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# Gunshot injuries of the popliteal vessels: A report of three cases

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**ABSTRACT**

Lower extremity vascular injuries occur due to gunshot wounds, traffic accidents, penetrating and blunt injuries, or industrial injuries. Gunshot wounds with vascular injuries have been increased among the civilian population. Lower extremity gunshot wounds have severe and acute complications of bone fractures, abundant bleeding, hypovolemic shock, soft tissue disruption, acute ischemia, neurological deficit, limb loss, or even death. The amputation rate of the popliteal injuries differs between 27% and 54%. In this paper, preoperative management and surgical experience in the popliteal region vascular injuries in three massively impaired cases were presented. Different surgical approaches performed in these patients due to the variety of pathologies were also discussed.

***Key words:*** *Gunshot, popliteal, vascular injury*

## Introduction

Lower extremity vascular injuries include gunshot wounds (GSWs), traffic accidents, penetrating injuries, blunt injuries, and industrial injuries. Major vascular injuries after GSWs may associate with different findings like bone fractures, massive bleeding, hypovolemic shock, soft tissue disruption, acute ischemia, and neurological deficit. The main predispositions for the limb loss after lower extremity GSWs are associated with various factors. These factors include the extent of tissue damage, duration of ischemia, concomitant arterial and venous involvement, and the presence of compartment syndrome [1]. In this paper, three cases with lower extremity GSWs in the popliteal region were presented. It aimed to emphasize the importance of prompt diagnosis and the management and to remind the readers of the related procedural information in the light of these cases.

## Case 1

A 24-year-old male patient was examined at the Emergency Department with low velocity (bullet injury) GSW on his right lower extremity. His blood pressure was 110/70 mmHg and heart rate was 120 bpm (sinus tachycardia). Distal pulses on his right lower extremity were not palpable. The musculoskeletal defect of the right popliteal region was severe, and the disruption was between the popliteal artery (POPA) and tibioperoneal artery (TPA) at the popliteal region. On the other hand, sciatic nerve and the peroneal nerve were not affected by the thermal damage. Computerized

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Tomography (CT) Angiography views demonstrated contrast agent leakage around the right tibioperoneal artery (Figure 1A). The patient was taken to the operating room, and, under general anesthesia with the prone position, the right popliteal region was explored with a 15 cm vertical incision. There was 10 cm segmental loss of vascular tissue in the TPA and partial venous defect that required venous patch plasty in the tibioperoneal vein. The small saphenous vein (SSV) was harvested at the beginning of the operation as a vascular graft. TPA was repaired with interposition of a 10 cm reversed SSV graft segment. Tibioperoneal vein repaired by venous patch plasty also used initial harvested SSV (Figure 1B). The patient was then taken to the cardiovascular intensive care unit after the operation is over and extubated. Dorsalis Pedis Artery (DPA) and Posterior Tibial Artery (PTA) were palpated normally, and there was no neurological deficit. During the follow-up under medical treatment, the patient was hemodynamically stable and he was discharged on the seventh day without any complication.

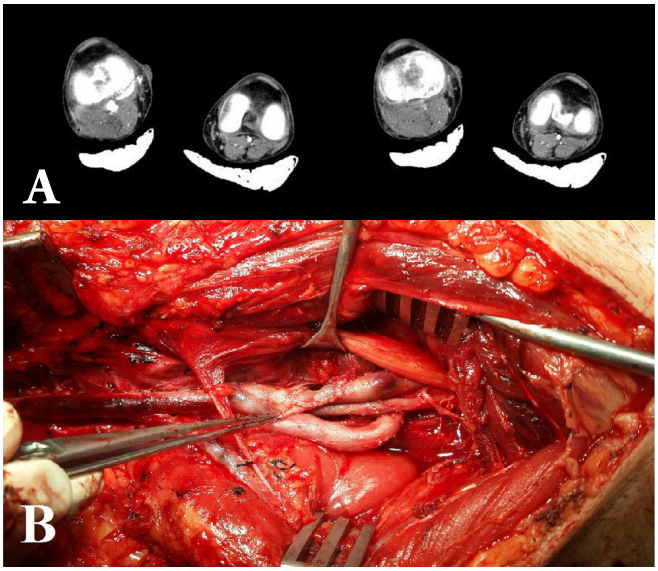


**Figure 1.** Computerized Tomography (CT) Angiography showing the extravasation of opaque outside the right popliteal artery and subsequent distal lack of circulation **(A)**. Intraoperative image demonstrating the surgically corrected right popliteal artery and popliteal vein **(B).**

