ORIGINAL ARTICLE

CORRELATION OF CLINICAL EXAMINATION AND MRI FINDINGS WITH ARTHROSCOPIC EVALUATION OF MENISCUS TEARS AND CRUCIATE LIGAMENT RUPTURES

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ABSTRACT

Objectives: This study aimed to evaluate the correlation between clinical examination and MRI findings with arthroscopy in diagnosing meniscal tears and cruciate ligament ruptures.

Methods: The research involved a retrospective review of 165 patients, 142 males and 23 females who underwent arthroscopy for meniscal or cruciate ligament injuries between January 2018 and July 2020. The arthroscopic findings were compared with MRI reports and clinical examination results, including Lachman, anterior and posterior drawer tests for cruciate ligament injuries, and McMurray tests for medial and lateral meniscus injuries.

Results: The study demonstrated that clinical examination showed strong sensitivity and specificity when compared to arthroscopy: Lachman test (84.76% sensitivity, 95% specificity), anterior drawer test (88.54%, 91.66%), and posterior drawer test (92.85%, 96.6%). McMurray tests for medial and lateral meniscus injuries yielded sensitivities of 81.51% and 68.42%, respectively, with corresponding specificities of 58.6% and 86.11%. MRI performance was also evaluated, with anterior cruciate ligament (ACL) tears showing 93.33% sensitivity and 90% specificity, while medial meniscus injuries had 84.87% sensitivity and 80.43% specificity. The lowest sensitivity was observed in diagnosing articular cartilage defects (29.16%), highlighting MRI's limitations in certain areas.

Conclusion: In conclusion, despite arthroscopy's superiority as the gold standard for knee injury diagnosis, it remains an invasive procedure. A well-conducted clinical examination, supplemented by MRI, remains invaluable in the diagnostic process, allowing for precise management of meniscal tears and ligamentous injuries.

Keywords: Meniscal injury; ACL injury; PCL injury; Arthroscopy; Clinical examination

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INTRODUCTION

The menisci and intra-articular ligaments of the knee play a fundamental role in maintaining knee homeostasis, stability, and lubrication while also allowing shock absorption and distribution [1]. Injuries to these vital structures are most frequently seen in the young, athletic population. They can lead to pain, debility, andÊinability to return to previous levels of activity while also hastening the onset of osteoarthritis of the knee, thus giving rise to what is known as 'a young adult with an old knee'[1-4]. Such injuries are frequent in recreational and professional athletes, particularly inÊlanding and pivoting sports [5]. Sports-related knee injuries are reported to account for around 15-50% of all sports-related injuries, and timely diagnosis, along with appropriate management, is of paramount importance

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[6]. In a study by et al., internal injuries to the knee were seen to comprise 44.8% of all sports-related knee injuries, 20.3% of which involved injuries to the anterior cruciate ligament (ACL) and 14.5% of which involved meniscal tears [7].

The ACL is vital for preventing anterior tibial translation, as well as valgus and internal rotation of the tibia [3,8,9]. The posterior cruciate ligament (PCL), on the other hand, prevents posterior translation of the tibia and external rotation of the tibia at flexion angles beyond 60 degrees [4]. In addition to a thorough medical history, a focused physical examination for meniscal andligamentous injuries is performed for diagnosis. However, diagnostic dilemmas are not uncommon in experienced hands, and studies have reported variable accuracies of tests performed for meniscal injuries [10].

Over the past few decades, magnetic resonance imaging (MRI) has emerged as the diagnostic tool of choice, being a noninvasive modality with high sensitivity for detecting intra-articular knee abnormalities [10]. However, the incidence of unnecessary MRIs has resultantly increased; a study published by Solivietti et al. reported that nearly 20% of patients had not had an adequate physical examination done before their MRI [11]. It would thus be deemed reasonable that MRI, being an expensive modality with limited availability, only be prescribed in the presence of a justifiable clinical indication following adequate physical examination [12,13]. The study aims to correlate clinical examination and MRI findings of meniscus tears and cruciate ligament ruptures in the injured knee with arthroscopy being considered as a gold standard procedure.

