

Diagnositic Accuracy of Magnetic Resonance Imaging with Arthroscopy in the Diagnosis of Meniscal Tear

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Abstract

Many clinical studies have been done to facilitate physicians in making accurate diagnoses of knee injuries. The knee injuries related to meniscal tear resulted in significant pain and disability to patient mobility. In the current study, the efficiency of clinical examination in contrast with MRI was examined in the diagnosis of a meniscal tear with the help of the gold standard method, arthroscopy. All the patients with suggested arthroscopy were included in the study and enlisted from City care hospital, Latifabad, Hyderabad. The clinical examination conducted before the arthroscopy involved the following test such as Thessaly test, Apley test, and McMurray test. These results along with MRI were recorded in special forms. Finally, arthroscopy was carried out and results were mentioned as the definite diagnosis. To compare all the obtained results statistical analysis was performed by SPSS software (version 18; SPSS Inc., Chicago, IL, USA). A total of 75 patients were considered. The average age was 32 years consisting of both male and female patients. All candidates had knee injuries due to different reasons i.e., trauma, twisting, and sports, respectively. The Arthroscopic study identified 34 meniscal tears, consisting of medial and lateral nature comprising longitudinal, bucket handle, transverse, radial, and oblique injuries. The comparison analysis of both MRI and arthroscopic results exhibited 1 false-negative and 1 false-positive case. Considering the McMurray test, 55 cases came out accurate in which 13 cases were considered as false positive and 10 cases as a false negative. The results of the Apley test showed 50 cases as accurate consisting of 13 cases as false-positive and 7 cases as

a false negative. In the case of the Thessaly test, 67 cases showed accuracy with false negative and false positive as 3 and 5 cases, respectively. The statistical significance ($P < 0.05$) results were obtained when Thessaly results were compared with Apley and McMurray test. The comparison analysis of MRI results with Thessaly test results resulted in a non-statistical significance value ($P = 0.151$). It was found from the current study that the clinical examination conducted by a competent examiner has the same diagnostic power as that of MRI results. In the current study, the Thessaly test was also found as a major clinical test to diagnose the meniscal injury.

Keywords: knee injuries; meniscal rupture; arthroscopy; MRI; McMurray test; SPSS software

Introduction

Acute knee injury has been considered a commonly discussed issue for many years. Many diagnostic studies have been carried out to facilitate the physician in making the prompt and accurate diagnosis of knee problems. The physician can make accurate and prompt treatment of lesions that resulted from torn meniscus or ligaments of knee joints [1-3]. The meniscus injuries during exercise resulted in complicated consequences so accurate and timely diagnosis is a prerequisite in their treatment.

Both physical examination and diagnostic tests determined the need for surgery for meniscus injury. The examination of the injury site includes its full description, palpation of the specific site as well as the need for specific tests. Patients with a meniscus injury, for example, athletes, feel a pop-like sound when the foot heel is bent by colliding with another player [4].

The meniscal injury also resulted in a joint-like effusion and tenderness. The palpation felt beside the knee axis might have undetermined results in considering meniscus rupture. For internal axis knee palpation, specificity and selectivity were 34% and 49%, respectively. However, for external axis palpation, the specificity and selectivity were 49% and 57%, respectively. In the absence of ACL injury, tenderness along the joint axis identifies the meniscal injury more accurately 77% [5].

A few tests that might help to treat the patient with symptoms include the McMurray test, palpation of the joint border, Thessaly test, and Apley grind test [6-7]. Arthroscopy is a gold standard method used for quick diagnosis of traumatic injury of the knee joint. Regardless of higher accuracy, arthroscopy is a costly procedure that needs patient hospitalization and anesthesia. This procedure also increases the chances of infection, vascular and neurological injury, linked to intra-articular injury components of the knee joint. Knee arthroscopies cases are increasing with 1200 and more in a year [8]. Therefore a noninvasive diagnostic tool requires that reduce the potential risks as well as the possibility of arthroscopy. Previously, several studies have been done to define the role of an experienced clinician. Therefore, the precision of clinical examination was determined for MRI results and standard method, arthroscopy, in the present study [9].