**Case 2**

A 28-year-old female patient was admitted to the Emergency Department with a damaged left lower limb due to a hunting rifle wound. Her heart rate was 115 bpm and blood pressure was 95/60 mmHg. Distal pulses on her left leg could not be palpated. Her left ankle had a cyanotic and cold appearance. The lower extremity was totally examined due to the prolonged ischemia. CT Angiography views were evaluated before the operation demonstrating the cluster of hunting rifle pellets and blood leakage around the injury (Figure 2A). The patient was taken to the operation room, and, under general anesthesia, the lesion was explored with the posterior popliteal approach (Figure 2B). There was large dermal and musculoskeletal defect in the popliteal fossa. The medial-lateral head of gastrocnemius muscle below the knee and the semimembranosus-semitendinosus muscles above the knee have a severe injury by the pellets. Popliteal artery was explored without active arterial bleeding due to the vasospasm. There was a 13 cm segmental loss of vascular tissue of both popliteal artery and vein. Both of POPA and popliteal vein (POPV) were prepared for end-to-end anastomosis by circumference with elastic vascular

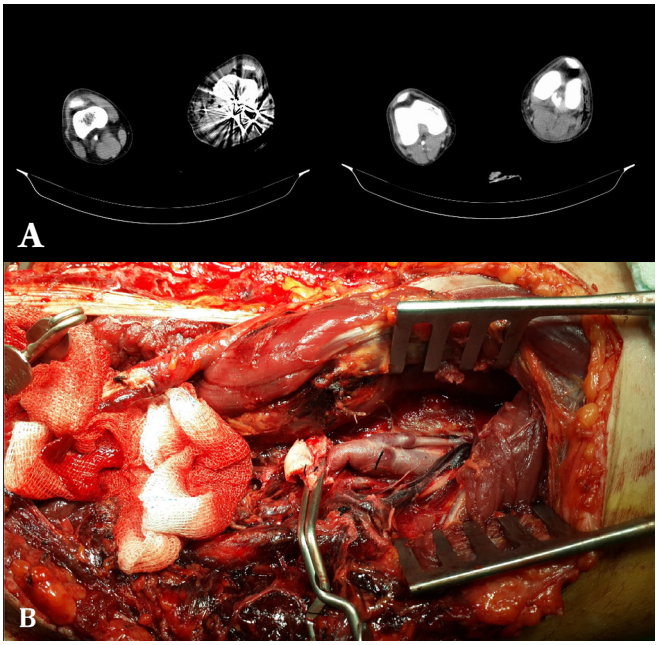


**Figure 2.** Computerized Tomography (CT) Angiography showing the pellet clusters and distal lack of circulation in the left popliteal artery **(A)**. Intraoperative image demonstrating the total popliteal artery and vein interruption **(B).**

tapes. A 6-millimeter diameter ringed expanded polytetrafluoroethylene (ePTFE) graft was interposed between the distal and proximal end of the vessels. POPA was clamped after an intravenous injection of 5,000 IU of unfractionated heparin. A 6-0 polypropylene suture was used in an end-to-end manner for the proximal and distal anastomosis. Anastomosed native POPA segment was unclamped. Duplex ultrasound (DUS) demonstrated triphasic flow pattern view to the distal

