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Evaluation of Retrograde Tibiopopliteal Access in Failed Femoral Access for Chronic Femoral Artery Occlusion

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ORIGINAL ARTICLE

Evaluation of Retrograde Tibiopopliteal Access in Failed Femoral Access for Chronic Femoral Artery Occlusion

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Abstract

Background: **The retrograde contralateral ('crossover'), antegrade ipsilateral, or retrograde tibiopopliteal ('facedown') methods may be used to treat superficial femoral artery (SFA) occlusions. The retrograde strategy originally had several drawbacks but served as a fallback.**

Objective: **To evaluate the results (efficacy, patency, limb salvage rate, improvement of clinical outcome and complications) of revascularization in total femoral arterial occlusive disease using retrograde distal (tibiopopliteal) access in failed femoral access.**

Patients and methods: **This prospective cohort research was conducted in Al-Azhar University Hospitals (Al-Hussain and Bab-Alsheryah) between January 2019 and October 2022 on 31 patients with a superficial femoral artery Lesions cannot be treated from femoral approach.**

Results: **The most frequent clinical finding was severe claudication (61.29%). All patients received local anasethia. Most patients were treated by balloon angioplasty (71%) and (29%) need SFA stenting. High rate of Technical Success was observed (92.86%) with popliteal access and (100%) with tibial access. Ankle-brachial index (ABI) showed marked improvement after procedure from 0.35 to 0.87. Low rates of peri-procedural complications occurred in (16.1%) of patients which are mainly hematomas at puncture sites in (12.9%) of patients. Significant improvement in ankle-brachial index in follow-up visits as 0.78 at 3-months visit and 0.75 at 12-months visit with major amputation in only (9.7%) at 3-months visit and (19.35%) at 12-months visit.**

Conclusion: **When femoral access is restricted, the retrograde popliteal artery approach with duplex guiding might be thought of as a safe, effective, and practical access for SFA occlusions.**

Keywords: Popliteal approach, SFA lesions, Tibial approach

1. Introduction

After myocardial infarction and stroke, peripheral arterial disease (PAD) is the third most common source of cardiovascular morbidity.[1]

The elevated calcium concentration of the plaque and arterial wall, the length of the lesions, and the particular dynamic stresses present inside the superficial femoral artery (SFA) and popliteal artery (PA) may impair treatment efforts.[2]

The majority of these occlusions are Trans-Atlantic Inter-Society Consensus (TASC) II C and D lesions, for which surgery is still advised as the best course of therapy.[3]

Even complete occlusions of the SFA, including the proximal portion of the PA, may now be treated endovascularly in greater than 90% of patients.[4]

The SFA occlusions are typically treated with an intraluminal or subintimal recanalization of the artery lumen using an antegrade ipsilateral or

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retrograde contralateral femoral method. Retrograde popliteal access (RPA) is seen as a viable fallback in the event of failure.[5]

The retrograde popliteal technique was originally constrained and was used as a fallback.[5]

However, improvements to this method have made it an alluring choice.[6]

The RPA procedure was chosen as a first option in patients with typical femoral artery stenosis or obstruction, proximal SFA lesions without a stump, extreme obesity, tandem iliac, and SFA lesions rather than its use after antegrade recanalization failed.[7]

The popularity of this procedure, which Tonnesen and colleagues[8] initially reported years ago, has decreased because of potential complications include dissections, artery ruptures, arteriovenous fistulas, pseudo-aneurysms, and hematomas that may form at the puncture site.

Since Trigaux and colleagues described the connection between the popliteal vein and the PA as well as the safest method to puncture the PA, a number of guidance methods for PA puncture have been reported. These include ultrasound (US) guidelines and digital subtraction angiography, which both produce a road map to direct the needle as it is progressed in the PA.[9]

For distal retrograde access, the PA, distal anterior tibial artery (AT), distal posterior tibial artery (PT), or dorsalis pedis artery (DP) are often employed. Numerous research has indicated the PA as the retrograde approach, according to Noory and colleagues,[10] but there have been fewer reports on the use of the tibial/pedal vessel at the ankle or foot.[11]

2. Patients and methods

This prospective interventional study was carried out in the vascular surgery department at Al-Azhar university hospitals. A total of 31 individuals with chronic SFA occlusion were included in the study.

The inclusion criteria were SFA and/or above-knee popliteal occlusion greater than 3 cm with vessel diameter of 4–10 mm, symptomatic patients with intermittent claudication on one side, critical limb ischemia (CLI; Rutherford stages 2–6), persisting for greater than 6 months after adequate medical treatment with walking activity, wire cannot pass femoral access (Ipsilateral and Contralateral Femoral access), patient adherence with therapy, and informed consent.

