

Chapter one

Chapter one

1-1Introduction:

Knee joint is one of the most important hinge joints of our body. We use our knee joints several times in a day. They are used when we sit, fold legs, run and walk or do any kind of leg movement. They connect the lower leg to the rest of the body and give stability, flexibility and strength. They support the legs to bear the body weight and also help in proper locomotion. Any disorder or defect in the knee bones can restrict the activities of the leg which can directly affect our locomotion (Cindy et al, 2014)

In Sudan to the knowledge of the author there is no sufficient data published locally or internationally regarding the knee joint measurement or significance of gender or even occupation in knee measurement.

The main objective of the current study was to characterize the knee joints in Sudanese population using computed tomography to explain the differences that arise in the knee joints measurements which might be attributed to body characteristic or pathological changes.

Osteoarthritis of the knee is commonly associated with deformities of lower limb, which may be seen as abnormal alignment of the limb segment in the frontal plane. A common pattern is bilateral varus knee alignment (bow-leg) which is a focus of arthritic change in the medial compartment.

Another is valgus limb alignment with damage primarily on the lateral side. Among subjects with knee OA in the Framingham Osteoarthritis Study, the ratio of prevalence of medial to lateral disease was roughly 5 to 1 in women, and 8-9 to 1 in men. A difference in hip morphology between sexes may help to explain this finding.

Association between osteoarthritis and deformities is well recognized, but the pathogenetic relationship are poorly understood. While it is agreed that deformities arise from progression of osteoarthritis the reverse may also be true—that developmental abnormalities are factors that contribute to osteoarthritis later in life.

Several factors such as overweight during adolescence, female gender and certain types of knee joint have been associated with the development of osteoarthritis, some authors have postulated that different risk factors are involved in the development of tibiofemoral and patellofemoral osteoarthritis of the knee but only tried to distinguish between the etiologies of medial and lateral osteoarthritis.

1-2Knee measurements:-

Ct are valuable for detecting abnormalities in bone and are taken to evaluate painful, deformed, or suspected abnormal areas of bone. Often, ct can help to diagnose fractures, tumors, injuries, infections, and deformities (such as congenital hip dysplasia). Also, sometimes ct are helpful in showing changes that confirm a person has a certain kind of arthritis (for example, rheumatoid arthritis or osteoarthritis).ct don't show clearly soft tissues such as muscles, bursae, ligaments, tendons, or nerves. To help determine whether the joint has been damaged by injury, a doctor may use an ordinary (non-stress) ct or one taken with the joint under stress (Merck, 2010).

Unlike knee plain radiography which can only detect joint space narrowing and osteophytes, magnetic resonance imaging can directly visualize and analyze the whole knee structure, including bone size, cartilage defects and loss of cartilage volume. Tibial subchondral bone area expansion may be primary and it associated with risk factors such as age, body mass index (BMI), genetics and/or limb malalignment. It can lead to the development of knee defects, which may also be caused by demographic, anthropometric and environmental factors such as age, female sex, BMI and smoking as well as structural changes such as osteophytes, bone marrow lesions, meniscal tears, meniscal extrusion and ligament abnormalities. Once knee cartilage defects develop, they have a variable natural history but are associated with subsequent cartilage loss in a dose-response manner. Both tibial subchondral bone area and knee cartilage defects are quantitatively related to the severity of knee osteoarthritis (OA), and predictive of the need for knee joint replacement in subjects with knee OA independent of radiographic change. Taken as a whole, these studies suggest that tibial subchondral bone expansion and cartilage defect development represent important targets for the prevention of cartilage loss and joint replacement (Ding et al, 2007).

Gender differences could be reduced for cartilage volume and surface area when normalized to body weight and body weight x body height.

The study demonstrates significant gender differences in cartilage volume and surface area of men and women, which need to be taken into account when retrospectively estimating articular cartilage loss in patients with symptoms of degenerative joint disease. Differences in cartilage volume are primarily due to differences in joint surface areas (epiphysial bone size), not to differences in cartilage thickness (Faber et al, 2001).

Measurement of joint space width (JSW) from ct image is widely considered the best available surrogate criterion to assess the progression of osteoarthritis (OA) in clinical trials and epidemiological studies. OA progresses slowly and joint space narrowing varies from 0.1 to 0.6 mm/year

Many efforts have been made to improve the reliability of joint space assessment, particularly the choice of the measuring instrument, that of the

site of measurement and the quality of reading (training session, centralized reading). In contrast, the influence of patient positioning and of the radiographic procedure has never been carefully studied, except for the influence of weight bearing. According to some authors, slight changes in patient positioning or radiographic procedure may modify JSW and compromise the reliability of measurements. Fife et al. found that JSW in a normal volunteer decreased by 17% when the ct position was lowered by 1 cm below its original alignment initially centered at the midpoint of the patella. (Karen et al, 2008)

They also found that with 10° flexion the medial joint space width decreased by 25% compared to 0° flexion. Lynch et al. studied the influence of knee position in five post-mortem subjects and found that the error of JSW measurement was ~0.15 mm/10° of internal or external rotation of the knee joint. Therefore, standardization of patient positioning and radiographic procedure seems necessary, particularly for the quantitative assessment of JSW. However, in many studies there is no standardization of the radiographic procedure or of patient positioning. The knees are generally radio graphed standing, with the joint in a fully extended position beam inclination or direction are rarely specified. In other studies, the ct was or parallel to the joint surface and directed at the midpoint or the lower pole of the patella. (Karen et al, 2008) Evaluations of knee alignment are useful in the diagnosis of arthritic conditions affecting the knee joint, serving also as a guide for conservative management and surgical planning. They are also fundamental to various aspects of musculoskeletal research. Recently, there has been great interest in frontal plane alignment measures related to the pathogenesis of knee osteoarthritis (OA). Several approaches have been proposed over the years to describe and measure alignment, but the differences between them have made it difficult to compare or correlate the results of independent studies. Toward a standard approach to the measurement and reporting of alignment data that may be equally applicable to clinicians and researchers, we discuss a system of measurements based on geometric analysis of the femur, tibia and knee joint surfaces. We also discuss a standardized methodology for measurement and computation of these parameters (T Derek et al, 2007)

1-3 problem of study

They found anatomical variations at the hip and pelvis are associated with compartment-specific knee OA and may help to explain sex differences in the patterns of knee OA. Hip and pelvic geometry were associated with the presence of compartment-specific knee OA. A reduced femoral offset, increased height of hip center (figure 2.3)

1-4 Significant of the study

This study will give measurement of knee joint without bone changes and those with bone changes and hence objectively classify the symptomatic patient with changes manifested in the x-ray from those without changes

shown in the x-ray. Also it will facilitate the knowledge of differences between male and female in respect to knee joint measurement. In the same essence it will help in estimating the artificial knee size components before the surgery rather than what happening now

1-5 Objectives

1-5-1 general objective:

To characterize the knee Osteoarthritis Deformities Using CT Scanogram-

1-5-2 specific objective

To measure HKA angle to judge in varus and valgus .

- To correlate effected side (right or left).
- To correlate deformities with age.
- To correlate deformities with gender

1-6Thesis out line:

The flowing research will be consisting of five chapter:

-chapter one will deal with introduction, problem of study, objectives and thesis out line

Chapter two will highlights the literature review related to the current study and the theoretical view for the study

-chapter three will show the methodology

-chapter four will show the results and discussion

-chapter five will show the conclusion, and recommendation, references and appendices

Chapter two

Literature Review
Previous Studies

Chapter Two

Literature review

2.1. Anatomy of the knee joint:-

Our knee is the most complicated and largest joint in our body. It's also the most vulnerable because it bears enormous weight and pressure loads while providing flexible movement. When we walk, our knees support 1.5 times our body weight; climbing stairs is about 3-4 times our body weight and squatting about 8 times (Cindy et al, 2014).

The knee joint connects the femur, our thigh bone and longest bone in the body, to the tibia, the second longest bone. There are two joints in the knee, the tibiofemoral joint, which joins the tibia to the femur and the patellofemoral joint which joins the kneecap to the femur. These two joints work together to form a modified hinge joint that not allows the knee to bend and straighten, but also to rotate slightly and from side to side. The knee is part of a chain that includes the pelvis, hip, and upper leg above, and the lower leg, ankle and foot below. All of these work together and depend on each other for function and movement. The knee joint bears most of the weight of the body. When we're sitting, the tibia and femur barely touch; standing they lock together to form a stable unit. Let's look at a normal knee joint to understand how the parts (anatomy) work together (function) and how knee problems can occur (Cindy et al, 2014).

Anatomical terms allow us to describe the body clearly and precisely using planes, areas and lines. Instead of your doctor saying "his knee hurts" she can say "his knee hurts in the anterolateral region" and another doctor will know exactly what is meant. Some anatomic terms surgeons use as these terms apply to the knee.

Anterior—facing the knee, this is the front of the knee.

Posterior — facing the knee, this is the back of the knee, also used to describe the back of the kneecap, that is the side of the kneecap that is next to the femur.

Medial — the side of the knee that is closest to the other knee, if you put your knees together, the media side of each knee would touch.

Lateral — the side of the knee that is farthest from the other knee (opposite of the medial side). Structures often have their anatomical reference as part of their name, such as the medial meniscus or anterior cruciate ligament (Cindy et al, 2014).

The main parts of the knee joint are bones, ligaments, tendons, cartilages and a joint capsule, all of which are made of collagen. Collagen is a fibrous tissue present throughout our body. As we age, collagen breaks down. The adult skeleton is mainly made of bone and a little cartilage in places. Bone and cartilage are both connective tissues, with specialized cells called chondrocyte embedded in a gel-like matrix of collagen and elastin fibers. Cartilage can be

hyaline, fibrocartilage and elastic and differ based on the proportions of collagen and elastin. Cartilage is a stiff but flexible tissue that is good with weight bearing which is why it is found in our joints. Cartilage has almost no blood vessels and is very bad at repairing itself. Bone is full of blood vessels and is very good at self repair. It is the high water content that makes cartilage flexible (Cindy et al, 2014).

2.1.1. Bones of the Knee

The bones give strength, stability and flexibility in the knee. Four bones make up the knee, see figure (2.1.)

Tibia :commonly called the shin bone, runs from the knee to the ankle. The top of the tibia is made of two plateaus and a knuckle-like protuberance called the tibial tubercle. Attached to the top of the tibia on each side of the tibial plateau are two crescent-shaped shock-absorbing cartilages called menisci which help stabilize the knee.

Patella : the kneecap is a flat, triangular bone; the patella moves when the leg moves. Its function is to relieve friction between the bones and muscles when the knee is bent or straightened and to protect the knee joint. The kneecap glides along the bottom front surface of the femur between two protuberances called femoral condyles. These condyles form a groove called the patellofemoral groove.

Femur: commonly called the thigh bone; it's the largest, longest and strongest bone in the body. The round knobs at the end of the bone are called condyles.

