Imaging of Anterior Cruciate Ligament Graft Reconstruction

Ön Çapraz Bağ Greft Rekonstrüksiyonunda Görüntüleme Bulguları

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ABSTRACT

Objective: The purpose of this study was to describe the postoperative X-Ray and magnetic resonance imaging(MRI) appearance of normal anterior cruciate ligament (ACL) graft reconstructions and to demonstrate most common potential complications.

Material and Methods: Fifty-two patients with ACL reconstruction were included in the study. The X-Ray and MRI scans were reviewed retrospectively for the assessment of integrity of the reconstructed ligament and the presence of related complications.

Results: Pathologic findings were observed in 18 of 52 ACL reconstruction operations; Four total ACL graft ruptures and one partial rupture, two loosening grafts, 10 anteriorly localized tibial tunnels, eight roof impingements, two side wall impingements, four cystic tunnel dilatations, one patellar fracture, two iliotibial band friction syndromes because of hardware related complications, and four arthrofibrosis cases were observed.

Conclusion: MRI is an effective imaging technique for evaluating the position of ACL grafts, tunnels and fixation materials and for investigating the cause of pain and loss of function.

Key Words: Anterior Cruciate Ligament, Graft reconstruction, MR imaging

ÖZ

Amaç: Ön çapraz bağ (ÖÇB) greft rekonstrüksiyonunun postoperatif direkt grafi, manyetik rezonans görüntüleme(MRG) normal bulgularını tanımlamak, operasyon sonrası gelişebilecek potansiyel komplikasyonlarının MRG bulgularını sunmaktır.

Gereç ve Yöntemler: Çalışmaya ÖÇB rekonstrüksiyon cerrahisi geçirmiş 52 hasta alındı. Hastaların direkt grafi, manyetik rezonans görüntüleri ÖÇB greft bütünlüğü ve eşlik edebilecek komplikasyonlar açısından retrospektif olarak değerlendirildi.

Bulgular: Çalışmaya alınan 52 hastanın 18'inde postoperatif patolojik bulgular saptandı. Dört hastada total greft rüptürü, bir hastada parsiyel greft rüptürü, iki hastada gevşek greft, 10 hastada anterior yerleşimli tibial tünel, sekiz hastada tepe impigement, iki hastada yan duvar impigement, dört hastada tünelde kistik genişleme, bir hastada patellar fraktür, iki hastada operasyon materyaline bağlı iliotibial band sürtünme sendromu ve dört hastada artrofibrozis saptandı.

Sonuç: MRG, ÖÇB greftinin, tünellerin ve fiksasyon materyallerinin pozisyonunu değerlendirmede, operasyon sonrası ağrı ve fonksiyon kaybının nedenini araştırmada kullanılabilen etkili bir görüntüleme yöntemidir.

Anahtar Sözcükler: Ön çapraz bağ, Greft rekonstrüksiyonu, MR görüntüleme

INTRODUCTION

ACL tears are the most common complete ligamentous injury in the knee. Graft reconstruction of the ACL has become an accepted treatment for symptomatic ACL deficiency. The goal of surgery is to prevent joint instability, which may further damage the articular cartilage

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and menisci (1,2). In recent years, the increased number of patients undergoing arthroscopy or surgery of the knee for ACL tears has lead to an increase in the number of patients referred for MRI after surgery because of failure to improve, recurrent symptoms, or new injury (3).

The prevalence of recurrent instability after primary ACL reconstruction ranges from 1% to 8%. MRI is the preferred advanced imaging modality for the evaluation of symptomatic ACL graft reconstructions (2). Early graft failures secondary to poor surgical technique, postoperative stiffness, and postoperative complications such as recurrent instability, complete or partial graft tear, roof impingement, side wall impingement, arthrofibrosis, tunnel widening due to cyst formation, iliotibial band friction syndrome, arthrofibrosis, hardware failure, bone fracture and infection have been extensively evaluated by using MRI (4).

In this article, our purpose is to describe the postoperative X-Ray and MRI appearance of normal ACL graft reconstructions, demonstrate the most common potential complications encountered after ACL reconstruction and to evaluate the role of MRI in their diagnosis.

MATERIAL and METHOD

Patients who had undergone ACL reconstruction surgery followed by X-Ray radiography or MRI at our radiology clinic later on were included in the study. These patients were evaluated retrospectively by scanning the radiology archive. Our study included 52 patients (45 males and 7 females) who had an unilateral reconstructed ACL in the period between March 2012 and November 2016. The ages of the patients ranged from 18 to 45 years with a mean age of 31.5 years. All patients were symptomatic and suffered from knee pain and the inability to continue activity, loss of range of motion, and swelling after ACL reconstruction surgery. Patients who were asymptomatic, came for postoperative routine control, had only direct X-ray radiography in our radiology archives, who did not undergo MRI, and where the MR images could not be accessed were excluded. Surgical results were evaluated by X-Ray radiography (Fujifilm Digital Radiography, USA) and MRI (Siemens Magnetom Essenza, Germany). X-Ray images were obtained in the standing, anterior-posterior (A-P) and lateral positions. The localization of the operation materials and tunnels and the tunnel widths were first evaluated by X-Ray radiography. Indications for MRI after ACL reconstruction included continued joint instability, knee stiffness or pain, a new injury of the knee, and preoperative evaluation for revision of a clinically apparent failed ACL graft.

