

Comparison of MRI Versus Arthroscopy in Assessment of Anterior Cruciate Ligament Injuries of the Knee Keeping Arthroscopy as Gold Standard

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ABSTRACT

Objective: To evaluate the correlation between Magnetic Resonance Imaging (MRI) findings and Arthroscopy in diagnosing anterior cruciate ligament (ACL) injuries, using Arthroscopy as the gold standard.

Methodology: This prospective cross-sectional study was conducted at the Department of Orthopedic Surgery, Combined Military Hospital, Rawalpindi, from February to August 2019. Clinical evidence of ACL injury was present in 127 individuals. They had an MRI as well as an arthroscopy. The diagnostic efficacy of MRI for ACL tears was evaluated, and its sensitivity, specificity, PPV, NPV, and accuracy were all calculated.

Comparisons between arthroscopic and magnetic resonance imaging (MRI) findings yielded three classifications: True Positive (MRI verified by Arthroscopy), True Negative (both MRI and Arthroscopy negative for ACL injury), and False Positive/False Negative (differences between MRI and Arthroscopy). The arthroscopic inspection and MRI findings were entered into SPSS 23 software for tabulation and analysis. When necessary, both descriptive and inferential statistics were used.

Results: The study of statistics Arthroscopy was performed on 127 patients, either for diagnostic or therapeutic purposes. A correlation was found when all the data was analyzed and tabulated. The majority of the patients were males (85.8%) in the second and third decades of life. The sensitivity, specificity, NPV, PPV, and accuracy of MRI in diagnosing ACL injuries were 89.89%, 64.28%, 64.28%, 89.89%, and 84.25%, respectively.

Conclusion: MRI is an accurate and non-invasive modality for assessing ACL tears, showing good accuracy and high sensitivity. However, Arthroscopy remains the gold standard for diagnosing ACL injuries.

Keywords: Arthroscopy, Anterior Cruciate Ligament, Knee, Magnetic Resonance Imaging, MRI.

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Introduction

MRI clearly displays the ACL, menisci, ligaments, and articular surfaces of the knee, it has become an essential tool for assessing ACL damage. MRI provides extensive information about the ACL's architecture and condition through the use of different imaging sequences like T1- and T2-weighted imaging. ACL injuries can be detected

with great sensitivity and specificity¹, allowing for a precise initial diagnosis and the creation of targeted treatment programmes.

When compared to other joints, knees are the most likely to be injured in sports and car accidents.² Menisci, tendons, ligaments, and bones all make up the knee joint.³ These structures are crucial in keeping the bones in their proper

positions and the joints stable.⁴ Internal knee joint disorders are a common health concern for young athletes.⁵ This can cause damage to the menisci and ligaments, preventing the joint from functioning normally. To arrive at a correct diagnosis, it is necessary to isolate the relevant mechanisms. The severity of a knee injury can be estimated from the results of a clinical examination and initial imaging (often an X-ray).⁶

Common knee injuries include tears in the meniscus and the anterior cruciate ligament (ACL). The clinical examination was once the mainstay of medical diagnosis.⁷ However, modern diagnostic tools have improved the likelihood of a correct diagnosis.⁸

The use of MRI has greatly enhanced the accuracy and non-invasiveness of diagnosing ACL and meniscal injuries. MRI allows for a more in-depth understanding of the knee than is achievable with more traditional testing methods.³ Compared to computed tomography, magnetic resonance imaging (MRI) provides a more comprehensive evaluation of the knee's soft tissues and bones.⁹ Arthroscopy is another common method since it allows for in-depth examination of the knee joint and, consequently, more accurate diagnosis and treatment. Arthroscopy is the best diagnostic tool for identifying knee problems.^{10, 11} It is essential to keep in mind, however, that arthroscopy is an invasive procedure that calls for a hospital. Accurate results are highly dependent on the operator's skill and experience. The study's overarching objective is to determine the relative benefits of magnetic resonance imaging (MRI) and arthroscopy for diagnosing ACL injury stay.¹¹

The purpose of this research is to improve our knowledge of ACL injuries and provide reliable guidance for diagnosis and rehabilitation. The results will help medical personnel choose the most appropriate imaging modalities, factoring in factors like precision, invasiveness, cost, and level of expertise. The results will be more effective treatment for patients and less waste of healthcare resources.

Methodology

This study employed a prospective cross-sectional design to compare the diagnostic accuracy of Magnetic Resonance Imaging (MRI) and Arthroscopy in assessing anterior cruciate ligament (ACL) injuries. The study was conducted at the Combined Military Hospital in Rawalpindi, Pakistan, from February to August 2019. The study received approval from the ethical review

committee, and all participants provided written consent before participating in the research.

