RESEARCH PAPER

MRI Evaluation of Knee Diseases: Correlation with Clinical Findings

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ABSTRACT

Introduction: Knee disease is the term that describes the changes in the structure of the normal knee. It is common in older adults. It occurs when your knee joint is affected, causing pain, swelling, and stiffness by damaging the bone, cartilage, ligaments or any surrounding structures.

Aim: To assess the diagnostic value and accuracy of MRI in identifying and describing different pathologies of the knee joint in patients suffering from knee pathologies.

Objectives: • To determine the range of knee anomalies observed by MRI, such as tears of the meniscus, damage to the ligaments (ACL, PCL), intra-articular fluid, bone marrow oedema, fractures, and cystic lesions. • To determine the demographic attributes of the patients, including age and gender, and how these attributes relate to the relative frequency of various knee pathologies. • To relate the findings of the MRI to the clinical manifestation of knee pain, swelling, and locking. • To show some of the many benefits of MRI over other imaging techniques, including the precise details of the anatomy and exact diagnosis of diseases of the knee.

Material and Methodology: A retrospective study of 40 patients conducted in a hospital in Jaipur met the inclusion criteria of the study. The inclusion criteria were to include all those cases who presented with knee disease and all of them were subjected

to knee MRI. The imaging findings were analysed, described, and represented in the form of charts.

Results: In this study, the MRI results showed knee diseases with a wide range of abnormalities which includes: tear of medial meniscus 5 cases, mild joint effusion 8 cases, tear of ACL 9 cases, marrow oedema 1 case, fractured line 2 cases, PCL tear 3 cases, lateral meniscus tear 8 cases, peri meniscal cyst 1 case, baker's cyst 3 cases. This study also concluded that males aged above 60 years are more prone to knee diseases than females.

Conclusion: According to the study's findings, MR Imaging is the optimal imaging modality for accurately diagnosing knee pathology due to its absence of radiation, superior soft tissue contrast, and exact localization of anatomical abnormalities in the knee. In this investigation, ligament and meniscal tears and joint effusion were the most common findings in knee disease patients.

Keywords: Knee disease, MRI, ACL tear, mild joint effusion, lateral meniscus tear, tear of medial meniscus, baker's cyst.

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I. Introduction

MRI is a safe imaging technique that produces high-quality 3D images of various body structures including organs, soft tissues, bones and blood vessels. Unlike X-rays, MRIs do not use radiation, and can be used to identify and diagnose conditions such as tumours, infections, and other structural abnormalities. MRIs give images in three orientations: axial, coronal and sagittal.

Knee pathology can now be diagnosed noninvasively, without the need for an operator, and at a reasonable cost thanks to developments in MRI and the advent of high-resolution coils. MRI helps differentiate pathologic knee disorders that may have similar clinical indications and symptoms (e.g., meniscal tears, osteochondral lesions) and is well tolerated by patients and largely accepted by evaluating physicians.[10]

Various knee pathologies can be identified including meniscal tears, ACL/PCL tears, collateral ligament injuries, joint effusions & bursitis, soft tissue oedema& cellulitis, baker’s cyst and arthritic changes.[1]

Anatomy of knee:

- **Bone Structure:**

The knee is a highly modified hinge joint with the broadest range of mobility for both varus and valgus rotation about the frontal plane and flexion and extension about the sagittal plane. Also, it lets both the lateral rotation at the knee's terminal

extension and the medial rotation at the point of knee flexion in the transverse plane. In a number of stressful circumstances, the knee maintains stability and control.

Knee contains two bone articulations between the femur and tibia, where tibia handlesmost weight of the body, and the articulation between the patella and femur helps in friction freemovement of knee with femoris muscles.[2]

- **Knee Ligaments, Cartilage, and Bursae:**

Knee has cartilages (meniscus and articular cartilage) and ligaments [including anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), medial collateral ligament (MCL), and lateral collateral ligament (LCL)] and tendons. Knee supports in weight bearing for performing activities like walking, running, and jumping while also flexion and extension of leg.

