

ROLE OF ULTRASONOGRAPHY IN THE DIAGNOSIS OF KNEE JOINT LESIONS

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**ABSTRACT**

Introduction: Ultrasound can provide clinically useful information on a wide range of pathologic conditions affecting components of the knee joint, including the tendons, ligaments, muscles, synovial space, articular cartilage, nerves and surrounding soft tissues. The advantages of ultrasound include low cost, portability, real-time assessment, and facilitated side-by-side comparisons. The aim of the study was to study the various pathological conditions of painful knee joint by using ultrasound for early diagnosis and prompt therapeutic approach and to evaluate the osteoarthritic changes in the painful knee joint by ultrasound.

Materials and Methods: This is a prospective observational study conducted in the Department of Radiology and Orthopedics & trauma surgery, National Medical College & teaching hospital, Birgunj, Parsa, Nepal for the 6 months duration, patients presented with knee joint pathology including swelling, and pain. Patients included in this study was above 20 years with unilateral (single) knee joint pain. With ethical clearance from the Institutional Review Committee of National Medical College and after obtaining the informed consent of the patient, prospective observational study was conducted.

All ultrasound assessments were performed using the same machine with a 9 MHz linear transducer of GE Logiq P7 USG machine. A30–45-degree flexion of the knees was standardized by using the same wedge for all ultrasound assessments.

Results: This study included 40 symptomatic patients with knee joints pain included in this study. In 40 patients 19 were females (47.5%) and 21 males (52.5%), with ages ranged from 20 to 70 years. Ultrasound findings showed joint effusions in 25 (62.5 %) as most common finding in painful knees, synovial thickening in 17 (42.5 %) knees, Synovitis in 14 (35.0%) and tendinopathy seen in only 1 (2.5%) knee joint pain. Osteoarthritis such as narrow joint space in 4 (10%) knees, marginal osteophytes in 4 (10%) knees, loose bodies in 3 (7.5%) knees, Baker's cyst in 1 (2.5%) knee. Most common involved age group is 51-60 years with 17 cases followed by 41-50 years in 11 cases.

Conclusion: Ultrasound is a simple and reproducible technique for the assessment of knee joint effusion, synovial changes and osteoarthritis related changes.

Keywords: Knee joint pain, Knee joint effusion, Osteoarthritis, Synovitis, Tendinopathy

INTRODUCTION

Ultrasonography is a noninvasive imaging modality used for the assessment of the musculoskeletal system. It can provide clinically useful information on a wide range of pathologic conditions affecting components of the knee joint, including the tendons, ligaments, muscles, synovial space, articular cartilage, nerves and surrounding soft tissues. The advantages of ultrasound include low

cost, portability, real-time assessment, and facilitated side-by-side comparisons. Its major disadvantage is its operator-dependence: it requires trained experienced hands with appropriate high-resolution equipment. Ultrasound examinations of the knee joint are usually performed using a high-frequency linear transducer (7.5-12 MHz).¹ The aim of this article is to see the sonographic

appearances of common disorders involving the tendons, ligaments, muscles, menisci, synovium, cartilage, and soft tissues of the knee joint. Tendons may be involved in acute inflammation or more chronic degenerative processes (tendinopathy), such as jumper's knee. Tendons cannot be assessed by arthroscopy because they are extra-articular structures. Ultrasound identification of the site and extent of tendinopathy has been used successfully in surgical planning.²⁻⁶ Ultrasound can demonstrate different types of injury in the peripheral part of the meniscus. However, magnetic resonance imaging is more sensitive than ultrasound for detection of meniscal lesions. Parameniscal cysts appear as rounded hypoechoic lesions related to the outer margin of the lateral meniscus and connected with the linear hypoechoic meniscal tear.^{3,4,7} Sonography can detect joint effusions that include even a few milliliters of fluid. The fluid within the suprapatellar bursa should not be more than 2 mm. The fluid can be aspirated under ultrasound guidance. Simple effusions are almost always anechoic. Debris within a joint effusion may represent pus, blood clots, fat lobules, or osteochondral fragments.⁸ Baker's cysts (popliteal cysts) has a characteristic crescent shape and involves the medial border of the gastrocnemius muscle and the semimembranosus tendon.^{9,10} Loose bodies are the result of detached osteochondral fragments, osteoarthritis, or synovial osteochondromatosis. Loose bodies appear as focal echogenic structures separated from other structures, lying within the joint space.¹¹

