# Knee Magnetic Resonance Imaging: Descriptive Frequency and Outcome in University of Jordan Hospital

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**Abstract**

**Aims**: To evaluate the experience of the university of Jordan hospital regarding knee magnetic resonance imaging and to compare our findings with those published in the medical literature.

**Methods**: 575 knee magnetic resonance imaging exams for 569 patients performed over the period of 10 years were reviewed. 109 patients, 66 males and 43 females with a percentage of (19.1 %) had normal knee magnetic resonance image and were excluded from the study while the remaining 460 patients (80.9 %) with variable abnormalities were included in our study.

**Results**: Variable knee pathologies were noted, the most common was knee fluid found in 381 patients representing (81.7 %) of the pathologies detected, followed by bone marrow edema in 240 patients (51.5 %), while cruciate ligament tear of the knee was found in 205 patients (43.99 %), followed by meniscal tear in 184 patients (39.48%) and meniscal degeneration in 135 patients (28.96 %). Finally, osteoarthrosis which was the least common finding seen in 63 patients (13.5 %).

**Discussion**: Patients referred for knee magnetic resonance imaging scanning in the university of Jordan hospital showed diverse imaging findings with the most common abnormality detected being joint fluid followed by bone marrow edema and cruciate ligament tear. The great benefit from knee magnetic resonance imaging was in diagnosing meniscal tear, staging fractures and characterization of other miscellaneous pathologies. The prevalence of knee pathologies among our patients as revealed by knee magnetic resonance imaging was not in concordance with what is published in the literature especially for gender distribution of anterior cruciate ligament tear.

**Keywords**: Knee Pathologies, Knee MRI, ACL, PCL, BME, Collateral Ligaments and Menisci.

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## Introduction

Knee magnetic resonance imaging (MRI) has emerged as an important modality in the evaluation of osseous and soft tissue structures of the knee. MRI is painless and non-invasive,

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without ionizing radiation and without any known adverse biological effects on humans. MRI can provide high sensitivity, specificity and accuracy in the diagnosis of cruciate ligament injuries, meniscal tears and bone marrow pathologies, and it is also proven useful in the diagnosis of patello-femoral disorders, intra articular loose bodies and osteochondral lesions. MRI is equal, if not superior to clinical examination in detecting knee internal derangement even approaching that of the gold standard diagnostic arthroscopy (1).

**Material and Methods**

In our retrospective study done in the university of Jordan hospital, we reviewed knee MRI images of 569 patients done between January 2001 and December 2010 (10 years). In which 109 (19.15 %) patients with normal MRI were excluded (66 males and 43 females).

The remaining 460 patients with abnormal knee MRI were included in our study with mean age of 43.2 years (range 5-100 years). Of these 460 patients 316 were males (68.7 %), and 144 were female patients (31.3 %). Male to female ratio was 2.2:1. Mean age for females was 48.8 years (range 5-100 years) and mean age for males was 37.6 years (range 9 -85 years) table 1. Neither institutional ethics committee approval nor informed consent was required for reviewing patient records and images.

**Techniques**:

Knee MRI was performed using 1.5 Tesla superconducting MRI unit (Magnetom vision plus, Siemens, Erlangen, Germany). A pre-designed protocol was done using Knee coil. The knee joint was imaged using coronal and axial T2 spin echo sequences with and without fat Saturation as well as sagittal, axial and coronal T1spin echo sequences. In our department, coronal images were acquired routinely from anterior to posterior, axial images from proximal to distal and sagittal images from lateral to medial. Images were reviewed by two consultant radiologists experienced in MRI followed by a consensus to resolve any difference in interpretation. Knee MRI was studied thoroughly for any abnormality in joint space, focal bony lesions, bone marrow signal, bone contour, surrounding soft tissue and fracture lines.

**Results**

The results are summarized in tables 2 and 3 which showed variable knee pathologies, the most common was knee fluid found in 381 patients representing (81.7%) of the pathologies detected, followed by bone marrow edema (BME) in 240 patients (51.5%), cruciate ligament tear in 205 patients (43.99 %), meniscal tear in 184 patients (39.48%), meniscal degeneration in 135 patients (28.96 %) and osteoarthrosis which was the least common seen in 63 patients (13.5%).

