



Direct Arthrography

Arthrography is a type of medical imaging used to help evaluate and diagnose joint conditions and unexplained pain. It is very effective at detecting disease within the ligaments, tendons and cartilage. It may be indirect, where contrast material is injected into the bloodstream, or direct, where contrast material is injected into the joint.

Arthrography may use computed tomography (CT) scanning, magnetic resonance imaging (MRI) or fluoroscopy – a form of real-time x-ray.

Your preparation may vary depending on which imaging method your exam will use. Tell your doctor if there's a possibility that you are pregnant and discuss any recent illnesses, medical conditions, medications you're taking, and allergies – especially to contrast materials. Leave jewelry at home and wear loose, comfortable clothing. You may be asked to wear a gown.



What is Direct Arthrography?

Arthrography is medical imaging to evaluate conditions of joints. It can either be direct or indirect. Indirect arthrography is a medical imaging technique in which contrast material is injected into the blood stream and eventually absorbs into the joint.

With direct arthrography, however, the contrast material is injected directly into the joint by a radiologist. Direct arthrography is preferred over indirect arthrography because it distends or enlarges the joint thus allowing for enhanced imaging of small internal structures. This leads to improved evaluation of diseases or conditions within the joint. It is often performed only if a non-arthrographic exam is felt to be inadequate in assessing a joint abnormality.

There are several methods to perform direct arthrography.

Conventional direct arthrography of a joint often uses a special form of x-ray called fluoroscopy to guide and evaluate the injection of iodine contrast material directly into the joint. In some cases, ultrasound may be used to guide the procedure. Alternate methods of direct arthrography examinations may also use magnetic resonance imaging (MRI) or computed tomography (CT) following contrast material injection into the joint.

An x-ray (radiograph) is a noninvasive medical test that helps physicians diagnose and treat medical conditions. Imaging with x-rays involves exposing a part of the body to a small dose of ionizing radiation to produce pictures of the inside of the body. X-rays are the oldest and most frequently used form of medical imaging.

Fluoroscopy makes it possible to see bones, joints and internal organs in real time. When iodine contrast is injected into the joint, it fills the entire joint which becomes clearly visible during x-ray evaluation, allowing the radiologist to assess the anatomy and function of the joint. Although the injection is typically monitored by fluoroscopy, the examination also commonly involves taking radiographs for documentation. These images are most often stored and viewed electronically.

Similarly, direct MR arthrography also involves the injection of a contrast material into the joint. The contrast material used for MR evaluation is different from that used for x-ray; it contains gadolinium, which affects the local magnetic field within the joint and appears on the MR images. As in conventional direct arthrography, the contrast material outlines the structures within the joint, such as cartilage, ligaments and bones, and allows them to be evaluated by the radiologist after the MR images are produced.

MRI uses a powerful magnetic field, radiofrequency pulses and a computer to produce detailed pictures of organs, soft tissues, bone and virtually all other internal body structures. The images can then be examined on a computer monitor connected to an image archive (PACS system) or printed or copied to CD. MRI does not use ionizing radiation (x-rays).

CT direct arthrography uses the same type of contrast material as conventional direct arthrography and may be supplemented by air to produce a double contrast CT arthrogram. CT makes cross sectional images processed by a computer using x-rays.

What are some common uses of the procedure?

Arthrographic images help physicians evaluate alterations in structure and function of a joint and help to determine the possible need for treatment, including arthroscopy, open surgery or joint replacement.

The procedure is most often used to identify abnormalities within the:

- shoulder
- elbow
- wrist
- hip
- knee
- ankle

The procedure is often used to help diagnose persistent, unexplained joint pain or discomfort. In some cases, local anesthetic medications or steroids may be injected into the joint along with the contrast material. These medications may temporarily decrease joint-related pain or inflammation and provide physicians additional information about possible sources of pain.

How should I prepare?

No special preparation is necessary before direct arthrography. Food and fluid intake do not need to be restricted, unless a sedative will be given.

You should inform your physician of any medications you are taking and if you have any kidney problems or allergies, especially to iodinated or gadolinium-based contrast materials. Also, inform your doctor about recent illnesses or other medical conditions.

Some MRI examinations may require you to receive an injection of contrast into the bloodstream. Some of this contrast material is absorbed into the joint resulting in an indirect arthrogram. The radiologist or technologist may ask if you have asthma, or allergies of any kind, such as an allergy to iodine or x-ray contrast material, drugs, food, or environmental agents. However, the contrast material used for an MRI exam, called gadolinium, does not contain iodine and is less likely to cause side effects or an allergic reaction.

