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كلية الطب والعلوم الصحية

قسم تكنولوجيا الأشعة التشخيصية

Assessment of Prevalence and Risk Factors of Knee Disorders Among Yemeni Population Using Magnetic Resonance Imaging

تقييم انتشار أمراض مفصل الركبة بين المرضى اليمنيين باستخدام التصوير بالرنين المغناطيسي

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Dedication

We dedicate this research to our fathers, mothers, family and everyone who contributed to the completion of this research, to our college and its teaching staff and to our country.

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List of Abbreviations

MRI	Magnetic resonance imaging
ECM	Extra cellular matrix
PG	Proteoglycan
TII	Thermal infrared imaging
LCL	Lateral collateral ligament
MCL	Medial collateral ligament
ACL	Anterior cruciate ligament
PCL	Posterior cruciate ligament
PD	Proton density
USG	Ultrasonography
PTFJ	Proximal tibiofibular joint
PDW	Proton density weighting
FOV	Field of view
FSE	Fast spin echo
GRE	Gradient recalled echo
ICC	intra-observer correlation coefficient
PACS	Picture archiving and communication system
UST	University of science and technology

Abstract

Objective: This analytic and cross-sectional descriptive study aimed to evaluate of knee disorders among Yemeni population using MRI.

Material and Methods: this study carried out, in Sana'a city among radiology departments at different hospitals during the period from December, 2022 to March, 2023 with 886 patients who having an issue in the knee joint and suspected any knee diseases and underwent Knee MRI scan, the study data including patients' demographic data, medical history and features of knee disorders

Results: 400 of study sample (45.1 %) their age between 21 to 40 years 254 (63.5%) of them were male while 146 (36.5%) were female. Also, this study revealed that males had more prevalence of knee disorders than females 483 (54.5%) comparing with 403 (45.5%) of females. Furthermore, the study founded that the common knee disorders were as follows: meniscus tear, degeneration, ligament tear, ACL tear, degenerative/thin articular cartilage disorder, mild effusion of synovial membrane, edema of bone marrow, bone cyst, mild effusion joint, bursa effusion, narrowing joint space, osteophyte, chondromalacia patellae and subchondral bony edema with percentages of 68.7 %, 33.7 %, 25.8 %, 77.5%, 3.4%, 18.3%, 19.2 %, 14.7%, 37%, 2.3%, 12.4% , 13.3%, 47.7% and 14.2%.respectively. In addition, the BMI, smoking, chewing Qat, Vitamin D-deficiency and walk level have no significant effect on knee disorders ($P > 0.05$). While DM, blood hypertension, previous knee injury and occupation have significant association with some of knee disorders ($P < 0.05$).

In Conclusion: knee disorders had more prevalence in men among Yemeni population, and the common knee disorders was meniscus tear. Magnetic resonance is considered as a golden standard medical diagnostic imaging tool in the evaluation of knee disorders.

Chapter One

Introduction

Chapter One

Introduction

1.1 Overview

The knee joint consists of different tissues with various structural and mechanical properties. Articular cartilage and meniscus are two important components of the knee that are regularly under compressive mechanical loads. Collagen, the most abundant structural macromolecule in the extracellular matrix (ECM), makes up approximately 60–70% of the dry weight of cartilage and meniscus. Type II collagen represents majority of the collagen content in the cartilage and meniscal white-white zone, forming fibrils and fibers intertwined with proteoglycan (PG) aggregates, it should be noted that in red-red meniscal zone the type I collagen is predominant (Jerban et al. 2020).

The diagnosis of knee diseases initial involves a patient history and preliminary physical examination followed by different other tests including X-ray (radiography) and ultrasound, magnetic resonance imaging, radionuclide bone scan, computed tomography scan, arthroscopy and biopsy in order to identify the etiology of the knee problem. In addition to these methods, thermal infrared imaging (TII) has been used for several years as an alternative and complementary method for the diagnosis of knee pathologies (Colin et al. 2015).

With the escalating cost of health care, it is important to evaluate the cost-effectiveness of new medical technology.15 Magnetic resonance imaging (MRI) offers the physician the ability to evaluate the internal architecture of the knee and other body parts noninvasively and without radiation. Because of the detailed anatomic information that MRI scans can provide, this imaging method has become a valuable diagnostic adjunct for the evaluation of musculoskeletal tumors, spinal disorders, and infections (Gelb et al. 1996).

As with other technology, MRI is an adjunct and should be used to assist in establishing the diagnosis of knee disorders. In our current health care system, any physician can order an MRI scan. Because of the increasing number of patients who have suspected knee disorders among Yemenis patients, we designed this study to evaluate the clinical value of MRI in diagnosing spectrum disorders of Knee.

1.2 Problem of the Study

Knee pain affects approximately 25% of adults. The prevalence of knee pain has increased almost 65% over the past 20 years. (*Bunt et al. 2018*) Besides, the increase of Yemeni patients who have suspected with knee disorders, so the main question of this research focused on the assessment of knee disorders and its association with some sociodemographic variables such as (age, gender, BMI, etc.), as well as, the association of knee disorders with some risk factors (Diabetic, vitamin D deficiency and smoking).

1.3 Justification/ Rationale

This study will provide detailed information about the use of resonance imaging in the diagnosis of knee disorders through several potential risk factors. Therefore, through the procedures and data that we obtain, we will determine knee diseases among Yemeni patients.

1.4 Objectives of the Research

1.4.1 General Objective:

To assess knee disorders prevalence and risk factors among Yemeni population using magnetic resonance imaging.

1.4.2 Specific Objectives:

- To identify the common MRI findings in patients with knee diseases.
- To determine the demographic characteristics of patients with knee disorders as (age, gender, BMI and occupation).
- To correlate between the risk factors and knee disorder.

1.5 Study outlines:

This Study is concerned about the Characterization of knee diseases patterns using Magnetic Resonance Imaging among Yemenis patients. It divided into the five chapters. **Chapter one**, which is an introduction, deals with theoretical frame work of the study. It presents the statement of the study problems, objectives of the study, it also provides on outlines of the thesis. **Chapter two** includes theoretical background and literature review (previous studies). **Chapter three** deals with materials and method used to identify the manifestations of knee disorders. **Chapter four** deals with (result) data presentation, **Chapter five** discusses the data (discussion), analysis, and conclusion, recommendation for this thesis and suggestions for future work.

1.6 Study's Strengths and Limitations

1.6.1 Strengths

This study is the first study done in this area in Yemen by using MRI.

1.6.2 Limitations

An insufficient time was made the data collection mechanisms difficult to be accomplish.

Some radiologic department refuse to cooperate with scientific research.

Chapter Two

Literature Review

Chapter Two

Literature Review

2.1 Theoretical Background

2.1.1 Anatomy of Knee

The knee joint is made up of two parts. The part of the knee between the end of the thigh bone (femur) and the top of the shin bone (tibia) is called the tibiofemoral joint. The patellofemoral joint is between the end of the thigh bone (femur)and the kneecap (patella). The knee joint is surrounded by synovial fluid which keeps it lubricated. The bones are covered by smooth joint surface (articular) cartilage that allows them to glide smoothly together without friction. If the joint surface is damaged through wear and tear or a knee injury, arthritis can develop as it shows in figure 2.1(Adrian et al.2017).

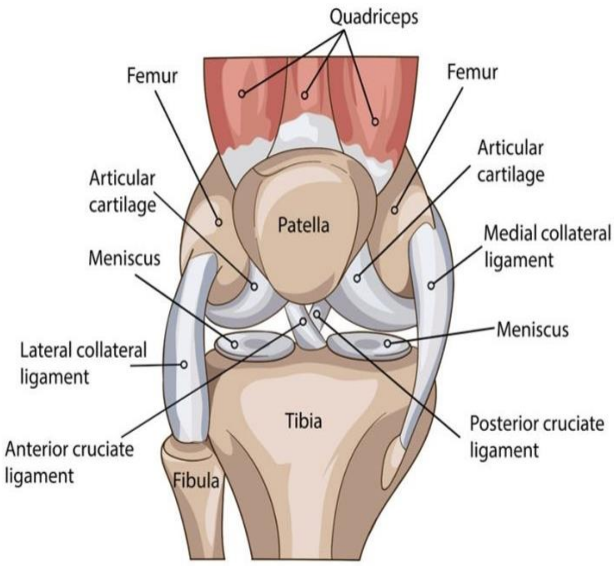

Figure 2.1: General Anatomy of Knee (Adrian et al.2017).

2.1.1.1 Articular Surfaces

During flexion–extension, the knee acts as a hinge joint, whereby the articular surfaces of the femur roll (and glide) over the tibia surface. The distal femur can be compared with a double wheel, in which the medial and lateral condyles are the components and the intercondylar notch the junction between them (Fig.2.2). The condyles are convex in both planes. The medial condyle extends a little more distally than the lateral.

The greater prominence of the lateral femoral condyle prevents the patella from sliding laterally *(Admin Et al .2016).*

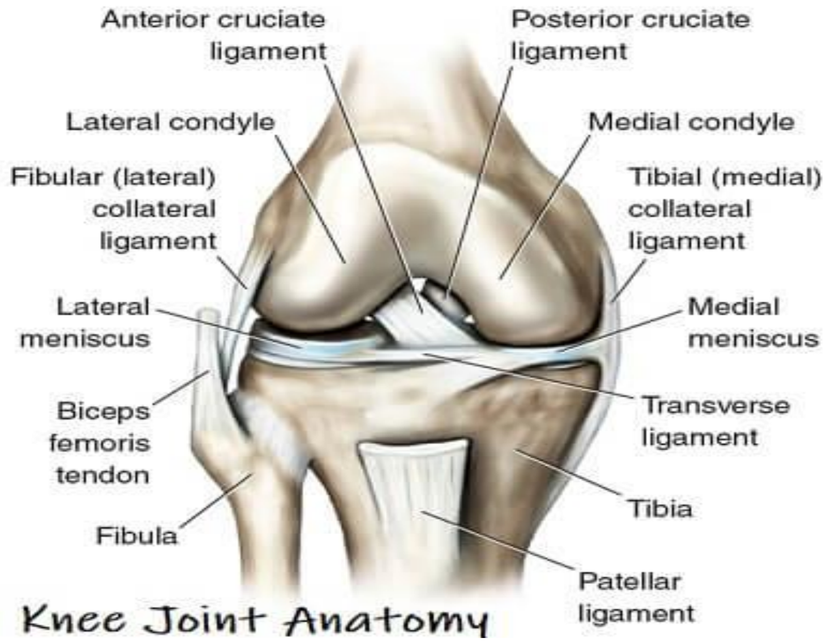

Figure 2.2: General Anatomy of Articular Surface of the Joint (Admin Et al 2016).

2.1.1.2 The Menisci

Each knee has two menisci, a medical meniscus and a lateral meniscus. The medial meniscus is located towards the inside of the knee and it has a more distinctive crescent shape than the lateral, which is located on the outside of the knee. Both menisci are attached to the tibia by the menisci tibial ligaments with the medial meniscus also being firmly attached to the medial collateral ligament (the lateral meniscus is not attached to the lateral collateral ligament). This makes the medial meniscus less mobile and more prone to injury compared to the lateral meniscus, especially due to valgus and torsional movement sit as it shown in figure 2.3 (Brindle et al. 2001).

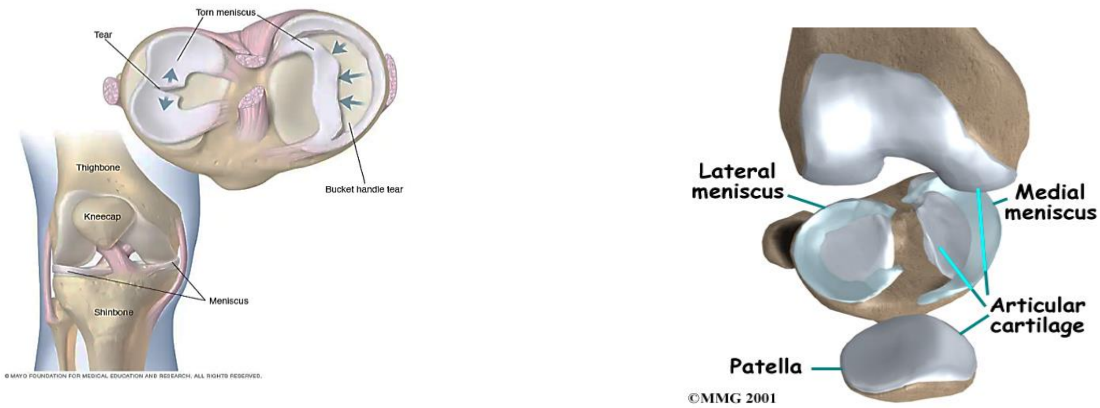

Figure 2.3: Anatomy of Meniscus (Brindle et al. 2001).

2.1.1.3 The Patella

The patella has a triangular shape, with anterior and posterior surfaces. The apex of the patella is situated inferiorly and is connected to the tibial tuberosity by the patellar ligament. The base forms the superior aspect of the bone and provides the attachment area for the quadriceps tendon. The posterior surface of the patella articulates with the femur, and is marked by two facets: **Medial facet** – articulates with the medial condyle of the femur, and **Lateral facet** – articulates with the lateral condyle of the femur as it shown in figure 2.4(Aaron et al 2023).

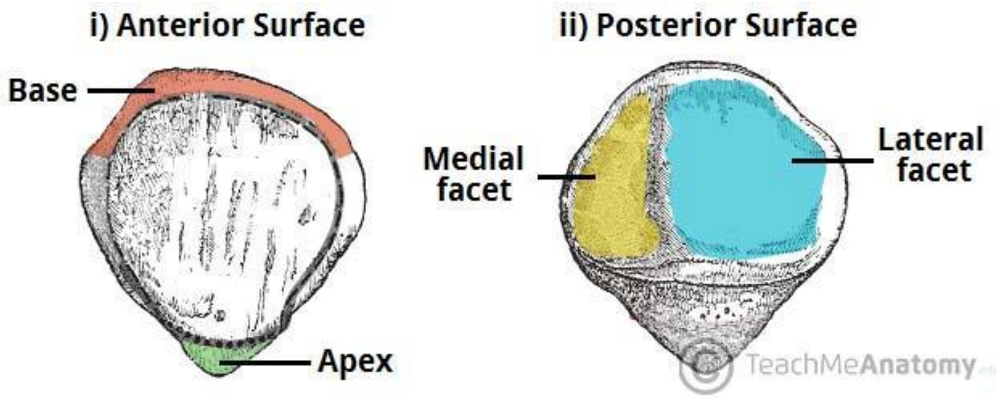

Figure 2.4: Anatomy of Patella (Aaron et.al. 2023).

2.1.1.4 Ligaments & Joint Capsule

2.1.1.4.a Capsule

The capsule contains synovial fluid, which is found in the cavities of highly mobile joints called synovial joints. This fluid circulates around the patella, tibia, and femur. It helps lubricate and provide nutrients to the joint *(Healthline Et al. 2018).*

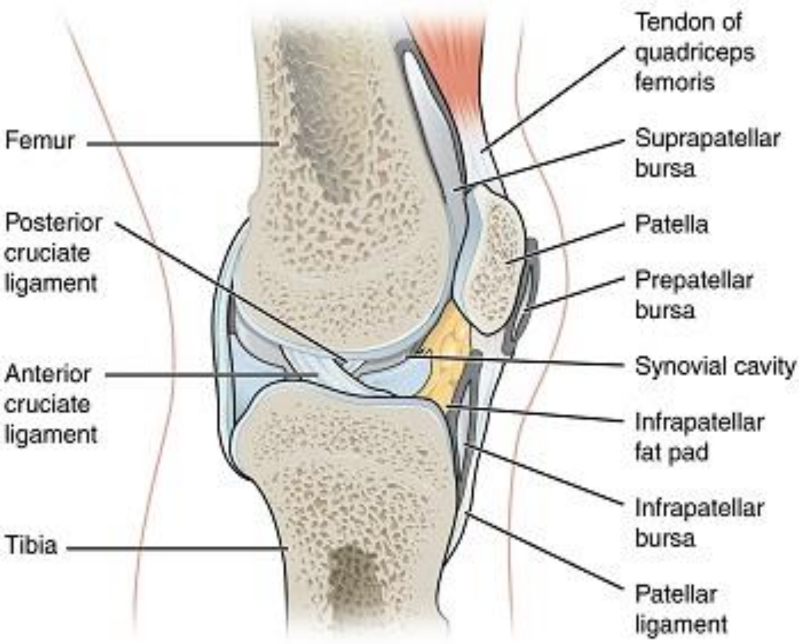

Figure 2.5: Anatomy of Joint Capsule (Schinke & Schumacher et al. 2005).

2.1.1.4.b Bursa

A bursa is a small sac made of fibrous tissue that has an inner lining of synovial type membrane. It is filled with synovial fluid, or lubricant, made by the membrane. Bursae, plural for bursa, are located at certain points where there is a tendon on top and a bone beneath it. The bursae act as cushions and provide lubrication for the joint as it shown in figure 2.6 (Kelly & Charity et al.2022).

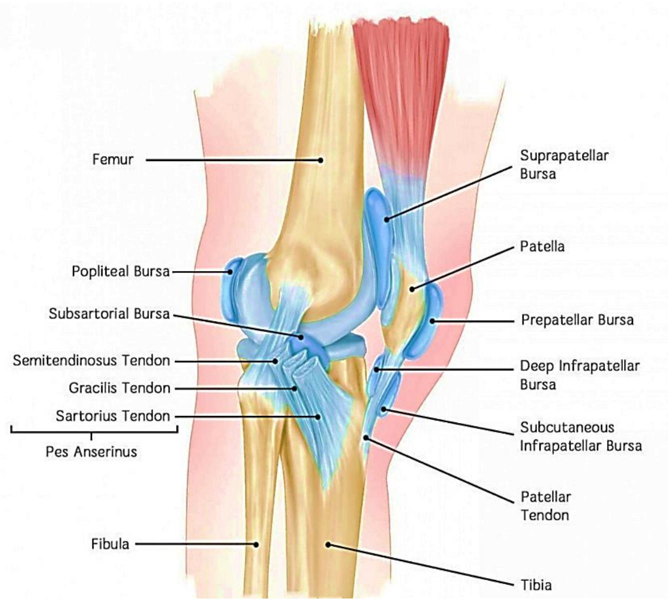

Figure 2.6: Anatomy of Knee Bursa (Kelly & Charity et al.2022)

2.1.1.4.b.1 Lateral Knee Bursa

lateral knee bursa, known as the lateral gastrocnemius, fibular, fibulopopliteal, and the subpopliteal bursa. These bursae help lubricate and cushion the outer part of the knee, including the calf muscle, tibia, and biceps femoris (Kelly & Charity et al.2022).

2.1.1.4.b.2 Medial Knee Bursa

The inner part of the knee. The medial gastrocnemius bursa is located by the upper end of the tibia. It helps to cushion and support the inner part of the knee, including the calf muscle (Kelly &Charity et al.2022).

2.1.1.4.b.3 Anterior Knee Bursa

Is an additional bursa on the front of the knee, known as the pretibial bursa. It helps protect the front of the knee joint including the tibia (Kelly &Charity et al.2022).

2.1.1.4.b.4 Suprapatellar Bursa

Which infers that the suprapatellar bursa is located above the patella. This bursa is found between the quadriceps femoris and the femur. It helps to cushion and lubricate the quadriceps femoris from the femur, as the knee joint bends and extends (Kelly & charity et al.2022).

2.1.1.4.b.5 Infrapatellar Bursae

A superficial infrapatellar bursa is located closer to the surface of the skin. In fact, it is found between the skin and the patellar tendon, which is found near the head of the tibia. On the other hand, the deep infrapatellar bursa is located further in the knee, below the superficial. It is found under the patella tendon and on the tibia. Both infrapatellar bursae help protect the patellar tendon as it moves over the tibia, when the knee joint bends or extends (Kelly &Charity et al.2022).

2.1.1.4. c The Lateral Collateral Ligament

Lateral collateral ligament (LCL) it is one of 4 critical ligaments involved in stabilizing the knee joint. Is a cord-like band and acts as the primary Varus stabilizer of the knee the LCL stabilizes the lateral side of the knee joint, mainly in Varus stress and posterolateral rotation of the tibia relative to the femur. The LCL acts as a secondary stabilizer to anterior and posterior tibial translation when the cruciate ligaments are torn.

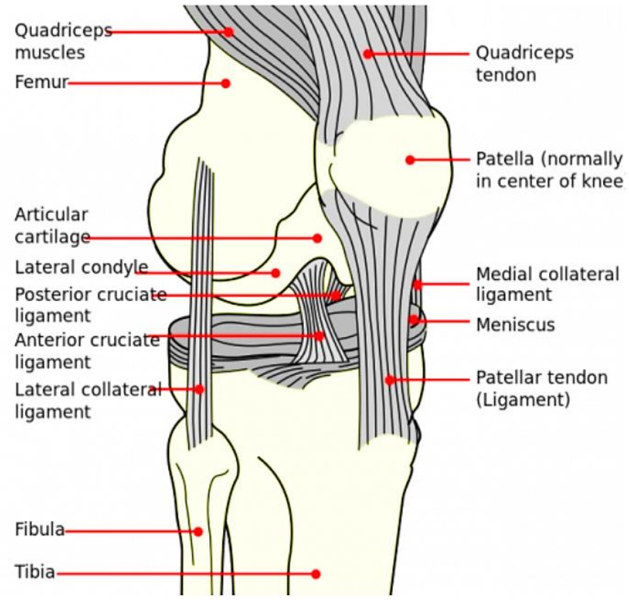

Figure 2.7: Anatomy of Lateral Collateral Ligament (Zernicke et al 2008).

2.1.1.4.c.1 The Medial Collateral Ligament.

The medial collateral ligament is recognized as being a primary static stabilizer of the knee and assists in passively stabilizing the joint. The superficial and deep ligaments each have a unique function, making the MCL the primary responder to valgus stress and a secondary restraint to rotational forces. The sMCL, specifically the proximal division, resists valgus forces through all degrees of knee flexion. The distal division of the sMCL helps stabilize external rotation of the knee at 30-degree flexion. The dMCL helps stabilize internal rotation of the knee from full extension through 90-degree flexion (assists the knee in rotational stability primarily in extension moving through into early flexion). Despite the relationship of the dMCL with the medial meniscus, there is no influence of the MCL on the stability of the medial meniscus. Together, the MCL also helps guide the knee joint through its full range of motion when a tensile load is applied. With low load, the ligament is relatively compliant; with increasing load, the ligament responds with increasing stiffness until it is nearly linear. Beyond this, the MCL will continue to absorb energy until failure. The MCL also prevents hyperextension of the joint and posterior translation of the tibia, secondary to the function of the posterior cruciate ligament (PCL). The posterior oblique ligament, a continuum of oblique fibers at the posterior aspect of the MCL, is responsible for this function. The ligament also plays a role in joint position sense or proprioceptive feedback. When the MCL is stretched beyond its ability or exposed to an excessive load, it evokes neurological feedback signals that then generate a muscle contraction. *(Usker Naqvi et al).*

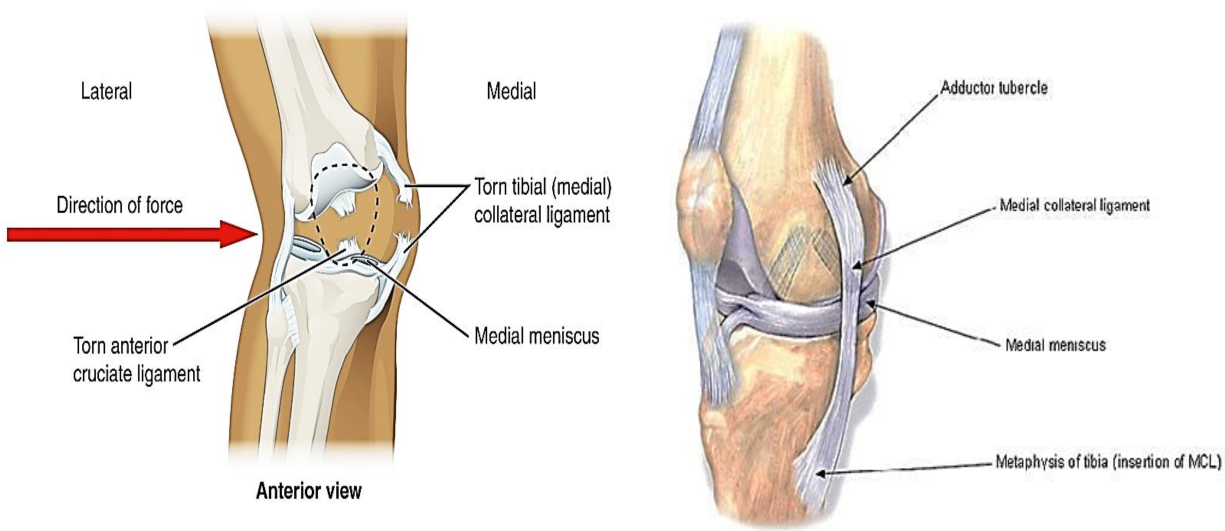

Figure 2.8: Anatomy of Medial Collateral Ligament (Adrian Wilson.et al .2017).

2.1.1.4. c.2The Cruciate Ligaments

The cruciate ligaments are named based on their attachments on the tibia and their relationships to the intercondylar eminence of the proximal tibia. They are essential to the function of the knee joint. the cruciate ligaments act to stabilize the knee joint and prevent antero-posterior displacement of the tibia and the femur. They also contain numerous sensory endings implying an important role in proprioceptive function. These ligaments are intra-articular but because they are covered by synovium they are considered extra-synovial. They receive their blood supply from branches of the middle genicular and both inferior genicular arteries (Zernicke et al. 2008).

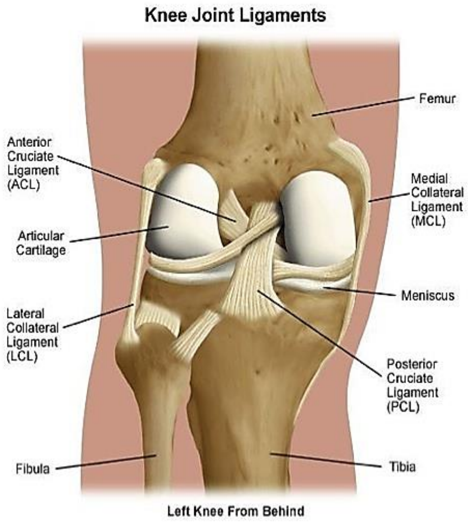

Figure 2.9: Anatomy of Cruciate Ligaments (Google images)

2.1.1.4.c.3 Anterior Cruciate Ligament

Anterior cruciate ligament (ACL) - The ligament, located in the center of the knee, that controls rotation and forward movement of the tibia (shin bone).

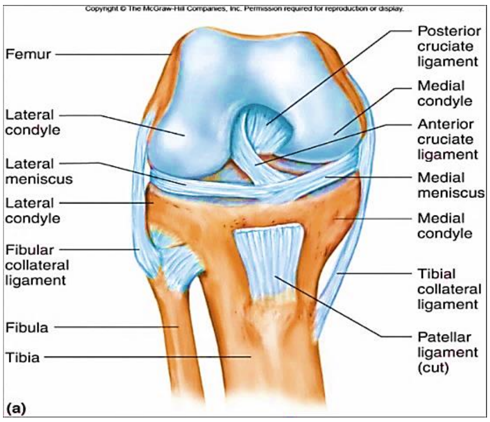

Figure 2.10: Anatomy of Anterior Cruciate Ligament (*Zernicke et al 2008).*

2.1.1.4.c.4 Posterior Cruciate Ligament

The PCL is composed of two functional bundles and has important implications for knee stability. The anterolateral and posteromedial bundles have different patterns of tensioning throughout knee range of motion. The two bundles therefore contribute to resisting posterior tibial translation and rotation at different angles of knee flexion. (Stephanie et Al. 2018).

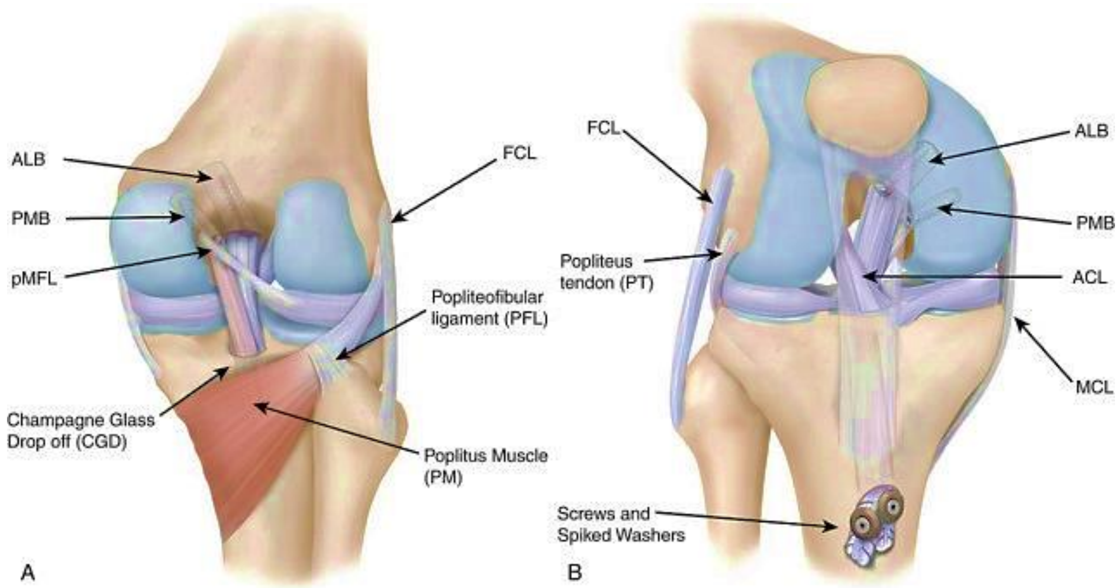

Figure 2.11: Anatomy of knee (Zernicke et al 2008)

2.1.1.5 Blood Supply

The knee joint blood supply is derived from a rich anastomosis of the five major constant arteries, namely, the superior medial and lateral, the middle (posterior), and the inferior medial and lateral genicular arteries. Anastomosis also occurs with descending genicular arteries and the anterior tibial recurrent artery. These branches form anastomoses in and around the knee joint, while each major vessel was noted to provide the respective major blood supply to specific areas (shim et al .1986).

