ISSN - 2394-7721

American Journal of Oral Medicine and Radiology

Journal homepage: www.mcmed.us/journal/ajomr

MRI AND ARTHROSCOPIC CORRELATION IN INTERNAL DERANGEMENT OF KNEE JOINT

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Article Info

Received 23/10/2015
Revised 16/11/2015
Accepted 19/11/2015

Key words:- Knee joint, Trauma, Repetitious activities, Multiple imaging modalities, Internal derangement.

ABSTRACT

The knee joint is a common site of injury. Most cases are due to trauma, repetitious activities and due to sports. Multiple imaging modalities are currently used to evaluate pathologic conditions of the knee including conventional radiography, fluoroscopy, sonography, nuclear medicine and MR imaging. Magnetic resonance imaging has revolutionized our ability to understand the soft tissue anatomy and pathology of musculoskeletal system. Radiological evaluation of internal derangement of the knee joint using magnetic resonance imaging. To study the pattern of internal derangement in relation to mechanism of injury. To correlate MRI changes with that of arthroscopic findings in patients with internal derangement. This is a prospective study on the patients of sample size 50, clinically suspected of internal derangement of the knee joint referred to the department of Radio-diagnosis at Sree Siddhartha Medical College and Research Centre, Tumkur, November 2008 – April 2010 (period of 1½ year). The patient will be examined using a 0.25 T MRI unit (Siemens Magnetom concerto). Data regarding loose bodies, synovial plicae, hypertrophied synovium, chondromalacea, medial meniscus injuries, synovial cysts, ACL, PCL injuries, lateral meniscus injuries and patellar tilt, patellar subluxation collected.

INTRODUCTION

MRI has very useful for workup of knee joint pathology, particularly when internal derangement in cases of twisting injuries to the knee is suspected [1-4], which has clearly emerged as a primary tool in the evaluation of knee injuries and for the proper management [1-3]. The knee joint is a common site of injury. Most cases are due to trauma, most commonly seen in adults, repetitious activities and due to sports. Currently multiple images used to evaluate pathologic conditions of the knee including conventional radiography, fluoroscopy, sonography, nuclear medicine and MR imaging. The use of fluoroscopy and sonography to guide interventional procedures and Computerized Tomography (CT) to evaluate complex fractures has become routine [5].

Magnetic resonance imaging has revolutionized our ability to understand the soft tissue anatomy and pathology of musculoskeletal system. Increased soft tissue contrast coupled with multi planar slice capability has made magnetic resonance imaging ideal modality for imaging complex anatomy [4]. Another advanced modality in the management of internal derangement of knee joint is arthroscopy, which can be used in its dual mode, either as diagnostic or as therapeutic tool [6-7].

AIMS AND OBJECTIVES OF THE STUDY

1. Radiological evaluation of internal derangement of the knee joint using magnetic resonance imaging.
2. To study the pattern of internal derangement in relation to mechanism of injury.

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3. To correlate MRI changes with that of arthroscopic findings in patients with internal derangement.

MATERIALS AND METHODS

Source of Data

This is a prospective study on the patients, clinically suspected of internal derangement of the knee joint referred to the department of Radio-diagnosis at Sree Siddhartha Medical College and Research Centre, Tumkur.

Sample size - 50

Period of Study – November 2008 – April 2010 (period of 1½ year)

Method of Collection of Data

Relevant history followed by patient or patient's attender consent for magnetic resonance imaging will be taken.

The patient will be examined using a 0.25 T MRI unit (siemensmagnetom concerto) study has been done using various relevant sequence.

Images were studied for meniscal, cruciate ligament, collateral ligaments tear, fluid collections in and around the joint and also for any signal changes in the surrounding bones, muscles and tendons. Then these cases were subjected to arthroscopy.

Method of Data Analysis

Collected data was presented in the form of tables and diagrams. Sensitivity, specificity and predictive values were calculated. Using data was analysed for finding the significant correlation between MRI knee and arthroscopic findings by kappa statistics.

Interpretation of sensitivity:

0.9 – 1	Excellent
0.8-0.9	Very Good
0.7 – 0.8	Good
0.6 -0.7	Average
< 0.6	Poor

Interpretation of Kappa Statistics:

< 0.20	Poor agreement
0.21 – 0.4	Fair agreement
0.4 – 0.6	Moderate
0.61 – 0.8	Good
0.81 – 1.0	Very good

Interpretation of 'P' value:

P < 0.05 - Significant
P < 0.01 - Highly significant
P> 0.05 - Not significant

Inclusion Criteria

- The study will include 50 patients, clinically suspected of internal derangement of the knee joint.
- Acute traumatic internal derangement of knee joint.

