Correlation of Magnetic Resonance Imaging and Arthroscopy Findings in Cruciate Ligaments and Meniscus Injury of Knee in West Nepal

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ABSTRACT

Introduction:

Magnetic resonance imaging is a noninvasive diagnostic modality and provides clinically relevant information to orthopaedic surgeons by detecting and characterizing injuries of cruciate ligaments and meniscus of the knee. MRI is routinely used before arthroscopic examination and surgery. Arthroscopy is considered the reference standard for the diagnosis of injuries of cruciate ligaments and meniscus of the knee and hence the efficacy of MRI needs to be compared with arthroscopic findings.

Methods:

This was a retrospective observational study at Bheri hospital, Nepalgunj. A total of 114 Patients who were investigated with MRI and managed with arthroscopic procedures for a knee injury, between June 2017 to February 2022, were included in the study.Data analysis was done for determining true positive, true negative, false positive and false negative as per MRI and arthroscopic findings.Sensitivity, specificity, positive predictive value and negative predictive value were calculated based on specific equations.

Results:

The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of MRI for ACL were 89.65%, 96.42%, 96.29%, 90% & 92.98%, PCL was 96.42%, 100%, 100%, 97.72% & 99.12%, the medial meniscus was 88.46%, 88.70%, 86.79%, 90.10% & 88.59% and lateral meniscus was 84.61%, 94.31%, 81.48%, 95.40% & 92.10% respectively.

Conclusions:

MRI is an excellent noninvasive modality for imaging the knee and it yields high accuracy in diagnosing injuries of cruciate ligaments and meniscus.

Keywords: Magnetic Resonance Imaging; Arthroscopy; Cruciate Ligaments; Meniscus

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INTRODUCTION

Magnetic resonance imaging (MRI) has been successfully used to diagnose knee lesions and is considered a noninvasive alternative to diagnostic arthroscopy. However, arthroscopy has remained the reference standard for the diagnosis of injuries of cruciate ligaments and meniscus of the knee.[1]

Numerous large studies have evaluated the diagnostic capabilities of MRI, with varied outcomes.[1-24] MRI is routinely used to support the diagnosis of meniscal or cruciate ligament injuries before recommending arthroscopic examination and surgery. The identification of meniscal tears can be difficult to interpret and depends on both the observer and the sensitivity of the scanner.[12,24] The arthroscope provides an easy method to examine the interior of the knee; it provides a good view of the patellofemoral joint and is associated with very low morbidity. The role of arthroscopic examination in the diagnosis of knee problems has been reported many times.

This study aims to analyze the findings and reliability of MRI and its correlation with Knee Arthroscopy in west Nepal. Bheri Hospital is located in the Lumbini province of Nepal and receives referral patients from the Lumbini, Karnali and sudurpaschim province of Nepal. Bheri hospital is the only centre in west Nepal to perform regular arthroscopic procedures of the knee including ligament reconstructions, meniscus repair and excisions.

METHODS

This is a retrospective observational study at Bheri hospital, Nepalgunj.

Permission for the study was obtained from the hospital administration and subsequent ethical clearance was obtained from Nepal Health Research Council (NHRC ref no: 2012/23-03-2022).

Patients who were investigated with MRI and managed with arthroscopic procedures for a knee injury, between June 2017 to February 2022, were included in the study. We retrieved complete data from 114 patients. Partial tear of cruciate ligaments was not separately calculated. Patients with previous surgery or arthroscopy on the same knee were excluded.

The scans were performed on a 1.5T Siemens MRI machine using the protocol mentioned in Table 1.

Table 1: MRI Protocol

Plane	Sequences
Sagittal	T1 W , T2 W, PD
Axial	T2W
Coronal	STIR
Additional GRE, Sagittal oblique and 3D sequences in selected cases depending on the clinical scenario	

Demographic data with MRI and arthroscopic findings for each patient were collected and recorded in a pre-designed data collection sheet. Data analysis was done for determining true positive, true negative, false positive and false negative as per MRI and arthroscopic findings. Sensitivity, specificity, positive predictive value and negative predictive value were calculated based on the following table as shown in table 2.