2.1.2 Physiology of Knee Joint

2.1.2.1 The Menisci and Their Functions

The menisci are fibro-cartilaginous structures that are interposed between the femoral condyles and the tibial plateaus. The lateral meniscus is more circular, while the medial is semicircular. Both are thicker at the periphery, becoming progressively thinner towards the centre of the tibial plateau. The medial is closely connected to the medial collateral ligament (MCL), while the lateral meniscus has greater freedom of movement during flexion and extension. The menisci act as joint shock absorbers by distributing evenly the load between the medial and lateral compartments. In the absence of the menisci, the stress per unit area unavoidably increases. Furthermore, these two structures increase joint congruity and diffusion of synovial fluid along the articular surfaces (Vaienti, et al. 2017).

2.1.2.2 The ligaments and their functions

2.1.2.3 Collateral Ligaments

The MCL is composed of two layers: superficial and deep. During flexion of the knee, the superficial vertical fibres are taut, while the posterior and deep are unstretched. The opposite happens during the extension. The primary function of the MCL is to prevent a deviation of the knee during valgus stress. The dissection of its superficial component determines a significant increase of the deviation in valgus between 0° and 45° of flexion, as well as external rotation. On the other hand, the dissection of deep fibres or deep oblique ligaments or the posterior capsule does not increase joint instability during these movements. This means that the superficial component of the MCL is the main structure that counteracts the stresses in the valgus and external rotation and it offers a weak resistance to anterior translation of the tibia. The posterior oblique and deep fibres seem to play a secondary role as stabilizers. The lateral collateral ligament (LCL) origin on the lateral femoral epicondyle anteriorly to the origin of the gastrocnemius muscle. It has a structure similar to a cord that passes under the lateral retinaculum to insert on the head of the fibula, merging at this level with the insertion of the biceps femoris tendon. It prevents the deviation in Varus as well as the excessive internal rotation of the knee. The LCL is taut when the knee is extended; as a consequence, Varus laxity increases when this joint is flexed. The popliteus muscle function is still controversial, but it appears to act together with the meniscus-femoral ligaments in the control of the external meniscus movement during flexion of the knee and at the same time it facilitates the external rotation of the femur during load. This popliteal-arcuate complex also plays a role, together with the LCL and the posterior cruciate ligament (PCL), in stabilizing the posterior-lateral corner against Varus movements and tibial external rotation (Vaienti, E. et al. 2017).

2.1.2.4 Cruciate Ligaments

The cruciate ligaments of the knee act as articular stabilizers, preventing the anterior-posterior translation of the tibia. They also have an important proprioceptive function, due to the presence inside them of mechanoreceptors and free nervous terminations. The anterior cruciate ligament (ACL) is characterized by having a straight anterior conformation while it is convex in its posterior surface. Its average length is 38 mm and its average thickness is 11 mm. ACL's primary function is to prevent anterior translation of the tibia on the femur with the knee in flexion; it provides up to 85% of this anterior stability. A secondary function is that of resistance to Varus valgus deviations and internal rotation of the tibia, especially between 10° and 30° of flexion. Over 30° it becomes taut and the internal rotation is limited by the anterior-lateral and posterior-medial capsule. The PCL has an average length of 38 mm and an average thickness of 13 mm. Its main function is to prevent posterior translation of the tibia on the femur. It is stretched at extreme degrees of flexion and internal rotation of the tibia. It is composed of two components: one anterior, which is the most represented portion, which tightens in flexion, and the other posterior, which tightens in extension (Vaienti et al. 2017).

2.1.2.5 Knee Stability and Its Movements

The overall stability of the knee depends on the interaction of the capsule, menisci, ligaments, and muscles, the geometry of the articular surfaces, and the femora-tibial modifications during loading. These are all interdependent between them, thus allowing normal motility and, at the same time, effective stability. The knee is a modified hinge joint where the lack of congruence between the bone surfaces permits six degrees of movement, three translational (anterior-posterior, medial-lateral, and inferior-superior) and three rotational (flexion-extension, intra-external rotation, adduction-abduction). The movements are determined by the sliding of the articular surfaces of the tibia and femur and the orientation of the four major ligaments of the knee. In particular, the movement of flexion and extension is the broadest and more important. The first is defined as a posterior approaching movement of the leg to the thigh, which can be active or passive and dependent on the hip position. During the active flexion, the knee can reach 120°-140° with the hip flexed, while passively reaching up to 160°. The medial compartment has a contact 1.6 times greater than the lateral. Flexion is ensured by a combination of rotation ("roll-back") and sliding of the femur over the tibia. The movements of the articular surfaces mainly depend on the conformation and orientation of the articular surfaces and ACL, PCL, MCL, and LCL. The lateral femoral condyle rotates more than the medial in the first 15°-20° of flexion, because of its greater radius of curvature. This different parameter of the two condyles determines a movement of tibial internal rotation during flexion. Beyond 20° of flexion, slippage on both condyles becomes predominant. On the contrary, extension is associated with an external rotation of the tibia relative to the femur; this rotation has been called "the screw-home movement" and is purely passive and dependent on the articular geometry. The menisci, crushed between the articular surfaces in extension, move posteriorly together with the femur in flexion (the lateral more than the medial (Vaienti, et al. 2017).

2.1.2.6 Patellofemoral Joint

The patella is a triangular bone in the frontal plane, wider at the top and narrower at the bottom. The articular surface of the patella has seven facets, which are almost divided vertically into third equal parts medially and laterally. The articular surfaces of the femur and the patella are not perfectly congruent. The patellofemoral joint has four functions:1-increase the lever arm of the quadriceps, 2-ensure stability under load, 3-allow the transmission of the force of the quadriceps on the tibia, 4-provide bone protection to the trochlea and femoral condyles with the knee flexed. During flexion of the knee, the patella moves distally on the femur, while it rotates on itself about a transverse axis. The patellofemoral joint contact areas determine the capacity of the patella to transmit the load to the trochlear surface, which depends on the quadriceps muscle activity. The contact between the patella and trochlea begins between 10° and 20° of flexion along a portion of the medial and lateral facets of the lower margin of the patella. With the increase of knee flexion, the contact area increases and moves progressively proximally. At about 90° of flexion, the articular surface of the patella comes in contact with the lower part of the trochlea. After 120° the patella is in contact with the femoral condyles. The patellofemoral joint stability is ensured by anatomical and biomechanical factors, such as the trochlear and patellar articular surfaces, as well as the muscles around the knee and alar ligaments. The quadriceps muscle does not act in a straight line from the femoral head to the centre of the patella. The angle formed between the line connecting the anterior superior iliac spine and the centre of the patella and the line between its centre and the tibial tuberosity is defined as the angle Q. When the knee is extended, it is only present a small contact between the patella and femoral trochlea. During the first part of the flexion (0°-30°), additional stability is provided by the fibres of the vastus medialis muscle. Q angle increases with increasing knee flexion, as a consequence of the internal rotation of the tibia, and in addition, the patella tends to lateralize (Vaienti et al. 2017).

2.1.2.3 Pathology of Knee Joint

2.1.2.3.1 Anterior Cruciate Ligament

The ACL extends from the posterior part of the medial aspect of the femoral condyle to the anteromedial tibial plateau. The normal sagittal angle between ACL and the tibial plateau depends on patient's age and gender. The mean sagittal angle between ACL and the tibial plateau in adults is between 54° and 55.5° with a cutoff angle smaller than 45° suggestive of an ACL tear in adults. The ligament is intra-articular but extra synovial being enveloped by a fold of synovium. It consists of two bundles named according to their tibial insertion: a small anteromedial bundle and a larger posterolateral bundle. The posterolateral bundle is shorter (18.4–22.9 mm) than the anteromedial bundle (34.1–39.7 mm). The anteromedial bundle limits anterior- posterior translation, while the posterolateral bundle limits anterior tibial translation and knee rotation. On MR images, the ACL is seen as a band of low signal intensity in all sequences. The different bundles can however be well appreciated on MR images. The anteromedial bundle can be seen on MRI in the sagittal and coronal planes as oblique fibers inserting at the anterior border of the ACL on the tibia and the proximal aspect of the femoral insertion on the lateral fem-oral condyle (The posterolateral bundle is represented by oblique fibers inserting posteriorly On the tibia and on the distal aspect of the femoral insertion just below the anteromedial bundle. As a consequence, in general the low signal intensity of the ACL is separated by several lines of increased signal intensity on T1- or intermediate-weighted images, most prominently near the tibial attachment. These lines are consistent with stripes of fat and synovium of high signal intensity at the tibial as it shown in figure 2.12 (B0log Et al. 2015).

Figure 2.12 a: Normal anterior cruciate ligament (ACL). Sagittal proton-density (PD) FSE image thicker (B0log, Et al. 2015).

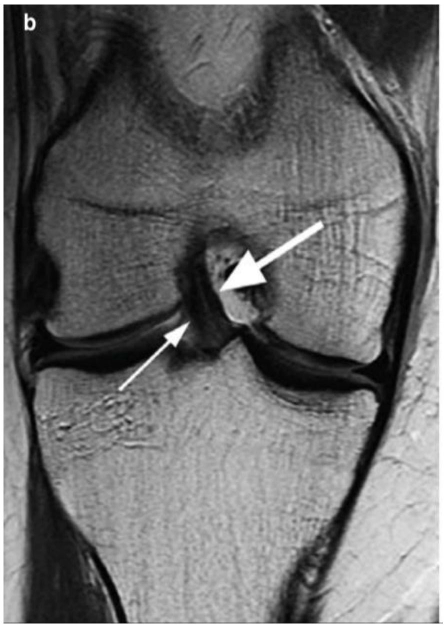

Figure 2.12.b: Coronal proton-density (PD) FSE MR image (b), and axial proton-density (PD) FSE fat- *ge* thicker (B0log, Et al. 2015).

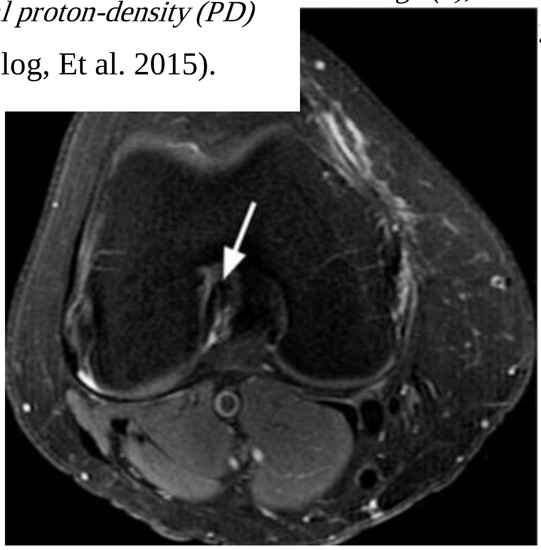

Figure 2.12 c:

Figure 2.12 c: Axial proton-density (PD) FSE fat suppressed image. thicker (B0log, Et al. 2015).

Axial proton-density (PD) FSE fat suppressed image (c) show the anteromedial bundle of ACL inserting at the anterior border of the ACL on the tibia (large arrow) and the posterolateral bundle which is shorter and thicker (B0log Et al. 2015).

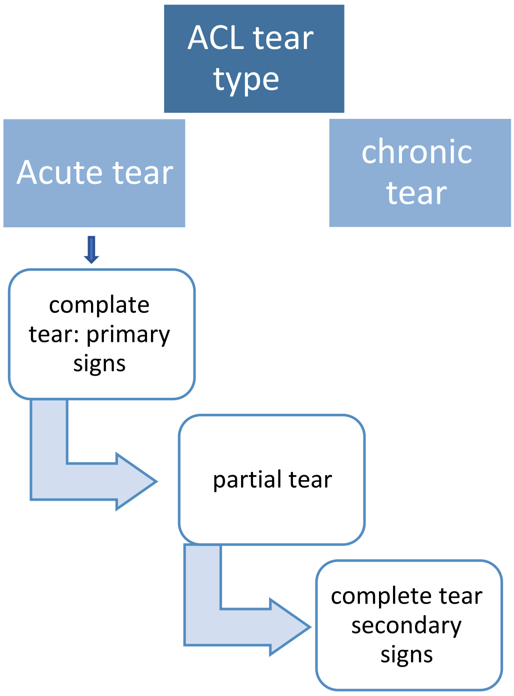

Figure 2.13: Types of Anterior Cruciate Ligament (ACL), axial view

2.1.2.3.2 Acute ACL tear

2.1.2.3.a.2 Complete Tear (Primary Signs)

Ligament discontinuity and an abnormal high signal intensity with no depiction of the ACL are direct signs of ligament tear. The presence of fluid or high signal intensity between ACL and the lateral femoral condyle on axial images indicates a proximal tear.

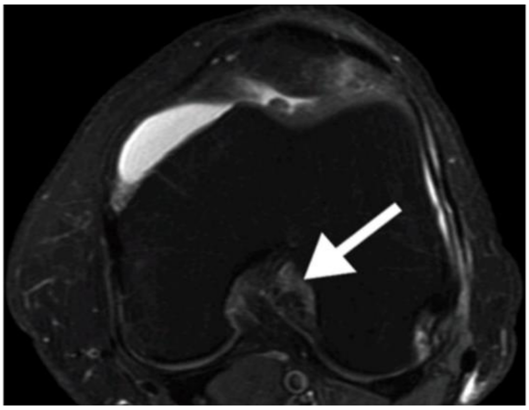

Figure 2.14: Complete acute tear of ACL, axial view (Bolog, Et al. 2015).

An ACL acute tear may present with a mechanical block caused by an ACL stump between fem- oral condyle and tibial plateau. The stump may also appear as a nodular mass with heterogeneous signal on T2-weighted images reflecting fibrosis or an inflammatory response (B0log, Et al. 2015).

Complete acute tear of the anterior cruciate ligament (ACL) at the femoral insertion in a 36-year-old female. Axial proton-density (PD) FSE fat-suppressed image shows high-signal intensity changes due to hematoma at the femoral insertion of ACL The presence of fluid or high signal intensity between ACL and the lateral femoral condyle on axial images.

Complete acute sagittal T2-weighted FSE fat- suppressed image (b) show an abnormal high signal intensity with no depiction of the ACL representing direct signs of a complete tear Medial Meniscus. The medial meniscus has a more open C-shaped structure than the lateral meniscus, covers approximately 60 % of the corresponding tibial plateau and is wider posteriorly than anteriorly. In a loaded, in vitro situation, 50% of the axial load in the medial compartment is absorbed by the medial meniscus. (B0log, Et al. 2015).

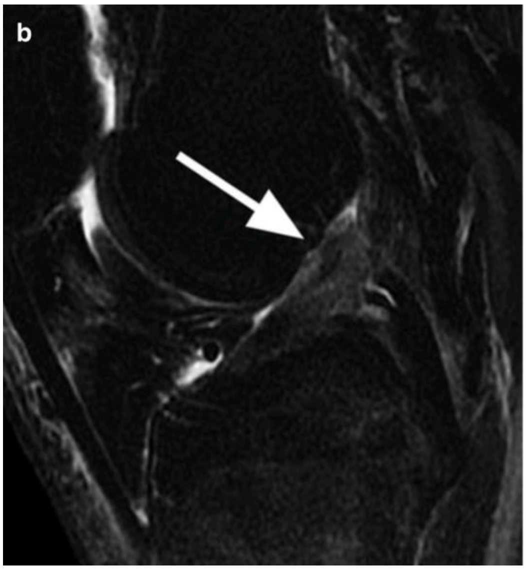

Figure 2.15 complete acute sagittal T2 FSE fat- suppressed image. (B0log, Et al. 2015).

2.1.2.3.b.2 Complete Tear (Secondary Signs)

Signs in addition to direct visualization of the torn ACL, MR images can be evaluated for indirect signs known to be typically associated with ACL tears. The secondary signs may appear in more than 90 % of the acute ACL tears and the mostly used secondary signs for diagnosis of ACL tears are as follows: the femoral and tibial contusion in angle between lateral tibial plateau and ACL (less than 45°) altered posterior cruciate ligament angle (less than 107°) abnormal (buckled) course of the PCL .and the anterior displacement of tibia. These secondary signs have high specificity and their presence corroborates with the diagnosis the lateral compartment (indicated by an acute traumatic bone marrow edema) altered (B0log, Et al. 2015).

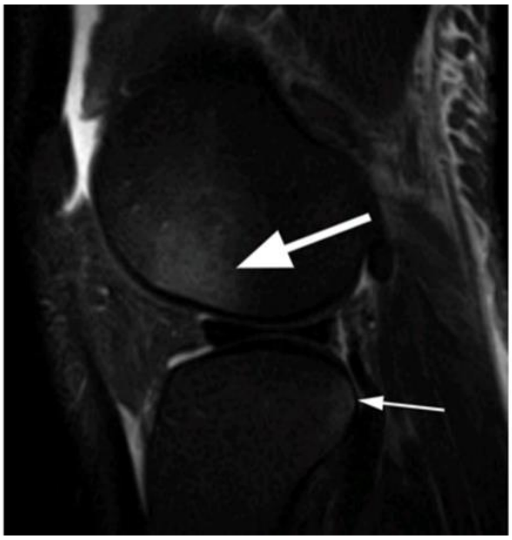

Figure 2.16: Sagittal T2-weighted FSE fat. *(B0log, Et al. 2015).*

Bone marrow contusions as indirect sign of anterior cruciate ligament (ACL) tear in a 27-year-old male. suppressed image shows high-signal-intensity contusions of the lateral fem-oral condyle (large arrow) and posterolateral tibial Plateau (small arrow) (B0log, Et al. 2015).

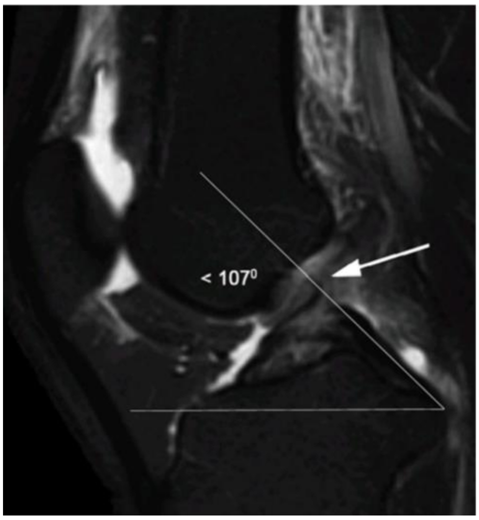

Figure 2.17: Anterior cruciate ligament (ACL) tear Sagittal T2-weighted FSE fat image

Anterior cruciate ligament (ACL) tear in a 27-year-old male (arrow). suppressed image 2.17 shows the angle between the posterior cruciate ligament and the plane of the tibial plateau less than 107° (B0log, Et al. 2015).

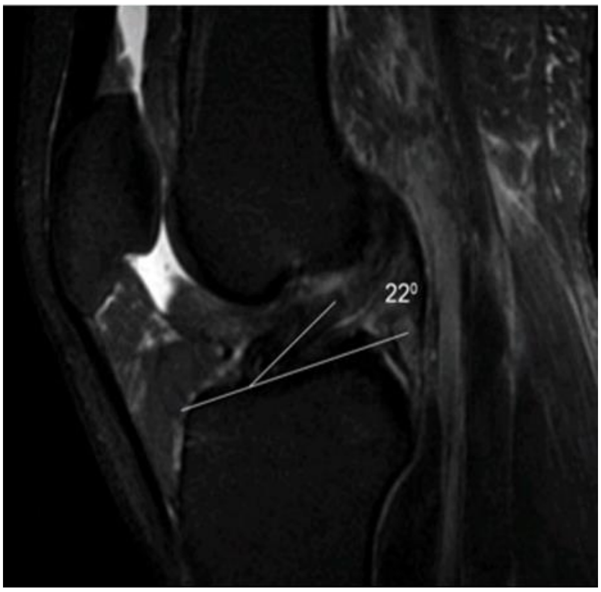

Figure 2.18: Angle (22°) Sagittal T2-weighted FSE fat- suppressed ACL (B0log, Et al.2015).

Altered angle (22°) between lateral tibial plateau and anterior cruciate ligament (ACL) (normal value 45° or more) as an indirect sign of complete ACL tear in a 27-year-old male.

2.1.2.3.c.2 Partial ACL tears

The partial tears represent 10–28 % of all ACL tears. The criteria of diagnosis include the absence of primary signs of complete ACL tear in conjunction with discrete focuses of high signal intensity within the mid substance of the ACL. The non-visualization of the ACL on one MRI sequence with visualization of the fibers on other sequences or the bowing or undulating course of otherwise intact ACL also indicates a partial ACL tear, Partial tearing may affect one or both bundles of the ACL which means that one bundle can be torn completely with the other bundle being partially torn at the same time. In partial ACL tears, the involved fibers and bundles can often be well seen, and the percentage of torn fibers should be reported (e.g., "75% of the substance of the ACL is torn and. Diffuse high signal intensity changes of one of the bundles at the tibial insertion with the no visualization of the linear high-intensity distal stripes indicate a partial distal tear of one of the bundles (B0log, Et al. 2015).

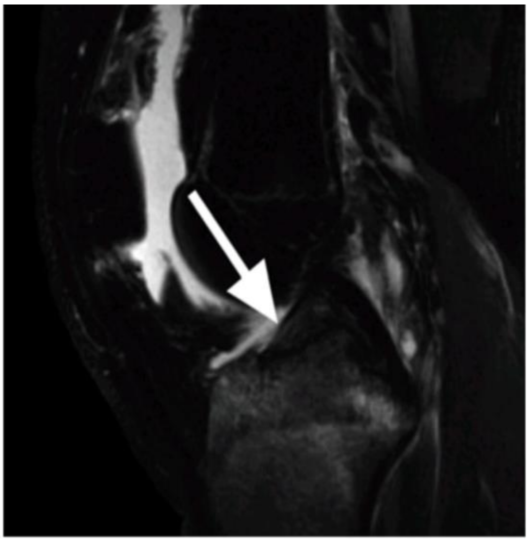

Figure 2.19: Partial tear for ACL Sagittal T2-weighted FSE fat-. (B0log, Et al. 2015).

Partial tear of the anterior cruciate ligament (ACL) involving more than 75 % of the distal ligament thickness in a 19-year-old male. shows diffuse high-intensity changes (arrow) which involve the entire posterolateral bundle and partially the anteromedial bundle at the tibial insertion of the ligament as it shown in figure 2.19 *(*B0log, Et al. 2015).

2.1.2.3.a Chronic anterior cruciate ligament tear

Diffuse or focal midsubstance low or intermediate signal changes of the ACL without visualization of the fibers are signs of chronic ACL tears. Fibrotic changes of low signal intensity at the insertions in the case of ACL healed on the notch or a normal ACL course without a clear delineation of the fibers in the case of chronic ACL tear healed on the as it shown in figure 2.20 (B0log, Et al. 2015).

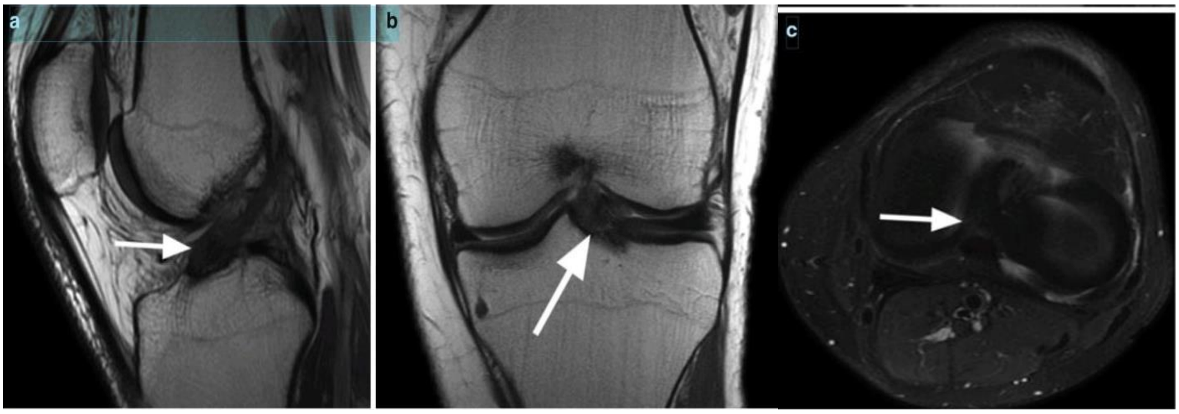

Figure 2.20: a: Chronic ACL tear sagittal image, b. coronal proton-density (PD) FSE MR image, c. axial proton-density (PD) FSE.

Chronic distal tear of anterior cruciate ligament (ACL) healed on the notch in a 28-year-old male with old knee trauma. (a), and image (c) show thickening of the ligament with diffuse intermediate signal changes at the tibial insertion (arrow). The absence of a clear delineation of the fibers is also an indicator of chronic tear as it shown in figure 2.20 (B0log, Et al. 2015).

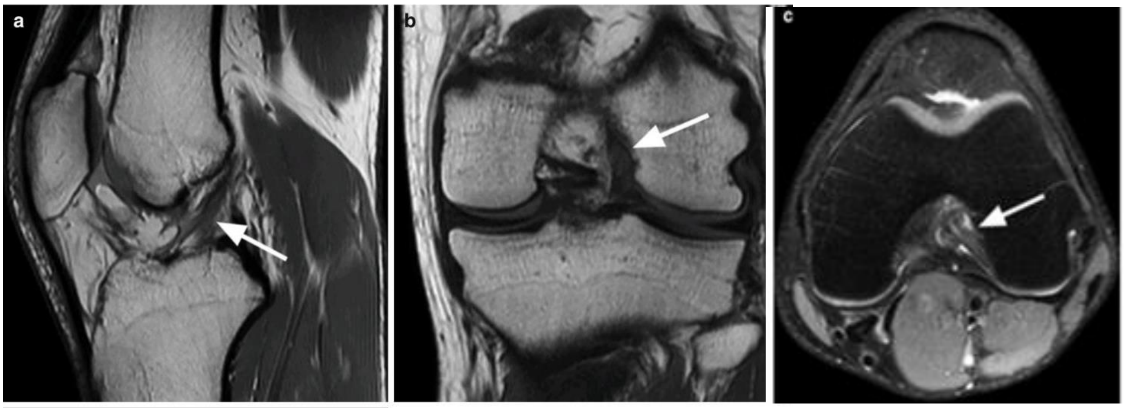

Figure 2.21: Chronic distal tear of anterior cruciate ligament (ACL), Sagittal and axial proton-density (PD) FSE FS. (B0log, Et al. 2015).

Chronic anterior cruciate ligament (ACL) tear healed on the notch in a 21-year-old patient with old knee trauma. Sagittal proton-density (PD) FSE image (a) shows a thin ACL with intermediate-signal-intensity changes (arrow). However, the ligament does not display discount women. The ACL appears hypertrophied with diffuse high signal with subtle appearance of some linear, low-signal-intensity fibers parallel to the long axis of the ligament ("celery stalk" sign) nuity and the course is linear. Coronal T1-weighted FSE MR image (b) and axial proton-density (PD) FSE fat- suppressed image (c) show fibrotic changes at the femoral insertion of the ACL with no visualization of the normal fibers (arrow in b and c) as it shown in figure 2.21 (B0log, Et al. 2015).

2.1.2.3. b Posterior Cruciate Ligament (PCL)

Posterior Cruciate Ligament (PCL) The posterior cruciate ligament (PCL) is the strongest ligament of the knee. It is intra-articular and extra synovial. The PCL arises from the anterolateral surface of the medial femoral condyle and reaches the posterior intercondylar area of the tibia. The femoral origin is more anterior than that of anterior cruciate ligament (ACL), and in contrast to the ACL, the PCL is larger at its femoral origin than at its tibia insertion. The tibia attachment is extra-articular, and it is approximately 1 cm distal to the plane of the articular surface. The PCL is the primary restraint to posterior tibia translation relative to the femur and becomes more important in pre- venting distraction of the joint as the knee reaches higher degrees of flexion. The PCL consists of two functional bundles: the anterolateral and the posteromedial bundle. The anterolateral bundle (65 %) is usually thicker and stronger than the posteromedial bundle (35 %) Most PCL fibers are not isometric and the bundles have different functions that enable the PCL to resist posterior translation The length of the ligament is similar to that of the ACL (mean length, 38 mm). The PCL is seen as a band of low signal intensity in all MR sequences and is usually visualized in its entire length on one or two consecutive sagittal images. The two-bundle anatomy is often well visualized on axial planes, and all axial planes should thoroughly be evaluated for partial (unbundle) rupture. To assess the intact attachments of the PCL, axial, sagittal, and coronal images should be evaluated. The axial images are especially helpful for the femoral attachment, whereas the sagittal images are especially helpful for assessing the tibial attachment. Since the PCL appears as an angulated structure on sagittal MR images, several indirect signs have been described to detect other ligament abnormalities, one of which is the PCL angle. The mean PCL angle is 123° and is smaller in patients with acute anterior cruciate ligament (ACL) tear but also in younger patients without ACL abnormalities Due to this overlap, indirect signs for ACL tears, i.e., quantitative and semi quantitative signs, should be used with care, especially in the skeletally immature patient as it shown in figure 2.22(B0log, Et al. 2015).

