

Evaluation of Post Operative Knee Surgery and its Complications with Magnetic Resonance Imaging

Dr. Charan Chandrashekar Masali¹, Dr. Shrishail. S. Patil²

Post Graduate, M. D Radio Diagnosis, Mahadevappa Rampure Medical College, Kalaburagi (585102)

Mobile Number: 7259366265

MD Radio Diagnosis, Professor, Departement Of Radio Diagnosis, Mahadevappa Rampure Medical College, Kalaburagi (585102)

Mobile Number - 9845199335

Abstract: ***Title:** Evaluation of post operative knee surgery and its complications with magnetic resonance imaging. **Aims and Objectives:** To assess the role of MRI in evaluation of the post - operative knee joint. Assessment of the complications after ACL, meniscal and cartilage surgical repair procedures. **Methods and Materials:** This prospective study was conducted in the department of Radio diagnosis at Basaveshwara Teaching and General Hospital on patients who were referred for MRI exam for post - operative assessment and patients presenting with complications after knee surgeries. **Sample size:** 25 The patients were evaluated with MRI using standard protocol. **Results:** 1) Data of 25 patients were analysed in the study. 2) 12 out of 25 patients (50%), underwent reconstruction of the ACL ligament and ACL was the most common ligament to be reconstructed in knee surgeries. 3) 4 (16%) patients were operated with PCL reconstruction and 9 (36%) patients underwent meniscal repair. 4) 5 patients (41.66%), who underwent ACL reconstruction, had graft failure and graft impingement was seen in 1 patient (8.33%). 5) 1 each patient (25%), who underwent PCL reconstruction, developed laxity of the graft and focal artrofibrosis. 6) 2 patients (22.22%) who had meniscal repair were diagnosed with return meniscus. **Conclusion:** MRI has high sensitivity and specificity regarding the assessment of the post - operative knee joint and MRI imaging provides excellent anatomical and morphological assessment of the knee joint after surgical intervention of ACL, PCL and meniscal repair. It is important to be able to recognize the normal MR imaging appearance of the knee after the more common procedures, as well as complications associated with such procedures.*

Keywords: ACL and PCL Reconstruction, Graft Failure, Graft Impingement, Return Meniscus

1. Introduction

- The knee is frequently injured joint and thus a common focus of operative intervention. As operative techniques and imaging modalities evolve, radiologist must be aware of the expected post operative appearance after knee surgeries that are commonly performed and also must be able to recognise complications encountered in the immediate or delayed post operative period
- Magnetic resonance imaging (MRI) is often the method of choice to evaluate soft tissue injuries in acute knee trauma and has widely replaced diagnostic arthroscopy. MRI is a non - invasive examination that allows excellent soft tissue contrast without ionising radiations.

Aims and Objectives

- 1) To assess the role of MRI in evaluation of the post operative knee joint.
- 2) Assessment of the complications after ACL, PCL, meniscal and cartilage repair procedures.

2. Materials and Methods

Source of Data

The study was conducted in the department of Radio diagnosis at Basaveshwara Teaching and General Hospital on patients who were referred to Radio diagnosis department for MRI exam for post - operative assessment after orthopedic examination from Orthopedic Department at Basaveshwara Teaching and General Hospital.

Sampe Size: 25

Type of Study: Prospective study

Inclusion Criteria

- Post - operative Patient of both sex.
- Patients with a history of knee joint intervention with complication.

Exclusion Criteria

- Any electrically, magnetically or mechanically activated implant, cardiac pace maker, cochlear implant and hearing aids.

MRI Protocol

- Proton density fat suppressed (PDFS) images in coronal, axial and sagittal planes.
- T2 weighted FSE images in sagittal and coronal planes.
- T1 weighted FSE images in coronal plane.

3. Results

- Data of 20 patients were analysed in the study.