Fibula :long, thin bone in the lower leg on the lateral side, and runs alongside the tibia from the knee to the ankle (Cindy et al, 2014)

Bones of the Knee

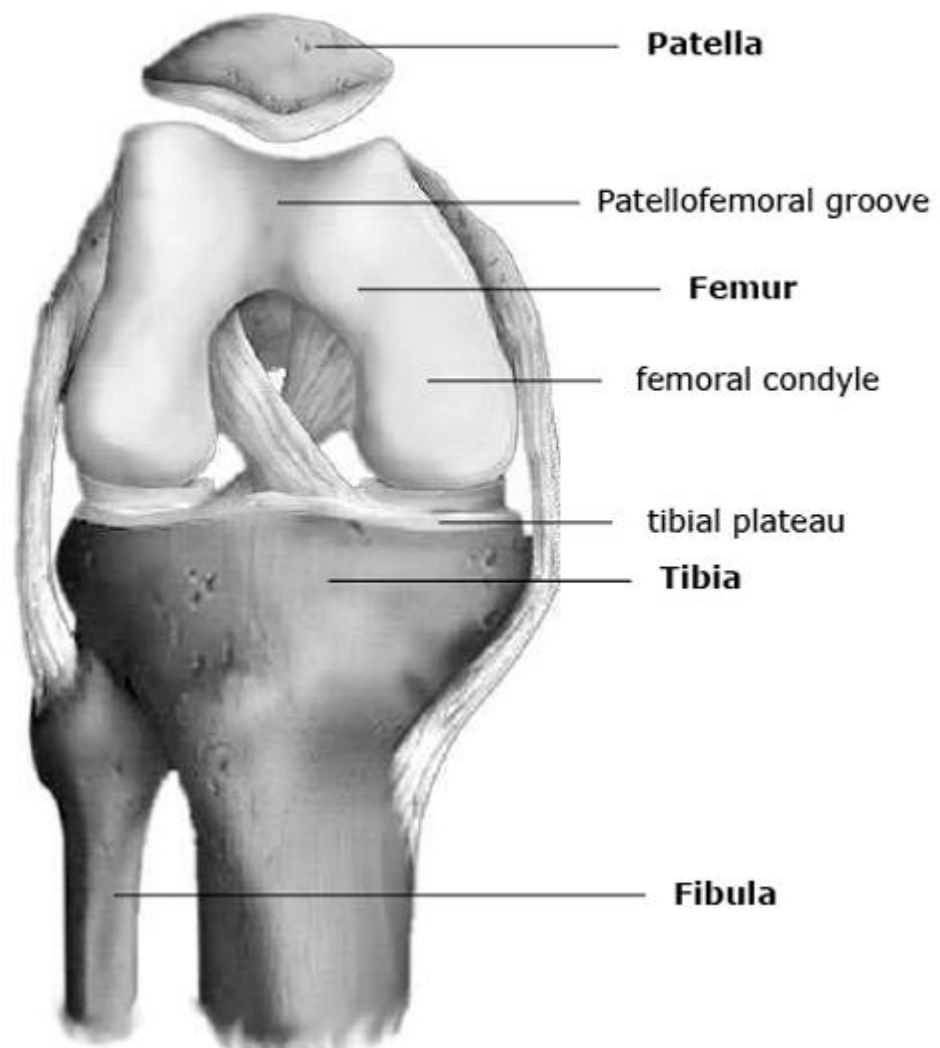


Figure (2.1) Bones of the knee

2.1.2. Tendons in the Knee

Tendons are elastic tissues that technically part of the muscle and connect muscles to bones. Many of the tendons serve to stabilize the knee. There are two major tendons in the knee—the quadriceps and patellar. The **quadriceps tendon** connects the quadriceps muscles of the thigh to the kneecap and provides the power for straightening the knee. It also helps hold the patella in the patellofemoral groove in the femur. The patellar tendon connects the kneecap to the shinbone (tibia)—which means it’s really a ligament (Cindy et al, 2014).

2.1.3. Ligaments in the knee:

The knee works similarly to a rounded surface sitting atop a flat surface. The function of ligaments is to attach bones to bones and give strength and stability to the knee as the knee has very little stability. Ligaments are strong, tough bands that are not particularly flexible. Once stretched, they tend to stay stretched and if stretched too far, they snap.

- **Medial Collateral Ligament** (tibial collateral ligament) – attaches the medial side of the femur to the medial side of the tibia and limits sideways motion of your knee.
- **Lateral Collateral Ligament** (fibular collateral ligament) – attaches the lateral side of the femur to the lateral side of the fibula and limits sideways motion of your knee.
- **Anterior cruciate ligament** – attaches the tibia and the femur in the center of your knee; it’s located deep inside the knee and in front of the posterior cruciate ligament. It limits rotation and forward motion of the tibia.
- **Posterior cruciate ligament** – is the strongest ligament and attaches the tibia and the femur; it’s also deep inside the knee behind the anterior cruciate ligament. It limits the backwards motion of the knee.
- **Patellar ligament** – attaches the kneecap to the tibia. The pair of collateral ligaments keeps the knee from moving too far side-to-side. The cruciate ligaments crisscross each other in the center of the knee. They allow the tibia to “swing” back and forth under the femur without the tibia sliding too far forward or backward under the femur. Working together, the 4 ligaments are the most important in structures in controlling stability of the knee. There is also a patellar ligament that attaches the kneecap to the tibia and aids in stability. A belt of fascia called the iliotibial band runs along the outside of the leg from the hip down to the knee and helps limit the lateral movement of the Figure (2.2.)

Ligaments of the Knee

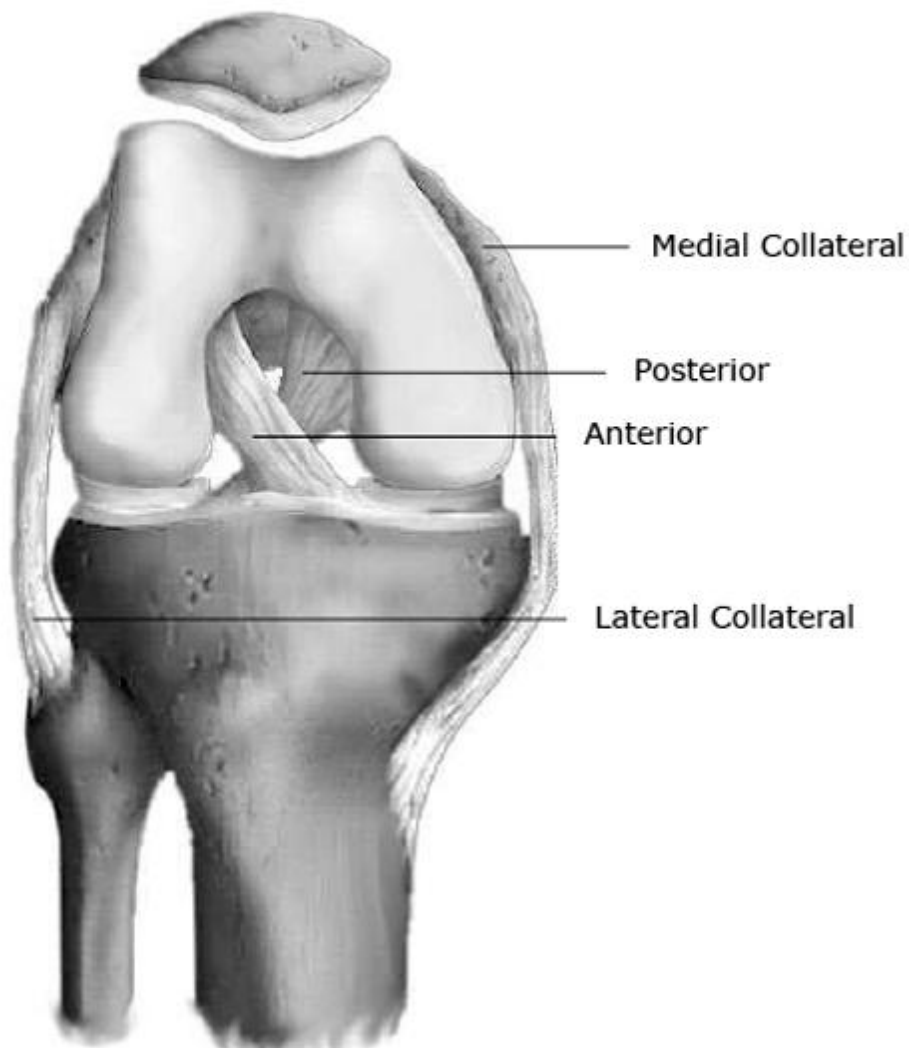


Figure (2.2.) Ligaments of the knee

2.1.4. Nerves of the knee

The two plexi that contribute to the innervations of the lower limbs are the lumbar plexus and sacral plexus. The lumbar plexus, L1-5 gives rise to the femoral and obturator nerves that innervate the hip flexors and adductors and the knee extensors. The sacral plexus, L4-S4 forms the sciatic nerve which will divide into the common peroneal and tibial nerves at the popliteal fossa (David et al, 2015).

Knee nerves are present which allow the sensory orientation in the joints. These nerves help in coordinating movements while walking, running,

standing, etc. These nerves are very delicate and can be affected in case of injury which may lead to severe knee pain.

2.1.5. Cartilage of the knee

The ends of bones that touch other bones—a joint—are covered with articular cartilage. It gets its name “articular” because when bones move against each other they are said to “articulate.” Articular cartilage is a white, smooth, fibrous connective tissue that covers the ends of bones and protects the bones as the joint moves. It also allows the bones to move more freely against each other. The articular cartilages of the knee cover the ends of the femur, the top of the tibia and the back of the patella. In the middle of the knee are menisci—disc shaped cushions that act as shock absorbers. See Figure (2.3.)

- **Medial meniscus** is made of fibrous, crescent shaped cartilage and attached to the tibia.
- **Lateral meniscus** is made of fibrous, crescent shaped cartilage and attached to the tibia.
- **Articular cartilage** is on the ends of all bones in any joint, in the knee joint it covers the ends of the femur and tibia and the back of the patella. The articular cartilage is kept slippery by synovial fluid (which looks like egg white) made by the synovial membrane (joint lining). Since the cartilage is smooth and slippery, the bones move against each other easily and without pain (Cindy et al, 2014).

