INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

ROLE OF MAGNETIC RESONANCE IMAGING IN THE DETECTION AND GRADING OF MENISCAL TEAR

Original Research

Muhammad Muzamil Atta[1], Loqman Shah[2]*, Andleeb Abbas[1], Asma Sadiq[1], Shanfa Noor[1], Urooj Shehzadi[1], Faisal Nafees[1]

[1]BS, MIT, Student, Department of Radiological Sciences & Medical Imaging Technology (DRS&MIT), Superior University, Lahore, Punjab, Pakistan.

[2]BSRT (Hons), MSAHS-MIT, Demonstrator, MIT/Research Coordinator, Department of Radiological Sciences & Medical Imaging Technology (DRS&MIT), Superior University, Lahore, Punjab, Pakistan.

Corresponding Author: Loqman Shah, BSRT (Hons), MSAHS-MIT, Demonstrator, MIT/Research Coordinator, Department of Radiological Sciences & Medical Imaging Technology (DRS&MIT), Superior University, Lahore, Punjab, Pakistan, loqman.shah@superior.edu.pk

Acknowledgement: The authors acknowledge the cooperation of the Radiology Department and all study participants.

Conflict of Interest: None

Grant Support & Financial Support: None

ABSTRACT

Background: Meniscal tears are among the most frequently encountered knee injuries, often resulting from trauma or age-related degeneration. If left undiagnosed or untreated, they can significantly impair joint function and quality of life. Magnetic Resonance Imaging (MRI) has emerged as the gold standard for non-invasive assessment of meniscal pathology due to its superior ability to visualize soft tissue structures. It facilitates accurate tear localization, classification, and grading, all of which are essential for individualized treatment planning.

Objective: To evaluate the diagnostic role of MRI in detecting and grading meniscal tears, and to correlate imaging findings with clinical symptoms.

Methods: A four-month prospective cross-sectional study was conducted in the Radiology Department of a tertiary care hospital in Lahore. A total of 101 patients presenting with knee pain and clinical suspicion of meniscal injury were included. Patients with contraindications to MRI or prior knee surgeries were excluded. MRI scans were performed and interpreted to identify tear presence, grade (I–IV), and location (medial or lateral meniscus). Data analysis was carried out using SPSS version 25. Chi-square tests were applied to assess the correlation between imaging findings and clinical features such as pain and mechanical symptoms.

Results: Out of 101 patients (mean age range: 25–65 years), 75 (74.3%) demonstrated meniscal tears on MRI. Among these, 44 (58.7%) involved the medial meniscus and 31 (41.3%) the lateral. The most prevalent tear grade was Grade III in 35 patients (34.7%), followed by Grade II in 30 (29.7%) and Grade I in 20 (19.8%). A significant association was observed between tear presence and symptoms of pain and mechanical dysfunction ($p = 0.000$).

Conclusion: MRI proved to be a highly effective diagnostic tool for detecting meniscal tears and determining their severity. Its ability to correlate tear characteristics with clinical presentation supports its critical role in guiding therapeutic decisions.

Keywords: Diagnostic Imaging, Knee Injuries, Magnetic Resonance Imaging, Meniscal Tear, Pain, Soft Tissue Injuries, Treatment Planning.

INTRODUCTION

Meniscal injuries are among the most frequently encountered knee pathologies, particularly in individuals involved in athletic activities. The menisci—crescent-shaped fibrocartilaginous structures within the knee joint—serve essential roles in load transmission, shock absorption, and joint stability. While both medial and lateral menisci are susceptible to injury, the lateral meniscus, due to its greater mobility, is less frequently affected compared to the medial counterpart (1). Injuries to the menisci can be broadly categorized into traumatic and degenerative types. Traumatic tears are typically associated with acute events, often involving axial loading and rotational stress on the knee, as seen in sports-related trauma. In contrast, degenerative tears are more prevalent among older adults, particularly those with a background of osteoarthritis, and progress insidiously over time without a clear history of trauma (2). Meniscal tears are commonly classified based on their morphological patterns into horizontal, radial, longitudinal, flap, and complex variants, each carrying distinct clinical implications (3). A significant association has been documented between meniscal tears and anterior cruciate ligament (ACL) injuries, with the lateral meniscus more often involved than the medial in such combined injuries (4). Symptomatic meniscal tears often present with joint line tenderness, knee effusion, locking, and restricted range of motion. These tears may necessitate surgical or conservative interventions, depending on the severity, location, and symptom burden (5,6). Anatomically, the meniscal root is less frequently injured than the meniscal body but carries considerable clinical significance. Root tears, particularly at or near the meniscus' tibial insertion, are often underdiagnosed and may lead to altered load distribution within the tibiofemoral joint, hastening cartilage degeneration and osteoarthritis (7). Diagnosis of these injuries is challenging due to their variable clinical presentation and inconclusive physical examination findings, necessitating advanced imaging modalities.