A bursa is a fluid-filled structure that is present between the skin and tendon or tendon and bone. Its main function is to reduce friction between adjacent moving structures.[3]

MRI protocol and sequences which are used for knee:

In this examination 3T MRI machine(Siemens MAGNETOM)has been used along with circumferential or knee coil. Position the patient on MRI examination table in supine position with feet first. Fix the knee coil with strap and pads to restrict patient motion. To get everything right we will use a laser to find the lower border or apex of the patella.Then we will make sure your knee is at the center of the machine and if you need to,we can slightly bend knee so patient is more comfortable.

A variety of sequences within three orthogonal scanning planes are usually acquired during a conventional MRI evaluation of the knee. Nevertheless, depending on site-specific variables and patient indications, the precise approach may differ considerably. For instance, thin and ultra-thin oblique sagittal or coronal MRI, which has been shown to improve the diagnostic accuracy for ACL injuries, may be included in response to signs of ACL injury on MRI requests.[12]

Sequence planning for the knee scan:

For axial slices:The planning block should be angled parallel to the femur's medial and lateral condyles in order to plan the axial slices on the coronal plane. Check the other two planes' planning block. Establish a suitable angle in the sagittal plane that is perpendicular to the tibia and femur lines. Make sure the slices completely enclose the knee joint from the superior border of the patella to the tibial tuberosity.To minimize popliteal artery pulsation artifacts, slices should adequately cover the entire knee joint from anterior to posterior. Saturation bands above and below the coronal block will further reduce arterial pulsation artifacts. The phase direction in the axial scans should be head to feet.[7]

For sagittal slices: Plan the sagittal slices in the axial plane, then angle the planning block parallel to the lateral condyle of the femur (ACL). Examine the other two planes' planning block. In the coronal plane, which is parallel to the midline of the tibia and femur, a suitable angle must be provided. There must be enough slices to completely enclose the knee joint from right to left. To prevent artifacts from popliteal artery pulsing, the phase orientation in the axial scans must be head to feet. Arterial pulsation artifacts can

Sequences	Use
Localizer (scout image)	**Localizer determines the position and orientation of subsequent imaging slices.**
Pd_ tse_ fs _tra	**is utilized to identify soft tissue lesions such bone marrow oedema, ligament tears, and degeneration of cartilage.**
T2_tse_tra	**T2 identifies knee pathology, visualize fluid and soft tissue structures**
Pd_tse _fs_ cor	**Fluid sensitive sequence for meniscal, ligament tear**
Pd_ tse_ fs_ sag	**Fluid sensitive sequence for meniscal, ligament tear**
T2_tse_sag	**is utilized to identify soft tissue lesions such bone marrow oedema, ligament tears, and degeneration of cartilage.**
T2_me2d_sag	**Used to detect biochemical and structural changes in cartilage**
T2_tse_stir_cor_Acl_obl	**To see ACL tear**
Blade	**Used for patient undergoing movement**

be further reduced by using saturation bands above and below the sagittal block.[7]

For coronal slices: The planning block should be angled parallel to the femur's medial and lateral condyles in order to plan the coronal slices on the axial plane. Examine tibia and femur midlines. The entire knee joint, from anterior to posterior, should be adequately covered by slices. To reduce popliteal artery pulsation artifacts, the phase direction in the axial scans should be head to the other two planes' planning block. It is necessary to provide a suitable angle in the sagittal plane that is parallel to the

feet. Arterial pulsation artifacts can be further minimized by using saturation bands above and below the coronal block.[7]

Pathology of knee:

- **Meniscal tears**: can be degenerative or sudden, and they often show up as high signal changes on T2-weighted imaging.[4]
  The allocation of MRI intensity of signals and its relationship to the articular surface are popular methods for assessing meniscal injury.[9]
- **Anterior Cruciate Ligament (ACL) tears:** Common in sports, they show discontinuity or high signal on T2-weighted images instead of the normal low-signal band.[4]
  If the ligament's usual continuity could not be seen in the sagittal plane with the knee externally rotated by 20 degrees, an anterior cruciate ligament tear was deemed to be evident on MRI.[11]
- **Posterior Cruciate Ligament (PCL) tears**: Less common, typically resulting from high-impact trauma. Tears appear as high signal or thickening on T2-weighted images.[4]
- **Medial and Lateral Collateral Ligament (MCL/LCL) tears:** MCL tears are caused by valgus stress, while LCL tears result from varus stress. They show high signal oedema or discontinuity on T2 or PD-W images.[4]
- **Baker's cyst (popliteal cyst):** A fluid-filled sac behind the knee, appearing as a high signal on T2-weighted images. It is a sign of an underlying knee problem, such as arthritis.[4]
- **Parameniscal cysts:** Cysts that form adjacent to a meniscal tear.[4]

- **Synovitis:** Inflammation of the synovial membrane lining the joint.[4]
  If the synovial space was enlarged and loaded with fluid (high signal intensity on fat saturated proton density weighted images), indicating synovial thickening and joint effusion, then synovitis was deemed to be present.[8]

II. Review of Literature:

1. Knee joint examinations by magnetic resonance imaging: The correlation of pathology, age, and sex:

Serhat Avcu et al.conducted study on knee disease by local ethics committee of Marmara University. The data from a total of 308 patients (160 males, 148 females) who were evaluated with MRI examination of the knee joint using a 1.5 Tesla magnetic resonance unit (GE, Milwaukee, USA) between August 2002 and July 2003 were included in this retrospective study. The ages of the patients ranged between 1 and 74 years (mean = 43.3 years). The pathologic findings on the MRI examinations such as injuries of the menisci, medial and lateral collateral ligaments, and anterior and posterior cruciate ligaments, as well as parameniscal cyst, Baker cyst, osteochondral lesion, chondromalacia patellae, patellae Alta, bone bruise, bursitis, and tumour were noted in all patients.

Results: The ages of the patients ranged between 1 and 74 years (mean: 43.3 years). Age was significantly correlated with meniscal degeneration and tears, medial collateral ligament degeneration, parameniscal cyst, and chondromalacia patellae. There was a significant correlation between male gender and anterior cruciate ligament injury. Meniscal injury was significantly correlated with bursitis, as well as medial collateral ligament injury. Bone bruise was significantly correlated with medial collateral ligament injury, lateral collateral ligament injury, Baker's cyst, and anterior cruciate ligament injury. Chondromalacia patellae were significantly correlated with anterior cruciate ligament injury, patellae Alta, and osteochondral lesion. Bursitis (in 53.2% of the patients) followed by grade-II meniscal degeneration (in 43% of the patients) were the most common knee pathologies observed by MRI.[5]

2. Evaluation of Knee Joint by Ultrasound and MRI:

Bhanupriya Singh et al.conducted a study on 50 symptomatic patients who suffered knee joint disorders like pain, swelling, locking, limitations of movements, and external injury. They were included in the study. After clinical assessment, all patients were subjected to sonographic examination. The diagnosis was confirmed by MR imaging. They were males & females, with an age range between 11 and 65 years. All the patients are subjected to history taking, ultrasonography (US), and magnetic resonance imaging (MRI) using a 1.5 Tesla GE MRI machine with a knee extremity circumferential coil. They used the PHILIPS EnVisor HD and MINDRAY Colour Doppler machine with the 7.5 to 12 MHz multi-frequency linear array probe for real-time B-mode scanning.

Findings: In the present study, the most frequent knee finding was joint effusion, which was seen in 44 (88%) followers, followed by ligament 33 (66%), 11 osseous (22%), and 1 muscular (2%). No specific sex predilection was found. The most frequent age group affected in this work was the second decade.[6]

3. Material and Methodology:

Type of Study: A retrospective-based study was used.