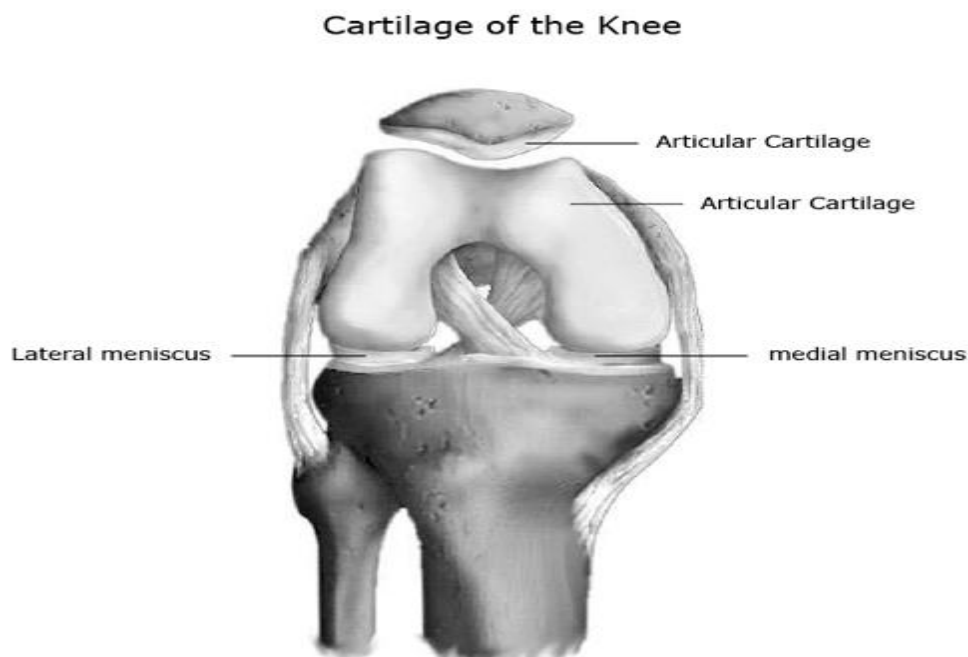


Figure (2.3) Cartilages of knee

In a healthy knee, the rubbery meniscus cartilage absorbs shock and the side forces placed on the knee. Together, the menisci sit on top of the tibia and help spread the weight bearing force over a larger area. Because the menisci are shaped like a shallow socket to accommodate the end of the femur, they help the ligaments in making the knee stable. Because the menisci help spread out the weight bearing across the joint, they keep the articular cartilage from wearing away at friction points.

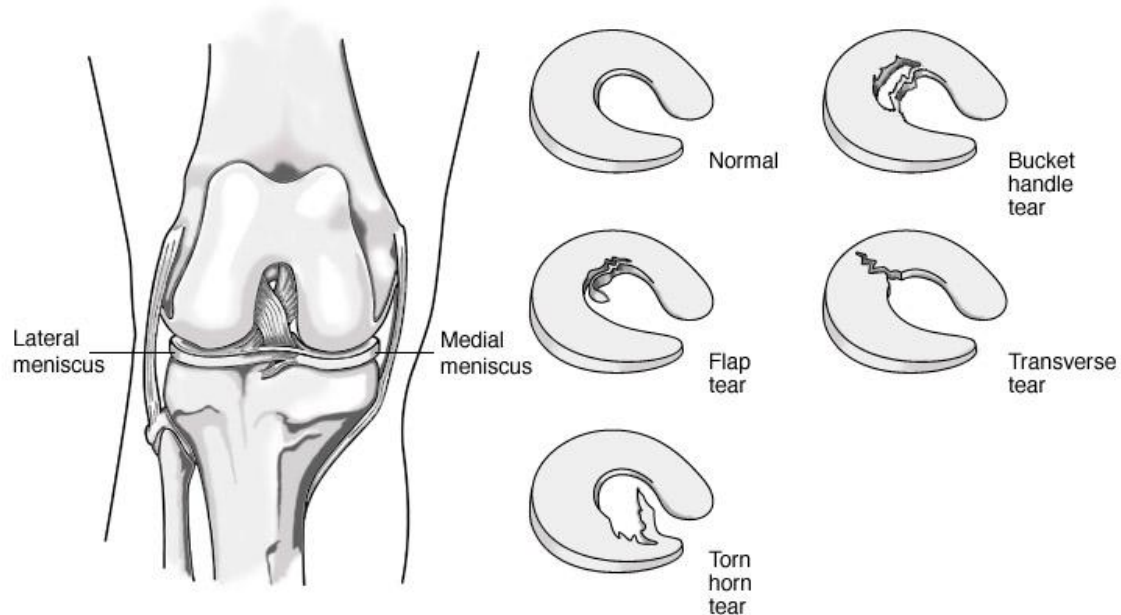


Figure (2.4.) Diagram of normal meniscus and its tears.

The weight bearing bones in our body are usually protected with articular cartilage, which is a thin, tough, flexible, slippery surface which is lubricated by synovial fluid. The synovial fluid is both viscous and sticky lubricant. Synovial fluid and articular cartilage are a very slippery combination—3 times more slippery than skating on ice, 4 to 10 times more slippery than a metal or plastic knee replacement. Synovial fluid is what allows us to flex our joints under great pressure without wear (Cindy et al, 2014).

2.1.6. Muscles

The muscles in the leg keep the knee stable, well aligned and moving—the quadriceps (thigh) and hamstrings. There are two main muscle groups—the quadriceps and hamstrings. The quadriceps are a collection of 4 muscles on the front of the thigh and are responsible for straightening the knee by bringing a bent knee to a straight position. The hamstrings is a group of 3 muscles on the back of the thigh and control the knee moving from a straight position to a bent position, see figures (2.5.) and (2.6.) (Cindy et al, 2014).



Figure (2.5.) A coronal section of the knee joint shows its muscles.



Figure (2.6.) A sagittal section of the knee joint shows its muscles.

2.1.7. The Joint Capsule

The capsule is a thick, fibrous structure that wraps around the knee joint. Inside the capsule is the synovial membrane which is lined by the synovium, a soft tissue that secretes synovial fluid when it gets inflamed and provides lubrication for the knee.

Bursae There are up to thirteen bursae of various sizes around the knee. These fluid-filled sacs cushion the joint and reduce friction between muscles, bones, tendons and ligaments. The prepatellar bursa is one of the most significant bursae and is located on the front of the knee.

Plicae are folds in the synovium. Plicae rarely cause problems but sometimes they can get caught between the femur and kneecap and cause pain (Cindy et al, 2014).

2.1.8 Knee Arteries and Veins

The main arteries supplying the knee region are femoral, popliteal, anterior tibial and posterior tibial arteries. Although the popliteal artery is deep in the popliteal fossa, the popliteal pulse can still be felt but the knee has to be bent and the person still has to press deep into the fossa.

The deep veins are the same as the names of the artery they accompany. There are two important superficial veins: the great and lesser saphenous veins. The great saphenous is often used in coronary bypass operations as it has thicker walls than most veins and therefore it can substitute for an artery. Removal of this vein does not cause a problem as there are still the deep veins to return the blood to the heart (David et al, 2015).

2.2. Physiology of the Knee:-

So now we have all the parts, let's see how the knee moves (articulates)—which is how we walk, stoop, jump, etc. The knee has limited movement and is designed to move like a hinge.

The **Quadriceps Mechanism** is made up of the patella (kneecap), patellar tendon, and the quadriceps muscles (thigh) on the front of the upper leg. The patella fits into the patellofemoral groove on the front of the femur and acts like a fulcrum to give the leg its power. The patella slides up and down the groove as the knee bends. When the quadriceps muscles contract they cause the knee to straighten. When they relax, the knee bends. In addition the hamstring and calf muscles help flex and support the knee (Cindy et al, 2014).

2.3. Pathology of the Knee:-

The knee doesn't have much protection from trauma or stress (pressure or nm force).

2.3.1. Symptoms

Knee symptoms come in many varieties. Pain can be dull, sharp, constant or off-and-on. Pain can also be mild to agonizing. The range of motion in the knee can be too much or too little. You may hear grinding or popping, the muscles may feel weak or the knee can lock. Some knee problems only need rest and ice; others need physical therapy or even surgery.

- **Swelling.** One of the most common symptoms is local swelling. There are two types of swelling. One is caused by the knee producing too much synovial fluid and the other is caused by bleeding into the joint (hemarthrosis). Swelling within the first hour of an injury is usually from bleeding. Swelling from 2-24 hours is more likely to be from the joint producing large amounts of synovial fluid trying to lubricate an abnormality inside the knee. The best home treatment for swelling is R.I.C.E. therapy.

Chronic swelling can distend the knee, prohibit full range of motion and the muscles can atrophy from non-use. Also, if the cause of the swelling is blood, the blood can be destructive to the joint.

- **Locking.** Locking is when something is keeping the knee from fully straightening out. This is usually a loose body in the knee. The loose body can be as small as a grain of sand or as big as a quarter. The best treatment is removal of the loose body by arthroscopy. Another type of locking is when the knee hurts so bad that you just won't use it. The best treatment here is rest and maybe some ice; swelling is not usually present.

- **Giving Way.** If your kneecap slips out of its groove for an instant, it causes your thigh muscles to lose control causing the feeling of instability—that is, you don't feel like your knee is stable, won't support your weight—and you usually try to grab hold of something for support. Giving way can also be caused by weak leg muscles or an old ligament injury.

- **Snaps, Crackles and Pops.** Noises coming from your knee without pain

are likely nothing to worry about. Sometimes the noise is caused by loose bodies that just float around and are not causing pain or injury to the knee. However, if you have pain, swelling or loss of knee function, you should see an orthopedist. The most common cause—Chondromalacia patella—is caused by an injury. Another common cause is a dislocating kneecap—that is, a kneecap that keeps slipping out of its groove. Pops without trauma (injury) are not worrisome; pops with trauma can mean ligament tears.

Crackling, grinding or grating (crepitus) means there is a roughness to the bone surfaces and likely from degenerative disease or wear-and-tear arthritis (osteoarthritis).

Pain and Tenderness. Where and how bad the pain is will help find the underlying cause. It also helps to know what caused it and what makes it hurt. Pain that gets worse with activity is often tendinitis or stress fractures. Pain and tenderness accompanied by swelling can be more serious such as a tear or sprain. Some pain can be caused by muscles spasms associated with trauma (Cindy et al, 2014).

2.3.2. Pathological Conditions and Syndromes

- Osteochondritis Dissecans
- Osteoarthritis (Degenerative Arthritis) and Infectious Arthritis
- Chondromalacia Patellae
- Gout
- Plica Syndrome
- Rheumatoid Arthritis
- Chondromalacia

2.3.3. Traumatic Knee Injuries

- Anterior cruciate ligament (ACL) Injury
- Meniscus tear
- Lateral and Medial Collateral Ligament Injury
- Posterior Cruciate Ligament (PCL) Injury
- Patellar Injuries and Rupture of the Patellar Tendon
- Dislocation of the Patella
- Fracture and Stress Fracture

2.3.4. Repetitive Knee Injuries

- Patellofemoral Syndrome (Runner's Knee)
- Tendinitis
- Bursitis (Housemaid's Knee)
- Iliotibial Band Syndrome
- Osgood-Schlatter Disease

2-4 Osteoarthritis (OA): also known as degenerative joint disease, is the most common form of arthritis—the medical term for a wide variety of disorders that involve inflammation of a joint.

OA results from the gradual destruction of cartilage, the smooth lining of a joint that reduces friction and absorbs shock. As the disease progresses gradually over the years, the cartilage cracks and flakes off, leading to subsequent pain and sometimes deformity whenever the underlying and now exposed bones rub together. All joints may be affected, but it is most common in the fingers, ankles and feet, knees, hips, neck and the spine. About 90 percent of people over the age of 40 show x-ray evidence of OA—typically a gradual loss of the soft, smooth cartilage at joint surfaces and frequently compensatory overgrowths of bone at the joints, called spurs. These spurs may grind against each other as the joint moves. But most people do not experience symptoms until later in life. About 27 million Americans have symptoms of the disorder. There are two types of OA. Primary osteoarthritis, resulting from normal wear and tear, most commonly affects thumb joints and the end joints of other fingers, as well as the hips, knees, neck, and lower spine. Secondary osteoarthritis can occur after injury to a joint; from disease; or as a result of chronic trauma (due to obesity, posture problems, or occupational overuse). In some people symptoms of OA remain mild or even fade away. In others, symptoms grow progressively worse until they are disabling. Because the joints become stiff and painful, a person's natural tendency is to minimize movement. Unfortunately, this can simply lead to a wasting of the muscles and to stiffer joints—and consequently more pain—since inactivity weakens the muscles that stabilize joints.

