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ORIGINAL ARTICLE

Surgical Management of Popliteal Artery Aneurysms via Posterior Approach: Our Institutional Experience

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What is already known on this topic?

- *Popliteal artery aneurysms (PAAs) are the most common peripheral arterial aneurysms and may lead to severe complications, including acute limb ischemia.*
- *While both endovascular and open surgical techniques are used in treatment, the posterior approach in open repair allows direct access to the aneurysm.*
- *Posterior approach is associated with good long-term patency;however, concerns regarding nerve injury and technical difficulty persist.*

What this study adds on this topic?

- *This study reviews outcomes of patients who underwent open posterior repair for PAAs at a single tertiary center and demonstrates favorable results in terms of graft patency and limb salvage.*
- *No nerve injuries were observed in the cohort, supporting the safety of the posterior approach when performed in experienced centers.*
- *Secondary interventions were effective in maintaining graft patency, highlighting the importance of close follow-up and timely management of complications.*

Abstract

Objective: This study aims to evaluate the outcomes of patients with popliteal artery aneurysms (PAAs) who underwent open posterior surgical repair, focusing on the efficacy and safety of this approach.

Methods: This retrospective study includes 31 patients with radiologically confirmed PAAs who underwent open posterior surgical repair between 2007 and 2023. Patient demographics, comorbidities, aneurysm characteristics, surgical techniques, and postoperative outcomes were analyzed. Revascularization was performed using either prosthetic grafts or autologous saphenous veins. Follow-up included clinical and radiological evaluation of graft patency and limb salvage.

Results: The majority of the patients were male, and common comorbidities included hyperlipidemia and hypertension. Bilateral aneurysms were observed in 29% of cases, and 25% had coexistent abdominal aortic aneurysms. Surgical revascularization was achieved using either prosthetic grafts or autologous saphenous veins. Early postoperative complications included 1 amputation and a 25% rate of reintervention via embolectomy. However, long-term patency and limb salvage were successfully maintained. The mean follow-up duration for patency was 112.35 months (median: 114.63 months; range: 3.37-200.00 months), while for survival, it was 108.22 months (median: 114.40 months; range: 3.37-200.00 months). Kaplan–Meier analysis showed no statistically significant difference in survival or graft patency between graft types.

Conclusion: The findings indicate that the posterior approach is a secure and efficient surgical method for PAA repair, demonstrating acceptable rates of complications and reinterventions. These results align with existing literature emphasizing the long-term durability of open surgical techniques, particularly when performed in experienced centers.

Keywords: Popliteal artery aneurysm, open vascular surgery, Peripheral arterial aneurysm, Posterior surgical repair

Introduction

Popliteal artery aneurysms (PAAs) are the most common peripheral arterial aneurysms, comprising approximately 70% of all cases.[1] They predominantly affect males and individuals of Caucasian descent.[2]

While PAAs are often asymptomatic and incidentally detected during imaging for unrelated indications, they may also present with clinical symptoms associated with acute or chronic arterial ischemia.[3] Bilateral involvement is observed in nearly 50% of cases.[1,4]

The normal diameter of the popliteal artery ranges between 7 and 11 mm; a localized dilation exceeding 50% of the normal diameter is defined as an aneurysm. Computed tomography angiography is the most frequently used imaging modality for diagnosis, while digital subtraction angiography may be considered in selected cases requiring further evaluation.[5]

Treatment options include open surgical repair and endovascular intervention. In asymptomatic or elective cases, surgical repair is generally recommended for aneurysms exceeding 20 mm in

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diameter. While endovascular repair offers a minimally invasive alternative, the choice of approach is influenced by anatomical factors, particularly in relation to joint mobility and aneurysm morphology. In the institution, the posterior approach is the preferred surgical technique. However, in cases with extensive proximal or distal aneurysmal involvement, a medial approach with bypass and aneurysm sac ligation may also be performed.

This study aims to present the institutional experience with the posterior surgical approach for PAA repair between 2007 and 2023, along with the outcomes observed in the patient cohort.

Methods

Study Design and Ethical Approval

A retrospective analysis was conducted on patients who underwent this surgical intervention at the University Hospital between the years 2007 and 2023.

Prior to the initiation of the study, ethical approval 05,was obtained from İstanbul University-Cerrahpaşa Clinical Research Ethics Committee (Approval No: 2025/67, Date: February 5, 2025,), ensuring compliance with the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all individual participants included in the study.

