

Injury to the Anterior Tibial Artery during Bicortical Tibial Drilling in Anterior Cruciate Ligament Reconstruction

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Many complications have been reported during or after anterior cruciate ligament (ACL) reconstruction, including infection, bleeding, tibial tunnel widening, arthrofibrosis, and graft failure. However, arterial injury has been rarely reported. This paper reports a case of an anterior tibial arterial injury during bicortical tibial drilling in arthroscopic ACL reconstruction, associated with an asymptomatic occlusion of the popliteal artery. The patient had a vague pain which led to delayed diagnosis of compartment syndrome and delayed treatment with fasciotomy. All surgeons should be aware of these rare but critical complications because the results may be disastrous like muscle necrosis as in this case.

Keywords: *Anterior cruciate ligament, Anterior cruciate ligament reconstruction, Compartment syndromes, Arterial embolism, Arterial injury*

Anterior cruciate ligament (ACL) reconstruction is a well-established surgical technique to treat ACL injuries.¹⁾ Although arthroscopic ACL reconstruction is safe, it may be followed by various complications such as patellofemoral pain, arthrofibrosis, tibial tunnel widening, graft failure, bleeding, and infection.^{2,3)} There are also a few reports of vessel injuries such as rupture or embolism of the popliteal artery, pseudoaneurysm of the medial inferior genicular artery and avulsion of the middle genicular artery.^{4,5)} This paper reports a case of a patient who developed a vascular complication after arthroscopic ACL reconstruction.

CASE REPORT

A 31-year-old male suffered a pivot injury to the left knee during a basketball game 5 days ago. During the patient's

initial visit to Inje University Seoul Paik Hospital, a physical examination revealed positive anterior drawer, Lachman, and pivot shift tests. Preoperative X-rays did not show any definite bony abnormalities. On magnetic resonance imaging (MRI), the continuity of the ACL signal was disrupted in the midportion. We decided to perform an arthroscopic anatomic single-bundle ACL reconstruction after allowing 2 weeks to regain the full range of motion. The patient was admitted to the hospital the day before surgery. Under spinal anesthesia, the patient was placed in the lithotomy position, keeping the involved knee in deep flexion. With a 3-cm skin incision over the pes anserinus, the semitendinosus tendon was harvested, and then prepared to form a quadruple-stranded graft. Under arthroscope, the ACL was found to be completely ruptured in the midportion as observed on the MRI. The ruptured ligament was debrided for complete visualization of the femoral ACL footprint. We marked a hole with an awl, at the center of the femoral anatomical footprint where the bifurcate and intercondylar ridges meet. The femoral tunnel was drilled through this point using the transanteromedial portal technique. Drilling was performed with caution, to avoid any neurovascular or cartilage injuries, keeping the

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knee in deep flexion of at least 120°. No posterior cortical wall breakage of the tunnel was noted on arthroscopy. The quadruple semitendinosus autograft was pulled from the tibial tunnel to the femoral tunnel, and it was fixed in the femoral tunnel with an EndoButton (Smith & Nephew Endoscopy, Andover, MA, USA) and in the tibial tunnel with a bioabsorbable interference screw. A 4.5-mm bicortical drill hole was made perpendicular to the tibial surface, 1 cm distal to the tibial tunnel, for post-tie screw fixation. The tibial screw could not be engaged with the posterior cortex after the first drilling; hence, one more session of drilling was performed for proper bicortical fixation. All the procedures were performed by one main operator. The tourniquet time was approximately 90 minutes. A long-leg splint was applied immediately afterwards. Postoperative X-rays showed that the position of the tibial tunnel was satisfactory but the direction of the screw was relatively posterior and the length was long (Fig. 1). The patient complained of pain around the surgical site the night after surgery. On the first day after surgery, he also complained of pain around his left ankle. He was still able to actively dorsiflex and plantarflex his ankle. There were no sensory deficits. The pulses were palpable in his lower leg. We thought that the pain was due to postoperative soft tissue swelling, and hence, we prescribed nonsteroidal anti-inflammatory drugs. On the second postoperative day, the lower leg pain worsened and a small sensory deficit developed on the dorsal aspect of the foot. However, there was no increase in pain on passive stretching of the muscles and the dorsalis pedis artery pulse was palpable. On the fourth postoperative day, severe edema developed with