Age and Sex Distribution (Table and chart 1)

- Of the 25 patients, 17 (68%) were male and 8 (32%) patients were female.
- The age group ranged between 14 to 50 years

Distribution of Different Kinds of Knee Surgery (Table and chart 2)

- 12 out of 25 patients (48%) underwent reconstruction of the ACL ligament and ACL was the most common ligament to be reconstructed in knee surgeries.
- 4 (16%) patients were operated with PCL reconstruction and 9 (36%) patients had meniscal repair, in the study.

Table1: Age and Sex Distribution

Age	Minimum	Maximum	Mean ± SD
	14	50	32±12.72

		Frequency	Percent
Sex	Female	8	32.00%
	Male	17	68.00%

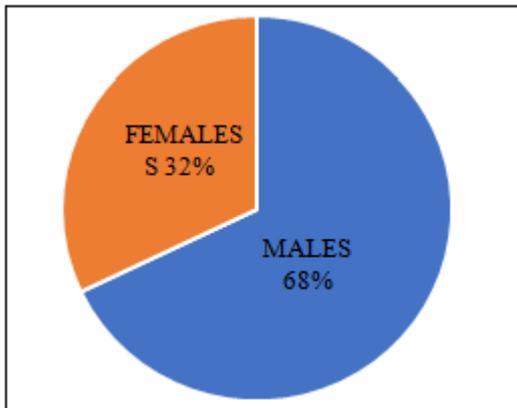
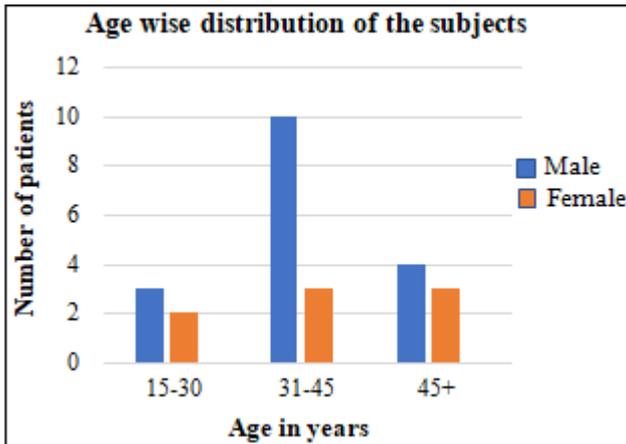


Chart 1: Age and Sex Distribution

Chart Showing Sex Distribution

Table 2: Different Kinds IOF Knee Surgery

Surgery	Frequency	Percent
ACL Reconstruction	12	48%
PCL Reconstruction	4	16%
Meniscus Repair	9	36%

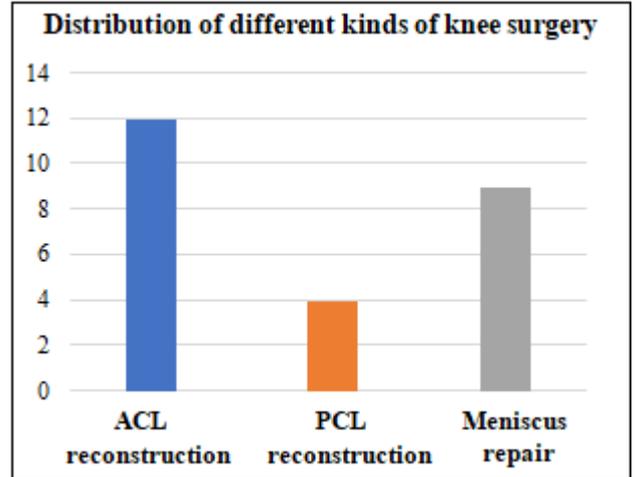


Chart 2: Distribution of Different Kinds of Knee Surgery

- Post operative MR imaging was done to evaluate for tunnel placement and graft integrity in patients who underwent ACL&PCL reconstruction.
- Fig 1a & 1b shows optimal positioning of the femoral and the tibial tunnel in ACL reconstruction surgeries.
- The femoral tunnel is seen at the intersection of the lines drawn along posterior femoral cortex and the posterior intercondylar roof on sagittal MR images. On coronal MR images the femoral tunnel is seen at approximately 11'o'clock position in right knee.
- The tibial tunnel is seen parallel and posterior to the line drawn along the slope of the intercondylar roof (Blumensaat line).

