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Popliteal Artery Injuries in Motorcycle Accidents Following Posterior Knee Dislocation: Surgical Outcomes of Saphenous Vein Graft Repair — A Single-Center Case Series from Nishtar Hospital, Multan

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Author`s Contribution

[1,2]Substantial contributions to the conception or design of the work; or the acquisition, [4,6]Active participation in active methodology, [2,3]analysis, or interpretation of data for the work, [5]Drafting the work or revising it critically for important intellectual content

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ABSTRACT

Objective: To assess the surgical outcomes and early functional recovery of patients undergoing great saphenous vein graft repair for popliteal artery injuries following posterior knee dislocations caused by motorcycle accidents.

Methodology: This Descriptive case series study was conducted at Plastic Surgery and General Surgery Departments, Nishtar Hospital, Multan, from January 2021 to December 2024, included 21 male patients aged 12 years and older who sustained posterior knee dislocations due to motorcycle-related trauma. All patients had intraoperatively confirmed injuries to the popliteal artery and underwent arterial reconstruction using reversed autologous great saphenous vein grafts. Fasciotomy and orthopedic stabilization were performed as required. Patients who presented more than 12 hours after trauma with non-viable limbs or incomplete follow-up data were excluded. Graft patency was evaluated with Doppler ultrasonography on days 2 and 7, and with CT angiography at six months. Functional outcomes were assessed at 12 weeks using the Lower Extremity Functional Scale (LEFS).

Results: All patients achieved limb salvage, with no amputations recorded. Graft patency at six months was confirmed in all cases. The mean LEFS score was 65.0 ± 4.1, with 18 patients (85.7%) achieving scores of 60 or higher, reflecting satisfactory recovery. Postoperative complications occurred in 5 patients (23.8%) and included wound infection, early graft thrombosis, seroma, and wound dehiscence—all managed conservatively.

Conclusion: Timely revascularization using reversed saphenous vein grafts offers excellent outcomes in terms of limb salvage, graft durability, and early functional recovery in patients with motorcycle-related popliteal artery injuries.

Keywords: Popliteal artery, Knee dislocation, Motorcycle trauma, Saphenous vein graft, Limb salvage, Functional recovery

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Introduction

The last twenty years witnessed a phenomenal growth in the use of motorcycles in Pakistan, with the number of people registering more than 23 million motorcycles by 2022. Motorcycles currently make up close to 77 percent of all vehicles that are registered in the country, and young men form the majority of those who are riding the bikes.[1,2] Although motorcycles are cheap and convenient modes of transport, particularly among the working population, they also have a significant impact on the road traffic injury in the country. National statistics indicate that more than 60 percent of trauma occurring during crashes is related to motorcycles, and lower limbs injuries have the highest prevalence.[3,4]

The posterior knee dislocation is one of the most crippling and destructive injuries in this category and it is a high-energy injury that is typified by the tibia moving backward in position with respect to the femur. It is also rare but is increasingly being reported in motorcycle accidents, and

mostly it is as a direct anterior collision with a flexed knee.[5]

This mechanism exposes the popliteal artery that passes through the popliteal fossa to high risk of traction, thrombosis or transection.[6,7] Late recognition and treatment past the critical 6-8 hours period of ischemia can severely escalate the threat of irrevocable ischemia, amputation rates are up to 37 percent in late treatments.[8,9]]Autologous great saphenous vein (GSV) grafts are still the gold standard in the reconstruction of the arteries in such limb-threatening emergencies. They are very useful in the trauma environment due to their wide availability, excellent biocompatibility, and long-term patency.[10,11] Nevertheless, the bulk of evidence providing GSV use is based on highincome nations, and there is a significant gap in the available information about low- and middle-income nations (LMICs), specifically long-term vascular and functional outcomes in patients undergoing the revascularization procedure following the motorcycle-induced posterior dislocation.[12] Also, it is not a secret that popliteal artery is relatively weak at the anatomical fixation points, but the nature and site of arterial injury in posterior knee dislocations have not been thoroughly studied. Other reports indicate that intimal delamination immediately posterior of the superior genicular artery could be a biomechanically predictable shear zone.[13,14] An improved comprehension of these anatomical patterns might be helpful in the early diagnosis and more focused vascular repair strategies.[15]

The following case series study by Nishtar Hospital, Multan, seeks to fill the following clinical and anatomical gaps. It provides the surgical and functional findings of 21 consecutive male victims of motorcycle related popliteal artery-injured dislocations of the anterior knee. Reversed GSV grafts and orthopedic stabilization were used to treat all patients. The work has not only shown good limb salvage and graft patency results but has also shown a pattern of intimal separation at particular segment of arteries consistently observed in future trauma care guidelines especially within a resource-limited setting.