Duration of Study: The study was carried out for a period from 1 August 2025 to 30 November,2025.

Study Area: The study was conducted conducted in a hospital in Jaipur,Rajasthan, India.

Sample Size: The study was conducted on 40 patients in the radiology department.

Inclusion and exclusion criteria: The study delineated specific inclusion and exclusion criteria as follows:

- **Inclusion criteria:** It includes the study of patients of the knee disease.
- **Exclusion criteria:**

a) It excludes the study of the patients of the femur and leg disease.
b) uncooperative patients
c) patients with metallic implants

Equipment:

a) MRI examinations for all patients included in the study were conducted using a 3 Tesla scanner (Siemens MAGNETOM) MR machine in the department of Radiology, conducted in a hospital in Jaipur, Rajasthan, India.
b) circumferential or knee coil

4. Results:

Observations:
A retrospective based study was undertaken involving 40 patients to assess the role of MRI in evaluation of knee disease.

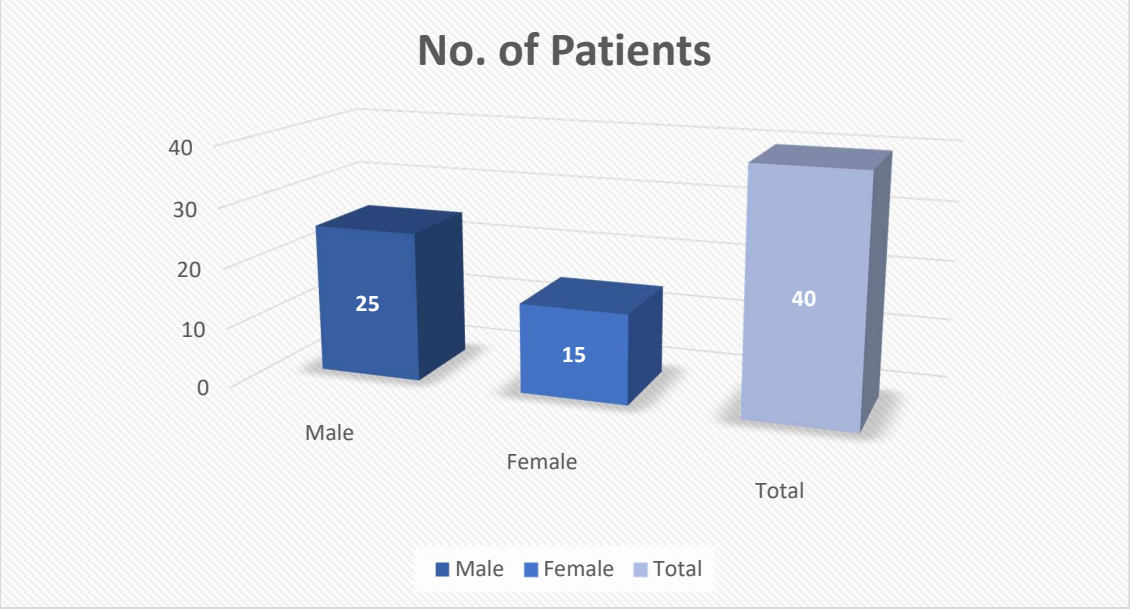
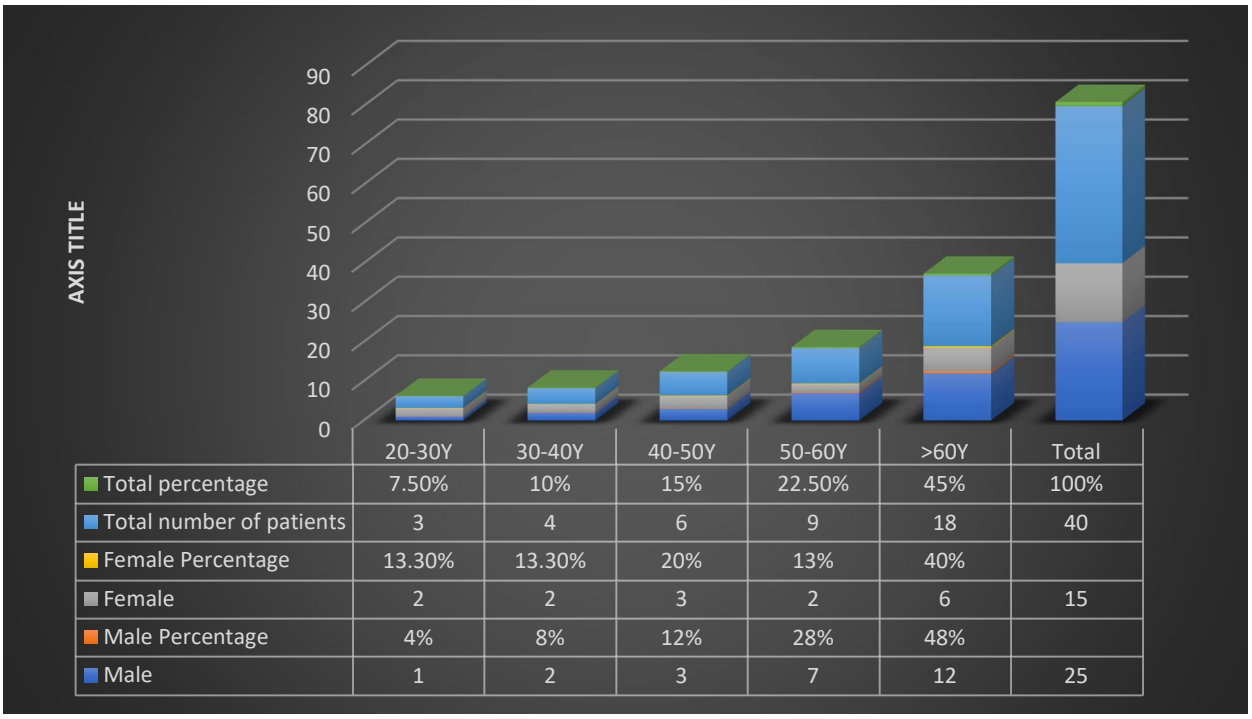


