Original Research

Assessment of lesions causing painful knee joint using magnetic resonance imaging

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ABSTRACT

Aim: This study aimed to assess the prevalence and types of knee lesions causing pain in 80 patients using magnetic resonance imaging (MRI), focusing on identifying the most common lesions and their distribution across various demographic factors.

Materials and Methods: A cross-sectional analysis was conducted with 80 patients (aged 18-75 years) who presented with knee pain at an outpatient clinic. MRI scans were performed using a 1.5 Tesla MRI scanner, following a standardized protocol to assess articular cartilage, menisci, ligaments, bone marrow, synovium, joint capsule, and the patellofemoral joint. Lesions were categorized into degenerative, traumatic, inflammatory, and other types. Data analysis was performed using descriptive statistics and statistical tests to examine the relationships between lesion types, age, sex, and BMI.

Results: The mean age of the cohort was 47.3 ± 13.1 years, with 57.5% males and 42.5% females. Degenerative lesions were the most common, present in 62.5% of patients, followed by traumatic lesions (26.25%), inflammatory lesions (7.5%), and other lesions (3.75%). Articular cartilage abnormalities were the most prevalent (58.75%), followed by meniscal lesions (35%) and ligament injuries (23.75%). The prevalence of degenerative lesions increased with age, while traumatic lesions were more common in younger individuals. Males had a higher incidence of both degenerative and traumatic lesions compared to females. The average pain duration was longest for degenerative lesions (7.1 \pm 3.2 months) and shortest for inflammatory lesions (4.2 \pm 1.8 months).

Conclusion: MRI is a valuable diagnostic tool for assessing knee pain, revealing that degenerative lesions are the most common cause, particularly in middle-aged and older individuals. The findings emphasize the importance of considering patient demographics, such as age, sex, and BMI, in the diagnosis and management of knee pathologies. MRI plays a crucial role in guiding treatment strategies for patients with knee pain.

Keywords: Magnetic resonance imaging, knee pain, degenerative lesions, traumatic lesions, MRI assessment

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Introduction

People of all ages experience knee pain as a frequent clinical problem that generates important health problems. Thousands of diverse knee joint lesions emerge because of injuries or develop from degenerative conditions along with overuse damage and diseases. Proper diagnosis of knee pain remains essential because the condition seriously affects the ability to move as well as patient quality of life. MRI stands as a vital imaging method which enables noninvasive assessment of knee joint lesions by providing excellent visualization of soft tissues. The knee examination enabled by MRI shows detailed visualizations of ligaments and menisci and cartilage together with bone structures thus aiding physicians to detect many different knee injuries. The main strength of MRI tests for knee assessment includes showing detailed images of soft tissues that dangerously include the anterior cruciate ligament (ACL) along with menisci structures commonly found in knee injuries. As the main stabilizer of the knee joint the ACL remains under high risk of damage which occurs most often when athletes undergo sudden twisting or impact movements. The diagnostics power of MRI helps precisely identify ACL injuries along with their diverse origins since these conditions occur frequently according to research findings. Medical professionals studying the Makkah population discovered that ACL

injuries are common so they performed MRI tests to identify clear signs of these injuries.^[1,2]

Ligament injuries andernoisesalisions are two major factors which lead to development of knee pain. The occurrence of meniscal injuries frequently happens alongside ACL tears because these tears present as either acute cases or develop through degeneration. Through MRI the detection of meniscal tears becomes highly successful including difficult tears that physical examination alone cannot identify. Medial tears of the meniscus show age-related differences since degenerative alterations increase their occurrence rates. MRI techniques provide doctors with detailed accurate imaging of tears which enables them to make better clinical choices.^[3,4]

Through MRI healthcare providers can effectively spot overuse injuries which happens often in children. The problem of overuse injuries affects young athletes who sustain these injuries due to repetitive stress or activity. Through MRI doctors can see joint changes that standard X-rays along with physical tests cannot diagnose including small tears or inflammation. Childhood knee injuries from repetitive stress show distinct patterns of damage that MRI scanning reveals whereas traditional methods would miss these findings according to research findings.^[5-7] The identification of these findings through MRI is vital for determining appropriate treatments that reduce further damage to joints.

evaluation The process for knee internal derangements depends heavily on MRI because it offers vital insights about cartilage damage and synovial inflammation and osteoarthritis. The diagnostic presence of cartilage tears exists frequently as the primary cause of persistent knee discomfort among patients dealing with degenerative joint disease. The analysis of cartilage wear alongside osteophytes and bone marrow edema by MRI helps medical professionals decide between conservative approaches and surgical treatments for patients. A study conducted by Englund et al. showed that middle-aged and elderly persons had their meniscal tears and cartilage degeneration detected incidentally by MRI which emphasizes the importance of this technology to detect early degenerative changes in asymptomatic individuals.^[8,9]

