

Retrograde Transpopliteal Approach for the Endovascular Treatment of Chronic Lower Limb Ischemia

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Aim: Access site is one of the initial steps in the endovascular management of chronic lower limb ischemia. In addition to antegrade contralateral and ipsilateral, the retrograde transpopliteal approach is suggested to be used in certain indications. This study aimed to describe the feasibility and complications of this approach.

Patients and methods: Retrograde transpopliteal approach was used in 23 patients, attending Suez Canal University Hospital for the treatment of chronic lower limb ischemia, in whom the antegrade approach was not possible. The success to access the popliteal artery, crossing the lesion, effectively dilating the artery, patency up to one month and complications rate were measured.

Results: In all patients the popliteal artery was successfully accessed and the lesion was crossed. Post dilatation contrast study confirmed successful dilatation, that was maintained up to one month follow up. No complications were recorded.

Conclusion: Retrograde transpopliteal approach is a feasible and safe alternative method to approach SFA and CFA lesions when the antegrade approach cannot be used.

Key words: Endovascular, transpopliteal, retrograde.

Introduction:

Patients with lower extremity peripheral artery disease (PAD) experience substantial functional disability due to claudicating pain, rest pain, or the loss of tissue integrity in the affected limbs. The number of patients requiring lower limb revascularization for limb ischemia are likely to increase significantly worldwide as a result of ageing populations, the increasing prevalence of diabetes, and the failure so far to significantly reduce global tobacco consumption.¹

The goals of treatment are: To provide pain relief, promote wound healing, and preserve limb function, whilst minimizing overall cardiovascular risks. These goals help maintain independence and quality of life. They are best attained by limb revascularization whenever possible, as the risk of limb loss within 1 year is estimated to be 70% in the presence of rest pain and 95%

if there is tissue loss.²

The growth of endovascular interventions and the evolution of various endovascular devices and techniques have overcome many of the previous anatomic barriers that limited their safe and wider use. Particularly for superficial femoral artery (SFA) lesions, among others, arterial access alternatives currently facilitate percutaneous transluminal angioplasty (PTA) of lesions previously considered inaccessible, this lead to a shift in the management to consider PTA as the primary treatment strategy.^{3,4}

Endovascular specialists who treat patients with advanced symptomatic peripheral arterial disease are commonly faced with long segments of complex TASC D or chronically occluded lesions, especially in the SFA.⁵ SFA chronic total occlusions (CTO), especially in the ostial location, present the greatest operator challenge. Crossing these

lesions, especially at ostial or proximal SFA locations, involves prolonged procedures with significant radiation exposure for the patient and operator, and requires large volume of contrast loads for the patient.⁶

Operator experience and comfort with the use of subintimal dissection techniques and true lumen re-entry devices is also crucial. All of the above factors limit the scope and success of traversing SFA CTO to modest 50% to 70% rates.⁶

The principle reasons for procedural failure are the inability to remain intraluminal during crossing the CTO segment, or re-entering the true lumen when subintimal technique is used. There is also an associated risk of perforation dissection, and creation of arteriovenous fistulas.⁷

Therefore, in addition to other indications, The retrograde transpopliteal access is a potentially effective alternative for endovascular treatment of SFA and certain indications in common femoral artery (CFA) arterial lesions in patients not amenable to the antegrade procedures.^{8,9}

Patients and methods:

Patients whom symptoms and signs, including measuring the ankle-brachial pressure index (ABPI) necessitates revascularization were subjected to laboratory testing, including serum creatinine, Prothrombin time and Partial thromboplastin time. Fit patients were considered candidates for endovascular intervention. In those patients arterial duplex and Computed Axial Tomography Angiography (CTA) were performed before the procedure.

Those patients whom underwent endovascular intervention through an antegrade transfemoral (ipsilateral or contralateral) approach to treat CFA or SFA lesions, in whom the following criteria was present, were included in the study:

Inclusion Criteria:

- Failed entry due to flush SFA occlusion.
- Failed re-entry after subintimal dissection.
- Inability to detect the SFA due to large

collateralization at the site of occlusion.

In addition, in patients with the following criteria the transpopliteal approach was used as the first choice:

- In morbidly obese patients with difficult femoral access.

- Groin scar tissue.

On the other hand, patients with the following criteria were excluded from the study. Exclusion criteria:

- The presence of lesions distal to the SFA.

