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# CORRELATION OF CLINICAL, MRI AND ARTHROSCOPIC FINDINGS IN INTERNAL DERANGEMENTS OF KNEE – A CROSS- SECTIONAL STUDY IN A TERTIARY CARE HOSPITAL, RAJAHMUNDY, ANDHRA PRADESH, INDIA

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### Abstract

**Background:** Knee joint is the most frequently injured joint as it is more superficial and susceptible. Previously, clinical examination was the sole method used to diagnose various knee disorders. Later, MRI and Arthroscopy were introduced and suggested by many surgeons.

**Aims and Objectives:** This study was conducted to analyze the correlation between all three methods in the diagnosis of internal derangement of the knee in a tertiary care centre.

**Methodology:** A hospital based cross-sectional study conducted at a tertiary care centre in Rajahmundry, India, between January 2017 to December 2017 among 124 patients aged 18-60 years and with internal derangement of the knee.

**Results:** Among 124 patients, 111 (89.52%) were males and 13 (10.48%) females. Right side 84 (67.74%) was affected more than the left side 40 (32.26%). Mean age of the patients was 31 years with maximum number of them within 20-40 years. The most common mode of injury was road traffic accident followed by sports injuries. Clinically, ACL was the structure most commonly involved followed by medial meniscus, lateral meniscus, PCL, medial collateral ligament and lateral collateral ligament. MRI also revealed similar hierarchy in the involvement of structures, while arthroscopy showed that medial meniscus was most commonly involved followed by lateral

meniscus, ACL, PCL, medial collateral ligament and lateral collateral ligament. With respect to correlation between procedures, medial meniscus, lateral meniscus, anterior cruciate ligament, posterior cruciate ligament and lateral collateral ligament injuries could be detected better by combined MRI and Arthroscopy, with Spearman's rho being 0.671, 0.499, 0.477, 0.385 and 0.383 respectively and significant 'P' value (0.000). However, medial collateral ligament injuries could be detected better by combined clinical examination and MRI (Spearman's rho 0.352 and 'P' 0.000).

**Conclusion:** The sensitivity and specificity of MRI with Arthroscopy were higher for the diagnosis of internal derangements of knee, in comparison to the sensitivity and specificity of Clinical examination with Arthroscopy. However, Clinical examination is still dependable whenever possible.

**Keywords:** Correlation, Clinical, MRI and Arthroscopy internal derangements of knee, India

## Introduction

Either as an isolated injury or as a component of multiple trauma injury, knee joint is the most frequently injured joint as it is more superficial and susceptible because of its anatomical structure, its exposure to external forces and the functional demands placed on it.<sup>1</sup> The knee is a complex joint, consisting of two condylar joints between the corresponding condyles of femur and tibia and a stellar joint between the patella and femur.<sup>2</sup> The principal intra-articular structures in knee are the two menisci, the two cruciate ligaments, and the two collateral ligaments. The menisci serve to distribute joint fluid, provides cartilage nutrition, mechanical shock absorption, increasing the surface area of the joint and therefore the stresses, serve to stabilize the joint, and support weight bearing function. The cruciate ligaments function as stabilizers of the knee in both forward and backward motions of the tibia on the femur and provide an axis around which both medial and lateral rotatory movements are assisted.<sup>3</sup> The injury to these intraarticular structures is generally termed as "Internal derangement of knee" which was first coined by William Hey in 1784.<sup>4</sup>

Previously, clinical examination was the sole method used to diagnose various knee disorders in the late 1960's and early 1970's. A new procedure "Arthroscopy" was later introduced and suggested by many surgeons through numerous studies.<sup>5</sup> Arthroscopy of the knee is a key hole surgery performed as a daycare procedure. Being an invasive procedure, it is associated with some disadvantages such as intra-articular damage to surface, hemarthrosis, thrombophlebitis, infection, tourniquet paresis.<sup>6</sup> However, the advantages

of arthroscopy far outweigh the disadvantages. The advantages include smaller incisions, reduced post operative morbidity (where patient can return to work in 1-2 weeks after most arthroscopic procedures) and less intense inflammatory response than standard arthrotomy.<sup>7</sup>

Magnetic resonance imaging (MRI) was developed in late 1980's. Many studies have proved that the diagnosis of internal derangements of knee with MRI is far simpler, because it has several advantages compared to arthroscopy, including it's noninvasive technique, minimal risk if any, minimal patient discomfort and easy visualization of posterior cruciate ligament on MRI.