The exclusion criteria were: individuals who need revascularization immediately (acute ischemia), patients whose distal popliteal lesions are unreachable through the popliteal technique, and patients through whom a femoral access wire may pass (Ipsilateral and Contralateral Femoral access).

2.1. Methods

All patients had thorough clinical examinations and pertinent research. An angiography of the femoro-popliteal section was conducted after ankle-brachial index (ABI) measures and Doppler ultrasound (DUS) examinations in order to describe the architecture of the arteries and specify the lesion features. Treatment and monitoring in accordance with the established standard operating procedures in our vascular department. Before having the operation, all patients provided signed informed consent.

2.2. Treatment procedure

Initially, revascularization of the SFA occlusion were planned to be performed via ipsilateral and contralateral common femoral artery. Attempts at crossing the complete total occlusions (CTOs) in the SFAs were unsuccessful. So, the retrograde approach via ipsilateral popliteal access or ipsilateral tibial access (In case of PA lesion or if PA is superimposed by popliteal vein). With the patient is under local anesthetic, all operations were carried out in the sterile angio-suite, the region close to the knee joint that a color DUS system analyzed.

The muscles surrounding the popliteal fossa were recognized in this examination, and the PA and popliteal vein were separated based on their US appearance and a straightforward compression procedure. The best puncture site was then noted on the skin so that the PA could be seen there without the vein superimposing. This location was not penetrated since it is medial and proximal to the knee joint and caudal to the semimembranosus muscle.

A local anesthetic was administered around the PA under US, and the US probe was positioned in a transverse position and oriented about 30 cranially. Under US supervision, an 18-gauge needle was used to prick the PA. After performing a diagnostic angiography and inserting a 6 F introducer sheath (or a 4-F micropuncture sheath in the case of the tibial artery), intravenous heparin (100 ml/kg) was given. Through the right 5–6 F guiding catheter, a 0.035 Road Runner guidewire was utilized to bridge the chronic complete occlusion.

The first passage of the occlusion has been completed, and a 0.018-in wire will be used in its place. After the first passage, a control angiography was conducted, followed, if required, by subsequent passes until the occluded portion recanalized. after balloon angioplasty to recanalize the SFA and proximal PA.

Before placing a stent, all lesions were regularly dilated utilizing a balloon that was 0.5–1.0 mm bigger than the standard vessel diameter to allow for sufficient stent expansion. The lesion and at least 5 mm of lesion-free proximal and distal vasculature were covered by the stenting length that was chosen. Stents were to be overlapped by at least 10 mm when more than one was required. If the operator saw that certain stent segments were under inflated, dilation with a noncompliant balloon was done following stent implantation.

To see the flow inside the SFA and PA and rule out the existence of thromboembolic material distally, a control angiography was performed. A semi-compressive bandage system was used to cover the popliteal access and was left in place at the access site for 12 h. Popliteal access was controlled with vigorous manual compression (minimum 15 min). The antithrombotic regimen was delivered in accordance with customary institutional procedures, which included periprocedural weight-based heparin anticoagulation to keep the activated clotting time above 250 s. After the operation, aspirin alone was administered indefinitely, followed by dual antiplatelet treatment with aspirin and clopidogrel for at least 30 days, unless contraindication occurred.

2.3. Definitions, follow-up, and study end points

Before patients were discharged from the hospital, each patient had an evaluation, and ambulatory follow-up appointments were planned for them at 1, 3, 6, and 12 months after the treatment.

Physical exams, Rutherford-Becker class classification, ABI measures, and DUS tests for the identification of restenosis were carried out during these visits. Our study's main effectiveness endpoint was stent patency, which was determined as the lack of binary restenosis (>50% reduction in artery diameter) on DUS inspection, as shown by a peak systolic velocity ratio greater than 2.4.

A technically successful puncture is one in which a sheath is retrogradely inserted into the PA without passing through the vein or popliteal muscles or resulting in local dissection or rupture. Puncture-related complications are complications with their onset and clinical effects can be directly linked to the puncture, whereas angioplasty-related complications may be immediately linked to the angioplasty treatment. Angioplasty efficiency, and clinical, hemodynamic, and anatomical patencies were all defined in accordance with the Society for Vascular Surgery/International Society for Cardiovascular Surgery criteria Figs. 1–6.

