

ORIGINAL ARTICLES**MRI Evaluation in Traumatic Knee Injury- A Prospective Study**SYED MAKSUMUL HAQUE¹, HAWA BEGUM², SMOROJIT KUMAR MONDOL³.**Abstract:**

62 patients of acute traumatic knee injury underwent MRI was included in this prospective study, Highest number 21(33.87%) were found within 21-30 years group and second highest 16(25.81%) were in 31-40 years. Among 62 patients sports injuries 37(59.68%) was leading cause and then RTA 21(33.87%). Among all injured structures meniscal tears were highest 44(70.96%). ACL tears 34(54.83%) were more than PCL tears 02(3.22%). Collateral ligaments tears were 17(27.41%). Joint effusion 56(90.32%), bony lesions 25(40.32%) and bursitis 5(8.06%) were among other lesions. Among 44 Meniscal tears, medial meniscal tears were 22(50%) lateral meniscus 9(20.45%) and both menisci 13(74.24%). Posterior horn of medial meniscus 26(74.28%) were involved more than the posterior horns of lateral meniscus 06(17.14%). Anterior horn of medial meniscus 18(81.18%) were involved more than anterior horns of lateral meniscus 06(17.14%). Meniscal body injuries were 4(8.57%) & 2(9.09%) in medial and lateral meniscus receptively. Vertical tears were highest 25(56.8%) types. Horizontal meniscal tears were 10(22.72%), radial tears 2(4.54%), Bucket handle tears 4(9.09%), complex tears 02(4.54%) and displaced flap tear 01(2.27%). Out of 34 ACL tears 22(64.71%) were complete tears and 12(35.29%) were incomplete tears. PCL tears were complete tears (3.22%). Among 17 collateral ligament tears MCL tears 12(70.58%) were more than LCL tears 5(29.42%). In MCL tears highest 8(47.05%) were incomplete or grade-II tears, 3(17.64%) were complete or grade-III tears and 1(5.88%) was grade-I or sprain. Out of 5(29.42%) LCL tears incomplete and complete tears were equal 2(11.76%) and 1(5.88%) was grade-I or sprain.

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Objective: MRI evaluation in traumatic knee joint for accurate diagnosis of nature of injuries in soft tissue like menisci, ligaments, tendons, muscles, bursa, cartilage's and bones.

Introduction:

The knee is one of the largest and most complex joints in the body. It is constructed by four bones and extensive networks of ligaments and muscles. The knee is one of the most common body part to be injured. Though knee injury is rarely life threatening but it remains clinical burden and public health problems specially for athletes & sportsmen.

Magnetic resonance imaging (MRI) has revolutionized our ability to picture soft tissue structure of the musculoskeletal system. Increased soft tissue contrast coupled with multi-planner slice capability allows visualization of muscles, tendons, ligaments, cartilage and bone marrow by MRI in a way that is unprecedented. Although the knee is a common site for all disorders occurring in and about the joints, most cases requiring MRI are traumatic in nature.¹ MRI allows superior soft tissue details with multi-planner imaging capability that provides accurate evaluation of this intra and extra articular structures of the knee not demonstrated with any other imaging modalities currently available.² A complete examination of intra and extra articular structures and bone marrow includes all three planes sagittal, coronal, axial in T1W, T2W, proton density and fat suppression or STIR sequences.

The assessment of the meniscus is usually the primary clinical concern in MRI of the knee. The meniscus consists of type-I collagen, which contains few excitable protons and should remain

