Section: Orthopaedics

Original Research Article

PREVALENCE AND MRI CHARACTERIZATION OF DEGENERATIVE MENISCAL INJURIES IN MILD TO MODERATE KNEE OSTEOARTHRITIS: A CROSS-SECTIONAL OBSERVATIONAL STUDY

Arjun Bhoomraddi[1], Mahantesh Y Patil[2], Jagadish Bhoomraddi[3]

[1]Assistant Professor, Department of Orthopaedics, K H PATIL Institute of Medical Sciences, Gadag, Karnataka, India
[2]Professor and Head of the Department, Department of Orthopaedics, K H PATIL Institute of Medical Sciences, Gadag, Karnataka, India
3 Assistant Professor, Department of Orthopaedics, K H PATIL Institute of Medical Sciences, Gadag, Karnataka, India

Received : 02/10/2025
Received in revised form : 16/11/2025
Accepted : 03/12/2025

Keywords:
Osteoarthritis knee; Meniscal tear; MRI; Kellgren–Lawrence grade; Degenerative joint disease.

Corresponding Author:
Dr. Arjun Bhoomraddi,
Email: arjbhoomraddi@gmail.com

DOI: 10.47009/jamp.2025.7.6.127

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (6); 692-696

ABSTRACT

Background: Osteoarthritis (OA) of the knee is a leading cause of disability and pain among middle-aged and elderly populations. Meniscal degeneration plays a crucial role in the pathogenesis and progression of OA. Magnetic resonance imaging (MRI) provides an accurate non-invasive tool to detect early meniscal structural changes. This study aimed to evaluate the prevalence and pattern of degenerative meniscal injuries in patients with mild to moderate knee OA using MRI and to analyze their association with disease severity. **Materials and Methods:** A cross-sectional observational study was conducted on 92 symptomatic patients with radiologically confirmed knee OA attending the Orthopaedics Department of a tertiary care center in Belagavi. Patients with Kellgren–Lawrence (K–L) grade 2 or 3 OA were included. MRI of the affected knee was performed using a 1.5-Tesla Siemens scanner with standard proton-density and T1-weighted sequences. Meniscal tears were classified by morphology (horizontal, radial, vertical, complex, root) and location (anterior horn, body, posterior horn). Associated intra-articular abnormalities such as effusion or cysts were also recorded. Statistical analysis was performed using Stata 10, with Chi-square and ANOVA tests; $p < 0.05$ was considered significant. **Result:** Meniscal pathology was identified in 70.7% of knees. The medial meniscus was most frequently involved (51.1%), followed by both menisci (15.2%) and the lateral meniscus (4.3%). The posterior horn was the most common site of involvement (52.1%), and horizontal tears predominated (27.1%). Joint effusion was present in 65.2% of cases. A statistically significant association was found between higher K–L grade and increased meniscal tear frequency ($p < 0.05$). **Conclusion:** Degenerative meniscal injuries are highly prevalent in mild to moderate knee OA, predominantly affecting the medial posterior horn. The frequency and complexity of tears increase with disease severity, underscoring the importance of MRI in early diagnosis and management of osteoarthritic knee degeneration.

INTRODUCTION

Osteoarthritis (OA) of the knee is a leading cause of pain, disability, and reduced mobility among adults worldwide. It is a progressive degenerative joint disorder characterized by articular cartilage loss, subchondral sclerosis, osteophyte formation, and meniscal degeneration. The Kellgren–Lawrence (K–L) grading system remains the most accepted radiographic method to classify the severity of OA, with grades 2 and 3 representing mild to moderate disease where structural changes are present but joint space is relatively preserved. Early detection and characterization of associated meniscal pathology in this phase are crucial, as interventions may still alter the course of degeneration and delay functional deterioration.

