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CLINICAL, MRI AND ARTHROSCOPIC CORRELATION OF MENISCAL AND ANTERIOR CRUCIATE LIGAMENT INJURIES OF THE KNEE

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Abstract

Background: Internal derangement of knee can pose diagnostic challenges to the orthopaedic surgeon, especially in acute settings. Clinical tests like McMurray test can be unreliable in the detection of meniscal tears. MRI is an investigative tool with high sensitivity and specificity for the diagnosis of ligamentous injuries of the knee. However, it is expensive. Arthroscopy can confirm the diagnosis but has associated surgical risks.

Materials and methods: 56 patients with ligamentous injuries of the knee, satisfying our inclusion criteria, were evaluated by clinical examination, MRI and arthroscopy. The results were analysed statistically (accuracy, sensitivity, specificity, positive predictive value and negative predictive value) to find a correlation among the three modalities.

Results: >85% accuracy was noted while correlating clinical examination, MRI and arthroscopy for ACL injuries and lateral meniscal tears. The accuracy rates dropped to 55% for medial meniscal tears.

Conclusion: There is high degree of correlation when clinical examination is compared with MRI and arthroscopy for ACL tears and lateral meniscal tears. There is a low correlation between clinical findings in medial meniscal tears and MRI and arthroscopy findings of the same. Tests for medial meniscus can be false-positive in patients with Osteochondral defects of medial side of the knee.

Keywords: *Arthroscopy, Magnetic Resonance Imaging, Meniscus*

Introduction

The incidence of ligamentous injuries of knee is increasing steadily due to an increase in road traffic accidents and increased participation in contact sports. Injury to any of these supporting structures leads to alteration in the overall motion of the knee, leading to knee instability[1]. Each specific knee injury has its own mechanism of occurrence and underlying risk factors. Injuries to ACL usually occur when the coefficient of friction between the athlete's foot and the playing surface increases, whereas meniscal injuries occur due to rotation stresses[2].

A detailed history and a thorough clinical examination are crucial in the diagnosis of ligamentous injuries of the knee. However, clinical examination may be inaccurate and inconclusive in many cases, especially with meniscal injuries[3, 4]. Clinical tests like the McMurray test for meniscus is reported to be positive in only 58% of the cases and a negative McMurray test does not rule out a meniscal tear[5]. Also, the clinical examination is subject to inter observer variations.

Diagnostic arthroscopy is regarded as the gold standard in the diagnosis of ACL and meniscal injuries[6]. However, it is associated with complications like infection, need for anesthesia etc.MRI is a sensitive (90-98%) and specific (90-100%) imaging method for the diagnosis of ACL injuries[7]. The sensitivity of MRI is superior to clinical examination and also more specific than diagnostic arthroscopy[8].

We performed a prospective study to find a correlation between clinical examination, MRI and arthroscopic findings in meniscal and ACL injuries in our institute.

Materials And Methods

The prospective study was performed between June 2016 and June 2018 in Shree Dharmasthala Manjunatheshwara College of Medical Sciences and Hospital, Dharwad. All the patients admitted in our institution, who were scheduled to undergo arthroscopic surgery of the knee for either meniscal injuries or ACL injuries and who satisfied our inclusion criteria, were included in the study.

The inclusion criteria were

1) Patients aged between 18 years- 60 years
2) Posted for arthroscopic surgery for meniscal injuries or ACL injuries based on clinical examination and MRI findings.
3) Time interval between MRI and arthroscopy being not more than 1 month, with no history of fresh injury in the interval period.

The exclusion criteria were

1) Patients aged < 18 years or > 60 years
2) Patients undergoing arthroscopy for ACL and meniscal injuries without MRI.
3) Arthroscopy done for other indications
4) Patients with associated collateral ligaments or PCL injuries.

56 patients, who satisfied the inclusion criteria, were enrolled in the study. Most of these patients were aged between 20 years- 30 years (Table No.1). Road traffic accident and self-fall were the most common modes of injury (Table No.2). Knee pain was the most common symptom (Table No.3).

Table No. 1. Age distribution

Age Group	No. Of Patients	Percentage
< 20 Years	4	7.1%
21-30 Years	22	39.3%
31-40 Years	14	25%
41-50 Years	12	21.4%
51-60 Years	4	7.1%

Table No. 2. Mode of injury

Type Of Injury	No. Of Patients	Percentage
Road Traffic Accident	16	28.6%
Self-Fall	16	28.6%
Sports Injury	11	19.6%
Others	13	23.2%

Each patient was clinically examined in detail by an experienced orthopedic surgeon and the examination findings were documented in separate case sheets. A detailed history was elicited and a clinical examination was performed. The clinical findings like medial and lateral joint line tenderness, effusion and range of motion were noted. The ligaments were assessed by performing the special tests. Anterior drawer test and Lachman's test were done to detect ACL injury. The meniscal injuries were detected by McMurray test and Apley's grinding test. Posterior drawer test was performed to rule out PCL injury and Dial test was done to rule out injuries of the posterolateral corner of knee. The medial and the lateral collaterals were assessed with valgus and varus stress tests.

