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Early and midterm results of the retrograde transpopliteal approach as the first-line treatment for total occlusions of iliofemoral arteries

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Abstract. – OBJECTIVE: This study aims to present our early and midterm results regarding the use of the retrograde popliteal artery approach as the first-line treatment for patients with total occlusions of the iliac or femoropopliteal arteries.

PATIENTS AND METHODS: Between July 2017 and July 2019, 84 patients underwent transpopliteal retrograde subintimal recanalization for iliac and femoral artery occlusive disease.

RESULTS: The procedure was technically successful in 92.9% of the patients and had a complication rate of 5.95%. Complications, including stent thrombosis, dissection, and rupture, were treated successfully. No hematomas were observed at the puncture site. The primary patency rates at 6, 12, and 18 months were 86.9%, 82.1%, and 77%, respectively.

CONCLUSIONS: With respectable early and midterm results, the retrograde popliteal artery approach can be considered a primary treatment option for iliac or femoropopliteal arteries' recanalization in selected patients.

Key Words:
Iliofemoral arteries, Retrograde popliteal artery approach, Total occlusions.

Introduction

There has been tremendous growth in endovascular interventions. Various endovascular devices and techniques have evolved, with percutaneous transluminal angioplasty (PTA) becoming the primary option for the treatment of chronic atherosclerotic stenoses and occlusions in the iliac and femoral vessels. This procedure is usually performed using a common femoral artery (CFA) approach. However, in cases of an absent femoral pulse due to iliac or CFA occlusions, a failure of antegrade recanalization, the inability to reenter the true lumen distal to the obstruction, or superficial femoral artery (SFA) occlusion with a small stump (5 mm) and tandem lesions, the retrograde transpopliteal approach, also called the "facedown technique" can be a potentially effective alternative[1-4].

The facedown technique has not been widely used to treat femoropopliteal lesions in the past. Possible complications, such as popliteal artery (PA) occlusion at the puncture site, distal emboli, and arteriovenous fistula due to popliteal vein injury, hematomas, pseudoaneurysm, iliac-femoral dissection, and occlusion of the origin of the deep femoral artery, cause vascular surgeons to hesitate when considering this option[5]. However, case series from the last five years have reported low rates of major complications[6-9]. Surgeons tend to prefer the facedown technique after a failed antegrade approach, yet we always use the retrograde PA approach as the first-line treatment of femoropopliteal occlusive lesions. An antegrade CFA puncture can be associated with significant puncture site complications, including retroperitoneal, scrotal, and groin hematomas, as well as arteriovenous fistulas, which were reported in up to 20% of cases[10].

This study presents our early and midterm experience with the retrograde transpopliteal approach as the first-line treatment for recanalization in patients with total occlusions in iliac or femoropopliteal arteries.

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Patients and Methods

Patient Population

This retrospective study included 84 (63 male and age range between 33-92) patients who underwent PTA via the retrograde transpopliteal approach for iliac and femoral artery occlusive disease between November 2017 and November 2019. The indication for treatment was intermittent claudication or rest pain with or without tissue loss. In all 84 patients, a preprocedural computed tomography angiography (CTA) was performed to achieve a complete anatomical overview of the aorta, iliac, and femoral arteries, diameters of the vessels, length of the occluded segment, morphology and diameter of the PA, distal runoff, and patency of the tibial and peroneal arteries. All patients provided written informed consent. Patients who did not agree to participate in the study, had a history of chronic renal failure or previous vascular surgeries, and/or did not come to the post-interventional follow-up were excluded.

