Sudan University of Science and Technology

Collage of Graduate Studies

Study of MRI Image Artifacts in Khartoum State hospitals

دراسة الشوائب في صور الرنين المغناطيسي في مستشفيات ولاية الخرطوم

A thesis submitted for partial Fulfillment for the Requirement of the M.SC Degree in Diagnostic Radiologic Technology

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

الأيـــــــة

قَالَ تَعَالَىٰ:

﴿ أَلَمْ نَشْرَحْ لَكَ صَدْرَكَ ﴿١﴾ وَوَضَعْنَا عَنكَ وِزْرَكَ ﴿٢﴾ ٱلَّذِىٓ أَنقَضَ ظَهْرَكَ ﴿٣﴾ وَرَفَعْنَا لَكَ ذِكْرَكَ ﴿٤﴾ فَإِنَّ مَعَ ٱلْعُسْرِ يُسْرًا ﴿٥﴾ إِنَّ مَعَ ٱلْعُسْرِ يُسْرًا ﴿٦﴾ فَإِذَا فَرَغْتَ فَٱنصَبْ ﴿٧﴾ وَإِلَىٰ رَبِّكَ فَٱرْغَب ﴿٨﴾ ﴾

صدق الله العظيم

سورة الشرح الأيه من 1-8

Dedication

To

My family
****

My teachers
****

My friends
****

My colleagues
****

Acknowledgments

Firstly I thank my God for his help to finish this work successfully I would like to express my deepest gratitude dedication to Mysupervisor Dr. IKHLAS ABDELAZIZ HASSAN MOHAMMED For her guidance. I also need to thank all people help me to finish this work.

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List of Abbreviations

MRI Magnetic Resonance Imaging

NMR Nuclear Magnetic Resonance

FSE Fast Spin Echo

FOV Field of View

PERU Physiological Electro-Cardiography Respiratory Unit

ECG Electro- Cardiography

RF Radio Frequency

T Tesla

SE Spin Echo

CSF Cerebro Spinal Fluid

TE Echo Time

MRA Magnetic Resonance Angiography

EPI Echo Planar Imaging

KADC Khartoum Advance Diagnostic Center

MR Magnetic Resonance

Abstract

The aim of this study was to evaluate the common Artifacts in MR images in Khartoum State hospitals and detecting their Causes in order to give a solution for each if possible. Using observation to calculate the data along 4 month on Alzytona specialist hospital and Alribat university hospital , Artifacts in magnetic resonance images, as in different Radiologic imaging Modalities are common and lead to misdiagnosis or at least decrease the Image quality. The causes are different and as a result there are many Types of Artifacts and The result showed that the most common Artifact is Motion record High percentage 48%, the second common Artifacts was Phase mismmaping 18%, then Truncation and magic angle 8% ,from coil(cross excitation) and breathing and chemical shift 6% Through my search for most common Artifacts in the magnetic resonance imaging hospitals in Khartoum state we found most common artifacts that is of patient movement (motion Artifacts) due to differentials reasons e.g.: unconscious patient ,lack cooperation .And Phase mismmaping Artifacts appear from involuntary motion e.g: Brain artifacts appear because of the phase missmapping artifacts and truncation . And also we found Artifacts in the Pelvic because of the following reasons Motion of the patient. It also the artifacts appears in the Cervical because motion . And knee because magic angle and chemical shift and motion. And lumber because chemical shift ,motion and truncation. Accorndingly most technologists used FSE Sequence to reducal shift and the Artifacts. All the Examination in department is done on Adults because of the lack of the Anesthetic for children.

الملخص

الهدف من الدراسه هو تقييم أشهر أنواع الشوائب التي تظهر في صور الرنين المغناطيسي والكشف عن اسبابها من اجل اعطاء حل لكل إذا كان ذلك ممكنا وذلك بالملاحظه لحساب البيانات علي مدي 4 اشهر في المستشفيات المتخصصه في ولاية الخرطوم . الشوائب في صور الرنين المغناطيسي تؤدي الي تشخيص خاطئ فتقلل من جودة الصوره.لذلك الشوائب لها انواع واسباب مختلفه. فنجد اكثر انواع الشوائب انتشارا ناتجه عن حركة المريض سجلت اعلي نسبه تصل الي 48% . ويأتي ثانيا من حيث تسجيل أعلي نسبه الشوائب الناتجه من الحركه الاإراديه وتصل نسبة حدوثها ل 18% ، وثالثا اختلاف الاشارات في الصوره من اعلي اشاره الي اقلها ناتجه من تكرار الاشاره في موضع معين ومن الشوائب الناتجه من الزاويه وتصل حتي 8%،رابعا الشوائب من الملف ومن التنفس ومن التحول الكيميائي وتصل الي 6%. من خلال بحثي عن اشهر انواع الشوائب في مستشفيات التصوير بالرنين المغناطيسي في ولاية الخرطوم ، وجدت ان اكثر انواع الشوائب ظهورا ناتجه عن حركة المريض ناتجه عن المريض فاقد للوعي، وعدم تعاون المريض. ومن ثم النوع الثاني من انواع الشوائب ناتجه عن الحركه الاإراديه مثل تحرك الصدر أثناء التنفس ثالثا إشارات مختلفه عاليه ومنخفضه ناتجه عن ازدواج الاشارات ، لكن هناك بعض أنواع الشوائب تظهر بنسب منخفضه، مثل: عدم التخطيط السليم لصور الرنين المغناطيسي، وتظهر خاصة في الفقرات نتيجه لانه لايجب ان لا تقل الفجوه عن 30% بين الشرائح.

Chapter one

1-1Introduction

Artifacts in magnetic resonance imaging and foreign bodies within the patient's body may be confused with pathology or may reduce the quality of examinations. Radiologists are frequently not informed about the medical history of patients and face postoperative/other images they are not familiar with. A gallery of such images was presented in this manuscript. A truncation artifact in the spinal cord could be misinterpreted as a syrinx. Artifacts in MR images refer to pixels that do not faithfully represent the anatomy being studies. (Mark. Brown, 2010). In the images, the general appearance is that the underlying anatomy is visualized, but spurious Signals are present that do not correspond to actual tissue at the location.The artifact may ormay Not be easily discernible from normal anatomy, particularly ifthey are of low intensity, and may or May not be reproducible.Artifacts can be categorized in many ways. (Mark. 2010).Artifact is a structure that is not anatomically present but isvisible in a MRI examination; they are sometimes present in MRimages and tend to affect them.MRI artifacts, however, can also have clinical utility and even help radiologists to reach a diagnosis (Zhu., 2006).To remedies of the artifacts that are controlled by operator variable parameters.. These artifacts can usually be ameliorated or avoided by altering parameters that are under operator control and employing remedial measures, thus maintaining good image quality and avoiding diagnostic errors, thereby enhancing the usefulness of MRI in clinical .practice.. Finally the high information content of MRI exams brings with it unintended effects, which we call artifacts. The purpose of this review is to promote understanding of these artifacts; so they can be prevented or properly interpreted to optimize diagnostic effectiveness. We begin by addressing static magnetic field.(Uniformity. (Martin. 2013)

1.2 Problems of the study

There are many MRI artifacts their causes are unknown, in this Study there is a trial to know some of them.

1.3 Objectives of the study

1.3.1 General objectives

Study of MRI Image Artifacts in Khartoum State .The aim of this study was trying to understand the Artifacts to be in magnetic Resonance devices and find a way to remove them from the images because it causes problems in the proper diagnosis of MRIs.

1.3.2Specific objectives

To determine the MR images artifacts in MR hospitals in KhartoumState.To know and evaluate the causes of the causes of the MR imagesartifacts in MR centers.To recommend how to avoid or treat the MR images artifact.

1.4 Importance of the study

List the MRI artifacts and their causes in order to avoid them.
To gain a high images quality without any artifacts.