Rheumatoid arthritis in ultrasound shows synovial thickening and effusion. The former appears as hypoechoic or heterogeneous proliferation of the synovial membrane with poorly defined contours. The clinical status of a patient with rheumatoid arthritis depends upon the degree of synovial thickening and effusion. Patients with higher grades of effusion and synovial thickening have more severe symptoms. This correlation between ultrasound and clinical findings suggests that ultrasound is a useful method for monitoring the response to the treatment of rheumatoid arthritis. Power doppler sonography depicts increased vascularity within hypertrophied synovium. There is markedly increased vascularity within synovium that presents a higher grade of thickening whereas in patients with smaller effusions and less synovial thickening, the synovial leaflets display low vascularity. Power Doppler ultrasound may thus be used to identify rheumatoid arthritis activity and to monitoring responses to treatment.^{12,13}

Ultrasound, with its exquisite resolution, allows a detailed assessment of the anatomical structure as well as of the regional knee pathology. Therefore, US should be performed in all patients with inflammatory and degenerative diseases in clinical practice and for research purposes. Ultrasound allows fast and accurate imaging

of joints and related structures leading to detection of joint inflammation, assessing ongoing disease activity and monitoring of therapeutic responses. Ultrasound evaluation enhances the possibility of detecting and aspirating small amounts of fluid that are not always easily detected with clinical examination.¹⁴

Lee and Chow reported that ultrasonography is a sensitive tool to assess knee joint effusion, and a minimal amount of joint effusion as low as 7 to 10 ml could be optimally detected.¹⁵

According to Draghi et al. ultrasonography had 100% sensitivity and specificity in detecting deep infrapatellar bursa.¹⁶

Blankstein et al. in the assessment of the bipartite patella and reported 100% sensitivity and specificity of ultrasonography.¹⁷

The aim of the study was to study the various pathological conditions of painful knee joint by using ultrasound for early diagnosis and prompt therapeutic approach and to evaluate the osteoarthritic changes in the painful knee joint by ultrasound.

MATERIALS AND METHODS

This is a prospective observational study conducted in the Department of Radiology and Orthopedics&trauma surgery, National Medical College & teaching Hospital, Birgunj, Parsa, Nepal for the 6 months duration from October 2022 to March 2023 in 40 patients presented with unilateral (single) knee jointswelling and pain. Patients included in this study were above 20 years. With ethical clearance from the Institutional Review Committee of National Medical College and after obtaining the informed consent of the patient, prospective observational study was conducted.

Ultrasound assessment

All ultrasound assessments were performed using the same machine with a 9 MHz linear transducer. A 30–45-degree flexion of the knees was standardized by using the same wedge for all ultrasound assessments. At first all anatomical structures around the knee joint were examined which includes tendons, synovium, menisci and bursa followed by the assessment of pathology around knee joint likely effusion, synovial thickening, tendinopathy, osteoarthritic change. Bony outline of knee joint was also assessed. Any inflammatory change related to the synovium or tendon was assessed by using both grey scale and Doppler study. The size of effusion was measured in the longitudinal supra-patellar position, with the knee in 30 degrees of flexion. The maximum diameter of the effusion in the longitudinal view was used to quantify it. Joint effusion was defined by using

