

Functional MRI (fMRI) of the Brain

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What is fMRI of the Brain?

Magnetic resonance (MR) imaging uses radio waves and a strong magnetic field rather than x-rays to provide clear and detailed pictures of internal organs and tissues. Functional magnetic resonance imaging (fMRI) is a relatively new procedure that uses MR imaging to measure the quick, tiny metabolic changes that take place in an active part of the brain. Physicians know the general areas of the brain where speech, sensation, memory, and other functions occur. However, the exact locations vary from individual to individual. Injuries and disease, such as stroke or brain tumor, can even cause functions to shift to other parts of the brain. fMRI not only helps radiologists look closely at the anatomy of the brain, but can help them



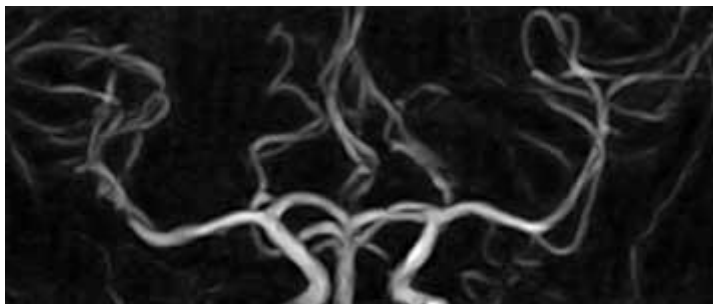
Open MRI scanning of lower extremity.

determine precisely which part of the brain is handling critical functions such as thought, speech, movement, and sensation. This information can be critical to planning surgery, radiation therapy, treatment for stroke, or other interventions to treat brain disorders.

What are some common uses of fMRI of the Brain?

fMRI is becoming the diagnostic method of choice for learning how a normal, diseased or injured brain is working, as well as for assessing the potential risks of surgery or other invasive treatment of the brain. The term "Functional MRI" (with a "capital F") can also include other MRI techniques that are sensitive to physiologic changes (such as changes in water motion), whereas "little f" fMRI usually refers to mapping of brain activity using MRI. As a group, these "Functional MRI" techniques appear to provide the most sensitive method currently available for identifying, investigating, and monitoring brain tumors, strokes, and certain chronic disorders of the nervous system such as multiple sclerosis. In addition, these methods appear to provide a useful means of documenting some brain abnormalities related to dementia or seizures.

In routine practice, fMRI studies are often used in planning brain surgery, since they can help physicians monitor normal brain function as well as any disturbed brain function. While research is still ongoing, it appears that fMRI can also help assess the effects of stroke, trauma, or degenerative disease (such as Alzheimer's) on brain function.



MRI of brain.

How should I prepare for my fMRI of the Brain?

Since fMRI uses an MRI device, the standard preparations for an MRI procedure are necessary. For example, because the strong magnetic field used for MRI will pull on any ferromagnetic metal object implanted in the body, MRI staff will ask whether you have a heart pacemaker (or artificial heart valve), implanted port, infusion catheter (brand names Port-o-cath, Infusaport, Lifeport), intrauterine device (IUD), or any metal plates, pins, screws, or surgical staples in your body. In most cases, surgical staples,

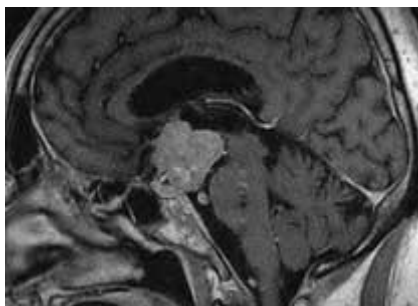
plates, pins and screws pose no risk during MRI. Red dyes used in tattoos and permanent eyeliner may contain metallic iron oxide and could heat up during MRI, however this is rare. You will be asked if you have ever had a bullet or shrapnel in your body, or ever worked with metal. If there is any question of metal fragments, you may be asked to have an x-ray that will detect any such metal objects. Tooth fillings are not affected by the magnetic field, but they may distort images of the facial area or brain, so the radiologist should be aware of them. The same is true of braces, which may make it hard to "tune" the MRI unit to your body. You will be asked to remove anything that might degrade MRI images of the head, including hairpins, jewelry, eyeglasses, hearing aids, and any removable dental work.

The radiologist or an assistant may ask about drug allergies and whether head surgery has been done in the past. If you might be pregnant, this should be mentioned. Less than one in 20 patients who undergo MRI in an enclosed unit may feel confined or claustrophobic.

How does the fMRI of the Brain procedure work?

MRI uses radio waves and a strong magnetic field rather than x-rays to provide clear and detailed pictures of internal organs and tissues. fMRI uses this technology to identify regions of the brain where blood vessels are expanding, chemical changes are taking place, or extra oxygen is being delivered—all signs that this part of the brain is currently processing information and giving commands to the body.

In fMRI, the patient performs a particular task while the imaging is taking place. The metabolism in the area of the brain responsible for this task will increase, and the signal in the MR image will change. By performing specific tasks that correspond to different functions, it is possible to locate the corresponding area of the brain that governs the function. This information can then be incorporated into a surgical planner to help a surgeon avoid these areas.



MRI of brain.

How is the fMRI of the Brain performed?

The patient lies on a sliding table, with his or her head in a brace designed to help hold the head still. This brace may include a mask created especially for the individual. As the examination proceeds, the patient will be asked to perform a number of small tasks, such as tapping the thumb of one hand against each of the fingers of that hand, or rubbing a block of sandpaper, or answering simple questions. The patient is able to communicate with the radiologist or technologist throughout the exam. Also, many MRI centers allow a friend or, if a child is being examined, a parent, into the room.

Depending on how many images are needed, the exam will generally take from 15 to 45 minutes, although a very detailed study may take longer. You will be asked not to move during the actual imaging process, but between sequences some movement is allowed. Patients are generally required to remain still for only a few minutes at a time.

When the exam is over the patient is asked to wait until the images are examined to determine if more images are needed.

What will I experience during my fMRI of the Brain procedure?

MRI causes no pain, but there may be discomfort from being closed in or from the need to keep your head very still. You may notice a warm feeling in the area under examination; this is normal, but if it bothers you the radiologist or technologist should be told. The loud tapping or knocking noises heard at certain phases of imaging can be bothersome to some people. However, in fMRI exams, the actual imaging is done in a series of very short bursts, so the noise will not last long.

What are the benefits vs. risks of fMRI of the Brain?

Benefits

- Functional MRI can identify the location of normal brain function in order to allow surgeons to attempt to avoid these areas during brain surgery.
- Functional MR images can enable detection of a stroke at a very early stage, so physicians can initiate effective treatments earlier.
- fMRI studies can help physicians monitor the growth and function of brain tumors and guide the planning of radiation therapy or surgical treatment.

- fMRI images of the brain and other head structures are clearer and more detailed than images obtained with other methods.
- Exposure to radiation is avoided.
- fMRI enables the detection of abnormalities that might be obscured by bone tissue with other imaging methods.

Risks

- An undetected metal implant may be affected by the strong magnetic field.
- fMRI is generally avoided in the first 12 weeks of pregnancy. Doctors usually use other methods of imaging, such as ultrasound, on pregnant women, unless there is a strong medical reason for using fMRI.

See the MRI Safety page for additional information.

What are the limitations of fMRI of the Brain?

Functional MRI is still evolving and improving. While it appears to be as accurate in finding the location of brain activity as any other method, overall there is less experience with fMRI than with many other MRI techniques. In most cases the exam is safe for patients with metal implants, with the exception of a few types of implants, so patients should inform the technician of an implant prior to the test. MRI is often more expensive than CT scanning.