Table No. 3. Presenting symptom

Symptoms	No. Of Patients	Percentage
Knee Pain	29	51.8%
Knee Pain & Swelling	12	21.4%
Knee Pain & Instability	07	12.5%

Knee Pain & Locking	05	8.9%
Instability	02	3.6%
Knee Pain, Swelling, Locking & Instability	01	1.8%

The patients then underwent MRI scan (1.5 Tesla machine). The protocol for imaging the knee included was multiplanar with following sequences.

(a) Localizer sequences in sagittal, coronal and axial planes
(b) Fat suppressed T2 axial Turbo spin echo
(c) Short Tau inversion recovery (STIR) coronal
(d) Proton density (PD) and T2 turbo spin echo sagittal
(e) Proton density (PD) and T2 turbo spin echo coronal
(f) T1 spin echo sagittal.

The images were reported by a single experienced radiologist.

Arthroscopic surgery was performed within a month after MRI evaluation. The arthroscopy was done by an experienced orthopedic surgeon. The surgeries were performed under spinal or general anaesthesia. A thorough examination under anesthesia (EUA) was done prior to arthroscopy and Pivot shift test was done to detect ACL injury. The sequence of arthroscopic examination was:

1. Suprapatellar pouch and patellofemoral joint
2. Medial gutter
3. Medial compartment
4. Intercondylar notch
5. Posteromedial compartment
6. Lateral compartment
7. Lateral gutter and posterolateral compartment

After performing a thorough arthroscopy of the knee, the injured structure was identified and treated accordingly. The arthroscopic findings were recorded in detail in the operative notes.

Results

Statistical analysis was used to calculate sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV), accuracy in order to assess the reliability of the Arthroscopy and MRI results. To evaluate the sensitivity, specificity and accuracy of MRI, the findings at arthroscopy were taken to be the true diagnosis.

Sensitivity was calculated from the number of true positive results divided by the sum of the true positive results and the false negative results.

Specificity was calculated from the number of true negative results divided by the sum of the true negative results and the false positive results.

Positive predictive value was calculated by true positive divided by sum of true and false positive results multiplied by 100.

Negative predictive value was calculated by true negative divided by sum of true and false negative results multiplied by 100.

Accuracy was calculated from the sum of the true positive and the true negative results divided by the total number of patients who underwent arthroscopy. The data was analysed using SPSS 17.26 version. The following were the results of the study.

Arthroscopic findings

Longitudinal tears were the most common type of medial meniscal tears seen followed by bucket handle tears.Longitudinal tears were the most common type of lateral meniscal tear followed by radial tears.

Isolated ACL tears were seen in 4 patients, ACL + Medial Meniscus tears were seen in 4 patients, isolated Medial Meniscus tears were seen in 13 patients and isolated Lateral Meniscus tears were seen in 06 patients. Osteochondral defects were noted in 17 patients.

1) Correlation of Clinical Examination with Arthroscopic Examination of Medial Meniscal tears:

The Sensitivity was 72%, Specificity was 42%, Positive Predictive Value was 50%, Negative Predictive value was 65% and Accuracy was 55% (Table No.4).

Table No. 4

Clinical Examination	Tear Present On Arthroscopy		
	Yes	No	Total
Positive	18	18	36
Negative	07	13	20

2) Correlation of MRI findings with Arthroscopic Examination of Medial Meniscal tears:

The Sensitivity was 92%, Specificity was 77%, Positive Predictive Value was 76.7%, Negative Predictive value was 92.3% and Accuracy was 83% (Table No.5).

Table No. 5

Clinical Examination	Tear Present On Arthroscopy		
	Yes	No	Total
Positive	23	07	30
Negative	02	24	26

3) Correlation of Clinical Examination with Arthroscopic Examination of Lateral Meniscal tears: (Table No. 6)

Table no.6

Clinical Examination	Tear Present On Arthroscopy		
	Yes	No	Total
Positive	08	00	08
Negative	02	46	48

The Sensitivity was 80%, Specificity was 100%, Positive Predictive Value was 100%, Negative Predictive value was 95.83% and Accuracy was 95% (Table No.6).

4) Correlation of MRI findings with Arthroscopic Examination of Lateral Meniscal tears: (Table No. 7)

Table No. 7

Clinical Examination	Tear Present On Arthroscopy		
	Yes	No	Total
Positive	09	00	09
Negative	01	46	47

The Sensitivity was 90%, Specificity was 100%, Positive Predictive Value was 100%, Negative Predictive value was 97.9% and Accuracy was 98% (Table No.7).

5) Comparison of Clinical Examination with Arthroscopic Examination of ACL tears: (Table No. 8)

Table No. 8

Clinical Examination	Tear Present On Arthroscopy		
	Yes	No	Total
Positive	11	04	15
Negative	04	37	41

The Sensitivity was 73.3%, Specificity was 90.2%, Positive Predictive Value was 73.3%, Negative Predictive value was 90.2% and Accuracy was 86% (Table No.8).

