Delayed Pseudoaneurysm of the Popliteal Artery Following ACL Reconstruction

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Abstract

Arterial complications following arthroscopic anterior cruciate ligament (ACL) reconstruction of the knee are rare. Injuries to vascular structures around the knee have historically been reported more commonly, with reconstructive procedures occurring more posteriorly, such as posterior cruciate ligament (PCL) reconstruction. The authors present a report of sequelae following a postoperative popliteal artery spasm in an 18-year-old female soccer player who underwent ACL reconstruction using an ipsilateral autologous hamstring graft along with a medial meniscal repair and developed immediate spasm of the popliteal artery responding to sustained balloon angioplasty. Seven weeks postoperatively, she developed foot paresthesias and was noted to have a 3.5×3.1×1.3-cm pseudoaneurysm of her popliteal artery. She underwent popliteal artery bypass with reverse saphenous vein autograft and had an uneventful recovery. This case highlights the importance of prolonged follow-up and maintaining a high degree of suspicion for further arterial complications, even after routine arthroscopic knee procedures. In addition to maintaining close and extended follow-up, the authors agree with other authors’ suggestions that urgent computed tomography angiogram be obtained to evaluate the vascular tree in a patient presenting with a cold, pulseless extremity after routine arthroscopic knee procedures. In this particular case, angiography of the uninvolved side also proved useful in identifying the patient’s aberrant vascular anatomy and may be useful in patients with bilateral aberrant vascular anatomy to better facilitate interpretation of the injured side. To the author’s knowledge, this is the first case of popliteal artery spasm initially responding to sustained angioplasty with the delayed development of a pseudoaneurysm. [Orthopedics. 2015; 38(6):e543-e546.]
Arterial complications following anterior cruciate ligament (ACL) reconstruction during arthroscopy of the knee are rare. Reconstructive procedures around the posterior knee, such as PCL reconstruction, have a historically higher incidence of vascular injury attributable to both the proximity of neurovascular structures and the relative inexperience in reconstructing the PCL. Although the current patient appeared to fully recover following treatment with sustained angioplasty, the vessel presented with a false aneurysm 7 weeks postoperatively. Many reports of false aneurysms following femoral catheterization have been published; incidences of up to 9% during therapeutic procedures have been reported. The overall complication rate following peripheral angioplasty was studied by Axisa et al., and they concluded that the procedure was associated with an overall low risk of major medical and surgical complications.

**Case Report**

A healthy 18-year-old woman experienced a noncontact ACL injury while playing soccer. On presentation to the authors’ clinic, she had a significant knee effusion with a positive Lachman test. She had a normal neurovascular examination with excellent pedal pulses. She subsequently underwent an uneventful ACL reconstruction with ipsilateral hamstring autograft using an Arthrex tight-rope (Naples, Florida) with tibial interference screw fixation. Intraoperatively, it was noted she had a medial meniscal tear midbody in the posterior horn without involvement of the root. The tear was amenable to repair using an all-inside technique with the Smith & Nephew Fast-fix 360 system (Memphis, Tennessee). The tourniquet was released prior to wound closure, with no active bleeding noted from either the pes anserine area of hamstring harvest or the arthroscopic portals.

On arrival to the post-anesthesia care unit, the patient reported pain throughout her foot, which was noted to be cold and poorly perfused, with pedal pulses unable to be found using a Doppler. Computed tomography angiography showed vasospasm of the popliteal artery without any perforation or thrombus. There was a small amount of contrast extending to the proximal anterior tibial, posterior tibial, and peroneal arteries (Figure 1). Interestingly, angiography of the uninvolved side demonstrated 2-vessel runoff distally, indicating congenital absence of the posterior tibial artery.

The patient was transferred to the interventional radiology suite where an unsuccessful attempt was made to abate the spasm with intra-arterial nitroglycerin and then verapamil. Balloon angioplasty was subsequently attempted. The first attempts at angioplasty were only temporarily successful, with recurrence of vessel spasm and the loss of pedal pulses after only 1 minute. Repeat sustained angioplasty was required before the stenotic segment became patent (Figures 2-3). Specifically, a 5-mm × 10-cm Vascutrak balloon catheter (San Diego, California) was used to dilate the stenotic segment using a 6F catheter. The patient noted immediate resolution of the pain in her foot with the return of a normal neurovascular examination. Due to her use of oral contraceptives preoperatively, she was discharged with 4 weeks of lovenox.

Seven weeks postoperatively, she presented to the clinic with a 1-day history of dorsal foot paresthesias and weak pedal pulses. She was sent for duplex ultrasonography that day, which demonstrated a 3.5×3.1×1.3-cm pseudoaneurysm of the popliteal artery. Vascular surgery was immediately consulted and the patient underwent a same-day popliteal artery bypass with reverse saphenous vein autograft. She began taking aspirin following this procedure. She then experienced full functional recovery of her knee and remained neurovascularly intact. At her last follow-up appointment 8 months postoperatively, she had regained full range of motion and strength. She continues to enjoy sports, including surfing, but no longer competes in collegiate athletics.

