MORPHOLOGY OF KNEE JOINT DISEASES WITH BAKER'S CYST

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PAKISTAN

MORPHOLOGY OF KNEE JOINT DISEASES WITH BAKER'S CYST

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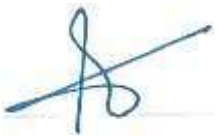

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This is dedicated to my beloved Husband and Daughter for their constant support and understanding towards my academics.

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I dedicate this thesis to my loving parents (Mr. and Mrs. Saghir), husband (Major Mohammed Uzair), and daughter whose unwavering support and encouragement have been the driving force behind my academic journey. This accomplishment would not have been possible without their sacrifices and belief in my abilities. My academic supervisor Dr Ambreen Usmani's patience, and understanding have been my constant motivation, and I am deeply grateful for her belief in me. I also want to mention Bahria University Health Sciences Campus for giving me this chance to do my postgraduate degree from this brilliant institute. I also extend my heartfelt appreciation to my batchmates (Dr Jaweria Aslam and Dr Sitwat Sagheer) and mentors especially my father-in-law (Raees Pervaiz), whose guidance and wisdom has shaped my intellectual growth. Finally, I dedicate this thesis to all those who aspire to make a positive impact in their respective fields, as a reminder that dedication, perseverance, and passion can bring about meaningful change.

ABSTRACT

Rheumatoid arthritis (RA), osteoarthritis (OA), and psoriatic arthritis (PsA) are the inflammatory knee diseases that cause excessive production of synovial fluid in the knee joint which is already present in there and makes up a part of synovial joint. The excessive production is due to inflammatory changes caused by disease, which can later lead to formation of the Baker's Cyst. Pain and swelling are clinical signs. Followed by thrombophlebitis and gangrene formation if the cyst is left untreated and it bursts inside the calf muscles region due to lack of proper treatment. Nerve entrapment of surrounding nerves of knee joint is one leading cause of pain and discomfort which can cause disability in walking and difficulty in performing daily tasks. The purpose of this study was to determine the morphological changes and factors affecting Baker's Cyst in patients of RA, OA, and PsA. Sixty-six participants were arranged in 2 groups. Group-A consisted of cases; Group-B consisted of control group (with no Baker's Cyst). A case-control observational study was conducted in the radiology ward in public hospital of Karachi for a period of six months. History and a well-informed consent from each participant followed by a thorough examination of knee joint was conducted. A detailed ultrasound examination was performed on all the participants. Data was assembled on a predefined proforma which was compared with control subjects based on age of patients, age of disease, for pain measurement WOMAC (Western Ontario and McMaster Universities Arthritis Index) score, osteophytes, calcification, partition in cyst, length breath and area of the cyst, gender, diseases knee, state of rupture and presence of rheumatoid arthritis factor. The result was extracted by using SPSS version 23.0. There will be recommendations related to the effects of Baker's cyst in the patients of RA, OA, and PsA on knee joint diseases regarding the policy changes that needed to consider in the revolutionary world of rheumatology.

Key words: Baker's cyst, Ultrasound, Knee joint, Osteoarthritis, Rheumatoid Arthritis, Psoriatic Arthritis, Osteophytes, Calcification, Gender, Partitions in cyst, Cyst Length, Cyst breath and area of the cyst.

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ACL	-	Anterior Cruciate Ligament
BC	-	Baker's Cyst
BMI	-	Body Mass Index
CRP	-	C-reactive protein
IgM	-	Immunoglobulin M
MKS	-	Musculoskeletal System
MRI	-	Magnetic Resonance Imaging
OA	-	Osteoarthritis
PCL	-	Posterior Cruciate Ligament
PSA	-	Psoriatic Arthritis
RA	-	Rheumatoid Arthritis
RAF	-	Rheumatoid Arthritis Factor
SPSS	-	Statistical Package for Social Sciences
TKA	-	Total Knee Arthroplasty
US	-	Ultrasonography
WOMAC	-	Western Ontario and McMaster Universities Arthritis Index

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CHAPTER 1

INTRODUCTION

The knee joint stands as a remarkable and indispensable element within the human anatomical framework. Its intricate design and functionalities empower us with an expansive spectrum of movements, while also furnishing the vital stability needed during a multitude of activities. The profundity of its anatomy, the intricacies of its structure, and the intricacies of its function collectively contribute to a pivotal role in facilitating our capacity to walk, run, and actively partake in the array of physical endeavours that punctuate our daily lives.

Situated at the intersection of the femur, tibia, and patella, the knee joint functions as a hinge joint but encompasses a more intricate nature due to its capacity to permit not only flexion and extension but also slight degrees of rotation and lateral movement. The ligaments, tendons, and cartilage interwoven within its composition lend stability and coordination, facilitating these diversified motions with remarkable efficiency. The patella, or kneecap, also assumes a significant role, acting as a fulcrum that reinforces the mechanics of the knee joint during activities that involve forceful leg movements (Sinnatamby, C. S. 2011. Last's Anatomy Regional and Applied 12th ed Elsevier).

With every step, jog, or leap we take, the knee joint unfailingly stands as a silent partner in our physical pursuits. Whether we're navigating a busy urban street or traversing a serene hiking trail, the knee joint plays an integral role, merging fluidity with stability. This amalgamation not only defines our physical capabilities but also signifies the crucial linkage between bodily functionality and overall quality of life. In acknowledging its complexity and embracing its significance, we honour the extraordinary mechanism that propels our bodies forward, enriching our existence in multifaceted ways.

The knee joint is classified as a hinge joint, primarily operating along a single axis, rendering it capable of executing motions in only one plane. Its primary movements are flexion and extension, which allow the leg to bend and straighten within a confined range. This articulation, pivotal to ambulation and countless activities, bridges the femur to the tibia while incorporating the patella bone. The amalgamation of these elements creates a sophisticated machinery that balances mobility and stability.

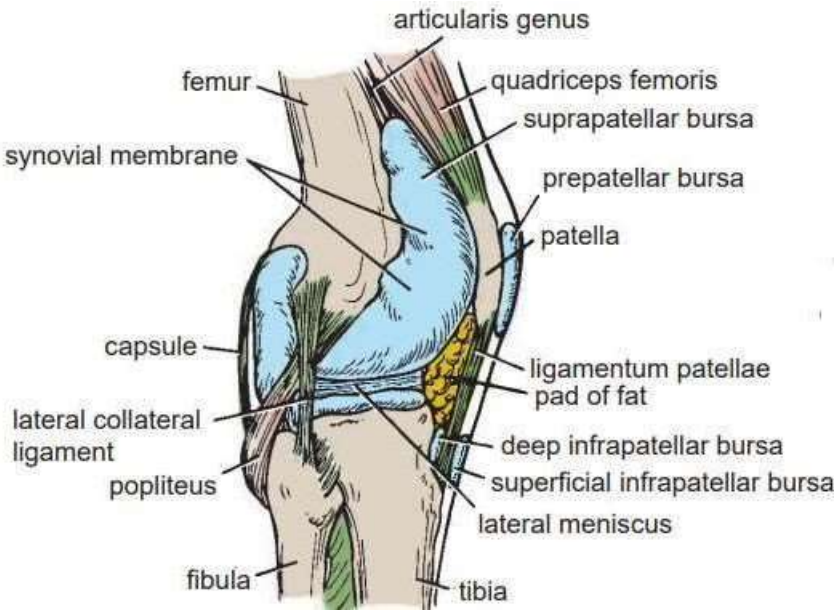
Comprising a network of interdependent components, the knee joint orchestrates a symphony of movement. Ligaments, namely the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL), are crucial in anchoring the femur and tibia, supplying the stability necessary for controlled motion. The patellar and quadriceps tendons interconnect muscles and bones, amplifying joint mobility while transferring force (Sinnatamby, C. S. 2011. Last's Anatomy Regional and Applied 12th ed Elsevier).

Meanwhile, articular cartilage enshrouds the terminal surfaces of the femur, tibia, and patella. This resilient cartilage layer cushions impact, absorbs stress, and diminishes friction during movement, contributing to joint health and longevity. Synovial fluid, another essential component, functions as a natural lubricant. It imbues the joint with viscosity, reducing friction during articulation and ensuring seamless motion as shown in fig 1.1.

As the leg propels forward in a step or bends during daily activities, the knee joint's orchestrated mechanics foster motion without undue stress. Its simplicity belies the intricate interplay of ligaments, tendons, cartilage, and fluid, each working harmoniously to maintain an equilibrium between movement and stability. While its range of motion may seem limited in comparison to more versatile joints, the knee joint's specialized architecture serves as an essential cornerstone for human mobility and function, underscoring its indispensability in our lives.

Fig1.1: Lateral view of right knee joint

Snell, R.S (2012). Snell's Clinical Anatomy by Regions (9th edition)



The knee joint is an intricate structure surrounded by various anatomical components that contribute to its stability and function. In addition to the ligaments, capsule, tendons, and cartilage within the joint itself, there are several structures close to the knee joint that play important roles in its overall anatomy.

The largest sesamoid bone found in the body is patella which is located anteriorly in the knee joint as shown in fig 1.1. It serves as a protective shield, while providing mechanical advantage to the quadriceps femoris muscles (collection of four muscles rectus femoris, vastus lateralis, vastus medialis and vastus intermedius). The patella helps to increase the leverage of the quadriceps tendon, which runs from the quadriceps muscles over the patella and attaches to the tibia. This mechanism enhances the extension of the knee joint and contributes to its overall strength during activities like jumping and climbing.

Adjacent to the knee joint, another integral structure deserving attention is the meniscus. This vital anatomical component comprises the medial meniscus and the lateral meniscus, two crescent-shaped cartilaginous formations positioned strategically between the femur and tibia as shown in fig 1.1. Serving multifarious functions, the menisci stand as indispensable entities in the knee's intricate mechanism. The medial and lateral menisci are anatomically important structures that play pivotal roles in maintaining joint health and function. These C-shaped structures act as nature's shock absorbers, a vital role that's especially crucial considering the knee's weight-bearing responsibility. Their innate capacity to absorb and disperse forces lends crucial cushioning to the joint, protecting it from the impacts of daily activities such as walking, running, and jumping (Snell, R. S. 2012. Snell's Clinical Anatomy by Regions 9th ed).

Beyond their shock-absorbing role, the menisci contribute significantly to joint stability. By deepening the articulating surfaces of the femur and tibia, they enhance the congruence of the joint, which in turn promotes stability during movement. Furthermore, they facilitate the biomechanics of the joint, ensuring optimal distribution of forces across its surfaces. In addition to their mechanical functions, the menisci partake in joint lubrication. Their presence helps facilitate the movement of the femur on the tibia, aided by the synovial fluid within the joint space. This synergistic action

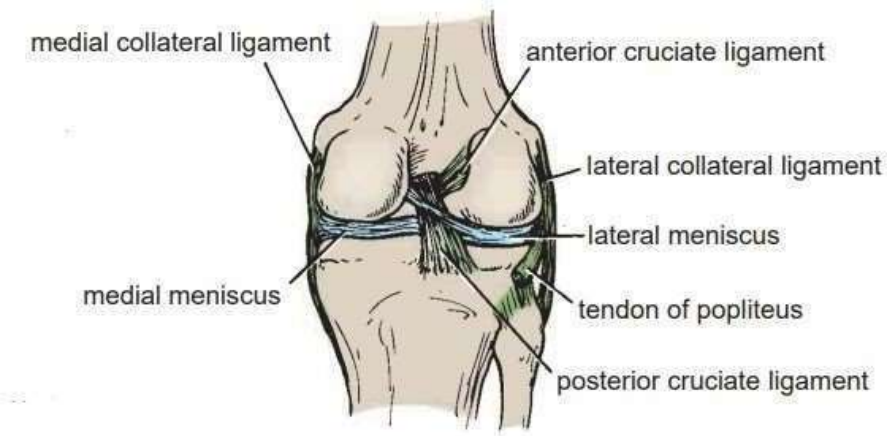
between the menisci and synovial fluid serves to minimize friction, enabling smooth, pain-free motion.

However, the intricate architecture and location of the menisci make them susceptible to injury, especially in sports or activities that involve sudden pivots or twists as shown in fig 1.2. Damaged menisci can compromise their shock-absorbing and stabilizing roles, leading to discomfort, swelling, and even mechanical issues in the joint. In essence, the menisci exemplify the remarkable interplay of form and function within the human body. Their seemingly modest crescent shapes belie the complexity of their roles—distributing forces, ensuring stability, and lubricating the joint. Acknowledging their importance underscores the significance of maintaining knee health, preventing injuries, and ensuring the longevity of a joint that forms the bedrock of our daily mobility.

The knee joint capsule, a resilient and intricate structure, derives its stability from a network of attachments that reinforce its integrity. This capsule envelops the knee joint, safeguarding its components and facilitating coordinated movement as shown in fig 1.3. Supported by various connections, its structural robustness is the cornerstone of knee joint functionality. Posteriorly, the capsule adheres firmly to the upper margins of the femoral condyles and nestles within the contours of the intercondylar fossa. This robust connection ensures that the knee joint is securely enveloped, anchoring it against the pressures generated during movements that demand flexion and extension (Sinnatamby, C. S. 2011. Last’s Anatomy Regional and Applied 12th Ed Elsevier).

On the inner aspect, the capsule intertwines with the articular margin of the femur, fortifying the joint's medial aspect as shown in fig 1.3. This attachment augments the stability necessary for actions that involve weight-bearing and locomotion, conferring resilience to the joint's inner mechanics. The outer periphery of the capsule establishes a firm linkage adjacent to the groove housing the popliteus tendon. This anatomical association guarantees the joint's lateral stability, crucial for lateral movements and pivoting motions. Together, the inner and outer connections contribute to the knee's ability to navigate an array of dynamic movements while maintaining structural integrity.

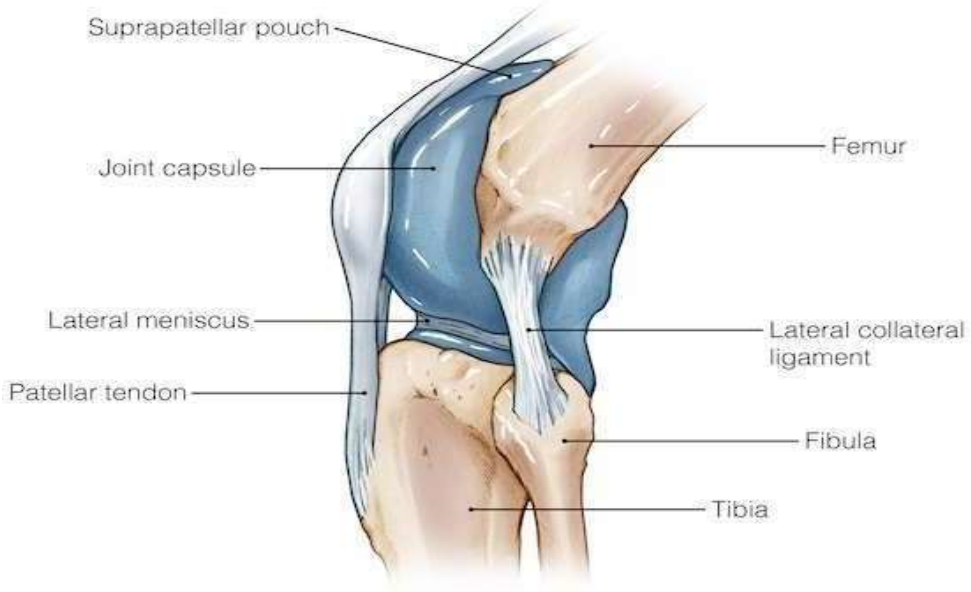
Fig 1.2: The posterior view of the knee joint
Snell, R.S. (2012). Snell's Clinical Anatomy by Regions (9th Ed.)



Anteriorly, the capsule integrates with the patellar retinacula, a web of fibers that encapsulates the patella. This interplay generates a seamless continuity between the capsule and the patella's surroundings, offering stability to the anterior knee region. The capsule's firm grasp extends further to anchor itself to the sides of the patellar ligament and the patella itself. This comprehensive encirclement ensures that anterior forces and tensions are efficiently managed, upholding knee stability during activities like jumping or brisk walking. Collectively, these attachments form a robust framework that encases the knee joint, transforming it into an intricate mechanism that combines resilience and agility. The capsule's multifaceted connections operate synergistically, rendering the knee joint not only a pivot for movement but also a bastion of stability. Understanding this network of interconnections enriches our appreciation of the knee's remarkable intricacies and highlights the importance of safeguarding its health for the preservation of our everyday mobility (Snell, R. S. 2012. Snell's Clinical Anatomy by Regions 9th ed).

Above the kneecap, the knee joint capsule does not have any attachments, allowing the suprapatellar bursa to have direct communication with the joint. On the back side of the tibia, the capsule is connected to the borders of the tibial condyles and to the lower edge of the groove where the posterior cruciate ligament is located. There is an opening in the attachment to the lateral condyle that allows for the passage of the popliteus tendon as shown in fig 1.4. On the sides of the knee joint, the capsule attaches to the borders of the tibial condyles as well as to the head of the fibula. On the inner side of the knee joint, the capsule forms a thickened portion that contributes to the deep component of the tibial collateral ligament. This thickened portion is firmly attached to the medial meniscus, a C-shaped cartilage structure that provides cushioning in the knee joint. Deep within the capsule, there are weak attachments to the edges of both menisci, which are referred to as the coronary ligaments. These ligaments connect the menisci to the tibia, the larger bone of the lower leg. Towards the front of the knee, the attachment line of the fused capsule and patellar retinacula slopes downward from the medial and lateral condyles of the knee joint to the tibial tuberosity, a bony prominence on the tibia (Sinnatamby, C. S. 2011. Last’s Anatomy Regional and Applied 12th Ed Elsevier).

Fig 1.3: The capsular attachments on knee joint
https://anatomy.lexmedicus.com.au/collection/knee



The tibial collateral ligament, also known as the medial ligament, is a flat, triangular band that has specific attachments within the knee joint. It originates above from the medial femoral epicondyle, which is located just below the adductor tubercle. It attaches below to the upper portion of the medial surface of the tibia, the larger bone of the lower leg.

The anterior margin of the ligament forms the vertical base of the triangle and is free, except for its attached ends. The posterior apex of the triangular ligament merges with the joint capsule and becomes attached to the medial meniscus, a cartilage structure in the knee joint. Directly above its lower attachment point, the ligament is crossed by the tendons of the sartorius, gracilis, and semitendinosus muscles, and there is a bursa, a fluid-filled sac, located between them. Deep to the lower part of the ligament, there are the medial inferior genicular vessels and nerve, as well as the anterior expansion of the semimembranosus tendon, with another bursa in between. These structures and attachments are important for the stability and function of the knee joint.

The fibular collateral ligament, also known as the lateral ligament, has a cord-like shape. It is attached proximally to the lateral epicondyle, which is located below the attachment of the lateral head of the gastrocnemius muscle and above the tendon of the popliteus muscle. Distally, it attaches to the head of the fibula, with the tendon of the biceps femoris muscle overlapping it. A bursa, a fluid-filled sac, is present between the ligament and the tendon (Snell, R. S. 2012. Snell's Clinical Anatomy by Regions 9th Ed).

