

## Case Report

# Novel technique for resolving a stuck rotational atherectomy device in a peripheral artery: a case report

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**Abstract:** Rotational atherectomy device entrapment is a rare but challenging complication of peripheral vascular interventions. This case report details a novel dual-access endovascular technique for retrieving an entrapped atherectomy burr from the posterior tibial artery of a 70-year-old man with severe peripheral arterial and chronic kidney disease. When conventional retrieval methods failed, retrograde posterior tibial access was established as an adjunct to the existing femoral access, enabling sequential balloon angioplasty with progressively larger balloons (1.5-2.5 mm) around the entrapped device. This dual-access approach successfully liberated the burr without requiring surgical extraction or arteriotomy. Following device retrieval, definitive treatment with balloon angioplasty and stent placement was completed immediately, achieving excellent restoration of flow. This minimally invasive technique offers several advantages over traditional surgical approaches, including vessel patency preservation, reduced procedural morbidity, avoidance of general anesthesia, and protection of potential future bypass targets. The described methodology expands the endovascular options for managing complex device-related complications and demonstrates particular value in high-risk patients with significant comorbidities.

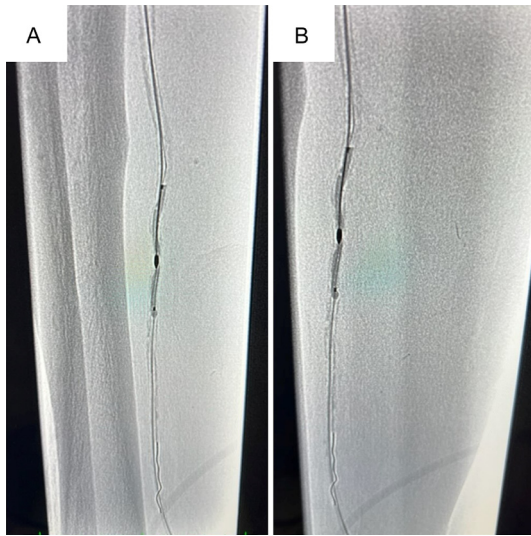
**Keywords:** Rotational atherectomy, device entrapment, peripheral vascular intervention, endovascular technique

### Introduction

Peripheral arterial disease (PAD) represents a substantial source of vascular morbidity, particularly in advanced manifestations classified as Rutherford category IV, wherein patients experience ischemic rest pain and confront an elevated risk of limb amputation consequent to severe atherosclerotic occlusive disease [1]. The presence of extremely calcified arterial lesions constitutes a formidable barrier to endovascular revascularization strategies, frequently excluding the success of routine percutaneous transluminal angioplasty interventions [2]. Rotational atherectomy (RA) has become a valuable component of the interventional armamentarium, enabling the creation of a favorable environment by remodeling calcified atherosclerotic plaques, followed by subsequent balloon angioplasty or stent deployment [3].

Contemporary atherectomy devices demonstrate exceptional technical success rates, frequently exceeding 90% in both coronary and peripheral arterial interventions, establishing their utility in complex revascularization procedures [4].

The etiology of device entrapment during rotational atherectomy is multifactorial, encompassing device-related, anatomical, and procedural factors. Device-related causes include mechanical stress from high-speed rotation against resistant calcified plaques, inherent design limitations of cutting mechanisms, and potential durability issues, leading to device fracture or component separation. Anatomical factors significantly contribute to entrapment risk, particularly in vessels with severe calcification, extreme tortuosity, or significant luminal narrowing that creates size mismatches bet-



**Figure 1.** A, B. Balloon angioplasty of the posterior tibial artery across the stalled 1.5 mm Rotablator burr. Balloon delivered via the posterior tibial artery access.

ween the burr and vessel diameter. The natural tapering of peripheral arteries, especially in tibial vessels, increases the likelihood of device impaction when burrs are advanced too distally or inappropriately upsized. Additionally, suboptimal guidewire positioning, particularly subintimal wire placement, can predispose to device entrapment by creating unfavorable tracking conditions [5-7].

