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To examine the reliability and validity of diagnosing a knee injury using magnetic resonance imaging

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Abstract

Introduction: Following the routine use of MRI as a screening test after the clinical diagnosis for knee injuries such as meniscal or ligament injury has a potential detrimental effect on the affected patients particularly in developing countries. The major objective of this study is to assess the reliability and validity in diagnosing a knee injury with the help of magnetic resonance imaging technology.

Materials and Methodology: This study series comprised of 68 patients that included 50 men and 18 women. After obtaining the ethical clearance from the institutional ethical committee, the study was commenced on the patients attending the Department of Orthopaedics in our hospital. MRI scanning of all knees was done before doing diagnostic arthroscopy. Information about the patients were swiftly collected through interviews and filled in the structured questionnaires that were issued to the study participants; physical examination, MRI scanning and arthroscopic findings were also recorded.

Results: Among all the participants, there were male predilection in the group with 73.5% (n=50). And the median age was observed to be around 39 years with the range between 29 – 44 years. Female with knee injuries were observed to be in age range of 36 – 46 years. This difference was observed to be statistically significant. The contingency table of sensitivity and specificity of 68 patients with various knee injuries. Total number of patients with positive MRI findings 83% have an ACL lesion diagnosed by arthroscopy as well. The result obtained refers to the sample comprising 68 patients and must not be generalised but it can serve as a good orientation tool.

Conclusion: MRI is a non-invasive screening modality; it provides detailed insight and is an essential tool in decision-making before planning for any therapeutic intervention.

Keywords: MRI, accuracy, reliability, ACL, meniscal injury

Introduction

Based on the anatomy of the knee joint, it has a complex structure because of which it is more susceptible to various types of injuries like fracture, dislocation and tear in the ligaments, tendons and cartilage. Owing of its nature, it is considered to be more vulnerability to external forces as well as the functional demands that has been imposed on it hence the knee joint is one of the most commonly injured joints in the human body ^[1]. Additionally, due to its anatomical localization and function, it is of great importance to working ability such as performing daily tasks, recreational and professional sports by an individual. Any observable damage to tissues such as menisci, ligaments or hyaline cartilage can be directed to irreversible osteoarthritic changes of the joint ^[2]. Therefore, rapid and accurate diagnosis of intra-articular lesions is highly recommended in selecting adequate treatment, and they served as of great importance ^[3].

When comparing with the earlier times where the technology was not so developed, we had limited resources to diagnose and treat cases related with a knee injury and it was solely done based on the clinical examination and x-rays. Clinical examinations are basically used to diagnose knee injuries, with few of them have become standard clinical tests for particular injuries a long term before ^[4]. With the advancement in radiological advancements such as MRI and CT scans, the clinicians can look more clearly and deeply inside the joint. Moreover, MRI provides the advantage of being a fast, non-invasive, diagnostic tool for examining the ligament and menisci injuries. Therefore, it minimizes the agony and morbidity usually faced by the patients in routine clinical examination, along with the ease in the management with better planning and optimal intervention.

MRI provides a better understanding in identifying the ligament, menisci, synovial injury. MRI diagnosed almost all the ligamentous and meniscus injuries with a great level of confidence and accuracy. [5] Hence, it is routinely used after the clinical assessment of patients, a trend that shows the potential risk of lowering the complications that doctors need to put on clinical examinations of such patients [6, 7]. Unfortunately MRI is scarcely available in developing countries like India and even if available it is quite expensive. This might help in preventing early and timely treatment of many patients. This might cause delays in providing prompt and timely treatments. Hence the objective of this study is to assess the reliability and validity in diagnosing a knee injury with the help of magnetic resonance imaging technology.

Materials and Methodology

This study series comprised of 68 patients that included 50 men and 18 women. After obtaining the ethical clearance from the institutional ethical committee, the study was commenced on the patients attending the Department of Orthopaedics in our hospital.

The major inclusion criteria that were followed throughout the course of the study included those patients who had given their consent by duly signing in the consent forms provided, those of 18 years and above, patients with the history of knee symptoms and clinically diagnosed to have menisci tear and or ACL tear, those patients who were suitable for undergoing MRI procedure and clinically fit for any arthroscopic procedure. The exclusion criteria included those patients with the earlier history of any kinds of surgical interventions of the ipsilateral knee due to neoplasms, inflammatory diseases, any infections, degenerative changes as seen on plain radiograph.

MRI scanning of all knees was done before doing diagnostic arthroscopy. Information about the patients were swiftly collected through interviews and filled in the structured questionnaires that were issued to the study participants; physical examination, MRI scanning and arthroscopic findings were also recorded. In order to process the data obtained, we used the validation process in order to assess the validity and reliability of the method compared to the gold standard.

Results

Table-1 tabulated the socio-demographic characteristics of all the study participants. Among all the participants, there were male predilection in the group with 73.5% (n=50). And the median age was observed to be around 39 years with the range between 29-44 years. Female with knee injuries were observed to be in age range of 36-46 years. This difference was observed to be statistically significant.

Table 1: Patients’ socio-demographic characteristics

Characteristics	Male [n=50]	Female [n=18]	Total [n=68]
Age in years	39 (26-43)	41 (35-44)	40 (29-43)
Education, n (%)			
Primary	5 (9)	6 (31)	12 (18.2)
Secondary	30 (59)	4 (21.5)	30 (43.5)
Graduate	15 (32)	9 (47.5)	26 (38.3)
Occupation, n (%)			
Self-employed	18 (36.2)	2 (8.9)	17 (24.8)
Formally employed	30 (59.3)	15 (87.2)	49 (71.5)
Student	2 (4.5)	1 (3.9)	2 (3.7)

Table-2 shows summary of the clinical examination and MRI findings of the knees that were examined. And both the MRI and the clinical examination observed meniscal tears in most of the cases.