- If the patient was uncomforted with lying prone for long time.

The following data were obtained for all patients:

Demographic data: The patient's name, age, sex, address, occupation and phone number. Risk factors: Diabetes, ischemic heart disease, hypertension, hyperlipidemia or smoking. Clinical presentation: Patients' symptoms were classified according to Rutherford classification.¹⁰ Examination: In addition to the general examination, data of the local ischemic manifestations were recorded, in addition to the ABPI in both the AT and PT arteries bilaterally. Radiological investigations: Results of CTA and arterial Duplex were recorded.

The indication/s to do the trans-popliteal approach was documented.

The following technique was used for the trans-popliteal approach in all patients and was performed by the same person:

All patients were pre-loaded with Clopidogrel 75 mg/ once daily for at least 4 days before intervention. When the indication was failed antegrade approach, the groin sheath was connected to an extension line and covered with a sterile gauze and tape. The patient was turned to the prone position and 5-10 ml of 1% lignocaine was given as local anesthesia. The popliteal artery was accessed slightly above the popliteal crease, guided by the injection of contrast through the groin access, or guided by a hand Doppler. After gaining access, a 6-F sheath, 11 cm long was inserted and flushed with heparinized saline, then 3000 - 5000 IU heparin were given intra-arterially. A 10 ml of contrast (ULTRAVIST

300, Bayer Inc. Canada) was used to visualize the lesion, which was crossed with a 0.035 inch hydrophilic wire (Terumo Corporation, Tokyo, Japan) supported with a 4-F vertebral configuration catheter.

After crossing the lesion and confirming the luminal position, angioplasty was performed using 5-6 mm balloon inflated for 2 minutes. A post-procedure angiogram was then performed and balloon dilation was repeated for any residual stenosis greater than 30%. The plan was to use a 6 mm self expandable stent when a Stenosis >30% remains in spite of the repeated dilatation, or whenever flow limiting dissection occurred. Catheters and guide-wires were removed and Manual compression of the accessed popliteal artery (15-20 minutes), followed by a soft compression was applied for 6 hours.

Post procedural medication: All patients asked to take Acetylsalicylic acid 75 mg once/day for life and Clopidogril 75 mg once/day for three months and discharged in the same day.

Technical success was defined as restored patency with no stenosis greater than 30%, or limiting flow dissection. A poor result was defined as improvement in the patency but with stenosis greater than 30% whilst failure was defined as no change in patency.

Follow up: The improvements in symptoms, presence of complications, results of peripheral pulsations and ABPI were recorded just before discharge, after 1 week and then after one month.

Study end point:

- Failure to access the popliteal artery.
- Failure to cross the lesion.

Follow up of change in symptoms, based on Rutherford upward categorical shift, were increase in the ABPI and presence of previously absent pulses in addition to the presence of complications, up to one month.

Results:

During a period of 18 months, 112 patients had 121 endovascular interventions to treat lower limb ischemia at Suez Canal University Hospital. Out of those, 23 patients had 23

procedures (19%) through the retrograde transpopliteal approach, **Figure (1)**.

Those 23 patients were 18 males and 5 females. Their age ranged between 49 and 71 years, with a mean age of 64 years.

Regarding the risk factors, 20 patients (87%) were diabetics, 15 patients (65%) were hypertensive, 18 patients (78%) had ischemic heart disease and 5 out of those 18 patients (22%) had coronary stents. Twenty out of 23 patients (87%) had hyperlipidemia. All of the 18 male patients were smokers, while the 5 females denied smoking, **Figure (2)**.

HTP: Hypertension, IHD: Ischemic Heart Disease, Hy.Lipi: Hyperlipidemia Regarding the presenting symptoms, 5 patients (22%) presented with limiting claudication, 13 patients (56%) presented with ischemic rest pain and 5 patients (22%) with toes gangrene, **Figure (3)**.

Regarding the examination, for the presenting limb; 20 out of the 23 patients (89%) had palpable femoral pulsations before the intervention, and no pulses were felt distally in all of them. On the other hand, for the non-presenting limb, the femoral pulse was palpable in 20 patients (89%), the popliteal was palpable in 13 of them (56%), and no tibial pulses were felt in all of them, **Figure (4)**.

All of the 23 patients had atrophic changes in the form of hair loss, brittle nails and dry skin, and in 8 of them (33%) the size of the calf muscle was reduced in comparison to the non presenting limb.

