SUDAN University of Sciences and Technology

Collage of Graduate Studies

**Study of the Internal Derangement**

**of the Knee using Ultrasound and MRI**

**دراسة التغيرات الداخلية للركبة بواسطة الموجات فوق الصوتية والرنين المغنطيسي**

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الأيــــــة:

( رَبِّ أَوْزِعْنِي أَنْ أَشْكُرَ نِعْمَتَكَ الَّتِي أَنْعَمْتَ عَلَيَّ وَعَلَىٰ وَالِدَيَّ وَأَنْ أَعْمَلَ صَالِحًا تَرْضَاهُ وَأَدْخِلْنِي بِرَحْمَتِكَ فِي عِبَادِكَ الصَّالِحِينَ )

صدق الله العظيم

Abstract

Musculoskeletal sonography is rapidly evolving modality which is gaining popularity for the evaluation and management of joint and soft tissue disorder the purpose of this exhibit was to study the internal derangement of the knee using ultrasound and MRI. All patients (50 patients) were scanned by MRI 1.5 Tesla as standard and by ultrasound using high linear frequency transducer. The study took place in Sudan Khartoum 2014-2015. The part examined in the knee include meniscuses (Lateral anterior, lateral posterior, medial anterior and medial posterior meniscus), ligaments (anterior curciate, posterior curciate, medial collateral and lateral collateral ligament), supra patella, infra patella, posterior component and presence or absence of backer cyst. The results showed that the overall accuracy of ultrasound in diagnosing the meniscuses was 95.5%, for collateral ligaments was 99.7%, for supra and infra patellar was 50%., and for posterior component was 61%; With a sensitivity of 91.7 for diagnosing backer cyst.

ملخص الأطروحة

شهد مجال التشخيص بالموجات فوق الصوتية تقدما ملحوظا في الاونة الاخيرة وذلك الفضل يعود التطور الكبير في تطبيقات الكمبيوتر الملحق بالجهاز وامكانية استخدام ترددات عالية اتاح لعمل تقنية صور ثلاثية و رباعية الابعاد و صور ذات درجة عالية من النقاء و الوضوح بالاضافة لتصوير الشرايين والاوردة وامكانية التصوير الحي الفيديو. مما زاد من استخدامها في مجالات اوسع في التشخيص والعلاج رغما عن ذلك ظل التصوير بواسطة الرنين المغنطيسي هنا في السودان هو المتصدر والاكثر استخداما في تشخيص بعض الحالات التي يمكن للموجات فوق الصوتية ان تلعب دورا ملموسا فيها كتصوير العضلات والاربطة والغضاريف في الجهاز الحركي . يهدف البحث لابراز دور الموجات فوق الصوتية في تصوير و تشخيص المفاصل ااخذا مفصل الركبة كمثال باعتبار انه المفصل الاكتر طلبا للتصوير بالرنين المغنطيسي , وفقا لشكوي وحالة المريض وذلك للمساعدة المريض في لتخيف الصرف الزائد و المحافظة علي الزمن بالاضافة للحفاظ علي موارد المستشفيات و التقليل من الحجوزات المتراكمة . حيث قمت بعمل 50 بفحصين مختلفين لمفصل الركبة واحد بالموجات فوق الصوتية واخر بالرنين المغنطيسي ومقارنة النتائج. مستخدما جهازي رنين مغنطيسي سمينز واخر فيليبس 1,5 تسلا و جهازي موجات فوق صوتي توشيبا حيث نجحت الموجات فوق الصوتية في تشخيص بعض معظم محتويات مفصل الركبة واخفقت في تشخيص حالات الرباط الصليبي كما سنري لاحقا باذن الله .

Acknowledgments

To all dear

Dear mom

Brothers little family and share my concern walk fullness

Dear to brother

Dr/ Mohamed Alfadil

MR/ Faig Alfadil

Thode give me their time knowledge and efforts

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**Chapter one**

**Introduction**

Ultrasound is a power full diagnostic tool for the imaging evaluation of musculoskeletal disorder; recently there has been increased demand for expanding the clinical application of musculoskeletal sonography. Continual improvement in technology, wide availability, and relatively lower cost are factors contributing to the growth of sonography, which is become more frequently utilized in routine evolution of the MSK, Compare to other cross sectional modalities ultra sound has several inherent advantages, which also apply to the musculoskeletal system, Among these are really accessibility, portability, quick exam time, and better patient for liability.

The dynamic real time nature of sonography requires personal interaction with patient often resulting in more directed examination, specific for each individual, scanning technique is easy modified, as needed to optimized the diagnostic effectiveness of the power Doppler capability and extended {FOV} function has facilitated the progressive development of sonography.

Newer lnnovalative features such as tissue harmonics and 3D imaging may prove to beneficial in diagnosis of musculoskeletal disease, As with ultra sound in general, MSK sonography in high operator, dependent and experience and proper training is required to perform currently high quality studies.

Currently musculoskeletal ultrasound is offered on a routine basis at only limited number in united state compared to Sudan, Most training programs don’t perform significant number of musculoskeletal ultra sound examination, therefore don’t include this modality as their curriculum.