2-4-1 Symptoms of Osteoarthritis: For some people, symptoms remain mild or nonexistent, while for others, symptoms worsen to the point of becoming disabling. Stiffness in the morning or after exercising Joint stiffness and pain that is aggravated by movement, relieved by rest Limited movement and loss of flexibility in the joints Audible crackling noises when an affected joint moves Redness, warmth, or swelling of a joint rare

2-4-2 Causes Osteoarthritis

The exact cause of osteoarthritis is still unknown, but it appears to be a combination of several factors, most notably a breakdown of the cartilage, the cushioning material of the joints. Time and use may wear it away, but OA is known to be not simply wear and tear but a disease that prevents the cartilage from repairing and renewing itself normally. Genetic factors are also probably involved—OA appears to run in families.

Obesity seems to increase the risk of developing arthritis in the back, hips, and knees. Poor posture and being sedentary may also promote OA. Also, a broken bone or overuse of a joint—common among athletes—may speed up the development of osteoarthritis and causes of knee osteoarthritis: previous knee injury repetitive strain on the knee fractures, ligament tear, and meniscal

injury which can affect the alignment of the knee and leg and promote further wear and tear genetics, which makes some people more likely to develop knee osteoarthritis obesity - being overweight or obese raises your risk of knee osteoarthritis problems with subchondral bone (the bone layer underneath the cartilage in the knee)

2-4-3How OA May Affect Overall Health

Women with radiographically defined knee OA have greater BMD than do women without knee OA and are less likely to lose that higher level of BMD. There was less bone turnover among women with hand OA and/or knee OA. These findings suggest that bone-forming cells might show a differential response in OA of the hand and knee. It may be time to have knee replacement surgery if you have:Severe knee pain that limits your everyday activitiesModerate or severe knee pain while resting, day or nightLong-lasting knee inflammation and swelling that doesn't get better with rest or medicationsA bowing in or out of your legKnee stiffness

2-4-4Knee Malalignment Raises the Risk of Knee Osteoarthritis:

A knee that is perfectly aligned has its load-bearing axis on a line that runs down the middle of the leg -- through the hip, knee, and ankle. When the knee is not perfectly aligned, otherwise known as malaligned, it is known as either varus(bowlegged) or valgus alignment (knock-knee. In a study done by L .Sharma and J. Song . they found that varus but not valgus increased the risk of incident tipiofemoral osteoarthritis in a knee with osteoarthritis varus and valgus alignment each increase the risk of progression in biomechanically compartmen

2-5 Principles and measurements of alignment

The load-bearing axis of the lower limb can be represented by a line extending from femoral head center to ankle joint center. In a varus (bow-leg) knee, this line passes medial to the center of the knee, increasing force across the medial tibiofemoral compartment. In a valgus (knock-knee) knee, the axis passes lateral to knee center, increasing force across the lateral compartment. Animal studies and human studies of complicated fractures provided some early evidence that alignment may influence development and progression of knee osteoarthritis

2-5-1 Effect of hip and pelvis geometry on specific knee compartment osteoarthritis

Previous studies done by a Boissonneault and colleagues studied the association of hip and pelvic geometry with tibiofemoral osteoarthritis. The objective was; lateral tibiofemoral osteoarthritis (OA) is overall less common than medial tibiofemoral OA. It is more prevalent in women. This may be explained by sex differences in hip and pelvic geometry. There are aim to explore the sex differences in hip and pelvic geometry and determine if such parameters are associated with the presence of compartment-specific knee OA. They found anatomical variations at the hip and pelvis are associated with compartment-specific knee OA and may help to explain sex differences in the patterns of knee OA. Hip and pelvic geometry were associated with the presence of compartment-specific knee OA. A reduced femoral offset, increased height of hip center, increased abductor angle, and increased (more valgus) neck-shaft angle were associated with lateral compartment OA. A reduced abductor angle and decreased (more varus) neck-shaft angle were associated with medial compartment OA. Variations in hip and pelvic geometry were also shown to differ significantly between sexes. The cohort in this study was predominantly women (71%) because it was determined by first selecting all participants with lateral OA at the Multicenter Osteoarthritis Study (MOST) Boissonneault et al .(This was an expected sex distribution as the increased prevalence of lateral OA in women has already been shown in this cohort⁽³⁾. After adjusting for age, height, BMI, and Femoral Head to Femoral Head(FH-FH) length, the only

2-5-2 Femoral Neck Angle

Neck extends inferolaterally from head to meet shaft of femur at angle of about 125 degree (Figure 2.3). Angle varies with age, stature, and width of pelvis, being less in adult, in persons with short limbs, and in women. When this angle is > 135 degree, condition is known as coxavalga. When < 120 degree, coxavara. Femoral neck is not parallel to frontal plane or plane of femur. Instead, head is located anterior to midline of shaft of femur and is thus said to be anteverted. Functionally this results in internal rotation of

femoral shaft, so that patient with increased anteversion may walk with in-toeing gait. In adult, neck-shaft angle is approximately between 5 -15 degrees. When > 15 degree, increased femoral anteversion is present. When <5 degree, condition is termed femoral retroversion .

2-5-3Acetabulum to acetabulum distance

Is the distance between medial borders of both acetabulae, it varies from person to another the distance has large value in wide pelvis and small value in narrow pelvis (Figure2.3)

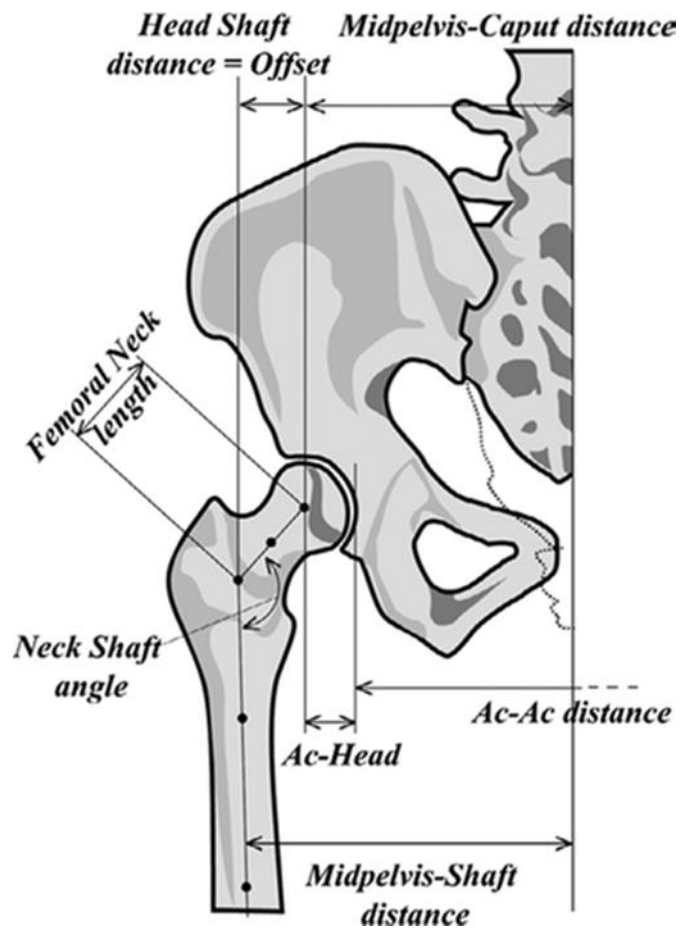


Fig 2.7 normal measurement and alignment

2.6 Methods of imaging Knee joint:-

2.6-1.1 Plain x-ray:- Basic Projections: - AP, Lateral, Oblique, Tunnel and skyline view Lateral knee joint: Mediolateral or lateromedial AP Oblique knee joint (Lateral or external rotation) Medial Oblique knee joint Exposure Factors (as above) Knee joint (Tunnel view for intercondylar fossa) (Tangential View) (Axial or skyline)

2.6-2 Magnetic Resonance Imaging (MRI):

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

2.6.3 Computed Tomography (CT scan):

Computed tomography and magnetic resonance imaging give much more detail than conventional x-rays and may be done to determine the extent and exact location of damage. These tests can also be used to detect fractures that are not visible on x-rays (such as some small fractures of the hip and pelvis). MRI is especially valuable for imaging muscles, ligaments and tendons. MRI can be used if the cause of pain is thought to be a severe softtissue problem (for example, rupture of a major ligament or tendon or damage to important structures inside the knee joint). CT is useful if MRI is not recommended or unavailable. CT exposes people to ionizing radiation. CT best images bone. However, sometimes MRI is better than CT for imaging bone. The amount of time a person spends undergoing CT is much less than for MRI. MRI is more expensive than CT and with the exception of when the open-sided units are used, many people feel claustrophobic inside the MRI unit.

Routine Knee CT

Positioning

□ Pt. supine. Slide patient over so that the knee being imaged is centered in scanner. Taping the feet together helps stabilize knees. In most cases it is fine to leave the other knee straight and within scanning field. If there is metal in the other knee, try to bend other knee so it is not in the scanning field. Plaster casts are not a problem. Scout in 2 planes.



