Research Article

Role of MRI in delineation of internal derangement of knee in trauma patients

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Abstract

Introduction: Knee joint is one of the most commonly injured joints, as an isolated injury or a frequent component in a multiple trauma patient. Knee joint injury is a significant cause of morbidity in young and active individuals especially amongst sports person, laborers, soldiers and military recruits. Multiple imaging modalities are currently being used to evaluate various pathological conditions of the knee including conventional radiography, CT scan, sonography , nuclear medicine and MR Imaging. Multi planar imaging and excellent soft tissue contrast has made the MRI an ideal modality for imaging of complex anatomy of knee joint in trauma patient. **Objective:** To study the diagnostic accuracy & efficacy of MRI in evaluation of internal derangement of knee joint in trauma patient. **Material & Method**: 44 cases with history of trauma were evaluated by Siemens magnetom vision plus 1.5 tesla MRI machine. **Results:** Mean age of patient - 32.2 years. Count of male patients exceeded the count of female patients. ACL injury was observed in 81.8%, PCL injury in 6.8%, MCl in 11.3%, LCL in 2.3%, medial meniscal tear in 45.5%, joint effusion in 95%. **Conclusion:** MRI emerged as a front line investigation for the assessment of internal derangement of knee joint in trauma patient.

Keywords: Knee Trauma, Internal Derangement of Knee.

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Introduction

Knee joint is one of the most commonly injured joints, as an isolated injury or a frequent component in a multiple trauma patient. Trauma to the knee joint is a significant cause of morbidity in young and active individuals especially amongst sports person, laborers, soldiers and military recruits. Multiple imaging modalities are currently being used to evaluate various pathologic conditions of the knee including conventional radiography, CT scan, sonography, nuclear medicine and MR imaging. The injury of intra articular structures is generally termed as "Internal derangement of knee" which was first coined by William Hey in 1784[1].

Magnetic resonance imaging (MRI) has now been accepted as the best imaging modality for non-invasive evaluation of knee injuries. It has been reported to have a high diagnostic accuracy and does not involve the use of ionizing radiation Keith et al [2].

MRI has proved to be reliable, safe and offers advantages over diagnostic arthroscopy, which is currently regarded as the reference standard for the diagnosis of internal derangements of the knee Edwin H G Oei et al [3].

In the context of trauma, post traumatic limited range of motion and mechanical knee symptoms MRI is generally considered a valuable diagnostic tool. MRI has made it possible to look into the injured knee non invasively, there by avoiding invasive procedures and further morbidity Singh JP et al [4]. Increased soft tissue contrast coupled with multi planar slice capability has made magnetic resonance imaging ideal for imaging complex anatomy of knee joint. An acute injured knee is readily imaged for the detection of meniscal and ligamentous injury. With the development of new sequences having improved SNR, higher resolution, reduced artifacts, shorter imaging times and improved accuracy, MRI has changed the traditional

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algorithm for workup of knee joint pathology, particularly when internal derangement in cases of twisting injuries to the knee joint is suspected.

Aims & Objectives

1. Radiological evaluation of internal derangement of the knee joint using magnetic resonance imaging.
2. To study spectrum of MRI findings in all consecutive cases of knee trauma.
3. To establish diagnostic accuracy of MRI in delineation of knee joint lesions in cases of trauma.
4. To grade various ligaments and meniscal injuries on the basis of MRI Findings.
5. To study the pattern of internal derangement in relation to nature of injury

Method & Material

It is a prospective study. Study was performed in department of Radio-diagnosis, People's College of Medical Sciences, Bhopal, MP, India

44 cases with history of trauma to the knee reported to the orthopedics department, who were referred to radiology department of Peoples Hospital, Bhanpur, Bhopal, suspecting internal derangement of knee, served as the subjects for this study.

Method of data collection

a) **Duration of study:** 1 Nov 2012 – 1 April 2014

b) **Inclusion Criteria:**

i. The study included patients who were clinically suspected of internal derangement of the knee joint followed by traumatic knee injury.
ii. Patient with any relevant history provided by patient's attender or patient.

c) **Exclusion Criteria:**

i. Age related degenerative arthrosis of knee joint.
ii. Patients with major injuries like liver/splenic rupture and flail chest
iii. Patients with unstable vital parameters especially in the setting of trauma
iv. Patients with ferromagnetic implants, pacemakers and aneurysm clips
v. Any other absolute contraindication for MRI
vi. Patients below the age of 18 and above the age of 60 yrs

MRI Scanning Technique

i. Patient positioning- Feet first
ii. Type of coil- Transmit /Receive knee array coil
iii. Topogram position- Axial , Sagittal , Coronal
iv. Slice thickness – 4mm
v. Scan range- 2-3 min
vi. Overall duration of examination- 20-30 min.