Outside the Sudan and particular Europe MSK sonography in often the primary modality performed for many clinical indications because of the wide availability of magnetic resonance imaging arthrosonograply has been relatively less underutilized in Sudan additionally physicians including radiologist are often times un ware of the potential applications of sonography for assessment of joint and soft tissue disease. As cost constrains continue to influence patient management.

Ultra sound may become the preferred method for imaging evaluation over expensive studies. In this tutorial general principle and proper technique in musculoskeletal sonography are demonstrated.

Normal anatomy present in static and real time video clips is shown we illustrate abroad spectra of pathologic conditions of MSK system of MSK system that are commonly diagnosed with sonography interventional procedures using ultra sound guidance such as joint aspirations and soft tissue biopsy are also shown Our goal is to give through the illustration of the potential applications of sonography in MSK system and in the process it is our hope to inspire radiologist to consider MSK sonography as a viable and frequently primary option in the assessment and soft tissue disorder.

* 1. **Problem of the study**

Generally knee joint today investigated using MR where costive and time consuming and unavailable region wise, therefore ultrasound con play a major role in bridging this gab by diagnosing knee problem in essence as by transferring the MRI knowledge to ultrasound.

**1-2 Objectives**

The general objective of this study is to evaluate the internal derangement of the knee using ultrasound in order to reduce time and cost.

**1-2-1 Specific objective:**

* To cross correlate between ultrasound finding and MRI.
* To correlate the diagnosis with body characteristic gender and occupation
* To find the accuracy sensitivity and specificity of ultrasound in diagnosing knee problems creative to MRI.

**1-3 Important of the study:**

Knee pain injuries osteoarthritis is very common in all young and of older people male and female. X-ray is usually the first method of assessing the knee doesn’t show the soft tissue in it ligament tendon cartilage and fluid that may contribute to the experience of pain or cause symptoms.

Ultra sound scanning is relatively new way of examine the soft tissue of the joint Abroad spectrum of make disorder will be present in this interactive tutorial allows the user to scroll through an noted normal anatomy section the self based example cases section feature patient pathologic condition and brief text discussions provided at the users request.

Real time video clips example are shown to emphasize the dynamic nature of sonography imaging .Ouray to use program is organized by anatomic location correlative imaging {plain film CT, MRI} will be shown as appropriate.

**Chapter Two**

**Background and literature review**

**2-1 Human knee joint anatomy**:

Our knee is the most complicated largest joint in our body it also the most vulnerable because it bears enormous weight and pressure loads while providing flexible movement when we walk our knee support 1/5 times our body weight climbing stairs is about 3/4 times our body weight about time ‘goute’ (John 2006)

The knee is a synovial joint which connect the femur our thigh bone and longest bone in the body to tibia our shine bone and second longest bone in the body .There are two joint in the knee.

- The tibia femoral joint which joint the tibia to femoral.

- Patella femoral joint which joint the knee cop to femur,

These two joint work together to form a modified hinge joint to allow the knee to bend and straighten, but also no slightly and from side to side.

The knee is part chain that includes the pelvis, hips and lower leg ankle and foot below, all of this work together and depended on each other for function and movement.

The knee joint bears most of the weight body when were sitting the tibia and femur barely touch standing they lock together to form a stable unit.

Let’s look at normal knee joint to understand how the parts {anatomy} work together {function} and how problem can occur.

**2-1-1 Anatomical Terms:**

The high content of water make cartilage flexible clearly and prissily using planes areas and lines instead of your doctor saying his knee hurt she can say his hurt in the anterior lateral region another doctor will know exactly what is meant ,below are some anatomic terms surgeons uses as there terms apply to the knee.

* Anterior it facing knee this is the front of the knee.
* Posterior it facing the back of the knee also use to describe the back of knee cap that is the side of the knee cap that is next the femur.
* Medial the slice of the knee that close to the other knee each if you put knees together the medial side of each knee the mould touch.
* Lateral the side of the knee that is farther from the other knee {opposite of the medial side.

Structures have their anatomical reference as part such anterior curciate ligament mechial meniscus.

**2-1-2 Structures of the Knee:**

The main parts of the knee are bones ligament tendons cartilage and joint capsule all of which made of collagen. Collagen is fibrous tissue present throughout are body. As we age collagen breaks down.

The adult Skelton is mainly made of bones and little cartilage. Bone and cartilage are both connective tissue with specialized cells called chondrocytes embedded in aged like matrix collagen and elastic fiber cartilage and elastic and differ based on the proportion of collagen and elastin .Cartilage is as tiff but flexible tissue that is good weight bearing which is why found in our joint cartilage has almost no blood vessels and is very bad at repairing itself. Bone is full blood and is very good at repair.

***Bone of the knee:***

The bone gives strong the stability and flexibility in the knee four bone make up the knee.

*Tibia:*

Commonly called shin bone runs from knee head to the ankle the top of the tibia is made of two plateaus and knuckle like protuberaus called tibia tubercle.