Unlike the tibial collateral ligament, the fibular collateral ligament does not connect to the joint capsule and does not have any attachment to the lateral meniscus, which is a cartilage structure in the knee joint. There is a bursa between the ligament and the capsule, and the tendon of the popliteus muscle lies deep to the capsule in that area. The lateral inferior genicular vessels and nerve are located deep to the distal part of the ligament. These structures and attachments contribute to the stability and function of the knee joint, specifically on the lateral side. The oblique popliteal ligament is an extension originating from the semimembranosus tendon. It merges with the joint capsule at the posterior aspect of the knee joint and extends laterally towards the intercondylar fossa

and the lateral femoral condyle. The popliteal artery lies on this ligament, and genicular vessels and nerves penetrate through it.

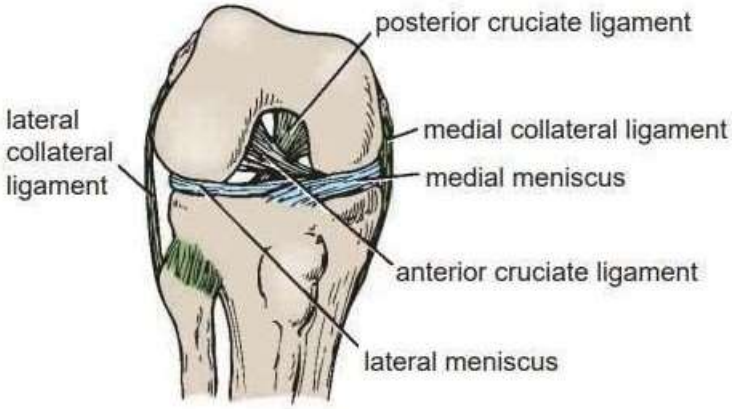
On the other hand, the arcuate popliteal ligament is shaped like the letter "Y" and represents a thickening of the posterior fibers of the joint capsule. The longer stem part of the "Y" attaches to the proximal end of the fibula. The medial part of the ligament arches over the popliteus tendon and reaches the posterior edge of the tibial intercondylar area. Some fibers of the popliteus muscle are connected to this ligament. The lateral limb of the ligament ascends towards the lateral femoral condyle along with the popliteus tendon.

The cruciate ligaments are strong ligaments that connect the tibia to the femur within the knee joint. Although they are situated within the knee joint capsule, they are not positioned within the synovial membrane. Instead, it appears as though they extend into the synovial membrane from the back, which means that the front and sides of the ligaments are covered by the synovial membrane, while the posterior aspect remains uncovered.

The anterior cruciate ligament (ACL) connects to the front part of the tibial plateau, located between the attachments of the anterior horns of the medial and lateral menisci. It then ascends in a posterolateral direction, twisting upon itself, and attaches to the posteromedial aspect of the lateral femoral condyle as shown in fig 1.4.

On the other hand, the posterior cruciate ligament (PCL) is stronger, shorter, broader, and less oblique compared to the ACL. It attaches to a smooth impression on the posterior part of the tibial intercondylar area, extending to the uppermost portion of the posterior surface of the tibia. The PCL then ascends in an anteromedial direction and attaches to the anterolateral aspect of the medial femoral condyle. The cruciate ligaments cross each other in a pattern resembling the limbs of the letter "X," with the anterior ligament primarily positioned anterolaterally to the posterior ligament as shown in fig 1.4.

Fig1.4: The anterior view of the flexed knee joint
Snell, R.S. (2012). Snell's Clinical Anatomy by Regions (9th Ed.)



The muscles that surround the knee joint are essential for maintaining its stability and facilitating proper movement. These muscles are responsible for extending the knee joint, allowing for leg straightening. On the back of the thigh, we find the hamstring muscles, which include the biceps femoris, semitendinosus, and semimembranosus. These muscles contribute to knee flexion, allowing for the bending of the knee. Together, the quadriceps and hamstring muscles play a crucial role in the overall function and stability of the knee joint, enabling a wide range of movements and activities.

Furthermore, there are several bursae near the knee joint. Bursae are fluid-filled sacs that act as cushions between tendons, ligaments, and bones, reducing friction and facilitating smooth movement. The prepatellar bursa is in front of the patella, while the infrapatellar bursa is situated below it. These bursae help to reduce friction between the skin, tendons, and bones during knee movement (Moore K. L., Dalley A. F., & Agur A. M. R. 2017. Clinically Oriented Anatomy 8th Ed. Lippincott Williams & Wilkins)

Understanding the anatomy and interactions of these structures is crucial for comprehending the complexity and function of the knee joint. It also helps in diagnosing and treating various knee conditions and injuries.

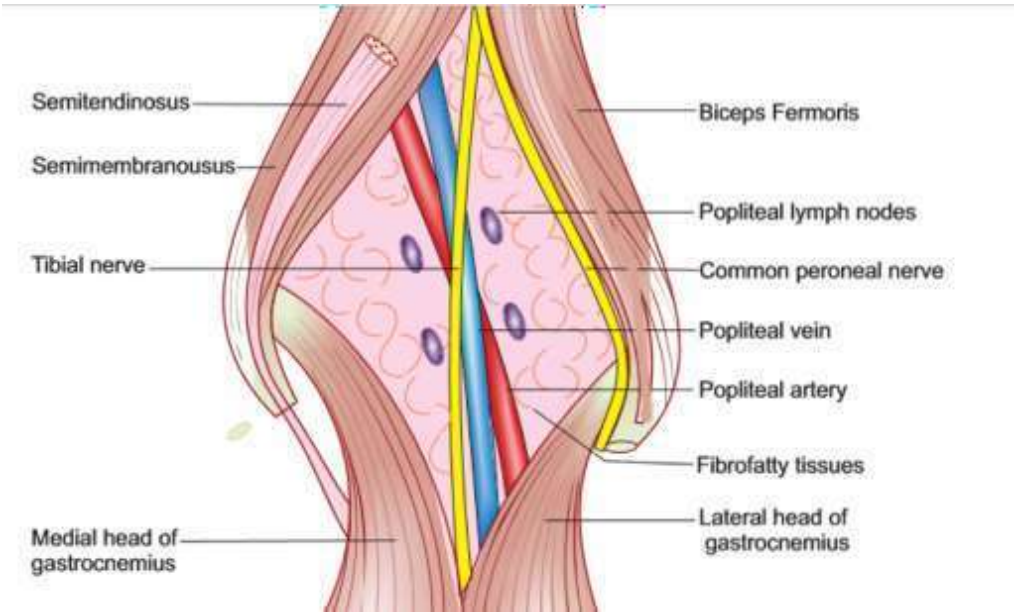
The knee joint flexes and extends; Flexion refers to the bending of the knee, bringing the heel closer to the buttocks, while extension involves straightening the leg. These movements are crucial for activities such as walking, climbing stairs, and sitting down. In addition to flexion and extension, the knee joint permits limited rotation, abduction, and adduction. These movements contribute to the joint's overall functionality and coordination.

The knee joint bears significant weight and stress during activities such as walking, running, and jumping. Acting as a shock absorber, it distributes the forces generated during movement, reducing the impact on other structures such as the hips and spine. The knee joint's stability and balance enable us to maintain an upright posture, perform tasks that require agility, and engage in sports and physical activities. However, due to

its complex structure and high usage, the knee joint is prone to injuries. Common knee injuries include ligament sprains (such as ACL and PCL tears), meniscus tears, and patellar dislocations. These injuries can result from sudden trauma, overuse, or degeneration over time. Rehabilitation is crucial for recovering from knee injuries and restoring normal joint function. It typically involves a combination of physical therapy, strengthening exercises, and, in some cases, surgical interventions which entirely depends on the nature of the injury. The knee joint is one of the remarkable structures that enables essential movements and functions in the human body. Its anatomy and function contribute to the overall stability, balance, and mobility of an individual. Understanding the knee joint's mechanics, taking proactive measures to maintain its health, and seeking appropriate treatment for injuries are essential for ensuring optimal joint function and overall well-being (Snell, R. S. 2012. Snell's Clinical Anatomy by Regions 9th Ed).

The popliteal fossa is another significant anatomical region found at the posterior part of the knee joint. It is shaped like a diamond and has specific boundaries formed by muscles present in the region. The upper boundary of the popliteal fossa is formed by the semimembranosus and semitendinosus muscles on the medial side and on the lateral side is the biceps femoris muscle. These muscles converge to form the apex of the popliteal fossa. Fascia lata makes up the upper part of the popliteal fossa. It is a strong connective tissue, which is strengthened by transverse fibers. This region is penetrated by the small saphenous vein and the posterior femoral cutaneous nerve. Moving downward, the floor of the fossa is formed by the distal end of the femur along with the two condyles, the capsule present around the knee joint, which is strengthened externally by the oblique popliteal ligament, and the popliteus muscle covered by its fascia. Within the popliteal fossa, the popliteal artery and vein, as well as the tibial and common peroneal nerves, pierce this region. These important blood vessels and nerves play a significant role in the vascular supply and innervation of the lower leg and foot. Additionally, a cluster of popliteal lymph nodes is situated adjacent to the popliteal vein. These lymph nodes are part of the lymphatic system and contribute to immune function and drainage in the lower limb (Sinnatamby, C. S. 2011. Last’s Anatomy Regional and Applied 12th edition. Elsevier).

Fig 1.5: The posterior view of the knee showing popliteal fossa
https://anatomyqa.com/popliteal-fossa-boundaries-contents-applied



When the knee is flexed in a living body, the back of the knee exhibits a concave appearance between the ridges formed by the tightened hamstring tendons. This can be observed by palpating the region behind the flexed knee. However, when the knee is extended, the hamstring tendons rest against the rounded bony prominences of the femoral condyles, while the fat within the popliteal space causes the roof of the depression to bulge.

The heads of the gastrocnemius muscle occupy the lower part of the diamond-shaped popliteal fossa, which is one of the calf muscles. These heads are only separated, and the lower part of the fossa is opened when the gastrocnemius muscle heads are artificially pulled apart or stretched.

Understanding the anatomy of popliteal fossa is important for various medical and clinical contexts. It assists in diagnosing and treating conditions related to the structures within the fossa, such as the nerves, blood vessels, and lymph nodes that pass through or are in this region.

Baker's Cyst is the abnormal accumulation of synovial fluid and distention in the gastrocnemius-semimembranosus preexisting bursae that fills up the anatomical communication between joint and bursae as shown in fig 1.6 (Di Sante et al., 2012). It is found in the medial aspect of the popliteal fossa of knee joint near femoral condyle. It is a painful palpable slightly mobile swelling extending in the leg accompanied by enlargement in the space of knee joint (Yang et al., 2019). It is also vastly named in literature as the gastrocnemius-semimembranosus bursa, it represents a structure composite of two separate bursae: a bursa anterior to the medial tendon of gastrocnemius (the sub gastrocnemius bursa) and another bursa between the two tendons i.e. gastrocnemius and semimembranosus tendons. Therefore, in some research it is mentioned at two different bursae, naming them as semimembranosus bursae (present in between the medial head of gastrocnemius and semimembranosus muscle) and another is marked as gastrocnemius bursae (located behind the medial head of the gastrocnemius muscle only). It is marked as pseudocyst and it lacks the epithelial lining and is not a closed cyst, but it has a lining of cells that separates it from the nearby structures like muscles, bone, ligament, and vessels (Torreggiani et al., 2002).

Baker’s cyst has a true synovial sheet along with synovial fluid and is basically an extension of the associated knee joint down into the leg. It is the most common avascular abnormality found in the knee joint.

No race or gender preference has been observed. Baker’s Cyst is less common in children than in adults. Body Mass Index (BMI) may have an impact on the development of this Cyst. (Jovanovi, J., & Skaki, V., 2004).

Baker's Cyst has been found due to various knee pathologies. Some of the knee conditions that have been linked to the development of Baker's Cyst include:

1. Meniscus tears: Meniscus tears are the most common cause of Baker's Cyst. When the meniscus, which is rubbery cartilage in the knee joint, gets damaged or torn, it can lead to enhanced formation of synovial fluid, resulting in the formation of a cyst.

2. Osteoarthritis: Osteoarthritis, a degenerative joint disease, can cause inflammation and damage to the knee joint. This inflammation can lead to increased production of synovial fluid, potentially resulting in a Baker's Cyst.

3. Chondral lesions: Chondral lesions refer to damage or injury to the cartilage surface of the knee joint. These lesions can trigger an inflammatory response, leading to the Baker's cyst.

4. Inflammatory arthritis: Certain types of arthritis, such as rheumatoid arthritis or psoriatic arthritis, involve chronic inflammation in the joints. This inflammation can contribute to the development of a Baker's cyst.

5. Cruciate ligament (ACL) tears: When the anterior cruciate ligament, one of the significantly important ligaments in the knee, gets torn, it can cause increased production of synovial fluid. This excess fluid can accumulate and result in Baker’s Cyst.

Among these knee pathologies, meniscus tears have been found to be most frequently associated with Baker's cysts. However, it is important to note that Baker's cysts can also occur independently or due to other factors not mentioned in this list. Proper diagnosis and treatment by a healthcare professional are essential to address both the underlying condition and the associated Baker's cyst (Frush, T. J., & Noyes, F. R., 2015).

The walls of the capsule of knee joint shows signs of synovitis with mild to moderate amount of fibrosis and fibrin collection (Frush, T. J., & Noyes, F. R., 2015). The cyst is formed when there is excessive synovial fluid produced in the knee joint due to intraarticular changes happening in the joint. These changes can occur because of secondary to some disease causing the inflammation of the lining of synovial membrane of the knee joint. Therefore, excessive fluid produced is transferred to the Baker’s Cyst thus maintaining the optimum pressure needed for a functional knee joint. This proves that Baker’s Cyst works as a protective mechanism in the knee where effusion is taking place and thus reduces the hazardous and rather potentially destructive pressure raising in the associated space. This also explains why there is no reverse flow of fluid from the cyst to the knee joint (Jovanovi, J., & Skaki, V., 2004). The presence of fibrin is also another factor contributing to its one-way flow of synovial fluid.

Fig 1.6: Healthy knee compared with Baker's Cyst
https://www.myphysiomyhealth.com.au/conditions/bakers-cyst/

Baker's Cyst appears as firm palpable mass in the posterior one third of the knee on full extension and softens up when the flexion of knee is performed. This sign is called Foucher's sign. First reported in case-report and later established as the distinguishing feature for diagnosis of Baker's Cyst. Foucher's sign helps in distinguishing it from nearby lesion of popliteal artery aneurysm, adventitial cyst, sarcomas, and ganglia where there is little to no effect on position of mass in changing the motion of knee joint and muscular contraction (Canoso et al., 1987). Bruising below the medial malleolus is suggestive of presence of ruptured Baker's Cyst as the inflammatory and proteolytic fluid from the broken cyst starts accumulating due to the gravity and gathers around the ankle joint. The skin around the ankle area appears purplish blue in a freshly ruptured cyst and changes color with passage of time. This clinical finding indicated the Baker's Cyst has been ruptured and is thus called Crescent sign. It is also stated in medical literature as the only clinical sign which can help in differentiating between Baker's Cyst and Deep Vein Thrombosis (DVT) (Mizumoto, J., 2019).

The studies done so far on the topic suggested that Baker's Cyst is formed by two mechanisms present in the human body. In almost 30–50% of cases there is a natural existing connection between the articular joint space of knee and the gastrocnemius semimembranosus bursa. This connecting channel is a 15–20 mm transverse slit-like opening present close to the proximal posterior-lateral side of the medial condyle of femur bone. Due to the continuous bending and folding action of the semitendinosus and gastrocnemius muscles a ―valve‖ like effect between the joint and the communicating bursa, is formed. While performing flexion of the knee joint ―valve‖ opens up the channel and the synovial fluid found inside the joint, under immense power escalate inside the bursa; while relaxation the ―valve‖ closes this communication due to the tension created by the muscles close to the joint and the synovial fluid remains inside the bursa (Jonovan et al., 2004).

There are two different types of Baker's Cyst based on clinical and anatomical findings (Di Sante, L. et al., 2012). Primary or idiopathic; these cysts are ones which are formed because of no prior damage to the intra-articular knee joint structures i.e., synovial

membrane, capsule, or menisci. The presence of valvular connections with the joint is observed. Synovial membrane, folds and bands can be seen through the radiological examination of the involved joint. Synovial folds are formed by the scaring and irritation that are continuously happening inside the joint. Similarly, the synovial bands are produced by the presence of remnants of connective tissue that are present between the bursal cavity and the effected joint. Fluid extracted from this kind of cyst is viscous in appearance due to presence of high amount of fibrin and connective tissue. Patients don't complain of presence of pain and swelling in knee joint prior to the formation of the cyst. There are no signs of any inflammatory changes inside the joint. The patients of idiopathic Baker's Cyst are mostly young age group with no associated prior knee inflammatory joint diseases.

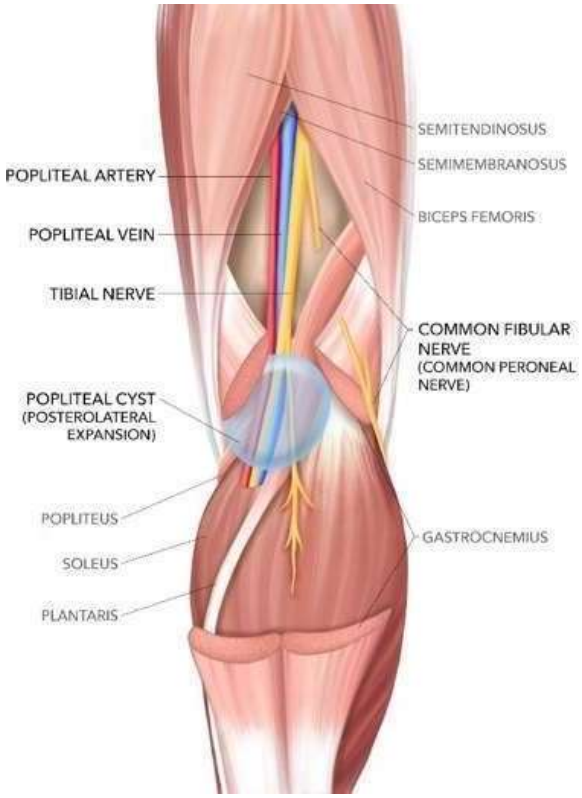
Secondary Baker's cyst is the one which has direct communication with the effected knee joint. The fluid present inside the cyst is of normal viscosity in appearance. This type of cyst usually involves the joint which already have the inflammatory changes taking place in the synovial membrane of the knee joint secondary to any inflammatory knee joint diseases for e.g., osteoarthritis, rheumatoid arthritis, psoriatic arthritis, ankylosing spondylitis, nonspecific synovitis, capsule damage due to trauma and meniscal tears. The patients complain of pain and swelling in the joint prior to palpable swelling mass in the calf muscles. Therefore, the type of Baker's Cyst is also called symptomatic. Patients often complain of the locking of joint, buckling and clicking sound present in the joint associated after prolong change of state of joint like in sitting and standing (Visser et al., 2016).