The study comprised 127 people who were showing symptoms of an ACL tear. Patients who presented with edoema, instability, or pain in the absence of a suspected ACL injury met the inclusion criteria. Patients were limited to those between the ages of 18 and 50, and those who were either incompatible with anaesthesia or had metal implants were disqualified. Fractures to the femoral condyle, plateau, or tibial spine, or isolated injuries to the anterior, lateral, or posterior cruciate ligaments, ruled out patients.

Using a GE 1.5 TESLA MRI scanner, participants were scanned. T1 and T2 weighted sequences were used to create images of the knee in the coronal and sagittal planes. The hospital's Radiology department reported the MRI scans.

The arthroscopic inspection and MRI findings were entered into SPSS 23 software for tabulation and analysis. Depending on whether MRI and arthroscopy disagreed on the presence of an ACL tear, the results were classified as either true positive (arthroscopy confirmed the MRI diagnosis) or true negative (both procedures showed no ACL injury). When necessary, both descriptive and inferential statistics were used.

Results

Out of the 127 patients, 109 (85.8%) were male, while 18 (14.2%) were female. This gender distribution can be attributed to the fact that males are typically more physically active in sports. Table I displayed the frequency distribution of age groups among the patients.

Table I: Frequency Distribution with respect to Age.

Age	Number of response rate	
	Frequency	(%)
18 to 25 Years	30	23.6
26 to 30 Years	34	26.8
31 to 35 Years	29	22.8
36 to 40 Years	31	24.4
41 Years and Above	3	2.4
Total	127	100.0

Table II provided descriptive statistics and frequency distribution related to the MRI and arthroscopy results, indicated that 107 patients (true positive and true negative) had the same diagnosis on both MRI and arthroscopy. Ten patients had ACL instability that was missed on MRI but diagnosed on arthroscopy (false negatives). Conversely, ten patients had ACL instability detected on clinical evaluation and MRI, but arthroscopy did not show an ACL

Table II: Descriptive Statistics and Frequency Distribution

Variable	Percentage response rate (N=127)				Mean	SD
	True Positive	True Negative	False Positive	False Negative		
MRI vs. Arthroscopy	89	18	10	10	1.5354	.9411

Note: True Positive = MRI Positive and Arthroscopy Positive (Value assigned = 1), True negative = MRI Negative and Arthroscopy Negative (Value assigned = 2), False Positive = MRI Positive and Arthroscopy Negative (Value assigned = 3), False Negative = MRI Negative and Arthroscopy Positive (Value assigned = 4)

injury. An independent sample t-test was performed to evaluate the gender distribution. Table III presented the results of the t-test, showing no statistical difference between the genders in terms of the MRI and arthroscopy diagnoses.

Table III: Independent Sample t-test with respect to Gender

Variables	Gender	N	Mean	SD	F	Sig.
MRI vs.	Male	109	1.5596	.9759	2.363	.127
Arthroscopy	Female	18	1.3889	.6978		

ANOVA was used to analyze the distribution according to age, as shown in Table IV. The results indicated statistical significance when the findings were distributed based on age.

Table IV: One Way ANOVA concerning age

Variables	Age	N	Mean	F	Sig.
MRI vs. Arthroscopy	20 to 25 Years	30	1.3667	2.087	.087
	26 to 30 Years	34	1.3235		
	31 to 35 Years	29	1.6552		
	36 to 40 Years	31	1.8710		
	41 Years and Above	3	1.0000		
	Total	127	1.5354		

Table V presented the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of MRI in detecting ACL tears.

Table V: ACL findings on MRI.

TESTS	ACL (%)
Sensitivity	89.89
Specificity	64.28
Positive Predictive Value (PPV)	89.89
Negative Predictive Value (NPV)	64.28
Accuracy	84.25

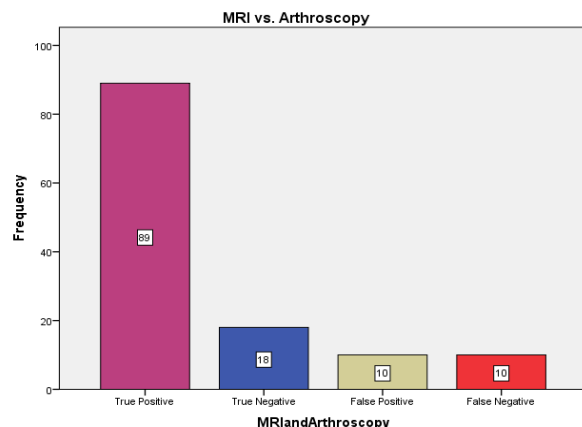


Figure 1 provided the findings of both MRI and arthroscopy for ACL tears. Among the 127 cases, 89 were arthroscopically positive and MRI positive (true positives), 10 were arthroscopically negative but MRI positive (false positives), 10 were arthroscopically positive but MRI negative (false negatives), and 18 were arthroscopically negative and MRI negative (true negatives).