MRI was performed with a 1.5 Tesla dedicated system using an eight-channel extremity transmit-receive coil. The knee was placed in 10–15 degrees external rotation to orient the ACL with the sagittal imaging plane. The same MR scanning protocol was used for all patients: sagittal proton density (PD) fat suppressed fast-spin-echo sequence (time of repetition (TR) 2310 ms, time of echo (TE) 26 ms, 16 cm field of view (FOV), 3.5 mm slice thickness with no interslice gap and a 256 matrix), coronal PD fat-suppressed fast-spin-echo sequence (TR 2420 ms, TE 27 ms, 16 cm FOV, 3.5 mm slice thickness with no interslice gap, and a 256 matrix), transverse PD fat suppressed fast-spin-echo sequence (TR 2540 ms, TE 30 ms, 20 cm FOV, 3.5 mm slice thickness and a 256 matrix), sagittal T1-weighted fast-spin-echo sequence (repetition time of 700 ms, echo time of 10 ms, 16 cm field of view, 3.5 mm slice thickness with no interslice gap, and a 256 matrix).

The X-Ray and MRI scans were reviewed retrospectively by three experienced senior radiologists for the assessment of the integrity of the reconstructed ligament and the presence of related complications such as complete or partial ACL graft tear, presence or absence of graft impingement, cystic graft degeneration, arthrofibrosis, tunnel widening, iliotibial band friction syndrome, hardware failure and bone fracture. A consensus was reached in all cases.

RESULTS

Bone-patellar tendon-bone grafts had been used for ACL reconstruction in 52 patients. Graft fixation was done in the femur by using the endobutton system, transgraft bioabsorbable or metallic interference screws. Graft fixation in the tibial tunnel was performed by using metallic interference screws, bioabsorbable interference screw or staple type of fixation material.

According to the X-ray images of the cases, staple type fixation material was used as fixation material in 33 patients, metal interference screws in 12 patients, transfix implant in 19 patients, and endobutton in 17 patients (Figure 1A-E). Non-metal interference screws were not visible on x-rays and thus evaluated on MRI and their use was evident in 32 individuals.

Of the 52 cases included in this study, 34 had normal post op findings. Pathologic findings as follows were observed in 18 of 52 ACL reconstruction operations: Four ACL ruptures, one ACL partial rupture, two loosened ACLs, 10 anteriorly localized tibial tunnels, eight roof impingements, two side wall impingements, four cystic tunnel dilatations, one patellar fracture, two iliotibial band friction syndromes caused by hardware-related complications, and four arthrofibrosis cases. There were two tibial and femoral tunnels in one case; the anteriorly located and more vertically extending tunnel belonged to the previous operation and the case was operated on for a second time for the ACL graft rupture (Table I).

Complete graft tear was seen in four patients, and partial graft tear in one patient. T2-weighted MRI showed complete graft disruption including an absence of intact graft fibers and a fluid-filled defect. In two of the cases with ACL graft rupture, the tibial tunnel extended anteriorly and vertically, and roof impingement was primarily considered as the cause (Figure 2A-D).

Roof impingement was seen in eight patients. The impinged graft was in contact with the anterior inferior margin of the intercondylar roof and appeared posteriorly bowed on MRI. Signal intensity alteration selectively involved the anterior of the graft, at the intercondylar notch level. In these cases, the tibial tunnel was located anteriorly and vertically (Figure 3A-C).

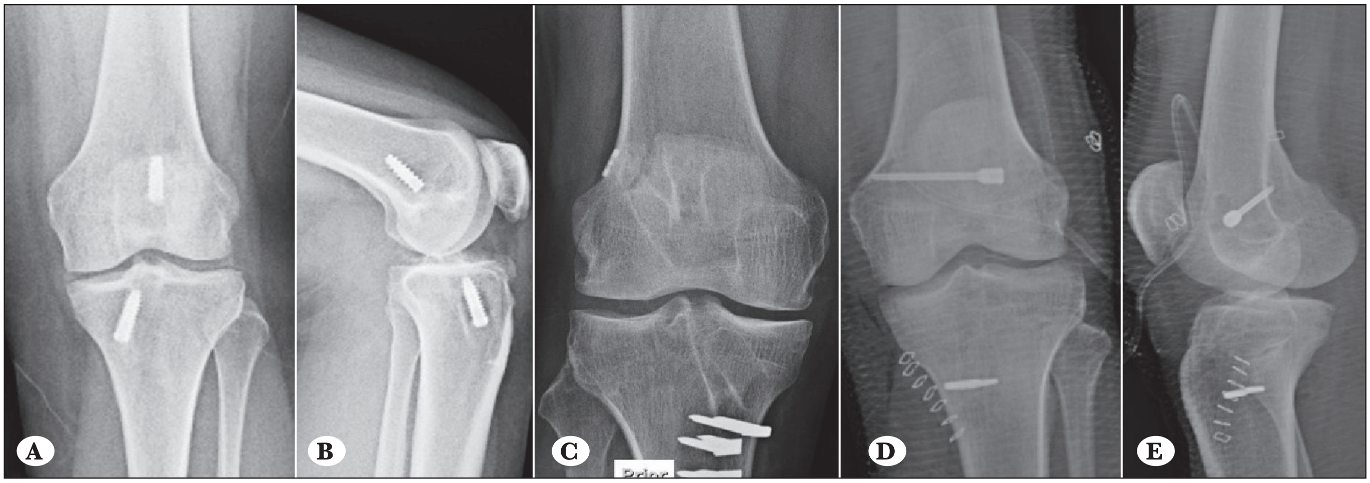

Figure 1: **(A, B)** A-P and lateral position X-Ray image of the patient's left knee where a metal interference screw in the femoral and tibial tunnels was used as fixation materials. **(C)** A-P X-Ray image of the patient where ACL reconstruction surgery was performed for a second time because of ACL graft rupture (direct radiography images showing two tibial tunnels and two femoral tunnels). The graft fixation was done by endobutton in the proximal part of the femoral tunnel and by using staple type of fixation materials in the distal part of the tibial tunnel. In this case, there were also non-metallic interference screws in the tunnels which could not be seen on X-Ray radiography **(D, E)**. Early post operative A-P and lateral position X-Ray images of the patient's left knee showing that graft fixation was done in the femoral tunnel by using transfix screw, and in the distal part of the tibial tunnel by using staple type of fixation material.