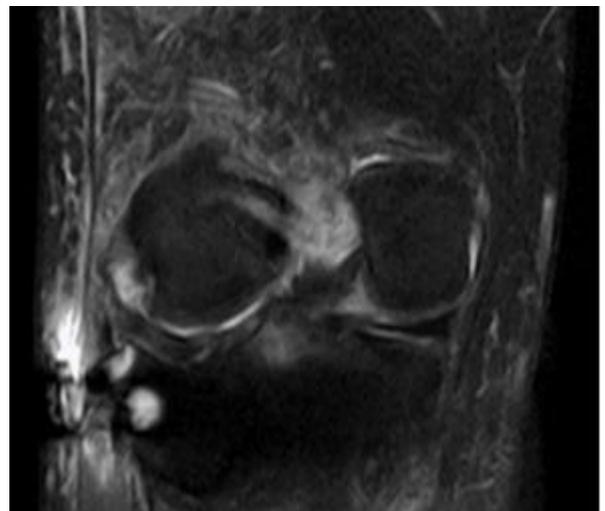


Figure 1 (a)

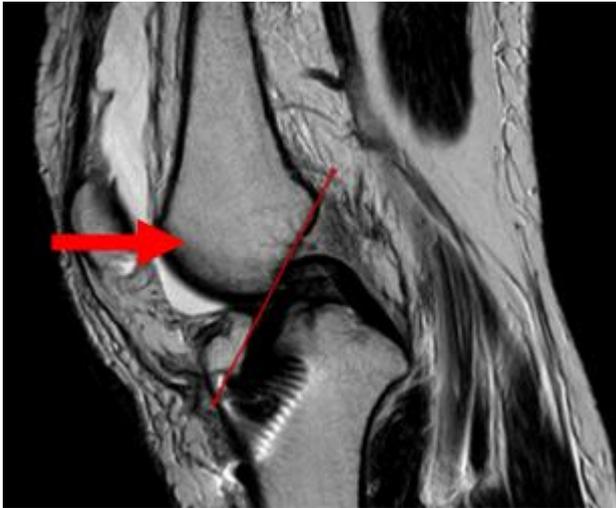


Figure 1 (b)

Fig 1a and 1b, coronal PDFS and T2 sagittal images of right knee in 40 year old male patient, show normal position of the femoral and tibial tunnel in ACL reconstruction. The femoral tunnel is seen at approx. 11'0 clock position in the coronal image (red arrow in fig 1a) and the tibial tunnel is seen posterior and parallel to the blumensaatt line (red line in fig 1b)

- Fig 2a & 2b shows optimal positioning of the femoral and the tibial tunnel in PCL reconstruction surgeries .
- The location of the femoral tunnel depends on the number of bundles.
- In the single bundle technique, the opening is located in the anterior half of the insertion site of the native PCL, at 11'0 clock in the left knee, approximately 9mm from the articular margin.
- The tibial opening is seen in the middle of posterior half of the retro spinal surface, medial to the articular midline, 10 mm distal to the articular surface.



Figure 2 (a)

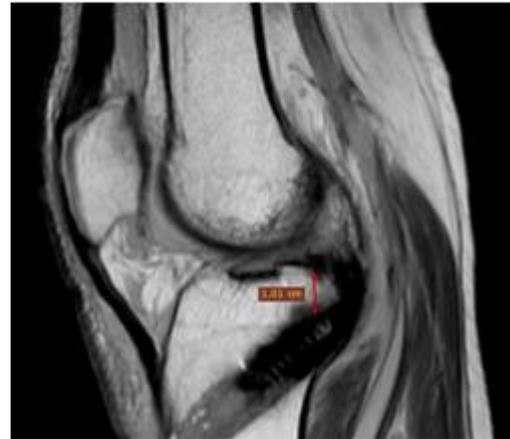


Figure 2 (b)

Figure 2: Fig 2a & 2b coronal T2 and sagittal PD images of left knee in a 45 year old male patient, shows normal position of the femoral and tibial tunnel In PCL reconstruction. The femoral tunnel is seen at approx. 11'0 clock position (red arrow in fig 2a) and tibial tunnel (fig 2b) is seen in the retro spinal surface, 10 mm distal to the articular surface.