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dark (low signal intensity) on all pulse sequences. Meniscal tear and degeneration are manifested as increased signal intensity on T1 and T2 weighted sequences within the substance of meniscus primarily because of influx of fluid. The posterior horn of medial meniscus is the most common site of injury. Isolated tear of anterior horn of meniscus are uncommon. One early MRI study reported a sensitivity of 95%, specificity of 91% and accuracy of 93% for MRI detection of meniscal tears.³ A commonly used surgical classification of meniscal tears enclosed the following types; horizontal, longitudinal, radial, bucket handle, displaced flap and complex.⁴ Horizontal tears are sometimes classified as degenerative. Horizontal tears appear on MRI as a horizontally oriented line of increased intrameniscal signal that extends to superior or inferior surface of the meniscus near the free edge. Longitudinal tears have a vertically orientation on MR images of meniscus and extends parallel to the circumference of the meniscus. These tears are almost always associated with a significant knee injury.⁵ Longitudinal tears almost always involve the posterior horn in medial and lateral menisci. They are diagnosed on MRI by the presence of a vertical line of increased signal intensity containing the superior, inferior or both surface of the meniscus.⁶ The central fragment of a meniscus with a peripheral longitudinal tear may displace centrally into the joint creating a bucket handle tear. The displaced fragment is considered to resemble the lifted up handle of the bucket. Various signs have been used to describe this centrally displaced fragment including the double PCL sign (fig-4) and flipped meniscal sign.⁷ Radial tears are vertically oriented tears that arise from free edge of a meniscus and extend into the meniscus. The common locations for radial tears are the posterior horn in the medial meniscus and at the junction of the body and anterior horn in the lateral meniscus.⁶ Complex meniscus tears are those in which the tear extends in more than one plane creating separate flaps of meniscus.⁴ In addition to the presence of a torn postero-superior fascicle, two other MR findings have a meniscal tear; Subchondral edema beneath a meniscus and the presence of meniscal cyst. If either of these findings is noted the overlying meniscus should be carefully evaluated on MRI for a tear.⁶

The anterior cruciate ligament is the most commonly injured of the major knee ligaments (fig-2). ACL is the main obstacle to anterior tibial translation in response of internal tibial rotation and varus or valgus angulation. The main mechanism of knee trauma are external, extreme valgus unintentionally applied to a flexed knee, hyper extension and valgus or direct side impact.⁸ Tears of the ACL occurs more commonly at its proximal portion. Complete or partial avulsion occur more commonly at the femoral origin, where as avulsion fractures are more common at the tibial insertion, Tears of PCL is uncommon. Perhaps 50 ACL tears imaged for each PCL tear. Most are incomplete and occurs at mid portion of the ligament. Others involve the tibial insertion, where avulsion fracture may be present. In 30% of patients PCL injury is isolated.¹

Tears of collateral ligaments manifest as disruption of the ligament or as abnormal high signal intensity in the adjacent soft tissue that often displaces the ligament indicating bleeding or oedema. MCL is more commonly injured than lateral components. Incomplete tears of collateral ligaments result in increased signal intensity within the (normally dark) ligaments and adjacent soft tissue on T2 weighted scans. The course of the ligament, however, will be unchanged. Complete tears are identified by increased signal intensity on T2 weighted scan of the site of tear together with lack of continuity of the ligament (and typically refraction). A common classification scheme for MCL tears is based on their severity, which spans the spectrum from ligament sprain (grade-I) to partial tear (grade-II) to complete rupture (grade-III).³

Materials & methods:

The prospective study was carried out during January 2017 to December 2019 among patients who were referred to different diagnostic centers in Barishal for MRI of knee joints with history of trauma. A total 62 patients with history of trauma to knee joint were included in this study. Patients were selected irrespective of age & sex. All patients were evaluated by details history and clinical examination and underwent MRI of the affected knee joints. MRI protocol was selected which included T1, T2, fat suppression T2 or STIR in all patients in sagittal, coronal and axial sections. Two

specialist radiologists evaluated separately at the same date. The types of lesion of menisci, ligaments, bones and muscles were categorized and collected data was analyzed.