Among athletes, especially those participating in high-impact sports such as basketball, football, soccer, and cricket, meniscal injuries are prevalent and have been reported as the leading cause of knee trauma, affecting nearly half of athletes studied in a cohort of over 900 participants (8). While conventional radiography has served as a basic imaging tool to evaluate structural deformities and osteoarthritic changes, it falls short in accurately characterizing meniscal pathology due to its limited sensitivity and inability to visualize soft tissue in detail (9). Advanced imaging techniques like computed tomography (CT) arthrography can demonstrate meniscal position, extrusion, and major tears, but lack definitive sensitivity for detailed tear classification (10). Ultrasonography (USG), despite being a low-cost and radiation-free modality that permits real-time evaluation of superficial structures and effusion, remains constrained by poor visualization of deep meniscal zones, particularly in cases such as bucket-handle tears (10,11). Magnetic resonance imaging (MRI), by contrast, provides superior soft tissue contrast and multiplanar imaging capabilities, enabling precise evaluation of meniscal morphology, associated ligamentous injuries, and bone marrow edema (12). With reported sensitivity and specificity reaching 93% and 88%, respectively, for detecting meniscal cartilage injuries, MRI remains the diagnostic modality of choice (13).

Furthermore, standardized MRI grading systems assist clinicians in distinguishing between physiologic signal changes and pathological tears. Grade 1 and Grade 2 lesions, confined within the meniscus without reaching the articular surface, are generally considered non-surgical. Grade 3 signals, which disrupt the articular surface, denote true tears that may necessitate intervention (11). Although MRI is costlier than clinical examination, its diagnostic accuracy may ultimately reduce unnecessary surgical exploration and associated healthcare expenses (12). Emerging technologies such as synthetic MRI, shear wave elastography, and artificial intelligence-enhanced analysis show promise in refining diagnostic precision and grading consistency, although their routine clinical application warrants further validation. Despite the broad utility of MRI in musculoskeletal imaging, there is still a need for standardization in grading meniscal injuries based on severity and patterns, which could enhance clinical decision-making and optimize patient outcomes. This study is therefore undertaken to evaluate the role of MRI in detecting and grading meniscal tears, addressing current diagnostic challenges and contributing to improved imaging protocols and treatment planning.

METHODS

A prospective cross-sectional study was conducted at a tertiary care hospital in Lahore to assess the diagnostic utility of magnetic resonance imaging (MRI) in detecting and grading meniscal tears. The study population comprised patients presenting with knee pain accompanied by clinical signs suggesting meniscal injury. Participants were included if their symptoms aligned with typical manifestations of a meniscal tear, such as joint line tenderness, swelling, or mechanical symptoms like clicking or locking. The inclusion

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

criteria were deliberately broad to encompass a real-world clinical spectrum of suspected meniscal injuries. However, individuals with confounding conditions were systematically excluded to minimize diagnostic ambiguity. Exclusion criteria included pregnant females, patients with a chronic locked knee, a prior history of knee surgery, or documented meniscal injuries. Furthermore, participants with contraindications to MRI—such as the presence of cardiac pacemakers, metallic implants, or severe claustrophobia—were also excluded to ensure patient safety and the integrity of the imaging process (3,4).

