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**Research Article**

# Clinical Profile, Epidemiological Trends, and Surgical Outcomes of Infrainguinal Arterial Disease: A Single-Center Descriptive Study from South Asia

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## ABSTRACT

**Background:** Infrainguinal arterial occlusive disease constitutes a substantial proportion of peripheral arterial disease requiring surgical revascularization. Patients presenting with advanced infrainguinal disease frequently have multiple cardiovascular risk factors and may present with critical limb ischemia, particularly in resource-constrained populations. The present study evaluated the demographic characteristics, socioeconomic profile, risk factors, etiological patterns, clinical presentation, anatomical distribution, and early surgical outcomes of patients undergoing open revascularization for infrainguinal arterial occlusive disease at a high-volume tertiary vascular center. **Methods:** A single-center descriptive observational study was conducted from August 2013 to August 2015. Consecutive patients presenting with infrainguinal arterial occlusive disease who underwent open surgical bypass were included. Patients with significant inflow disease, acute limb ischemia, incidental aneurysmal disease, or previous vascular interventions were excluded. Demographic and socioeconomic characteristics, cardiovascular risk factors, etiology of arterial disease, clinical presentation, procedural revascularization success, postoperative major adverse cardiovascular events (MACE), and six-month amputation-free survival (AFS) were assessed. **Results:** Among 512 patients assessed for infrainguinal arterial disease, 217 underwent open surgical bypass and constituted the operative study population. Males predominated, accounting for 76.95% of patients. A low socioeconomic background, corresponding to Kuppuswamy socioeconomic Classes IV and V, was observed in 58.07% of patients. Early-onset disease was prominent, with 32.58% of patients belonging to the 30–45-year age group. Atherosclerosis obliterans (ASO) was the predominant etiology (52.99%), followed by thromboangiitis obliterans (TAO) (19.35%). Smoking was

the most prevalent risk factor (84.79%), while diabetes mellitus was present in 33.18% of patients. Critical limb ischemia (CLI) was the predominant clinical presentation, occurring in 89.40% of operative patients. Successful initial procedural revascularization was achieved in 83.0%. Early postoperative major adverse cardiovascular events occurred in 12 patients (5.53%). At six months, the overall amputation-free survival rate was 75.57%. **Conclusion:** Infrainguinal arterial disease in this cohort was characterized by a high prevalence of advanced clinical presentation, smoking exposure, early age at presentation, and socioeconomic vulnerability. Open surgical bypass achieved satisfactory initial revascularization and limb-salvage outcomes despite the advanced nature of disease. The findings emphasize the importance of early identification of peripheral arterial disease, aggressive modification of cardiovascular risk factors, smoking cessation, and timely referral to vascular services.

**Keywords:** Infrainguinal arterial disease; Peripheral arterial disease; Open bypass surgery; Critical limb ischemia; Thromboangiitis obliterans; Atherosclerosis obliterans; Limb salvage; Amputation-free survival; Smoking; Vascular surgery.

## INTRODUCTION

Chronic lower-extremity ischemia secondary to peripheral arterial disease (PAD) is an important cause of disability, tissue loss, limb amputation, and cardiovascular morbidity and mortality worldwide [1]. The prevalence of PAD, a symptom of systemic atherosclerotic disease, rises with age and the presence of cardiovascular risk factors such dyslipidaemia, diabetes mellitus, smoking, and hypertension [1,2]. Despite the fact that PAD is typically associated with older persons, patients in poor nations may have severe illness at a comparatively younger age. Severe ischaemia and tissue loss may manifest as a result of delayed diagnosis, restricted access to specialised vascular services, socioeconomic obstacles, and a lack of knowledge about early signs [2, 3].

Infrainguinal artery occlusive disease, involving the superficial femoral, popliteal, and infrapopliteal arterial segments, comprises a key component of lower-extremity arterial illness. Patients may appear with intermittent claudication, ischemic rest discomfort, ulceration, or gangrene, with the latter signs constituting chronic limb-threatening ischemia (CLTI) and carrying a considerable risk of limb loss and death [4,5]. Revascularisation may be technically difficult because to the anatomical intricacy of infrainguinal illness, which includes long-segment occlusions, arterial calcification, multilevel involvement, and poor distal drainage. Objective evaluation utilising clinical examination, ankle-brachial pressure index, and suitable vascular imaging is critical for characterising disease severity and planning revascularizatio [3].

