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Clinical Vision Special Edition

Critical Limb Ischemia: EVI 2006

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In coronary or in peripheral arteries, re-canalizing arterial chronic occlusions by endovascular techniques implies, in almost all cases, preliminary crossing of the occlusion with guidewires. Once the lesion has been crossed, it then becomes possible to use the most appropriate device for the case, for example, balloon catheter, atherectomy or laser, to complete the intervention. Thus, a correct and efficient technique to cross the occlusion is a key step in restoring blood flow by endovascular interventions.

Despite some reports about recanalization possibilities of occluded small size arteries with sub-intimal techniques[1], the passage of the wire through the "true lumen" is the most desirable way to achieve the recanalization of coronary as well as tibial arteries.

Based on our experience with respect to chronic tibial occlusions, the technique that has been successful, and also feasible in 80% of attempted cases, consists of using a system combining:

- balloon catheters with small guidewire compatibility (*Bijou™* 0.018", Boston Scientific)
- a high support, polymeric-hydrophilic 0.014" coronary-type wire (*PT Graphic™ Extra Support*, Boston Scientific).

For more information you can also check our website www.extrem-es-angioplasty.it.

Alternatively, it is possible to use a 4Fr Bernstein angled catheter over a 0.35" wire. Although this system allows correct crossing of occlusions in the majority of cases[2, 3], in some situations it is not possible to do so with this standard technique. Implications in the case of failure would be sending the patient to undergo traditional bypass surgery or even major amputation. Given the higher morbidity rate associated with both these procedures[4, 5], there are other alternative endovascular alternatives worth exploring in order to cross chronic tibial occlusions.

These are:

- **angioplasty of stenotic collaterals to obtain direct flow to the foot**
- **loop approach (plantar arch recanalization, opposite tibial artery recanalization)**
- **opposite double-wire technique**
- **retrograde puncture of the tibial or pedal arteries**

In this Special Edition we describe some clinical cases in which these above-stated alternative approaches were successfully adopted.

References

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Obtaining direct flow to the foot by PTA of stenotic collaterals

Patient Background

This is a case of a 72-year-old patient with diabetes mellitus and an ischemic ulcer, localized at the forefoot. After angiography it was evident that the peroneal artery was the only patent infrapopliteal artery (Fig 1 & 2). It gave stenotic collateral (Posterior Communicating Branch) to the plantar artery. The plantar artery itself was severely stenosed at the origin of its two major branches. This finding was particularly evident with a contrast medium injection using a small balloon catheter with its tip in the distal peroneal artery (Fig 3).


Fig 1


Fig 2

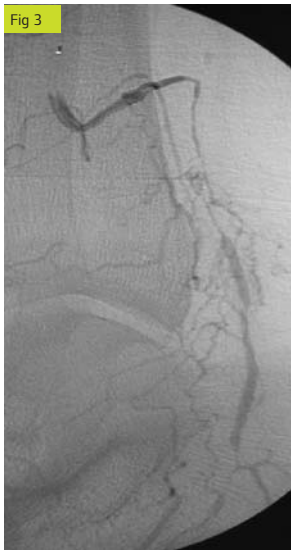


Fig 3

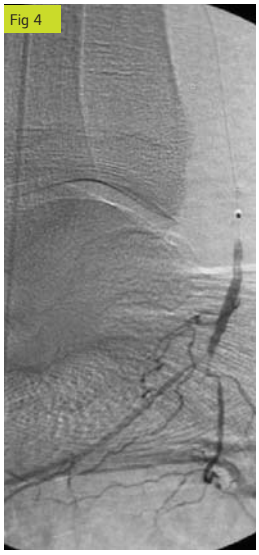
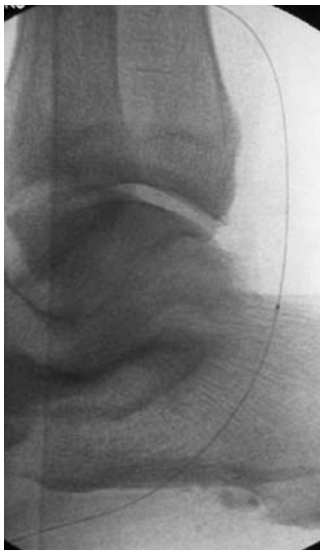


Fig 4




Baseline


Final Result

Procedure

A *PT Graphic™ Super Support,* a 0.014" coronary guidewire, Boston Scientific, was advanced through the peroneal artery, the stenotic collateral and then positioned into the distal plantar artery.