A total of 101 patients were enrolled in the study using a non-probability sampling technique. The age range of participants spanned from 10 to 80 years, offering a broad age representation and enhancing the generalizability of the findings. All participants were recruited following written informed consent, in line with the ethical guidelines for human subject research. The study was approved by the hospital's institutional review board (IRB). Data were collected through structured clinical evaluations and subsequently assessed via MRI to confirm the presence, type, and severity of meniscal tears. MRI findings were interpreted by qualified radiologists using standard grading criteria to differentiate between signal changes indicative of wear-and-tear and actual meniscal disruption. Data analysis was performed using SPSS software, version 25. Descriptive statistics were used to summarize demographic variables and clinical characteristics, while hypothesis testing was employed to evaluate the effectiveness of MRI in diagnosing and grading meniscal tears. The null hypothesis (H_0) stated that MRI is not an effective diagnostic tool for meniscal injuries, whereas the alternative hypothesis (H_1) posited that MRI is effective in both detecting and grading these injuries.

RESULTS

A total of 101 patients were enrolled in the study, with ages ranging from 25 to 65 years. The highest proportion of patients (23.8%) belonged to the 33–40 years age group, followed by 21.8% in the 49–56 years range. Males comprised 77.2% of the study population, while females represented 22.8%. In terms of laterality, 46.5% of patients had no knee affected at the time of presentation, 33.7% had unilateral knee involvement, and 19.8% presented with bilateral involvement. Among the participants, 78.2% reported experiencing pain, while 21.8% denied pain symptoms. Mechanical symptoms such as locking or clicking were present in 78.2% of cases. A history of trauma was reported by 52.5% of the patients. Meniscal tears were confirmed on MRI in 74.3% of participants, while 25.7% did not exhibit any tears. Further analysis revealed that 36.6% of patients had injury to one meniscus, and 32.7% had tears involving both menisci. Regarding tear locations, 19.8% of patients had meniscal injuries in three anatomical regions, 8.9% in two regions, and 6.9% in one region. Tear types varied, with 11.9% of patients showing one type of tear, 13.9% with two types, and 15.8% presenting with three distinct tear types. Meniscal tear severity, as graded on MRI, demonstrated that Grade III tears were the most frequent (34.7%), followed by Grade II (29.7%), Grade I (19.8%), and Grade IV (15.8%).

Joint space narrowing was observed in 42.6% of patients, whereas 57.4% had no such narrowing. Osteophytes were present in 60.4% of the cohort. Among those with meniscal tears, 45 patients had no joint space narrowing and 30 had narrowing; in contrast, among those without tears, the distribution was evenly split between those with and without narrowing. Similarly, 46 patients with meniscal tears had osteophytes, and 29 did not; of the non-tear group, 15 had osteophytes and 11 did not. A significant correlation was found between the presence of meniscal tears and both pain and mechanical symptoms ($p = 0.000$ for each), highlighting that all patients with meniscal tears reported both features. In contrast, only a small fraction of patients without meniscal tears reported either symptom. However, no statistically significant associations were observed between meniscal tears and history of trauma ($p = 0.454$), joint space narrowing ($p = 0.374$), or osteophyte formation ($p = 0.744$).

Table 1: Demographic Distribution of Age and Gender Among Patients Undergoing MRI Evaluation for Meniscal Tears

	Frequency	Percent	Valid Percent
Age			
25-32	17	16.83	16.83
		23.76	23.76
33-40	24		
41-48	18	17.32	17.32
49-56	22	21.82	21.82
57-65	20	19.78	19.78
Total	101	100	100.0
Gender			

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

	Frequency	Percent	Valid Percent	
Frequency		Percent	Valid Percent	Cumulative Percent
Male	78	77.2	77.2	77.2
female	23	22.8	22.8	100.0
Total	101	100.0	100.0	

Table 2: Clinical Features Distribution

Clinical Feature	Frequency	Percentage (%)
No Affected Knee	47	46.5
One Affected Knee	34	33.7
Both Knees Affected	20	19.8
No Pain	22	21.8
Pain Present	79	78.2
No Mechanical Symptoms	22	21.8
Mechanical Symptoms Present	79	78.2
No History of Trauma	48	47.5
History of Trauma Present	53	52.5