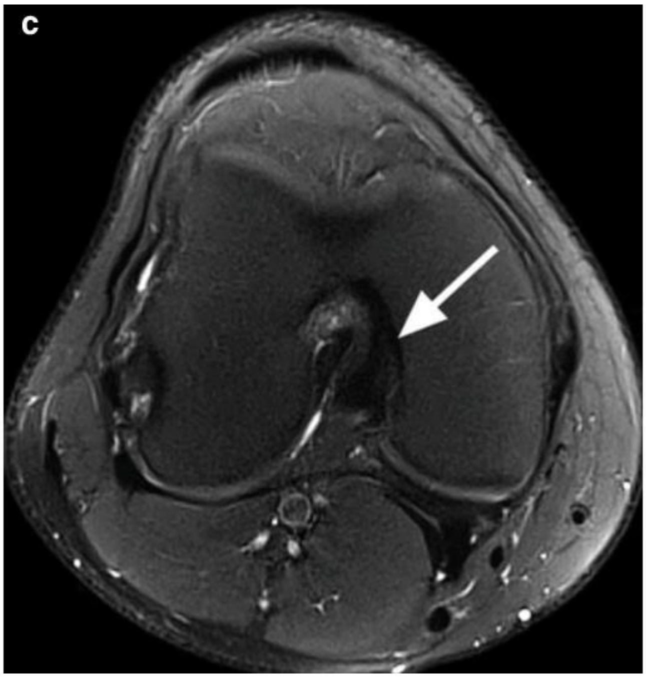

Figure 2.22: Normal Axial proton-density (PD) FSE image. (B0log, Et al. 2015).

Normal posterior cruciate ligament (PCL) in a 17-year-old male. shows the PCL as a band of low signal intensity.

2.1.2.3.c Acute tear

2.1.2.3.c.1 Complete Tear

Complete Tear Focal discontinuity and an amorphous high signal intensity due to hemorrhage and edema without visualization of the ligamentous fibers are signs of PCL tear and Isolated PCL tears are found in 24 % of patients and they can be localized at the femoral insertion, in the midsubstance, or at the tibial insertion. The associated findings of other coexisting knee injuries may be present in 76 % of cases and include involvement *(B0log, Et al. 2015).*

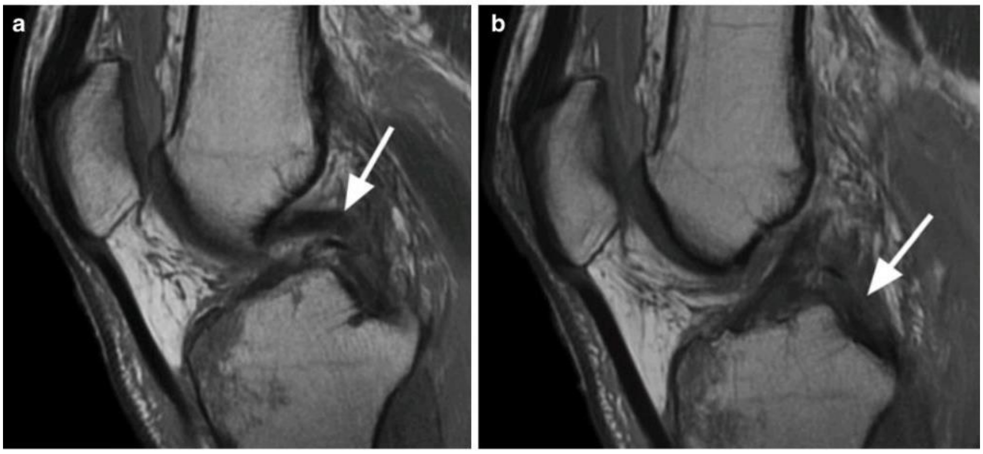

Figure 2.23: Complete acute tear of the posterior cruciate ligament sagittal proton-density (PD) FSE images (a, b).

Complete acute tear of the posterior cruciate ligament in a 50-year-old male. Two consecutive show complete discontinuity of the fibers (arrow) (a) with hemorrhage and edema in the midsubstance and at the femoral insertion of the ligament (b) as it shown in figure 2.23 (B0log, Et al. 2015).

2.1.2.3.c.2 Partial Tear Partial tears

Partial Tear Partial tears represent 55 % of all PCL tears. Criteria of diagnosis include the presence of increased signal intensity with discernible fiber along the course of the ligament. The partial tear can be interstitial or can involve one of the above described PCL bundles. In partial interstitial tears, there is an increased longitudinal ligamentous signal intensity without disruption of the fibers. In these cases, the PCL bundles can be separated by the signal-intensity changes. The findings of interstitial tear of the PCL must beas it shown in figure 2.24 *(*B0log, Et al. 2015).

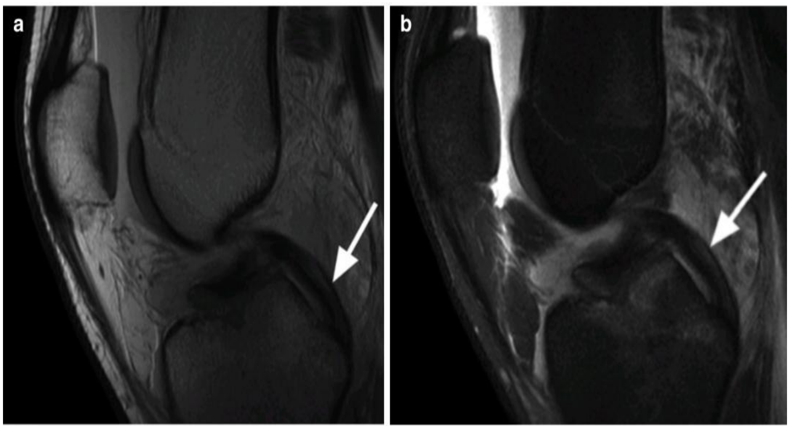

Figure 2.24: Partial interstitial acute tear of the posterior cruciate ligament, Sagittal proton-density (PD) FSE image (a), sagittal T2-weighted FSE fat- suppressed image (b (B0log, Et al. 2015).

Partial interstitial acute tear of the posterior cruciate ligament involving the posteromedial bundle in an 18-year-old male with recent knee trauma. Sagittal proton-density (PD) FSE image show increased longitudinal signal intensity changes within the ligament (arrow) without complete discontinuity of the fibers (small arrow in c) as it shown in figure 2.25 (B0log, Et al. 2015).

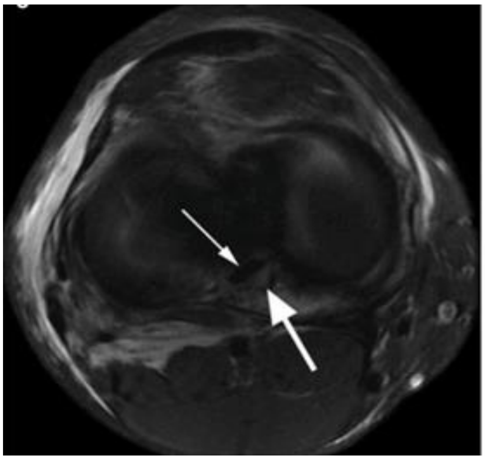

*Figure 2.25**:** Partial PCL axial proton-density (PD) FSE fat image. (B0log, Et al. 2015).*

2.1.2.3.d Medial collateral ligament

The knees are made up of bones, ligaments, tendons and cartilage The medial collateral ligament (MCL) is located on the inner side of your knee, and it's eight to 10 centimeters in length. It connects your thigh bone (femur) to your shin bone (tibia). Your MCL also provid strength "and stability to your knee joint. It's one of four primary ligaments in your knee. Ass it sown in figure 2.26 (Cleveland .et al 2021).

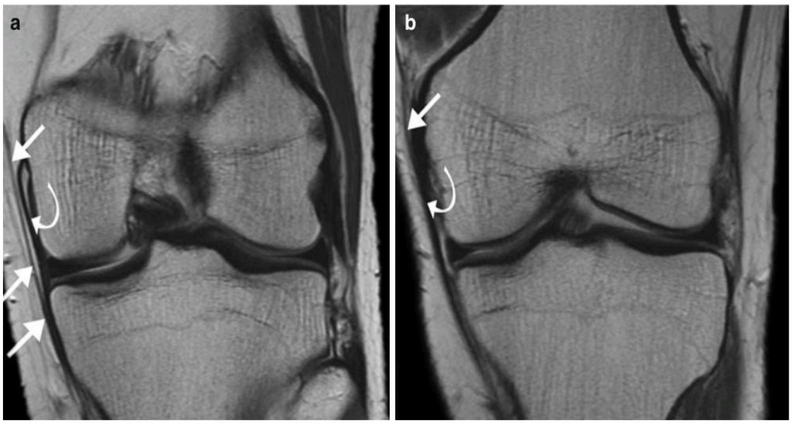

*Figure 2.26**:** Normal collateral ligament Coronal proton-density (PD) FSE image (a), Anteriorly, mid-coronal proton-density (PD) FSE image (b). (Cleveland .et al 2021).*

Normal superficial layer of the medial supporting structures or layer 1 represented by deep corral fascia in a 36-year-old male. obtained posteriorly through the joint – the plane is drawn in c as line 3.1.A. At this level, the deep corral fascia that is seen on MR images as a thin low-intensity structure (arrows) separated by a variable amount of fat from the superficial layer of medial collateral ligament known also as the vertical part of the ligament (curved arrow). – the plane is drawn in c as line 3.1.B – the deep crura fascia (arrow) joins the medial collateral ligament (curved arrow in b) as it shown in figure 2.26 (B0log, Et al. 2015).

2.1.2.3.d.1 Medial collateral tear

A MCL tear is damage to the medial collateral ligament, which is a major ligament that's located on the inner side of your knee. The tear can be partial (some fibers in the ligament are torn) or complete (the ligament is torn into two pieces). A ligament is a tough band of tissue that connects one bone to another bone or holds organs in place. MCL tears are fairly common. MCL tears are the most common knee ligament injury, and approximately 40% of all knee injuries involve the MCL as it shown in figure 2.27 (Cleveland, et al 2021).

Figure 2.27: Partial tear of the medial collateral ligament (MCL) Coronal (PD) FSE image. (Cleveland. et al 2021).

Partial tear of the medial collateral ligament (MCL) or grade II tear in a 22-year-old female. shows focal signal abnormalities of the ligament involving the deep layer (arrow). There is a poorly defined internal structure of the ligament, and the fibers are displaced from the adjacent bone at the femoral insertion. However, the superficial layer is still in continuity) as it shown in figure 2. 27 (B0log, Et al. 2015).

2.1.2.3.d.3 Different types of MCL tears

Grade 1: A grade 1 MCL tear is a mild tear in which less than 10% of fibers in the ligament are torn and the knee is still stable.

Grade 2: A grade 2 MCL tear is a moderate tear in which the MCL is partially torn - usually the superficial part of the MC.

Grade 3: A grade 3 MCL tear is a severe tear in which the MCL is completely torn - both the superficial and deep parts. The knee will likely be very unstable and loose.

2.1.2.3.e Medial Meniscus

Medial Meniscus The medial meniscus has a more open C-shaped structure than the lateral meniscus, covers approximately 60 % of the corresponding tibial plateau and is wider posteriorly than anteriorly. In a loaded, in vitro situation, 50% of the axial load in the medial compartment is absorbed by the medial meniscus (B0log, Et al. 2015).

Figure 2.28: Normal menisci sagittal view in MRI, proton-density. (B0log, Et al. 2015).

Normal menisci in a 19-year-old female. Sagittal proton-density (PD) FSE image through the medial compartment (a) shows the medial meniscus which is wider posteriorly than anteriorly (arrows) as it shown in figure 2.28 (B0log, Et al. 2015).

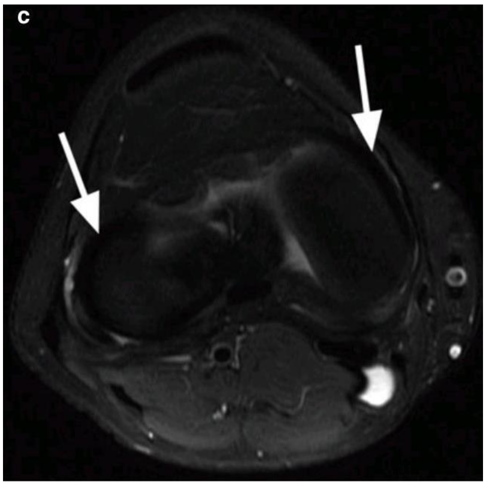

Figure 2.29: Axial view, (PD) FSE fat suppressed image. (B0log, Et al. 2015).

A complete evaluation of the meniscus should include axial images as shown in the axial proton-density (PD) FSE fat suppressed image (arrows in c) (B0log, Et al. 2015).

2.1.2.3.e.1 The meniscal tear

The meniscal tear is described as a linear increased signal intensity within the meniscus. The MR report should not only identify the presence of a linear meniscal tear but also should accurately describe the orientation, location, length and stability, because these criteria are important and may influence the choice of operative or non-operative treatment. The classifications of meniscal tears are based on different criteria. According to the orientation, a meniscal tear can be vertical, horizontal, or complex. Vertical tears are further subdivided into radial (perpendicular to the long axis of the meniscus), which includes the tears of the meniscal root and longitudinal (parallel to the long axis of the meniscus) as it shown in figure 2.30 (B0log, Et al. 2015).

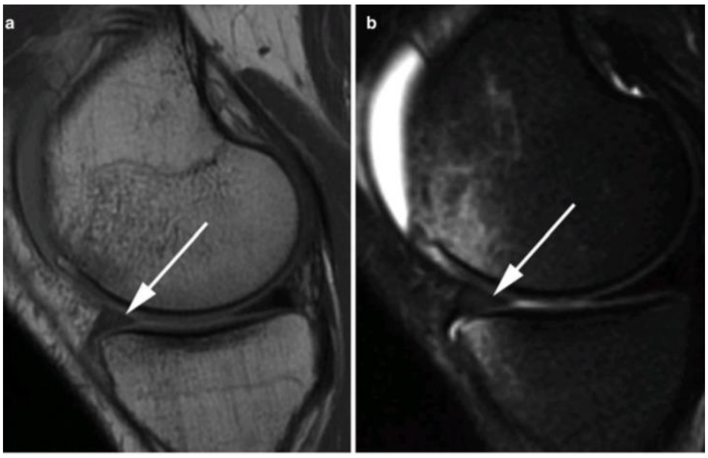

Figure 2.30: Sagittal proton-density (PD) FSE image (a) and sagittal proton-density (PD) FSE fat-suppressed image. (B0log, Et al. 2015).

Meniscal contusion in a 32-year-old male with knee injury.) show diffuse signal intensity changes in the anterior horn of the medial meniscus that extends to the articular surface (arrows). Note the bone marrow contusion of the medial femoral condyle as it shown in figure 2.30(B0log, Et al. 2015).

Figure 2.31: Meniscal tear sagittal (PD) FSE. (B0log, Et al. 2015).

Vertical longitudinal tear of the posterior horn of the lateral meniscus in a 27-year-old male. shows the vertical tear typically located in the peripheral zone of the meniscus (B0log, Et al. 2015)

Figure 2.32: Vertical radial tear of the lateral meniscus (B0log, Et al. 2015).

The cleft sign revealing vertical radial tear of the lateral meniscus in a 44-year-old male. Coronal proton-density (PD) FSE image shows the vertical high-signal extending through The cleft sign revealing vertical radial tear of the lateral meniscus in a 44-year-old male. Coronal proton-density (PD) FSE image shows the vertical high-signal extending through as it shown in Figure 2.23(B0log, Et al. 2015).

2.1.2.3.f Cyst

2.1.2.3.f.1 Introduction:

A cyst is defined as a closed cavity, or sac, that is lined with epithelium. It can contain liquid or semisolid material, can be normal or abnormal, and can occur in soft tissue or in bone. Benign or malignant masses must be distinguished from cystic lesions. (David, et al. 2022).

Cysts and cystic-appearing soft-tissue lesions in and around the knee are common and can create a diagnostic dilemma if one is not aware of the potential diagnoses and pitfalls. Most of these lesions are benign and are related to the collection of fluid in bursae, herniation of synovium from the joint, or ganglia arising from tendons and ligaments. However، other processes, both benign and malignant, can produce a cystic-appearing mass and lead to misdiagnosis. Ultrasonography (USG) and magnetic resonance imaging (MRI) are the most useful imaging modalities in evaluating these cystic lesions. USG can distinguish cysts from solid lesions and assess the degree of vascularity within the lesion. MRI can help delineate the location of the lesion in relation to anatomic structures and also determine if the lesion is cystic or solid when contrast is administered. In most instances, the location of the lesion and the enhancement pattern are the most important factors in determining its etiology. Given the many cystic lesions encountered around the knee, it is helpful to divide them into two categories: true cysts (those lined by cells; synovial, bursae, ganglia, and meniscal) and cyst mimickers (traumatic lesions, infectious processes، vascular lesions, and neoplasms). (Telischak, et al. 2014).

The problems related to cysts around the knee are largely proportional to the size and location of the cyst. One of the most common knee cysts is the popliteal cyst, otherwise known as a Baker cyst; its symptoms can include pain. This type of cyst most often develops in the bursa beneath the medial head of the gastrocnemius and from the semimembranosus bursa. Because the development of popliteal cysts correlates with intra-articular pathology, they usually point to a problem of one or both menisci, a complete or partial cruciate ligament tear, a chondral injury, or a combination of any of these. Large popliteal cysts can rupture and become quite painful; it is important to rule out deep vein thrombosis in these instances. Meniscal cysts, as previously noted, are problematic because of the pain that is often associated with a palpable, firm mass. Cysts about the knee have multiple etiologies, including irritated and inflamed bursae, meniscal cysts caused by intra-articular pathology. The pathophysiology of benign knee cysts depends on the specific etiology. Although at times controversial، the underlying causes of most cysts are similar; a benign cyst results whenever a saclike structure is formed secondary to a mechanical or biochemical irritant. A sac that already is present, such as an epithelial-lined bursa, is subject to the same irritants. These potential spaces then become filled with a fluid or with degenerative myxoid products. Over time, the cyst becomes mucoid and semisolid if resorption of the fluid is slow and if the fluid has a high protein content (David, et al. 2022).

2.1.2.3.f.3 Classification of cysts of the knee:

2.1.2.3.f.4 Synovial cyst:

Synovial cysts connect to the joint space, since they represent herniation of synovial tissue into the surrounding soft tissues. At times, it may be difficult or even impossible to distinguish them from bursae or ganglia, which lack a true connection to the joint but at times can connect to the joint. Moreover, the inconsistent use of the terms synovial cyst, bursa, and ganglion in clinical practice and in literature further complicates matters (Telischak, et al. (2014).

2.1.2.3.f.5 Popliteal (Baker's) cyst

The popliteal (Baker's) cyst is by far the most common cyst in the knee, seen in up to 40% of MRI examinations. It represents a communication between the posterior joint capsule and the normally occurring gastrocnemius-semimembranosus bursa/recess [Figure 2.34]. This connection can have a “ball-valve” like mechanism, which is typically opened during knee flexion and closed during extension. Popliteal cysts are lined by synovium, may be simple or septate, and contain hemorrhage, debris, or even osseous loose bodies. Visualizing a communicating fluid collection arising between the tendons of the medial head of the gastrocnemius and semimembranosus is the key to making the diagnosis. Although many popliteal cysts are asymptomatic, large cysts may cause nerve entrapment, compress adjacent vascular structures, or limit knee flexion. Popliteal cysts can be complicated by cyst rupture, which can be indistinguishable clinically from deep venous thrombosis and result in edema in the surrounding fascial planes and subcutaneous fat (Telischak, et al. (2014).

Figure 2.34: Popliteal cyst (A) Lateral knee Radiograph, (B) Gray scale USG image, (C) Axial T2W image (Telischak, et al. (2014).

Figure 2.34 (A-C) Popliteal cyst. A 60-year-old female with knee pain. (A) Lateral knee radiograph demonstrates coarse calcifications (arrow) in the popliteal fossa. (B) Gray scale USG image at the level of popliteal fossa demonstrates a cystic lesion containing echogenic calcifications (arrow) with posterior acoustic shadowing. (C) Axial T2W image through right knee demonstrates the hyperintense popliteal cyst fluid arising between semimembranosus (arrowhead) tendon and medial head of gastrocnemius (asterisk), with hypointense loose bodies (arrow) layering dependently (Telischak, et al. (2014).

2.1.2.3.f.6 Proximal tibiofibular joint cyst

The proximal tibiofibular joint (PTFJ) is a synovial joint that connects to the knee joint in 10% of patients [Figure 2.35]. It is hypothesized that increased knee joint pressure in these patients can result in the formation of a synovial cyst in the PTFJ. These cysts are more common in patients with chronic knee pain and osteoarthritis, but have also been described in high-performance athletes. Although relatively uncommon (<1% of MRI examinations) and often asymptomatic, large PTFJ cysts can compress the common peroneal nerve and result in foot drop and muscle weakness as it shown in Figure 2.35. (Telischak, et al. (2014).

Figure 2.35: (A-C) PTFJ cyst axial T1W MR image, (B) (STIR) MR image (Telischak, et al. (2014).

Figure 2.35: (A-C) PTFJ cyst. A 50-year-old male with palpable mass. Axial T1W MR image (A) demonstrates uniformly hypointense mass (arrow) with small tail (arrowhead),

arising from proximal tibiofibular joint. Lesion (arrow) is hyperintense on coronal short tau inversion recovery (STIR) MR image (B) and does not enhance on post-contrast T1W fat-saturated image (C).

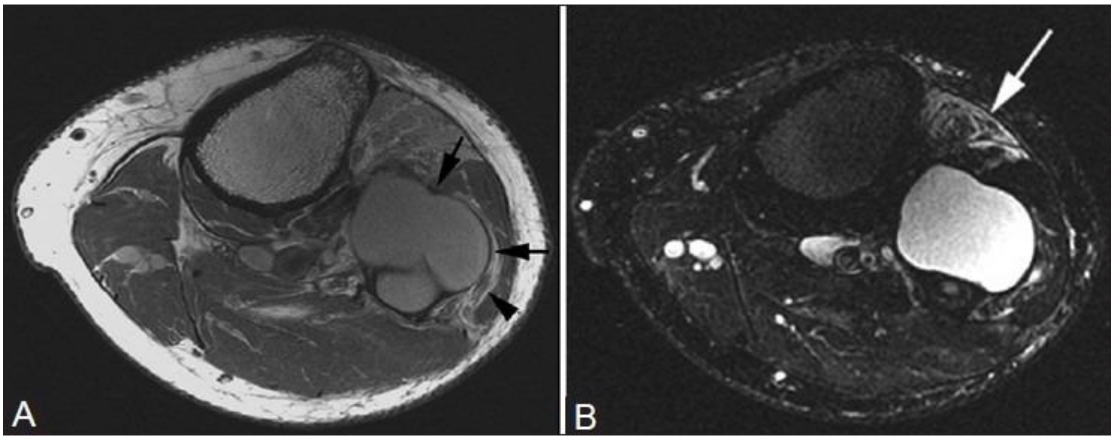

Figure 2.36: (A) PTFJ cyst axial proton density (PD) image, (B) axial STIR image (Telischak, et al. (2014).

Figure 2.36: (A, B) PTFJ cyst. A 57-year-old man with foot drop. Axial proton density (PD) image (A) shows large cyst (arrows) compressing the common peroneal nerve (arrowhead). There is muscle edema (arrow) in anterior tibialis on the axial STIR image (B) (Telischak, et al. (2014).

2.1.2.3.g Bursae:

Bursae are cystic lesions containing synovial fluid that reduces friction between moving structures such as tendons، ligaments, bone, and skin. Bursae are often not visible on imaging unless irritated or inflamed due to trauma، infection, or arthritis. In general, bursae do not connect to the joint space, which distinguishes them from synovial cysts and normal joint recesses; however, at times, they can connect to the joint, such as the iliopsoas bursa. There are numerous bursae in and around the knee. The PR patellar, superficial infrapatellar, and deep infrapatellar bursae are associated with the patella, whereas the pes anserine, iliotibial (IT), and medial (tibial) collateral ligament، fibular collateral, and semimembranosus-tibial collateral ligament bursae [Figure 2.37] are not. Other classification systems categorize the suprapatellar, popliteal, and the gastrocnemius-semimembranosus joint spaces as bursae, though they connect to the knee joint and, thus, are technically joint recesses Figure 2.37 Semimembranosus/tibial collateral ligament bursa. A 45-year-old woman with posteromedial knee pain. Sagittal T2W fat-saturated image demonstrates a tubular bright cystic mass (arrow) just posterior to the semimembranosus tendon (arrowhead) (image courtesy of Dr. Justin Kung, Boston, MA) (Telischak, et al 2014).

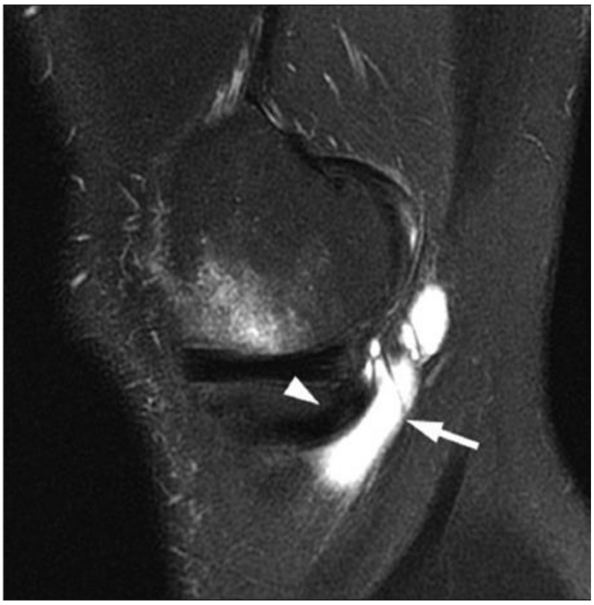

Figure 2.37 Semimembranosus/tibial collateral ligament bursa Sagittal T2W fat-saturated image (Telischak, et al. (2014).

2.1.2.3.g.1 Prepatellar and infrapatellar bursitis

The prepatellar bursa is located anterior to the patella, deep to the subcutaneous soft tissues. Inflammation of the bursa، popularly referred to as “housemaid's knee,” can result from direct trauma to the patella or repetitive injury, producing anterior knee pain which may be associated with a palpable mass [Figure 2.38]. Infrapatellar bursitis can occur in the superficial (between the tibial tubercle and the overlying skin) or deep (between the posterior aspect of the patellar tendon and the tibia) bursae. Often called “vicar's” or “clergyman's” knee, it is caused by repetitive knee flexion from deep knee bends or jumping. On MRI, the bursa often appears as a triangular, uniformly T2 bright structure between the distal patellar tendon and anterior tibia [Figure 2.39] (Telischak, et al. (2014).

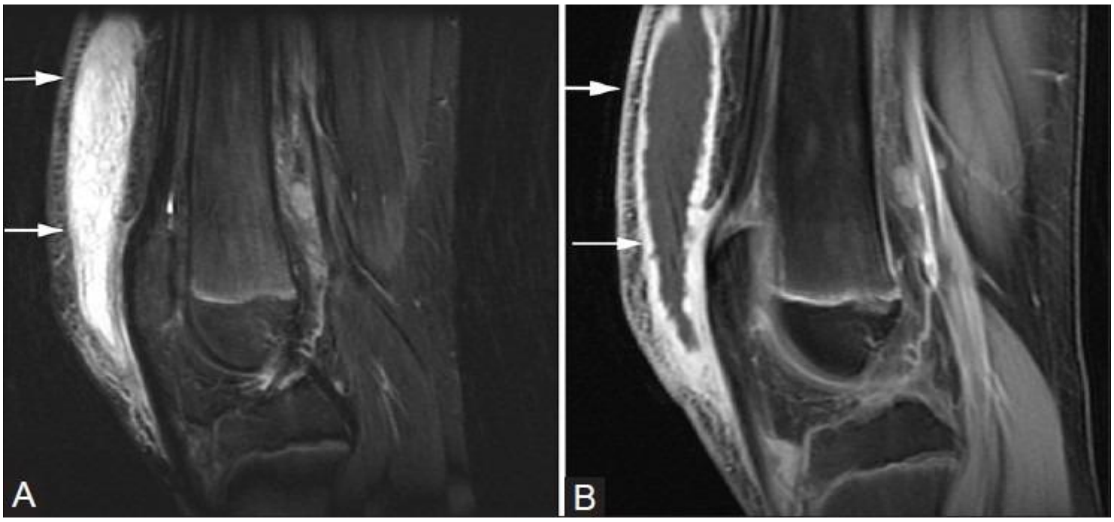

Figure 2.38: (A, B) Prepatellar bursitis A, T2W fat-saturated image B, T1W post contrast image (Telischak, et al. (2014).