Procedure and Follow-Up

All patients received dual antiplatelet regimens (acetylsalicylic acid 100 mg and clopidogrel 75 mg) five days before the intervention. All procedures were performed during dedicated angiography with continuous monitoring of vital signs by a single surgeon. Each patient was placed in a prone position, after which 0.1 mg/kg iv midazolam was administered for sedation, and 5,000 IU of heparin were given intravenously to achieve activated clotting time values between 250 and 300 seconds. After preparing the popliteal fossa, an ultrasound-guided ipsilateral retrograde PA puncture was performed. An ultrasound examination was used to avoid vascular complications or nerve injury. A 7F introducer sheath was then placed into the PA using the Seldinger technique. The PA and crural arteries were visualized via angiogram, and retrograde subintimal recanalization of SFA occlusions was performed using a 0.035-inch floppy-tip hydrophilic guidewire and microcatheter support. Reentry was confirmed by injection of 15 cc of contrast. If the lesion could not be crossed with a microcatheter, we used an atherectomy device (TemREN®; Invamed, Ankara, Turkey). After successful lesion crossing, the entire subintimal space was dilated with a balloon catheter at 8 atm for 1 minute. Resistant stenoses were redilated with a 1-mm larger balloon. Angioplasty was then performed with a drug-eluting balloon catheter (Extender®; Invamed, Ankara, Turkey) at 8 atm for 3 minutes. We used 4-5-mm diameter balloon catheters for distal SFA, 5-6-mm catheters for proximal SFA and CFA, and 6-7-mm catheters for iliac arteries due to the vessels' diameter. The same procedure was repeated on patients with iliac artery occlusions. A stent was implanted to fully cover the lesion, if needed. The procedure was then terminated with control digital subtraction angiography (DSA) of the iliac, femoropopliteal, and crural arteries. Hand compression was performed for puncture site hemostasis. After the procedure, 1 mg/kg of enoxaparin was applied twice during the next 24 hours. On the day after the index procedure, duplex ultrasonography of the lower limb was performed in all cases, and the puncture site was controlled. A dual antiplatelet regimen continued for six months after the intervention, and clopidogrel was prescribed as a lifetime medication. Patients were followed up during visits to the outpatient clinic at one, three, and six months and thereafter once at six months after the procedure. Duplex ultrasonography was performed as part of the follow-up examination. Clinical follow-up data in the electronic medical records and CTA results were reviewed.

Statistical Analysis

Statistical analyses were performed using the IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation for normally distributed variables. Nominal variables were given as a number and a percentage.

Results

The patients' demographics are summarized in Table I, while the lesion characteristics and procedural results are given in Table II. Concomitant iliac and SFA procedures were performed on 24 patients, and the SFA procedure alone was performed on 60 patients. Occlusions were bilateral in the isolated SFA group, and the concomitant two-leg approach was performed in 28 patients (Table II). The procedure was well tolerated by all patients.

Stent implantation was necessary in 12 (14.3%) patients. Eight iliac occlusions were treated with stents; six of them were self-expandable, and two were balloon-expandable. In two patients,

Table I. Demographic variables of the patients.

Target lesion	Iliac + SFA	Isolated SFA
Total (n)	24 (15 male)	60 (48 male)
Age (years)	69.1 ± 13.5 (40-92)	62.6 ± 11.9 (33-85)
Diabetes mellitus	10 (42%)	29 (48%)
Hypertension	12 (50%)	21 (35%)
Hyperlipidemia	7 (29%)	14 (23%)
Cardiovascular disease	6 (25%)	15 (25%)
Active smoker	13 (54%)	26 (43%)
Chronic obstructive pulmonary disease	7 (29%)	9 (15%)
Obesity (BMI > 30 kg/m^2)	4 (17%)	7 (12%)
Chronic kidney disease	1 (4%)	2 (3%)
Preinterventional ABI	0.58 ± 0.12	0.60 ± 0.07
Cilostazol	16 (67%)	40 (67%)
Clopidogrel	20 (83%)	42 (70%)
Acetylsalicylic acid	24 (100%)	48 (80%)
Rutherford classification		
3	20 (83%)	56 (93%)
4	2 (8%)	2 (3%)
5	2 (8%)	2 (3%)
6	–	–

ABI: Ankle brachial index, BMI: Body mass index, SFA: Superficial femoral artery.

PTA was technically difficult because of heavily calcified SFA. Two SFA occlusions were treated with self-expandable stents. One patient was treated with a 6-mm self-expandable nitinol stent because of SFA dissection, and one patient was treated with a 5-mm covered stent graft due to rupture of the distal SFA. No major hematomas were observed at the puncture site.

Technical success, defined as restored patency with no stenosis greater than 30%, was achieved in 78 (92.9%) of 84 patients. A patient who was a heavy smoker showed acute symptoms of claudication due to 80% stenosis of the iliac stent 20 days after discharge and was treated with balloon angioplasty. After six months, two patients who showed early iliac stent thrombosis with symptoms of acute limb ischemia were successfully treated with thrombectomy. The early and mid-term complication rates were 2.38% and 5.95%, respectively. There was no mortality.

At 6, 12, and 18 months post-treatment, the primary patency rates were 86.9%, 82.1%, and

Table II. Lesion Characteristics and procedural results.