Exclusion Criteria:

- Age related degenerative arthrosis of knee joint.
- Any absolute contraindication for MRI

Imaging Protocol

Specific imaging techniques can increase the sensitivity and specificity for particular knee disorders, so a short relevant clinical history greatly helps to optimize the protocol for maximum diagnostic information protocols:

Equipment: The patient will be examined using a 0.25 T MRI unit (siemensmagnetom concerto)

Pulse Sequences and Imaging Planes

T1 & PD weighted sequences in sagittal and coronal planes.

T2- weighted in axial, coronal and sagittal planes.

Fat suppressed T2 or STIR sequences wherever indicated.

We used SE, fast sequences such as GRE, FSE OR STIR sequences as required. The three standard imaging planes used are the direct coronal, sagittal and axial views. We examined the knee in these three planes using a FOV of 16X16 cm, 256 X 256 matrix, & 3 mm slice thickness.

An axial acquisition through patellofemoral joint is used as initial localizer for subsequent sagittal and coronal plane images. The coronal plane optimally evaluates the collateral ligament and body of the menisci. The sagittal plane reveals the cruciate ligaments, menisci and synovial anatomy especially the suprapatellar pouch. Overall the bones, muscles, tendons and neurovascular structuresare fully evaluated with integration of all three planes.

Positioning and Coil Selection

Patient is placed in supine position with the knee in a closely coupled extremity coil. The knee is externally rotated 15-20°, in order to facilitate the visualization of ACL completely on sagittal images [9]. The knee is flexed slightly 5-10°, to increase the accuracy of assessing the patellofemoral compartment and patellar alignment [10].

Excessive flexion or hyperextension does not permit accurate evaluation of patellar alignment. The MRI was performed within a time period of 6 days to 30 days from the date of injury. The time lag between MRI and arthroscopy was 1 day to 30 days with an average of 7 days.

The time varied according to the convenience of the patient, the surgeon and the availability of the operating room. All observations were made from the film hard copy images and from the monitor. The images were reviewed for the presence or absence of meniscal tears and evaluated for ACL or PCL tears. The criterion that was used for determining the presence of a meniscal tear was

the presence of a high signal that extended to one of the articular borders of the meniscus {Grade 3}.

The diagnostic criteria for ACL and PCL tears were the presence of any of the primary signs as mentioned earlier. Arthroscopy was performed through anteromedial and anterolateral portals to look for suprapatellar pouch, medial gutter, medial joint space, intra condylar space, later joint space, later gutter and patellofemoral space. Data regarding loose bodies, synovial plicae, hypertrophied synovium, chondromalacea, medial meniscus injuries, synovial cysts, ACL, PCL injuries, lateral meniscus injuries and patellar tilt, patellar subluxation collected.

OBSERVATIONS AND RESULTS

Table 1. Age distribution of the patients

Age(yrs.)	Frequency	%
11-20	8	16
21-30	18	36
31-40	16	32
41-50	6	12
51-60	2	4
Total	50	100

21-40 age group comprises the maximum number of patients which suffered knee injuries.i.e.36% of the patients are in this group followed by 32%,16%,12% and 4% in the age group of 31-40,11-20,41-50 and 51-60 respectively.

Table 2. Sex distribution of the patients

Age(yrs.)	Frequency	%
Male	35	70
Female	15	30

Male patients are more in number compared to females. This suffered knee injuries

Table 3. Internal derangement observation based on MRI

Internal derangement observation	Number of Cases	Percentage
Anterior Cruciate Ligament	32	64%
Posterior Cruciate Ligament	4	8%
Medial Meniscus	17	34%
Lateral Meniscus	10	20%
Medial Collateral Ligament	5	10%
Lateral Collateral Ligament	4	8%
Bony Contusion	10	20%
Joint Effusion	38	76%

Total positive cases detected on MRI compared with true positive cases on arthroscopy.

Table 4. Anterior Cruciate Ligament (ACL Tears)

MRI	Arthroscopy		
	Positive	Negative	Total
Positive	32	5	37
Negative	0	13	13
Total	32	18	50

Sensitivity - 100%, Specificity–94.74%, Positive predictive value–85.71%, Negative predictive value – 100%. Kappa - 0.89 – Very good, P < 0.001, H.S Sensitivity and Specificity of MRI with respect to Arthroscopy is 100% and 94.74 % and is excellent in diagnosing ACL tears.