The knee joint alignment together with possible deformities that affect pain can be evaluated through MRI assessments. MRI ensures essential evaluation of patellofemoral joint through its identification of abnormalities which lead to severe anterior knee pain from patellar malalignment or instability conditions. MRI enables complete evaluation of knee joint surfaces through which doctors detect problems with patellar tracking disorders and cartilage defects that contribute to painful symptoms.^[10]MRI system delivers multiple benefits when used to evaluate knee pain however it faces important constraints in this application. MRI interpretations become difficult when clinicians must distinguish acute from chronic

lesions because several pathologies can demonstrate similar or nonspecific scan results. The excellent imaging capabilities of MRI extend to soft tissue evaluation but it might lack clarity when observing specific bone pathologies like stress fractures therefore extra diagnostic methods may be needed for full assessment.Modern MRI technology advances mean that knee imaging has become more accurate in identifying various types of knee pathologies.The diagnostic capability of MRI keeps improving because it merges with other diagnostic tests including physical examinations and clinical evaluations.

Materials and Methods

This study was designed as a cross-sectional analysis to assess lesions causing painful knee joints using magnetic resonance imaging (MRI). The study aimed to determine the prevalence and types of lesions in the knee joint associated with pain in a cohort of 80 patients. A total of 80 patients, both male and female, aged between 18 and 75 years, who presented with knee pain at the outpatient clinic, were included in this study. The study was approved by the institutional ethics review board, and all participants provided written informed consent before participation. All patient data were anonymized and confidential throughout the study.

Patients were selected based on the following inclusion criteria:

- Presence of knee pain lasting for at least 4 weeks.
- Clinical examination suggesting intra-articular pathology (e.g., joint effusion, instability, or mechanical symptoms).
- No prior knee surgery or major trauma to the knee.
- No contraindications to MRI (e.g., implanted pacemakers, severe claustrophobia).

Exclusion criteria included:

- Known history of malignant conditions in the knee joint.
- Patients with infections, systemic inflammatory diseases, or neurological disorders affecting the knee.
- Pregnancy.

Patient Demographics: The demographic characteristics of the patients, including age, sex, body mass index (BMI), and the duration of knee pain, were collected through a structured questionnaire prior to MRI scanning.

MRI Imaging Protocol: MRI examinations were performed using a 1.5 Tesla (or higher) MRI scanner (e.g., [Scanner Model, Manufacturer]). A standardized knee MRI protocol was followed to ensure consistency and comprehensive evaluation of the knee joint. The protocol included the following imaging sequences: in the sagittal plane, T1-weighted spin-

echo (SE) and T2-weighted fat-saturated (FS) images were obtained to evaluate the soft tissues and cartilage. In the coronal plane, T2-weighted FS and T1-weighted images were used to assess the menisci, ligaments, and cartilage. The axial plane included proton density (PD) FS and T2-weighted FS sequences to examine the articular surfaces and other intra-articular structures. In select cases, additional sequences, such as 3D gradient-echo imaging, were performed for more detailed evaluation of cartilage. The total MRI scanning time for each patient was approximately 30 minutes, and all images were obtained with the knee in a neutral position. In the standard protocol, no contrast agent was used. However, in some cases, intra-articular contrast (Gadolinium) was administered for more detailed joint analysis if required.

Image Analysis: The MRI images were analyzed by two experienced musculoskeletal radiologists, each with more than five years of experience in interpreting knee MRI scans. They independently reviewed the images to identify and assess any lesions present in various knee structures. The radiologists focused on several key areas, including the articular cartilage, menisci, ligaments, bone marrow, synovium, joint capsule, and the patellofemoral joint. Articular cartilage was evaluated for degenerative changes such as osteoarthritis or defects. The menisci were assessed for tears, degeneration, or other pathologies. Ligaments, including the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), and collateral ligaments, were analyzed for tears or other injuries. Bone marrow was checked for contusions, cysts, or subchondral sclerosis. The synovium and joint capsule were examined for effusion, synovitis, or Baker's cysts. The patellofemoral joint was evaluated for any misalignment or chondromalacia.