On radiological examination a soft tissue mass is observed on the posterior aspect of the knee joint with the presence of partitions along with calcified structures present in the cyst. The presence of many variable sizes of the loose calcified bodies have also been observed in one giant Baker's Cyst. Occasionally there is bony involvement also. The cyst may have a high amount of calcium present so much as it can resemble the head of fibula if its present in the lateral side of knee joint. An uncontrolled large Baker's Cyst may extend downward and more towards the medial of the joint results in formation of a Giant Baker's Cyst that can come in between the proximal part of calf muscles.

Superior and lateral extension is rare (Guo D et al., 2020). Baker's Cyst is associated with many more joint deformations, which may include an internal derangement of joint structures, OA, or arthritis; the most common associations include effusion of knee joint, any tear in meniscal discs, and natural degenerative changes taking place in knee joint disease (Jovanovi, J., & Skaki, V., 2004). This condition can affect the patient mobility by limited movement of the joint which can be secondary to damage to the menisci found in the knee joint. Other causes of the painful condition can be due to deposition of the synovial fluid crystals, less amount of synovial fluid, less space present in the synovial joint other than normal and presence of osteophytes.

There are a few structures found close to the knee joint which can mimic the Baker's Cyst. The meniscal cyst is the cystic mass found posterior to the knee joint, have a fluid collection in a cyst with closed lining. This structure can be differentiated based on presence of meniscal tear in the associated joint which is not present in the Baker's Cyst. Pes anserine bursitis or bursitis of the lateral tibial ligament is also a cystic collection of the fluid present on the posterior side but can be differentiated from Baker's Cyst where the damage to the ligament is not mandatory for the diagnosis to be made. Ganglia of the posterior side is present and can extend downwards to the knee giving a false presentation of Baker's Cyst. All these conditions can be ruled out based on extension of cyst in leg where Baker's Cyst holds a specific position for extension between gastrocnemius and semitendinosus. Any solid structure found on the MRI or ultrasonography leads to the diagnosis of synovial tumor rather than Baker's Cyst (Torreggiani et al., 2002).

Fig 1.7: The posterior view of the knee showing Baker's Cyst
https://www.sportsinjurybulletin.com/diagnose--treat/bakers-cysts-an-early-indication-of-pathology



Patient comes with complaints of painful palpable knee swelling, non-flexible knee joint, clicking and buckling of the joint and locking of the knee joint of effected side (Abate et al., 2021). Signs of tenderness and thrombophlebitis are also seen in patients. There is mostly no numbness, coldness or paralysis found in the leg region. The symptoms are caused by the excessive amount of synovial fluid and damage to the menisci causing the clicking sound on movement of knee joint in sudden change of position. Pain and tenderness in leg are the result of compression of structure which are pain sensitive structures e.g., tibial nerve and common fibular nerve, found adjacent to knee joint as well as inflammatory and proteolytic content of the ruptured cyst (Mizumoto., 2019). Entrapment neuropathy is caused by the compression of nerves found close by.

Thrombophlebitis is the inflammatory condition caused by formation of a blood clot and blocking of the vein (mainly popliteal vein in this case) by this clot thus result in mimicking the deep vein thrombosis which results in swelling and pain in proximal part of calf muscles. The condition is of great importance as it also mimics the Baker's Cyst and can be distinguished by Foucher's sign which was described earlier (Marcello Di Nisio, Iris M Wichers, Saskia Middeldorp 2018). Leakage and rupture are the most common end stages of the disease which further lead to the localized or in rare cases systemic infection of the involved leg. Pressure induced by cyst can lead to devastating damage to the lower leg causing deep vein thrombosis and distal ischemia of the foot leading to less mobility and initial stage gangrene formation in the effected side of the bodyas shown in fig 1.8 (Saylik et al., 2021). Hematoma is also one of the recognized complications of the Baker's Cyst. The giant cyst can also make the leg susceptible to posterior secondary compartment syndrome of leg due to bursting of the giant Baker's Cyst because of immense pressure from structures surrounding it (Torreggiani et al., 2002). Baker's Cysts are frequently discovered alongside intra-articular knee conditions. Pulmonary embolism is also one of the fatal conditions associated with ruptured Baker's Cyst caused by hemorrhage (Jovanovi, J., & Skaki, V., 2004). Cutaneous malignancy is also one of the renowned complications of the cyst as the fluid

starts draining outside the skin through a small opening in dermis thus leading to the dermatological tumour (Kano, Y., & Harada, Y., 2021).

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Fig 1.8: Gangrene formation in a patient after rupture of Baker's Cyst
Wu, Keng-Yi, Deng-Ho Yang, and Chun-Wen Chen. "Pyogenic Baker cyst in a patient with psoriatic arthritis during etanercept therapy." *Annals of Saudi Medicine* 35(3) (2015): 260-262.

For Baker's Cyst pain and suffering to be reduced, proper diagnosis, testing, and treatment are essential (Frush, T. J., & Noyes, F. R., 2015).

Treatment is followed by physiotherapy mainly focusing on the strengthening of the hamstrings, quadriceps, and gastrocnemius muscles to prevent reoccurrence of the Baker's Cyst. Working on these muscles helps in prevention of formation of ―valvel mechanism. The therapy also focuses on more range of motion and flexibility of the knee joint. Patients usually report with great relief of pain in their joints. Weight reduction and keeping inflammatory knee disease in control have also shown great prognosis (Saylik, M., Gokkus, K., & Sahin, M. S. 2021).

The study examines the morphological characteristics of Baker's Cyst in RA in relation to the deposition of rheumatoid changes within the synovial joint. These changes lead to joint tightness and an abnormal increase in the production of synovial fluid. In patients of RA the occurrence of the Baker's Cyst ranges from 20% to 40%, and the chance of having this cyst multiplies with advancing age, forward prognosis of RA, and prolong duration of the disease. Baker's Cysts are very common in RA but may escape clinical recognition. A high-resolution ultrasound scan of the area is a simple, highly sensitive, non-invasive technique that can solve this problem. Therefore, it should be used more extensively by physicians in diagnosing Baker's Cyst, which can be associated with significant morbidity. In RA (more commonly in activate knee rheumatoid arthritis) synovial fluid production is enhanced which leads to the filling and the production of Baker's Cyst (Andonopoulos et al., 1995).

Baker's Cyst are also observed in patients of OA especially knee osteoarthritis as these are the normal wear and tear of the knee joint and develops with advancing age. The Baker's Cyst is also associated with the meniscal tear that is caused either by direct trauma or damage because of osteoarthritis. Cartilage of knee joint is also affected in this disease thus limits the movement of knee. Knee osteoarthritis mainly causes inflammation of the lining of synovial membrane; a highly pain sensitive area which

cause formation of extra synovial fluid which is histologically characterized by hyperplasia of the synovial membrane, fibrin production and angiogenesis. The extra synovial fluid is then passed down through the valve into a collecting cyst, hence formation of Baker's Cyst takes place. This form of arthritis has the most subsequent impact on the patient's functional ability and therefore studied widely in medicine literature. In normal conditions the amount of fluid is negligible and can be easily reabsorbed in the body (Bohler et al., 2016).

Spondyloarthropathies is an umbrella term used for arthritis which includes arthritis representing in patients either in clinical form or genetic features form. They are classified according to the involvement of affected joints predominantly, which is either axial or peripheral. One of the spondyloarthropathies includes ankylosing spondylitis, an autoimmune disorder which mainly affects the spine joints particularly the sacroiliac joint and the adjacent soft tissue including tendon and ligaments. In later advanced stages of disease there is formation of fibrosis and calcified bodies in the involved joints causing less flexibility of joint and later fusion of the joint. The main clinical signs are pain and swelling in the diseased joint which in more severe clinical form can involve peripheral joints for e.g., knee.

Psoriatic arthritis is a subset of spondyloarthropathies and is characterized as a chronic inflammatory condition of joint which has some association with human leukocyte antigen i.e., HLA-B-27 in almost 50% of the affected patients. The specific antigen is present in only 8% of the diseased individual so cannot be the diagnostic feature of this disease. PsA is mostly proceeded with psoriasis of the involved region. The clinical features include asymmetrical involvement of one or more joints, interphalangeal joint of hands and feet, mutilating arthritis. Extra articular clinical manifestation is of uveitis, enthesitis, dactylitis etc. Studies in South Asian population have proved that their prevalence rate is low as compared to the western countries. The prevalence rate is 11% in the general population coming to the outpatient clinic with the complaint of psoriasis as it is the chief complaint. Its involvement in the asymmetry of knee joints makes it a great choice of inflammatory disease associated with formation of Baker's Cyst in effected individuals (Kim et al., 2022).

A Baker's Cyst can be visualized as an anechoic region of fluid with posterior acoustic enhancement and has direct or indirect communication with the part of knee joint. A complex Baker's cyst appears as many small internal hyperechoic regions in a singular cyst. Calcified bodies can also be seen inside Baker's cyst which appear as movable echoic foci of different sizes having distal acoustic shadowing (Jovanovi, J., & Skaki, V., 2004).

The purpose of the study is to correlate the morphology of the Baker's cyst in RA, OA and PsA and. This study can help in early diagnosis of cyst using ultrasonography which could have been a clinical and prognostic value in patients already suffering from above mentioned inflammatory knee joint diseases. High recurrence rate of the Baker's Cyst suggests that there is neglect underlying pathological disease (Mehmet Sabri Balik, Arzu Turan, Fatma Beyazal Celik 2019). The correlation can help in early diagnosis of Baker's cyst even if it is in small size which can lead to painful swelling and limited movement of the knee joint effecting the quality of life of patient by effecting the flexibility of joint. Timely diagnosis of this chronic disease can prevent the patient from having lifelong disability of the effected joint.

A range of sophisticated imaging techniques are employed to diagnose and monitor the prognosis of cysts, with magnetic resonance imaging (MRI) and ultrasonography taking centre stage. MRI, renowned for its exceptional diagnostic capabilities, stands as a pivotal tool in the armamentarium of medical practitioners. Its non-invasive nature and unparalleled ability to offer detailed cross-sectional images of soft tissues make it an ideal choice for cyst assessment. Often hailed as the "gold standard," MRI excels in swiftly and effectively diagnosing cysts, thus facilitating prompt intervention (Liu, K., Li, X., Weng, Q., Lei, G., & Jiang 2022).

However, the widespread adoption of MRI encounters certain limitations that necessitate considering alternative options. The scarcity of MRI machines and the associated expenses render it a less viable choice, particularly for outpatient departments. The protracted duration of MRI scans further compounds the situation, as the time-intensive process is not always amenable to the fast-paced nature of clinical

settings. These practical constraints often prompt healthcare providers to explore more accessible and time-efficient alternatives (Wu et al., 2015).

Among the newer contenders in the realm of radiological techniques is the utilization of computed tomography (CT) scans of the knee joint. Emerging as a promising option, CT scans exhibit accuracy levels comparable to ultrasonography (US) and MRI. This technique capitalizes on advanced computer processing to generate cross-sectional images of the knee joint, unveiling detailed anatomical structures, including cysts. Its enhanced accessibility, comparative accuracy, and potential for rapid imaging make it an appealing choice for patients and practitioners alike.

As the medical landscape advances, the choice of imaging technique becomes pivotal. MRI, with its unparalleled precision, remains a cornerstone for accurate cyst diagnosis. Nonetheless, practical considerations and technological evolution propel the exploration of alternative approaches. CT scans emerge as a contemporary contender, offering comparable precision to traditional methods while addressing some practical constraints. This nuanced understanding of available imaging techniques empowers medical professionals to make informed choices tailored to patient needs, striking a balance between diagnostic excellence and pragmatic feasibility.

Ultrasonography is a non-invasive way for radiological assessment. The technique itself is easy, cost effective, patient friendly and mobile. It has a good reliable diagnostic property due to its high specificity and sensitivity in diagnosis of Baker' cyst. It is a very helpful tool for determining whether the mass consists of solid structure or collection of fluid inside it. Its easy availability and no prior need of training for examiner in different hospital setups makes it a great tool of choice for the cyst (Macchioni et al., 2019). The radiological technique is a good choice not for only diagnostic purpose but also very helpful in assessment of quality of treatment and its effect on joint without being repeatedly invasive to the patient which is highly convenient and makes it patient friendly in cases of bedside ultrasonography for patients who have problematic mobility. The early diagnosis of Baker's Cyst is important to

prevent the entrapment neuropathy which is irreversible in most cases and end stage complication. Early diagnosis and removal by aspiration can help in reducing the pressure in the associated knee joint. Thus, minimizing the symptoms of pain and swelling and leading to betterment in the quality of life of the patient (Wu et al., 2015).

1.7 RATIONALE

The importance of the knee diseases studied in this research will help in further surgical procedures.

1.7.1 Research gap:

Literature research shows that no research has been performed on RA, OA and PsA and its progressive effect on morphology of knee joint with Baker's Cyst. Rheumatoid factor, osteophytes, capsule state, and partitions present in the cyst were never analyzed by ultrasonography in Pakistani population especially in Karachi population.

1.7.2 Theoretical gap:

None of the former studies have used 3 different knee joint diseases i.e., RA, OA and PsA.

1.7.3 Contextual gap:

The use of ultrasonography has not been used in the former studies in Pakistani population. The use of Parameter like space present in the knee joint, degeneration of the menisci, fluid viscosity and its correlation with advancement of disease and age along with the gender.

1.8 PROBLEM STATEMENT

Baker's Cyst is a painful condition whose prevalence is increasing at an alarming rate. This study can help in early diagnosis of the Baker's Cyst in patients of RA, OA, and PsA. Other Parameters are also noted to see the advancement of the disease and to associate it with the Baker's Cyst. (Mohammed Hassan et al., 2020).

1.9 RESEARCH QUESTIONS

- What are the morphological changes observed in Baker's Cyst in patients with RA, OA, and PsA?
- How do these changes correlate with the associated risk factors in these patients?
- What are the differences in the effects observed between the presence of rheumatoid factors and crystals in patients with a normal knee?
- How are the length, breadth, and area of the cyst associated with other parameters and the WOMAC score?

A) NULL HYPOTHESIS:

There is no correlation between Baker's Cyst and knee joint diseases.

B) ALTERNATIVE HYPOTHESIS:

There is a strong correlation present between Baker's Cyst and knee joint diseases.

1.10 OBJECTIVES

1) To identify the morphological changes of Baker's Cyst in RA, OA, PsA and correlating its associated risk factors in patients.
2) To compare the effects of presence of rheumatoid factor and crystals in patients with a normal knee.
3) To measure and compare the advancement of the disease with the presence of Baker's Cyst.
4) To associate length, breadth, and area of cyst with age of patients, duration of disease, weight of patients, calcification of knee joint space, partitions of cyst, WOMAC score, gender, diseased knee and presence of osteophytes.

1.11 SIGNIFICANCE OF STUDY

The significance of this study lies in its exploration of the morphological changes of Baker's Cyst in rheumatic diseases, specifically psoriatic arthritis, which have not been thoroughly studied before. The utilization of ultrasonography, which is cost-effective, reliable, and readily available in hospital settings, presents an excellent opportunity to investigate these changes and possible risk factors related to the cyst's development in a large cohort of homogenous patients from the Pakistani population. This study focuses on patients with diagnosed cases of knee osteoarthritis across all age groups, who share similar anatomical and functional characteristics.

Through this research, we aim to determine the frequency of Baker's Cyst among Pakistani patients with established knee osteoarthritis, using ultrasonography to evaluate various parameters of the knee joint. By enabling early diagnosis, this study can help prevent painful fluid accumulation and potential damage due to muscular knee joint action, along with the possible prevention of entrapment neuropathy. Furthermore, the study's findings can aid orthopedic specialists in better understanding prognosis and managing associated painful conditions related to the disease.

Overall, this study holds potential significance in the field of orthopedics, as it can contribute valuable insights to enhance patient care, early detection, and management of Baker's Cyst in the context of rheumatic diseases like psoriatic arthritis.

CHAPTER 2

LITERATURE REVIEW

The term "Baker's cyst" originates from research conducted by William Morant Baker, who identified this cyst in 8 cases. The eponym was assigned to the cyst in honour of Baker's pioneering work as the initial researcher in this field. This is one of the few research projects in which the mention of Baker's Cyst was mentioned. The author recruited patients who had suspicious and abnormal growth present in the posterior region of knee joint. All these patients had the same clinical findings of pain and unexplainable swelling in the knee region. The author also studied in detail the cases of the amputated legs and concluded that there was an abnormal cyst present in the bursa of the semimembranosus muscle which was not present in patients of normal knee. This cyst was in connection with the knee joint capsule through a track. The late author also highlighted the fact that synovial membrane was thinnest at the point where the bursa of popliteus muscle was present thus giving away a partial opening to the knee joint for formation of the cyst. The author also assumed that synovial bursae swelling, and extension must be the first sign towards formation of the Baker's Cyst. In this research there were two cases of osteoarthritis which were diagnosed later. The author also mentioned that while bandages had been applied to the affected area, the size of swelling was not reduced and after laying down for extended time, it disappeared. The researcher also stated the fact that there was a fluctuation mechanism present in between knee joint and cyst but in some cases, it might be absent, which does not contraindicate the fact that cyst was absent in these effected joints. The author also acknowledged that in 6 of these cases there was a decrement in the space between the effected joint, which was more remarkable in the diagnosed case of osteoarthritis and was correlated later. The researcher also mentioned the recurrence of the same cyst in some of the cases which was observed over the period of 5 years. With the sudden disappearance of the cyst, the study also concluded that it may dissolve on its own

without depending on the size. The author also tried to give the concept of reoccurrence of the cyst as secondary which is larger and is more observed by the patient. (Baker, Morant, 1994).

Adams in 1840 was the first one to report a case where there was a mass found in synovial joint of the knee in patients with rheumatoid arthritis while in 1877 Baker found the synovial joint disease. J. Paul Harvey and Josue Crocs in 1960 collected sample of four patients in Hospital of Special Surgery who were reported in a year span and had same disease presentation of rheumatoid arthritis along with pain in knee joint leading to their surgical management. They concluded that Baker's cyst is presented with rheumatoid arthritis more frequently which contained lymphocytes, large mononuclear cells, and plasma cells. A large formation of hyaline-like substance was found. In the research gross and microscopically pathological features were discussed and the result was obtained as there was a strong correlation present between the rheumatoid arthritis and Baker's cyst and reoccurrence is frequently found (Levy et al., 1970).