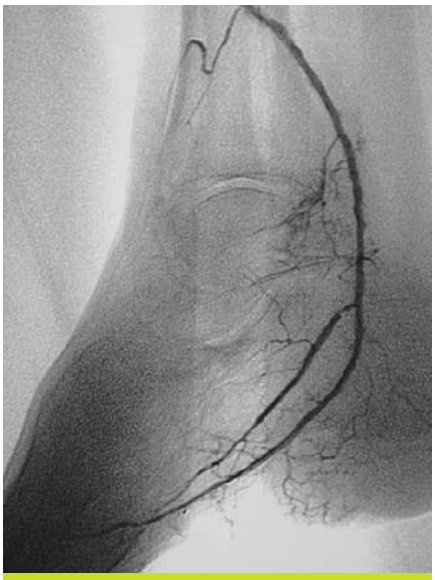
.A balloon catheter was then advanced into the collateral and an angiography through the catheter confirmed its continuation with the plantar artery (Fig 4). A 2 x 80mm OTW balloon catheter was positioned into the plantar artery, and then inflated at 12 ATM (Fig 5 & 6).

Outcome

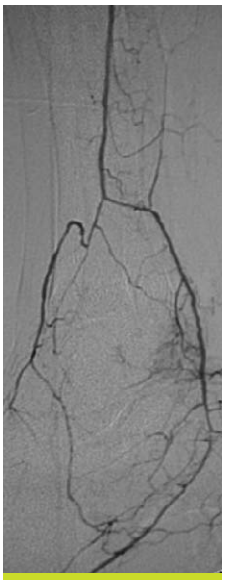
The final result consisted in obtaining direct flow to the foot through a recanalized peroneal and plantar artery, as can be seen from the Baseline and Final Result angiograms.

Transluminal angioplasty of stenotic collaterals to obtain direct flow to the foot

Baseline



Result



6 months follow-up

Patient Background

This was a dialysis patient with Critical Limb Ischemia and an ischemic, non-healing ulcer of the right forefoot.

There was occlusion of both anterior and pedal artery and occlusion of the long part of the posterior tibial artery. The posterior communicating branch of the posterior tibial artery was also occluded.

Procedure

A similar approach to the one described in the first case study was adopted and the result is shown in the figure on the left.

Outcome

At six months, we performed an angiographic follow-up angiography of the same foot. It showed a patency of the dilated collateral, with persistence of direct flow to the foot which resulted in healing the ulcer and avoiding amputation.

Trans-Loop opposite tibial artery recanalization

Patient Background

This case shows a left leg angiographic image of a 68-year-old man with type 2 diabetes mellitus complicated by a non-healing ischemic ulcer of the calcanear region with a TcPO2 of 16mmHg.

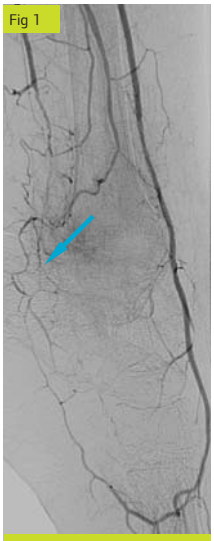
The angiogram was done through an ipsilateral antegrade femoral approach and with a 6ml injection of 50% diluted contrast media.

The main finding was an isolated occlusion (blue arrow) of the distal segment of the posterior tibial artery and of the plantar artery (Fig 1).

Procedure

It was not possible to cross this occlusion using a standard antegrade approach.

A 0.014″ hydrophilic guidewire *(PT Graphic™ Standard,* Boston Scientific) was advanced through the anterior tibial artery and the plantar loop. The posterior tibial artery occlusion was crossed by this retrograde approach, supporting the guidewire with a 2.0 x 80mm over-the-wire balloon, which was inflated at 14atm (Fig 2 and 3).



Baseline

Final Result

Outcome

The final result, shown in Fig 4, consisted in restoring direct antegrade flow to the posterior tibial and plantar artery (green arrow), which corresponded to the area where the ischemic ulcer was present.

The passage of the balloon caused residual, transient spasm in the distal anterior tibial artery, marked here by the small white arrow.

Plantar arch recanalization

Patient Background

This a case of a 71-year-old woman with type 2 diabetes mellitus complicated by a non-healing right foot calcanear ischemic ulcer with a TcPO2 of 26 mmHg. Figures 1 and 2 show the angiographic findings using an antegrade femoral approach, with a 6ml of 50% diluted contrast media injection.

