Mid-term results and predictors of restenosis in patients undergoing endovascular therapy for isolated popliteal artery steno-occlusive disease

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ABSTRACT

Background and aim: There is only a limited number of major publications on the outcome of interventions for isolated popliteal artery stenosis. The purpose of this study was to report our results on mid-term patency and predictors of restenosis.

Patients and methods: This single-center retrospective study included 61 symptomatic patients (males, $N = 33$; median age, 65.1 years [IQR, 60.7–71.9 years]; Rutherford grade 4–6, $N = 14$) with at least two patent crural arteries, whose atherosclerotic stenoses/occlusions were treated with percutaneous transluminal angioplasty (PTA) or stenting (using self-expanding bare-metal Astron Pulsar stents) between 2011 and 2018.

Results: Twenty-six patients had PTA, while 35 underwent stenting. The median follow-up was 29 months (IQR, 10–47 months). The primary patency rates were not significantly different ($P = 0.629$) between PTA and stenting groups. Restenosis developed in nine patients (34.6%) in the PTA group, and in 12 (34.3%) in the stenting group. Restenotic lesions required re-intervention in nine cases (100%) in the PTA group, and in eight (66.7%) in the stenting group. Restenosis developed significantly less frequently ($P = 0.010$) in patients with a popliteal/P1 stent; the primary patency rates were also significantly better ($P = 0.018$) in patients with a popliteal/P1 stent when compared to popliteal/P2 plus multi-segment stents. Cox regression analysis identified lesion location as a predictor of in-stent restenosis (HR, 2.5; 95% CI, 1.2–5.5; $P = 0.019$).

Conclusion: Stenting was not superior when compared to PTA (if selective stenting was not considered as loss of patency). Follow-up should be more thorough in patients undergoing popliteal/P2 or multi-segment stenting.

KEYWORDS

popliteal artery, endovascular therapy, PTA, stenting, restenosis, patency

Introduction

Popliteal artery steno-occlusive disease could be truly isolated if no stenosis or occlusion were present elsewhere in the ipsilateral lower extremity. Atherosclerosis is usually a multilevel pathological process, therefore the probability of an isolated popliteal manifestation is minimal. In many cases, the cause of a truly isolated popliteal artery luminal narrowing is from external compression due to e.g. entrapment syndrome or cystic adventitial disease.

In the majority of studies, a presumed atherosclerotic popliteal artery stenosis is considered isolated if the patient has no ipsilateral femoral artery stenosis, requiring invasive therapy. However, publications are heterogeneous in terms of arterial runoff and the type of radiological intervention used [1–7]. Although percutaneous transluminal angioplasty (PTA) with a plain or drug-coated balloon plus or minus bare-metal stenting is the most commonly applied treatment method [1, 2, 4, 7–11], reports have outlined stentgraft implantation [12]

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and atherectomy [3, 4, 13]. However, studies also appear to be inconsistent in terms of the composition of deployed (mainly self-expanding) stents [1, 2, 5, 7–9, 11].

The mid- and long-term efficacy of endovascular procedures can be characterized by the restenosis rate. Depending on radiological intervention types, the restenosis rate of popliteal endovascular therapy is approximately 5–70% [1–6], which is slightly better than the restenosis rate of femoropopliteal interventions (40–70%; most likely because femoral lesions are almost always longer than popliteal lesions, and the longer the treated lesion, the greater the probability of restenosis) [14, 15].

Therefore, the goal of this study was to examine mid-term results of endovascular methods and identify predictors of restenosis in a single-center, homogeneous population in terms of crural runoff arteries and implanted stent type.

Patients and methods

Patient selection

Sixty-one patients from a single institution, who underwent an intervention for symptomatic isolated popliteal artery *de novo* steno-occlusive disease (no ipsilateral iliofemoral stenosis, two patent crural run-off arteries) between June 2011 and June 2018, were retrospectively analyzed. The study procedures were carried out in accordance with the Declaration of Helsinki. Institutional review board approval was granted (Approval No: 138/2013). Due to the retrospective nature of the study, no informed consent for analysis of data was obtained from patients.