Rauschning published research which was later in 2015 republished as part of the great literature value in the world of rheumatology. In this study the author focused on the findings of Baker's Cyst in relation to rheumatoid arthritis. As the research was published when there was no imaging technique discovered, the findings were solely dependent on the procedure of necropsy which is a generalized term used for the postmortem of both animals and humans. The author took 120 knees specimen from cadavers and inclusion criteria included that the age of patient should be younger than 50 and must not have any knee injury or surgery found in the record. It was found that there are two types of Baker's Cyst in one group which consisted of more than 50% of cases. There was a valve like mechanism present in between the knee joint and cyst. In the other group there was no such communication and herniation of the synovial membrane was present at the posterior and inferior side of the joint. Both the groups had synovial membrane thinning present. The opening was more like slit thus giving it the appearance of valve. The cyst was found at the site where the gastrocnemius muscle was merging with the knee joint capsule. The alternative opening and closing of the communication between the joint and the cyst explained the Foucher's sign where cyst

was sometimes visible on physical examination of the joint and sometimes it was not. The increase in pressure inside the knee joint also explains why there was a particular position required to get this cyst diagnosed, which is the basis of modern days of knee semi flexed position for the imaging technique of smaller cysts. The mechanism also explained why patients felt discomfort during extension and it also became the basis of modern days questionnaire for pain scale in rheumatology. The closing mechanism played an evident role in small joint effusion and their relationship with the development of the future Baker's Cyst. The fluid of the cyst when extracted out and tested showed that it had presence of RAF (Rheumatoid Arthritis Factor) (Rauschning, W. 1980).

Dixon and Grant found and described 4 patients out of 20 who had rheumatoid arthritis along with Baker's Cyst in one of the knee joints. The patients included in the study came to the outpatient clinic with painful swelling in the middle third of the calf muscles which later disappeared. In these patients there were clinical signs of thrombophlebitis and thus were included in the study. In these patients they diagnosed acute synovial rupture of a knee effusion into the calf muscles of the affected side. The author emphasized the fact that the cyst should be differentiated from thrombophlebitis on an urgent basis so that early diagnosis of the Baker's Cyst can be made. The research also highlighted that any joint effusion without any previous history of injury or surgery should be considered a Baker's Cyst. The researcher also described the fact that there was a valvular mechanism at the level of knee joint and cyst which explains why patients feel pain in knee joint. The buildup of intermittent pressure in the knee joint leads to effusion and thus the herniation of the synovial membrane. The valvular mechanism and the presence of the slit like opening which got closed when the knee is in extended position explained the fact that there was no relief of pain in this position (GBW Tait, F Bach, ASJ Dixon.,1965).

Hall and Scott studied 20 patients of rheumatoid arthritis who got selected in the time span of 2 years. The study was done retrospectively in which the patients were selected solely on the complaints of knee joint pain and swelling. Exclusion criteria contained patients who had a previous history of any direct injury to the knee or those who had any medical procedure or surgery. Among them 4 had cysts present in their knee joint in

which either the cyst was intact or ruptured. The method used to diagnose the cyst is simple clinical examination in the procedure room. This method had been used by Beatty (1959) Harvay and Crocs (1960) and Tait, Bach, and Dixon (1965). Contrast medium was injected in the effected knee joint and later studied microscopically for better results. Two cases were sera-positive rheumatoid arthritis which leads to the conclusion that Baker's Cyst was also a common finding in the disease (Hall A.P., 1966).

Mundinger et al from the department of radiology in a general hospital of Germany conducted research. Research was published in which a case control study was presented in which 52 patients with rheumatoid arthritis and 22 patients with spondyloarthropathy were taken along with the same number of control patients in the time of two years. The imaging technique used was MRI and plain X rays. All MRI examinations were cross checked by two radiologists for the absence or presence and localization of joint effusion synovitis and erosions. The research demonstrated that erosion, narrowing of joint space and Baker's Cyst were significantly higher in MRI finding in patients with rheumatoid arthritis than spondyloarthropathies. Additionally, patients with diagnosed rheumatoid arthritis had more extensive erosions, short multi compartment effusion that typically included the posterior compartment. Similarly, more osteophytes masses were found in the posterior compartment in the rheumatoid arthritis patient. The most remarkable feature in the rheumatoid arthritis group was combination of bone destruction, osteophyte formation and presence of moderate to severe extrudes in more than half of the patients in sample size. Arthritic lesions of the knee were found in up to 70% of patients with rheumatoid arthritis three years after disease onset which was the greatest finding in the history of rheumatology. The radio graphic changes of periosteal reactions and fibrositis as well as preservation of bone density were more likely to occur in ankylosing spondylitis and psoriatic spondylitis than in adult rheumatoid arthritis. The data concluded that patients with rheumatoid arthritis had more severe signs of destruction on MRI with larger and more frequent erosions than spondyloarthropathies. The clear imaging shown by MRIs had greater advantage on giving a clean picture of osteophyte formation and thinning of cartilage as compared to conventional radio graphic methods. The higher frequency of Baker's Cyst and osteophyte formation was clearly higher in rheumatoid arthritis patient's group.

The author also mentioned that almost 3 patients in the case study had shown allergic reaction to the dye injected in the knee joint so clinicians need to be very careful in usage of the imaging technique and should first try a less invasive method. (Mundinger, A. et al., 1991).

Suradia along with fellow colleagues conducted research on the topic of rheumatoid arthritis. It was a case control study in which 36 patients took part who had diagnosed rheumatoid arthritis and 50 cases were taken as control. Bilateral knee scans were taken in patients who have rheumatoid arthritis either active or non-active. The parameters which author included were synovial thickness, gap between the joint and assessing the cartilage condition by detecting any blurring in the outer membrane of the articular cartilage present in the knee joint. Knee inflammation was assessed by physical examination. Some patients showed signs of inflammation while those who had no signs of inflammation were marked as non-active. In all patients' plain X-ray radiograph was taken in the frontal and lateral projection. Which was later compared with the ultrasound radio graphic results on the same day. The author concluded by mentioning that rheumatoid arthritis was a chronic disorder which led to changes in the synovial membrane across the articular cartilage and can erode the bone at the osteochondral junction. The author also mentioned that various non-invasive diagnostic methods had been suggested for detecting the presence of synovial thickening before the advent of any change that can be appreciated on radiograph. It was also mentioned that the extent of changes taking place in rheumatoid arthritis were better seen with magnetic resonance imaging, but ultrasound was a simple and relatively inexpensive method that shows the same result. Ultrasound accurately gave the result in the extent of remedied involvement of soft tissues in the knee. It also helped in differentiation between normal knees found in the control cases as compared to the rheumatoid affected knees. Synovial thickening was statistically greater in rheumatoid arthritis patients than in control suggesting the active stage of disease. The author also emphasized on using of ultrasound machines as a sensitive technique for detecting the presence of small suprapatellar effusions which was high in this study which was not visible on physical examination. The author also stated that ultrasound had demonstrated accuracy and reliability in the evaluation of joint inflammation in rheumatoid arthritis affected knees.

It also enabled declination to find out the accidental findings like Baker's Cyst, which in this case was present in almost half of the cases (Sureda D., 1994).

Andonopoulos along with fellow colleagues in a multi cantered study aimed to determine the prevalence of Baker's Cysts, in patients with rheumatoid arthritis (RA) using high-resolution ultrasonography, which is a sensitive and non-invasive imaging technique. Ninety-nine consecutive patients with RA were included in this study. After undergoing routine clinical and laboratory evaluations, knee radiographs and ultrasound examinations of both knees, including the popliteal fossae and calves, were performed. The presence of Baker's cysts was assessed. Among the participants, 47 patients (47.5%) had a Baker's Cyst, and a total of 67 out of the 198 knees (33.8%) were affected. Notably, 4 of the 67 cysts were found to be ruptured. Clinical diagnosis had only identified 29 out of the 67 cysts (43.3%). Statistical analysis revealed a significant correlation between the presence of a Baker's Cyst and both clinical and radiologic involvement of the knee due to rheumatoid arthritis. Furthermore, a highly significant association was observed between the presence of a cyst and ultrasonographical detected joint effusion. The findings of this study demonstrate that Baker's cysts were highly prevalent in patients with RA, often escaping clinical detection. However, the use of high-resolution ultrasound scanning in the affected area can overcome this limitation. This imaging technique was simple, highly sensitive, and non-invasive, making it a valuable tool for diagnosing Baker's Cyst. It has wider utilization by clinicians and was recommended as it can help identify these cysts, which may occasionally lead to significant morbidity. This study revealed the common occurrence of Baker's cysts in patients with RA, highlighting the limitations of clinical detection. High-resolution ultrasound scanning emerges as a straightforward, highly sensitive, and non-invasive approach to address this issue. Therefore, it was crucial for clinicians to incorporate this imaging technique into the diagnosis of Baker's Cysts, as these cysts can have considerable clinical implications. By employing ultrasonography, clinicians can improve the accuracy of diagnosis and enhance patient care in cases involving Baker's cysts (Andonopoulos et al., 1995).

Department of Paediatrics, Rheumatology Unit, University of Florence, Italy published a study where 49 paediatric patients were selected. Among them 31 were females and

18 were males in the time from February 1993 to September 1996. The patients were selected on the basis where they had knee joint restricted mobility due to the presence of pain and swelling. The main objective of the study was to find the correlation between clinical and ultrasonography finding of the presence of Baker's cyst in juvenile rheumatoid arthritis. Wilcoxon and Spearson's test were used. The whole sample size was further divided into two groups based on the active and non-active disease. These two groups were later passed through the ultrasonography for the diagnostic purpose. The results showed increased joint effusion and synovial thickness in groups with active disease. Thus, leading to the conclusion that patients who had active stage of the disease were more vulnerable to the formation of the Baker's Cyst. Therefore, clinicians should be more concerned with any joint effusion suspected in these patients (Bianchi et al., 1998).

Handy along with a fellow colleague conducted a seminar in arthritis and rheumatism in which he gave many aspects of the prevalence of Baker's Cyst in rheumatoid arthritis. Four hundred consecutive MRI were conducted in the department of radiology in a local hospital setting where patients were considered who came to the outpatient clinic with the presenting complaint of knee joint pain and clinical positive Foucher's sign. Seventy seven percent of sample size had Baker's Cyst and rheumatoid arthritis along with other spondyloarthropathies. This study excluded osteoarthritis to emphasize more on the prevalence of Baker's Cyst in other knee diseases except knee osteoarthritis. The result was obtained by using three different techniques which include MRI, arthrography, and ultrasound. It also highlighted the fact that arthrography was not suitable for the diagnosis of Baker's Cyst as the injection of dye and the volume of air in the effected knee joint can increase the joint space and popliteal bursa thus effecting the result of the imaging technique. The study also focused on the age parameter of the diseased patients which is more in elderly patients as well as in those have severe advancement of the disease. In young patients the cyst develops because of inwards derangement but in elderly patients it is rather as extension of the joint itself as a protective mechanism. Of all the diagnosed cases of cyst there was a strong correlation between joint effusion and cyst as this can be the early sign of development of cyst. The author also suggested that the use of ultrasound should be promoted in the clinical

practice of rheumatology as it can help in the early diagnosis of joint effusion leading to the Baker's Cyst (Handy J, J. R., 2001).

Sato along with 4 other companions conducted a study in the hospital of Japan in the orthopedical unit of a medical school. In this study 106 patients were taken under study who came to the clinic of orthopaedics with the complaint of swollen legs either one or bilateral in the time of 3 years. They concluded that the leading cause of pain and swelling in these patients is either deep vein thrombosis or Baker's Cyst. They also found that most of the swelling were in left leg where female is more prone to the finding of Baker's Cyst. The instrument used for these findings was ultrasonography. They also highlighted that midcalf ultrasonography in patients of rheumatoid arthritis should be mandatory in all clinical settings after the physical examination in patients who come to the outpatient clinic with the complaint of swelling leg (Sato et al., 2001).

Giovagnero along with two other fellow colleagues conducted a pilot study in the local hospital setting of Italy. The study was conducted for a year where 22 patients were selected and were later followed with their clinical findings. The patients had the inclusion criteria of having pain in leg and swelling in the ankle region. The presence of hypervascularity, effusion and presence of Baker's Cyst were recorded. Disease activity of the involved individual was recorded by the c-reactive protein, sideremia, erythrocyte sedimentation rate, white cell count and haemoglobin. The study included patients with osteoarthritis, rheumatoid arthritis, and psoriatic arthritis. The instrument used to analyze this patient was sonography. The results were later analyzed by using the student's t test for unpaired data and the Chi-squared test. They found that all patients showed signs of synovial thickening and cartilage corrosion in the affected knee. Fourteen among them had joint effusion and 6 had Baker's cyst. Most of the patients showed various degrees of hyperaemia. They also concluded that joint effusion needs to be closely monitored in patients with arthritis i.e., osteoarthritis, rheumatoid arthritis and psoriatic arthritis which can further lead to formation of Baker's Cyst (Francesco Giovagnorio, Carlo Martinoli & Giulio Coari 2001).

Musculoskeletal ultrasonography had emerged as a valuable tool in rheumatological practice, providing real-time imaging of joint structures and complementing clinical

examinations. In this study, the author aimed to compare the effectiveness of ultrasonography and clinical examination (CE) in detecting knee effusion, suprapatellar bursitis, and Baker's Cyst in patients with rheumatoid arthritis. The goal was to determine whether ultrasonography could offer additional clinical information beyond what can be obtained through traditional clinical examination. A total of 22 patients diagnosed with RA according to the American College of Rheumatology criteria were included in the study. Each patient underwent independent clinical examination and ultrasonographic examinations of both knees to assess the presence of suprapatellar bursitis, knee effusion, and Baker's cyst. The clinical examination was conducted by an experienced rheumatologist using standard techniques. Patients with a history of knee surgery were excluded from the study. A total of 44 knees were examined (one patient was unable to undergo prone US of the popliteal fossae). The results showed that the US detected soft tissue abnormalities (suprapatellar bursitis, knee effusion, or Baker's cyst) in 54 out of 130 knees, while clinical examination identified such abnormalities in 36 out of 130. Specifically, the US detected suprapatellar bursitis in 17 cases (39%) out of 44 knees. By using simple technique of clinical examination only the clinician was able to detect Baker’s cyst in only 7 cases. Ultrasound was able to detect minor knee joint effusions which were present in 27 cases out of all sample. Additionally, the US identified Baker's cysts in 10 cases (23.81%) out of 42 knees, while clinical examination only detected 2 cases (4.76%). When considering US of the knee as the gold standard, clinical examination demonstrated specificity but lacked sensitivity in detecting soft tissue abnormalities in the knee joints of RA patients. These findings suggest that the US was more sensitive than clinical examination in detecting suprapatellar bursitis, knee effusion, and Baker's Cyst in patients with RA. Clinical examination tended to underestimate knee inflammation in RA. These results have implications for the use of clinical examination as part of standardized disease activity scores and in guiding knee joint aspiration. Incorporating US into routine assessments can enhance the accuracy of diagnosing and monitoring knee joint involvement in RA, leading to more informed treatment decisions (Kane D, Balint PV, Sturrock RD., 2003).

Jovanovi conducted a study in Banja Luke State establishing an association between Baker’s cyst and rheumatoid arthritis. For these 124 patients were selected which were divided into groups based on presence of knee arthritis (82) and no knee arthritis (42).

The patients with knee arthritis showed the incidence of Baker's Cyst in 54 of patients showing a strong correlation between disease and Baker's Cyst. Other included parameter were presence or absence of rheumatoid factor IgM class (RF) and C-reactive protein (CRP) (Jovanovi et al., 2004).

Chávez-López et al in Mexico and Spain conducted medical research on patients of the Rheumatoid Arthritis. They took 40 patients including both men and women. The patients were first evaluated by physical examination followed by musculoskeletal ultrasound in which 12 patients had Baker's Cyst. The outstanding part about this research paper was that 3 different ultrasound machines and data were analysed in which all of them gave the same result. Joint effusion was also found in 35 patients which was later corroborated by the findings of the ultrasound machine. They concluded that the physical examination showed acceptable diagnostic accuracy for the clinician and the complementary use of the muscular skeletal ultrasound can change the therapeutic and diagnostic approach in patient with rheumatoid arthritis and Baker's Cyst. (Chávez-López et al., 2007).

A retrospective study by which 998 patients were taken under the study who visited the outpatient clinic in 3 different hospitals setting in a local area. The study comprised of old records of patients visiting the same hospital. All the patients were diagnosed with cases of Baker's Cyst, and they were followed for 20 years. The findings of the study included that the right knee was more involved in frequent development of Baker's Cyst. They also concluded that the patients of rheumatoid arthritis had high prevalence of Baker's Cyst especially in patients who had the same cyst in previous record of their disease. They also included that Baker's Cyst should be considered a highly susceptible finding in the physical examination of rheumatoid arthritis patient. It should be treated with conservative or preventive treatment regime before it extended downward more in calf muscles and become giant Baker's cyst and lead to more complication like compression, rupture, and pseudo-thrombophlebitis (Massoud Saghafi and Azita Azarian 2008).

Chiuo et al issued research in the international journal of rheumatology. The study consisted of the retrospective study in which patients with primary osteoarthritis took

part. For the study purpose ultrasound machine was used. The research stated that the number of patients who were diagnosed with Baker's Cyst by clinical examination as well through ultrasound were far greater than the number of patients who were diagnosed with Baker's Cyst by just clinical examination. This finding illustrates the fact that the use of ultrasound for diagnostic purposes had shown some remarkable results. The study also stated the joint effusion is usually the primary finding in the development of Baker's Cyst, thus a statistically significant correlation was present. The association between osteophytes and Baker's Cyst is one of the remarkable findings of this research as it showed that the altered biomechanics of the knee joint due to the presence of the osteophytes was enough to squeeze out the small amount of the synovial membrane into the potential space between the two muscles and thus resulted in the formation of the Baker's Cyst. The presence of synovitis can also be detected by ultrasonography and thus can lead to excessive formation of the synovial fluid leading to the formation of the Baker's Cyst because of the defense mechanism against the increased pressure. Thus, a statistically significant association was found in between two variables (Chiou et al., 2008).

Kwak along with fellow colleagues conducted research in the local hospitals of Korea. It was a multicentred retrospective study where 197 patients took part. All these patients visited the outpatient department. All patients who visited the orthopaedics and rheumatologists were selected based on presence of calf symptoms. Exclusion criteria contained patients who had varicose vein or patients who had direct injury to the knee joint or patients who had any surgical procedure done on the knee joint. The patients record of physical examination were taken after detailed clinical insights. All the patients had swelling and pain on the posterior side of the knee. The images were taken retrospectively using MRI, arthropathy and Ultrasonography. The results stated that the patients had DVT (deep vein thrombosis) as the leading cause of the calf symptoms in patients. Another leading cause was the Baker's Cyst. Where there was presence of complicated ones as well including the presence of septations and ruptured ones. The ruptures ones were identified as the cystic mass visible as opened mass and whose cystic covering were going into the fasciae of the muscles of calf. The ruptured
Baker's Cyst also had the presence of clinical symptoms of pain and swelling. Haemorrhage in the complicated cyst were also present and were identified by MRI,

arthropathy and US. The author concluded the study by stating that the leading cause of the calf symptoms was deep vein thrombosis, another cause was the ruptured Baker's Cyst. The ruptured ones were caused by exercise or too much use of the calf muscles without any support. The complicated and post rupture of the Baker's Cyst was also one of the main causes of the clinical symptoms of the intense pain and swelling. The author also mentioned that any patients with clinical signs and symptoms of calf muscles should go through ultrasonography to eliminate the chances of ruptured cyst. As it was the fastest way of diagnosis and can be used to prevent the further progress of the cyst where it can cause compression symptoms and pseudo thrombophlebitis. The author also mentioned that during the process of arthropathy injected dye can sometimes make a false cyst which gives impression of the Baker's Cyst. This phenomenon can reduce the sensitivity of the test from dissecting this cyst. The patients who had complicated Baker's Cyst were diagnosed with cases of rheumatoid arthritis, Osteoarthritis, and psoriatic arthritis. Mentioning the disease, the author emphasized the use of ultrasonography mandatory for these patients during routine checkup for the follow up of disease prognosis (Kwak et al., 2008).