Revascularization remains the cornerstone of therapy for patients with advanced limb ischemia when technically feasible. Although endovascular techniques have expanded considerably and are increasingly used for many patients with PAD, open surgical bypass continues to have an important role in selected patients with extensive or complex disease, particularly when a suitable autogenous venous conduit is available [5,6]. The BASIL trial demonstrated that both bypass surgery and balloon angioplasty could provide useful treatment strategies in severe limb ischemia, while longer-term outcomes suggested potential advantages of bypass in appropriately selected patients who survived beyond the initial treatment period [6,7].

More recently, the BEST-CLI study further showed the relevance of patient selection and conduit availability, with surgical bypass demonstrating excellent results among patients with a sufficient great saphenous vein [8]. Risk-factor reduction

remains necessary since people with PAD have a significant systemic cardiovascular risk. Smoking is particularly relevant because of its strong link with illness development and progression, whereas diabetes mellitus is associated with widespread vascular disease, tissue loss, delayed wound healing, and higher risk of amputation [2,3]. Early detection, smoking cessation, optimum diabetic control, antiplatelet medication, statin treatment, and proper cardiovascular risk reduction are therefore key components of comprehensive PAD care.[9]

Despite advances in endovascular therapy, there remains a need to characterize the clinical and epidemiological profile of patients undergoing open infrainguinal bypass in tertiary-care vascular centers, particularly in South Asian populations where patients may present with advanced disease at younger ages. The present study assesses the demographic features, clinical risk factors, etiological patterns, surgical techniques, and mid-term results of patients receiving open infrainguinal bypass surgery at a high-volume tertiary vascular center.[10]

## MATERIALS AND METHODS

### Study Design and Study Setting

This was a descriptive, prospective observational study conducted at the Institute of Vascular Surgery between August 2013 and August 2015. The study included consecutive adult patients presenting with symptomatic infrainguinal arterial occlusive disease who underwent open surgical bypass during the study period.

Institutional Ethics Committee approval was obtained before initiation of the study. Written informed consent was obtained from all eligible participants before enrollment and surgical treatment.

### Patient Selection

#### Inclusion Criteria

Patients were eligible for inclusion if they fulfilled all of the following criteria:

- Adult patients presenting with symptomatic infrainguinal arterial occlusive disease.
- Patients with a clinical indication for open surgical revascularization.
- Patients who underwent open infrainguinal arterial bypass during the study period.
- Patients who provided written informed consent for participation.

All consecutive eligible patients were considered for inclusion to minimize selection bias.

#### Exclusion Criteria

Patients were excluded if they had any of the following:

- Significant inflow (aortoiliac) occlusive disease requiring correction of proximal inflow.
- Incidental aneurysmal disease.
- Previous ipsilateral arterial intervention, either open surgical or endovascular.
- Acute limb ischemia.
- Premature departure from treatment before completion of the planned management, including discharge against medical advice or absconding.

These criteria were applied to maintain a relatively homogeneous cohort of patients undergoing primary open revascularization for chronic infrainguinal arterial occlusive disease.

### Preoperative Clinical Assessment

All patients underwent a detailed preoperative clinical evaluation. Clinical staging of limb ischemia was conducted based on presenting symptoms and physical examination. Peripheral arterial pulse examination and pulse mapping were conducted to assess the amount of arterial insufficiency.

The clinical examination includes documenting of symptoms such as intermittent claudication, ischemic rest discomfort, ulceration, and gangrene. The existence of tissue loss and severity of limb ischemia were also examined. Resting ankle-brachial pressure index (ABPI) was

evaluated using a hand-held Doppler ultrasonography equipment as part of the physiological assessment of lower-extremity arterial perfusion.

**Laboratory and Perioperative Risk Assessment**

Baseline investigations were performed to evaluate the general medical condition of the patients and identify factors that could influence perioperative risk and surgical outcomes.

The preoperative investigations included:

- Complete blood count.
- Renal function tests.
- Liver function tests.
- Glycemic indices.
- Electrocardiography.
- Echocardiography.
- Pulmonary function testing.

Additional investigations were performed when clinically indicated.

