Journal of Orthopaedics, Trauma and Rehabilitation 24 (2018) 52–56

Contents lists available at ScienceDirect

Journal of Orthopaedics, Trauma and Rehabilitation

Journal homepages: www.e-jotr.com & www.ejotr.org

Research Paper

Clinical, Magnetic Resonance Imaging, and Arthroscopic Correlation in Anterior Cruciate Ligament and Meniscal Injuries of the Knee
膝關節前交叉韌帶和半月板損傷的臨床、磁共振成像和關節鏡的相關性

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ARTICLE INFO

Article history:
Received 9 August 2016
Received in revised form
27 December 2016
Accepted 9 May 2017

Keywords:
ACL
arthroscopy
ligament injury
meniscus
MRI

ABSTRACT

Background: The aim of this study is to compare and correlate the clinical, magnetic resonance imaging (MRI), and arthroscopy findings in anterior cruciate ligament (ACL) and meniscal injuries of the knee.
Methods: This was a prospective study of 30 cases of ACL and meniscal injuries of the knee admitted between September 2014 and May 2016, who underwent clinical examination, MRI, and arthroscopy of the knee.
Results: In our study of 30 cases, there were 26 male and four female patients with age ranging from 18 years to 60 years, with most patients in between 21 years and 30 years. Clinical examination had sensitivity of 90.91%, specificity of 100%, and accuracy of 93.33% for ACL, sensitivity of 83.33%, specificity of 77.78%, and accuracy of 80% for medial meniscus, and sensitivity of 75%, specificity of 77.27%, and accuracy of 76.67% for lateral meniscus. MRI had sensitivity of 95.45%, specificity of 87.5%, and accuracy of 93.33% for ACL, sensitivity of 91.67%, specificity of 55.56%, and accuracy of 70% for medial meniscus, and sensitivity of 62.5%, specificity of 72.73%, and accuracy of 70% for lateral meniscus.
Conclusion: In conclusion, the present study supports that clinical diagnosis is of primary necessity, as the positive predictive value is high for all the lesions. MRI is an additional diagnosing tool for ligament and meniscal injuries of the knee. Routine use of MRI to confirm the diagnosis is not indicated, as the positive predictive value is low, but can be used to exclude pathology, as the negative predictive value is high for all the lesions.

中 文 摘 要

背景: 研究的目的是比較和相關膝關節前交叉韌帶和半月板損傷的臨床、磁共振成像和關節鏡檢查結果。
方法: 從2014年9月至2016年5月入院，對30例膝關節前交叉韌帶和半月板損傷患者接受臨床檢查、膝關節MRI和關節鏡檢查，進行前瞻性研究。
結果: 本研究中30例，26例男性，4例女性，年齡18至60歲，絕大多數患者為21至30歲。臨床檢查對前交叉韌帶的靈敏性為90.91%，特異性為100%，準確率為93.33% ； 內側半月板的靈敏度為83.33%，特異性為77.78%，準確率為80% ； 外側半月板的靈敏性為75%，特異性為77.27%，準確率為76.67%。而磁共振成像對前交叉韌帶的靈敏性為95.45%，特異性為87.5%，準確率為93.33% ； 內側半月板的靈敏性為91.67%，特異性為55.56%，準確率為70% ;外側半月板的靈敏性為62.5%，特異性為72.73%，準確率為70%。
結論: 本研究支持臨床診斷是首要必需的，因為所有病變的陽性預測值都很高。磁共振成像是膝蓋韌帶和半月板損傷的附加診斷工具。因為陽性預測值低，常規使用磁共振成像來確認診斷沒有必要。但因為所有病變的陰性預測值都很高，可以用於排除病變。

Introduction

The knee joint is a common site of injury due to trauma, repetitive activities, and sports activities. Clinical tests used in the diagnosis of meniscal and ligament injuries have limitations and it may be difficult to elicit objective signs repeatedly, mainly due to pain in an acute or subacute presentation. History taking regarding the mechanism of knee injury gives a vital clue to the structures injured in the knee joint. Hyperextension with an audible pop

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http://dx.doi.org/10.1016/j.jotr.2017.05.005

would suggest an anterior cruciate ligament (ACL) tear. A direct blow to the knee from the side would point toward collateral ligament injury, and from the front, would indicate a cruciate ligament injury. Although clinical examination is most important for the diagnosis of a ligament injury, painful stress examinations are not always accurate in the acute phase of the injury. Clinical tests may be confusing and may cause a delay in diagnosis. Therefore, complementary diagnostic tools are often necessary, mainly when suspicion of multiple lesions exists.

Magnetic resonance imaging (MRI) has a better soft tissue contrast and multiplanar slice capability which has revolutionized and has become the ideal modality for imaging the complex anatomy of the knee joint.[1]

MRI is a completely noninvasive diagnostic modality and there is no ionizing radiation. Moreover, the ligaments of the knee are divided into intraarticular and extraarticular. MRI plays a most important role in their evaluation. This division is important, as the extraarticular ligaments are not visible on routine arthroscopic procedures. However, identification of meniscal tears can be difficult to interpret and can be observer dependent as well as dependent upon the sensitivity of the scanner.