	Iliac + SFA	Isolated SFA
Total (n)	24	60
Occlusion length		
In iliac arteries (mm)	77 ± 9	–
In femoral arteries (mm)	155 ± 23	176 ± 65
Concomitant two leg approach	0	28
Balloon angioplasty	20	87
Stenting		
Self-expandable	6	3
Balloon-expandable	2	0
Covered-balloon-expandable	0	1
Atherectomy	11	28
Complications		
Puncture site bleeding	0	0
Occlusion	3	0
Dissection	0	1
Rupture	0	1

SFA: Superficial femoral artery.

77%, respectively. At the outpatient follow-up, 15 patients showed symptoms of claudication and were controlled with CTA. No patients showed stenosis of more than 50%. Symptomatic patients were treated medically and referred to the tobacco cessation service.

Discussion

Tønnesen et al[4] first described the retrograde PA approach, also known as the facedown technique, in 1988. Although surgeons frequently do not choose retrograde popliteal access as the first-line treatment to prevent potential complications, in this study, due to low complication and high patency rates, we preferred this approach. In our series, no hematomas, pseudoaneurysms, and/or arteriovenous fistula were observed. To prevent these complications, three methods have been reported in the literature[11]. We used ultrasound-guided puncture to avoid these complications. Atherosclerotic plaques or calcification of the PA represent a potential risk factor for certain complications. Conversely, other unexpected complications were repaired successfully. SFA dissection was seen in one patient and treated with a 6-mm self-expandable nitinol stent, and rupture was seen in one patient and treated with a 5-mm self-expandable nitinol stent.

CTA is another important PA evaluation modality. We evaluated all patients' PA via CTA before the procedure to avoid having an unsuitable puncture site, plaque rupture, and distal emboli. Contraindications for the retrograde popliteal approach are distal stenosis or occlusion in the crural arteries and massive calcification and/or PA a diameter of < 3 mm.

In 24 patients in our study group, additional ipsilateral iliac artery stenoses were successfully treated through the retrograde popliteal approach. The coexistence of femoropopliteal occlusions and iliac artery stenoses is not rare, and transpopliteal intervention may allow percutaneous treatment of these lesions during the same session. Yılmaz et al[3] reported six patients who were treated through the retrograde popliteal approach who had ipsilateral and contralateral iliac artery stenoses.

Most major collateral vessels of the lower extremity originate from the deep femoral artery (DFA) in cases of femoropopliteal occlusive disease. If the procedure fails or re-occlusions occur in the future, DFA plays an important role in the recanalization of collateral vessels to protect the leg. Entrance into the subintimal space can generally be easily controlled manually, but reentry into the true lumen is more difficult and cannot be controlled in most cases. Involuntary occlusion of the ipsilateral deep femoral artery at its origin while trying to reenter the true lumen may be dangerous. In our study, all DFA were seen patent after the control angiogram and follow-up CTA.

In the literature, Brountzos et al[11] reported that the primary patency rate of retrograde PA access for iliofemoral lesions at 6, 12, and 18 months was 86.4%, 65.8%, and 65.8%, respectively, in 24 patients. The complication rate and technical success were 12.5% and 91.7%, respectively. Yilmaz et al[3] reported 39 SFA occlusions in 37 patients who were treated with retrograde PA access; technical success was 82%, and the patency rates at 6, 12, and 18 months were 66%, 62%, and 59%, respectively. They reported two minor hematomas and two SFA ruptures, which required no treatment for complications. Matsumi et al[8] reported on the microcatheter-based retrograde PA approach to chronic total occlusions in the iliac or femoropopliteal artery in 20 patients with low complication rates (4.8%). Matsumi's postprocedural primary patency rates at 1, 2, and 3 years were 89.5%, 72.0%, and 41.2%, respectively[8]. Our technical success rate was 92.9% with a low complication rate (2.38%), and the patency rates at 6, 12, and 18 months were 86.9%, 82.1%, and 77%, respectively. Based on the results of our study, we conclude that the retrograde popliteal approach is a safe and feasible method for iliofemoral occlusive disease.

The main limitations of our study are its retrospective design, single-center experience, limited patient number, relatively short follow-up period, and the absence of a control group.

Conclusions

The transpopliteal approach should be considered the first-line treatment for iliofemoral occlusive disease due to its high technical success rate and low complication rate. To minimize complications, low-profile introducing sets and ultrasound-guided punctures are offered.

Conflict of Interest
All authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Authors' Contribution
AÜY conceptualized the study and performed the operations and followed up the patients who participated in this study. AÜY also collected data set. ÖFÇ made data analysis and interpretation. AY and ÖY made literature review and drafted the manuscript. MCÇ reviewed and edited the manuscript. All authors read and approved the final version of manuscript.

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