Inclusion/Exclusion Criteria

Patients who underwent surgical repair of PAAs via the posterior approach at the institution between January 2007 and December 2023 were included in the study. Inclusion criteria comprised individuals aged 18 years or older with a radiologically confirmed diagnosis of PAA who were treated electively using the posterior approach, either with autologous vein grafts or prosthetic conduits. Patients with both unilateral and bilateral aneurysms were eligible.

Exclusion criteria included patients treated with endovascular techniques or those who underwent surgery via the medial approach. Additionally, cases with insufficient operative or follow-up data were excluded from the analysis.

Surgical Procedure

Clinical stage at presentation was classified using the Rutherford system: chronic limb ischemia (stages 0-6) and acute limb ischemia (stages I-III).[6] Under general anesthesia, the patient was positioned prone to optimize exposure of the popliteal artery. A posterior longitudinal incision was made along the popliteal fossa, and careful dissection was performed to isolate the aneurysmal segment while preserving adjacent neurovascular structures (Figure 1A). Proximal and distal vascular control was established, followed by aneurysm resection. Revascularization was achieved using an interposition graft with either an autologous saphenous vein or a polytetrafluoroethylene prosthetic conduit (Figure 1B), selected based on intraoperative findings. Following hemostasis, a drain was placed and the wound was closed in anatomical layers. Postoperative care included close monitoring of limb perfusion and graft patency. The primary outcome was long-term graft patency, while secondary outcomes included limb salvage and overall survival.

Statistical Analysis

All statistical analyses were performed on R version 4.0.3 (R Foundation for Statistical Computing). Continuous variables are presented as mean ± standard deviation, while categorical variables are represented as percentages and numbers ((n)%). The comparison of patient demographics, preoperative, intraoperative, and postoperative continuous quantitative variables was executed through Student's *t*-test. For the analysis of categorical variables, the Chi-square test and Fisher's exact test were employed. Survival

