

# Occurrence of isolated and combined anterior cruciate ligament injuries in traumatic knee-by MRI

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## Abstract

**Background:** Anterior Cruciate Ligament (ACL) provides 90% of stability to the knee joint. Injuries to the ligament are common in active individuals. 50% of these injuries are associated with injuries to other structures which may alter treatment plan when detected. Arthroscopy, though gold standard, it is invasive. Magnetic resonance imaging (MRI) is now accepted as the best imaging modality for evaluation of knee injuries.

**Aim:** To estimate incidence of ACL tear and associated combined injuries in traumatic knee and to highlight importance of MRI in assessing these injuries.

**Methods:** 111 patients with trauma to knee were included. All the patients were subjected to MRI (Siemens Magnetom Avanto 1.5 Tesla). ACL injuries categorised into complete and partial tears for both isolated and combined lesions. Comparison of findings of MRI with arthroscopic was done where indicated. Statistical analysis using Microsoft excel and open epi software version 2.3.1. Chi-square test and correction test applied.

**Results:** ACL tear noted in 76 (68.5) patients. Isolated injury noted in 35 (46.05%) and combined injuries in 41 (53.94%) patients. Most common combined injury is ACL with medial menisci tear (31.7%) and ACL with lateral menisci tear (7%). Arthroscopy done in 21 patients. There was no statistically significant difference noted in MRI and arthroscopic findings ( $\tilde{\alpha}^2=1.02$ )

**Conclusion:** ACL tear is most common ligament injury in traumatic knee. ACL tears are not isolated events, but only the most obvious sign of a complex knee injury. MRI is an excellent, noninvasive, radiation free imaging modality to detect, localize and characterize various internal derangements of the knee joint.

**Key words:** Traumatic Knee, ACL tears, isolated and combined injuries, MRI

## Introduction

The knee joint is a large compound type of synovial joint. Due to the lack of bony support, stability of the joint is highly dependent on its supporting ligamentous structures, and therefore injuries of ligaments and menisci are extremely common especially in active individuals like athletes, military recruits and soldiers<sup>[1]</sup>. The Anterior Cruciate Ligament (ACL) is one of four major ligaments of the knee joint that coordinate function and promote stability of the knee joint. In an adult knee, the ACL

prevents forward movement of the tibia<sup>[2, 3]</sup>. It also provides roughly 90% of stability in the knee joint<sup>[4]</sup>. The majority of ACL injuries (70%) occur while playing agility sports<sup>[5]</sup>. Approximately 50% of ACL injuries occur with injuries to other structures in the knee<sup>[6]</sup>.

The most widely used diagnostic modalities to assess the joint injury are arthroscopy and MRI. Arthroscopy, though accurate, is invasive and can cause complications. Magnetic resonance imaging (MRI) has now been accepted as the best imaging

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modality for non-invasive evaluation of knee injuries<sup>[7,8]</sup>.

We have conducted this study to estimate the incidence of ACL tears and to identify the combined injuries associated with ACL tear in traumatic knee joint and also to highlight importance of MRI in assessing these injuries.

**Materials and methods**

This study was conducted at department of Radiodiagnosis and Imaging, Command Hospital (Air Force), Bangalore from August 2007 to June 2009. All the patients who were referred to our department with clinically suspected internal derangement of knee following trauma to knee were included in the study. Patients with ferromagnetic implants, pacemakers, aneurysm clips and individuals with major injuries like liver / splenic rupture or flail chest and with unstable vital parameters especially in the setting of polytrauma were excluded in the study. All the patients were subjected to MRI (Siemens Magnetom Avanto 1.5 Tesla. Whole- body MR scanner) within 4 days of clinical evaluation using T1W and PD sequences in sagittal and coronal planes, T2W sequence in axial, coronal and sagittal planes (along the plane of ACL) and STIR sequences in coronal and sagittal planes. MRI reporting is done by reputed senior radiologist of Command Hospital (Air Force).

All the patients are evaluated for ACL injuries and are categorised into complete and partial tears for both isolated as well as combined lesions, and graded accordingly.

Comparison of findings of magnetic resonance imaging with arthroscopic and/or surgical findings was done in few selected cases where indicated for diagnostic or therapeutic purposes. Arthroscopy was carried out by senior orthopaedic surgeon of the hospital. Statistical analysis was done using Microsoft excel and open epi software version 2.3.1. Chi-square test and correction test was applied

**Results**

Out of 111 patients included in the study, ACL tear was detected in 76 (68.5%) patients (Table 1). Age of the patients ranged from 16 to 73 (28.66+-8.73) (Table-2). Most of the patients had history of trauma with duration of injury ranging from 2 days to 3 years (Table-3). Isolated ACL tears are noted in 35(46.05%)

patients and in 41(53.94%) patients it is associated with other injuries. Among isolated injuries, partial tear is noted in 20(57.1%) and complete tear 15(42.8%) patients. Among combined injuries partial tear is noted in 17 (41.46%) and complete tear 24 (58.53%).

Among combined injuries, most common association is ACL with Medial Menisci (MM) tear seen in 13 (31.7%) patients. Followed by ACL with lateral menisci tear is seen in 7 (17%) patients. ACL tear with medial collateral ligament tear and ACL with injury to gastronomies muscle was seen in 2 patients’s each. ACL tear associated with involvement of 2 or more injuries was seen in 16 patients.

