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Relationship between Clinical Features and Ultrasonographic Findings in Knee Osteoarthritis

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Introduction: One of the leading causes of disability and morbidity is knee Osteoarthritis. Clinical symptoms, careful examination, and radiographic evidence like Magnetic Resonance Imaging diagnose knee OA. MRI is expensive and scarce, but MSK USG is cheaper and more accessible, especially in peripheral locations. Thus, this study examined the link between clinical characteristics and ultrasonographic data in knee OA patients to simplify investigation.

Methods: The Department of Physical Medicine and Rehabilitation and Department of Radiology and Imaging, Dhaka Medical College Hospital (DMCH), Dhaka collaborated on this cross-sectional study. The trial lasted a year. This study comprised 90 knee OA patients who met inclusion and exclusion criteria. Participants gave written informed consent. Every patient had a complete history and clinical evaluation. WOMAC measured pain, stiffness, and physical function. X-rays and MSK US were done on each patient. Data were gathered by questionnaire. The data was analyzed using SPSS 23.

Results: The mean age of responders was 50.9±7.6 (SD) years, with a 4:6 male-female ratio. The mean WOMAC scores for pain, stiffness, and physical function were 10.7±2.2, 3.7±2.4, and 41.3±5.3, respectively MSK US showed osteophytes in 76.7%, effusion in 51.1%, articular cartilage degeneration in 35.6%, and power dropler change in 37.8%. These features were significantly linked to KLS grading (X-ray) and WOMAC scores (Pain & stiffness) ($p<.05$).

Conclusion: This study observed significant positive association between MSK US findings and clinical features among patients with knee OA. Sill, further larger study is recommended.

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INTRODUCTION

Osteoarthritis (OA) damages cartilage, subchondral bone, synovium, and muscle. OA causes localized loss of hyaline cartilage, increased thickness and sclerosis of the subchondral bone plate, osteophyte development at joint borders, synovial inflammation, and muscle weakness surrounding the afflicted joint[1]. In developed countries, knee OA is the major cause of disability, increasing healthcare use and reducing quality of life. An aging global population will increase knee OA rates in approaching decades[2].

Epidemiological study methods and clinical or radiological diagnostic criteria determine knee OA prevalence. Radiographic knee OA involves 37%–68% of 60-year-olds[3]. Knee OA is 7.5% in rural Bangladesh, 9.2% in urban slums, and 10.6% in affluent regions[4]. Most instances occur between 50 and 59. Females start the illness at 35–45 and males at 55–65[5]. Local and systemic dangers occur. Systemic factors include age, obesity, ethnicity, bone mineral density, diet, smoking, and occupational activity; local factors include joint damage, tissue abnormalities, malalignment, and neuromuscular dysfunction (Sharma, 2019). Knee OA is 43% heritable and hip and hand OA 60–65%[6].

It causes pain, stiffness, deformity, crepitus, instability, edema, stride changes. Between-remission acute exacerbations last weeks to months[7]. OA pain occurs from synovium, ligaments, joint capsule, muscles, and subchondral bone because articular cartilage is uninnervated. Iliotibial band

$$N = \left(\frac{Z\propto+Z\beta}{C(r)}\right)^2+3$$

syndrome and anserine bursiti scan induce symptoms[1]. Severe pain requires medical attention[8]. Imaging and clinical diagnosis as needed. Radiographs, particularly the Kellgren-Lawrence (K/L) grading system, are still used to assess disease severity due to osteophyte development, joint space constriction, and subchondral sclerosis.

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scale is commonly used to assess pain and function[9]. Conventional radiography (CR) is still used for diagnosis, however it may not match clinical symptoms. MSK US and MRI show soft tissue characteristics and inflammation better than radiography[10]. Ultrasonography is cheaper, radiation-free, and accessible than MRI for knee OA assessment. Synovial hypertrophy, effusion, osteophytes, and cartilage loss are structural joint pathology. Ultrasound identifies knee OA abnormalities better than radiography and clinical evaluation[11]. It can help track disease progression and therapeutic response.

Ultrasound knee OA assessment is rising internationally, however Bangladeshi clinical and ultrasound research is scarce. Other investigations link pain, physical function, and sonographic abnormalities[12,13,14,15,16,17,18,19]. These findings may not apply to Bangladesh owing to demographic and socioeconomic factors. Data shortage necessitates regional research. Ultrasonographic data and Bangladeshi knee OA patients' pain and function are compared in this research. This group uses the Bengali WOMAC scale to evaluate ultrasonographic knee OA diagnosis and monitoring capabilities.

