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A Study on Correlation of Magnetic Resonance Imaging and Arthroscopy in Evaluation of Anterior Cruciate Ligament Injury in Cases of Acute Traumatic Haemarthrosis of Knee: A Prospective Study

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ABSTRACT

Background: Swelling and discomfort in acute knee injuries make knee clinical tests challenging and ineffective. Magnetic Resonance Imaging (MRI) could also be used to diagnose intra-articular and extra-articular traumatic lesions in the knee while Arthroscopy was the traditional gold diagnostic method for evaluating intra-articular knee injury. We proposed the study to evaluate the effectiveness of MRI in assessing the Anterior Cruciate Ligament injury in comparison to arthroscopy of the knee.

Method: Study was undertaken in the Department of Orthopaedics, Datta Meghe Hospital, Nagpur in collaboration with Datta Meghe Hospital, Sawangi, India from August 2019 to March 2020 to ascertain the need for routine MRI of the knee for assessment of an injury of the anterior cruciate ligament in sudden traumatic haemarthrosis. 16 yrs to 60 yrs age were included and intra-articular fractures, patellar dislocations, extraarticular ligamentous lesion, previous injury to the same joint, non-haemorrhagic, and haemophilias were excluded.

Results: 32 cases of acute traumatic haemarthrosis of the knee during the period from August 2019 to March 2020 were subjected to MRI examination and arthroscopic examination and findings noted on the scoring system based on The International Knee Documentation Committee (IKDC) 2000 scoring system. Total MRI positive ACL deficient patients were 18 out of 32 and total Arthroscopically positive ACL deficient patients were 13. 10 patients were ACL deficient both in MRI and Arthroscopically and 11 were having normal ACL both in MRI and Arthroscopic evaluation. Fisher exact test p= 0.0751 and Chi-square with Yates correction p= 0.1125. The sensitivity of MRI in detecting ACL injury is 76.92 in comparison to arthroscopy. In spite of the high sensitivity, the specificity of 57.89 shows there is a decreased probability of detecting true negatives. The positive predictive value is 55.55 and the negative predictive value is 78.51 with an accuracy of 65.62.

Conclusion: The cost of MRI although reduced is significant in comparison to arthroscopy. MRI with a sensitivity of 76.92 has a high index of detecting true positives. The probability of detecting true negatives is low with high false negatives. Arthroscopy examination is superior to MRI in detecting ACL injuries from the comparison with significant P-value.

Key Words: Haemarthrosis, MRI, Arthroscopy, ACL

INTRODUCTION

Swelling and pain in acute knee trauma render knee clinical examination tricky and unreliable¹. MRI is a non-invasive tool for analyzing structures of the osseous and soft tissue without using ionizing radiation. The utility of magnetic resonance imaging in evaluating knee injuries has been documented by several authors (Dandy 1997 & Boeree et al. 1991). MRI can be used in the treatment of intra-articular and extra-articular traumatic lesions in the knee while

Arthroscopy was the traditional gold diagnostic method for the assessment of intra-articular knee damage^{2,3,4}.

The use of MRI for diagnosing intraarticular ligaments injuries is increasing due to increased demand for the same by the patients. Most surgeons tend to assume that MRI is an accurate, non-invasive type of knee injury diagnostic tool, adequate to lead to prudent medical decisions and to avoid unnecessary arthroscopic surgery^{5,6,7}. MRI shows a decrease in its sensitivity in detecting ACL injury when

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there are concomitant lesions in other internal structures in the knee [Rubin et al.; 1998] and there is an increase in sensitivity when interpreted by a musculoskeletal radiologist⁸.

MRI is being demanded by patients in our institute being part of industrial setup and as well as it is made available at a considerably less cost due to competitive pricing among service providers and lastly the procedure being non-invasive. Even with the competitive pricing, the amount spent on MRI is considerable. We proposed the study to evaluate the effectiveness of the MRI in assessing the Anterior Cruciate Ligament injury in comparison to arthroscopy of the knee.

MATERIAL AND METHODS

The present study was conducted in the Dept. of Orthopedics and Dept. of Radiology at Datta Meghe Medical College, Shalinitai Meghe Hospital and Research Centre, Nagpur in collaboration with Jawaharlal Nehru Medical College, Datta Meghe Institute of Medical Sciences, Sawangi, (Meghe), Wardha, Maharashtra.

