

## CASE REPORT

## Substent Anchor Technique for Recanalisation of a Full Metal Jacket Femoropopliteal In-Stent Occlusion

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**Purpose:** To report the endovascular treatment of a full metal jacket (FMJ) femoropopliteal chronic total occlusion (CTO) using a new ancillary retrograde technique.

**Case report:** An 80 year old woman with type 2 diabetes presented to the Diabetic Foot Clinic with critical limb ischaemia with tissue loss in the right leg. Her comorbidities included coronary artery disease, morbid obesity, hypertension, dyslipidaemia, and active smoking habit. The patient had been treated at another hospital by femoropopliteal FMJ stenting six years before this presentation. The duplex ultrasound showed a full length in-stent re-occlusion. An antegrade recanalisation was attempted via contralateral femoral access, but was unsuccessful. An ultrasound guided retrograde puncture of the popliteal artery in the P2 segment was performed very close to the distal occluded stent. A 0.018 guidewire was pushed in the substent plane, functioning as an anchor to achieve a stable system. The FMJ was then retrogradely recanalised with a second guidewire. The procedure was completed by antegrade angioplasty with drug coated balloons.

**Conclusion:** The substent anchor technique can help to achieve stability even if close to the occluded stents, and spares the distal landing zone for surgical revascularisation if the endovascular approach fails. This technique could be useful in retrograde treatment of long in-stent CTO.

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### INTRODUCTION

Recanalisation of in-stent chronic total occlusion (CTO) is one of the more challenging procedures among the endovascular treatments of peripheral artery disease. The intraluminal progression of the guidewire is often unsuccessful, leading to the need for a subintimal/substent approach. In long in-stent occlusion this may represent a technical challenge and require side by side stenting with poor long-term results.<sup>1</sup> Full metal jacket (FMJ) stenting is typically described as long segment continuous stenting of a vessel segment. When such a long stented tract occludes, it often becomes very difficult to treat the target lesion with a standard antegrade approach. In most cases the retrograde route allows easier access to the stent true lumen. Nevertheless, it is crucial that the retrograde approach does not

result in loss of the distal landing zone for further surgical revascularisation. The aim of this case report is to describe a novel technique that could help to gain system stability as well as being in proximity to the end of the CTO.

### CASE REPORT

An 80 year old woman with type 2 diabetes presented to the Diabetic Foot Clinic with untreatable rest pain and ischaemic non-healing ulcers of the right forefoot and ankle. Her past medical history included coronary artery disease, morbid obesity, hypertension, dyslipidaemia, and active smoking habit. Six years before attending the Diabetic Foot Clinic, the patient was treated at another hospital with a femoropopliteal recanalisation and FMJ stenting covering the proximal part of the superficial femoral artery (SFA) to the P2 segment of the popliteal artery (PA).

The ankle brachial index at rest was non-diagnostic because of arterial incompressibility and the transcutaneous oxygen tension (TcPO<sub>2</sub>) measurement on admission was 18 mmHg. The duplex ultrasound showed a full length in-stent re-occlusion (Tosaka<sup>2</sup> class III) with flush occlusion at the level of the SFA and patency of PA at the joint as well as the anterior tibial and peroneal arteries.

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The body habitus of the patient and the presence of the flush occlusion of the SFA meant that the access of choice was an antegrade approach via contralateral retrograde common femoral artery (CFA) puncture. A 6 F reinforced 45 cm sheath (Accuflex Bipore, Northvale, NJ, USA) was placed at the right CFA. After sheath insertion, 5,000 units of heparin were administered and the activated clotting time was maintained in the range of 200–250 s throughout the procedure. Pre-procedural angiography confirmed the duplex findings (Fig. 1). Antegrade attempts to cross the FMJ occlusion intraluminally with a 0.018 inch hydrophilic guidewire (V-18 Control Wire, Boston Scientific, Marlborough, MA, USA) supported by a 4 F diagnostic type 2 Berenstein catheter (Tempo, Cordis, Miami Lakes, FL, USA) were unsuccessful. The guidewire was unable to proceed beyond the proximal third of the SFA as it engaged the stent strut and entered into the subintimal/substent space. The right lower limb was then positioned in external rotation and the knee in a moderate flexion. Retrograde ultrasound guided puncture (20 gauge needle) of the PA in the P2 segment about 1 cm below the end of the distal stent was performed. A 0.018 inch hydrophilic V-18 Control guidewire was pushed into the substent plane taking advantage of the guidewire engagement angle and the arterial wall stiffness in the stented tract. A 5 F transradial thin wall introducer sheath (Glidesheath Slender, Terumo, Somerset, NJ, USA) was placed with just the tip in the PA lumen (Fig. 2a and b). The distal end of the FMJ was interrogated with a 4 F type 2 Berenstein catheter and a second 0.018 inch V-18 Control guidewire, which was advanced intraluminally (Fig. 2c and d). The correct position was checked with multiple oblique projections. The tip of the guidewire was immediately looped to avoid accidental extraluminal passage through the struts. The wire and the catheter were pushed up to the



