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MRI Spectrum of ACL Tears in Pediatric Age Group.

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ABSTRACT

Background: Anterior cruciate ligaments (ACL) injuries are common in adolescent age group because of the high outdoor activities. These ligamentous tears of knee are always associated with other injuries. We had demonstrated the spectrum of various injuries which we come across in pediatric adolescent group. There are various knee injuries as that of menisci and bone marrow oedema which are not picked up by routine radiography. Magnetic resonance imaging (MRI) MRI plays a very vital role in elaboration of this spectrum. **Methods**: Five male patients of the age group 13-18 years (mean age 15 years) who had suffered trauma of knee region by various means underwent MRI investigations and were studied with different spectrum of ACL tears along with associated manifestations. The range of focal injury could involve ACL itself, meniscofemoral attachment or medial collateral ligaments. In addition the bony avulsion fractures are common because of immature pediatric skeleton. The study plays a great role in the management as per the description of the specific injury. The patients having any history of previous injury or ailment of the knee were not included in the study. **Results**: Majority of the patients were in pediatric adolescent group (mean age 15 years) .Left knee was injured in 60% and right knee in 40% of the cases. Meniscal tear were involved in 20% and 40% among those were having bony injury which was picked up only in MRI study while plain skiagram was normal. Posterior cruciate ligament (PCL) was involved in 40% of cases. **Conclusion**: ACL tears with associated injuries are having different spectrum in pediatric and adolescent group of children and should not be either diagnosed or treated on the lines of adult cases.MRI evaluation plays a crucial role for the description of such traumatic injuries because of epiphyseal non union.

Keywords: Anterior cruciate ligament, Adolescent, Ligamentous tear, Knee, Menisci, MRI.

INTRODUCTION

ACL injuries occur because of axial rotation along with full extension in valgus position. These injuries lead to the soft tissue as well as that of immature skeleton manifestations.[1]

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MATERIAL AND METHODS

Case 1: 14-years old boy who got his right knee twisted while playing wrestling reported to the outpatient department with pain and restricted movements. Plain X-ray of the knee was unremarkable. He underwent MRI examination and was found to be having ACL tear with associated injuries [Figure 1a and b and Figure 2].

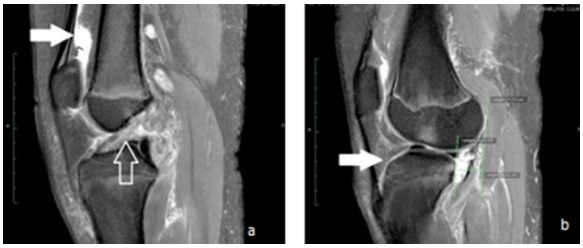

Figure 1: MR Sagittal Proton Density fat suppression images (a) isolated ACL tear shows high signal intensity in the whole course with fuzzy outline (white hollow arrow) with post traumatic fluid in the supra-patellar fossa (white solid arrow). (b) anterior translation of tibia (white solid arrow) following trauma with sequel of trauma in soft tissues.

Case 2: 18-years old boy injured his left knee while playing football. The injury was due to sudden stoppage while running. There were complaints of pain and feeling of giving away of the knee joint. Plain X-ray knee was unremarkable .He was subjected to MRI examination. There was ACL tear which was seen as high signal intensity at the distal end of the ligament along with anterior translation

[Figure 3 a and b].There was fracture of the lateral tibial condyle in the form of Segond fracture [Figure 4].

Figure 2: Coronal T2W STIR images show high signal intensity in ACL with disrupted distal attachment.

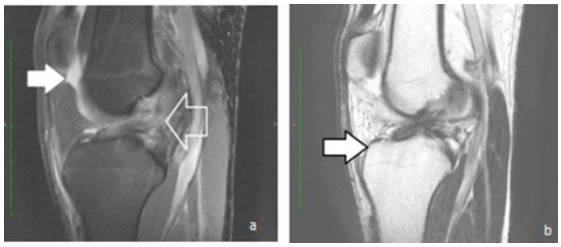

Figure 3: MR sagittal sections.(a)PDW SPIR shows distal end ACL tear with high signal intensity (hollow white arrow) with supra patellar effusion (white solid arrow). (b) T2W image shows anterior translation of tibia (white arrow).