The menisci are essential fibrocartilaginous structures that distribute load, stabilize the knee, and protect the articular cartilage. Degeneration or tearing of the meniscus disrupts its biomechanical role, increasing joint contact stress and accelerating cartilage loss. Several studies have demonstrated a strong association between meniscal pathology and the presence or progression of OA.[1,2] Meniscal extrusion and complex or horizontal tears are

ISSN (O): 2687-5365; ISSN (P): 2753-6556

frequently observed in osteoarthritic knees and correlate with higher disease severity.[3,4] Moreover, meniscal degeneration itself may act as a precursor to OA, highlighting a bidirectional relationship between these pathologies.[5]

Magnetic resonance imaging (MRI) is the modality of choice for detecting subtle meniscal and chondral lesions due to its superior soft-tissue resolution and multiplanar capability. MRI not only allows identification of degenerative meniscal tears but also quantifies meniscal extrusion and associated cartilage defects.[6,7] The prevalence of MRI-detected meniscal tears increases significantly with age, and degenerative changes are common even in early OA.[8] Advanced MRI techniques such as ultrashort echo-time imaging have further refined the detection of microstructural meniscal degeneration.[9]

However, despite growing use of MRI, data on the prevalence and patterns of degenerative meniscal injuries among patients with mild to moderate knee OA (K–L grade 2 and 3) remain limited in the Indian population. Understanding the distribution and morphology of these tears could enhance early diagnosis and management strategies. The present cross-sectional observational study was therefore undertaken to determine the prevalence and distribution of degenerative meniscal injuries in patients with mild to moderate knee OA using MRI and to explore their relationship with OA severity.

MATERIALS AND METHODS

This cross-sectional observational study was conducted in the Department of Orthopaedics at a tertiary care medical centre in Belagavi. A total of 84 symptomatic patients presenting with clinical features suggestive of knee osteoarthritis (OA) were enrolled over the study period. Institutional Ethics Committee approval was obtained prior to commencement of the study, and written informed consent was secured from all participants. Patients were included if they were skeletally mature and demonstrated radiographic features consistent with Kellgren–Lawrence grade 2 or 3 osteoarthritis on weight-bearing anteroposterior and lateral knee radiographs. Patients with rheumatoid arthritis, previous knee trauma or surgery, a history of intra-articular corticosteroid injection, or contraindications to MRI were excluded from the study.

All participants underwent standard radiographic evaluation using anteroposterior and lateral weight-bearing views of the affected knee. Grading of osteoarthritis severity was performed according to the Kellgren–Lawrence classification (grades 0–4). Only patients with mild-to-moderate disease (grades 2 and 3) were further evaluated by magnetic resonance imaging (MRI) to assess meniscal morphology and integrity. MRI examinations were performed on a 1.5-Tesla Siemens scanner using a dedicated knee coil. The imaging protocol included sagittal and coronal fat-saturated proton-density–weighted turbo spin-echo sequences (repetition time = 3610 ms, echo time = 40 ms, slice thickness = 3.5 mm, interslice gap = 0 mm, matrix = 256 × 256, field of view = 140 × 140 mm), and sagittal T1-weighted spin-echo sequences (TR = 475 ms, TE = 24 ms). All images were interpreted independently by an orthopaedic specialist trained in musculoskeletal imaging and re-evaluated by a senior musculoskeletal radiologist in cases of diagnostic ambiguity. Inter-observer agreement for meniscal injury detection was satisfactory ($\kappa = 0.72$). Readers were blinded to clinical and radiographic findings to minimize interpretation bias.