Categorization of Lesions: Each lesion identified was categorized by the radiologists into one of four groups: degenerative lesions, traumatic lesions, inflammatory lesions, and other lesions. Degenerative lesions included conditions like osteoarthritis and meniscal degeneration. Traumatic lesions encompassed injuries such as meniscal tears and ligament ruptures. Inflammatory lesions included conditions like synovitis, while other lesions covered a broad range of abnormalities, including bone cysts, Baker's cysts, and chondromalacia. If there were any discrepancies between the radiologists' findings, these were resolved through a consensus discussion to ensure accurate lesion categorization and diagnosis.

Data Collectionand Statistical Analysis: The data collected included patient demographics, clinical symptoms (e.g., pain duration, joint instability), and MRI findings. The MRI findings were categorized as per the lesion type and anatomical location. Data were analyzed using descriptive statistics, including

frequencies and percentages for categorical variables (e.g., type of lesion) and means and standard deviations for continuous variables (e.g., age, duration of pain).

Statistical significance between lesion types and patient demographics (e.g., age, sex) was determined using chi-square tests for categorical variables and independent t-tests for continuous variables. The level of statistical significance was set at p<0.05. Data analysis was performed using SPSS version 25.].

Results

Patient Demographics (Table 1)

Table 1 identifies basic characteristics of the group of 80 patients. A middle-aged group of patients participated in the study since their mean age came to 47.3 ± 13.1 years. The patient population consisted of 57.5% males who represented 46 individuals and 42.5% females who amounted to 34 participants with an observed male prevalence. Most of the study participants demonstrated overweight or obese body mass status based on their calculated mean body mass index which was 29.4 ± 4.7 kg/m². Six months served as the mean time period during which patients experienced knee pain thus indicating symptoms evolved at a medium pace throughout the population study. The diverse age distribution combined with sex BMI variation among the and participants demonstrates numerous possible factors that might affect MRI detection of knee lesions.

Lesion Distribution by Type (Table 2)

Table 2 shows the different knee lesion types together with their prevalence rates. Degenerative lesions appeared in 62.5% of patients with osteoarthritis affecting 42.5% of patients and meniscal degeneration present in 20% of patients. This high frequency of degenerative changes aligns with the study population characteristics since it contains middle-aged overweight individuals who have both been proven to develop osteoarthritis. The population demonstrated traumatic lesions damaging the meniscus (15%) or ligaments (11.25%) in 26.25% of participants thus confirming knee injuries generated a notable level of pain. Medical examinations revealed that synovitis occurred as inflammatory lesions in 7.5% of patients to indicate inflammatory processing in knee pain manifestations. Other knee lesions including bone cysts and chondromalacia were detected in 3.75% of the evaluated cases thereby establishing their position as minimal yet clinically significant abnormalities within the group.

Lesion Location Distribution (Table 3)

The distribution pattern of knee lesions emerges from Table 3 through its presentation of their knee anatomical locations. The most prevalent finding in the patients led to articular cartilage abnormalities at 58.75% while matching previous data regarding Table

2 that shows degenerative lesion rates especially osteoarthritis. Independent studies established that meniscal lesions existed within 35% of evaluated knees due to the vital function of menisci in knee pathophysiology. Twenty-three point seventy-five percent of patients showed ligamentous injuries where the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) appeared as the most injured structures. Among the patient group 11.25% presented Bone Marrow Lesions which reflect degenerative or traumatic involvement of subchondral bone. Synovial abnormalities together with joint capsule issues appeared in 7.5% of patients but Baker's cysts were found in less than half (5%) of patients.

Lesion Distribution by Age Group (Table 4)

The analysis of different age groups shows their respective lesion distribution based on Table 4 data. Degenerative lesions were less common than traumatic lesions among patients aged 18 to 30 as the former comprised 10% of cases but the latter were seen in 8% of patients. The occurrence of traumatic lesions decreases as people get older but degenerative lesions become more prevalent throughout life. The evaluation of patients aged 31-45 demonstrated degenerative lesions in 32% of cases along with traumatic lesions found in 16% of patients. The incidence of degenerative lesions increased by 34% for the 46-60 year old age segment with traumatic lesions decreasing to 14%. The oldest participant group consisting of individuals between 61 to 75 years old exhibited degenerative lesions in 24% of cases but showed 4% traumatic lesions therefore indicating the degenerative joint disease's natural progression with maturation. This table demonstrates how the proportion of degenerative lesions tends to progressively increase as patients grow older in relation to traumatic lesions that cause knee pain.