ABPI in the presenting limb ranged between 0.5 and 0.7 with a mean of 0.61 (± 0.079) as shown in **Table (1)**.

In 20 out of the 23 patients (89%), the treatment initiated by cross over contralateral antegrade approach before changed to the transpopliteal approach. The reason of changing to trans-popliteal **Figure (5)**, was failure to access the SFA due to flush occlusion or huge collaterals in 13 out of the 20 patients (65%), figure (6), and failure to re-entry to the true lumen after subintimal dissection in 7 of them (35%). While in the remaining 3 patients the decision was made to access transpopliteal from the start as

they had a common femoral occlusion, with contra-lateral iliac occlusion, **Figure (7)**, that did not enable cross over technique. Furthermore, those patients were obese and it was thought risky to use the transbrachial approach for him.

All the 23 procedures were accomplished in the prone position, with a contra-lateral groin sheath in 20 of them. Popliteal access was achieved with contrast guided injected through the contralateral sheath in the 20 patients, while was guided with the popliteal pulsations localised by the hand doppler in 3 patient. In all of the 23 patients the popliteal access was successful, **Figure (8)**.

The lower limit of the SFA lesion was confirmed by contrast injection, **Figures (9-11)**. It was crossed successfully in the 23 patients, subintimally in 18 of them (78%), and intraluminally in 5 of them (22%).

Balloon angioplasty was performed in all patients, **Figures (12,13)**, and one of them required the insertion of a stent. Successful results were confirmed radiologically and documented in all patients.

The mean (and standard deviation) of the ABIP raised from 0.61 (± 0.079) to 0.91 (± 0.047) then 0.94 (0.067) and then 0.98 (± 0.080), before the intervention, before discharge, after one week and after one month respectively in all patients, **Figure (14)**.

Rest pain disappeared in all of the 13 patients, claudicating pain improved in the 5 patients and in the remaining 5 patients the wound healed after amputating the gangrenous toes.

By the end of one month, a part of minor skin bruises, none of the patients had thrombosis, re-occlusion, haematoma, infection, AVF, or aneurysm.

Discussion:

Over a period of 18 months, 19% of the performed procedures in our institute were through the transpopliteal approach. Which indicates that the antegrade approach, when feasible, is the preferred one. This is because of few reasons. First, most of the PVD patients in our community are diabetics.¹¹ The atherosclerotic lesions in those patients

are usually extends to include the popliteal as well as the tibial vessels, and therefore, the popliteal approach is not suitable. Second, it is thought to be wise to introduce the used sheath, catheters, balloons and stents through the wider lumen of the CFA in comparison to the popliteal artery.

The demographic data and risk factors of the studied patients were as expected for this type of disease.^{12,13} Diabetes, hypertension, ischemic heart disease, hyperlipidemia and smoking all were prevalent among the studied group of patients.

Regarding the presenting symptoms, in his study Evans et al, used the transpopliteal approach for a group of 88 patients, only 31% of those patients were critical.¹⁴ However, in this study most of the patients (78%) presented with critical ischemia. This was associated with low mean ABIP (0.61 \pm 0.079) in this study. This is not uncommon in similar studies in the same community,¹¹ which may reflect an awareness or financial problems that prevent the patient from seeking medical advice in early stage of this disease. This, most probably, should affect the outcome of management for such cases, making the comparison of interventional outcome with the international publications difficult.

In 20 out of the 23 patients, when the antegrade approach was failed, the procedure was changed to the transpopliteal approach. At that time this was the second option to cross the SFA lesion. It is worth be mentioned that it is possible now to use the distal SFA, if patent, for a retrograde approach. This would leave the patient in the supine position, for more comfort and for the possibility of using a double approach technique.

In the remaining 3 patients, the transpopliteal approach was selected as the first choice because of the absent pulse in both CFA, in spit of a normal ipsilateral CIA.