There were no inflow obstructions, whereas moderate stenoses at the levels of the proximal anterior tibial and the peroneal arteries were evident. The posterior tibial artery was occluded, and blood flow to the foot was guaranteed by the anterior tibial artery. However there was a poor supply of blood to the back foot. The two main reasons for that were a typical lack of collaterals formation from the peroneal artery and, secondly, an interruption (signalled by an arrow) of the plantar loop (Fig 3).

Fig 1

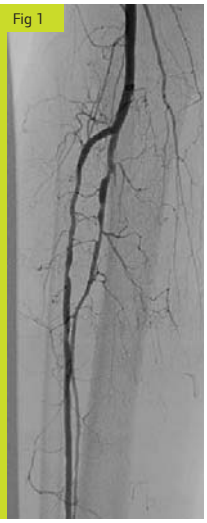


Fig 2

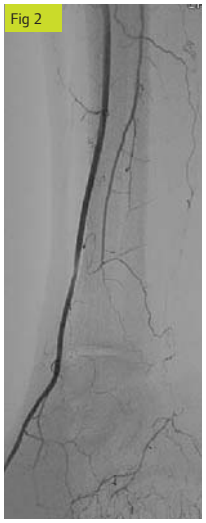


Fig 3

Fig 4

Fig 5

Fig 6

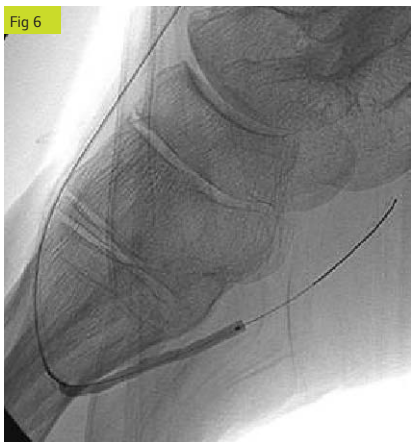


Fig 7

Fig 8

Procedure

A hydrophilic 0.014″ guidewire (*PT Graphic™ Standard,* Boston Scientific) was advanced supported by a small-vessel over-the-wire balloon catheter, which was brought to the plantar arch. A selective injection of contrast medium was performed from the deflated balloon catheter for a better clarification of the anatomy (Fig 4). The wire was then advanced to the plantar artery, and then a 2.0 x 40mm balloon was inflated in two steps at 12 atm. (Fig 5 and 6).

Outcome

Figures 7 and 8 show the final result where the blood flow increased significantly to the back foot. Ten days after the intervention the TcPO2 went up to 38 mmHg.

Opposite double guidewire technique – Case 1


Fig 1


Fig 2

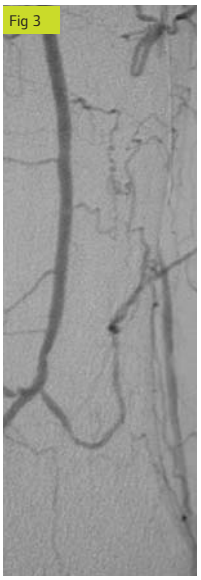


Fig 3

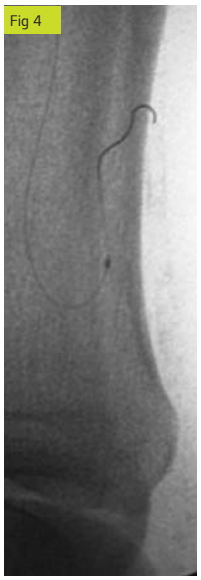


Fig 4


Fig 5

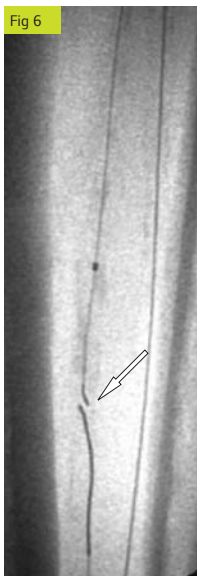


Fig 6


Fig 7


Fig 8


Baseline


Final Result

Patient Background

Figures 1 and 2 show findings of an ipsilateral antegrade femoral angiography in a 65-year-old woman with type 2 diabetes mellitus complicated by a non-healing ischemic ulcer localized at the forefoot (TcPO2=11mmHg). The only patent infrapopliteal vessel was the peroneal artery, which provided a thin collateral coming through the anterior perforating branch into the isolated pedal artery (Fig 3).