Tell the radiologist if you have any serious health problems or if you have recently had surgery. Some conditions, such as severe kidney disease, may prevent you from being given MRI or CT arthrogram contrast material.

If you are scheduled to have MR or CT arthrography and have claustrophobia (fear of enclosed spaces) or anxiety, you may want to ask your physician about being sedated prior to the scheduled examination.

Jewelry and other accessories should be left at home, if possible, or removed prior to the MRI scan. Because they can interfere with the magnetic field of the MRI unit, metal and electronic items are not allowed in the exam room. In addition to affecting the MRI images, these objects can become projectiles within the MRI scanner room and may cause you and/or others nearby harm. 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, pocket knives and eyeglasses
- body piercings

In most cases, an MRI exam is safe for patients with metal implants, except for a few types. People with the following implants cannot be scanned and should not enter the MRI scanning area:

- cochlear (ear) implant
- some types of clips used for brain aneurysms
- some types of metal coils placed within blood vessels
- nearly all cardiac defibrillators and pacemakers

You should tell the technologist if you have medical or electronic devices in your body. These objects may interfere with the exam or potentially pose a risk, depending on their nature and the strength of the MRI magnet. Many implanted devices will have a pamphlet explaining the MRI risks for that particular device. If you have the pamphlet, it is useful to bring that to the attention of the scheduler before the exam and bring it to your exam in case the radiologist or technologist has any questions. Some implanted devices require a short period of time after placement (usually six weeks) before being safe for MRI examinations. Examples include but are not limited to:

- artificial heart valves
- implanted drug infusion ports
- artificial limbs or metallic joint prostheses
- implanted nerve stimulators
- metal pins, screws, plates, stents or surgical staples

If there is any question of their presence, an x-ray may be taken to detect and identify any metal objects. In general, metal objects used in orthopedic surgery pose no risk during MRI. However, a recently placed artificial joint may require the use of another imaging procedure.

Patients who might have metal objects in certain parts of their bodies may also require an x-ray prior to an MRI. You should notify the technologist or radiologist of any shrapnel, bullets, or other pieces of metal that may be present in your body due to prior accidents. Foreign bodies near and especially lodged in the eyes are particularly important because they may move during the scan, possibly causing blindness. Dyes used in tattoos may contain iron and could heat up during an MRI scan, but this is rare. Tooth fillings and braces usually are not affected by the magnetic field, but they may distort images of the facial area or brain, so you should let the radiologist know about them.

You will be asked to remove some of your clothes and to wear a gown during the exam. You may also be asked to remove jewelry, removable dental appliances, eye-glasses and any metal objects or clothing that might interfere with the x-ray images.

Women should always inform their physician and x-ray technologist if there is any possibility that they are pregnant. Many imaging tests are not performed during pregnancy so as not to expose the fetus to radiation. If an x-ray is necessary, precautions will be taken to minimize radiation exposure to the baby. See the Safety page for more information about pregnancy and x-rays.

Though MRI does not use ionizing radiation, women should still inform their physician and technologist if they may be pregnant.

Children younger than 13 may need to be sedated in order to hold still for the procedure. Parents should ask about sedation before the procedure and realize that there are food and drink restrictions that may be required prior to sedation.

You should plan to have a relative or friend drive you home after your procedure.

What does the equipment look like?

The equipment typically used for this examination consists of a radiographic table, one or two x-ray tubes

and a television-like monitor that is located in the examining room. Fluoroscopy, which converts x-rays into video images, is used to watch and guide progress of the procedure. The video is produced by the x-ray machine and a detector that is suspended over a table on which the patient lies.

The traditional MRI unit is a large cylinder-shaped tube surrounded by a circular magnet. You will lie on a moveable examination table that slides into 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 size patients or patients with claustrophobia. Other MRI machines are open on the sides (open MRI). Open units are especially helpful for examining larger patients or those with claustrophobia. Newer open MRI units provide very high quality images for many types of exams. Older open MRI units may not provide this same image quality. Certain types of exams cannot be performed using open MRI. For more information, consult your radiologist.

The computer workstation that processes the imaging information is located in a separate room from the scanner.

Other equipment necessary for performing arthrography include a variety of needles, syringes and a water-soluble contrast material.

How does the procedure work?

X-rays are a form of radiation like light or radio waves. X-rays pass through most objects, including the body. Once it is carefully aimed at the part of the body being examined, an x-ray machine produces a small burst of radiation that passes through the body, recording an image on photographic film or a special detector.