Table I: Eighteen patients with pathologic findings on MRI.

Complications	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Complete ACL graft tear	x	x	x														x	
Partial ACL graft tear													x					
Laxity in ACL				x					x									
Anterior tibial tunnel		x		x	x	x	x						x	x	x	x	x	
Roof Impingement				x	x	x	x						x	x	x	x		
Sidewall impingement								x	x									
Tunnel cyst			x							x			x			x		
Patellar bone fracture											x							
Iliotibial band friction syndrome cause of Hardware related complications				x						x								
Arthrofibrosis											x					x	x	x
Two tibial and femoral tunnel												X						

Sidewall impingement was seen in two patients. Coronal images of these cases demonstrated increased graft intensity at the level where the graft entered the tibial tunnel, and edema in the adjacent bone structures. In one patient, the impingement was due to osteophytes from the intercondylar notch, and in the remaining one case the graft was mildly impinged by osteophytes from the tibial plateau and margins of the tibial tunnel (Figure 4A-D).

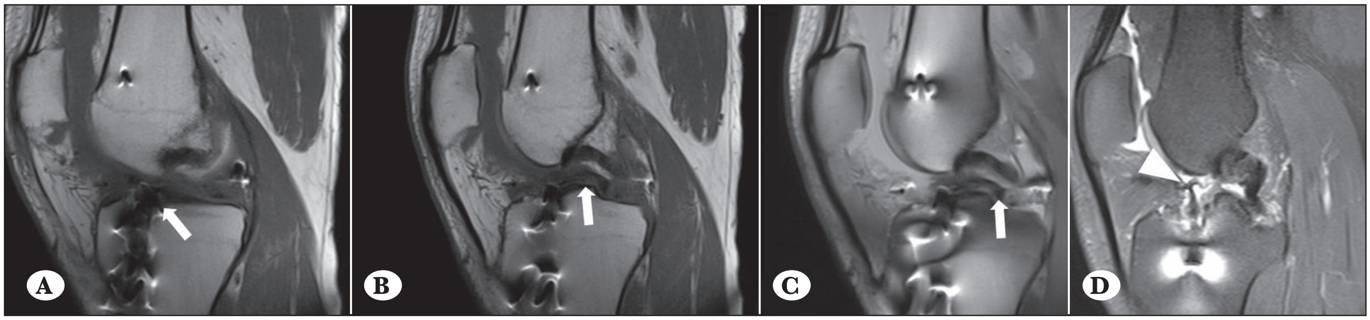

Figure 2: Sagittal T1-weighted consecutive MR images showing **(A, B, C)** vertical and anterior placement of the tibial tunnel and complete tear of the reconstructed ACL graft. ACL graft extending posterior-medial to the knee joint(arrow). Sagital PD-weighted fat suppressed MR image showing **(D)** decrease in graft size in the middle of the ACL graft (arrow head) when compared to the proximal and distal part (partial graft tear of ACL graft).

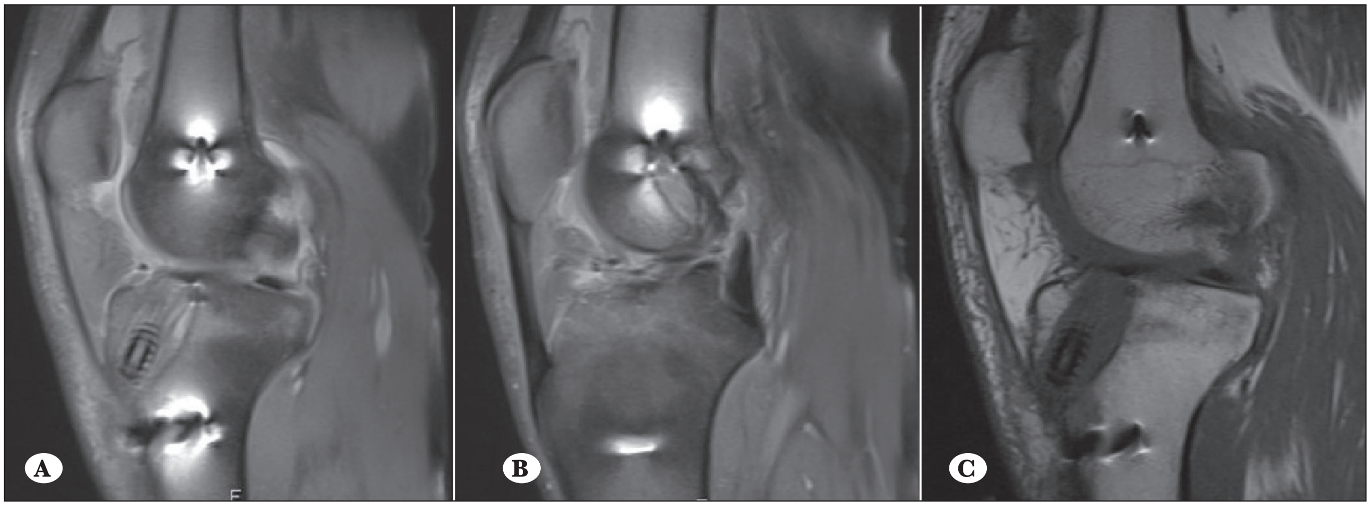

Figure 3: **(A, B)** Sagittal PD-weighted fat suppressed MR images showing anterior placement of the tibial tunnel in relation to the projected slope of the intercondylar notch resulting in marked ACL graft impingement against the anterior inferior margin of the intercondylar roof. **(C)** Sagittal T1 MR image for the same patient demonstrating the significantly widened tibial tunnel.