Meniscal pathology was classified as longitudinal, radial, horizontal, complex, or root tears, according to established MRI morphology criteria. Destruction or absence of meniscal tissue secondary to advanced degeneration was recorded as meniscal loss. A tear was diagnosed when an abnormal high-signal intensity extended to the meniscal surface on at least two consecutive images. Additional intra-articular abnormalities, including effusion, cyst formation, and ligamentous injury, were also documented. Statistical analysis was performed using Stata version 10 (StataCorp, College Station, TX, USA). Descriptive statistics were presented as frequencies and percentages. Associations between categorical variables such as osteoarthritis grade and meniscal involvement were analyzed using the Chi-square test, while continuous variables were compared using analysis of variance (ANOVA). A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 92 symptomatic patients with radiologically confirmed osteoarthritis (OA) of the knee were included in this study. The majority of patients (63%) were between 50 and 60 years of age, followed by 33.7% in the 40–50-year group, while only 3.2% were above 60 years. The mean age of presentation was in the mid-fifties, reflecting a predominance of middle-aged individuals. The sex distribution was nearly equal, with 45 males (49%) and 47 females (51%). The right knee was affected slightly more often (52.2%) than the left (47.8%). Based on the Kellgren–Lawrence (K–L) grading, 67.3% of patients had Grade 2 OA and 23.2% had Grade 3 OA, indicating a predominance of mild-to-moderate disease. Chronic knee pain (47.8%) and acute-on-chronic pain (28.2%) were the most frequent presenting complaints.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 1: Demographic and Clinical Profile of Study Participants (n = 92)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	40–50	31	33.7
	50–60	58	63.0
	>60	3	3.2
Gender	Male	45	49.0
	Female	47	51.0
Side affected	Right	48	52.2
	Left	44	47.8
OA Grade (Kellgren–Lawrence)	Grade 2	62	67.3
	Grade 3	24	23.2
History of symptoms	Chronic knee pain	44	47.8
	Acute on chronic pain	26	28.2
	NAD / Occasional / Trauma	22	24.0

Magnetic resonance imaging (MRI) revealed that meniscal pathology was highly prevalent among the study population. The medial meniscus was the most frequently involved structure, seen in 51.1% of knees, while lateral meniscal tears were less common (4.3%). Involvement of both menisci was observed in 15.2% of patients, and 29.3% showed no evidence of meniscal injury. Tear localization analysis demonstrated that the posterior horn was the most common site of involvement (52.1%), followed by the anterior horn (15.2%) and the body of the meniscus (5.4%). These findings emphasize that degenerative meniscal changes in OA predominantly affect the posterior horn of the medial meniscus, likely due to its critical role in load transmission and limited vascularity.

Table 2: MRI Distribution of Meniscal Involvement and Tear Location

Meniscus Involved	Frequency (n)	Percentage (%)	Predominant Tear Location	Frequency (n)	Percentage (%)
Medial	47	51.1	Anterior horn	14	15.2
Lateral	4	4.3	Posterior horn	48	52.1
Both	14	15.2	Body	5	5.4
None	27	29.3	Nil	27	29.3

Table 3: Types of Meniscal Tears Detected on MRI

Tear Type	Frequency (n)	Percentage (%)
Horizontal	25	27.1
Myxoid degeneration	7	7.6
Radial	7	7.6
Vertical	1	1.1
Total with identifiable tear	40	43.5

The distribution of tear morphology showed that horizontal tears were the most frequent (27.1%), followed by myxoid degeneration and radial tears (7.6% each), while vertical tears were rare (1.1%). Horizontal tear patterns are known to reflect chronic degenerative mechanisms rather than acute trauma, aligning with the clinical profile of the study group. Associated intra-articular findings were also frequently detected on MRI. Joint effusion was present in 65.2% of cases, followed by mild intra-articular injury changes (29.3%), synovial cysts (17.3%), and moderate injuries (8.7%). These concomitant findings further reflect the chronic inflammatory and degenerative milieu typical of osteoarthritic knees.

A clear correlation was observed between Kellgren–Lawrence grade and meniscal involvement. In Grade 2 OA, 37 knees (59.6%) demonstrated some form of meniscal tear (medial, lateral, or both), whereas in Grade 3 OA, the frequency increased to 22 knees (91.6%). The number and complexity of tears also increased with higher OA grade, with combined medial and lateral involvement becoming more frequent. Statistical analysis using the Chi-square test revealed a significant association ($p < 0.05$) between OA severity and the presence of meniscal tears, indicating that progressive joint degeneration is strongly linked with meniscal structural compromise.