Chapter Two

Literature Review
The MR component

2.1 The magnet

The homogeneous magnetic field required for MR imaging is generated by a strong magnet. This magnets if the mostimportant and expensive component of the MR System , Thestrength of the magnetic field, expressed by the notation (B), or inthe Case of more than one field, primary field (Bo) and thesecondary field (B1), Can be measure in one of three units: gauss((G), Kilogauss (Kg), and Tesla (T.Tesla is the unit used to measure higher magnetic field strength.One Tesla Equal 10 (kg) equal 10.000 G, Most MR systems operateform as low as 0.3 T to as high as 2 T range, There are manyhazards created by the presence of the magnetic field, Ferrousobjects are attracted by the magnetic field and can act asprojectiles, Being pulled by the magnetic field if brought the tooclose to the magnet, Serious injury or damage could result. Also,common hospital equipment may be adversely affected when inproximity to the magnetic field, or image quality May be affectedby the presence of this equipment.There are three basic types of magnets used in MR system:-

2.1.1 Resistive magnets

The magnetic field strength in a resistive magnet is dependentupon the Current which passes through its coils of wire thedirection of main magnetic Field in resistive magnet follow theright hand thumb rule, and produces lines of flux runninghorizontally from the head to the foot of the magnet.As resistive system primarily consists of loops carrying current, itis lighter in weight than the permanent magnet and although itscapital quite high due to the large quantities of power required tomaintain the magnet field. The maximum field strength in asystem of this type is less than 0.3 T due to its excessive power(requirement.

2.1.1.2 Permanent magnet

Its magnet field is always there and always on full strength, so itcosts nothing to maintain the field. The major drawback is thatthese magnets are extremely Heavy – many, tons in weight at the0.4 Tesla level. A stronger field would require a magnet so heavyit would be difficult to construct. Permanent Magnets are gettingsmaller, but are still limited to low field strength. (Catherine (Westbrook. Et al 1998.

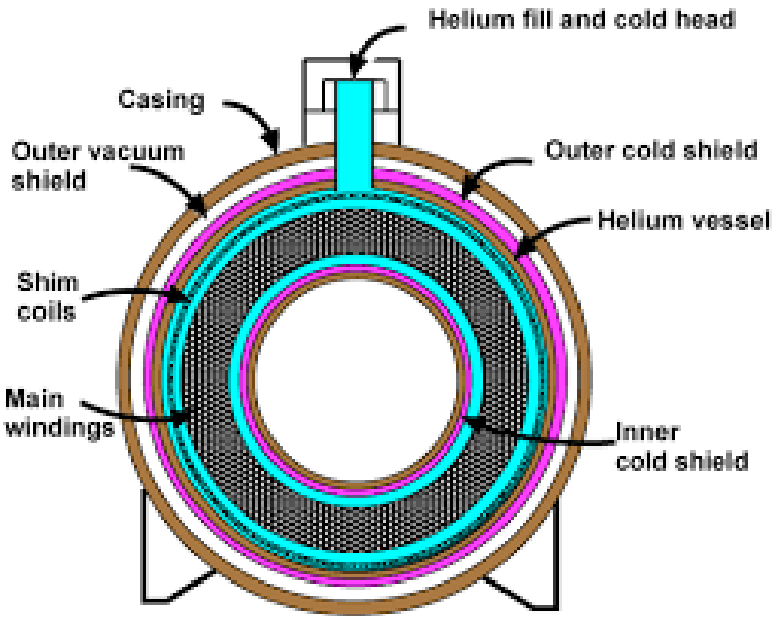
2.1.1.3 Superconducting magnets

Are the most commonly used a resistance decrease the currentdissipation also decreases. A superconducting magnet issomewhat similar to resistive Magnet coils or windings of wirethrough which current electricity is passed create the magnetfield. The important difference is that the wire is Continuallybathed in liquid helium at 452.4 degrees below zero cold causesThe resistance in the wire to be drop to zero, reducing cold causesthe Resistance in the wire to be drop to zero; reducing theelectrical requirement For the system and making it much moreeconomical to operate. Superconductive systems are veryexpensive, but they can easily generate 0.5 Tesla to 2T fieldallowing for much high quality imaging. (Catherine. Et(al 1998.

2.1.2 The coils

2.1.2.1 Shim coil

Due to design limitations it is almost impossible to create anelectromagnet which produces a perfectly homogeneousmagnetic field, to correct for these in homogeneities, other loopsof current carrying wire are placed around the Bore, This processis called Shimming and the extra loop of wire is called a shim coil,Shim coils produce magnetic field evenness of homogeneity. Forimaging Purpose, homogeneity of the order of 1.0 pmm isrequired. Spectroscopic Procedures require a more homogeneousenvironment of 1 pmm.The shim system requires a power supply which is separate from the other Power supplies within thesystem. This is important because a fault in the shim Powersupplies within the system. This important because a fault in theshim Power supply compromises image quality. (Catherine. Et al 1998.



(Fig (2.1): Parts of magnet (Shim coil

2.1.2.2 Gradient coils

The gradient coils are the three sets coils within the magnethousing. Running through these coils in a specified mannercreates controlled And graded variations in the static magnetic.field, thus affect nuclear Processional frequency in away givenvoxel of anatomy and allowing for spatial Detection of signalwithin slice. An MRI systems uses three gradient coils, eachaffects a different plane, the XY, YZ or XZ plane, as it is turned onand off at different points in a pulse Sequence. How all three areused depends on the scan plane and the pulse Sequences being used, the system calculated this automatically.

Fig (2.2): Gradient Coils

2.1.2.3RF coils

MRI machines come with many different coils designed fordifferent Parts of the body: knees, shoulders, wrists, head necksand so on. These coils usually conform to the contour of the bodypart being imaged, of at least reside very close to it during theexam.bat approximately the same time. The three gradientmagnets jump into the act. They are arranged in such a mannerinside the main magnet that when they are turned on and off veryrapidly in a specific manner, they alter the mainmagnetic field onA very low level. What this means is that we can pick exactly whatarea we Want a picture of an MRI we speak of "slices". We can"slices" any part of the Body in any director giving us hugeadvantage over any other imaging Modality. This means themachine will not move to get an image from a Different direction;the machine can manipulate everything with the gradientMagnets. RF coils are the "antenna" of the MRI system thatbroadcasts the RF signal to the patient and/ or receive the returnsignal. RF coils can be receive only, in which case the body coils isused as a transmitter, or transmit and receive (Transereceiver).Surface coils are the simplest design of coil. They are simply aloop of wire, either circular or rectangular, that is placed over theregion of interest. The depth of the image of a surface coils isgenerally limited to about one Radius. Surface coils arecommonlyused for spines, shoulders, TMJ's, and Other relatively small bodyparts. Paired saddle coils are commonly used for imaging of theknee. These Coils provide better homogeneity of the RF in thearea of interest and are used as volume coils, unlike surface coils.Paired saddle coils are also used for the X and Y gradient coils. By running current in opposite directions in the two halves of thegradient coil.

(Fig (2.3): RF coils (Head coils

2.1.2.4 The Helmholtz pair's coils consist of

Two circular coils parallel to each other. They are used as zgradient coils In MRI scanners. They are also used occasionally asRF coils for pelvis Imaging and cervical spine imaging. The birdcage coil provides the best RF homogeneity of all the RF coils. Ithas the appearance of a bird cage; hence, its name. This coil iscommonly used as a transceiver coil for imaging of the head. This type of coil is also used occasionally for imaging of the extremities, such as the knee.

2.1.3 The Computer systems

We have the computer that directs all of the action in the MRIacquisition and acquires and processes the data. The computertells the gradient Amplifiers and RF transmitter when to run onand off to obtain the proper Pulse sequence. The RF receiveramplifier is also controlled by the computer and relays the signalreceived by the RF coil from the patient to the A-D Converter thatdigitizes the signal, and from there to the computer to be reconstructed into an image.

