



Diagnostic Radiology

BY:

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Diagnostic Radiology

Is one of the specialties of the Faculty of Applied Medical Sciences, which is interested in teaching medical imaging methods to diagnose diseases and help in treatment. The specialization is divided into several subsections, each of which has its characteristics and uses in the field of diagnosis of diseases such as MRI, CT, X-ray, nuclear medicine, And interventional radiography and ultrasound

X-RAY



X-rays are a quick and painless test that produces images of the structure within the body - especially bones

X-ray packets pass through the body, and are absorbed in different quantities depending on the density of the substances passing through them. Materials with a density, such as bones and minerals, appear white in X-rays. The air inside the lungs is black. Fat and muscle look like a gray spectrum Of x-ray benefits

Helps diagnose diseases in a painless way to .evaluate available treatment options

How X-rays are performed: briefly X-ray tube from the ray tube .Radiation is directed toward the patient .The radiation penetrates the patient's body and is recorded on the receiver's rays

X-ray technology is used to examine many parts of the body including and the most common:

Chest, abdomen, neck and head

Hands, legs and pelvis.

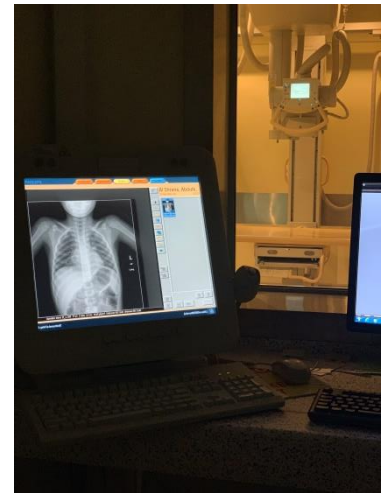
***Patient preparation and safety:**

You do not need to prepare the patient for her ease

- **check name of the pt and ID.(If the patient is a female, we make sure to get pregnant)**
- **Remove all metallic like(phone, key , jewelry)From the examination area**
- **Do not wear clothing that contains metals such as buttons, belts, bras and so on.**
- **Explain generally for the pt about examination**
- **Put the pt on table supine or standee On the Bucky**
- **Select the central ray and center point Appropriate for each examination.**

chest X-ray

WHY DO I NEED A CHEST X-RAY?



Suspicious symptoms may include:

chest pain

fever

persistent cough

shortness of breath

These symptoms could be the result of the following conditions, which a chest X-ray can detect:

broken ribs

emphysema (a long-term, progressive lung condition that causes breathing difficulties)

heart failure

lung cancer

pneumonia

pneumothorax (a collection of air in the space between your lungs and your chest wall)

Indications for chest Radiography:

- **Clinical Problem**
- **Chest pain**
- **Acute aortic dissection**
- **Pulmonary embolus**
- **Pericardial effusion**
- **Pleural effusion**
- **Vascular disease**
- **Chest trauma**
- **Pneumonia follow up**
- **Haemoptysis**
- **Non specific chest pain**
- **Chest trauma**
- **Upper respiratory tract infection**
- **Chronic obstructive lung disease**
- **Chest masses**
- **Chest infection consolidation(**
- **Pneumothorax**
- **Hydropneumothorax**
- **Haemothorax**
- **Hydrohaemopneumothorax**

Chest Projections:

Basic views

PA/ AP

Upright Lateral

RAO/LAO

RPO/LPO

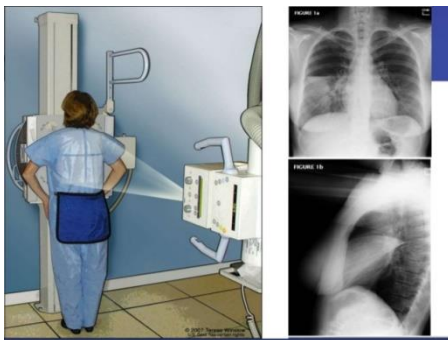
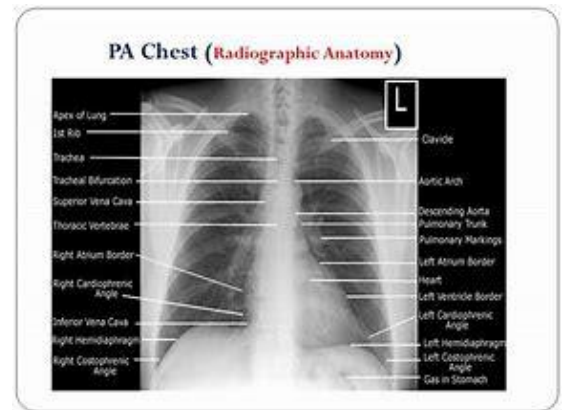
PA chest

Central Ray:

Perpendicular to medial sagittal plane

Center Point:

At level of T7 (Inferior angle of scapula)



AP Chest

Central Ray:

Angled caudad to be perpendicular to long axis of the sternum

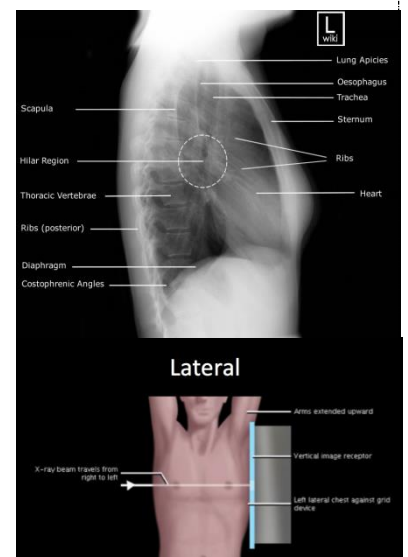
Lateral Chest

Central Ray:

perpendicular directed to mid thorax

Center Point:

level of T7(3-4 inches below jugular notch) Structure shown



Indication for hand Radiography:

1. TRAUMA
2. PATHOLOGICAL(TUMOR)
3. FRACTURE
4. DISLOCATION
5. PAIN
6. R. T. A

Radiography of the hand

Basic Projection's:

1. Posteroanteri (PA)
2. Lateral (Lat)
3. Oblique



1- PA Hand

Central Ray:

Perpendicular

Center Point:

**To third metacarpophalangeal
joint**



2- Lateral Hand

Central Ray

Perpendicular

Center Point

To second metacarpophalangeal joint



3- Oblique Hand

Central Ray

Perpendicular

Center Point

To third metacarpophalangeal joint





Indications for Abdominal imaging:

1. Bowel gas patterns in obstruction, intussusceptions volvulus, fibrous adhesions, perforation
2. Investigation of biliary and lithiasis
3. Aortic Aneurysm when sclerotic and with calcification
4. Renal stones renal masses
5. Abdominal masses
6. Ascites
7. Control or preliminary films for contrast studies

Abdomen Basic Projections

Abdomen (KUB)

Basic

AP supine

Special

PA prone

Lat decubitus

AP erect Dorsaldecubitus

Abdomen AP Supine

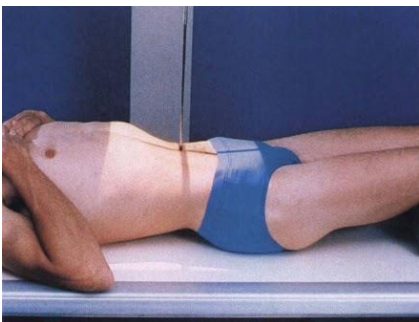


Central Ray

perpendicular

Center Point

To mid line at level of iliac crests



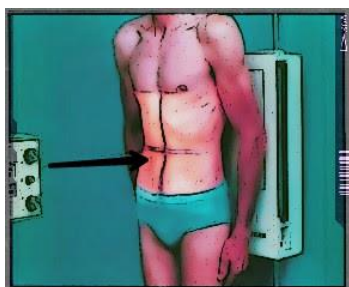
Abdomen PA Prone

Central Ray

perpendicular

Center Point

To mid line at level of iliac crests



Abdomen AP Erect

Central Ray

1. Horizontal & perpendicular To Film

Center Point

To mid line 2-3 inches above iliac crest

Pelvis

Basic projections

AP pelvis

AP Axial sacroiliac joint

Posterior oblique SI joints



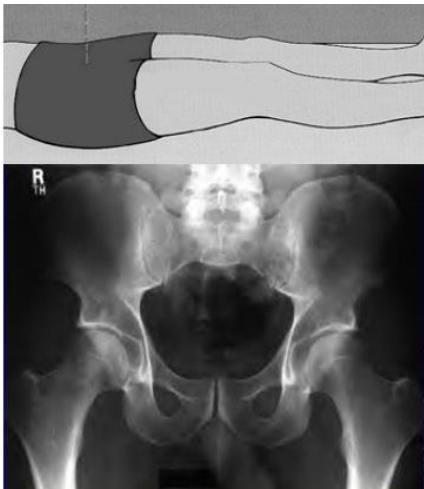
AP pelvis

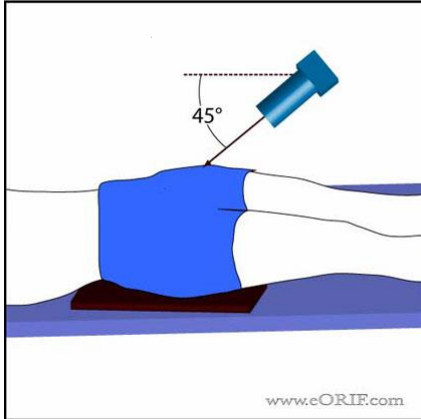
Central Ray

perpendicular

Center Point

Midway between level of anterior
superior iliac spine and symphysis
pubis





AP Axial Sacroiliac joint

Central Ray

30-45degrees(cephalic

Center Point

(2 inches below level of anterior superior iliac
spines



Most common : One of the major causes of pediatric morbidity today at the community level is infection involving the ear, nose, and throat.

Mammography



part from department of Radiology

The goal of mammography is the early detection of breast cancer and sometimes five years before the patient feels or is detected by the doctor, usually by detecting the .characteristic blocks or micro-analysis mammograms use doses of ionizing radiation to create images.

***Patient preparation and safety:**

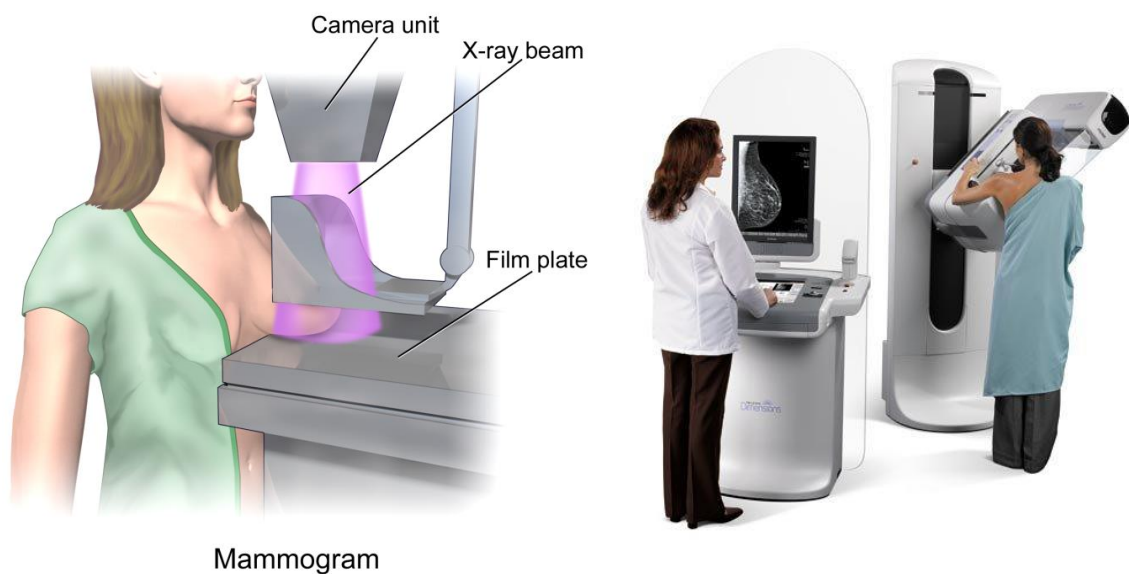
You do not need to prepare the patient for her ease

- **check name of the pt and ID.(If the patient is a female, we make sure to get pregnant(**
- **Remove all metallic like(phone, key , jewelry)From the examination area**
- **Do not wear clothing From the examination area.**
- **Explain generally for the pt about examination**
 - **clean the examination**
 - **start the examination.**



Method of conducting the examination:

During the procedure, the breast is compressed using a dedicated breast imaging unit. Parallel lobes compress the thickness of the breast tissue to increase image quality by reducing the thickness of the x-ray tissue, reducing the amount of dispersion radiation (dispersing reduces image quality), reducing the required radiation dose, and still holding breast cancer (preventing blurry



CT Scan

(CAT Scan, Computerized Axial Tomography)

What Is CT Scan?



