



# POSTOPERATIVE IMAGES OF ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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## Objective

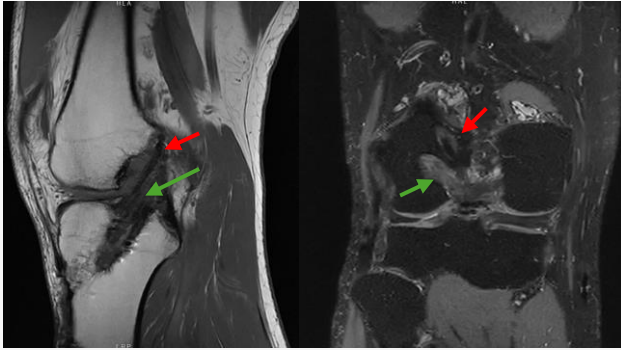
To illustrate images of knees after anterior cruciate ligament (ACL) reconstruction with review of normal post-operative findings and surgical complications.

## Materials and Methods

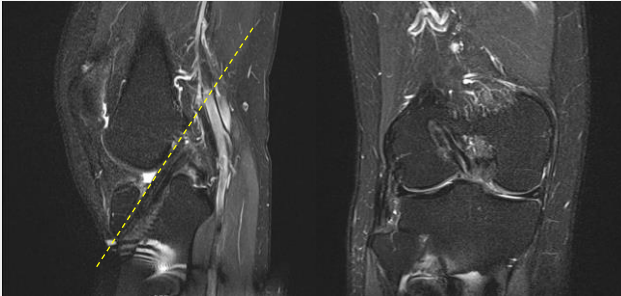
A retrospective search through our local database to identify patients with ACL reconstruction. Their CT and MRI images were reviewed and analyzed.

## 1. Normal post-operative findings

Double or single bundle graft can be used for ACL reconstruction. Double bundle consist of separate posterolateral and anteromedial bundles to recreate native morphology of ACL.

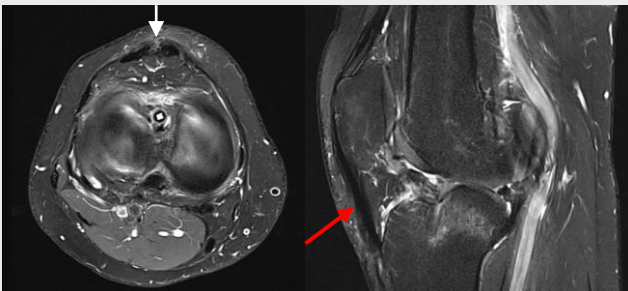


**Fig. 1** ACL reconstruction with double bundle graft. Right knee normal femoral tunnel position: AM bundle 10-11 o'clock (red arrow), PL bundle 9-10 o'clock (green arrow) on coronal plane.

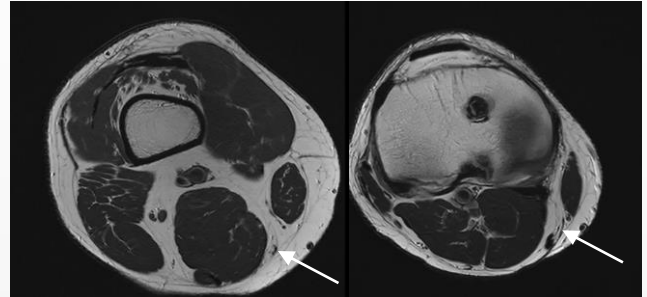


**Fig. 2** Normal single bundle graft alignment. The tibial tunnel is parallel to intercondylar roof's projected slope (the Blumensaat line; yellow dashed line). The proximal tibial tunnel opening should be posterior to the intersection of the Blumensaat line and tibia.

Several types of graft for ACL reconstruction: bone patella bone, hamstring and quadriceps grafts with corresponding features in donor sites can be seen in post-op images.



**Fig. 3** MR Images 7 months post ACL reconstruction with bone-patella-bone graft. Donor site defect at patellar tendon (white arrow) with patellar tendon thickening (red arrow)

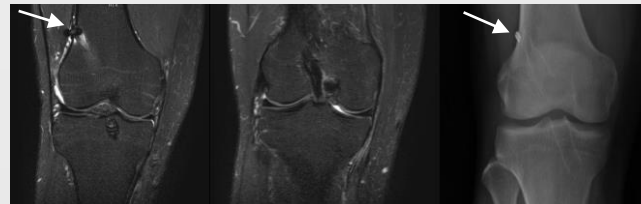


**Fig. 4** ACL reconstruction with hamstring graft. Thinning of the gracilis tendon is noted (arrows).

Bioabsorbable screw, metallic screw and endobutton are the common fixation devices.