Procedure

Given the run-off situation, recanalization of the anterior tibial artery was the best interventional option. However, despite some attempts, it was not possible to completely cross the occlusion from above. We were able to pass through the upper part of the occluded anterior tibial artery with a .014" hydrophilic wire (*PT Graphic™ Super Support,* Boston Scientific). An adjunctive .014" guidewire (same type) was advanced through the peroneal artery, the anterior perforating branch collateral and then the anterior tibial artery in a retrograde fashion (Fig 4 and 5). The two wires, one from above and the other from below, met at the intermediate part of the occlusion (Fig 6).

The possibility of partially crossing the occlusion from the retrograde approach provided a sort of road-map which made it possible for the wire from above to go further down, as far as the pedidis artery (Fig 7). Over this latter wire, we advanced and inflated a 3.0 x 80mm *Bijou™ Balloon Catheter,* Boston Scientific (Fig 8).

Outcome

The final result shows, in comparison with the baseline situation, a significant improvement in blood flow supply.

Retrograde puncture of the tibial artery

Patient Background

Figures 1, 2 and 3 show angiographic findings through an ipsilateral antegrade femoral approach in a 68-year-old man with type 2 diabetes mellitus complicated by a non-healing ischemic ulcer (TcPO2=14mmHg) of the big toe.

No inflow obstruction was noted. The posterior tibial artery was completely occluded. The peroneal artery was patent, whereas the anterior tibial artery was occluded at the proximal portion, with good distal run-off.

Procedure

It was not possible to cross the anterior tibial artery occlusion from above, thus, a retrograde approach was chosen:

The Dorsalis Pedis artery was punctured with a 19-G needle under fluoroscopy (Fig 4). A 4-F sheath was introduced into the artery (Fig 5). A 0.014" hydrophilic wire was advanced from below, and the occlusion was completely crossed (Fig 6 and 7). A 3.0 x 120mm balloon catheter was advanced over the wire and inflated in three steps.

Outcome

Figures 8 and 9 respectively show the acute final result and the follow-up angiography at 30 days.