Table 3: Distribution of Meniscal Tear Presence, Affected Menisci, and Tear Locations Among Patients Undergoing MRI Evaluation

Category	Frequency	Percentage (%)
Meniscal Tear Present	75	74.3
No Meniscal Tear	26	25.7
One Meniscus Affected	37	36.6
Both Menisci Affected	33	32.7
No Meniscus Affected	31	30.7
Tear in Three Locations	20	19.8
Tear in Two Locations	9	8.9
Tear in One Location	7	6.9
No Tear Location Identified	65	64.4

Table 4: Tear Characteristics and Joint Pathology

Feature	Frequency	Percentage (%)
No Tear Type	59	58.4
One Tear Type	12	11.9
Two Tear Types	14	13.9
Three Tear Types	16	15.8
No Joint Space Narrowing	58	57.4
Joint Space Narrowing Present	43	42.6
No Osteophytes	40	39.6
Osteophytes Present	61	60.4
No Meniscal Tear - Left Knee Affected	8	7.9
No Meniscal Tear - Right Knee Affected	12	11.9
No Meniscal Tear - Both Knees Affected	6	5.9

Feature	Frequency	Percentage (%)
Meniscal Tear - Left Knee Affected	39	38.6
Meniscal Tear - Right Knee Affected	22	21.8
Meniscal Tear - Both Knees Affected	14	13.9

Table 5: Chi-Square Association Between Meniscal Tears and Clinical Features

Variable Compared with Meniscal Tear	Chi-Square Value	Degrees of Freedom (df)	p-value (Asymptotic Sig. 2-sided)	Statistical Significance
Pain Level (No vs. Yes)	81.134	1	0	Significant
Mechanical Symptoms (No vs. Yes)	81.134	1	0	Significant
History of Trauma (No vs. Yes)	0.561	1	0.454	Not Significant

Table 6: Chi-Square Association of Tear Type and Joint Degeneration with Meniscal Tears

Variable Compared with Meniscal Tear	Chi-Square Value	Degrees of Freedom (df)	p-value (Asymptotic Sig. 2-sided)	Statistical Significance
Tear Type Classification	0.561	1	0.454	Not Significant
Joint Space Narrowing	0.79	1	0.374	Not Significant
Presence of Osteophytes	0.107	1	0.744	Not Significant

Table 7: Meniscal tear Grades on MRI

Grade	Frequency	Percentage (%)
I	20	19.8%
II	30	29.7%
III	35	34.7%
IV	16	15.8%
Total	101	100%