Studies have reported an almost 70% accuracy in diagnosing the knee joint pathology using a detailed clinical examination along with the numerous stability tests.<sup>8,9,10</sup> However, it would be difficult to perform clinical tests in the acute stage following injury, as it might cause more pain. Hence, MRI becomes the preferred modality of investigation in such cases, as it is non invasive, and considered to be highly sensitive to meniscal injuries,<sup>11,12,13</sup> but is less so for the Anterior cruciate ligament injuries. In case of ACL tears, MRI often is not helpful in differentiating partial from complete tears. In case of medial collateral ligament injury, mild degrees of injury correlate well; imaging is less accurate in grading more severe injuries.<sup>14</sup>

A number of studies have analyzed the correlation between two out of the three diagnostic tools (clinical examination, MRI scan, and arthroscopy), in internal derangement of the knee. Hence, this study was conducted to analyze the correlation between all three methods in the diagnosis of internal derangement of

the knee in a tertiary care centre.

## Aims And Objectives

1. To establish the diagnosis of internal derangements of knee by clinical examination, MRI and arthroscopy (gold standard).
2. To correlate the diagnostic findings of clinical examination, MRI and arthroscopy.

## Material And Methods

This is a hospital based cross-sectional study conducted at a tertiary care centre in Rajahmundry, India. The study was conducted between January 2017 to December 2017 among 124 patients with internal derangement of the knee. The study was carried out in the Orthopaedics department of the hospital.

**Inclusion criteria:** All the patients aged 18-60 years presenting to the OPD of Department of Orthopaedics with history of trauma involving the knee and those who were scheduled to undergo arthroscopic surgery of the knee following clinical and MRI findings were included in the study.

**Exclusion criteria:** Patients undergoing knee joint arthroscopy without MRI, those with primary traumatic haemarthrosis of the knee, patients having fractures around the knee joint, active infection in the knee joint and those with degenerative changes in the knee were excluded from the study. Patients with contraindication to MRI like intracerebral aneurysmal clips, cardiac pacemaker, metallic foreign body in eye, implants in middle ear, patients who had recent knee injury but who on clinical examination had no instability in any plane and negative McMurray test and patients who had prior arthroscopy or surgical intervention to knee joint were also excluded from the

study.

**Sample size and sampling:** A total of 141 patients presented to the OPD of the department of Orthopaedics during Jan 2017 to Dec. 2017, of which 124 patients who fulfilled the inclusion criteria and consented for the study were included in the study.

**Procedure:** All the study participants were explained about the study in their local language in understandable manner and were free to withdraw from the study anytime at their voluntary will. The confidentiality of the study was assured. A written informed consent was taken from the participant or their guardian, prior to the study. Following thorough history, all the participants were subjected to thorough clinical examination, MRI and arthroscopy of the injured knee joint. Clinical examination included anterior drawers test, posterior drawers test, pivot shift test and Lachman test for ACL and PCL disruption, McMurray's test and Apley grinding test for meniscal injuries. In case of collateral ligament injury varus or valgus stress test were done to evaluate it. Duration post injury ranged from 4 weeks to 6 months. Each MRI was performed using the MR protocol of 1.5 Tesla on PHILIPS GYROSCAN ACHIEVA. T1 & T2 weighted sequences were done on coronal, sagittal and axial planes of the knee. All the sections were 3mm thick. MRI images were reported on an objective proforma by a single senior consultant radiologist, who was blinded to the clinical findings. The status of menisci, cruciate and collateral ligaments, cartilage and subchondral bone were registered.

This was followed by diagnostic arthroscopy of the knee joint. Arthroscopy was performed in an Operation Theatre under regional

or general anaesthesia with patient in supine position with lateral post around proximal thigh. Proximal thigh tourniquet were used in each case. The operating surgeon was not told about the MRI findings. All the patient were under antibiotic cover. To classify the location of meniscal tear arthroscopically each meniscus was divided into three equal segments:

1. The anterior 1/3 or anterior horn
2. The middle 1/3 or body
3. Posterior 1/3 or posterior horn

The collateral ligaments, ACL and PCL were classified as partial disruption or complete ligament injury.

Following the diagnostic arthroscopy, definitive surgeries were performed depending on the findings and the consent given by the patients.

**Statistical Analysis:** The collected data was entered in Microsoft excel, double checked for errors and analyzed using epi – info software. Results were expressed as percentages, mean and standard deviation for continuous variables. Chi square test was used to compare categorical variables. A P-value of <0.05 is considered statistically significant and 0.000 is very highly statistically significant. Spearman's rank correlation was used to analyze the correlation between procedures. Sensitivity, specificity, positive predictive value and negative predictive value was calculated and compared. The composite data was tabulated and studied for correlation with clinical examination and MRI findings and grouped into four categories as follows:

1. **True-Positive** - If the MRI diagnosis or clinical diagnosis was confirmed by arthroscopic evaluation.
2. **True-Negative** - When the MRI and clinical examination were negative for injury and confirmed

by Arthroscopy.