Chart 3 shows distribution of the various complications of ACL and PCL reconstruction

- 6 patients (24%) who presented with joint instability in the post operative period were subjected to MRI.
- 5 patients out of 12 (41.66%), who underwent ACL reconstruction, had graft failure.
- Fig 3 shows complete absence of graft fibres and increased T2 signal intensity in the expected location of the graft.
- 1 patient out of 4 (25%), who underwent PCL reconstruction, had laxity of the graft.
- Fig 4 shows buckling and thickening of the PCL graft with mild posterior displacement of the tibia.

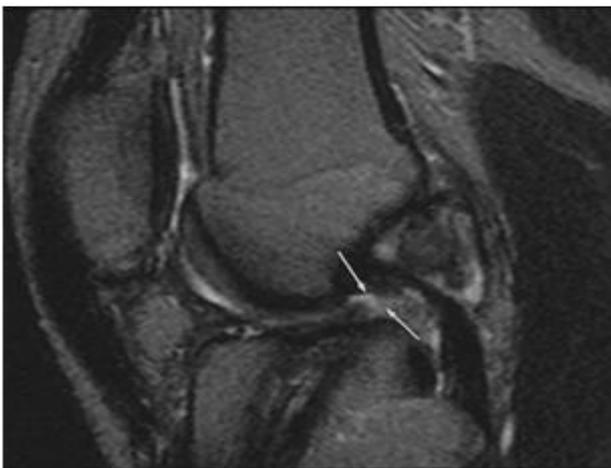
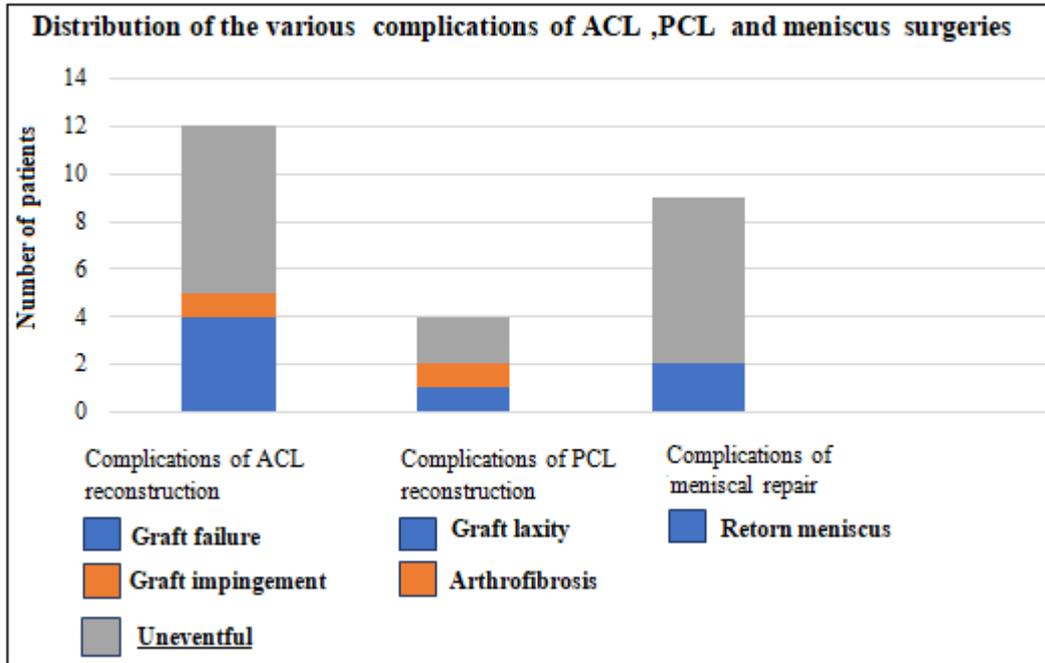