Observations & Results:

A total 62 cases of trauma knee were included in this study. The age ranged from 7 to 70 years. Highest number 21(33.87%) of cases were found between 21-30 years age group and second highest number 16(25.81%) of cases within 31-40 years groups. Among all about 60% were within 21-40 years groups (Table-I). Out of 62 patients 57(91.94%) were male and 05(8.06%) were female (Table-II). Among 62 cases of knee trauma sports injury 37(59.68%) was found as the leading cause. Next common cause was road traffic accident 21(33.87%). (Fig-1). On MRI evaluation out of 62 patients 34(54.83%) had ACL tears, 02(3.22%) had PCL tears. Among the study patients menisci was abnormal in 44(7.96%), collateral ligament was abnormal in 17(27.41%), joint effusion in 56(90.32%) bony lesions in 25(40.32%) and bursitis was found in 05(8.06%).(Table III).

Table-I

Showing Age distribution of traumatic knee Injury (N=62).

Age range	Frequency (N)	Percentage
07- 10 yrs.	01	1.61
11-20 yrs.	13	20.97
21-30 yrs	21	33.87
31-40 yrs	16	25.81
41-50 yrs	06	9.68
51-60 yrs	03	4.84
61-70 yrs	02	3.22

Table-II

Sex distribution of traumatic Knee injury (N=62).

Sex	Frequency (N)	Percentage
Male	57	91.94
Female	05	8.06

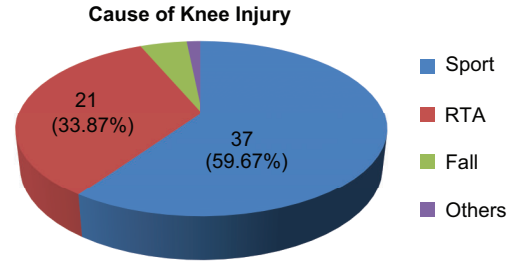


Fig-1: Cause of Traumatic Knee injury (N= 62)

Table-III

Distribution of site of lesions of traumatic knee injury

Site of Lesion	Frequency (N)	Percentage
ACL	34	54.83
PCL	02	3.22
Menisci	44	70.96
Collateral ligaments	17	27.41
Joint Effusion	56	90.32
Bony lesion	25	40.32
Bursitis	05	8.06

Table-IV

Distribution of Meniscal tears among medial and lateral (N=44).

Meniscal tear	Frequency (N)	Percentage
Medial Meniscus	22	50
Lateral Meniscus	09	20.45
Both Menisci	13	29.56
Total	44	100

While analyzing the distribution of 44 menisci lesions 22(50%) had medial meniscal tears, 09(20.45%) had lateral meniscal tears and 13(29.56%) had both menisci tears. (Table-IV)

Table-V

Distribution of Medial Meniscal tears among anterior and posterior horn and body (N=35).

Medial Meniscal tear	Frequency (N)	Percentage
Anterior Horn	06	17.14
Posterior horn	26	74.28
Body	04	8.57
Total	35	100

Among medial meniscal tears found in MRI maximum 26(74.28%) had posterior horn involvement, 06(17.14%) had anterior horn and 03(8.57%) had involvement at body shown in Table-V.

Table-VI

Distribution of lateral Meniscal tears among anterior and posterior horn and body (N=35).

Lateral Meniscal tear	Frequency (N)	Percentage
Anterior horn	02	9.09
Posterior horn	18	81.81
Body	02	9.09
Total	22	100

Lateral meniscal tears involved maximum 18(81.18%) at posterior horn, 02(9.09%) anterior horn and 02(9.09%) involved at body (Table-VI).

Table-VII

Distribution of Types of Meniscal tears (N = 44).

Meniscal Tear (Types)	Frequency (n)	Percentage
Vertical tear	25	56.81
Horizontal tear	10	22.72
Radial tear	02	4.54
Bucket Handle tear	04	9.09
Displaced flap tear	01	2.27
Complex tear	02	4.54
Total	44	100

While studying the types of meniscal tears among 44 meniscal lesion vertical tears were 25(56.81%), horizontal tears were 10(22.72%) radial tears 02(4.54%) bucket handle tears 04(9.09%) displaced flap tears 01(2.27%) & complex tears were in 02(4.54%) shown in Table-VII.