Figure (2.8) patient positioning for ct knee



Figure (2.9)diagram show lower limb area

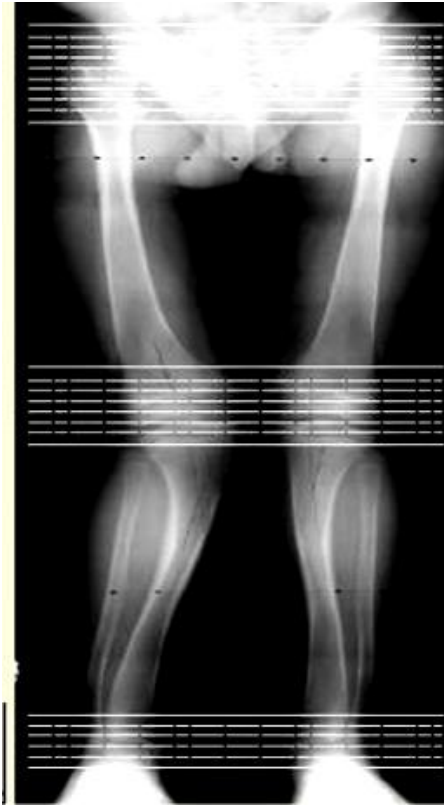


Figure (2.10) Scout view

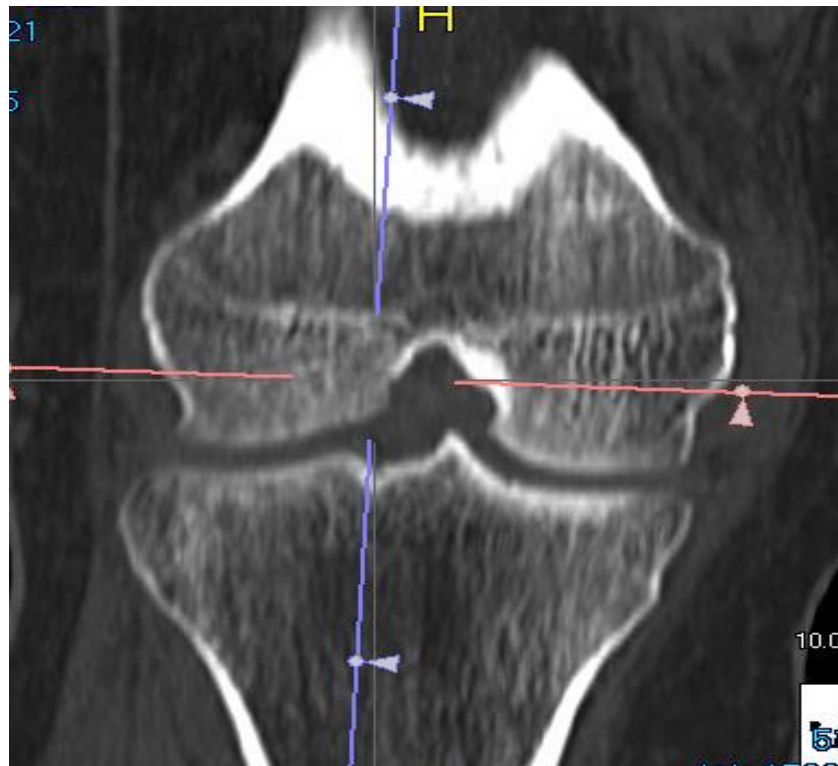


Figure (2.11) coronal section of knee

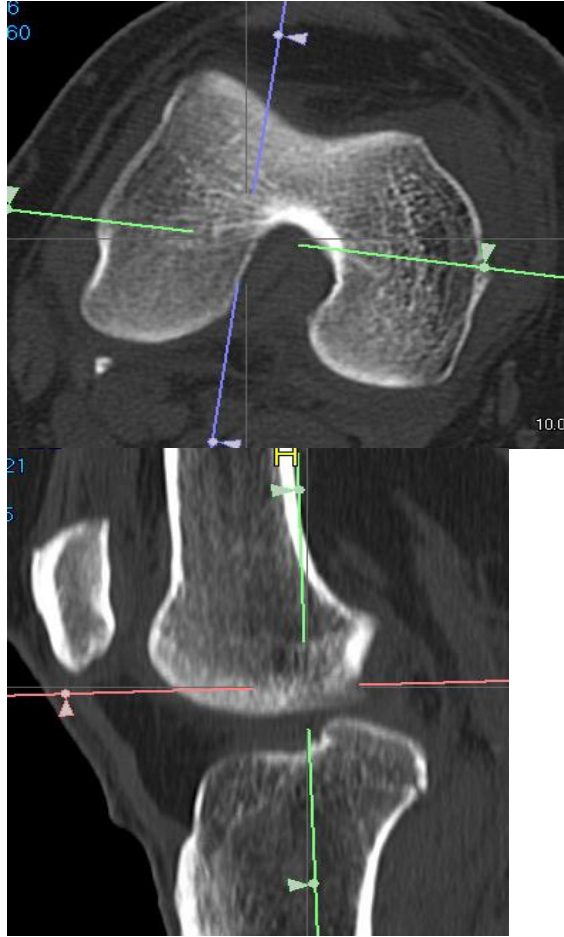


Figure (2.12) **Planes for Reformatted Images**

A

B



Figure (2.13) A . B . C. D 3D MPR

2.6.4 Ultrasonography

Ultrasonography is being used more and more frequently to identify inflammation in and around joints and tears or inflammation of tendons. Ultrasonography is also used as a guide when a needle needs to be put into a joint (for example, to inject drugs or to remove joint fluid). As an alternative to CT and MRI, ultrasonography is less expensive and, unlike CT, involves no exposure to radiation. However, ultrasonography is not always available and requires that the people doing and interpreting the scan be very skilled.

2.6.5 Bone Scanning

Bone scanning is an imaging procedure that is occasionally used to diagnose a fracture, particularly if other tests, such as plain x-rays and CT or MRI, do not reveal the fracture. Bone scanning involves use of a radioactive substance (technetium-99m–labeled pyrophosphate) that is absorbed by any healing bone. The procedure can also be used when a bone infection or a tumor that has spread from a cancer elsewhere in the body is suspected. Although a bone scan may show a problem in the bone, it may not show whether the problem is a fracture, tumor, or infection. The radioactive substance is given by vein (intravenously) and is detected by a bonescanning device, which creates an image of the bone that can be viewed on a computer screen.

2.6.6 Joint Aspiration

Joint aspiration (arthrocentesis) is used to diagnose certain joint problems. For example, it is the most direct and accurate way to determine whether joint pain and swelling is caused by an infection or crystal-related arthritis (such as gout). For this procedure, a doctor first injects an anesthetic to numb the area. Then the doctor inserts a larger needle into the joint space, draws out (aspirates) joint fluid (synovial fluid), and examines the fluid under a microscope. A doctor removes as much fluid as possible and notes its color and clarity. Other tests, such as white blood cell count and culture, are done on the fluid. The doctor can often make a diagnosis after analyzing the fluid. For example, a sample of fluid may contain bacteria, which confirm a diagnosis of infection. Or, it may contain certain crystals. For example, finding uric acid crystals confirms a diagnosis of gout, and calcium pyrophosphate dehydrate crystals confirm a diagnosis of pseudo gout. Usually done in the doctor's office or an emergency department, this procedure is typically quick, easy, and relatively painless. The risk of joint infection is minimal.

2.6.7 Arthroscopy

Arthrography is an x-ray procedure in which a radiopaque dye is injected into a joint space to outline the structures, such as ligaments inside the joint. Arthrography can be used to view torn ligaments and fragmented cartilage in the joint. However, MRI is now generally used in preference to arthrography.

Arthroscopy is a procedure in which a small (diameter of a pencil) fiberoptic scope is inserted into a joint space, allowing the doctor to look inside the joint and to project the image onto a video monitor. The skin incision is very small. This procedure is done in a hospital or surgical center. The person is

given local, spinal, or general anesthesia or a combination. During arthroscopy, doctors can take a piece of tissue (such as joint cartilage or the joint capsule) for analysis (biopsy), and, if necessary, do surgery to correct the condition. Disorders commonly found during arthroscopy include inflammation of the synovium lining the joint (synovitis); ligament, tendon, or cartilage tears; and loose pieces of bone or cartilage. Such conditions affect people with arthritis or previous joint injuries as well as athletes. All of these conditions can be repaired or removed during arthroscopy. There is a very small risk of joint infection

with this procedure. See Figure (2.7.) Recovery time after arthroscopic surgery is much faster than after traditional surgery. Most people do not need to stay overnight in the hospital



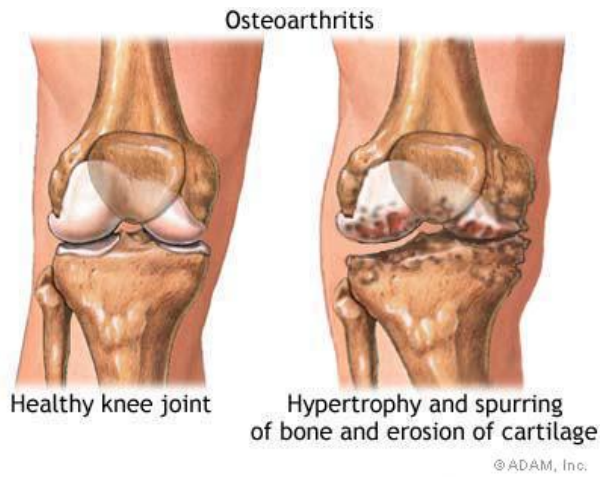
Figure (2.14)image show knee orthopedic

2.6.8Knee joint replacement:

Joint replacement procedures have improved dramatically during the past 30 years fueled by the changes in techniques for hips and knees. Joint replacements in other anatomic regions also have become more popular. It is essential to understand the importance of pre- and postoperative imaging for evaluating patients. Preoperative images are used in concert with clinical data to select the appropriate patients and components. Postoperative imaging is critical for evaluating position and potential complications. Appropriate selection of imaging modalities is essential to provide optimal, cost-effective patient care.

(Media Partners, 2010).

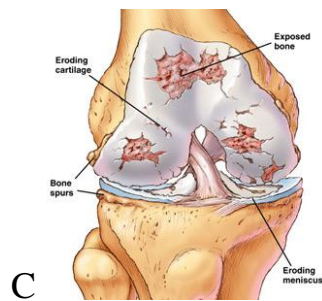
Your surgeon explained the results of the exam, x-rays and diagnostic tests. He told the patient why surgery is recommended, and explained the surgical procedure and the expected outcome you. The risks of having or not having the surgery, the benefits of having the surgery, and the options available to patient instead of surgery will be explained. The more the patient knows, the more confident he will be about doing his part in his treatment and recovery. The surgeon asks at the patient to sign a surgical consent form. This form is a legal paper that says the surgeon has told the patient about surgery and any risks you might be taking by having the surgery. By signing this form, the patient saying that he *understands* the risks and agrees to have the surgery. Ask the surgeon about any concerns he has *before* sign this form (Media Partners, 2010).



