



Role Of Magnetic Resonance Imaging in Evaluation of Anterior Cruciate Ligament Injuries with Arthroscopic Correlation

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ABSTRACT

Aim: To assess the correlation between MRI findings and Arthroscopy results in diagnosing ACL injuries.

Methodology: A prospective study was carried out on 64 patients of all age group, both men and women referred to the department of radiology with history of knee trauma and knee pain with follow up arthroscopy.

Result: Arthroscopy was performed on 64 patients, either for diagnostic or therapeutic purposes. A correlation was found when all the data was analysed and tabulated. The majority of the patients were male. The sensitivity, specificity, PPV, NPV and accuracy of MRI in diagnosing ACL injuries were 90%, 64.3%, 30.28%, 97.39 % and 84%, respectively.

Conclusion: MRI is pivotal in visualizing the ACL, menisci, ligaments, and articular surfaces of the knee, making it indispensable for diagnosing ACL injuries. It provides comprehensive details about the ACL's structure and health by employing imaging sequences like T1- and T2-weighted imaging, which are highly effective in identifying ACL damage with considerable accuracy.

KEYWORDS: MRI, knee injury, arthroscopy

- ACL injury can be diagnosed in majority of patients by history and clinical examination. The clinical diagnosis is sometime difficult in acute cases. Also partial tears are difficult to diagnose and the associated injuries can't be completely evaluated by clinical examination.
- MRI is pivotal in visualizing the ACL, menisci, ligaments, and articular surfaces of the knee, making it indispensable for diagnosing ACL injuries. It provides comprehensive details about the ACL's structure by employing imaging sequences like T1- and T2-weighted imaging, which are highly effective in identifying ACL damage with great sensitivity and specificity.
- MRI plays a crucial role in pre-operative planning for ACL reconstruction surgery by providing detailed anatomical information about the extent and location of ACL injury, associated intra-articular pathology, and potential surgical obstacles. This information helps orthopedic surgeons to formulate appropriate surgical strategies, select optimal graft options, and anticipate potential intraoperative challenges, thereby enhancing the overall success and outcomes of ACL reconstruction procedures.
- Despite its high sensitivity and specificity, MRI interpretation for ACL injuries is not without pitfalls. Common pitfalls include misinterpretation of normal anatomic variants as pathological findings, failure to detect partial tears or subtle injuries, and misdiagnosis of artifacts or imaging artifacts as ligamentous pathology. Moreover, concomitant injuries such as meniscal tears or chondral lesions may sometimes overshadow the primary ACL injury, leading to diagnostic challenges and interpretation errors.

I. INTRODUCTION

- Anterior cruciate ligament is the most commonly injured of the major knee ligaments. Injuries occur frequently in both athletes and nonathletes. These injuries can result in significant functional impairment and may predispose individuals to the development of osteoarthritis later in life, therefore accurate diagnosis and evaluation of ACL injuries are paramount for guiding appropriate treatment decisions and optimizing patient outcomes.



- Arthroscopic correlation is crucial in ACL injuries as it serves as the gold standard for confirming the diagnosis, assessing the extent of ligamentous damage, and identifying associated intra-articular lesions. By directly visualizing the ACL and surrounding structures during arthroscopy, surgeons can accurately evaluate the integrity of the ligament, determine the presence and location of tears or ruptures, and assess for concomitant injuries such as meniscal tears, chondral defects, or synovial impingement.

II. METHODOLOGY

- Study population : A prospective study was carried out on 64 patients over a period of one year.
- Inclusion criteria : Patients of all age group, both men and women referred to the department of radiology with history of knee trauma and knee pain with follow up arthroscopy were included in the study.
- Exclusion criteria : Patients with prior h/o surgery, arthroscopy, Patients with MR incompatible devices or implants, Patients with claustrophobia, Patients on life support systems.
- Method : After obtaining consent, all patients were sampled for MRI. The MRI study was performed on GE (Signa explorer) 1.5 T machine with dedicated knee coil.
- Scanning technique : Patient was positioned in supine position with feet pointing towards the

magnet. A knee coil was placed over the knee joint to obtain uniform signal to noise ratio. All patients were subjected to T1 axial and coronal, T2 axial, coronal and sagittal, STIR coronal and PD sagittal sequences, axial GRE. Intravenous contrast was given when needed based on MRI findings.

III. RESULTS

The ability of MRI to diagnose ACL injury was compared with arthroscopy and the results were analyzed by statistics. Primary and secondary signs for ACL tear in MRI were also studied in detail in correlation with arthroscopy. A diagnosis of complete tear of ACL was based on the presence of the following primary findings: a) abnormal high signal intensity within ACL b) abnormal axis/ angle (fibres not parallel to intercondylar line of Blumensaat) c) discontinuity of the fibres d) non-visualization of ACL. For the diagnosis of partial tears the direct signs include focal increase in signal intensity, focal angulation, ligament enlargement and partial discontinuity. The primary signs were evaluated and ACL status classified as normal, partial or complete tear. The final arthroscopic findings after evaluation with MR imaging were accepted as gold standard against which the MR findings were compared. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy were calculated for MR imaging in diagnosing ACL tears in correlation with arthroscopy.