Figure 2.38 (A, B) Prepatellar bursitis. A 16-year-old female with anterior knee pain. (A) T2W fat-saturated image demonstrates enlarged fluid-filled space in prepatellar region (arrows) with surrounding fat stranding. (B) T1W post contrast image demonstrates only peripheral enhancement (arrows).

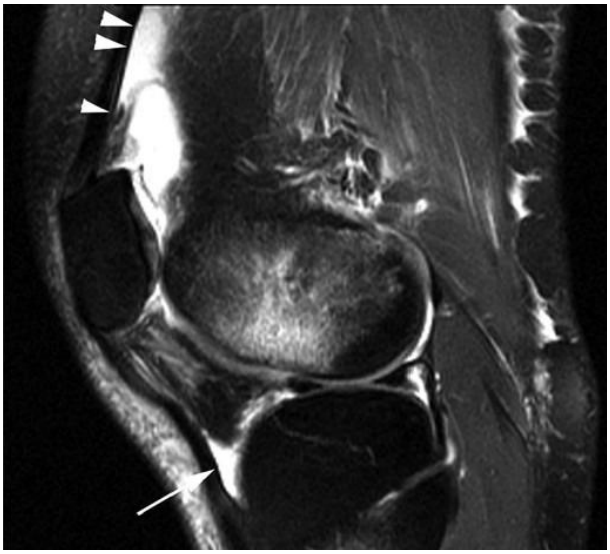

Figure 2.39: Infrapatellar bursitis Sagittal fat-saturated T2W image.

Figure 2.39 Infrapatellar bursitis. A 28-year-old male with anterior knee pain. Sagittal fat-saturated T2W image shows triangular pocket of fluid (arrow) between distal patellar tendon and anterior tibia. There is also bone contusion in lateral femoral condyle and fluid in suprapatellar recess (arrowheads), resulting from transient lateral patellar dislocation. (Telischak, et al. (2014).

2.1.2.3.g.2 Iliotibial (IT) bursitis

IT bursitis occurs secondary to friction of the IT band against the lateral femoral epicondyle prominence. It is common in patients who participate in intense physical activity, such as distance runners, cyclists, and football players. Repetitive Varus stress to the knee can irritate the bursa, resulting in fluid accumulation within cyst-like structures that can appear as T2 bright masses near the distal insertion of the IT band onto Gerdy's tubercle [Figure 2.40].

Figure 2.40: (A and B) Iliotibial band cyst A, Coronal T2W fat-saturated image B, post-contrast T1W fat-saturated image (Telischak, et al. (2014).

(A and B) Iliotibial band cyst. A 46-year-old man with palpable abnormality. (A) Coronal T2W fat-saturated image demonstrates well-circumscribed hyperintense cyst (arrows) abutting the iliotibial band, which does not enhance internally following contrast administration on the post-contrast T1W fat-saturated image (B) (Telischak, et al. (2014).

2.1.2.3.g.3 Pes anserine bursitis

The pes anserine bursa is situated on the medial aspect of the knee, between the pes anserine tendons (gracilis, Sartorius، and semitendinosus) and the tibial insertion of the tibial collateral ligament. Pes anserine bursitis affects both genders equally, classically occurring in older overweight women with knee osteoarthritis or in athletes in sports that require running and side-to-side movement. On MRI, there is a T2 bright cystic structure intimately associated with the pes anserine tendons on the posteromedial aspect of the knee, extending toward their insertion onto the anteromedial aspect of the tibia [Figure 2.41]. At times, pes anserine bursitis can be confused with a popliteal (Baker's) cyst. Baker's cysts are often larger, communicate with the joint, and can extend into the thigh, whereas pes anserine bursitis does not. Close scrutiny of the tendons associated with the cystic structure is most helpful in distinguishing between these two entities (Telischak et al (2014).

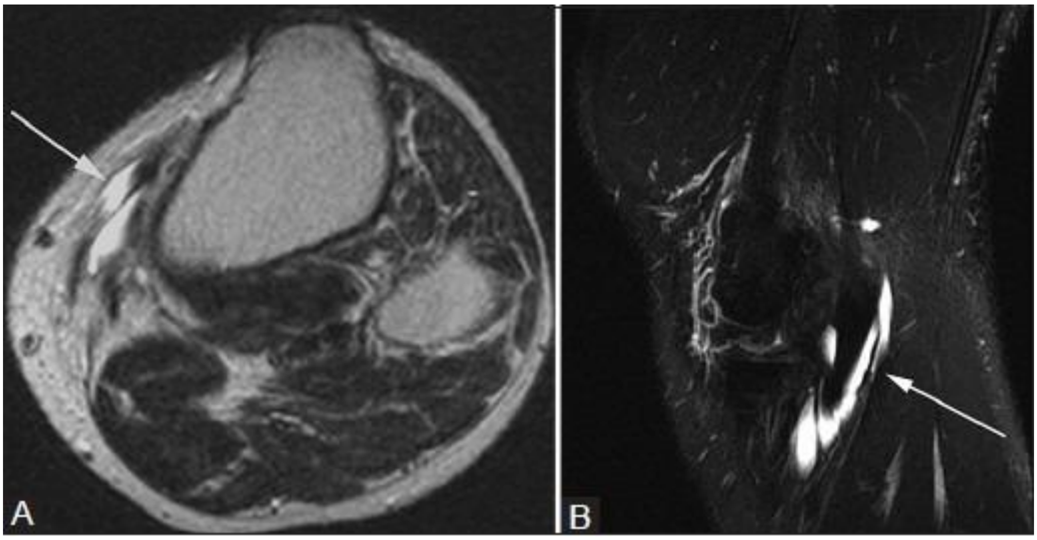

Figure 2.41 (A, B) Pes anserine bursitis A, Axial T2W. B, sagittal T2W fat saturated images. (Telischak, et al. (2014).

Figure 2.41 (A, B) Pes anserine bursitis. A 30-year-old male with medial knee pain. (A) Axial T2W and (B) sagittal T2W fat saturated images demonstrate fluid signal (arrows) adjacent to the insertion of the pes anserine tendons (Telischak, et al. (2014).

2.1.2.3.g.4 Medial (tibial) collateral ligament bursitis

The medial collateral ligament bursa, which lies between the superficial and deep layers of the medial collateral ligament [Figure 2.42], infrequently becomes inflamed and filled with fluid. Physical activities that irritate the medial knee soft tissues, such as horseback and motorcycle riding, are potential causes. Mass effect from osteophytes and rheumatoid arthritis are other precipitating factors. On imaging, an oblong fluid collection distends the deep and superficial fibers of the medial collateral ligament. Medial collateral ligament bursitis can at times be confused with a partial tear of the medial collateral ligament or a paramedical cyst (Telischak, et al. (2014).

Figure 2.42: Medial collateral ligament bursitis Coronal T2W fat saturated image (Telischak, et al. (2014).

Figure 2.42 Medial collateral ligament bursitis. A 56-year-old man with medial knee mass and pain. Coronal T2W fat saturated image shows an oblong heterogeneous cystic mass (arrow) adjacent to the medial collateral ligament (arrowhead.) (Telischak, et al. (2014).

2.1.2.3.h **Ganglia**

Ganglia are myxoid lesions of unknown cause which are characterized by dense connective tissue filled with gelatinous fluid rich in hyaluronic acid and other mucopolysaccharides. Unlike synovial cysts, ganglia do not communicate with the joint space and lack a cellular lining. Based on imaging, however, it is difficult (or impossible) to distinguish ganglia from synovial cysts. Ganglia demonstrate low signal intensity on T1W images, high signal intensity on T2W images, and may show rim enhancement. They classically lack solid internal enhancement; though small multistate ganglia can simulate this appearance. Moreover, long-standing ganglia can cause pressure erosions in the adjacent bone, mimicking an aggressive process. Ganglia around the knee can occur at any tendon insertion, but are most common at the tendon insertion of the medial and lateral gastrocnemius and the popliteus Gastrocnemius ganglia are more common at the medial head and often multistate [Figure 2. 43]. Ganglia can be painful if large, although a major concern is mistaking one for a soft-tissue tumor. Popliteus tendon ganglia often arise near their insertion onto the lateral femoral condyle and are usually asymptomatic [Figure 2.44].

They may be mistaken for paramedical cysts, and large ganglia can be painful (Telischak, et al. (2014).

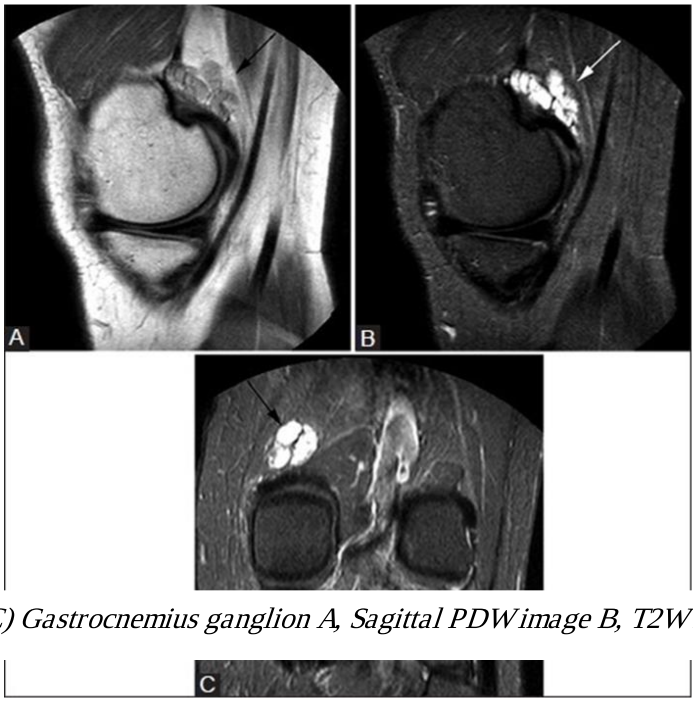

Figure 2.43: (A-C) Gastrocnemius ganglion A, Sagittal PDW image B, T2W fat-saturated images.

Figure 2.43 (A-C)

Gastrocnemius ganglion. A 45-year-old male with knee pain. Sagittal PDW image (A) demonstrates lobulated lesion (arrows) at insertion of medial head of gastrocnemius that is hyperintense on sagittal (B) and coronal (C) T2W fat-saturated images (Telischak, et al. (2014).

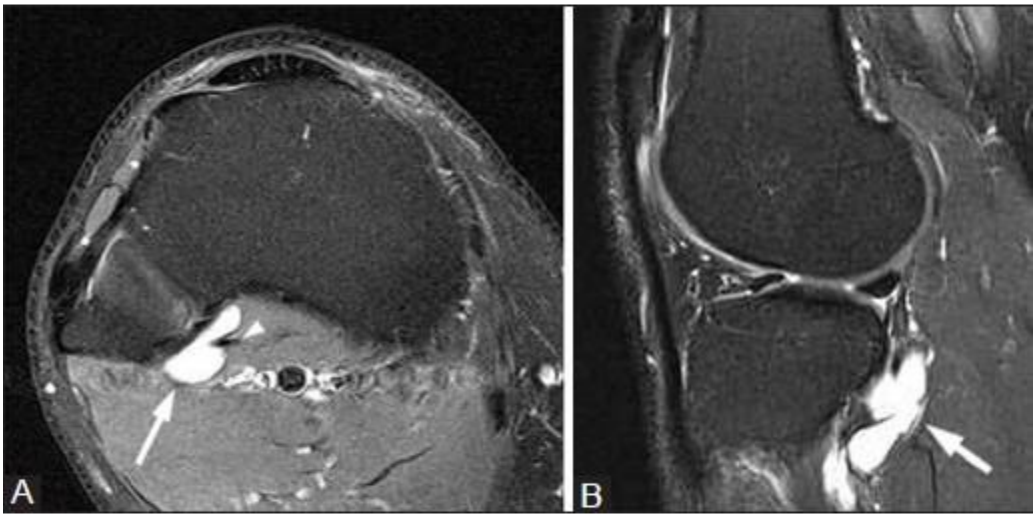

Figure 2. 44 (A, B) Popliteus ganglion(A) Axial and (B) sagittal T2W fat-saturated images (Telischak, et al. (2014).

Figure 2. 44 (A, B) Popliteus ganglion. A 34-year-old woman with knee pain. (A) Axial and (B) sagittal T2W fat-saturated images show a cystic lesion (arrow) in the popliteus tendon sheath.

Intra-articular ganglia can be associated with cruciate ligaments. Anterior cruciate ligament (ACL) ganglia are more common than posterior cruciate ligament (PCL) ganglia and can have a "drumstick" appearance with enlargement and increased T2 signal in the proximal ACL fibers [Figure 2.45]. This increased T2 signal can be seen as a discrete focus of fluid or a more diffuse abnormality of "mucoid degeneration." It is important to distinguish ACL ganglia from a ligament tear because patients with ACL ganglia do not have instability and are usually asymptomatic. Although the ACL becomes enlarged due to the ganglion, one should still be able to see continuous intact ligament fibers, which distinguishes this process from an ACL tear. A PCL ganglion [Figure 2.46] is less common (Telischak, et al. (2014).

Figure 2.45 (A, B) ACL ganglion. (A) Sagittal PDW and (B) T2W fat-saturated images (Telischak, et al. (2014).

Figure 2.45 (A, B) ACL ganglion. A 31-year-old male with knee pain. (A) Sagittal PDW and (B) T2W fat-saturated images demonstrate cystic lesion in proximal fibers of anterior cruciate ligament (arrows), which expands ligament fibers and produces "drumstick" appearance. Note the presence of continuous intact ACL fibers (Telischak, et al. (2014).

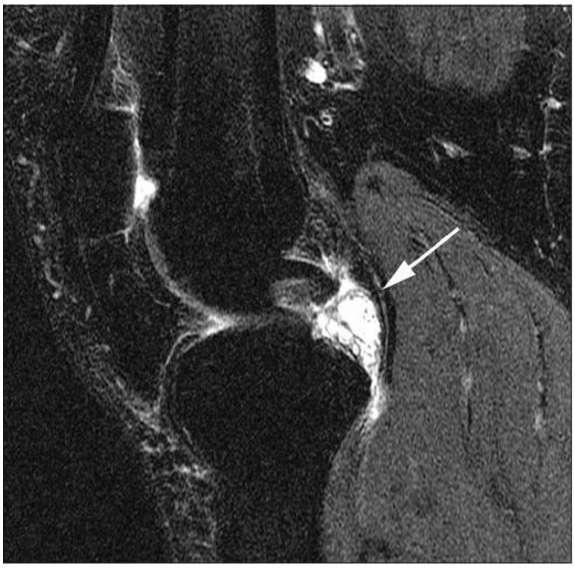

Figure 2.46 PCL ganglion. Sagittal T2W fat-saturated.

Figure 2.46 PCL ganglion. A 28-year-old male with persistent pain after injury. Sagittal T2W fat-saturated image demonstrates multilobulated cystic lesion (arrow) involving distal posterior cruciate ligament (Telischak, et al. (2014).

2.1.2.3.i Meniscal cysts

The medial and lateral menisci are composed of type I collagen fibers oriented in a circumferential pattern in order to resist hoop stress. They participate in load sharing and shock absorption. Meniscal cysts are believed to form as a result of tears in the meniscal fibrocartilage, with extrusion of synovial fluid through the meniscal tear. Although lateral cysts are more common in the arthroscopic literature, medial paramedical cysts are 2 times more common than lateral cysts in the radiologic literature. Medial meniscal cysts are typically associated with posterior horn tears‹ whereas lateral meniscal cysts arise from anterior horn and body tears. Lateral cysts are more symptomatic, with patients presenting with a painful palpable lump, which may account for its higher prevalence in the arthroscopic literature. Meniscal cysts can be classified into three types: intrameniscal, paramedical, and synovial. Synovial meniscal cysts are rare, representing cystic outpouchings of the joint capsule that are not associated with trauma. Para meniscal cysts are the most common subtype and occur at the joint line as a focal mass emanating from a meniscal tear [Figure 2.47]. It is important to remember that medial paramedical cysts may dissect through the soft tissues of the joint capsule or medial collateral ligament (MCL), thus appearing far from the tear origin. A thin connection to the original tear can usually be demonstrated. Intrameniscal cysts are rare and represent fluid collections within the meniscus that are in continuity with a meniscal tear (Telischak, et al. (2014)).

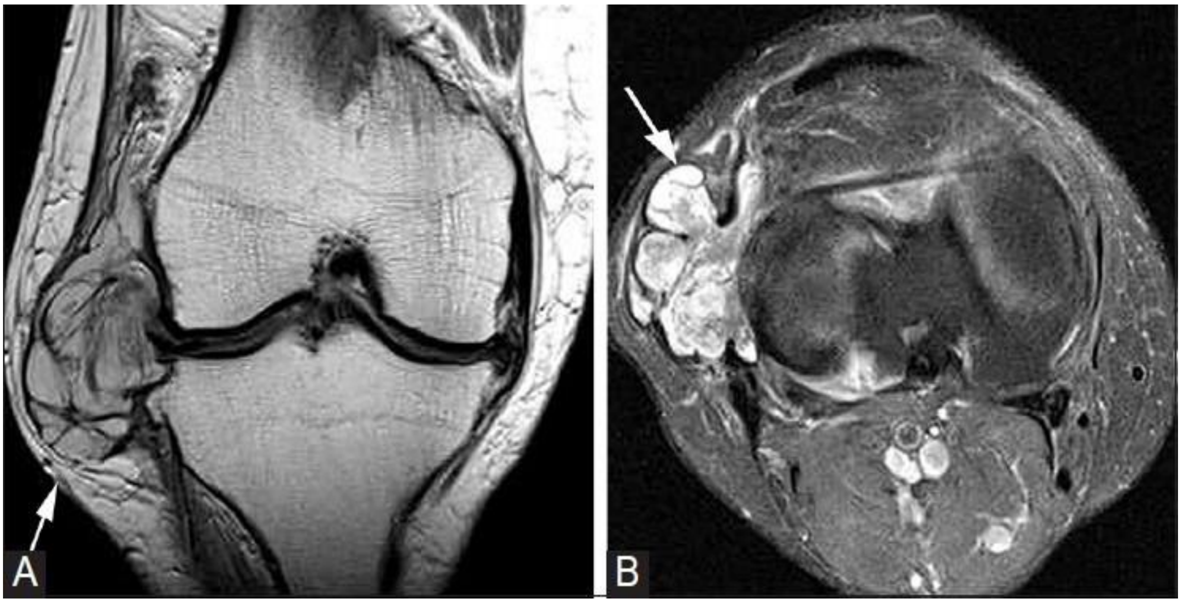

Figure 2.47 (A, B) Meniscal cyst(A) Coronal PDW, (B) T2W fat-saturated image
(*Telischak, et al. (2014)*).

Figure 2.47 (A, B) Meniscal cyst. A 42-year-old female with knee pain and palpable lateral mass. (A) Coronal PDW image of the right knee demonstrates a multilobulated cyst (arrow) with internal septations, which arises from tear of body of lateral meniscus. (B) T2W fat-saturated image demonstrates cystic nature of this lesion (arrow), which did not enhance following contrast administration (not shown)

Meniscal cysts have low signal intensity on T1W images and increased signal intensity on fluid-sensitive sequences. Loculations or septations are common and show peripheral contrast enhancement, unlike the solid areas of enhancement seen with a neoplasm. On arthrography, a meniscal cyst may fill with contrast, but a lack of filling should not exclude the diagnosis. Treatment of symptomatic cysts is by arthroscopic resection and repair of the causative meniscal tear (Telischak, et al. (2014)).

2.1.2.3. j` Osteophyte

2.1.2.3.j.1 Introduction:

Osteophyte is a fibrocartilage-capped bony outgrowth originating from precursor cells in the periosteum, the tissue that lines the bones and contains the cells that form new bone. Transforming growth factor β plays a role in their development. Osteophytes often develop in joints that show signs of degeneration. They are associated with the most common type of arthritis, osteoarthritis. Their presence can serve to distinguish osteoarthritis from other types of arthritis. While osteoarthritis involves the degradation of cartilage, there is also remodeling of the subchondral bone in the joint, which can include forming bone spurs. (verywellhealth. 2023) [Figure 2.48.]

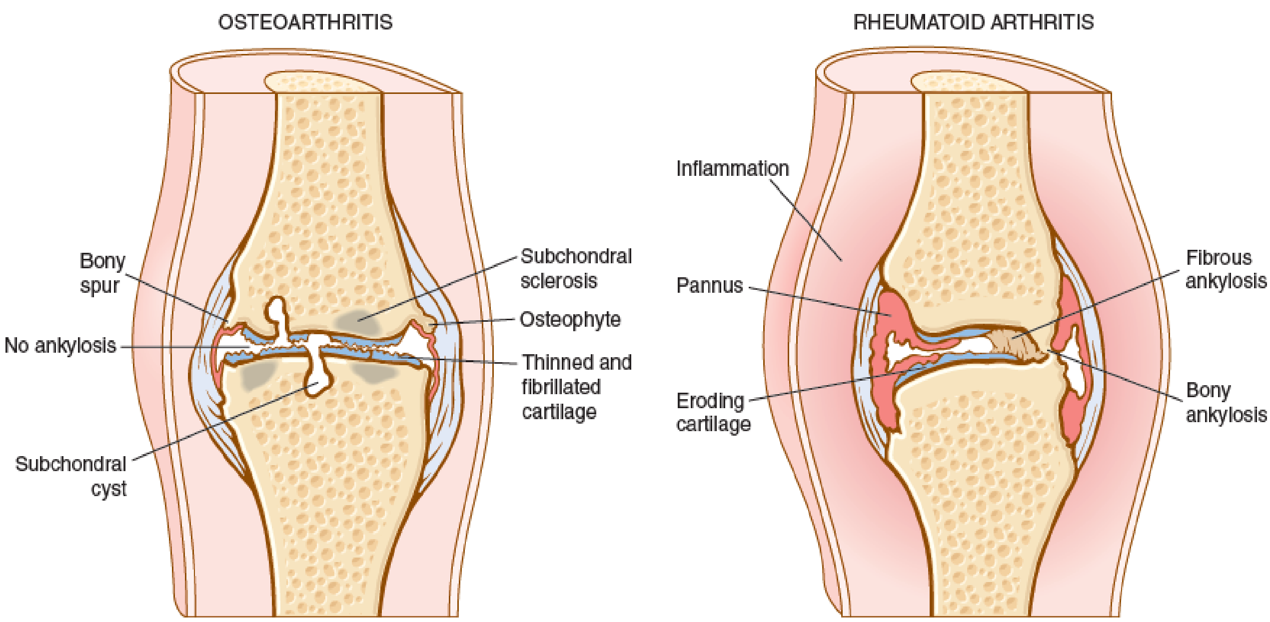

*Figure 2.48.7.1 Comparison of the morphologic features of rheumatoid arthritis and osteoarthritis (*Klatt, & Kumar, et al (2014). Robbins and Cotran review of pathology. Elsevier Health Sciences. Tenth edition).

An osteophyte develops when the remaining cartilage in a damaged joint attempts a repair after there is cartilage loss elsewhere in the joint. It tends to form in the joint compartment where there has been cartilage loss, suggesting it is a localized event. Osteophyte formation stabilizes the damaged joint. That said, exactly how they form and what stimulates their formation is not completely understood. Osteophytes can also develop in the absence of explicit cartilage damage. Location of Osteophyte Formation Marginal osteophytes can develop at the periphery or margin of any joint. Central osteophytes are most prominent in the hip and knee. Osteophytes also may be found in the spine region, where they are associated with back or neck pain and considered a common sign of degenerative arthritis (osteoarthritis). In the spine, an osteophyte or bone spur can cause nerve impingement (compression of the spinal cord or nerve roots) at the neuroforamen (the empty space to the left and right of each vertebra that allows nerves to pass from the spinal cord to other parts of the body). Sensory symptoms in this situation include pain, numbness, burning, and pins and needles in the extremity served by the affected spinal nerve root. Motor symptoms include muscle spasm, cramping, weakness or loss of muscular control in an associated part of the body. The osteophyte itself is not painful, but its location and therefore its effect on other structures of the body can cause pain. *(verywellhealth. 2023*).

Bone Spurs in the knee form over long periods of time due to "wear and tear" on the knee joint. There are a variety of genetic and lifestyle factors that are known to contribute to their growth. Due to the amount of time it takes bone spurs to form, age is a key consideration. Almost everyone will have some sort of bone spur formation as they age. Bodyweight and lifestyle factors may also increase the size and number of bone spurs on the knee. Elevated Body Mass Index (BMI), heavy physical activity, and frequent kneeling and squatting all contribute to excessive wear on the knee joint and bone spur formation. Preliminary evidence suggests that a variety of dietary deficiencies, low birthweight and heritable genetic factors may also contribute to the risk and progression of bone spur formation throughout the body (*www.springloaded.com*). The presence of an osteophyte can be diagnosed using imaging studies, such as X-rays, magnetic resonance imaging (MRI) or computerized tomography (CT) scan. If X-rays were performed on everyone over 50 years of age, most would show some evidence of osteophyte formation. Yet, most osteophytes don't produce any symptoms. Approximately 40% of people with osteophytes develop symptoms that require treatment. *(verywellhealth. 2023)*

Figure 2.49: Sample images show magnetic resonance imaging (MRI)-detected osteophyte (OP) progression. (Zhu, et al 2018)

Figure 2.49 Sample images show magnetic resonance imaging (MRI)-detected osteophyte (OP) progression. a Tibial MRI-detected OP increases from baseline to follow up (wider arrow indicates follow-up MRI-detected OP). b Femoral MRI-detected OP increases from baseline to follow up (wider arrow indicates follow-up MRI-detected OP) *Arthritis Research & Therapy*. (Zhu, et al 2018).

2.1.2.3.k Synovial Osteochondromatosis

Normally, the patellar hyaline cartilage has a bluish-white, smooth, glistening, and resilient appearance. The pathology of chondromalacia patellae starts with softening, swelling, and edema of the articular cartilage that gives it a dull or even slightly yellowish-white appearance. The pathology, characteristically starts in the middle of the medial patellar facet, or just distal to it, and starts small measuring about half an inch or more in diameter This will then progress to cartilage fibrillation, fissuring, and fragmentation in the more advanced stages. Some reports suggest that CMP may be reversible or might progress to advanced patellofemoral joint osteoarthritis (Habusta, et al. 2022).

2.1.2.3.l Subchondral bone edema

Bone marrow is a fatty substance found in the center of bones that helps produce new blood cells. Bone marrow edema, also referred to as a bone marrow lesion, is a condition where the normal fatty bone marrow is replaced with a watery material when there is damage to normal bone structure. This abnormal watery material within the bone marrow results from the leakage of fluid and blood into the bone due to damage to the walls of surrounding capillaries and changes in blood flow to and from the bone marrow. Fluid is more likely to accumulate in the bone marrow when there is also damage to the cortical bone that surrounds the bone marrow cavity.1While bone marrow edema can occur in any bone, it is most frequently observed in the lower limbs, especially within the bones that form the knee joint. Bone marrow edema of the knee can be asymptomatic or painful and is diagnosed via magnetic resonance imaging (MRI) (Eriksen, et al .2015).

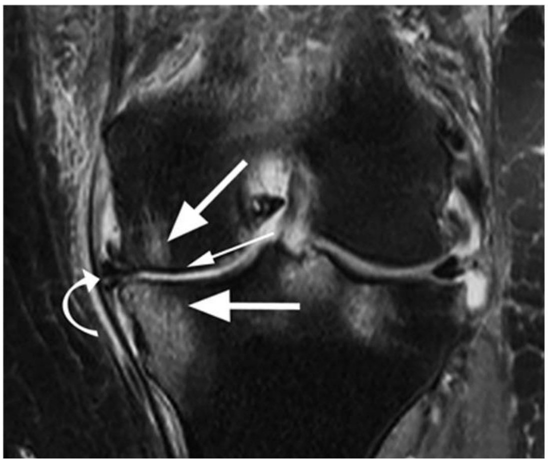

Figure 2.50: Coronal proton-density (PD) FSE fat-suppressed image (B0log, Et al. 2015).

Subchondral tibial (curved arrow) and femoral edema in a62 year old female with advanced medial osteoarthritis shows diffuse high-signal-intensity edema of the sub-chondral bone (large arrows) in the areas of bone denudation (small arrow). Note the medial meniscal extrusion (curved arrow as it shown in figure 2.50 (B0log, Et al. 2015).

2.1.2.3.m Joint Effusions Synovial

A joint effusion is defined as an increased amount of fluid within the synovial compartment of a join There is normally only a small amount of physiological intra-articular fluid. Abnormal fluid accumulation can result from inflammation, infection (i.e. pus) or trauma and might be exudate, transudate, blood and/or fat. As part of an arthrogram, deliberate injection into the joint space of a contrast medium results in an iatrogenic effusion (El-Feky, et al 2022).