Table 4: Associated Intra-Articular MRI Findings

Associated Finding	Frequency (n)	Percentage (%)
Joint effusion	60	65.2
Synovial cyst	16	17.3
Mild intra-articular injury changes	27	29.3
Moderate intra-articular injury changes	8	8.7

A total of 92 symptomatic patients with radiologically confirmed osteoarthritis (OA) of the knee were included in this study. The majority of patients (63%) were between 50 and 60 years of age, followed by 33.7% in the 40–50-year group, while only 3.2% were above 60 years. The mean age of

ISSN (O): 2687-5365; ISSN (P): 2753-6556

presentation was in the mid-fifties, reflecting a predominance of middle-aged individuals. The sex distribution was nearly equal, with 45 males (49%) and 47 females (51%). The right knee was affected slightly more often (52.2%) than the left (47.8%). Based on the Kellgren–Lawrence (K–L) grading, 67.3% of patients had Grade 2 OA and 23.2% had Grade 3 OA, indicating a predominance of mild-to-moderate disease. Chronic knee pain (47.8%) and acute-on-chronic pain (28.2%) were the most frequent presenting complaints.

Magnetic resonance imaging (MRI) revealed that meniscal pathology was highly prevalent among the study population. The medial meniscus was the most frequently involved structure, seen in 51.1% of knees, while lateral meniscal tears were less common (4.3%). Involvement of both menisci was observed in 15.2% of patients, and 29.3% showed no evidence of meniscal injury. Tear localization analysis demonstrated that the posterior horn was the most common site of involvement (52.1%), followed by the anterior horn (15.2%) and the body of the meniscus (5.4%). These findings emphasize that degenerative meniscal changes in OA predominantly affect the posterior horn of the medial meniscus, likely due to its critical role in load transmission and limited vascularity.

Table 5: Association between Kellgren–Lawrence Grade and Meniscal Involvement

OA Grade	Medial Tear	Lateral Tear	Both	None	Total (n)
Grade 0	2	1	2	0	5
Grade 1	0	0	1	0	1
Grade 2	31	2	4	25	62
Grade 3	14	1	7	2	24
Total	47	4	14	27	92

The distribution of tear morphology showed that horizontal tears were the most frequent (27.1%), followed by myxoid degeneration and radial tears (7.6% each), while vertical tears were rare (1.1%). Horizontal tear patterns are known to reflect chronic degenerative mechanisms rather than acute trauma, aligning with the clinical profile of the study group. Associated intra-articular findings were also frequently detected on MRI. Joint effusion was present in 65.2% of cases, followed by mild intra-articular injury changes (29.3%), synovial cysts (17.3%), and moderate injuries (8.7%). These concomitant findings further reflect the chronic inflammatory and degenerative milieu typical of osteoarthritic knees.

A clear correlation was observed between Kellgren–Lawrence grade and meniscal involvement. In Grade 2 OA, 37 knees (59.6%) demonstrated some form of meniscal tear (medial, lateral, or both), whereas in Grade 3 OA, the frequency increased to 22 knees (91.6%). The number and complexity of tears also increased with higher OA grade, with combined medial and lateral involvement becoming more frequent. Statistical analysis using the Chi-square test revealed a significant association ($p < 0.05$) between OA severity and the presence of meniscal tears, indicating that progressive joint degeneration is strongly linked with meniscal structural compromise.

