

Precision In The Diagnosis Of Medial Meniscal And Anterior Cruciate Ligament Tears By MRI

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Abstract

MRI is the more commonly advised diagnostic method in diagnosing musculo-skeletal pathologies. Knee joint is the most common articulation subjected to imaging studies. MRI has high accuracy in diagnosing the knee conditions like medial meniscal tears and ACL disruptions. The present study compares the MRI scan diagnosis and the finding of the arthroscopy which was as set as a gold standard. The results were obtained using statistical formulae, to calculate sensitivity, specificity, positive and negative predictive value of the MRI scan. The study showed sensitivity and specificity rates in accordance with the reports in the literature. Current findings suggest that MRI helps the clinician in diagnosing these lesions with a high level of precision and proceeding with the definite intervention without subjecting the patient to invasive diagnostic modalities like arthroscopy.

INTRODUCTION

No imaging modality (With the exception of roentgenography) has had as great an impact on the current practice of orthopaedics as magnetic resonance imaging (MRI). It provides unsurpassed soft tissue contrast and multiplanar capability with spatial resolution that approaches that of computed tomography.

With the availability of the specialized extremity coil, the knee has become the most frequently studied articulation¹. A large percentage of knee pain or disability is caused by the pathological condition of the menisci and cruciate ligaments. MRI is one of the non invasive means of imaging the cruciate ligament and meniscal injuries with reports of high success rate in diagnosing the lesions. The diagnosis of knee pathology is usually followed by diagnostic arthroscopy, however, the criteria for selecting patients for this invasive procedure is not clearly defined², resulting in unnecessary invasive examination. Tait³ reported that nearly 33% of arthroscopies are unnecessary, resulting in an excess annual cost of \$150,750 in 251 consecutive arthroscopies.

The present study was aimed at comparing the diagnostic accuracy of MRI for medial meniscal and anterior cruciate ligament injuries with the arthroscopic examination as the gold standard.

MATERIAL AND METHODS

This was a retrospective study of 140 patients who were diagnosed as having a medial meniscal injury, a cruciate ligament injury or a combination on magnetic resonance imaging and were subsequently subjected to arthroscopic examination by the senior orthopaedic surgeon (MF).

Patients with acute knee injury with hemarthrosis, obvious ligamentous instability and knee deformity due to a non-traumatic disorder were excluded from study.

These were 98 male and 42 female patients. The patient age averaged 42 years (range 16 to 57 years). None of these patients had previously undergone any surgical procedure around the knee joint.

Initial clinical evaluation included general physical examination, palpation for patellar crepitus, patellar mal tracking and specific tests for intraarticular lesions – McMurry's test, Appley's grinding test, Squat test, and drawer tests.

An MRI scan was performed in coronal and sagittal planes, using 1.5 tesla superconducting image (Siemens). MRI diagnosis was recorded on a case sheet.

Arthroscopy was carried out under general anesthesia, epidural or spinal anesthesia. All arthroscopies were performed by the senior orthopedic surgeon (MF). The joint

was distended with normal saline before inserting the Storz arthroscope with 30° fore lens via an anterolateral and anteromedial portal. The findings of arthroscopic examination were recorded.

The results of MRI were compared with those an arthroscopic examination.

The data was analyzed to calculate true positive, true negative, false positive and false negatives. Using these specificity and sensitivity positive and negative predictive values was calculated with arthroscopic examination as the gold standard for comparison.

RESULTS

MRI SCAN AND ARTHROSCOPY FOR MEDIAL MENISCAL

Imaging of the medial meniscal tear yielded eighty-five true positive, six false positive, four false negative, forty five true negative results. The sensitivity was 95.5% and specificity 88.23%. The positive predictive value of imaging, i.e. the percentage of patients who were diagnosed as having a tear on MRI and were subsequently found to have a tear on arthroscopy, was 93.4%, and negative predictive value i.e. the percentage of patients who were diagnosed as having no tear on MRI and were subsequently found to have no tear on arthroscopic examination, was 91.83%.