2.2MRI artifacts

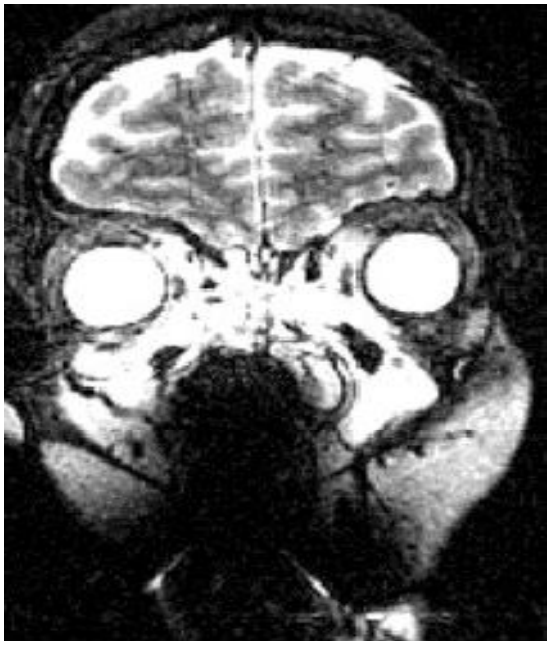
Items of magnetic resonance (MR) image, artifact is an abnormalarea of Signal in the image that does not normally arise frompatient anatomy or pathology. An artifact may be defined as anobject that has been intentionally made or Produced for a certainpurpose. Also an artifact' is sometimes used to refer toexperimental results which are not manifestations of the naturalPhenomena under investigation, but are due to the particular(experimental Arrangement. (Catherine Westbrook, 1999.

2.2.1 MRI Artifacts: causes and their compensation

2.2.1.1 Ferromagnetic Artifacts

Magnetic susceptibility artifact) Magnetic susceptibility is the)ability of a substance to be magnetized. Is caused by focaldistortions in the main magnetic field due to presence offerromagnetic objects such as orthopedic devices, surgical clipsand Wire, dentures, and metallic foreign bodies in the patient. Theartifact is seen as signal void at thelocation of

the Meta implant,often with aim of increased intensity and distortion of the image in the vicinity.



.**Fig (2.4): Ferromagnetic material**

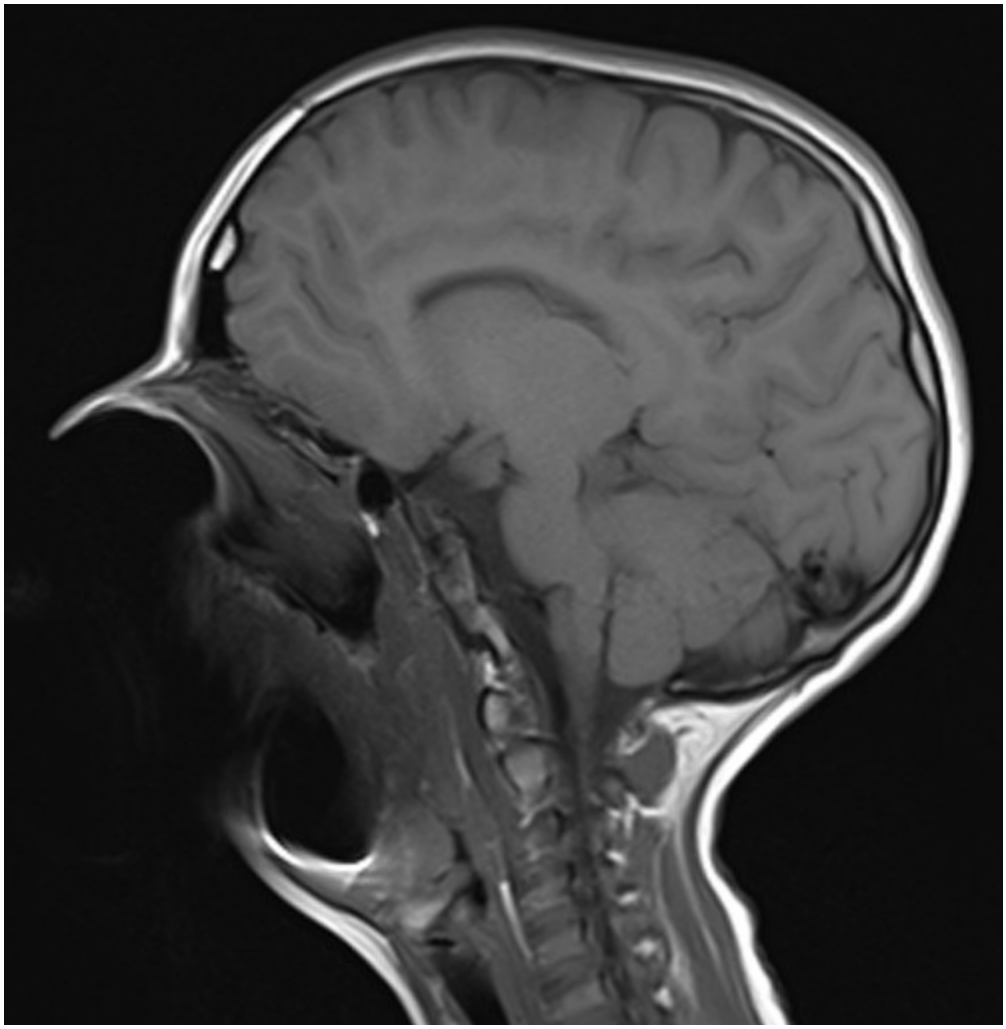


Fig (2.5): A metal artifact

2.2.1.1.1The remedy of M.S

1- Removed all metal items where possible before scan.

2- The use of spin echo sequences reduces the artifact.

3- MS can be used to aid diagnosis in case of hemorrhage.

2.2.1.2 (Phase mismapping (Motion Ghosting

Is produced and originates from any structure that moves duringAcquisition of data, for example, chest wall during respiration, Pulsate movement of vessels, swallowing, eye movement…etc. This artifact may result in fuzziness on the image or a lack ofDetails. Phase mismapping always occurs during along the phaseencoding Axis. This due to the inherent time delay between phase (encoding and readout. (Catherine Westbrook, 1999.