CT, or CAT scans, are special X-ray tests that produce cross-sectional images of the body using X-rays and a computer.

1. CT Scan Preparation:

1. If a patient is going to have a contrast injection, he or she should not have anything to eat or drink for a few hours before the CT scan because the injection may cause stomach upset.
2. If the patient female should you ask pregnant or no
3. remove any metal
4. **CONTRAST MEDIA:** Some patients should not have an iodine-based contrast media. If you have problems with kidney function, You will be asked to sign a consent form that will detail the risks and side-effects associated with contrast media.

5. ALLERGY

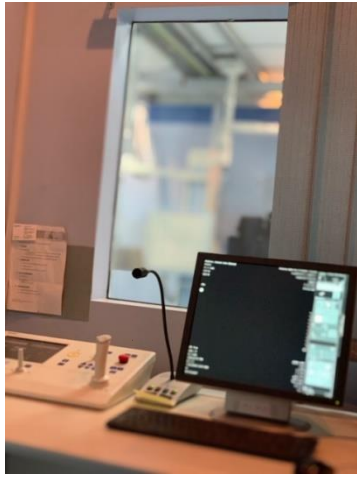
6. DIABETICS: Diabetics should eat a light breakfast or lunch three hours prior to the scan time.

APPLICATIONS:

Head:

CT scanning of the head is typically used to detect infarction, tumors, calcifications, haemorrhage and bone trauma.





FLUOROSCOPY

Description

Fluoroscopy is a type of medical imaging that shows a continuous X-ray image on a monitor, much like an X-ray movie. During a fluoroscopy procedure, an X-ray beam is passed through the body. The image is transmitted to a monitor so the movement of a body part or of an instrument or contrast agent (“X-ray dye”) through the body can be seen in detail.

This is useful for both diagnosis and therapy and occurs in general radiology, interventional radiology, and image-guided surgery. In its simplest form, a fluoroscope consists of an X-ray source and a fluorescent screen, between which a patient is placed.

Common procedures using fluoroscopy:

Investigations of the gastrointestinal tract, including barium enemas, defecating proctograms, barium meals and barium swallows, and enteroclysis.

Liver biopsy is performed under fluoroscopic guidance at many centers.

Orthopaedic surgery to guide fracture reduction and the placement of metalwork.

Podiatric Surgery to guide fracture reduction and in use in certain procedures that have extensive hardware.

Angiography of the leg, heart and cerebral vessels.



Applications

Hysterosalpingogram (HSG) is a fluoroscopic examination of the uterus and the Fallopian tubes, most commonly used in the investigation of infertility or recurrent spontaneous abortions.

Contraindications

pregnancy

active pelvic infection

recent uterine or tubal surgery

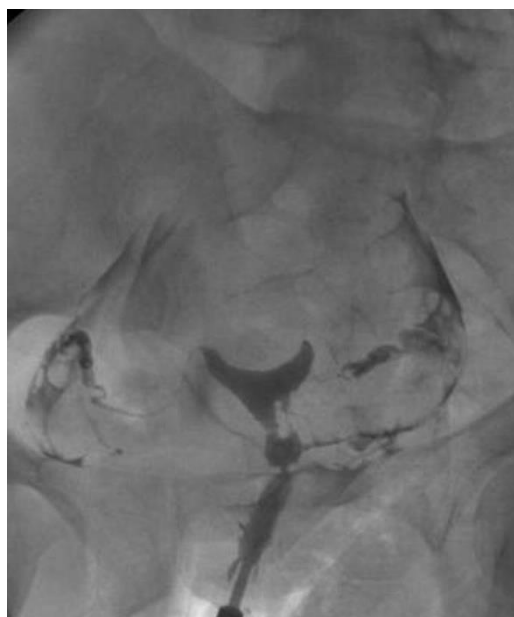
Technique

the procedure should be performed during the proliferative phase of the patient's menstrual cycle (days 6-12), when the endometrium is thinnest

this improves visualization of the uterine cavity, and also minimizes the possibility that the patient may be pregnant 1

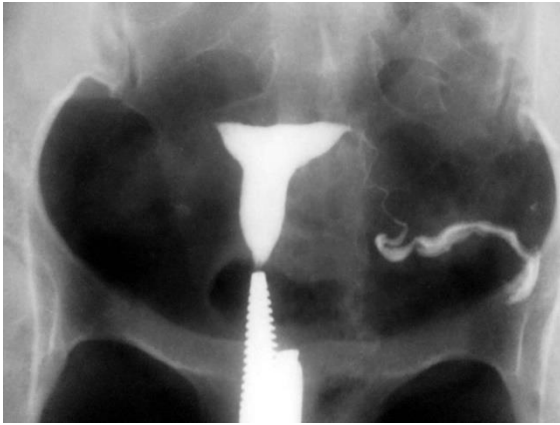
water soluble iodinated contrast is subsequently injected slowly under fluoroscopic guidance.

a typical fluoroscopic examination includes a preliminary frontal view of the pelvis, as well as subsequent spot images that demonstrate uterine endometrial contour, filled Fallopian tubes and bilateral intraperitoneal spill of contrast, to establish tubal patency

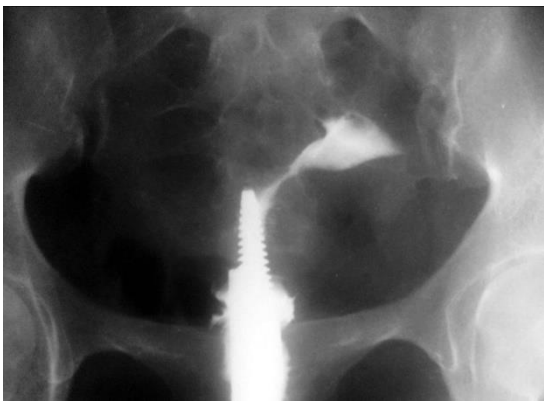


Intra_uterine adhesions

Containdication



unilateral block



Bilateral block

MAGNETIC RESONANCE IMAGING MRI

Magnetic resonance imaging (MRI) is one of the modern means of medical imaging that uses magnetic field and radio waves to produce detailed pictures of the organs and tissues within your body. It is classified as from a Radiology section, but MRI has advantages that distinguish it from the rest of the devices In this section. It does not cause any kind of pain when the person does it. It diagnoses all diseases with extreme precision and is also a very safe diagnostic tool because it is free of ionized radiation. It also diagnoses several diseases including heart, cancer, bone, joint, muscle Brain spinal cord .blood vessels Internal organs and breast The most common Brain .