The research published included 100 Pakistani patients who were selected with knee joint pain in a single centre study conducted in the Afro-Asian hospital of Lahore for one year period from December 2007 to December 2008. Patients were selected because of the presence of pain and swelling on the posterior side of the calf muscles. Patients were selected from the outpatient department who visited the rheumatology department with complaints of knee joint pain. Patients were already diagnosed with cases of osteoarthritis, rheumatoid arthritis and spondyloarthropathies. Sixty five percent of the cases were diagnosed with Baker's Cyst showing high prevalence in above mentioned diseases. The objective of the study was to focus on the use of ultrasonography as a cheap and reliable source of investigation. Beside the cheapest and simplest way of testing the dynamic of ligaments and tendons, high-resolution imaging of internal tendon structures and the capacity to distinguish collections of fluid makes the ultrasound a better choice in knee joint investigation (Chen et al., 2010).

Yeh published research in which they worked on the frequency of ruptured and non-ruptured Baker's Cyst. The sample size was 198 which was collected in 3 years from

the department of radiology in collaboration with the rheumatology department. Non ruptured Baker's Cyst was found mostly in osteoarthritis. The other leading causes were RA and spondyloarthropathies. Ruptured Baker's Cyst was present in high number in Rheumatoid arthritis and then OA followed by spondyloarthropathies leading to potential complications. These all-clinically diagnosed Baker's Cyst was done by ultrasound imaging technique. (Yeh et al., 2010).

Rienete along with his fellow colleague researched and found the pathological findings of the knee joints in rheumatoid arthritis with the clinical assessments. Hundred patients were included in the study. The parameters included were signs of synovitis, knee effusion, synovial proliferation, bone cartilage, femoral cartilage abnormalities. These parameters were assessed by clinical evaluation and ultrasonography. Calf muscles were also evaluated for the Baker's Cyst. Joint effusion was present in 70% of the cases. Eighty-two percent of the cases had synovial hypertrophy. Pyrophosphate crystals were present in 3 patients in the form of hyperechoic region in the cartilage region. Thirty three percent of the patients had Baker's Cyst found in the cases. The clinical findings were then evaluated by ultrasound findings. The author concluded that ultrasonography was more sensitive than the clinical examination for the assessment of joint inflammation. It also helped in identification of the different patterns for the pathological changes happening at the knee level which can further lead to the formation of Baker's Cyst. It can also be a keen tool in the detection of the early changes at both the structural as well as the tendon level (Riente et al (2010).

Ward along with fellow colleagues did research in North America where it was a single cantered study. The objective of this study was to assess the ability of sonography to reveal Baker's Cyst using MRI as a comparison. Here 36 patients were included having 36 consecutive knees. The inclusion criteria involved patients who had a history of Baker's Cyst. The MRI all these patients needed were taken retrospectively and then was compared with the sonographic image of the same knee. Both the scan and sonography were then compared to find any association in between them. The specificity and sensitivity were 100% which shows promising result. The author concluded the study by mentioning that MRI was a gold standard for the identification of Baker's cyst and demarcating it from the sarcomas present in the knee region. The

research also mentioned that sonography is an emerging technique in which early detection of Baker's Cyst was possible without any intervening technique (Ward et al., 2001).

Neubaeur along with his colleagues from same department conducted research based on rheumatoid arthritis and Baker's cyst. The researcher took over 80 patients which have unexplained knee joint pain and swelling and have no known disease, over the extended period of 7 years followed retrospectively. Later found that Baker's Cyst was present in 55 of them. The patients were examined through both MRI and ultrasound and a few conclusions were made. Most common cause of the cyst was osteoarthritis which was almost the half of the cases in the selected sample. The second leading cause was rheumatoid arthritis followed by spondyloarthropathies. These diagnoses were later confirmed by doing some diagnostic tests required for specific diseases. Age and gender had no correlation with disease and cyst development. The purpose of the researcher was to make a comparison between MRI and ultrasound. The author concluded that ultrasound was easier, less invasive, and more efficient imaging technique as compared to MRI. The highlight of the research published was that ultrasound had the additional feature of showing joint effusions which were not detected by the MRI. Ultrasound was also giving a greater look into the cyst by adding echogenicity as a remarkable feature of the cyst. The fact that it saved the patient from injecting any medium and the possible hazardous hypersensitivity caused by the dye was also mentioned. Most pronouncing factor was the time saved by ultrasound in detecting the cyst was very crucial in this regard and prognosis of complications (Neubauer, 2011).

Alessi published research where a study was conducted in 16 patients with diagnosed Baker's Cyst. The imaging technique used was ultrasonography. The study concluded that 9 patients who had Baker's Cyst were later diagnosed with arthritis. The finding clearly stated that patients with arthritis were more prone to formation of Baker's Cyst.

The study also concluded that all the patients who had Baker's Cyst and arthritis had hyperechoic region along with hypertrophic synovium found on ultrasonography. The lesion was unilateral in patients with arthritis. Joint effusion was the common complaint

of the patients included in the research. The study also added that hyperechoic region clearly depends on the presence of debris, synovial calcification, and fibrous connective branches. The study further added that the imaging technique can be used as ultrasonic guided drainage of the cyst using a needle or syringe. It also stated that the size of the cyst was in close relation with the advancement of the disease (Alessi et al., 2012).

Picerno conducted research with the objective of finding the prevalence of Baker's Cyst in patients of knee joint pain and to find the correlation of Baker's Cyst with joint effusion and osteophytes. In this study 399 patients were taken who visited the department of radiology with complaints of knee pain either unilaterally or bilaterally. The results included the presence of osteoarthritic changes in the joint in close association with the prevalence of Baker's Cyst, which in this study was 102. The study also revealed that the presence of osteophytosis in the ante femoral area of the knee joint was highly correlated to the Baker's Cyst. The study also stated that patients who had higher degree of knee joint effusion were more prone of developing Baker's Cyst. However, a small percentage of the patients showed no signs of osteoarthritis clinically, but presence of the Baker's Cyst was suggestive of the disease after ultrasonographic detailing. A correlation of the increasing age was also found among the increasing age of patient and prevalence of Baker's Cyst. Gender proved to be an independent factor with regards to the cyst. Use of ultrasonography was highly appreciated in finding osteophytes and varying degree of osteoarthritis. It has sensitivity to the MRI and similarity of results was also appreciated among the authors of the research (Picerno et al., 2013).

Saghafi along with a fellow colleague published research in Iranian international journal of Rheumatology. In this study 40 patients were included who were followed retrospectively over the time of 20 years. The study concluded that rheumatoid arthritis is the most common prevalent disease in patients with diagnosed Baker's Cyst and was present in 21 of the sample size. The second most leading cause was spondyloarthropathies i.e., ankylosing arthritis and psoriatic arthritis and was 10 in number. A large frequency of patients came with signs of pseudo-thrombophlebitis which made it the most prevalent presenting feature of patients with giant Baker's Cyst. Predisposing factors were evaluated through a questionnaire which concluded that

patients who have recent exacerbation of physical activity and those who had more advanced disease showed more prevalence towards formation of cyst. Prevalence was more found in left knee and 4 different imaging techniques were used which includes MRI, arthrography, ultrasonography, and CT. Among all these imaging technique ultrasounds was the popular one due to being cost effective, easy to perform and non-invasive procedure (Saghafi & Azarian, 2013).

The journal of rheumatology published research based on a retrospective study on rheumatoid patients, who were registered in the hospital and had been given treatment for rheumatoid disease only. The sample size was 300 which included both genders. The objective of the study was to find the frequency of Baker's Cyst in rheumatoid arthritis, and it was found in more than half of the cases. They also found that there was no association of size of the cyst with the advancement of the disease, the diameter of the cyst was not associated with the incidence of rupture of cyst. The research also stated that there was no easy way of finding Baker's Cyst just on physical examination. A common practice of introduction of ultrasonography should be induced in patients with knee joint pain and swelling without any apparent injury. Clinicians should also be alerted regarding this common complication of RA which can later be accompanied by morbidity (Lin et al., 2015).

In this research only patients with psoriatic arthritis were included which were chosen in a multicentered study. Eighty-three patients were taken into consideration who were diagnosed with psoriatic arthritis early. The patients were both outpatient and in-patient and exclusion criteria involved any severe trauma or injury to the knee joint. The patients first went through the physical examination and then later assessed by ultrasonography. The parameters include joint effusion, synovial hypertrophy and inflammatory signs present on the cartilage. The results coincided with the findings of clinical findings, where inflammatory signs were evaluated by both ultrasound and clinical examination. More than 80% of patients had joint effusion. Signs of inflammation were present in 50 cases and interestingly 26 patients among them have Baker's Cyst present in them. Knee involvement was found in less than half of patients and was not a common finding. Synovitis was also not a common finding present in psoriatic arthritis. Findings were consistent with both genders (Delle Sedie, 2015).

In this prospective cohort study, the aim was to assess the outcomes of Baker's cysts and their associated symptoms following total knee arthroplasty (TKA) through ultrasonography. A total of 102 patients with confirmed Baker's cysts, primary osteoarthritis, and scheduled for TKA were included in the study. Ultrasound examinations were conducted to determine the presence and size of the cysts before and one year after the TKA procedure. Additionally, the patient's symptoms related to the Baker's cysts were recorded before and after the surgery. After one year, it was observed that 87 patients (85%) still had Baker's cysts, despite undergoing TKA. However, there was a significant decrease in the occurrence of associated symptoms caused by the cysts. Prior to the surgery, 71% of the patients reported symptoms, whereas after the procedure, only 31% experienced such symptoms. Encouragingly, none of the patients developed new symptoms associated with Baker's cysts following the surgery. However, it is important to note that among the 72 patients who initially reported symptoms related to the Baker's cysts, 44% still experienced these symptoms even after one-year post-surgery. This suggested that TKA may not entirely resolve the cyst or alleviate all associated symptoms in a significant number of patients. In conclusion, this study highlighted the limited resolution of Baker's cysts following TKA. Further research is warranted to better understand the factors influencing the outcomes of Baker's cysts after TKA and explore potential interventions to improve their resolution and alleviate associated symptoms. The author strongly emphasized the use of ultrasonography in diagnosis and resolution of the Baker's cyst (Hommel, 2016).

The state of Netherland conducted a population-based study in which 1285 patients took part which fell in the category of inclusion criteria. Age limit was 45-60 years and body mass index were 30 kg/m² and among them 177 had symptomatic osteoarthritis. Sagittal magnetic resonance imaging was obtained in the patients. Baker's Cyst was present in most of the symptomatic osteoarthritis patients with regression coefficient of 0.029 showing a strong correlation between the osteoarthritis and prevalence of Baker's Cyst. Other structural abnormalities were also considered in this study which were presence of osteophytes in the medial trochlear facet and effusion (Visser et al., 2016).

Venables along with fellow researcher published a study on clinical manifestation of Rheumatoid, arthritis in which 29 patients were selected who were diagnosed with hematite arthritis according to American Association of Rheumatoid Arthritis. In this study the author took the finding of Baker's Cyst and joint effusion in patients. The author concluded that ultrasonography is an alternative sensitive imaging technique whose result can be compared to MRI, both the imaging technique can be used to check the joint effusion and the extent of damage of inflamed tissue. Both imaging techniques can be used to find the features of inflammation in patients in which there is no visible tenderness or swelling found on physical examination. They also mentioned in the study that ultrasonography can be used to access the small joints present in the hand which may become affected early in the course of the disease (Venables, 2016).

Remnev from the department of rheumatology collected 397 patients who were clinically diagnosed with cases of rheumatoid arthritis and spondyloarthropathies. These patients were followed retrospectively and were analysed by questionnaire. The study emphasized the fact that patients who were ignored for minor Baker's Cyst had a reoccurrence rate higher than those who were treated for the cyst. The author also focused on the fact that patients who were aspirated under the guidance of ultrasound had more success rate of better result as compared to those who were injected with drugs. In conclusion, these facts author focused on the role of use of ultrasound not only for diagnostic purpose but also for therapeutic measures (Remnev 2017).

An Egyptian researcher who studied the association between the prevalence of Baker's Cyst and osteoarthritis among female patients. One thousand, five hundred and sixty-eight patients participated in the study through a questionnaire, among them 203 had Baker's Cyst which was confirmed by ultrasonography in the year of 2016. It was a cross sectional study pattern. Baker's Cyst was more common in patients who reported the fact that the disease was 5 or more years old. Patients with large effusion rate showed more prevalence than those with moderate or low amount of effusion (Ahmad et al., 2017).

Yang along with fellow researchers published a study where they collected 257 samples in four years' time i.e., from 2006 to 2010. The prevalence of bilateral cysts was 5.9–27.3% across its different etiologies. They found that the most common cause of Baker's Cyst was osteoarthritis (53.5%), while the most common cause of a ruptured Baker's Cyst was RA in women (47%) and gout in men (35%). The relationship between the etiology of Baker's Cyst and its clinical manifestation included gender, size of cyst, symptoms, physical examination, and complication. Data was analyzed using Pearson correlation coefficient, Student's t test, one-way ANOVA, and multiple logistic regression. The etiology of Baker's Cyst was different between the two different genders. For early detection, musculoskeletal ultrasonography should be performed in patients with advanced knee effusions. In addition, patients with a Baker's cyst in one knee, should be examined for the contralateral side. The technique of ultrasonography was used (Yang et al., 2019).

A university hospital in Korea conducted a study where 62 patients with diagnosed cases of rheumatoid arthritis visited the department of Radiology between the year 2010- 2018. It was a case control study so 50 cases were selected as controls. The study concluded that the prognosis of rheumatoid disease and the enlargement of the Baker's Cyst were significantly related. It also stated that more progressed the disease, the more joints were involved which led to more enlargement of the cyst. Larger cysts lead to more involvement of systems and eventually lead to more chances of rupture of cyst leading to infection in involved area of the calf muscles (Wang Zengzeng, Ting, Min, 2019).

Varma had conducted a study in the small population of the province of Guajarwala, India where 25 patients of paediatric population of which 15 were males and 10 were females were included. They visited the hospital and were admitted with the complaint of knee joint of one side or both plain X-ray and ultrasonography were used to detect the presence of Baker's Cyst. All of them were diagnosed based on their findings in the images obtained from the diagnostic tests. Among them 7 had rheumatoid arthritis which led to the conclusion that basic diagnostic tests like X-ray and ultrasonography can be used to detect Baker's Cyst which was the second most common cause of the knee join pain (Varma & Pandey, 2019).

A single cantered study was conducted in South Korea which was done retrospectively, 4 patients were selected in which osteoarthritis and rheumatoid arthritis was present along with Baker's Cyst. They visited the OPD and later got admitted in the department of rheumatology in one year duration in which cases were studied along with their different lines of treatments and the conclusion was made that etiology of the Baker's Cyst was equally related to osteoarthritis and rheumatoid arthritis (Yang et al., 2019).

Park published research based on a study where a comparison between the simple Baker's Cyst and complicated Baker's Cyst was made. The study was based on 45 Baker's cysts which were identified after a review chart in the period of 4 years. Two subgroups were made where simple Baker's Cyst were classified where no septations are present and complicated Baker's Cyst were marked where more than two septations are present in the cyst cavity. The author concluded there is more suprapatellar effusion in complicated Baker's Cyst in comparison with simple Baker's Cyst. The cases were then followed prospectively for two years after the ultrasound results had been taken. Patients with complicated Baker's Cyst later developed rheumatoid arthritis while patients with simple Baker's Cyst soon developed osteoarthritic changes. The imaging technique used in the study was ultrasound (Park, Gi-Young, Kwon, 2020).

Saghafi published research in the Iranian journal of rheumatology emphasizing on relationship between giant Baker's Cyst and rheumatoid arthritis. The author took 993 patients who were selected retrospectively in the last 20 years. The patients were selected based on the painful lower leg thrombophlebitis and ecchymosis along with the history of rheumatoid arthritis. These patients were then classified later by the imaging technique of both X ray and ultrasonography. Among them 23 patients had giant Baker's Cyst in which female ratio was more. The right knee was more involved than left one. The author concluded in the given study that Baker's Cyst was a more frequent finding in rheumatoid arthritis. The older the disease was, the bigger the size of the cyst. Clinician should be concerned about any swelling which had no history of direct injury or surgery, the clinician should make sure that all patients diagnosed with rheumatoid arthritis in knee should go through regular examination of ultrasonography to exclude any joint effusion and Baker's Cyst. Recurrence of the cyst happened in patients who do

not take any measurement in prevention and development of Baker's Cyst. Pain was a major contributor to disability in individuals with knee osteoarthritis. While conventional radiography was commonly used to assess this condition, it often failed to correlate well with pain severity. However, ultrasonography offered a promising alternative by allowing the evaluation of soft tissue structures in the knee that may be associated with pain (Saghafi & Azarian, 2020).

This cross-sectional study aimed to assess pain-related soft tissue structures in the knee using ultrasonography. A total of 99 patients with knee osteoarthritis, contributing to 198 knees, were included in the study. Pain and functional status were measured using the visual analogue scale (VAS) and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Ultrasonography was utilized to evaluate cartilaginous thickness, knee effusion, and the presence of Baker's Cyst, with a specific focus on their correlation with pain. The findings revealed that Baker's Cyst was significantly more prevalent in symptomatic knees (13.9%) compared to asymptomatic knees (2.5%). Patients who presented with Baker's cyst demonstrated a significantly restricted range of knee flexion, higher resting VAS pain scores, and worse WOMAC scores when compared to those without Baker's Cyst. Furthermore, long-linear analysis indicated that the presence of Baker's Cyst increased the risk of pain by approximately 2.94 times. Ultrasonography proved to be a valuable and easily accessible imaging modality for investigating factors associated with pain in knee osteoarthritis. Not only was it cost-effective, but it also avoided the risks associated with radiation exposure. By allowing for the assessment of soft tissue structures, ultrasonography provided valuable insights into the underlying mechanisms of pain in knee osteoarthritis. In conclusion, this study demonstrated the utility of ultrasonography in evaluating pain related soft tissue structures in individuals with knee osteoarthritis. The presence of Baker's cyst was found to be significantly associated with pain, limiting knee flexion, and poorer functional outcomes. Ultrasonography offered a non-invasive, cost-effective, and radiation-free approach to identify and assess factors contributing to pain in knee osteoarthritis. This information can assist clinicians in developing targeted treatment strategies and improving patient management for this debilitating condition (Kandemirli, Basaran, Inceoglu, 2020).

