بسم الله الرحمن الرحيم

كلية الدراسات العليا

Sudan University of Science &Technology

College of Graduate Studies

Study of Knee Joint Injuries Using Magnetic Resonance Imaging

دراسة اصابات مفصل الركبه باستخدام تصوير الرنين المغنطيسي

A thesis Submitted for Partial Fulfillment of the Requirements of M.Sc. Degree in Diagnostic Radiological Technology

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الآية

بسم الله الرحمن الرحيم

قال تعالى:

وَلَوْلَا فَضْلُ اللَّهِ عَلَيْكَ وَرَحْمَتُهُ لَهَمَّتْ طَائِفَةٌ مِنْهُمْ أَنْ يُضِلُّوكَ وَمَا يُضِلُّونَ إِلَّا أَنْفُسَهُمْ ۖ وَمَا يَضُرُّونَكَ مِنْ شَيْءٍ ۚ وَأَنْزَلَ اللَّهُ عَلَيْكَ الْكِتَابَ وَالْحِكْمَةَ وَعَلَّمَكَ مَا لَمْ تَكُنْ تَعْلَمُ ۚ وَكَانَ فَضْلُ اللَّهِ عَلَيْكَ عَظِيمًا ﴿113﴾

صدق الله العظيم

سورة النساء الآية: 113

Dedication

To my lovely sweet family

To all whom I met while I'm inquiring for knowledge

Have faith.

Acknowledgment

This research project would not have been possible without the assistance of Many great people. Much gratitude to my supervisor Dr. Asma Ibrahim Ahmed for her supervision, encouragement and support through this work. My thanks also extend to the staff of Aliaa diagnostic Medical Center, for Their effort.

Abstract

The knee joint is the largest joint in the human body and is very complicated structure any injury to the ligaments can affect joint movement there for it is important to recognize these injuries.

The study was aimed to assess knee joint injuries by magnetic resonance imaging in order to find the associated factors. This descriptive study was conducted in Khartoum - Sudan at Aliaa hospital from 1/11/2019 up to1/1/2020 to evaluate knee joint injuries by magnetic resonance imaging.100 patient (66females and 34males) were scanned by 1.5 Tesla Toshiba system , the data was collected ,classified and analyzed using SPSS, and found that anterior curciate ligament (ACL) tear is the most common knee joint tear with a prevalence of 33% then 16% for medial meniscus (MM) and also found that females (66) were more affected than males(34), and the age group of (22-37) were more affected to knee joint injuries ,the study also concluded that there was no relation between patient's occupation and types of injury.

Finally, the study recommended that further studies should be done by larger sample size to determine the grade of ligaments tear and to assess knee joint osteoarthritis as incidental findings in young people.

الملخص

مفصل الركبه هو اكبر مفصل في جسم الانسان وله تركيب معقد اي اصابة للاربطة يمكن ان تؤثر على حركة المفصل لذلك من المهم التعرف على هذه الاصابات.

هدفت الدراسة الى تقييم اصابات مفصل الركبة باستخدام الصويربالرنين المغنطيسي لاجل ايجاد العوامل المؤثرة هذه الدراسة الوصفية قد تمت في ولاية الخرطوم بالسودان في مستشفى عليا التخصصي في الفترة من نوفمبر 2019حتى يناير2020 لتقييم اصابات مفصل الركبة بالرنين المغنطيسي .100 مريض 66 اناث و 34 ذكور تم فحصهم بجهاز توشيبا شدة المجال المغنطيسي(1.5 تسلا) تم جمع البيانات وصنفت وحللت باستخدام التحليل الإحصائي العلمي وقد وجدت الدراسة أن تمزق الرباط الصليبي الامامي هو الاكثر شيوعا بمعدل انتشار 33% ثم 16% للغضروف المفصلي الانسي ايضا وجدت ان الاناث (66) هن الاكثر تعرضا من الذكور(34) والفئة العمرية 22-34 هم الاكثر تعرضا لاصابات مفصل الركبة خلصت الدراسه ايضا الى انه لا توجد علاقه بين مهنة المريض ونوعية الاصابة .

اخيرا اوصت الدراسه بعمل دراسات باستخدام عينات اكبر حجما لتحديد درجة تمزق الاريطة و لتقييم مرض التهاب مفصل الركبة كنتيجة عرضية لدى الشباب .

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List of abbreviations:

ACL Anterior Circuate Ligament

BMI Body Mass Index

CL Cruicate Ligament

CT Computed Tomography

IT Iliotibial Band

LCL Lateral Collateral Ligament

LM Lateral Meniscus

LR Lateral Retinaculum

MCL Medical Collateral Ligament

MM Medial Meniscus

MR Medial Retinaculum

MRI Magnetic Resonance Imaging

PCL Posterior Cruicate Ligament

T Tesla

US Ultrasound

PD proton density

Chapter One

Introduction

Chapter One

1.1: Introduction

The knee Joint joins the thigh with the leg and consists of two articulation: one between the femur and tibia, and one between the femur and patella. It is the largest joint in the human body and is very complicated. The knee is a mobile trocho-ginglymus (a pivotal hinge joint), which permits flexion and extension as well as a slight medial and lateral rotation. The bony structures, ligament and tendons of the knee joint, Patella: protects quadriceps tendons as tendon move across the knee joint. The lateral and medial femoral condyles articulate with tibia. The lateral and medial tibia condayles are articulate with femoral condayles. The medial collateral ligament"MCL" are provides stability to inner (medial) aspect of the knee. Lateral cruciate ligament "LCL" is provides stability to outer (lateral) aspect of the knee. The anterior cruciate ligaments "ACL" are limits rotation and the forward movement of the tibia. Posterior cruciate ligament "PCL" are limits backward movement of the tibia. The quadriceps tendons are connects the quadriceps muscle to the patella and provide power to extend the legend. The patella tendon are connecting the patella to the tibia. The menisci are act as shock absorbers.

Since in humans the knee supports nearly the whole weight of the body, it is vulnerable to both acute injury and the development of osteoarthritis, and it is one of the most frequency injured regions of the body, and knee injuries of both an acute and chronic nature constitutes a major cause of pain and disability of among the athletic and non athletic population.Over the last decade, advances have been

made in the treatment of the knee disorders of equal importance have been improved in the diagnosis of these disorders. **(C.K.Warrick 1969)**

MRI of the knee provides detailed images of structures within the knee joint, including bones, cartilage, tendons, ligaments, muscles and blood vessels, from many angles. Magnetic resonance imaging (MRI) is a Non invasive medical test that physicians use to diagnose and treat medical conditions.MRI uses a powerful magnetic field, radio frequency pulses and a computer to produce detailed pictures of organs, soft tissues, bone and virtually all other internal body structures. MRI does not use ionizing Radiation (x-rays).Detailed MR images allow physicians to evaluate various parts of the body and determine the presence of certain diseases. The images can then be examined on a computer monitor, transmitted electronically, printed or copied to a CD. **(http://WWW.radiology Info.org).**

1.2: Problem:

Ligaments injury can affect the normal movement of the joint there for it needs a proper imagining modality to demonstrate that joint, request for MRI of the knee joint are most often made when patients present with painful knee, complete clinical examination is not possible in such situation due to severe pain.

1.3 Objectives:

1.3.1 General objectives:

The general Objective of this study is to characterization knee joint injuries by MRI in order to find the associated factors.

1.3.2 Specific objectives:

To identify knee joint injuries using MRI.

To assess the frequencies of knee joint injuries.

To find the patient bodies characteristics (age, BMI and gender).

To cross-correlate between types of knee joint injuries and body characteristics.

To detect the direct impact of individual’s occupation on incidence of injures.

Chapter Two

Literature Review

Literature Review

2.1 Anatomy of the knee joint:

The knee is the most complicated and largest joint in our body. It's also the most vulnerable because it bears enormous weight and pressure loads while providing flexible movement. It is support 1.5 times our body weight; climbing stairs is about 3-4 times of body weight and squatting about 8 times. The knee joint is a synovial joint which connects the femur, thigh bone and longest bone in the body, to the tibia, shinbone and second longest bone. There are two joints in the knee the tibiofemoral joint, which joins the tibia to the femur and the patellofemoral joint which joins the knee cap to the femur. These two joints work together to form a modified hinge joint that allows the knee to bend and straighten, but also to rotate slightly and from side to Side.

Anatomically allow describing the body clearly and precisely using planes, areas and lines there are Anterior facing the knee, this is the front of the knee, Posterior facing the knee, this is the back of the knee, also used to describe the back of the knee cap, that is the side of the kneecap that is next to the femur. Medial the side of the knee that is closest to the other knee, , the medial side of each knee would touch .Lateral the side of the knee that is farthest from the other knee (opposite of the medial side) Structures often have their anatomical reference as part of their name, such as the medial meniscus or anterior cruciate ligament. The medial meniscus would refer to the meniscus on the inside of the knee; the anterior crucial ligament would be on the anterior side (front) of the knee. **(C.K.Warrick 1969)**.

