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Original Research Article

MRI vs arthroscopy in the diagnosis of meniscal tears: A comparative study

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ABSTRACT

Background: The diagnostic accuracy of magnetic resonance imaging (MRI) for meniscal tears has not been adequately investigated, although it has been utilized extensively. By contrasting MRI results with arthroscopy findings, we hoped to gauge MRI's diagnostic precision.
Objectives: Investigating the incidence of ACL and meniscal tears; establishing a correlation between arthroscopy and MRI findings by calculating the specificity, sensitivity, positive and negative predictive values (with arthroscopy highly esteemed); grading the degree of subluxation; and ascertaining the minimal quantity of fluid that ought to be present in the knee.
Materials and Methods: The MRI of forty patients in the age range of twenty to forty years old and twelve arthroscopic correlations was evaluated in the year 2021-2022.
Results: In percentage form, the sensitivity, specificity, PPV, and NPV were calculated. For MM, the ACL results were 87.87, 81.57, 80.55, and 88.57, whereas for LM, they were 77.77, 81.81, 72.41, and 85.71. One patient had anterior tibial subluxation, which accounted for 35.6% of all cases. Joint fluid was seen in 201 cases when the suprapatellar pouch appeared laterally with internal disruption.
Conclusion: Patients with ACL injuries should be carefully evaluated during arthroscopy since preoperative MRI has a limited diagnostic accuracy.

1. Introduction

The diagnosis of acute knee injuries has been a topic of discussion in orthopaedic literature for quite some time. There have been a number of diagnostic investigations and clinical trials aimed at improving doctors' capacity to identify knee issues. Ruptures of the meniscus or other knee ligaments may result in substantial pain and impairment, making timely and precise treatment and care essential.[1] "Due to the catastrophic effects of meniscus injuries in patients, particularly for those damaged during activity, prompt and precise identification of these injuries is critical.[2]

Whether or not a meniscus injury requires surgery is heavily influenced by the results of the first physical examination and other diagnostic testing. "Full description of the injury, palpation of the injured area, and a battery of diagnostic tests all constitute essential components of a thorough examination.[3] A pop-like sound is often reported by athletes with meniscus tears when they change direction suddenly during a sprint, such as by turning their heel, with or without colliding with another player.[4]

Point line discomfort and effusion are also symptoms of meniscal damage. Meniscus ruptures in patients with an acute ACL injury may be predicted with some degree of certainty by palpating the knee along its axis, "with an internal axis palpation having a specificity of 34.5% and a sensitivity of 44.9%, and an exterior axis palpation

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having a specificity of 49.1% and a sensitivity of 57.6%. Tenderness at the joint line is a more accurate (77%) indicator of meniscal ruptures in circumstances when the ACL remains uninjured.[5] The McMurray test, the Apley grind test, and the Thessaly test have been the most used diagnostic procedures for symptomatic patients thus far.[6,7]

When it comes to diagnosing knee injuries from trauma, arthroscopy is the method of choice. "Although arthroscopy is highly accurate, it is an invasive and costly intervention that necessitates hospitalization and general or regional anesthesia, and it can impose complications upon an open surgery, including infections, neurological and vascular injuries, and injury to the intra-articular elements of the knee.[8] "There are already over 1,200 knee arthroscopies performed annually, and the number is expected to continue growing until a noninvasive diagnostic tool is developed that does not need an intra-articular approach. Although the value of a physical examination performed by an experienced clinician has been assessed in many studies, further research is required to determine whether or not it should be preferred over other diagnostic approaches.[9,10]

2. Materials and Methods

From June 1, 2021, to June 1, 2022, researcher at BRIMS Bidar conducted this prospective analytical investigation. The research included individuals of 20-40 age group who had suffered knee trauma and had an ACL or meniscal injury. Exclusion criteria were a history of knee surgery, MRI imaging contraindications, and a femoral condyle, tibial plateau, or dislocation fracture. Patients undergoing arthroscopy had their sensitivity, specificity, PPV, and NPV determined.

2.1. MRI technique

Following a thorough explanation of the examination technique to patients with traumatic aetiology, informed permission was acquired prior to the investigation. A magnetic resonance imaging (MRI) scanner administered the tests. The patient was positioned on the MRI table in a supine posture. The knee was allowed to fully extend while being rotated externally by ten to fifteen degrees in the coil. Making sure the joint was in the centre made sure the knee was fixed firmly in the coil. Standard magnetic resonance imaging techniques, including saggital Coronal PD FATSAT and axial STIR sequences, were used for the MRI.