Hommel in Germany issued research which included 105 patients in single cantered study. The study was conducted prospectively and followed for over a year, all were diagnosed cases of osteoarthritis and shows posterior or anterior effusion, which were either moderate or severe. Among them 85% developed Baker's Cyst and were symptomatic. They were then followed up for 5 years. And were monitored by ultrasonography for the development of Baker's Cyst. The parameters included were Body Mass Index (BMI) and age of patients. Another unusual parameter was involvement of size of the cyst before and after treatment. The author concluded by mentioning that there are many factors that lead to the formation of the cyst including the valve like mechanism where there is an unusual increase amount of fluid in the area around knee joint as well as intra-cystic area, the unidirectional flow due to the valve is the main cause. The author also mentioned that prognosis of the cyst needed to be informed to the patients suffering from it as the resolution of smaller cyst are common but not of larger size cyst (Hommel et al., 2020).

Abbasi conducted a study in which 169 patients were included who came up with the complaint of knee pain for more than 3 months. Both male and female gender with age more than 18 years were included in the study. Exclusion criteria were trauma joint surgery and any inflammatory condition like osteoarthritis. All the patients underwent ultrasonographic examination and were analysed by a senior consultant radiologist. One hundred and nine patients had sonographic evidence of Baker cyst. In the discussion part of the research the author concluded that sonographic evidence of Baker's Cyst was found in more than 24% of patients. The study also concluded that there is a positive correlation between the size of the Baker's Cyst with underlying severity of inflammatory condition. The study also stated that Baker's Cyst was more commonly found in females due to high prevalence rate of osteoarthritis. The author also concluded that ultrasonography detected abnormal signals originating from the joint menisci and ligaments. Ultrasonography had the advantage that it detects small morphological changes not even visible on clinical examination or conventional radiographs (Abbasi et al., 2023).

An Irish study included 13 patients which were selected in the time of 2 years. These patients were selected when they visited three different hospitals in the department of

radiology. The patients were all then classified as having giant Baker's Cyst by the imaging technique of both X ray and ultrasonography and then later confirmed by magnetic resonance imaging MRI. Three imaging techniques were used to diagnose the signs of disease better. The patients were later divided into two groups where two different methods for treatment of Baker's Cyst were done. In the first group there was simple aspiration done by physical examination and in another group, there was ultrasound guided bursography. The patients were later followed up on telecommunication for the checking of results of both types of treatment. The author pointed out that MRI was a preferred imaging technique for the findings of diverse types of pathologies related to the formation of the Baker's Cyst. But ultrasonography was the preferred method for early diagnosis in no time. The success rate of ultrasound guided aspiration was also more as compared to the other group. Thus, making it a preferred way of imaging technique for the treatment as well (Stroiescu et al., 2023).

2.1 OPERATIONAL DEFINITION

1. **Baker's cyst**: A fluid filled cyst present in the popliteal fossa behind the knee and can extend downward in the calf muscles. Abogamal (2017).

2. **Rheumatoid arthritis**: It is an auto immune inflammatory disorder caused by both environmental and genetics factors, where the body starts producing the antibodies usually against the lining of the synovial joint involved. Croia et al (2019).

3. **Rheumatoid factor**: These are the IgM antibodies produced by the body plasma cells against the Fc portion of the IgG. Ingegnoli et al (2013).

4. **Osteoarthritis**: It is a degenerating disease in which the cartilage cushion present in between the joint starts breaking apart due to wear and tear of the joint. Zhang et al (2010).

5. **Psoriatic arthritis**: An auto immune inflammatory disorder where HLA-B27 gene of the DNA of the effected person is mutated. Chandran (2019).

6. **Ultrasonography**: It is a technique where high frequency sound waves are used to produce a black and white image of the tissue and internal organs of the body. Hooley et al (2013).

CHAPTER 3

METHODOLOGY

3.1 Study Design

This cross – sectional study was done on patients of age between 20 – 70 years. The study was conducted during a period of 6 months.

3.2 Subjects

Participants fulfilling the inclusion criteria.

3.3 Setting

Two public hospitals in Karachi.

3.4 Inclusion criteria

- Participants with normal knee morphology
- Age group 20-70 years old
- Participants who agreed to participate in the study by signing consent form.
- Patients who were diagnosed with osteoarthritis and rheumatoid arthritis, and psoriatic arthritis.

3.5 Exclusion criteria

- Not willing to take part.
- Previous knee surgeries
- Trauma
- Patients with vitamin D deficiency
- Patients with calcium deficiency

3.6 Duration of study

Individual Study Period:

The duration of the individual study period was 4 – 6 hours per day.

Total Study Period:

The duration of the total study period was 6 months (December 2022-May 2023).

3.7 Sample size estimation

The sample size was based on population prevalence and was calculated using www.openepi.com. The prevalence of population was 5%. The sample was calculated with a 5% margin of error and 95% confidence interval. The sample size calculated was N = 66.

3.8 Sampling technique

Convenience sampling technique was used.

The study included patients who came for ultrasound of knee for pain in the joint along with swelling in leg and it eliminated those participants who met the exclusion criteria.

3.9 Human Subjects & Consent

The study recruited Pakistani patients between the ages of 20 and 70 with knee pain. After the principal investigator had thoroughly explained the study's parameters and its rationale to the patients, in both English and Urdu, they each signed or left a thumb impression on a printed form indicating their informed permission. The research subjects had the option of discontinuing participation at any time or choosing not to participate at all.

3.10 Materials

A questionnaire in which the study's parameters were filled out. Scans were conducted using the Sonoscape S22 ultrasound machine and a 1 MHz to 7 MHz convex transducer. A weight measuring scale was used to measure the weight of the patient.

3.11 Parameters of Study

The study's parameters comprised the following:

- Age of patients
- Area of cyst
- Breadth of cyst
- Calcification of knee joint space
- Diseased knee (Right or left)
- Duration of disease
- Gender
- Length of cyst
- Osteophytes
- Partitions of cyst
- Weight of patient
- WOMAC score

History taking and WOMAC score:

History-taking is a fundamental component of patient care, enabling healthcare professionals to gather crucial information about a patient's medical background, symptoms, and concerns. It's a dialogue that offers valuable insights into a patient's health. It involves the questioning regarding chief aspects of questionnaire. Followed by a series of questions included in WOMAC score system. The WOMAC score is widely used as a self-administered health status measure in assessing pain, stiffness, and function in patients of osteoarthritis of the hip or knee. This has been used to access back pain, rheumatoid arthritis, juvenile rheumatoid arthritis, Systemic lupus erythematosus and fibromyalgia. Each subscale of the WOMAC score contains a series of questions, typically 5 for pain, 2 for stiffness, and 17 for physical function. Patients are asked to rate their experience for each item on a Likert scale, which usually ranges from 0 to 4:

0: No pain/stiffness/difficulty

1: Slight pain/stiffness/difficulty

2: Moderate pain/stiffness/difficulty

3: Severe pain/stiffness/difficulty

4: Extreme pain/stiffness/difficulty

To calculate the WOMAC score, the individual scores for each item within the three subscales are added up. This results in three separate scores, one for pain, one for stiffness, and one for physical function. These scores can then be analyzed individually or combined to form a total WOMAC score. The total WOMAC score provides an overall assessment of the patient's osteoarthritis symptoms, with higher scores indicating greater pain, stiffness, and functional limitation.

The WOMAC score is a valuable tool for clinicians to monitor the progress of osteoarthritis, assess the effectiveness of treatments such as medications or physical therapy, and tailor interventions to improve the patient's quality of life. It allows for a comprehensive evaluation of the impact of osteoarthritis on an individual's daily activities and well-being.

Weight:

The weight of the patient was taken by using a measuring scale for normal routine checkup documenting the weight by both manual and digital measuring scale (fig 3.1). It was recorded in kilograms. The protocol involved removal of shoes and use of any excess chaddar or shawls.

Fig 3.1: Digital measuring scale for weight

https://www.telegraph.co.uk/recommended/home/best-kitchen-scales/

Clinical examination (CE):

The patient was asked to sit on the chair and inquiry for any painful areas in knee joint was done. Physical inspection and examination for swelling and signs of inflammation (fig 3.2). After permission, detailed ultrasonography was done to determine morphological changes.

Fig 3.2: Examination in sitting position
https://www.wikidoc.org/index.php/Knee_examination

Knee ultrasound:

On the ultrasonography console (fig 3.3 and 3.4), the MSK (musculoskeletal) program and then knee joint was chosen. After choosing the MSK option, a caliper was displayed on the monitor. The caliper was placed about at the level of the suprapatellar region, then prepatellar region followed by infrapatellar region. The lateral part of the knee was then examined in the same manner. The patient was asked to move to prone position so calf area can be examined. On posterior view first the lower end of femur and head of tibia (Fig 3.5) was observed for any irregularities on surfaces. The effusion of the knee joint is observed posteriorly (Fig 3.6). The inside of the knee joint was then seen for any presence of calcification particles seen as small opaque objects (Fig 3.8). The lower medial part of the knee joint was then checked for any Baker's Cyst (Fig 3.7). The caliper was used in length and another caliper was used to measure the breath of the cyst. The partitions and osteophytes as small, attached growths to bones present inside the cyst were also observed (Fig 3.6). The patient was then asked to stand, and the same procedure was repeated (Fig 3.10).

Fig 3.3: The instrument room in hospital

Fig 3.4: The instrument room in hospital

Fig 3.5: US MKS showing the end of femur and head of tibia

Fig 3.6: US showing posterior effusion of the knee joint

Fig 3.7: US showing the Baker's cyst of a patient

Fig 3.8: US showing the presence of osteophytes and less knee joint space

Fig 3.9: US showing arthritic changes and calcifications of knee joint

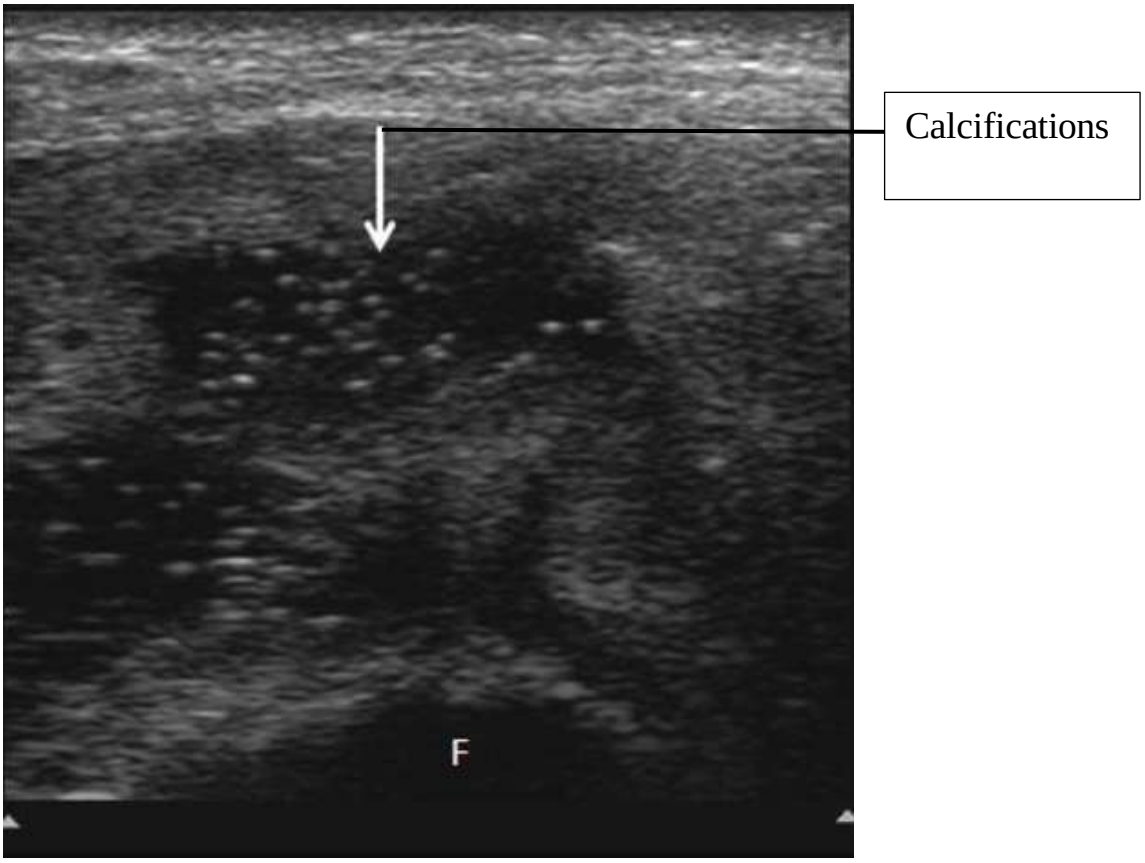


Fig 3.10: Ultrasound in standing up position

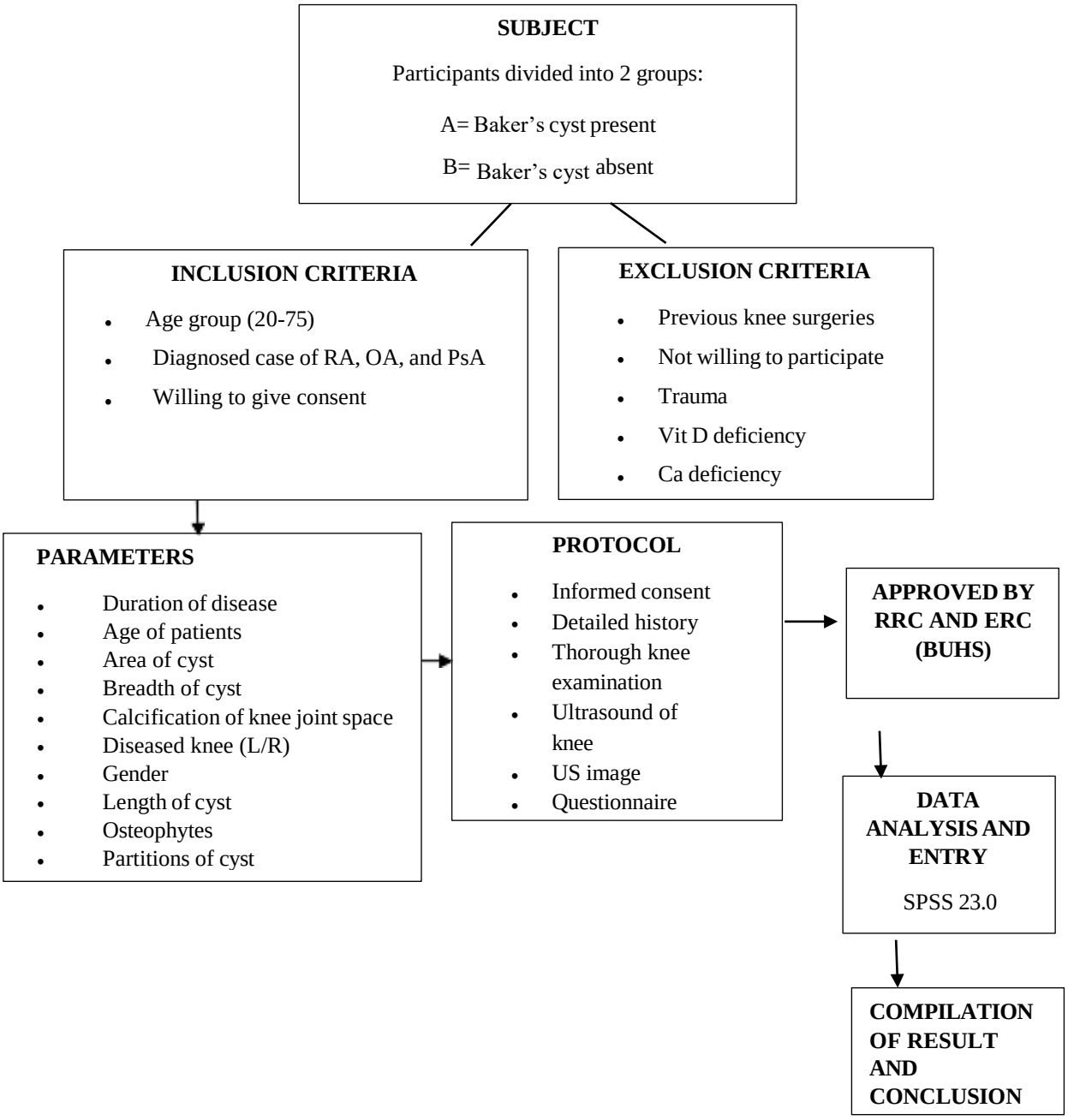
3.12 Protocol of Study

The sample was collected in two public hospitals which includes Jinnah Postgraduate Medical College and PNS Shifa Hospital of Karachi from the department of radiology. The patients who came in with the complaint of the knee pain unilaterally or bilaterally were recruited. The patients who came in with the complaint of the knee pain unilaterally or bilaterally were recruited. The data was then collected through an interview questionnaire from all the participants, which was prepared by the researcher and included questions about demographic data details as well as risk factors associated with the presence of Baker's Cyst.

The patient was then requested to lay down on the examination table with a fully exposed knee, and examination was done taking care of the privacy of the patient during exposure and examination. Both the knees of all the patients were evaluated. All the tendons, ligaments, bursae, cortical part of the bone, articular cartilage, & both the menisci of the knee joints were evaluated for shape, echogenicity, and consistency while knee joint in hyper flexion their average was calculated.

Only those patients who met the inclusion criteria were chosen after a comprehensive ultrasound was conducted by a consultant radiologist utilizing a Sonoscape S22 ultrasound system. The coupling gel was applied to the knee joint in semiflexion position of 45 degrees. Patient was asked to stand up on the table to perform the ultrasonography in a standing position on the table. A detail ultrasonography image was obtained on thermal paper which include articular cartilage, effusion, Baker's Cyst, space between joint, calcification, osteophytes, capsule status, and bone densities which was then compared with the findings of the patients who have no diagnosed disease of knee joint or orthopaedics and have no Baker's Cyst. The data was collected in 6 months period. Individual time taken was 40-45 minutes per patient.

3.13 Algorithm of study



3.14 Statistical Analysis:

The collected data was entered and processed by the researcher using SPSS version 23.0. The Kolmogorov Smirnov test was used to check the normal distribution of the data. Continuous variable was presented as mean + SD. While categorical variables were reported as frequency and percentages. One way ANOVA, independent sample t test and bi-variate correlation test was applied for significance. p value ≤ 0.05 was considered statistically significant.

CHAPTER 4

RESULTS

The parameters being compared include age of patients (years), duration of disease (years), weight of cyst, length of cyst, breadth of cyst, area of cyst, calcification (present or absent), partitions (present or absent), WOMAC score, gender (Male or female), diseased knee (Right or left), and osteophytes (present or absent).

The values in the table represent the mean values (± standard deviation) for each parameter in each group. The "p-value" column indicates the statistical significance (p-value) associated with the comparison of each parameter among the groups.

Age of patients (years): The mean age of patients in the OA group is significantly higher compared to the RA and PsA groups ($p \leq 0.006$) as shown in table 4.1.