Figure 3: Sagittal T2 image in 35 yr old patient, shows complete absence of graft fibres and increased T2 signal intensity in the expected location of the graft suggestive of graft failure

- 3 patients (12%) who presented with limitation of movement in the post operative period were evaluated with MRI.
- 1 patient of the 12 patients (8.33%) who underwent ACL reconstruction, had graft impingement.
- Fig 5 shows abnormal intermediate signal intensity in the distal portion of the ACL graft. The tibial tunnel is seen anterior to the intersection of the intercondylar roof and the proximal tibia.
- 1 patient of the 4 patients (25%) who underwent PCL reconstruction, had focal arthrofibrosis.
- Fig 6 shows hypointense nodule surrounding the intercondylar portion of the PCL, consistent with focal arthrofibrosis.

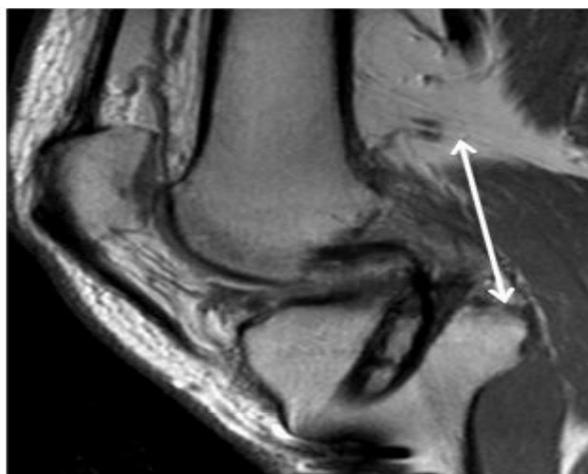


Figure 4: Sagittal PD image in a patient with graft laxity shows buckling of the PCL graft and posterior displacement of the tibia (arrow), indicating instability

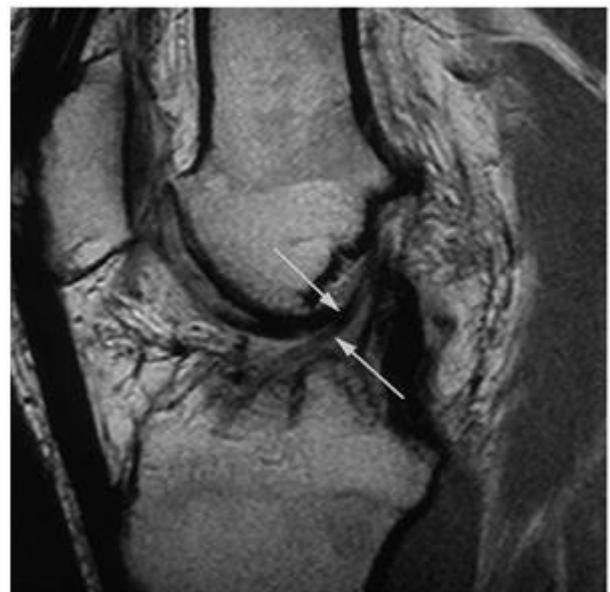


Figure 5: Sagittal T2 image in a 30 year old female patient, shows abnormal intermediate signal intensity in the distal portion of the ACL graft (arrows), consistent with graft impingement.



Figure 6: Sagittal PDFS image in a 43year patient shows hypointense nodule surrounding the intercondylar portion of the PCL, consistent with focal arthrofibrosis.

- 2 patients (22.22%) of the 9 patients who had meniscal repair, presented with persistent pain in the post operative period and were subjected to MRI.