A



B



C

Figure (2.15)A,B,C show the causes of knee joint replacement

2.7 Previous studies:

Andrew et al, (2011) said that it has been suggested that knee height is a determinant of knee joint load. Nonetheless, no study has directly examined the relationship between anthropometric measures of height and knee joint structures, such as cartilage. 89 asymptomatic community-based adults aged 25-62 with no diagnosed history of knee arthropathy were recruited. Anthropometric data (knee height and body height) were obtained by standard protocol, while tibial cartilage volume and defects, as well as bone area were determined from magnetic resonance imaging. Static knee alignment was measured from the joint radiograph. All anthropometric height measures were associated with increasing compartmental tibial bone area ($p \leq 0.05$). Although knee height was associated with tibial cartilage volume (e.g. $\beta = 27 \text{ mm}^3$ 95% CI 7- 48; $p = 0.009$ for the medial compartment), these relationship no longer remained significant when knee height as a percentage of body height was analysed. Knee height as a percentage of body height was associated with a reduced risk of medial tibial cartilage defects (odds ratio 0.6; 95% confidence interval 0.4 - 1.0; $p = 0.05$). The association between increased anthropometric height measures and increased tibial bone area may reflect inherently larger bony structures. However the beneficial associations demonstrated with cartilage morphology suggest that an increased knee height may confer a beneficial biomechanical environment to the chondrocyte of asymptomatic adults. Nicholas et al, (1976) said that the circumference of the knees and thighs at three locations were measured in 10 patients on two consecutive occasions by three observers. Analysis of the results for interobserver, intraobserver and among-patient variation established that a change in circumference noted by different observers on two different days is significant if it exceeds 1V5 cm at the midpatella, 2-7 cm at 7 cm above, and 3-5 cm at 15 cm above the patella. If a single observer performs both measurements, the change need exceed only 1'0, 2-0, and 2-7 cm, respectively, to be significant. The objective measurement of joint inflammation is a frequent research study, but often a neglected part of clinical evaluation (Boardman and Hart, 1967). The complicated equipment necessary for joint scanning and infrared photography, and even the measurement of the proximal interphalangeal and distal interphalangeal joints by jewelers' rings (Hart and Clark, 1951) and tape devices (Willkens, Gleichert and Gade, 1973; Webb and others, 1973) undoubtedly discourage the adoption of these techniques for routine clinical evaluation. An ordinary tape measure would satisfy the need for simple, readily available equipment to measure joint circumference, an acknowledged index of joint inflammation. The results of this study indicate that measurement of the knee with an ordinary tape measure provides reproducible results when used by both single and multiple observers. Hohe et al, (2002) assessed knee joint incongruity using MRI. Their purpose of this study was to develop an MR-based technique for quantitative analysis of joint surface size, surface curvature, and joint incongruity and to assess its reproducibility under in vivo imaging conditions. The surface areas were determined after 3D reconstruction of the joint by triangulation and the incongruity by Gaussian curvature analysis. The precision was tested by analyzing four replicated MRI datasets of human knees in 14 individuals. The algorithms were shown to produce accurate data in geometric test objects. The interscan precision was <4% (CV %) for surface area, 2.9 -5.7 m-1 (SD) for the mean principal curvature, and 4.1-7.4 m-1 for congruence indices. Incongruity was highest in the femoropatellar joint (79.7 m-1) and lowest in the medial femorotibial joint (28.6 m-1). This technique will permit identification of the specific role of surface size, curvature, and incongruity as potential risk factors for osteoarthritis. The computation of the size of the surface areas displayed no difference with the expected value for a plane and a consistent underestimation of 1.4% for cylinders of

different radii (10 mm, 20 mm, and 40 mm). For spheres, the differences were 3.2%, 1.6%, and 4.1% for radii of 10 mm, 20 mm, and 40 mm, respectively. The minimal and maximal curvatures were accurately computed for the plane and were consistently underestimated by 0.2% in cylinders of various sizes. In a quarter sphere, the differences were 1%, and in a semi sphere 2%. For the parabolic and the hyperbolic parabolic, the deviations were 0.2%, both for the minimal and maximal principal curvatures. Mazzuca et al, (2003) states the recent research on the radiographic imaging of knee OA has helped clarify the features of imaging protocols that contribute to accurate representation of disease severity--specifically, the thickness of articular cartilage--and to sensitive detection of disease progression. The absence of standards for reproducible positioning of the knee in the conventional standing AP view obscures the true rate and variability of JSN in knee OA. Moreover, the standing AP view is susceptible to systematic bias insofar as longitudinal changes in knee pain might lead to over- or underestimation of radiographic JSW depending on the direction of change in pain. More recent protocols for standardized knee 42 radiography have been designed to achieve reproducible alignment of the medial tibial plateau and x-ray beam. As a group these protocols permit measurement of tibiofemoral JSW with remarkable precision--the sine qua non of sensitivity to change--however, only limited longitudinal data is available to permit a direct evaluation of the suitability of these protocols for use in clinical DMOAD trials. Longitudinal studies published to date suggest that fluoroscopic positioning methods are superior to nonfluoroscopic methods with respect to reproducing the position of the knee in serial examinations performed several years apart. Fluoroscopic methods also appear to be superior with respect to achieving parallel alignment of the medial tibial plateau and x-ray beam in serial radiographs, a positioning marker strongly associated with sensitive detection of JSN in knee OA. It is important to note that while the various standardization protocols described in this article perform with great success in short-term demonstrations of the reproducibility of positioning and radiographic JSW, differences clearly exist between protocols in the quality of performance over intervals relevant to clinical DMOAD trials. Over intervals of 2 to 3 years, changes in patient characteristics (e.g., severity of knee pain, body weight, load bearing, varus-valgus deformity) and uncontrollable events related to radiography (e.g., technologist turnover, equipment upgrades) have ample opportunity to affect the technical quality of a radiological knee examination. It is difficult, therefore, to conclude whether or not an apparent difference with respect to sensitivity to OA progression between specific radiographic protocols, implemented in separate locations with different cohorts, reflects a robust difference in technical quality or uncontrollable patient variables and events. The most informative recent studies have provided the results of head-to-head longitudinal comparisons of alternative standardization protocols or 43 conventional examination methods performed concurrently in the same subjects [20, 22]. Additional comparative studies of this nature are needed, however, to fully characterize the strengths and weaknesses of currently available alternatives in a way that will permit generalizable conclusions regarding the best radiographic methods for multicenter DMOAD trials. Karen, et al. (2008) study the clinical use of minimum joint space width (mJSW) and cartilage volume and thickness has been limited to the longitudinal measurement of disease progression (i.e. change over time) rather than the diagnosis of OA in which values are compared to a standard. This is primarily due to lack of establishment of normative values of joint space width and cartilage morphometry as has been done with bone density values in diagnosing osteoporosis. Thus, the purpose of this pilot study is to estimate reference values of medial joint space width and cartilage morphometry in healthy individuals of all ages using standard radiography and peripheral magnetic resonance imaging. For this cross-sectional study, healthy volunteers underwent a fixed-flexion knee X-ray and a

peripheral MR (pMR) scan of the same knee using a 1T machine (ONI OrthOne™, Wilmington, MA). Radiographs were digitized and analyzed for medial mJSW using an automated algorithm. Only knees scoring ≤ 1 on the Kellgren-Lawrence scale (no radiographic evidence of knee OA) were included in the analyses. All 3D SPGRE fat-sat sagittal pMR scans were analyzed for medial tibial cartilage morphometry using a proprietary software program (Chondrometrics GmbH). Of 119 healthy participants, 73 were female and 47 were male; mean (SD) age 38.2 (13.2) years, mean BMI 25.0 (4.4) kg/m². Minimum JSW values were calculated for each sex and decade of life. Analyses revealed mJSW did not significantly decrease with increasing decade ($p > 0.05$) in either sex. Females had a mean (SD) medial mJSW of 4.8 (0.7) mm compared to males with corresponding larger value of 5.7 (0.8) mm. Cartilage morphometry results showed similar trends with mean (SD) tibial cartilage volume and thickness in females of 1.50 (0.19) $\mu\text{L}/\text{mm}^2$ and 1.45 (0.19) mm, respectively, and 1.77 (0.24) $\mu\text{L}/\text{mm}^2$ and 1.71 (0.24) mm, respectively, in males. These data suggest that medial mJSW values do not decrease with aging in healthy individuals but remain fairly constant throughout the lifespan with "healthy" values of 4.8 mm for females and 5.7 mm for males. Similar trends were seen for cartilage morphology. Results suggest there may be no need to differentiate a t-score and a z-score in OA diagnosis because cartilage thickness and JSW remain constant throughout life in the absence of OA. Alexandra et al, (2008) stated that the gold standard for measuring knee alignment is mechanical axis determined using full-limb radiographs (FLR). Measurement of joint alignment using antero-posterior (AP) knee radiographs is more accessible, economical and involves less radiation exposure to the patient compared with using full-limb radiographs. The aim of this study was to compare and assess the reproducibility of knee joint alignment on full-limb radiographs and conventional AP knee radiographs. Knee alignment was measured in 40 subjects (80 knees) from the Twins UK registry. Measurement of mechanical knee alignment was from FLR, and anatomic knee alignment from weight-bearing AP knee radiographs. Reproducibility was assessed by intra-class correlation coefficients and kappa statistics. Reproducibility of knee alignment for both methods was good, with intra-observer ICC's of 0.99 for both FLR and AP

Chapter three

Chapter three

Materials and methods

Material

3.1 Study population

All Sudanese patients with knee pain seen at POLICE hospital from August 2016 to October 2017

3.2 Study setting

- Advance Orthopedic and trauma center, **POLICE HOSPITEL** hospital
- Radiology department supplied by modern CT scan (16 slices) – **NEU SOFT**
- Is the private hospital FOR POLICE PATIENT Include nine orthopedic surgeons in different subspecialties (Arthroplasty, Arthroscopy and Sport medicine, Spine, Foot and Ankle and deformity correction)
- Two regular external visitors specialized in shoulder and pediatric orthopedics
- Refer clinic every day have two clinic with different consultant; seen about 240 pts./week
- Operations list (elective) four days/week; about 20 operations/week
- Trauma list every day

3.3 Inclusion criteria

- All Patients are seen in referred clinic complaining of knee pain at POLICE hospital from August 2015 to October 2016.

3.4 Exclusion criteria

1. All patients who had congenital anomaly around the
2. All patients who underwent TKR(Total knee replacement) or THR(Total hip replacement).
3. All patients had previous history of trauma around the knee and Pregnant women.

3.5 Method Data collection

3.5.1 List of variable: The following variables were collected from the sample;

- Age.
- HKA angle.

3.5.2 Data instrument

1. Proper history and clinical examination.
2. Data collection sheet
1. Assessment of radiological study by CT scanogram of bilateral lower limb in supine position using the following step :

3.5.3 Measurement of HKA angle:

We drew a line from the center of the femoral head to the center of ipsilateral ankle (load bearing axis), if the line passes medial to center of the knee joint that mean patients have varus mal-alignment

and if it passes lateral to center of knee joint means patients have valgus mal-alignment, and if it passes through center of knee joint means patients have neutral alignment. After that we drew mechanical axis of both femur and tibia separately by drawing line from the center of femoral head running distally to the mid-condylar point between the cruciate ligaments. Then from center of tibial plafond to center of tibial plateau (interspinousintercruciate midpoint). Then we measured the angle that is formed by the crossing of the two mechanical axes below the knee joint, if patients have varus deformity the angle become -ve HKA and if have valgus deformity the angle become +ve HKA see (figure 2.4).

3.6 Sample size and sampling technique

- Patients were seen in the period from August 2016 to March 2017 in POLICE hospital in the refer clinic.
- Patients enrolled in this study were 50.
- Random sample technique.
- Computerized statistical packages were used.

3.7 Ethical consideration

1. Ethical clearance from the ethical committee of SMSB was obtained after approval of submitted research proposal.
2. Permission from hospital authorized person was taken.
3. Verbal Consent was obtained from patients and confidentiality was considered throughout the study.
4. CT scanogram cost was funded by POLICE hospital.

3.8 The method of data analysis

Data was processed and analyzed using the computer software programs Microsoft office excel 2010 and IBM SPSS version 19. Data was presented in the form of simple frequency statistical tables, figures and cross tabulation

Chapter four

Result

Chapter four

Result

This chapter showed the statistical analysis results of the study in tables and descriptive figures.