Multidisciplinary evaluation was carried out where necessary since patients with peripheral artery disease often have related cardiovascular and systemic comorbidities. Consultations with cardiologists, pulmonologists, and diabetologists were acquired according to specific patient requirements to optimize patients before surgical surgery.

**Anatomical Vascular Assessment**

Detailed preoperative anatomical mapping of the arterial circulation was performed using either 64-slice computed tomography angiography (CTA) or magnetic resonance angiography (MRA).

Imaging reached the pedal arch via the lower-extremity artery circulation and the abdominal aorta. Anatomical imaging was used to plan the best bypass operation, identify a suitable distal target artery, measure proximal input, quantify distal runoff, and ascertain the degree and extent of arterial occlusion. The clinical examination, pulse mapping, and ABPI readings were all taken into consideration when interpreting the imaging results.

**Prevention of Contrast-Associated Renal Injury**

For patients undergoing contrast-enhanced CTA, measures were undertaken to minimize the risk of contrast-associated renal injury. Standard hydration protocols were followed.

Oral N-acetylcysteine at a dose of 600 mg twice daily was administered beginning 24 hours before contrast exposure and continued for 48 hours after CTA. Renal function was assessed as part of the preoperative evaluation, and patients were monitored according to their individual risk profile.

**Preoperative Medical Management**

Medical management was standardized across the study cohort as part of perioperative vascular care.

Patients received single-antiplatelet therapy with aspirin 75 mg once daily and statin therapy with atorvastatin 40 mg once daily. Antihypertensive therapy was continued or initiated as clinically indicated.

Patients presenting with tissue loss or severe ischemic rest pain received intravenous unfractionated heparin according to the institutional treatment protocol.

Patients with diabetes mellitus who were receiving oral antidiabetic medications were transitioned to subcutaneous insulin during the perioperative period to facilitate optimal glycemic control.

**Surgical Technique**

Open infrainguinal bypass procedures were performed using standard vascular surgical techniques. The procedures included:

- Femoropopliteal bypass.
- Femorotibial bypass.
- Popliteal-tibial bypass.

The choice of bypass level was determined by the anatomical distribution of arterial occlusive disease, the quality of the proximal inflow, the availability of a suitable distal target vessel, and the extent of distal arterial runoff.

The proximal inflow and distal target vessels were exposed, the chosen conduit was prepared and harvested, an anatomical tunnel was created, systemic anticoagulation was administered, the

bypass graft was placed, and proximal and distal vascular anastomoses were constructed.

When necessary, conduit harvesting and vascular exposure were accomplished by medial longitudinal incisions. The chosen venous conduit was collected and processed when the input and outflow veins had been sufficiently exposed. Unfractionated heparin at a dosage of 100 IU/kg was used to achieve systemic heparinization prior to arterial clamping and anastomosis formation. Using continuous tiny polypropylene sutures, the proximal and distal anastomoses were completed end-to-side. Following completion of the anastomoses, graft flow and distal limb perfusion were assessed using clinical examination and hand-held Doppler ultrasound.

**Conduit Selection Strategy**

A predefined hierarchy was used for selection of the bypass conduit, with preference given to autologous venous conduits.

The conduit selection hierarchy was as follows:

**1. Ipsilateral Autologous Vein**

The ipsilateral great saphenous vein (GSV) was preferred whenever suitable. The small saphenous vein (SSV) was also considered when appropriate and available.

**2. Contralateral Lower-Limb Vein**

When a suitable ipsilateral venous conduit was unavailable, a non-diseased vein from the contralateral lower limb was considered.

**3. Upper-Extremity Vein**

If suitable lower-extremity venous conduits were unavailable, upper-extremity veins, including the cephalic or basilic veins, were considered.

**4. Synthetic Conduit**

Synthetic conduits, such as expanded polytetrafluoroethylene (ePTFE), were reserved for patients in whom suitable autologous venous options were unavailable or had been completely exhausted.

Thus, the operative strategy prioritized autologous vein whenever technically feasible.

**Postoperative Monitoring**

Following surgery, patients underwent close postoperative monitoring to assess graft function, limb perfusion, and early postoperative complications.