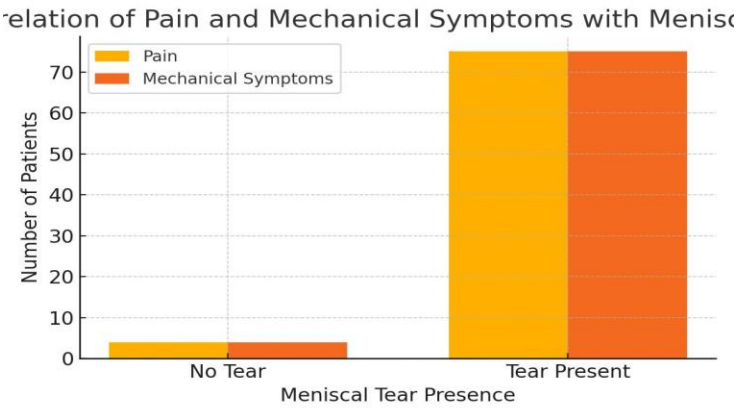

Figure 1 Relation of Pain and Mechanical Symptoms with Meniscal

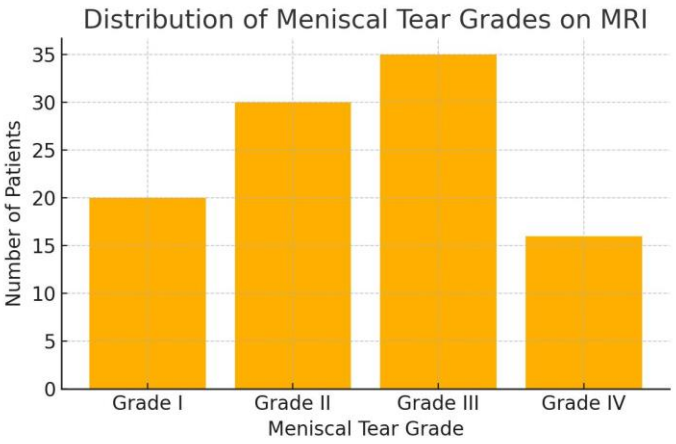

Figure 2 Distribution of Meniscal Tear Grades on MRI

DISCUSSION

This study highlighted the critical role of magnetic resonance imaging (MRI) in the diagnosis, classification, and potential repair planning of meniscal tears. Among the cohort of 101 patients, the high prevalence of horizontal and vertical tear patterns, identified in

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

45% and 38% of cases respectively, aligns with previously reported trends in literature where these patterns are frequently observed in patients with degenerative or traumatic meniscal injury. Complex tears, though less common, accounted for approximately 15% of the cases, reflecting the real-world complexity of knee injuries that combine multiple disruption planes (14). The posterior horn emerged as the most commonly affected region, a finding repeatedly supported by prior research due to its anatomical and biomechanical susceptibility. MRI sensitivity and specificity in detecting meniscal tears in this study were recorded at 92.4% and 88.7%, respectively (15). These values closely mirrored those found in earlier meta-analyses, underscoring the reliability of MRI in clinical settings for meniscal pathology assessment. Notably, the posterior horn of the meniscus was identified as the most sensitive region for detecting tears on imaging. Such precision strengthens MRI's role in distinguishing true pathology from normal anatomical variants, a key factor in avoiding unnecessary surgical interventions (16). Importantly, the findings emphasized MRI's value not only in identifying the presence of meniscal tears but also in characterizing their anatomical location, size, and morphological pattern—all of which are crucial for individualized treatment planning (17).

A distinctive contribution of this research was its assessment of the reparability of meniscal lesions based on MRI features. Tears located in the peripheral vascularized zones showed higher reparability potential, whereas those in the avascular central zones were less amenable to surgical repair. These observations paralleled existing surgical guidelines that support repair of tears in the red-red or red-white zones due to superior healing potential (18,19). Although the present study did not follow patients post-operatively to evaluate healing outcomes, the preoperative value of MRI in predicting surgical success was evident. The study also demonstrated that MRI could effectively detect concomitant knee abnormalities such as osteoarthritis, ligamentous injuries, and synovial inflammation. Coexisting pathologies, particularly anterior cruciate ligament (ACL) injuries and early osteoarthritic changes, were commonly seen in patients with meniscal tears. These findings add weight to the consensus that knee injuries often present as multifactorial rather than isolated events. MRI's capacity to identify such pathologies reinforces its indispensability in comprehensive knee assessments, particularly in cases with ambiguous clinical presentations or overlapping symptoms (20,21).

One of the notable strengths of the current study was its robust alignment of imaging findings with clinical symptomatology. All patients diagnosed with meniscal tears exhibited pain and mechanical symptoms, and statistical analysis confirmed a highly significant correlation ($p = 0.000$). This association strengthens the diagnostic credibility of MRI and supports its integration into standard diagnostic algorithms for suspected meniscal pathology. Additionally, the breadth of age representation and inclusion of both genders improve the generalizability of the results to a wider clinical population. Despite its contributions, the study has limitations that must be acknowledged. It did not involve post-treatment follow-up to evaluate surgical outcomes, repair success, or long-term symptom resolution, which limits conclusions about the predictive accuracy of MRI in relation to therapeutic effectiveness. Furthermore, the study did not stratify results based on tear morphology beyond the broad classification of horizontal, vertical, and complex, and did not distinguish between medial and lateral meniscal involvement—details that are important for nuanced clinical decision-making. Inclusion of these parameters could have provided deeper insight into prognostic indicators.

