

Assessment of Anterior Knee Pain with Ultrasonography: A Comparison with Clinical and MRI Results

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Abstract

Background: Anterior knee pain is a frequent clinical problem. It provides a common challenge to diagnose and manage. In this study we clarified the diagnostic accuracy of ultrasonography as a fast imaging technique in the assessment of patients with AKP and in comparison of the clinical and MRI assessment.

Material and Method: In this prospective study we examined 178 Knees of 150 patients by clinically, Ultrasonographic and by MRI in patients who complain anterior knee pain.

Result: The most common age group was between 25 and 35-year-old (35%). 28 patients (18.6%) had bilateral AKP. 32 knees showed positive MRI only, and 128 knees showed positive ultrasonography and MRI. Joint effusion was the most common finding (38%) followed by trochlear cartilage defect (20.6%) and superficial infrapatellar subcutaneous edema (20%) by both ultrasonographic and MRI. The overall accuracy of ultrasonography was 83.4% sensitivity and 100% specificity. The ultrasonography provided the highest sensitivity (100%) in detecting bipartite patella, followed by 90.5% for joint effusion, and 84.9% for Supra patellar fat impingement.

Conclusion: Ultrasound can be a good alternative for Orthopaedic surgeon to management of anterior Knee Pain where patient need urgent treatment, in MRI unavailability and in contraindication of MRI.

Keywords: Supra Patellar Fat, Subcutaneous Edema, Ultrasonography, Joint Effusion.

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Introduction

A troubling condition, anterior knee pain (AKP) is thought to be the primary reason people seek orthopaedic consultation for

knee issues [1-4]. The differential diagnosis for AKP falls under a broad category that is currently overlapping and unclear [5]. Young

adults between the ages of 15 and 30 are more likely to experience it, and women experience it more often than males. In a study conducted in a sports medicine clinic, Nejadi *et al.* discovered that the prevalence rate of AKP was 16.7%. [6] This rate was comparable to that reported by Boling *et al.* in a research involving US Naval Academy participants. A prevalence of 15% in females and 12% in males was discovered by Boling *et al.* [7] Despite being common, AKP's nature and causes are still poorly understood, which can be troublesome for patients and clinicians given that it results in persistent impairment, restricted sports and activity, and a poor quality of life [8,9].

When it happens during extended knee flexion or when ascending or descending steps, the patellofemoral joint may be the source of anterior knee pain. The discomfort may be nebulous in character and frequently localised in the retropatellar or peripatellar region. Paying close attention to the pain diagrams can assist localise symptoms and concentrate the physical assessment. [10] In several investigations, structural defects in AKP patients were found to be minimal, and there was no conclusive evidence linking patellofemoral misalignment to long-term treatment outcomes. [11] The clinical history and physical examination of the patient are of utmost significance in determining the cause of AKP. Imaging tests are added to the physical examination, and the result should be a precise diagnosis that serves as the cornerstone of a suitable treatment plan. [12] To determine the severity of the bone and soft tissue anomaly and to direct therapeutic intervention as needed, imaging workup is crucial [13,14]. Ultrasonography and magnetic resonance imaging (MRI) are the most beneficial diagnostic methods for assessing soft tissue alterations. Computed tomography is not advised, and plain radiography has limited value [15,16]. As MRI offers high contrast quality pictures of

the soft tissue as well as the underlying bone and allows for a precise assessment of the underlying cause, it is the method of choice in orthopaedics for knee imaging [17,18].

Moreover, for many knee diseases, MRI has replaced diagnostic arthroscopy as the primary diagnostic method [19]. Because it is rapid, easy, affordable, and dependable, ultrasonography has grown in popularity. It can evaluate the soft tissues in the knee's anterior aspect, which may be the major source of pain [20].

Therefore, we conducted a prospective study to evaluate the utility of ultrasonography as a quick imaging method in the evaluation of patients with anterior knee pain, to correlate ultrasound findings with clinical characteristics and MRI findings, and to evaluate the most effective ultrasonographic technique for identifying normal anatomy and diagnosing findings in patients with anterior knee pain.