Table 2: Clinical examination and MRI findings

Parameters	Frequency (n)	Percentage (%)
Clinical findings		
ACL tear	9	13.4
Meniscal tear	50	74.2
ACL + Meniscal tear	9	12.4
MRI findings		
ACL tear	6	9.3
Meniscal tear	49	71.4
ACL + Meniscal tear	6	8.6
Normal findings	7	10.7

Table-3, 4 summarized the contingency table of sensitivity and specificity of 68 patients with various knee injuries. Total number of patients with positive MRI findings 83% has an ACL lesion diagnosed by arthroscopy as well. The result obtained refers to the sample comprising 68 patients and must not be generalised but it can serve as a good orientation tool. It has been shown that out of the total number of patients with positive MRI findings 100% have positive arthroscopic findings, i.e., that the capacity of the arthroscopic finding to detect patients with positive MRI findings amounts to 100%. The result obtained refers to the sample comprising 68 patients and must not be generalised, but it can serve as a good orientation tool.

Table 3: Contingency table: MRI finding – arthroscopic finding – anterior cruciate ligament (ACL)

Parameters	Findings	Arthroscopic findings		
		Positive	Negative	Total
MRI findings	Positive	22	13	35
	Negative	6	27	33
	Total	28	40	68

Table 4: Contingency table: MRI finding – arthroscopic finding – posterior cruciate ligament (PCL)

Parameters	Findings	Arthroscopic findings		
		Positive	Negative	Total
MRI findings	Positive	2	5	7
	Negative	0	61	61
	Total	2	66	68

Table-5 shows that in the examined sample, we conclude that 85.23% of patients with positive findings for medial meniscus lesions diagnosed by MRI also have positive arthroscopic findings for lesions in the same meniscus. The result obtained refers to the sample comprising 68 patients and must not be generalised.

Table-6 displayed that 77.32% of patients who are diagnosed with lesions of the lateral meniscus by MRI also have lesions of the same meniscus confirmed arthroscopically. The result obtained refers to the sample comprising 68 patients.

Table 5: Contingency table: MRI finding – arthroscopic finding – medial meniscus (MM)

Parameters	Findings	Arthroscopic findings		
		Positive	Negative	Total
MRI findings	Positive	25	19	44
	Negative	5	19	24
	Total	30	38	68

Table 6: Contingency table: MRI finding – arthroscopic finding – lateral meniscus (ML)

Parameters	Findings	Arthroscopic findings		
		Positive	Negative	Total
MRI findings	Positive	19	8	27
	Negative	6	35	41
	Total	25	43	68

Discussion

Among 68 patients, 50 were males and 18 were females of 28-46 years age group having clinically suspected traumatic ligamentous and meniscal injuries, we found that it was more common in males of 26-35 years age group. A study by Avcu *et al.*, showed that knee injuries were common among male population due to their active participation in outdoor works and sports activities.^[8] In this study, right knee is more frequently involved than the left knee due to the dominating side among most of the sports persons.

Based on the various studies available in the literature, it had been reported with high values of accuracy for the MRI diagnosis of PCL injuries. In a prospective study series comprising of 50 patients with a history of knee injury, Polly *et al.*,^[9] did a study in comparing the effectiveness of MRI with arthroscopy. For PCL tears the specificity and accuracy of MRI were both reported as 100%. But no PCL tears were actually diagnosed on either MRI or arthroscopy. Similarly, Heron and Calvert^[10] compared the MRI and arthroscopic findings among 100 injured knees. For the PCL, they observed that both the sensitivity and specificity of MRI was 100%. But only one patient in the study had a PCL injury. Grover *et al.*,^[11] did a study which reviewed 610 consecutive MRI scans of knee injuries. Two-hundred and two patients underwent a subsequent arthroscopy or author to my. Eleven PCL injuries were showed on MRI: eight complete or incomplete ligament disruptions and three avulsions. Four were not diagnosed at the initial clinical examination, but all were confirmed at the time of surgery. There was no instance of an abnormal PCL being identified at arthroscopy in the presence of a normal MRI. In other words, this study showed a sensitivity of 100% for the diagnosis of PCL injury. Gross *et al.*,^[12] conducted a retrospective study of 203 knee injuries in comparing the MRI diagnosis with the diagnosis made immediately at the time of surgery or previously on clinical examination. The cohort included 13 PCL tears and the specificity and sensitivity values for this group were both 100%. Fischer *et al.*,^[13] compared the MRI and arthroscopic diagnoses for a range of knee injuries and reported 99% specificity for the MRI diagnosis of PCL injury over arthroscopic examination.

While analysing the online reading materials from 1966 to 2000 and selected papers in order to compare the validity of clinical tests for diagnosing intraarticular lesions with MRI with arthroscopic findings of the knee, Solomon *et al.*,^[14] conducted the data that the sensitivity of the McMurray test varied between 29% and 63% and the specificity between 20% and 100%. In their prospective study covering 213 in-patients with acute knee injuries, Karachalios *et al.*,^[15] conducted a study in determining the validity of the McMurray test compared to the arthroscopic finding. The obtained value of this test for the medial meniscus was 48%. In their study, while examining the positive predictive value of the McMurray test in comparison with the arthroscopic finding, Chan *et al.*,^[16] established that it is lower than 75%.

Conclusion

To conclude, MRI has been proved to be an effective alternative at time when it is difficult to diagnose the condition such as ACL, PCL, MM, ML injury and also in detecting any associated ligamentous or bony injury with both clinical examination and arthroscopic examination. Since MRI is a non-invasive screening modality, it provides detailed insight and is an essential tool in decision-making before planning for any therapeutic intervention.

Conflict of Interest

Not available

Financial Support

Not available

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