Different parts of the body absorb the x-rays in varying degrees. Dense bone absorbs much of the radiation while soft tissue, such as muscle, fat and organs, allow more of the x-rays to pass through them. As a result, bones appear white on the x-ray, soft tissue shows up in shades of gray and air appears black.

Until recently, x-ray images were maintained on large film sheets (much like a large photographic negative). Today, most images are digital files that are stored electronically. These stored images are easily accessible for diagnosis and disease management.

Fluoroscopy uses a continuous or pulsed x-ray beam to create a sequence of images that are projected onto a fluorescent screen, or television-like monitor. When used with a contrast material, which clearly defines the area being examined by making it appear dark (or by electronically reversing the image contrast to white), this special x-ray technique makes it possible for the physician to view joints or internal organs in motion. Still images or movies are also captured and stored electronically on a computer.

Unlike conventional x-ray examinations and computed tomography (CT) scans, MRI does not utilize ionizing radiation. Instead, radiofrequency pulses 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 body tissue they are in.

The MR scanner captures this energy and creates a picture of the tissues scanned based on this information.

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

A computer then processes the signals and generates a series of images, each of which shows a thin slice of the body. The images can then be studied from different angles by the interpreting radiologist.

Frequently, the differentiation of abnormal (diseased) tissue from normal tissues is better with MRI than with other imaging modalities such as x-ray, CT and ultrasound.

How is the procedure performed?

This examination is usually done on an outpatient basis.

The patient is positioned on the examination table. X-rays of the joint may be taken prior to the procedure to help in guiding the injection and also to provide a baseline exam to be compared later with the arthrogram images. If recent x-rays are available, the physician may choose to use these for reference.

Next, the skin around the joint is cleansed with antiseptic and is often covered with a sterile surgical drape. Using a small needle, the physician injects local anesthetic into the area.

After the local anesthetic has taken effect, a longer needle is then inserted into the joint. The radiologist, a physician specially trained to supervise and interpret radiology examinations, will often use fluoroscopy or ultrasound to guide the needle into the correct position. The physician will sometimes use a syringe to drain (or aspirate) the joint fluid, which may be sent to a laboratory for analysis. Aspiration is typically performed when an infection is suspected.

The contrast material and sometimes air are injected into the joint space while the radiologist observes with fluoroscopy or ultrasound. In some cases, additional medications, such as anti-inflammatory steroids, may be injected into the joint along with the contrast material. After the needle is removed, the patient will be asked to move the affected joint to distribute the contrast material throughout the space. The radiologist may move the joint while evaluating the joint motion under fluoroscopy.

A conventional direct arthrography exam is usually completed within 30 minutes. Exams involving MRI may take more than one hour.

What will I experience during and after the procedure?

You will experience a slight pinprick and may feel a momentary burning if a local anesthesia is used to numb the joint area. You may feel pressure or even pain when the needle is advanced into the joint. Inform the radiologist performing the procedure if you have pain so more local anesthetic can be injected

into the area.

You may feel fullness in the joint as it is filled and possibly hear gurgling when the joint is moved.

If your arthrography exam involves MR imaging:

It is normal for the area of your body being imaged to feel slightly warm, but if it bothers you, notify the radiologist or technologist. It is important that you remain perfectly still while the images are being obtained, which is typically only a few seconds to a few minutes at a time. You will know when images are being recorded because you will hear and feel loud tapping or thumping sounds when the coils that generate the radiofrequency pulses are activated. Some centers provide earplugs, while others use headphones to reduce the intensity of the sounds made by the MRI machine. You may be able to relax between imaging sequences, but will be asked to maintain your position without movement as much as possible.

You will usually be alone in the exam room during the MRI procedure. However, the technologist will be able to see, hear and speak with you at all times using a two-way intercom. Many MRI centers allow a friend or parent to stay in the room as long as they are also screened for safety in the magnetic environment.

Children will be given appropriately sized earplugs or headphones during the exam. MRI scanners are air-conditioned and well-lit. Music may be played through the headphones to help you pass the time.

In some cases, intravenous injection of contrast material may be administered before the images are obtained. The intravenous needle may cause you some discomfort when it is inserted and you may experience some bruising. There is also a very small chance of irritation of your skin at the site of the IV tube insertion. Some patients may sense a temporary metallic taste in their mouth after the contrast injection.

If you do not require sedation, no recovery period is necessary. You may resume your usual activities and normal diet immediately after the exam. On very rare occasions, a few patients experience side effects from the contrast material, including nausea, headache and pain at the site of injection. Similarly, patients are very rarely allergic to the contrast material and experience hives, itchy eyes or other reactions. If you experience allergic symptoms, notify the technologist. A radiologist or other physician will be available for immediate assistance.