Duration of disease (years): There is a trend towards a higher mean duration of disease onset in the OA and PsA groups compared to the RA group, but it does not reach statistical significance ($p \leq 0.05$) as shown in table 4.1.

Weight of patient (kg): There are no significant differences observed among the three groups for these parameters ($p > 0.05$) as shown in table 4.1.

Length, breadth and area of cyst (cm): As shown in table 4.1 there are no significant differences observed among the three groups for these parameters ($p > 0.05$).

Calcification and partitions in cyst (present or absent): There are no significant differences observed among the three groups for these parameters ($p > 0.05$) as shown in table 4.1.

WOMAC score: As shown in table 4.1 there are no significant differences observed among the three groups for these parameters ($p > 0.05$).

Gender: As shown in table 4.1 there are no significant differences observed among the three groups for these parameters ($p > 0.05$).

Diseased knee (Right/ Left): The mean score for the presence of a diseased knee is significantly higher in the OA and PsA groups compared to the RA group ($p \leq 0.000$). Another significant finding is formation of Baker's cyst is more in right knee as compared to the left knee as shown in table 4.1.

Osteophytes (Present/ Absent): The mean score for the presence of osteophytes is significantly higher in the OA group compared to the RA group ($p \leq 0.012$) as shown in table 4.1.

TABLE 4.1: Comparison of parameters among different types of arthritis (OA, RA, and PsA)

PARAMETERS	OA (1)	RA (2)	PsA (3)	p-VALUE
Age of Patients (years)	50.0±10.3	36.0±8.7	48.25±11.7	0.006**
Duration of disease (years)	11.3±6 .5	6.3±3.3	11.4±6.2	0.05*
Weight of patient (Kg)	73.1±10.3	71.36±7.21	73.9±14.6	0.88
Length of cyst (cm)	3.09±2.06	2.78±1.49	50.0±10.3	0.91
Breath of cyst (cm)	2.38±2.15	2.89±1.95	3.05±1.97	0.72
Area of cyst (cm)	11.13±15.8	8.98±8.72	10.29±15.31	0.93
Calcification (present/absent)	1.36±0.50	1.36±0.50	1.25±0.45	0.810
Partitions (present/absent)	1.5±0.5	1.3±0.5	1.4±0.5	0.697
WOMAC score	3.8±0.7	3.0±0.8	3.6±1.3	0.215
Gender (M/F)	1.5±0.5	1.5±0.5	1.5±0.5	0.980
Diseased knee (R/L)	3.0±0.0	1.6±0.3	3.0±0.0	0.000**
Osteophytes (present/absent)	2.0±0.0	1.6±0.5	2.0±0.0	0.012*

Osteoarthritis (OA), rheumatoid arthritis (RA), and psoriatic arthritis (PsA)

** shows highly significant findings

*Shows significant findings

p-value <0.005

The Kolmogorov Smirnov

M/F: male/ female

R/L: right/ left

OSTEOARTHRITIS:

Comparison of various parameters between cases and controls has been performed in the present study. The parameters being compared included age, duration of disease, weight of patient, WOMAC score and the presence of osteophytes. The mean age of the cases was 50.0±10.3 years, while the mean age of the controls was 48.9±7.9 years. The p-value of 0.00 indicated a statistically significant difference in age between the two groups. The mean duration of disease onset in the cases was 11.3±6.5 years, whereas it was 8.5±8.5 years in the controls. However, the p-value of 0.16 suggested that this difference was not statistically significant. The mean weight of the cases was 73.1±14.6 kg, and the mean weight of the controls was 69.3±10.0 kg. The p-value of 0.885 indicated that there was no statistically significant difference in weight between the two groups. The mean WOMAC score for the cases was 3.8±0.7, while it was 3.0±0.7 for the controls. The p-value of 0.033 suggests a statistically significant difference in WOMAC scores between the two groups, indicating a difference in osteoarthritis symptoms. The mean score for the presence of osteophytes was 2.0±0.0 in the cases and 1.5±0.5 in the controls. The p-value of 0.011 indicated a statistically significant difference, suggesting a higher presence of osteophytes in the cases compared to the controls (Table 4.2).

Table 4.2: Comparison of parameters between cases and controls in osteoarthritis patients

Parameters	**Cases (1)**	**Controls (2)**	**p-value**
Age of patient (years)	50.0±10.3	48.9±7.9	0.00**
Duration of disease (years)	11.3±6.5	8.5±8.5	0.16
Weight (kg)	73.1±14.6	69.3±10.0	0.885
WOMAC score	3.8±0.7	3.0±0.7	0.033**
Osteophytes (present/absent)	2.0±0.0	1.5±0.5	0.011*

**Shows highly significant findings

*Shows significant findings

p-value <0.005

The one-way ANOVA test, independent t test, bi-variate correlation test

2-RHEUMATOID ARTHRITIS

Comparison of various parameters between cases and controls have been performed in the present study. The parameters being compared include age of participant, duration of disease, weight of patient, WOMAC score, and the presence of osteophytes. The mean age of the cases was 36.0±8.6 years, while the mean age of the controls was 34.3±11.0 years. The p-value of 0.00 indicated a statistically significant difference in age between the two groups. The mean duration of disease onset in the cases was 6.3±3.3, whereas it was 4.9±3.8 in the controls. However, the p-value of 0.16 suggested that this difference is not statistically significant. The mean weight of the cases was 71.3±7.2 kg, and the mean weight of the controls was 71.5±13.2 kg. The p-value of 0.885 indicated that there was no statistically significant difference in weight between the two groups. The mean WOMAC score for the cases was 3.0±1.3, while it was 2.7±0.7 for the controls. The p-value of 0.033 suggested a statistically significant difference in WOMAC score between the two groups' suggesting a significant difference in rheumatoid arthritis symptoms. The mean score for presence of osteophytes was 1.6±0.5 in the case and 1.4±0.5 in the controls. The p-value of 0.011 indicated a statistically significant difference, suggesting a higher presence of osteophytes in the cases compared to the controls (Table 4.3).

Table 4.3: A comparison of parameter between cases and control in Rheumatoid Arthritis

Parameters	**Cases**	**Controls**	**p-value**
Age of participants (years)	36.0±8.6	34.3±11.0	0.00*
Duration of disease (years)	6.3±3.3	4.9±3.8	0.16
Weight of patients (kg)	71.3±7.2	71.5±13.2	0.885
WOMAC score	3.0±1.3	2.7±0.7	0.033*
Osteophytes (present/absent)	1.6±0.5	1.4±0.5	0.011*

**Shows highly significant findings

*Shows significant findings

p-value <0.005

The one-way ANOVA test, independent t test, bi-variate correlation test

3-PSORIATIC ARTHRITIS

The parameters being compared include age of patients, duration of disease, weight of patients, WOMAC score, and the presence of osteophytes. The mean age of the cases was 48.2±11.7 years, while the mean age of the controls was 39.6±8.5 years. The p-value of 0.00 indicated a statistically significant difference in age between the two groups, suggesting that cases are older on average compared to controls. The mean age of disease onset in the cases was 11.4±6.2 years, whereas it was 5.3±3.0 years in the controls. However, the p-value of 0.16 suggested that this difference was not statistically significant, indicating that the duration of disease onset may not differ significantly between the two groups. The mean weight of the cases was 73.9±14.1 kg, and the mean weight of the controls was 75.1±9.9 kg. The p-value of 0.885 indicated that there was no statistically significant difference in weight between the two groups. The mean WOMAC score for the cases was 3.6±0.8, while it was 2.9±0.8 for the controls. The p-value of 0.033 suggested a statistically significant difference in WOMAC scores between the two groups, indicating that cases have higher WOMAC scores on average, indicating more severe osteoarthritis symptoms compared to controls. The mean score for the presence of osteophytes was 2.0±0.0 in the cases and 1.5±0.5 in the controls. The p-value of 0.011 indicated a statistically significant difference, suggesting a higher presence of osteophytes in the cases compared to the controls (Table 4.4).

Table 4.4: A comparison of parameters between cases and control in Psoriatic Arthritis

Parameters	**Cases**	**Controls**	**p-value**
Age of patient (years)	48.2±11.7	39.6±8.5	0.00*
Duration of disease (years)	11.4±6.2	5.3±3.0	0.16
Weight of patient (Age)	73.9±14.1	75.1±9.9	0.885
WOMAC score	3.6±0.8	2.9±0.8	0.033*
Osteophytes (present/absent)	2.0±0.0	1.5±0.5	0.011*

**Shows highly significant findings

*Shows significant findings

p-value <0.005

The one-way ANOVA test, independent t test, bi-variate correlation test

DISCUSSION

5.1 SEQUENCE OF DISCUSSION EXPERIMENT/HYPOTHESIS WISE

The current study aimed to investigate the prevalence and characteristics of Baker's Cysts in patients with knee arthritis, with a focus on exploring potential risk factors and associations related to cyst formation. The findings of this study provide valuable insights into the morphological changes and of Baker's Cysts in the context of knee arthritis, and they shed light on various factors that may contribute to their development.

Our study has come to the conclusion that there is some prevalence in gender as males are prone to formation of Baker’s cyst. A study conducted by Chen et al. (2017) investigated the prevalence of Baker's Cysts in patients with knee osteoarthritis. The study utilized data from the Osteoarthritis Initiative, a long-term study focusing on knee osteoarthritis, and aimed to identify the prevalence and potential risk factors associated with the detection of Baker's Cysts in individuals with this condition. The study included 782 participants, consisting of 457 females and 325 males. The findings revealed a higher prevalence of Baker's Cysts in males (23.7%) compared to females (14.5%). These results suggest that there may be a gender difference in the area as well as length of the cysts within all groups of cases. Another study conducted by Karim et al. (2015) and published in the Journal of Clinical Rheumatology aimed to assess the prevalence of Baker's Cysts in patients experiencing knee pain. The study included a total of 200 participants, with 100 males and 100 females. The findings of this study indicated a higher prevalence of Baker's Cysts among male participants, with a rate of 17%, as compared to female participants, where the prevalence was 11% (Karim et al., 2015). In a retrospective study conducted by Tanyildizi et al. (2019) and published in the Journal of Clinical Imaging Science, the prevalence of Baker's Cysts detected by ultrasonography was examined. The study included a total of 533 participants, with 280 males and 253 females. The results of this study revealed a higher prevalence of Baker's

Cysts in male participants, accounting for 24.3%, as compared to female participants, where the prevalence was 15.8% (Tanyildizi et al., 2019). Collectively, these studies provide evidence supporting the observation of a higher prevalence of Baker's Cysts in males as compared to females. However, it is crucial to acknowledge that individual study findings may vary, and further research is necessary to gain a comprehensive understanding of the gender-related differences in the occurrence of Baker's Cysts.

Although there is limited research specifically focusing on the relationship between age of patient and Baker's Cyst formation in patients with PsA, our study identifies statistically significant findings across all three disease groups. The results indicate that the gender of patients plays an important role in development of Baker's Cyst, and males are more susceptible to formation of cyst. Another study by Chavez Lopez et al.,2007 where patients with rheumatoid arthritis and psoriatic arthritis were taken and the study focused on the fact that the mean age of the patient was 61.5 years and onset of disease was 9.5 years which is more than the values found in our current study. The study also focused that females have higher prevalence of Baker's Cyst as compared to males which is contrary to our findings.

Our current study tells that the advancing age of patient is directly proportional to the formation of Baker's Cyst with an average of 50 years. In 2016, a descriptive study was conducted in Peshawar, focusing on the prevalence of Baker's Cysts in individuals with knee osteoarthritis. This study was carried out at the department of radiology, Lady Reading Hospital, from April 2015 to September 2015. The study included a total of 241 consecutive patients, both male and female, who presented with painful swollen lower limbs and ranged in age from 23 to 85 years. These patients were referred to the department of radiology for ultrasound examination, and each patient underwent sonographic examinations. The study's findings revealed that the average age of the patients was 58 years, while in our present study, it is 50 years, indicating that Baker's Cysts can also be detected in individuals at an earlier age of 50. Moreover, the results demonstrated a notable increase in the prevalence of Baker's Cysts with advancing age, with a higher incidence observed in older individuals. These findings are consistent with our current study, supporting the notion that the presence of Baker's Cysts tends to be more prevalent in older patients (Hadi, Iqbal, Awan., 2016).

The existing studies suggest a potential correlation between a patient's age and the formation of Baker's Cysts which is 50 years for all three diseases. However, it is essential to consider that this relationship might be influenced by various other factors, such as underlying knee conditions or injuries or hereditary factor. Additionally, individual variations among patients could also play a role, warranting further research to comprehensively investigate this relationship. Another study conducted by Visser involved a population-based cohort of individuals aged 45 to 65 years. Within this study, MRI scans of the right knee were obtained from 1285 participants, with a median age of 56 years, which aligns closely with the mean age of our patients. The knee osteoarthritis (OA) scoring system was employed to assess structural abnormalities in specific knee regions, including the patellofemoral and tibiofemoral regions. The abnormalities evaluated included osteophytes, cartilage loss, bone marrow lesions (BMLs), subchondral cysts, meniscal abnormalities, effusion, and Baker's Cyst. Symptomatic OA in the imaged knee was defined according to the criteria set by the American College of Rheumatology.

To determine the most effective structural abnormalities in distinguishing individuals with and without symptomatic OA, logistic ridge regression analysis was conducted. This analysis revealed that patients with advancing age had an increased likelihood of being diagnosed with Baker's Cyst. This finding supports the potential association between age of patient and Baker's Cyst formation, underscoring age as a potential risk factor in the development of the cyst (Visser et al., 2016). Nevertheless, further research is imperative to gain deeper insights into the underlying mechanisms of this relationship and to account for other confounding variables that might influence the occurrence of Baker's Cysts in patients with knee arthritis.

Another notable discovery is the direct relationship between the advancement of the disease over the years and the formation of Baker's Cyst.

In a study published, researchers investigated the clinical characteristics and prognostic factors of knee arthritis (OA) patients with Baker's Cysts. The study's sample size included 130 patients diagnosed with knee joint disease. This sample was further

divided into two groups: the first group comprising patients with a disease duration of 3 months, and the second group with patients diagnosed for 6 months. These patients underwent ultrasound examinations, leading to the diagnosis of Baker's Cyst. The study's findings revealed that the presence of a Baker's Cyst was associated with more severe knee pain and limitations in physical function in patients who had a disease history of 6 months. The study's p-value was reported as 0.002, which closely aligns with our current study's p-value of 0.00 (Abate et al., 2021).

This significant finding underscores the link between disease progression and the occurrence of Baker's Cyst in knee arthritis patients, suggesting that the presence of the cyst might be indicative of more advanced disease and associated clinical symptoms. However, further research is necessary to corroborate and expand upon these findings, shedding more light on the potential implications for diagnosis and management of knee arthritis with Baker's Cyst.

Another cross-sectional study published in 2020 by Chernyad'ev et al. examined the relationship between patients with knee arthritis and Baker's Cyst. The study included 37 patients with knee arthritis and Baker's Cyst, with a mean disease duration of 5-10 years. These findings are consistent with our current study, which also observed a mean disease duration of 6-11 years. These studies suggest a higher likelihood of Baker's Cyst development in patients who have a history of knee arthritis of that magnitude. However, it is important to note that while there is an association between Baker's Cysts and certain clinical characteristics or outcomes, these studies do not provide conclusive evidence of a direct link between cyst formation and prognosis of the underlying knee condition. The prognosis of the underlying knee condition is influenced by various factors, including the specific diagnosis, disease severity, treatment response, and individual patient characteristics.

Another study conducted by Zenzeng et al in 2019 concluded that as the duration of RA in patients increases, the disease activity becomes more pronounced, leading to more severe systemic damage and a higher likelihood of developing popliteal cysts. Moreover, larger cysts are at a greater risk of rupture. Treatment involving a

combination of medication and joint cavity puncture shows a faster onset of action, resulting in quicker symptom relief which is very similar to our findings. Like the findings of Riente et al in 2010 who also concluded that enthesopathy was found to be more prevalent in the PsA group compared to the RA group. The research consisted of 30 PsA patients and same amount of RA patients.

The relationship between osteophyte formation and the development of Baker's Cysts is well-supported by several studies which have the p-value of 0.00 making it highly significant.

A study published in Rheumatology International examined the association between arthritis-related features and the presence of Baker's Cysts in patients with knee arthritis. The study included 47 patients of both genders and was conducted in a local hospital using a cross-sectional design. All patients had symptomatic knee disorders, and the study found a significant association between the presence of osteophytes and Baker's Cysts. The p-value for this finding was 0.001, while in our current study, it was 0.00 (Martusevitch et al., 2019).

Similarly, a study published in Clinical Rheumatology in 2016 examined 80 patients with knee arthritis and Baker's Cysts using a prospective study design. The study observed a significant association between the presence of osteophytes on ultrasound images and Baker's Cysts. Although the p-value in our study was 0.00, and in the referred study it was 0.001, the slight difference may be attributed to the variation in sample sizes (Razek & El-Basyouni, 2016).

Another study conducted by Visser in 2016 selected 1258 patients to explore the associations of painful knee swellings with various knee joint injuries, including meniscal tears, ACL and PCL damage, and presence of osteophytes. The study concluded that a higher number of osteophytes were present in Baker's Cysts. This finding aligns with our current study, suggesting a direct relationship between the presence of osteophytes and Baker's Cysts (Visser et al., 2016).

These studies collectively suggest an association between the presence of osteophytes and the occurrence of Baker's Cysts in patients with osteoarthritis and psoriatic arthritis. While our present study provides evidence supporting a direct relationship, it is essential to acknowledge that larger sample sizes may further strengthen and validate these findings. Further research is needed to explore the precise mechanisms and implications of this relationship, which could lead to advancements in the understanding and management of Baker's Cysts in knee arthritis patients. In their 2016 study, Eslaman et al. investigated patients with rheumatoid arthritis and found that older patients had a higher prevalence of osteophytes compared to those with fewer years of rheumatoid disease.

One of the significant findings in our study is the strong correlation between the WOMAC score and the area of the cyst. The bigger area of cyst is directly proportional to the higher scores of the WOMAC. The p-values of RA, OA and PsA when compared differently in table 4.2, 4.3 and 4.4 is 0.003. The p-value of all three disease combinedly is 0.03 consisted of comparison between cases and controls. This finding is consistent with previous research conducted in 2020 by Kandemirli et al., where 198 knee ultrasounds were considered in a cohort study design. The study concluded that patients with arthritis (OA, RA, PsA) of the knee joint, along with Baker's Cyst, exhibited higher WOMAC scores compared to those without the disease, with a significant p-value of 0.002. Our current study's finding of a p-value of 0.003 aligns closely with this result, further validating the association between the WOMAC score and the cyst area (Kandemirli et al., 2020).

Additionally, Calgyan et al. (2015) conducted a case-control study with 52 patients having symptomatic Baker's Cyst and knee arthritis (OA and RA), which was compared to an equal number of control patients with no diagnosed disease. The study evaluated the WOMAC score in both groups and found a p-value of 0.005, which closely resembles our current study's p-value of 0.003, reinforcing the relationship between the WOMAC score and Baker's Cyst (Çağlayan, Özçakar, Kaymak, 2016).