Failure to return to the true lumen after subintimal dissection can be managed by a re-entry device. This is expensive and requires a learning curve. In 7 of the patients the indication for transpopliteal approach was re-entry failure, this was managed by the transpopliteal approach which is far cheaper

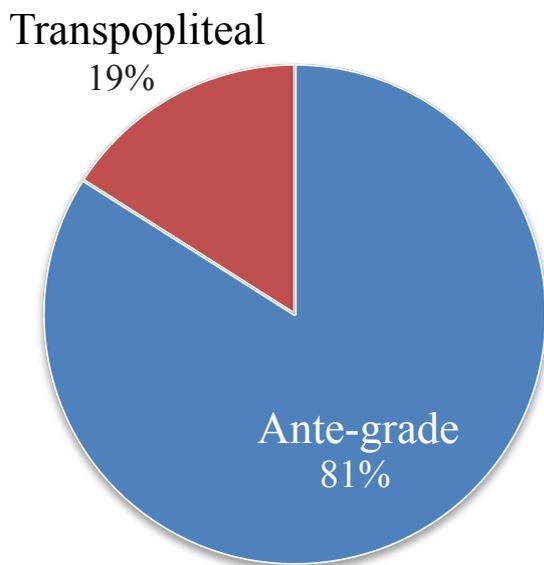


Figure (1): The trans-popliteal approach in relation to the ante-grad approach procedures.

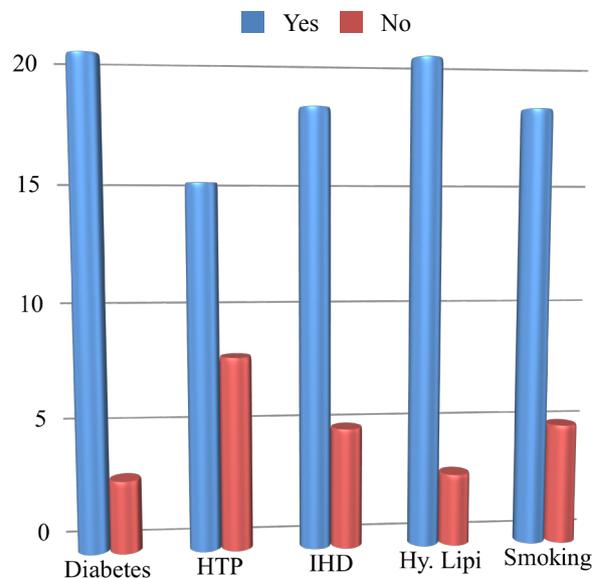


Figure (2): Distribution of the patients according to the risk factors HTP: Hypertension, IHD: Ischemic Heart Disease, Hy.Lipi: Hyperlidemia

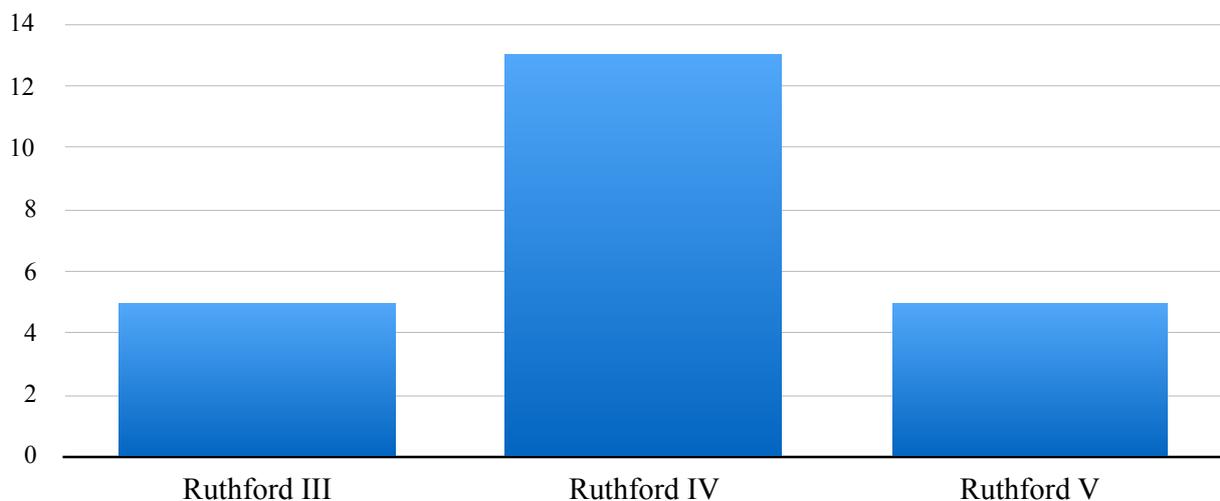


Figure (3): Distribution of the patients according to their presentation

than the re-entry device.