Lipomatosis is a particular type of effusion that occurs in the setting of intra-articular fracture where a fat-fluid level is seen due to marrow fat leaking into the joint via the fracture. Fat, being less dense than blood, will float to the surface and present as a 'fat-fluid' level on top of the blood on any radiographs with the horizontal beam parallel to the level. Lipohemarthroses can occur in other joints (e.g. shoulder) but are most readily identified in the knee. Recognition of joint effusion on plain radiographs can be difficult, particularly for non-radiologist. Appreciation of the typical appearances and signs of joint effusions can assist diagnosis (El-Feky, et al 2022).

Figure 2.51 synovial plica Sagittal T2-weighted fat-suppressed image (B0log, Et al. 2015).

Suprapatellar plica in a 28-year-old female. shows the synovial plica as a low-signal-intensity thin bands as it shown in (B0log, Et al. 2015).

2.1.2.3.n Bursitis

A bursa is a fluid-filled structure that is present between the skin and tendon or tendon and bone. The main function of a bursa is to reduce friction between adjacent moving structures. Bursae around the knee can be classified as those around the patella and those that occur elsewhere. In this pictorial essay we describe the most commonly encountered lesions and their MRI appearance (Chatra, et al. 2012).

Bursitis occurs when trauma or inflammation distends a bursa. Regardless of cause, bursitis is characterized on MR images by fluid-intensity signal within the known anatomic location of a bursa. Recesses are normal extensions and outpouchings of a joint that may become distended by joint fluid when an effusion is present. They can become particularly enlarged when a one-way valve mechanism prevents the flow of fluid back into the joint (Jennifer, et al. May 2000).

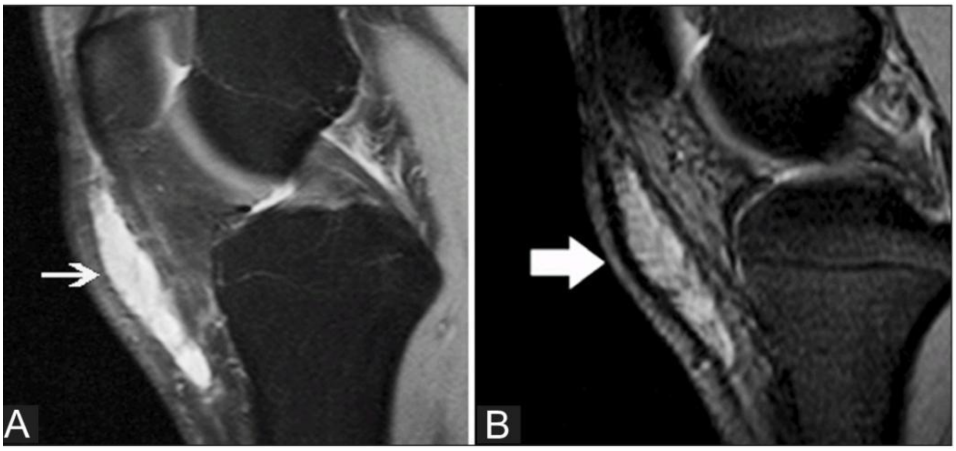

Figure2.52: Superficial infrapatellar bursitis Sagittal proton-density fat saturated (A) and sagittal gradient-echo T2W (B) images) (Jennifer, et al.2000).

Superficial infrapatellar bursitis. A 42-year-old female presented with an anterior knee swelling. distended superficial infrapatellar bursa (arrows) as it shown in figure 2.52 (Jennifer, et al.2000).

2.1.2.4 Magnetic Resonance Imaging (MRI)

MRI is a non-invasive method of mapping the internal structure and certain aspects of function within the body. It uses non-ionizing electromagnetic radiation and appears to be without exposure-related hazard. It employs radio frequency (RF) radiation in the presence of carefully controlled magnetic fields in order to produce high quality cross-sectional images of the body in any plane (Zhang, et al. 2006).

Figure 2.53: MRI System (google image)

2.1.2.4.a MRI Components

A strong magnet to generate the static magnetic field (B0). A gradient system consisting of three coils to produce linear field distortions in the x-, y-, and z-directions and the corresponding amplifiers. A radiofrequency (RF) transmitter with a transmit coil built into the scanner. A highly sensitive RF receiver to pick up and amplify the MR signal. Alternatively, imagers may use a single RF coil switched between the transmit and receive modes. Additional coils, either receive coils or transmit/receive coils. Various computers for controlling the scanner and the gradients (control computer), for creation of the MR images (array processor), and for coordinating all processes (main or host computer, to which are connected the operator’s console and image archives). Other peripheral devices such as a control for the patient table, electrocardiography (ECG) equipment and respiration monitors to trigger specialized MR sequences, a cooling system for the magnet, a second operator’s console (e.g. for image processing), a device for film exposure, or a PACS (picture archiving and communications system) (kochi, et al.2006).

2.1.2.4.b Preparation

Satisfactory written consent form must be taken before staring the examination. Ask patient change to remove all metal objects including keys, coins, wallet, cards with magnetic strips, jewellery, hearing aid and hairpins. If possible provide a chaperone for claustrophobic patients (e. g. relative or staff) offer earplugs or headphones, possibly with music for extra comfort. Explain the procedure to the patient. Instruct the patient to keep still. note the weight of the patient (Mrimaster.com).

2.1.2.4.c Patient position

The patient lies supine on the examination couch with their knee in a relaxed, slightly flexed position within the 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 lies 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 centre of the coil. The knee is placed within the coil so that the centre of the coil corresponds to the lower border of the patella. A clear display of the anterior cruciate ligament is essential in knee examinations for pain, trauma or suspected joint damage. The ligament is best seen in oblique sagittal scans oriented to the appropriate anatomical plane. If your equipment is not capable of oblique imaging, or oblique scan prescription compromises other significant technical choices, the patient's knee should be positioned with a slight (5–10°) external rotation (under-rotation is better than over-rotation). If the scanner can only employ a single-plane oblique, the sagittal scan plane can be prescribed along the internal margin of the lateral femoral condyle from an axial localizer. A more accurate approach is described within the Suggested protocol section below (Westbrook, et al. 2021).

Figure 2.54: knee MRI position image (Mrimaster.com).

2.1.2.4.d MRI suggested Protocol

2.1.2.4.d.1 Axial/multiplanar coherent gradient echo T2*

Acts as a localizer if three-plane localization is unavailable, or as a diagnostic sequence. If the knee is not at isocentre, the FOV is offset so that the knee is in the middle of the image. Medium slices/gap are prescribed on either side of the horizontal alignment light to locate the knee and ensure correct positioning. With an axial localizer, a slice in which the patella is clearly demonstrated is chosen to prescribe the following sequences as this ensures that the knee joint is centred to the FOV. If coronal or sagittal localizers are used the knee joint should be in the middle of the image 2.56 (Westbrook, et al. 2021).

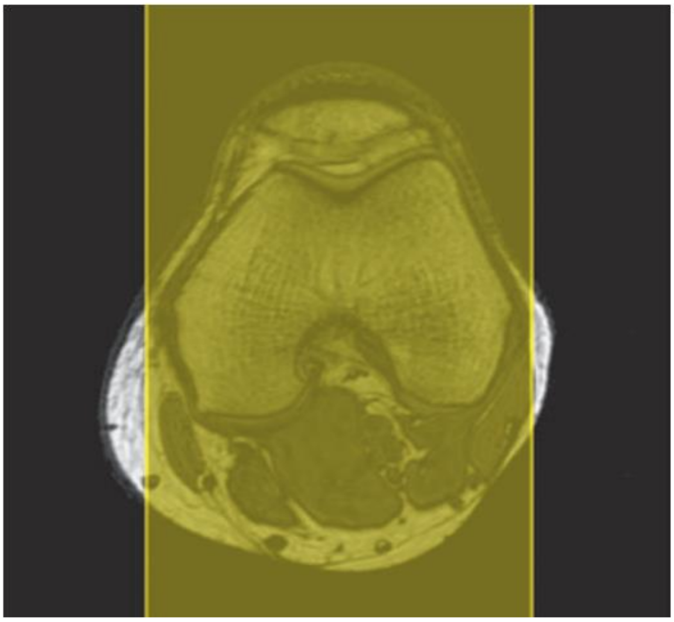

Figure 2.55: Axial T1 weighted localizer of the knee showing slice prescription boundaries and orientation for sagittal imaging. (Westbrook, et al. 2021).

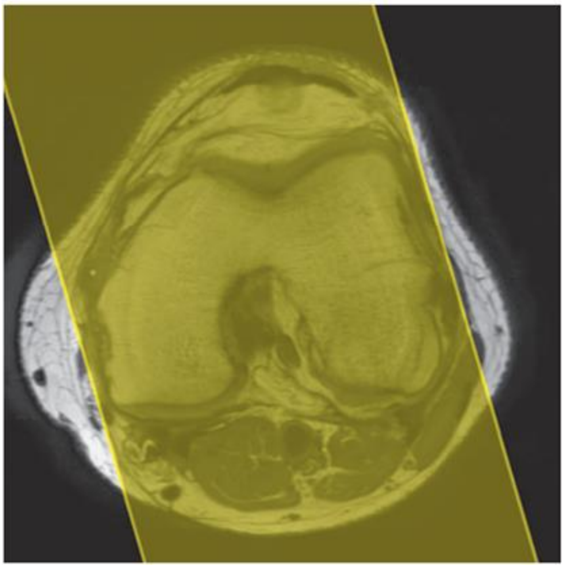

Figure 2.56 Axial T1 weighted localizer of the knee showing angled slice prescription boundaries and orientation for sagittal imaging of the anterior cruciate ligament. (Westbrook, et al. 2021).

2.1.2.4.d.2 Sagittal coherent GRE T2*

Thin slices/gap are prescribed from the lateral to the medial collateral ligament and aligned parallel with the anterior cruciate ligament which runs at an angle (5–10°). The superior edge of the patella to below the tibial tuberosity is included on the image 2.57 (Westbrook, et.al. 2021).

Figure 2.57: sagittal coherent GRE T2 weighted image of the knee with spectral presaturation. (Westbrook, et al. 2021).*

2.1.2.4.d.3 Coronal SE/incoherent (spoiled) GRE T1

This sequence is useful to demonstrate joint anatomy, meniscal tears, musculature, and the collateral ligament complexes. Due to great differences in equipment and sequence performance, FSE should not be used in this application unless the ETL is very short and the accuracy of your sequences in identifying meniscal tears, compared with SE or incoherent (spoiled) GRE, has been tested. The receive bandwidth should be selected to reduce chemical shift to less than two pixels otherwise the femoral or tibial cartilage may be obscured as shown in figure 2.58 (Westbrook, et.al. 2021).

Figure 2.58: Coronal FSE T1weighted image of the knee. (Westbrook, et al. 2021).

2.1.2.4.d.4 Coronal stir

Thin slices/gap are prescribed from the lateral to the medial collateral ligament and aligned parallel with the anterior cruciate ligament which runs at an angle (5–10°). The superior edge of the patella to below the tibial tuberosity is included on the image 2.59 (Westbrook, et.al. 2021).

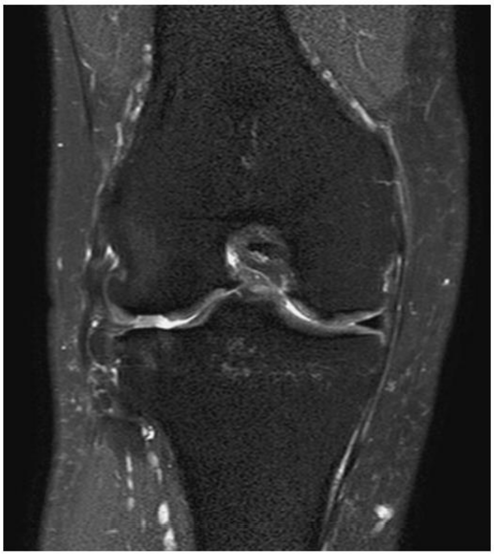

Figure 2.59: Coronal STIR image of the knee. (Westbrook, et al. 2021).

2.1.2.4.d.5 Axial FSE PD/T2

Thin slices/gap are prescribed from the superior surface of the patella to the tibial tuberosity. Thin axial slices are essential for patellar tracking problems and to identify chondral damage of the patella and anterior femoral condyles. Images can be repeated with the knee at various degrees of flexion in order to track patella tracking (Westbrook, et al. 2021).

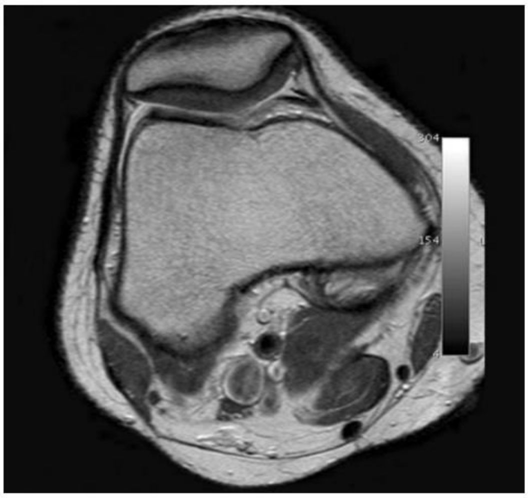

Figure 2.60: Axial FSE PD weighted image of the knee (Westbrook, et al. 2021).

2.1.2.4.e Additional sequences:

2.1.2.4.e.1 Axial SE/FSE T1

Thin slice, high-resolution imaging is required if patellar tendonitis is suspected.

2.1.2.4.e.2 3D coherent GRE PD/T2*

Thin slices with a medium to large number of slice locations and an isotropic dataset are required to view anatomy in any plane. This is especially useful if evaluation of anatomy and pathology is difficult. Sagittal acquisitions large enough to include the entire knee, from above the patella to below the tibial tuberosity, are necessary (Westbrook, et.al. 2021).

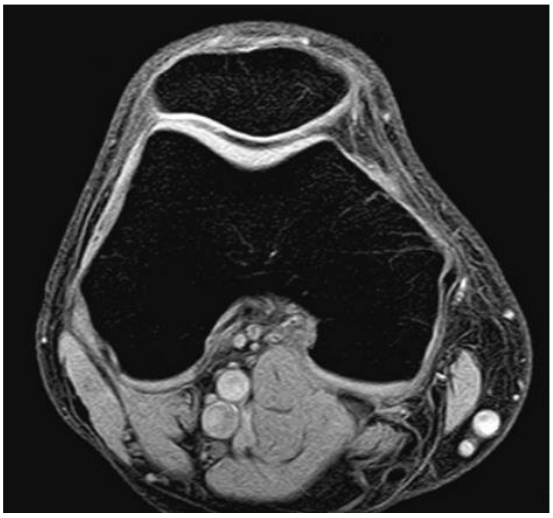

Figure 2.61: Axial slice from a 3D acquisition using spectral presaturation (Westbrook, et al. 2021).

2.1.2.4.e.3 Dynamic imaging

Some open systems, including small bore magnets designed for orthopedic imaging permit dynamic imaging of joints. In the knee this is particularly useful for visualizing patellar tracking but may also be used to image other structures during movement (Westbrook, et al. 2021).

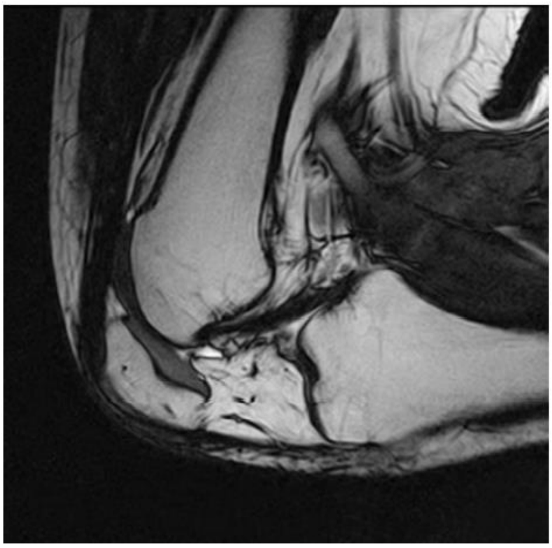

Figure 2.62: Sagittal T1 weighted image of a flexed knee during a dynamic study (Westbrook, et al. 2021).

2.1.2.4.f Proper pathology MRI sequence

2.1.2.4.f.1 Meniscal tears

With a sensitivity of ~95% and a specificity of 81% for medial meniscal tears and sensitivity of ~85% and a specificity of 93% for lateral meniscal tears 2,5, MRI is the modality of choice when a meniscal tear is suspected, with sagittal images being the most sensitive .There are three basic MR characteristics/criteria of meniscal tears high intrameniscal signal extending to at least one articular surface, which should be seen in at least two slices: two slice touch rule (do not have to be contiguous, e.g. sagittal and coronal slices) distortion of the normal meniscal morphology if no prior surgery . Each type of meniscal tear has its own characteristics on MRI, but in most cases, the following can be seen .T1: a hyperintense line in the meniscus can be seen, but it is difficult to differentiate between degeneration and meniscal tear on this sequence; in the case of a bucket-handle tear an empty groove can sometimes be seen T2: a hyperintense line in the meniscus, which indicates synovial fluid in the meniscus the high T2 signal in mid-substance of the meniscus without extension to the surface is not necessarily a tear and can be: in adults: secondary to degeneration, in children: high vascularity of meniscus (De Smet, et al. 2012).

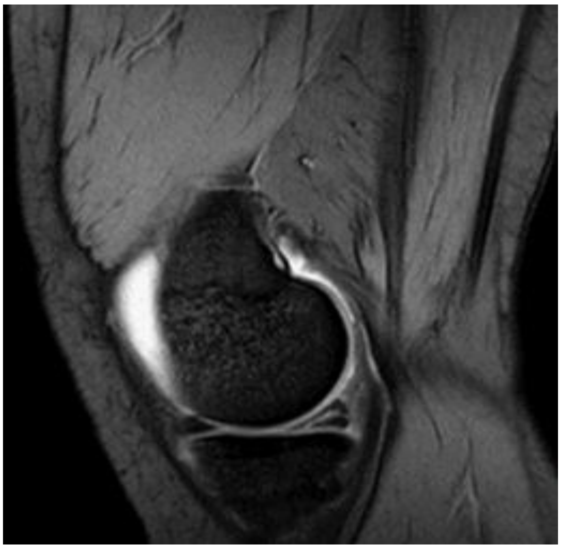

Figure 2.63: Sagittal T2 fat sat (De Smet, .et .al 2012).

2.1.2.4.f.2 Posterior Cruciate Ligament

Features of posterior cruciate ligament tears include PCL usually remains contiguous (~70%) although there may be complete or partial ligamentous disruption absent PCL replaced by high T1 and T2 signaled large and swollen PCL: >7 mm AP diameter of the vertical portion on sagittal imaging is indicative of a tear posterior tibial translation of >2-3 mm measured in the mid medial compartment Posterior cruciate ligament (PCL) tears are less common than anterior cruciate ligament tears. (DePhillipo, et al. 2017) & (Degnan, et al. 2017).

Figure 2.64: Sagittal T2 (DePhillipo, et al. 2017) & (Degnan, et.al. 2017).

2.1.2.4.f.3 Synovitis

Siderotic synovitis is a condition that can occur with chronic haemarthroses May be seen as a focal or diffuse proliferation of the synovium. Signal characteristics can mimic tenosynovial giant cell tumors and include T1: low signal T2: low signal gradient echo (GE): blooming artifact as it shown in figure 2.65 (* (Narváez, et al 2003) & (Boles et al. 2000).

Figure 2.65: Axial T2 image (Narváez, et.al. 2003) & (Boles, et al 2000).*

2.1.2.4.f.4 Baker cysts

Baker cysts, or popliteal cysts, are fluid-filled distended synovial-lined lesions arising in the popliteal fossa between the medial head of the gastrocnemius and the semimembranosus tendons via a communication with the knee joint. They are usually located at or below the joint line. They represent neither a true bursa nor a true cyst, as they occur as a communication between the posterior joint capsule and the gastrocnemius-semimembranosus bursa. On MRI exquisitely outlines the cyst as a mass extending from the joint space with high T2 signal content (Ranched et .al 2023).

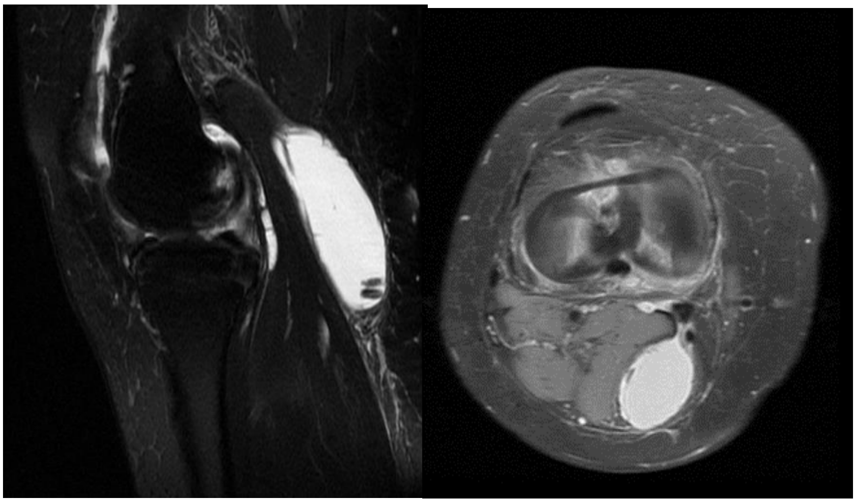

Figure2.66: Sagittal T2 fat sat, Axial PD fat sat (Ranched, et al. 2023).

2.1.2.4.f.5 Osteophytes

Osteophytes were also assessed for increased signal intensity on fat suppressed images in the axial, sagittal and coronal planes in locations analogous to where they are scored for size. MRIs of all patients were reviewed for the presence of osteophytes and their size and location. Then the slice of MRI (± one slice) which had the largest osteophyte was scored for signal intensity A scale of 0–2 was used in terms of signal intensity (0 = normal intensity, 1 = possible high-intensity, and 2 = probable high-intensity). The osteophyte signal measures anywhere within one given knee were summed, creating an osteophyte signal aggregate. The intra-observer correlation coefficient (ICC) for osteophyte signal aggregate was 0.74. For this analysis the predictor (osteophyte signal) was read at baseline. Osteophyte signal was defined as areas of increased signal intensity in the osteophyte on fat-suppressed T2 weighted images, and graded in the joint margins where osteophyte size is graded (Sengupta, et al., 2006).

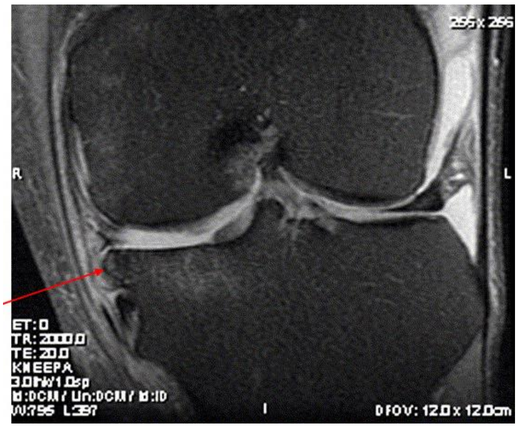

*Figure 2.67: Coron*al fat-*suppressed al T2 WI (Zhang, et.al. 2006).*

2.1.2.4.f.6 Bursitis

Prepatellar bursitis is inflammation and fluid collection within the prepatellar bursa, located between the patella and the overlying subcutaneous tissue. It has been historically referred to as "housemaid's knee". Oval shaped fluid-filled sac is seen anterior to the patella and displays low T1 and bright T2/STIR signal intensity. When hemorrhage occurs T1 signal increases and T2 GRE signal reduces. The wall of the bursa may show increased thickness and irregularity as it shown in figure 2.68 (El-Feky, et al. 2022).

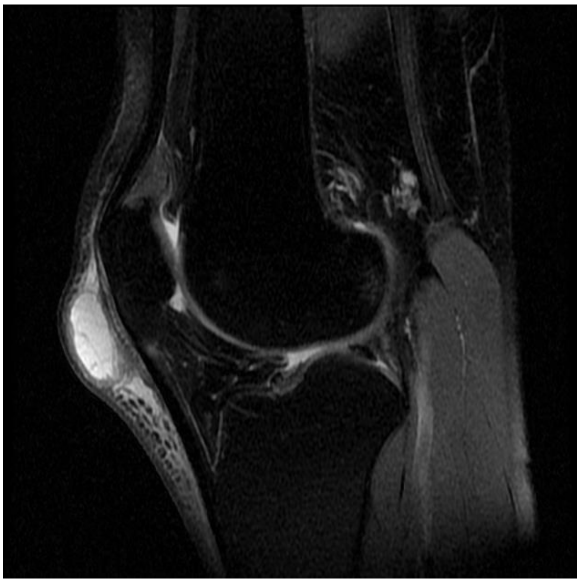

Figure 2.68: Sagittal PD fat sat (El-Feky, et al. 2022).

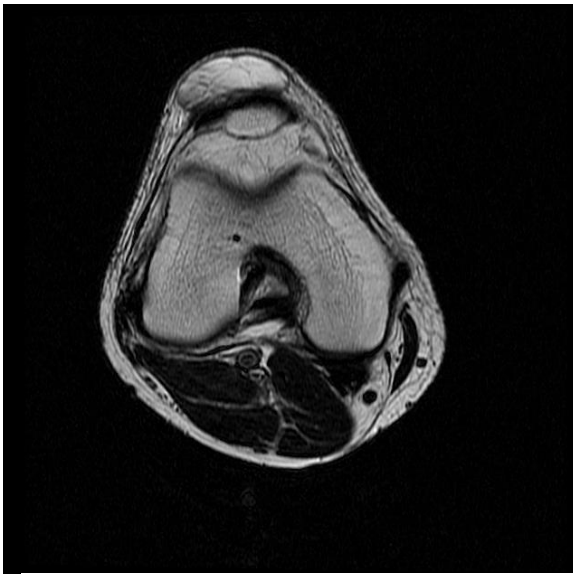

Figure 2.69: Axial T2 (El-Feky, et al .2022).

2.2 Previous Studies:

- *Guermazi, et al. (2012)* Used magnetic resonance imaging (MRI) of knees with no radiographic evidence of osteoarthritis to determine the prevalence of structural lesions associated with osteoarthritis and their relation to age, sex, and obesity. They found that of the 710 participants, 393 (55%) were women, 660 (93%) were white, and 206 (29%) had knee pain in the past month. The mean age was 62.3 years and mean BMI was 27.9. Prevalence of "any abnormality" was 89% (631/710) overall. Osteophytes were the most common abnormality among all participants (74%, 524/710), followed by cartilage damage (69%, 492/710) and bone marrow lesions (52%, 371/710). The higher the age, the higher the prevalence of all types of abnormalities detectable by MRI. There were no significant differences in the prevalence of any of the features between BMI groups. They concluded that lesions in the tibiofemoral joint in most middle aged and elderly people in whom knee radiographs do not show any features of osteoarthritis, regardless of pain.
-
- *Plachel, et al. (2022)* conducted their prospective study which was to validate the SKV with accepted multiple-item knee surveys across patients with orthopaedic knee disorders. They stated that Subjective Knee Value exhibits acceptable validity across all investigated knee-specific patient-reported outcome measure (PROMs) in a broad patient population with a wide array of knee disorders. The simplified survey format without compromising the precision to evaluate individual's knee function justifies implementation in daily clinical practice
-
- *Horga, et al. (2020)* aimed to identify abnormalities in asymptomatic sedentary individuals using 3.0 Tesla high-resolution MRI. They resulted that MRI showed abnormalities in the majority (97%) of knees. Thirty percent knees had meniscal tears: horizontal (23%), complex (3%), vertical (2%), radial (2%) and bucket handle (1%). Cartilage and bone marrow abnormalities were prevalent at the patellofemoral joint (57% knees and 48% knees, respectively). Moderate and severe cartilage lesions were common, in 19% and 31% knees, respectively, while moderate and severe bone marrow oedema in 19% and 31% knees, respectively. Moderate intensity lesion in tendons was found in 21% knees and high-grade tendonitis in 6% knees—the patellar (11% and 2%, respectively) and quadriceps (7% and 2%, respectively) tendons being most affected. Three percent partial ligamentous ruptures were found, especially of the anterior cruciate ligament (2%).

- *Jensen, et al. (1996*) aimed to review the literature on the risk of knee disorders in connection with kneeling or squatting work and heavy physical work. they found that the prevalence ratio in most of these studies was between 1.4and 4.1. All the studies on bursitis showed an increased prevalence of bursitis in subjects with kneeling work. Occupational exposure could not be sufficiently documented as the cause of meniscal lesions and chondromalacia.

- *Cui, et al. (2020)* identified eligible studies with information on the prevalence or incidence of knee OA in population-based observational studies and extracted data from published reports. They found that out of 9570 records identified, 88 studies with 10,081,952 participants were eligible for this study. The pooled global prevalence of knee OA was 16 0% (95% CI, 14 3%-17 8%) in individuals aged 15 and over and was 22 9% (95% CI, 19 8%-26 1%) in individuals aged 40 and over. Correspondingly, there are around 654 1 (95% CI, 565 6 745 6) million individuals (40 years and older) with knee OA in 2020 worldwide. The pooled global incidence of knee OA was 203 per 10,000 person-years (95% CI, 106 331) in individuals aged 20 and over. Correspondingly, there are around annual 86 7 (95% CI, 45 3 141 3) million individuals (20 years and older) with incident knee OA in 2020 worldwide. The prevalence and incidence varied substantially between individual countries and increased with age. The ratios of prevalence and incidence in females and males were 1 69 (95% CI, 1 59 1 80, p<0 00) and 1 39 (95% CI, 1 24 1 56, p<0 00), respectively. Interpretation: They study provided the global prevalence and incidence (203 per 10,000 person-years) of knee OA. These findings can be used to better assess the global health burden of knee OA.