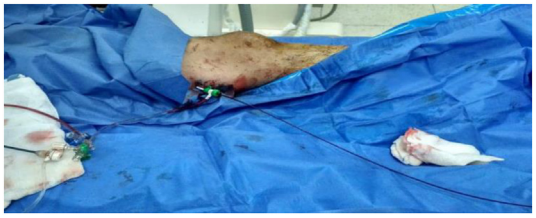

Fig. 1. Popliteal artery sheath.

Fig. 2. Femoral and Popliteal sheathes.

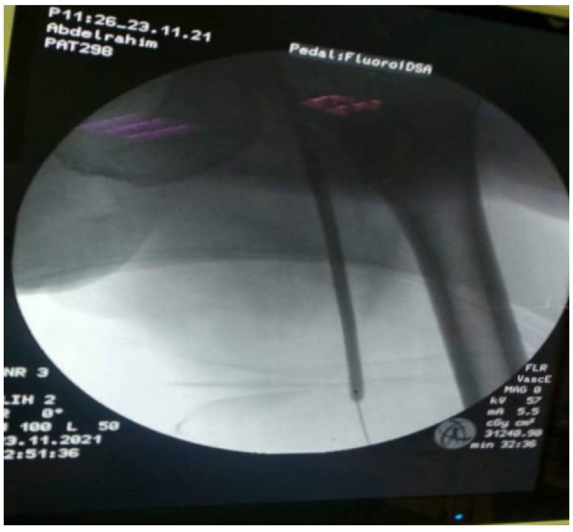

Fig. 3. Balloon angioplasty of SFA through Popliteal access.

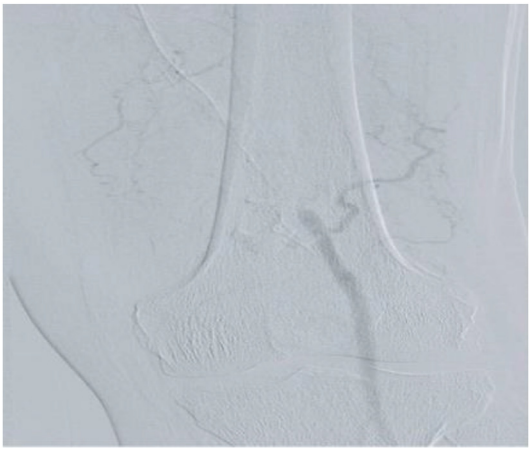

Fig. 4. SFA Lesion as seen from retrograde injection of the dye.

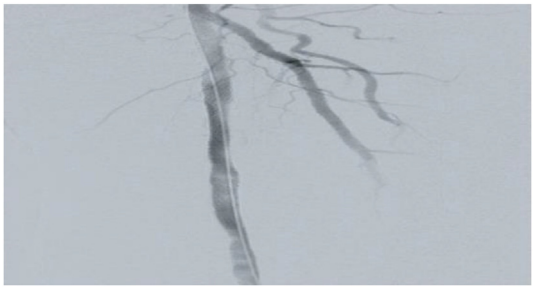

Fig. 5. Post recanalization.

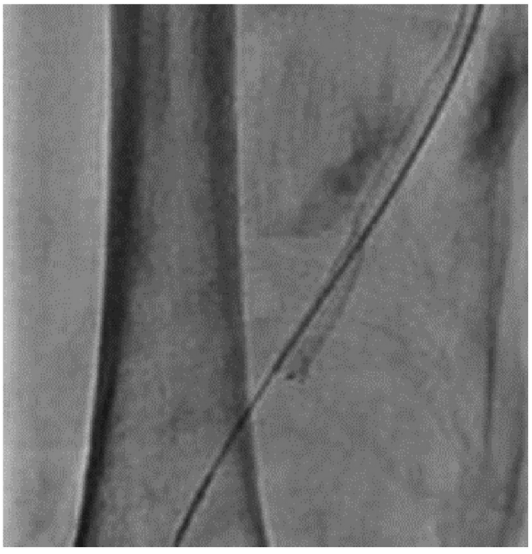

Fig. 6. Stenting of SFA.

3. Results

3.1. Demographic data

Regarding age distribution the mean is about 62.61 y with SD 7.

Regarding gender distribution males are about double of females in our study Fig. 7.

3.2. Associated comorbidities

D.M and dyslipidemia have strong relation to PAD Table 1.

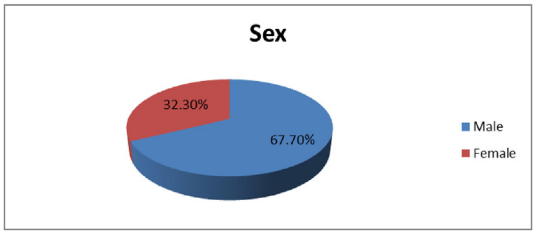

Fig. 7. Sex distribution among the study group.

