information about pregnancy and MRI.

If you have claustrophobia (fear of enclosed spaces) or anxiety, ask your doctor to prescribe a mild sedative prior to the date of your exam.

Leave all jewelry and other accessories at home or remove them prior to the MRI scan. Metal and electronic items are not allowed in the exam room. They can interfere with the magnetic field of the MRI unit, cause burns, or become harmful projectiles. These items include:

- jewelry, watches, credit cards, and hearing aids, all of which can be damaged
- pins, hairpins, metal zippers, and similar metallic items, which can distort MRI images
- removable dental work
- pens, pocketknives, and eyeglasses
- body piercings
- mobile phones, electronic watches, and tracking devices.

In most cases, an MRI exam is safe for patients with metal implants, except for a few types. People with the following implants may not be scanned and should not enter the MRI scanning area without first being evaluated for safety:

- some cochlear (ear) implants
- some types of clips used for brain aneurysms
- some types of metal coils placed within blood vessels
- some older cardiac defibrillators and pacemakers
- vagal nerve stimulators

Tell the technologist if you have medical or electronic devices in your body. These devices may interfere with the exam or pose a risk. Many implanted devices will have a pamphlet explaining the MRI risks for that device. If you have the pamphlet, bring it to the attention of the scheduler before the exam. MRI cannot be performed without confirmation and documentation of the type of implant and MRI compatibility. You should also bring any pamphlet to your exam in case the radiologist or technologist has any questions.

If there is any question, an x-ray can detect and identify any metal objects. Metal objects used in orthopedic surgery generally pose no risk during MRI. However, a recently placed artificial joint may require the use of a different imaging exam.

Tell the technologist or radiologist about any shrapnel, bullets, or other metal that may be in your body. Foreign bodies near and especially lodged in the eyes are very important because they may move or heat up during the scan and cause blindness. Dyes used in tattoos may contain iron and could heat up during an MRI scan. This is rare. The magnetic field will usually not affect tooth fillings, braces, eyeshadows, and other cosmetics. However, these items may distort images of the facial area or brain. Tell the radiologist about them.

## What does the equipment look like?

The traditional MRI unit is a large cylinder-shaped tube surrounded by a circular magnet. You will lie on a table that slides into a tunnel towards the center of the magnet.

Some MRI units, called short-bore systems, are designed so that the magnet does not completely surround you. Some newer MRI machines have a larger diameter bore, which can be more comfortable for larger patients or those with claustrophobia. "Open"

MRI units are open on the sides. They are especially helpful for examining larger patients or those with claustrophobia. Open MRI units can provide high quality images for many types of exams. Open MRI may not be used for certain exams. For more information, consult your radiologist.

## How does the procedure work?

Unlike x-ray and computed tomography (CT) exams, MRI does not use radiation. Instead, radio waves re-align hydrogen atoms that naturally exist within the body. This does not cause any chemical changes in the tissues. As the hydrogen atoms return to their usual alignment, they emit different amounts of energy depending on the type of tissue they are in. The scanner captures this energy and creates a picture using this information.

In most MRI units, the magnetic field is produced by passing an electric current through wire coils. Other coils are inside the machine and, in some cases, are placed around the part of the body being imaged. These coils send and receive radio waves, producing signals that are detected by the machine. The electric current does not come into contact with the patient.

A computer processes the signals and creates a series of images, each of which shows a thin slice of the body. The radiologist can study these images from different angles.

MRI is often able to tell the difference between diseased tissue and normal tissue better than x-ray, CT, and ultrasound.

## How is the procedure performed?

MRI exams may be done on an outpatient basis.

The technologist will position you on the moveable exam table. They may use straps and bolsters to help you stay still and maintain your position.

For an MRI of the breast, you will lie face down on a platform specially designed for the procedure. The platform has openings to accommodate your breasts and allow them to be imaged without compression. The electronics needed to capture the MRI image are actually built into the platform. It is important to remain very still throughout the exam. This is best accomplished by making sure you are comfortable and can relax rather than trying to actively hold still tensing your muscles. Be sure to let the technologist know if something is uncomfortable, since discomfort increases the chance that you will feel the need to move during the exam.

If MRI of the breast is being performed for the sole purpose of determining if you have a ruptured breast implant, you will not be given contrast material. If the exam is being performed for any other reason, you will need to have a contrast material injected intravenously. MRI of the breast *without* contrast material is inadequate for identifying breast cancers.

If your exam uses a contrast material, a doctor, nurse, or technologist will insert an intravenous catheter (IV line) into a vein in your hand or arm. They will use this IV to inject the contrast material.

You will be placed into the magnet of the MRI unit. The technologist will perform the exam while working at a computer outside of the room. You will be able to talk to the technologist via an intercom.

If your exam uses a contrast material, the technologist will inject it into the intravenous line (IV) after an initial series of scans. They will take more images during or following the injection.

When the exam is complete, the technologist may ask you to wait while the radiologist checks the images in case more are needed.

The technologist will remove your IV line after the exam is over and place a small dressing over the insertion site.

The imaging session lasts between 30 minutes and one hour and the total examination is usually completed within an hour and a half.

The doctor may also perform MR spectroscopy during your exam. MR spectroscopy provides additional information on the chemicals present in the body's cells. This may add about 15 minutes to the total exam time.

## What will I experience during and after the procedure?

Most MRI exams are painless. However, some patients find it uncomfortable to remain still. Others may feel closed-in (claustrophobic) while in the MRI scanner. The scanner can be noisy.

It is normal for the area of your body being imaged to feel slightly warm. If it bothers you, notify the radiologist or technologist. It is important that you remain perfectly still while the images are being recorded, which is typically only a few seconds to a few minutes at a time. For some types of exams, you may be asked to hold your breath. You will know when images are being recorded because you will hear tapping or thumping sounds when the coils that generate the radiofrequency pulses are activated. You will be able to relax between imaging sequences but will be asked to maintain your position as much as possible.