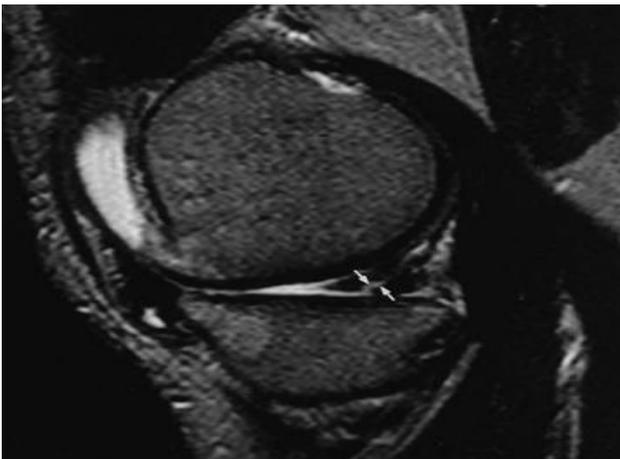


Figure 7: Shows fluid signal intensity within the remnant of the posterior horn of the medial meniscus, finding indicative of return meniscus.

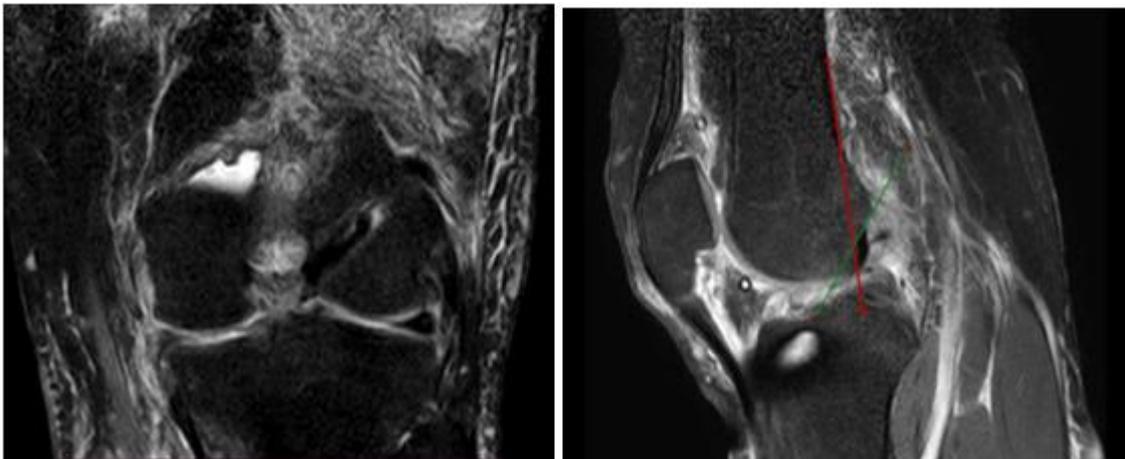


Figure 8: (a) sagittal and 8 (b) coronal PDFS image of left knee in a 35 year old male patient, shows normal position of the femoral tunnel

4. Discussion

Evaluation of ACL reconstruction

- The most commonly reconstructed ligament in the knee is the ACL. Its clinical evaluation can be difficult.
- Post - operative ACL graft patients complaining of knee instability and loss of extension, limitation of movement, swelling, or pain are indicated for clinical and radiological examination aiming to diagnose ACL graft failure, ACL graft complication or other internal derangement.
- The most common methods of reconstructing the ACL are to use a bone–patellar tendon–bone autograft (i. e, patellar tendon autograft) or hamstring autograft.
- The positions of the bone tunnels in the distal femur and proximal tibia are crucial for proper function of the ACL graft, and it is important to evaluate the bone tunnel position on MR images.

Assessment of the tunnel position:

- The position of the femoral tunnel should be at the intersection of the posterior femoral cortex and the posterior physeal scar corresponding to the posterior intercondylar roof on sagittal MR images.
- On coronal MR images, the femoral tunnel should be at the 11 o'clock and 1 o'clock positions in the right and left knees, respectively

The position of the tibial tunnel should be parallel but posterior to the slope of the intercondylar roof (Blumensaat line) as seen on sagittal MR images.

- On coronal MR images, the tibial tunnel should open on the intercondylar eminence.