Despite its therapeutic efficacy, RA carries inherent procedural risks. Although uncommon, complications including vessel perforation, distal embolization, and device entrapment may occur with potentially significant clinical sequelae [8]. Device entrapment, characterized by immobilization of the atherectomy burr within the target vessel, represents a particularly challenging complication documented in both coronary and peripheral vascular interventional settings. Multiple factors predispose to this complication, including severe calcification, vessel tortuosity, and technical procedural limitations [9]. Traditional management approaches frequently necessitate conversion to open surgical extraction, representing a high-morbidity intervention, particularly in peripheral arterial territories where surgical access presents anatomical complexities and the patient population frequently exhibits multiple comorbidities that increase perioperative risk [10].

As the application of RA techniques has expanded from coronary to peripheral arterial interventions, the development of specialized complication management algorithms has become increasingly essential. Herein, we present a case of RA device entrapment during peripheral arterial intervention that was successfully resolved using a novel, minimally invasive endovascular approach incorporating a dual-access technique with retrograde posterior tibial access and targeted balloon angioplasty techniques, thus avoiding the morbidity associated with conventional surgical extraction.

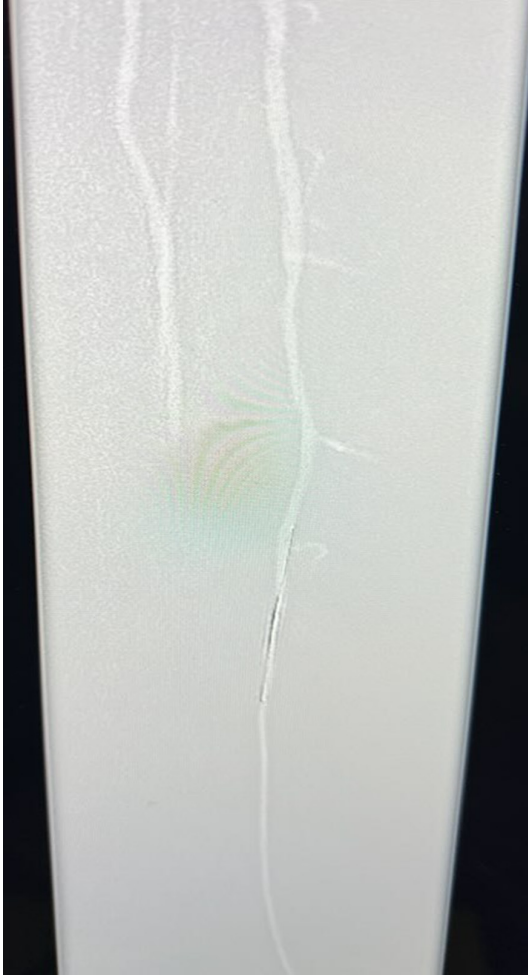
## Case presentation

A 70-year-old male with a history of severe PAD, Rutherford class IV (resting pain), and chronic kidney disease (CKD) presented to our hospital for endovascular intervention. The patient had undergone prior revascularization of both lower extremities. Doppler studies confirmed severe disease involving the SFA, popliteal, and tibial arteries.

Ultrasound-guided access was initially obtained in the right common femoral artery (CFA) for the primary intervention. Following device entrapment, additional retrograde access was obtained via the right posterior tibial artery (PTA) to facilitate device retrieval. CO<sub>2</sub> angiography revealed total occlusion in the proximal to mid SFA and popliteal artery, with single-vessel runoff via the peroneal artery. PTA was occluded in the midportion, and the anterior tibial artery was occluded proximally with distal reconstitution.

The lesions in the SFA and popliteal artery were crossed with difficulty using a glide wire and a NavaCross catheter. A RotaWire was placed in the distal PTA and rotational atherectomy was performed using a 1.5 mm burr. During atherectomy of PTA, the burr became lodged in the distal segment and could not be retrieved using standard methods (**Figure 1**).

A novel retrieval technique was employed to resolve this complication. Under ultrasound guidance, retrograde access was obtained via the right PTA (**Figure 2**). The occluded PTA was then retrogradely crossed, with the wire advanced into the popliteal artery. Sequential balloon angioplasty was performed around the



**Figure 2.** Patent Posterior tibial artery post retrieval of the Rotablator burr.

entrapped burr using balloons measuring  $1.5 \times 40$  mm,  $2.0 \times 40$ , and  $2.5 \times 40$  mm (**Figure 3**). Following this pre-dilation, the rotator device was successfully retrieved without any residual complications.