Methodology

This series of cases was done in the Nishtar Hospital and Nishtar Medical University, Multan, which is a tertiary care hospital serving Southern Punjab, Pakistan. It covered the period between January 2021 and December 2024 and covered patients who came in with closed posterior knee dislocation with popliteal artery injury as a complication of motorcycle accidents. The Departments of Plastic Surgery, General Surgery and Orthopaedics in the Accident and Emergency Unit handled all cases in the multidisciplinary manner they had.

The Nishtar Medical University Institutional Review Board (Ref #: IRB/NMU/2022/234) provided an ethical approval to this study. All the patients or legal guardians gave written informed consent to undergo treatment, as well as to participate in this study.

The sampling method was non-probability consecutive method. All the patients who came with suspected vascular injury because of the dislocation of the knees after the occurrence of motorcycle crashes within the study period were screened. Out of the total patients the eligibility criteria were met, 21 patients were chosen and the final analysis was performed. The size of the sample was determined by the number of eligible cases over the study period; no statistical significance of the sample size was conducted due to the descriptive study.

Inclusion criteria included: age 12 years and above, popliteal artery injury due to motorcycle injury of the posterior knee, intraoperative confirmation of popliteal artery injury, orthopedic stabilization (immediate or staged) and a minimum of six months of clinical and radiological follow-up.

Exclusion criteria were blunt trauma without dislocation, penetrating injury (e.g. gunshot wound or stab), presentation more than 12 hours with non-viable limbs, incomplete documentation, or loss to follow-up within six months. The 12 hour constraint was used to exclude cases where there was probable irreversible ischemia which may bias surgical outcome evaluation.

All patients on presentation were immediately assessed with regards to acute limb ischemia such as absent distal pulses, pallor, poikilothermia, slower capillary fill-up, and impaired neurological functions. The time window of limb salvage is very critical and hence clinical diagnosis was stressed. CT angiography was not done as a routine to prevent any delays, but selective bedside Doppler ultrasonography as vascular status remained doubtful.

Management of orthopedics started with the emergency department with the immediate closed reduction of the knee dislocation. External fixation during operation was done in cases of prolonged instability or related fracture. The reconstruction using ligament was also deliberately postponed to a later time to focus on revascularization and to keep the ischemic time as short as possible.

Surgery was done under a general anesthetic condition. The popliteal artery exposure was done via a medial or posterior approach, depending on the location of injury and the condition of the surrounding soft tissues. Proximal and distal vascular control was established after which the injured arterial section was resected and a reversed great saphenous vein (GSV) graft, harvested on the opposite leg, replaced it. Systemic heparinization (100 IU/kg) was given before clamping the vessels. Intraoperative graft patency and distal perfusion were assessed with handheld Doppler and physical evaluation.

All the patients were subjected to prophylactic fasciotomy. This was because of the duration of ischemia, edema, and compartmental tension. Wounds of fasciotomy were subsequently sewn up mainly or overlays with skin grafts according to tissue viability and healing.

The repair of the ligament was delayed by 6 to 12 weeks to enable the stabilization of the vascularity, healing of the wound, and also the assessment of the joint by means of MRI. This effect was achieved through the use of a staged solution, whereby the soft tissue was not compromised during the acute phase.

After the surgery, the patients were followed in a high-dependency unit, or a surgical ward, based on the clinical status. Close monitoring of vascular condition was done by routine evaluation of pulses, capillary refill, skin temperature and color of the limbs.

Low molecular weight heparin (LMWH) was initiated as anticoagulation postoperative within 24 hours and then proceeded to oral aspirin (75150 mg/day) to help maintain patency of the grafts in the long term. The perioperative antibiotic prophylaxis was carried on to decrease the chances of infection.