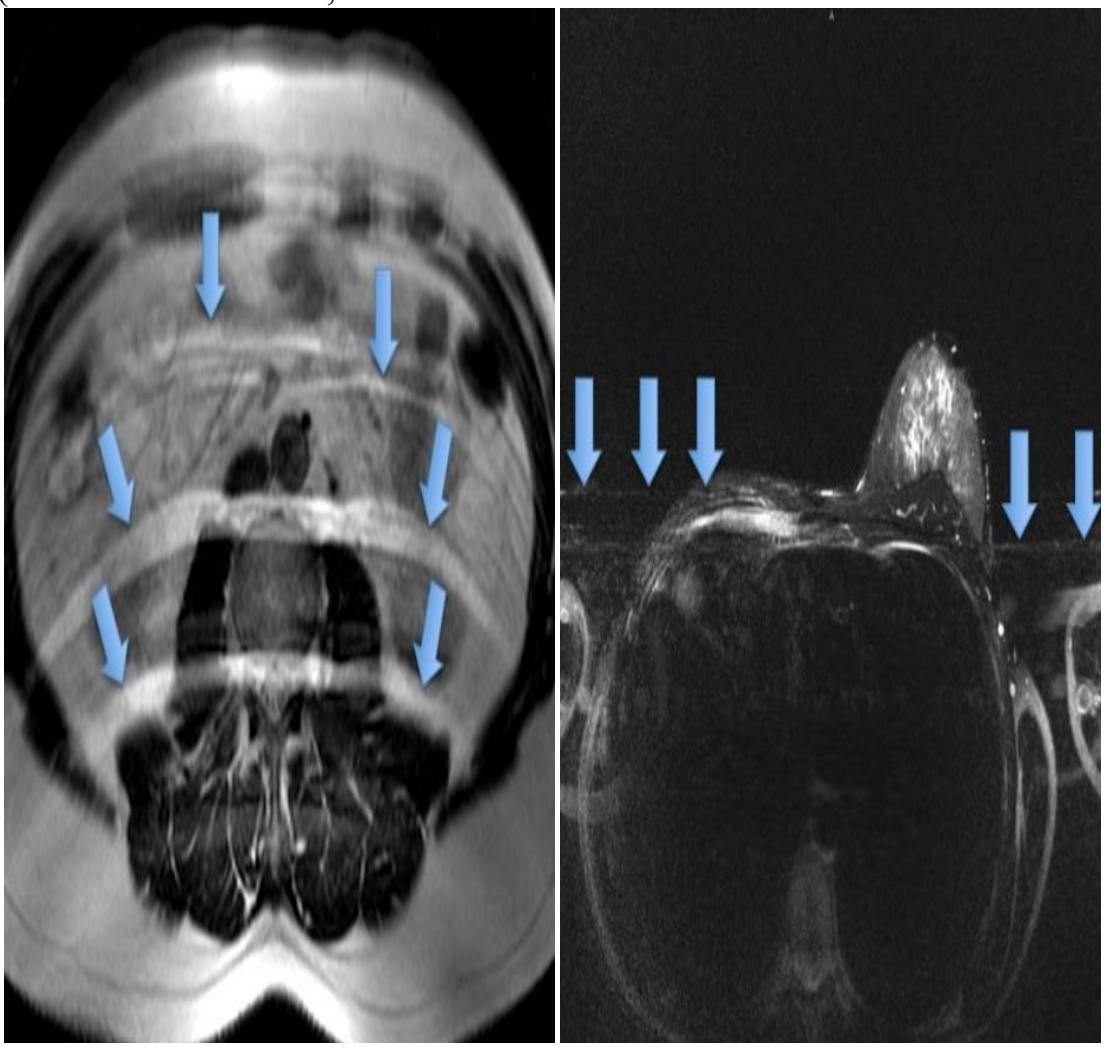


Fig (2.6): Phase Mismmaping

2.2.1.2.1The remedy of ghosting artifact

Changing direction of phase encoding axis, so that the artifactdoes not interfere with area of interestProcess known as pre-saturation null signal from specified areasPlacing pre-saturation volumes over the area producing artifactNullified signal and reduces the artifactUsed respiration compensation(Gating (ECG, Peripheral.

2.2.1.3 Chemical shift Artifact

Occurs at bound interfaces between fat and water. Proton in lipidmolecules Experience a slightly lower magnetic influence thanprotons in water when exposed to an externally applied gradientmagnetic field resulting in Misregistration of signal location. Thisoccurs along the frequency encoding Axis. (Catherine Westbrook,(1999.

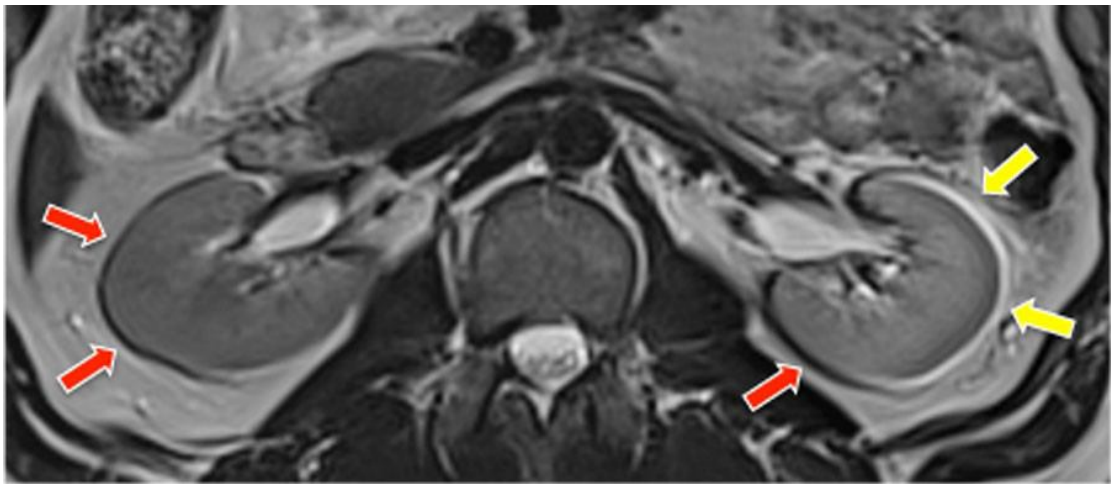


Fig (2.7): Chemical Shift Artifact

2.2.1.3.1 The remedy of chemical shift

1-Scanning at low field.

2-Keeping (FOV) to minimum.

3-At high field strengths the size of receive band width is the oneway of Limiting chemical shift. Widest band width

2.2.1.4 Chemical misregistration

This artifact is caused by the difference in processional frequencybetween Fat and water, which are in phase at certain times andout of phase at others. Fat and water in phase their signal isadded, fat and water out of phase their signal cancel each otherout, this cancellation causes a ring of a dark signal around certainorgans where fat and water interface occur within the same voxel.

2.2.1.4.1 The remedy of chemical misregistration

USE (SE) or fast spin echo (FSE) pulse sequences
Use a TE that matches the periodicity of fat and water so that theecho is generated when fat and water are in phase.

2.2.1.5 Truncation artifact

This artifact results from under sampling of data at the interfaceof high and low signal, which are incorrectly represented on theimage. A common site for this artifact is in T1 sagittal image ofcervical spine, where There CSF and spinal cord (Gibbs artifact).Occurs in phase direction. The truncation artifact appears asmultiple rings of regular periodicity or duplication at transitionbetween high and low intensity signals. (Catherine, (1999.

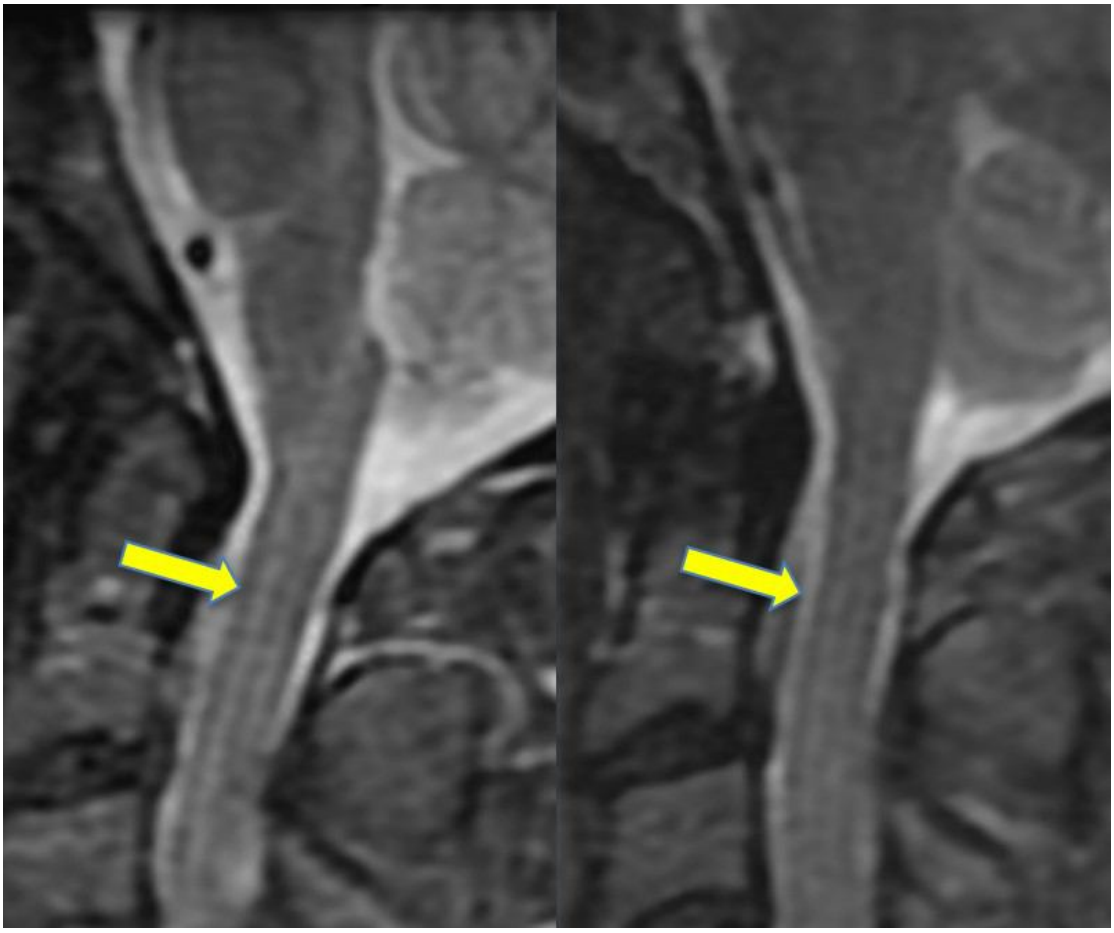


Fig (2.8): Truncation Artifact

2.2.1.5.2 The remedy of truncation

Increase the number of phase in coding stepsForexample, use 256*256 matrixes instead of 256*128.