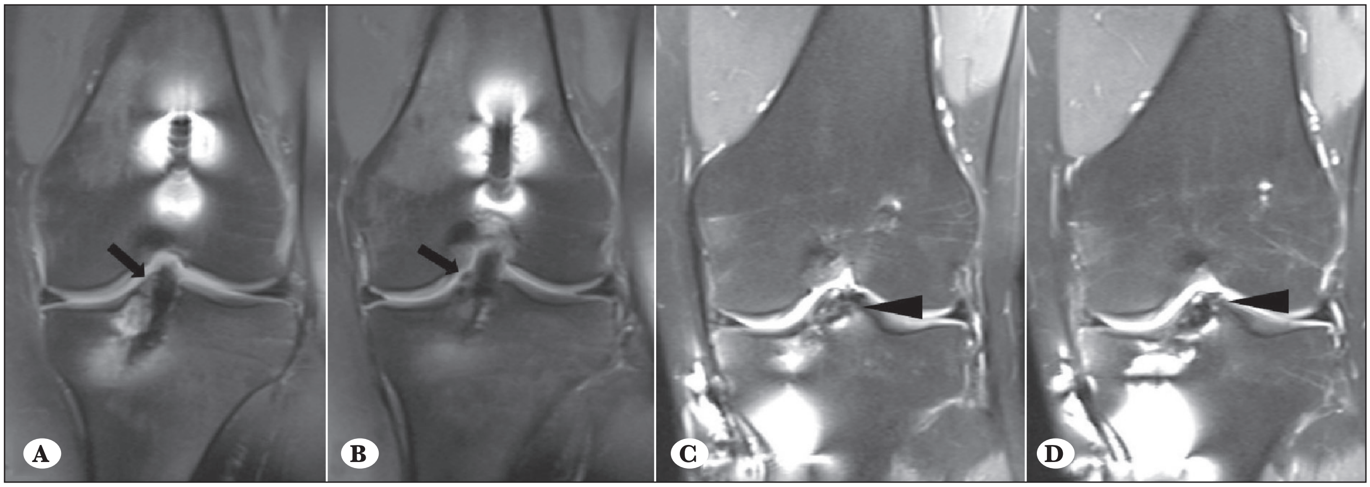

Figure 4: Coronal PD-weighted fat suppressed MR images showing **(A, B)** that the graft was mildly impinged by the margins of the tibial tunnel (arrow). **(C, D);** the graft was mildly impinged by an osteophyte (arrow head) from the tibial plateau and margins of the tibial tunnel.

Arthrofibrosis was also seen in four patients who complained of loss of the final degrees of extension. On MRI, a fibrous soft tissue mass with irregular contours and low signal intensity was seen both on T1-weighted and PD–weighted fat saturated images, consistent with a cyclops lesion. These lesions were located posterior to the infrapatellar fat pad and anterior to the ACL graft, anterior to the intercondylar notch, protruding anteriorly into the femoro-tibial joint space (Figure 5A-C). The reconstructed ACL grafts were intact.

Tunnel cysts were seen in four patients. The diameter of the tibial tunnel was increased from 12.5 mm to 15 mm (N: 10-11 mm) in these patients. These individuals also had fluid extending through the tibial tunnel adjacent to the graft (Figure 6A-D). The femoral tunnel diameter was within the normal limits (8-9 mm) in two patients and increased (10.4 mm and 11.0 mm) in another two. In all of these four cases, the time interval between the operation and MR examination was more than one year.

Iliotibial band friction syndrome caused by hardware-related complications was seen in two patients. In both cases, the ACL graft at the proximal level of the femoral tunnel was detected with the external fixator. The iliotibial band friction syndrome had occurred as a result of the contact of the external fixator to the iliotibial band. In one patient, there was endobutton displacement with contact to the adjacent iliotibial band that caused frictional minimal thickening and increased signal intensity. A metal transfix device was used as an external fixator in the other patient, and the tranfix device was in contact with and protruding laterally to the iliotibial band, and caused frictional thickening and increase signal intensity (Figure 7A-D).

Anterior tibial tunnel and ACL graft laxity was seen in two patients. The ACL graft was observed to have a loose and tortuous graft appearance. In these cases, the tibial tunnel was located more anteriorly than the normal location with a vertical course. The ACL graft was observed to be loose and tortuous (Figure 8A-C).