After retrieving the device, definitive treatment was performed. Post-dilation of the SFA and popliteal artery was accomplished using a  $6 \times 200$  mm balloon. Stenting was completed with a  $7 \times 80$  mm biomimetic stent in the popliteal artery and an  $8 \times 40$  mm stent in the SFA. Final angiography showed improved flow with 40% residual stenosis in both lesions.

The patient tolerated the procedure well and experienced no complications. Post-procedural angiography demonstrated excellent flow through the PTA and peroneal arteries. The right CFA access site was closed with a Celt device



**Figure 3.** Balloon positioned across the stalled Rotablator burr via the tibial access.

and manual pressure was applied to the PTA access site. Importantly, the novel technique avoids the need for open arterial surgery, preserves limb function, and minimizes patient morbidity.

### Discussion

This case report describes the successful endovascular retrieval of an entrapped RA device within the PTA using an innovative dual-access technique that integrates retrograde posterior tibial access with sequential balloon angioplasty. This approach effectively circumvented the need for surgical intervention in patients exhibiting significant comorbidities and heightened procedural risk, thereby presenting a viable alternative for managing such complex complications. In our experience, this technique was chosen intraoperatively after standard retrieval attempts (e.g., gentle traction and advancing the burr further) failed, as we prioritized minimizing vessel trauma in a patient with CKD, in whom surgical options

could exacerbate the renal burden through contrast use or anesthesia. We believe that this decision reflects a shift toward fully endovascular solutions in high-risk cases, allowing us to proceed directly to definitive treatment without delay.

RA has solidified its role as an essential modality in the treatment of heavily calcified peripheral arterial lesions, particularly among patients with critical limb ischemia. Nevertheless, entrapment of the atherectomy device represents an infrequent yet potentially catastrophic complication, with its documentation in peripheral vascular interventions remaining notably sparse [3]. Existing literature indicates that the incidence of rotablator entrapment in coronary interventions is less than 1%; however, its occurrence in peripheral arteries lacks precise characterization because of the limited number of reported instances [11]. A comprehensive review by Sulimov et al. [12] identified only 14 documented cases of RA devices entrapped in coronary vessels, with management approaches evenly distributed between surgical and endovascular methodologies. The risk of entrapment increases in vessels characterized by severe calcification, tortuous anatomical structures, and suboptimal burr-to-vessel size ratios. In the peripheral vasculature, these risks are intensified by the frequent presence of extreme calcification patterns and protracted lesion lengths, which are the hallmarks of advanced PAD. From our perspective, the severe calcification in this patient's tibial artery likely contributed to the entrapment, as the high-speed rotation of the burr may have embedded it deeper into the plaque than anticipated. This underscores our view that pre-procedural imaging, such as intravascular ultrasound, could enhance burr-sizing accuracy, which we now incorporate more routinely in similar cases to prevent such events.

Instrument entrapment during RA procedures can result from several mechanical, anatomical, and operational problems. Mechanical stress and structural limitations of the device itself play significant roles; high-speed rotating atherectomy devices with sharp cutting edges can exert considerable stress on the vessel wall, potentially leading to dissection, perforation, and entrapment of the device. Device durability issues may result in breakage, where some parts are left in the vessel, complicating

retrieval. Anatomic challenges, such as navigating tiny, tortuous, or severely calcified arteries, significantly increase the risk of device entrapment. For instance, distal arterial stenosis can cause the entrapment of larger burrs when pushed too distally or when they are inappropriately oversized. Poor guidewire position, particularly in the subintimal plane, can also predispose patients to entrapment by altering the course of the device [5, 6].

The operational conditions also play a very important role in the procedure. Excessive rotation or force against resistant plaque can result in a catch or jam of the device, while complications such as distal embolization, vessel spasm, or acute occlusions hinder device retrieval and increase the risk of entrapment of the device. Occasionally, breakage of the instrument and migration of the device fragments to important anatomical sites can result in extreme challenges, with the risk of significant complications, such as occlusion or perforation of vessels [7].