2.2.1.6 Zipper artifact

This artifact appears as a dense line on the image at a specificpoint. This is caused by extraneous RF entering the room atcertain frequency, and interfering with the inherent weak signal .coming from the patient. It is caused by a leak in the RF shielding(of the room. (Catherine Westbrook, 1999

Fig (2.9): Zipper Artifact

2.2.1.6.1 The remedy of zipper artifact

Call the engineer to locate the leak and require it.

2.2.1.7 (Aliasing artifact and remedy (Wrap around

Aliasing is an artifact produce when anatomy that exists outsidethe F.O.V is mapped inside the F.O.V. for example: on a midlinesagittal brain MR image, the patient nose may artifactuallydisplayed over the area of Posterior fossa. Aliasing can occuralong both the frequency and phase axis. The appearance is asthough the image that was not properly sampled has been folded(over on the opposite of the image. (Catherine Westbrook, 1999.

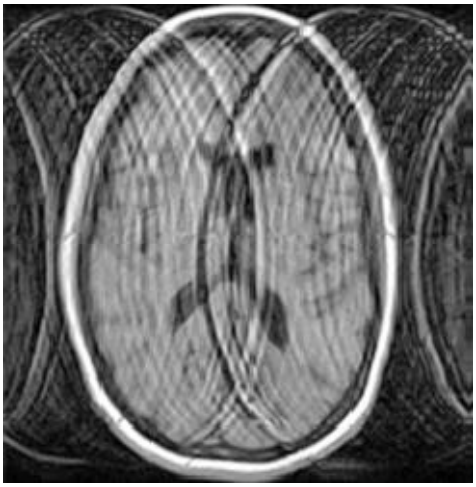


Fig (2.10): .(Aliasing Artifact (Wrap around

2.2.1.7.1 The Remedy of aliasing artifact

1-Increase the FOV (decrease resolution).
2- Oversampling the data in the frequency direction (standard) and increasing phase steps in the phase- encoded direction- phase compensation (time or SNR penalty).
3-Swapping phase and frequency direction so phase is in the narrower direction.
4-Use surface coil so no signal detected out side of FOV.
5-Saturation pulses may also be applied to structures in the nonimage portion of the FOV to reduce signal and, thuse, signal overlap.

2.2.1.7.2 Frequency wrap

Aliasing along the frequency encoding axis this is caused byunder sampling the frequencies that are present in the echo,these frequencies originate from any signal. Regardless ofwhether the Anatomy producing it is inside or outside the selected F.O.V. (Catherine Westbrook, 1999).

2.2.1.7.3 Phase wrap

Aliasing along the phase encoding axis. This is caused by undersampling alongThe phase axis, every phase value must be mapped into FOV inthe phase encoding direction.

2.2.1.7.4 Anti-aliasing

Anti-aliasing along frequency axis

Termed on frequency wrap uses digital RF phase to cut off signalfrequenciesAt the edges of the F.O.V along the frequencyaxis. (Catherine(Westbrook, 1999.

2.2.1.7.5 Anti-aliasing along the phase axis

Termed no phase wrap. No phase wrap over samples along thephase Encoding axis by increase the number of phase encodingaxis by Increasing the number of phase encoding perform. This done by Enlarging the F.O.V. (Catherine Westbrook, 1999)

2.2.1.8 Shading artifact

Appears as a loss of signal intensity in one part of the image. Itsmain cause Is uneven excitation of nuclei within the patient dueto RF pulses applied at Flip angles other than 90 degree and 180degree, my occur with a large patient, who touches side of thebody coil and couples It at the point. Can also be caused byinhomgeneities in main magnetic field. (Catherine Westbrook,1999).

2.2.1.8.1 The remedy of Shading

1-Always ensure that the coil is laded correctly.
2-Patient is not touching the coil at any point.
3-frequency and amplitude of Applied RF pulses

2.2.1.9 Cross excitation and cross talk

Energy given to nuclei in adjacent slices by the RF pulse, so thatthey become saturated when they themselves are excited. Theaffect is produced by energy Dissipation to adjacent slices, asnuclei within the selected slice relaxes to Bo. Cross excitation andcrosstalk affect image contrast.

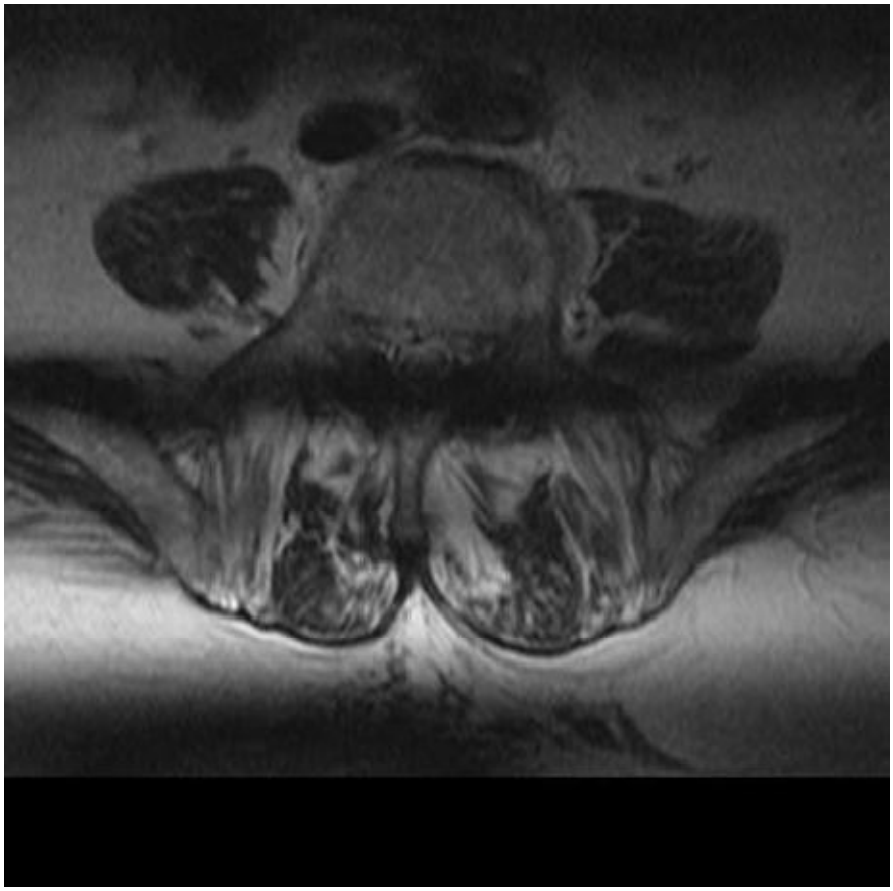


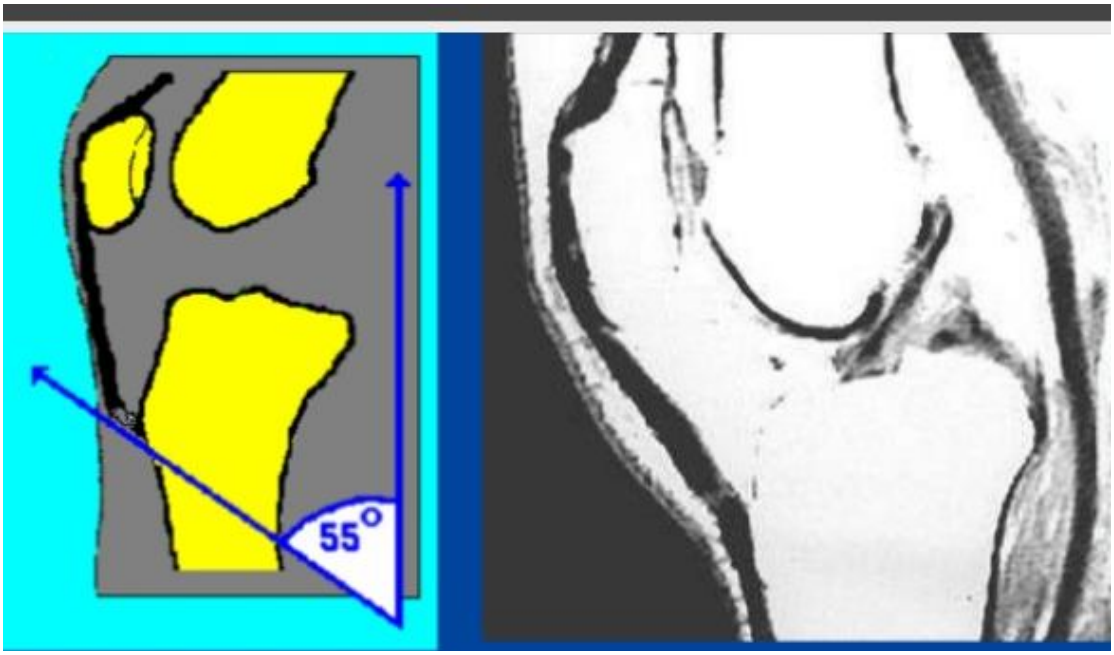
Fig (2.11): Cross .excitation and crosstalk