**Discussion**

The knee is the largest joint in the body composed of cartilage, ligaments, muscles, and tendons. Knee joint is a compound (complex) single cavity joint but it is more convenient to describe it as two condylar joints between femur and tibia and a sellar joint between patella and femur. It is lined with synovium that secretes synovial fluid which lubricates the joint resulting in friction reduction. Bursae are also found around the knee joint acting as a cushion in areas where skin or tendons glide across bone (2).

Descriptive epidemiological studies are important as they show variations in frequency and prevalence of the studied abnormality by time, age, gender histological type, geographic region, and ethnicity. This study is meant to be a descriptive retrospective study evaluating the prevalence of different knee pathologies in the university of Jordan hospital patients as revealed by MRI.

In reviewing the literature, many studies had been conducted to evaluate certain knee pathologies regarding incidence, prevalence and risk factors. Others had compared the incidence of certain pathologies in normal population and among those with obvious or supposed increased risk.

Anterior cruciate ligaments (ACL) injuries studies have attracted more interest in the orthopaedic literature than studies of the posterior cruciate ligament injuries (PCL), which represent (1-44 %) of all knee ligament injuries in various studies (3,4,5,6). Our results showed that Cruciate ligament tear (43.99%) was more common in ACL 41% than PCL (3%) in which ACL to PCL ratio is 13.6:1. We found ACL tear 3 times more common in males than females especially in the ages between 20-50 years, while other studies reported ACL injuries to be more common in females except Gille et al (7). This was attributed to high percentage of athletic females which is not common in our community and which plays a major role in increasing ACL injuries (8, 9).

In our results, ACL injuries were commonly associated with other knee injuries, (37 %) of ACL injuries were associated with BME compared to (68%) in another study (10). Furthermore, (31%) of ACL injuries in our study were associated with medial meniscal tear compared to (43%) reported by others (10).

We found that PCL rupture (3%) was 6 times more common in males than females. PCL injury was associated with joint effusion in (85%), with BME in (57%), with ACL injury in (57%) and with lateral meniscal tear in (7%); however we did not find PCL injury to be associated with medial meniscus nor with collateral ligaments injuries. In other studies PCL injuries were associated with effusion in (65%), with BME in (35%), with medial meniscus injury in (32-35%), with lateral meniscus injury in (28-30%), with ACL injuries in (17-27%), with medial collateral injury in (20-23%) and lateral collateral injury in 6-7% (4). We did not find an isolated PCL injury while isolated PCL injuries were reported in 24-30% (4, 5, 11, 12); however, Fanelli reported 7.4% in one study (4) and (3.5%) in another study (5).

We found Meniscal tear (39.48 %) more commonly in medial meniscus (74%) than in lateral meniscus (26%), Medial to lateral 2.8:1. Both meniscal tear was found in 9 cases (5%). Mesgarzadeh et al studied 194 knees and reported (74%) of cases to have teared meniscus, of these (45%) were limited to medial meniscus, (22%) were limited to lateral meniscus and 33% occurred in both meniscii (13). Also Englund et al (14) reported that prevalence of menscial tear was 31 %, medial meniscus was involved in (66%), lateral in 24 % and both in (10%). On the otherhand, Zanetti et al reported meniscal tear in 57% of symptomatic knees and in (36%) of the contralateral asymptomatic knees in the same patients (15).

Our results showed that Medial meniscus tear

was 4 times more common in males particularly at ages between 20-50 years old, while Lateral meniscal tear was 3 times more common in males.

Meniscal degeneration (28.96%) was more common in the medial meniscus (79%) than in the lateral meniscus (21%), Medial to lateral ratio is 3.8:1 with medial meniscal degeneration more common in females between 20-70 years old.

We found BME in (51.5%) of cases compared to (35-36%) in the published data (3, 15). BME was 2 times more common in males than females especially between the ages 20-40 years, the male to female ratio was 2.7:1 but with nearly equal frequencies in femur and tibia 1.1:1.

Joint fluid was more common in males between ages of 20-40 years, while above the age of 40 years it became equal in both sexes. It was the most common knee pathology (81.75%) in our study compared to (65%) in another study (3)

Collateral ligament tear (6.86%) was found nearly equally in the medial (47%) and lateral (53%) collateral ligaments with a ratio of 1: 1.1. This is different from the result of Sonin et al where medial collateral ligament tear was more common than lateral tear (20%), (7%), respectively (3). Both collateral ligament tear were more common in males than females with a ratio of 1.4:1.