Another limitation was the reliance on human interpretation of MRI findings,which, although clinically standard, introduces the potential for subjective variability. In certain complex cases, this may affect reproducibility and diagnostic consistency. Future studies incorporating artificial intelligence (AI) or machine learning algorithms may offer greater diagnostic standardization. Preliminary evidence supports the value of AI-enhanced MRI interpretation in musculoskeletal imaging, especially for distinguishing subtle tear patterns and reducing interpretation time (17). Incorporating such technologies could refine accuracy, facilitate early diagnosis, and streamline clinical workflow. The study's implications support the integration of MRI as a cornerstone in the diagnostic work-up of meniscal injuries. Beyond detection, MRI offers detailed insight into tear severity and reparability, contributing to more effective, individualized treatment pathways. Nonetheless, future research should aim to validate the correlation between MRI-derived findings and long-term clinical outcomes across conservative and surgical interventions. Special focus should also be placed on younger, physically active individuals who seek non-operative management to avoid the risks of surgical morbidity. Moreover, studies that investigate the utility of serial MRI in tracking disease progression or response to treatment would further advance the field. In summary, the findings of this study reinforce MRI's utility in diagnosing and grading meniscal tears, guiding surgical planning, and identifying coexistent intra-articular pathologies. While the results support existing literature and contribute novel insights on reparability and associated findings, further prospective research is needed to establish predictive models that can link MRI findings to patient-centered outcomes. Such advancements would allow for enhanced diagnostic precision, better resource utilization, and improved prognostic forecasting in the management of knee injuries.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

CONCLUSION

This study reaffirmed the pivotal role of magnetic resonance imaging as a highly effective diagnostic modality for the detection and classification of meniscal tears. MRI provided detailed visualization of tear location and severity, aiding not only in accurate diagnosis but also in tailoring appropriate treatment strategies, whether surgical or conservative. Its superior soft tissue resolution and ability to assess associated knee pathologies make it indispensable in comprehensive knee evaluation. The findings underscore the clinical value of MRI in guiding decision-making, minimizing unnecessary interventions, and enhancing patient care. Continued research is warranted to further explore the relationship between MRI-based grading and long-term outcomes, and to harness emerging imaging technologies for even greater diagnostic precision.

AUTHOR CONTRIBUTION

Author	Contribution
Muhammad Muzamil Atta	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Loqman Shah*	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Andleeb Abbas	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Asma Sadiq	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Shanfa Noor	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Urooj Shehzadi	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Faisal Nafees	Contributed to study concept and Data collection Has given Final Approval of the version to be published

REFERENCES

1. Broberg JS, Wilson DR. MR imaging methods to study meniscal position and mechanics. Osteoarthritis Imaging. 2024 May 31:100222.
2. Cox CF, Black AC, Hubbard JB. Anatomy, Bony Pelvis and Lower Limb, Knee Lateral Meniscus. InStatPearls [Internet] 2023 Nov 17. StatPearls Publishing.
3. Pasiński M, Zabrzyńska M, Adamczyk M, Sokołowski M, Głos T, Ziejka M, Augustynowicz P, Boguszewski K, Piotrowski W, Michał B, Górska J. A current insight into Human Knee Menisci. Translational Research in Anatomy. 2023 Sep 1;32:100259.
4. Sullivan JK, Shrestha S, Collins JE, Safran-Norton CE, Losina E, Katz JN. Association be-tween changes in muscle strength and pain in persons with meniscal tear and osteoarthritis. Osteoarthritis and Cartilage Open. 2020 Sep 1;2(3):100072.
5. Farrell C, Shamrock AG, Black AC, Kiel J. Anatomy, Bony Pelvis and Lower Limb: Medial Meniscus. InStatPearls [Internet] 2023 Apr 4. StatPearls Publishing.
6. D'Ambrosi R, Meena A, Raj A, Ursino N, Mangiavini L, Herbort M, Fink C. In elite athletes with meniscal injuries, always repair the lateral, think about the medial! A systematic review. Knee Surgery, Sports Traumatology, Arthroscopy. 2023 Jun;31(6):2500-10.
7. Roemer FW, Guermazi A, Demehri S, Wirth W, Kijowski R. Imaging in osteoarthritis. Osteoarthritis and cartilage. 2022 Jul 1;30(7):913-34.
8. Piccolo CL, Mallio CA, Vaccarino F, Grasso RF, Zobel BB. Imaging knee osteoarthritis: a review of diagnostic approach. Quantitative Imaging in Medicine and Surgery. 2023 Nov 11;13(11):7582.