Patients who had clinical testing, MRI, and arthroscopy sequentially for suspected meniscal and ligament injuries were considered for the present analysis, and the results were reviewed. Clinical data reported and analyzed include patient demographics, waiting time between MRI and arthroscopy, suggestive symptoms including effusion, the emergence of a "pop," locking, cause of injury, clinical diagnosis and surgical information. The investigator and professional orthopedic experts have looked at all cases. Clinical testing included Mc Murrays's for meniscal injury, Lachman, cruciate injury drawer tests, and valgus and varus stress tests for the integrity of collateral ligaments. A clinical diagnosis was made, and all patients were requested for an MRI of the affected knee. MRI has been requested for confirmation of the clinical diagnosis and for further detail.

MRI tests were conducted in three different research centers with randomized patient selection. Weighted images T1 and T2 were collected in coronal, axial, and sagittal planes. The thickness of the cuts ranged from 3 to 5 mm. The films were viewed by qualified radiologists who were aware of the results of the clinical evaluation as stated in the initial letter of reference. In a standard type, any abnormalities of the cruciate ligaments, menisci, or hvaline cartilage were identified. The surgeon performing the arthroscopy also evaluated each MRI preoperatively. All arthroscopic findings were considered accurate, and served as a reference point for further study. To determine the reliability of the clinical and MRI tests, statistical analysis was used to measure sensitivity, accuracy, positive predictive value (PPV), and negative predictive value (NPV). True positives and True negatives have been calculated on the basis of clinical conditions and arthroscopic correlations for meniscal and anterior cruciate

ligaments (ACL), and MRI and arthroscopic correlations. An irregular finding (meniscus, ACL) identified by MRI and confirmed during arthroscopy surgery had a true-positive result. There were no recorded abnormalities in a true negative test either clinically or by MRI or Arthroscopy. A false positive was considered when a clinical examination or MRI detected an abnormality but was not confirmed during arthroscopic surgery. A false-negative result has both a negative MRI clinical examination or analysis and a positive operating outcome.

The association of clinical exam and MRI with Arthroscopy was expressed as a percentage from the combined data of all patients. The study confines to the ethics and was done with the consent and full cooperation of the patients.

RESULTS

The ability of MRI and Clinical examination to diagnose intraarticular knee injury was compared with arthroscopy and the results were analyzed using various statistical tests. The final arthroscopic findings after evaluation with MRI were accepted as the reference standard against which the MRI and Clinical findings were compared.

The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were calculated for Clinical and MR imaging in diagnosing the intraarticular knee injuries in correlation with arthroscopy. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were calculated using Statistical Package for the Social Sciences (SSPS 25) software.

Fable 1: Gender distribution of knee haemarthrosis
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Sex	Frequency	Percent
Male	29	90.6
Female	3	9.4
Total	32	100.0

In this study, total 32 patients were selected randomly, out of which 29 were males.

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Side	Frequency	Percent
Left	10	31.3
Right	22	68.8
Total	32	100.0

10 patients had left knee affection while remaining 22 had right knee affection

Table 3: Mechanism of trauma for knee injury

Mode of injury	Frequency	Percent
Slip and fall	17	53.1
Road Traffic Accident	9	28.1
Sports	6	18.8
Total	32	100.0

Most common mechanism of injury was slip and fall followed by road traffic accident and sport activities.

Table 4a: Findings of studyMRI ACL Vs Arthroscopic ACL

Test	ACL
Accuracy	65.62
Positive predictive value	55.55
Negative predictive value	78.51
Sensitivity	76.92
Specificity	57.89

Table 4b: True Positive, Negative and False Positive,Negative of Arthroscopic ACL

		Arthros	Total	
		Positive	Negative	
MRI ACL	Positive	10	8	18
	Negative	3	11	14
Total		13	19	

Table 4c: True Positive, Negative and False Positive,Negative of MRI positive ACL

Test	True	True	False	False
	positive	negative	positive	negative
ACL MRI finding	10	11	8	3



Total MRI positive ACL deficient patients were 13. 10 patients were ACL deficient both in MRI & Arthroscopically and 11 were having normal ACL both in MRI and Arthroscopic evaluation. Fisher exact test p=0.0751 and Chi-square with Yates correction p=0.1125. The sensitivity of MRI in detecting ACL injury is 76.92 in comparison to arthroscopy. In spite of the high sensitivity, the specificity of 57.89 shows there is a decreased probability of detecting true negatives. The positive predictive value is 55.55 and the negative predictive value is 78.51 with an accuracy of 65.62.