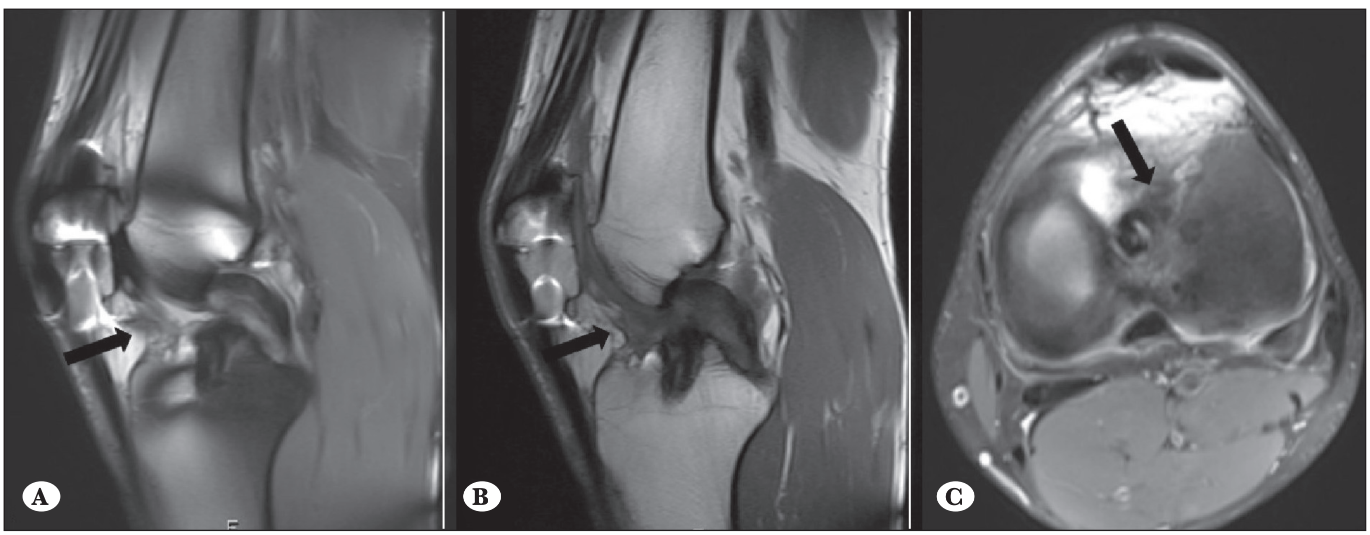

Figure 5: Sagittal PD-weighted fat suppressed (**A**), T1-weighted (**B**) and axial PD-weighted fat suppressed (**C**) MR images showing hypointense soft tissue mass (arrow) anterior of the ACL graft and intercondylar notch to the posterior to the infrapatellar fat pad.

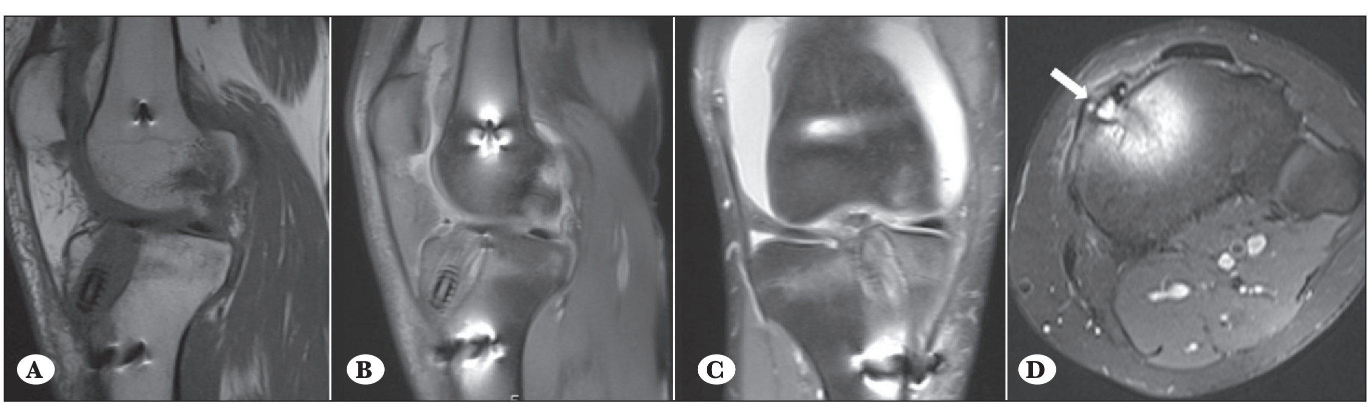

Figure 6: Sagittal T1-weighted **(A),** sagittal PD-weighted fat suppressed (**B**), and coronal PD-weighted fat suppressed (**C**) MR images showing tibial bone tunnel enlargement and fluid that is hypointense on T1-weighted and hyperintense on PD-weighted images. Axial PD-weighted fat suppressed (**D**) MR image showing extrusion of tunnel fluid (arrow) to the pretibial soft tissue.

Patellar fracture was seen in one patient. In this case, a bone-patellar tendon-bone auotogenous graft was used on the same side, and patella fracture occurred during the operation (Figure 9A-D).

DISCUSSION

The preferred surgical method for ACL rupture is reconstruction with graft. The goal of surgery is to prevent joint instability, which may further damage the articular cartilage and menisci. The most commonly used methods are bone–patellar tendon–bone and hamstring autografts(2,5). When an autogenous bone-patellar tendon-bone graft is used, the graft material and bone plugs are anatomically stabilized within the tunnels opened in the femur and tibia in accordance with the normal course of the ligament. As autogenous hamstring tendon grafts do not involve bony blocks, fixation is usually performed from outside the bone tunnel (5).