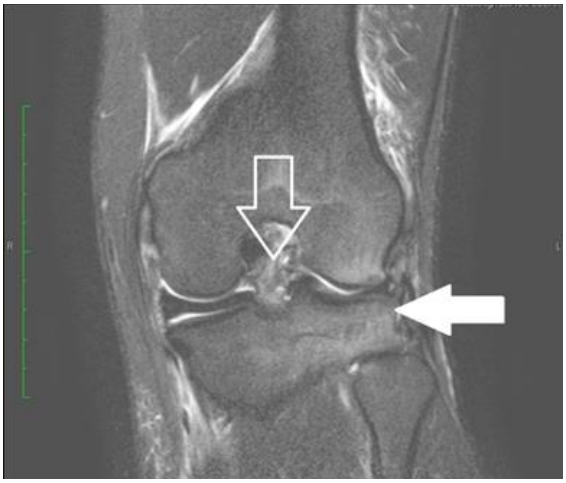

Figure 4: Coronal short tau inversion recovery (STIR) sequences shows Segond fracture of lateral tibial condyle (white arrow) with ACL tear (hollow white arrow).

Case 3:

16 –year old sustained left knee injury after falling from scooty.He was unable to move his left knee.No fracture was noticed in plain X-ray of the left knee.He underwent MRI examination and was found to be having complete ACL tear and contusion of the lateral femoral condyle [Figures 5 a,b ,c and 6a,b].

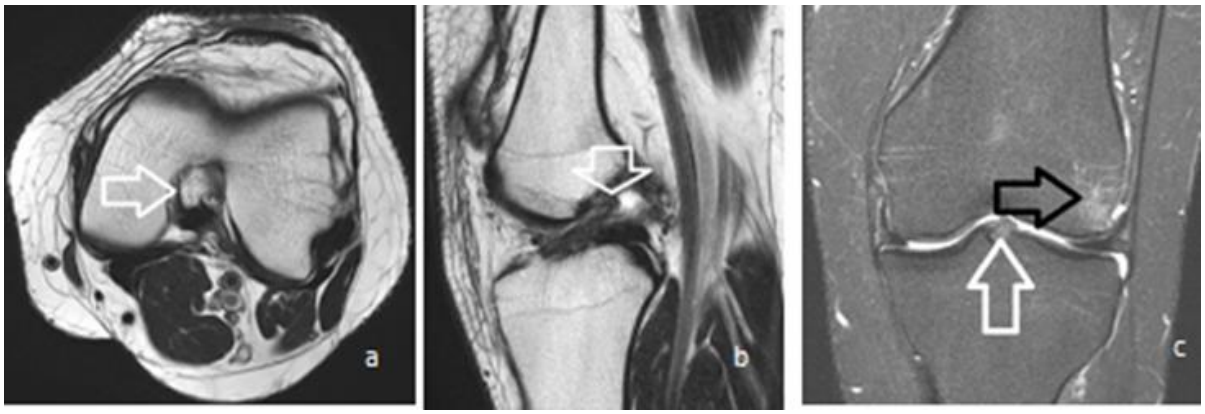

Figure 5: MRI of Left knee.(a) T2W axial section shows tear in the distal end of the ACL (white arrow).(b) T2W sagittal section shows hyperintensity of the ACL (vertical white inverted arrow) (c) Proton density fat saturated coronal section shows ACL tear (vertical white arrow) and hyperintensity in the lateral condyle of the femur depicting edema because of contusion (black arrow).

Case 4:

14-years old boy sustained right knee injury while doing jumping exercises. There was immediately restriction of movements with excruciating pain. Plain skiagram of right knee did not reveal anything and he was subjected to MRI examination. The study revealed complete ACL tear with buckling of PCL [Figures 7 a,b,c and 8 a, b].

Case 5:

13- years old with left knee trauma while playing"kabadi".All the movements were restrictedThere was no relief with analgesics-ray knee was unremarkable.MRI study picked up ACL tear with medial meniscal tear [Figures 9 a,b,c and 10 a, b, c].

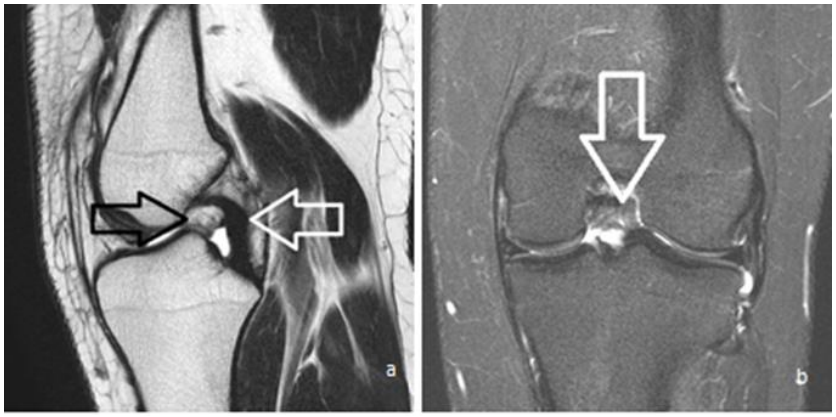

Figure 6: Contd. (a) T2W sagittal section shows tear in the distal end of the ACL (black arrow) and intact PCL (white arrow). (b) Proton density coronal image shows tear of ACL in the form of hyperintensity (white arrow).

