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Study on evaluation of post traumatic knee joint injuries

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Abstract---Background: The knee being the largest joint in the human body withstands complex forces which are exerted during various activities, rendering it prone to a number of acute and chronic injuries. It is also one of the most frequently injured joints, whether as an isolated injury or as a component in a multiple trauma patient. Aim and Objectives: The objective of the present study was to evaluate the incidence of various ligamentous and meniscal injuries of post-traumatic knee joint. Materials and Methods: Once a patient fulfilled the inclusion criteria for this study he / she was administered the predesigned / pretested proforma. Demographic characteristics of the study population such as age, sex were obtained through an interview. The patients were then briefed about the procedure i.e. about the noise of the gradient coils and need to control the body movements for successful image acquisitions. The patient is asked to lie in supine position with the knee in close relation to the knee coil. The knee is then externally rotated 15-20° and is also minimally flexed 5-10°. Statistical Analysis: The data obtained was coded and entered into Microsoft Excel Worksheet. The categorical data was expressed as rates, ratios, proportions and percentages. Results: We found that the Anterior cruciate ligament was the most commonly torn ligament, 77.5 % (n = 62), among the menisci the medial menisci (MM) tears were more common as compared to lateral menisci (LM), grade III tear was more common in both LM and MM, Medial Cruciate Ligament (MCL) was more commonly injured as compared to Lateral Cruciate Ligament (LCL), osseous/ osteochondral lesions were noted in 44 patients (55%) majority of which were bony contusions and majority of the injuries were a combination of two or more injured components.

Discussion & Conclusion: Magnetic resonance imaging is valuable non-invasive, radiation free tool with multiplanar capabilities which not only provides precise information in localizing and characterizing the internal derangements among the patients with trauma around the knee joint but is also helpful in identifying the exact extent of the injury and any other associated findings thus helping in the further management of the patient. We found that the Anterior cruciate ligament (ACL) was the most commonly torn ligament, 77.5 % (n = 62), among the menisci the MM tears were more common as compared to LM, grade III tear was more common in both LM and MM, MCL was more commonly injured as compared to LCL, osseous/osteochondral lesions were noted in 44 patients (55%) majority of which were bony contusions and majority of the injuries were a combination of two or more injured components.

Keywords---post traumatic knee joint, ligament injuries, magnetic resonance imaging, meniscal injuries.

Introduction

The knee being the largest joint in the human body withstands complex forces which are exerted during various activities, rendering it prone to a number of acute and chronic injuries. It is also one of the most frequently injured joints, whether as an isolated injury or as a component in a multiple trauma patient¹. Trauma to the knee is a substantial cause of disease in the young, active individuals particularly amongst military personnel's and athletes. A precise diagnosis concerning the extent and type of injuries is indispensable for early non-operative as well as operative treatment. This necessitates a precise clinical history, a thorough physical examination, and corresponding diagnostic tools. With the availability of enhanced surgical possibilities, precise imaging of the knee becomes all the more important².

MRI and arthroscopy are the most extensively used diagnostic modalities to evaluate the joint injury. Arthroscopy, nonetheless accurate, is invasive and may cause complications^{3, 4}. Magnetic resonance imaging (MRI) has now been recognized as the unsurpassed imaging modality for non-invasive assessment of knee injuries. It has been reported to have an extraordinary diagnostic precision without involvement of ionizing radiation⁵. Since its induction for clinical use in the role of MRI in the analysis of knee injuries has been well recognized. MRI has proved consistent, safe and offers several benefits over diagnostic arthroscopy, which is at present looked upon as the reference standard for the diagnosis of internal derangements of the knee⁶. In the setting of trauma, post-traumatic inadequate range of motion and mechanical knee symptoms MRI is usually considered a valued diagnostic tool⁷. It has made it possible to evaluate an injured knee non-invasively, subsequently evading invasive procedures and additional morbidity⁸.