Disadvantages : Longer examination times . More patient non-acceptance due to claustrophobia One of the most costly examination



Physics

What is the mechanism of action of the machine protons (hydrogen atoms) in tissues containing water molecules create a signal that is processed to form an image of the body.

First, energy from an oscillating magnetic field temporarily is applied to the patient at the appropriate resonance frequency.

The excited hydrogen atoms emit a radio frequency signal, which is measured by a receiving coil. The radio signal may be made to encode position information by varying the main magnetic field using gradient coils. As these coils are rapidly switched on and off they create the characteristic repetitive noise of an MRI scan. The contrast between different tissues is determined by the rate at which excited atoms return to the equilibrium state. Exogenous contrast agents may be given to the person to make the image clearer.

Shimming Is the process of creating a uniform magnetic field

The factors affected of the quality image?

1-FOV

2- Thickness

3- No of slice

Units

0 Tesla (T) -SI unit

(Gauss (G

IT 10,000 G

Note

Magnet The device always works even after the device is shut down

Types of device Magnetic Resonance :

There are two types of + magnetic resonance devices (This device is used to \ Magnetissy resonance FMRI measure changes in nerve signals in the brain resulting from changes in neural activity .

Multinuclear imaging (Hydrogen has the most frequently imaged nucleus in MRI because it is present in biological tissues in great abundance , and because its high gyromagnetic ratio gives a strong signal . However , any nucleus with a net nuclear spin could potentially be imaged with MRI . Such nuclei include helium - 3 , lithium - 7 , carbon - 13 , fluorine - 19 , oxygen - 17 , sodium - 23 , phosphorus - 31 and . xenon - 129

Types of magnetic resonance in terms of shape:

- ✓ Closed Magnetic Resonance Devices

(It is considered the best and most reliable image quality)



- ✓ Open magnetic resonance imaging devices



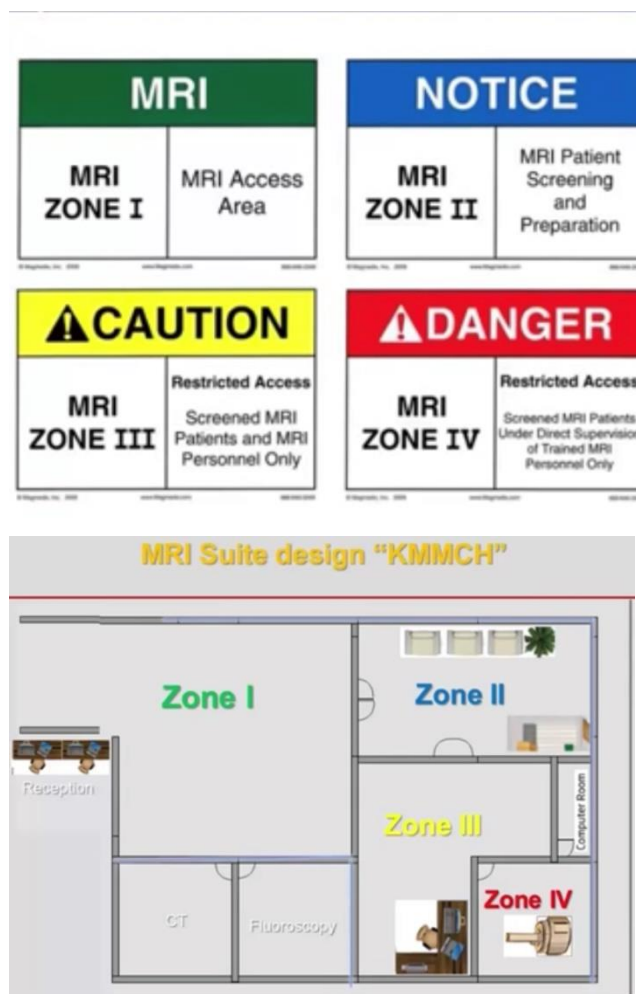
- ✓ Vertical Magnetic resonance imaging devices



- ✓ Magnetic Resonance Systems Ltd.



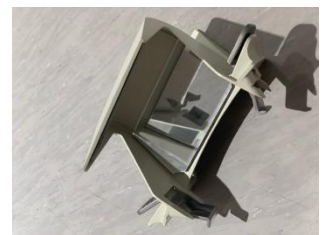
MRI safety zones: to control access and prevent devastating mishaps in MRI environment



Remember Zone roles are Not only for the patient but for all who may present in that region. e.g.: Nurse with pace-maker should be preclude from zone3/4

Patient preparation and safety:

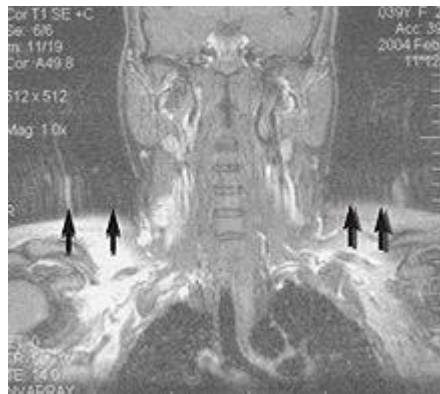
- check name of the pt and ID.
- Remove all metallic like(phone, key , jewelry ,card)
 - Ask pt about (previous operations , skewers)
- should be take the weight and height for pt
-
- Explain generally for the pt about examination
- Put the pt on table
- Choose coils appropriate for the procedure 8lif the pt is afraid
- put for pt headphones to reduce noise
- don't forget the bell for any help you m
- Move the table on the appropriate organ.
- start the Examination use the (mirror)
-
- **If the scan needs to CM make Kidney function analysis is necessary**



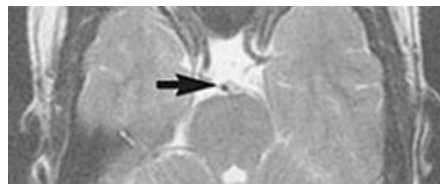
Artifact

Patient - related MR artifacts . .