Fig 1


Fig 2

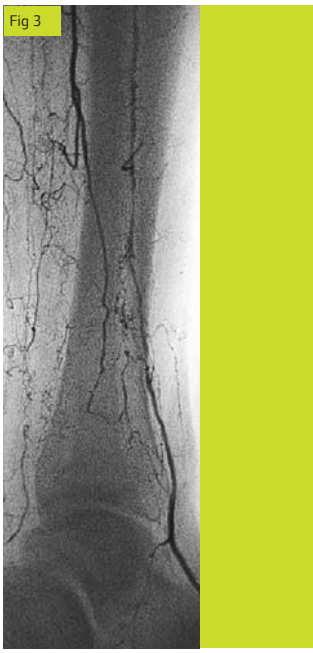


Fig 3


Fig 4


Fig 5


Fig 6


Fig 7

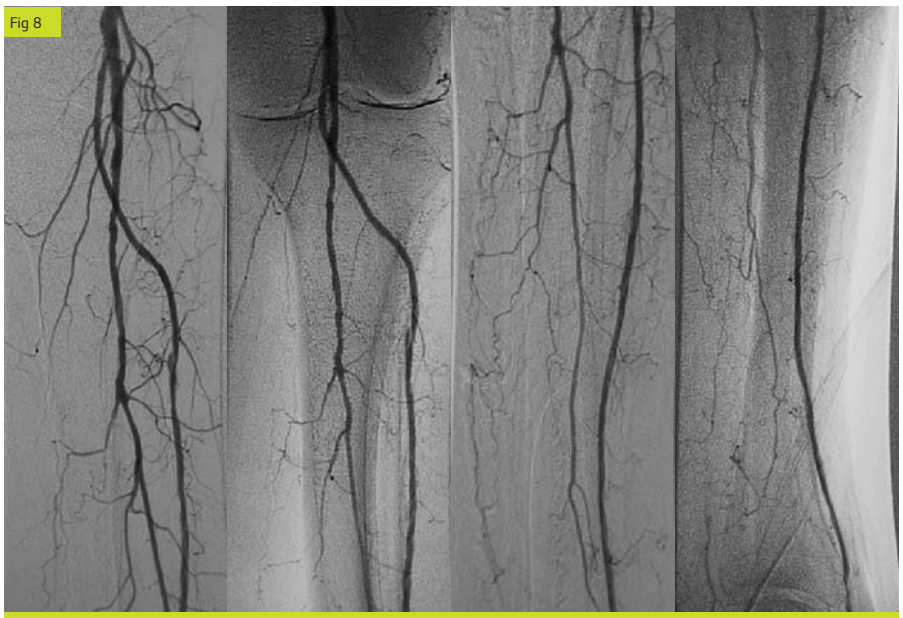


Fig 8

Final Result


Fig 9

One month follow-up

Opposite double guidewire technique – Case 2

Patient Background

This is a case of a 67-year-old male with Critical Limb Ischemia, rest pain and an ulcerated foot (Fig 1).
The antegrade right leg angiography shows a popliteal occlusion with the anterior tibial artery as the only patent crural vessel.

Procedure

An angled 4Fr catheter was advanced from above over a .035″ straight wire. Once at the level of the ostium, we tried, unsuccessfully, to reach the anterior tibial artery with a .014″ hydrophilic wire. This can be seen by noting the wire tip position in the extra vascular space.

An angiography of the foot showed a good and patent Dorsalis Pedis artery (Fig 2). We then punctured this artery and catheterized it with a 4Fr vascular sheath (*Medikit™ Super Sheath,* Boston Scientific).

Using the same kind of wire (*PT Graphic™ Super Support,* Boston Scientific), a second angled 4Fr catheter was advanced upward over the ostium of the anterior tibial artery to force the occlusion into a "loop" configuration for a sub-intimal crossing and hence reaching the popliteal lumen. From the puncture site below, the 4Fr catheter followed a guidewire into the popliteal lumen. The wire was then removed.

To gain an antegrade approach for a popliteal and tibial recanalization, the first .014″ wire was advanced downward through the first 4Fr catheter and then into the second catheter.

Figure 3 shows the tips of the two angled 4Fr catheters pushing one against the other, thus behaving as one unit. The whole system was pulled down, to minimize trauma in the occluded segment. Once the tip of the 4Fr catheter advanced from above completely crossed the occlusion, the 4Fr catheter advanced from below was removed.

Over the 0.014″ support wire in place (*PT Graphic™ Super Support,* Boston Scientific), two balloon catheters (*Bijou™* 3.0 x 80mm and *Synergy™* 5 x 80mm, both Boston Scientific) were introduced and used to dilate respectively the anterior tibial and popliteal arteries. The placement of a nitinol stent was necessary to achieve a good result at the level of the popliteal artery.

Fig 1

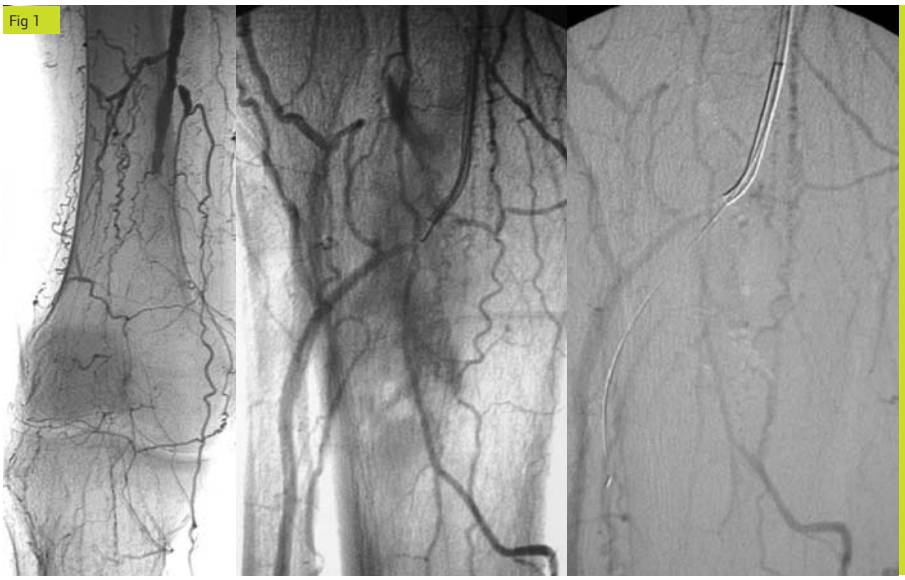


Fig 2

Fig 3

ClinicalVision Special Edition

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