2.1.1 Bones of the Knee joint:

The main parts of the knee joint are bones, ligaments, tendons, cartilages and a joint capsule, all of which are made of collagen. Collagen is a fibrous tissue present throughout our body. Due to age, collagen breaks down. Bone and cartilages are both connective tissues, with specialized cells called chondrocytes embedded in a gel-like matrix of collagen and elastin fibers. Cartilage can be hyaline, fibrocartilage and elastic and differ based on the proportions of collagen and elastin. The bones give strength, stability and flexibility in the knee. Four bones make up the knee Tibia commonly called the shin bone, runs from the knee to the ankle. The top of the tibia is made of two plateaus and a knuckle-like protuberance called the tibia tubercle. Attached to the top of the tibia on each side of the tibia plateau are two crescent-shaped shock-absorbing cartilages called menisci which help stabilize the knee. (www.healthpage.org).

Patella the kneecap is a flat, triangular bone; the patella moves when the leg moves. The kneecap glides along the bottom front surface of the femur between two protuberances called femoral condyles. These condyles form a groove called the patellofemoral groove .Femur commonly called the thigh bone; it's the largest, longest and strongest bone in the body. The round knobs at the end of the bone are called condyles. Fibula long, thin bone in the lower leg on the lateral side. (www.healthpage.org/wp-content/uplaods/2012.07/knee-bones).

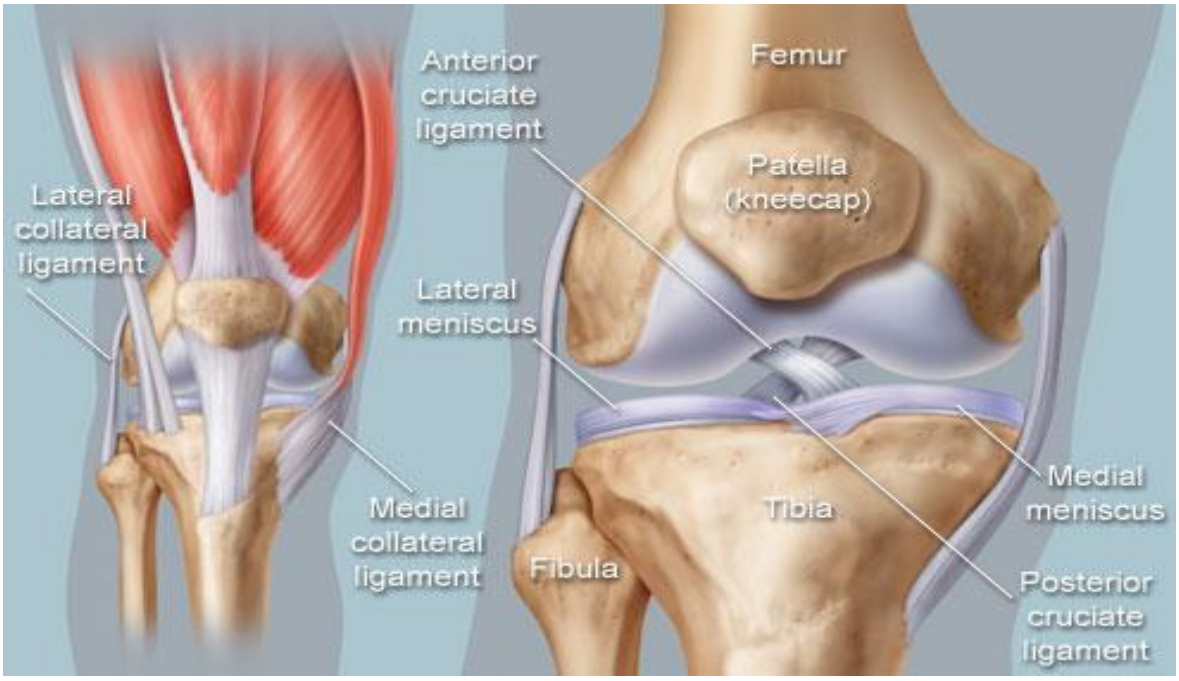

Figure (2.1.1) Bone of the Knee

(https://ohiodance.org)

2.1.2 Ligaments of the Knee joint:

The ligaments attach bones to bones and give strength and stability to the knee. There is Medial Collateral Ligament (tibia collateral ligament) attaches the medial side of the femur to the medial side of the tibia and limits sideways motion of knee. Lateral Collateral Ligament (fibular collateral ligament) attaches the lateral side of the femur to the lateral side of the fibula and limits sideways motion of knee. Anterior cruciate ligament attaches the tibia and the femur in the center of knee, Posterior cruciate ligament is the strongest ligament and attaches the tibia and the femur; it's also deep inside the knee behind the anterior cruciate ligament. It limits the backwards motion of the knee. Patellar ligament attaches the knee cap to the tibia; the pair of collateral ligaments keeps the knee from moving too far side-to-side. The cruciate ligaments crisscross each other in the center of the knee. They allow the tibia to "swing" back and forth under the femur without the tibia sliding too far forward or backward under the femur. Working together, the four ligaments are the most important in structures in controlling stability of the knee. There is also a patellar ligament that attaches the kneecap to the tibia and aids in stability. A belt of fascia called the iliotibial band runs along the outside of the leg from the hip

down to the knee and helps limit the lateral movement of the knee. (www.healthpage.org/wpcontent/uplaods/2012.07/kneeligament)Surgeons1995,http://orthoinfo.aaos.org/topic.cfm?topic=A00294.

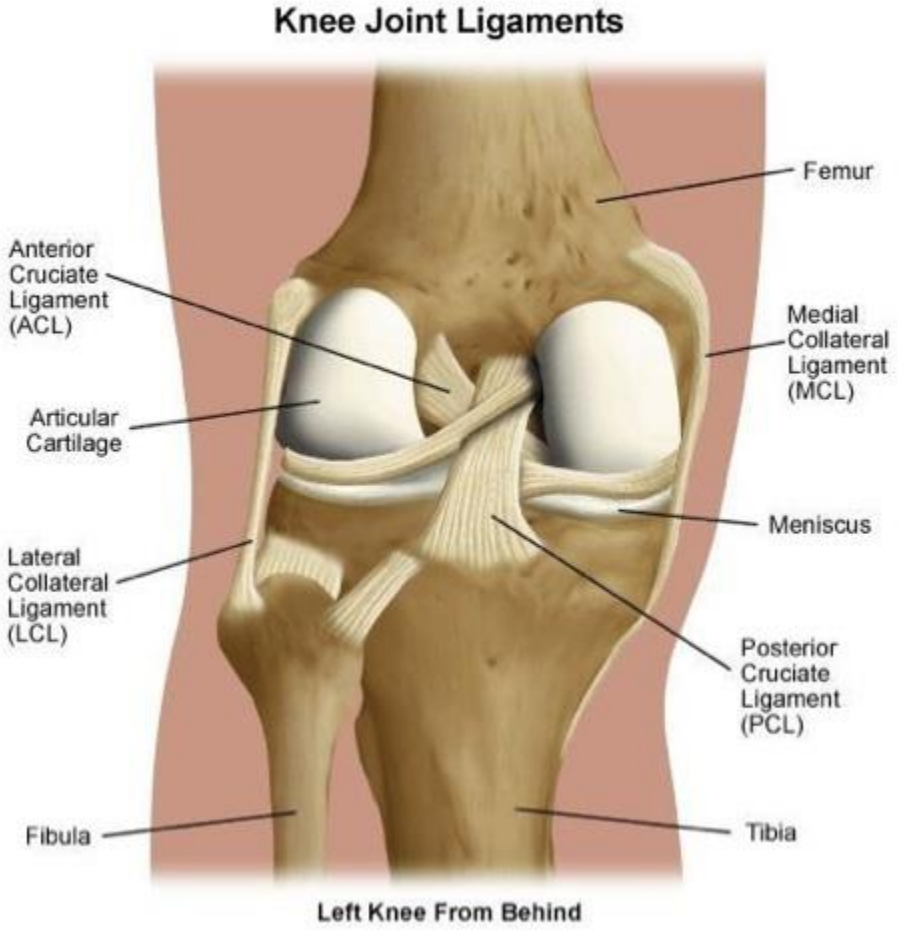

Figure (2.1.2) Ligaments of the Knee

(https://stanfordhealthcare.org)

2.1.3 Meniscus of the knee

The menisci of the knee are two pads of fibrocartilaginous tissue which serve to disperse friction in the knee joint between the lower leg (tibia) and the thigh (femur). They are concave on the top and flat on the bottom, articulating with the tibia. They are attached to the small depressions (fossae) between the condyles of the tibia (intercondyloid fossa), and towards the center they are unattached and their shape narrows to a thin shelf. The blood flow of the meniscus is from the periphery (outside) to the central meniscus. Blood flow decreases with age and the central meniscus is avascular by adulthood, leading to very poor healing rates.**(*Lippincott Williams & Wilkins. 2003*).**