Materials and Methods

This study included all patients who presented for an ultrasonography knee between November 2021 and October 2022 at the Department of Orthopedic, Radiodiagnosis, and Anesthesiology at Government Medical College and Bangur Hospital, Pali (Rajasthan), with anterior knee discomfort and a recent MRI knee. 150 patients with clinically proven AKP who have also recently had MRI knee imaging are scheduled for knee ultrasonography. Pregnant women, people with hemodynamic instability, people who are unable to understand the details of the protocol, and anyone who refuse to provide their consent will all be excluded from the study. Those who had not recently had a knee MRI were not included in the study (iii). All patients gave their informed consent. Throughout the trial, standardised data collection forms were employed, and the investigator filled them out. It includes the date, the patient's

information, their symptoms and physical indicators, and the results of any laboratory tests, including all relevant ultrasound, radiographic, and MRI findings. MRI findings served as the foundation for the patients' final diagnosis. Individuals with proven anterior knee discomfort who visited the orthopaedic department and had a recent MRI of the knee were booked for a USG of the knee. The ultrasound conducting radiologist completed a separate Standardized ultrasound data collecting form. All of the physicians involved in the trial filled out the MRI results. Afterwards,

clinical information, ultrasound results, and MRI results were analysed.

Results

Our analysis included 178 knees from 150 patients (80 men, 70 women; mean age, 33.6 13.9 years; range, 12-62 years). The age range of 25 to 35 years old was the most prevalent (35%). In 28 individuals (18.6%), the AKP was bilateral. Knee discomfort or impairment was our patients' main complaint. Patients' VAS scores was 5.26±1.3 and Duration of pain was 18.44±6.2 months. (Table 1).

Table 1: Clinical characteristics of the studied group (n=48)

Duration of pain (month) (Mean±SD)		18.44±6.2	
VAS (pain score) (Mean± SD)		5.26±1.3	
Variable		No	%
Laterality	Right	110	61.79
	Left	68	38.20
Presenting symptom			
Anterior knee pain		106	59.55
Anterior knee pain plus giving away		42	23.59
Anterior knee pain plus difficult kneeling		20	11.23
Anterior knee pain plus limited range of motion		10	5.61

In comparison to the 318 findings in 129 knees revealed by MRI, the ultrasonography found 248 findings in 120 knees. 58 knees were shown by ultrasonography to be unaffected, compared to 32 by MRI (Table 2).

Table 2: Number of findings in each knee as detected by ultrasonography and MRI

Number of findings	Ultrasonography	MRI
No findings	58	32
one findings	40	62
Two findings	44	34
Three findings	24	22
Four Findings	12	18
Five Findings	0	10

The most frequent finding (58 patients, 32.58%) was joint effusion, while 5.6% and 20.22% of patients, respectively, had trochlear cartilage defects and superficial infrapatellar subcutaneous edoema (Table 3)

Table 3 :Frequency of each finding as detected by ultrasonography

	TP	FP	FN	TN
Joint effusion	58	10	12	98
Trochlear cartilage defect	10	8	24	136
Superficial infrapatellar tissue edema	36	0	16	126
Synovial plica	16	0	14	148
Patellar tendinopathy	34	0	12	132
Patellar cartilage defect	0	0	39	139
Suprapatellar fat impingement	24	0	12	142
Hoffa's fat pad impingement	35	0	8	135
Quadriceps tendinopathy	32	0	12	134
Infrapatellar bursitis	22	0	18	138
Bipartite patella	13	0	0	165

TR true positive, FP false positive, FN false negative, TN true negative

Table 4: MRI protocol for evaluation of the knee

	TR (ms)	TE (ms)	Thickness (mm)	Interslice gap (%)	FOV (cm)	Matrix	Scan time (min)
T2 FSE axial	3200–3800	92	3	10	16×16	356×286	321
PDFS axial	2100–2600	34	3	10	16×16	284×256	342
PDFS sagittal	2100–2600	32	3	10	16×16	284×256	295
T1 FSE sagittal	400–410	14	3	10	16×16	56×286	30
PDFS coronal	2100–2600	34	3	10	17×17	284×256	250

