

Basics of MR Imaging

Dynamic MRI



MRI Closed



The bed rotates from Upright to Recumbent, stopping at any angle in between



MRI Open

Patient with Low Back Pain **After** Surgery



Extremity MRI



Sagittal T2 WI of the lumbar spine with the patient supine position (left) and sagittal T2 WIs of the same patient in the erect position (right) Note the marked narrowing of the spinal canal in the erect film denoting marked spinal instability.

MRI advantages

- ◆ Superior soft tissue contrast
- ◆ Multiplanar imaging capability
- ◆ Absence of artifact from bone
- ◆ Tissue characterization based on signal behavior

Surface coils

The surface coils are designed to be as close as possible to the examined area. This ensures better resolution of the images with adequate adjustment of the field of view

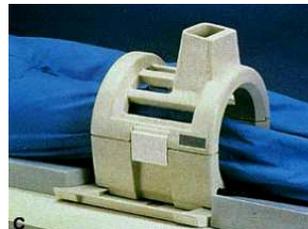
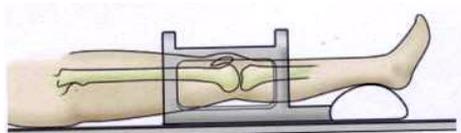


Neck surface coil



Spine surface coil

Knee surface coil

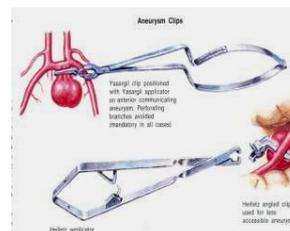


Absolute contra-indications to MRI

- ◆ Cardiac pace maker
- ◆ Intra-cranial aneurysmal clipping
- ◆ Intraocular metallic FB



Cardiac pace maker



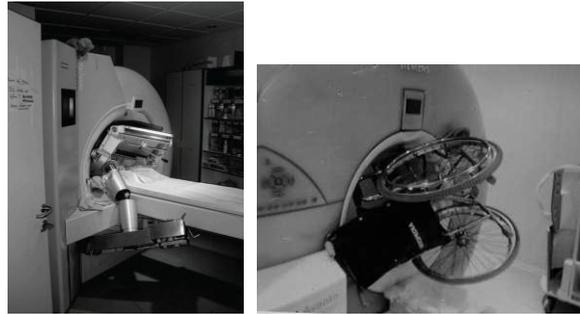
Aneurysm clip

Relative contra-indications to MRI

Ferro- magnetic metallic objects [wheel chair, trolley,..]

Metallic internal fixation devices [nails, screws, plates,..]

Artificial valves and internal stents are no more contraindications for MRI



How are MR images produced?

Images are created by the interaction between the external magnet in the machine and the internal magnet in the human body

The targeted internal magnet in the human body is the hydrogen proton because of its widespread availability through out the tissues (about 80% of the human body is made of water molecules)

The MR images are obtained by applying radiofrequency (RF) waves having the same frequency of vibration similar to the hydrogen proton. This will make these protons to move. This movement is utilized by the MR machine to produce the image.

So that:

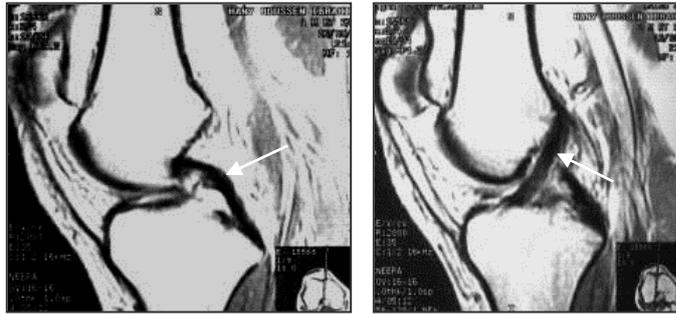
Non mobile protons will give no image, they appear black

If there is no enough protons as in air which contains minimal hydrogen, then there will be no image as well.

Non mobile hydrogen protons are present in the following sites:

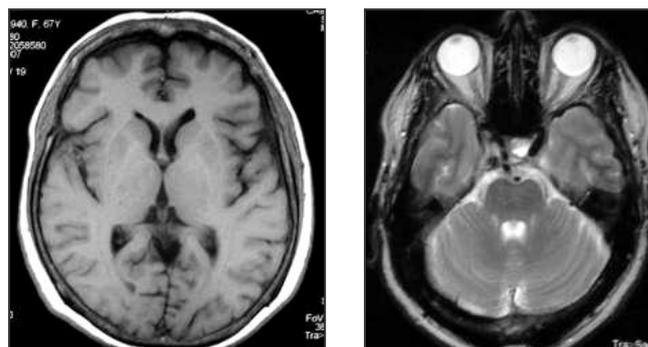
- ♦ Cortical bone
- ♦ Mature fibrous tissue [ligaments and tendons in the body]
- ♦ Calcifications