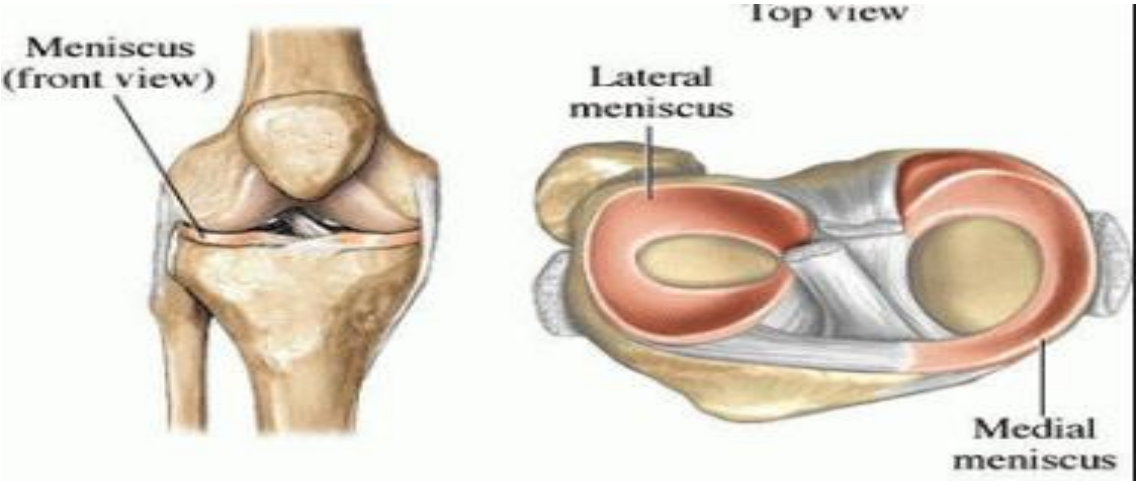

Figure (2.1.3) meniscus of the Knee

(www.osc-ortho.com**)**

2.1.4 Tendons of the Knee:

Tendons are elastic tissues that technically part of the muscle and connect muscles to bones. Many of the tendons serve to stabilize the knee. There are two major tendons in the knee the quadriceps and patellar. Quadriceps tendon connects the quadriceps muscles of the thigh to the kneecap and provides the power for straightening the knee. It also helps hold the patella in the patellofemoral groove in

the femur. The patellar tendon connects the kneecap to the shinbone (tibia) which means it's really a ligament. (www.healthpage.org/wp).

2.1.5 Cartilage of the knee:

The ends of bones that touch other bones a joint are covered with articular cartilage. Articular cartilage is a white, smooth, fibrous connective tissue that covers the ends of bones and protects the bones as the joint moves. It also allows the bones to move more against each other. The articular cartilages of the knee cover the ends of the femur, the top of the tibia and the back of the patella. In the middle of the knee are menisci disc shaped cushions that act .medial meniscus made of fibrous, crescent shaped cartilage and attached to the tibia. Lateral meniscus made of fibrous, crescent shaped cartilage and attached to the tibia.articular cartilage is on the ends of all bones as shock absorbers. In the knee joint it covers the ends of the femur and tibia and the back of the patella. The articular cartilage is kept slippery by synovial fluid (which looks like egg white) made by the synovial membrane (joint lining). Since the cartilage is smooth and slippery, the bones move against each other easily and without pain. In the knee, the rubbery meniscus cartilage absorbs shock and the side forces placed on the knee. Together, the menisci sit on top of the tibia and help spread the weight bearing force over a larger area. Because the menisci are shaped like a shallow socket to accommodate the end of the femur, they help the ligaments in making the knee stable. Because the menisci help spread out the weight bearing across the joint, they keep the articular cartilage from wearing away at friction points. The weight bearing bones in the body usually protected with articular cartilage, which is a thin, tough, flexible, slippery surface which is lubricated by synovial fluid. The synovial fluid is both viscous and sticky lubricant. Synovial fluid and articular cartilage are a very slippery combination 3 times more slippery than skating on ice, 4 to 10 times more slippery than a metal or plastic knee replacement. Synovial fluid is what allows us to flex our joints under great pressure without wear. (www.healthpage.org).

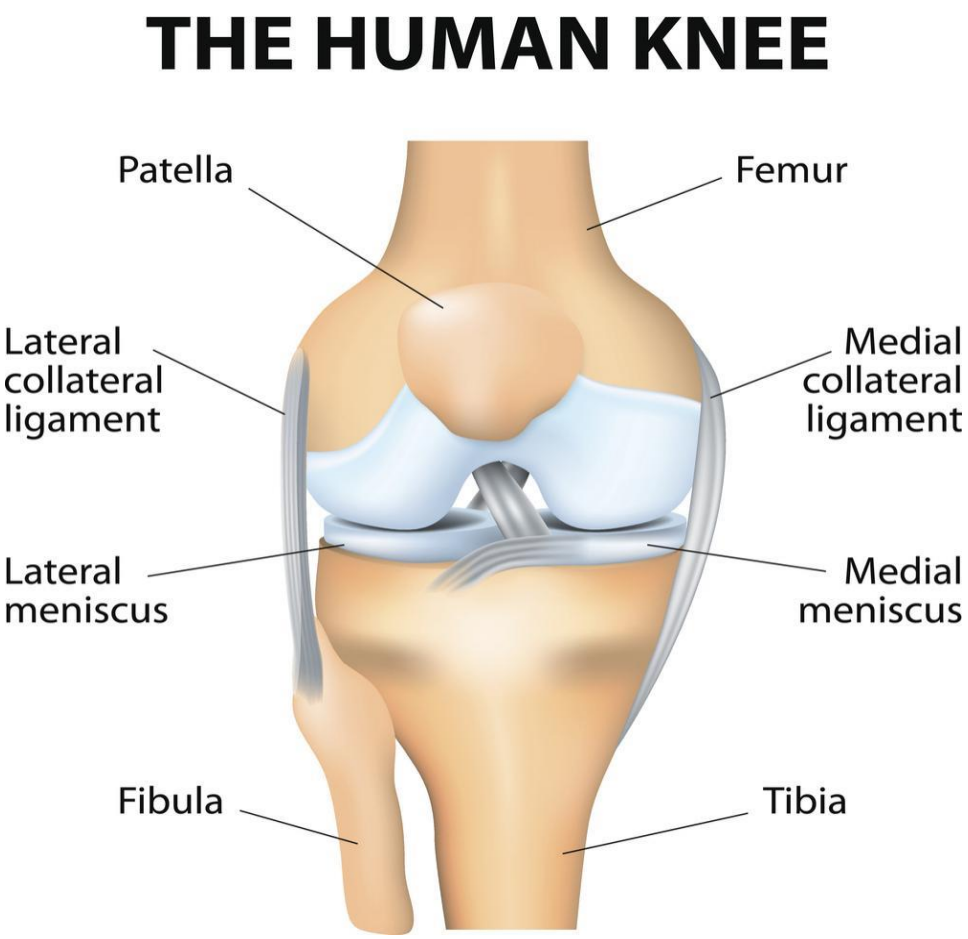

Figure (2.1.4) Cartilage of the knee

(www.medicalnewstoday.com)

2.1.6 Muscles around the Knee:

The muscles in the leg keep the knee stable, well aligned and moving the quadriceps (thigh) and hamstrings. There are two main muscle groups, the quadriceps and hamstrings. The quadriceps are a collection of four muscles on the front of the thigh and are responsible for straightening the knee by bringing a bent knee to a straight position. The quadriceps are the muscles on the front of the thigh. This muscle group is composed of the vastus lateralis (outside), vastus medialis (inside), vastus intermedius (underneath), and rectus femoris (on top). All four parts connect into one tendon that encases the patella. This tendon continues below

the patella to connect to the tibia. These muscles extend, or straighten, the knee.hamstrings are a group of three muscles on the back of the thigh and control the knee moving from a straight position to a bent. (www.healthpage.org/anatomy-function/knee).