Table 5. Posterior Cruciate Ligament (PCL tears)

MRI	Arthroscopy		
	Positive	Negative	Total
Positive	4	0	4
Negative	0	46	46
Total	4	46	50

Sensitivity-100%, Specificity - 100%.Positive predictive value – 100%, Negative predictive value – 100%. Kappa-1.00-Very good, P <0.001, H.S

Both sensitivity and specificity of MRI in relation to Arthroscopy is 100% shows excellent correlation.

Table 6. Medial Meniscus injuries

MRI	Arthroscopy		
	Positive	Negative	Total
Positive	17	4	21
Negative	0	29	29
Total	17	33	50

Sensitivity – 100%, Specificity – 92.11%, Positive predictive value – 80%, Negative predictive value – 100%,Kappa - 0.85 - Very good, P < 0.001 , H.S

Sensitivity and Specificity of MRI with respect to Arthroscopy is 100% and 92.11% and is excellent in detecting medial meniscus injury. MRI detected more number of cases compared to Arthroscopy since grade I and grade II injuries may not be picked up by arthroscopy.

Table 7. Lateral Meniscus injuries

MRI	Arthroscopy		
	Positive	Negative	Total
Positive	10	0	10
Negative	2	38	40
Total	12	38	50

Sensitivity-100%, Specificity – 95.23%, Positive value – 80%, Negative value - 100%, Kappa - 0.87 – Very good, P < 0.001, H.S

Sensitivity and Specificity of MRI compared to Arthroscopy is 100% and 95.23% and is excellent in detecting lateral meniscus injury. MRI detected more number of cases compared to Arthroscopy since grade I and grade II injuries may not be picked up by arthroscopy.

DISCUSSION

This is a prospective study involving 50 patients with history of knee injuries who had undergone MRI in department of Radio diagnosis, Sree Siddhartha Medical College Hospital with0.25 T MRI unit (Siemens magnetom concerto). Then these patients underwent diagnostic and therapeutic arthroscopy.

MRI images are studied for evidence of injuries to menisci, cruciate ligaments, collateral ligaments, articular cartilage, loose bodies, meniscal cysts and bony contusions, evidence of soft tissue injuries around the knee joint. Arthroscopy was done to look for injuries to menisci, cruciate ligaments collateral ligaments, articular cartilage, loose bodies and meniscal cyst

A Study done by Fritz et al [8] showed males are most likely to suffer knee injuries since they are active in sports and right knee injuries are more common than left.

In the present study males comprise the predominant number of patients who suffered knee injuries who are active in sports like football. Young patients of age group 21-40yrs are the maximum who suffered knee injuries.

Out of 50 patient knee injuries, right knee is involved in 35 cases and left is involved in 15 cases. Right knee is involved more compared to left.

Cruciate ligament lesions:

Among the structure involved in knee injuries. ACL injury is the most common accounts for 32 cases in MRI with percentage of 64% arthroscopy detected 27 cases. Sensitivity and Specificity of MRI with respect to Arthroscopy is 100% and 94.74% and is excellent in diagnosing ACL tears.

Positive predictive value of MRI is 87.5%. Negative predictive value of MRI is 100%.

Out of 50 cases MRI detected 4 PCL injuries and arthroscopy detected 4 cases. Sensitivity and specificity of MRI in relation to Arthroscopy is 100% with positive and negative predictive value 100% and shows excellent correlation in detecting PCL injuries. PCL injuries are most commonly associated with chip fractures near the tibia attachment.

In tears of the anterior cruciate ligament, the sensitivity, specificity and accuracy was found to be 100, 95% and 87%, which were corresponding to Fischer et al study [9-11].

MRI is accurate in identification of ACL tears, ranging from 93% to 97%. The sensitivity and specificity in various studies have shown to range between 61% and 100%, and 82% and 97% respectively [12].