MRI is the best imaging modality for assessment of acute traumatic musculo-tendinous injuries to the knee. It can provide valuable information regarding the

extent and location of the injury along with related bone, meniscal, and ligamentous irregularities in patients with these traumatic lesions⁹. Knee joint is a compound type of synovial joint and owing to the absence of bony support, stability of the joint is vastly reliant on its supporting ligamentous structures, and consequently injuries of ligaments and menisci are exceedingly common¹⁰. The present study was an attempt to assess the types and incidence of injuries in traumatic knee joint by MRI.

Aim & Objectives

The objective of the present study was to evaluate the incidence of various ligamentous and meniscal injuries of post-traumatic knee joint.

Materials & Methods

Sample Size: A total of 80 patients fulfilling the selection criteria were studied. Patients who present with the history of trauma around the knee coming for MRI examination during the study period were enrolled.

Sampling Procedure: A minimum sample of 60 patients who fulfill the selection criteria and advised to undergo MRI knee joint for evaluation of internal derangements of the knee during the study period was planned. However, 80 patients fulfilled the selection criteria and were enrolled in the study.

Inclusion Criteria: All patients, of different age groups presenting with history of trauma to the knee joint, who are sent for magnetic resonance imaging of the knee.

Exclusion Criteria:

- Post-operative cases.
- Patients with ferromagnetic implants, pacemakers and aneurysm clips.
- Patients with major injuries like liver / splenic rupture and flail chest and patients with unstable vital parameters especially in the setting of trauma.

Informed Consent: Patients fulfilling the selection criteria were informed about the purpose and nature of the study and were enrolled after obtaining a written informed consent.

Data Collection

Once a patient fulfilled the inclusion criteria for this study he / she was administered the predesigned / pretested proforma. Demographic characteristics of the study population such as age, sex were obtained through an interview. The patients were then briefed about the procedure i.e. about the noise of the gradient coils and need to control the body movements for successful image acquisitions. The patient is asked to lie in supine position with the knee in close relation to the knee coil. The knee is then externally rotated 15-20° (for better evaluation of ACL on sagittal images) and is also minimally flexed 5-10° (for better visualization of the patella-femoral compartment).

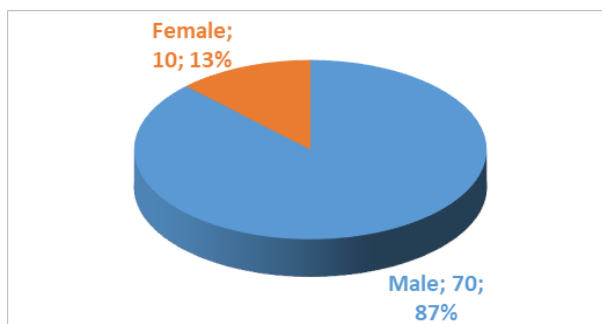
Imaging

All patients underwent MRI of the knee joint using a using a dedicated knee coil on a Siemens 1.5 Tesla Symphony Magnetom class-MRI. An axial acquisition through the patella-femoral joint is used as the localizer. The field of view is variable ranging from 14 to 16cms depending on patient's size. The scan was carried out for all the patients using T2 PD Coronal / sagittal (TR: 4250 & TE 107); T2 Axial (TR: 6680 & TE 115); TIRM Coronal (TR: 5240 & TE 70); T1 SE Coronal/Sagittal (TR: 600 & TE 15) ; STIR Coronal; STIR Axial; MEDIC FAT SAT Sagittal (TR: 1430 & TE 18), PD FAT SAT coronal / sagittal / transverse (TR: 2000 & TE 18) sequences to evaluated the knee joint. All the images were acquires with a slice thickness of 3.0mm. Statistical Analysis: The data obtained was coded and entered into Microsoft Excel Worksheet. The categorical data was expressed as rates, ratios, proportions and percentages.