Discussion

Due to its complexity, MRI is commonly used and recommended by doctors for evaluating knee injuries.³ Knee injuries are commonly diagnosed by MRI.¹² MRI scans have the benefit of not necessitating intravenous contrast dyes or needle sticks.¹³

The menisci and both the anterior and posterior cruciate ligaments (ACL and PCL) can be injured, and MRI can identify these lesions.¹⁴ However, a doctor's expertise and the MRI equipment itself can affect how reliable the results are.^{7, 15} Here, we looked at how well arthroscopy and MRI both diagnosed ACL injuries. Men are more prone than women to have knee injuries, according to a prior study by Avcu et al. Furthermore, they discovered that the right knee is more prone to damage than the left.¹⁶

Injuries that necessitate prompt surgical intervention are more common in younger men.^{8, 17}

ACL tears are the most common kind of knee ligament damage, as reported by Shetty et al.¹⁵ Hetta et al.¹⁸ observed that 15 of the 30 patients in our study (60%) had ACL tears, and that 35 of the patients overall had a history of trauma. Out of 54 patients in another study, 31 (57.5%) had a medial meniscal tear and 11 (20.3%) had an ACL tear.¹⁹

Since measuring joint instability during a clinical evaluation of patients with knee injuries is rather straightforward, we restricted our investigation to ACL rips. Berquist et al.²⁰ found that mid-substance tears were the most common form of ACL injury in our patients. Ankle ligament injuries are best detected using T2-weighted scans of the knee.²¹ The incision was checked using axial and coronal pictures. T2-weighted pictures are the gold standard for diagnosing ACL rupture, according to research by Mink et al.²² ACL injuries can be diagnosed

with greater precision using MR imaging with an oblique axial view, as reported by Kamal et al.²³

However, we were only able to get sagittal, coronal, and axial views according to our institute's MRI methodology. About a quarter (26.7%) of our patients were between the ages of 26 and 30, with men accounting for 109 of the 127 instances and women for just 18 of them. These percentages are consistent with what Sathish et al.³ found.

Fisher et al.²⁴ found that MRI was more accurate than arthroscopy in terms of sensitivity, specificity, and total accuracy. However, our research showed that MRI was more accurate than arthroscopy, with a sensitivity of 89% and a specificity of 64.28 percent. Positive and negative predictive values for MRI range from 70% to 76% and 100%, respectively, as reported by McGinty et al.²⁵, whereas sensitivity and specificity can range from 61% to 100% and 82% to 97%, respectively.

They rated the MRI as 88 percent accurate, with "extremely good" interpretation.⁸ A radiologist's skill in interpreting MRI scans is highly dependent on their level of education and experience. Other studies^{14, 27} find that MRI and Arthroscopy are the best ways to assess knee health.

The skill of the surgeon is crucial to the outcome of an arthroscopic procedure.²⁸ Due to its oblique position at the knee joint, the ACL is difficult to capture in a single MRI sequence.²¹ Although useful, arthroscopy is not a substitute for magnetic resonance imaging (MRI).²⁹ It's crucial to educate the patient on the surgical approach beforehand.

Arthroscopic procedures rely heavily on the knowledge and experience of the operating surgeon.²⁸ The anterior cruciate ligament (ACL) at the knee joint lies at an oblique angle, making it unusual for a full ACL to be visible in an MRI sequence.²¹ Although useful for diagnosis, arthroscopy is not a replacement for magnetic resonance imaging (MRI).²⁹ Therefore, it is crucial to provide the patient an in-depth explanation of the surgical method before beginning the operation.

Conclusion

Non-invasive imaging techniques like MRI have allowed for the early diagnosis of meniscal and ACL tears in the knee. Without the need for ionising radiation or intrusive treatments, it provides an accurate assessment of ACL damage and soft tissue anomalies. MRI is noninvasive and therefore free of the dangers and restrictions of

arthroscopy, a surgical procedure. The posterior capsule may be difficult to examine during arthroscopy, and extra-articular knee problems may not be amenable to evaluation in some clinical settings. Despite its reliance on operator expertise, arthroscopy continues to be the gold standard for assessing ACL damage. MRI is the gold standard for evaluating internal and exterior knee abnormalities following a knee injury.

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