Fig 1.1 Distribution of patient as per sex/gender

Fig 1.1 shows that distribution of patients according to sex/gender. Out of 40 patients, 25 patients (62.5%) were male while the remaining 15 patients (37.5%) were females.



	20-30Y	30-40Y	40-50Y	50-60Y	>60Y	Total
Total percentage	7.50%	10%	15%	22.50%	45%	100%
Total number of patients	3	4	6	9	18	40
Female Percentage	13.30%	13.30%	20%	13%	40%	
Female	2	2	3	2	6	15
Male Percentage	4%	8%	12%	28%	48%	
Male	1	2	3	7	12	25

Fig 1.2 Distribution of patients as per age and sex

Fig 1.2 shows that distribution of patients as per age,7.50%(n=3) patients were in the age group of 20-30 years, 10%(n=4) patients were in the age group of30-40 years, 15% (n=6) patients were in the age group of 40-50 years, 22.50%(n=9) patients were in the age group of 50-60 years, 45%(n=18) patients are in the age range of>60 years.

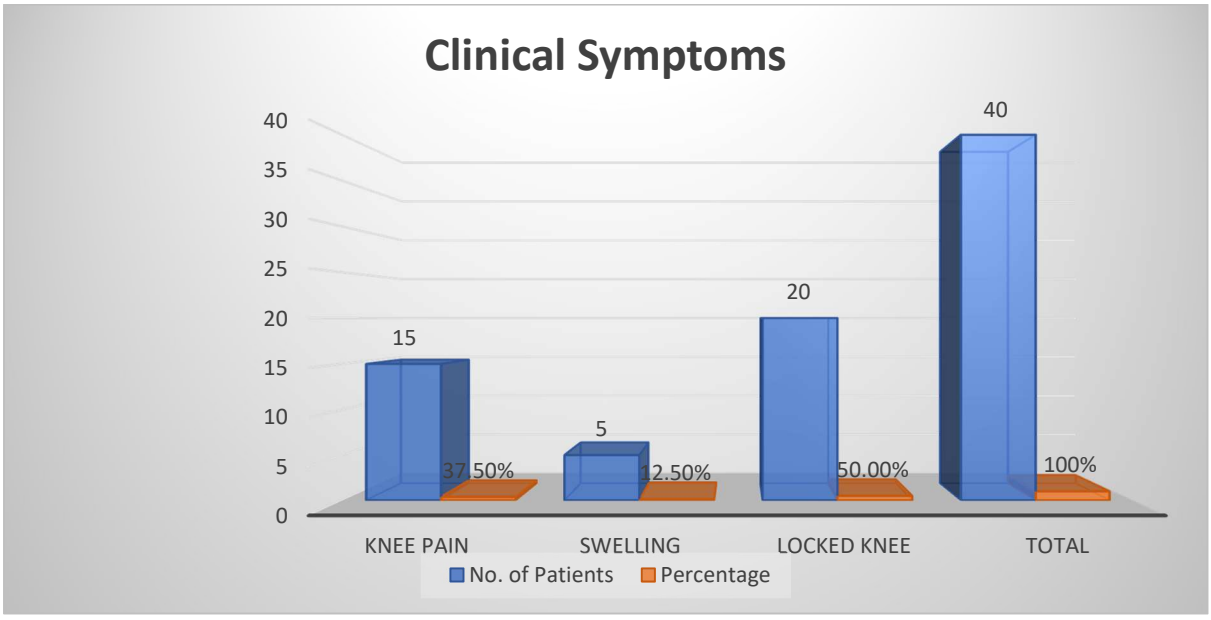


Fig 1.3 Distribution of patients as per clinical symptoms

Fig. 1.3 shows that distribution of patients as per clinical symptoms: 37.50% (n=15) had knee pain, 12.50% (n=5) had swelling, and 50% (n=20) had locked knee.