Pre-procedural data

The following clinical data were collected from our medical record archiving system (MedSol; T-Systems Hungary Ltd., Budapest, Hungary): age; gender; anthropometric parameters (e.g. weight, height); atherosclerotic risk factors and comorbidities (smoking, hypertension, hyperlipidemia, diabetes mellitus, chronic kidney disease); past medical history (coronary, supra-aortic, and/or lower extremity radiological interventions or surgical reconstructions); Rutherford grade [16]; ankle-brachial index (ABI); and medication regimen.

Procedural information

Radiological interventions were executed through the common femoral artery. The choice of approach (antegrade versus retrograde) was left to the discretion of the interventional radiologist performing the procedure. Patients underwent either PTA or stenting (selective or primary). Selective stenting was defined as stent placement after PTA with suboptimal results (residual stenosis of $\geq 30\%$, flow-limiting dissection). Primary stenting was defined as stent placement after predilation of the lesion, regardless of the PTA outcome [17]. Generally, in patients with non-occlusive, short lesions, PTA was favored, while in the presence of heavily calcified, long lesions or total occlusions, primary

stenting was chosen. All procedures were performed by three experienced interventional radiologists with more than 10 years of experience in the treatment of peripheral arterial occlusive disease.

Technical success was defined as $<30\%$ residual stenosis without dissection or extravasation [16]. Punctured arteries were manually compressed. In uncomplicated cases, patients were discharged 1–2 days after the procedure. Patients were on dual antiplatelet therapy for 1 month, followed by a lifelong acetylsalicylic acid or clopidogrel monotherapy.

Post-procedural data

According to international and in-house guidelines, patients were scheduled for a follow-up visit at 6 weeks, 6 months, and 12 months after the intervention, and yearly thereafter, or sooner if symptoms arose. The following follow-up data were collected: Rutherford grade [16], ABI, and duplex ultrasound (DUS) results. Significant restenosis was defined as peak systolic velocity of ≥ 250 cm/s as measured by DUS in the treated popliteal segment. Primary patency was defined as a patent popliteal artery, without further intervention. Secondary patency was defined as an open popliteal artery after endovascular re-intervention or surgical reconstruction due to restenosis. Clinical success was defined as subjective improvements as reported by the patient, and/or at least one stage improvement in Rutherford grade.

Imaging data

Digital subtraction angiography data were extracted from picture archiving and communication systems (PACS; GE Healthcare Inc., Chicago, IL, USA). Lesion parameters consisted of localization (P1: from the intercondylar fossa to the proximal edge of the patella; P2: from the proximal edge of the patella to the center point of the knee joint; P3: from the center of the knee joint to the origin of the anterior tibial artery, and multi-segment disease: combinations of the above) [18], stenosis grade and length, calcification presence and grade, and residual stenosis grade.

Calcification was evaluated on the baseline fluoroscopic images. Lesions were mildly calcified if single or multiple punctate calcifications were present, moderately calcified if single or multiple linear areas of calcification were seen, and heavily calcified if continuous calcification with no visible breaks was observed [19].

Analyzed parameters

Both PTA and stenting groups were divided into restenotic and non-restenotic subgroups, and were compared for pre-procedural, imaging, procedural, and post-procedural data.

Statistical analysis

Statistical analyses were performed using StatSoft Statistica 13.4 (Moonsoft Oy, Espoo, Finland) and GraphPad Prism 7.01 (GraphPad Software Inc., La Jolla, CA, USA) software. Continuous data were expressed as medians and interquartile ranges (IQR, Q1–Q3); categorical data were

represented as counts (percentages). Significant differences in groups/subgroups for continuous and categorical data were evaluated using Mann-Whitney *U* and Fisher's exact tests, respectively. Patency was calculated using Kaplan-Meier analysis. Kaplan-Meier curves were compared using a log-rank test. Cox regression analysis was used to determine significant predictors of restenosis; the hazard ratio (HR) was presented together with its 95% confidence interval (CI). The threshold for statistical significance was $P < 0.05$.

Results

Patient data

Twenty-six patients (42.6%) were in the PTA group, while 35 patients (57.4%) were in the stenting group.

The median age was 65.1 years (IQR, 60.7–71.9 years) in the PTA group. Indications for radiological intervention were severe claudication (Rutherford grade 3) in 12 cases (46.2%), and critical limb ischemia (CLI; Rutherford grade 4–6) in 14 cases (53.8%). Twenty-two patients (84.6%) smoked, 22 (84.6%) had hypertension, 10 (38.5%) had hyperlipidemia, 13 (50%) had diabetes mellitus, six (23.1%) were obese, and three (11.5%) had chronic kidney disease (Table 1). Six patients (23.1%) had coronary artery bypass grafting and/or percutaneous coronary intervention, one

patient (3.8%) had supra-aortic surgical and/or endovascular reconstruction, and three patients (11.5%) had contralateral lower extremity open and/or percutaneous revascularization.