Table 2: (Table for statistical analysis)

	MRI	Arthroscopy
True positive	Tear detected	Tear detected
True negative	No tear	No tear
False positive	Tear detected	No tear
False negative	No tear	Tear detected

RESULTS

We enrolled 114 cases. 69 patients were male and 45 were female. The mean age was 37.

We detected a total of 58 ACL tears on arthroscopy, 52 of them were picked up correctly on MRI. Partial tears were not separately calculated. 6 cases were reported normal on MRI but found to be ruptured on arthroscopy. Two cases were reported having a tear in MRI, which were intact in arthroscopy. The overall sensitivity of MRI for diagnosing ACL tear was 89.65 %, specificity was 96.42% and accuracy was 92.98%.

There were 27 PCL tears in our study. All the tears were accurately diagnosed by MRI and confirmed on arthroscopy. Two cases were PCL avulsion fractures from the tibia attachment site. One partial tear was found to be normal on arthroscopy. The injured PCL might have healed as there was a time interval between MRI and arthroscopy.

MRI was 96.42% sensitive and 100% specific for picking up PCL tears. The accuracy of MRI to detect PCL was 99.12%. (Table 3&4)

Table 3: MRI detection of different tears

	ACL	PCL	Medial meniscus	Lateral meniscus
True Positive	52	27	46	22
True Negative	54	86	55	83
False Positive	2	0	7	5
False Negative	6	1	6	4

Table 4: Sensitivity, specificity, positive predictive value and negative predictive value in % of MRI in detecting different tears

	ACL	PCL	Medial meniscus	Lateral meniscus
Sensitivity (%)	89.65	96.42	88.46	84.61
Specificity (%)	96.42	100	88.70	94.31
Positive predictive value (%)	96.29	100	86.79	81.48
Negative predictive value (%)	90	97.72	90.10	95.40
Accuracy (%)	92.98	99.12	88.59	92.10

We detected 3 ramp lesions on arthroscopy that were not reported correctly on MRI. There were 11 bucket handle tears on arthroscopy and 8 of them were correctly reported on MRI as shown in figures 1, 2 & 3. Fragment in the intercondylar area, double PCL sign and flipped meniscus were the most commonly reported findings. MRI was 88.46%

sensitive and 88.70% specific for diagnosing medial meniscus tears. The positive predictive value was 86.79% and the negative predictive value was 90.10%.

MRI had an accuracy rate of 88.59% and 92.1% respectively to detect medial meniscus and lateral meniscus.

Five vertical tears of the lateral meniscus were not reported in MRI. We didn't encounter any bucket handle tear of the lateral meniscus. One discoid tear was accurately diagnosed by MRI. The sensitivity of MRI to detect lateral meniscus tear was 84.61%, specificity was 94.31%, positive predictive value was 81.48% and negative predictive value was 95.40%.