Results

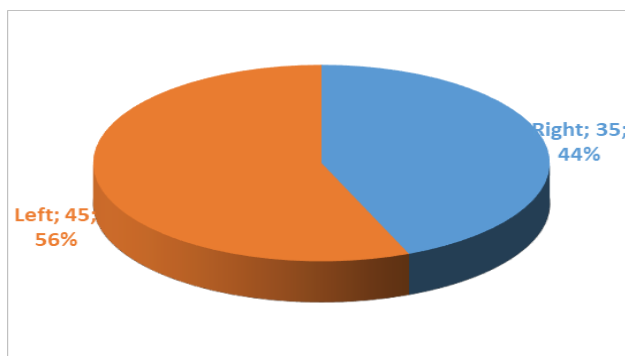
We included a total of 80 patients based on inclusion and exclusion criteria were enrolled.

Graph 1: Shows Gender wise distribution of subjects

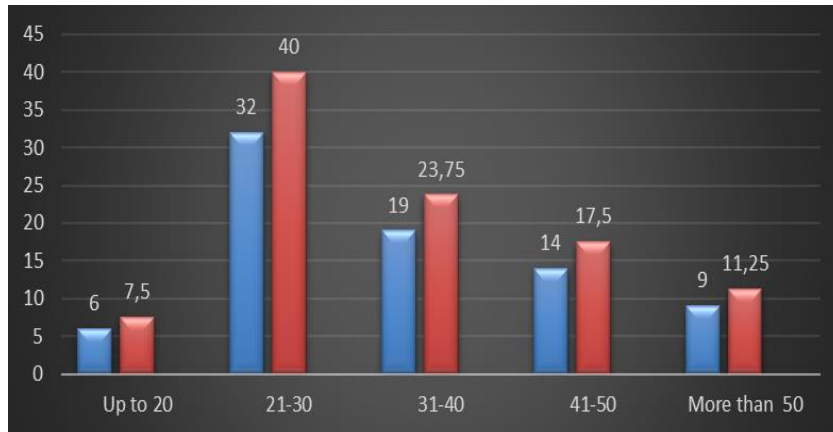


In the present study, majority were males 87.5 % (n = 70). The male to female ratio was 7:1

Graph 2: Shows Side wise distribution of Subjects

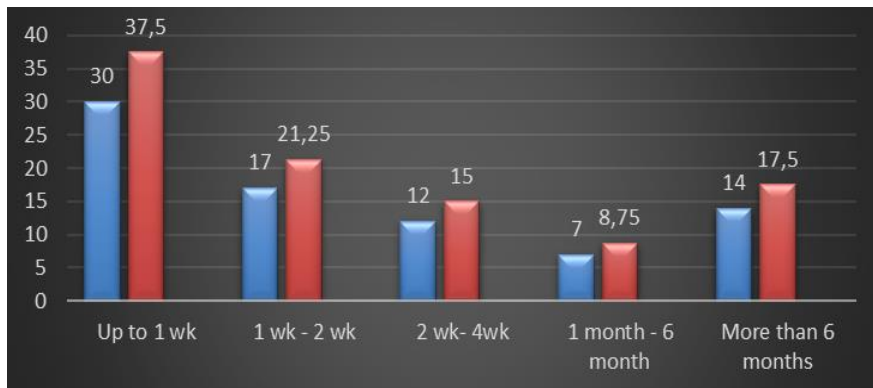


Graph 3: Shows Age wise distribution of Subjects



In this study, the maximum number of patients were in the age group between 21-30 years 40% (n = 32) followed by age group 31-40 years 23.75%(n = 19). The mean age was 32 ± 9.4 years.

Graph 4: Shows Duration of trauma of Subjects



In this study maximum number of patients presented with an acute history of trauma to the knee i.e. 37.5% (n =30) belonged to less than week duration trauma. The second highest patient belonged to 1-2 weeks 21.25% (n = 17) followed by patients presenting after 6 months of trauma 17.5% (n = 14).