4.1. Distribution of the variables:

Gender distribution frequency an

	FREQUENCY	PERCENT
female	25	50.0
male	25	50.0
Total	50	100.0

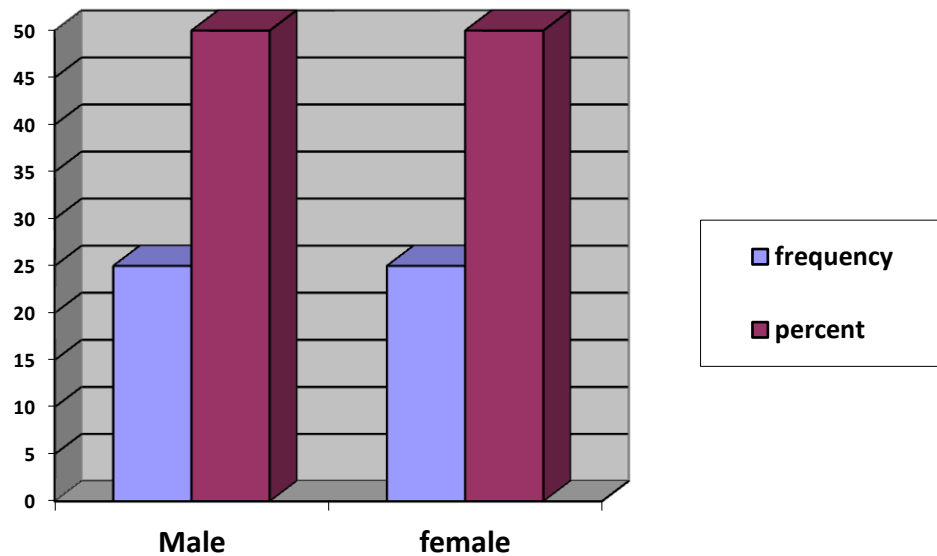


Figure (4.1.) Gender distribution

Table (4.2.)
Age group distribution frequency, percent.

Age group	frequency	Percent
35-40	5	10
40- 50	6	12
50-60	10	16
60-70	12	24
70-80	13	26
80-86	4	8

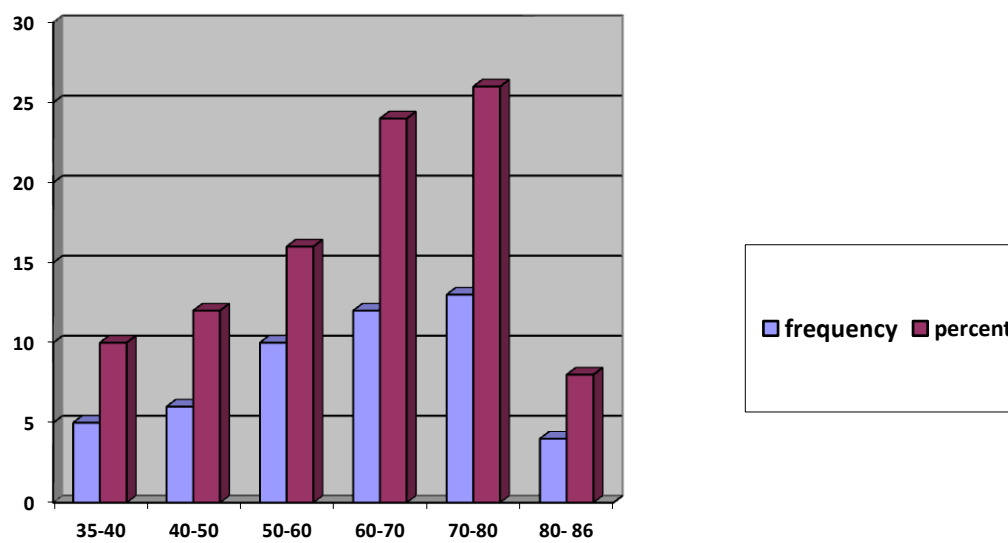


Figure (4.2.) Age group distribution

**Table (4.3.)
ct scan findings distribution frequency . Percent .**

	Frequency	Percent
bone change	24	48.0
bone joint change	4	8.0
joint change	22	44.0
Total	50	100.0

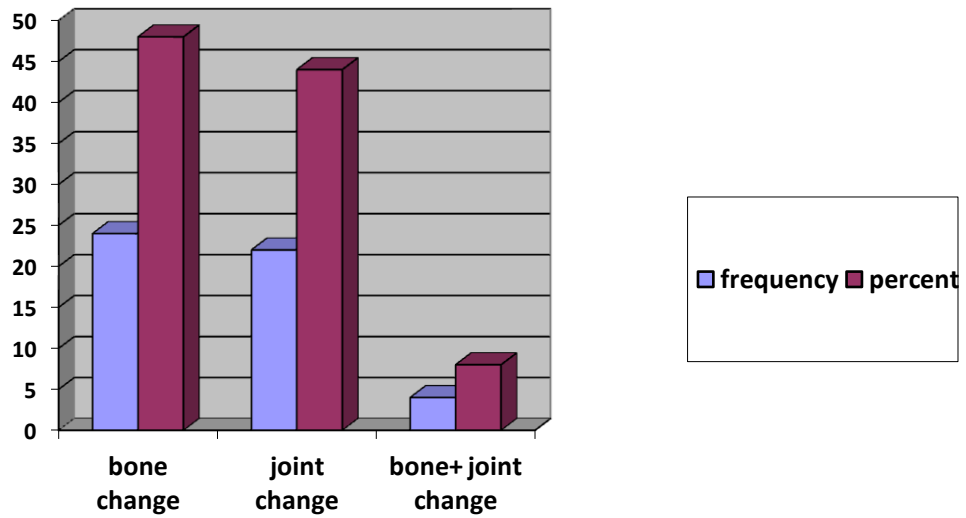


Figure (4-3)) ct scan findings distribution

Table (4-4)
Site distribution frequency, percent.

	Frequency	Percent
LT knee	24	48.0
NON	1	2.0
RT knee	23	46.0
R+L	2	4.0
Total	50	100.0

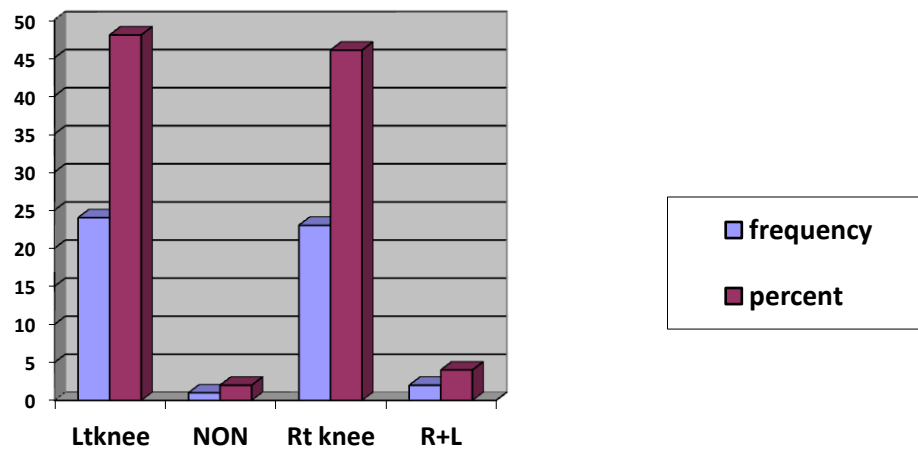


Figure (4-4) site distribution frequency

Table (4-5)
Hip, knee, ankle angle distribution frequency , percent .

	Frequency	Percent
NON	1	2.0
varsus	26	52.0
valgus	23	46.0
Total	50	100.0

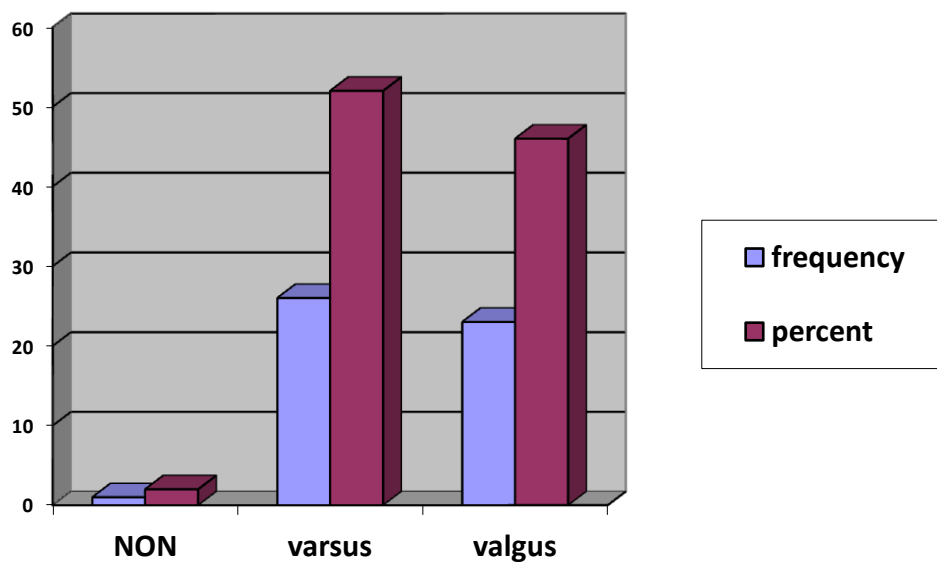
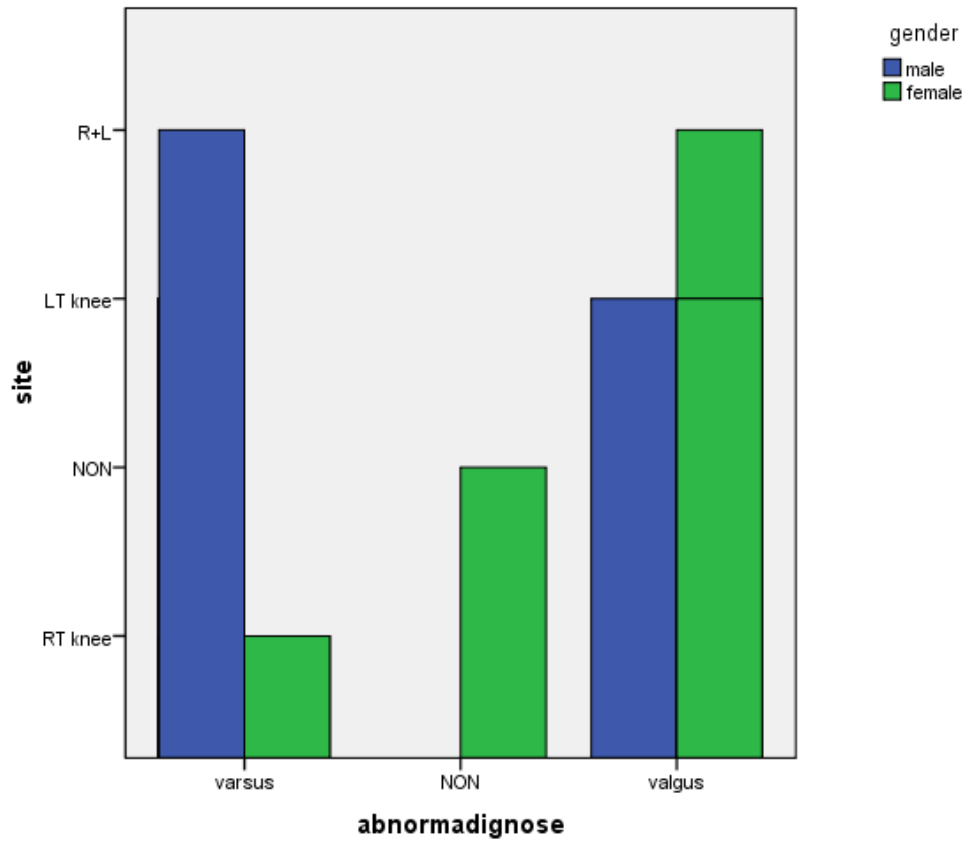
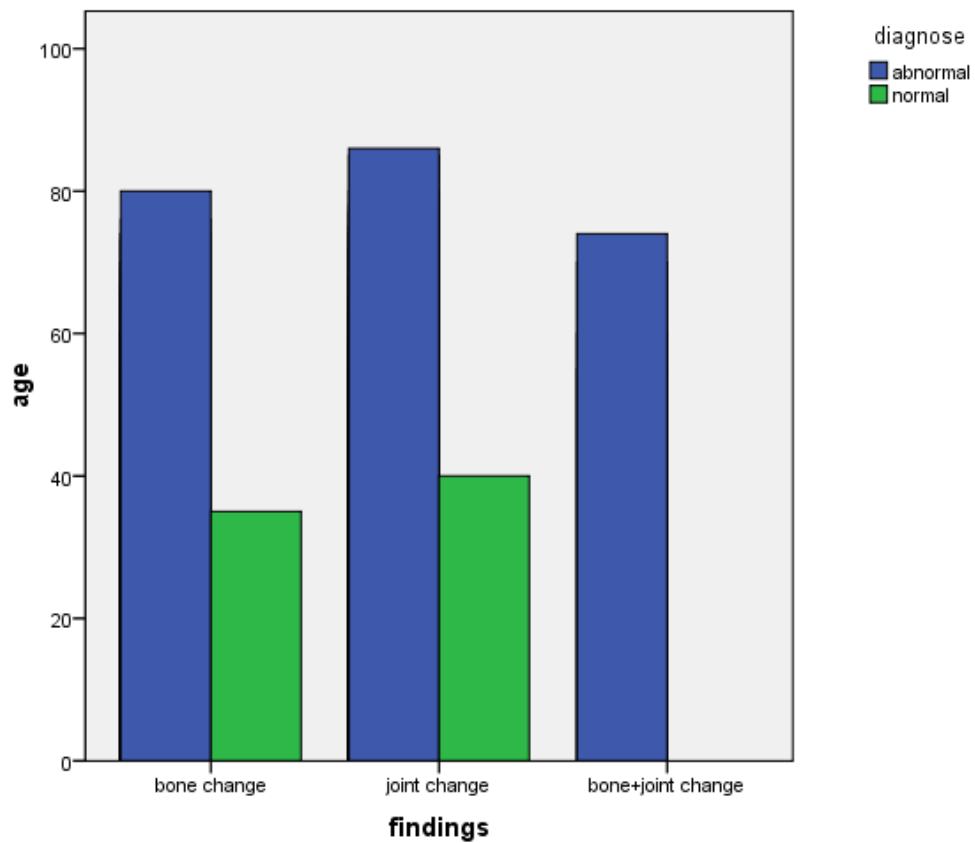


