Retrograde Transplantar Arch Angioplasty of Below-the-Knee Arterial Occlusions:

Outcomes Compared to Anterograde Recanalization

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Rationale and Objectives: To compare the clinical outcomes of retrograde transplantar arch angioplasty and conventional below-the-knee (BTK) anterograde recanalization.

Materials and Methods: One hundred twelve limbs in 96 patients underwent attempt at antegrade tibial angioplasty. Among 27 technical failures, retrograde trans-dorsal or -planter percutaneous transluminal angioplasty was attempted in 22 limbs. Ankle–brachial index (ABI), thrombolysis in myocardial infarction (TIMI) flow grade, and dorsal/plantar arterial pulse score improvement were compared immediately after the procedures between patients received successful anterograde angioplasty (anterograde angioplasty group [AAG], 85 limbs in 71 patients) and retrograde angioplasty (retrograde angioplasty group [RAG], 22 limbs in 20 patients). Target vessel restenosis and limb salvage were observed during follow-up.

Results: Primary technical success rate was 75.9% in the RAG (vs. 74.0% AAG, $P > .05$). ABI improved from 0.55 ± 0.21 to 0.93 ± 0.19 in the RAG (vs. 0.56 ± 0.14 to 0.89 ± 0.18 AAG, $P > .05$). TIMI flow grade demonstrated greater reperfusion of distal foot tissue in the RAG (2.3 ± 0.8 vs. 1.0 ± 0.8, $P < .05$). Primary patency rates at 12 and 24 months were 63.6% (14 of 22) and 45.5% (10 of 22) in the RAG and 52.9% (45 of 85) and 37.6% (32 of 85) in the AAG, respectively ($P > .05$). Kaplan–Meier analysis after 24 months found limb salvage rates of 93.8% in the RAG and 96.5% in the AAG ($P > .05$).

Conclusions: Retrograde transplantar arch angioplasty achieved better immediate blood flow and similar ABI improvement, primary patency rate, and limb salvage rate compared to conventional transtibial angioplasty for BTK occlusions. This could become a supplementary technique when anterograde angioplasty fails.

Key Words: Below the knee; angioplasty; plantar arch.

In patients with diabetes, peripheral vascular disease is a major vascular complication associated with high morbidity and mortality (1). Severe occlusive disease is often observed in the leg, especially in below-the-knee (BTK) arteries (2). The development of long balloons and new interventional procedures has provided effective treatments (3–5), but the success rate of percutaneous transluminal angioplasty (PTA) for BTK arterial occlusion remains suboptimal because of poor vessel runoff and high surgical risk. Since Fusaro et al. (6) reported a case of plantar to dorsalis pedis artery (DPA) subintimal angioplasty (SA), there have been several reports on retrograde transplantar arch angioplasty in BTK arterial occlusion (7,8). However, most published articles are case reports or small sample studies and focused mainly on the technical success rate. There is a lack of research comparing retrograde transplantar arch angioplasty with anterograde angioplasty in terms of clinical outcome, vascular restenosis, and limb salvage rate. The aim of this study was to compare the clinical results of retrograde transplantar arch angioplasty via the DPA or the lateral plantar artery (LPA) for BTK arterial occlusion with those of conventional angioplasty.

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MATERIALS AND METHODS

Patient Information

One hundred twelve limbs in 96 patients underwent attempt at antegrade tibial angioplasty. Among 27 technical failures, retrograde trans-dorsal or -planter PTA was attempted in 22 limbs. Ninety-one successfully treated patients were divided

TABLE 1. Patient and Lesion Characteristics in the Retrograde Angioplasty Group (RAG) and Anterograde Angioplasty Group (AAG)

Patient Characteristic	RAG (n = 20)	AAG (n = 71)	P Value
Age (years)	72.3 ± 6.0 (62–82)	70.0 ± 9.4 (52–85)	.431
Gender (male)	14 (70.0)	52 (73.2)	.774
Diabetes duration (years)	14.0 ± 4.5 (8–20)	14.0 ± 8.6 (1–30)	.850
Hypertension	15 (75.0)	38 (53.5)	.085
Chronic renal insufficiency (creatinine > 133 μmol/L)	6 (30.0)	16 (22.5)	.778
Coronary artery disease	3 (15.0)	8 (11.3)	.701
Smoking habit	6 (30.0)	25 (35.2)	.383
Intermittent claudication	15 (75.0)	49 (69.0)	.605
Rest pain	4 (18.2)	11 (12.9)	.734
Ulcer	4 (18.2)	12 (14.1)	.746
Rutherford classification			.244
Stage 0	1	16	
Stage 1	1	11	
Stage 2	2	14	
Stage 3	8	5	
Stage 4	4	3	
Stage 5	0	0	
Stage 6	4	22	
Lesion characteristic			—
Total number of limbs	22	85	
Unilateral limb	18 (93.3)	57 (80.3)	
Bilateral limbs	2 (6.7)	14 (19.7)	
Location			
ATA + DPA	14	80	
PTA + LPA	6	5	
DPA	1	0	
LPA	1	0	
Length (cm)			
≥10	18	76	
<10	4	9	

ATA, anterior tibial artery; DPA, dorsalis pedis artery; LPA, lateral plantar artery; PTA, posterior tibial artery.
Continuous data are presented as the mean ± standard deviation (range); categorical data are given as counts (percentages).

into a conventional anterograde angioplasty group (AAG; 85 limbs in 71 patients) and a retrograde angioplasty group (RAG; 22 limbs in 20 patients); other angioplasty techniques such as collateral vessel angioplasty and subintimal arterial flossing with antegrade–retrograde intervention technique via direct puncture of the DPA or the anterior or posterior tibial artery were beyond the scope of this study. Ulcer was present in four (18.2%) limbs in the RAG and 12 (14.1%) limbs in the AAG. Rest pain was present in four (18.5%) limbs in the RAG and 11 (12.9%) limbs in the AAG. The general condition and clinical data of the patients are outlined in Table 1. All patients underwent a detailed physical examination, clinical assessments, and radiologic evaluation, including DPA or LPA pulse volume score, ankle–brachial index (ABI), and lower limb magnetic resonance angiography (MRA) or arterial ultrasonography. Indications of arterial occlusive disease on evaluation were reduction or absence of DPA or LPA pulse; ABI <0.9 (in the absence of arterial calcification); and vascular occlusion of BTK arteries confirmed by lower limb MRA or arterial ultrasonography. When two of these three indications were present, digital subtraction angiography was performed to further assess the vascular condition, with subsequent angioplasty if necessary.

Procedures

All angioplasty procedures were performed under local anesthesia through anterograde access to the common femoral artery. A 4-F vertebral catheter (Cook, Bloomington, IN) was inserted through a 5-F introducer, and baseline diagnostic angiography was performed using an iodinated contrast agent.

For anterograde angioplasty, PTA or SA was performed depending on the length of occluded BTK artery. In PTA, if the occlusive lesion was <3 cm in length, a 0.035-in hydrophilic guide wire (Terumo, Tokyo, Japan) or microguide wire (PT2 or V18) was advanced slowly through the lesion followed by the 4-F catheter; if the length of the occlusive lesion was >3 cm, a U-shaped loop was created in the tip of a guide