In all of the 23 patients, the popliteal artery was punctured successfully. This was achieved by other authors,^{14,15} which reflects the simplicity of this technique. Furthermore, the improvement of the mean ABPI after the intervention also reflects the success of the approach in treating the lesion. This was also observed by Elias Noory et al,¹⁵ and matches the results when compared to the antegrade approach by Evans et al.¹⁴

Minor complications were reported by others in the form of non significant haematoma and distal embolisation that was

treated by suction.¹⁶ These complications are also expected during the antegrade transfemoral approach. Saim Yilmaz et al¹⁷ reported a massive thigh haematoma after transpopliteal approach, this was following the use of a Closer suture-mediated device.¹⁷ Elias Noory et al has used the Starclose and Perclose (Abbott Vascular Devices, USA), and the AngioSeal (St. Jude Medical, USA) and did not record complications.¹⁵ However, in the presenting study, only manual compression was used as suggested in other literatures to be sufficient.¹⁸

No complications were recorded up to one

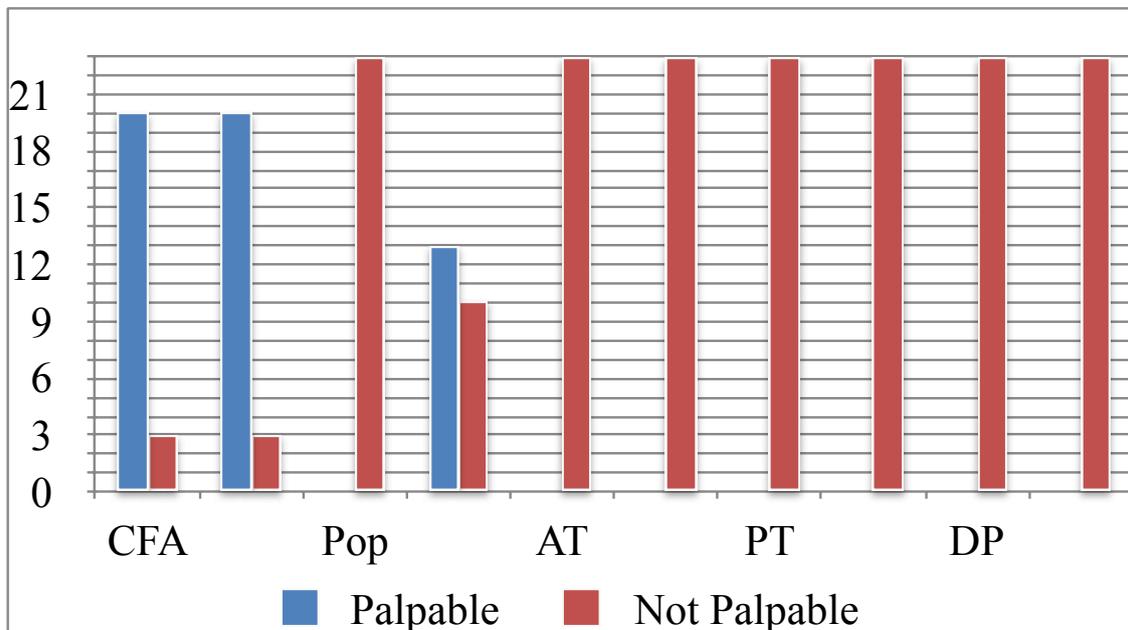


Figure (4): Distribution of the patients according to the pulsations in the presenting and non presenting limb. (Cont: Contralateral).

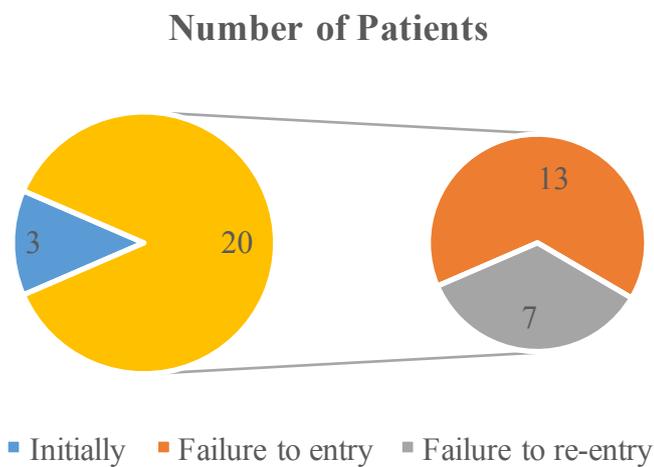


Figure (5): Distribution of patients according to the indication of the Trans-popliteal approach.