METHODS

This cross-sectional study included 90 patients with knee osteoarthritis (OA) who attended the department of Physical Medicine and Rehabilitation at Dhaka Medical College Hospital (DMCH), from October 2020 to September 2021 by purposive sampling technique and the

sample size was calculated by using the following formula,

The study comprised men and women over 40 with ACR clinical and radiographic knee OA diagnoses Patients with inflammatory knee disorders, metabolic bone diseases, malignancies, tubercular or septic arthritis, or other arthropathies, patients with knee injuries or surgery, intra-articular steroid injection, or cognitive issues preventing conversation were excluded. Participants supplied informed written consent, comprehending the study's purpose, methods, and withdrawal. Confidentiality was strictly maintained and ethical clearance was given by Dhaka Medical College Ethical Review Committee

The diagnosis was confirmed by ACR criteria, Kellgren-Lawrence radiograph grading, and ultrasound examinations by an experienced musculoskeletal sonography expert. Validated Bengali WOMAC scales measured pain and functional impairment. Standardized ultrasonic analysis of knee structures using a 6–11 MHz linear transducer. Laboratory tests (CBC with ESR, RA, serum uric acid, creatinine, blood sugar, urine R/E) were performed as needed. Synovial fluid was tested if needed.

A systematic questionnaire collected demographic and clinical data. The WOMAC scale[20] graded pain and physical function from 0 (None) to 4 (Extreme). Ultrasound scores were rated using OMERACT knee ultrasound OA atlas. Data were rigorously recorded and analyzed using SPSS 23.0. Quantitative factors were provided as mean ± standard deviation, while qualitative variables were reported as frequency and percentage. The statistical analyses included chi-square and independent t-tests. A p-value < 0.05 indicated significance.

RESULTS

Table 1: Distribution of the respondents according to age, sex and BMI (n=90)

The mean age of the respondents was 50.9±7.6 (SD) years and the mean BMI was 24.8±4.5 (SD) kg/m^2. The highest number of respondents were female (60%).

Age group (years)	Frequency	Percentage	Mean±SD (Range min-max)
40 to 49	45	50	50.9±7.6 (40 - 64)
50 to 59	27	30	
60 and above	18	20	
Total	90	100	
Sex			
Male	36	40	-
Female	54	60	
BMI			24.8±4.5 (18.9 – 34.2)
18.5 to 24.99 (Normal)	36	40	
25 to 29.99 (Over wight)	45	50	
≥30 (Obese)	9	9	
Total	90	100	

Table 2: Distribution of the patients by Knee alignment (n=90)

Among all, 90% had a normal alignment of knee besides 7.8% had genu varus and 2.2% had genu valgus

Knee alignment	Frequency (n)	Percentage (%)
Normal	81	90
Genu Varus	7	7.8
Genu valgus	2	2.2
Total	90	100

About 60% of OA cases were in the right knee and 40% of cases were in the left knee of the patients.

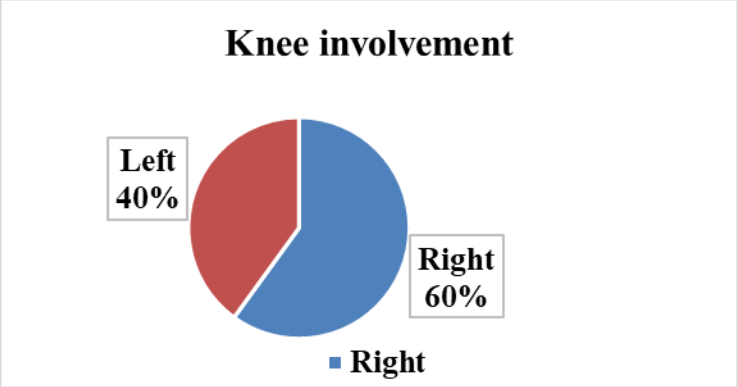

Figure I: Distribution of the patients by knee involvement (n=90)

Table 3: Distribution of the patients by duration of the pain and pain score, Stiffness score, Physical function score (n=90)

The majority (70%) of the patients had OA for 5 years or less than 5 years. The mean duration of pain was 5.0±3.4 (SD) years and the mean pain score was 10.7±2.2. The mean Stiffness score was 10.7±2.2 and mean physical function score was 41.3±5.3.