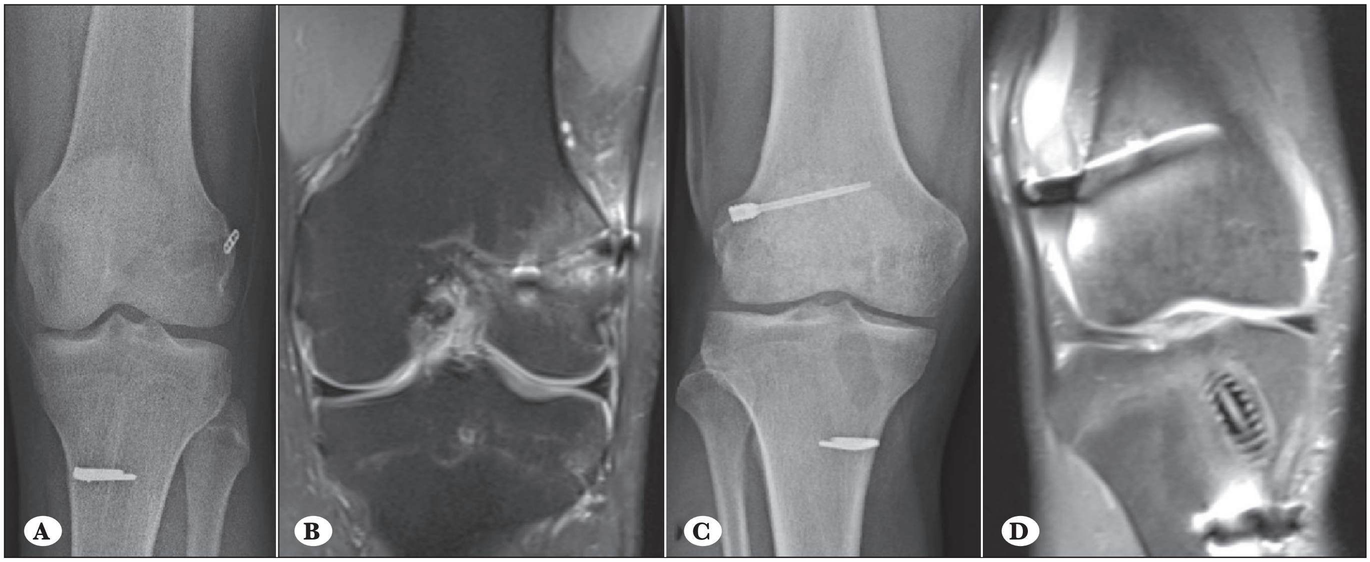

Figure 7: (**A**) A-P X-Ray image showing endobutton displacement (**B**) and the same patient's coronal PD-weighted fat suppressed MR image showing endobutton displacement was contacting the adjacent iliotibial band and causing frictional minimal thickening and increased signal intensity. (**C**) Anterior-posterior X-Ray image showing that a metal transfix device was used as an external fixator, (**D**) and a transfix device was contacting and protruding lateraly the iliotibial band, and causing frictional thickening and increased minimal signal intensity.

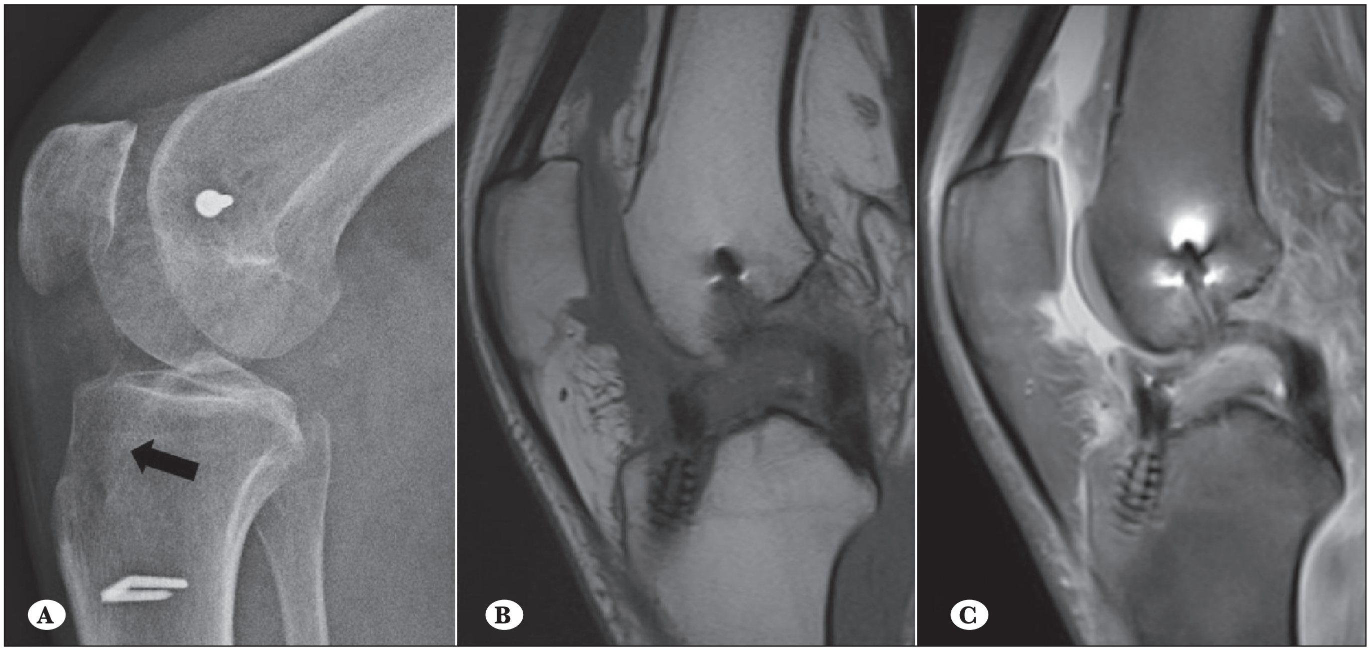

Figure 8: (**A**) Lateral X-ray image showing the anterior and vertical localization of the tibial tunnel(arrow), and the same patient's sagittal T1-weighted (**B**) and sagittal PD-weighted fat suppressed (**C**)MR images showing anterior, vertical localization of the tibial tunnel and laxity of the ACL graft.

Proper fixation of the graft with endobuttons, interference screws, a screw-washer construct, or staples is crucial to avoid changes in the graft position during the initial postoperative incorporation period. Interference screws are commonly used as fixation devices in bone–patellar tendon–bone graft reconstruction (5).

Positioning of the femoral and tibial tunnels is of paramount importance for proper function of the ACL graft (2). On coronal images, the femoral tunnel should open superiorly above the lateral femoral condyle. The femoral tunnel should be oriented on an coronal MR image between 10-and 11-o'clock position in the right knee and between 1-and 2-o'clock position in the left knee (5, 6). Accurate location of the femoral tunnel is essential to achieve isometry of the ACL graft. Over-the-top placement is not isometric; it results in increased graft length and tension as the knee is extended. If the femoral tunnel is placed too far anteriorly, the length and tension of the graft greatly increase as the knee is flexed (7). The tibial tunnel should be oriented parallel to the projected slope of the intercondylar roof. The lowermost level of the tibial tunnel should be just below the tibial tubercle. In the sagittal plane, the opening of the proximal tibial tunnel should be posterior to the intersection of the Blumensaat line and the tibia. In the coronal plane, the tibial tunnel should open at the intercondylar eminence. If the tibial tunnel is located too anteriorly, the graft will be impinged, and if it has too vertical a course, the graft will be laxated (2, 5).