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After the examination, you may experience swelling and discomfort. You may apply ice to the joint to reduce swelling if it is bothersome. A mild over-the-counter analgesic can be taken for pain. These symptoms usually disappear after 48 hours. Contact your doctor if they persist after two days.

Vigorous exercise is not recommended for at least 24 hours after the exam as there is a slight increased risk of dislocation after your procedure. Typically, if an arthrogram is performed on a joint, you will be asked to minimize activity using that joint for about 24 hours after the procedure to allow your body to eliminate the injected fluid from the joint.

If steroids or anesthetic medications are injected into the joint during the arthrogram, you may be asked to keep a log of your level of joint discomfort over the following days or weeks. This information may help

your physician determine the cause of chronic joint pain and what therapies may be effective. It is also recommended that you refrain from vigorous exercise of the joint for about two weeks.

Who interprets the results and how do I get them?

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

Follow-up examinations may be necessary. Your doctor will explain the exact reason why another exam is requested. Sometimes a follow-up exam is done because a potential abnormality needs further evaluation with additional views or a special imaging technique. A follow-up examination may also be necessary so that any change in a known abnormality can be monitored over time. Follow-up examinations are sometimes the best way to see if treatment is working or if a finding is stable or changed over time.

What are the benefits vs. risks?

Benefits

- Direct arthrography is particularly effective for detecting disease of the structures within the joints such as ligaments, tendons and cartilage. This is particularly true for the shoulder in the setting of shoulder dislocation and in the hip, wrist and elbow.

Exams involving x-ray imaging:

- No radiation remains in a patient's body after an x-ray examination.
- X-rays usually have no side effects in the typical diagnostic range for this exam.

Exams involving MR imaging:

- MRI is a noninvasive imaging technique that does not involve exposure to ionizing radiation.
- MRI enables the discovery of abnormalities that might be obscured by bone with other imaging methods.
- The contrast material used in MRI exams is less likely to produce an allergic reaction than the iodine-based contrast materials used for conventional x-rays and CT scanning.

Risks

- Any procedure where the skin is penetrated carries a risk of infection. The chance of infection requiring antibiotic treatment appears to be less than one in 1,000.
- There is always the possibility of injuring a vessel or a nerve adjacent to the joint. Injury to these

structures, however, is minimal particularly when the procedure is performed under ultrasound guidance.

Exams involving x-ray imaging:

- There is always a slight chance of cancer from excessive exposure to radiation. However, the benefit of an accurate diagnosis far outweighs the risk.
- Patients who have known allergies to iodine may have an adverse reaction to the contrast material. Because the contrast material is put in a joint and not a vein, allergic reactions are very rare, although in some cases, mild nausea to severe cardiovascular complications may result.
- Women should always inform their physician or x-ray technologist if there is any possibility that they are pregnant. See the Safety page for more information about pregnancy and x-rays.
- The effective radiation dose for this procedure varies. See the Safety page for more information about radiation dose.

Exams involving MR imaging:

- The MRI examination poses almost no risk to the average patient when appropriate safety guidelines are followed.
- If sedation is used, there are risks of excessive sedation. However, the technologist or nurse will monitor your vital signs to minimize this risk.
- Although the strong magnetic field is not harmful in itself, implanted medical devices that contain metal may malfunction or cause problems during an MRI exam.
- Nephrogenic systemic fibrosis is currently a recognized, but rare, complication of MRI believed to be caused by the injection of high doses of gadolinium-based contrast material in patients with very poor kidney function. Careful assessment of kidney function before considering a contrast injection minimizes the risk of this very rare complication.
- There is a very slight risk of an allergic reaction if contrast material is injected. Such reactions are usually mild and easily controlled by medication. If you experience allergic symptoms, a radiologist or other physician will be available for immediate assistance.

A Word About Minimizing Radiation Exposure

Special care is taken during x-ray examinations to use the lowest radiation dose possible while producing the best images for evaluation. National and international radiology protection organizations continually review and update the technique standards used by radiology professionals.

Modern x-ray systems have very controlled x-ray beams and dose control methods to minimize stray (scatter) radiation. This ensures that those parts of a patient's body not being imaged receive minimal radiation exposure.

What are the limitations of arthrography?

The limitations of arthrography include:

- Partial tears of the rotator cuff may not be detected with conventional direct arthrography.
- Some joint injuries cannot be detected with conventional direct arthrography, including defects of the cartilage, which can be found inside and along the edges of some joints, bruising of neighboring bones and injuries to ligaments outside the joint.

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