exacerbation of pain in the ipsilateral lower leg. Computed tomography (CT) angiography performed to evaluate the patient's circulation showed that the left popliteal and anterior tibial arteries were completely blocked, while the posterior tibial and fibular arteries were intact. The screw tip seemed to be close to the occlusion site in popliteal and anterior tibial arteries (Fig. 2). Although the anterior tibial artery was not visualized, the dorsalis pedis artery seemed to be perfused distally (Fig. 3). We diagnosed his condition as the compartment syndrome due to direct drilling injury to the anterior tibial artery. A fasciotomy was immediately performed for decompression. Approximately 94 hours had passed between ACL reconstruction and fasciotomy. The muscles in the anterior compartment were pale, implying necrosis, but without any hematoma. The pain was relieved immediately after surgery and the patient underwent wound debridement twice subsequently. We decided to excise the necrotic extensor hallucis longus, extensor digitorum longus, and anterior tibialis totally on the ninth day after ACL reconstruction. As the final outcome at the 1-year follow-up, the patient has dorsiflexion of motor grade 0 in the involved ankle and he ambulates with an ankle-foot orthosis.

DISCUSSION

Vascular complications after ACL reconstruction are rare and they mostly include venous lesions. A case of fatal pulmonary embolism after ACL reconstruction was reported recently.⁴⁾ There are two reported cases of middle genicular artery injury: the first case was caused by eleva-



Fig. 1. (A) Postoperative anteroposterior X-ray. (B) Postoperative lateral X-ray. These postoperative X-rays demonstrate that the direction of the screw is relatively posterior and that the length is long.

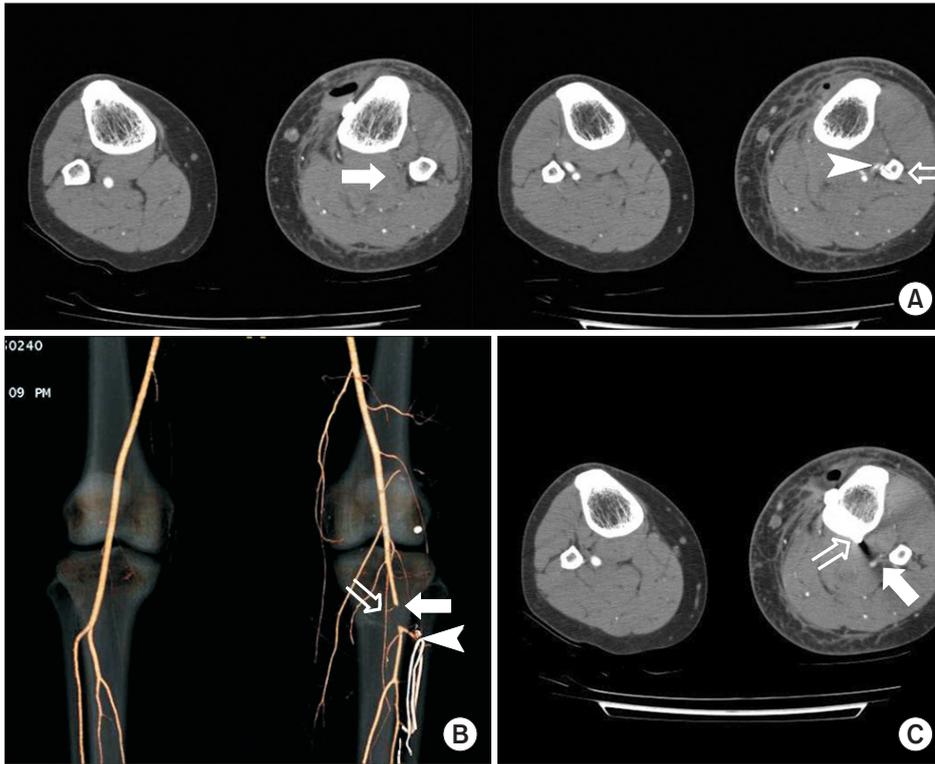


Fig. 2. Postoperative computed tomography (CT) and angiogram images. (A) The axial CT images show total occlusion of the left popliteal artery (arrow) and nonvisualization of the left anterior tibial artery (arrow head) with a trace of drilling in the fibula (open arrow). (B) The screw tip (open arrow) is placed 1 cm distal to the popliteal occlusion site (arrow) and 5 mm proximal to the root of the anterior tibial artery (arrow head). (C) On the axial CT image, the screw tip (open arrow) is 15 mm away from the anterior tibial artery (arrow).