Up until hospital departure, distal limb perfusion and graft patency were evaluated every four to six hours. Clinical examination, hand-held Doppler ultrasonography, and, where necessary, ABPI measures were all part of the assessment. Distal Doppler signals, limb perfusion abnormalities, recurring ischaemic symptoms, wound state, and other indicators of graft malfunction or immediate postoperative ischaemia were all given special consideration.

**Postoperative Follow-Up**

Following discharge, patients were followed prospectively according to a predefined outpatient schedule.

Patients were reviewed:

- Weekly during the first postoperative month.
- Monthly thereafter until six months after surgery.

At each follow-up visit, patients underwent clinical assessment of graft function and limb perfusion. Hand-held Doppler examination and ABPI measurements were performed when clinically indicated.

The follow-up assessment focused on graft patency, recurrent ischemic symptoms, wound healing, tissue loss, limb viability, and other postoperative complications.

**Outcome Assessment**

The principal outcomes evaluated during the study included the immediate success of surgical revascularization, postoperative graft patency, limb perfusion, postoperative complications, and clinical status during six months of follow-up.

Early postoperative adverse cardiovascular events were documented during the postoperative period. Six-month amputation-free survival was assessed as an important clinical endpoint, reflecting

survival without major amputation during the follow-up period.

**Data Collection and Statistical Analysis**

Demographic, clinical, laboratory, imaging, operative, postoperative, and follow-up data were recorded prospectively for all eligible patients.

Categorical variables were summarized using frequencies and percentages, while continuous variables were summarized using appropriate descriptive statistics. The analysis was primarily descriptive and was performed to characterize the epidemiological profile, clinical presentation, operative management, and outcomes of patients undergoing open infrainguinal bypass surgery.

Where comparative analyses were performed, appropriate statistical tests were selected according to the type and distribution of the data. A p-value of $<0.05$ was considered statistically significant for inferential analyses.

## RESULTS

**Study Population and Patient Selection**

During the two-year study period from August 2013 to August 2015, a total of 7,623 outpatient presentations were recorded at the Institute of Vascular Surgery. Among these, 2,742 patients presented with peripheral arterial pathology. Of the 1,034 patients admitted to the institute, 512 fulfilled the criteria for infrainguinal arterial disease. Following application of the study eligibility criteria, 217 patients underwent open surgical bypass and constituted the final study cohort.

The study population demonstrated a marked male predominance. Of the 217 patients who underwent open infrainguinal bypass, 167 (76.95%) were male and 50 (23.05%) were female, giving a male-to-female ratio of approximately 3.4:1.

A substantial proportion of the cohort belonged to lower socioeconomic groups. According to the Kuppuswamy classification, 77 patients (35.48%) were classified as Class IV (lower-middle socioeconomic status), while 72 patients (33.18%) belonged to Class V (lower socioeconomic status). Thus, 149 patients (68.66%) were from Classes IV and V.

The age distribution demonstrated a considerable burden of relatively early-onset disease. Seventy-one patients (32.58%) were aged 30–45 years, 88 (40.55%) were aged 46–60 years, and 58 (26.87%) were aged >60 years. Therefore, nearly one-third of the operative cohort presented with infrainguinal arterial disease between 30 and 45 years of age

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**Table 1. Baseline Epidemiological Characteristics and Clinical Profile of the Study Population (N=217)**

| Variable/Parameter | Subcategory | Patient Count (n) | Percentage (%) |
|---|---|---|---|
| **Age group (years)** | 30–45 | 71 | 32.58 |
| | 46–60 | 88 | 40.55 |
| | >60 | 58 | 26.87 |
| **Sex distribution** | Male | 167 | 76.95 |
| | Female | 50 | 23.05 |
| **Socioeconomic status** | Class IV (Lower-middle) | 77 | 35.48 |
| | Class V (Lower) | 72 | 33.18 |
| **Etiology** | Atherosclerosis obliterans (ASO) | 115 | 52.99 |
| | Thromboangiitis obliterans (TAO) | 42 | 19.35 |
| | Arteritis/Hypercoagulable/Other | 60 | 27.66 |
| **Comorbidities and risk factors** | Tobacco/Cigarette smoking | 184 | 84.79 |

| | | | |
|---|---|---|---|
| | Diabetes mellitus | 72 | 33.18 |
| | Critical ischemia (ABPI <0.4) | 88 | 40.55 |
| | Calcified non-compressible vessels | 66 | 30.41 |