Moreover, Hautmann et al. (2019) conducted a study involving 20 patients with arthritis involving both osteoarthritis and rheumatoid arthritis of the knee joint, utilizing the WOMAC score to assess the pain in these patients. Their findings demonstrated that patients with higher WOMAC scores were more likely to have Baker's Cyst, with a pvalue of 0.005. This result further supports our study's finding of a p-value of 0.003 in table 4.1, 4.2, 4.3, indicating the strong correlation between the WOMAC score and the presence of Baker's Cyst (Hautmann, M. G., 2019).

Together, these studies provide robust evidence of the association between the WOMAC score and Baker's Cyst, validating our findings and underscoring the significance of this relationship in assessing and managing knee arthritis and its related complications.

This research introduces a novel parameter called the "diseased knee," which distinguishes between the right and left knees. The study's results indicate that the right knee is more impacted compared to the left knee, with this discrepancy attributed to the higher level of usage and activity experienced by the right knee. Research conducted by Boodt and Cheryl in 2008 reported that bilateral knee involvement is more prevalent, accounting for 40% of cases, while unilateral involvement was observed in 20% of all cases presented to the rheumatology department. Emerging from recent research is a compelling revelation that underscores the preferential impact of knee pain on the right knee joint, particularly among individuals grappling with osteoarthritis and rheumatoid arthritis. A Pakistani journal in 2023 under the author name Abbasi et al (2023) brought forth this intriguing insight through a meticulous study encompassing 169 patients, each undergoing the scrutiny of ultrasound examinations. The findings reverberate with significance, as they unveil that a notable 57.4% of these patients were diagnosed with Baker's Cyst in their right knee joint. This discovery adds a distinct layer of nuance to our understanding of knee ailments and their potential predilections.

Worth noting is the statistical underpinning that accompanies these findings. The calculated p-value, obtained after subjecting the data to the rigorous scrutiny of the chi-square test, is registered at 0.837. While this figure may not reach the conventional thresholds of statistical significance, it remains a noteworthy element in the discourse.

The subtleties revealed here beckon a deeper exploration into the complex interplay between knee pain and its asymmetric manifestation across the right and left sides.

Of paramount importance is the delineation of parameters. In this particular study, the differentiation between the right and left-sided knees emerged as a crucial axis of investigation. This meticulous dissection offers a unique vantage point, allowing researchers and practitioners alike to gain insights that extend beyond the realm of mere symptoms into the domain of structural predilections.

This study, rooted in a Pakistani context, resonates with the broader global pursuit of medical understanding, revealing patterns that hold potential implications for diverse populations.

5.2 IMPLICATIONS OF THE STUDY

5.2.1 THEORETICAL IMPLICATIONS

Previous research has yielded varying results regarding the relationship between knee joint changes and the development of Baker's Cyst. Exploring any potential genetic link to the formation of Baker's Cyst could provide valuable insights. Studies have indicated that monozygotic twins are more likely to develop Baker's Cyst compared to dizygotic twins, suggesting a possible genetic influence on the condition. Therefore, investigating the genetic aspect in this study could offer further understanding of the etiology of Baker's Cyst.

MacGregor, A. J., Antoniades, L., Matson, M., Andrew, T., & Spector, T. D. (2000). The genetic contribution to radiographic hip osteoarthritis in women: results of a classic twin study. *Arthritis & Rheumatism: Official Journal of the American College of Rheumatology*, *43*(11), 2410-2416.

5.2.2 PRACTICAL IMPLICATIONS

To the best of our knowledge and in reflection of the current study physicians and rheumatologists should include ultrasound as a regular tool for early and efficient way of diagnosis of the Baker’s Cyst. The tool can also be used as the distinguishing tool for differentiating deep vein thrombosis and other lower limb swellings.

5.2.3 POLICY IMPLICATIONS

Many hospitals with rheumatology services lack adequate radiological facilities for the general population. The patient's age and disease progression should be regarded as potential indicators for Baker's Cyst formation. To detect knee joint inflammatory diseases, regular radiological examinations, specifically through ultrasonography, should be included for patients experiencing knee joint pain and swellings. Ultrasonography proves to be a cost-effective option compared to other radiological investigations, offering prompt results and being less invasive, thereby saving time.

5.3 LIMITATIONS

- Small sample size and limited time
- Limited number of diseases

5.4 STRENGTHS

- Inclusion of 3 different knee joint inflammatory diseases
- Large influx of patients in OPD

5.5 RECOMMENDATION

Our research has yielded compelling evidence underscoring the significance of ultrasonography as a readily accessible and practical radiographic tool. This insight advocates for its incorporation as a standard practice in the evaluation of patients afflicted by inflammatory knee joint diseases. Our study specifically highlights the relevance of routine radiological assessment for individuals with a disease history surpassing five years. Furthermore, the identification of calf muscle swelling emerges

as a key clinical indicator, warranting suspicion of Baker's Cyst irrespective of the patient's age.

As we peer into the horizon of future investigations, an array of potential avenues emerges. Delving into additional parameters, such as joint space measurements, C-reactive protein levels, and cytokine concentrations, could potentially unravel deeper layers of understanding regarding the early detection of Baker's Cyst. These dimensions hold the potential to shed light on innovative methods for prompt diagnosis.

The collective impact of these endeavours extends beyond diagnosis, potentially transforming the management strategies for this condition. By enhancing our comprehension of the underlying mechanisms, we could potentially devise more effective interventions, enabling individuals to navigate the challenges posed by Baker's Cyst with improved outcomes.

The journey of medical inquiry is perpetual, guided by the quest to unravel mysteries and ameliorate human suffering. Our study contributes to this ongoing narrative, bridging existing knowledge gaps and setting the stage for further exploration. As we delve deeper into the realm of diagnostic methodologies, the potential to amass insights capable of shaping the future of patient care and management becomes increasingly apparent.

5.6 CONCLUSION

Several key observations have emerged from our investigation into Baker's cyst. Firstly, we found that males exhibit a greater susceptibility to developing Baker's cyst. Secondly, patient age bears a substantial correlation with disease progression and the formation of this cyst. Notably, osteophyte formation demonstrated a direct association with the occurrence of Baker's cyst, shedding light on a potential contributing factor. Additionally, our research revealed a predilection for the right knee over the left, with the former being more frequently impacted. Moreover, the size of the cyst exhibited a

direct relationship with the WOMAC score, emphasizing the clinical significance of cyst dimensions. Lastly, intriguingly, we noted that the presence of rheumatoid factor and crystals did not exert a significant effect on the development of Baker's cyst. These findings collectively enrich our understanding of this condition and its multifaceted determinants, providing valuable insights for both diagnosis and treatment strategies.

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Annexure —A‖

Bahria University
Discovering Knowledge
Health Sciences Campus Karachi

ETHICAL REVIEW COMMITTEE
LETTER OF APPROVAL

Date: 19-Dec-22

Reference:
N/A

PATRON
Prof. Ambreen Usmani
Principal & Dean
Health Sciences(BU)

CHAIRPERSON
Dr. Quratulain Javaid

SECTRETARY
Dr. Ambreen Surti

MEMBERS
Prof M Alamgir
Prof Anis Jafarey
Prof Aisha Qamar
Ms Nighat Huda
Surg Cdre Amir Ejaz
Prof Reza H Syed
Ms Shabina Arif
Mr M Amir Sultan
Prof Dr Rafat Murad
Ms NajmusSahar Ilyas

Dr. Rubab Saghir
MPhil Candidate
Department of Anatomy
BUHS-Karachi

Subject: Institutional approval of research study

Title of Study: Morphology of the knee joint diseases with Baker's cyst

Principal Investigator: Dr. Rubab Saghir

Reference No: ERC 114/2022

Dear Dr. Rubab Saghir,

Thank you for submitting the above mentioned study proposal. ERC Bahria University Health Sciences Campus has reviewed this project in the meeting held on 16-Dec-2022 and gives approval. Kindly notify us when the research is complete.

Regards,

DR. QURATULAIN JAVAID
Chairperson, ERC
BUHS

Cc:
Principal BUHS

Annexure —B‖

Bahria University
Discovering Knowledge
Health Sciences Campus, Karachi

FACULTY RESEARCH COMMITTEE
BAHRIA UNIVERSITY HEALTH SCIENCES - KARACHI

LETTER OF APPROVAL

Date: 13-10-2022

To,
Dr. Rubab Saghir
MPhill - Student
Department of Anatomy
BUHS - Karachi

Subject: **Faculty Research Committee**
FRC-BUHS Approval of Research Study

Title of Study (Revised): Morphology of knee joint disease with baker's cyst.

Name of Student: **Dr. Rubab Saghir**

Reference No: **FRC-BUHS -50/2022-502**

Dear: **Dr. Rubab Saghir**

Thank you for submitting research proposal to FRC-BUHS. The committee has approved your project.

This letter is referred to ERC for approval.

Regards

Dr. Mehreen Lateef,
Associate Professor,
CO- CHAIRPERSON FRC-BUHS

Cc:
DG-BUHS
Principal Medical
Principal Dental
Vice Principal BUHS
Co-chairperson FRC
Secretary

Annexure —C‖

IRB

NO.F.2-81/2022-GENL/351/JPMC
JINNAH POSTGRADUATE MEDICAL CENTRE
KARACHI.75510.

Dated the 30-12-2022

Dr. Rubab Saghir
Department of Bahria University Medical and Dental College,
Karachi.

Subject: **Morphology of knee joint disease with baker's cyst.**

With reference to your application / letter dated 31st October, 2022, on the subject noted above and to say that the Institutional Review Board has approved your subject proposal.

Prof. Dr. Tariq Mehmood, Head Department of Radiology, JPMC, Karachi is the co-supervisor in this study.

Prof. Syed Masroor Ahmed
Prof. of Medicine / Dean and
Chairman, Institutional Review Board Committee
JPMC, Karachi.

Copy forwarded for information and necessary action to:

- **Prof. Dr. Ambreen Usmani, Principal of Bahria University Medical Sciences, Department of Anatomy Bahria Medical and Dental College,**
- **Prof. Dr. Tariq Mehmood, Head Department of Radiology, JPMC, Karachi.**

Annexure ―D‖

WRITTEN INFORMED CONSENT FORM OF PATIENT

You are giving your consent to participate voluntarily and at your own will in the research project that aims for the investigation of presence of Baker's Cyst in patients with knee joint issue. The project will evaluate the changes that will help prevent any anatomical variations in the future that could possibly result in altered leg and knee function and daily life. You have been explained in detail the nature and significance of participating in the project, and that the radiographic and clinical analysis of your leg and knee will help notify you about any possible abnormalities and to prevent or correct them. You have been told that all the findings and your personal data will be kept strictly confidential and will be used only for the benefit of orthopedics and rheumatology to consider prevalence of Baker's Cyst and hence to advise precautions and preventive measures in the future. The study will be strictly used only for the betterment of the community, in publications and paper presentations. You have been told that radiological investigations will be conducted to evaluate your health status. You have been notified about the amount and time of exposure to x-rays and ultrasonography. You have been explained about any possible harm related to the study and the measures that would be taken to compensate if any harm was to occur. I agree to give all the relevant information needed to the researcher in full and to the best of my knowledge. It is clarified to me that no incentive, financial assistance, or reimbursement will be provided to me for Participating in the study whereas I do have the right to withdraw from the study at any time. Keeping all the above in mind, I agree to give my full consent for this purpose.

You are advised to contact **Dr. Rubab Saghir** on

Mobile number: **0347-2095546** or visit **BUMDC** in case of any query.

Name of participant_____
S/o, D/o, W/o_____
Signature of participant _____
Name of Researcher: _____
Signature of Researcher: _____
Date: _____

Annexure —E‖

تحریری طور پر انفارمیشن کنٹیٹ فارم برائے مریضہ

آپ اس تحمیمی پروجیکٹ میں رضاکارانہ طور پر اور اپنی مرضی سے حصہ لینے کے لیے اپنی رضامندیکی Baker's Cyst دے رہے ہیں جس کا ممصد گھٹنوں کے جوڑوں کے مسئلے والے مریضوں مینموجودگی کی تحمیمات کرنا ہے۔ پروجیکٹ ان تبدیلیوں کا جائزہ لے گا جو مستمبل میں کسی بھی جسمانیتغیرات کو روکنے میں مدد کرے گی جس کے نتیجے میں ٹانگ اور گھٹنے کے افعال اور روزمرہ کیزندگی میں ممکنہ طور پر تبدیلی ہو سکتی ہے۔ آپ کو پروجیکٹ میں حصہ لینے کی نوعیت اور اہمیت کےبارے میں تفصیل سے بتایا گیا ہے، اور یہ کہ آپ کی ٹانگ اور گھٹنے کا ریڈیوگرافک اور طبی تجزیہ آپکو کسی بھی ممکنہ اسامانیتاوں کے بارے میں مطلع کرنے اور ان کو روکنے یا درست کرنے میں مددکرے گا۔ آپ کو بتایا گیا ہے کہ تمام نتائج اور آپ کے ذاتی ڈیٹا کو سختی سے خفیہ رکھا جائے گا اور

اسےکے پھیالؤ Baker's Cyst صرف آرتھوپیڈکس اور ریمیٹولوجی کے فائدے کے لیے استعمال کیا جائے گا تاکہپر غور کیا جا سکے اور اس لیے مستمبل میں احتیاطی تدابیر اور احتیاطی تدابیر کا مشورہ دیا جا سکے۔مطالعہ کو صرف کمیونٹی کی بہتری کے لیے، اشاعتوں اور کاغذی پیشکشوں میں سختی سے استعمال کیاجائے گا۔ آپ کو بتایا گیا ہے کہ آپ کی صحت کی حالت کا جائزہ لینے کے لیے ریڈیوالجیکل تحمیمات کیجائیں گی۔ آپ کو ایکس رے اور الٹراسونگرافی کے سامنے آنے کی ممدار اور ولت کے بارے میں مطلع کردیا گیا ہے۔ آپ کو مطالعہ سے متعلك کسی بھی ممکنہ نمصان کے بارے میں اور ان الدامات

کے بارے مینبتایا گیا ہے جو کوئی نمصان پہنچنے کی صورت میں معاوضہ کے لیے اٹھائے جائیں گے۔ میں مکمل طورپر اور اپنی بہترین معلومات کے مطابك محمك کو درکار تمام متعلمہ معلومات دینے سے اتفاق کرتا ہوں۔میرے لیے واضح کیا جاتا ہے کہ مجھے مطالعہ میں حصہ لینے کے لیے کوئی ترغیب، مالی امداد، یامعاوضہ فرابم نہیں کیا جائے گا جبکہ مجھے کسی بھی ولت مطالعہ سے دستبردار ہونے کا حك حاصل ہے۔مندرجہ باال تمام چیزوں کو ذہن میں رکھتے ہوئے، میں اس ممصد کے لیے اپنی مکمل رضامندی

دینے سے اتفاق کرتا ہوں۔

آپ کو مشورہ دیا جاتا ہے کہ ڈاکٹر رباب صفیر سے رابطہ کریں۔

BUMDC ۔ یا کسی بھی سوال کی صورت میں03472095546موبائل نمبر

_____حصہ لینے والے کا نام

S/o, D/o, W/o_____

_____ شرکت کنندہ کے دستخط

_____ :محمك کا نام

_____ :محمك کے دستخط

_____ :تاریخ

Annexure ―F‖

QUESTIONNAIRE

S#	DEMOGRAPHICS:
1.	Name (optional):
2.	Gender:
3.	Phone no:
4.	Age:
5.	Marital status:
6.	Ethnicity:
7.	Age:
9.	Weight:
10.	No. of children:

PRESENTING COMPLAIN:

FAMILY HISTORY:

KNEE INVOLVED:

Diseased knee	
Diagnosis of diseased knee	
Normal knee	

ASSESSMENT OF KNEE JOINT PAIN:

S#	Question	Yes	No
1.	Do you have pain in knee joint?		
2.	Improvement in pain in shifting of leg		
3.	Do you have trouble in walking on stairs?		
4.	Do individuals complain that you have issue in sleeping due to pain in knee?		
5.	Do you need to strain to move from sitting to standing?		
6.	Do you have trouble in walking long distance?		
7.	Do you have unsteadiness, pain, discomfort, while sitting down?		

CLINICAL HISTORY

S#	Question	Yes	No
1.	Are you a diagnosed case of rheumatoid arthritis?		
2.	Are you a diagnosed case of osteoarthritis?		
3.	Are you a diagnosed case of ankylosing spondylitis/ psoriatic spondylitis		

SURGICAL HISTORY:

S#	Type of surgery	Yes	No
1.	Knee replacement		
2.	Arthroplasty		
3.	Any other surgery done concerning knee? If yes mention (name of the surgery)		
4.	Surgery other than knee? If yes mention (name of the surgery)		

HISTORY OF ANY TRAUMA TO KNEE JOINT

CLINICAL INVESTIGATION:

S#	Examination	Yes	No
1.	Pain in effected knee		
2.	Swelling of effected knee		
3.	Ultrasound		

MEASUREMENTS:

PART OF BONE	LENGTH (mm)	WIDTH (mm)
Articular cartilage		
Width of knee joint		

	Yes	No
Presence of osteophytes		
Presence of Baker cyst		
Presence of RAF		
Capsule ruptured		

INVESTIGATION PERFOMED:

Name of investigation:	
Date of investigation performed:	
PATIENT'S ID:	

Annexure —G‖

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)

Name:_____ Date:_____

Instructions: Please rate the activities in each category according to the following scale of difficulty: 0 = None, 1 = Slight, 2 = Moderate, 3 = Very, 4 = Extremely

Circle **one number** for each activity

Pain	1. Walking	0 1 2 3 4
	2. Stair Climbing	0 1 2 3 4
	3. Nocturnal	0 1 2 3 4
	4. Rest	0 1 2 3 4
	5. Weight bearing	0 1 2 3 4
Stiffness	1. Morning stiffness	0 1 2 3 4
	2. Stiffness occurring later in the day	0 1 2 3 4
Physical Function	1. Descending stairs	0 1 2 3 4
	2. Ascending stairs	0 1 2 3 4
	3. Rising from sitting	0 1 2 3 4
	4. Standing	0 1 2 3 4
	5. Bending to floor	0 1 2 3 4
	6. Walking on flat surface	0 1 2 3 4
	7. Getting in / out of car	0 1 2 3 4
	8. Going shopping	0 1 2 3 4
	9. Putting on socks	0 1 2 3 4
	10. Lying in bed	0 1 2 3 4
	11. Taking off socks	0 1 2 3 4
	12. Rising from bed	0 1 2 3 4
	13. Getting in/out of bath	0 1 2 3 4
	14. Sitting	0 1 2 3 4
	15. Getting on/off toilet	0 1 2 3 4
	16. Heavy domestic duties	0 1 2 3 4
	17. Light domestic duties	0 1 2 3 4

Total Score: _____ / 96 = _____%

Annexure —H‖

Morphology of knee joint diseases with Baker's Cyst

ORIGINALITY REPORT

11%	8%	8%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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