A Doppler ultrasonography of the graft was regularly measured on the 2 nd and 7 th days of operation. CT angiography was done at six months to ensure long-term patency, to exclude thrombosis or stenosis and triphasic flow of the distal arteries.

Rehabilitation was also started to go hand in hand with physiotherapy. Passive range-of-motion exercises were initiated in the second week of the postoperative period when the condition of edema subsided and the wound stabilized. The weight-bearing was not started until the vascular and orthopedic stability has been achieved. The mobilization was determined based on the joint stability and tolerance of the patient.

A minimum of six months follow up was done on all patients. The follow up process involved sequential clinical, vascular and functional assessment. The aim of monitoring was to determine the presence of complications at an early stage and evaluate the progress of recovery.

The main outcomes were limb salvage, graft-patency, and functional recovery. The secondary outcomes were concerned with complication rates and duration of stay in a hospital. Limb salvage was determined as limb survival without above-ankle discharge amputation or follow-up. Doppler and CT angiography were used in the evaluation of graft patency. The Lower Extremity Functional Scale (LEFS) was used to measure functional recovery at 12 weeks. LEFS score of 60 or higher was a sign of good functioning, as it included independent ambulation and execution of day-to-day activities.

Prospective recording of postoperative complications was done. They were wound infection, early graft thrombosis, seroma formation, wound dehiscence and compartment syndrome that needed re-intervention. Everything was under the regular surgical procedures.

The length of stay in the hospital was captured in the number of days since surgery until discharge, which is the postoperative recovery and rehabilitation requirements.

Patient records, operative notes, imaging reports, and outpatient charts were the sources of clinical, surgical, and follow-up data collected retrospectively. The variables of interest were age, BMI, time to surgery, graft type, orthopedic type of stabilization, fasciotomy, complications, hospitalization, and Lower Extremity Functional Scale (LEFS) values. The data were entered and analyzed with the help of Microsoft Excel and IBM SPSS Statistics Version 25.0 (IBM Corp., Armonk, NY, USA). Continuous data (e.g., age, LEFS score, hospital stay) were presented as the mean values with the standard deviation, whereas the categorical data (e.g., limb salvage, complications) were presented as frequencies and percentages. Since it was a descriptive case series design, there were no inferential statistical tests. .

Results were interpreted to illustrate clinical patterns and outcomes.

- Posterior Knee Dislocation: Displacement of the tibia posteriorly relative to the femur.
- Popliteal Artery Injury: identified intraoperatively
- GSV Graft: Reversed great saphenous vein used for arterial bypass or interposition.

- Limb Salvage: Preservation of a viable limb without above-ankle amputation.
- Graft Patency: Verified triphasic Doppler flow and patent lumen on six-month CT angiogram.
- Functional Recovery: LEFS score of ≥60 at 12 weeks, indicating independent ambulation and daily activity performance.
- Delayed Presentation: Hospital arrival occurring more than six hours post-injury.

Study Variables and Measurement.

Category	Variable	Type	Source/Measurement
Independent	Age	Continuous (years)	Patient records
	BMI	Continuous (kg/m²)	Calculated at admission
	Time to surgery	Continuous (hours)	Time from ER admission to incision
	Orthopedic stabilization	Categorical	None / Manipulation / External fixation
	Fasciotomy performed	Binary (Yes/No)	Intraoperative documentation
	Graft type	Categorical	All received reversed GSV graft
Dependent	Limb salvage	Binary (Yes/No)	Viable limb at discharge and 6-month follow-up
	Graft patency	Binary (Patent/Thrombosed)	Doppler (Day 2, 7) + CT angiogram (6 months)
	Functional outcome (LEFS)	Continuous (0–80)	Administered at 12 weeks
	Complications	Categorical	Infection, thrombosis, seroma, wound dehiscence
	Hospital stay	Continuous (days)	From surgery to discharge
Confounding	Delay in referral	Continuous (hours)	Based on EMS timestamps or patient history
	Soft tissue injury	Ordinal (Gustilo I–IIIc)	Gustilo-Anderson classification
	Associated fractures	Binary (Yes/No)	Radiographic confirmation
	Ligament injury	Ordinal (Mild–Severe)	MRI at six weeks post-op
	Smoking status	Binary (Yes/No)	Documented in patient history
	Diabetes mellitus	Binary (Yes/No)	Recorded comorbidity

Results

In this study, 21 males were included, and they all had posterior dislocations of the knee joint caused by an accident on the motorcycle. Mean age was 25.0±6.2 years (range: 19-45), and the mean BMI was 23.5± 2.8 kg/m 2. The mean duration of surgical revascularization was 6.2 ±1.5 hours after the emergency admission which guaranteed that all the patients had definitive care during the 8-hour critical ischemic period. It had an average hospital stay of 12.0 ± 3.0 days that included postoperative care, wound care, and immediate rehabilitation.