**Figure 1.** Pre-procedural angiogram shows the full metal jacket (A), the proximal superficial femoral artery occlusion (B), the distal recanalisation (C), and the below the knee outflow (D).

proximal SFA, re-entering in the CFA (Fig. 2e and f). From the antegrade sheath, a 0.014 inch nitinol wire (Hi-Torque Command ES, Abbott, Santa Rosa, CA, USA) was advanced through the occluded FMJ following the retrograde guidewire and reaching the PA (Fig. 2g and h). The guidewire crossed the PA and was positioned in the peroneal artery (Fig. 2i). Balloon angioplasty was performed via the antegrade approach (Fig. 2j and k) with 4.0×200 mm (Armada 14, Abbott, Santa Rosa, CA, USA) and 5.0×250 mm balloon catheters (Armada 35 LL, Abbott, Santa Rosa, CA, USA). Drug coated balloons were finally deployed (Elutax, Aachen Resonance, Luxembourg) to reduce risk of recurrent stenosis. A 4.0×40 mm balloon catheter was positioned from the antegrade approach in the popliteal puncture site. The retrograde sheath was removed while the balloon catheter was inflated for 4 min at nominal pressure to achieve haemostasis. The completion angiogram showed patency of the recanalised FMJ and PA with preservation of two vessel runoff (Fig. 3).

The patient had an uncomplicated recovery and was discharged three days post-operatively, with resolution of rest pain. Dual antiplatelet therapy (aspirin 100 mg and clopidogrel 75 mg once daily), started the day before the procedure, was continued for three months and thereafter aspirin was prescribed lifelong.

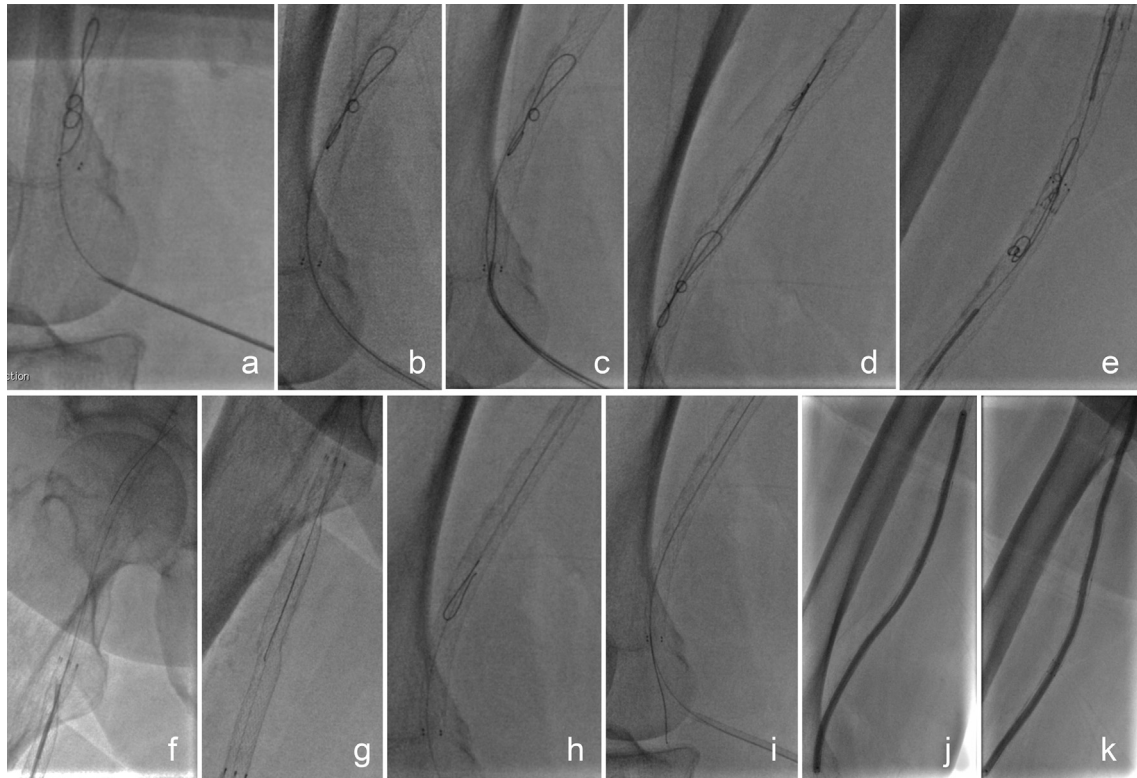
One month after the procedure, TcPO<sub>2</sub> increased to 48 mmHg. At two months' clinical follow up no recurrent rest pain was present and ulcers were completely healed. The patient had a duplex ultrasound examination six months after the procedure, which confirmed patency of the recanalised FMJ without significant restenosis.