METHODOLOGY

This retrospective study was conducted at Liaquat National Hospital and Medical College (LNH) orthopedic department. A hundred and sixty-five patients were selected from the hospital's electronic records who had presented with meniscal tears and/or cruciate ligament ruptures and underwent MRI and arthroscopy of the injured knee from January 2018 to July 2020. Patients who were 18 years of age or older and presented with injuries to the cruciate ligaments and/or menisci, having been diagnosed through physical examination followed by an MRI and arthroscopy, were included in the study. Those with associated fractures or a previous history of surgery of the affected knee, presence of degenerative or inflammatory joint disease, a recent (less than 4 weeks since the new injury) history of injury of the affected knee, or those with multi-ligamentous knee injuries were excluded from the study. Patients were recruited from the hospital's electronic records, and aÊnon-probability consecutive sampling technique was employed. The calculated sample size was 165 patients, using a sensitivity of 89% and a specificity of 62% for MRI in medial meniscus injuries, prevalence of knee injuries being 44.8 % and a confidence interval of 95% [14].

Data collected included age, gender, site of injury, mechanism of injury, as well as a concise history including aÊdescription of the presenting complaint, that is, pain, instability, and/or locking, time from onset of complaints to presentation, and reason for delay, if any. Findings of clinical examination focused on meniscal and ligamentous injury, namely the Lachman test and anterior draw test for ACL injury, posterior draw test for PCL injury, McMurray's test with external rotation of the tibia for medial meniscus injury, McMurray's test with internal rotation of the tibia for lateral meniscal injury, and valgus and varus stress test for medial and lateral collateral ligament injuries, respectively. The subjects' MRI reports were reviewed for the radiological presence of injuries to the cruciate ligaments and menisci, and arthroscopic findings mentioned in operative notes and identified on arthroscopic images were documented. Ethical approval was obtained from Liaquat National Hospital's ethical review committee (ERC) (Ref: App#0639-2021, LNH-ERC; dated April 27, 2021). Data was compiled by orthopedic post-graduate trainees. Subjects deemed eligible per the predetermined inclusion and exclusion criteria were contacted by the investigators via their provided phone numbers and invited to participate in the study. Each participant was assigned a unique identification number to ensure confidentiality. Data was analyzed

using Software for data science (STATA) version 23. Mean and standard deviation were computed for continuous variables such as age. In contrast, frequencies and percentages were calculated for qualitative variables such as gender, mechanism of injury, site of injury, symptoms, as well as clinical examination, MRI, and arthroscopic findings.

RESULTS

165 patients with meniscal tears and cruciate ligament ruptures were analyzed, of which the vast majority (86.6%, n=143) were male, and the subjects' mean age was 27.75+8.47 years. The principle presenting complaints were joint pain (88.48%, n=146), instability (67.2%, n=111), and locking (39.3%, n=65). The most common mechanisms of injury were due to sports (58.7%, n=97) and motor vehicle accidents (27.87%, n=46), and the most frequently damaged structures on arthroscopy were found to be the medial meniscus (72.12%, n=119) and the ACL (63.3%, n=105). These findings are summarized in Table 1. Clinical examination demonstrated a positive Lachman test in 87.76% (n=89) of individuals with ACL tears, a positive anterior draw test in 88.54%(n=93) of individuals with ACL tears, a positive posterior draw test in 92.85% (n=13) of individuals with PCL tears, a positive Mc Murray test on external rotation in 81.51% (n=97) of individuals with medial meniscus tears and a positive Mc Murray test on internal rotation in 68.42% (n=39) of individuals with lateral meniscus tears. cases (4.8%), and a mean age of 21 years. Mixed germ cell tumors accounted for 5 cases (3.4%), with a mean age of 23 years, and

Table 1: Frequency of presenting complaints, mechanism of injury, and arthroscopic findings