We observed Osteoarthritic changes (13.51 %) slightly more frequently in males, with male to female ratio of 1.42:1 especially at the ages between 40-60 years. This was similar to the ratio in another published study (16), but discordant to another study for patients between 45-75 years, where the prevalence of knee osteoarthritis in men was (2.6%) compared to (4.9%) in women (17)

One of the limitations of our study my be the lack of following up the patients or reviewing their medical records to compare our MRI findings with their final diagnosis, as most of these patients continued their follow up in primary care centers after receiving their essential treatment. The novelty of our study is that it is the first study in the region addressing this issue in terms of number of case sas well as studying most of the common knee pathology detected by MRI compared to the published studies in the literature that concentrate on some of these abnormalities. Our results were discordant with the published literature, and this may be related to different age groups and to difference in life style and athletic activities which are not practiced on a wide basis in our community. We are hoping in the near future to elaborate more on this topic and to bypass the above mentioned limitations.

**Table (1):** Demography of our patients

| | **Male (%)** | **Female (%)** |
|---|---|---|
| Number | 316(68.7%) | 144(31.3%) |
| Mean age | 37.6 | 48.8 |
| Age range | 9-85 | 5-100 |
| Right knee | 157 | 69 |
| Left knee | 153 | 75 |
| bilateral | 6 | 0 |

**Table (2): Different knee pathologies regarding age and sex.**

| Age | Total number for age | Gender | | Female:male | Meniscal tear | | Meniscal degeneration | | Cruciate tear | | Collateral tear | | Bone marrow edema | | Joint fluid | Osteoarthrosis |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | medial | lateral | Medial | lateral | ACL | PCL | Medial | lateral | femur | tibia | | |
| < 20 | 21 | male | 17 | 1:42 | 4 | 1 | 2 | 0 | 7 | 1 | 2 | 0 | 4 | 4 | 14 | 0 |
| | | female | 4 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 20-30 | 142 | male | 119 | 1:5.1 | 45 | 17 | 14 | 3 | 64 | 5 | 1 | 5 | 32 | 31 | 92 | 5 |
| | | female | 23 | | 3 | 2 | 3 | 0 | 3 | 1 | 0 | 1 | 3 | 2 | 17 | 0 |
| 31-40 | 76 | male | 61 | 1:4 | 21 | 8 | 9 | 5 | 30 | 1 | 4 | 2 | 14 | 14 | 54 | 4 |
| | | female | 15 | | 2 | 0 | 6 | 0 | 4 | 0 | 0 | 0 | 3 | 1 | 12 | 0 |
| 41-50 | 82 | male | 52 | 1:1.7 | 20 | 4 | 11 | 5 | 24 | 3 | 0 | 2 | 16 | 13 | 39 | 6 |
| | | female | 30 | | 6 | 2 | 16 | 1 | 11 | 1 | 1 | 0 | 7 | 11 | 30 | 5 |
| 51-60 | 62 | male | 31 | 1:1 | 9 | 5 | 7 | 1 | 6 | 0 | 1 | 2 | 10 | 10 | 26 | 8 |
| | | female | 31 | | 3 | 4 | 15 | 6 | 12 | 0 | 0 | 0 | 8 | 3 | 30 | 8 |
| 61-70 | 54 | male | 21 | 1.57:1 | 7 | 1 | 9 | 3 | 10 | 1 | 2 | 3 | 8 | 6 | 21 | 5 |
| | | female | 33 | | 9 | 4 | 7 | 0 | 15 | 0 | 3 | 2 | 11 | 9 | 27 | 10 |
| 71-80 | 17 | male | 13 | 1:3.2 | 3 | 0 | 2 | 0 | 3 | 1 | 0 | 0 | 6 | 5 | 8 | 8 |
| | | female | 4 | | 2 | 0 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 4 | 2 |
| > 80 | 6 | male | 2 | 2:1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 2 | 0 | 2 | 1 |
| | | female | 4 | | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 2 | 3 | 4 | 1 |
| | Male | | | | 110 | 36 | 55 | 18 | 144 | 12 | 11 | 14 | 93 | 83 | 256 | 37 |
| | Females | | | | 26 | 12 | 52 | 10 | 47 | 2 | 4 | 13 | 35 | 29 | 125 | 26 |
| Total both genders | | | | | 136 | 48 | 107 | 28 | 191 | 14 | 15 | 17 | 128 | 112 | 381 | 63 |
| % | | | | | 29 | 10 | 23 | 6 | 41 | 3 | 3 | 3 | 27 | 24 | 81 | 13 |
| Female : male | | | | | 1: 4.2 | 1:3 | 1:1.05 | 1:1.8 | 1:3 | 1:6 | 1:2.75 | 1:4.6 | 1:2.65 | 1:2.86 | 1:2 | 1:1.42 |
| Ratio | | | | | Medial : lateral | | Meidal :lateral | | ACL:PCL | | Medial : lateral | | Femur:tibia | | - | - |
| | | | | | 2.8:1 | | 3.8:1 | | 13.6:1 | | 1:1.1 | | 1.1:1 | | - | - |
| % to the total knee MRI | | | | | 39.48 | | 28.96 | | 43.99 | | 6.86 | | 51.50 | | 81.75 | 13.51 |