TABLE 1-GENDER DISTRIBUTION OF PATIENTS

| Sex of patients | No. | (%) |
|-----------------|-----|-------|
| Male | 53 | 82.8% |
| Female | 11 | 17.2% |
| Total | 64 | 100% |

TABLE II- STATISTICS AND FREQUENCY DISTRIBUTION

| TESTS | ACL(%) |
|--------------------------------|--------|
| Sensitivity | 90% |
| Specificity | 64.3% |
| Positive predictive value(PPV) | 30.28% |
| Negative predictive value(NPV) | 97.39% |
| Accuracy | 84% |

TABLE III-DIAGNOSIS AND FREQUENCY OF DISTRIBUTION :

| MRI | Arthroscopy | |
|--------------|--------------|-------------|
| | Tear Present | Tear absent |
| Tear Present | 45 (TP) | 5 (FP) |
| Tear absent | 5 (FN) | 9 (TN) |



Total number of patients evaluated were 64. Out of the 64 patients, 53 (82.8%) were male, while 11 (17.2%) were female. Male preponderance may be related to more outdoor activity and sports participation. Out of 64 patients, 58 were below age of 40 years and 6 patients were above 40 years. Table II presented the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of MRI in detecting ACL tears. Table III provided diagnosis and frequency distribution related to the MRI and arthroscopy results, indicated that 54 patients (true positive and true negative) had the same diagnosis on both MRI and arthroscopy. Among the 64 cases, 45 were arthroscopically positive and MRI positive (true positives), 5 were arthroscopically negative but MRI positive (false positives), 5 were arthroscopically positive but MRI negative (false negatives), and 9 were arthroscopically negative and MRI negative (true negatives).

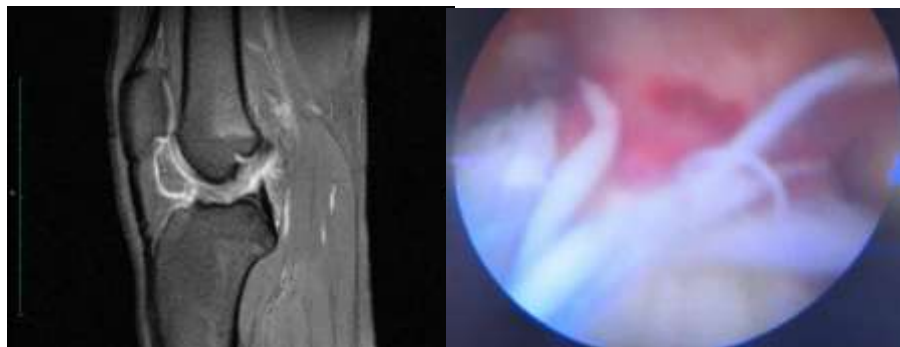
IV. DISCUSSION

The role of MRI has greatly expanded, making it the preferred method for diagnosing most knee lesions. Unlike other modalities such as radiography, arthrography, and ultrasonography, MRI allows for a comprehensive evaluation of all internal knee structures. It is also used for both pre- and post-operative evaluations. It is a non-invasive

technique. Even arthroscopy have limitation for lesions, such as peripheral meniscal tears, inferior surface tears, and osteochondritis dissecans without articular cartilage damage. Meniscal injuries are associated with ACL injury. It is a common cause of knee dysfunction, accounting for two-thirds of all knee disturbances. Similarly, ACL tears significantly destabilize the knee joint. Despite being the most frequently injured knee ligament, clinical diagnosis of ACL tears remains challenging. MRI, being a non-invasive and radiation-free diagnostic tool, is commonly employed to detect these internal derangements.

Rubin et al. found 93% sensitivity for diagnosing isolated ACL tear. Fisher et al reported that MRI was more accurate than arthroscopy in terms of sensitivity, specificity, and total accuracy. Our study also showed that MRI was more accurate than arthroscopy, with a sensitivity of 90% and a specificity of 64.3%.

It's crucial to educate the patient on the surgical approach beforehand. Arthroscopic procedures rely heavily on the knowledge and experience of the operating surgeon. It is important to provide the patient an in-depth explanation of the surgical method before beginning the operation. Although useful, arthroscopy is not a substitute for magnetic resonance imaging (MRI).



MRI knee of a patient with complete ACL tear shows hyperintense signal involving anterior cruciate ligament with disruption of its fibers on STIR sequence.

Arthroscopy image of the patient showing complete tear of anterior cruciate ligament.

V. CONCLUSION

MRI plays a crucial role in the evaluation of anterior cruciate ligament (ACL) injuries, offering several advantages including non-invasiveness, multiplanar imaging capabilities, and superior soft tissue contrast resolution. MRI provides detailed information about the extent and

severity of ACL injuries, aiding in pre-operative planning and facilitating accurate diagnosis of associated intra-articular pathologies. Arthroscopic correlation serves as the gold standard for confirming the diagnosis and assessing the extent of ligamentous damage, highlighting the importance of comprehensive evaluation in guiding treatment decisions.

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