Duration of the pain (Years)	Frequency	Percentage	Mean±SD (min-max)
≤5 years	63	70	5.0±3.4 (1 – 13)
6 to 10 years	18	20	
11 to 15 years	9	10	
Total	90	100	
Pain score			10.7±2.2 (8 – 15)
less or equal 10	49	54.4	
>10	41	45.6	
Total	90	100	
Stiffness score			3.7±2.4 (0– 8)
0 to 3	50	55.6	
4 to 8	40	44.4	
Total	90	100	
Physical function score			41.3±5.3 (34 – 52)

less or equal 40	47	52.2	
41 to 50	36	40.0	
>50	7	7.8	
Total	90	100	

Table 4: Radiographic features and Ultrasound findings of the respondents (n=90)

The majority (42.2%) of the patients showed radiographic features grade 2, 25.6% showed grade 1, 22.2% showed grade 3 and 10% showed radiographic features grade 4. About 77% USG showed Osteophyte presence, 51.1% USG showed Effusion, 35.6% showed articular cartilage degeneration and 37.8% USG showed Power Doppler Change.

Radiographic features (Kellgren-Lawrence grade)	**Frequency**	**Percentage**
Grade 1	23	25.6
Grade 2	38	42.2
Grade 3	20	22.2
Grade 4	9	10
Total	90	100
Ultrasound findings		
Osteophyte		
Grade 0	21	23.3
Grade 1	27	30
Grade 2	18	20
Grade 3	24	26.7
Effusion		
Grade 0	44	48.9
Grade 1	11	12.2
Grade 2	13	14.4
Grade 3	22	24.4
Articular cartilage degeneration		
Grade 0	58	64.4
Grade 1	2	2.2
Grade 2	16	17.8
Grade 3	14	15.6
Power Doppler Change		
Grade 0	56	62.2
Grade 1	4	4.4
Grade 2	14	15.6
Grade 3	16	17.8

Table 5: Association of USG finding (Osteophytes) with WOMAC score (n=90)

Table 5 states Pain score and stiffness score significantly increases with increased grading of osteophyte.

WOMAC score	**USG finding (Osteophyte)**				**p value**
	Grade 0 n (%)	**Grade 1 n (%)**	**Grade 2 n (%)**	**Grade 3 n (%)**	
Pain					

≤10	16 (76.2)	25 (92.6)	8 (44.4)	0 (0)	<0.01*
>10	5 (23.8)	2 (7.4)	10 (55.6)	24 (100)	
Mean±SD	9.7±1.8	9.2±1.1	10.8±1.9$^{\$}$	13.3±1.1$^{\#\$\&}$	<0.01**
Stiffness					
0 to 3	18 (85.7)	18 (66.7)	6 (33.3)	8 (33.3)	<0.01*
4 to 8	3 (14.3)	9 (33.3)	12 (66.7)	16 (66.7)	
Mean±SD	2.0±1.6	3.3±2.1	4.8±2.4	4.7±2.5$^{!}$	<0.01**
Physical function					
≤40	17 (81)	12 (44.4)	9 (50)	9 (37.5)	0.102*
40 to 50	4 (19)	12 (44.4)	8 (44.4)	12 (50)	
>50	0 (0)	3 (11.2)	1 (5.6)	3 (12.5)	
Mean±SD	37.3±3.6	40.8±5.3	40.9±6.0	41.1±5.3	0.06**

p value determined by the *Chi-square test and One way ANOVA test. Data are expressed in the column.
$^{\#}$denotes significant difference between Grade 0 vs Grade 3 regarding pain score.
$^{\$}$denotes significant difference between Grade 1 vs Grade 2 and Grade 3 regarding pain score.
$^{\&}$denotes significant difference between Grade 2 vs Grade 3 regarding pain score.
$^{!}$denotes significant difference between Grade 0 vs Grade 3 regarding Stiffness score.

Table 6: Association of USG finding (Effusion) with WOMAC score (n=90)
Pain score and stiffness score significantly increases with increased grading of effusion.