Emergency vascular reconstruction with reversed autologous great saphenous vein (GSV) grafts obtained from the opposite limb was performed on all the patients. During surgery, total arterial transections were observed in most of the cases and intimal delamination or segmental thrombosis were observed in the rest. Access to the vascularity was done through the medial/posterior methods and systemic heparinization (100 IU/kg) was administered before clamping. Intraoperative confirmation of graft patency was done with the help of Doppler and distal pulse restoration.

All 21 patients underwent prophylactic or therapeutic fasciotomy depending on the ischemia time, compartment pressure or observable edema. Delayed primary closure or skin grafting was done as part of wound management based on tissue viability.

Intraoperative external fixation was done to stabilize the joint in 11 (52.4) of the patients as a result of instability or associated fractures of the joint. The other 10 patients (47.6%), had closed reduction and immobilization. No case received acute ligamentous reconstruction, and future assessments of the same through MRI were to be done at a 6 to 12 weeks.

With no significant amputations during hospitalizations or at six months follow-up, limb salvage was realized in all the cases (100%). Clinical evaluation revealed restoration of distal perfusion in all the patients immediately after the procedure.

All the patients underwent emergency vascular reconstruction using reversed autologous great saphenous vein (GSV) using the grafts collected on the other limb. In surgery, total arterial transections were noted in the majority of cases and intimal delamination or segmental thrombosis were noted in the rest. The vascularity was accessed either via the medial/posterior approaches and systemic heparinization (100 IU/kg) was performed prior to clamped vascularity. Doppler and distal pulse restoration were used to intraoperatively verify the presence of graft patency.

The 21 patients all received prophylaxis or therapeutic fasciotomy based on the time of the ischemia, compartment or edema on observation. Depending on the viability of tissues, delayed primary closure or skin grafting was considered as wound management.

As a consequence of joint instability or related joint fractures intraoperative external fixation was performed to stabilize the joint in 11 (52.4) of the patients. The remaining 10 patients (47.6%), had closed reduction and immobilization. Each case was not subjected to acute ligamentous reconstruction and further evaluation of the same with the MRI was to be carried out at 6 to 12 weeks. Limb salvage was achieved in all the cases (100%), with no important amputations in the course of hospitalization or six months follow-up. Clinical assessment showed that there was restoration of distal perfusion in all the patients immediately after the procedure.

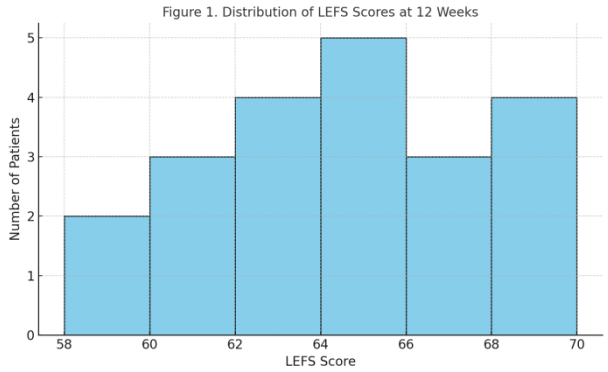

Figure 1. Distribution of LEFS Scores at 12 Weeks: A histogram depicting the LEFS scores of the 21 patients. The majority scored above 60, indicating good functional recovery.