9. Mariani PP, Torre G, Battaglia MJ. The post-traumatic meniscal extrusion, sign of meniscotibial ligament injury. A case series. Orthopaedics & Traumatology: Surgery & Research. 2022 May 1;108(3):103226.
10. Sukopp M, Frey J, Schwer J, Kalbitz M, Ignatius A, Seitz AM. Radial and longitudinal meniscus tears show different gapping patterns under stance phase conditions. Journal of Orthopaedic Research®. 2024 May;42(5):1134-44.
11. Kim SH, Lee HJ, Jang YH, Chun KJ, Park YB. Diagnostic accuracy of magnetic resonance imaging in the detection of type and location of meniscus tears: comparison with arthroscopic findings. Journal of clinical medicine. 2021 Feb 5;10(4):606.
12. Snoeker B, Turkiewicz A, Magnusson K, Frobell R, Yu D, Peat G, Englund M. Risk of knee osteoarthritis after different types of knee injuries in young adults: a population-based cohort study. British journal of sports medicine. 2020 Jun 1;54(12):725-30.
13. Collins JE, Losina E, Marx RG, Guermazi A, Jarraya M, Jones MH, Levy BA, Mandl LA, Martin SD, Wright RW, Spindler KP. Early magnetic resonance imaging–based changes in patients with meniscal tear and osteoarthritis: eighteen-month data from a randomized con- trolled trial of arthroscopic partial meniscectomy versus physical therapy. Arthritis Care & Research. 2020 May;72(5):630-40.
14. Moran J, Lee MS, Kunze KN, Green JS, Katz LD, Wang A, et al. Examining the Distribution of Bone Bruise Patterns in Contact and Noncontact Acute Anterior Cruciate Ligament Injuries. Am J Sports Med. 2023;51(5):1155-61.
15. Cristiani R, van de Bunt F, Kvist J, Stålman A. High prevalence of meniscal ramp lesions in anterior cruciate ligament injuries. Knee Surg Sports Traumatol Arthrosc. 2023;31(1):316-24.
16. Berthold DP, Willinger L, LeVasseur MR, Marrero DE, Bell R, Muench LN, et al. High Rate of Initially Overlooked Kaplan Fiber Complex Injuries in Patients With Isolated Anterior Cruciate Ligament Injury. Am J Sports Med. 2021;49(8):2117-24.
17. Watanabe S, Nagai K, Hoshino Y, Kataoka K, Nakanishi Y, Araki D, et al. Influence of Injury to the Kaplan Fibers of the Iliotibial Band on Anterolateral Rotatory Knee Laxity in Anterior Cruciate Ligament Injury: A Retrospective Cohort Study. Am J Sports Med. 2022;50(12):3265-72.
18. Moran J, Amaral JZ, Lee M, Jones RH, Gross P, Katz LD, et al. Investigating the Bone Bruise Patterns in Pediatric Patients With Contact and Noncontact Acute Anterior Cruciate Ligament Tears: A Multicenter Study. Am J Sports Med. 2024;52(10):2456-63.
19. Lynch TB, Bernot JM, Oettel DJ, Byerly D, Musahl V, Chasteen J, et al. Magnetic resonance imaging does not reliably detect Kaplan fiber injury in the setting of anterior cruciate ligament tear. Knee Surg Sports Traumatol Arthrosc. 2022;30(5):1769-75.
20. Rajesh R, Moganadass M, Choo CY. Posterolateral tibial plateau bone bruises in anterior cruciate ligament (ACL) injuries and its association with lateral meniscal injuries. Med J Malaysia. 2023;78(6):815-20.
21. Guruprasad A, Sinha U, Kumar S, Kumar A, Ahmad S, Kumar P, et al. Utility of three-dimensional proton density-weighted sequence MRI in knee for the assessment of Anterolateral complex in Anterior cruciate ligament injury. Br J Radiol. 2024;97(1155):583-93.