WOMAC score	**USG finding (Effusion)**				**p value**
	Grade 0 n (%)	**Grade 1 n (%)**	**Grade 2 n (%)**	**Grade 3 n (%)**	
Pain (n%)					
≤10	36 (81.8)	7 (63.6)	4 (30.8)	2 (9.1)	<0.01*
>10	8 (18.2)	4 (36.4)	9 (69.2)	20 (90.9)	
Mean±SD	9.4±1.4	10.4±1.7	11.3±1.5$^{\#\$}$	13.2±1.6$^{\#\$\&}$	<0.01**
Stiffness (n%)					
0 to 3	36 (81.8)	9 (81.8)	1 (7.7)	4 (18.2)	<0.01*
4 to 8	8 (18.2)	2 (18.2)	12 (92.3)	18 (81.8)	
Mean±SD	2.4±1.7	2.9±2.2	5.7±1.6$^{!\wedge}$	5.4±2.3$^{!\wedge}$	<0.01**
Physical function (n%)					
≤40	27 (61.4)	4 (36.4)	5 (38.5)	11 (50)	0.160*
40 to 50	15 (34.1)	6 (54.5)	8 (61.5)	7 (31.8)	
>50	2 (4.5)	1 (9.1)	0 (0)	4 (18.2)	
Mean±SD	39.1±4.9	40.8±5.1	41.7±5.1	40.7±6.3	0.381**

p value was determined by the *Chi-square test and One way ANOVA test. Data are expressed in the column. $^{\#}$denotes a significant difference between Grade 0 vs Grade 2 and 3 regarding pain

score.[$]denotes that significant difference between Grade 1 vs Grade 2 and Grade 3 regarding pain score.[&]denotes a significant difference between Grade 2 vs Grade 3 regarding pain score.[!]denotes that significant difference between Grade 0 vs Grade 2 and 3 regarding stiffness score.[^]denotes that significant difference between Grade 1 vs Grade 2 and 3 regarding stiffness score.

Table 7: Association of USG finding (Articular cartilage degeneration) with WOMAC score (n=90)

Pain score and stiffness score significantly increases with increased grading of articular cartilage degeneration.

WOMAC score	USG finding (Articular cartilage degeneration)				P value
	Grade 0 n (%)	Grade 1 n (%)	Grade 2 n (%)	Grade 3 n (%)	
Pain					
≤10	43 (74.1)	1 (50)	3 (18.8)	2 (14.3)	<0.01*
>10	15 (25.9)	1 (50)	13 (81.3)	12 (85.7)	
Mean±SD	9.8±1.6	1050±3.5	12.0±1.9[#]	13.1±1.9[#$]	<0.01**
Stiffness					
0 to 3	40 (69)	0 (0)	8 (50)	2 (14.3)	0.001*
4 to 8	18 (31)	2 (100)	8 (50)	12 (85.7)	
Mean±SD	3.0±2.1	4.5±0.7	4.3±2.5	5.8±2.1[!]	<0.01**
Physical function					
≤40	34 (58.6)	1 (50)	6 (37.5)	6 (42.9)	0.687*
40 to 50	21 (36.2)	1 (50)	8 (50)	6 (42.9)	
>50	3 (5.2)	0 (0)	2 (12.5)	2 (14.2)	
Mean±SD	39.5±5.0	40.0±7.1	41.7±6.0	40.9±5.8	0.468**

p value was determined by the *Chi-square test and One way ANOVA test. Data are expressed in the column.[#]denotes significant difference between Grade 0 vs Grade 2 and 3 regarding pain score.[$]denotes significant difference between Grade 1 vs Grade 3 regarding pain score.[!]denotes significant difference between Grade 0 vs Grade 3 regarding the Stiffness score

Table 8: Association of USG finding (Power Doppler change) with WOMAC score (n=90)

Pain score and stiffness score significantly increases with increased grading of Power Doppler change

WOMAC score	USG finding (Powe doppler change)				p value
	Grade 0 n (%)	Grade 1 n (%)	Grade 2 n (%)	Grade 3 n (%)	
Pain					
≤10	40 (71.4)	1 (25)	4 (28.6)	4 (25)	0.001*
>10	16 (28.6)	3 (75)	10 (71.4)	12 (75)	
Mean±SD	9.9±1.7	11.2±1.2	11.7±1.9[#]	12.8±2.3[#]	<0.01**
Stiffness					
0 to 3	42 (75)	1 (25)	2 (14.3)	5 (31.3)	0.001*
4 to 8	14 (25)	3 (75)	12 (85.7)	11 (68.8)	

Mean±SD	2.8±2.0	4±3.2	5.3±2.1[!]	5.1±2.4[!]	<0.01**
Physical function					
≤40	31 (55.4)	2 (50)	6 (42.9)	8 (50)	0.520*
40 to 50	22 (39.3)	2 (50)	6 (42.9)	6 (37.5)	
>50	3 (5.4)	0 (0)	3 (14.3)	2 (12.5)	
Mean±SD	39.6±4.9	42.0±6.3	41.7±6.0	40.0±6.1	0.180**

p value was determined by the *Chi-square test and One way ANOVA test. Data are expressed in the column.[#]denotes a significant difference between Grade 0 vs Grade 2 and 3 regarding pain score.[!]denotes a significant difference between Grade 0 vs Grade 2 and 3 regarding Stiffness score.