a cut off of ≥ 4 mm effusion depth, as seen in a previous multicenter European study.¹⁸ The thickness of the femoral condylar cartilage was measured in the medial and lateral condyles and in the notch, with the knee in maximum flexion. Cartilage thickness was measured from the thin hyper-echoic line at the soft tissue-cartilage interface to the hyper-echoic line at the cartilage-bone interface. The probe was placed transversely to the leg and perpendicular to the bone surface, just above the superior margin of the patella; this technique being derived from the methods described by Aisen and Iagnocco.^{19,20} There were no other lines drawn to demarcate the probe position. The presence or absence of osteophytes was assessed at the tibial and femoral sites in painful knees in longitudinal scan positions of transducer.

Data processing and analysis done by using SPSS version 23 and statistical tests applied are Count, Percentage, Mean, Median and Standard Deviation. Findings were presented as tables and bar diagrams.

RESULTS

This study included 40 symptomatic patients with knee joints pain included in this study. In 40 patients 19 were females (47.5%) and 21 males (52.5%), with ages ranged from 20 to 70 years. Ultrasound findings showed joint effusions in 25 (62.5 %) as most common finding in painful knees, synovial thickening in 17 (42.5 %) knees, Synovitis in 14 (35.0%) and tendinopathy seen in only 1 (2.5%) knee joint pain. Osteoarthritis such as narrow joint space in 4 (10%) knees, marginal osteophytes in 4 (10%) knees, loose bodies in 3 (7.5%) knees, Baker's cyst in 1 (2.5%) knee. Most common involved age group is 51-60 years with 17 cases followed by 41-50 years in 11 cases. One patient presented with only knee joint pain was found sonologically normal.

Table 1: Age and Gender distribution

| Gender | Age | | | | | Total |
|--------|-------|-------|-------|-------|-------|------------|
| | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | |
| Female | 1 | 0 | 6 | 8 | 4 | 19 (47.5%) |
| Male | 0 | 2 | 5 | 9 | 5 | 21(52.5%) |
| Total | 1 | 2 | 11 | 17 | 9 | 40 |

Above table shows Age and gender distribution of study population. In which males 21 (52.5%) are more commonly involved than females 19 (47.5%). Most common age group is 51-60 years followed by 41-50 years. With male predominance in 51-60-year age group and female predominance in 41-50years age group.

Table 2: Joint effusion with age distribution

| Joint Effusion | Age | | | | | Total |
|----------------|-------------|-------------|---------------|---------------|--------------|------------|
| | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | |
| Present | 1 | 2 | 7 | 9 | 6 | 25 (62.5%) |
| Absent | 0 | 0 | 4 | 8 | 3 | 15 (37.5%) |
| Total | 1 (2.5%) | 2 (5.0%) | 11 (27.5%) | 17 (42.5%) | 9 (22.5%) | 40 |

Above table shows Joint effusion with age distribution which shows joint effusion in 25 pain full knee joint out of 40. Most common age group is 51-60 years followed by 41-50 years.

Table 3: Joint effusion with Synovial thickening

| Joint Effusion | Synovial Thickening | | Total |
|----------------|---------------------|---------|------------|
| | Absent | Present | |
| Present | 9 | 16 | 25 (62.5%) |
| Absent | 14 | 1 | 15 |
| Total | 23 | 17 | 40 |

Above table shows relationship of synovial thickening with joint effusion out of 40 study population, 17 (42.5%) patients show synovial thickening, out of which 16 (94.1%) patients presented with synovial thickening with joint effusion. Only one patient shows synovial thickening without effusion.

Table 4: Synovitis and age group

| Synovitis | Age | | | | | Total |
|-----------|-------|-------|-------|-------|-------|-------|
| | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | |
| No | 1 | 1 | 7 | 11 | 6 | 26 |
| Yes | 0 | 1 | 4 | 6 | 3 | 14 |
| Total | 1 | 2 | 11 | 17 | 9 | 40 |

Table shows relationship of Bursitis with age group. Most common age group with collection in bursa and in joint with synovitis is 51-60 years followed by 41-50 years. synovitis seen in 14 (35.0%) Knee pain out of 40.