Among cruciate ligament injuries evaluated in this preset study 34(54.83%) had ACL and 02(3.22%) had PCL injury. Out of 34 ACL tears complete acute tear found in 22(64.71%) & incomplete acute tears found in 12(35.29%) cases. Out of 2 PCL injuries all 2(3.22%) were complete tears.(Table-VIII).

Among 17 collateral ligament injuries 12(70.58%) had medial collateral ligament (MCL) injury & 5(29.42%) had lateral collateral ligament (LCL) injury. Out of 12 MCL injury 1(5.88%) was sprain grade-I injury, 8(47.05%) were grade-II or incomplete tear, (3(17.64%) were grade-III on complete tear. Out of 5 LCL tear (1(5.88%) was grade-I or sprain, 2 (11.76%) were grade-II & 2(11.76%) were grade-II tear shown in Table-IX.

Table- VIII

Distribution of ACL & PCL tear and Types of tears.

Cruciate Ligament tear	Frequency (%)	Types of tear	Frequency (%)
ACL tear	34(54.83%)	Complete Acute	22(64.71%)
		Incomplete Acute	12(35.29%)
PCL tear	02(3.22%)	Complete	02 (3.22%)
		Partial	00 (00%)

Table- IX

Distribution of MCL & LCL tear & grade / Types of tears (N= 17).

Collateral Ligament Tear	Frequency (%)	Tear		Frequency (%)
		Grade	Type	
MCL Tear	12(70.58%)	I	Sprain	01(5.88%)
		II	Incomplete tear	08(47.05%)
		III	Complete tear	03(17.64%)
LCL Tear	05(29.42%)	I	Sprain	01(5.88%)
		II	Incomplete tear	02(11.76%)
		III	Complete tear	02(11.76%)

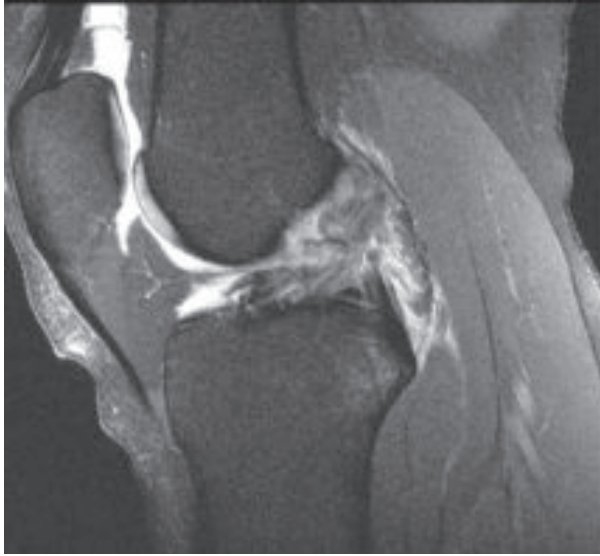


Fig.-2: *Acute complete ACL tear with Joint effusion & Bursitis.*

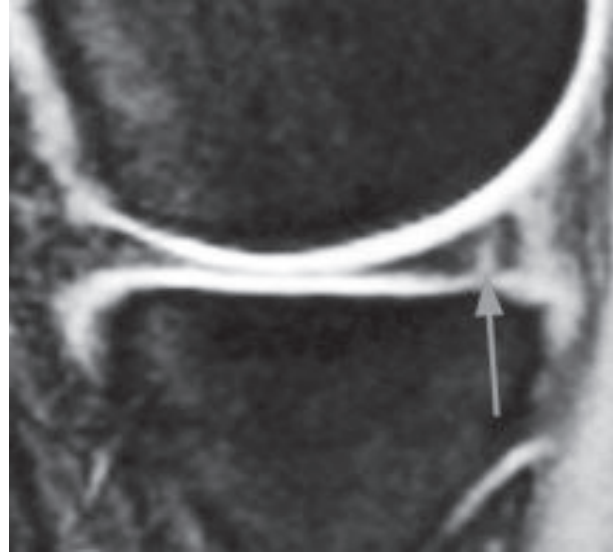


Fig.-3: *Vertical Meniscal tear.*



Fig.-4: *Bucket handle tear of posterior Horn of medial meniscus (Double PCL sign).*