Imaging protocols

Patients will be subjected to MRI within 4 days of clinical evaluation according to the following protocols: Axial PD Fat Sat, Sagittal PD Fat Sat, Coronal PD Fat Sat, Axial T2 FSE, Sagittal T2 FSE, Coronal T2 FSE, Sagittal FSE, Axial GRE

Equipment: Siemens Magnetom Vision plus, 1.5 Tesla. Whole - body MR scanner.
Statistical method used – Chi square and T test type. SPSS version 20.0 software were used.

Results

There were 37 males and 7 females in this study. Males comprised of 84.1% and females comprised of 15.9% of the total study group. Male patients exceeded the number of female patients in all the age groups. The age group ranged from 20 to 60 years with mean age being 32.2 years.

Table 1: Age distribution of patients studied

Age in years	Number	Percentage
upto 20 years	2	4.50%
21-30 years	18	40.90%
31-40 years	14	31.80%
41-50 years	8	18.20%
>50 years	2	4.50%
Total	**44**	**100.00%**

20-30 year was the commonest age group in our study.

Table 2: Nature of injuries

Mechanism of injury	Number (n=44)	Percentage
Road Traffic Accident	20	45.5%
Fall for stairs	3	6.8%
Sports Injury	13	29.5%
Repeated trauma	5	11.4%
Fall from tree	1	2.3%
Fall from roof	1	2.3%
Fall from chair	1	2.3%
Total	**44**	**100.0%**

Road traffic accident was the most common mode of injury in our study

The common mechanism of injury noted was road traffic accident with 20 patients (45.5% of the total population) followed by sports related injuries with 13 patients (29.5% of the total population)

Out of the total number of patients studied, 42 (95.5%) of the patients had joint effusion. Amongst the positive cases, 20 (45.5%) had hemorrhagic joint effusion and 22 (50%) had non hemorrhagic joint effusion.

Out of the total patients, 36 (81.8%) had ACL injuries - 17 (38.6%) had complete ACL tear and 19 (43.2%) had partial ACL tear. Association with joint effusion was noticed in 79.5%. Bone contusion was associated in 13.91% of ACL tears. PCL tear was found in 3 cases.

MCL tear was found in 5 (11.3%) of patients. Grade 1 tear was found in 2 (4.5%) of patients and grade 2 tear was found in 2 (4.5%) of the total population with MCL injuries.

Medial meniscal tear was found in 20 cases with Grade 1 tear noted in 6 (13.6%) ,Grade 2 and Grade 3 tear in 7 (16.0%) and grade 4 tear in 4 (9.0%) patients.

In lateral meniscus, there was preponderance of tear in anterior horn of lateral meniscus (15.3%) compared to posterior horn.

Table 3: Spectrum of MRI findings

MRI Findings	Number	Percentage
Alignment	30	68.2%
Soft tissue injury	19	43.2%
Muscle injury	9	20.5%
Joint Effusion	42	95.5%
ACL Injury	36	81.8%
PCL Injury	3	6.8%
MCL Injury	5	11.3%
LCL Injury	1	2.3%
Medial Meniscal Tear	20	45.5%
Lateral Meniscal Tear	6	13.6%
Osseous and Osteochondral Lesions	25	56.8%
Ileo-tibial band injury	2	4.5%
Patellar tendon injury	1	2.3%
Quadriceps tendon injury	2	4.5%

ACL injury was the most common injured ligament in our study

Discussion

Maximum subjects belong to the young age group of 21-30 years (40.9% of the total population). Acute traumatic injuries to the knee joint were common in the age group ranging from 20-29 years. 70% of them were males as study done by Majewski et al.[5]

In our study, traumatic injuries to the knee joint were reported in 100% of the total population**.** The ACL injury associated with other injuries was found in sports person, while ACL injuries with associated PCL injuries were common in road traffic accidents. The findings in our study coincided with findings by Bispo et al.[6].

In our study, ligamentous injury was seen in 72% of the patients, of which, 81.8 % had ACL injury, 6.8% had PCL injury, 11.3% had MCL injury and 2.3% had LCL injury. Medial meniscal injuries were seen in 20 patients (45.5%) It was the second most common injury after ACL injury.

Cruciate ligament: Out of 36 patients (81.8 %) of ACL tear, 19(43.2%) were partial tears and 17(38.6%) were complete tears of ACL. 68% of them involved mid substance. Mid substance tear was demonstrated in 90% of ACL tears in study done by Mink et al [7].