Material and methods

This cross-sectional study was carried out on both male and female patients who had any signs and symptoms of meniscus tear that was resulted due to athlete trauma or accidents. All these patients were referred for arthroscopic surgery to City care hospital, Latifabad, Hyderabad. Patients were further selected based on available sampling. Patients regardless of MRI results exhibited positive examination results of meniscus injury along with clinical complications were underwent with arthroscopy. In addition, those patients whose MRI results show meniscus injury and a normal physical examination go through arthroscopy were also involved in the current study. All patients with a history of meniscectomy, knee injury, repair of ligament, knee arthroscopy were as well involved in the study.

- Experienced clinical surgeon conducted the clinical evaluation with competency, unaware of the patient's MRI results. The data obtained from clinical examination along with patient characteristics were noted in separate forms. Finally, all results of the MRI were entered. The test employed in the current study included the Apley test, McMurray test, and Thessaly test. The radiologist then examined each patient for MRI imaging, and results were noted in separate forms. Finally, arthroscopy was carried out by the qualified surgeon of all patients. The results provided by the surgeon were reported as a definitive diagnostic result and when they were compared with other test results and MRI, four types of cases were found such as true negative and positive and false negative and positive. The statistical tool was applied by employing SPSS (version 18; SPSS Inc., Chicago, IL, USA) McNemar and chi-square (χ^2) tests. The results were analyzed by descriptive statistics, values of specificity, selectivity, positive predictive value (PPV), and negative predictive values (NPV) were noted. For the comparison analysis between tests result and MRI, chi-square and McNemar tests were used. The final results having a P value less than 0.05 were taken as statistically significant values.

Results

In the present study, the test results of 75 patients were taken. The average age of patients was 32 years (17-47). Table 1 describes the results with location, frequency, and type of injury. The arthroscopy results displayed 34 cases of ligament rupture, comprising 32 cases of medial meniscus injuries and 2 cases of lateral meniscus injuries. Of these, percentages of male and female study cases were 68% and 32%, respectively, consisting of right knee injuries (56%) and left knee injuries (38%). Arthroscopy study also displayed a wide range of injuries comprising longitudinal injury, bucket handle injury, transverse, radial, and oblique injuries. The MRI images were compared with arthroscopy data, the positive and negative results were 31% and 50% percent, respectively. However, in the case of reported error cases, two were falsely positive and the other two were false negative. The false-positive cases were further classified into the longitudinal and radial tear whereas false positive was of bucket handle and longitudinal tear nature. The descriptive statistics data exhibited the diagnostic accuracy,

specificity, and sensitivity of MRI results as 95.3%, 96.3%, and 93.7%, respectively. Figure 1.1 shows some MRI Images.



Figure 1.1 Sagittal and coronal sections of MRI brain, knee without contrast showing a tear in the posterior horn of medial meniscus getting up to the articular surface represent grade iii tears. There is a bone bruise at the proximal tibia as well.

