# Popliteal Artery Injuries

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## Injury/Disease Demographics

- Popliteal injuries can occur following blunt or penetrating trauma; a high index of suspicion is warranted in patients with distal femur fractures or knee dislocations
- Blunt trauma results in a stretch injury with intimal disruption and subsequent occlusion of the artery at the level of the associated fracture or joint dislocation.
- Penetrating wounds can produce either vessel transection or a pseudoaneurysm.

## Clinical Presentation

- Prompt diagnosis is based on injury mechanism and systematic evaluation for the 6 P's in the emergency department (ED).
- Popliteal injuries more commonly present with ischemia rather than overt external hemorrhage; if there is overt bleeding, initial hemorrhage control should be accomplished with digital compression.
- Motor/sensory defects may be the first sign of arterial injury due to ischemia, rather than an absent pulse.

## Evaluation/Diagnostics/Imaging

- Examination of the extremity should note "hard" and "soft" signs of vascular injury.
- Hard signs of injury (pulsatile hemorrhage, absent pulses, expanding hematoma, or arteriovenous fistula) constitute an indication for operation.
- Soft signs of injury (significant hematoma, thrill/bruit, associated nerve injury, proximity to vasculature) warrant imaging and potentially non-operative management.
- Doppler pressure measurements comparing extremities provides quantitative measurements of arterial flow and can determine ancillary imaging; ABI < 0.9 deserves contrast imaging (CTA, digital subtraction angiography, or on-table angiography).
- Bony fractures or knee dislocations should be realigned before definitive vascular examination.
- A complete neurologic exam is mandatory prior to transport to Radiology or to the operating room (OR).

## Role of Nonoperative Management and Associated Considerations

- Arterial injuries that may be treated nonoperatively include small pseudoaneurysms and arteriovenous fistulas following blunt injury, intimal dissections, and small intimal flaps in the extremities. Pseudoaneurysm and arteriovenous fistulas following penetrating trauma are predominantly managed with an operation.
- Follow-up imaging is performed 1 to 2 weeks after injury to confirm healing.

## Indications for Operative Intervention

- Significant flow-limiting popliteal artery injury or vessel disruption by physical exam or imaging is an indication for surgery.

## Pre-operative Preparation

- Need for on-table lower extremity angiography should be anticipated and appropriate fluoroscopy including fluoro-compatible OR tables should be readied.
- Placement of a tourniquet around the proximal thigh may be considered; this can then be inflated intraoperatively if local hemorrhage control becomes difficult.
- Arterial access for on-table angiography can be obtained percutaneously at the femoral vessels with a standard arterial catheter, via femoral vessel exposure and direct cannulation, or with SFA exposure just above the knee. Access to circumferential bilateral extremities from the hips down is necessary.

## Impact of Associated Injuries

- Associated fractures or joint instability should be stabilized prior to definitive vascular repair.
- The preferred approach is to identify the vascular injury and place an intraluminal shunt to restore flow to the extremity; a Pruitt-Inahara shunt permits vascular shunting while also providing an infusion port for vasodilatory medication administration (verapamil, nitroglycerine, and papaverin) and contrast delivery for on-table angiography to determine distal outflow.
- Following shunt placement, definitive orthopedic fixation may occur followed by vascular reconstruction.

## Operative Techniques/Intraoperative Considerations

- Preferred access to the popliteal space for an acute injury is the medial approach with one incision detaching the semitendinosus, semimembranosus, and gracilis; these tendons are re-approximated following vascular repair.
- Other options include a medial approach with two incisions (distal SFA access and below-the-knee popliteal access) or a straight posterior approach with an S-shaped incision (which may provide too limited a view and requires prone positioning).
- If the patient has an associated popliteal vein injury, this should be repaired first while the artery is shunted. If technically possible, the vein may be primarily repaired if there is minimal damage; alternatively, RSVG or ringed PTFE interposition graft may be used for destructive injuries to the vein. Ligation of popliteal vein injuries, although not optimal, is a viable option depending on the patient's intraoperative physiology.
- For an isolated popliteal artery injury, RSVG from the contralateral thigh is performed either with an end-to-end or end-to-side proximal anastomosis and an end-to-end distal anastomosis.

The contralateral thigh is used for vein harvesting to maintain the superficial venous system in the injured leg.

- Compartment syndrome is common, and presumptive 4-compartment fasciotomies is warranted in the majority of cases with combined arterial/venous injury, for ischemic periods greater than 6 hours, and when instability precludes the ability to repair the vein and ligation is performed.

## Postoperative Management/Complications

- Vascular exam should be monitored hourly in the immediate postoperative period. Any change in pulse exam should raise immediate concern of occlusion of the popliteal repair or development of compartment syndrome.
- If presumptive 4-compartment fasciotomies were not done, close monitoring for calf compartment syndrome is mandatory (physical exam and compartment pressure in high-risk patients).
- Postoperative use of antithrombotics is individualized based upon the surgeon's impression of the durability of the repair, outflow considerations, and risk of bleeding from associated injuries. Antiplatelet agents are used in the majority with some receiving systemic heparin infusions in the first postoperative week.
- Ligation of the popliteal vein is associated with significant venous hypertension; temporary use of elastic bandages (Ace wraps) and elevation of the lower extremities may alleviate these issues. If the patient has no peripheral edema with ambulation after one week, these maneuvers are no longer required.
- Prosthetic graft infections are rare complications.
- Long-term arterial graft complications such as stenosis or pseudoaneurysms are uncommon, and routine graft surveillance is rarely performed.

## Considerations for Special Populations

- ABI measurements in older patients may be reflective of atherosclerotic disease rather than acute injury. This must be incorporated into the decision making for ancillary imaging.
- Angiography in the pediatric population may be problematic due to the small caliber of vessels and associated vasospasm.