figure (4-5) Hip, knee, ankle angle distribution frequency

(4-6) comparison the relationship between the gender , abnormal diagnose and site



(4-7) compare the diagnose with age differences and the findings



Chapter Five

- Discussion
- Conclusion
- Recommendations
- Outcome of this study

Chapter Five

5.1. Discussion

The result of this study reveal that equal distribution of gender in study cases the male gender about 25 and female gender is about 25 also in Figure (4.1.) Figure (4.2.) Show age group in both gender male female as 35-40 frequency 5 percent 10% 40-50 frequency 6 percent 12% 50-60 frequency 10 percent 16% 60-70 frequency 12 percent 24% 70-80 frequency 13 percent 26% 80-86 frequency 4 percent 8 The age group 70-80 show the higher frequency and percent because degenerative joint disease Figure (4.3.) Show the ct findings as : Bone change frequency 24 percent 48 % Joint change frequency 22 percent 44% Bone and joint change frequency 4 percent 8% The higher frequency is bone change is 48 due to age distribution group 70-80 and DJD. Figure (4.4.) The affected site distribution Left knee is most affected site has higher frequency 24 percent 48% Right knee frequency 23 percent 46% Non is normal frequency is one percent is 1% Both side frequency is 2 percent 4% Figure (4.5.) Show the distribution of knee angle Non is normal distribution Varsus has the higher 26 percent 52% Valgus frequency 23 percent 46% higher female genders Figure (4.6.) Show the relationship between the gender abnormal diagnose and the site of affected The higher percent in male with varsus in both site RT Lt Female show higher percent of valgus in both site Figure (4.7.) Compare between the diagnose and difference and the finding Bone change with increasing in age with group age 70- 80 in female Joint change with age group above 70- 80 in both male female gender due to several factors like weight workload and DJD.

5.2. Conclusion

This study found that ct scanogram with volumetric scanning god tool for evaluation of osteoarthritis Ctscan to be a useful and reliable tool for describing calcium crystal deposition in the knee and therefore potentially for studying role of calcium crystals in oa.

5.3. Recommendations:-

- VOLUMETRIC CT MEASUREMENT (3D) IS BEST MODALITY FOR EVALUATION OF OSTEOARTHRITIS
- FURTHER STUDY BY CT ARTHROTHROGRAPHY FOR EVALUATING OSTEOARTHRITIS
- FURTHER STUDY COMPARE THIS STUDY WITH ANOTHER STUDY BY CT ARTHROGRAPHY IN SPECIFIC AGE GROUP
- FURTHER STUDY COMPARE THIS STUDY WITH OTHER STUDY SPECIFIC IN JOINT CHANGE AND CARTILAGE CHANGE WITH ACCORDING TO TYPE OF WORK. .
- FURTHER TO SAME STUDY IN COMPARE BETWEEN THE SCANOGRAM AND VOLUMETRIC SCANNING IN HOW MUCH THE DOSE DELIVERED TO PATIENT.
- FOR RECENT KNEE REPLACEMENT USING CT VOLUMETRIC SCANNING PRE POST SURGERY
- BECAUSE SIDE OF RADIATION DOSE DELIVERED TO PATIENT RECOMMENDED TO USE GONADAL SHIELD FOR YOUNG PATIENT AND USE THICK SLICE THICKNESS DURING SCANNING AND THEN RECONSTRUCTED TO THIN SLICE THICKNESS

5.4. Outcome of this study:-

- THE OUTCOME OF THIS GIVE KNOWLOADGE FOR ORTHOPEDIC IN EVALUTION HOW TO MAINTAIN KNEE DEFORMITY IN SUDANES
- THIS STUDY CAN MORE WIDE AND USING MULTIPLE VARIABLE TAKEIT IN ACCOUNT.

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Appendices

B

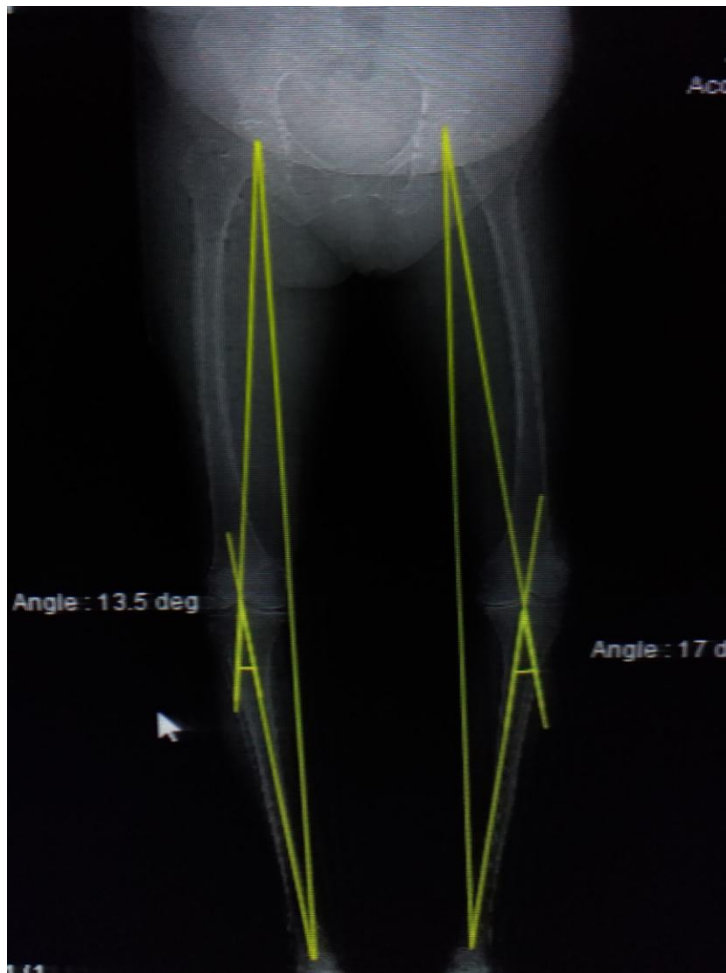


FIGURE (7.1)PATIENT WITH valgus by using CT Scanogram

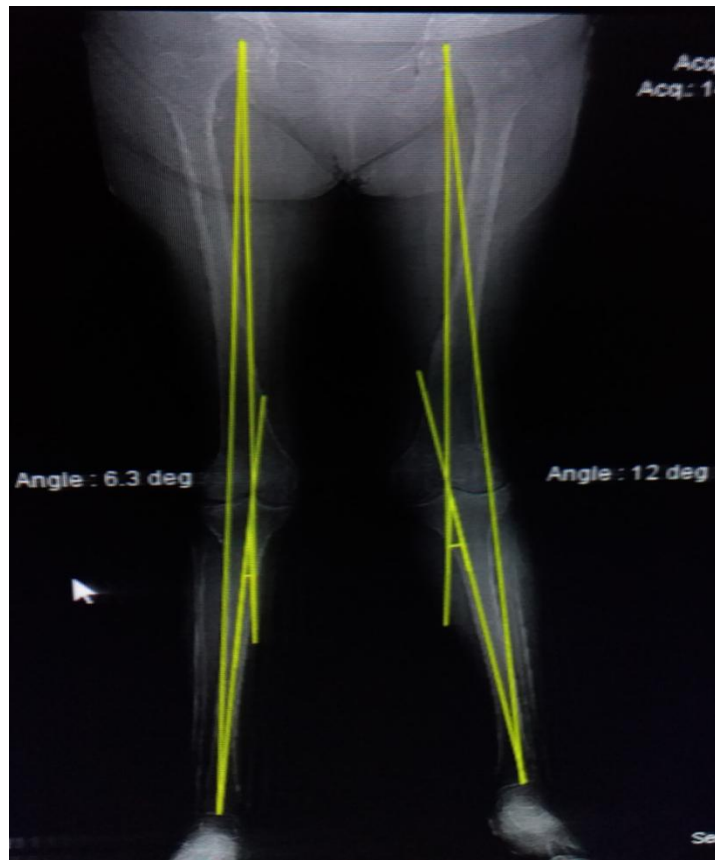


FIGURE (7.2) patient with varus by using CT Scanogram