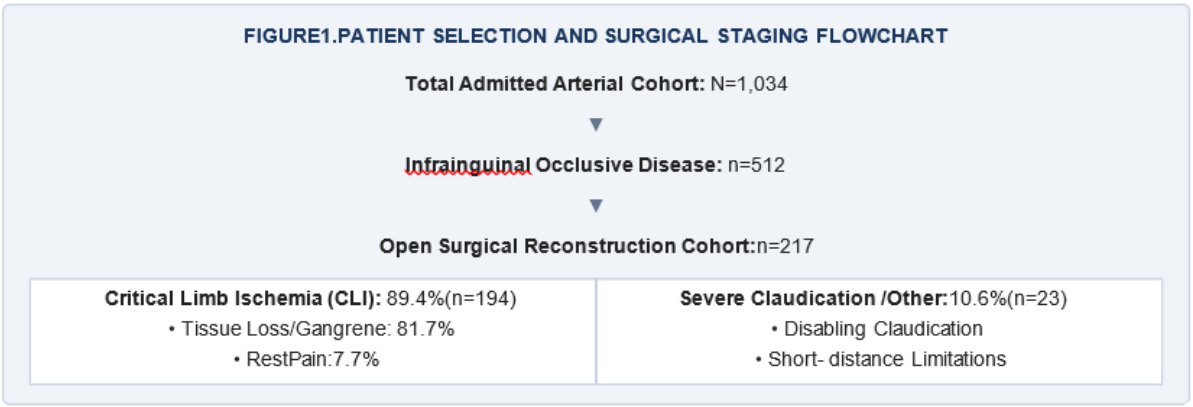
**Etiological Profile and Risk Factors**

With 115 patients (52.99%), atherosclerosis obliterans (ASO) was the most common cause of infrainguinal arterial occlusive disease. Buerger's disease, or thromboangiitis obliterans (TAO), was found in 42 individuals (19.35%). The remaining 60 patients (27.66%) were classified as having various aetiologies, hypercoagulable conditions, or arteritis. The most common risk factor for vascular disease was tobacco use. 184 patients (84.79%) had a history of either current or past cigaret smoking. 72 individuals (33.18%) had diabetes mellitus. 88 patients (40.55%) had critical ischaemia, which was characterised in the dataset as an ABPI <0.4, while 66 patients (30.41%) had calcified non-compressible arteries.

The high prevalence of smoking was particularly notable in view of the substantial proportion of younger patients and the presence of thromboangiitis obliterans in nearly one-fifth of the cohort.

**Clinical Presentation and Severity of Ischemia**

The surgical cohort's most common clinical presentation was advanced ischaemic disease. Critical limb ischaemia was seen in 194 out of 217 individuals (89.40%). Of these patients, 7.70% reported ischaemic rest discomfort, while 81.70% suffered gangrene or tissue loss. With a mean delay of 47.4 days, the median time between the beginning of symptoms and a specialist vascular consultation was 30 days. This suggests a significant lag between the start of symptoms and professional evaluation. 67 individuals had forearm gangrene, whereas 24 patients had significant tarsal bone tissue loss. These results show that a significant percentage of patients had advanced tissue loss and compromised limb viability when they arrived at the tertiary vascular clinic.




**Anatomical Distribution and Distal Target Vessels**

The superficial femoral artery (SFA) was identified as the principal site of infrainguinal arterial occlusive disease. A significant load of multilevel illness was indicated by the concomitant presence of infrapopliteal arterial disease in 48.3% of individuals. With 61 treatments (28.11%), the posterior tibial artery was the most commonly utilised distal target arterial used for surgical bypass. With 32 surgeries (14.74%), the peroneal artery was the second most commonly chosen distal target. The peroneal artery was comparatively spared in diabetic individuals, according to the operational data that was supplied. The amount and severity of infrainguinal pathology as well as the availability of appropriate distal runoff for rebuilding were reflected in the distribution of distal target vessels.