Attached to the top of tibia on end side of tibia plateaus are two crescent shape shocks absorbing cartilage called menisci which help stabilize of the knee.

*Patella:*

The knee cap is flat triangular bone. The patella moves when the leg moves it is function is to relieve friction between the bones and muscle when the is bent or straightened and to protect the knee joint .The knee cap glide along the button front surface of the femur between tow protuberance called femoral condoyle . These condoyle form groove called patella femoral groove.

*Femur:*

Called thigh bone it is longer and strongest bone in the body the round knobs at the end of bone are condoyle.

*Fibula:*

Lang thin bone is the lower leg on the lateral side, and runs along the side of tibia from knee to ankle.

***Ligament in the knee:***

The knee works similar to rounded surface sitting atop at flat surface the function of the ligament is to attach bones to bones and give strength and stability to the knee they has very little stability.

Ligament are strong tough bands that are not particularly flexible once stretched they tend to stay stretched and stretched too far they snap.

- Medial Collateral Ligament:

Tibia collator ligament attaches to 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 of attaches the lateral side of femur to the lateral side of the fibula and limit side way motion of your knee.

- Anterior Curciate Ligament:

Attaches the tibia and femur in the center of the knee it located deep inside the knee and front of the posterior cruciate ligament it limiter rotation and for word motion of the tibia.

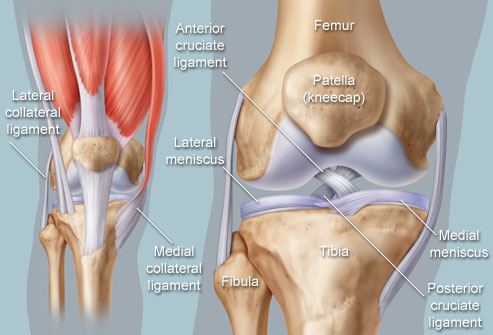
- Posterior Cruciate Ligament:

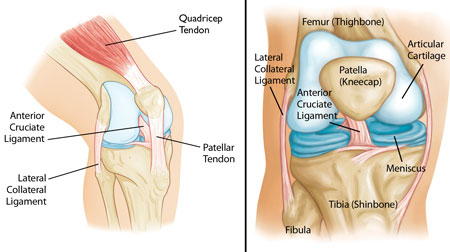
Is the strongest ligament and attaches the tibia and the femur. It’s also deep inside the joint behind the anterior cruciate ligament it limit the back words motion of the knee.

- Patellar Ligament:

Attaches the knee cap to the tibia the pair of collateral ligament knee the knee from moving too for side to side the cruciate ligament crisscross each other in the center of the knee they allow the tibia to swing back and forth under or back word under the femur. Working together the (4) ligament are the most important in structures in controlling stability of the knee.

There also patellar ligament that attaches to the knee cap to the tibia and aids instability. Abet of fascia called iliotibial band runs along the outside of the leg from the hip down to knee and helps limit the lateral movement of the knee.

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***Tendons in the knee:***

Tendon are also tic tissue that technically port of the muscle and connect muscle to the bones many of the tendon serve to stabilize the knee there are two major tendons in the knee ,

- Quadriceps tendon connect the guardricips muscle of the thigh to the kneecap and provide the power for straightening the knee it also helps hold the patellar in patella femoral groove in the femur.

- The patellar tendon connect the knee cap to the slim bone (tibia) which means its really alignment.

***Cartilage of the knee:***

The ends of the bones that touch other bone joint are covered with auricular cartilage because when bones or more against each other the are said to articulate.

Articular cartilage is white smooth fibrous connective tissue that covers the end of the bones and protects the bone as joint moves. lt also allows the bones to move more Freddy against each other the articular cartilages of the knee covers end of the femur and top of the tibia and back of the patella, in the medial of the knee are meniscus disc shaped cushion that acts as shock absorber.

*- MEDIAL MENISCUS*

Made of the fibrous crescent shaped cartilage and attached to the tibia on the inside of the knee.

*- LATERAL MENISCUS*

Made of fibrous crescent shaped cartilage and attached the tibia on the outside of the knee.

*- ARTICULAR CARTILAGE*

Is on the end of bone in any joint in the knee joint it covers the end of femur, tibia and the back of the patella the articular cartilage is kept slippery by synovial fluid (which looks like eggs white) made by synovial membrane (joint lining) Since the cartilage is smooth and slippery bone move without pain.

In a healthy knee the rubbery meniscus cartilage absorbs shock and the side force place on the knee.

Together the menisci sit on top of the tibia and help spread the Wight bearing force over a large area because the menisci are shaped liked shallow socket to accommodate the end of the femur they help the ligament in making the knee stable. Because the menisci help spread out the Wight bearing across the joint they keep the articular cartilage wearing away at friction point.

The weight bearing bone in our body is usually protected with articular cartilage which is 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 very slippery combination3 time more slippery than metal on plastic knee replacement. Synovial fluid is what allows us to flex our joint under great pressure without wear.