DISCUSSION

Different studies have highlighted the significance of proper diagnosis in patients with knee haemarthrosis (Noyes, Paulos et al., 1980; Mariani, Puddu and Ferretti 1981). These have shown that misdiagnosed and chronic knee injuries results poorly, and Smillie (1978) has stated that: "there are few worse errors than to enclose a recently injured knee in a plaster cast without a diagnosis".

Clinical tests used to diagnose meniscal and cruciate ligament damage have shortcomings, and accurate signs may not be reliably obtained, particularly in a crowded orthopedic clinic, and painful in an immediate or subacute presentation. Although difficult to quantify, an accurate clinical diagnosis requires practice. Magnetic resonance imaging [MRI] has completely changed the diagnosis and management of intraarticular anatomy and ligament injuries. While noninvasive and highly responsive diagnostic tools, MRI often detects early and subtle changes in soft tissue. The highly sensitive and reliable arthroscopy technique is both diagnostic and therapeutic however it is invasive.

Considering that health economics plays a significant role in patient care, many questions arise as to when and how frequently an MRI will be required after clinical testing has confirmed the diagnosis of meniscal tear or cruciate ligament rupture¹.

Rose et al.² reported that clinical evaluation in the diagnosis of meniscal tears and ACL ruptures is as successful as MRI, so they concluded that MRI is not required in patients with the clinical possibility of the meniscus and cruciate ligament tears due to its high cost. Boden et al.³, who concluded that if clinical examination sets out the diagnosis of meniscus injury, MRI would not influence treatment decisions.

Ruwe et al.⁴ found that preoperative MRI in 50 percent of patients can avoid needless arthroscopy, so it is of great benefit and should be done prior to surgery. Boeree et al.⁵ suggest that clinical assessment in the treatment of medial meniscus, lateral meniscus, and ACL tear is of limited importance with a sensitivity of 67%, 48%, and 55%, respectively. Kocher et al. noticed that selective MRI over clinical analysis does not have an enhanced diagnostic benefit. Brooks et al. measured the agreement between pre-operative clinical / arthroscopic and MRI / arthroscopic results in a prospective sample (79% vs. 77% agreement, respectively) and concluded that MRI did not decrease the number of adverse arthroscopic procedures.

MRI is also useful for the treatment of meniscal and ligament cruciate injuries. Yet its value is still unclear in countable percentage records with incorrect outcomes and chondral defects. Arthroscopy at present remains the authoritative diagnostic gold standard⁶.

BN Lakhar, KV Rajagopal and P. Rai et al. studied 173 patients of which 78 showed ACL tears. They reported 98.7% sensitivity, 98.9% specificity, 98.1% positive predictive value, and 98.8% negative predictive value for MRI in evaluation of ACL tear as compared with arthroscopy. Nevertheless, when other major ligament injuries are present in the knee, responsiveness is considerably diminished (Rubin et al., 1998).

Recent findings have indicated that arthroscopy can be supported by objective clinical evaluation done by a qualified doctor with positive signs alone. A normal MRI won't be enough evidence to refuse an arthroscopy specifically in people with arthritic knees. The use of MRI as an alternative tool for clinical decision-taking should be extremely individualized⁷. Furthermore, there is no evidence that the number of negative arthroscopies can be decreased by an MRI scan⁸.

Boden et al.⁹ demonstrated that bypassing MRI and moving straight to arthroscopy based on their mathematical model would be cost-effective. He showed that care includes arthroscopy for up to 78 percent of the knees tested. Kocabey et al.¹⁰ claimed that clinical analysis in the hands of the professional orthopedic surgeon is as effective as MRI, and that MRI should be reserved for more complex and ambiguous situations.

CONCLUSION

MRI with a sensitivity of 76.92 has a high index of detecting true positives. The probability of detecting true negatives is

low with high false negatives.MRI is not superior to Arthroscopy examination in detecting ACL injuries from the comparison with insignificant P-value. The cost of MRI although reduced is significant in comparison to arthroscopy.

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