In the stenting group, the median age was 63.5 years (IQR, 56.9–71 years). Indications for radiological intervention were severe claudication in 21 cases (60%), and CLI in 14 cases (40%). Thirty patients (85.7%) smoked, 30 (85.7%) had hypertension, 20 (57.1%) had hyperlipidemia, 15 (42.9%) had diabetes mellitus, 11 (31.4%) were obese, and one (2.9%) had chronic kidney disease (Table 2). Six patients (17.1%) had coronary artery bypass grafting and/or percutaneous coronary intervention, three patients (8.6%) had supra-aortic surgical and/or endovascular reconstruction, and 14 patients (40%) had contralateral lower extremity open and/or percutaneous revascularization.

Lesion, balloon, and stent characteristics

For all cases, the pathological background was atherosclerosis. The ipsilateral antegrade approach was chosen in 42 patients (68.9%), while the contralateral approach was used in 19 cases (31.1%).

In the PTA group, lesions were left-sided in 12 patients (46.2%). Steno-occlusive disease affected the P1 segment in 13 cases (50%), and the P2 in eight cases (30.8%). Multi-segment disease within the popliteal artery was observed in five cases (19.2%). The median degree of stenosis was 95%

Table 1. Indication for treatment, atherosclerotic risk factors, and comorbidities in the PTA group

Indication, atherosclerotic risk factors, comorbidities	PTA group (N = 26)		P value
	RR subgroup (N = 9)	Non-RR subgroup (N = 17)	
CLI, N (%)	4 (44.4)	10 (58.8)	>0.999
Age (year), median (IQR)	70.3 (63–75.5)	63.5 (56.2–69.9)	0.124
Female gender, N (%)	5 (55.6)	11 (64.7)	0.692
Smoking, N (%)	9 (100)	13 (76.5)	0.263
Hypertension, N (%)	9 (100)	13 (76.5)	0.263
Hyperlipidemia, N (%)	3 (33.3)	7 (41.2)	0.206
Diabetes mellitus, N (%)	4 (44.4)	9 (52.9)	>0.999
Obesity (BMI ≥ 30 kg/m ²), N (%)	2 (22.2)	4 (23.5)	>0.999
Chronic kidney disease, N (%)	1 (11.1)	2 (11.8)	>0.999

BMI, Body mass index; CLI, critical limb ischemia; IQR, interquartile range; PTA, percutaneous transluminal angioplasty; RR, restenotic.

Table 2. Indication for treatment, atherosclerotic risk factors, and comorbidities in the stenting group

Indication, atherosclerotic risk factors, comorbidities	Stenting group (N = 35)		P value
	RR subgroup (N = 12)	Non-RR subgroup (N = 23)	
CLI, N (%)	6 (50)	8 (34.8)	0.477
Age (year), median (IQR)	63.3 (57.9–70.2)	63.5 (56.9–71.5)	0.794
Female gender, N (%)	3 (25)	9 (39.1)	0.477
Smoking, N (%)	11 (91.7)	19 (82.6)	0.640
Hypertension, N (%)	10 (83.3)	20 (87)	>0.999
Hyperlipidemia, N (%)	6 (50)	14 (60.9)	0.721
Diabetes mellitus, N (%)	5 (41.7)	10 (43.5)	>0.999
Obesity (BMI ≥ 30 kg/m ²), N (%)	2 (16.7)	9 (39.1)	>0.999
Chronic kidney disease, N (%)	0 (0)	1 (4.3)	>0.999

BMI, Body mass index; CLI, critical limb ischemia; IQR, interquartile range; RR, restenotic.

(IQR, 90–100%), the median lesion length was 26.7 mm (IQR, 11.6–72.9 mm), and calcification was observed in 13 patients (50%). The median balloon diameter and the median balloon length were 5 mm (IQR, 5–5 mm) and 40 mm (IQR, 40–80 mm), respectively (Table 3).