***Muscles around the knee:***

The muscles in the leg keeps the knee stable well aligned and moving. The guadricips (thigh) and hamstrings’ muscle group the guadricips and hamstrings are collection of (4) muscle on front of the thigh and are responsible bent knee to straight position. The hamstring is group pf (3) muscle on the back of the thigh and control the knee moving from straight position to bent position.

***The joint capsule:***

The capsule is thick fibrous structure that wraps around the knee joint inside the capsule is the synovial the membrane which is lined by the synovial soft tissue that secrets synovial fluid when it get in flamed and pored lubricant for the knee.

***Bursae:***

There are up to (3) bursa of various size in and around the knee. These fluid filled sacs cushion the joint and reduce friction between muscle bones tendons and ligaments.

There are bursa located underneath the tendons and ligament on both lateral and medial sides of the knee.

The prep teller bursa is one of the most significant bursa and located on the front of the knee just under the skin. It protect the knee cap in addition to bursa there is a infra patellar fat that helps cushion the knee cap.

***Plicae :***

Plicae are folds in the synovial plicae rarely cause problems but sometimes they can get cough bet mean the femur and knee cap and cause pain.

***2-2 Physiology:***

***2-3-1 Knee function:***

So now we have all structures let’s see how the knee move (articulates). Which is how we walk stoop jump the knee has limited movement and is designed to move like aligned. The guadricips mechanism is made up the patella (knee cap) patellar tendon and guaitricips muscle (thigh) on front of the upper leg. The patella fits into patella femoral groove as the knee bend. When the quadricips muscle contract on the front of the femur and act like a fulcrum to give the leg its power the patella slides up and downs to the groove as the knee bends when the guadricip muscle contract they canes the knee to staring I on when they relax the knee bends, In addition the hamstring and calf muscle help flex and support the knee.

***2-3 Pathology:***

***2-3-1 Problem of the knee:***

The knee doesn’t have much protection from trauma or streets (pressure or force). In addition to wear and tear on the knee (sport injuries) are the source of many problems.

***2-3-2 Symptoms:***

Knee symptoms come in many variety pains can be dull sharp constant or of \_and on .Pain also can be mild to agonizing. The prance of motion in the knee can be too much or too little you may haw griddling or popping the muscle may feel weak or the knee can lock.

Some knee problems only need rest and other need physical therapy (knee rehab exercise) or even surgery.

*Swelling:*

One of the most common symptoms is local swelling; there are two type of swelling

Is caused by knee producing too much synovial in to the joint (Hemorthrosis) Swelling with in the first hour of an injury is usually from bleeding swelling from 2\_24 hour is more likely to be from the joint producing large amount of synovial fluid trying to lubricated and abnormality inside the knee, Chronic swelling can distend the knee prohibit full range of motion and muscle atrophy from non use. Also if the cause of swelling is blood the blood can be destruction to the joint

*Locking:*

Is one something is keeping the knee from fully straightening out. There is usually loose body in the knee. The loose body can be small as again of sand or big as garter. Treatment by removal of loose body.

Another type of locking is when hurt so bad that you just want use it. The best treatment here is rest and may be some ice swelling is not usually pregent.

*Giving way:*

If you knee cap slip out its groove for an instant {it cause you thigh musclesto loose control causing the feeling of instability that is you don’t feel like your knee is stable. Wont support your weight and usually try to grab hold of something for support giving way can also be caused by weak leg muscle or an old ligament injury.

*Snaps coracles and pops:*

Noise coming from your knee with pain are likely nothing to wary about Some time 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 lose of knee function you should see on orthopedist . The most common cause is dislocating chondromalacia patella is cause by an injury. Another common cause is disco locating knee cap that is keeps slipping out of its groove pops without trauma (injury) are not worrisome pops with trauma can mean ligament tears (racking grinding or grating crepitus)mean there is roughness to bone. Surface and likely from degenerative disease or wear \_and tear arthritis (osteoarthritis).

***2-3-3 Pain and tenderness:***

Where and how bad the pain is with help find the underlying cause. It also help to knee 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 tear sprain, some pain can caused by muscle spasms associated with trauma.

**Pathological condition and syndromes in knee:**

* Osteochondritis dissecans, Osteoarthritis (degenerative arthritis)caused by aging and wear and tear of cartilage symptoms pain stiffness swelling. Infection arthritis, Chondromalacia patella:
* Pain from irritation of the cartilage on the under Gide of the cartilage on the under Gide of the knee cap common cause of knee pain in young people.
* Gout:

A form of arthritis caused by blued up of uric acid crystal in joint some time the knee may be affective causing severe pain and swelling,

* Pica syndrome:
* Rheumatoid arthritis:

An autoimmune condition that can cause arthritis in any joint including the knee, if untreated rheumatoid arthriti scan cause permanent joint damage.