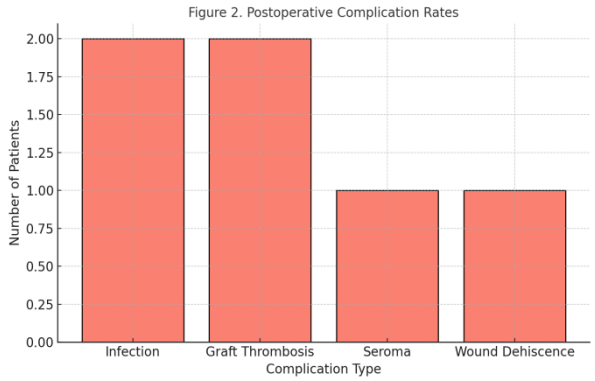

Figure 2. Postoperative Complication Rates: A bar chart illustrating the distribution of postoperative complications across the cohort.

Complications occurred in 5 patients (23.8%), with all managed conservatively. There were no cases of mortality or limb loss. The most frequently encountered complications included:

- Infection in 2 patients (9.5%)
- Graft thrombosis in 2 patients (9.5%) – resolved with anticoagulation and close Doppler follow-up
- Seroma formation in 1 patient (4.8%)
- Wound dehiscence in 1 patient (4.8%)

Table I: Summary of Key Outcomes and Surgical Variables

Variable	Mean ± SD / Count (%)
Age (years)	25.0 ± 6.2
BMI (kg/m²)	23.5 ± 2.8
Time to Surgery (hr)	6.2 ± 1.5
Hospital Stay (days)	12.0 ± 3.0
LEFS Score at 12 Weeks	65.0 ± 4.1
Fasciotomy Performed	21 (100%)
Limb Salvage	21 (100%)
Graft Patency at 6 Months	21 (100%)
External Fixation Used	11 (52.4%)
Infection	2 (9.5%)
Graft Thrombosis	2 (9.5%)
Seroma	1 (4.8%)
Wound Dehiscence	1 (4.8%)

Discussion

In this case series, the results of 21 male patients who had sustained posterior dislocations of the knee joint after a motorcycle accident. All of these patients sustained popliteal artery injury after motorcycle accidents. Diagnoses were established primarily and solely on clinical suspicion, and in all cases, revascularisation was attempted using reverse great saphenous vein (GSV) grafts. In our case series, we achieved 100% limb salvage, graft patency, and high early functional recovery. These conclusions support the importance of early diagnosis, timely surgical intervention, and a standardized interdisciplinary methodology in resource-constrained environments that not only saves limbs but also decreases the economic loads on the healthcare system. Trauma associated with motorcycles is an increasing public health issue in the low and middle-income countries (LMICs), including Pakistan.[1]

A very important factor that should be taken into consideration is that most of the motorcycle users in Pakistan are young males, who make a young popuon a demographic inherently at high risk of having trauma. As a general rule, as the number of vehicles increase it proportionally increases the risk of injury secondary to road traffic accidents. As the road traffic accidents involving the motorcycle have sharply increased that resulted in the complex nature of the limb injuries.[2,3] Posterior dislocation of the knee joint is rare and is due to high-impact trauma. When two wheelers collide, two different things happen: 1st flexed knee position, and 2nd a direct trauma to the knee joint. This sometimes becomes so high-impact that it leads to the posterior dislocation of the knee joint. [4,5]

The mean age in our case series was 25 years, and all the patients were male. The position of the popliteal artery is very important. Anatomically, the popliteal artery is fixed at the knee joint, which predisposes it to injury after the posterior dislocation of the knee joint. [6,7] Open posterior dislocations of the knee joint have a very high incidence of vascular injury. Even closed dislocations, posterior dislocations of the knee joint may cause severe vascular impairment. The incidence of vascular injury reported in posterior dislocations of the knee joint, either open or closed, ranges between 30 and 45 percent.[8,9] As the popliteal artery is the main artery that supplies the blood to the limb below the knee joint, injury to the popliteal artery will compromise the vascular supply to the lower limb, and that will lead to amputation. Whenever there is a vascular injury to the popliteal artery, an urgent intervention is needed to prevent irreversible ischemic damage to the lower limb. As the critical ischemia time is 6 to 8 hours, it is important to revascularize the lower limb in this time window. In our series, all the patients underwent surgical revascularization within 8 hours, which is well within the critical ischemia window. [10]

It is important to note that for a successful management and a successful outcome, time is the most important limiting factor. If a patient presents in a daily accident and emergency department after an injury, in six hours, a well-planned, focused clinical examination is sufficient for the early diagnosis and planning. Sometimes bedside Doppler assessment is helpful, but it is very important to note that this Doppler assessment is only a supplement to the clinical examination. It is not mandatory for the diagnosis.