2.2.1.9.1 The remedy of cross excitation and Crosstalk

Ensuring that there is at least a 30% gap between slicesSquaring off the RF pulses by software.

2.2.1.10 Magic Angle Effects

-Produced by the particular physical properties of fibrillary tissue and their interaction with the static magnetic field.
-Seen most frequently in tendons and ligaments that are oriented at a 55 degree angle to the main magnetic field.
-Due to diplor intractions that reduce their T2 relaxation time.
-Normal diplor interaction between the H+ is in water molecular aligned in tendons shortens T2, causing loss of signal.
-T2 relaxation time is leghthened and maximal when these fibrillary structures are at 55 degree angle to B0.
-Maximal for short TE.



Fig(2.12) Magic angle effects

2.2.1.10.1 The Remedy of magic angle effects

-Lengthening TE.
-T1 weighted imaging.

2.2.1.11 Motion of the patient

Any motion of the patient causes artifact – motion is usually eitherInvoluntary (twitching, pulsation, bowel motion) or voluntary(Swallowing, nervousness), and cause image degradation. Motionartifacts are always propagated in the phase – encoding direction.Random patient motion appears as a blurring of the image. ((Catherine Westbrook, 1999.

2.2.1.11.1 The remedy of Motion

Involuntary motion can often be compensated for bowel motioncan be reduced by giving the patient an anti – spasmodic agentprior to the scan when imaging the abdomen or pelvisPulsation can be reduced by the use of pre – saturation gating orgradient moment nulling techniquesIncreasing NEX may also help, as this increases the number oftimes the signal is averaged. Motion artifact is averaged out ofthe image s it is more random in Nature than the signal itselfVoluntary motion can be reduced by making the patients ascomfortable as Possible

and immobilizing them with pas andstrapsA nervous patients always benefits from thoughtful explanation ofthe Procedure, and a constant reminder over the system intercome to keep stillA relative or friend in the room can also help in someCircumstances.

2.3 Previous study

In previous study done ALMOATASIM BELLAH YAGOOB, the result showed that the most common Artifact isMotion record High percentage 63%, the second common Artifacts was Phase mismmaping 30%, then Truncation 7%.

Chapter Three

3. Materials and Methods

3.1Materials

3.1.1Machine used

1-MRI machine in alribat university hosbital:-Coils: All the coils used. Magnet power:0.35T. Magnet type: Superconductive. Company: Neusoft medical.

2- MRI machine in ALZYTONA SPECIALIST HOSPITAL. Coils: All the coils used. magnetic power: 1.5T. Magnet type: Superconductive. Company: Toshiba.

3.1.2Area and duration

1-Area :- ALRIBAT UNIVERCITY HOSPITAL.
2-Area:- ALZYTONA SPICIALIST HOSPITAL.
DURATION:- FROM NOVEMBER 2016 TO FEBRUARY 2017.

3.2Methods of data collection :

3.2.1Practical Observation

By observation and analysis of MR images which has commonartifacts by Continuous visits to the ALRIBAT UNIVERCITY HOSPITAL and AL-Zaytona Specialist HOSPITAL and help some technicians.

3.2.2 The Data sheet:

Data Sheet for all technologists who work in the MR departmentBy distribution of the data sheet to the technologist in the MRdepartment, the findingof the data analysis was 100% of the staff proved that the mostcommon Artifacts are motion, Phase mismapping, cross excitation, truncation, for every hospital.

3.3 Data analysis

By analysis of MR Image we found the motion artifact and phasemismmaping artifact andtruncation, magic angle artifact
also from coil ,breathing ,chemical shift artifact. But the motionartifact is highest ratio and it is the common artifact in Khartoumhospitals.

Chapter Four

4.1 Result

This study has been done in MRI department at the ALRIBAT UNIVERCITY HOSPITAL and ALZYTONA SPRCIALIST HOSPITAL, for 50 subjects. The Total of the subjects 50 was classified into a or hospital artifacts, 4 groups, group one structure of artifacts, group two area or hospital artifacts,group three type of artifacts, group four get rid of artifacts.

Table (4.1) Frequency distribution of structure in which the artifact happen

Structure	Frequency	Percent	Valid Percent	Cumulative Percent
brain	11	22.0	22.0	22.0
cervical	9	18.0	18.0	40.0
knee	7	14.0	14.0	54.0
lumber	5	10.0	10.0	64.0
other area	8	16.0	16.0	80.0
pelvic	10	20.0	20.0	100.0
Total	50	100.0	100.0	

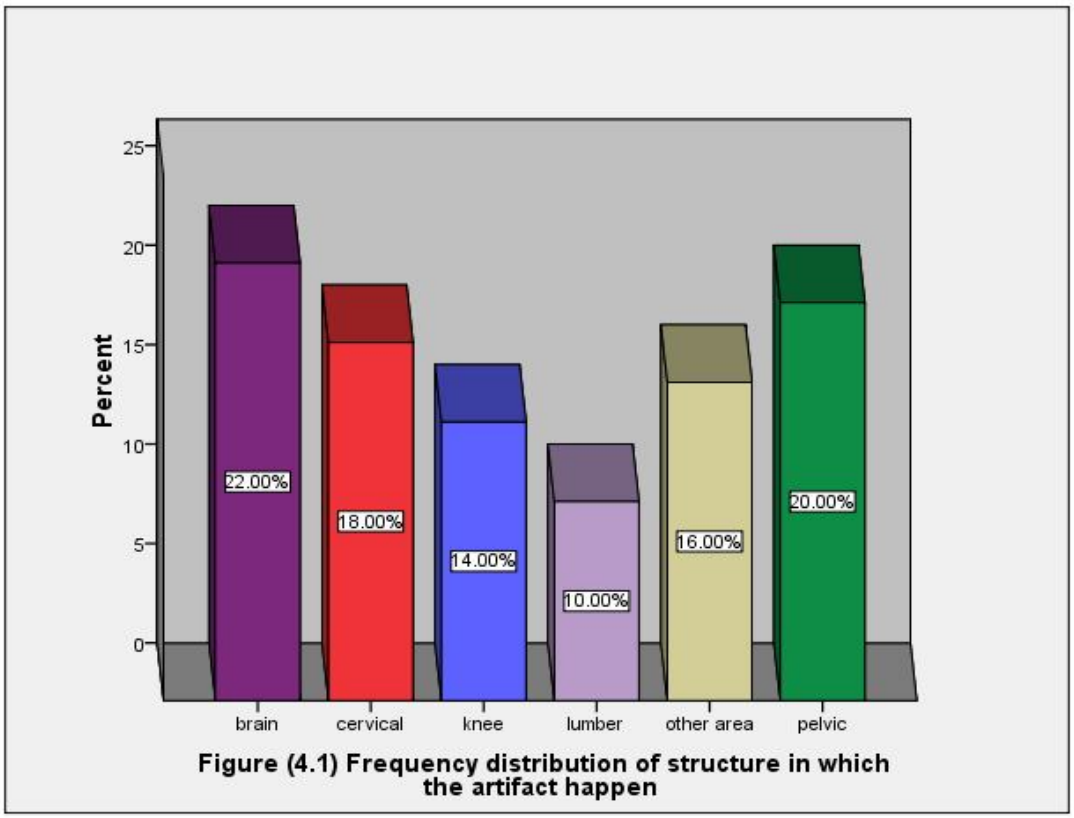


Figure (4.1) Frequency distribution of structure in which the artifact happen

Table (4.2) Frequency distribution of area or hospital in which the artifact happen