6) Correlation of MRI findings with Arthroscopic Examination of ACL tears:

The Sensitivity was 80%, Specificity was 92%, Positive Predictive Value was 80%, Negative Predictive value was 92.68% and Accuracy was 89% (Table No.9).

Table No. 9

Clinical Examination	Tear Present On Arthroscopy		
	Yes	No	Total
Positive	12	03	15
Negative	15	41	56

7) Correlation for a particular type of lesion in all three aspects (Clinical Examination, MRI, Arthroscopic Examination).

Correlation in all three aspects was 72% for medial meniscal tears, 80% for lateral meniscus and 73.3% for ACL tears.

8) Comparison of Clinical Examination for ACL, Medial Meniscus and Lateral Meniscus (Table No. 10):

Table No.10

Results	Accuracy	Sensitivity	Specificity	Ppv	Npv
Acl	86%	73.5%	90.2%	73.3%	90.2%
Medial Meniscus	55%	72%	42%	50%	65%
Lateral Meniscus	95%	80%	100%	100%	95.83%

9) Comparison of MRI findings for ACL, Medial Meniscus and Lateral Meniscus (Table No. 11):

Table No. 11

Results	Accuracy	Sensitivity	Specificity	Ppv	Npv
Acl	89%	80%	92.7%	80%	92.7%
Medial Meniscus	83%	92%	77.1%	76.7%	92.3%
Lateral Meniscus	98%	90%	100%	100%	97.9%

Discussion

In the past, the ligamentous injuries of the knee were primarily diagnosed on detailed clinical examination, as radiographs alone were inadequate to diagnose them. Clinical examination alone, even in experienced hands, produced false diagnosis rates ranging between 40%-85%, especially for meniscal injuries[3,4]. Clinical examination is also subject to inter observer variations.

Subsequently, many studies were performed evaluating the efficacy of combination of clinical examination and diagnostic arthroscopy in the diagnosis of meniscal and ACL injuries. DeHaven et al, reported a very high incidence of ACL tears and meniscal injuries in patients with acute traumatic hemarthrosis in whom arthroscopy was done as a diagnostic procedure[9]. Johnson LL et al, compared clinical examination and diagnostic arthroscopy, and found a significant number of additional diagnoses, including some which were

completely different from the clinical diagnosis[10]. Curran et al studied 396 knee arthroscopies and found that the total clinical accuracy rate was only 71%. Diagnostic arthroscopy increased their accuracy rates to 97%[11].

MRI of the knee has become a reliable tool in the detection of knee injuries and is the preferred investigative modality today. It is non-invasive, and allows the evaluation of all the soft tissues and bony structures, including the articular cartilage. The sensitivity and specificity of MRI in the diagnosis of ligamentous injuries is more than 90%[7, 8].

A review of literature suggests a good correlation for ACL injuries diagnosed clinically and then evaluated by MRI and arthroscopy. However, when evaluating clinically suspected meniscal injuries, there is less correlation between clinical examination and MRI and arthroscopy. We compared our study with previous similar studies done. Rayan[12] et al performed a similar study on 131 patients. While correlating clinical examination with arthroscopic finding of medial meniscal tear they found an accuracy of 79%, sensitivity of 86%, specificity of 73%, positive predictive value of 76% and negative predictive value of 83%. The correlation of clinical examination with MRI and arthroscopy for ACL tears were much higher, with accuracy being 93 %, sensitivity 77%, specificity 100%, positive predictive value 100% and negative predictive value 95%.

Similar studies done by other authors like Navaliet al[13], Nikolaou et al[14], Loo WH et al[15] have yielded similar results while correlating clinical examination with MRI and arthroscopy in the diagnosis of ligamentous injuries of the knee.

The accuracy of clinical examination for medial meniscus in our study is less than that found in other studies (50%). This can be explained by the fact that many of our cases in which tests for medial meniscus were positive had an Osteochondral defect on arthroscopy. All the patients in our study underwent MRI evaluation in a 1.5 Tesla machine with no special sequences for articular cartilage imaging. Hence, these defects were missed in the MRI image.

The results of our study are comparable to other studies for ACL and lateral meniscal injuries. Hence, a patient diagnosed clinically with either an ACL injury or lateral meniscal injury can be counselled for definitive management of these injuries with greater degree of confidence, relying solely on clinical examination. However, it has become a standard practice to do MRI pre-operatively before subjecting the patient for surgery.

Conclusion

We would like to arrive at these conclusions from our study

1) Clinical tests to detect ACL and lateral meniscal injuries have a high degree of correlation when compared with MRI and arthroscopy.
2) Clinical tests to detect medial meniscal tears have a low degree of correlation when compared with MRI and arthroscopy.
3) Clinical tests done to detect medial meniscal injuries can be false positive for Osteochondral defects of the medial compartment of the knee.
4) When treating medial meniscal tears, the surgeon should be prepared to treat unsuspected Osteochondral defects found at arthroscopy, especially when no MRI or a sub-optimal MRI has been done.

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