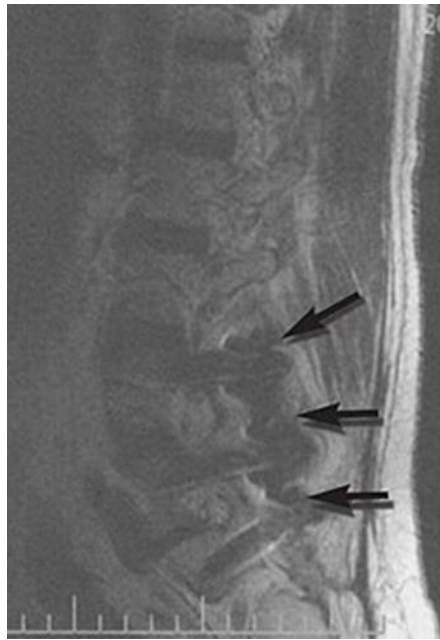
Motion artifacts : motion artifact is one of the most common artifacts in MR imaging



Flow: Flow can manifest as either an altered intravascular signal (flow enhancement or flow-related signal loss), or as flow-related artifacts (ghost images or spatial misregistration)

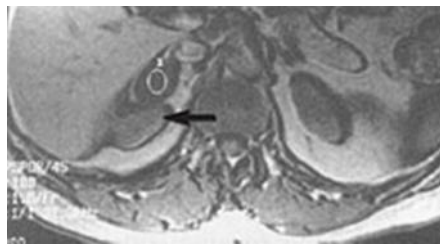


Metal artifacts:



Signal processing dependent artifacts

Chemical shift artifact



Chemical shift artifact: bright and dark streaks around the .
kidneys in an axial gradient echo opposed-phase image

Chemical shift artifact occurs at the fat/water interface in the
phase encoding or section-select directions

Partial volume

Partial volume artifacts arise from the size of the voxel over which the signal is averaged



contrast media +INJECTOR use in MRI GADOLINIUM to enhances and improve the quality of the MRI images, improves the visibility of inflammation, tumors , blood vessels and for some organs, blood supply e calculated dose-the weight pt 0.1

Before any MRI scan, you will be asked a number of questions about your medical history, and any implants you might have, to make sure that you will not be at risk from the strong magnetic fields of the scanner. You will also be asked about conditions that might mean a gadolinium injection would not be recommended (e.g. pregnancy, previous allergic reaction, severe kidney disease). If you have any of these conditions, then you

wil not be given gadolinium, but if there is no condition preventing injection, you might be asked to sign form in case gadolinium is required. a consent How is gadolinium contrast medium given to the Gadolinium contrast medium is given by intravenous injection, that is, through a small needle into a vein in your arm, either by hand injection or by an automated .injector

Pregnancy, possible pregnancy and lactation If you are % ١٩٤ pregnant, or think you might be pregnant, please inform your doctor or radiologist before having the procedure, so that your doctor can consider and talk to you about any risks and benefits of having an MRI scan, and a possible gadolinium injection, for you and your unborn baby. Where relevant, you will be asked about the possibility of pregnancy as part of the safety screening before any MRI scan. If you are pregnant or possibly pregnant, it is unlikely that you will have a gadolinium injection unless it is absolutely essential. If an injection is recommended, this would be discussed with you and your doctor before giving you the injection. If you are breast-feeding, it is safe to continue normal breast-feeding after the gadolinium contrast medium has been given. There is no requirement to express and dispose of breast milk or to withhold breast-feeding v 194 % Although the gadolinium is eliminated from the body through the kidneys, if you are breast-feeding, it has been shown that a tiny part (less than 1 part in 1000) of the injected gadolinium can enter the breast milk. An ever smaller amount of gadolinium from the breast milk might be swallowed by the baby and taken into the

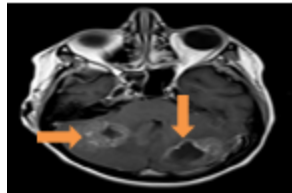
baby's bloodstream. The amount received by your baby is so small it is not thought to represent any danger to your child

<https://www.insideradiology.com.au/gadolinium-contrast-medium>

applications and most pathology

BRAIN

INDICATION:



metastases

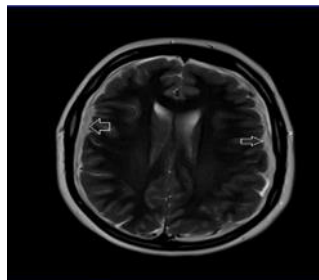
abscesses

brain stem lesion

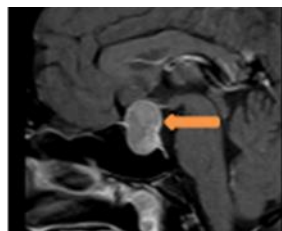
congenital abnormalities

headaches

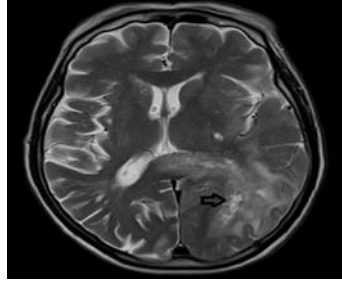
subdural haemorrhage



Pituitary adenomas



Glioblastomas, also called malignant gliomas, are the most common brain tumours in adults