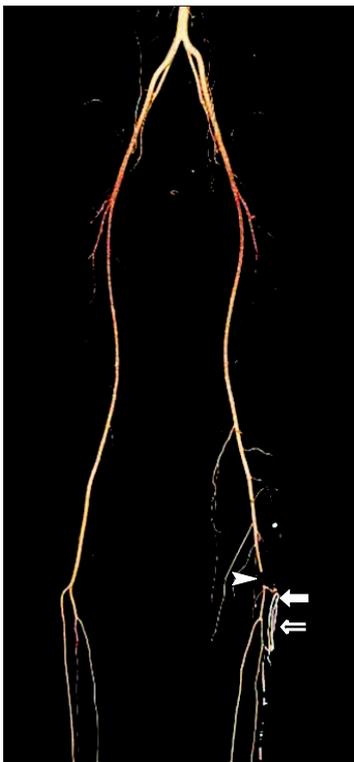


Fig. 3. The computed tomography angiogram shows filling defects along the entire course of the anterior tibial artery (arrow), a section of the popliteal artery (arrow head), and collateral vessels around the bicortical screw fixation site (open arrow).

tion of the periosteum for tibial tunnel preparation,⁶ and the second case was due to debridement of the remnant femoral ACL tissue.⁷ Janssen and Sala⁴ reported three cases of embolism of the popliteal artery after ACL reconstruction. In the first case, the drill caused an intimal lesion at the level of the infragenicular popliteal artery during bicortical tibial fixation. The second case was of a traumatic pseudoaneurysm combined with thrombosis of the popliteal artery, which was in line with the drill hole for bicortical tibial fixation.⁵ The last patient had a history of repair of the medial and lateral collateral ligaments due to an injury 15 years ago. There was no definite evidence of arterial injury during arthroscopic ACL reconstruction. Therefore, the authors hypothesized that the reason for the occlusion was an intimal injury of the artery during knee dislocation, 15 years ago.⁴

In our case, we did not observe any significant bleeding caused by direct vessel injury during ACL reconstruction. On the fourth postoperative day, occlusion of the anterior tibial and popliteal arteries was detected on CT angiography. Collateral vessels were already present around the occlusion, and perfusion of the distal extremity was fair. The main reasonable cause of the compartment syndrome was that the anterior tibial artery might have been injured directly during drilling for bicortical screw fixation, causing the occlusion. For tibial screw fixation,

we drilled twice because we failed to engage the screw with the posterior cortex for bicortical fixation in the first attempt. This is supported by the CT image, which shows a trace of drilling in the fibula and a nonenhanced anterior tibial artery near the screw fixation site. The screw tip was placed very close to the occlusion site (Fig. 2).

In addition, the patient was possibly vulnerable to compartment syndrome because of a prolonged ischemic state of the leg. As reported by Jackson et al.,⁸⁾ we postulate that the intima of the popliteal artery was previously injured at the time of the ACL tear, 2 weeks ago. An itinerant thrombus was formed from this intimal lesion and it caused asymptomatic obstruction of the anterior tibial artery. This obstruction was superimposed on the arterial narrowing, caused by the use of a tourniquet during ACL reconstruction. The final result was complete obstruction of the anterior tibial artery. The collateral vessels around the occlusion in the anterior tibial artery support this hypothesis. Therefore, we think that the main reason for the compartment syndrome was a direct drilling injury to the anterior tibial artery. In addition to this injury, the leg was possibly vulnerable to necrosis because the intimal injury decreased blood perfusion of the leg. Postischemic compartment syndrome is also a considerable factor in this case because no hematoma was found intraoperatively or on CT. Reperfusion after a prolonged period of ischemia leads to tissue swelling and compartmental hypertension.⁹⁾ In this case, we think that the underlying thrombosis had induced mild ischemia of the leg. After tourniquet usage, reperfusion might have led to postischemic compartment syndrome.

Post and King¹⁰⁾ reported that although bicortical drilling for fixation of ACL grafts is reasonably safe, the

structures at greatest risk for injury are the bifurcation of the popliteal artery or vein and then the anterior tibial vein. They drilled a hole perpendicular to the tibial surface as we did. All surgeons should be cautious when drilling the posterior cortex, and not only when considering the direction and the entry point. These authors also recommended flexing the knees to release any potential tension in the posterior neurovascular structures.

The lack of preoperative image evaluation of the vessels is a limitation of this study. Postoperative ultrasonographic screening for vessel injuries after arthroscopic surgery is not recommended routinely because of their rarity. However, when a patient develops an unusual pattern of pain or sensory change in the involved leg, immediate evaluation of the vascular injury is imperative. Once the injury is detected, surgical exploration without any delay is necessary since the outcomes of vessel injuries are devastating.

In conclusions, we report a case of a very rare arterial injury after arthroscopic ACL reconstruction. Drilling for tibial bicortical fixation during ACL reconstruction can directly injure the anterior tibial artery. In addition, there can be an asymptomatic occlusion of the popliteal artery resulting from intimal injury at the time of ACL rupture. After prolonged compartment ischemia, reperfusion can lead to postischemic compartment syndrome. Surgeons should always be aware of vessel injuries since these injuries may lead to a devastating outcome.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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