Variables		Percentage (Frequency)
Presenting complaints	Joint pain	88.48% (n=146)
	Instability	67.2% (n=111)
	Locking	39.3% (n=65)
Mechanism of injury	Sports	58.7% (n=97)
	Road traffic accidents	27.87% (n=46)
	Fall from a height	3.63% (n=6)
	Other	9.69% (n=16)
Arthroscopic findings	ACL tears	63.3% (n=105)
	PCL tears	8.48% (n=14)
	Medial meniscus tear	72.12% (n=119)
	Lateral meniscus	34.54% (n=57)
	Osteochondral defects	8.48% (n=14)
	Cartilage defects	14.54% (n=24)
	MCL tears	4.84% (n=8)

Table 2 shows the diagnostic accuracy of the Lachman test, anterior draw test, posterior draw test, McMurray test for medial meniscus injuries, and McMurray test for lateral meniscus injuries. The Lachman test demonstrated the highest positive predictive value (PPV) of 96.73%, followed by the anterior draw test (94.89%) and the McMurray test for medial meniscus injuries (83.62%).

Table 2 show results from correlating clinical examination with arthroscopy results taking into consideration arthroscopic results as the definitive diagnosis

Parameter	True Positive (n)	True Negative (n)	False Positive (n)	False Negative (n)	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive value (%)	Accuracy (%)
Lachman Test	89	57	16	3	84.76	95	96.73	78.0	88.48
Anterior Draw test	93	55	12	5	88.54	91.66	94.89	82.08	89.69
Posterior Draw test	13	146	1	5	92.85	96.6	72.22	99.30	96.36
Medial Meniscus	97	27	22	19	81.51	58.69	83.62	55.10	75.15
Lateral Meniscus	39	93	18	15	68.42	86.11	72.22	83.78	80.00

Table 3 illustrates the diagnostic accuracy of MRI in diagnosing injuries to the ACL, PCL, medial and lateral meniscus, and articular cartilage, as well as for diagnosing osteochondral defects. Once more, MRI findings of anterior cruciate ligament injuries showed the highest PPV, followed by posterior cruciate ligament and medial meniscus injuries.

Table 3 show results from correlating MRI with arthroscopy results taking into consideration arthroscopic results as the definitive diagnosis

Parameter	True Positive (n)	True Negative (n)	False Positive (n)	False Negative (n)	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive value (%)	Accuracy (%)
Anterior cruciate ligament	98	54	7	8	93.33	90.00	92.45	88.52	92.12
Posterior cruciate ligament	13	137	1	14	92.85	90.72	48.14	99.27	90.90
Medial Meniscus	101	37	18	9	84.87	80.43	91.81	67.27	83.63
Lateral Meniscus	41	81	16	24	71.92	75.00	63.07	83.50	73.93
Articular cartilage Injury	7	113	17	28	29.16	80.14	20.00	86.92	72.72
Osteochondral defect	13	116	1	35	92.85	76.82	27.08	9914	78.18

DISCUSSION

Intra-articular injuries of the knee, namely ACL, PCL, and meniscal injuries, are a common occurrence in orthopedics and are initially evaluated with physical examination and imaging, including orthogonal x-rays of the affected knee to rule out bone pathology, followed by MRI to assess soft tissue. Although arthroscopy has long been considered the gold standard for diagnosing injuries to the cruciate ligament and menisci, MRI has emerged as a reliable, safer, and less invasive diagnostic modality and is often used as an adjunct to arthroscopy [15]. The diagnostic accuracy of MRI and clinical examination was gauged in this study when compared to arthroscopic findings [16].