Table 1: Shows spectrum of MRI findings

MRI finding	Number (Positive)	Percentage (%)
Joint Effusion	70	87.5
ACL	62	77.5
PCL	3	3.75
MM	37	46.25
LM	11	13.75
MCL	14	17.5

LCL	12	15
Osseous/ Osteochondral Lesion	44	55

In the present study, we see that the tear of anterior cruciate ligament was most frequently encountered, n= 62 followed by the tear of medial meniscus n=37. The medial meniscus is also the more commonly torn / injured menisci of the two.

Table 2: Shows Combined / Multiple Injuries

Number of injuries	Number	Percentage (%)
One	31	38.75
Two	20	25
Three	18	22.5
Four	7	8.75
Five	4	5

In the present study, single ligamentous injury was most commonly encountered 38.75% (n=31) followed by injury two structures 25% (n=20). The least common injury was simultaneous injury to five structures 5% (n=4).

Discussion

Injury to the knee joint is an important cause of morbidity in the population affecting particularly the young active individuals. Hence, a precise diagnosis concerning the type and extent of the injuries is mandatory for early operative or non-operative intervention. This essentially requires a comprehensive clinical history coupled with a thorough physical examination and a complementary imaging tool.

Conventionally, the injuries around the knee joint were assessed clinically, and were subjected to radiographs. In modern times, MRI with or without a subsequent arthroscopic procedure has become the state of the art imaging modality. The knee can be imaged with many different imaging modalities: radiography, ultrasound, bone scintigraphy, CT scan, arthroscopy & MRI. The MRI is being used as both a pre and post-operative evaluative method. Since the 1990's MRI has been the modality of choice for imaging the internal derangements of the knee joint. MRI has become a valuable tool in the determining the treatment plan in 18% of patients and therefore permitting earlier surgical intervention based on the diagnosis obtained. Development of newer sequences have contributed to an improved SNR (signal to noise ratio) along with higher resolution and reduced artifacts as well as shorter imaging times, accentuating the diagnostic accuracy. The traditional algorithm for diagnosis of knee joint pathology has been changed by the use of MRI. Because of MRI it is possible to visualize into the injured knee noninvasively hence evading invasive procedures and additional morbidity.

In the present study, males outnumbered females i.e. 87.5% of the patients were males and 12.5% were females with male to female ratio as high as 7:1. These ratios are alike to the ones in the study conducted by Clayton et al.¹¹ The

probable reason for male predominance over the females can be credited to increased tendency of road traffic accidents and more sports related activities. The left knee joint was more commonly affected 56.5% whereas the right knee was affected in 43.5% of the study group. The age distribution analysis showed a wide range with the youngest patient 17 years of age and the eldest of 65 years of age. The maximum numbers of patients were ranging between 21 to 30 years of age while the second largest group of patients belonged to the age group between 31 - 40 yrs. The age distribution in our study is similar to the results of previously carried out studies by LaPrade et al¹², Incesu et al¹³ with a mean age of 24 - 36 years. This can be attributed to the fact that young individuals have a relatively more active life style and hence have a higher risk of sustain an injury to the knee joint.

Joint effusion was the most common finding, with as many as 87.5% of the study group being affected by it. Of the ligamentous and meniscal injuries, the anterior cruciate ligament was the most commonly injured (in 61 patients out of 80: 76.25%) and medial meniscus was the second most commonly injured (in 37 patients out of 80: 46.25%) with grade III injury being the most common subtype. Cruciate ligament Injury: The ACL was the most commonly injured ligament in our study with a total of 62 patients out of 80 (77.5%) sustaining ACL tear which is consistent with a study by Singh JP et al. In our study, partial tear of the ACL was more commonly encountered 53.25% as compared to the complete tear 47.6% which is in accordance to the previous studies conducted by Singh JP et al¹⁴ and Berquist et al¹⁵ which had 66.6% and 90.0%, respectively, of partial ACL tears in all the patients sustaining ACL tear in their studies. The higher ratio of complete ACL tear in our study could be attributed to the increased severity of the injury from the road traffic accidents. The posterior cruciate ligament injury is less common as compared to the ACL because it is the stronger and thicker of the two. In our study posterior cruciate ligament injuries were comparatively uncommon, in our study it was seen in only 3 patients (3.75%). Of the 3 patients one had a partial tear with intra substance hyper intensities whereas two patients had a full thickness tear with non-visualization of its either attachment. The findings in our study are in agreement to the study conducted by Sonnin et al.