2.2. Interpretation of images

Using a digital imaging and communications in medical picture archiving and communication system, all MRI images were digitally collected. After then, a radiologist who was not privy to the patient's clinical diagnosis used software to evaluate the pictures. In order to determine whether the ACL was intact or damaged, saggital, coronal, and axial images were used for evaluation. When a structure resembling a hypointense band was seen, it was thought to be a normal ACL. Torn anterior cruciate ligaments were defined as those with a focal discontinuity or no ligament at all, abnormally high or low ligament signals, a wavy shape, or poorly defined ligament tendons. A normal meniscus would have a hypointense appearance and no changes to the signal intensity. If the signal intensity inside the meniscus is high, it is considered a tear, and its severity is determined by whether or not it reaches the joint surface.

Assessed the severity of anterior tibial subluxation (ATS) using saggital images, a vertical line, devoid of cartilage, was superimposed over the selected image so that it ran perpendicular to the posterior aspect of the mid-lateral femoral condyle. The vertical line and the posterior cortical border of the lateral tibial condyle were used to measure the degree of subluxation. The outcome was that ATS was assessed in 5mm increments; patients without subluxation were given a grade of 0, those with 0 to 5mm of displacement a grade of 1, those with more than 5mm of displacement a grade 2, and so on. To quantify the amount of fluid, the antero-posterior distance of the effusion at its widest point in the midline and lateral aspect of the suprapatellar pouch on saggital imaging was studied. An antero-posterior measurement of 10mm or fewer was considered an adequate threshold value for discriminating between healthy and unhealthy quantities of fluid.

2.3. Arthroscopic examination

Our hospital's orthopaedic surgeon performed the arthroscopic examination. Under spinal anaesthesia, every arthroscopy was carried out. The space above the patella, the patellofemoral joint, the gutter on the medial side, the intercondylar notch on the medial side, the compartment posteromedial, the compartment lateral, the gutter on the lateral side, and the compartment posterolateral. The pathogenic structure was detected after a comprehensive evaluation of the knee. Apical collateral ligament (ACL) repair and partial/total menisectomy were the subsequent surgical procedures performed for ACL and meniscal injuries, respectively. When anterior cruciate ligament (ACL) injuries were isolated, patellar tendon bone (PTB) or semitendinous gracilis graft (STG) were used for ACL restoration.

2.4. Statistical analysis

The results of the arthroscopy and the magnetic resonance imaging (MRI) were compared in order to detect abnormalities that were either positively or negatively identified. When the results of the arthroscopy and the MRI were identical, it was considered a true positive. In a true negative case, neither the magnetic resonance imaging (MRI) nor the joint examination (arthroscopy) revealed the

lesion. The findings were deemed false positives for patients whose lesions were identified on arthroscopy but not on magnetic resonance imaging (MRI), and false negatives for patients whose pathology was not identified on MRI but showed up on arthroscopy.

For statistical analysis, tools such as the chi-square test and predictive values were used, along with descriptive and inferential statistics. Using the statistical tool SPSS 20.0, the Spearman correlation coefficient was calculated to see whether there was a link between the arthroscopy and MRI data.

3. Results

The research included 40 patients with knee injuries, 12 of whom had arthroscopic co-relation. The orthopaedic surgeon decided to do an arthroscopy. Due to cautious management of some patients with minor to severe injuries, arthroscopy was not performed on the remaining 28 patients. All forty patients had their incidence, degree of subluxation, and knee joint effusion measured.

Twelve patients had their magnetic resonance imaging (MRI) results correlated with their joint examination results, and the results were classified as either positive (true positive), negative (true negative), or unclear (false positive). It was determined the sensitivity, specificity, PPV, and NPV (in %). There was a substantial correlation between the two investigations (0.577 for ACL, 0.805 for MM, and 0.746 for LM) when the MRI and arthroscopy were linked using the spearman co-relation test.

An ACL tear occurred in 74.7% of cases, whereas a lateral meniscus (LM) tear occurred in 28.2% of cases and a medial meniscus (MM) tear in 47.3% of cases. The largest number of patients with ATS was 35.6%, and the most common kind of subluxation was grade 1. Full ACL tears were more likely in patients with a grade of 2 or above.

In investigation, 10 mm in the lateral side of the suprapatellar pouch was the threshold value for differentiating between a normal and pathological quantity of fluid. Patients with 10mm or more of fluid in the lateral suprapatellar pouch are more likely to have tibial subluxation, bone bruising, anterior cruciate ligament (ACL) tears, meniscal tears, and other injuries (Table 4).

4. Discussion

Magnetic resonance imaging (MRI) has grown in importance to the point that it is now the gold standard for investigating knee lesions. Both pre- and post-operative evaluations make use of it as well. It is a non-invasive method that doesn't rely on the operator and doesn't involve the delivery of contrast. No imaging modality can reveal the inner workings of the knee as precisely as radiographs, arthrograms, and ultrasound can. Artroscopy is not always able to identify osteochondritis dessicans, inferior surface tears, or peripheral meniscal tears in cases when the articular cartilage has not been injured.