**2-4 Previous study:**

* Dr. Cook and his colleagues conducted a study to determine the clinical usefulness of ultra sound for diagnosis maniacal pathology in patient with acute knee pain and compare it, diagnosis accuracy to MRI and clinical setting .the study include 71 patient with acute pain .in this prospective clinical study ultra sound was two time more likely than MRI to correctly determine the presence or absence of maniacal pathology seen arthroscopiclly (Cook 2013).
* The inter observer reliability of ultra sound in osteoarthritis {to assess the inter observer reliability between sonography with different level of experience in detecting inflammatory and structure damage abnormality in patient with AS {joint effusion / synovial hyper atrophy power Doppler signal, backer cyst }and structure osteophytes and cartilage abnormalities
* Relationship between symptoms of jumpers knee and the ultrasound characteristic of the patellar tendon among high level male volley ball players ( Lina K.J. Holen L. ) Anger Bersten 4 and R. Bahr. Article list published online 15 FEB 2008. Key words tendon injuries patellar tendon ultrasound this study assessed the u/s characteristic of patellar tendon in two group of volley ball players. One group with symptoms of jumper knee other group with on symptoms. 47 male player, 25 were diagnosed to have symptoms of jumpers knee, as determined by clinical examination. since some player had bilateral problem there 34 with current problem ,7 of the 30 of clinical diagnosis of jumpers knee in the patellar tendon had normal u/s finding ,and u/s changes believed to be associated with jumbers knee tendon thickening echo signal changes irregular paratenon appearance were observed in 12 of 15 knee without symptoms.

**Chapter three**

**Material and methods**

**3-1 MRI:**

We used liner extremity coil in 1.5 super conducting machine Semins of Philip machine.

**3-2 Ultrasound:**

Ultrasound high frequency liner transducer ranged (5-15 MHz) Toshiba machine.

**3-3 Design of the study:**

This is a descriptive, cross-sectional study where the data collected from patient underwent MRI and ultrasound examination simultaneously.

**3-4 Population of the study:**

All patients with symptomatic knee joint problem from both gender and their age above 18 years old with positive MRI results

*Exclusion criteria*

All traumatic patients because the result of damage associated with fracture, tears or rupture.

* 1. **Size of sample and type:**

The data of this study collected from 50 knee symptomatic patients visited MRI department for knee joint scanning, they were selected conveniently.

**3-6 Place and duration of the study:**

This study carried out in Ribat and Alatiba hospital, Khartoum Sudan, during the period from Jan 2014 to December 2014.

**3-7 Method of data collection**

*3-7-1 MRI*

MusculoskeletalMRI imaging there are two fundamental tenantof MSK imaging

{1} Definition of the normal anatomy.

{2} Detection of abnormal fluidenhamcement {pathology}.

**Protocol:**

{1} There are four basicprotocolinclude anatomy definingsequence such as T1 , GRE and proton density or {PD OR ST1 ECHO T2}

{2} And fluid sensitivesequence such inversion recovery {IR }and fat saturation .Although there isoverlapbetween them {T post contrast \_intra articular or intra venoms } are also used for definition of anatomy and detection of pathology respectively ,,,,

1. Ti:
2. Gre:
3. Proton density:
4. Inversion recovery:
5. Fat saturations:

Is the process of utilizing specific MRI parameters to remove detectioneffect of fat from the resulting image egt with STIR fat sat saturation or water selective (prose +wats \_watronly selection).

**3-7-2 MRI procedure (technique):**

The positioning patient must also be taken in account in certain instant to better align the anatomical structures being studied.

Knee is high soft tissue contrast is one of the main tool depict knee joint pathology, MRI allow accurate image of intra articular structures, ligament cartilage, menisci, bone marrow, synovium and adjacent soft tissue.

MRI knee need extremity coil providing a homogenous image volume maximal 4mm thick slice sagital coronal axial image.

**3-7-3 Ultra sound technique:**

*General principle*

When performing musculoskeletal sonography several factors should be taken in to consideration in order to obtain a high quality diagnostic examination. As with other types of ultrasound the proper selection of equipment is essential to facilitate adequate visualization of the region of interest.

In general the structures evaluated will be superficial therefore high frequency (7\_12 M HZ) linear array transducer are usually the most appropriate choice transducer the high resolution attainable allows detailed anatomic depiction of superficial structures.

***Exam technique*:**

Musculoskeletal sonography is high operator dependent however the interactive nature between the examiner and the patient can be of great benefit clinical history as well as direct feedback about the precise anatomic location and character of symptoms tenderness with probe palpation and the positions or movements which illicit or aggravate symptoms can be invaluable for accurate interpretation of finding. One of the most important advantages of sonography is the flexibility and dynamic capability of any given study allowing for targeted examination specific for each individual.

Contra lateral comparison is easily performed in the musculoskeletal system and can help distinguish significant findings from variation of normal on occasion contra lateral comparison can detect un suspected abnormalities which can be cruial to the diagnosis and management of the patient. Comparison by applying transducer pressure under real time visualization can reveal important information about the composition of under lying structures (ie cyst \_lipoma vs solid) and allows for increased conspicuity or detection of abnormalities which are otherwise vs. hidden 1\_c subtle contour defect in full thickness rotator cuff ear color or power Doppler features show the degree of vascularity associated with solid mass.