**Fig. 5 (a)** Bioabsorbable interference screw used. Its signal is low in all sequence. It has lower mechanical strength and can lead to issues like screw breakage or insufficient fixation strength. **(b)** Metallic interference screw causing artefacts with signal loss (white arrow) and signal pile-up (red arrow). Metallic interference screw provides high mechanical strength with good graft stability.

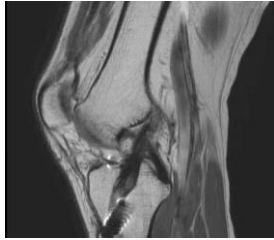


**Fig. 6** Endobutton suspending a hamstring graft. It provides cortical suspensory fixation of graft to femur.

## 2. Complications

### a. Technical complications

#### i. Unsatisfactory femoral and tibial tunnels position



**Fig.7** The tibial tunnel placed too posteriorly. Center of the tibial tunnel should be located between the anterior third and midpoint of the sagittal length of the tibia. Too posteriorly placed tunnel can cause extension instability. Too anteriorly placed tunnel can cause graft impingement against the intercondylar roof.

#### ii. Tunnel enlargement

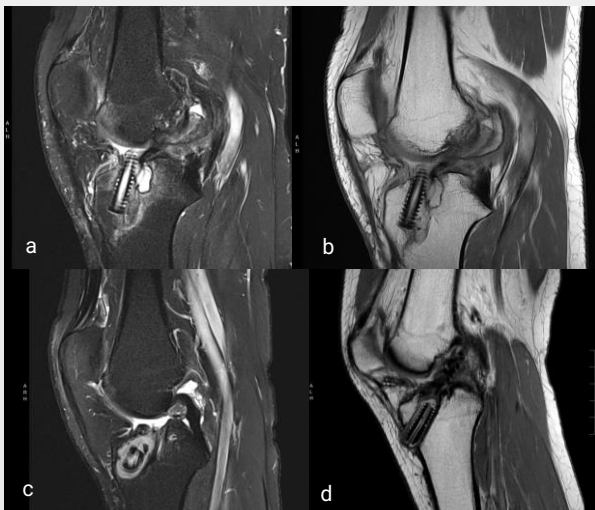
Filled with fluid or cysts. It is seen usually 6 months to 24 months post-operation, more at middle third of tibia tunnel, result from motion between tunnel and graft interface. Misplaced tunnel is one of the important risk factors. Other causes include ganglion cysts, graft tunnel size mismatch.



**Fig.8** (a, b) Enlarged tibial tunnel associated with ganglion cyst. (c) Enlarged tibial tunnel filled with fluid. (d) CT of patient with enlarged tibial tunnel.

#### iii. Hardware complication

Includes fixation screw fracture and migration.

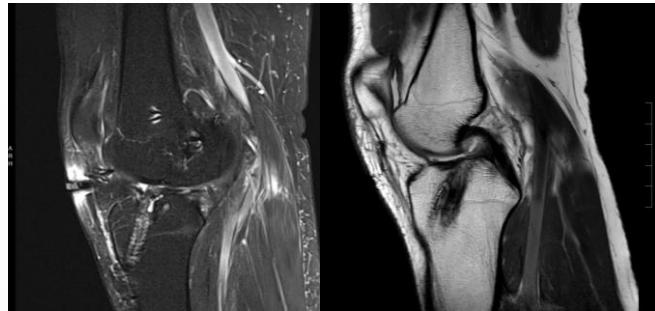


**Fig. 9** (a, b) Superior migration of tibial screw with tunnel enlargement and ganglion cyst formation. (c) Bioabsorbable screw fracture with tunnel enlargement in patient with complete ACL tear. (d) Protrusion of the tibial screw head beyond the anterior tibia cortex.