ANT. CRUCIATE LIGAMENT TEAR

Imaging for anterior cruciate tear yielded seventeen true positive, one hundred and eighteen true negatives, three false positives and two false negatives results. The sensitivity, i.e. the ability of MRI to identify correctly those who had anterior cruciate ligament tear, was 89.47%. The specificity i.e. the ability of MRI to diagnose correctly all those who had no anterior cruciate ligament tear, was 97.52%. The positive predictive value of imaging, therefore, was 85% and negative predictive value was 98.33%.

DISCUSSION

A large percentage of knee pain or disability is caused by pathological condition of the menisci. One study reported this to be the cause of two – thirds of all derangements of the knee joint₄. Likewise the disruption of the anterior cruciate ligament, a major stabilizer of the knee, leads to loss of stability of the knee and potentially significant dysfunction. Although the ACL is the most frequently torn ligament of the knee, the ACL tear has remained clinically elusive. These injuries account for a large no. of referral to hospitals.

The evaluation of these lesions remains a difficult clinical problem. The MRI is a frequently used diagnostic modality for these internal derangements because of being non-invasive, painless and unassociated with risk of radiation.

The accuracy, sensitivity and specificity values for knee lesions vary widely in literature. Rubin et.al.₅ reported 93% sensitivity for diagnosing isolated ACL tears. Similarly several prospective studies have shown a sensitivity of 92 – 100% and a specificity of 93 – 100% for the MR Imaging diagnosis of ACL tears_{6,7,8}. The sensitivity for diagnosing isolated medial meniscal tears in Rubin's series was 98% and it decreased when other structures were also injured. The specificity in isolated lesion was 90%. In a multicentric analysis Fisher₈ reported an accuracy of 78 – 97% for the anterior cruciate ligament and 64 – 95% for medial meniscal tears.

The menisci are composed of fibro cartilage and appear as low-signal structures on all pulse sequences. The sensitivity and specificity of MRI in detecting meniscal tears exceeds 90%₁. Ryan et.al.₉ in a prospective comparison of clinical examination, MRI, bone SPECT and arthroscopy to detect meniscal tear reported high diagnostic ability of MRI along with bone SPECT to detect meniscal tears, with a sensitivity and specificity of 80% and 71% respectively.

Simultaneous injury to several supporting structures is relatively common in the knee. When more than one lesion was present completely correct diagnosis was rendered only 30% the time. This phenomenon was reported by Rubin₅.

In the present study the specificity and sensitivity of MR Imaging for knee for ACL and medial meniscal lesion was 89.47% and 97.52% and 95.5% and 88.23% respectively. The positive predictive value for medial meniscal tear was 93.4% and negative predictive value of 91.83%. Similarly the positive predictive value for ACL tear was 85% and negative predictive value of 98.33%. This means that the MR Imaging modality has a high accuracy in ruling out the lesions of intraarticular structures.

In a prospective study reported by Imhoff et al₁₀, the negative predictive value was 94% but the positive predictive value was only 54%. They concluded that due to a high negative predictive value, a normal MRI scan allows eliminating a meniscal lesion and so there is no need for a diagnostic arthroscopy. They suggested that due to low positive predictive value of MRI it should not be routinely used to confirm clinical diagnosis and its use should be

limited to those cases where clinical examination is inconclusive. A diagnostic arthroscopy would be a better choice in those cases.

Compared with other diagnostic modalities that have been used to evaluate internal derangements of knee, arthroscopy, arthrography and computed tomography, magnetic resonance imaging has many advantages¹¹. It is non-invasive unlike arthroscopy and arthrography, is painless and allows imaging the various para-axial and orthogonal planes, it does not use ionizing radiation like CT, and its accuracy is not impaired by the superimposition of osseous structures. Its only disadvantages are its costs and overuse. It is, nonetheless, an important diagnostic tool and in combination with thorough clinical examination helps diagnosing the knee pathologies and their subsequent effective management.

MRI can also reduce the requirement of a diagnostic arthroscopy¹² and prevent unnecessary invasive examination and be cost effective. Our study also supported this preview.

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