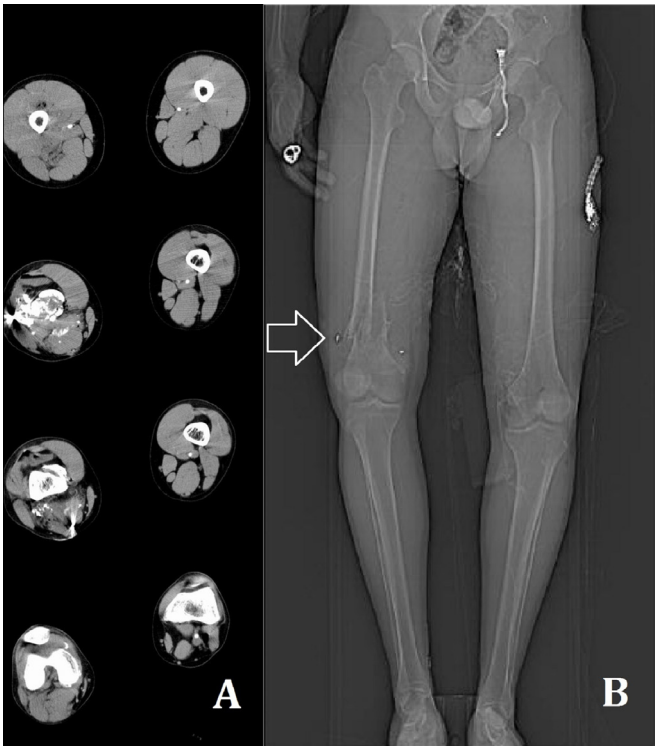


**Figure 3.** Computerized Tomography (CT) Angiography views showing the femur fracture and lack of opacification of the popliteal artery distal to the fracture **(A).** Direct X-ray showing the distal femur fracture (arrow) and lateral displacement of the femur shaft **(B).**

arteries of unilateral extremity. Metronidazole 1000 mg/day and gentamicin 80 mg/day were given as the antibiotherapy during the next ten days. The patient was discharged after ten days with no complication and recommended for physiotherapy due to flexion contracture of the left lower limb.

**Case 3**

A 25-year-old male patient was admitted to the Emergency Department with GSWs due to the pistol injury on the right lower extremity. Heart rate was 125 bpm and blood pressure was 100/60 mmHg. On physical examination, there were bullet entrance and exit way through the lateral supracondylar to popliteal fossa and supracondylar femur fractures. There were clinical hard signs of arterial injury on the right limb with the loss of distal pulses, expanding hematoma in the popliteal region, pulsatile bleeding and soft signs of a cool limb, and change in color. The patient was evaluated with CT Angiography at the Emergency Department for planning the surgical approach. CT Angiography views showed the POPA injury with a contrast leakage (Figure 3A) and the femur fracture (Figure 3B). After applying a femoral tourniquet, the patient was urgently taken to the operation room because of active arterial bleeding. Under general anesthesia, a 15 cm vertical incision was performed from the upper popliteal fossa to below knee by the posterior popliteal approach. The proximal segment of POPA was explored in the hunter channel output, cross-clamped after 5.000 IU of unfractionated heparin due to active pulsatile arterial bleeding. 15 cm segmental loss of POPA vascular tissue because of the additional thermal injury was observed. The distal popliteal artery has retrograde hemorrhage prior to the trifurcation. Six-millimeter ringed ePTFE graft was interposed and sutured by 6-0 polypropylene suture between the distal and proximal segments of the POPA with end-to-end anastomosis. The segment distal to the anastomosis was unclamped after the air removal. Distal pulses were palpated after the operation. The operation was ended with the subcutaneous and skin sutures. Orthopedic internal fixation of the supracondylar fracture was performed by the orthopedic surgery team at the supine position by the lateral distal femur approach. Bone reduction and osteosynthesis were performed by a plate and screws. Two units of erythrocyte suspension were given during the operation. Metronidazole 1000 mg/day and gentamicin 80 mg/day were prescribed during seven days at the intensive care unit. The patient was discharged on the tenth day after operation with no further complication.