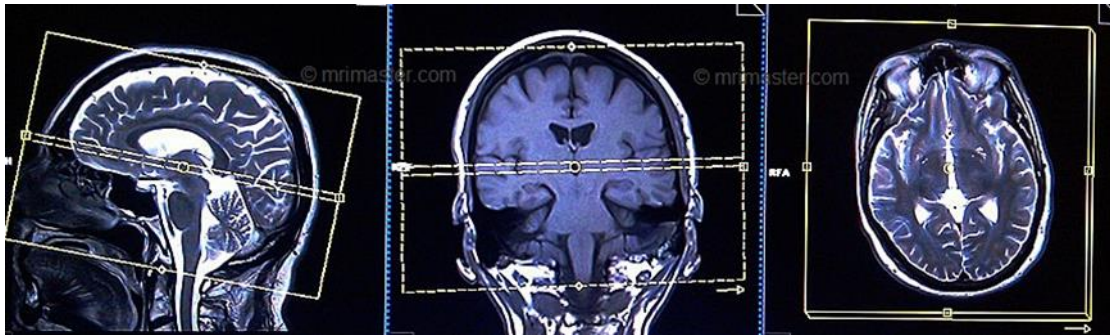


position:

head first, supine , give the sponge under the legs ,center the laser over the glabella

planning:

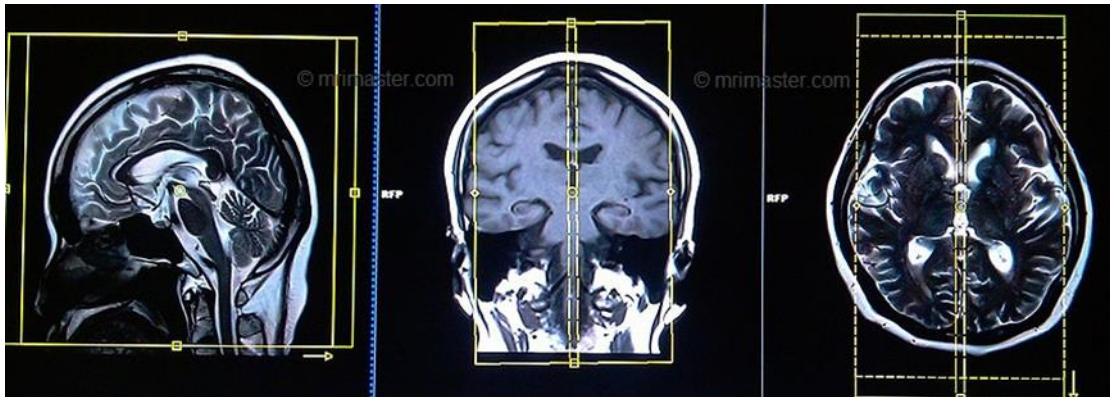
Axial



Coronal



Saggital



LUMBER SPINE

Indications:

Spine cord tumour

Tumors or inflammations CNS or meninges

Congenital malformations of spine cord

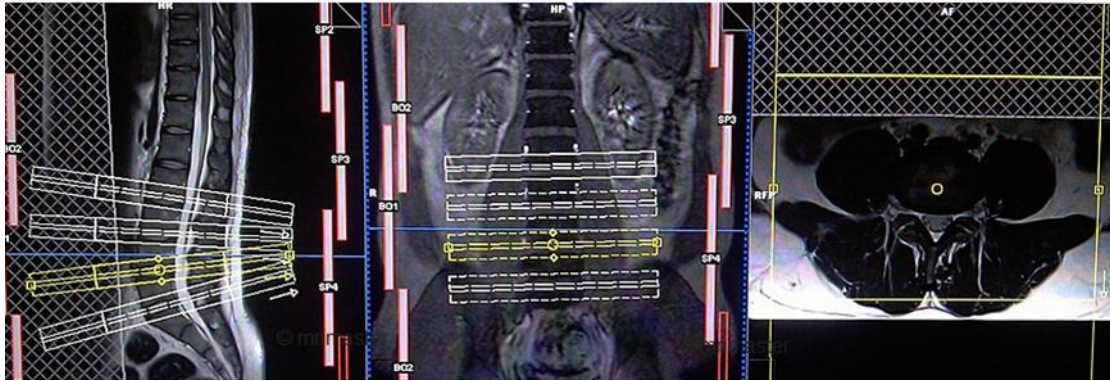
Position:

Head first , supine

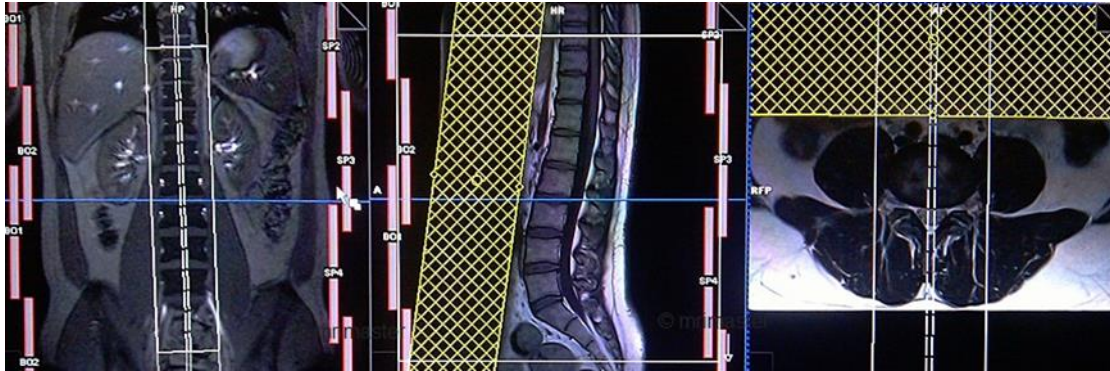
The Centre in the mid abdomen (the umbilical region)

Planning:

Axial



Saggital



Knee

Indications:

Marrow abnormalities

Fractures

Acute trauma

Ligament tears: Cruciate, collateral, retinacular

Positions:

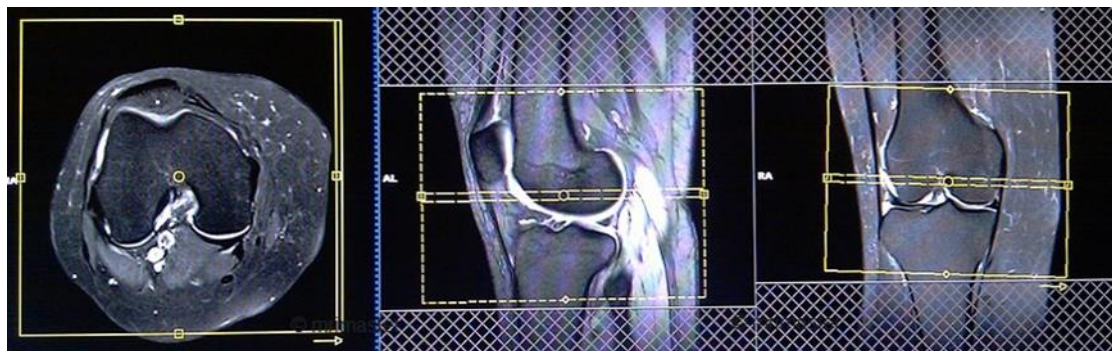
Feet first , supine

Give sponge under ankle joint

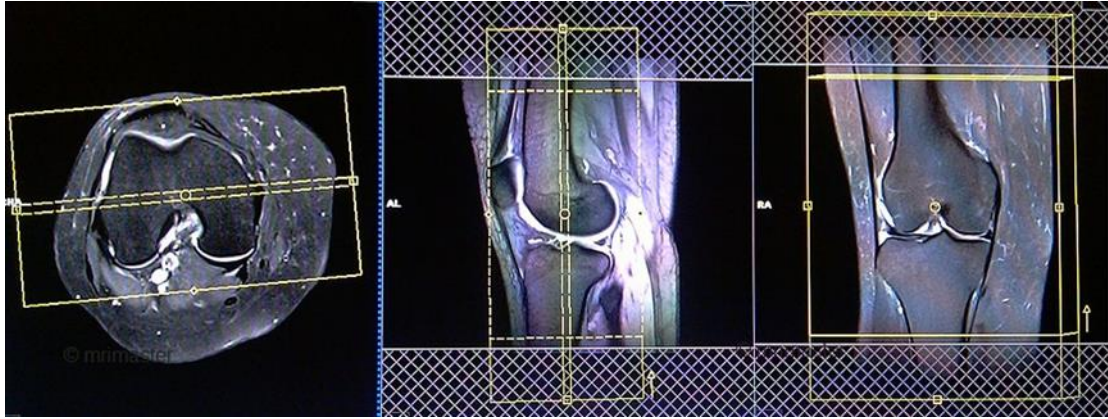
The centre over the lower border patella

Planning:

Axial



Coronal



Saggital



Shoulder

Indications:

Marrow abnormalities

Fractures

Ligament tears

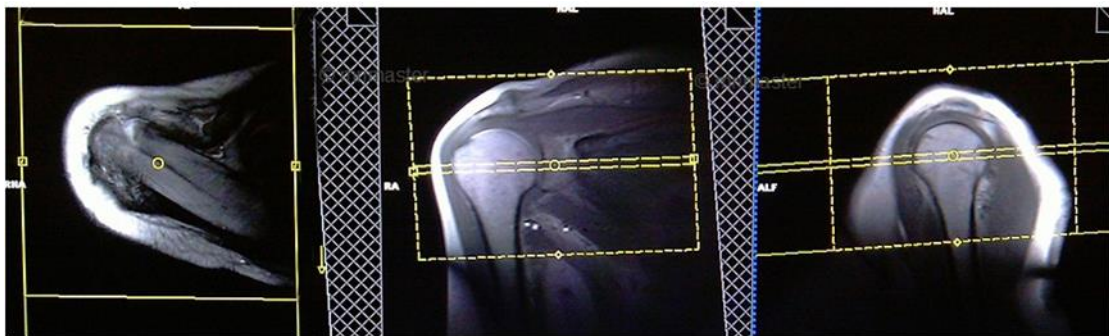
Positions:

Head first , supine

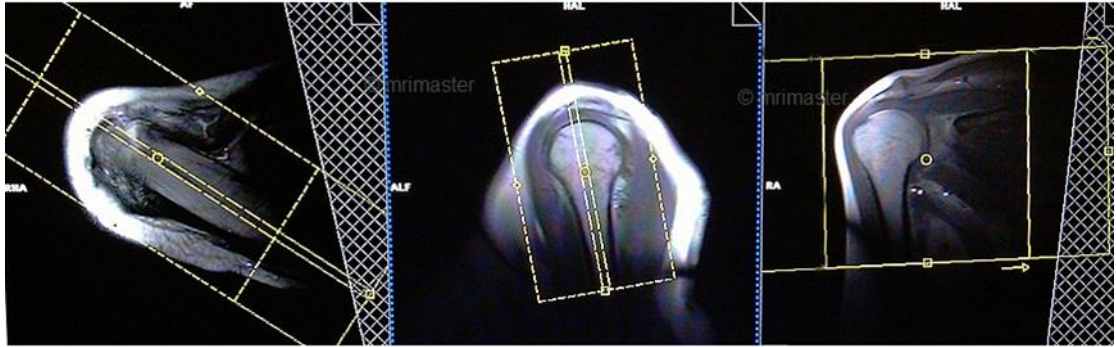
The centre over the shoulder j

Planning:

Axial



Coronal



Saggital



Ultrasound

Ultrasound imaging uses sound waves to produce pictures of the inside of the body. It is used to help diagnose the causes of pain, swelling and infection in the body's internal organs and to examine a baby in pregnant women and the brain and hips in infants. It's also used to help guide biopsies, diagnose heart conditions, and assess damage after a heart attack. Ultrasound is safe, noninvasive, and does not use ionizing radiation.

Ways to work US...

Conventional ultrasound displays the images in thin, flat sections of the body. Advancements in ultrasound technology include three-dimensional (3-D) ultrasound that formats the sound wave data into 3-D images.

A Doppler ultrasound study may be part of an ultrasound examination.

Doppler ultrasound, also called color Doppler ultrasonography, is a special ultrasound technique that allows the physician to see and evaluate blood flow through arteries and veins in the whole body.

There are three types of Doppler ultrasound:

- **Color Doppler** uses a computer to convert Doppler measurements into an array of colors to show the speed and direction of blood flow through a blood vessel.
- **Power Doppler** is a newer technique that is more sensitive than color Doppler and capable of providing greater detail of blood flow, especially when blood flow is little or minimal. Power Doppler, however, does not help the radiologist determine the direction of blood flow, which may be important in some situations.
- **Spectral Doppler** displays blood flow measurements graphically, in terms of the distance traveled per unit of time, rather than as a color picture. It can also convert blood flow information into a distinctive sound that can be heard with every heartbeat.