3. **False-Positive** - When the MRI or clinical examination shows injury, but the Arthroscopy was negative.
4. **False-Negative** - Result when Arthroscopy was positive, but the MRI or clinical examination showed negative findings.
5. **Sensitivity**  $(\text{True-positives} \times 100 / [\text{True-positives} + \text{false-negatives}])$ ,
6. **Specificity**  $(\text{True-negatives} \times 100 / [\text{True-negatives} + \text{false-positives}])$ ,
7. **Positive predictive value**  $(\text{True-positives} \times 100 / [\text{True-positive} + \text{false-positives}])$ ,
8. **Negative predictive value**  $(\text{True-negatives} \times 100 / [\text{True-negatives} + \text{False-negatives}])$  were calculated from the data.

Ethical clearance was obtained from the institutional ethics committee.

## Results

Study included a total of 124 patients, of which 111 (89.52%) were males and 13 (10.48%) females. Right side 84 (67.74%) was affected more than the left side 40 (32.26%), similar to the findings of Clayton et al<sup>15</sup> on the epidemiology of musculoskeletal tendinous and ligamentous injuries. Mean age of the patients was 31 years with maximum number of them within 20-40 years. The most common mode of injury was road traffic accident followed by sports injuries. Clinically, ACL was the structure most commonly involved followed by medial meniscus, lateral meniscus, PCL, medial collateral ligament and lateral collateral ligament. MRI also revealed similar hierarchy in the involvement of structures, while arthroscopy showed that medial meniscus was most commonly involved followed by lateral meniscus, ACL, PCL, medial collateral ligament and lateral collateral ligament. (Table 1)

**Table 1 Number of patients showing knee structure injuries Clinically, by MRI and Arthroscopy**

Knee structure injured	Clinically No. (%)	MRI No. (%)	Arthroscopy No. (%)
Medial meniscus	72 (58.1)	70 (56.5)	74 (59.7)
Lateral meniscus	66 (53.2)	65 (52.4)	70 (56.5)
Anterior cruciate ligament	73 (58.9)	72 (58.1)	68 (54.8)
Posterior cruciate ligament	56 (45.2)	48 (38.7)	63 (50.8)
Medial collateral ligament	33 (26.6)	35 (28.2)	37 (29.8)
Lateral collateral ligament	23 (18.5)	17 (13.7)	21 (16.9)

Sensitivity and Specificity of clinical examination and MRI for internal derangement of knee were assessed in relation to arthroscopy, which is considered the gold standard for the diagnosis of these injuries. For the diagnosis of injuries to any of the six structures (Medial meniscus, Lateral meniscus, ACL, PCL, Medial collateral ligament and Lateral collateral ligament), the sensitivity and specificity were higher for MRI with arthroscopy compared to clinical examination with arthroscopy. (Table 2)

**Table 2 Sensitivity and specificity of clinical examination and MRI with Arthroscopy**

Knee structure injured	Clinical examination with Arthroscopy		MRI with Arthroscopy	
	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)
Medial meniscus	62	48	83	84
Lateral meniscus	58	54	74	76
Anterior cruciate ligament	64	49	79	68
Posterior cruciate ligament	47	58	57	81
Medial collateral ligament	35	77	49	81
Lateral collateral ligament	33	85	43	93

With respect to correlation between procedures, medial meniscus, lateral meniscus, anterior cruciate ligament, posterior cruciate ligament and lateral collateral ligament injuries could be detected better by combined MRI and Arthroscopy, with Spearman's rho being 0.671, 0.499, 0.477, 0.385 and 0.383 respectively and significant 'P' value (0.000). However, medial collateral ligament injuries could be detected better by combined clinical examination and MRI (Spearman's rho 0.352 and 'P' 0.000). (Table 3)

**Table 3 Correlation between procedures for diagnosis of internal derangement of knee**

	Clinical examination and MRI		Clinical examination and Arthroscopy		MRI and Arthroscopy	
	Spearman's rho	P value	Spearman's rho	P value	Spearman's rho	P value
Medial meniscus	0.275	0.002	0.101	0.26	0.671	0.000
Lateral meniscus	0.143	0.11	0.122	0.17	0.499	0.000
Anterior cruciate ligament	0.186	0.03	0.131	0.14	0.477	0.000
Posterior cruciate ligament	0.077	0.39	0.050	0.58	0.385	0.000
Medial collateral ligament	0.352	0.000	0.126	0.16	0.296	0.001
Lateral collateral ligament	-0.009	0.919	0.172	0.05	0.383	0.000