In the stenting group, lesions were left-sided in 15 patients (42.9%). Steno-occlusive disease affected the P1 segment in 14 cases (40%), and the P2 in 12 cases (34.3%). Multi-segment disease within the popliteal artery was present in nine cases (25.7%). The median degree of stenosis was 100% (IQR, 90–100%), the median lesion length was 52.8 mm (IQR, 23.4–80.6 mm), and calcification was observed in 22 patients (62.9%) (Table 4). In all cases, a self-expanding Astron Pulsar stent (Biotronik AG, Bülach, Switzerland) was deployed. The median stent diameter was 6 mm (IQR, 6–7 mm), while the median stent length was 60 mm (IQR, 40–120 mm). Primary stenting was performed in

15 patients (42.9%), while selective stenting was chosen for 20 cases (57.1%).

Early post-procedural period (within 30 days)

Technical success was achieved in 100% of patients. In one of the stented patients, a retroperitoneal hematoma was observed, but did not require evacuation. After observation for 2 days, the patient was discharged. None of the patients had distal embolization. The 30-day all-cause mortality rate was zero.

Follow-up period

At 6 weeks, the clinical success rate was 92% in the PTA group, while it was 89% in the stenting group. In the PTA group, the median resting ABI was significantly improved ($P < 0.001$) from 0.40 (IQR, 0.28–0.52) before the procedure to

Table 3. Lesion and balloon parameters in the PTA group

Parameters	PTA group (N = 26)		
	RR subgroup (N = 9)	Non-RR subgroup (N = 17)	P value
<i>Lesion</i>			
Left-sided, N (%)	5 (55.6)	7 (41.2)	0.683
P1 segment, N (%)	6 (66.7)	7 (41.2)	0.411
P2 segment, N (%)	2 (22.2)	6 (35.3)	0.667
P3 segment, N (%)	0 (0)	0 (0)	NA
Multi-segment disease, N (%)	1 (11.1)	4 (23.5)	0.628
Stenosis grade (%), median (IQR)	100 (90–100)	90 (90–100)	0.293
Occlusion, N (%)	6 (66.7)	7 (41.2)	0.411
Length (mm), median (IQR)	49.6 (17.3–72.6)	24.9 (11.6–60.9)	0.666
Calcification, N (%)	4 (44.4)	9 (52.9)	>0.999
Heavy calcification, N (%)	1 (11.1)	1 (5.9)	>0.999
<i>Balloon</i>			
Diameter (mm), median (IQR)	5 (5–5)	5 (4–5)	0.686
Length (mm), median (IQR)	40 (40–80)	40 (40–80)	0.225

IQR, Interquartile range; NA, not applicable; P1–3, popliteal; PTA, percutaneous transluminal angioplasty; RR, restenotic.

Table 4. Lesion and stent parameters in the stenting group

Parameters	Stenting group (N = 35)		
	RR subgroup (N = 12)	Non-RR subgroup (N = 23)	P value
<i>Lesion</i>			
Left-sided, N (%)	5 (41.7)	10 (43.5)	>0.999
P1 segment, N (%)	1 (8.3)	13 (56.5)	0.010
P2 segment, N (%)	6 (50)	6 (26.1)	0.261
P3 segment, N (%)	0 (0)	0 (0)	NA
Multi-segment disease, N (%)	5 (41.7)	4 (17.4)	0.220
Stenosis grade (%), median (IQR)	100 (100–100)	100 (90–100)	0.357
Occlusion, N (%)	10 (83.3)	15 (65.2)	0.434
Length (mm), median (IQR)	58.3 (30.6–82.7)	49.6 (17.3–72.6)	0.289
Calcification, N (%)	9 (75)	13 (56.5)	0.463
Heavy calcification, N (%)	2 (16.7)	4 (17.4)	>0.999
<i>Stent</i>			
Diameter (mm), median (IQR)	6 (6–7)	6 (6–7)	0.972
Length (mm), median (IQR)	60 (60–120)	60 (40–80)	0.476

IQR, Interquartile range; NA, not applicable; P1–3, popliteal; RR, restenotic.

0.90 (IQR, 0.84–1.02) at the 6-week follow-up. For the stenting group, it significantly improved ($P < 0.001$) from 0.37 (IQR, 0.24–0.51) to 0.89 (IQR, 0.80–1.0).