In our study the positive predictive value and negative predictive value was 92.8 and 100 respectively. The positive predictive value and negative predictive value range frSom 70% to 76% and 70% to 100% respectively. The results of two large studies [5-6] showed that MR imaging has relatively low sensitivity (40%-75%) but moderate to high specificity (62%-94%) in diagnosis of partial tears. T_2 weighted images showed clearly the signal intensity changes seen with these tears as excellent contrast is provided by normal low signal intensity of ligaments Mink et al [9]. 2 cases of PCL tears were detected both by MRI and Arthroscopy. The use of MRI to identify PCL tears has proven to be extremely accurate. This might be expected in light of the fact that the PCL is usually very easily visualized as a homogenous,

continuous low-signal structure. Several studies have reported sensitivity, specificity, accuracy, positive predictive value and negative predictive value to be 99-100% [11]. In our study too the sensitivity, specificity, accuracy, positive predictive value and negative predictive value was 100%.

Meniscal Injuries

Medial meniscus injury is the second most common type of injury comprising 17 cases (34%). MRI detected 17 cases of medial meniscus injury, arthroscopy detected only 13 cases. Sensitivity and specificity of MRI with respect to Arthroscopy is 100% and 92.11%. MRI is excellent in diagnosing medial meniscal injury [12]. In our study the sensitivity, specificity and accuracy for detecting medial meniscal tears was corresponding to the Fischer et al [13]. A study by Elvenes et al [14] showed accuracy rate of 90% for MRI in the detection of Meniscal tears compared with the arthroscopy and found the sensitivity, specificity, positive and negative predictive value of MRI for medial meniscus tears were 100%, 77%, 71% & 100%. In present study sensitivity, specificity, positive and negative predictive value are 100%, 92.11%, 80% and 100% and correlated with the findings of Elvenes et al[14].

In our study MRI detected 10 cases of lateral meniscal injury and arthroscopy positive cases are 8 out of 50 cases. Sensitivity and specificity of MRI in relation to Arthroscopy is 100% and 95.23%. MRI is excellent in detecting lateral meniscus injuries.Positive predictive value of MRI in detecting lateral meniscus injuries is 80% with negative predictive value of 100%. Silva and Silver [15] have studied the probability of a tear being identified at arthroscopy for each grade MRI signal. The probability of tear with grade I signal is about 5%, grade II 17-20% and grade III 80%-95%. The occurrence of the false positive meniscal tears at MRI imaging has been noted earlier. There are explanations for this apparent discrepancy between findings at MR Imaging and arthroscopy Mink J H et al [16].

- Misinterpretation of normal anatomy like Meniscofemoral ligaments etc.
- The presence of intrasubstance tears, which are not seen on arthroscopy
- The operator dependence of Arthroscopy
- The presence of loose bodies.

Sensitivity of MRI is more compared to arthroscopy because grade I and grade II tears unlike grade III tears may not be detected by arthroscopy. So MRI is more useful for detection of grade I and grade II injuries. So MRI is more sensitive in detection of meniscal injuries.

Articular cartilage injuries

Sensitivity of MRI can be increased by using newer sequences dedicated to articular cartilage imaging. Unlike arthroscopy MRI was able to detect bony contusions, fluid collection in and around the knee joint, soft tissue injuries and collateral ligament injuries. MRI in spite of detecting meniscal, cruciate ligament and collateral ligament injuries can detect bone and soft tissue injuries around the knee joint.

Mechanism of Injuries

The ligaments are often injured in athletic activities especially in footballplayers. The mechanism of adduction, flexion and external rotation of the femur on the tibia produces injury on the lateral aspect of the knee – tibia collateral ligaments, capsular ligaments, acute ligaments, cruciate ligaments and lateral ligaments may be injured by this mechanism.

CONCLUSION

MRI is an excellent, noninvasive, radiation free imaging modality with multilane capabilities and excellent soft tissue delineation. It can accurately detect, localize and characterize various internal derangements of the knee joint and help in arriving at a correct anatomical diagnosis thereby guiding further management of the patient. Knee joint injuries are common. The need to accurately evaluate the knee injuries is very crucial for the proper management and outcome; otherwise it will lead to chronic debility to the patient. Both MRI and arthroscopy have their limitations. These shortcomings might be overcome by combining both modalities when clinically indicated. MRI should be the initial investigation of choice in the evaluation of all cases of knee joint injuries. Because it can detect both intra and extra articular pathologies and also osseous structures. Based on the findings of MRI it acts as road map for arthroscopy. Later arthroscopy will be done as a diagnostic and also as therapeutic procedure.

ACKNOWLEDGEMENT: None

CONFLICT OF INTEREST:

The authors declare that they have no conflict of interest.

STATEMENT OF HUMAN AND ANIMAL RIGHTS

All procedures performed in human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

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