- *Turmezei, et al. (2014)* used a new technique for identifying, grading, and mapping the severity and spatial distribution of osteoarthritic disease features at the hip in 3D with clinical computed tomography (CT). They resulted that feature severity maps showed a propensity for osteophytes at the infer posterior and super lateral femoral head neck junction. Subchondral cysts were a less common and less localized phenomenon. Joint space narrowing <1.5 mm was recorded in at least one sector of 83% of hips, but most frequently in the posterolateral joint space. Concluded that the first description of hip osteoarthritis using unenhanced clinical CT in which they describe the co-localization of posterior osteophytes and joint space narrowing for the first time. They believed that their technique can perform several important roles in future osteoarthritis research, including phenotyping and sensitive disease assessment in 3D.

Chapter Three

Materials and methods

Chapter Three

Materials & Methods

3.1 Materials

3.1.1 Study Design:

This work was a cross-sectional descriptive study combined between retrospective & prospective methods.

3.1.2 Study Duration:

The study duration was between December 2022 and March 2023.

3.1.3 Study Area:

The study carried out in Sana’a city (capital of Republic of Yemen). The study population was registered patients and their saved reports in the PACS of radiology department of UST Hospital, Al- Ma’amon Medical Center Diagnostic, Europe Hospital, New scan Diagnostic Medical center, advanced AL-Razi Diagnostic center, Alfoad Diagnostic Medical center, smart scan, and Ranin Scan.

3.1.4 Sampling:

A convenient sample consist of 886 cases with suspected knee disorders and having MRI knee scan. The retrospective were 721 cases, while the prospective were165 cases.

3.1.5 Study Population:

3.1.5.a. Inclusion Criteria:

The study sample includes all patients who have an issue in the Knee joint and undergone an MRI examination.

3.1.5.b Exclusion Criteria:

Patients who have prosthetic joint, fracture and trauma in knee, patients who have an issue in the knee joint but they have not Yemeni population were excluded from this study.

3.1.6 Equipment:

Study was performed using The primary devices are close MRI with a 1.5 tesla scanner (Siemens Medical Systems, Erlangen, Germany) with a phased array knee coil, open MRI with a 0.5 tesla Hitachi, close MRI with a 1.5 tesla Philips and Dynamic MRI.

3.2.7 Study Variables:

- Demographic Characteristics such as (Age, Gender, BMI and occupation level)
- Radiographic MRI knee disorder.
- Potential risk factors **(**Diabetic, Blood hypertension, Chewing Qat Smoking, Vitamin D deficiency).

3.1.8 Tools:

MRI machine, Knee Coil, Weight scales, Height measurement meters, Report, and Data collection sheet.

3.2 Methods of Date acquisition

3.2.2 MRI Imaging Acquisition:

The most common sequence and protocols of knee MRI that use in most Sana'a hospitals for diagnosis for knee disorder are PD axial and coronal T1coronal, flash 2d, and STIR sagittal.

3.2.2 Sample Technique

All the data of prospective cases was obtained from the direct conversation with patients randomly and fill out in the data sheet, then the final diagnosis of hard and software fill out in the data sheet collection (appendix).

3.2.3 Data Management and Statistical Analysis

Statistical Software (SPSS Statistics, version 26.0, Chicago, IL, USA) was used to perform all statistical analyses. *P*-value < 0.05 was considered statistically significant.

3.4 Ethical Considerations

After the researcher prepared the study proposal and evaluated it by our Supervisor, written permission was obtained from the radiology department of the selected hospital and imaging medical center.

3.5 Confidentiality

The data was collected with ensuring by hiding the medical record names of patients from data handlers.

3.6 Conflict of Interest:

There is no conflict of interest exits for this work.

Chapter Four

Results and Discussion

Chapter Four

Results and Discussion

4.1 The Results

After data collection, some statistical tests were performed such as frequency, percentage, T-test, and cross-tabulation, the results can be described as the following.

4.1.1 Age of the Study Sample

The age distribution of the study sample was presented in Table 4.1.

Table 4.1: Age groups of study sample

Age group	No.	%
1 – 20 years	100	11.3
21 – 40 years	400	45.1
41 - 60 years	323	36.5
More than 60 years	63	7.1
Total	886	100%

The results showed that the age group (21 – 40) was the majority age group of 400 cases (45.1 %). Whereas, cases with age groups more than 60 years were the less age group in this study 63 (71%).

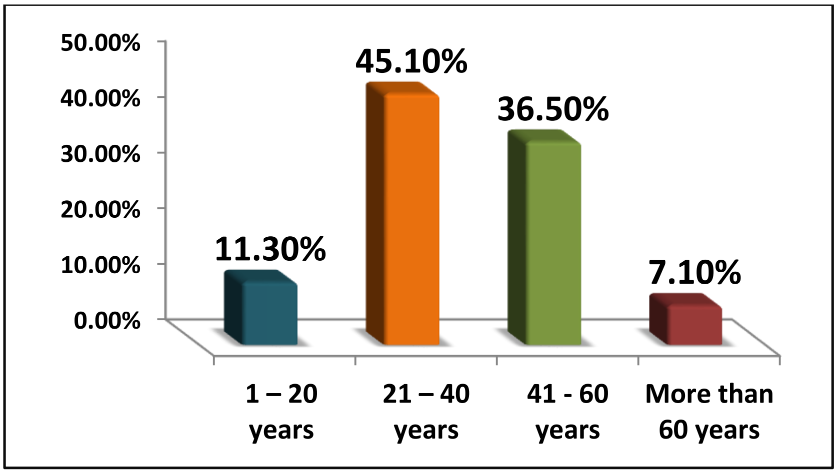

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Figure 4.1: Age groups of the study sample

4.1.2 Gender of the study sample

The gender group numbers were recorded in Table 4.2.

Table 4.2: Gender of the study sample

Gender	No.
Male	483
Female	403
Total	886

The results showed that males were more than females in this study 483 (54.5 %) out of 886 patients.

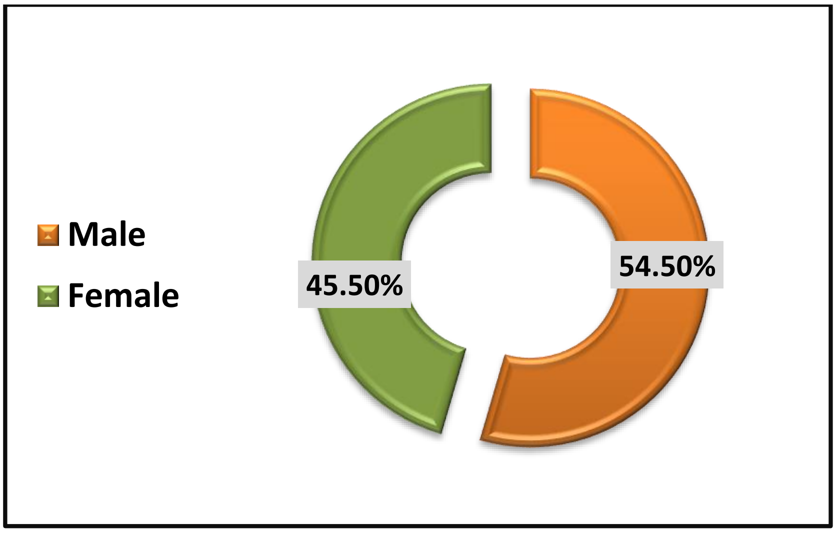

Figure 4.2: Gender of the study sample

4.1.3 The prevalence of knee disorders

The prevalence of knee disorders among the study sample was recorded in Table 4.3.

Table 4.3: Prevalence of knee disorders among the study sample

Knee disorders	Type	No.	Total	%	%
Meniscus Tear	Normal	216		24.4%	
	Medial	607	668	68.7 %	75.6%
	Lateral	23		2.6 %	
	Both	38		4.3 %	
	Total	884		100%	
Meniscus Tear Type	No mention	18		2.7 %	
	Type 1	71		10.8 %	
	Type 2	160		24.3 %	
	Type 3	187		28.4 %	
	Degeneration	222		33.7 %	
	Total	658		100%	
Ligamentum tear	No	656		74.2 %	
	Yes	228		25.8 %	
	Total	884		100%	
Ligamentum tear type	ACL tear	176		77.5 %	
	PCL tear	16		7.0 %	
	ACL+PCL tear	15		6.6 %	
	Collateral tear	2		0.9 %	
	ACL + Collateral tear	15		6.6 %	
	ACL + Patellar retinacular tear	3		1.3 %	
	Total	227		100%	
Articular cartilage disorder	Normal	845		95.5%	
	Degenerative/thin	30	40	3.4 %	4.6%
	Thickening	4		0.5 %	
	Irregular	5		0.6 %	
	Effusion	1		0.1 %	
	Total	885		100%	
Synovial disorder	Normal	595		67.2%	
	Trivial effusion	18	291	2.0 %	32.8%
	Mild effusion	162		18.3 %	
	Moderate effusion	86		9.7 %	
	Synovitis	19		2.1 %	
	Effusion and Synovitis	6		0.7 %	
	Total	886		100.0%	
Bone Marrow Disorder	Normal	703		79.5%	
	Mass	2	181	0.2 %	20.4%
	Edema	170		19.2 %	
	Bone	2		0.2 %	
	Fracture	7		0.8 %	
	Total	884		100%	

Knee disorders	Type	No.	Total	%	%
Cyst	No cyst	658		74.4%	
	Bone cyst	130	226	14.7 %	25.6%
	Soft tissue cyst	96		10.9 %	
	Total	884		100%	
Joint Effusion	Normal	382		43.2%	
	Trivial	86	502	9.7 %	56.8%
	Mild	327		37.0 %	
	Moderate	54		6.1 %	
	Sever	7		0.8 %	
	No mention	28		3.2%	
	Total	884		100%	
Bursa Effusion	Normal	866		97.7 %	
	Bursa effusion	20		2.3 %	
	Total	886		100%	
Joint Space	Normal	767		86.7%	
	Narrowing	110	118	12.4 %	13.3%
	Thick	8		0.9 %	
	Total	885		100%	
Osteophyte	Normal	711		80.2 %	
	Osteophyte	175		19.8 %	
	Total	886		100.0%	
Chondromalacia Patellae	Normal	764		86.7 %	
	Chondromalacia patellae	117		13.3 %	
	Total	881		100%	
Chondromalacia Patellae Type	Type 1	31		47.7 %	
	Type 2	21		32.3 %	
	Type 3	5		7.7 %	
	Type 4	8		12.3 %	
	Total	65		100%	
Subchondral Bony Edema	Normal	759		85.8 %	
	Subchondral bony edema	126		14.2 %	
	Total	885		99.9%	

The illustrated results in Table 4.3 revealed that the medial meniscus tear was the most common type of knee disorder 607 (68.6%). Regarding ligament disorders, ACL tear was the commonest one 167 (77.6%). As well, normal articular cartilage was the common MRI finding 845 (95.5%). Moreover, out of other types of synovial disorders, mild effusion was the dominant one 162 (18.3%). According to BM disorders, edema was the common finding 170 (19.2%) while bursa had less effect. Regarding joint space, 110 (12.45%) had a narrowing joint space. Other knee disorders showed in this table and presented again in the following figures.

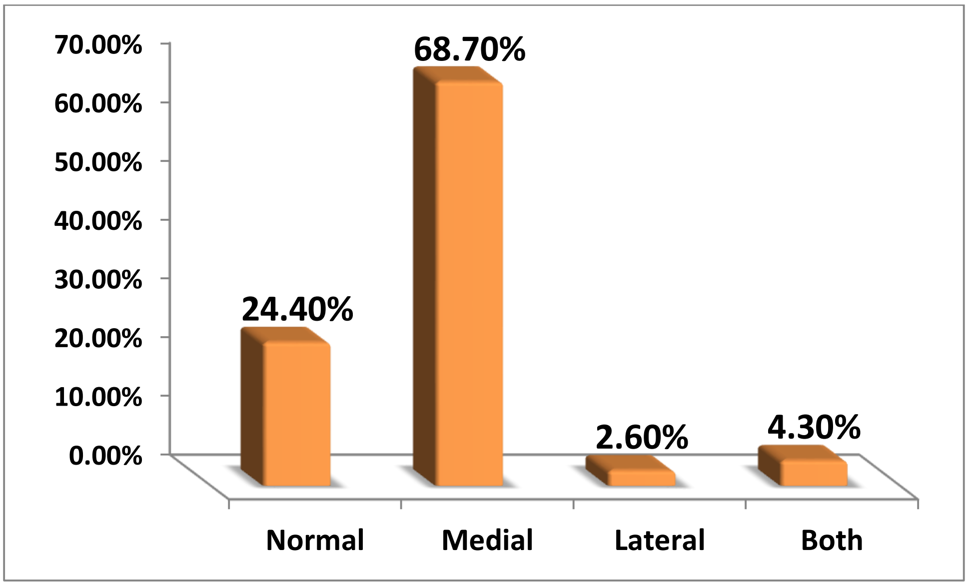

Figure 4.3: The meniscus tear sites among the study sample

Figure 4.3 showed that the medial meniscus tear is the most common site.

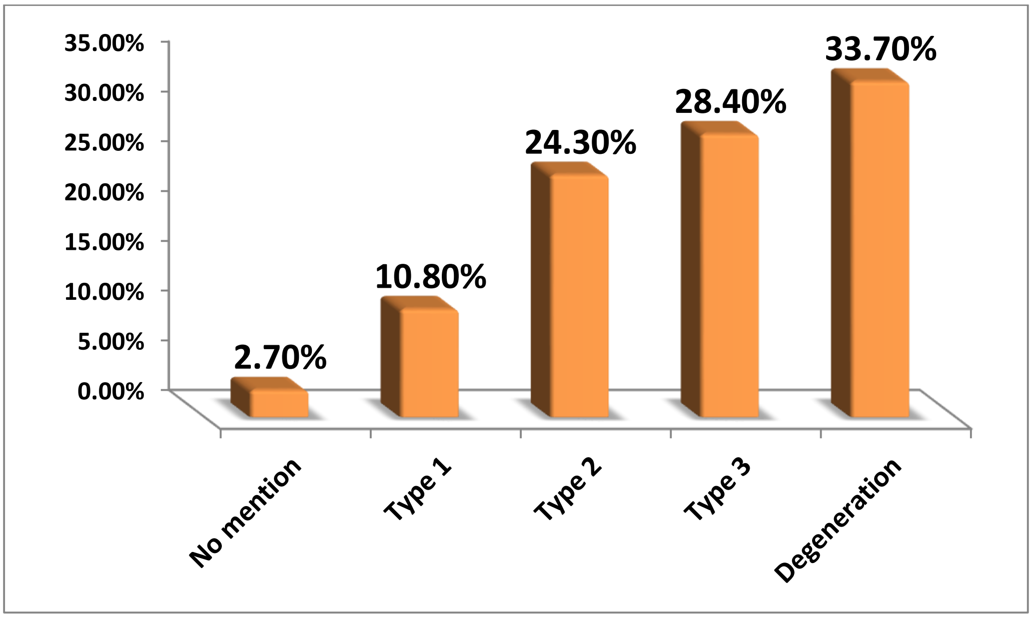

Figure 4.4: The meniscus tear types among the study sample

Figure 4.4 showed that degeneration is the most common type.

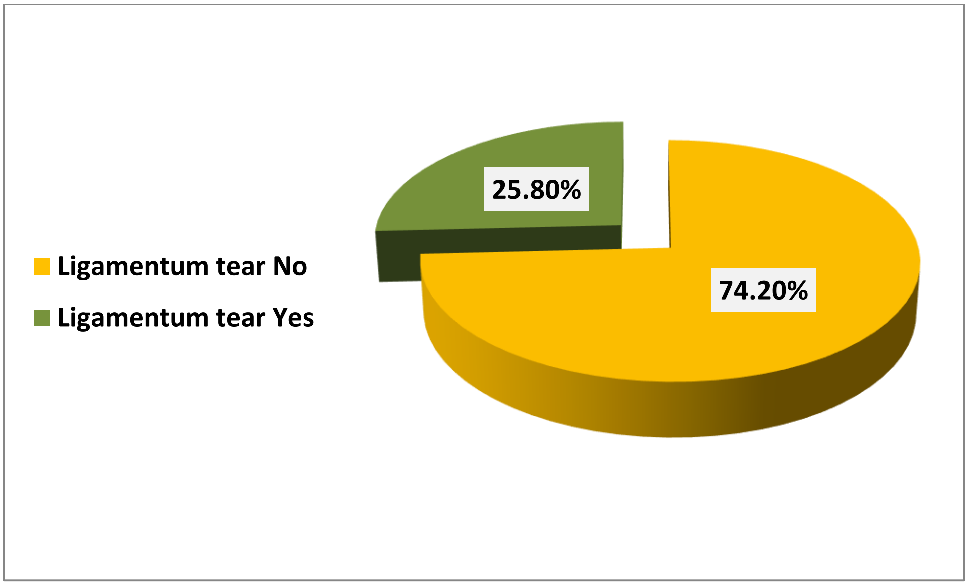

Figure 4.5: The ligamentum tear among the study sample

Figure 4.5 showed that the ligamentum tear is the most common in the study sample.

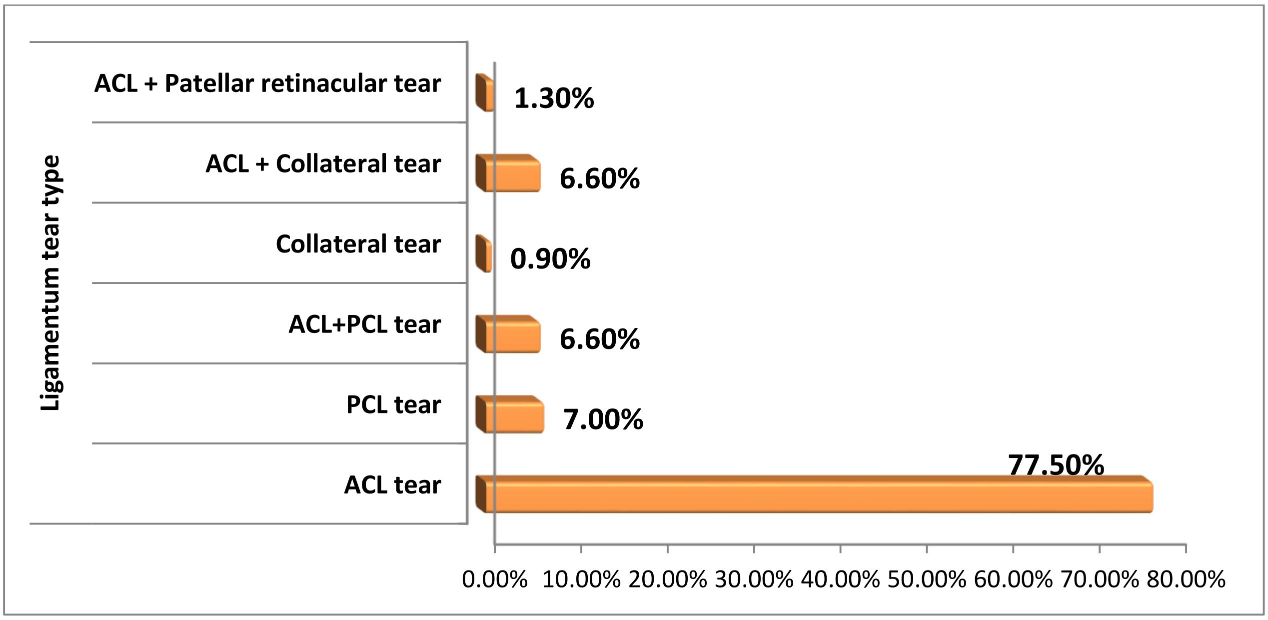

Figure 4.6: The ligamentum tear types among the study sample

Figure 4.6 showed that the ACL tear is the most common type.

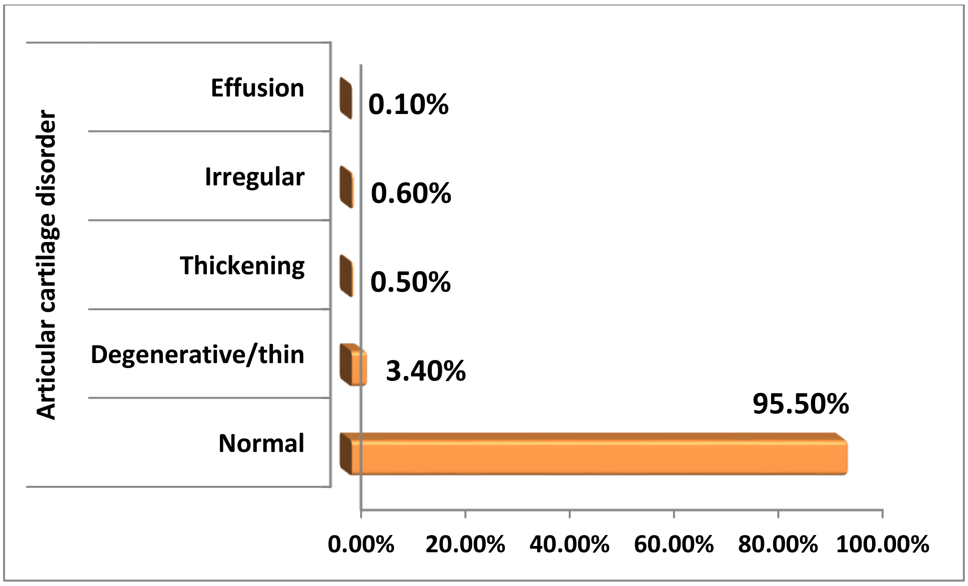

Figure 4.7: The articular cartilage disorders among the study sample

Figure 4.7 showed that the normal articular cartilage is the most common in the study sample.

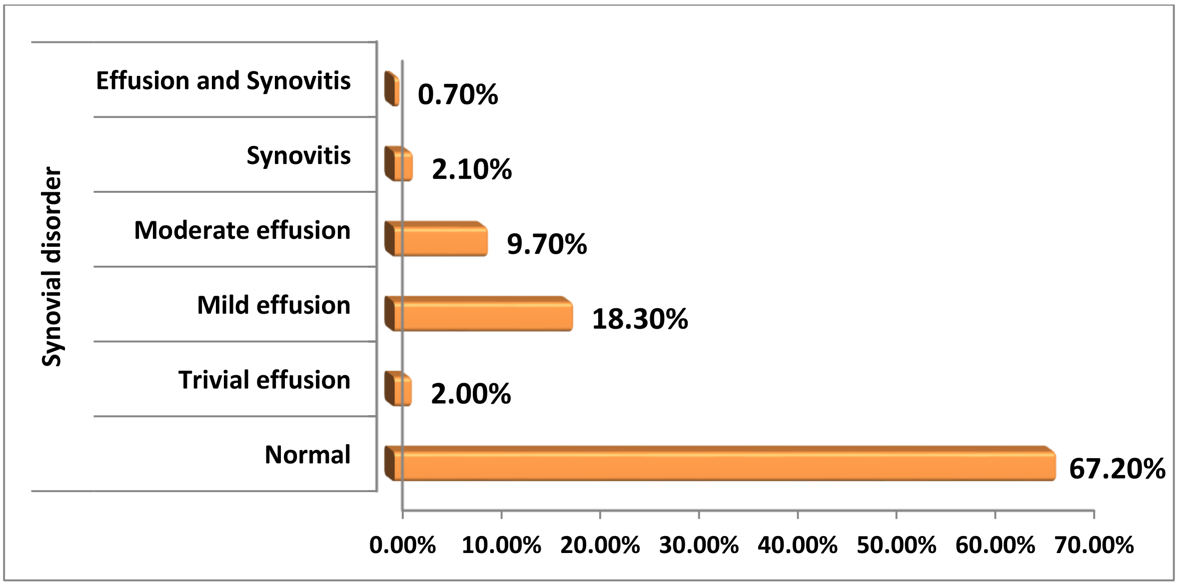

Figure 4.8: The synovial disorders among study sample

The Figure 4.8 showed that the normal synovial joint is the most common in study sample.

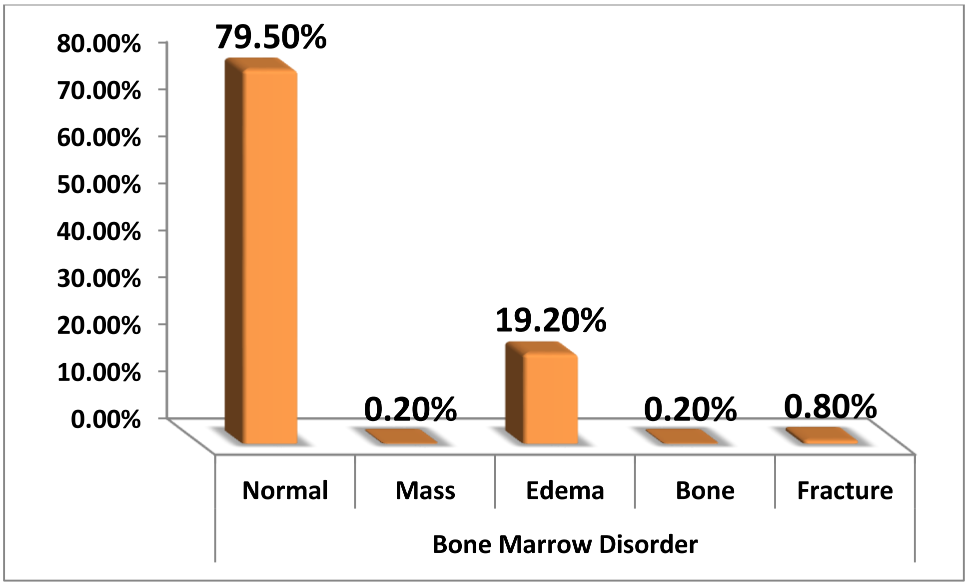

Figure 4.9: The bone marrow disorders among the study sample

Figure 4.9 showed that the normal bone marrow is the most common in the study sample.

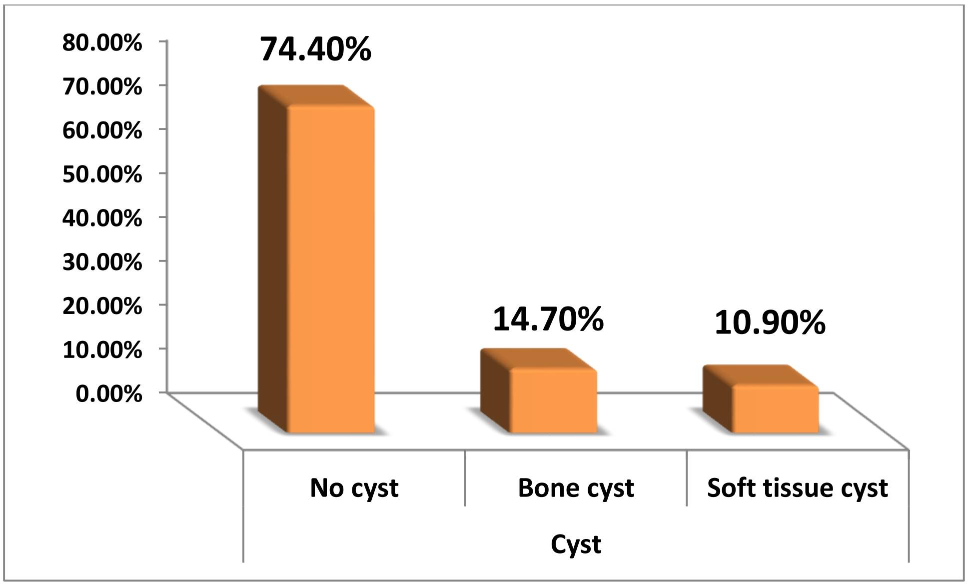

Figure 4.10: The cysts among the study sample

Figure 4.10 showed that the absence of cysts is the most common in the study sample.

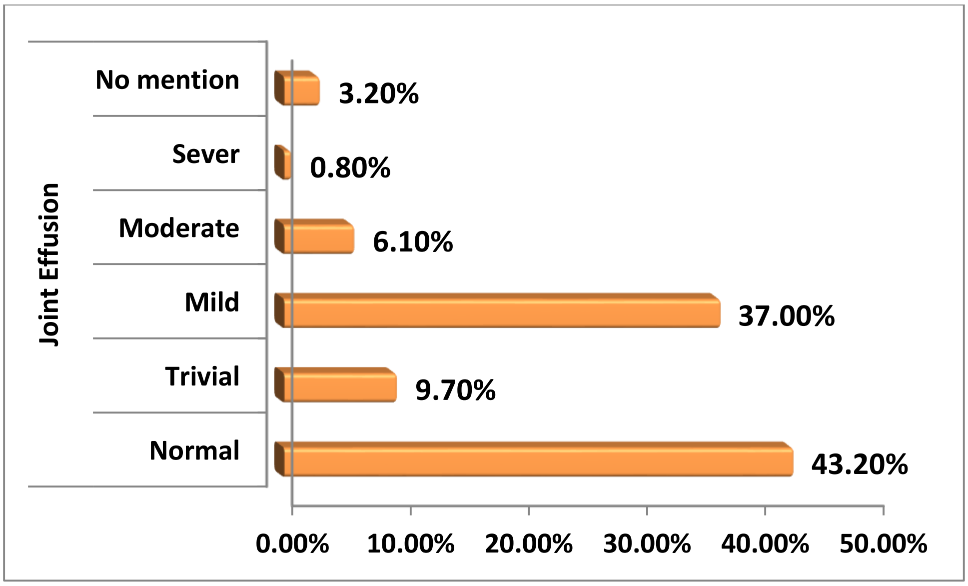

Figure 4.11: The joint effusion among the study sample

Figure 4.11 showed that the absence of joint effusion is the most common in the study sample.