These structures will normally appear black in all MR images



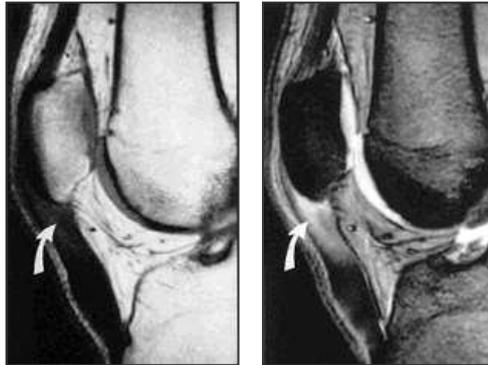
Sagittal MR images for the knee joint showing the cortex of the femur and tibia as well as the cruciate ligaments (arrows) as black lines because they contain non mobile hydrogen protons

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- ♦ Fluids as [CSF , effusion , ascites , urine , vitreous ,] will appear black in the T1 and bright in the T2 weighted images



Axial MR brain images showing the CSF in the ventricles of low signal (black) in the T1 weighted image (left), while the vitreous humor and CSF in the 4th ventricle appear of high signal (bright) in the T2 weighted image (right)

- ♦ Fat [Subcutaneous fat, bone marrow , dermoid cyst,...]will appear bright in the T1 weighted images and black in T2 weighted images



Sagittal MR images of the knee showing the bone marrow fat of bright signal (white) in the T1 weighted image (left) and of dark signal in the T2 weighted image (right). The arrow points to an abnormality in the patellar tendon which is not black in the T2 weighted image

Minimal hydrogen [air]

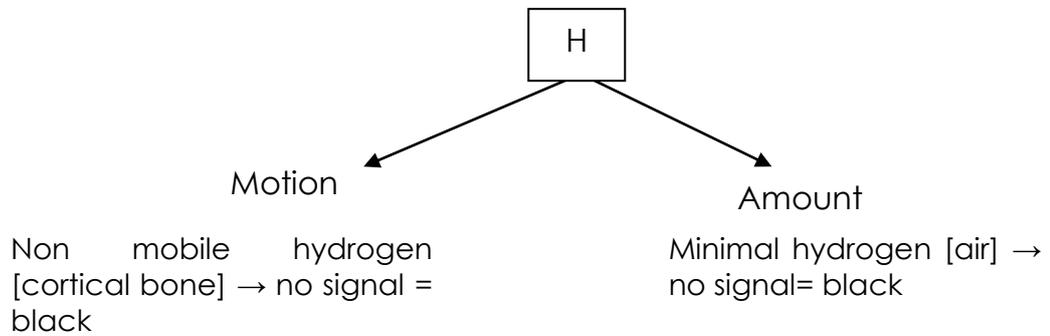
Air in the paranasal sinuses as well as in the lung appears black because it contains minimal hydrogen protons



Axial MR image showing black maxillary sinuses containing air

The resultant MR image depends on

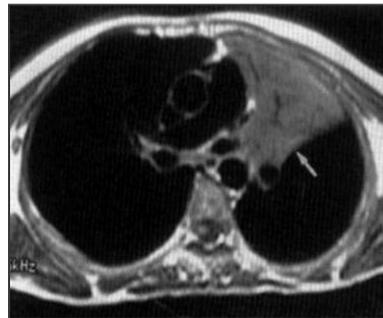
The presence of adequate amount of hydrogen protons that are mobile



Minimal hydrogen [air]



Air in the sinuses



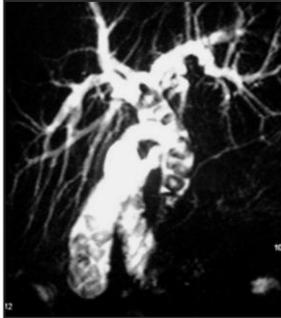
Air in the lungs

MR angiography **MRA**



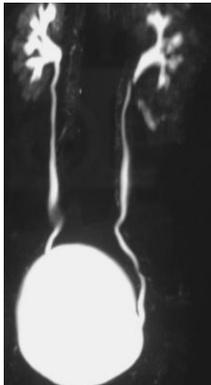
Normal MRA of the Circle of Willis

MR pancreatico-cholangiography **MRCP**



MR cholangiography showing multiple stones in the CBD as well as in the gall bladder

MR urography **MRU**



MR urography showing normal appearance of both pelvicalyceal systems, ureters and urinary bladder

MR Myelography **MRM**



MR myelography showing normal findings