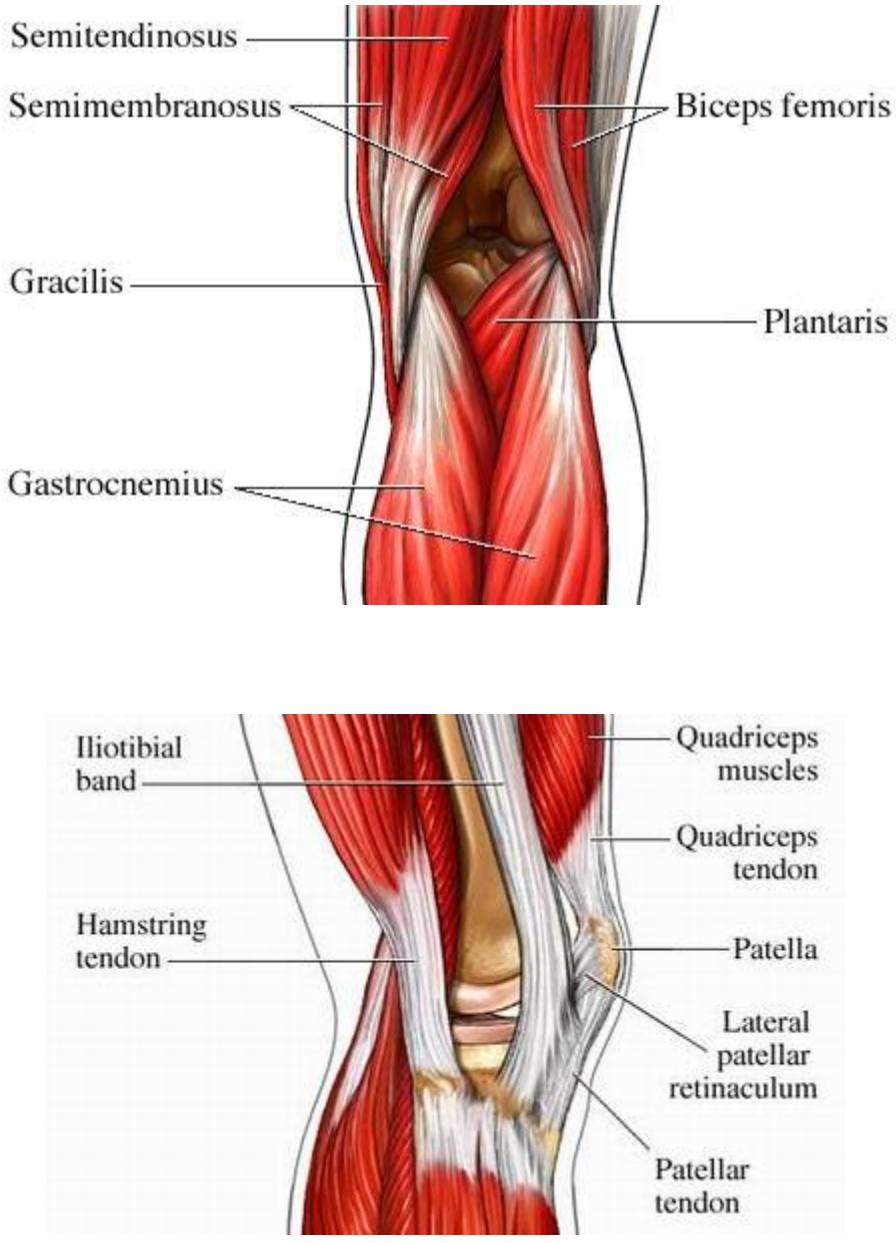

Figure (2.1.5) muscles Around the Knee

(https://ohiodance.org)

2.1.7 The Joint Capsule:

The capsule is a thick, fibrous structure that wraps around the knee joint. Inside the capsule is the synovial membrane which is line by the synovial, a soft tissue that secretes synovial fluid when it gets inflamed and provides lubrication for the knee**.(www.healthpage.org/anatomy-function/knee).**

2.1.8Bursa:

There are up to 13 bursa of various sizes in and around the knee. These fluid filled sacs cushion the joint and reduce friction between muscles, bones, tendons and ligaments. The prepatellar bursa is one of the most significant bursa and is located on the front of the knee**. (www.healthpage.org/anatomy-function/knee).**

2.1.9 Plaice:

Plaice are folds in the synovial. Plaice rarely cause problems but sometimes they can get caught between the femur and kneecap and cause pain. **(www.healthpage.org/anatomy-function/knee).**

2.1.10 Knee Arteries and Veins:

The knee joint received it is blood supply from branches of the femoral artery, the popliteal artery and the anterior tibia artery. (C.K.Warrick 1969).

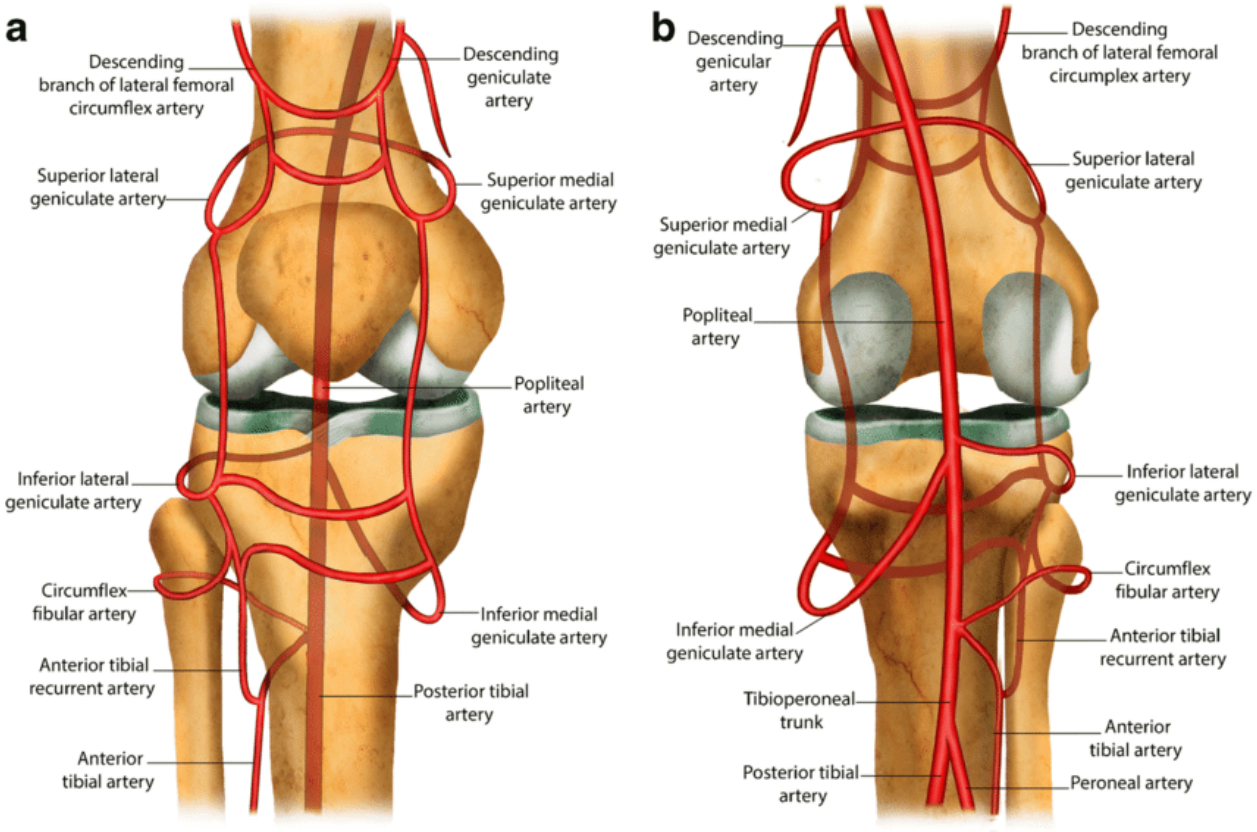

Figure (2.1.6) blood supply of the knee

www.researchgate.net

2.2 Physiology of knee joint:

The knee has limited movement and is designed to move like a hinge .The Quadriceps Mechanism is made up of the patella (kneecap), patellar tendon, and the quadriceps muscles (thigh) on the front of the upper leg. The patella fits into the patella-femoral groove on the front of the femur and acts like a fulcrum to give the leg its power. The patella slides up and down the groove as the knee bends. When the quadriceps muscles contract they cause the knee to straighten. When they relax, the knee bends .In addition the hamstring and calf muscles help flex and support the knee. (C.K.Warrick 1969) .

2.3 Pathology of the knee:

2.3.1Trauma or stress (pressure or force):

Knee symptoms come in many varieties. Pain can be dull, sharp, constant or off-and on. Pain can also be mild to agonizing. The range of motion in the knee can be too much or too little. Some knee problems only need rest and ice; others need physical therapy or even surgery.(www.healthpage.org/anatomy-function/knee-joint-structure-function-problems/ - Cached).

2.3.2 Osteoarthritis:

In this disease, the cartilage gradually wears away and changes occur in the adjacent bone. Osteoarthritis may be caused by joint injury or being overweight. It is associated with aging and most typically begins in people age 50 or older. A young person who develops osteoarthritis typically has had an injury to the knee or may have an inherited form of the disease. (www.healthpage.org/anatomy-function/knee-joint-structure-function-problems/ - Cached).

2.3.3 Rheumatoid arthritis:

Generally affects people at a younger age than does osteoarthritis, is an autoimmune disease. This means it occurs as a result of the immune system attacking components of the body. In rheumatoid arthritis, the primary site of the immune system's attack is the synovial, the membrane that lines the joint. This attack causes inflammation of the joint. It can lead to destruction of the cartilage and bone and, in some cases, muscles, tendons, and ligaments as well. (www.healthpage.org/anatomy-function/knee-joint-structure-function-problems/ - Cached).