About two-thirds of all knee problems have their origins in meniscal injury.[11] Similarly, a torn anterior cruciate ligament may cause a knee that is very unstable. The clinical diagnosis of this ligament is challenging even though it is the most often damaged knee ligament. For these interior disturbances, MRI is often the diagnostic tool of choice as it is noninvasive and does not emit radiation.

For this research, we included 40 individuals who were clinically thought to be suffering from an internal knee derangement. The largest age group consisted of participants between the ages of 20 to 40 (32.2%). There were more men than women across all age categories (77% vs. 27%) in this research. Twelve patients participated in our investigation, during which we determined sensitivity, specificity, PPV, and NPV by correlating MRI findings with arthroscopy. We found very few instances of both false positives and false negatives in our research.[12,13] Because clinical examiner, radiologist, and arthroscopist proficiency, as well as imaging equipment quality, determine the reliability of meniscal and cruciate ligament diagnoses. Additionally, technological considerations play a role. Overlying synovial response could make the diagnosis of partial ACL rupture inaccurate. Because of these variations in MRI sensitivity, many meniscal tears may go unnoticed or be overdiagnosed.[14,15] So, even with normal MRI, you still need solid clinical experience.

The best position for measuring the lateral suprapatellar pouch was for the patients to be positioned in the extremities coil with an external rotation of five to fifteen degrees. Their technique of measuring was the main shortcoming of their research. The measurements may have been more accurately taken using axial planes or volumetric measurement rather than the less precise saggital plane. As a result, they said that MRI can identify joint effusions with a high degree of sensitivity. There were no internal abnormalities in patients whose suprapatellar pouches did not exhibit a notable effusion on the side. Therefore, an MRI of the lateral suprapatellar pouch with a fluid level lower than 10 mm is considered abnormal and indicates a physiologic fluid level.

5. Conclusion

Research comparing magnetic resonance imaging (MRI) with arthroscopy for the detection of meniscal tears highlights the subtle benefits and drawbacks of each imaging technique. The menisci and other soft tissue structures may be better understood with the use of magnetic resonance imaging (MRI), a non-invasive imaging method that gives a thorough picture of the knee joint. An appealing first diagnostic tool, it is widely available and reasonably inexpensive. On the other hand, the research shows that MRI could not be as sensitive and specific as other diagnostic tools, which might lead to

Table 1: Findings from magnetic resonance imaging (MRI) and joint imaging (arthroscopy): positive, negative, false positive and false negative

Test	True positive	True negative	False positive	False negative
MM MRI findings	27	32	4	1
ACL MRI findings	27	29	6	3
LM MRI findings	19	31	7	6

Table 2: Considerations of PPV, NPV, specificity, sensitivity, and MRI in the diagnosis of ACL, MM, and LM tears during arthroscopic procedures

Accuracy of MRI findings			
Component Test	**ACL %**	**MM %**	**LM %**
Specificity	80.67	86.51	83.82
Sensitivity	85.77	94.55	75.75
Positive Predictive Value	81.65	83.26	70.42
Negative Predictive Value	86.56	93.56	82.73

Table 3: Linking arthroscopy results with MRI scans via the use of spearman correlation

	MRI		
	ACL	**MM**	**LM**
Arthroscopy	0.567**	0.815**	0.756**

Table 4: The occurrence of knee joint effusion is associated with internal derangement of the knee joint (Chi Square = 1.535, p Value = 0.215)

Amount of fluid	Fluid		Total (%)
	With internal derangement (%)	Without internal derangement (%)	
Less than 10 mm	62 (30.8)	12 (6.0)	74 (36.8)
More than 10 mm	114 (56.7)	13 (6.5)	127 (63.2)
Total	176 (87.6)	25 (12.4)	201 (100.0)

incorrect diagnosis. However, arthroscopy permits direct visualisation and contemporaneous therapeutic measures; it is an intrusive technique. It becomes the go-to method for conclusive diagnosis when MRI findings are unclear or contradictory. However, arthroscopy is more expensive, comes with hazards, and isn't always the best choice for a primary diagnosis. The majority of orthopaedicians acknowledge that arthroscopy has changed the way knee diseases are managed, but they also acknowledge the procedure's invasiveness, expense, and rare but real risks, including its inability to assess extra-articular pathology.

6. Author Contribution

The authors participated in research work and manuscript preparation. Dr Rajesh Sajjanshetty**:** Conceptualization, formal analysis and writing original draft. Dr Mallikarjun GB**:** Editing, reviewing and validation. Dr Rohit Ranjolkar**:** Reviewing, editing, and supervision. All authors read and approved the final manuscript.

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8. Conflicts of Interest

The authors declare that we have no conflict of interest.

9. Data Availability Statement

The data used to support the findings of this study are included in the article.

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No potential competing interest was reported by the authors.

11. Ethical Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

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