Table 1. Associated comorbidities.

	No. (%)
Smoking	
No	12 (38.7%)
Yes	19 (61.3%)
D.M.	
No	8 (25.8%)
Yes	23 (74.2%)
HTN	
No	9 (29.0%)
Yes	22 (71.0%)
IHD	
No	14 (45.2%)
Yes	17 (54.8%)
Dyslipidemia	
No	8 (25.8%)
Yes	23 (74.2%)
Previous Angio	
No	25 (80.6%)
Yes	6 (19.4%)

3.3. Vascular examination

3.3.1. Clinical findings

Gangrene was the most frequent lesion of patients in the group Table 2.

3.3.2. Rutherford classification of arterial lesion

We have divided patients into three main categories Table 3.

3.4. Procedure

3.4.1. Anesthesia

Local anesthesia with or without IV sedation was the most frequent method in all interventions.

3.4.2. Intervention

Balloon dilatation with or without stenting is the proper way to treat SFA lesions Table 4.

Table 2. Clinical findings.

Lesion	No. (%)
Severe Claudication	19 (61.29%)
Rest pain	9 (29.03%)
Minor tissue loss	3 (9.86%)

Table 3. Rutherford classification of arterial lesions.

Rutherford Classification	No. (%)
3	19 (61.29%)
4	9 (29.03%)
5	3 (9.86%)

Table 4. Angioplastic intervention.

Intervention	Balloon	22 (71.0%)
	Balloon and stent	9 (29.0%)

3.4.3. Technical success

Immediate morphological efficacy with less than 30% residual diameter reduction as determined by quantitative intraprocedural angiography was considered immediate morphological success in addition to efficient vascular access and endovascular treatment completion (see Table 5).

3.4.4. Stent patency

A peak systolic velocity ratio of 2.4 indicates stent patency, which is described as the lack of binary restenosis (50% reduction in vessel diameter) on DUS evaluation Table 6.

3.4.5. Clinical examination

Significant improvement of ABI after procedure from 0.35 to 0.87.

3.4.6. Peri-procedural complications

Peri-procedural complications rate reached 16.1% which are mainly hematomas at puncture sites.

3.4.7. 30 days mortality

30 days mortality rate reached 3.2%. Only 1 patient died due to heart failure.

3.4.8. Amputation rate on 3 months

Amputation rate reached 9.7% on the first 3 months after procedure. 2 patients suffered big toe amputation and 1 patient suffered transmetatarsal amputation with no major amputation Table 7.

Table 5. Technical success.

	Popliteal access ($n = 28$) N (%)	Tibial access ($n = 3$) N (%)	Total ($n = 31$) N (%)
Technical success	26 (92.86%)	3 (100%)	29 (93.55)

Table 6. Patency rate.

	No. (%)
Patency	
Occluded	1 (11.11%)
Patent	8 (88.89%)

Table 7. Amputation rate on 3 months.

Amputation	No. (%)
No amputation	28 (90.3%)
Minor Amputation	3 (9.7%)
Total	**31 (100.0%)**

3.5. Follow up

Follow-up was carried out immediately in the vascular surgery department at 1, 3, 6, and 12 months regarding the following points.

3.5.1. Hemodynamic state (ABPI)

All interventions lead to a significant improvement of ABI postoperatively Table 8.

3.5.2. Limb salvage rate (Nonneed for major amputation)

Amputation rate reached 9.7, 12.9, and 19.35% 3, 6, and 12 months postoperatively prospectively Table 9.

3.6. Assessment of patency

Patency rate reached 90.3% after 1 month with no change after 3 months but 80.65% after 6 months and 61.29% after 12 months Table 10.

4. Discussion

In this study, a 31 patients with femoral occlusions had effective revascularization utilizing the retrograde *trans*-popliteal or *trans*-tibial technique.

Table 8. ABI follow up.

ABPI follow-up	Mean	SD
Pre	0.35	0.06
Post	0.87	0.08
1 month	0.82	0.11
3 months	0.78	0.15
6 months	0.73	0.19
12 months	0.75	0.18
Paired *t*-test	**80.192**	
P-value	**<0.001 (HS)**	

Table 9. Limb salvage rate.

Major amputation	No. (%)
1 month	**3 (9.7)**
3 months	3 (9.7%)
6 months	4 (12.9%)
12 months	6 (19.35)
Chi-square test	**1.252**
P-value	**0.535 (NS)**

Table 10. Patency rate.