Surgical exploration is performed through an “S” shaped incision in the popliteal fossa. The predictable pattern of artery injury occurs in posterior dislocation of the knee joint following a motorcycle accident. The damaged segment of the artery is excised, and this is replaced with a reversed autologous great saphenous vein graft (GSV). The reversed autologous great saphenous vein graft (GSV) is the preferred choice for the arterial reconstruction because of its easy accessibility, biocompatibility, low donor site morbidity, and decreased rate of infection.[13,14] Our study demonstrates that all the grafts were patent after six months. The graft patency was confirmed by Doppler ultrasonography and CT angiography after six months. When we compared the existing trauma literature, in which the graft success rate ranged between 85 to 95%, however, graft patency was 100% in our study. These favourable results may be because of the early decision to revascularize with the ischemia window, meticulous graft preparation and handling, and structured anti-platelet therapy.[15]

Postoperatively, we did the fasciotomy in every patient. However, in the literature, many studies describe the selective fasciotomy after popliteal artery injury in around 30 to 60%. However, as we described earlier, we have adopted a universal strategy and performed prophylactic fasciotomy in every patient. The reason for the prophylactic fasciotomy was based on the aim to minimize the risk of compartment syndrome. After six hours, the irreversible changes start to happen. And obviously, operation time, if we include that, increases the chance of reperfusion injury leading to compartment syndrome. The outcome was favorable. The reconstruction of the facialotomy defect was covered with a split-thickness skin graft. In only one case, there was a wound dehiscence, and no major wound complication or infection was found in the fasiotomy wound our series. We support prophylactic fasciotomy in every case as ischemia time is often prolong and that leads to tissue edema, and this happens even if the patient comes within the ischemia window.

The results on functional outcomes were promising, and the mean was high. LEFS score was 65 at 12 weeks and 86 percent of patients gained recovery of adequate limb functioning. All patients became ambulatory with no assistive aid, emphasising the role of vascular integrity, early physiotherapy, and joint condition stabilization in achieving the recovery. [16,17]

In our case series, we have noticed a consistent pattern of arterial injury. That finding was in all the cases, irrespective of whether it was open or closed. The consistent intraoperative finding was the location of arterial injury. It was just distal to the superior genicular artery and was proximal to the popliteal artery bifurcation. Grossly, the affected segment of the artery appeared thickened and had no pulsations. When we removed that affected portion of artery, we found intimal delamination. In all the cases, the affected arterial segment, which was removed, was sent for histopathology, and that confirmed the separation of intima from the media. We think that this is because of the mechanically vulnerable position of the artery where it is fixed to the posterior knee joint. This pattern has not been described in current surgical literature. And that needs to be clarified in future studies if this is the consistent pattern in posterior dislocation of the knee joint.

The limitation of this study, is that it is a retrospective single-center case series, and so it carries a risk of selection and documentation bias. There is an absence of a control group that limits the comparison. Another limitation is the short-term

outcomes, such as graft patency and LEFS scores, one assessed at 12 weeks. Long-term outcomes has not been evaluated.

The benefits of this case series are that it provides a very meaningful contribution to the existing surgical literature, as this type of specific injury pattern has seldom been explored in large case series. It provides the value of in-time diagnosis, uniformity in surgical technique, consistent intraoperative findings, and use of vascular vein graft for the repair, Prophylactic fasciotomy, structured rehabilitation, and staged ligamentous repair. By demonstrating consistent outcomes with the structured surgical approach, this study adds relevant evidence to the field of trauma and vascular surgery. Some may find a few of the old references because this type of data has not been published in the recent past.

Conclusion

This case series demonstrates that motorcycle-associated posterior dislocation of knee joints has a very high incidence of popliteal artery injury that can be effectively managed through early in time clinical diagnosis, early revascularization using reversed autologous vein grafts, and along with timely orthopedic stabilization. In our cohort, limb salvage and graft patency were 100% with satisfactory early functional recovery and consistent intraoperative findings of intimal demyelination proximal to the bifurcation of the popliteal artery. This study emphasizes in-time diagnosis, standard and uniform surgical technique, multidisciplinary care, and post-operative rehabilitation in a resource-limited setting.

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