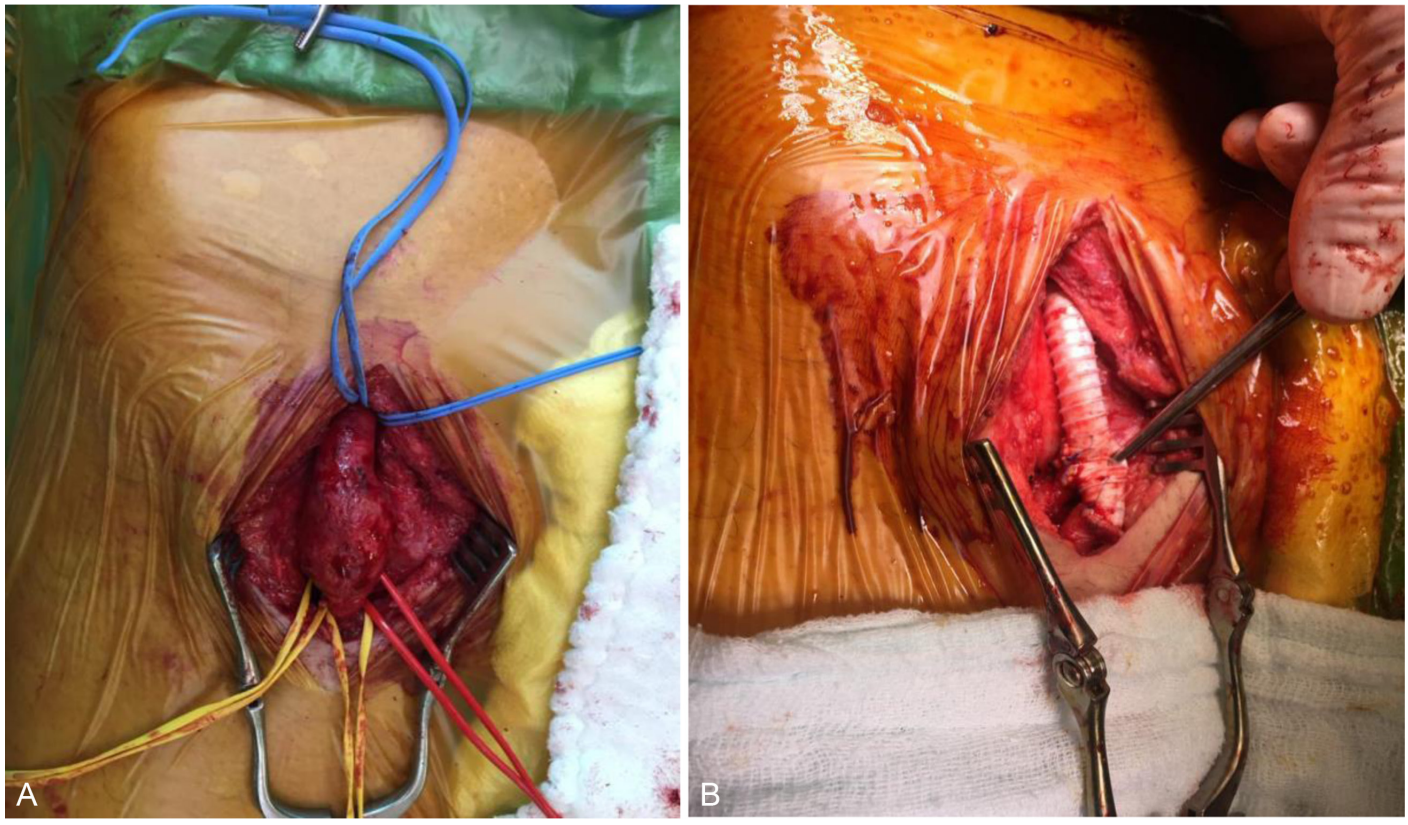


Figure 1. Isolated aneurysmal segment of the popliteal artery (A), revascularization with PTFE graft (B).

analysis was undertaken using the Kaplan–Meier test. Results with *P* values <.05 were regarded as statistically significant, indicating robust findings in the data.

Results

Table 1 provides a comprehensive summary of the demographic characteristics and medical backgrounds of the 31 patients in the cohort. The mean age was 54.4 years. The majority of the cohort was male (80%, n = 25), while females accounted for 19.4% (n = 6). Hyperlipidemia was the most common comorbidity, observed in 58% (n = 18) of patients, followed by hypertension in 48.4% (n = 15). A history of smoking was present in 45% (n = 14) of cases.

Table 1. Patients Characteristics and Preoperative Findings

	n	%	Mean
Age			54.4
Gender (male)	25	80	
Risk factors			
Hyperlipidemia	18	58	
Hypertension	15	48.4	
Smoking history	14	45	
Vasculitis	9	29	
Coronary artery disease	6	19.4	
Diabetes mellitus	2	6.5	
COPD	1	3.2	
Symptoms at presentation			
Asymptomatic (Rutherford 0)	21	67.7	
Chronic ischemia			
Rutherford 1	0	0	
Rutherford 2	2	6.5	
Rutherford 3	1	3.2	
Rutherford 4	2	6.5	
Rutherford 5	1	3.2	
Rutherford 6	0	0	
Acute ischemia			
Rutherford I	1	3.2	
Rutherford IIa	2	6.5	
Rutherford IIb	1	3.2	
Rutherford III	0	0	
Bilateral PAA	9	29	
Abdominal aortic aneurysm	8	25	
Trauma	7	22	

COPD, chronic obstructive pulmonary disease; PAA, popliteal artery aneurysm.

Vasculitis was identified in 29% (n = 9), and coronary artery disease in 19.4% (n = 6). Diabetes mellitus (6.5%, n = 2) and chronic obstructive pulmonary disease (3.2%, n = 1) were less frequent.

Among the patients who underwent a posterior surgical approach for PAA, 29% (n = 9) had bilateral aneurysms. Abdominal aortic aneurysm was present in 25% (n = 8) of cases, while a history of trauma was observed in 22% (n = 7). The majority of patients were asymptomatic, classified as Rutherford 0 (n = 21, 67.7%). Chronic ischemic symptoms were noted in 19.4% (n = 6) of patients, whereas 12% (n = 4) presented with acute ischemic findings preoperatively (Table 1). Among those with chronic limb ischemia, 2 patients were classified as Rutherford 2 (6.5%), 1 patient as Rutherford 3 (3.2%), 2 patients as Rutherford 4 (6.5%), and 1 patient as Rutherford 5 (3.2%). In the acute setting, 1 patient was categorized as Rutherford I (3.2%), 2 patients as Rutherford IIa (6.5%), and 1 patient as Rutherford IIb (3.2%).