Lesion Distribution by Sex (Table 5)

The data regarding different types of knee lesions is presented by sex in Table 5. Among male patients the degenerative background caused 71.7 percent of damage to the knee while females presented 28.3 percent degenerative defects. The data revealed that traumatic lesions occurred at higher rates among male patients to the extent of 57.1% as opposed to female patients who possessed 42.9% of these conditions. The male participants in this cohort seemed to have more degenerative as well as traumatic lesions based on these study results. The distribution of inflammatory lesions and other lesions maintained a balanced ratio between males and females since each sex experienced 50% inflammatory lesions and males reported slightly more often than females (66.7%) for other lesions. Observations from this table reveal male patients experience higher incidence of degenerative and traumatic lesions as compared to females who face roughly equal rates of inflammatory and other lesion occurrences.

MRI Findings and Associated Pain Duration (Table 6)

The table reveals data about knee pain duration for various lesions across different patient cases. The duration of knee pain extending to 7.1 ± 3.2 months existed among patients who had degenerative lesions because osteoarthritis and meniscal degeneration tend to become chronic. Patients who experienced traumatic knee injuries normally experienced pain for a period of 5.6 ± 2.5 months which appeared as the shortest among all observable pain durations. Patients with inflammatory lesions which included synovitis presented the quickest pain duration at 4.2 ± 1.8 months. The pain duration of bone cysts along with chondromalacia averaged at 4.9 ± 2.1 months among all affected patients. These findings suggest degenerative knee changes lead patients to experience sustained pain conditions in comparison to other conditions that result in shorter-term pain presentation.

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Demographic Characteristic	Number of Patients (%)	
Total Patients	80	
Age (mean \pm SD)	47.3 ± 13.1 years	
Sex		
Male	46 (57.5%)	
Female	34 (42.5%)	
Body Mass Index (mean ± SD)	$29.4 \pm 4.7 \text{ kg/m}^2$	
Duration of Knee Pain (mean ± SD)	6.2 ± 3.5 months	

Table 1: Patient Demographics

Table 2:	Lesion	Distribution	by	Туре	
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Lesion Type	Number of Patients	Percentage (%)
Degenerative Lesions	50	62.5
Osteoarthritis	34	42.5
Meniscal Degeneration	16	20
Traumatic Lesions	21	26.25
Meniscal Tears	12	15

Ligament Tears	9	11.25
Inflammatory Lesions	6	7.5
Synovitis	6	7.5
Other Lesions	3	3.75
Bone Cysts	2	2.5
Chondromalacia	1	1.25

Table 3: Lesion Location Distribution

Lesion Location	Number of Patients	Percentage (%)
Articular Cartilage	47	58.75
Menisci	28	35
Ligaments	19	23.75
Bone Marrow	9	11.25
Synovium/Joint Capsule	6	7.5
Patellofemoral Joint	4	5

Table 4: Lesion Distribution by Age Group

Age Group	Degenerative Lesions	Traumatic Lesions	Inflammatory Lesions	Other
(years)	(%)	(%)	(%)	Lesions (%)
18-30	5 (10%)	4 (8.0%)	1 (1.0%)	1 (2.0%)
31-45	16 (32%)	8 (16%)	2 (3.0%)	1 (1.0%)
46-60	17 (34%)	7 (14%)	2 (3.0%)	1 (2.0%)
61-75	12 (24%)	2 (4%)	1 (1.0%)	0 (0%)

Table 5: Lesion Distribution by Sex

Lesion Type	Male (%)	Female (%)
Degenerative Lesions	33 (71.7%)	17 (28.3%)
Traumatic Lesions	12 (57.1%)	9 (42.9%)
Inflammatory Lesions	3 (50%)	3 (50%)
Other Lesions	2 (66.7%)	1 (33.3%)

Table 6: MRI Findings and Associated Pain Duration

Lesion Type	Mean Pain Duration (Months)	
Degenerative Lesions	7.1 ± 3.2 months	
Traumatic Lesions	5.6 ± 2.5 months	
Inflammatory Lesions	4.2 ± 1.8 months	
Other Lesions	4.9 ± 2.1 months	

Discussion

The research analyzed different types of knee lesions which create pain in 80 diagnostic subjects using Magnetic Resonance Imaging as the evaluation method. A wide range of different knee lesions was detected through MRI scans where degenerative lesions dominated the findings followed by traumatic injuries and inflammatory pathology together with several uncommon pathologies.