**Operative and Postoperative Outcomes**

Of the 217 patients undergoing open infrainguinal bypass, successful initial revascularization was achieved in 180 patients (83.00%). 37 patients (17.05%) experienced primary graft failure during the first 30 days following surgery. Thirty-two patients (14.75%) needed major re-intervention. 16 (50.00%) of these 32 re-interventions were effective in restoring arterial flow haemodynamically. Twelve individuals (5.53%) experienced 30-day death and/or severe adverse cardiac events (MACE). 37 patients (17.05%) needed an early major amputation, which is defined as an above-ankle amputation that takes place within 30 days following surgery.

Another 16 patients (7.37%) had significant amputations between 30 days and 6 months later. The total amputation-free survival (AFS) rate was 75.57% after six months, with 164 patients still surviving without major amputation

.

**Table 2. Operative Outcomes, Complications, and Six-Month Limb-Salvage Outcomes (N=217)**

| Outcome Parameter | Postoperative Events (n) | Percentage/Rate (%) |
|---|---|---|
| Initial successful revascularization | 180 | 83.00 |
| Primary graft failure (≤30 days) | 37 | 17.05 |
| Major re-interventions | 32 | 14.75 |
| Hemodynamically successful re-interventions | 16 | 50.00* |
| 30-day mortality/MACE | 12 | 5.53 |
| Early major amputation (≤30 days, above ankle) | 37 | 17.05 |
| Late major amputation (30 days–6 months) | 16 | 7.37 |
| Six-month amputation-free survival (AFS) | 164 | 75.57 |

*Percentage calculated among patients requiring major re-intervention (16/32).

Overall, the study showed that severe tissue loss and advanced limb ischaemia were common presentations for patients receiving open infrainguinal bypass. In 83.00% of patients, initial revascularisation was effective despite the high severity of the illness. 17.05% of patients experienced early postoperative graft failure, and 14.75% needed significant re-intervention. 5.53% was the 30-day mortality/MACE rate. After the initial 30-day postoperative phase, 7.37% of patients experienced significant amputation during the six-month follow-up. Approximately three-quarters of the surgical group lived without major amputation during the follow-up period, as indicated by the subsequent six-month amputation-free survival of 75.57%.

**DISCUSSION**

The present study demonstrates that patients undergoing open infrainguinal bypass surgery frequently presented with advanced arterial disease, substantial tobacco exposure, socioeconomic vulnerability, and severe limb ischemia. Despite this high-risk clinical profile, 75.57% of patients had a six-month amputation-free survival (AFS) and 83.0% of patients had initial effective revascularisation. These results provide credence to the ongoing use of open surgical revascularisation in individuals with severe infrainguinal artery occlusive disease who are carefully chosen.

The comparatively early age at presentation was a startling discovery. Table 1 reveals that only 26.87% of patients were older than 60, whereas 71 patients (32.58%) were between the ages of 30 and 45. This is in contrast to the conventional epidemiological trend of PAD in high-income nations, where incidence rises significantly with age [11]. The remarkably high frequency of tobacco exposure, which was reported in 84.79% of patients, may be connected to the comparatively early presentation in the current group (Table 1). In addition to being a known risk factor for PAD, smoking is closely linked to thromboangiitis obliterans (TAO), which made up 19.35% of the study's patients. The large percentage of younger patients can thus be explained by the significant impact of TAO [12,13].

Another significant feature of the research group was socioeconomic vulnerability. Table 1 shows that 68.66% of patients were in Kuppuswamy Classes IV or V. Reduced access to specialised treatment, poor management of modifiable cardiovascular risk factors, and delayed detection of vascular symptoms can all be attributed to lower socioeconomic level. The potential of delayed presentation is further supported by the mean delay of 47.4 days and the median delay of 30 days between the beginning of symptoms and a specialist vascular consultation.

It was especially noteworthy how severe the illness was at presentation. In all, 89.40% of patients had critical limb ischaemia, 81.70% had gangrene or tissue loss, and 7.70% had rest discomfort. Twenty-four patients had significant tissue loss affecting the tarsal bones, and sixty-seven patients developed forefoot gangrene. These results show that the majority of patients did not receive specialised vascular treatment until their condition had progressed to a stage where it posed a hazard to their limbs. According to current standards, persistent limb-threatening ischaemia necessitates prompt vascular examination and revascularisation since it carries a significant risk of amputation and fatality [14].