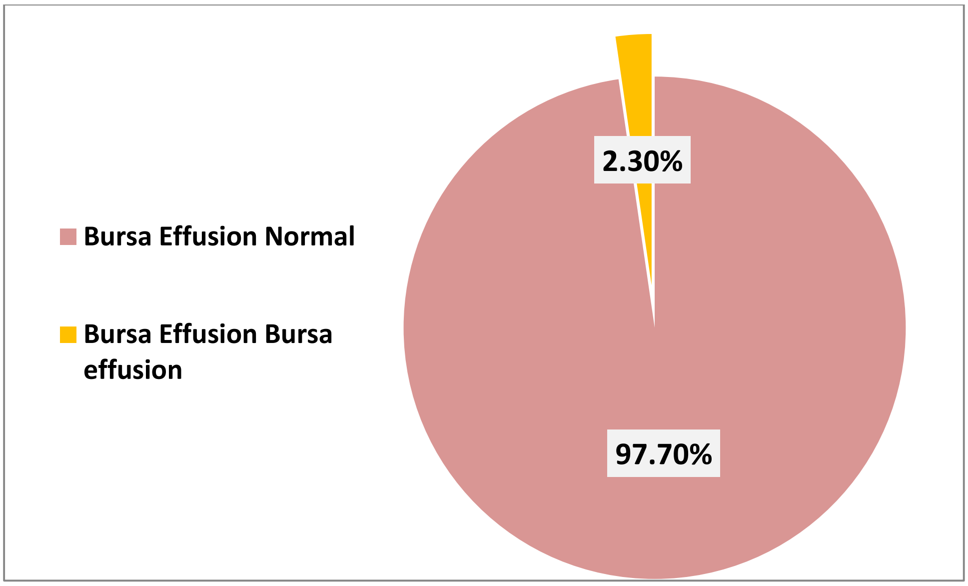

Figure 4.12: The bursa effusion among the study sample

Figure 4.12 showed that the absence of bursa effusion is the most common in the study sample.

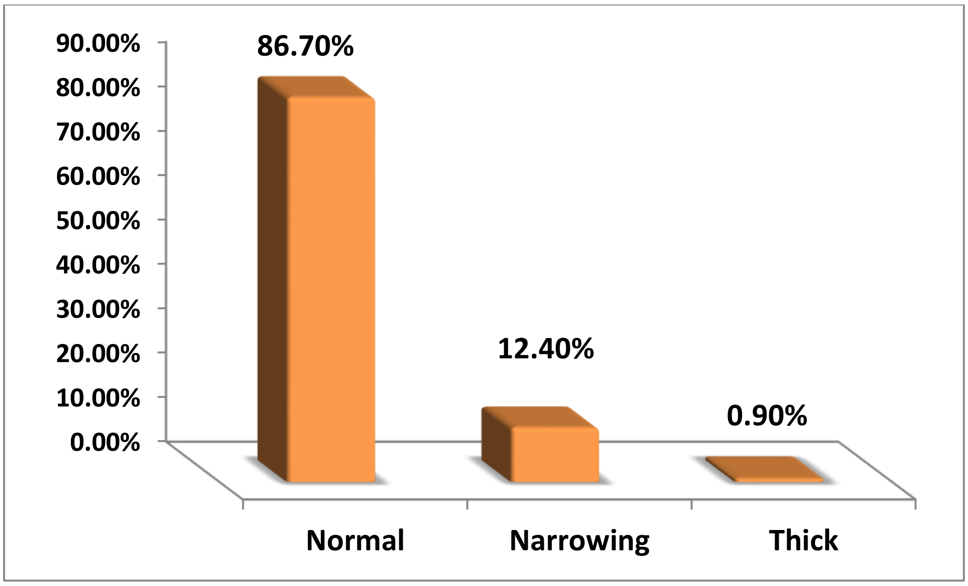

Figure 4.13: The joint space states of the study sample

Figure 4.13 showed that the normal joint space is the most common in the study sample.

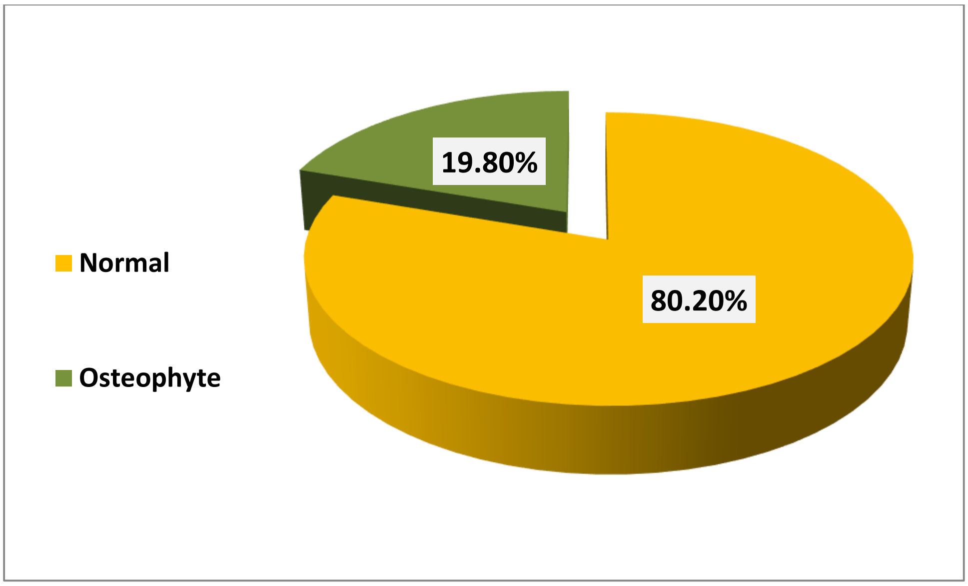

Figure 4.14: The osteophyte disorder among the study sample

Figure 4.14 showed that the absence of osteophyte is the most common in the study sample.

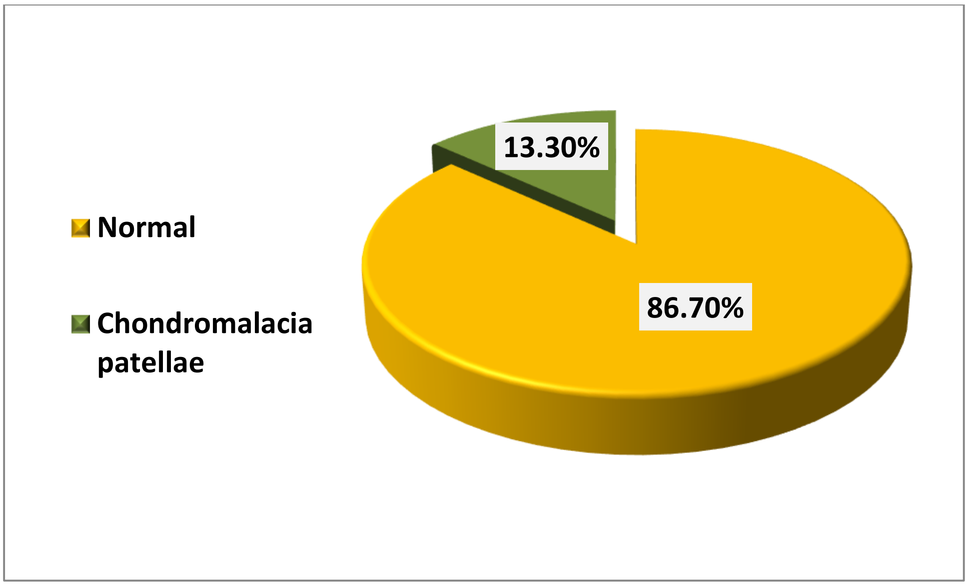

Figure 4.15: The Chondromalacia Patellae disorder among the study sample

Figure 4.15 showed that the absence of chondromalacia patellae is the most common in the study sample.

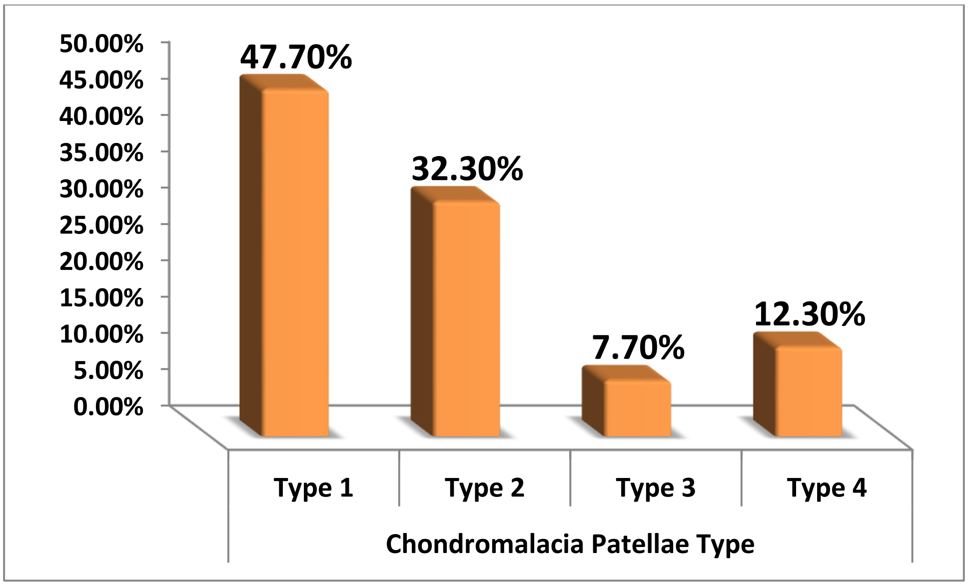

Figure 4.16: The Chondromalacia Patellae types among the study sample

Figure 4.16 showed that the type 1 of chondromalacia patellae is the most common type.

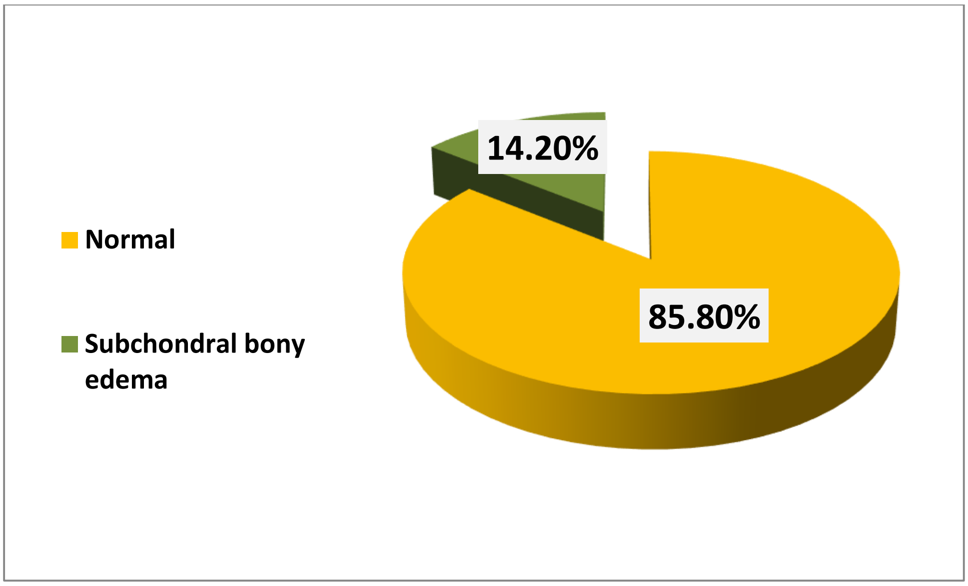

Figure 4.17: The Subchondral Bony Edema among the study sample

Figure 4.17 showed that the absence of subchondral bony edema is the most common in the study sample.

4.1.4 Association between Age and Gender

The association between the age & gender of the study sample was presented in Table 4.4.

Table 4.4: Association between Age group & Gender

Age group	Gender		Total	Chi-Square	Sig.
	Male	Female			
1 – 20-year-old	67	33	100	44.782	0.000
21 – 40-year-old	254	146	400		
41 – 60-year-old	132	191	323		
More than 60	30	33	63		
Total	483	403	886		

Based on Table 4.4, most males were between 21 – 40-year-old, which confirm 254 participants, and the less were more than 60 years old, which confirm 30 participants, while most females were between 41 – 60-year-old which confirmed 191 participants. There was a high significance association between age group & gender.

4.1.5 Association between Age and Knee disorders

The association between age and knee disorders of the study sample was presented in Table 4.5 & correlation between them was presented in Table 4.6.

Table 4.5: The effect of age on knee disorders

Knee disorder	Type	Age group				Total	Chi-Square	Sig.
		1-20	21-40	41-60	>60			
Meniscus Tear	Normal	63	98	49	6	216	113.740	0.000
	Tear	37	302	272	57	668		
	Total	100	400	321	63	884		
Meniscus Tear Type	Total	38	297	269	54	658	42.317	0.000
Ligamentum Tear	No	75	291	244	46	656	0.810	0.847
	Yes	24	108	79	17	228		
	Total	99	399	323	63	884		
Ligamentum Tear Type	Total	24	108	78	17	227	9.842	0.830
Articular Cartilage Disorder	Normal	97	390	300	58	845	16.763	0.159
	Disorder	3	10	22	4	40		
	Total	100	400	322	63	885		
Synovial Disorder	Normal	77	283	196	39	595	31.951	0.007
	Disorder	23	161	127	13	129		
	Total	100	400	323	63	886		
Bone Marrow Disorder	Normal	74	323	265	41	703	27.542	0.006
	Disorder	26	76	57	22	181		
	Total	100	399	322	63	884		

Knee disorder	Type	Age group				Total	Chi-Square	Sig.
		1-20	21-40	41-60	>60			
Cyst	No	80	334	206	38	658	48.381	0.000
	Yes	20	66	115	25	226		
	Total	100	400	321	63	884		
Joint Effusion	Normal	43	166	142	31	382	8.893	0.883
	Effusion	57	233	180	32	502		
	Total	100	399	322	63	884		
Bursa Effusion	Normal	98	392	316	60	866	1.953	0.582
	Effusion	2	8	7	3	20		
	Total	100	400	323	63	886		
Joint Space Disorder	Normal	43	166	142	31	382	8.893	0.883
	Disorder	57	233	180	32	502		
	Total	100	399	32	63	884		
Osteophyte	No	95	357	224	35	711	82.617	0.000
	Yes	5	43	99	28	175		
	Total	100	400	332	63	886		
Chondromalacia Patellae	No	94	351	267	250	764	11.805	0.008
	Yes	5	46	55	11	117		
	Total	99	397	322	63	881		
Chondromalacia Patellae Type	Total	4	25	32	4	65	14.279	0.113
Subchondral Bony Edema	No	95	360	259	45	759	30.957	0.000
	Yes	5	40	63	18	126		
	Total	100	400	322	63	885		

As it mentioned in Table 4.5, there was a significant association between the age group and a meniscus tear and its types, synovial disorder, bone marrow disorder, cyst, osteophyte, chondromalacia patellae, and subchondral bony edema. There was no significant association between the age group and other knee disorders.

Table 4.6: Correlation between knee disorder and age of participants

Knee disorder	Correlation Coefficient	Sig.
Meniscus disorder	0.252	0.000
Ligamentum disorder	-0.003-	0.926
Ligamentum disorder type	-0.027-	0.690
Articular cartilage disorder	0.084	0.012
Synovial disorder	0.118	0.000
Bone marrow disorder	0.001	0.967
Cyst	0.221	0.000
Joint effusion	-0.003-	0.918
Bursa effusion	0.012	0.732
Joint space	0.201	0.000
Osteophyte	0.317	0.000
Chondromalacia patellae	0.118	0.000
Chondromalacia patellae type	0.330	0.007
Subchondral bony edema	0.200	0.000

Table 4.6 illustrated that there was a significant association between age group and meniscus tear and its types, synovial disorder, bone marrow disorder, cyst, osteophyte, chondromalacia patellae, and subchondral bony edema. There was no significant association between the age group and other knee disorders.

4.1.6 Association between Gender & Knee disorders

The association between gender & knee disorders of the study sample was presented in Table 4.7.

Table 4.7: Association between knee disorders and gender

Knee disorder	Type	Gender		Total	Chi-Square	Sig.
		Male	Female			
Meniscus disorder	Normal	125	91	216	9.839	0.020
	Medial	315	292	668		
	Lateral	18	5			
	Both	25	13			
	Total	483	401	884		
Meniscus disorder type	No mention	10	8	18	5.274	0.260
	Type 1	41	30	640		
	Type 2	95	65			
	Type 3	101	86			
	Degeneration	107	115			
	Total	354	304	658		
Ligamentum disorder	No	344	312	656	4.962	0.026
	Yes	139	89	228		
	Total	483	401	884		
Ligamentum disorder type	ACL tear	107	69	227	7.670	0.466
	PCL tear	9	7			
	ACL+PCL tear	11	4			
	Collateral tear	1	1			
	ACL + Collateral tear	11	4			
	ACL + Patellar retinacular tear	0	3			
	Total	139	88	227		
Articular cartilage disorder	Normal	463	382	845	7.547	0.110
	Degenerative/thin	16	14	40		
	Thickening	3	1			
	Irregular	0	5			
	Effusion	1	0			
	Total	483	402	885		

Knee disorder	Type	Gender		Total	Chi-Square	Sig.
		Male	Female			
Synovial disorder	Normal	330	265	595	4.636	0.462
	Trivial effusion	13	5	291		
	Mild effusion	82	80			
	Moderate effusion	43	43			
	Synovitis	11	8			
	Effusion and Synovitis	4	2			
	Total	483	403	886		
Bone marrow disorder	Normal	383	320	703	7.582	0.108
	Mass	0	2	181		
	Edema	94	76			
	Bone	0	2			
	Fracture	6	1			
	Total	483	401	884		
Cyst	No cyst	386	272	658	19.763	0.000
	Bone cyst	50	80	226		
	Soft tissue cyst	46	50			
	Total	482	402	884		
Joint effusion	Normal	210	172	382	3.063	0.690
	No mention	13	15	502		
	Trivial	48	38			
	Mild	172	155			
	Moderate	33	21			
	Sever	5	2			
	Total	481	403	884		
Bursa effusion	Normal	474	392	866	0.747	0.387
	Effusion	9	11	20		
	Total	483	403	886		
Joint space	Normal	429	338	767	4.328	0.115
	Narrowing	50	60	118		
	Thick	4	4			
	Total	483	402	885		
Osteophyte	Normal	408	303	711	11.952	0.001
	Osteophyte	75	100	175		
	Total	483	403	886		
Chondromalacia patellae	No	433	331	764	11.145	0.001
	Yes	47	70	117		
	Total	480	401	881		

Knee disorder	Type	Gender		Total	Chi-Square	Sig.
		Male	Female			
Chondromalacia patellae type	Type 1	15	16	65	1.544	0.672
	Type 2	10	11			
	Type 3	2	3			
	Type 4	2	6			
	Total	29	36	65		
Subchondral bony edema	No	418	341	759	0.798	0.372
	Yes	64	62	126		
	Total	482	403	885		

As it revealed in Table 4.7, there was a significant association between gender and meniscus tear, ligamentum tear, cyst, osteophyte, and chondromalacia patellae. There was no significant association between gender and other knee disorders.

4.1.7 Knee disorders risk factors

The effect of risk factors on knee disorders of the study sample was presented in Table 4.8.

Table 4.8: Effect of risk factors on knee disorders

Risk factors	Answers	No.	%
BMI	Underweight	5	3
	Normal	54	32.7
	Overweight	68	41.2
	Obesity	38	23
	Total	165	100%
Smoking	No	125	75.8
	Yes	40	24.2
	Total	165	100%
Chewing Qat	No	65	39.4
	Yes	100	60.6
	Total	165	100%

Diabetic	No	152	92.1
	Yes	13	7.9
	Total	165	100%
Blood hypertension	No	142	86.1
	Yes	23	13.9
	Total	165	100%
Previous knee injury or pain	No	86	52.8
	Yes	77	47.2
	Total	163	98.8%
Vitamin D deficiency	No	83	50.3
	Yes	70	42.4
	Total	153	92.7%
Occupation	Light	61	37.0
	Moderate	74	44.8
	Heavy	28	17.0
	Total	163	98.8%
Walk level	Low	32	19.4
	Moderate	92	55.8
	High	41	24.8
	Total	165	100%

The results shown in Table 4.8 revealed the risk factors as the following: Overweight patients are the dominant finding 68 (41.2%), smoking 40 (24.2%), and 100 (60.6%) chewing Qat. As well, just 13 (7.9%), 23 (13.9%), and 77 (47.2%) had a history of DM, hypertension, and previous knee injury or pain. Moreover, 70 (42.2%) had vitamin D deficiency, 74 (44.8 %) had moderate occupation, and 92 (55.8 %) had a moderate walking level.

4.1.8 BMI Associations

The association between age and BMI of the study sample was presented in Table 4.9. Table 4.10 showed that the association between gender and BMI of the study sample. Table 4.11 presented the association between knee disorders & BMI of the study sample. And Table 4.12 showed the correlation between knee disorders & BMI of the study sample.

4.1.8.1 BMI Association with Age

Table 4.9: Association between BMI and Age

BMI group	Age group				Total	Chi-Square	Sig.
	1 – 20	21 – 40	41 – 60	More than 60			
Underweight	2	2	1	0	5	26.942	0.001
Normal	10	27	12	5	54		
Overweight	2	33	29	4	68		
Obesity	0	15	21	2	38		
Total	14	77	63	11	165		

Table 4.9 presented that there was a significant association between BMI and age group.

4.1.8.2 BMI Association with Gender

Table 4.10: Association between BMI and Gender

BMI group	Gender		Total	Chi-Square	Sig.
	Male	Female			
Underweight	3	2	5	3.098	0.377
Normal	33	21	54		
Overweight	31	37	68		
Obesity	21	17	38		
Total	88	77	165		

Table 4.10 showed that there was no significant association between BMI and gender.

4.1.8.3 BMI Association with Knee disorders

Table 4.11: Association between knee disorders and BMI

Knee disorder	Type	BMI				Total	Chi-Square	Sig.
		Under weight	Normal	Over weight	Obesity			
Meniscus tear	Normal	2	9	13	5	29	13.680	0.134
	Tear	3	45	55	33	136		
	Total	5	54	68	38	165		
Meniscus tear type	Total	3	43	52	32	130	7.621	0.573
Ligamentum tear	No	5	43	52	30	130	1.588	0.662
	Yes	0	11	16	8	35		
	Total	5	54	68	38	165		
Ligamentum tear type	Total	0	11	15	8	34	12.157	0.275
Articular cartilage disorder	Normal	4	53	67	37	161	21.278	0.011
	Disorder	1	1	1	1	4		
	Total	5	54	68	38	165		
Synovial disorder	Normal	3	36	51	27	117	9.018	0.877
	Disorder	2	18	17	11	48		
	Total	5	54	68	38	165		
Bone marrow disorder	Normal	4	40	49	26	119	0.516	0.915
	Disorder	1	14	19	12	46		
	Total	5	54	68	38	165		
Cyst	No	3	45	46	29	123	0.915	0.007
	Yes	2	8	22	8	40		
	Total	5	53	68	37	163		
Joint effusion	Normal	3	28	22	15	68	13.671	0.551
	Effusion	2	26	46	23	97		
	Total	5	54	68	38	165		
Bursa effusion	Normal	4	54	66	37	161	7.955	0.047
	Effusion	1	0	2	1	4		
	Total	5	54	68	38	165		
Joint space disorder	Normal	3	51	61	31	146	12.184	0.058
	Disorder	2	3	7	7	19		
	Total	5	54	68	38	165		

Knee disorder	Type	BMI				Total	Chi-Square	Sig.
		Under weight	Normal	Over weight	Obesity			
Osteophyte	No	5	46	48	27	126	5.726	0.126
	Yes	0	8	20	11	39		
	Total	5	54	68	38	165		
Chondromalacia patellae	No	4	46	58	33	141	0.183	0.980
	Yes	1	8	10	5	24		
	Total	5	54	68	38	165		
Chondromalacia patellae type	Total	1	5	5	3	14	2.847	0.828
Subchondral bony edema	No	4	51	59	30	144	5.126	0.163
	Yes	1	3	9	8	21		
	Total	5	54	68	38	165		

As it illustrated in Table 4.11, there was a significant association between BMI with articular cartilage disorder, cyst, and bursa effusion. There was no significant association between BMI and other knee disorders.

4.1.8.4 BMI Correlation with Knee disorders

Table 4.12: Correlation between knee disorders and BMI:

Knee disorder	Correlation Coefficient	Sig.
Meniscus disorder	0.074	0.348
Meniscus disorder tear	0.069	0.436
Ligamentum disorder	0.021	0.790
Ligamentum disorder type	0.233	0.184
Articular cartilage disorder	-0.042-	0.591
Synovial disorder	-0.046-	0.555
Bone marrow disorder	0.047	0.550
Cyst	0.058	0.464
Joint effusion	0.122	0.119
Bursa effusion	0.021	0.792
Joint space	0.089	0.254
Osteophyte	0.126	0.108
Chondromalacia patellae	0.019	0.809
Chondromalacia patellae Type	-0.248-	0.393
Subchondral bony edema	0.146	0.061

Table 4.12 showed that there was no significant association between BMI and knee disorder.

4.1.9 Smoking effect on knee disorders

The association between knee disorders and smoking in the study sample was presented in Table 4.13.

Table 4.13: Association between knee disorders and Smoking

Knee disorder	Type	Smoking		Total	Chi-Square	Sig.
		Yes	No			
Meniscus tear	Normal	6	23	29	0.423	0.935
	Tear	34	102	136		
	Total	40	125	165		
Meniscus tear type	Total	31	99	130	4.452	0.217
Ligamentum tear	No	30	100	130	0.453	0.501
	Yes	10	25	35		
	Total	40	125	165		
Ligamentum tear type	Total	10	24	34	5.818	0.324
Articular cartilage disorder	Normal	40	121	161	1.312	0.726
	Disorder	0	4	4		
	Total	40	125	165		
Synovial disorder	Normal	28	89	117	1.753	0.882
	Disorder	12	36	48		
	Total	40	125	165		
Bone marrow disorder	Normal	32	87	119	1.630	0.202
	Disorder	8	38	46		
	Total	40	125	165		
Cyst	No	30	93	123	0.416	0.812
	Yes	8	32	40		
	Total	38	125	163		
Joint effusion	Normal	15	53	68	9.568	0.088
	Effusion	25	72	97		
	Total	40	125	165		
Bursa effusion	Normal	40	121	161	1.312	0.252
	Effusion	0	4	4		
	Total	40	125	165		

Knee disorder	Type	Smoking		Total	Chi-Square	Sig.
		Yes	No			
Joint space disorder	Normal	38	108	146	2.505	0.286
	Disorder	2	17	19		
	Total	40	125	165		
Osteophyte	No	30	96	126	0.054	0.816
	Yes	10	29	39		
	Total	40	125	165		
Chondromalacia patellae	No	33	108	141	0.371	0.543
	Yes	7	17	24		
	Total	40	125	165		
Chondromalacia patellae type	Total	5	9	14	2.240	0.326
Subchondral bony edema	No	34	110	144	0.246	0.620
	Yes	6	15	21		
	Total	40	125	165		

Based on Table 4.13, there was no significant difference between smoking and knee disorder.

4.1.10 Chewing Qat effect on knee disorders

The association between knee disorders and chewing Qat of the study sample was presented in Table 4.14.

Table 4.14: Association between knee disorder and Chewing Qat

Knee disorder	Type	Chewing Qat		Total	Chi-Square	Sig.
		Yes	No			
Meniscus tear	Normal	16	13	29	2.147	0.542
	Tear	84	52	136		
	Total	100	65	165		
Meniscus tear type	Total	79	51	130	2.886	0.409
Ligamentum tear	No	73	57	130	5.088	0.024
	Yes	27	8	35		
	Total	100	65	165		
Ligamentum tear type	Total	27	7	34	3.794	0.580
Articular cartilage disorder	Normal	97	64	161	3.497	0.321
	Disorder	3	1	4		
	Total	100	65	165		

Knee disorder	Type	Chewing Qat		Total	Chi-Square	Sig.
		Yes	No			
Synovial disorder	Normal	71	46	117	1.799	0.876
	Disorder	29	19	48		
	Total	100	65	165		
Bone marrow disorder	Normal	74	45	119	0.446	0.504
	Disorder	26	20	46		
	Total	100	65	165		
Cyst	No	73	50	123	0.151	0.927
	Yes	25	15	40		
	Total	98	65	163		
Joint effusion	Normal	42	26	68	0.846	0.974
	Effusion	58	39	97		
	Total	100	65	165		
Bursa effusion	Normal	96	65	161	2.665	0.103
	Effusion	4	0	4		
	Total	100	65	165		
Joint space disorder	Normal	88	58	146	8.524	0.014
	Disorder	12	7	19		
	Total	100	65	165		
Osteophyte	No	73	53	126	1.591	0.207
	Yes	27	12	39		
	Total	100	65	165		
Chondromalacia patellae	No	86	55	141	0.061	0.805
	Yes	14	10	24		
	Total	100	65	165		
Chondromalacia patellae type	Total	7	7	14	1.200	0.549
Subchondral bony edema	No	85	59	144	1.180	0.277
	Yes	15	6	21		
	Total	100	65	165		

As it mentioned in Table 4.14, there was a significant association between chewing Qat and both ligamentum tear and joint space disorder. There was no significant association between chewing Qat and other knee disorder.