2.3.4 Gout:

An acute and intensely painful form of arthritis that occurs when crystals of the bodily waste product uric acid are deposited in the joints.(www.healthpage.org/anatomy-function/knee-joint-structure-function-problems/ - Cached).

2.3.5 Systemic lupus erythematosus (lupus):

An autoimmune disease characterized by destructive inflammation of the skin, internal organs, and other body systems, as well as the

joint.(www.healthpage.org/anatomy-function/knee-joint-structure-function-problems/ - Cached).

2.3.6 Ankylosing spondylitis:

An inflammatory form of arthritis that primarily affects the spine, leading to stiffening and in some cases fusing into a stooped position. (www.healthpage.org/anatomy-function/knee-joint-structure-function-problems/ - Cached) 2.3.7 Psoriatic arthritis:A condition in which inflamed joints produce symptoms of arthritis for patients who have or will develop psoriasis.(www.healthpage.org/anatomy-function/knee-joint-structure-function-problems/ - Cached)

2.3.8 Infectious arthritis:

It is caused by infectious agents, such as bacteria or viruses. Prompt medical attention is essential to treat the infection and minimize damage to joints, particularly if fever is present.(www.healthpage.org/anatomy-function/knee-joint-structure-function-problems/ - Cached).

2.3.9 Chondromalacia:

Called chondromalacia patellae, refers to softening of the articular cartilage of the knee cap. This disorder occurs most often in young adults and can be caused by injury, overuse, misalignment of the patella, or muscle weakness. Instead of gliding smoothly across the lower end of the thigh bone, the kneecap rubs against it, thereby roughening the cartilage underneath the kneecap. The damage may range from a slightly abnormal surface of the cartilage to a surface that has been worn away to the bone. Chondromalacia related to injury occurs when a blow to the kneecap tears off either a small piece of cartilage or a large fragment containing a piece of bone (osteochondral fracture).The most symptom dull pain around or under the kneecap, also pain when climbing stairs or when the knee bears weight as it straightens. The disorder is common in runners and is also seen in skiers, cyclists, and soccer players. (www.healthpage.org/anatomy-function/knee-joint-structure-function-problems/ - Cached).

2.3.10 Meniscal Injuries (Injuries to the Menisci):

The menisci can be easily injured by the force of rotating the knee while bearing weight. A partial or total tear may occur .If the tear is tiny, the meniscus stays connected to the front and back of the knee; if the tear is large, the meniscus may be left hanging by a thread of cartilage. The seriousness of a tear depends on its location and extent .The Symptoms is pain mild or severe and swelling may occur. (www.healthpage.org/anatomy-function/knee-joint-structure-function-problems/ - Cached).

2.3.11 Cruciate Ligament Injuries:

It referred to as sprains. Don't necessarily cause pain, but they are disabling. Most often stretched or torn (or both) by a sudden twisting motion. (www.healthpage.org/anatomy-function/knee-joint-structure-function-problems/ - Cached).

2.3.12 Medial and Lateral Collateral Ligament Injuries:

The cause of collateral ligament injuries is most often a blow to the outer side of the knee that stretches and tears the ligament on the inner side of the knee. Such blows frequently occur in contact sports such as football or hockey .the Symptoms pop, buckle sideways, Pain and swelling. (www.healthpage.org/anatomy-function/knee-joint-structure-function-problems/ - Cached).

2.3.13 Tendon Injuries:

Knee tendon injuries range from tendinitis. Tendinitis of the patellar tendon is sometimes called "jumper's knee. The Symptoms is pain during running, hurried walking, or jumping. (www.healthpage.org /anatomy-function/knee-joint-structure-function-problems/ - Cached).

2.3.14 Iliotibial Band Syndrome:

Is an inflammatory condition caused when a band of tissue rubs over the outer bone (lateral condyle) of the knee. The symptoms ache or burning sensation at the side of the knee during activity. Pain may be localized at the side of the knee or radiate up the side of the thigh, a snap when the knee is bent and then straight tended and swelling. (www.healthpage.org/anatomy-function/knee-joint-structure-function-problems/ - Cached).

2.3.15 Osteochondritis Dissecans:

Results from a loss of the blood supply to an area of bone underneath a joint surface Types of Knee Surgery are Knee Replacement, Knee Arthroscopy. (www.healthpage.org/anatomy-function/knee-joint-structure-function-problems/ - Cached).

4.1 Imaging for knee joint:

4.2.1 X-ray:

Radiography is the first step in the evaluation of knee pain. It is quick and inexpensive and can yield many diagnostic clues. It can readily reveal fractures, osteochondral defects, bony lesions, joint effusions, joint space narrowing, and bone misalignment. In patients with knee trauma, supine anteroposterior and cross-table lateral radiographic images are generally obtained. In patients whose knee pain is not due to trauma, standing projections are done, as well as dedicated projection of the patella femoral articulation. A standing series is most helpful for evaluating joint space and alignment.(Clark 2005).

4.2.2 MRI (Magnetic Resonance Imaging):

In MRI can show the ligament, muscle and any pathology in them without using contrast media. Limitations of it no signal from bone, long scan time and no signal from even number proton. (Dr .Hans 1990).

4.2.3 CT (Computed Tomography):

In CT can show the fracture and its fragment with good detail. (Euclid seeram 1994)

4.2.4 US (Ultrasound):

In US can show the muscle which can't be detected by other modality .basic images are anterior compartment include quadriceps tendon, patellar tendon, supra-patellar tendon, infrapatelar bursa and pesansieine bursa. Posterior compartment include blood supply, medial gastrocenmuis muscle, lower 1/3posterior CL, Gastrocenmuis bursa3. Medial compartment include MCL, MM,

MR,Pes.Anseriuns bursa. Lateral compartments include LCL, LM, LR and It. (Frederic 1980).

4.2.5 Nuclear Medicine:

Is a science and clinical application of radiopharmaceutical for diagnostic, therapeutic and investigation, the Indications of it Pain, Fractures, Infection sand Bone tumors. Used Tc99m with MDP Procedure Dynamic or Static. (F.W.Smith 1989).

4.2.6 Interventional Radiology:

Interventional radiology can be used for investigation by take biopsy if there is cyst or any accumulation of fluid, or to remove any abnormality of the knee joint. (Wilfrido1988).

2.5 Previous Study:

A. M. Kiapour, M. M. Murray(2014) study the Injury to the anterior cruciate ligament based on sports type The ACL is one of the most frequently injured ligaments of the knee, with a prevalence estimated to be 1 in 3000 in the United States (greater than 120 000 cases annually).Despite trivial injury incidences in the general population, ACL injury frequently affects young, active individuals, and females are at a reported two- to ten greater risk than males playing the same sport injuries are mainly associated with other concomitant articular injuries, and may result in an increased risk of early onset post-traumatic OA at ten to 15 years post-injury (as high as 80%), especially in the presence of concomitant meniscal damage.

Waleed Hetta,GamalNiazi (2014)MRI in assessment of sports related knee injuries From August 2012 to March 2013 thirty patients referred for sports related knee pain have been included in this study. Patients were subjected to a dedicated MR knee study and correlated knee arthroscopy and surgery. The study included thirty patients complaining of sports related knee pain, only 5 patients (16.6%) were with normal MRI findings and 25 patients (83.4%) were with abnormal MRI findings. Among the 25 patients who had injuries of their knees, 15 patients (60%) had ACL injuries, 2 patients (8%) had PCL injuries, 10 patients (40%) had meniscal injuries, 8 patients (32%) had collateral ligament injuries, 5 patients (20%) had bone injuries and 2 patients (8%) had muscular injuries. Only 7 patients (28%) were represented with isolated injury and 18 patients (72%) were represented with combined injuries. MRI represents the optimal imaging tool in the evaluation of the sports related knee injuries, which has been shown to be an accurate and non invasive method of diagnosing ligament, meniscal, cartilage and muscular knee injuries.

Imaging of meniscus and ligament injuries of the knee M. Faruch-Bilfeld, F. Lapegue, H. Chiavassa, N. Sans⁎ Imaging Department, Toulouse-Purpan University Hospital, France(2016) sports injuries are the leading cause with an incidence of meniscal damaging adults of approximately 9/1000 in men and 4.2/1000 in women . Traumatic fissures, which occur in a healthy meniscus and in young people, are the most common lesions(68 to 75%), which can be

distinguished from microtraumaticfissures in a degenerative meniscus, which is constantly increasing in incidence in ‘‘mature’’ older sportsmen and women.