Table 2 indicates that 180 patients (83.0%) had effective first revascularisation despite this advanced presentation. This result shows that open bypass is technically feasible even for individuals with severe illness. Since the great saphenous vein is still the favoured conduit for many infrainguinal bypass surgeries due to its endurance, the prevalence of autogenous venous conduits is compatible with contemporary vascular practice [14,7].

The intricacy of the illness is further demonstrated by the anatomical findings. 48.3% of patients had infrapopliteal involvement, with the posterior tibial artery being the most common distal target (28.11%). In 14.74% of surgeries, the distal target was the peroneal artery. Finding the right distal target is crucial for limb revascularisation in patients with severe crural disease. Modern data supports customised selection of surgical or endovascular therapy according to limb severity, anatomical complexity, operating risk, and availability of adequate venous conduit [14,15].

The clinical difficulties this demographic faces are further illustrated by the postoperative results. 17.05% of patients experienced primary graft failure within 30 days, and 14.75% needed significant re-intervention (Table 2). 5.53% of patients experienced 30-day death or MACE, highlighting the systemic cardiovascular burden linked to PAD. Because lower-extremity artery disease is a sign of generalised atherosclerosis, patients with PAD have much higher risks of cardiovascular events [11,4].

Significantly, the six-month AFS was 75.57% (Table 2). At six months, around 75% of patients were still living without significant amputation, despite the cohort's extremely high frequency of severe ischaemia and tissue loss. These results are in line with research showing that patients with severe chronic limb-threatening ischaemia can effectively preserve their limbs with

surgical bypass when a suitable autogenous vein is accessible [7,15]. All things considered, the current results highlight the significance of early identification, quitting smoking, modifying cardiovascular risk factors, prompt vascular referral, and choosing the right revascularisation approach. Reducing delays in expert consultation may be especially crucial in resource-constrained situations to improve limb-salvage results and stop the development of advanced tissue loss.

## LIMITATIONS

This study has several limitations that should be considered when interpreting the findings. First, the study was carried out in a single high-volume tertiary vascular center, which would restrict how broadly the findings can be applied to other organisations and people in the community. Second, it is unable to draw firm conclusions about causality or directly compare various revascularisation techniques due to the observational research design. Specifically, the lack of an endovascular treatment group makes it impossible to compare open bypass with modern endovascular techniques in a meaningful way. Third, the ability to find less common problems and clinically significant subgroup differences may have been hampered by the very small sample size of 217 surgically treated individuals. Fourth, the evaluation of long-term primary and secondary graft patency, recurrent ischaemia, late amputation, survival, and functional outcomes was limited by the six-month follow-up period. Finally, quality-of-life measures, walking capacity, and patient-reported functional recovery were not systematically assessed. Larger multicenter prospective studies with longer follow-up and standardized functional outcomes are therefore warranted.

## CONCLUSION

This study demonstrates that open infrainguinal bypass surgery can achieve satisfactory procedural success and meaningful mid-term limb salvage in patients presenting with advanced infrainguinal arterial occlusive disease. 83.0% of patients had successful initial revascularisation despite having a high-risk clinical profile that included a significant percentage of younger patients, significant tobacco exposure, socioeconomic disadvantage, delayed specialist consultation, and a very high prevalence of critical limb ischaemia. The effectiveness of open bypass as a limb-preserving technique in carefully chosen patients with complicated illness is further supported by the six-month amputation-free survival rate of 75.57%. The results also demonstrate the significant cost of avoidable vascular risk factors, especially smoking. Reducing delayed presentation and improving limb-related outcomes in this population requires community-based vascular awareness, early screening of high-risk persons, proactive cardiovascular risk-factor modification, quitting smoking, and prompt referral to specialised vascular services.

## DECLARATIONS AND COMPLIANCE

### Ethical Approval

The study protocol was reviewed and approved by the Institutional Ethics Committee of the Institute of Vascular Surgery (Reference No.: IVS-2013-08). The study was conducted in accordance with the ethical principles governing research involving human participants.

### Consent to Participate

Written informed consent was obtained from all participants prior to inclusion in the study and before undergoing the planned surgical intervention.

### Funding

No external funding was received for this study. The study was conducted using institutional resources.

### Conflict of Interest

The authors declare that they have no competing interests or conflicts of interest related to this study.

### Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request, subject to institutional and ethical restrictions.

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