Figure 1: Effusion with loose bodies

Figure 1: shows distribution of loose bodes with joint effusion. Total joint pain showing 3 (7.5%) out of which only one case is associated with joint effusion.

Table 5: Osteoarthritic change

| Joint narrowing | Marginal osteo-phytes | Loose bodies | Plica | Bakers Cyst | Joint effusion | Synovitis |
|-----------------|-----------------------|--------------|----------|-------------|----------------|------------|
| 4 (10.0%) | 4 (10.0%) | 3 (7.5%) | 2 (5.0%) | 1 (2.5%) | 25 (62.5%) | 14 (35.0%) |

Most common Osteoarthritic change seen is joint effusion in 25 patients out of 40 followed by narrow joint space in 4 cases & marginal osteophytes in 4 knees, loose bodies in 3 knees and Baker's cyst in 1 knee.

DISCUSSION

The current study shows the diagnostic role of ultrasound in the non-traumatic knee joint pain. Most common cause associated with the knee joint pain is joint effusion followed by the synovial thickening and synovitis. Most commonly seen in male population. Knee joint pain most commonly involved in all age group of study population but most commonly seen in 51-60 followed by 41-50 years among which joint effusion is the most common pathology. The early diagnosis by ultrasonography could allow early start of treatment without usual delay and that would have a good impact on patient recovery. Lee and Chow reported that ultrasonography is a sensitive tool to assess knee joint effusion, and a minimal amount of joint effusion as low as 7 to 10ml could be optimally detected.¹⁵

Naredo et al. included in their study of 50 patients (six males and 44 females), with mean age of 64.3 ± 7.9 years (51-78).²¹ In contrast to this study our study shows painful knee joint in 21 (52.5%) male and 19 (47.5%) female with common age 41-60 years.

D'Agostino et al. studied 600 patients with painful knee Osteoarthritis and found that inflammation evident by synovitis and joint effusions seen by US correlated statistically with the advanced radiographic disease.¹⁸ In our study joint effusion seen in 25 cases (62.5%) with predominant in the 51-60 years and 41-50 years with synovial thickening and inflammatory change (synovitis) noted in the 14 cases (35.0%).

Naredo et al. 50 patients in their study with primary knee osteoarthritis showed Baker's cysts in 20 (22.2%) knees.²¹ In our study Baker's cyst noted in only 1 painful joint.

In Suheil Atul et al. study showed synovitis in painful one knee joint. Fifty-three knees (18% of all the knees evaluated) had more than one imaging finding, mostly two and while some had three findings. The most common combination of findings was Medial meniscal tear and Baker's cyst (8 knees), Medial meniscal tear with Osteoarthritis (8 knees), and Medial meniscal tear with fluid (6 knee).²² In our study most common finding of painful joint is joint effusion in 25 cases (62.5%) and is associated with synovial thickening in 17 knees (42.5%), synovitis in 14 cases (30.5%) and loose bodies in only 1 case (2.5%).

Hayashi et al. stated that synovitis is increasingly

recognized as an important feature of the pathophysiology of osteoarthritis, and contrast-enhanced MRI and Ultrasound are the most important methods for assessing synovitis associated with osteoarthritis.²³ In contrast to this our study shows major finding is knee joint effusion in both non osteoarthritic painful knee joint and osteoarthritis.

CONCLUSION

Ultrasound is valuable in the early detection of pathology in painful joint and defining the type and extent of bone and cartilage damage. It is an excellent tool for the detection of soft tissue changes, and it also has potential in monitoring osteoarthritis progression. Assessment of soft tissue structures such as joint effusion, synovial thickening, synovial inflammatory change, Baker's cyst, and tendon pathology around knee joint can be done by musculoskeletal ultrasound.

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