DISCUSSION

In our cohort of 92 patients with mild to moderate knee osteoarthritis (OA) (Kellgren–Lawrence grade 2 and 3), we found a high prevalence of meniscal lesions detected by MRI: 70.7 % (65/92) had some form of meniscal involvement (medial, lateral, or both). Medial meniscus involvement was most common (51.1 %), involvement of both menisci occurred in 15.2 %, and no meniscal tear was observed in 29.3 %. The posterior horn of the meniscus was the most frequently affected region (52.1 %), horizontal tear morphology predominated (27.1 %), and joint effusion was present in 65.2 % of cases. We also observed a strong association between OA grade and meniscal injury: among Grade 2 OA patients (62 knees), 37 showed meniscal tear (~59.7 %), whereas among Grade 3 OA patients (24 knees), 22 had a tear (~91.7 %).

The prevalence of MRI-detected meniscal tears in our OA population aligns with the pathophysiological understanding of meniscal degeneration in OA. Several prior studies emphasize that degenerative meniscal tears increase with age and increasing OA severity.[1,10,11] In the landmark population-based study of 991 middle-aged to elderly individuals, the prevalence of meniscal tear or destruction ranged from 19 % (women 50-59 years) to 56 % (men 70-90 years), with 63 % prevalence among those with radiographic OA (K–L grade ≥2) and knee symptoms.[7] In that study, medial meniscus involvement was clearly predominant.[7] That 63 % figure in K–L grade ≥2 is a little lower than our 70.7 %, possibly reflecting our symptomatic outpatient sample rather than a community population.

Another systematic review assessing MRI features in asymptomatic knees reported a pooled meniscal tear prevalence of 19 % (13-26 %) in adults ≥40 years.[2] Our much higher figure supports the notion that in symptomatic knee OA populations the burden of meniscal pathology is substantially greater than in asymptomatic individuals.

With regard to tear morphology and location, our observation that posterior horn involvement dominates (52.1 %) and horizontal tears are most frequent (27.1 %) mirrors the characterization of degenerative meniscus lesions in OA described in the literature. For example, a review concluded that degenerative meniscus tears are typically atraumatic,

ISSN (O): 2687-5365; ISSN (P): 2753-6556

located in the posterior horn of the medial meniscus, and increase in prevalence with age and OA severity.[11] The pattern we observed (medial > lateral, posterior horn > body/anterior) conforms to that. Additionally, the higher meniscal tear rate in Grade 3 (91.7 %) vs Grade 2 (59.7 %) indicates that meniscal damage parallels worsening joint degeneration.

Some recent work provides further nuance: one MRI-based study of early medial knee OA found medial meniscus tears in a significant proportion of participants, with tear prevalence increasing with increasing K–L grade and age.5 While exact numeric comparison is difficult (because participant populations and inclusion criteria differ), their findings reinforce our detection of high meniscal involvement even in early/moderate OA. Furthermore, another study demonstrated that meniscal tear and extrusion are strongly associated with progression of symptomatic knee OA.[8] These findings suggest that meniscal injury is not just a concomitant finding but may play a role in OA progression — a concept supported by our finding that higher grade OA correlates with more frequent meniscal injury.[12-16]

Our associated MRI findings also merit discussion. The effusion rate in our sample (65.2 %) is consistent with the chronic inflammatory environment of degenerative knees with meniscal pathology. While many prior studies focus on meniscal tears in isolation, the broader intra-articular milieu (effusion, cysts, synovitis) is increasingly recognized as relevant in OA pathogenesis and symptomatology.

CONCLUSION

In this cross-sectional MRI-based study of patients with mild to moderate knee osteoarthritis, degenerative meniscal injuries were found to be highly prevalent, affecting over two-thirds of cases. The medial meniscus, particularly its posterior horn, was the most commonly involved site, and horizontal tear morphology predominated. The frequency and complexity of meniscal lesions increased significantly with advancing Kellgren–Lawrence grade, underscoring a strong association between meniscal degeneration and osteoarthritis severity.