Graft tear is often a result of recurrent trauma. Nonisotropic positioning of the graft tunnel resulting in abnormal stress to the graft during the normal range of motion has also been implicated as a cause of complete graft tear (2). Complete or partial discontinuity of the graft in both the coronal and sagittal planes is highly specific for diagnosing tears (5, 8). Interstitial graft tears appear as focal areas of increased signal intensity covering a portion of the graft with intact fibers still present on T2-weighted or PD-weighted MRI. The differential diagnosis for interstitial graft tear includes the normal revascularization, synovialization and ligamentization phase in clinically stable immature ACL grafts that commonly show increased signal on T2-weighted and PD-weighted sequences for 3-18 months after ACL reconstruction surgery (5,9). During the first three months after ACL reconstruction, graft constructs are typically uniformly low in signal intensity on T1-weighted, T2-weighted and PD-weighted MR images. Thereafter, progressive vascularization, synovialization and ligamentization start in the graft (5,9). However, by two years after ACL reconstruction, normal graft tendon should resume a uniform normal low-signal-intensity MRI appearance. Focal small areas of increased intermediate signal intensity within the graft because of ligamentization can persist for as long as four years after ACL graft reconstruction (5). Graft tear was the third most common cause (first anterior tibial tunnel, second impingement) of graft failure in our series. Complete graft tear was seen in four patients and partial graft tear was seen in one patient.

Graft impingement was the most common cause of graft failure in our series. Four patients had roof impingement and two patients had side wall impingement findings. Roof impingement is often secondary to an abnormal position of the tibial tunnel (5). The positioning of the tibial tunnel is the primary factor in preventing impingement of the graft against the roof of the intercondylar notch (10). On MRI, the tibial tunnel is most commonly malpositioned too far anteriorly and the impinged graft is in contact with the anterior-inferior margin of the intercondylar roof and may appear posteriorly bowed. MRI may show increased signal

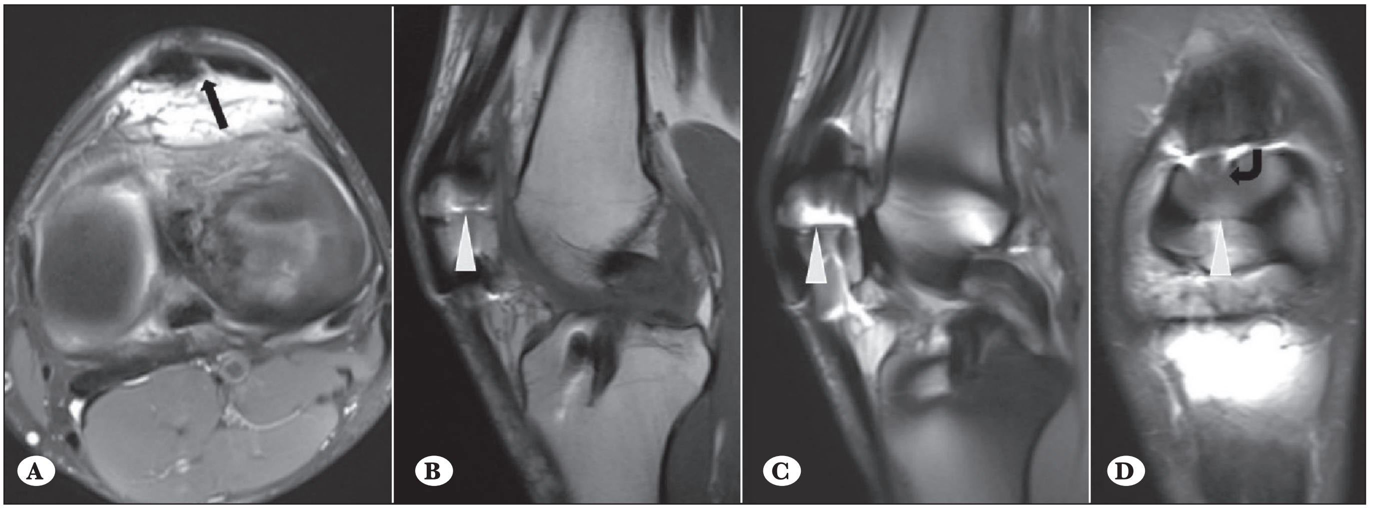

Figure 9: Axial PD-weighted fat suppressed MR image **(A)** showing patellar tendon defects (arrow) due to use of autogenous bone-patellar tendon-bone graft. Sagittal T1-weighted **(B),** sagittal PD-weighted fat suppressed **(C)**, and coronal PD-weighted fat suppressed **(D)** MR image showing nondisplaced patellar bone fracture (white arrow head) and patellar cleft (curved arrow).

in the graft on T1-weighted and T2-weighted (or PD-weighted) sequences in the setting of notch impingement. Roof impingement is best observed in oblique sagittal images (5,6). Sidewall impingement can occur on the graft by the medial aspect of the lateral condyle if the tibial tunnel is positioned too far laterally. Sidewall impingement is best evaluated on coronal MR images. A partial tear can be observed on T1-weighted and T2-weighted MRI images as a result of the pressure applied by the osteophyte or plateau edges to the graft at the level of the eminence intercondilaris where the graft enters the tunnel. If untreated, graft impingement can progress to graft rupture (5).