The median follow-up time was 29 months (IQR, 16–47 months) for the PTA group, and 26.5 months (IQR, 6–47 months) for the stenting group. Follow-up times did not significantly differ ($P = 0.435$) between groups. Restenosis developed in nine patients (34.6%) in the PTA group (stenosis, $N = 7$; occlusion, $N = 2$), and in 12 patients (34.3%) in the stenting group (stenosis, $N = 5$; occlusion, $N = 7$). Restenotic lesions required re-intervention in nine cases (100%) in the PTA group (PTA with a plain balloon, $N = 5$; stenting with an Astron Pulsar stent, $N = 4$), and in eight cases (66.7%) in the stenting group (PTA with a plain balloon, $N = 6$; stenting with an Astron Pulsar stent, $N = 1$; femoropopliteal bypass grafting, $N = 1$).

The primary patency rate was 86% at 6 months, and 71% at 12 and 24 months in the PTA group, while the rate was 91% at 6 months, 88% at 12 months, and 69% at 24 months in the stenting group. There were no significant differences ($P = 0.629$) in the primary patency rates between groups (Fig. 1A). The primary patency rate in the pooled patient group was 89% at 6 months, 82% at 12 months, and 70% at 24 months.

Recurrent restenosis was observed in three patients (3/9; 33.3%) in the PTA group, and in six patients (6/8; 75%) in the stenting group. Two of three patients received invasive therapy in the PTA group (PTA with a plain balloon, $N = 1$; femoropopliteal bypass grafting, $N = 1$), while four of six patients underwent repeat revascularization in the stenting group (PTA with a plain balloon, $N = 2$; stenting with an Astron Pulsar stent, $N = 1$; femorocrural bypass grafting, $N = 1$).

The secondary patency rate was 100% at 6 months, and 90% at 12 and 24 months in the PTA group, while the rate was 100% at 6 months, 94% at 12 months, and 90% at 24

Primary patency rates		6 months	12 months	24 months
PTA	%	85.7	71.4	71.4
	No. at risk	20	16	15
	SE	7.6	9.9	9.9
Stenting	%	91.2	88.2	68.9
	No. at risk	32	29	22
	SE	4.9	5.5	8.2

Fig. 1A. Primary patency rates of PTA and stenting groups. No., Number; PTA, percutaneous transluminal angioplasty; SE, standard error

Primary patency rates		6 months	12 months	24 months
P1 segment	%	100	100	90.9
	No. at risk	13	12	11
	SE	0	0	8.7
P2 and multi-segment	%	85.7	80.9	55.6
	No. at risk	19	17	13
	SE	7.6	8.6	11.1

Fig. 1B. Primary patency rates of different popliteal artery segments. No., Number; P1–2, popliteal; SE, standard error

months in the stenting group. There were no significant differences ($P = 0.603$) in the secondary patency rates between groups. The secondary patency rate in the pooled patient group was 100% at 6 months, 93% at 12 months, and 90% at 24 months.

Restenoses and recurrent restenoses were treated invasively only in patients with Rutherford stage 3–6.

Predictors of restenosis

In the PTA group, neither atherosclerotic risk factors nor lesion and balloon parameters significantly differed between restenotic and non-restenotic subgroups (Tables 1 and 3).

In the stenting group, restenosis developed significantly less frequently ($P = 0.010$) in stents implanted into the P1 segment when compared to P2 plus multi-segment stents. The primary patency rate was 100% at 6 and 12 months, and 91% at 24 months in patients with a P1 segment lesion location, while it was 86% at 6 months, 81% at 12 months, and 56% at 24 months in patients with P2 plus multi-segment lesion locations. The primary patency rates were significantly improved ($P = 0.018$) in patients with a P1 stent when compared to P2 and multi-segment stents (Fig. 1B). The secondary patency rate was 100% at 6, 12, and 24 months in patients with a P1 segment lesion location, while it was 100% at 6 months, 91% at 12 months, and 65% at 24 months in patients with P2 plus multi-segment lesion locations. The secondary patency rates were significantly improved ($P = 0.025$) in patients with a P1 stent when compared to P2 and multi-segment stents. Cox regression analysis identified lesion location as a predictor of in-stent restenosis (HR, 2.5; 95% CI, 1.2–5.5; $P = 0.019$).