The split screen function is availed on most ultra sound and is use full to demonstrate a large field of new (approximately double the width although precise image requires some skill and steady hand on the part of the examiner the extended FOV function currently available only on the Siemens unit can demonstrate very large contiguous sections of anatomy without distorting structural relationship and preserving spatial resolution.

3D imaging and tissue harmonics are more recent innovations which may be useful in the assessment of musculoskeletal disorder farther investigations are necessary to determine the role of these options.

**3-8variable of study:**

The data of this study collected using the following variables: gender, age, height, weight, body mass index

**3-9 Method of data analysis:**

The data of this study analyzed using Excel and SPSS under windows, where the frequency distributions of the qualitative variables were presented in table and the mean and standard deviation for quantitative variable were addressed. Cross-tabulation showing the relationship between MRI and ultrasound finding as well as graphs showing the association of body characteristics and finding were shown.

**Chapter four**

**Results**

The result of this study consisted of tables and figures; the tables shows the frequency distribution of the knee component condition using ultrasound and MRI while the figures displayed the cross-correlation frequencies between the ultrasound and MRI findings

Table 4-1 the mean and standard deviation of patient age and body mass index

|  |  |
| --- | --- |
| variable | Mean ±SD |
| AGE | 39.1±13.6 |
| BMI | 25.6±3.5 |

Table 4-2 the gender frequency distribution

|  |  |  |
| --- | --- | --- |
| Gender | Frequency | Percent |
| Male | 33 | 66 |
| Female | 17 | 34 |
| Total | 50 | 100 |

Table 4-3 frequency distribution table of Lateral anterior meniscus by ultrasound

|  |  |  |
| --- | --- | --- |
| Lateral anterior meniscus US | Frequency | Percent |
| not reported | 1 | 2 |
| Normal | 42 | 84 |
| Abnormal | 7 | 14 |
| Total | 50 | 100 |

Table 4-4 frequency distribution table of Lateral anterior meniscus by MRI

|  |  |  |
| --- | --- | --- |
| Lateral anterior meniscus MRI | Frequency | Percent |
| Normal | 41 | 82 |
| Abnormal | 6 | 12 |
| Abnormal & grading | 2 | 4 |
| Suspect | 1 | 2 |
| Total | 50 | 100 |

Figure 4-1 a bar graph show frequency cross-correlation between ultrasound results and MRI for Lateral anterior meniscus

Table 4-5 frequency distribution table of lateral posterior meniscus by ultra sound

|  |  |  |
| --- | --- | --- |
| Lateral posterior meniscus US | Frequency | Percent |
| not reported | 1 | 2 |
| Normal | 44 | 88 |
| Abnormal | 4 | 8 |
| Suspect | 1 | 2 |
| Total | 50 | 100 |

Table 4-6 frequency distribution table of lateral posterior by MRI

|  |  |  |
| --- | --- | --- |
| Lateral posterior meniscus MRI | Frequency | Percent |
| Normal | 42 | 84 |
| Abnormal | 1 | 2 |
| Abnormal & grading | 6 | 12 |
| Suspect | 1 | 2 |
| Total | 50 | 100 |

Figure 4-2 abragraph show frequency cross-correlation between ultra sound and MRI for the lateral posterior meniscus

Table 4-7 frequency distribution table of medial anterior meniscus by ultra sound

|  |  |  |
| --- | --- | --- |
| Medial anterior meniscus by u/s | Frequency | Percent |
| Normal | 47 | 94 |
| Abnormal | 2 | 4 |
| Suspect | 1 | 2 |
| Total | 50 | 100 |

Table 4-8 frequency distribution table of medial anterior meniscus by MRI

|  |  |  |
| --- | --- | --- |
| Medial anterior meniscus by MRI | Frequency | Percent |
| not reported | 2 | 4 |
| Normal | 46 | 92 |
| Abnormal & grading | 1 | 2 |
| Suspect | 1 | 2 |
| Total | 50 | 100 |

Figure 4-3 abargraph show frequency cross-correlation between ultra sound result and MRI for the medial anterior meniscus

Table 4-9 frequency distribution table of medial posterior meniscus by ultra sound

|  |  |  |
| --- | --- | --- |
| Medial posterior meniscus by u/s | Frequency | Percent |
| not reported | 2 | 4 |
| Normal | 23 | 46 |
| Abnormal | 25 | 50 |
| Total | 50 | 100 |

Table 4-10 frequency distribution table of medial posterior meniscus by MRI

|  |  |  |
| --- | --- | --- |
| Medial posterior meniscus by MRI | Frequency | Percent |
| not reported | 2 | 4 |
| Normal | 14 | 28 |
| Abnormal | 17 | 34 |
| Abnormal & grading | 17 | 34 |
| Total | 50 | 100 |

Figure 4-4 abargraph show frequency cross-correlation between ultra sound result and MRI for the medial posterior meniscus