## DISCUSSION

Stenting of the SFA and PA was introduced almost two decades ago, showing a high rate of technical success and low risk of complications. Stents are often required to treat significant recoil, flow limiting dissection, or residual stenosis after angioplasty. The metal stent itself can cause neointimal hyperplasia leading to restenosis and re-occlusion.<sup>3</sup> Although introduction of self expanding nitinol stents significantly improved intermediate outcomes, in-stent restenosis is reported in 18.7–37% of patients at one year and clearly remains a major concern.<sup>3,4</sup> In-stent occlusion is the most important complication, representing a technical challenge with a high recurrence rate after treatment.<sup>2,3,5</sup>

Although FMJ was reported to have good acute results, multiple overlapped stent deployment is related to poor patency because of increased stiffness and decreased flexibility within a background of extensive atherosclerotic lesions.<sup>5,6</sup>

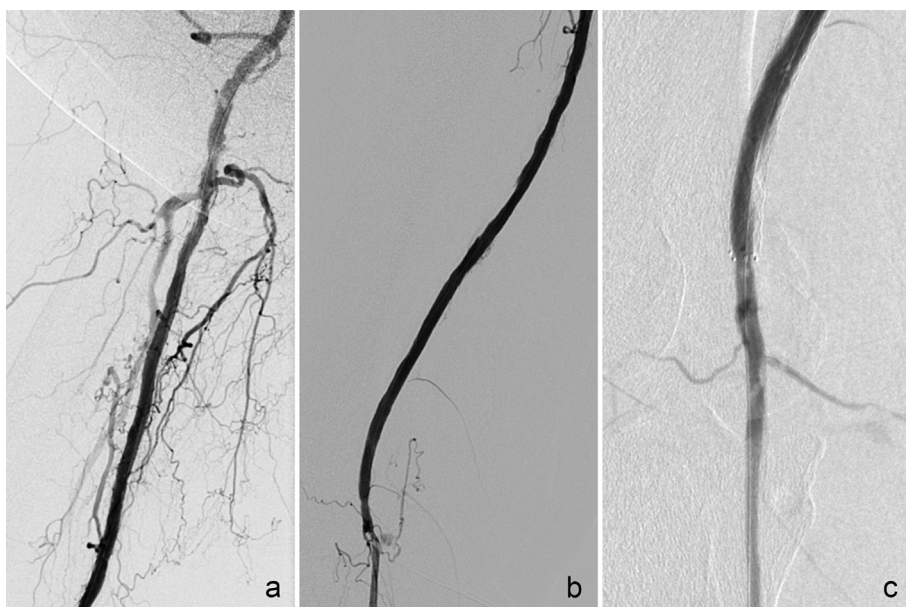
Intraluminal antegrade recanalisation of long in-stent occlusion is often impossible because of an inability to access the stent true lumen and maintain the guidewire intraluminally, avoiding engagement of the stent strut. Many devices, such as a support catheter and intraluminal crossing devices, can be used with good results to facilitate



**Figure 2.** Percutaneous retrograde popliteal puncture with subtent guidewire positioning (a) and sheath introduction (b); interrogation of the distal occlusion cap with Berenstein II catheter and a second 0.018 inch guidewire (c); recanalisation of the full metal jacket (d–h); re-entry into the popliteal artery with the antegrade 0.014 guidewire (i); and sequential angioplasty (j,k).

guidewire placement distal to the occlusion.<sup>7</sup> In addition, debulking devices (directional or laser atherectomy) can be useful in treatment of in-stent occlusions.<sup>3</sup> However, crossing the lesion with a guidewire is the main issue in treating CTO and represents the limit of almost all these devices. An exception and a possible option is the DABRA

system (Ra Medical Systems, Carlsbad, CA, USA), which is the first laser atherectomy device designed to be used without a guidewire. If the intraluminal recanalisation fails, a subintimal/subtent approach has been proposed.<sup>1</sup> When successful, this requires side by side stenting which is inadvisable in the case of FMJ occlusion.