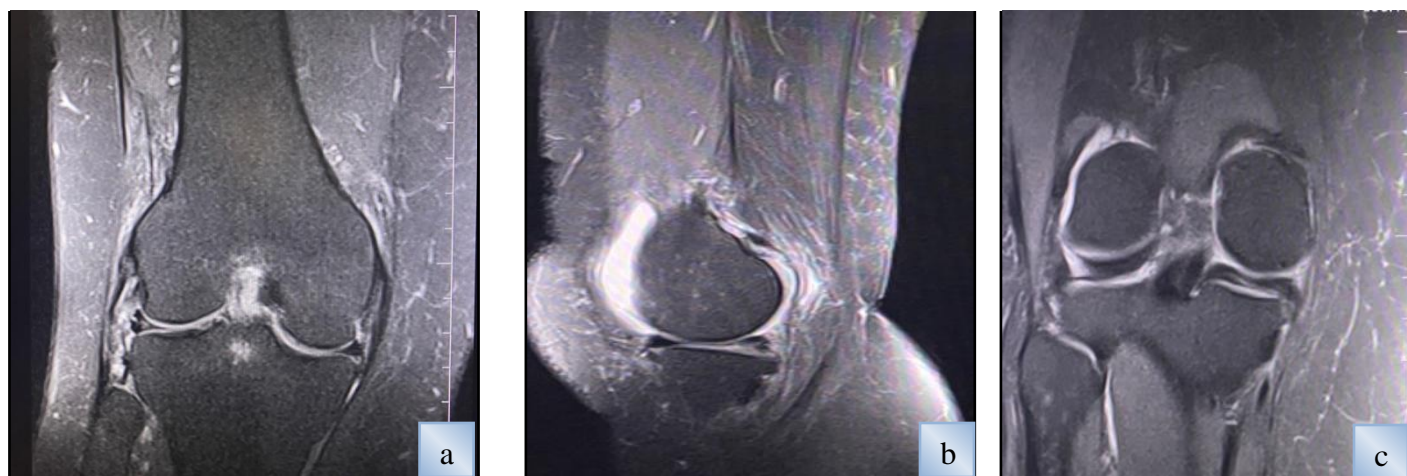


Figure 1.2 Arthroscopy findings (a) medial meniscus (b) lateral meniscus (c) median meniscus

The various test results of all examined cases are as follow

Out of 75 cases, 55 came out accurate in the McMurray test. Among error cases (22), false-positive were 13, which were further described as lateral cases (2) and 11 cases of medial meniscus while concerning false-negative cases (5) consisted of 1 rupture case in the lateral meniscus and, 4 cases in the medial meniscus. Figure 1.2 shows some arthroscopy findings.

Table 1: Frequency and location; along with the type of injury findings by arthroscopy in patients with a meniscus injury.

| | Frequency | Percent |
|------------------------|-----------|---------|
| Age | | |
| 17 to 27 | 20 | 26.6 |
| 27 to 37 | 42 | 56 |
| 37 to 47 | 13 | 17.3 |
| Gender | | |
| Male | 58 | 77.3 |
| Female | 17 | 22.6 |
| Cause of injury | | |
| Exercise | 54 | 72 |
| Trauma/torsion | 15 | 20 |
| Accidental injuries | 6 | 8 |
| Location | | |
| Right knee | 48 | 64 |
| Left knee | 27 | 36 |
| Arthroscopy injury | | |
| Medial meniscus injury | 32 | 91 |

| | | |
|--------------------------------|----|----|
| Lateral meniscus injury | 2 | 6 |
| Bucket handle tear | 7 | 27 |
| Longitudinal tear | 20 | 60 |
| Transverse/oblique/radial tear | 3 | 9 |

The result of the Apley test is as follows. From all cases, 60 came out accurate and 24 were error cases. Among error cases, 16 were falsely positive and 7 were false negative. The false-positive cases consisted of lateral meniscus rupture (3) and medial meniscus tear (13). While false negatives cases were described as lateral meniscus injury (1) and medial meniscus injury (6). The Thessaly test showed 67 cases as correct and the remaining 8 as error cases. Among error cases, five cases were false positive with 2 showing lateral meniscus injury and the other 3 showing medial meniscus injury. However, false-positive tests comprise of one articular cartilage and discoid meniscus injury, and 4 cases of medial meniscus injury were found in the false-negative case. Table 2 determines the frequency of rupture types in false-positive and false-negative examinations. The descriptive statistics tools were used for Thessaly, McMurray, Apley tests. In addition, sensitivity, accuracy, specificity, positive predictive value (PPV), and negative predictive value (NPV), were also defined, as presented in Table 3.

Discussion

The present study showed the higher diagnostic accuracy of physical examination combined with MRI in case of meniscus injuries. The diagnostic efficiency of the MRI test came out significantly higher as compared to other tests such as Apley, McMurray, and Thessaly. The specificity, sensitivity, and diagnostic efficiency of the MRI test are greater than other tests. Among the different tests conducted for knee injuries, the Thessaly test showed higher diagnostic power than others as indicated through their specificity, sensitivity, accuracy, negative and positive predictive values.

In contrast to our study, Navali *et al.* [10] showed the greater diagnostic power of MRI along with physical examination in meniscus injuries.