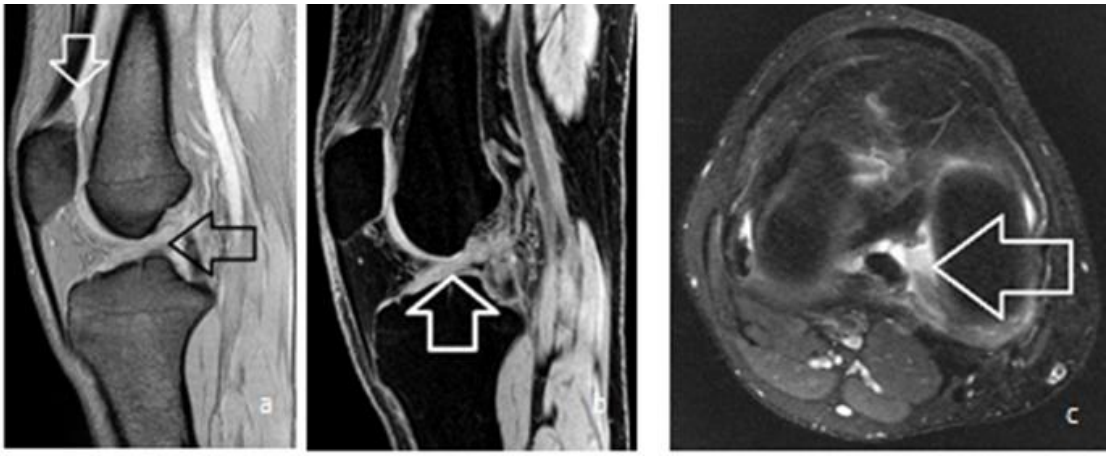

Figure 7: 14 years old boy with history of fall while doing exercises.(a) proton density image shows hyperintensity of ACL (black horizontal arrow) with minimal fluid in suprapatellar fossa (white inverted arrow).(b) Fast field echo (FFE) sagittal section shows torn ACL with intact articular cartilage (white upward arrow).(c)PDW image shows torn ACL.

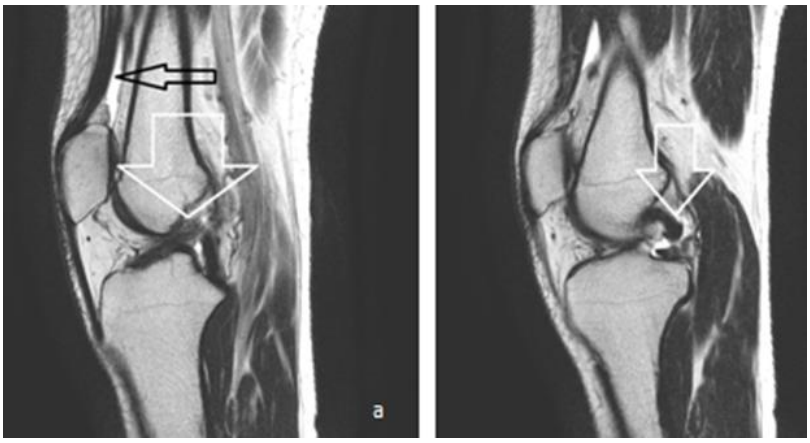

Figure 8: T2W sagittal sections.(a) ACL shows tear in the distal part (white inverted arrow)There is also minimal fluid seen in suprapatellar fossa (black horizontal arrow). (b) PCL buckling is seen (inverted white arrow).

RESULTS & DISCUSSION

ACL is important as it resists the anterior translation and stabilizes the knee against varus and valgus forces. This is also called as stabilizer of the knee. This also acts as mechanoreceptor. The injury may cause early osteoarthritis changes and secondary meniscal tears.ACL injuries with lateral collateral ligaments requires special attention because of the management, so the accurate diagnosis is of paramount importance .LCL repairs heal in short time and thereafter the ACL graft will not lead to failure.