**Figure 3.** Completion angiograms before (a,b) and after sheath removal (c).

For antegrade failure, an effective alternative may be to approach the CTO using the retrograde technique. A direct stent puncture was proposed for retrograde recanalisation with good clinical results and low complication rate.<sup>8</sup> However, this technique could be very difficult or unfeasible in obese patients with long occlusion involving both femoral and popliteal segments. The standard retrograde technique approaches the occlusion from the distal softer cap.<sup>9</sup> This technique has been reported with high procedural success and low peri-procedural complication rate as initial treatment for femoropopliteal CTO, but rarely for revascularisation of stent occlusion.<sup>10</sup> As a downside, this attractive technique involves the risk of damage to the outflow or the distal landing zone for further surgical revascularisation. For this reason, it is advisable to perform arterial puncture as close as possible to the end of occlusion. To overcome lack of sheath stability, required for managing long in-stent occlusion, immediately after arterial puncture a buddy wire was pushed into the substent plane. This procedure was relatively easy because of the engagement angle of the guidewire and the different mechanical compliance between the stented and non-stented tract of the arterial wall. The buddy wire, functioning as an anchor, allowed insertion of just a few millimeters of a 5F sheath inside the PA, at the same time being a stable system and offering proper support during the procedure.

### CONCLUSIONS

Recanalisation of a chronically occluded FMJ is a challenging but feasible procedure. The substent anchor technique could be useful in retrograde recanalisation of long in-stent occlusion after unsuccessful intraluminal lesion access via an antegrade approach.

This technique allows for a stable system while staying very close to the occluded stents. This offers greater ability to push through, and preserves the distal landing zone for further surgical revascularisation.

### CONFLICTS OF INTEREST

None.

### FUNDING

None.

### REFERENCES

- 1 Duterloo D, Lohle P, Lampmann L. Subintimal double-barrel restenting of an occluded primary stented superficial femoral artery. *Cardiovasc Intervent Radiol* 2007;**30**:474–6.
- 2 Tosaka A, Soga Y, Iida O, Ishihara T, Hirano K, Suzuki K, et al. Classification and clinical impact of restenosis after femoropopliteal stenting. *J Am Coll Cardiol* 2012;**59**:16–23.
- 3 van den Berg JC. In-stent restenosis management: the best is yet to come. *J Cardiovasc Surg (Torino)* 2017;**58**:508–17.
- 4 Grotti S, Liistro F, Angioli P, Ducci K, Falsini G, Porto I, et al. Paclitaxel-eluting balloon vs standard angioplasty to reduce restenosis in diabetic patients with in-stent restenosis of the superficial femoral and proximal popliteal arteries: three-year results of the DEBATE-ISR study. *J Endovasc Ther* 2016;**23**:52–7.
- 5 Yang X, Lu X, Li W, Huang Y, Huang X, Lu M, et al. Endovascular treatment for symptomatic stent failures in long-segment chronic total occlusion of femoropopliteal arteries. *J Vasc Surg* 2014;**60**:362–8.
- 6 Shah PS, Hingorani A, Ascher E, Shiferson A, Gopal K, Jung D, et al. Full metal jacket stenting of the superficial femoral artery: a retrospective review. *Ann Vasc Surg* 2011;**25**:127–31.
- 7 Banerjee S, Sarode K, Patel A, Mohammad A, Parikh R, Armstrong EJ, et al. Comparative assessment of guidewire and microcatheter vs a crossing device–based strategy to traverse infrainguinal peripheral artery chronic total occlusions. *J Endovasc Ther* 2015;**22**:525–34.
- 8 Palena LM, Manzi M. Direct stent puncture technique for intraluminal stent recanalization in the superficial femoral and popliteal arteries in-stent occlusion: outcomes from a prospective clinical analysis of diabetics with critical limb ischemia. *Cardiovasc Revasc Med* 2013;**14**:203–6.
- 9 Godino C, Carlino M, Al-Lamee R, Colombo A. Coronary chronic total occlusion. *Minerva Cardioangiol* 2010;**58**:41–60.
- 10 Schmidt A, Bausback Y, Piorkowski M, Werner M, Bräunlich S, Ulrich M, et al. Retrograde recanalization technique for use after failed antegrade angioplasty in chronic femoral artery occlusions. *J Endovasc Ther* 2012;**19**:23–9.