**Discussion**

Vascular injury during ACL reconstruction is a rare but potentially limb-threatening adverse event often attributable to errors of surgical technique. In a retrospective study by Small et al., it was found that 9 of 375,000 patients developed a pseudoaneurysm after knee arthroscopy. Few instances exist in the literature of popliteal vasospasm occurring after ACL reconstruction. False aneurysms, or pseudoaneurysms, contain vessel-derived hematoma surrounded by incomplete elements of the arterial wall, fibrous tissue, and neighboring stroma and typically occur after vascular intervention, with an incidence rate of 0.05% to 4% and a prevalence of up to 16% with interventions using larger sheaths.

There have been several unique cases of arterial injury during arthroscopy of the knee. For example, during drilling of the
tibial tunnel for bicortical screw placement, 2 case reports by Janssen et al\textsuperscript{9,11} highlighted a popliteal artery injury—1 patient required a venous jump graft to bridge a 4-cm popliteal thrombus and the other required direct intimal repair of the arterial wall with venous patch graft. In another case, Roth and Bray\textsuperscript{7} attributed popliteal injury to the improper use of the wire-passing device used to fix the composite graft in the over-the-top position. Janssen and Sala\textsuperscript{12,13} highlighted cases where emboli within the popliteal artery caused subtotal thrombus and death. Obtaining a thorough history is critical to detecting the risk factors for emboli. In the published popliteal emboli cases, 1 patient had a traumatic knee dislocation 15 years previously and the other patient was taking oral contraceptives 2 months preoperatively and had a family history of protein S deficiency.\textsuperscript{12,13}

The current case is particularly unique because the patient had no extravasation, dissection, or filling defect on computed tomography angiography or angiogram to imply perforation or thrombus. In cadaver studies, use of the FasT-Fix (Andover, Massachusetts) all-inside meniscal repair device showed difficulty for effective insertion into the extreme posterior horn of the lateral meniscus.\textsuperscript{14} In addition, working on the posterior horn of the lateral meniscus, not the medial meniscus, has been shown to place the popliteal vessels at risk.\textsuperscript{14,15}

It is important to note that the authors’ immediate postsurgical sequelae was vasoconstriction, without any clinical or radiographic evidence of a penetrating injury to the neurovascular structures of the knee. The tourniquet was taken down prior to wound closure with no signs of overt bleeding, making a traumatic laceration to the artery at least clinically unlikely. The authors postulate that the popliteal artery was irritated at some point during the procedure, possibly during harvesting of the hamstrings, and produced a sustained spasm that resulted in the postoperative findings of foot pain and a cold, pulseless foot.

![Figure 2: Angiogram before (A) and after (B) angioplasty.](image2)

It is impossible to determine whether the current patient’s pseudoaneurysm was a consequence of her original surgery or a byproduct of her catheterization and angioplasty. Her procedure was performed by an orthopedic surgeon (C.G.) with sports medicine training, more than 25 years of experience, and more than 1,800 ACL reconstructions (approximately 80 per year). Harvesting occurred from the tibial attachment of the hamstrings by elevation of the pes anserinus to identify the tendons.

Risk factors for iatrogenic injury include operator inexperience, age older than 60 years, female gender, catheter size greater than 8F, and concurrent anti-coagulation.\textsuperscript{5,16} Due to the rarity of these lesions, there is a paucity of data to guide treatment. The most catastrophic complication of a false aneurysm is rupture, occurring at a rate of 24%, which is typically seen in the common femoral artery. Reported risk factors for rupture include older age, the presence of peripheral vascular disease, and elevated plasma liver enzymes. General consensus dictates urgent intervention in virtually all cases of symptomatic popliteal artery aneurysms. Most false aneurysms smaller than 2 to 3

![Figure 3: Ultrasound showing a 3.5×3.1×1.3-cm pseudoaneurysm of the popliteal artery.](image3)
cm can be treated conservatively with surveillance duplex scanning until spontaneous resolution.

For larger and symptomatic lesions, those larger than 3 cm, common treatment options include ultrasound-guided compression, ultrasound-guided thrombin injection, endovascular stenting, and open repair. For younger, more active patients, early bypass grafting using the vein is preferable because patency rates for vein grafts have traditionally been superior to those of prosthetic stents. Elderly and more frail patients warrant consideration of possible endovascular treatment or even observation.

In a study addressing the complications of peripheral vessel angioplasty, Axisa et al. reported a 2.2% rate of amputation following angioplasty for critical limb ischemia. In addition, they noted that emergency surgical intervention was required after 2.3% of the peripheral angioplasties they studied, with most of these due to acute limb ischemia or hemorrhage.

Based on this particular case, the authors recommend urgent computed tomography angiography, over clinical examination and Doppler ultrasound, for the diagnosis of acute popliteal artery spasm after ACL reconstruction. In addition, the authors recommend vascular imaging of the uninjured side to evaluate for potentially aberrant anatomy, as was the case in the current patient who had 2-vessel runoff on the uninjured side. This would be especially useful in cases where a patient may have a bilaterally aberrant vascular anatomy to better facilitate interpretation of the injured side. Finally, although there may be a role for sustained angioplasty in the treatment of recalcitrant popliteal artery spasm prior to proceeding to a more aggressive surgical intervention, such as arterial bypass or stenting, the current case illustrates the importance of prolonged follow-up and maintaining a high degree of suspicion for further arterial complications, such as pseudoaneurysm.

**REFERENCES**