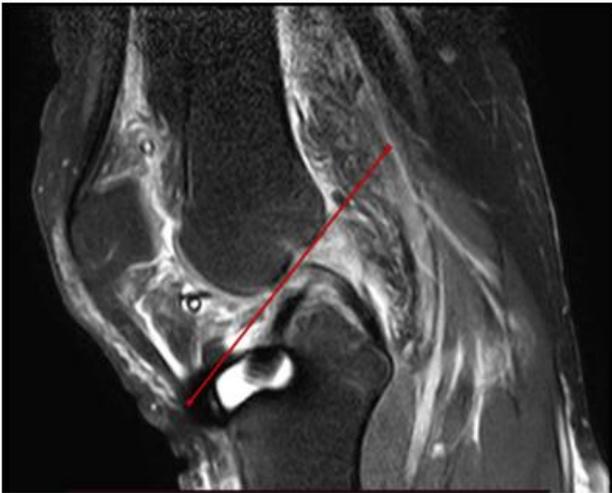


Figure 9: Sagittal PDFS image of left knee in a 35 year old patient shows normal position of the tibial tunnel, parallel and posterior to the blumensaat line (red line)

Assessment of the ligament graft

- Because both intact and torn ACL grafts can have intermediate signal intensity on short echo time images, T2 - weighted imaging findings are crucial for detection of graft disruption. T2 - weighted MR imaging findings of graft disruption include an absence of intact graft fibers and increased signal intensity similar to that of fluid within the expected region of the graft (1).



Figure 10: Sagittal proton density image in 23 year old male patient demonstrates homogeneous low signal intensity off the ACL graft.

Partial tears of the ACL graft are demonstrated as areas of increased signal intensity affecting a portion of the graft with some intact fibers still present (1).

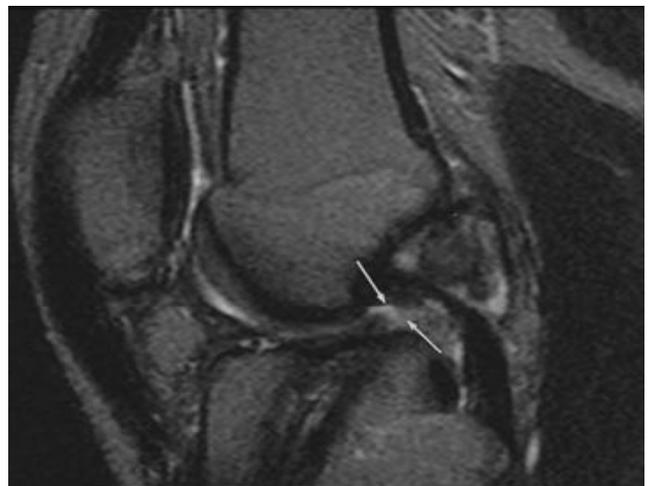


Figure 11: Sagittal T2 weighted image in a 45 old male patient shows increased signal intensity along the expected course of the ACL graft (arrows). No intact graft fibers are visible.

Evaluation of PCL Reconstruction

- Assessment of the tunnel position:



Figure 12 (a)

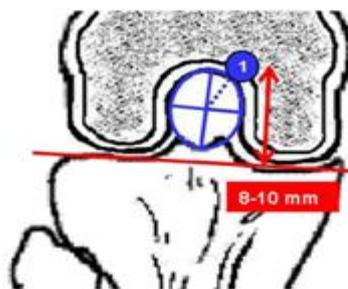


Figure 12 (b)

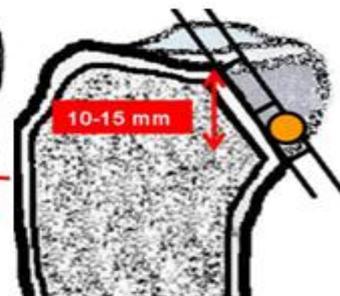


Figure 12 (c)

Figure 12: (a) In the sagittal plane the opening (in blue) of the femoral tunnel should be located in the anterior half of the insertion site of the native PCL and (b) in the coronal plane, at 1 o'clock or 11 o'clock in the right (as shown) and left knee, respectively, 8–10 mm from the articular margin. (c) on the sagittal plane, the tibial tunnel should be located in the middle of the posterior half of the retrosplinal surface, 8–15 mm distal to the articular surface.