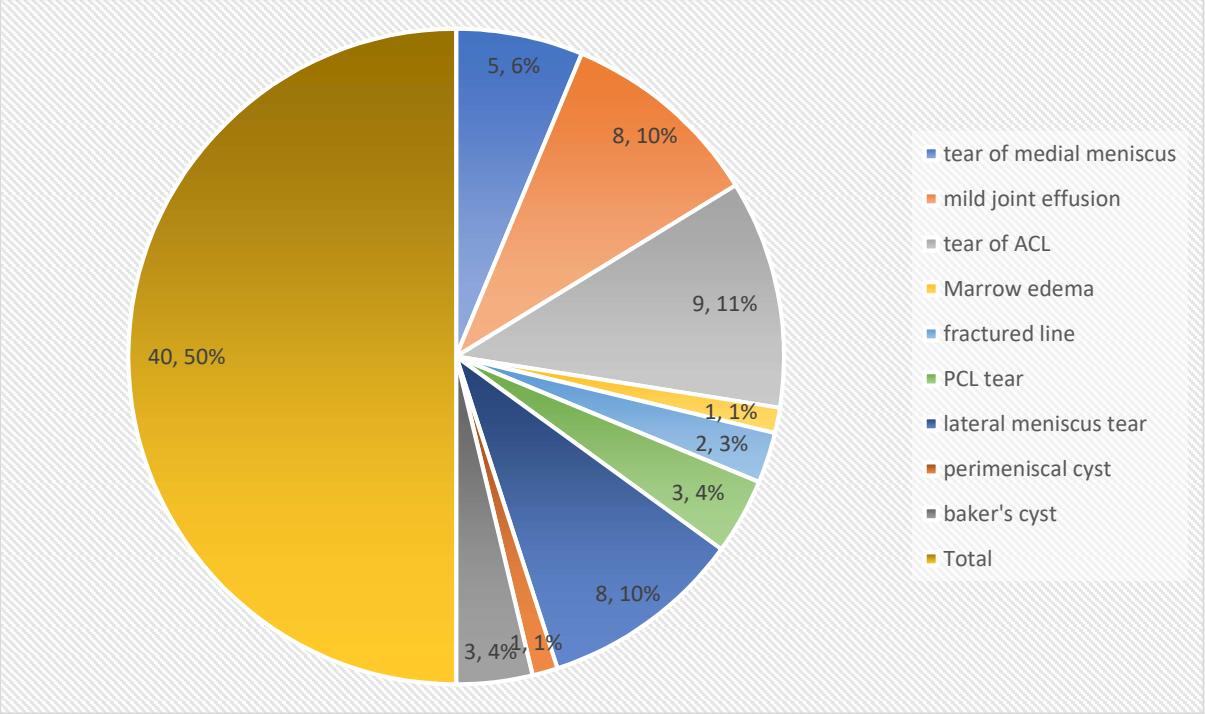


Fig 1.4 Distribution of MRI findings as per number of findings in patients

Fig 1.4 shows the distribution of MRI findings as per the number of findings in patients. It was observed that the majority of the patients had a tear of the ACL (9 out of 40). However, the least number of patients had marrow oedema and peri meniscal cysts (1 out of 40). Overall, ACL was observed as the most common finding, followed by mild joint effusion, marrow oedema, and lateral meniscus tear.

5. Discussion:

In a meticulously conducted retrospective study carried out in the Department of Radiology, conducted in a hospital in Jaipur, the pivotal role of MRI in the evaluation of knee disease was examined, involving 40 patients.

The gender distribution within the study displayed that men were more likely to have knee disease as compared to women, with 25 male (62.5%) and 15 female (37.5%) participants. Upon closer inspection of age demographics, the largest proportion falls above 60 years of age (45%), followed by individuals aged 50 to 60 years (22.50%); however, the smallest proportion falls within the 20-30 years age range (7.50%).

In this study with the help of MRI, I have concluded that male patients of age above 60 years are more prone to knee disease, i.e., 12 out of 25 (48%) male patients are of this age group. Meniscal and ligament tears are common in them, and they show knee pain (37.50%) and swelling (12.50%) as a common clinical symptom. Serhat Avcu et al. have concluded that age and sex factors have been significantly related to meniscal

degeneration and tears and medial collateral ligament degeneration. They have shown 18 (81.8%) out of 22 males show injuries of ACL and tears.[5]
Examining the MRI in further detail, I have concluded that mild joint effusions and lateral meniscus tears of the knee have been common in males, 8 (10%) out of 25 each; they show symptoms like locked knee or stiffness of knee in 20 (50.0%) out of 40 patients. Bhanupriya Singh et al. have concluded that the most frequent knee finding was joint effusion, which was seen in 44 (88%) followers, followed by ligament 33 (66%), by use of MRI and sonography without consideration of age and sex.[6]

6. Conclusion:

This article makes a significant contribution to our understanding of knee disease, specifically in terms of using MRI as a diagnostic tool. The gender distribution seen in the patient sample demonstrates that knee disease was common in older adults.
Furthermore, the range of ages manifested that meniscal and ligament tears increase with increasing patient age. The prevalence of abnormalities discovered by MRI highlights the diagnostic value of this imaging modality, allowing doctors to identify knee disease.
Moreover, meniscal and ligament tears were the most common findings in knee diseases that mostly affect older male patients. Last, but not least, MRI imaging is essential to accurately diagnose the knee pathology due to its advantage of lack of radiation, excellent spinal soft tissue contrast, and accurate localization of changes of ligament and meniscal changes.

- However, the findings of this study may vary with changes in location, sample size, characteristics and the types or severity of patient "diseases".

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