Operative details are summarized in Table 2. Surgical intervention involved the use of prosthetic grafts in 54% (n = 17) of cases, while 38% (n = 12) underwent bypass with an inverted saphenous vein graft. Aneurysmorrhaphy was performed in 6.5% (n = 2) of patients (Table 2).

Postoperatively, 61% (n = 19) of patients received dual antiplatelet therapy (acetylsalicylic acid (ASA) + P2Y12 receptor blockers (P2Y12)), while 19.4% (n = 6) were treated with warfarin, and 12% (n = 4) with ASA alone. The choice of antithrombotic regimen was individualized based on the patient's comorbidities, thromboembolic risk profile, and established clinical guidelines. Early complications included a 3.2% (n = 1) amputation rate within 30 days. Additionally, embolectomy was performed in 25% of patients (n = 9) as a secondary intervention to maintain primary patency. No transient or permanent nerve injuries were observed in any patient during the postoperative follow-up (Table 3).

Kaplan–Meier analysis, conducted over a mean follow-up duration of 112.35 months (median: 114.63 months; range: 3.37-200.00 months), demonstrated no significant difference in primary patency rates among the graft types (*P* = .281). While prosthetic grafts showed a trend toward better early patency, long-term outcomes were comparable across groups (Figure 2).

Similarly, cumulative survival did not differ significantly between the graft types (*P* = .443). This analysis was performed with a mean follow-up duration of 108.22 months (median: 114.40 months; range: 3.37-200.00 months). Although the saphenous vein graft group appeared to have a tendency for improved long-term survival compared to prosthetic grafts and aneurysmorrhaphy, this difference was not statistically significant (Figure 3).

Discussion

Popliteal artery aneurysms are often asymptomatic and frequently detected incidentally. However, a subset of patients may present with symptoms related to acute or chronic limb ischemia.

Table 2. Surgical Procedure Details

	n	%
Graft type		
Inverted saphenous	12	38
Prosthetic PTFE graft	17	54
Aneurysmorraphy	2	6.5

PTFE, polytetrafluoroethylene.

Table 3. Postoperative Management and Outcomes

	n	%
Anticoagulation		
ASA	4	12
ASA+P2Y12	19	61
Warfarin	6	19.4
Amputation (30 days)	1	3.2
Primary patency intervention	9	25
Nerve injury	0	0

ASA, acetylsalicylic acid.

Such ischemic presentations are often secondary to aneurysm thrombosis or distal embolization of intra-aneurysmal thrombus. In this series, 19.4% (n = 6) of patients presented with chronic ischemia, while 12.9% (n = 4) were admitted with acute ischemic findings. These findings are consistent with the literature.[4,7] Although the ischemic presentation rates were lower than those reported in these series, the overall distribution aligns with the established understanding that many PAAs are incidental diagnoses, while others manifest with ischemic symptoms. In this cohort, bilateral PAAs were identified in 29% of cases (n = 9), and coexisting abdominal aortic aneurysms (AAAs) were observed in 25% (n = 8). Compared to existing literature, the bilateral aneurysm rate is lower. Huang et al[4] reported bilateral involvement in 58% of cases, while another large series noted a 49.7% bilateral rate and AAA coexistence in 47.3% of patients.[8] Additionally, in a study focusing specifically on arteriosclerotic arterial aneurysms, 48% of popliteal aneurysms were found to be bilateral.[1]These differences may reflect variations in patient populations, diagnostic practices, or the underlying etiology of the aneurysms. Nevertheless, the presence of bilateral or concomitant aneurysms emphasizes the systemic nature of aneurysmal disease and underscores the need for comprehensive vascular evaluation in PAA patients.

Although elective repair of PAAs can be achieved through both open surgical and endovascular techniques, growing evidence suggests that open surgery—particularly via the posterior approach—may offer distinct advantages in selected patients. In the center, which has extensive experience in vascular surgery,the posterior approach is consistently preferred for true PAAs, as it provides direct aneurysm access, enabling precise dissection and anastomosis to healthy arterial segments. In the PARADE study, which included patients with PAAs measuring ≥60 mm, the 5-year primary patency rate was significantly higher in the posterior open surgery group compared to the endovascular group (79.8% vs. 63.8%). Furthermore, no need for reintervention was superior in the surgical group (82.2% vs. 68.4%), supporting the notion that the posterior approach may offer enhanced long-term vascular durability.[9]

Similarly, a meta-analysis of 7 studies confirmed the posterior approach's advantages, showing higher long-term primary/secondary patency and lower reoperation rates.[10]