4.1.11 Diabetic effect on knee disorders

The association between knee disorders and diabetes in the study sample was presented in Table 4.15.

Table 4.15: Association between Knee disorder and Diabetic

Knee disorder	Type	Diabetic		Total	Chi-Square	Sig.
		Yes	No			
Meniscus tear	Normal	0	29	29	4.144	0.246
	Tear	13	123	136		
	Total	136	152	288		
Meniscus tear type	Total	13	117	130	0.735	0.865
Ligamentum tear	No	1	118	25	1.543	0.214
	Yes	13	12	119		
	Total	14	130	144		
Ligamentum tear type	Total	1	33	34	0.813	0.976
Articular cartilage disorder	Normal	12	149	161	11.989	0.007
	Disorder	1	3	4		
	Total	13	152	165		
Synovial disorder	Normal	7	110	117	12.008	0.035
	Disorder	6	42	48		
	Total	13	152	165		
Bone marrow disorder	Normal	8	111	119	0.786	0.375
	Disorder	4	193	197		
	Total	12	303	316		
Cyst	No	10	113	123	2.226	0.329
	Yes	2	38	40		
	Total	12	151	163		
Joint effusion	Normal	7	16	23	2.472	0.781
	Effusion	6	135	141		
	Total	13	151	164		
Bursa effusion	Normal	13	148	161	0.351	0.554
	Effusion	0	4	4		
	Total	13	152	165		
Joint space disorder	Normal	11	135	146	0.981	0.612
	Disorder	2	17	19		
	Total	13	152	165		
Osteophyte	No	7	119	126	3.964	0.046
	Yes	6	33	39		
	Total	13	152	165		
Chondromalacia patellae	No	12	129	141	0.533	0.465
	Yes	1	23	24		
	Total	13	152	165		
Subchondral bony edema	No	11	133	144	0.090	0.765
	Yes	2	19	21		
	Total	13	152	165		

Based on Table 4.15, there was a significant association between diabetic and articular cartilage disorder, synovial disorder, and osteophyte. There was no significant difference between diabetes and other knee disorders.

4.1.12 Blood hypertension effect on knee disorders

The association between knee disorders and blood hypertension of the study sample was presented in Table 4.16.

Table 4.16: Association between knee disorder and Blood hypertension

Knee disorder	Type	Blood hypertension		Total	Chi-Square	Sig.
		Yes	No			
Meniscus tear	Normal	0	29	29	6.426	0.019
	Tear	23	110	133		
	Total	23	139	165		
Meniscus tear type	Total	22	108	130	2.003	0.672
Ligamentum tear	No	20	110	130	1.067	0.303
	Yes	3	32	35		
	Total	23	142	165		
Ligamentum tear type	Total	3	31	34	2.598	0.762
Articular cartilage disorder	Normal	21	140	161	12.779	0.005
	Disorder	2	2	4		
	Total	23	162	165		
Synovial disorder	Normal	11	106	117	19.567	0.002
	Disorder	12	36	48		
	Total	23	142	165		
Bone marrow disorder	Normal	13	106	119	3.234	0.072
	Disorder	10	36	46		
	Total	23	142	165		
Cyst	No	17	106	123	0.532	0.767
	Yes	5	35	40		
	Total	22	141	163		
Joint effusion	Normal	13	55	68	2.682	0.721
	Effusion	10	87	97		
	Total	23	142	165		
Bursa effusion	Normal	22	139	161	0.418	0.518
	Effusion	1	3	4		
	Total	23	142	156		

Knee disorder	Type	Blood hypertension		Total	Chi-Square	Sig.
		Yes	No			
Joint space disorder	Normal	17	129	146	5.572	0.056
	Disorder	6	13	19		
	Total	23	142	165		
Osteophyte	No	14	112	126	3.555	0.059
	Yes	9	30	39		
	Total	23	142	165		
Chondromalacia patellae	No	21	120	142	0.736	0.391
	Yes	2	22	24		
	Total	23	242	165		
Chondromalacia patellae type	Total	1	13	14	14.000	0.001
Subchondral bony edema	No	21	123	144	0.391	0.532
	Yes	2	19	21		
	Total	23	142	165		

As it illustrated in Table 4.16, there was a significant association between blood hypertension and meniscus tear, articular cartilage disorder, synovial disorder, and chondromalacia patellae. There was no significant association between blood hypertension and other knee disorder.

4.1.13 Previous knee injury effect on knee disorders

The association between knee disorders and previous knee injuries of the study sample was presented in Table 4.17.

Table 4.17: Association between knee disorder and Previous knee injury

Knee disorder	Type	Previous knee injury		Total	Chi-Square	Sig.
		Yes	No			
Meniscus tear	Normal	11	18	29	3.368	0.338
	Tear	65	64	129		
	Total	76	82	158		
Meniscus tear type	Total	64	64	128	6.619	0.085
Ligamentum tear	No	58	70	128	0.888	0.346
	Yes	19	16	35		
	Total	77	86	163		
Ligamentum tear type	Total	18	16	34	4.706	0.453

Knee disorder	Type	Previous knee injury		Total	Chi-Square	Sig.
		Yes	No			
Articular cartilage disorder	Normal	75	84	159	4.025	0.259
	Disorder	2	2	4		
	Total	77	86	163		
Synovial disorder	Normal	56	60	116	4.275	0.510
	Disorder	21	26	47		
	Total	77	86	163		
Bone marrow disorder	Normal	59	58	117	1.691	0.194
	Disorder	18	28	46		
	Total	77	86	163		
Cyst	No	59	64	123	0.188	0.910
	Yes	17	21	38		
	Total	76	85	161		
Joint effusion	Normal	29	37	66	12.466	0.029
	Effusion	48	49	97		
	Total	77	86	163		
Bursa effusion	Normal	76	83	159	0.814	0.367
	Effusion	1	3	4		
	Total	77	86	163		
Joint space disorder	Normal	69	76	145	0.242	0.886
	Disorder	8	10	18		
	Total	77	86	163		
Osteophyte	No	64	60	124	3.978	0.046
	Yes	13	26	39		
	Total	77	86	163		
Chondromalacia patellae	No	68	71	139	1.071	0.301
	Yes	9	15	24		
	Total	77	86	163		
Chondromalacia patellae type	Total	4	10	14	0.770	0.680
Subchondral bony edema	No	72	70	142	5.309	0.021
	Yes	5	16	21		
	Total	77	86	163		

Table 4.17 revealed that there was a significant association between previous knee injury and joint effusion, osteophyte, and subchondral bony edema. There was no significant difference between previous knee injuries and other knee disorders.

4.1.14 Vitamin D-deficiency effect on knee disorders

The association between knee disorders and vitamin D deficiency in the study sample was presented in Table 4.18.

Table 4.18: Association between knee disorder and Vitamin D-deficiency

Knee disorder	Type	Vitamin D-deficiency		Total	Chi-Square	Sig.
		Yes	No			
Meniscus tear	Normal	8	19	27	4.821	0.185
	Tear	62	64	126		
	Total	70	83	153		
Meniscus tear type	Total	60	60	120	4.929	0.177
Ligamentum tear	No	59	64	123	1.241	0.265
	Yes	11	19	30		
	Total	70	83	153		
Ligamentum tear type	Total	10	19	29	2.719	0.743
Articular cartilage disorder	Normal	69	81	150	2.876	0.411
	Disorder	1	2	3		
	Total	70	83	153		
Synovial disorder	Normal	45	63	108	4.241	0.515
	Disorder	25	20	45		
	Total	70	83	153		
Bone marrow disorder	Normal	48	61	109	0.449	0.503
	Disorder	22	22	44		
	Total	70	83	153		
Cyst	No	49	68	117	3.008	0.222
	Yes	19	15	34		
	Total	68	83	151		
Joint effusion	Normal	33	31	64	6.028	0.303
	Effusion	37	52	89		
	Total	70	83	153		
Bursa effusion	Normal	69	80	149	0.713	0.399
	Effusion	1	3	4		
	Total	70	83	153		
Joint space disorder	Normal	62	74	136	0.031	0.984
	Disorder	8	9	17		
	Total	70	83	153		
Osteophyte	No	52	65	117	0.342	0.558
	Yes	18	18	36		
	Total	70	83	153		

Knee disorder	Type	Vitamin D-deficiency		Total	Chi-Square	Sig.
		Yes	No			
Chondromalacia patellae	No	56	75	131	3.311	0.069
	Yes	14	8	22		
	Total	70	83	153		
Chondromalacia patellae type	Total	8	5	13	2.377	0.305
Subchondral bony edema	No	60	73	133	0.167	0.683
	Yes	10	10	20		
	Total	70	83	153		

Table 4.18 showed that there was no significant association between Vitamin D deficiency and knee disorder.

4.1.15 Occupation effect on knee disorders

The association between knee disorders and the occupation of the study sample was presented in Table 4.19.

Table 4.19: Association between knee disorder and Occupation

Knee disorder	Type	Occupation			Total	Chi-Square	Sig.
		Light	Moderate	Heavy			
Meniscus tear	Normal	13	9	7	29	7.975	0.240
	Tear	48	65	21	134		
	Total	61	74	28	163		
Meniscus tear type	Total	47	62	19	128	7.010	0.320
Ligamentum tear	No	44	62	22	128	2.693	0.260
	Yes	17	12	6	35		
	Total	61	74	28	165		
Ligamentum tear type	Total	16	12	6	34	13.893	0.178
Articular cartilage disorder	Normal	61	71	27	159	4.478	0.612
	Disorder	0	3	1	4		
	Total	61	74	28	163		
Synovial disorder	Normal	51	43	21	115	15.670	0.109
	Disorder	11	31	7	49		
	Total	62	74	28	164		
Bone marrow disorder	Normal	41	55	21	117	1.008	0.604
	Disorder	20	19	7	46		
	Total	61	74	28	163		

Knee disorder	Type	Occupation			Total	Chi-Square	Sig.
		Light	Moderate	Heavy			
Cyst	No	42	54	25	121	4.628	0.328
	Yes	19	18	3	40		
	Total	61	72	28	163		
Joint effusion	Normal	17	40	11	68	33.205	0.000
	Effusion	44	24	17	85		
	Total	61	64	28	153		
Bursa effusion	Normal	59	74	26	159	4.607	0.100
	Effusion	2	0	2	4		
	Total	61	74	28	163		
Joint space disorder	Normal	54	65	25	144	4.770	0.312
	Disorder	7	9	3	19		
	Total	61	74	28	163		
Osteophyte	No	45	54	25	124	3.254	0.197
	Yes	16	20	3	39		
	Total	61	74	28	163		
Chondromalacia patellae	No	54	61	25	140	1.346	0.510
	Yes	7	13	3	23		
	Total	61	74	28	163		
Chondromalacia patellae type	Total	4	6	3	13	2.476	0.649
Subchondral bony edema	No	47	72	23	142	12.959	0.002
	Yes	14	2	5	21		
	Total	61	74	28	163		

Based on Table 4.19, there was a significant association between occupation and joint effusion and subchondral bony edema. There was no significant association between occupation and other knee disorders.

4.1.16 Walk level effect on knee disorders

The association between knee disorders and the walk level of the study sample was presented in Table 4.20.

Table 4.20: Association between knee disorder and Walk level

Knee disorder	Type	Walk level			Total	Chi-Square	Sig.
		Low	Moderate	High			
Meniscus tear	Normal	4	16	9	29	6.265	0.394
	Tear	28	76	32	136		
	Total	32	92	41	165		
Meniscus tear type	Total	28	73	29	130	7.192	0.303
Ligamentum disorder	No	21	79	30	130	6.852	0.033
	Yes	11	13	11	35		
	Total	32	92	41	165		
Ligamentum disorder type	Total	11	12	11	34	10.095	0.432
Articular cartilage disorder	Normal	32	89	40	161	2.522	0.866
	Disorder	0	3	1	4		
	Total	32	92	41	165		
Synovial disorder	Normal	25	63	29	117	5.172	0.879
	Disorder	7	29	12	48		
	Total	32	92	41	165		
Bone marrow disorder	Normal	24	63	32	199	1.456	0.483
	Disorder	8	29	9	46		
	Total	32	92	41	165		
Cyst	No	27	64	32	123	3.624	0.459
	Yes	5	26	9	40		
	Total	32	90	41	163		
Joint effusion	Normal	13	40	15	68	16.201	0.094
	Effusion	19	52	26	97		
	Total	32	92	41	165		
Bursa effusion	Normal	32	91	38	161	5.640	0.060
	Effusion	0	1	3	4		
	Total	32	92	41	165		
Joint space disorder	Normal	29	81	36	146	1.101	0.894
	Disorder	3	11	5	19		
	Total	32	92	41	165		

Knee disorder	Type	Walk level			Total	Chi-Square	Sig.
		Low	Moderate	High			
Osteophyte	No	26	68	32	126	0.794	0.672
	Yes	6	24	9	39		
	Total	32	92	41	165		
Chondromalacia patellae	No	29	78	34	141	0.932	0.627
	Yes	3	14	7	24		
	Total	32	92	41	165		
Chondromalacia patellae type	Total	1	7	6	14	2.133	0.711
Subchondral bony edema	No	30	81	33	144	2.957	0.228
	Yes	2	11	8	21		
	Total	32	92	41	165		

Table 4.20 showed that there was a significant association between walk level and ligamentum tear. There was no significant association between walk level and other knee disorders.

4.2 Discussion:

This study conducted on 886 patients who underwent Knee MRI scan and having an issue in the knee joint, their demographic data, medical history and features of knee disorders were filled out in previous designed data collection sheets, whereas their age was categorized into four age groups by factor of 20 years, the majority of them were who had age between 21 to 40 years (400; 45.1 %) out of the total sample (254; 63.5% were male and 146; 36.5% were female) followed by patients who had age group between 41 and 60 years (323; 36.5 %) (132;38% were male and 191;62% were female) while the less affected age group among the total sample was for patients had age more than 63 years (63; 7.1 %). As shown in Table (4.1.1) and presented in Figure (4.1.1).

Other demographic characteristics data of study sample revealed that males had more prevalence of knee disorders than females (483; 54.5% for males comparing with 403; 45.5% of females). These results presented in Table and Figure (4.2.2).

Regarding the effect of risk factors on knee disorders among 165 patients, the results showed the following. BMI was organized into four categorical groups, thereby (68; 41.2 % had overweight, 54; 32.7 % had weight within the normal range, 38; 23% were obese and 5; 3% had underweight). Moreover, 40 (42.2%) of them had a history of smoking, 13 (7.9%) had DM history, 23 (13.9 %) had a prevalence of blood hypertension, 77 (47.2 %) had either previous knee injury or pain, 70 (42,4 %) had vitamin D deficiency and regarding the occupation (74; 44.8 % had a moderated nature of occupation, 61; 73 % had a light occupation and 28; 17 %) had a heavy nature of occupation). As shown in Table (4.8).

According to the prevalence of knee disorders; this study found that the common knee disorders were as follows: meniscus tear, degeneration, ligament tear, ACL tear, degenerative/thin articular cartilage disorder, mild effusion of synovial membrane, edema of bone marrow, bone cyst, mild effusion joint, bursa effusion, narrowing joint space, osteophyte, chondromalacia patellae and subchondral bony edema (68.7 %, 33.7 %, 25.8 %, 77.5%, 3.4%, 18.3%, 19.2 %, 14.7%, 37%, 2.3%, 12.4% ,13.3%, 47.7% and 14.2%. respectively) as shown in Table (4.3). These findings similar to previous study has been done by ***(Guermazi, et al. 2012)*** who found that osteophytes were the most common abnormality among patients with knee disorders (74%, 524/710), followed by cartilage damage (69%, 492/710) and bone marrow lesions (52%, 371/710). As well, in the same line with (***Horga, et al. 2020)*** who showed that thirty percent knees had meniscal tears: horizontal (23%), complex (3%), vertical (2%), radial (2%) and bucket handle (1%). Cartilage and bone marrow abnormalities were prevalent at the patellofemoral joint (57% knees and 48% knees, respectively). Moderate and severe cartilage lesions were common, in 19% and 31% knees, respectively, while moderate and severe bone marrow edema in 19% and 31% knees, respectively.

Using cross tabulation with considering p value (0.05) as a standard reference value for significant difference, the study results showed a significant correlation between age of patients with meniscus tear, synovial disorder, bone marrow disorder, cyst, osteophyte, chondromalacia patellae and subchondral bony edema whereas (p value < 0.05). whereas, there was no significant difference between age of patients with Ligamentum tear, Ligamentum tear type, Articular cartilage disorder, Joint effusion, Bursa effusion, Joint space disorder and Chondromalacia patellae type which p value more than 0.05. as shown in Table (4.5).

Furthermore, this study found that sex of patients has a significant difference with meniscus knee disorder (p < 0.05) as well with ligament disorders (p < 0.05). Moreover, with osteophyte and chondromalacia patellae which (p value < 0.05) as shown in Table (4.7). Furthermore, this results found that BMI, smoking, chewing Qat, Vitamin D-deficiency and walk level had no significant difference with MRI findings of knee disorders which p value more than 0.0. as shown in Table (4.11), (4.13), (4.14), (4.18), and (4.20). These results have been reached by ***(Guermazi, et al. 2012)*** who stated that there are no significant differences in the prevalence of any of the features of knee disorders between BMI groups.

Moreover, this study revealed that risk factor of DM had significant difference among patients with knee disorders regarding to articular cartilage, synovial disorder and osteophyte (p = 0.007, 0.0035 and 0.046. respectively) as shown in Table (4.15). In addition, risk factor of blood hypertension had also significant difference among patients with knee disorders regarding to meniscus tear, articular cartilage disorder, synovial disorder and chondromalacia patellae type (p = 0.019, 0.005, 0.002 and 0.001< 0.05. respectively) as shown in Table (4.16). Study also found there was a significant difference between previous knee injury with joint effusion, osteophyte and subchondral bony edema (p < 0.05) as shown in Table (4.17).

Chapter Five

Conclusion & Recommendation

Chapter five

Conclusion and Recommendation

5.1 Conclusion:

From the results of this study it can be concluded that magnetic resonance is accurate medical diagnostic imaging tool to evaluate knee disorders.

Patients with age between 21 and 40 years are the common affected by knee disorders based on the results of this study while male have affected by these diseases more than females.

Medial meniscus tear, degeneration, ligament tear, ACL tear, degenerative/thin articular cartilage disorder, mild effusion of synovial membrane, edema of bone marrow, bone cyst, mild effusion joint, bursa effusion, narrowing joint space, osteophyte, chondromalacia patellae and subchondral bony edema are the common MRI findings among Yemenis patients with knee disorders.

DM, blood hypertension, previous knee injury and occupation have significant association with some of knee disorders detected by MRI such as Ligamentum disorder, Subchondral bony edema, Joint effusion, Osteophyte.

BMI, smoking, chewing Qat, Vitamin D-deficiency and walk level have non-significant association with MRI findings of patients with knee disorders.

5.2 Recommendations:

Sample of this study included only knees that were lacking any radiographic features indicated to osteoarthritic changes. So we recommend future studies to take their sample from patients with osteoarthritis.

Further studies are needed with larger sample size and external validation in different provinces in Yemen to establish local reference values and to determine variations of knee disorders disease among Yemenis population.

Since the clinical characteristics of knee disorders change with the duration of this disease, study recommend future researchers to consider the duration of disease as a fundamental factor in their longitudinal studies.

Its recommend to use specialized protocols instead of using routine scanning protocol, functional MRI (fMRI) and FDG-PET scan for further diagnosis or when MRI is normal or showed nonspecific findings.

Further imaging modality can be used as Ultrasound and nuclear scan for comparing with these results for more accuracy.

Correlate this study with orthopedic consultant diagnosis to establish local guide.

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Appendix Ⅰ

REPUBLIC OF YEMEN
University of Science and Technology

الجمهورية اليمنية
جامعة العلوم والتكنولوجيا

Ref
Date :   /   /

الرقــم :
التــاريـخ :   /   /

التاريخ: 2022/12/26م

الأخ الفاضل / مدير مركز سام سكان **الأكرم**

السلام عليكم ورحمة الله وبركاته وبعد ،،،

الموضوع: التعاون مع طالبات مستوى رابع – بكالوريوس تكنولوجيا الأشعة والتصوير الطبي في إنجاز بحث التخرج

في البداية نهديكم أطيب التحايا .. ونتمنى لكم التوفيق والنجاح في جميع أعمالكم.

إشارة إلى الموضوع أعلاه، ستقوم طالبات المستوى الرابع ـ تكنولوجيا الأشعة والتصوير الطبي المذكورات أدناه بزيارة المركز لإنجاز بحث التخرج الذي يحمل عنوان:

"Prevalence and risk factors for knee osteoarthritis among Yemeni populations"

أسماء الطالبات:

1. نجلا خالد مبخوت
2. أسماء حمود أفلح
3. جميلة محمد زياد
4. شمس حسن مفرح
5. هديل عارف الهجامي
6. مرام عبد الرحمن الماوري

وعليه، يرجى التوجيه لتقديم المساعدة المطلوبة وتسهيل مهمتهن، وذلك ضمن متطلبات بحث.

شاكرين ومقدرين لكم دوام التعاون

وتفضلوا بقبول وافر الاحترام والتقدير

نائب العميد للعلوم الصحية

أ.د/ عبد الحبيب ردمان

جامعة العلوم والتكنولوجيا - كلية الطب والعلوم الصحية
University of Science & Technology - Faculty of Medicine & Health Sciences

صنعاء – شارع الستين (جولة مذبح) – تلفون : (37 32 37) فاكس : (530630) ص.ب : (13064)
رؤيتنا : الريادة إقليمياً .. التميز عالمياً
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BLIC OF YEMEN
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d Technology

الجمهورية اليمنية
جامعة العلوم والتكنولوجيا

الرقم:
التاريخ: / /

التاريخ: 2022/11/28م

الأخ الفاضل / مدير المستشفى الأوربي الحديث **الأكرم**

السلام عليكم ورحمة الله وبركاته وبعد ...

الموضوع: التعاون مع طالبات مستوى رابع – بكالوريوس تكنولوجيا الأشعة والتصوير الطبي في إنجاز بحث التخرج

في البداية نهديكم أطيب التحايا ... ونتمنى لكم التوفيق والنجاح في جميع أعمالكم

إشارة إلى الموضوع أعلاه، ستقوم طالبات المستوى الرابع - تكنولوجيا الأشعة والتصوير الطبي المذكورات أدناه بزيارة المستشفى لإنجاز بحث التخرج الذي يحمل عنوان:

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5. هديل عارف الهجامي
6. مرام عبد الرحمن الماوري

وعليه، يرجى التوجيه لتقديم المساعدة المطلوبة وتسهيل مهمتهن، وذلك ضمن متطلبات بحث.

شاكرين ومقدرين لكم دوام التعاون

وتفضلوا بقبول وافر الاحترام والتقدير

نائب العميد للعلوم الصحية

أ.د. عبد الحميد رمان

REPUBLIC OF YEMEN
University of Science
and Technology

والتكنولوجيا

Ref
Date : / /

مستشفى جامعة العلوم والتكنولوجيا الأكرم

السلام عليكم ورحمة الله وبركاته وبعد ،،،

مع طالبات مستوى رابع – بكالوريوس تكنولوجيا الأشعة والتصوير الطبي
في إنجاز بحث التخرج

البداية نهديكم أطيب التحايا .. ونتمنى لكم التوفيق والنجاح في جميع أعمالكم.

أعلاه، ستقوم طالبات المستوى الرابع - تكنولوجيا الأشعة والتصوير الطبي
رة المستشفى لإنجاز بحث التخرج الذي يحمل عنوان:
"Prevalence and risk factors for knee osteoarthritis among Yeme

خوت
أفلح
ياد
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لهجامي
من الماوري

يه لتقديم المساعدة المطلوبة وتسهيل مهمتهن، وذلك ضمن متطلبات بحث.

شاكرين ومقدرين لكم دوام التعاون

وتفضلوا بقبول وافر الاحترام والتقدير

نائب العميد للعلوم الصحية

أ.د. عبد الحبيب ردمان

University of Science & Technology
Faculty of Medicine & Health Sciences

مستشفى جامعة العلوم والتكنولوجيا

إدارة الموارد البشرية – قسم التدريب

مستشفى جامعة العلوم والتكنولوجيا
University of Science & Technology Hospital

التاريخ :

تعهـد

أنا: نجلاء خالد مبخوت

المرسل من جامعة: العلوم والتكنولوجيا

لجمع بيانات بحث بعنوان:

Prevalence and risk factors for knee osteoarthritis among Yemeni populations

اتعهد ان التزم بأخلاقيات البحث العلمي بالمحافظة على سرية البيانات التي سأقوم بجمعها من مستشفى جامعة العلوم والتكنولوجيا واتعهد باحترام خصوصية المرضى والموظفين وعدم استخدام البيانات التي سأجمعها لأي أغراض أخرى غير أغراض البحث العلمي واتحمل المسؤولية القانونية في حالة مخالفة ذلك كما اتعهد بتسليم نسخة من النتائج للمستشفى.

الاسم: نجلاء خالد مبخوت

التوقيع:

مستشفى جامعة العلوم والتكنولوجيا

إدارة الموارد البشرية – قسم التدريب

التاريخ :

نموذج موافقة جمع بيانات بحث علمي

اسم الباحث: نجلاء خالد طه مبخوت

عنوان البحث: prevlence and risk factors for knee osteoarthritis among Yemeni populations

الجامعة : العلوم والتكنولوجيا   التخصص: [illegible]

موافقة الادارة والقسم المعني بجمع البيانات:

القسم: [illegible]

الإدارة: [illegible]

تم الاطلاع على عنوان البحث وأداة جمع البيانات ونوافق على جمع البيانات

رئيس القسم	مدير الإدارة
الاسم: [illegible]	الاسم:
التوقيع: [illegible]	التوقيع:

موافقة إدارة الجودة

تم الاطلاع على عنوان البحث وأداة جمع البيانات ونوافق على جمع البيانات

الاسم [illegible]

التوقيع

اعتماد المدير العام أو المدير الطبي

ملخص البحث

الهدف

هدفت هذه الدراسة التحليلية الى تقييم مشاكل الركبة التي يعاني منها اليمنيين بواسطة التصوير بالرنين المغناطيسي.

المنهجية

أجُريت هذه الدراسة في أمانة العاصمة صنعاء في أقسام الأشعة لعدد من المستشفيات خلال الفترة ديسمبر ٢٠٢٢ وحتى مارس ٢٠٢٣ حيث خضع عدد ٨٨٦ لفحص مفصل الركبة ممن يعانون من مشاكل مفصل الركبة ومن لديهم تاريخ مرضي أو أعراض لمشاكل الركبة.

النتائج

أظهرت نتائج الدراسة أن حوالي ٤٥ % (٤٠٠ مريض) تتراوح أعمارهم بين ٢١ إلى ٤٠ سنة. ويحتل الذكور النسبة الأعلى حيث بلغ عددهم ٢٥٤ شخص بنسبة ٦٣,٥% بينما كان عدد الإناث ١٤٦ امرأة بنسبة ٣٦,٥% حيث أظهرت الدراسة أن الذكور لديهم معدل أكبر في انتشار مشاكل الركبة بمعدل ٥٤,٥% مقابل ٤٥,٥ % من النساء...كما توصلت الدراسة إلى أن مشاكل الركبة الشائعة كانت كالتالي:

تمزق غضاريف المفصل، تمزق الرباط، تمزق الرباط الصليبي الأمامي، اضطراب الغضاريف المفصلية التنكسية / الرقيقة، الانصباب الخفيف للغشاء الزليلي، وذمة نخاع العظم، كيس العظام، مفصل الانصباب الخفيف، انصباب الجراب، تضييق مساحة المفصل بنسب مئوية ٢٥,٨ ٪، ٧٧,٥ ٪، ٣,٤ ٪، ١٨,٣ ٪، ١٩,٢ ٪، ١٤,٧ ٪، ٣٧ ٪، ٢,٣ ٪، ١٢,٤ ٪، ١٣,٣ ٪، ٤٧,٧ ٪ و١٤,٢ ٪ على التوالي.

وبالنسبة لتأثير العوامل الأخرى فإن زيادة وزن الجسم والتدخين ومضغ القات ونقص فيتامين د ليس لها تأثير على مشاكل الركبة في حين أن ارتفاع ضغط الدم والسكر وطبيعة العمل والإصابة السابقة للركبة لها علاقة دالة احصائياً بأمراض مفاصل الركبة.

الاستنتاج

كان التمزق الغضروفي الأكثر شيوعاً لدى الرجال.

ويعتبر الرنين المغناطيسي أداة تصوير تشخيصية دقيقة في تقييم مشاكل مفاصل الركبة.