Assessment of the ligament graft

- The MR signal intensity changes with the age of the graft. In the first 3 - 4 months, the graft is avascular and appears hypointense on all sequences. At 4 - 8 months after surgery, the graft undergoes remodelling and resynovialization process called ligamentization. During this phase the high T2 signal intensity may appear that should not be mistaken for tear or impingement (2).
- Absence of visualization of the graft and presence of full thickness defect of fluid signal intensity are the most specific signs of graft disruption. Posterior displacement of the tibia may be present as an indirect sign of disruption (2).



Figure 13: Sagittal PD FS MRI in a 36 year old patient. No graft is identified in the intercondylar region, with fluid occupying the theoretical course of the graft. As an indirect sign of disruption, there is posterior displacement of the tibia (indicated by arrow)

Meniscal Surgery

- Following partial meniscectomy or meniscal repair, it can often be difficult clinically to distinguish knee pain caused by re-tearing of the meniscus from other causes of knee pain, and a reliable imaging method is needed.
- The findings of high - signal - intensity joint fluid extending into a cleft within the meniscal fragment on T2 - weighted images or of a displaced meniscal fragment are specific but not sensitive signs of a return meniscus (1).
- In an attempt to improve the accuracy of MR imaging for diagnosing return menisci, the use of direct MR arthrography, which involves the injection of intraarticular contrast material, has been proposed (1).

Pitfalls:

- Fixation devices can be an issue in the ACL post operative MRI evaluation, because metallic devices could be responsible for disturbing artifacts (3).
- Signal conversion is a potential pitfall mimicking a recurrent tear following partial meniscectomy. Signal conversion refers to the situation in which intrasubstance degenerative signal (grade 1 or 2), or the central healed margin of a prior meniscal tear cleft, extends to the neo articular surface of the post operative meniscus following resection of the unstable component of a tear. Such resultant signal change within stable post

operative meniscus may mimic the appearance of grade III signal intensity in the setting of a tear of non operative meniscus (4).

5. Conclusion

- MRI has high sensitivity and specificity regarding the assessment of the post - operative knee joint and MRI imaging provides excellent anatomical and morphological assessment of the knee joint after surgical intervention of ACL, PCL and meniscal repair.
- It is important to be able to recognize the normal MR imaging appearance of the knee after the more common procedures, as well as complications associated with such procedures.

References

- [1] Michael P. Recht, Josef Kramer MR Imaging of the Postoperative Knee: A Pictorial Essay; *RadioGraphics* 2002; 22: 765-774. Available from: <https://doi.org/10.1148/radiographics.22.4.g02j111765>
- [2] Alcalá - Galiano A, Baeva M, Ismael M, Argüeso MJ. Imaging of posterior cruciate ligament (PCL) reconstruction: normal postsurgical appearance and complications. *Skeletal Radiol.* 2014 Dec; 43 (12): 1659 - 68. doi: 10.1007/s00256 - 014 - 1975 - 6. Epub 2014 Aug 9. PMID: 25104102.
- [3] Grassi A, Bailey JR, Signorelli C, Carbone G, Tchongwakam A, Lucidi GA, Zaffagnini S. Magnetic resonance imaging after anterior cruciate ligament reconstruction: A practical guide. *World J Orthop.* 2016 Oct 18; 7 (10): 638 - 649. doi: 10.5312/wjo. v7. i10.638. PMID: 27795945; PMCID: PMC5065670.
- [4] Naraghi A, White L. MRI evaluation of the postoperative knee: special considerations and pitfalls. *Clin Sports Med.* 2006 Oct; 25 (4): 703 - 25. doi: 10.1016/j. csm.2006.06.007. PMID: 16962423.