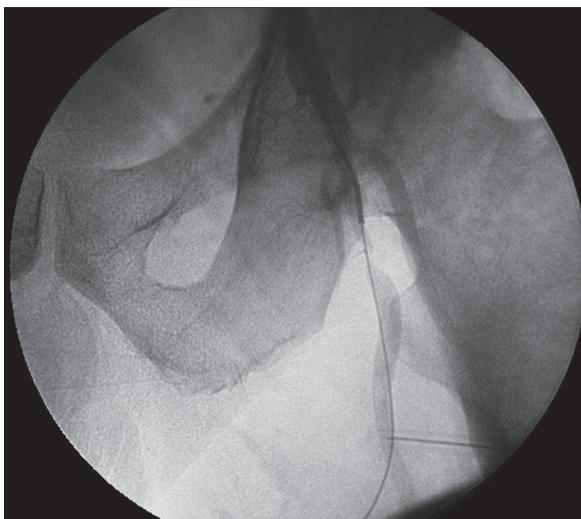


Figure (6): The wire passed through a huge collateral not the SFA.



Figure (7): CFA occlusion with contralateral iliac occlusion.



Figure (8): A 6-F sheath in the popliteal artery.



Figure (9): Confirmation of the lower limit of the SFA lesion.

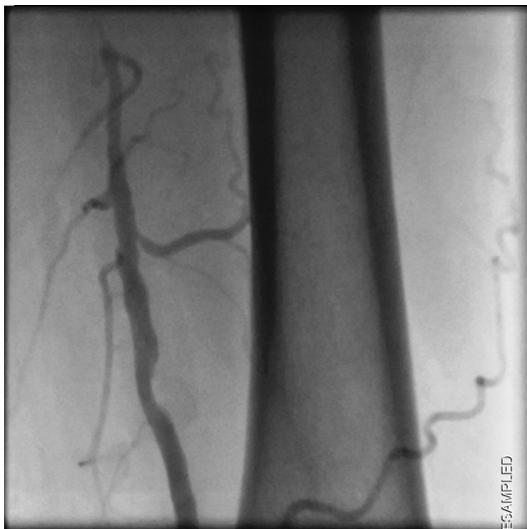


Figure (10): Another example of the lower end of the lesion.



Figure (11): A third example of the lower limit of the lesion.

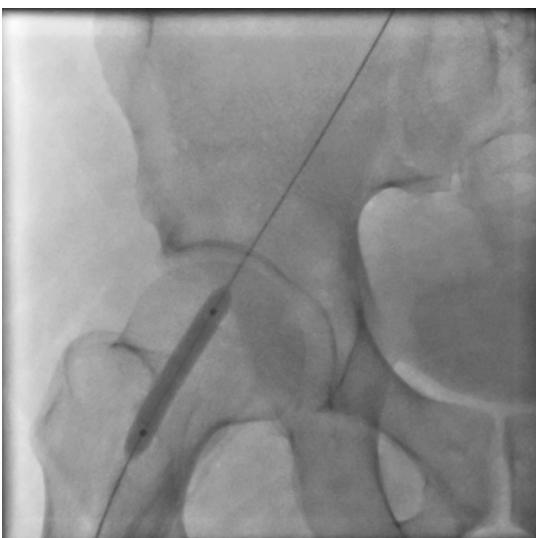


Figure (12): Retrograde balloon angioplasty.



Figure (13): Another example of retrograde balloon angioplasty.