Figure 1: PD sagittal and coronal STIR image showing Bucket handle tear of medial meniscus as evidenced by a small deformed anterior horn, posterior horn & body of medial meniscus with the fragment of the medial meniscus in intercondylar notch inferior to PCL giving double PCL sign. In addition, altered morphological appearance with complete disruption of fibres of ACL is noted with heterogenous high signal intensity along its course s/o complete ACL tear
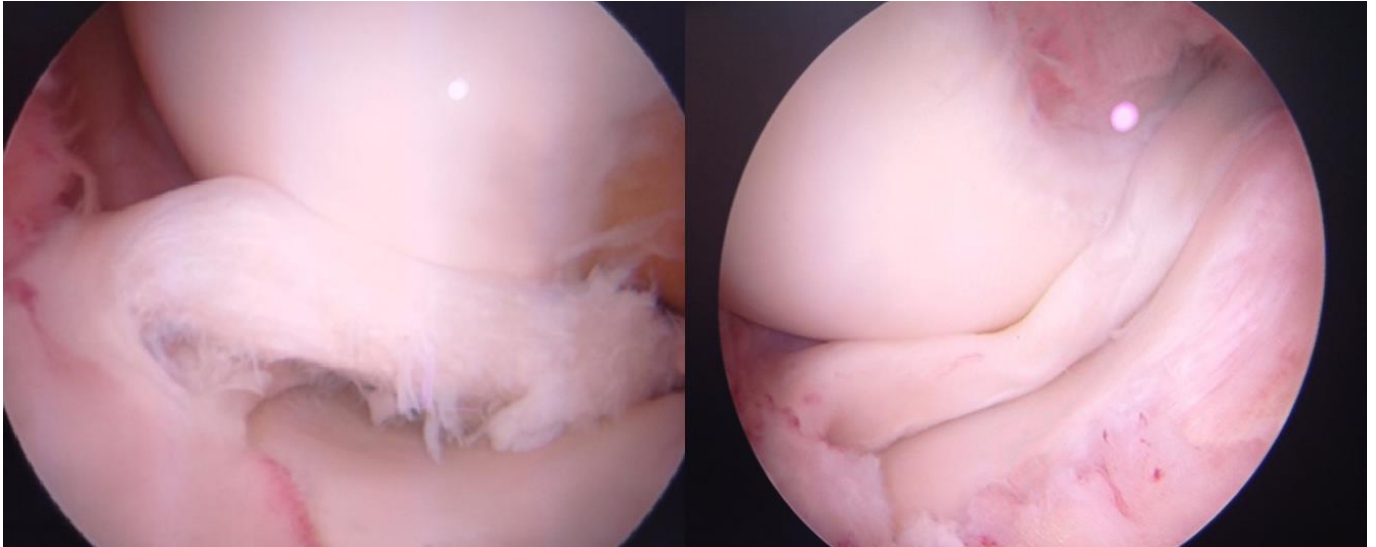
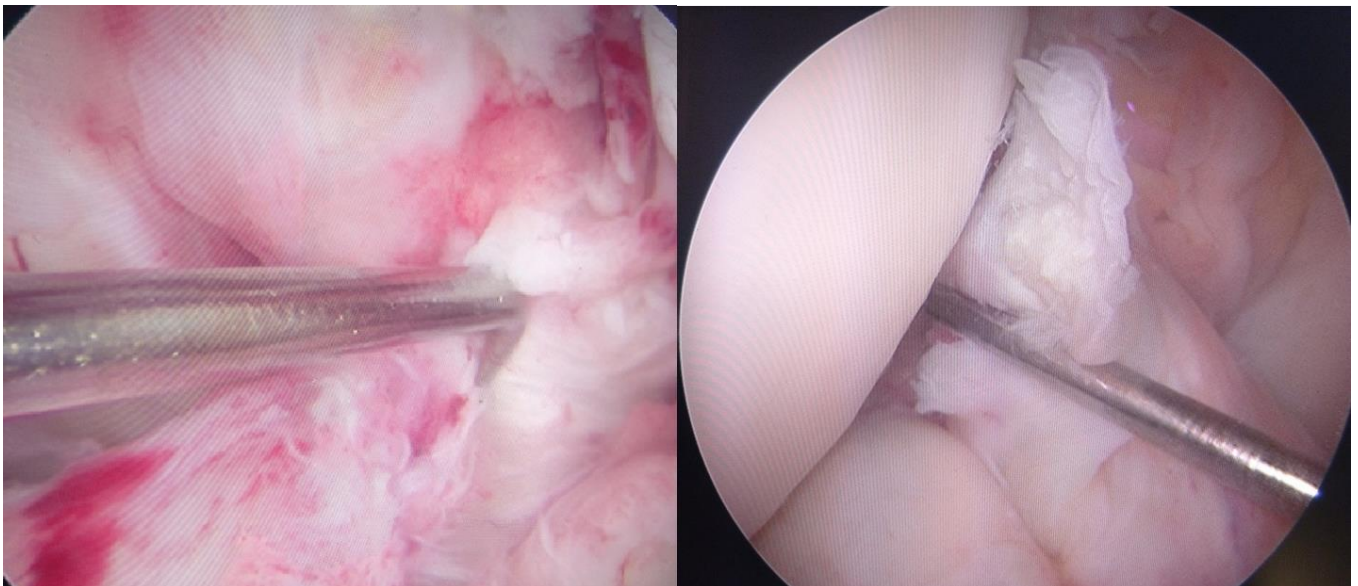*Figure 2: Bucket handle tear of the medial meniscus in arthroscopy*