The patients in this cohort mostly fell within middle age and their average age was 47.3 ± 13.1 years. The demographic reveals a high incidence of degenerative knee diseases because osteoarthritis together with meniscal degeneration appears commonly throughout the group. Male patients outnumbered females at 57.5% in this cohort according to research findings which match Pamrika et al. (2017) and their study of knee pathologies predominately in males. ^[11] People in this cohort presented with an elevated BMI level of 29.4 \pm 4.7 kg/m² which indicates obesity as a possible co-factor in developing knee pain because it is a risk

factor for knee osteoarthritis and meniscal tears (Al Saran et al., 2014). This 6.2-month duration of knee pain reflects a prolonged symptom occurrence that is typical for degenerative and traumatic lesions discovered in the study.^[12]

The majority of patients at 62.5% showed degenerative knee issues and osteoarthritis together with meniscal degeneration were the most common findings. Similar results emerge from Beaufils et al. (2017) who discovered degenerative changes pose as the main reason behind knee pain among middle-aged and older adults. ^[13] According to Al Saran et al. (2014) osteoarthritis appears with high frequency in knee pain patients and the menisci and cartilaginous tissue shows prominent degenerative changes after ACL tears. ^[12] Studies showed traumatic lesions occurring less frequently (26.25%) than other cases but meniscal tears appeared most often in such traumatic instances. The research results match those reported by Smith et al. (2015) who showed meniscal tears are the primary traumatic knee injury diagnosis

along with findings from Xu et al. (2018) about the prevalence of traumatic lesions in younger patients. [14,15]

Studies showed that articular cartilage abnormalities appeared as the main condition among patients at 58.75% while articular cartilage abnormalities led the list. Research results from Abbas et al. (2016) demonstrate that articular cartilage damage exists frequently within knees displaying pain symptoms especially among those with osteoarthritis. ^[16] This study revealed meniscal tears in 35% of patients demonstrating the fundamental role of menisci in knee pathology although Beaufils et al. (2017) already described meniscal tears along with degenerative changes in osteoarthritis. Bone marrow lesions (11.25%) together with synovial abnormalities (7.5%)provide evidence that traumatic and degenerative processes lead to knee pain in patients. ^[13] The research results connect to findings from Crues et al. (1990) which showed bone marrow lesions frequently develop with osteoarthritis and other degenerative knee diseases.^[17]

Patients show more traumatic knee lesions but as people age degenerative conditions become more prevalent. Research by Siddiqui et al. (2013) showed that traumatic knee injuries affect younger individuals between 18-30 years old just like the results of this [18] study. Degenerative lesions particularly osteoarthritis showed greater incidence among the participants in both age cohorts who were between 31 and 45 years old and between 46 to 60 years old. Agerelated knee degeneration stands true because Nandy and Sinha (2019) proved that knee lesions increase with age at similar rates. The prevalence of traumatic knee injuries remains at its lowest point in adults between the ages of 61 and 75 years which demonstrates that physical trauma decreases as people grow older. [19]

A greater number of males presented degenerative lesions at 71.7% compared to females who had them at 28.3%. According to Hash (2013) males tend to get degenerative joint diseases that form from mechanical stress and weight-bearing activities.^[20] The results of Pamrika et al. (2017) demonstrate that traumatic injuries like ligament and meniscal tears occur more frequently in male patients thus explaining their higher prevalence in the male study group. ^[11] The distribution of inflammatory lesions (synovitis) and other less common lesions (e.g., bone cysts, chondromalacia) showed sex similarity which supports Pasupuleti et al. (2015). ^[21]

The patients with degenerative lesions experienced knee pain for 7.1 months on average as reported by patients. Beaufils et al. (2017) supports this finding through research on cartilage wear and meniscal degeneration since degenerative knee conditions tend to produce prolonged pain. ^[13] Traumatic injuries resulted in shorter pain durations of 5.6 ± 2.5 months probably because they generally produce acute ligament and meniscal tears. Siddiqui et al. (2013)

reported traumatic knee injuries cause urgent pain problems primarily affecting younger patients. ^[18] Research by Arumugam et al. (2015) demonstrated that inflammatory conditions (synovitis) caused the shortest pain duration of 4.2 ± 1.8 months which matches results of this analysis. ^[22]

Conclusion

This research study shows that MRI examinations reveal various knee lesions which mostly include degenerative forms and traumatic and inflammatory conditions after degenerative lesions. MRIs help establish critical diagnosis of knee pathologies especially among middle-aged and elderly patients who experience chronic knee pain. Data from the research shows that age together with sex and BMI affect which knee lesions will manifest and where they will appear. MR imaging stands as a powerful diagnostic method for knee pain assessment which develop suitable helps physicians treatment approaches.

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