Rajesh Umap, Evaluation of traumatic knee joint injuries with MRI.(2018)

The knee joint is a biggest joint of the human body with complex articulation characterized by the presence of ligamentous and meniscal structures that play an important role in the stability and mobility. MRI due to its excellent tissue contrast resolution and multiplaner imaging capabilities provides significant advantages over other imaging techniques in the evaluation of traumatic injuries of knee joint. Study aimed to study the role of MRI in the evaluation of traumatic injuries of knee joint: A total number of 100 patients referred with history of knee injury were imaged with 1.5 Tesla GE-signal HdxII MRI machine in the department of radiology over a period of 18 months. Commonest injuries detected in the study are anterior cruciate ligament tear, tear of posterior horn of medial Meniscus, bone contusions and joint effusions. Clinical presentation and radiographs of the patient did not help in diagnosis in most of the cases of acute knee injury, especially in multiple ligament and bone injuries. MRI detected soft tissue injuries very well in addition to the bony injuries. Magnetic resonance imaging is the excellent non invasive investigation tool for knee injury due to excellent soft tissue contrast resolution and multiplanar imaging capabilities which provides the most detailed evaluation in cases of various soft tissue injuries of knee joint.

Chapter Three

Materials and Methods

Materials and methods

3.1 Materials and equipments:

This descriptive retrospective study was performed in radiology department of Aliaa Specialized Hospital in Khartoum, Sudan .During the period of 1/11/2019 up to1/1/2020, 100 abnormal subjects complain of pain were included in this study with range of ages (12-85) year's old and different gender, weight, height and occupation.

Equipment's used in this Study includes:

Toshiba MRI system 1.5 Tesla, Extremity coil for knee joint exam, Knee support pads, Ear plugs.

3.2 Methods:

3.2.1 Patient Preparation:

The patients filled out the questionnaire and remove anything containing metal (hearing aids, hair- pins, body jewelry, watch, etc.). Also we asked if the subject need to go the toilet before the study, then the procedure was Explained to the patient .The subject asked to undress except for underwear (perhaps offer hospital gown and disposable booties) and the patient ear protectors or ear plugs was offered.

3.2.2 Patient positioning:

The patient lies supine with feet first on MRI examination couch with their knee is in a relaxed, slightly flexed positioning within the extremities coil. The knee is well immobilized with pads .The coil can be offset so that the other leg rests comfortably at the side. The patient is positioned so that the longitudinal alignment light either along the midline of the leg under examination ,or displaced from it if the knee has been offset .The horizontal alignment light passes through the center of the coil . The knee is placed within the coil so that the center of the coil corresponds to the lower border of the patellar.

Fig (3-2) Shows Patient positioning on the Knee coil. (Toshiba Medical, joints study: knee joint)

3.2.3 Protocols and Parameters:

- Coronal PD STIR or PD FAT SAT.
- Saggittal PD STIR or PD FAT SAT.
- Axial PD STIR PD or FAT SAT.
- Coronal T1
- saggital T1.

3.3 Methods of data analysis:

Using SPSS program, version 25 the frequency and percentage, mean was used. Initially, all information gathered via questionnaire was coded into variables. Both descriptive and inferential statistics involving Chi-square test were used to present results. For each test, a P-value of less than 0.05 was considered statistically significant.

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Chapter Four

Results

Results

This study includes 100 patients, the data were collected by selected 6variables (gender, age, occupation, pre examination, BMI and types of injury) using MRI axial, sagittal and coronal view.

The results include the frequency distribution of the variables as well as relationship between types of injury and the age, occupation and weight of the patients.

Table (4-1): Frequency distribution of patient's gender

Table (1): Gender

Variable	*N (%)*
Female	**66 (66.0)**
Male	**34 (34.0)**

Figure (4-1) : Frequency distribution of patients gender

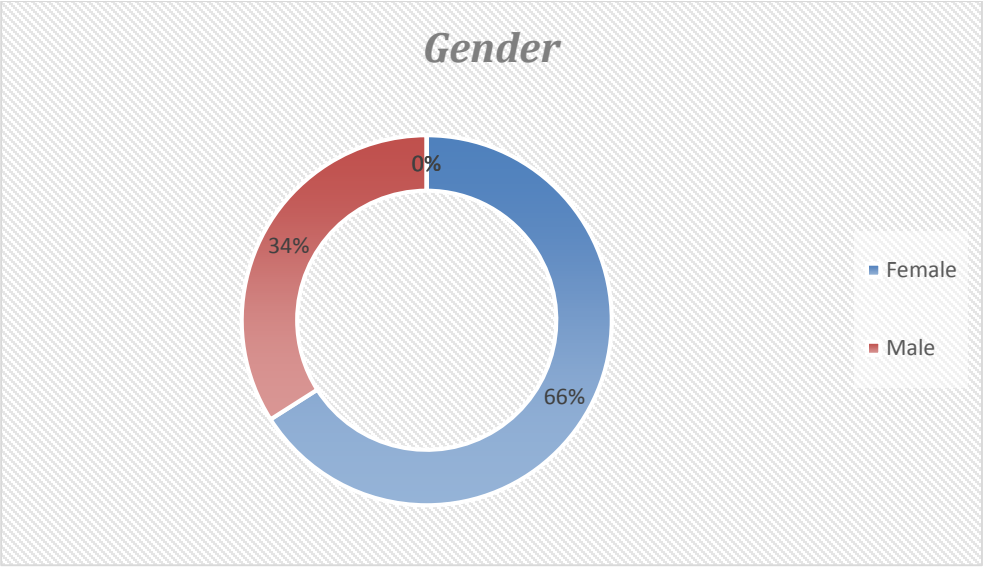
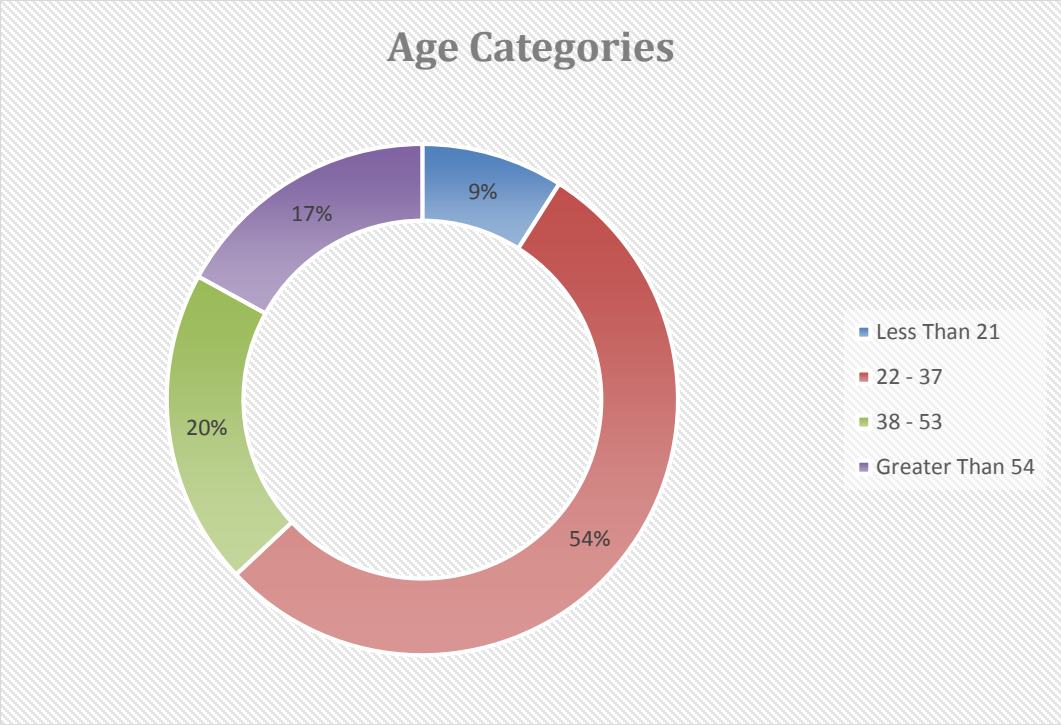


Table (4-2): Age Categories

Table (2): Age Categories	
Variable	***N (%)***
Less Than 21	**9 (9.0)**
22 – 37	**54 (54.0)**
38 – 53	**20 (20.0)**
Greater Than 54	**17 (17.0)**

Figure (4-2) *Age Categories*



Variables of the study:

Table (4-3): Frequency distribution of patient's Limb

Table (3): Limb

Variable	*N (%)*
Right	**46 (46.0)**
Left	**54 (54.0)**

Figure (4-3) *Limb*

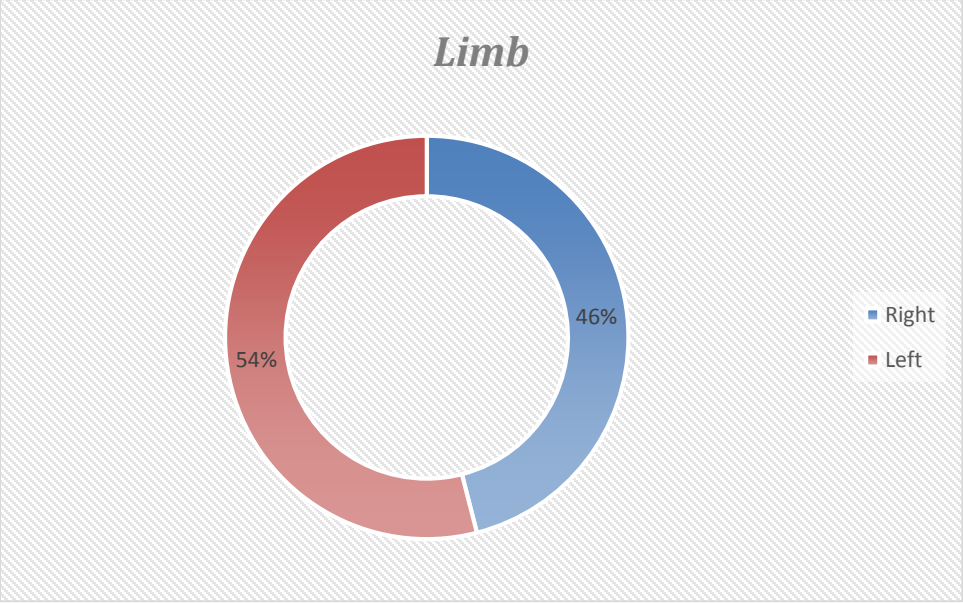


Table (4-4): Frequency distribution of patient's BMI

Table (4): BMI Categories	
Variable	***N (%)***
under weight	**1 (1.0)**
Normal Weight	**60 (60.0)**
over weight	**15 (15.0)**
Obese	**24 (24.0)**

Figure (4-4) *BMI*

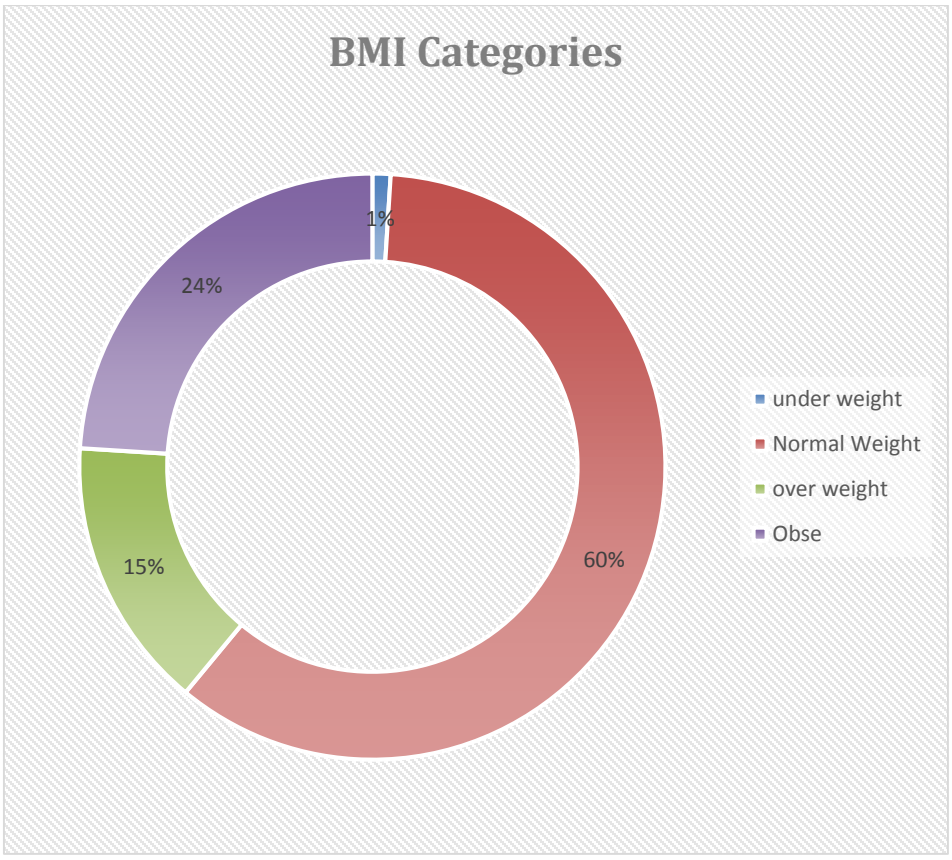


Table (4-5): Frequency distribution of patient's Occupation

Table (5): Occupation	
Variable	***N (%)***
Student	**10 (10.0)**
Military	**30 (30.0)**
Retired	**6 (6.0)**
Employee	**28 (28.0)**
House wife	**20 (20.0)**
Athletes	**6 (6.0)**

Figure (4-5): Occupation

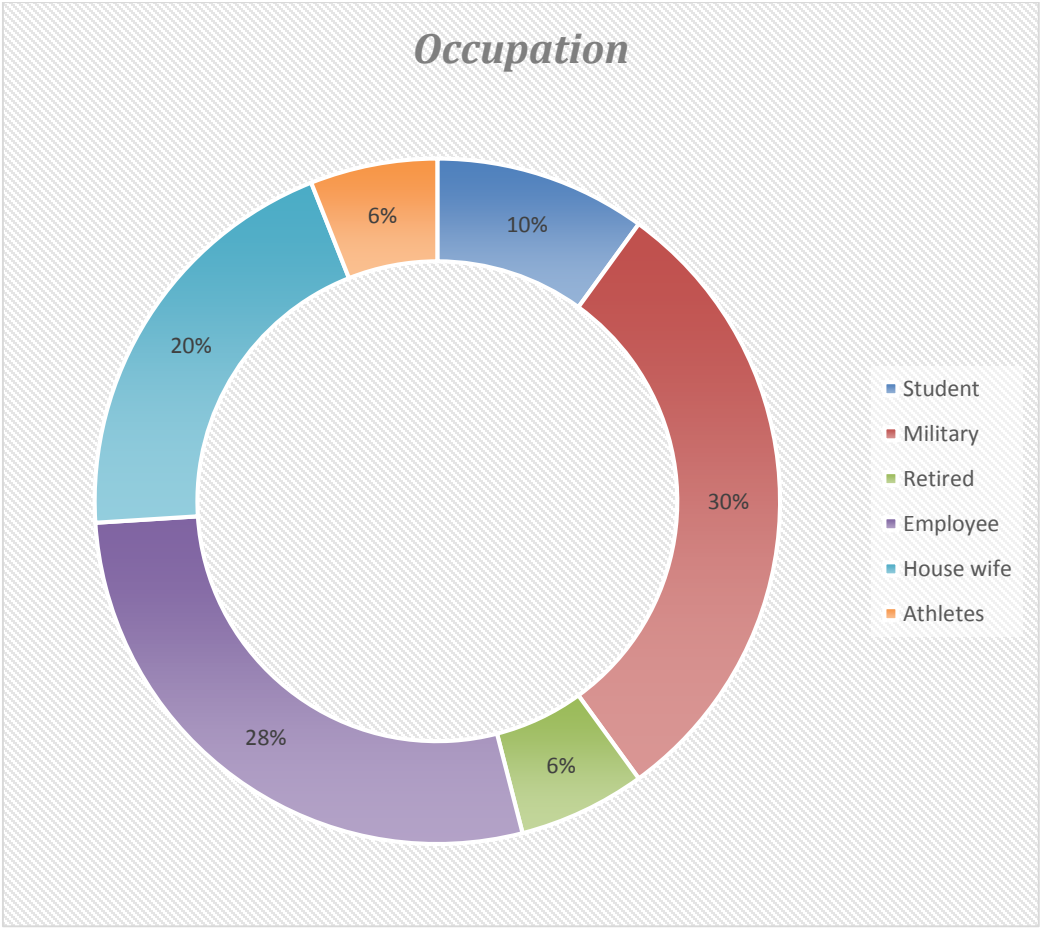


Table (4-6): Frequency distribution of pre examination

Table (6): Pre-Examination

Variable	*N (%)*
Yes	17 (17.0)
No	83 (83.0)