Figure 3: ACL rupture in arthroscopy

DISCUSSION

The normal ACL should have a taut, low to intermediate signal intensity with continuous fibres in all planes and sequences.[2] Diagnosis of ACL tear on MR images is usually based on direct signs.[3-5] The primary sign of ACL tear is fibre discontinuity. The oblique sagittal plane is the most helpful in diagnosis supported by coronal and axial imaging. The empty notch sign on coronal imaging is a frequent finding in complete ACL tears.[6] In acute or subacute injury, thickening and oedema of the ACL are found characterized by increased signal intensity on T2 or intermediate-weighted sequences. In chronic cases, the fibres can be completely absorbed.[2]

Singh J et al. conducted a study with 173 patients in India and the result showed sensitivity, specificity and accuracy of MRI in detecting ACL tear to be 98.72%, 98.94% and 98.84% respectively.[7] Orlando Júnior N et al. from Brazil conducted a prospective study on 72 patients which showed a sensitivity of 86.79%, specificity of 73.68% and accuracy of 83.33% for ACL injuries.[8] Schneider et al. from Brazil found that MRI was reliable for diagnosing knee injuries, with a sensitivity of 53% and a specificity of 95% for ACL injuries.[10]

In a multi-centre analysis of 1014 patients by Fischer SP et al. in California, the accuracy of MRI was 93 per cent for the anterior cruciate ligament.[11] Polly DW et al. in their study on selective MRI and arthroscopy with 54 patients found that the sensitivity, specificity and accuracy of selective MRI was 100%, 96.9% and 97.3% for ACL tears.[14]

The PCL is normally seen on MR as a well-defined continuous band of low signal intensity.[15,16] Any signal changes and structural discontinuity are easily identified; hence MRI is highly accurate in diagnosing PCL pathologies.[17]

Gross ML et al. in their study with 201 patients found that the sensitivity and specificity of MRI to detect PCL was 100%. The accuracy of MRI to detect PCL was 99% (Fischer SP et al.) and 100% (Gyawali B et al.) in different studies.[23,11,12]

A multi-centre analysis of 1014 patients by Fischer SP et al.in California found that the accuracy of MRI was 89 per cent for the medial meniscus and 88% per cent for the lateral meniscus.[11]

Gyawali B et al. conducted a prospective study on 52 patients at ShreeBirendra Hospital, Kathmandu. The accuracy of MRI for the medial meniscus and lateral meniscus was 92%, and 86% respectively.[12] In another study conducted at the private hospital of Kathmandu by Sharma UK et al., the sensitivity, specificity and diagnostic accuracy of MRI were 92.3%,100% and 95.1% respectively for medial meniscal tear and 84.6%, 96.4% and 92.6% for lateral meniscal tear.[13]

Bucket-handle tears are usually longitudinal tears of the knee menisci with an attached fragment displaced away from the meniscus and a group of MR imaging signs such as double-posterior cruciate ligament (PCL) a fragment in the intercondylar notch, flipped meniscus, and absent bow tie signs in the diagnosis of such tears have been reported over the years.[18-22]

A study conducted by Magee et al. showed the sensitivity of MRI for meniscal injuries of the knee to be 89% and demonstrated that signal abnormalities seen on MRI gave information about morphological alterations of injuries.[9]

Polly DW et al. conducted a study on selective MRI and arthroscopy with 54 patients. According to the study, sensitivity, specificity and accuracy of selective MRI were 95.8%, 100% and 98% respectively for medial meniscal tear and 66.7%, 95.1% and 90% for lateral meniscal tear. Our findings are comparable with the above studies.[14]

CONCLUSION

MRI is an excellent noninvasive modality for imaging the knee and it yields high accuracy in diagnosing injuries of cruciate ligaments and meniscus.

CONFLICT OF INTEREST
None

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