Association with joint effusion was noticed in 80%. Bone contusion was associated in 50% of ACL tears. Bony contusions of lateral compartment structures were noted in 18 cases (67.1%). In our study, there was a strong association noted between ACL and bone contusions injuries.

Amongst the selected cases that underwent through arthroscopy, 2 cases of partial ACL tears were not detected on arthroscopy whereas they were well delineated on MR being the intra substance tears. These findings are in correlation with S.Singla et al.[8]

ACL tears associated with PCL tears were found in 8.3% of cases which had Positive Anterior drawer test. Posterior cruciate ligament injuries were found to be relatively uncommon compared to ACL tears in our study. Injury to PCL was reported only in 3 cases (6.8%). 1 patient was demonstrated with thickening of ligament with abnormal signal intensity (partial tear) whereas 2 cases showed complete disruption of continuity of PCL fibres (complete tear). These results are comparable to the study done by Rodriguez W et al [9].

Bone contusions were seen in 79.6% of PCL tears and predominantly involved the anterior and lateral tibial surface in all the cases of our study and similar 83 % was found in study done by Mair et al [10].

High incidence of bone bruise in association with PCL tear ranging from 32 to 83% reported by Sonin et al [11].

Collateral ligaments: 11.3% of ligamentous injuries involved the MCL All these cases had history of trauma and were associated with multiple injuries. This suggests presence of a single injury should prompt the examiner to look for other subtle associated injuries, which was further confirmed by Mink JH et al [7].

Meniscal lesions: Meniscal tear was diagnosed by either an area of abnormal signal within the meniscus on at least one image that extended to the meniscal articular surface, or abnormal morphology of the meniscus.

Meniscal tear was found in 26 (59.0%) cases in this study. Of the positive patients, medial meniscus accounted for 23% only the lateral meniscus and 39% involved both menisci. Amongst the medial meniscal tears, Grade 1 tear was reported in 6 (13.6%) patients, grade 2 tear was reported in 7 (16.0%) of the population and grade 3 tear was reported in 7 (15.9%) and 4(9.0%) of patients had grade 4 tears in our study.

Only 23% of the patients had lateral meniscal tears .Injury to the anterior horn (15.3%) of the lateral meniscus was most common in the subjects studied.

There is preponderance of MM tears over LM tears in our study which is well correlated with the study of 173 cases, out of which 57 (38.23%) patient had MM tear and 28 (29.41%) patients showed LM tear as study done by Singh JP et al[4].

The importance of MR imaging in reliable identification of meniscal displacements and fragments was emphasized by Wright et al [12]. Displaced meniscal fragments are often clinically significant

lesions requiring surgical intervention and therefore are important to identify.

Osseous and Osteochondral injuries: In our study frank fractures were seen in 5 patients (46.8%). Bony contusions accounted for 13(65%) of the patients. Most of these were bony contusions involving the femoral and tibial condyles. Osteochondral lesions were seen in twenty patients. In our study we found a case of avulsion fracture of tibia. A case of old non united fracture of patella was also seen. A case of impacted fracture of lateral condyle of femur and posterior part of tibial condyles was also noted. These findings were correlated with spectrum of findings on osseous and myotendinous injuries in traumatic knee joint described by Thomas H. Berquist [13].

The finding of hemarthrosis and lipo hemoarthrosis was associated in two cases with presence of intercondylar fractures. These findings were correlated with findings described by Thomas H. Berquist [13].

Amongst the myotendenious injuries, we found 2 cases of ileotibial band injuries which accounted for 4.5% of the patients. We also found a case of patellar dislocation with patellar tendon injury with posterior subluxation of tibia. The findings of a partial tear of proximal fibers of medial head of Gastrocnemius muscle were seen in 6 patients in our study. These findings were correlated with findings described by Thomas H. Berquist. [13]

Summary & Conclusion

Magnetic Resonance imaging of knee joint complements clinical examination and arthroscopy by providing a non-invasive, radiation free, painless, and highly accurate imaging modality for preoperative anatomic assessment. MR imaging is superior in conditions where arthroscopy is not useful like peripheral meniscal tears and inferior surface tears. MRI is more sensitive in detection of multiple meniscal tears that may be overlooked on arthroscopy.

Magnetic Resonance imaging is an explicit diagnostic, non-invasive and non-ionizing technique, which allows meticulous examination of the ligaments and other soft tissue structures forming the knee joint. Planning of images in all three planes with the use of appropriate sequences and multiplanar capability with excellent soft tissue demonstration increases its diagnostic yield. Magnetic resonance imaging has emerged as a frontline investigation for the assessment of internal derangements of knee. Arthroscopy on the other hand, gives excellent visualization but is invasive and it can evaluate only surface abnormalities of the internal structures of the knee joint.

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