Arthrofibrosis is defined as the presence of scar tissue in at least one compartment of the knee joint, leading to a decreased range of motion (2). A cyclops lesion is a nodular fibrous lesion that is located in the anterior intercondylar notch; it sometimes adheres to the tibial fibers of the ACL graft. Cyclops lesions are typically small, with average sizes ranging from 10 to 15 mm (11). Cyclopoid scars are easily compressed by adjacent bones. This area of fibrosis limits complete extension of the knee (5). MRI findings of a cyclops lesion include an anterior intercondylar focal or generalized (arthrofibrosis is seen encasing the graft and extending into the infrapatellar fat pad and the posterior joint capsule) lesion with mixed intermediate signal intensity on T1-weighted, T2-weighted, and PD–weighted images (2). Arthrofibrosis was seen in 4 patients in our study, who complained of loss of the final degrees of extension.

Tunnel cysts; Small amounts of fluid may be seen within the tibial and femoral tunnels during the first year after ACL reconstruction (12). This fluid is generally reabsorbed within 18 months after surgery and does not lead to tunnel expansion, ganglion formation, or graft failure. The formation of tunnel cysts after ACL reconstruction has been attributed to several causes such as incomplete incorporation of allograft tissue within the bone tunnels and subsequent tissue necrosis that may allow synovial fluid to be transmitted through the tibial tunnel (13). Bioabsorbable interference screws, nonabsorbable suture fragments, and joint fluid leakage during failed ACL revision surgery have also been implicated in tunnel cyst formation. Extrusion of joint fluid into the tunnel may lead to formation of a ganglion. Tibial tunnel cysts may be incidentally found on MRI, or they may manifest as a palpable mass in the pretibial soft tissues. Femoral tunnel cysts are less common than tibial tunnel cysts (2). In our study, four patients had tibial tunnel cysts. The tunnel showed cystic expansion and fluid collection and fluid was extending through the tibial tunnel adjacent to the graft. In two patients, the diameter of the femoral tunnel was also increased. In all cases, the time interval between the operation and MRI examination was more than one year.

Hardware-related complications; A number of less common complications seen after ACL reconstruction include complications of the fixation devices (5). Iliotibial band friction syndrome is a potential complication of ACL reconstruction with the use of transfix device and endobutton (14). Partially dislodged or fragmented transfix device or endobutton may contact the adjacent iliotibial band and cause frictional thickening or tearing (14,15). Fractures can also occur in the patella, femur, and tibia during graft receiving and placement (15). In our study, the iliotibial band friction syndrome cause of hardware-related complications was seen in two patients. The ACL graft in the proximal level of the femoral tunnel was detected with the external fixator. Patellar fracture was seen in one patient and the patellar fracture occurred during the operation.

Anterior tibial tunnel and laxity in ACL; When the ACL graft is placed, it should be neither very tight nor too loose. The graft should be placed in such a way to allow posterolateral fibers to function and thus show no significant alteration in isometric, flexion, and extension length, and the tensile strength. If the graft is not stretched sufficiently or if the tibial tunnel is opened more anteriorly and vertically than the normal, the ACL graft becomes loose and tortuous. Roof impingement usually also accompanies these cases. Tortuous graft appearance and anterior and vertical location of the tibial tunnel are diagnostic hallmarks on MRI (2). In two of our cases, there was significant tortuous graft appearance; the tibial tunnel was anteriorly and vertically located in one of them, which also showed roof impingement.

Infection; Septic arthritis is a rare complication after ACL reconstruction (6). MRI findings of infection include synovitis, bone erosion, periarticular edema, marrow edema, sinus tracts, and soft-tissue abscesses (2, 16). There was no patient who was clinically or radiologically diagnosed with septic arthritis in our study.

Pathologic findings were observed in 18 (Five ACL graft tears (four total, one partial), two loosened grafts, 10 anteriorly localized tibial tunnels, eight roof impingements, two side wall impingements, four cystic tunnel dilatations, one patellar fracture, two iliotibial band friction syndromes, four arthrofibrosis cases) of the 52 ACL reconstruction operations in total. The patients who were included in the study were symptomatic and had various complaints after the operation. We therefore found high post operative complication rates in patients who underwent ACL reconstruction surgery in our study. If we had included all symptomatic and asymptomatic patients in our study, the postoperative complication rates would have been lower. However, the asymptomatic group of patients could not be included in the study as only X-Ray radiographs were taken on follow-up and there were no MRI images of this patient group.

Limitations

Our study was retrospective. Autogenous bone-patellar tendon-bone graft was used as ACL graft in all of our patients. We only included patients who presented to our clinic for follow-up after ACL reconstruction and for whom we were able to access X-Ray radiographs and MRI images from the archives and also the clinical findings. There could be patients who did not visit our clinic for follow-up after ACL graft reconstruction, and those are more likely to be asymptomatic. The exclusion of these cases may have somehow altered the results of our study.

CONCLUSIONS

X-Ray radiography should be the first examination method in evaluating ACL reconstructions. With X-Ray radiography, the position of the tunnels and the usage of metallic operating materials can be evaluated. MRI is the best imaging modality after ACL reconstruction surgery to evaluate the ACL graft condition and the position of the tunnels. Complications of ACL graft reconstruction surgery such as partial or complete tear of the ACL graft, laxity in ACL graft, impingement, arthrofibrosis, tunnel cyst, hardware-related complications, anterior and vertical placement of tibial tunnel, and postoperative infection can be diagnosed with MRI. The frequency of ACL reconstruction surgery is increasing day by day. MRI of ACL reconstruction surgeries and their common complications and the procedures of this surgery are important to know for the radiologists. In this article, we aimed to present the normal X-Ray and MR imaging findings and the appearances of common complications that can occur after ACL graft reconstruction surgery.

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Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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