REFERENCES

1. Resorlu M, Doner D, Karatağ O, Toprak CA. The relationship between chondromalacia patella, medial meniscal tear and medial periarticular bursitis in patients with osteoarthritis. Radiol Oncol. 2017;51(4):401-6.
2. Atik I, Gul E, Atik S. Evaluation of the relationship between knee osteoarthritis and meniscus pathologies. Malawi Med J. 2024;36(1):48-52.
3. Wu S, et al. Association between meniscal extrusion and disease severity in knee osteoarthritis: a retrospective case-control study. BMC Musculoskelet Disord. 2024;25:82-91.
4. Berthiaume MJ, Raynauld JP, Martel-Pelletier J, et al. Meniscal tear and extrusion are strongly associated with progression of symptomatic knee osteoarthritis as assessed by quantitative magnetic resonance imaging. Ann Rheum Dis. 2004;64(4):556-63.
5. Ward RJ, Driban JB, MacKay JW, et al. Meniscal degeneration is prognostic of destabilizing meniscal tear and accelerated knee osteoarthritis: data from the Osteoarthritis Initiative. J Orthop Res. 2023;41(10):2418-23.
6. Avcu S, Altun E, Akpınar I, Bulut M, Eresov K, Biren T. Knee joint examinations by magnetic resonance imaging: the correlation of pathology, age, and sex. N Am J Med Sci. 2010;2(5):202-4.
7. Lo GH, Hunter DJ, Nevitt M, Lynch J, McAlindon TE. Strong association of MRI meniscal derangement and bone marrow lesions in knee osteoarthritis: data from the Osteoarthritis Initiative. Osteoarthritis Cartilage. 2009;17(6):743-7.
8. Culvenor AG, Øiestad BE, Hart HF, Stefanik JJ, Guermazi A, Crossley KM. Prevalence of knee osteoarthritis features on magnetic resonance imaging in asymptomatic uninjured adults: a systematic review and meta-analysis. Br J Sports Med. 2019;53(20):1268-78.
9. Zhang X, Ma Y, Wei Z, Wu M, Ashir A, Jerban S, et al. Macromolecular fraction (MMF) from 3D ultrashort echo-time Cones magnetization transfer imaging predicts meniscal degeneration and knee osteoarthritis. Osteoarthritis Cartilage. 2021;29(10):1350-9.
10. Englund M, Felson DT, Guermazi A, Roemer FW, Wang K, Crema MD, et al. Risk factors for medial meniscal pathology on knee MRI in older US adults: a multicentre prospective cohort study. Ann Rheum Dis. 2011;70(10):1733-9.
11. Avcu S, Altun E, Akpınar I, Bulut M, Eresov K, Biren T. Knee joint examinations by magnetic resonance imaging: the correlation of pathology, age, and sex. N Am J Med Sci. 2010;2(5):202-4.
12. Atik I, Gul E, Atik S. Evaluation of the relationship between knee osteoarthritis and meniscus pathologies. Malawi Med J. 2024;36(1):48-52.
13. Wu S, et al. Association between meniscal extrusion and disease severity in knee osteoarthritis: a retrospective case-control study. BMC Musculoskelet Disord. 2024;25:82-91.
14. Berthiaume MJ, Raynauld JP, Martel-Pelletier J, et al. Meniscal tear and extrusion are strongly associated with progression of symptomatic knee osteoarthritis as assessed by quantitative magnetic resonance imaging. Ann Rheum Dis. 2004;64(4):556-63.
15. Ward RJ, Driban JB, MacKay JW, et al. Meniscal degeneration is prognostic of destabilizing meniscal tear and accelerated knee osteoarthritis: data from the Osteoarthritis Initiative. J Orthop Res. 2023;41(10):2418-23.
16. Lo GH, Hunter DJ, Nevitt M, Lynch J, McAlindon TE. Strong association of MRI meniscal derangement and bone marrow lesions in knee osteoarthritis: data from the Osteoarthritis Initiative. Osteoarthritis Cartilage. 2009;17(6):743-7.

ISSN (O): 2687-5365; ISSN (P): 2753-6556