Area	Frequency	Percent	Valid Percent	Cumulative Percent
Alribat	12	24.0	24.0	24.0
Alzaitona	38	76.0	76.0	100.0
Total	50	100.0	100.0	

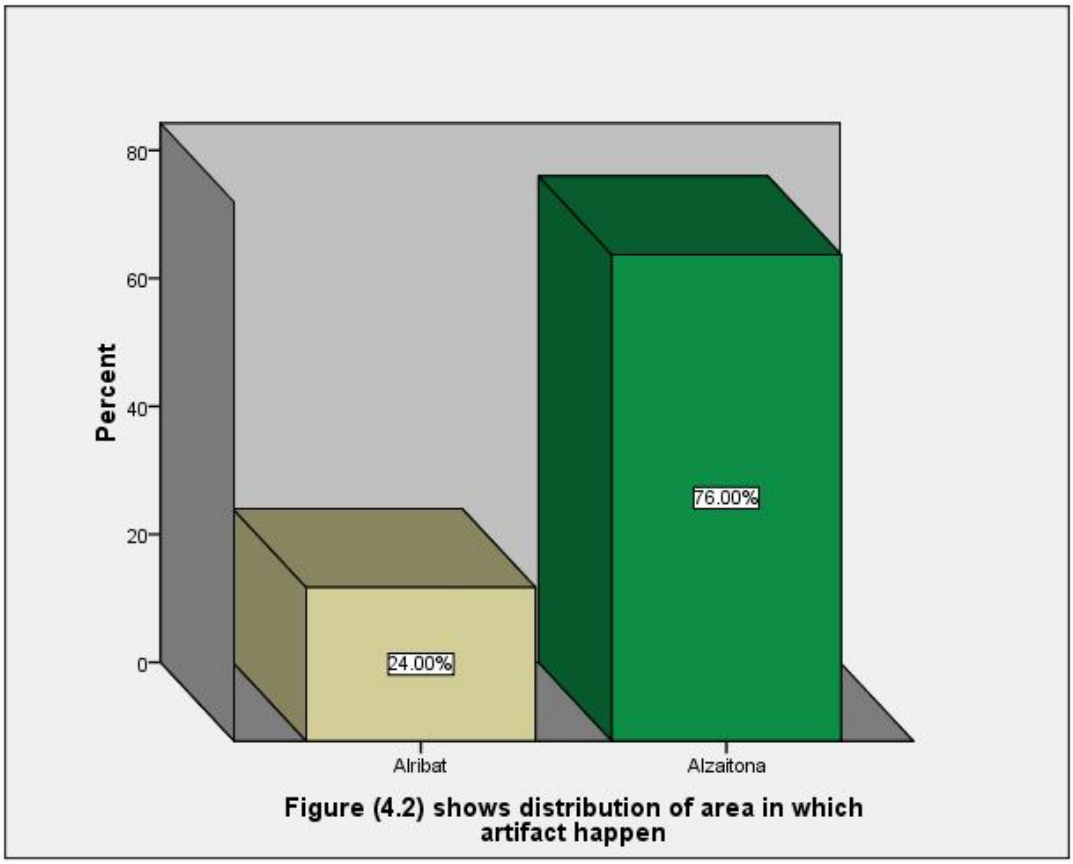


Figure (4.2) shows distribution of area in which artifact happen

Table (4.3) Frequency distribution of type of artifact

Type of artifacts	Frequency	Percent	Valid Percent	Cumulative Percent
Breathing	3	6.0	6.0	6.0
Chemical shift	3	6.0	6.0	12.0
From coil	3	6.0	6.0	18.0
Magic angle	4	8.0	8.0	26.0
Motion	24	48.0	48.0	74.0
Phase Missmaping	9	18.0	18.0	92.0
Truncation	4	8.0	8.0	100.0
Total	50	100.0	100.0	

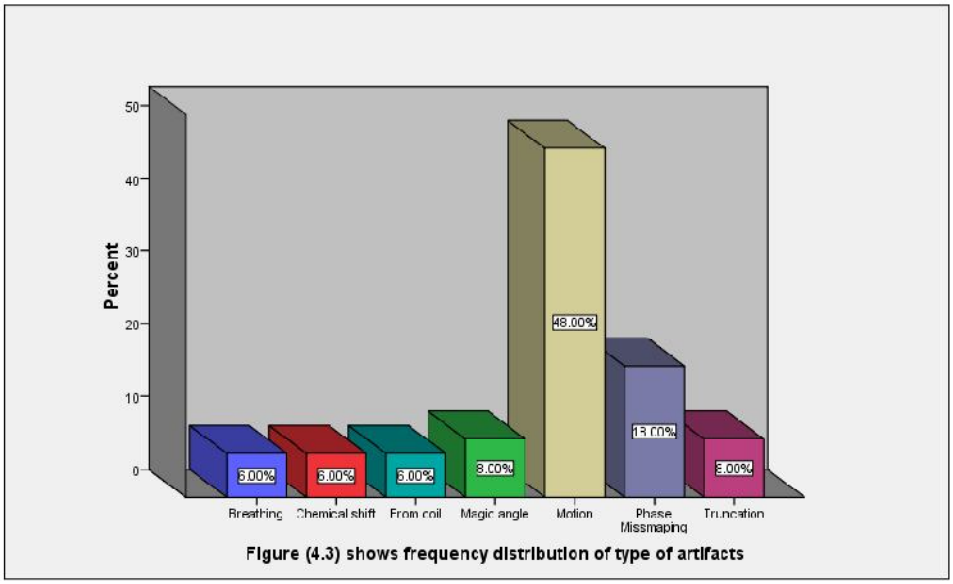


Figure (4.3) shows frequency distribution of type of artifacts

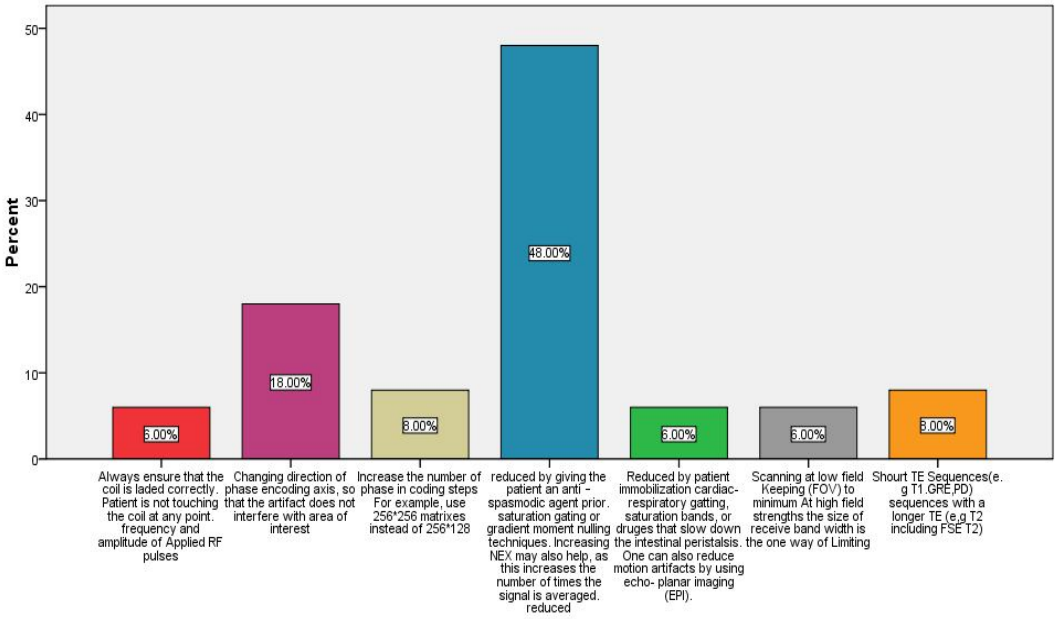


Figure (4.4) shows distribution of method of get rid of artifacts

Table (4.4) cross tabulation of structure and area of artifacts

Structure	Area		Total
	Alribat	Alzaitona	
brain	0	11	11
cervical	0	9	9
knee	7	0	7
lumber	5	0	5
other area	0	8	8
pelvic	0	10	10
Total	12	38	50
P value =0.000			