Table 4-10 frequency distribution table of anterior curciate ligament by ultra sound

|  |  |  |
| --- | --- | --- |
| Anterior Curciate by u/s | Frequency | Percent |
| not reported | 50 | 100.0 |

Table 4-11 frequency distribution table of anterior curciate ligament by MRI

|  |  |  |
| --- | --- | --- |
| Anterior curciate by MRI | Frequency | Percent |
| not reported | 2 | 4 |
| Normal | 14 | 28 |
| Abnormal | 17 | 34 |
| Abnormal & grading | 17 | 34 |
| Total | 50 | 100 |

Figure 4-5 abargraph show frequency cross-correlation between ultra sound and MRI for the anterior curciate ligament

Table 4-12 frequency distribution table of posterior curciate ligament by ultra sound

|  |  |  |
| --- | --- | --- |
| Posterior Curciate US | Frequency | Percent |
| not reported | 50 | 100.0 |

Table 4-13 frequency distribution table of posterior curciate ligament by MRI

|  |  |  |
| --- | --- | --- |
| Posterior Curciate MRI | Frequency | Percent |
| Normal | 37 | 74 |
| Abnormal | 10 | 20 |
| Abnormal & grading | 3 | 6 |
| Total | 50 | 100 |

Figure 4-6 abargraph show frequency cross-correlation between ultra sound result and MRI for posterior cuciate ligament

Table 4-14 frequency distribution table of medial collateral by ultra sound

|  |  |  |
| --- | --- | --- |
| Collateral Medial US | Frequency | Percent |
| Normal | 43 | 86 |
| Abnormal | 5 | 10 |
| Suspect | 2 | 4 |
| Total | 50 | 100 |

Table 4-15 frequency distribution table of medial collateral by MRI

|  |  |  |
| --- | --- | --- |
| Collateral Medial MRI | Frequency | Percent |
| not reported | 1 | 2 |
| Normal | 48 | 96 |
| Abnormal | 1 | 2 |
| Total | 50 | 100 |

Figure 4-7 abragraph show frequency cross-correlation between ultra sound result and MRI for medial collateral

Table 4-16 frequency distribution table of lateral collateral ligament by ultrasound

|  |  |  |
| --- | --- | --- |
| Collateral lateral US | Frequency | Percent |
| Normal | 47 | 94 |
| Suspect | 3 | 6 |
| Total | 50 | 100 |

Table 4-17 frequency distribution table of lateral collateral ligament by MRI

|  |  |  |
| --- | --- | --- |
| Collateral lateral MRI | Frequency | Percent |
| Normal | 36 | 72 |
| Abnormal | 2 | 4 |
| Abnormal & grading | 9 | 18 |
| Suspect | 3 | 6 |
| Total | 50 | 100 |

Figure 4-8abargraph show frequency cross-correlation between ultra sound result and MRI for the lateral collateral ligament

Table 4-18 frequency distribution table of supra patella by ultra sound

|  |  |  |
| --- | --- | --- |
| Supra Patella US | Frequency | Percent |
| Normal | 43 | 86 |
| Abnormal | 4 | 8 |
| Abnormal & grading | 1 | 2 |
| Suspect | 2 | 4 |
| Total | 50 | 100 |

Table 4-19 frequency distribution table of supra patella by MRI

|  |  |  |
| --- | --- | --- |
| Supra Patella MRI | Frequency | Percent |
| Normal | 46 | 92 |
| Abnormal | 1 | 2 |
| Abnormal & grading | 1 | 2 |
| Suspect | 2 | 4 |
| Total | 50 | 100 |

Figure 4-9 abargraph show frequency cross- correlation between ultrasound result and MRI for the supra patella

Table 4-20 frequency distribution table of infra patella by ultra sound

|  |  |  |
| --- | --- | --- |
| Infra Patella US | Frequency | Percent |
| Normal | 48 | 96 |
| Abnormal | 1 | 2 |
| Suspect | 1 | 2 |
| Total | 50 | 100 |

Table 4-21 frequency distribution table of infra patella by MRI

|  |  |  |
| --- | --- | --- |
| Infra Patella MRI | Frequency | Percent |
| not reported | 1 | 2 |
| Normal | 41 | 82 |
| Abnormal | 3 | 6 |
| Abnormal & grading | 3 | 6 |
| Suspect | 2 | 4 |
| Total | 50 | 100 |

Figure 4-10 a bar graph show frequency cross- correlation between ultra sound result and MRI of the infra patella

Table 4-22 frequency distribution table of posterior component by ultra sound

|  |  |  |
| --- | --- | --- |
| Posterior component Fluid US | Frequency | Percent |
| Normal fluid | 15 | 30 |
| Abnormal fluid | 35 | 70 |
| Total | 50 | 100 |

Table 4-23 frequency distribution table of the posterior component by MRI

|  |  |  |
| --- | --- | --- |
| Posterior component Fluid MRI | Frequency | Percent |
| Normal fluid | 4 | 8.0 |
| Abnormal fluid | 46 | 92.0 |
| Total | 50 | 100.0 |

Figure 4-11 a bar graph show frequency cross-correlation between ultra sound result and MRIfor the posterior component