Table 9: Association of radiographic feature with USG findings (n=90)

The severity of USG findings was significantly associated with Radiographic features.

Ultrasound findings	**Radiographic feature**				**p value***
	Grade 0 n (%)	**Grade 1 n (%)**	**Grade 2 n (%)**	**Grade 3 n (%)**	
	n (%)	n (%)	n (%)	n (%)	
Osteophyte					
Grade 0	21 (91.3)	0 (0)	0 (0)	0 (0)	<0.01
Grade 1	2 (8.7)	25 (65.8)	0 (0)	0 (0)	
Grade 2	0 (0)	7 (18.4)	10 (50)	1 (11.1)	
Grade 3	0 (0)	6 (15.8)	10 (50)	8 (88.9)	
Effusion					
Grade 0	23 (100)	18 (47.4)	3 (15)	0 (0)	<0.01
Grade 1	0 (0)	11 (28.9)	0 (0)	0 (0)	
Grade 2	0 (0)	9 (23.7)	4 (20)	0 (0)	
Grade 3	0 (0)	0 (0)	13 (65)	9 (100)	
Articular cartilage degeneration					
Grade 0	21 (91.4)	30 (78.9)	7 (35)	0 (0)	<0.01
Grade 1	1 (4.3)	0 (0)	1 (5)	0 (0)	
Grade 2	1 (4.3)	7 (18.4)	8 (40)	0 (0)	
Grade 3	0 (0)	1 (2.6)	4 (20)	9 (100)	
Power Doppler Change					
Grade 0	22 (95.7)	34 (89.5)	0 (0)	0 (0)	<0.01
Grade 1	1 (4.3)	3 (7.9)	0 (0)	0 (0)	
Grade 2	0 (0)	1 (2.6)	13 (65)	0 (0)	
Grade 3	0 (0)	0 (0)	7 (35)	9 (100)	

*p value was determined by the Chi-square test. Data are expressed in the column.

Table 10: Association of Socio-demographic profile with Pain score and Stiffness score (n=90)

Pain score significantly increases with increased age and increased BMI. No significant difference found regarding socio-demographic profile with Stiffness score.

Sociodemographic profile	**Pain score ≤10 n (%)**	**Pain score >10 n (%)**	**p value**
Age in years			0.030*
40 to 49	29 (59.2)	16 (39)	
50 to 59	15 (30.6)	12 (29.3)	
≥60	5 (10.2)	13 (31.7)	
Mean±SD	49.3±6.8	52.8±8.1	0.028**
Sex			
Male	20 (40.8)	16 (39)	0.518*
Female	29 (59.2)	25 (61)	
BMI in kg/m^2			
18.5 to 24.99	26 (53.1)	10 (24.4)	0.022*
25 to 29.99	19 (38.7)	26 (63.4)	
≥30	4 (8.2)	5 (12.2)	
Mean±SD	23.7±4.4	26.1±4.3	0.011**
Stiffness score	**Score 0 to 3 n (%)**	**Score 4 to 8 n (%)**	
Age in years	28 (56)	17 (42.5)	0.242*
40 to 49	15 (30)	12 (30)	
50 to 59	7 (14)	11 (27.5)	
≥60	49.7±7.0	52.5±8.1	
Mean±SD	28 (56)	17 (42.5)	0.076**
Sex			
Male	17 (34)	19 (47.5)	0.140*
Female	33 (66)	21 (52.5)	
BMI in kg/m^2			
18.5 to 24.99	23 (46)	13 (32.5)	0.402*
25 to 29.99	23 (46)	22 (55)	
≥30	4 (8)	5 (12.5)	
Mean±SD	24.2±4.4	25.5±4.5	0.154**

*p value was determined by * Chi-square test and **Independent sample t test. Data was expressed in column.

Table 11: Association of Socio-demographic profile with Physical function score (n=90)
No significant difference found regarding socio-demographic profile with Physical function score.