Fig.-5: *Medial collateral Ligament tear.*

Discussion:

The knee is one of the most common body part which is injured. The knee joint is a complex joint. Sport, motor vehicle accidents and fall account for vast majority of injuries to knee. Knee injuries are rarely life threatening commonest soft tissue injury that resembled with studies done by Nasir⁹ and Mohi et al² found 2(3.22%), collateral ligaments 17(27.41%), joint effusion 56(90.32%), though severe injuries may be disabling. Some knee injuries may lead to long term dysfunction or irreversible damage to knee. MRI is modality

of choice for imaging soft tissue. So, MRI is a highly accurate imaging method for diagnosing cruciate ligaments, collateral ligaments and menisci tears and surrounding structures.

The present prospective study included MRI of Knee joint of 62 patients having traumatic knee. The preset study of 62 patients the highest number 21(33.87%) were in 21-30 years age group and second highest 16(25.81%) were in 31-40 years age group. Thus about 60(59.68%) were in the most productive years of life between 21-40 years. In this study male were clearly predominant

57(91.94%) than female 5(8.06%). In this study of 62 patients, meniscal injury 44(70.96%) was also associated with bony lesion 25(40.32%) and bursitis 5(8.06%). In one study Mohi et al² found joint effusion in 86.2% which closely consistent with the current study (90%). In preset study out of 44 meniscal tears 22(50%) involved medial meniscus, 9(20.45%) lateral meniscus and 13(29.56%) both menisci. Mohi et al² also found medial meniscal tears more common (44.1%) than lateral meniscus (17.6%).

In current study among the medial meniscal tears maximum 26(74.28%) were in posterior horn, 6(17.14%) in anterior horn & 3(8.57%) in body. Cruse et al¹⁰ in their study also found posterior horns tears are more common (57%) than anterior horn tears (16%). Mohi et al², Singh et al¹¹ and Pame et al¹² also found similar results in their studies. In this study, lateral meniscal tears involved more in posterior horn 18(81.18%) compared to anterior horn 2(9.09%) and body 2(9.09%). Studying the types of meniscal tears present study shows out of 44 meniscal tear maximum 25(56.81%) were vertical tears, 10(22.72%) horizontal, 4(9.09%). Bucket handle tears, 02(4.54%) residual and complex tears and 1(2.27%) displaced flap tears. Helms et al¹³ in their study found 10% bucket handle tears which is almost similar to current study (9.09%). An investigation by Harper et al¹⁴ of about 200 knees that underwent arthroscopy by a single surgeon shows 15% including of radial tears that differ with the present study which found radial tears in only in 4.54% cases.

In present study out of 34 ACL tears 22(64.71%) were complete tears which are comparable to other studied done by Mohi et al² and Sohail et al¹⁵. In this study all 2 PCL tears had complete tear and were comparable with study of Pame et al.¹² In present study out of 17 collateral ligament injuries 12(70.58%) were MCL tears & 5(29.42%) were LCL tears which are reusable to Mark et al.³ Among collateral ligament tears, incomplete or grade-II tears are common in both MCL & LCL followed by complete grade-III tears and sprain or grade-I respectively in both medial and lateral collateral ligaments.

In present study about 60% knee injuries were due to sports 37(59.67%). The second common cause

was road traffic accident 21(33.87%). Sports and RTA accounted for >93% causes of knee traumatic injuries.

MRI of the knee joint is the most frequently requested investigation referred to radiologist especially to evaluate the traumatic knee. It has several advantages compared to other modalities. MRI is non-invasive, painless and provide excellent soft tissue contrast. So, MRI should be the modality of choice for accurate evaluation of soft tissue injuries involving menisci, ligaments, tendons, muscle, cartilage, bone contusions & marrow.

Conclusion:

MRI is an excellent modality in evaluating the internal structures and derangement of knee anatomy. It also provide a road map to Orthopedic surgeons performing arthroscopy or open surgery and helps avoid unwanted surgery.

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