Table 4-24 frequency distribution table of the backer cyst by ultra sound

|  |  |  |
| --- | --- | --- |
| Fluid Backer cyst US | Frequency | Percent |
| No backer cyst seen | 39 | 78 |
| backer cyst | 11 | 22 |
| Total | 50 | 100 |

Table 4-25 frequency distribution table of the backer cyst by MRI

|  |  |  |
| --- | --- | --- |
| Fluid Backer cyst MRI | Frequency | Percent |
| No backer cyst seen | 38 | 76 |
| backer cyst | 12 | 24 |
| Total | 50 | 100 |

Figure 4-12 a bar graph show frequency cross-correlation between ultra sound result and MRI for the back meniscus

**Chapter five**

**Discussion Conclusion and Recommendation**

**5-1 Discussion**

The result of this study showed that the mean age of the patients was 39.1±13.6 years with body max index of 25.6±3.5 kg/m2 which means most of the patients have middle age and within an appropriate body mass index so effect on knee might be attributed to other factors, while most of the patient were male 66%.

The result of this study concerning diagnosis of meniscus which consists of four meniscuses; lateral anterior and posterior, medial anterior and posterior using MRI and ultrasound; the result showed that in case of normal, MRI reveals that out of 50 cases 41, 42, 46 and 14 cases of lateral anterior, posterior, medial anterior and posterior meniscus respectively were diagnosed as normal while for ultrasound the result was 42, 44, 47 and 23 of the case respectively were diagnosed as normal. The agreement of ultrasound with MRI concerning the four meniscuses in diagnosis as normal was 100%, 97.6, 100% and 100% respectively which represent the specificity. Similarly for abnormal cases using MRI the results was 6, 1, 1 and 34 cases out of 50 for each meniscus. Ultrasound reported the abnormal cases as follows; 7, 4, 2, and 25 respectively as abnormal cases for the four meniscuses. The agreement of ultrasound with MRI in was 83% for lateral anterior, lateral posterior 100% and medial anterior meniscus88.2% while there is no abnormality detected by both models concerning medial anterior. The overall accuracy of ultrasound in respect to MRI in diagnosis the four meniscuses was 95.5%.

The results for diagnosis of anterior and posterior curciate ligaments by ultrasound showed no results because these ligaments obscured by bone therefore ultrasound can’t reveals their structure. For medial and lateral collateral ligament using MRI and ultrasound, the results for normal appearance was 36 MRI to 35 ultrasound and 46 to 46 respectively. The agreement of medial collateral ligament for normal was 97.2% and 100% for lateral collateral ligament concerning normal cases. While for abnormal cases the agreement was 100% for both. The overall accuracy for collateral ligament (medial and lateral) was 99.7% while it was 0% for anterior and posterior curciate ligaments.

The result of supra patella and infra patella examination showed that the ultrasound diagnosed all normal cases as normal similar to ultrasound (41 and 46 normal cases for supra and infra patellar) with 100% agreement, but for abnormal case there were 4 cases all of them diagnosed as normal by the ultrasound with 0% sensitivity. The overall accuracy was 50%. Diagnosis of posterior component by ultrasound showed that there were 2 normal cases out of 4 diagnosed by MRI with an agreement of 50% and for abnormal it was 33 out of 46 that diagnosed by MRI with an agreement of 71.7% with an overall accuracy of 61%. For the backer cyst there were 12 cases and ultrasound diagnosed 11 cases correctly with a sensitivity of 91.7%.

**5-2 Conclusion**

The general objective of this study was to evaluate the internal derangement of the knee usingultrasound in order to reduce time and cost and to explore reliability of ultrasound in respect to MRI.

Generally evaluation of knee joint for ligament and tendons were carried out by MRI scanner, while evaluation of bone done by CT or planner x-ray. Ultrasound involve in these study recently but not in a major scale.

This study included 50 patients visited the radiology department for knee examination by MRI and therefore ultrasound were done for them for comparison purposes.

The result of this study showed that for meniscuses the sensitivity was 83% for lateral anterior meniscus, 100% for lateral anterior and 88.2% for medial anterior meniscus with specificity 100%, 97.6, 100% and 100% for lateral anterior and posterior, medial anterior and posterior respectively. While the medial and lateral collateral ligaments showed sensitivity of 100% for both and specificity of 97.2% and 100%. Supra and infra patellar showed no sensitivity out of 4 cases and specificity of 100%, similarly for backer cyst ultrasound showed sensitivity of 91.7%.

In conclusion these results showed the potential of ultrasound in diagnosing knee problem mostly for meniscuses, ligaments and backer cyst and it can give a clue for abnormality before sending the patient for further expensive analysis.

**5-3 Recommendation**

* Hope to recommend that to examine large sample size to give more accurate result.
* To correlate this study with orthopedic consultant to see our results and to give their guide.
* Encourage radiologist and sonologest to have more training in this field and try to give grading in ultra sound exam.
* Any patients have any knee joint abnormality must do ultrasound firstly.

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**Appendix**