In 16.6% of the 178 knees, both MRI and ultrasonography revealed no abnormalities. The total diagnostic effectiveness of ultrasonography was 84.4% sensitivity, 100% specificity, 100% PPV, and 58.9% NPP in detecting abnormal abnormalities in AKP patients. (Table 5)

Table 5: Diagnostic accuracy of ultrasonography findings using MRI as the gold reference standard

	Sensitivity (%)	Specificity (%)	PPV	NPV	AUC(ROC)	Kappa agreement (Cohen's Kappa)
Joint effusion	90.5	92.2	92.3	94.2	0.91	0.85
Trochlear cartilage defect	72.8	96.3	91	92.3	0.84	0.74
Superficial infrapatellar tissue edema	74.6	100	100	94.2	0.86	0.85
Synovial plica	77.2	100	100	94	0.84	0.82
Patellar tendinopathy	80.3	100	100	96	0.91	0.83
Patellar cartilage defect	0	100	-	84.2	0.56	0
Suprapatellar fat impingement	84.9	100	100	96.1	0.95	0.89
Hoffa's fat pad impingement	65.6	100	100	94.5	0.81	0.74
Quadriceps tendinopathy	84.5	100	100	98.3	0.92	0.89
Infrapatellar bursitis	68.2	100	100	97.4	0.84	0.82
Bipartite patella	100	100	100	100	1.5	1
Overall validity	83.4	100	100	58.9	0.94	0.65

MRI magnetic resonance imaging, PPV positive predictive value, NPV negative predictive value, CI confidence interval, AUC area under curve, ROC receiveroperating characteristic curve

Discussion

Clinically, 59.55% of patients in our study reported anterior knee pain alone, 23.59% reported anterior knee pain plus giving away, 11.23% reported anterior knee pain plus problematic kneeling, and around 5.61% reported anterior knee pain plus limited range of motion. The mean number of months the discomfort persisted was 18.44 ± 6.2 .

That was a little bit longer, but about the same as the time period (9 ± 6.7 months) described by Kang *et al.* [21] The mean + SD pain score in our study (measured using the VAS) was 5.26 ± 1.3 . The results by Kang *et al.*, who reported mean + SD VAS scores of 4.7 ± 1.9 , corroborated this. The right side knee had 61.79% of the symptoms, and the left side had the remaining symptoms (38.20%). The findings of Fahmy *et al.*, who noted that 44% of complaints were on the left and 56% on the right, were consistent with this. [22]

The PFJ cartilage lesions, intraosseous oedema, synovial plica, and soft tissue impingement could all be found by MRI. In asymptomatic patients, imaging abnormalities such lateral patellar displacement may commonly be observed. [20]

A research by Artul *et al.* found that 66% of ultrasound reports were positive while 34% were negative. [23] In the current study, 16.8% (26 knees) of MRI reports and 29% (45 knees) of ultrasonography reports were normal. According to Lee and Chow, ultrasonography is a sensitive instrument for evaluating knee joint effusion, and a joint effusion with a minimum volume of 7 to 10 ml can be best recognised. [24] In the study by Draghi *et al.* ultrasonography was found to have 100% specificity and 81.3% sensitivity for the detection of knee effusion. [25]

In this study, we compared the high diagnostic accuracies of ultrasonography to those of magnetic resonance imaging (83.4% sensitivity, 100% specificity, 100% PPV, and 58.9% NPV). The majority of the abnormal results in this investigation were found using ultrasonography. While an MRI test takes time, the orthopaedic team was able to manage the patient right away because to the early and quick diagnosis provided by ultrasonography.

Conclusion

Although MRI has been shown to be the method of choice for differentiating between the different knee pathologies that lead to AKP and for detecting the various grades of some knee pathologies, such as trochlear dysplasia and chondromalacia patella, or factors that may predispose to them, ultrasound can be a good alternative for orthopaedic surgeons to manage anterior knee pain.

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