Terminology

Below are useful terms on ultrasound:

- Echogenic — giving rise to reflections (echoes) of ultrasound waves
- Hyperechoic – more echogenic (brighter) than normal
 - Hypoechoic – less echogenic (darker) than normal
 - Isoechoic – the same echogenicity as another tissue
- Transvaginal ultrasonography – Ultrasound is performed through the vagina
 - Transabdominal ultrasonography – Ultrasound is performed across the abdominal wall or through the abdominal cavity

What some common uses of the procedure?..

Ultrasound is used to help physicians evaluate symptoms such

as:

pain

swelling

infection

Doppler ultrasound images can help the physician to see and evaluate:

blockages to blood flow (such as clots)

narrowing of vessels

and others

Types the Transducers



Linear Probe

A linear probe uses high frequency ultrasound to create high resolution images of structures near the body surface. This makes the probe ideal for vascular imaging and certain procedures such as central line placement.



Curvilinear Probe

A curvilinear probe uses lower frequency ultrasound allowing a deep penetration and a wide depth of field, which is excellent for viewing intra-abdominal structures.(OB(



Phased Array Probe

Phased array probes give a large depth of field with a small footprint allowing the ultrasound to view deep structures though a small acoustic window. This makes it the ideal probe for viewing structure in the chest as the ultrasound waves are beamed between the ribs.(fetal)

Preparation:

Preparation for Obstetrical or Pelvic Ultrasound:

1. start drinking 4 full 8 ounce glasses of water.

Finish drinking the water 1 hour prior to your exam. DO NOT Empty bladder prior to your exam.

2. If the pressure on your bladder becomes unbearable, you can release the equivalent of 1 cup of fluid

Preparation for Abdominal Ultrasound (Liver, Spleen, Gallbladder, Pancreas, Aorta etc).

1. Nothing by mouth for 12 hours prior to your examination - ABSOLUTELY NO SMOKING AND NO CHEWING GUM.

2. If you have essential medication that must be taken, a small amount of water is permitted.

3. FOR INSULIN DEPENDANT DIABETICS ONLY

- If you are asked to miss breakfast, take ½ your normal dose of insulin
- If you are asked to miss any other meal, consult your physician for further instructions
- After the exam you may resume your normal eating and insulin routine.

Preparation for Abdominal and Pelvic Ultrasound:

1. Nothing by mouth except CLEAR FLUIDS for 12 hours prior to the exam - ABSOLUTELY NO SMOKING AND NO CHEWING GUM.
2. 4 Hours prior to your exam, empty your bladder and begin drinking 4 full 8-ounce glasses of water.
3. Finish drinking your water 1 hour prior to your exam. DO NOT empty your bladder before your exam.

Preparation for Renal (Kidney) Ultrasound:

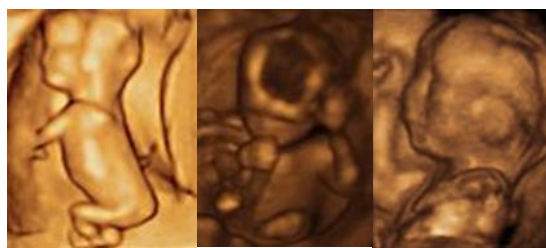
1. Eat normally.
2. Finish drinking 4 full 8-ounce glasses of water 1 hour prior to your exam. DO NOT empty your bladder.

Applications

1. Obstetric ultrasonography

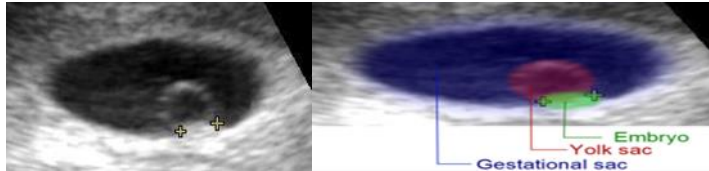
3D ultrasound

Modern 3D ultrasound images provide greater detail for prenatal diagnosis



Early pregnancy

A gestational sac can be reliably seen on transvaginal ultrasound by 5 weeks' gestational age , most miscarriages also happen by 7 weeks' gestation.



First trimester

In the first trimester, a standard ultrasound examination typically includes:

- Gestational sac size, location, and number
- Identification of the embryo and/or yolk sac
- Measurement of fetal length (known as the crown-rump length)
 - Fetal number, including number of amnionic sacs and chorionic sacs for multiple gestations
 - Embryonic/fetal cardiac activity
- Assessment of embryonic/fetal anatomy appropriate for the first trimester
- Evaluation of the maternal uterus, tubes, ovaries, and surrounding structures
- Evaluation of the fetal nuchal fold, with consideration of fetal nuchal translucency assessment

Second and third trimester

In the second trimester, a standard ultrasound exam typically includes:

- Fetal number, including number of amnionic sacs and chorionic sacs for multiple gestations
 - Fetal cardiac activity
 - Fetal position relative to the uterus and cervix
- Location and appearance of the placenta, including site of umbilical cord insertion when possible
 - Amnionic fluid volume
 - Gestational age assessment
 - Fetal weight estimation
 - Fetal anatomical survey
- Evaluation of the maternal uterus, tubes, ovaries, and surrounding structures when appropriate

Influencing factors

The accuracy of fetal sex discernment depends on:

- Gestational age
- Precision of sonographic machine
 - Expertise of the operator
 - Fetal posture

2. CRANIAL US

Ultrasound imaging of the head uses sound waves to produce pictures of the brain and cerebrospinal fluid. It is most commonly performed on infants, used to evaluate brain tissue and the flow of blood to the brain.

Transcranial Doppler

A transcranial Doppler (TCD) ultrasound evaluates both the direction and velocity of the blood flow in the major cerebral arteries of the brain. This type of ultrasound exam is also used during surgical procedures to monitor blood flow in the brain.

What are some common uses of the procedure?

Head ultrasound is a routine exam for infants who were born prematurely. The procedure is used to screen for brain conditions associated with prematurity, such as bleeding or brain tissue damage