### b. Graft complications

#### i. Complete tear

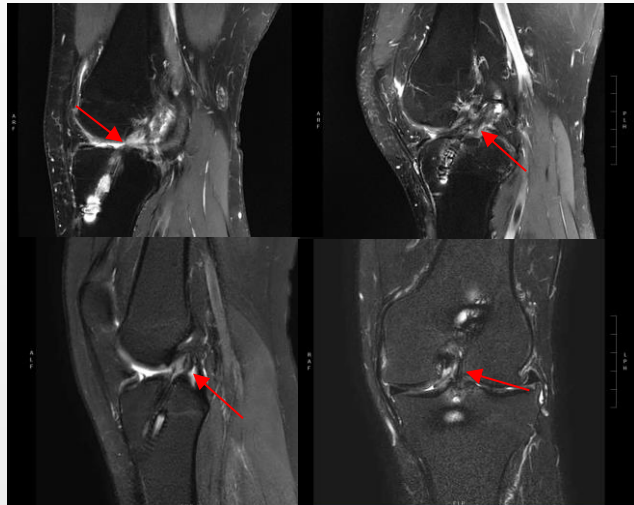
Features of complete graft tear include absence of intact graft fibers with fluid-filled defect, horizontal graft orientation or laxity, and associated marrow contusions.



**Fig.10** Two cases of complete ACL tear with absent of intact graft fibers.

#### ii. Partial tear

Features of partial graft tear is suspected when a portion of the graft shows focal areas of increased signal intensity at T2-weighted images. Some intact fibers should still present. Between 4-12 months, ACL grafts may show increased signal on T2-weighted sequences secondary to revascularization and may not indicate functional failure.

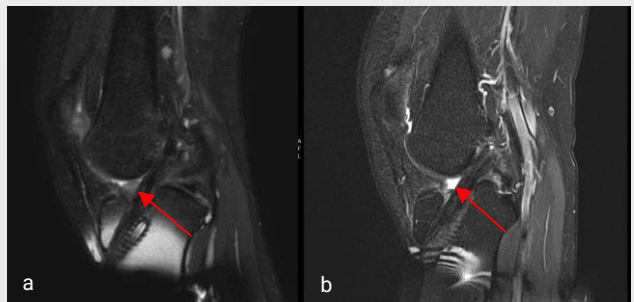


**Fig.11** Examples of partial ACL graft tear with remaining intact fibers seen.

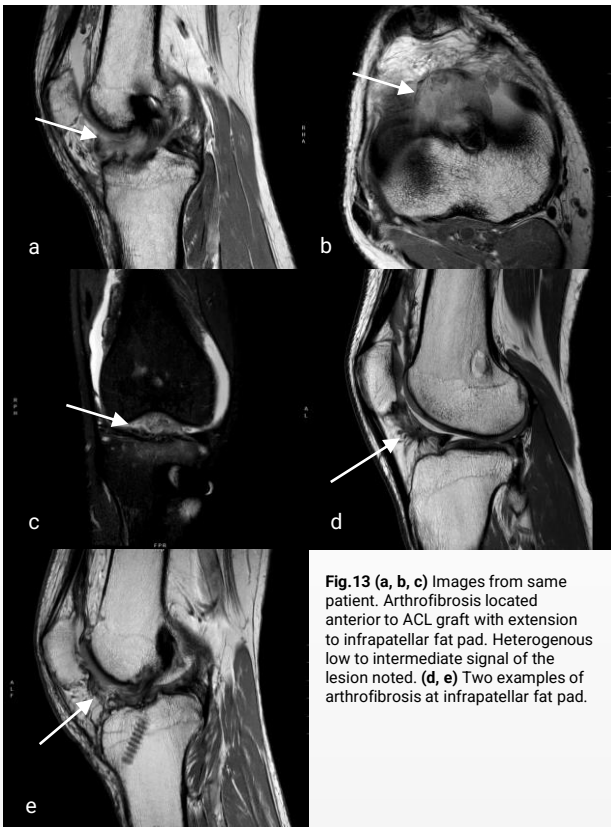
### c. Other complications

#### i. Arthrofibrosis

Scar tissue in at least one compartment of the knee joint, in and around the synovium. Cyclops lesion is the localized nodular anterior to the reconstructed ACL. It shows low to intermediate signal on T2-weighted images.