In this study, which only involved patients operated via posterior approach, the amputation rate was low (3.2%), and secondary interventions were required in 25% of cases to maintain primary patency. Although this reintervention rate appears relatively high, it is important to note that movement around the knee joint inherently increases the risk of graft kinking, which can result in thrombosis in up to 25% of cases. Beyond overall rates, the timing and context of complications in the cohort suggest that patient- and limb-specific factors were the main drivers rather than the posterior approach itself. The single early amputation occurred in a patient presenting with advanced ischemia (Rutherford 5), highlighting the critical impact of preoperative limb status on salvage outcomes. Among patients requiring embolectomy, several had significant comorbidities and unfavorable anatomic features. For example, a 74-year-old male with hypertension, hyperlipidemia,

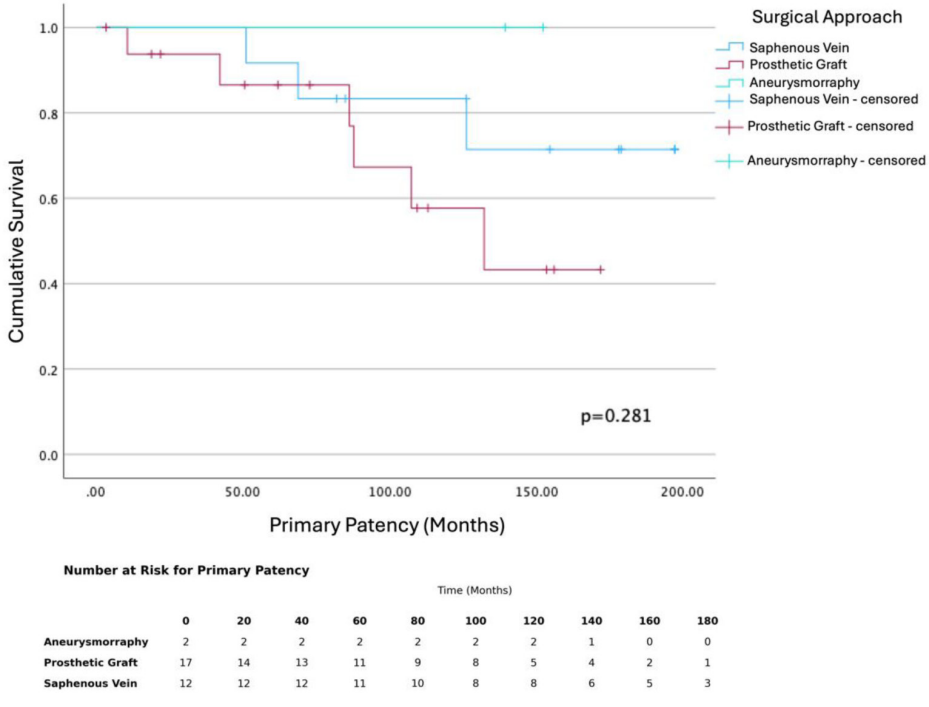
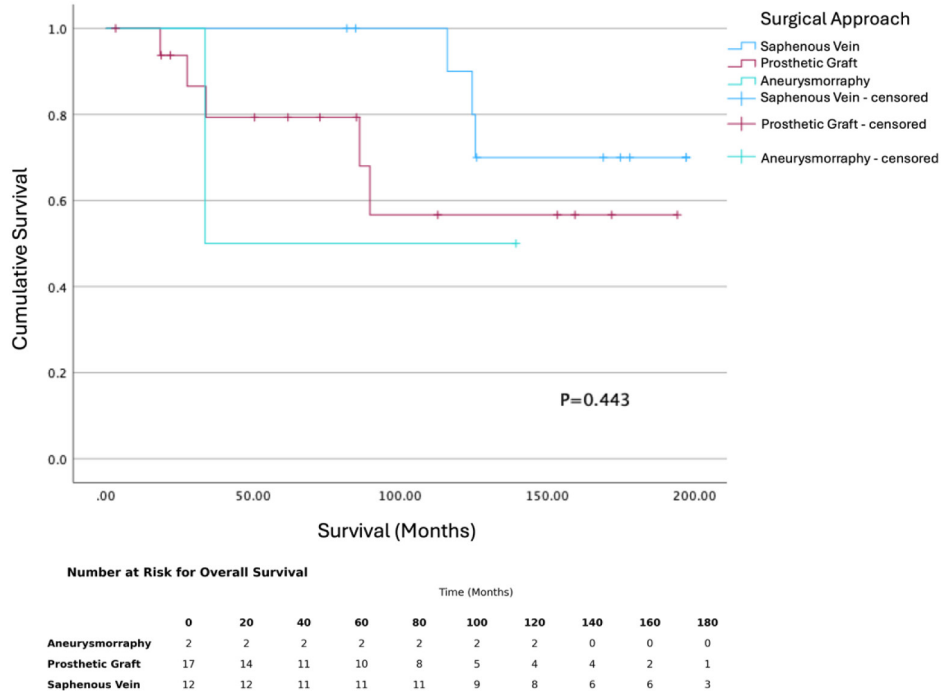