Patency rate	No. (%)
1 month	**29 (93.55%)**
3 months	29 (93.55%)
6 months	25 (80.65%)
12 months	19 (61.29%)
Chi-square test	**7.750**
P-value	**0.021 (S)**

This study's objective is to assess the results (efficacy, patency, limb salvage rate, improvement of clinical outcome and complications) of revascularization in total femoral arterial occlusive disease using retrograde distal (tibiopopliteal) access in failed femoral access.

Using a *trans*-popliteal method in 28.90% of cases and a *trans*-tibial approach in 3.9% of cases, percutaneous transluminal angioplasty was used to treat a total of 31 patients (21 males, mean age 62.6 ± 7 years) between February 2019 and August 2022 who had complete SFA blockage with excellent distal runoff. Balloon angioplasty was done for (22, 70.97%) of the patients and stenting for (9, 29.03%) of the patients.

Fanelli and colleagues,[5] with intermittent claudication and chronic SFA blockage (median length 97.4 ± 3.8 mm, range 35–220), 26 patients (16 males; average age 68 ± 6.3 years) received percutaneous recanalization from an RPA.

Clinically, 19 patients had severe claudication,9 patients had rest pain, 3 patients had minor tissue loss. According to Rutherford classifications 19 patients were grade 3, 9 patients were grade 4 and 3 patients were grade 5.

Technical success in our study was achieved in majority (29, 93.55%) of the patients with high patency rate postoperative about (29, 93.55%) of all patients. Great improvement of ABI from 0.35 ± 0.06 to 0.87 ± 0.08 postoperative.

This was in agreement with Kuserli and Kavala,[12] reporting that the ABI values rose from 0.63 ± 0.08 prior to the surgery to 0.90 ± 0.06 after it, showing a statistically substantial difference.

Dumantepe[13] achieved technical success in all his 28 cases. Popliteal access made endoluminal recanalization achievable in the vast majority (26, 92.8%) of the patients; in the remaining 2 instances, SFA recanalization was accomplished via the subintimal area.

It is the same with Fanelli and colleagues,[5] who reported that in every instance, technical achievement (recanalization of the SFA and puncture of the PA) was achieved. Endoluminal recanalization was achievable in the majority of patients (24, 91.6%) through the popliteal route; in the other 2 instances, SFA recanalization was accomplished through the subintimal region.

During follow-up visits at 1-, 3-, 6-, and 12-months rest pain, toe ulcers and wound healing improved significantly. ABI change from 0.35 ± 0.06 to 0.75 ± 0.15 1 year after procedure. Patency rate at 1, 3, 6, and 12 months were 93.55, 93.55, 80.65, and 61.29%, respectively.

This was matched with Kuserli and Kavala,[12] who reported that when Doppler results were analyzed, the successful RPA group's no-stenosis percent at the 1, 6, and 12-month follow-ups were 82.6, 72.1, and 65.1%.

At 6 months, primary patency was 80.7%, and at a year, it was 76.9% for Fanelli and colleagues,[5] which is considered near our results.

According to Dumantepe,[13] Claudication, intensity, rest discomfort, and toe ulcers all saw substantial improvements over the course of an average follow-up of 12.9 ± 2.5 months. At 1 year following intervention, the ABI increased from 0.54 ± 0.11 to 0.91 ± 0.2 ($P < 0.001$), and patency rates were 100, 92.8, and 85.7% at 1, 6, and 12 months after treatments, respectively, which is close to patency rates in our study.

Complications were limited to hematomas and ecchymosis in popliteal fossa in (5, 16.13%) of all patients. No pseudoaneurysm nor AV fistula could be detected at follow up visits.

During the 12-month follow-up, there were 6 restenosis following balloon dilation, 2 in-stent restenosis, and 2 stent occlusions. Reendovascular surgery was used to address these occlusions. We had an 87.09% secondary patency percentage. There were no stent fractures found.

Our complications are very close to Fanelli and colleagues,[5] who reported Two little hematomas were discovered in the popliteal area, but a mean 12.5-month follow-up revealed no arteriovenous fistulas or pseudoaneurysms (range 6–28). 20 SFAs (76.9%) were patent, while the remaining 6 (23%) had in-stent restenosis. There were no stent fractures found.

In Dumantepe[13] study on duplex exams, 1 pseudoaneurysm and 1 arteriovenous fistula were discovered in the popliteal area. In the 12-month follow-up, there were 2 in-stent restenosis and 3 occlusions.

4.1. Conclusion

When femoral access is restricted, the retrograde popliteal artery approach with duplex guiding might be thought of as a safe, effective, and practical access for SFA occlusions.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

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Conflicts of interest

The authors declared that there were NO conflicts of Interest.

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