**Discussion**

In a series of 550 patients with 641 lower limb arterial injuries, Hafez et al. found that the popliteal artery was the second most commonly injured vessel in the leg (31%) [2]. In all the three cases, different surgical approaches were performed to the patients, appropriate to the site and type of their vascular injuries.

The significance of Case 1 was the usage of the ipsilaterally harvested SSV within the same incision instead of using contralateral saphenous vein. Venous repair improves limb salvage rates by decreasing venous hypertension [3]. Another crucial surgical approach in the same case was the venous patch plasty repairing instead of the POPV ligation, although the ligation was an alternative. In case of the ligation of the central vein, the possibility of fasciotomy would be increased due to the compartment syndrome which is a major risk factor for limb loss. Thus, the venous patency should be saved at the end of the vascular operations [1].

In Case 2, a prolonged ischemic time more than six hours before hospitalization necessitated a rapid revascularization without harvesting a saphenous vein. Therefore, an ePTFE graft was interpositioned by end-to-end anastomosis in both of POPA and POPV without using a temporary vascular shunt. At the end of the revascularization, muscle and tendon repair or other orthopedic reconstructions were performed. In these cases with a delay in revascularization greater than 6 hours and in the presence of combined arterial and venous injury, a prophylactic fasciotomy should be performed [1].

In Case 3, active and pulsatile arterial bleeding and distal pulse deficit were seen at the Emergency Department. The patients' leg was cold and cyanotic despite the short ischemic time. The posterior approach is better with the prone position if the injury is between the superficial femoral artery through the aponeurotic tunnel in the middle third of the thigh (adductor canal) and POPA. The effect of ischemia time on limb viability and the effect of fracture stability on the revascularization procedure are the critical points in the repair of fractures with major vascular impairments [4]. Although the ePTFE graft was used in this presented case, using a temporary intravascular shunt prior to definitive vascular repair after the skeletal stabilization may be a choice that provides higher tissue viability and less neurologic deficit [4]. The use of temporary arterial shunts in all the three cases was not required though it has been suggested in some publications [3].

Internal orthopedic bone fixation was performed after the revascularization in the third case. Primary repair without grafting would significantly reduce the incidence of amputation especially the patients with prolonged ischemia [5]. However, in all the three cases, the segmental arterial loss was more than 10 cm which would be inappropriate to a primary repair without grafting.

The amputation rates from popliteal injury in Hafez and Moniz studies were 27% and 54%, respectively, and these rates are higher than in (Mullenix) the National Trauma Data Bank popliteal injury study, which reported an overall amputation rate of 14.5% [6,7]. No primary or secondary amputation was done in any of the three cases. In all the three cases, systemic anticoagulation was administered intravenously before the arterial cross-clamping. Systemic anticoagulation with heparin may provide the small vascular patency affecting the limb salvage [5].

When we compared the patient's values of mangled extremity severity score (MESS), Case 1 was 6, Case 2 was 11, and Case 3 was 7. Thus, the MESS appears to be a reasonable method to stratify extremity injury severity [8]. On the other hand, it is not enough scoring system for the decision of primary amputation [3]. Although the second case was prone to the limb amputation, the operation was performed successfully and long term consequence was fortunately well considering the patency of lower limb arterial and venous grafts. However, the relationship between ischemia times and ultimate limb function in patients with successful fracture repair and revascularization has not been reported; it is a fact that amputation rates decrease by the surgical technical developments [3]. In popliteal GSW injuries, latent popliteal artery aneurysms may also be encountered [9]. No arterial pseudoaneurysms were seen in any of these cases during the one-year follow-up after the operation.

In conclusion, our experience of what may be done before the amputation decision about the segmental arterial loss at GSWs in the civilian population was presented depending on these three interesting cases. The purpose of this study was to point out the pathology of a combined musculoskeletal-vascular injury and also the management strategy of the lower extremity GSWs.

**Conflict of interest statement**

The authors have no conflicts of interest to declare.

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