Nikolaou *et al.* [11] conducted the study and find out the low diagnostic efficiency of physical examination as compared to MRI tool. However, various studies have concluded that the physical examination done by experienced and qualified persons resulted in the same diagnostic results as the MRI method. Therefore in that case clinical examination can be used as a diagnostic tool [12].

The physical examination usually resulted in a better diagnosis of a lateral meniscus tear as compared to a medial meniscus tear. Navali *et al.* [10] mentioned the physical examination significance for medial meniscus injuries diagnosis. In another study, Wang *et al.* conducted the meta-analysis and found the sensitivity and specificity of MRI results. The percentages of meniscal rupture were 80.0% (95% CI: 66.0–89.0%) and 95.0% (95% confidence interval (CI):

91.0–97.0%) in lateral meniscal tears and 92.0% (95% CI: 88.0–95.0%) and 90.0% (95% CI: 85.0–95.0%), respectively [13].

Table 2 Type of Injury

| | False-negative Type of injury | | | False-positive | |
|----------|----------------------------------|--------------|---------------------------|-----------------|------------------|
| | Bucket handle | Longitudinal | Transverse/oblique/radial | Medial meniscus | Lateral meniscus |
| Thessaly | 1 | 2 | 0 | 3 | 2 |
| McMurray | 3 | 4 | 2 | 11 | 4 |
| Apley | 4 | 3 | 3 | 13 | 3 |

| Type of test | Accuracy (%) | Negative predictive value | Positive predictive value | Specificity (%) | Sensitivity (%) |
|--------------|--------------|---------------------------|---------------------------|-----------------|-----------------|
| Thessaly | 92.11 | 95.4 | 87.1 | 88.1 | 93.6 |
| McMurray | 76.13 | 83.5 | 58.2 | 70.4 | 74.5 |
| Apley | 65.25 | 82.1 | 54.4 | 67.2 | 73.1 |

The experienced surgeon can carry out the clinical examination and then decide where the patient requires further assessment like MRI or surgery. Inexperienced surgeons affect the accuracy of decision-making. Bohnsack *et al.* [14] described the importance of experienced surgeons as they can efficiently diagnose only through clinical examination. In their study, the clinical examinations done through an experienced surgeon resulted in 80% precise diagnosis of lateral meniscal rupture whereas 93% accuracy in detection of the medial meniscal tear. When the same clinical examination was done by the least experienced surgeon i.e., student, the diagnosis of lateral and medial meniscal tear was performed with 80% and 73% accuracy, respectively. When these results were compared with MRI reports, the accuracy of 83% was determined for both.

- Kharachalios *et al.* [15] described the Thessaly test (-20degree) results with 94% diagnostic accuracy in the case of medial meniscal tear whereas a precision rate of 96% in lateral meniscal tear case. They also mentioned the false negative and positive values. They described the Thessaly test, as an important tool for initial clinical examination of meniscal tear and considered it as an alternative method concerning the MRI test. The Thessaly test result was also compared with other test results i.e., McMurray and Apley test, and find them statistically significant showing the importance of the Thessaly test over others. In another study, Harrison *et al.* [16] examined 110 patients, and 66 cases came out as Thessaly positive with specificity, sensitivity, and diagnostic accuracy and recommended as an important test for meniscal tear diagnosis. Their results supported

the finding of our study. We had compared the results of the Apley and McMurray test and found no statistically significant difference ($P=0.267$) between them. The error rate between the two tests was found to be similar, but significantly higher than the Thessaly test.

Conclusion

Previously, various diagnostic studies have been carried out to facilitate the capability of physicians to diagnose meniscal injury correctly. Regardless of arthroscopy, another noninvasive methods to diagnose meniscus injury are MRI. It is a commonly used method that was usually carried out before arthroscopic and surgical examination. The results of the present study exhibited significant diagnostic power with greater specificity and sensitivity in the diagnosis of a meniscal tear. It was found that the physical examination of the patient proved to be as accurate as of the results of the MRI test. The Thessaly test was also found to be an appropriate examination test for the determination of meniscal rupture in this study.

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