You will usually be alone in the exam room during the MRI procedure. However, the technologist will always be able to see, hear, and speak with you using a two-way intercom. They will give you a "squeeze-ball" that alerts the technologist that you need attention right away. Many MRI centers allow a friend or parent to stay in the room if they are also screened for safety in the magnetic environment.

The technologist may offer (or you may request) earplugs to reduce the noise of the MRI scanner. The scanner produces loud thumping and humming noises during imaging. MRI scanners are air-conditioned and well-lit. Some scanners have music to help you pass the time.

When the contrast material is injected, it is normal to feel coolness and a flushing sensation for a minute or two. The intravenous needle may cause you some discomfort when it is inserted. Once it is removed, you may experience some bruising. There is also a very small chance of skin irritation at the site of the IV tube insertion.

If you have not been sedated, no recovery period is necessary. You may resume your usual activities and normal diet immediately after the exam. A few patients experience side effects from the contrast material, including nausea and local pain. Very rarely, patients are allergic to the contrast material and experience hives, itchy eyes, or other reactions. If you experience allergic symptoms, a radiologist or other physician will be available for immediate assistance.

## Who interprets the results and how do I get them?

A radiologist, a doctor trained to supervise and interpret radiology exams, will analyze the images. The radiologist will send a signed report to your primary care or referring physician, who will share the results with you.

You may need a follow-up exam. If so, your doctor will explain why. Sometimes a follow-up exam further evaluates a potential issue with more views or a special imaging technique. It may also see if there has been any change in an issue over time. Follow-up exams are often the best way to see if treatment is working or if a problem needs attention.

## What are the benefits vs. risks?

### Benefits

- MRI is a noninvasive imaging technique that does not involve exposure to radiation.
- MRI has proven valuable in detecting and staging breast cancer, particularly when other imaging studies (mammography, ultrasound, etc.) fail to provide adequate information.
- MRI as an addition to mammography has been shown to be useful in evaluating women at high risk for breast cancer.
- MRI can successfully image the dense breast tissue common in younger women, and it can successfully image breast implants. Both of these are difficult to image using traditional mammography.

- If a suspicious lesion is seen with MRI only, MRI can provide guidance for biopsy.
- The MRI gadolinium contrast material is less likely to cause an allergic reaction than the iodine-based contrast materials used for x-rays and CT scanning.

## Risks

- The MRI exam poses almost no risk to the average patient when appropriate safety guidelines are followed.
- If sedation is used, there is a risk of using too much. However, your vital signs will be monitored to minimize this risk.
- The strong magnetic field is not harmful to you. However, it may cause implanted medical devices to malfunction or distort the images.
- Nephrogenic systemic fibrosis is a recognized complication related to injection of gadolinium contrast. It is exceptionally rare with the use of newer gadolinium contrast agents. It usually occurs in patients with serious kidney disease. Your doctor will carefully assess your kidney function before considering a contrast injection.
- There is a very slight risk of an allergic reaction if your exam uses contrast material. Such reactions are usually mild and controlled by medication. If you have an allergic reaction, a doctor will be available for immediate assistance.
- Although there are no known health effects, evidence has shown that very small amounts of gadolinium can remain in the body, particularly the brain, after multiple MRI exams. This is most likely to occur in patients receiving multiple MRI exams over their lifetime for monitoring chronic or high-risk health conditions. The contrast agent is mostly eliminated from the body through the kidneys. If you are a patient in this category, consult with your doctor about the possibility of gadolinium retention, as this effect varies from patient to patient.
- IV contrast manufacturers indicate mothers should not breastfeed their babies for 24-48 hours after contrast material is given. However, the most recent American College of Radiology (ACR) Manual on Contrast Media reports that studies show the amount of contrast absorbed by the infant during breastfeeding is extremely low. *For further information please consult the ACR Manual on Contrast Media (<https://www.acr.org/Clinical-Resources/Contrast-Manual>) and its references.*

## What are the limitations of MRI of the Breast?

High-quality images depend on your ability to remain perfectly still and follow breath-holding instructions while the images are being recorded. If you are anxious, confused or in severe pain, you may find it difficult to lie still during imaging.

A person who is very large may not fit into certain types of MRI machines. There are weight limits on the scanners.

Implants and other metallic objects can make it difficult to obtain clear images. Patient movement can have the same effect.

A very irregular heartbeat may affect the quality of images. This is because some techniques time the imaging based on the electrical activity of the heart.

Present data show no convincing evidence that non contrast MRI harms the fetus of a pregnant woman. However, if the need for the exam is not time sensitive your doctor may delay the exam until after delivery. MRI gadolinium contrast agents are generally avoided during pregnancy except in very specific circumstances. Your doctor will discuss the benefits and risks of any MRI procedure with you. Doctors may perform MRI after the first trimester to assess the fetus for findings that are not fully evaluated by ultrasound.

MRI may not always distinguish between cancer tissue and fluid, known as edema.

An MRI exam typically costs more and may take more time than other imaging exams. Talk to your insurance provider if you have concerns about the cost of MRI.

Sometimes a benign (non-cancerous) piece of tissue in the breast can take up the contrast material and show up as a bright spot on the image. Often, the radiologist can tell by the appearance of the tissue whether it is cancer or not. When it is not possible, other testing such as ultrasound of that specific spot or a biopsy may be needed. If additional testing or biopsy shows no cancer, it is

called a false-positive test result.

## Which test, procedure or treatment is best for me?

- Breast Cancer Screening (<https://www.radiologyinfo.org/en/info/article-appropriateness-criteria#c9276d7c026c41649ed125328190de26>)

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