ACL: anterior cruciate ligament
PCL: posterior cruciate ligament

**Table (3): Comparison between males and females knee pathologies**

| Gender | Meniscal tear | | | | Meniscal degeneration | | | | Cruciate tear | | | | Collateral tear | | | | Bone marrow edema | | | | Joint fluid | OA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Male 316 pt | M | L | T | M:L | M | L | T | M:L | ACL | PCL | T | ACL: PCL | M | L | T | M:L | F | Ti | F+Ti | F:Ti | | |
| (322 knees) | 110 | 36 | 146 | 3:1 | 55 | 18 | 73 | 3:1 | 144 | 12 | 156 | 12:1 | 11 | 14 | 25 | 1:1.2 | 93 | 83 | 176 | 1.1:1 | 256 | 37 |
| % | *34.16* | *11.18* | *45.34* | | *17* | *5.5* | *22.6* | | *44.7* | *3.7* | *48.4* | | *3.4* | *4.3* | *7.7* | | *28.8* | *25.7* | *54.6* | | *79.5* | *11.4* |
| Female 144 pt | 26 | 12 | 38 | 2.1:1 | 52 | 10 | 62 | 5:1 | 47 | 2 | 49 | 23.5:1 | 4 | 13 | 17 | 1:3.2 | 35 | 29 | 64 | 1.2:1. | 125 | 26 |
| % | 18 | 8.3 | 26.3 | | 36.1 | 6.9 | 43 | | 32.6 | 1.3 | 34 | | 2.7 | 9 | 11.8 | | 24.3 | 20 | 44.4 | | 86.8 | 18 |

M : medial
L : lateral
F : femur
T : Total
Ti : tibia
Pt : patient
ACL : anterior cruciate ligament
PCL : posterior cruciate ligament