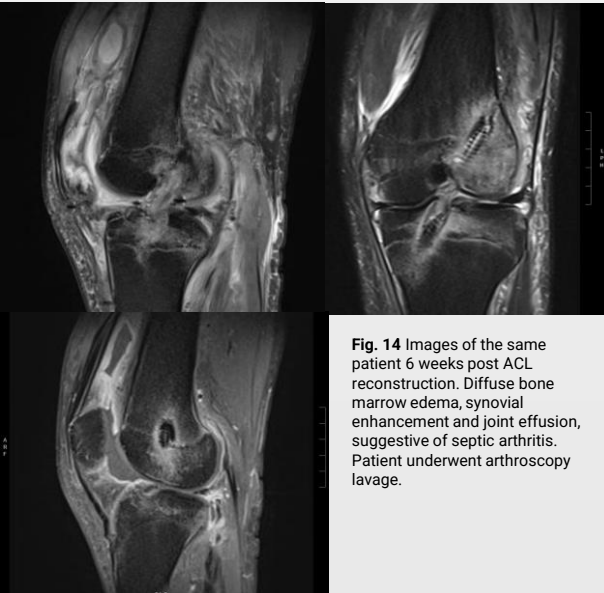
**Fig.12** (a) Patient complained of pain and clicking during knee extension post ACL reconstruction. MRI revealed cyclops lesions anterior to the ACL graft. (b) Arthroscopy resection of the cyclops lesion performed. Follow up MRI showed resection of the cyclops lesion. Patient's knee extension symptoms resolved after operation.



**Fig.13 (a, b, c)** Images from same patient. Arthrofibrosis located anterior to ACL graft with extension to infrapatellar fat pad. Heterogenous low to intermediate signal of the lesion noted. **(d, e)** Two examples of arthrofibrosis at infrapatellar fat pad.

## ii. Infection

The reported cumulative incidence of post ACL reconstruction septic arthritis is 0.1-0.9% . Most acute infection occurs within 2 weeks, with subacute infection occurs 2 weeks to 2 months. MR imaging findings of infection include sinus tracts, synovitis, bone erosion, marrow edema, periarticular edema and soft-tissue abscesses.



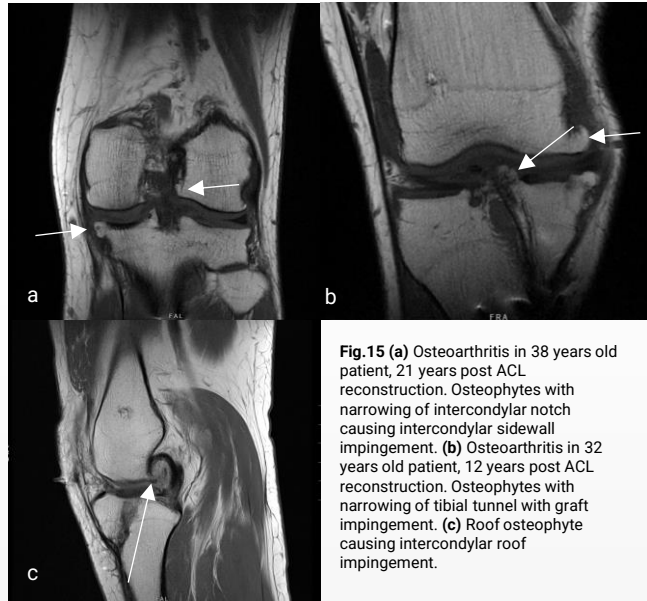
**Fig. 14** Images of the same patient 6 weeks post ACL reconstruction. Diffuse bone marrow edema, synovial enhancement and joint effusion, suggestive of septic arthritis. Patient underwent arthroscopy lavage.

## iii. Graft impingement

Abnormal position of tibial tunnel relative to femoral tunnel and osteophytes formation are the two main reasons for graft impingement.

### Osteoarthritis with osteophytes

ACL injuries lead to early osteoarthritis. Patients with ACL reconstruction still experience increased progression of osteoarthritis. Osteophytes formation around the graft could cause graft impingement.



**Fig.15 (a)** Osteoarthritis in 38 years old patient, 21 years post ACL reconstruction. Osteophytes with narrowing of intercondylar notch causing intercondylar sidewall impingement. **(b)** Osteoarthritis in 32 years old patient, 12 years post ACL reconstruction. Osteophytes with narrowing of tibial tunnel with graft impingement. **(c)** Roof osteophyte causing intercondylar roof impingement.

## Conclusion:

ACL reconstruction is a common orthopaedic surgery, which facilitates patients' early return to sports activities. Familiarizing with the normal post-operative images of ACL reconstruction would help identify complications of the surgery and guide further management.

### References:

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