Figure (4-6): pre examination

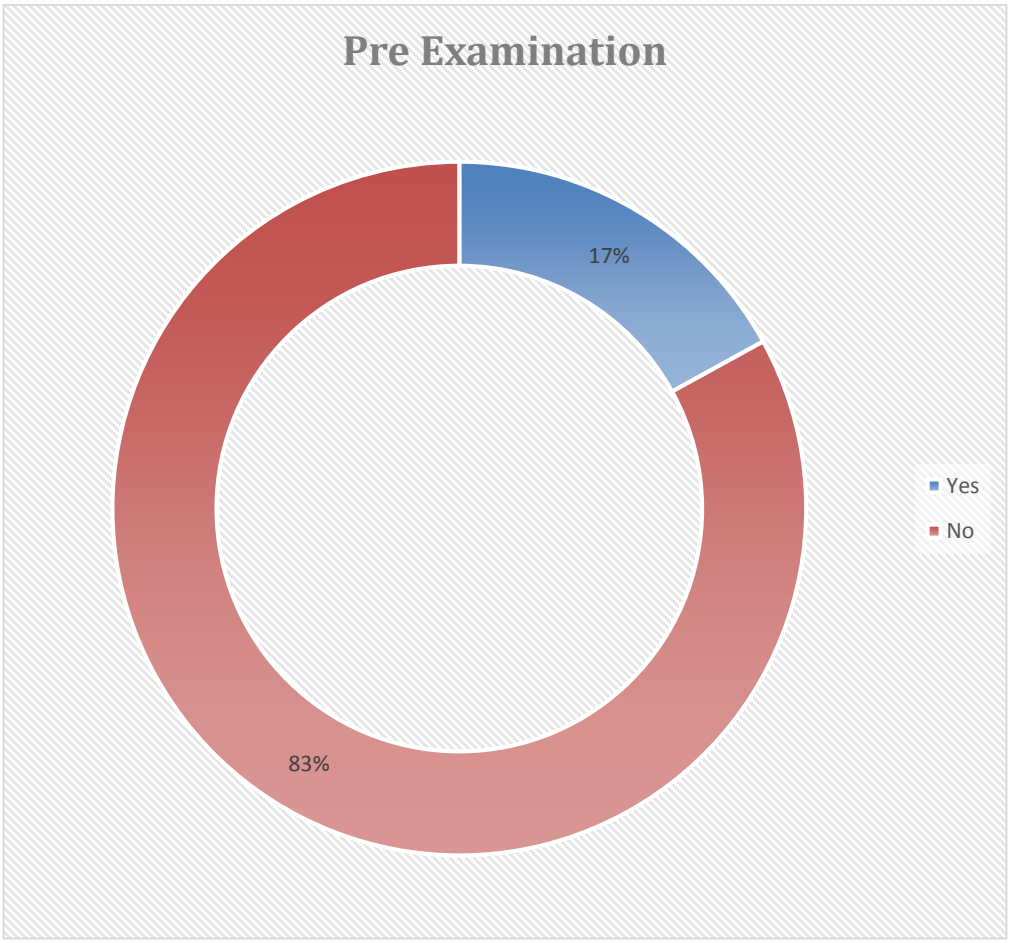


Table (4-7): Frequency distribution of patient's final diagnosis (injury)

Table (8): Final diagnosis	
Variable	***N (%)***
none	**17 (17.0)**
ACL	**33 (33.0)**
MCL	**4 (4.0)**
MM	**16 (16.0)**
LM	**4 (4.0)**
LCL	**1 (1.0)**
MM, LM	**5 (5.0)**
ACL, MCL	**7 (7.0)**
ACL, LCL	**2 (2.0)**
ACL, MM	**6 (6.0)**
MCL, MM	**2 (2.0)**
ACL, MM, LM	**3 (3.0)**

Figure (4-7) final diagnosis

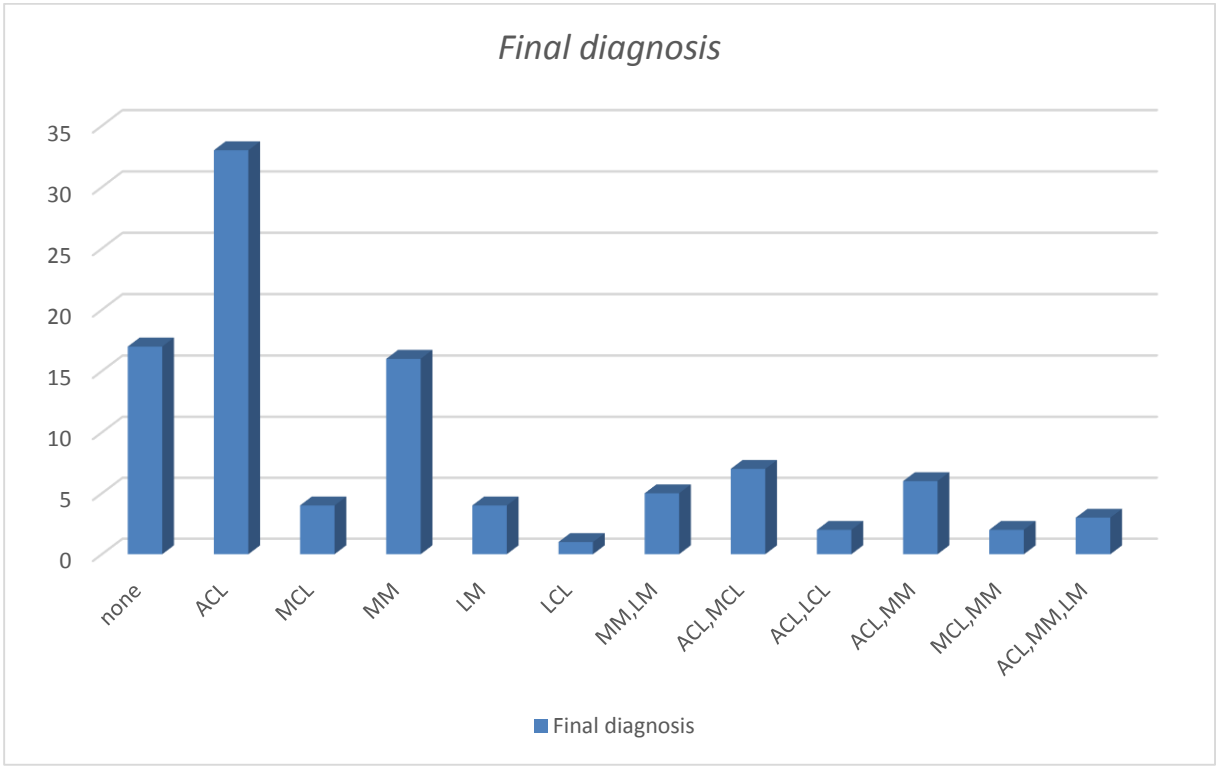


Table (8-9): Correlation between Variables

Table (9): Correlation between Variables						
Variables	***Phi***	***P-value***	***Cramer's V***	***P-value***	***Contingency Coefficient***	***P-value***
Final diagnosis & Age	**0.513**	**0.719**	**0.296**	**0.791**	**0.456**	**0.791**
Final diagnosis & gender	**0.361**	**0.289**	**0.361**	**0.289**	**0.340**	**0.289**
Final diagnosis & BMI	**0.518**	**0.766**	**0.299**	**0.766**	**0.460**	**0.766**
Final diagnosis & Limb	**0.388**	**0.181**	**0.388**	**0.181**	**0.362**	**0.181**
Final diagnosis & Occupation	**0.724**	**0.576**	**0.324**	**0.576**	**0.586**	**0.576**
Final diagnosis & Pre-Examination	**0.369**	**0.257**	**0.369**	**0.257**	**0.346**	**0.257**

Chapter five

Discussion, Conclusion And Recommendations

Discussion (5-1):

The goal of this study was to determine the prevalence of knee injuries on MRI scans and the associated factors in symptomatic patients through a controlled, retrospective study. This information may assist the clinician in correlating clinical signs and symptoms to MRI findings before instituting treatment.MRI of the knee joint is non invasive ,safe and good protocol which provide greater details than others modalities like conventional X-ray exams, this study includes 100 patients aged between (12_85) years old, the data were collected by selected 6variables (gender, age, occupation, pre examination, BMI and types of injury) using MRI axial, sagittal and coronal view by, study show that female were affected by of ligaments injury of knee joint more than male and age group of (22_37) was the most affected than other age groups, an group (12_21) had the lowest rate of affection. The study showed that left knee injuries were more prominence than right. The study also concluded that military patients were more affected than others.

The ACL tear was the most occurring injury and the LCL was the lowest.

A correlation between final diagnosis and all the other variables was also assessed, A positive correlation was observed between each in general, but the value of (P-value > 0.05) which is mean there is no significant, in other words those variables are independent

5.2 Conclusion:

The MRI is the modality of choice in diagnosing ligaments tear of the knee With high details and showed that ACL had the highest prevalence of the knee injuries the result found no relation between patient’s occupation and types of injury which indicate that the incidence is a result from trauma or pathology with no associated factors .

5.3 Recommendations:

More studies need to be performing in order do asses the relation between knee joint injuries and osteoarthritis in young individuals.

Larger study group and further analyzing is recommended.

Three images planes (axial, coronal and sagittal) should be perform together for patients complain of knee pain.

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Problems/ - CachedMagnetic Resonance Imaging (MRI) - Knee Page 1 of 8
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Appendix (1)

Data sheet

Pt name				
Age				
Gender				
Pt BMI				
Limb RT\LT				
Occupation				
Pre examination				
Final diagnosis				

Appendix (2)

MRI images of knee joint injuries

Sagittal T2 fat sat show tear of posterior horn of lateral meniscus

Sagittal T1 show complete tear o ACL and MCL

Corona PD fat sat show ACL rupture