Arthroscopy is considered as “the gold standard” for diagnosis of traumatic intraarticular knee lesions. Arthroscopy, being a highly sensitive and specific procedure, is both diagnostic and therapeutic, but is invasive and can cause complications like infection, haemarthrosis, adhesions, and reflex sympathetic dystrophy.

Materials and methods

This was a prospective study involving 30 patients with history of knee injuries who were admitted in the Department of Orthopaedics. Clinical examination and MRI of the knee joint was done for all these patients either before or after admission. The patients were then subjected to diagnostic and therapeutic arthroscopy by the arthroscopy team in the Department of Orthopaedics, JSS Hospital (Mysore, India) between September 2014 and May 2016.

Patients included in this study were aged between 18 years and 60 years, and had knee problems like pain, instability, and locking of the knee for more than 6 weeks.

Patients excluded from this study were those who had undergone previous meniscectomies, knee ligament repair or reconstructions and knee arthroscopies, posterior cruciate ligament injuries, knee joint neoplasm, infectious and inflammatory conditions of the knee joint, ferromagnetic implants, pacemakers, and aneurysm clips. Patients undergoing arthroscopy without MRI were also excluded from the study.

All patients gave written consent for inclusion in the study. The treatment process was explained to the patients and they were aware of his/her rights during the study. The written consent form was signed or fingerprinted by the patient. The institutional review board of JSS University approved the protocol of this study. The process of treatment did no harm to the health of the participants.

Complete examination of the knee was carried out 6 weeks post trauma, with particular emphasis on various tests. The Lachman test, anterior drawer test, and posterior drawer test were used for identifying cruciate ligament tears. McMurray's test and joint line tenderness were the diagnostic criteria considered for meniscal injuries. The tests for collateral ligament injuries were valgus/varus stress tests. Physical examination of all the patients was conducted by the most experienced orthopaedic surgeon. In case of any doubtful findings, all of the authors' opinions were sought and the final decision was then taken by the most experienced orthopaedic surgeon. X-ray of the involved knee, anteroposterior (AP) and lateral views, was done to rule out any bony injury. MRI of the knee joint was done 6 weeks post trauma and not immediately, in view of acute haemarthrosis or effusion of the knee, which would mask critical findings that would aid in diagnosis. MRI of the knee included the sequences in sagittal, coronal, and axial planes, fat suppressed T2 axial turbo spin echo, and T1 spin echo sagittal in a 3 Tesla MRI machine (Philips 3T Ingenia. Cleveland, Ohio).

Examination under anaesthesia was done to confirm the signs of instability. Patients underwent arthroscopy by a qualified and experienced orthopaedic surgeon and he was aware of the MRI findings prior to arthroscopy. Clinical, MRI, and arthroscopy findings were recorded and compared.

The composite data was tabulated and studied for correlation with clinical, MRI, and arthroscopic findings and grouped into four categories: (1) a result was considered to be true positive when the positive clinical or MRI diagnosis was confirmed by positive intraoperative arthroscopic evaluation; (2) a result was considered to be true negative when the absence of pathological findings in clinical examination or MRI could be confirmed by arthroscopy; (3) a false positive result was defined as a positive clinical or MRI diagnosis with negative arthroscopy findings; and (4) a false negative result was defined as a positive intraoperative arthroscopy finding, but clinical or MRI diagnosis was found to be negative.

Statistical analysis was used to calculate the sensitivity, specificity, positive predictive value (PPV), and the negative predictive value (NPV), in order to assess the reliability of clinical and MRI results.

Results

In our study, 26 male patients and four female patients in the age group of 18–60 years were included. The right knee joint was found to be more commonly involved (19 patients) than the left knee joint (11 patients). Domestic fall was found to be the common mode of injury.

Medial meniscus injury was more common than lateral meniscus injury in our study. A total of 14 cases of medial meniscus injury were detected on clinical examination; arthroscopy confirmed only 12 cases. The sensitivity and specificity of clinical examination with respect to arthroscopy were 83.33% and 77.78%, respectively (Table 1). MRI detected 19 cases of medial meniscus injury; arthroscopy confirmed only 12 cases. The sensitivity and specificity of MRI with respect to arthroscopy were 91.67% and 55.56%, respectively.

In our study MRI had a higher sensitivity (91.56%) and NPV (90.91%) when compared to clinical examination. Clinical examination had a higher specificity (77.78%), PPV (71.43%), and accuracy of (80%) (Figure 1) when compared to MRI for medial meniscus injury.

Eleven cases of lateral meniscus injury were detected on clinical examination; arthroscopy confirmed only eight cases. The sensitivity and specificity of clinical examination with respect to arthroscopy were 75% and 77.27%, respectively. In our study, MRI detected 11 cases of lateral meniscus injury; arthroscopy confirmed only eight cases. The sensitivity and specificity of MRI with respect

Table 1
Results for clinical examination in diagnosing anterior cruciate ligament (ACL) and meniscal tears

	ACL (%)	MM (%)	LM (%)
Sensitivity	90.91	83.33	75
Specificity	100	77.78	77.27
PPV	100	71.43	54.55
NPV	80	87.5	89.47
Accuracy	93.33	80	76.67

ACL = anterior cruciate ligament; LM = lateral meniscus; MM = medial meniscus; PPV = positive predictive value; NPV = negative predictive value.