Table (4.5) cross tabulation of type of artifact and area of artifacts

Area of artifact	Type of artifact							Total
	breathing	chemical shift	from coil	magic angle	motion	phase Missmaping	truncation	
Alribat	0	3	0	4	3	0	2	12
Alzaitona	3	0	3	0	21	9	2	38
P value = Total	3	3	3	4	24	9	4	50
P value =0.000								

Table (4.6) cross tabulation between type and how to get rid of artifacts

Type	Method of get rid of artifact							Total
	Always ensure that the coil is laded correctly. Patient is not touching the coil at any point. Frequency and amplitude of Applied RF pulses	Changing direction of phase encoding axis, so that the artifact does not interfere with area of interest	Increase the number of phase in coding steps For example, use 256*256 matrixes instead of 256*128	Reduced by patient immobilization cardiac-respiratory gatting, saturation bands, or druges that slow down the intestinal peristalsis. One can also reduce motion artifacts by using echo-planar imaging (EPI).	Scanning at low field Keeping (FOV) to minimum At high field strengths the size of receive band width is the one way of Limiting	Shourt TE Sequences(e.g T1.GRE,PD) sequences with a longer TE (e,g T2 including FSE T2)	reduced by giving the patient an anti – spasmodic agent prior. saturation gating or gradient moment nulling techniques. Increasing NEX may also help, as this increases	

							the number of times the signal is averaged. reduced	
breathing	0	0	0	3	0	0	0	3
chemical shift	0	0	0	0	3	0	0	3
From coil	3	0	0	0	0	0	0	3
magic angle	0	0	0	0	0	4	0	4
motion	0	0	0	0	0	0	24	24
phase Missmaping	0	9	0	0	0	0	0	9
truncation	0	0	4	0	0	0	0	4
Total	3	9	4	3	3	4	24	50
P value = 0.000								

Chapter Five

5. Discussion, conclusion and recommendations

5.1 Discussion

Artifacts in magnetic resonance images, as in different Radiologic imagingModalities are common and lead to misdiagnosis or at least decrease the Imagequality. The causes are different and as a result there are many Types of Artifacts.This aim of this study was to evaluate the common Artifacts in MR images inKhartoum State hospitals and detecting their Causes in order to give a solution foreach if possible. We found the motion artifact has the highest ratio, and Phase mismmaping artifact, also the Truncation artifact, magic angle andartifact from coil (cross excitation), Breathing and chemical shift artifact. More Organs have multiplied artifactse.g.: Brain artifacts lacks the patient's cooperation- and then the Truncation artifacts, phase miss mapping. We found that Pelvis artifacts appear because of the Following reasons: the return motion patient. And also we found Artifacts in the Cervical because of the following reasons: Motion of the patientthe flow of blood in the carotid artery. It also the artifacts appears in the knee because magic angle and motion. And lumber spine because motion and truncation. In previous research shows that it is consistent with research in that the largest proportion of artifacts in the patient motion second phasemissmapping artifact then truncation but percentages vary .most technologists used FSE Sequence to reduce theArtifacts. All the Examination in department is done on Adultsbecause of the lack of the Anesthetic for children.

5.2 Conclusion

-The result of statistical analysis showed the most commonArtifacts (Motion) That is common causes of the patient motionare: Phobia, unconscious Patients, pain (especially in spine exam), long Scan time, cooling condition inexamination room and case with head First like brain examination.

-There is a traffic Artifact which affects the MR image, andfortunately found the MR examination rooms support with shielding to prevent RF coming from round traffic and position ofMR room in the center of Hospital departments.

- The rest ofArtifact has programs in software that reduce them.

- Also, phasemismmaping artifacts, Truncation artifact, and(cross excitation) from coilartifact that the main factor to the control them is thetechnologies by his good skills and good instruction for thepatients .
-The most cases which has high ratio of Artifact are Brain,Pelvic,Cervical, Knee And Lumber spine.
- And the artifacts which caused by involuntarymotion controlled By software and hardware and accessoriesadded to the MR machines, and The Artifacts caused by voluntarymotion, controlled by technologists.
-High power of magnet playmain role in improves image quality.
- Accessories added tomachines reduced the ratio of Artifacts such as (PERU).
- Most ofmedical materials which used now a day- except electronic- toInsert in patient body, are made of non magnetic mineral, whichallow the Patient to have MR image in time of necessity, withoutany side effect on Patient health. These types of materials are pools, clips, and nails.

5.3 Recommendations

-Good instruction and explanation should be given for the Patient.
-The patient must be comfortable as possible and immobilizing them with Pas and straps.
-MR machine must be supported by essential accessories (PERU) such as (Respiratory compensation, cardiac andperipheral gating) to avoid Involuntary motion.
-MR machine with magnetic power (1.5 T to above) in ALZYTONA SPECIALIST HOSPITAL,(0.35T) in ALRIBAT UNIVERCITY HOSPITAL should be available in the hospitals.
-Continuous education should be held for Technologists .
-(FSE) pulse sequence must be used as standard technique.
-Technologists must take care to close the door of MR examination room tightly during the examination to preventextraneous RF entering the Room.
-The coils should be used according to the organs, and close the clips tightly during the preparation of the patient forexamination.
-The patient who has a Phobia to enter magnetic centre during Examination, optical system must be used, in order towithdraw the idea of their staying in magnetic centre. Inaddition to head phone conducts with Relax audio source.
-If the equipments mentioned above not offer, the patient should be Anesthesia and supervised during examination.

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Appendices (A)

Figure (A.1) Male Coronal SE T1 weighted image of the Abdomen showing Motion Artifact.

Figure (A.2) Male Sagital SE T1 Weighted image of the Brain showing Motion Artifact.

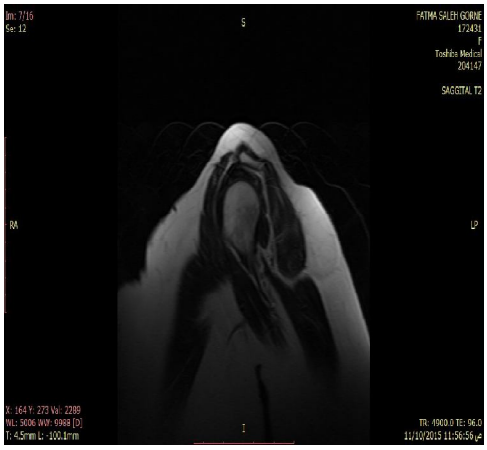

Figure (A.3) Female Sagital T2 Weighted image of the Shoulder showing Phase Mismmaping Artifact.

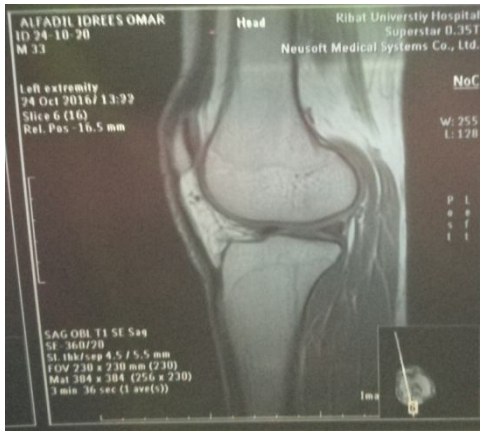

Figure (A.4) Male Sagital oblique SE T1 Weighted image of the knee showing magic angle .

Figure (A.5) FamalSagital oblique TSE T1 Weighted image of the lumber showing cross excitation (from coil).

Appendices

Study of MRI Image Artifacts in Two hospitals in Khartoum state
Data collection sheet

NO	CASE	HOSPITAL	ARTIFACT TYPE	AVOID