Various presentations of the ACL injury are of the following pattern:-Rupture of the ligament

- Avulsion of the posterior attachment of the lateral meniscus.
- Impaction of the femoral condyle
- Tear of medial menisco capsular junction

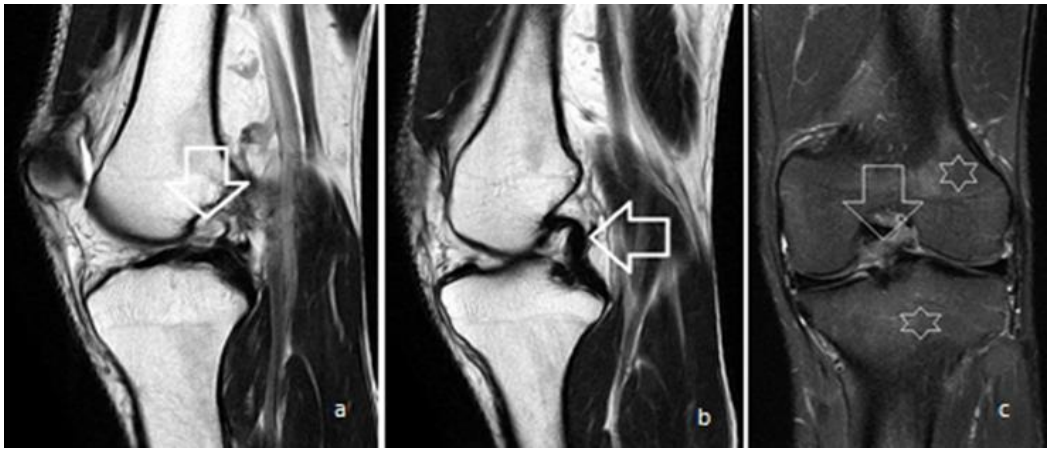

Figure 9: MRI of left knee of 13-years old boy.(a) sagittal T2W image show hyperintensity of the distal part of the ACL (white inverted arrow). (b) sagittal T2W section shows buckling of PCL (horizontal white arrow). (c)coronal STIR image shows ACL tear (inverted white arrow) with bony contusions (white stars).

Figure 10: (a) axial proton density image shows tear of ACL (white horizontal arrow).(b) sagittal proton density section shows hyperintensity of ACL (white upwards arrow) and fluid in suprapatellar fossa (white inverted arrow).(c) STIR sagittal section shows ACL tear in the distal part(white horizontal arrow).

In children ACL may be difficult to visualize in normal cases as it is thin. This has got two bundles as anteromedial meant for flexion and posterolateral meant for extension. The injury can include one or both the bundles. There are indirect evidence of tear in the form of thickening and edema. There may be difficulty in distinguishing between partially closed physis and impacted tibial plateau fracture.[2] Tibial spine avulsion also becomes difficult to delineate.[3] ACL requires a great force for the injury, so other associated findings are always there. This includes meniscal tears and bony contusions. The group constitutes to approximate 50% for these types of injuries.[4] The lateral compartment gets the impact during vertical halt when the load is on posteromedial corner of the joint and medial collateral ligament. There is paucity of the study of pediatric ACL injuries especially in teenager group.

Pivot-shift injury mechanism is the reason for ACL tears.Epiphyseal avulsion is more common in children as compared to the tear of ACL because of the anatomical architecture.[5] Medial meniscal displacement takes place later on rather than immediately evident in imaging studies. There is difficult to delineate the meniscofemoral ligament from the lateral meniscus on the posterior aspect which complicates the issue in diagnosis.[6] MRI is boon for the diagnosis in these types of injuries. Axial sectional images delineate medial collateral ligaments better than the coronal images.

CONCLUSION

MRI spectrum of ACL injury spectrum should be known to the clinician so that associated findings may not be overlooked. This will help in the management of the patients.

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Table 1: Descriptive Chart of the patients with MRI Findings.

S No	Name/ Affected Knee	Age	Sex	MRI FINDINGS					
				ACL Description	PCL	Avulsion Features	Meniscal Tear	Collateral Ligaments	Fluid Collection
1	RH RT KNEE	14	M	ACL tear with Anterior translocation	Intact	No	No	Intact	Yes in the supra patellar fossa
2	MH LT KNEE	18	M	ACL tear in the distal segment		Avulsion (Segond) fracture of the tibia	No	Intact	Yes in the suprapatellar fossa and minimal in the joint space
3	SH LT KNEE	16	M	Complete ACL tear	Intact	Contusion of the lateral femoral condyle	No	Intact	Only minimal in the joint space
4	SH RT KNEE	14		Complete ACL tear	Buckling of PCL	No	No	Intact	Minimal fluid in the suprapatellar fossa
5	GK LT KNEE	13		ACL tear in the distal part	Buckling of PCL	No	Posterior horn of the Medial Meniscus	Medial Collateral ligament tear	Minimal joint effusion

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