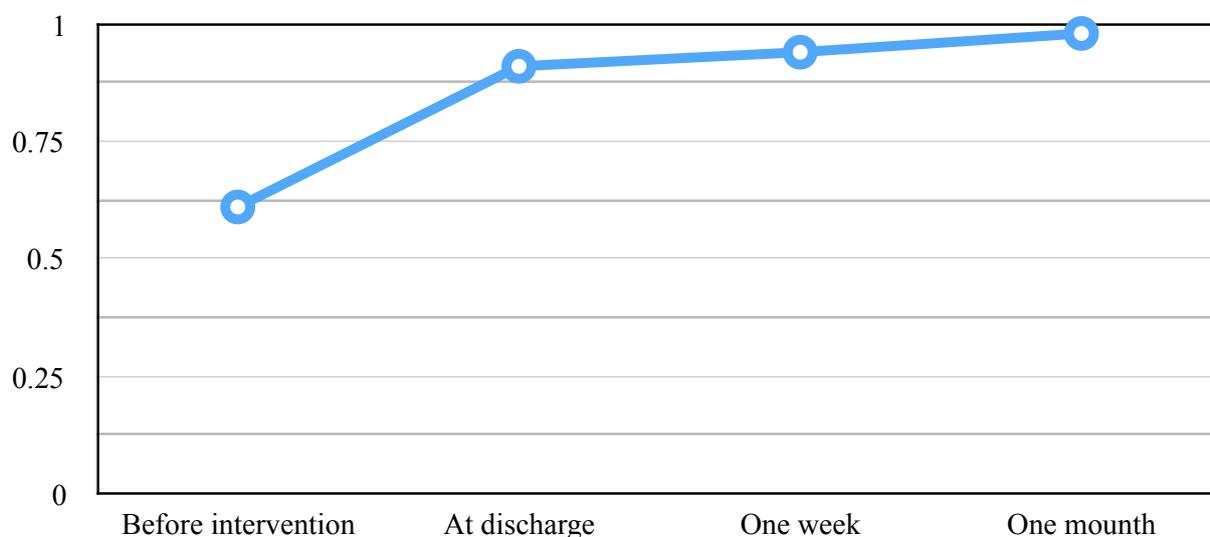


Figure (14): Change in the Mean of the ABIP

Table (1): Distribution of the ABIP at presentation.

ABIP		Number	%
The presenting Limb	0.3 - < 0.5	0	0%
	0.5 - < 0.7	18	78%
	0.7 - < 1	5	22%
Mean +/- St. D			0.61 +/- 0.079

month, that confirms the early suggestions regarding the safety of the procedure.^{19,20}

Conclusion:

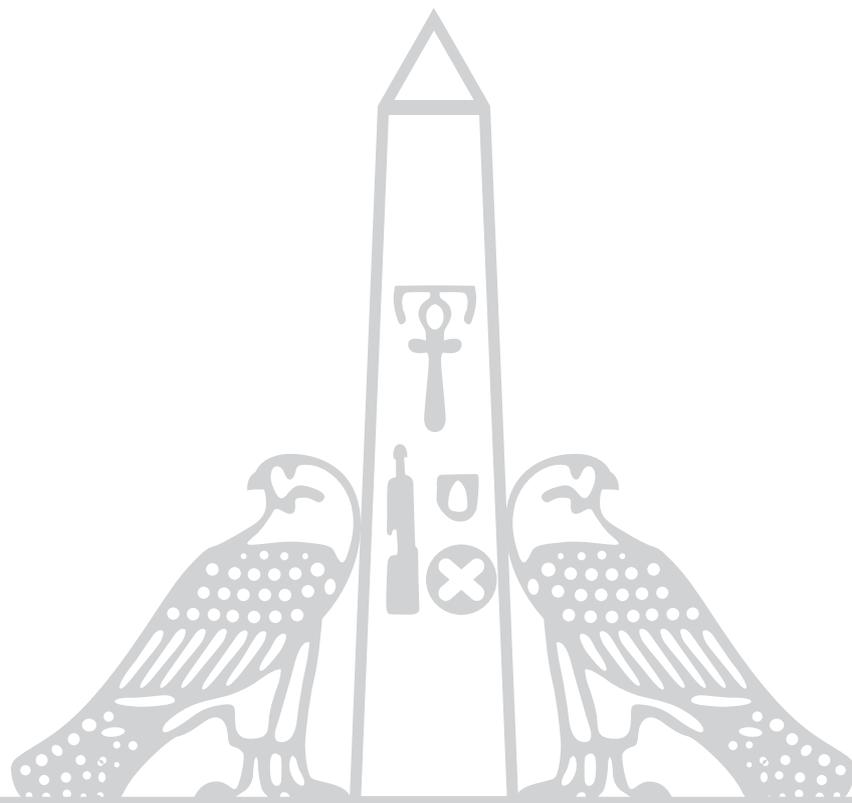
Transpopliteal approach is feasible, safe and successful in treating CFA or SFA lesions when indicated. This approach should augment the ability to continue using the endovascular procedure when the antegrade approach failed or cannot be used.

It is a cheap and simple alternative to the re-entry devices and can replace it when indicated.

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