## References


1. Patel NK, Bucknill A, Ahearne D, Denning J, Desai K, Watson M. Early magnetic resonance imaging in acute knee injury: a cost analysis. Knee Surg Sports Traumatol Arthrosc. 2012 [DOI 10.107/s00167-012-1926-5.
2. Williams et al, Grey's anatomy, thirty seventh editions, 1989.
3. Sonin AH, Fitzgerald SW, Hoff FL, Friedman H, Bresler ME. MR imaging of the posterior cruciate ligament: normal, abnormal and associated injury patterns. Radiographics 1995; 15: 551-561.
4. Fanelli GC. Posterior cruciate ligament injuries in trauma patients. Arthroscopy. 1993; 9(3):291-294.
5. Fanelli GC, Edson CJ. Posterior cruciate ligament injuries in trauma patients: part 2. Arthroscopic. 1995; 11(5):526-529.
6. Schulz MS, Russe K, Weiler A, Eichhorn HJ, Strobel MJ. Epidemiology of posterior cruciate ligament injuries. Arch Orthop Trauma Surg. 2003; 123(4):186-91.
7. Gille J, Kienast B, Voigt C, Oheim R, Schulz AP, Grosser V. Medical appraisal of anterior cruciate ligament ruptures.] Unfallchirurg. 2011. 10.1007/s00113-011-2079-6.
8. Bonci CM. Assessment and evaluation of predisposing factors to anterior cruciate ligament injury. J Athl Train. 1999; 34(2):155-164.
9. Dugan SA. Sports related knee injuries in female athletes; what gives? Am J Phys Med Rehabil. 2005; 84(2):122-30.
10. Remer EM, Fitzgerald SW, Friedman H, Rogers LF, Hendrix RW, Schafer MF. Anterior cruciate ligament injury: MR imaging diagnosis and patterns of injury. Radiographics. 1992; 12(5):901-15.
11. Sonin AH, Fitzgerald SW, Friedman H, Hoff FL, Hendrix RW, Rogers LF. Posterior cruciate ligament injury: MR imaging diagnosis and patterns of injury. Radiology. 1994; 190(2):455-8.
12. Burger et al. Acute ligamentous injury. The knee form, function, pathoplogy and treatment.philadelphia.pa. saunders 1993:513 – 598.
13. Mesgarzadeh M, Moyer R, Leder DS, et al. MR imaging of the knee: expanded classification and pitfalls to interpretation of meniscal tears. Radiographics. 1993; 13(3):489-500.
14. Zanetti M, et al, patients with suspected meniscal tears:prevalence of abnormalities seen on MRI of 100 symptomatic and 100 contralateral asymptomatic knees. AJR Am J Roentgenol 2003; 181(3):635-41.
15. Zanetti M, Pfirrmann CW, Schmid MR, Romero J, Seifert B, Hodler J. Patients with suspected meniscal tears: prevalence of abnormalities seen on MRI of 100 symptomatic and 100 contralateral asymptomatic knees. AJR Am J Roentgenol. 2003; 181(3):635-41.
16. Kopec JA, Rahman MM, Berthelot JM,et al. Descriptive epidemiology of osteoarthritis in British Columbia, Canada. J Rheumatol. 2007; 34(2):386-93.
17. Davis MA, Ettinger WH, Neuhaus JM, Hauck WW.Sex differences in osteoarthritis of the knee. The role of obesity. Am J Epidemiol. 1988; 127(5):1019-30.

# الرنين المغناطيسي للركبة: نتائج دراسة وصفيه وبائية في مستشفى الجامعة الأردنية

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الملخص

الهدف: تهدف الدراسة إلى مقارنة نتائج الرنين المغناطيسي للركبة عند المرضى المراجعين مستشفى تعليميا في الاردن مع النتائج العالمية بهدف معرفة ما إذا كانت هناك خصوصية لهؤلاء المرضى.

الطرق: شملت الدراسة 569 مريضاً أجري لهم الرنين المغنطيسي للركبة خلال عشر سنوات. تم استثناء نتائج 109 مرضى (66 ذكرا و43 انثى) وذلك لعدم وجود تغيرات في مفصل الركبة، وتم تحليل نتائج 460 مريضا من الجنسين.

النتائج: يظهر تحليل الصور وجود عدة تغيرات في مفصل الركبة عند هؤلاء المرضى، حيث كان اكثرها شيوعا تجمع السائل المفصلي الذي وجد عند 381 مريضا بنسبة 81,7% يليها تورم النخاع العظمي، حيث وجد في 240 مريضا بنسبة 51,5% وإصابة الرباط الصليبي الامامي بنسبة 39,96% ويعمر الغضروف الذي وجد في 138 مريضا بنسبة 28,967% ويعمر مفصل الركبة الذي كان الاقل شيوعا ووجد عند 63 مريضا بنسة 13,5%.

الخلاصة: خلصت الدراسة الى ان تنائج الرنين المغناطيسي عند مرضانا تماثل النتائج العالمية، باستثناء اصابات الرباط الصليبي الامامي، حيث اظهرت الدراسة أن نسبة إصابة الرباط الصليبي عند الرجال اكثر منها عند النساء، مع العلم أن النتائج العلمية تشير الى أن الإصابة اكثر عند النساء.

الكلمات الدالة: أمراض الركبة، الرنين المغناطيسي للركبة، الرباط الصليبي الأمامي، الرباط الصليبي الخلفي، تورم النخاع العظمي، المرابط الجانبية والغضروف.