Discussion

Among single-center studies, ours has the largest number of patients. The other studies included 18 to 46 patients [1, 3, 5,

6, 10, 11]. We have shown that the mid-term (24-month) primary patency of endovascular procedures performed on isolated popliteal artery stenosis was good (71% in the PTA group, 69% in the stenting group, 70% in the pooled group), and did not significantly differ between PTA and stenting groups (when selective stenting was not considered as loss of patency). In the stenting group, lesion location was identified as a predictor of restenosis.

As previously outlined, studies investigating patients with isolated popliteal artery steno-occlusive disease were heterogeneous in terms of patent crural runoff arteries. No studies were found where all crural arteries were patent. Our literature review revealed two studies where patients with no patent crural arteries were included [2, 10]. Other studies consisted of patients with at least one patent crural artery [1, 3–7, 13, 20]. To our knowledge, our study was the only investigation based on patients with at least two patent crural arteries.

The following treatment methods were used in these studies: (1) angioplasty with plain balloons, (2) PTA with drug-coated balloons, (3) stenting with bare-metal stents, (4) stentgraft implantation, (5) directional atherectomy, and (6) combinations of the above [1–7, 13]. For the majority of studies (similar to this study), PTA with plain balloons and stenting (either primary or selective) with bare-metal stents was the technique of choice [1, 2, 5–7, 10]. The type of stents implanted varies from study to study [1, 2, 5–11]. In the present patient population, only Astron Pulsar stents have been deployed, which has the advantage over other stents that in most cases the intervention can be executed through a 4F sheath.

In our study, the primary patency rate was 82% at 12 months, and 70% at 24 months in the pooled patient group. Other research studies have observed similar or worse patency rates [1, 2, 5, 7]. For example, in an article, published in 2020, similar rates (72%) [20], while in another article, published in 2018, worse 24-month primary patency rates (59%) [6] can be found when compared to our data. It should be noted that procedures performed with novel endovascular methods (atherectomy alone or combined with PTA with a drug-coated balloon) resulted in improved 12-month primary patency rates (atherectomy alone: 85%, atherectomy combined with PTA with a drug-coated balloon: 95%) [3, 4] when compared to plain balloon angioplasty with or without bare-metal stenting (PTA with bare-metal stenting: 68%, PTA without bare-metal stenting: 59%) [1]. In accordance with our findings, no studies evaluating the patency of PTA and stenting in patients with isolated popliteal artery stenosis showed any significant difference between the two radiological intervention types (when selective stenting was not considered as loss of patency) [1, 2, 5, 7].

Known predictors of restenosis in patients treated endovascularly for isolated popliteal artery stenosis include the following: body mass index (BMI), anemia, reference vessel diameter, long lesion (>60 mm), baseline occlusion, stent placement into the P3 segment, and high-grade residual stenosis [2, 5, 6]. In our study, restenosis occurred less frequently in patients with P1 segment stenting when compared to those with P2 segment and multi-segment

stenting. The popliteal region is critical in that vessels must adapt to movement-induced mechanical forces (e.g. axial compression and bending) [21–23]. Stent deployment disrupts artery elastic capabilities and results in reduced axial compressibility, which may cause extreme kinking at the marginal sections of the popliteal stents, leading to chronic vessel micro-trauma, intimal injuries, hyperplasia, and loss of patency [11, 21, 24]. Furthermore, stented popliteal arteries exhibit additional bending when compared to bare arteries. During knee flexion, bare popliteal arteries have a smooth C shape, while stented popliteal arteries adopt a ‘three-shape’ configuration, generating increased stress both inside and at marginal sections of the stents [23]. Movement-induced mechanical forces also affect each popliteal segment differently. Axial compression and bending are most pronounced behind the knee, suggesting that stents implanted into the P2 segment are exposed to greater mechanical forces than those placed into the P1 segment [21–23, 25]. Thus, patients with P1 segment stenting have reduced chances of restenosis when compared to those with P2 segment or multi-segment stenting.

The main limitation of the study was its retrospective nature. Additionally, stent fracture (an important cause of restenosis) was not examined.

In conclusion, mid-term patency of the popliteal artery interventions was good. Stenting exhibited no superiority when compared to PTA (if selective stenting was not considered as loss of patency). Lesions located in the P2 segment or at multi-segments were more prone to restenosis, therefore follow-up should be more thorough in patients undergoing stenting in these segments.

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