Socio-demographic profile	Score <40 n (%)	Score 40 to 50 n (%)	Score >50 n (%)	P value
Age in years				
40 to 49	25 (53.2)	17 (47.2)	3 (42.9)	
50 to 59	15 (31.9)	11 (30.6)	1 (14.2)	0.495*
≥60	7 (14.9)	8 (22.2)	3 (42.9)	
Mean±SD	50.4±7.1	51.2±8.2	53.4±8.4	0.594**
Sex				
Male	16 (34)	17 (47.2)	3 (52.9)	
Female	31 (66)	19 (52.8)	4 (57.1)	0.472*
BMI in kg/m^2				
18.5 to 24.99	22 (46.8)	11 (30.6)	3 (42.9)	
25 to 29.99	21 (44.7)	20 (55.6)	4 (57.1)	0.514*
≥30	4 (8.5)	5 (13.8)	0 (0)	
Mean±SD	24.2±4.6	25.8±4.4	23.9±3.8	0.235**

*p value was determined by * Chi-square test and **One Way ANOVA test. Data was expressed in column.

DISCUSSION

Osteoarthritis (OA), the most common musculoskeletal disease, affects the knee. In addition, 6–10% of people experience knee OA symptoms[21]. Clinical examination and plain radiography diagnose knee OA. PR cannot directly observe articular cartilage, synovial recesses, menisci, and other soft structures involved in OA etiology. MRI is expensive, while MSK US is non-invasive, rapid, affordable, consistent, can scan many joints, and patient-acceptable[22]. Ultrasonography features and knee OA clinical symptoms were evaluated in this study.

The study revealed an average age of 50.9±7.6 years, with 60% of respondents being female. The patients had a mean BMI of 24.8±4.5 kg/m2, with 40% having a normal BMI, 50% overweight, and 9% obese. Huang et al. discovered that 86% of patients were female, having a mean age of 60.3 years and BMI of 26.2 kg/m2. Hassan et al. found identical age, BMI, and gender statistics[23]. Age closely correlates with OA prevalence and incidence in all joints, and women are more likely than men to have it[21].

The predominant OA symptom is pain. Patients had an average pain score of 10.7±2.2, with 54.4% scoring 0-10 and 45.6% scoring 10+. In addition, 55.6% had stiffness scores from 0 to 3, 44.4% from 4 to 8, and a mean score of 3.7. Patients had a mean physical function score of 41.3±5.3, with 52.2% scoring <40, 40% scoring 41-50, and 7.8% over 50. Pain score was connected with age and BMI, but not stiffness or physical function. Weiss showed OA severity increases knee pain. Pain increases with age and weight[24]. Obese people suffer more from OA discomfort with age[21].

Grade 2 radiographic features were found in 42.2% of patients, 25.6% grade 1, 22.2% grade 3, and 10% grade 4. K–L Naredo et al. discovered I in 28% knees, II in 39%, III in 30%, and IV in 3%[22]. The majority (45.6%) of the respondents had

Kellgren-Lawrence radiographic symptoms of grade 2, 25 (27.8%) were in grade 1, 20 (22.2%) were in grade 3, and 4 (4.4%) were in grade 4. Other studies found most cases were grade 1 and 2, which have mild to moderate radiological features[25,26]. In 76.7% of patients, USG showed osteophyte presence, 51.1% effusion, 35.6% articular cartilage deterioration, and 37.8% Power Doppler Change. USG severity increased with advanced radiographic feature grading. Naredo et al. discovered K-L severity worsens USG grading[22]. Ultrasound found more abnormalities in patients with higher total radiographic severity[26].

The current study found that osteophyte grading, effusion, articular cartilage degeneration, and Power Doppler change significantly increase Pain and Stiffness ratings. Chan et al. says knee effusion worsens pain[15]. Additionally, US effusion was highly associated with higher pain levels[22]. Heidari says osteophyte is the radiographic feature most related with knee discomfort[27]. Peter et al. found a strong link between moderate and large effusion, knee discomfort, and stiffness. Central osteophytes did not cause knee pain. Only patellofemoral osteophytes caused knee pain[28]. This study connected USG findings to discomfort, stiffness, and radiographic severity. USG detects knee OA-related periarticular and intraarticular abnormalities.

CONCLUSION

The study found that the severity of musculoskeletal (MSK) US features in OA patients was significantly associated with KLS grading and WOMAC scores for pain and stiffness. However, the study's sample size was not representative and the cross-sectional design did not follow longitudinal follow-up. Future research should verify the findings and compare MSK US findings with radiographic progression of knee osteoarthritis.

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DECLARATION

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