## Discussion

Although clinical examination is the first possible modality in diagnosing injuries of the knee joint, the pain and swelling around the joint does not permit correct examination. MRI of the knee joint being a non-invasive investigation can be routinely used for

internal derangement of the knee joint. But, observer bias and the power of the machine play a major role in the final diagnosis given out.<sup>16</sup> Arthroscopic examination of the knee is considered as the gold standard for the diagnosis of internal derangements of knee. In our study the sensitivity of MRI

and arthroscopy for medial meniscal injuries was 83% and specificity 84% comparable to the findings of Mahibul Islam et. al<sup>17</sup>, reporting a sensitivity of 83.33 per cent and a specificity of 81.58 per cent for medial meniscus. For injuries of lateral meniscus, MRI and arthroscopy showed a sensitivity

of 74% and a specificity of 76% in our study consistent with a sensitivity of 73.33 and specificity of 82.99 per cent as reported by Mahibul Islam et. al<sup>17</sup>. Our study reported a sensitivity of 79% and specificity of 68% for ACL injuries while it was 57% and

81% respectively for PCL injuries, which is quite different compared to the findings of Mahibul Islam et. al<sup>17</sup>, reporting a sensitivity of 92.7 percent and specificity of 85.71 percent for the anterior cruciate ligament and sensitivity of 100% and specificity

of 100% for the posterior cruciate ligament.

The results of the present study are quite different compared to the results reported by RB Uppin et al<sup>18</sup> (Table 4)

**Table 4 Sensitivity and specificity of clinical examination and MRI with Arthroscopy (RB Uppin et al<sup>18</sup>)**

Knee structure injured	Clinical examination with Arthroscopy		MRI with Arthroscopy	
	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)
Medial meniscus	82	78	70	78
Lateral meniscus	67	70	72	70
Anterior cruciate ligament	100	95	100	90

Various studies have reported varied sensitivity and specificity of MRI and Clinical examination with Arthroscopy for diagnosis of internal knee injuries. The sensitivity of MRI with Arthroscopy is comparable to other studies for injuries of medial

meniscus and ACL injuries, while it is higher for lateral meniscus injuries, in comparison to other studies. The sensitivity of clinical examination with Arthroscopy is comparable to other studies for injuries of medial meniscus and lateral meniscus while it is quite

low for ACL injuries (Table 5). The results in the present study reflect the probable difficulty encountered with clinical examination of knee injuries in acute presentation due to associated pain and swelling.

**Table 5 Sensitivity of MRI and Clinical examination with Arthroscopy for diagnosis of Knee injuries as reported by various studies**

Authors (Year of publication)	MRI with Arthroscopy			Clinical examination with Arthroscopy		
	Medial meniscus	Lateral meniscus	ACL	Medial meniscus	Lateral meniscus	ACL
Dutka et al (19)	88	44	80	65	38	86
Rayan et al.(20)	76	61	81	86	56	96
Navali et al (21)	84	56	99	95	71	83
Nikolaou et al (22)	83	62	83	65	30	89
Present Study	83	74	79	62	58	64

The specificity of MRI with Arthroscopy is comparable to other studies for injuries of medial and lateral meniscus while it is quite low for ACL injuries. The specificity

of clinical with Arthroscopy is comparable to other studies for injuries of medial meniscus while it is quite low for lateral meniscus and ACL injuries.(Table 6). The results in

the present study reflect the probable difficulty encountered with clinical examination of knee injuries in acute presentation due to associated pain and swelling.

**Table 6 Specificity of MRI and Clinical examination with Arthroscopy for diagnosis of Knee injuries as reported by various studies**

Authors	MRI with Arthroscopy			Clinical examination with Arthroscopy		
	Medial meniscus	Lateral meniscus	ACL	Medial meniscus	Lateral meniscus	ACL
Dutka et al (19)	64	93	86	87	100	90
Rayan et al.(20)	52	92	96	73	95	100
Navali et al (21)	71	93	83	76	89	92
Nikolaou et al (22)	69	88	89	50	75	77
Present Study	84	76	68	48	54	49



## Conclusions

The sensitivity and specificity of MRI with Arthroscopy were higher for the diagnosis of internal derangements of knee, in comparison to the sensitivity and specificity of Clinical examination with Arthroscopy. Hence, MRI has emerged as the most dependable non-invasive tool to diagnose injuries around the knee joint, especially in acute presentation. However, Clinical examination is still dependable whenever possible, as the first modality for the diagnosis of internal derangements of knee, especially in settings with minimal possible access to MRI in acute situations.

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