Arthroscopy of knee joint was done in 21 patients with either complete ACL tear of multiple injuries requiring surgery. All the MRI findings correlated with arthroscopic diagnosis. There was no statistically significant difference noted in MRI and arthroscopic findings ( $\chi^2=1.02$ ) (Table 4).

**Table 1. Total proportion of ACL tears in knee injuries**

Type of injury	Number Of Patients	Proportion	95% confidence interval(CI)
ACL tears	76	68.46	59.39-76.59
No ACL tears	35		

**Table 2. Distribution of study subjects according to age**

Age of patients	Number	Percentage
<20	10	13.2%
21-30	40	52.6%
31-40	20	26.3%
41-50	5	6.6%
71+	1	1.3%
Total	76	100%

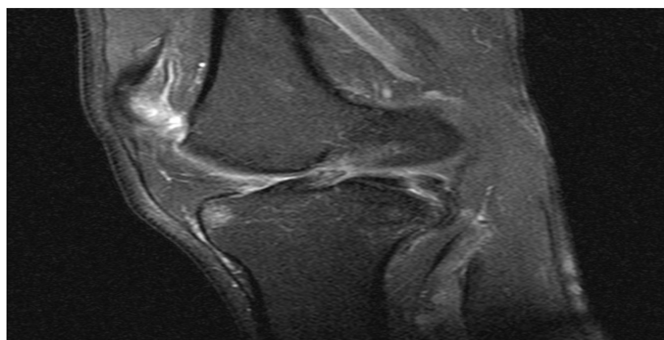
Mean +/-\_S D:28.66+/-8.73

**Table 3. Duration of injuries**

Duration of injury	Number of patients	Percentage (%)
<1 week	18	23.68
1-2 week	15	19.74
3-4 week	09	11.84
1-6 months	18	23.68
>6 months	16	21.05
Total	76	100

**Table 4. MRI and arthroscopy correlation in ACL tears (21 cases)**

	Yes	No	Correlation coefficient(?)	$\chi^2$	P
MRI	20	1	1	1.02	0.31
Arthroscopy	21	0		(not significant)	

**Figure 1. STIR Sagittal image showing midsubstance partial tear of ACL with edema****Figure 2. STIR sagittal image showing bucket handle tear of medial meniscus with positive double PCL sign**

### Discussion

Injury of the ACL most commonly occurs as a result of a pivot-shift injury requires substantial force to occur and is rarely a truly isolated event<sup>[5,6]</sup>. In non-contact injuries, the ACL is at greatest risk of injury when excessive valgus and knee axial rotation loads are combined near full knee extension, such as when the patient lands on the ground with their centre of gravity moving away from the landing limb. This type of injury may result in rupture of the medial collateral ligament, the dorsomedial capsule including the posterior horn of the medial meniscus, and the anterior cruciate ligament<sup>[9,10]</sup>.

Singh JP et al in their series of 173 patients, 78 patients (45.08%) showed ACL tears, among these 52 (66.67%), are partial, 16(20.51%) are complete and 10 (12.82%) cases showed non visualization

of ACL. The authors concluded that ACL tears are more common than other ligamentous injuries with partial tears being commoner<sup>[11]</sup>.

However in our study ACL tear was found in 76 patients (68.5 %) among these 36(47.4%) were partial tears and 40(52.6%) were complete. Most of the partial tears (57.1%) were isolated injuries whereas complete ACL tear (58.53%) were associated with other ligamentous and meniscal injuries. This shows that, as the severity of ACL tear increases; the chances of injury to other structures of knee joint increases. The increased incidence of complete ACL tear and other combined injuries can be attributed to the severity of training involved in military personnel.

In our study isolated ACL tears is noted in 35 patients where as rest 41 patients had combined injuries. The predominant pattern is ACL tear and Medial menisci tears, followed by ACL tear and lateral menisci tear, which is well correlated 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 ACL tear and medial meniscus tear (5 patients), followed by ACL and lateral meniscus (4 patients), or anterior cruciate ligament + medial meniscus + lateral ligament (4 patients)<sup>[12]</sup>.

Accurate assessment of the nature of these injuries is a prerequisite for appropriate therapy. Careful clinical examination provides essential functional information, but management decisions often cannot only be based on clinical findings alone when severe injury is suspected, since even an experienced examiner may err when assessing the extent of injury<sup>[13]</sup>. Physical diagnosis may be difficult in large patients, in patients with strong secondary muscular restraints, and in patients with an acute injury and soft tissue swelling and guarding. Partial ACL tears are especially difficult to diagnose on physical examination<sup>[14]</sup>. Accurate assessment of ligamentous injury can be achieved by arthroscopy which has become a mainstay of the evaluation of severe injury of the knee<sup>[15]</sup>. However, this technique is invasive and expensive, and a non-invasive means of evaluating injured knees would be very useful. MRI has been confirmed as the ideal approach for primary diagnosis of traumatic intra-articular knee lesions<sup>[16]</sup>.

In our study 21 patients with either complete tear or multiple injuries and requiring surgery were taken up for arthroscopy. All the findings of MRI were confirmed by arthroscopy. This correlated well with study conducted by Captain David w. et al<sup>[17]</sup>.

## Conclusion

It is important for the interpreting physician to remember that ACL tears are not isolated events, but only the most obvious sign of a complex knee injury involving multiple structures. The actual ACL injury is generally easily detected but some of the associated injuries remain subtle. Since these injuries may require treatment themselves, may alter the treatment plan when detected, or serve as markers of a prognosis. MRI may provide pivotal diagnostic information about the ACL in all of these settings.

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