Collateral ligaments injury: In our study, MCL tears (17.5%) were found to be more common than the LCL tear (15%). All but two cases were supplementary with multiple musculo-tendinous injuries which recommends presence of a solitary injury ought to prompt the examiner to evaluate for other delicate associated injuries, which is in accordance to the findings made by Mink JH et al.¹⁶ The medial collateral ligament tear is in agreement with the results of Adil I N¹⁷ which showed MCL tear in 18% of the patients in study group of 50 patients. Medial collateral ligament tear was noted in 14 patients, out of which 5 (35.7%) had grade I tear, 7 had (50 %) grade II tear and 2 had (14.3 %) grade III injury, this is in agreement with study by Schweitzer M et al¹⁸ on 76 patients, who found out that maximum number of medial collateral ligament tear belonged to grade II.

Menisci Lesions

In our study, there is preponderance of medial meniscal tears, 46.25% over lateral meniscal tears, 13.75% which is well correlated with the study conducted by

Singh JP et al, in a series of 173 cases of which they found 57 (38.23%) patients having MM tear and 28 (29.41%) patients having LM tear. Similarly in our study, medial meniscal tears were found in 37 patients (46.25%) with no patients of Grade I tear, Grade II tear in 3 patients (8.1%) and Grade III in 34 patients (87.8%) and lateral meniscal tear in 11 patients (13.75%) with Grade I tear in 1 patient (9.1%), Grade II tear in 3 patients (27.3%) and Grade III in 7 patients (63.4%). Grade III tears being more common in both the menisci which can be attributable to the severity of trauma and more number of cases due to road traffic accidents. In our study, the posterior horns of both medial and lateral meniscus were more frequently injured as compared to the anterior horn.

Osseous and Osteochondral Injuries

Our study showed Osseous/Osteochondral lesions in 44 patients (55.0%). Majority of the lesions were bony contusions involving the femoral and tibial condyles. Osteochondral lesions are seen in 12 patients. Hemarthrosis and lipohemarthrosis was associated in five cases, three of which had comminuted fractures. These findings are in correlation with the findings described by Thomas H. Berquist.

Combined Injuries

In our study, we observed 49 cases of combined injuries and 31 cases of isolated injuries. The leading pattern is ACL tear with MM tears (22); trailed by ACL tear with LM tear (11), which is well in correlation with a study by Ali Akbar Esmaili Jah et al, in a series of 17 cases of concomitant injuries at MRI and arthroscopy. The predominant pattern was anterior cruciate ligament rupture and medial meniscus tear (5 patients), followed by anterior cruciate ligament and lateral meniscus (4 patients), or anterior cruciate ligament + medial meniscus + lateral ligament (4 patients). The present study showed the capability of magnetic resonance imaging in assessment of the various internal derangements, together with their detection, localization, characterization and evaluation of extent of damage, hence, confirming the value of MRI in assessing internal knee structures.

Conclusion

Magnetic resonance imaging is a valuable non-invasive, radiation free tool with multiplanar capabilities which not only provides precise information in localizing and characterizing the internal derangements among the patients with trauma around the knee joint but is also helpful in identifying the exact extent of the injury and any other associated findings thus helping in the further management of the patient. We found that the Anterior cruciate ligament was the most commonly torn ligament, 77.5 % (n = 62), among the menisci the MM tears were more common as compared to LM, grade III tear was more common in both LM and MM, MCL was more commonly injured as compared to LCL, osseous/osteochondral lesions were noted in 44 patients (55%) majority of which were bony contusions and majority of the injuries were a combination of two or more injured components.

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