Our study demonstrates that, in comparison to diagnostic arthroscopy, clinical examination focused on assessing the integrity of the ACL, that is the Lachman test, has a sensitivity of 84.76% and specificity of 95%, whereas MRI has a sensitivity of 93.3% and a specificity of 90% for diagnosing ACL injuries (table 3). Navali et al studied 120 patients with knee injuries and found that clinical examination of ACL tears had a sensitivity of 98.6% and a specificity of 91.7%, whereas MRI evaluation of injuries to the ACL had a sensitivity of 98.6% and a specificity of 83.3% [17]. However, Sokal et al. published a meta-analysis of 22 studies in 2022, revealing the overall sensitivity of Lachman's test toÊbe 81% [95% CI, 73–87] and the sensitivity to be 85% [95% CI, 73–92] [18]. The authors also mentioned that the diagnostic accuracy of Lachman's test has been overestimated in previous studies, and this observation has been similarly reflected in our study. The sensitivity and specificity of MRI for detecting ACL injuries as reported by Navali et al, was consistent with our findings [17].

Similarly, the sensitivity of clinical examination of PCL injuries was found to be 92.58%, and the specificity was reported to be 96.%. We quantified the sensitivity and specificity of MRI evaluation of PCL injuries to be 92.85% and 90.72%, respectively. Jah et al reported the sensitivity of clinical examination of PCL injuries to be 100% whereas MRI evaluation had aÊsensitivity of 81.8%. However, theÊspecificity of both clinical examination and MRI evaluation of PCL was 100%, which was fairly similar to our study [19].

Moreover, clinical examinations of medial and lateral menisci injuries were seen to have specificities of 58.6% and 86.1%, respectively, while MRI evaluations had specificities of 80.43% and 75% respectively. Hashemi SA et al reviewed 86 patients who underwent arthroscopy for intra-articular knee injuries and reported the sensitivities and specificities of clinical examination for medial and lateral menisci injuries to be 71.9% (53.3–86.2) and 72.2% (58.5–83.5) respectively, and MRI evaluations had a sensitivity and specificity of 93.7% (79.2–99.1) and 96.3% (2–99.4) respectively, which were higher than was found in our study [20].

The sensitivity and specificity of MRI for injuries to the articular cartilage in correlation with arthroscopic findings were measured at 29.16% and 80.1% respectively in our analysis. Macarini et al enrolled 90 patients with injuries to the articular cartilage of the knee to analyze the diagnostic efficacy of MRI in such pathologies, thus revealing a sensitivity of 63-64%, which was high with respect to our findings, but in contrast our specificity was similar to his study which was of 74-90% [21].ÊFor osteochondral defects, the sensitivity and specificity of MRI in correlation with arthroscopic findings were comparable to that which is found in previous literature (92.85% vs. 75%) and (76.82% vs 94%) respectively [22]. Niazi et al also demonstrated that MRI is a reliable non-invasive tool for diagnosing ACL tears, with a sensitivity of 89.89%, specificity of 64.28%, and accuracy of 84.25%, though they concluded that arthroscopy remains the definitive gold standard for diagnosis [23].

Among the limitations of the current study, the lack of standardization of the MRI examinations can be cited, these were performed in several centers and this may have increased the dispersion of the data. Although a formal sample size calculation was undertaken prior to the study, theÊsomewhat modest

sample size could be perceived as a drawback. Another limitation was that the duration between the injury, the scans, and the surgical procedure was not taken into consideration, with injuries having possibly advanced during this period of time.

Conclusion

Although arthroscopy is considered the gold standard for diagnosis of intra-articular knee injuries, it is nevertheless an invasive surgical procedure and does not eliminate the need for focused clinical examination in the hands of experienced personnel, complemented by a well-reported MRI. These tools have good diagnostic accuracies and, for the most part, correlate well with arthroscopic findings, and thus help practitioners in providing patients with a prompt plan of action for managing intra-articular knee injuries.

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Author's Contributions:

SI: Data Collection, synopsis & article writing and responsible for accuracy and integrity of research

SK: Statistical analysis, article writing and responsible for accuracy and integrity of research

RM: Synopsis writing; M. Sufyan: Supervision and Reviewing article Compilation of results

MKN: Supervision and Reviewing article Compilation of results, and

AN: Data collection

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