Figure 2. Kaplan–Meier analysis of primary patency according to surgical technique.



Number at Risk for Overall Survival

Time (Months)

	0	20	40	60	80	100	120	140	160	180
Aneurysmorraphy	2	2	2	2	2	2	2	0	0	0
Prosthetic Graft	17	14	11	10	8	5	4	4	2	1
Saphenous Vein	12	12	11	11	11	9	8	6	6	3

Figure 3. Kaplan–Meier analysis of survival according to surgical technique.

and coronary artery disease developed early graft thrombosis and required embolectomy. Another patient with diffuse atherosclerosis, a history of coronary artery bypass surgery, and coexisting aneurysmal disease—including dissection—underwent multiple embolectomies. In yet another case, a patient with posterior tibial artery occlusion, concomitant thoracoabdominal aneurysm, and hyperlipidemia required reintervention to restore primary patency. Nevertheless, secondary patency was successfully achieved in all of these patients following timely reintervention, highlighting the effectiveness of close follow-up and early management of postoperative complications. This supports the feasibility of the posterior approach in achieving durable vascular continuity.

However, the posterior approach may be technically demanding for large or complex aneurysms requiring extensive dissection. In such scenarios, the medial approach may be preferred due to easier graft harvesting and popliteal access, especially when autologous vein grafts are employed. Nevertheless, neurological complications are rare with either approach.[7,10] This series observed no nerve injuries, supporting the safety of the posterior approach in experienced centers. Baccellieri et al[11] reported only a single case of permanent peroneal nerve injury following posterior surgery. Moreover, the study by Ge et al[12] highlighted the posterior approach's potential to reduce the incidence of type II endoleak and aneurysm sac enlargement, 2 complications commonly associated with endovascular repair, and underscored the superior long-term patency of autologous vein grafts compared to prosthetic ones.

This study provides valuable insight into outcomes of the posterior surgical approach for PAA repair, based on a relatively homogeneous cohort treated at a single center. The consistent use of 1 surgical technique and comprehensive follow-up strengthen the internal validity of the findings. The results indicate that in anatomically suitable patients, the posterior approach represents a reliable and effective surgical option that offers durable patency and reduces the likelihood of reinterventions. Although neurological complication risks remain low, they underscore the importance of meticulous preoperative assessment. Nevertheless, several limitations must be acknowledged. The retrospective design inherently carries risks of selection and information bias. Additionally, the relatively small sample size may reduce the statistical power and limit the generalizability of the findings. The absence of a control group treated with endovascular or medial surgical approaches also restricts direct comparison between different modalities. Treatment decisions should be individualized, considering factors such as age, comorbidities, anatomical characteristics, and thrombus burden. Further randomized controlled trials are warranted to clarify the optimal indications for each surgical approach and guide evidence-based clinical decision-making.

The institutional experience suggests that posterior open surgical repair is a feasible and reliable treatment modality for PAAs, particularly when performed in experienced centers. The low rates of amputation and neurological complications, along with acceptable secondary intervention rates, support the durability and safety of this approach. However, individualized treatment planning remains essential, and prospective comparative studies are warranted to better define the optimal surgical strategy for different patient populations.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: Ethics committee approval was received for this study from İstanbul University-Cerrahpaşa Clinical Research Ethics Committee (Approval No: 2025/67, Date: February 5, 2025,)

Informed Consent: Written informed consent was obtained from all participants in this study.

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Interpretation – Ç.T.Ü., O.O.B.; – Literature Search – L.Y., E.A.; – Writing Manuscript – Ç.T.Ü., L.Y.; – Critical Review – O.O.B., S.N.Ö., D.G.; – Other – Ç.T.Ü., B.A.

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