Several preventive strategies are recommended to reduce the risk of device entrapment. The selection of the device and burr based on vessel anatomy and degree of calcification and cautious upsizing to prevent overpassaging of smaller burrs beyond their maximal safe passage are significant. Continuous observation of device dynamics, including rotational speed, flushing, and excessive resistance, enables the prompt identification of impending entrapment. The use of embolic protection devices can reduce the risk of distal embolization, which can indirectly cause device entrapment and other complications. Operators should have complication management protocols, such as those for bradycardia, vessel trauma, or entrapped devices, for prompt recognition and intervention to prevent risks. Regular inspection of instrument integrity and maintenance, particularly for instruments that will be subjected to excess mechanical stress or are used in difficult cases, is crucial to prevent breakage and possible entrapment of the instrument [6, 13].

Historically, the management of entrapped atherectomy devices has spanned a range of strategies from the application of aggressive force and wire fracturing techniques to open surgical extraction. Traditional methodologies



often entail advancing the device further into the vessel, followed by gradual withdrawal, the use of deep sedation or general anesthesia to diminish arterial tone, and, in certain cases, intentional wire fracture to expedite retrieval [14]. However, these techniques are encumbered by significant hazards including vessel perforation, dissection, and distal embolization [9, 11]. While surgical extraction provides a definitive resolution, it introduces considerable morbidity risks, particularly in patients with prevalent comorbidities, such as CKD and severe cardiovascular disease, which are frequently observed within the PAD population. Published data suggest that approximately half of the entrapped RA devices require surgical retrieval, underscoring the need for less invasive therapeutic alternatives [11].

The innovative methodology detailed in this report utilizes dual access, incorporating retrograde pedal entry, to address complications in both the proximal and distal segments of the affected vessel. This approach employs sequential balloon angioplasty with progressively larger balloon diameters to incrementally modify the vessel architecture surrounding the entrapped device. This technique functions via several mechanisms. Initially, balloon inflation induced controlled distension of the arterial wall, thereby creating additional space around the entrapped burr. Subsequently, the graduated sizing method alters the morphology of the calcified plaque in a controlled manner, thereby reducing the risk of obstructing vascular trauma. Finally, the retrograde method enables precise balloon positioning relative to the sheathed device, thereby enabling gradual force application from the distal segment, an advance over conventional methods that are predominantly based on antegrade access or resort to surgical extraction after failed initial retrieval procedures.

This dual-access strategy offers several distinct advantages over the traditional management paradigms. In essence, it preserves vessel patency by avoiding surgical arteriotomy and the associated risks of vessel sacrifice. It also largely obliterates procedural morbidity, a scenario that is highly critical in patients with compromised cardiovascular reserves or comorbidities. The procedure has a completely endovascular construct, enabling immediate

crossover to final revascularization after successful device removal. In addition, avoiding general anesthesia in patients with severe cardiopulmonary comorbidities is an important safety benefit. In the case of the tibial vessels only, this strategy preserves potential pedal anastomosis targets, which is an important factor in patients with progressing PAD who may ultimately require surgical bypass.

Beyond the limitations of this particular case, the applicability of this technique extends to the management of entrapped devices in other distal vessels amenable to retrograde access, such as the anterior tibial and peroneal arteries, where surgical exposure poses formidable technical challenges. Furthermore, this method can be adapted to correct other occluded endovascular devices, including snares, guidewires, and stent delivery systems. However, its application is constrained by a number of preconditions, most notably the availability of patent distal vessel segments that can be accessed retrogradely and the technical skill required for pedal puncture and wiring maneuvers. Furthermore, this procedure requires a robust stock of appropriately sized balloon catheters and ancillary support hardware to ensure procedural efficacy.

Several pedagogical insights emerged from this case for interventionists managing complex PAD. Prevention remains paramount, and meticulous burr sizing, comprehensive lesion assessment, and judicious procedural progression can significantly mitigate the risk of entrapment. This case demonstrates that dual-access techniques represent a valuable addition to the interventional armamentarium for addressing intricate complications. Furthermore, establishing a predefined algorithmic approach to device entrapment enables rapid and systematic resolution, thereby minimizing ischemic injury due to procedural delays. The feasibility of this approach expands endovascular management options for these rare complications with potential applications across various peripheral vessels and entrapped devices, ultimately reducing procedural morbidity in high-risk populations with significant comorbidities.

### Conclusion

This case report demonstrates a novel dual-access endovascular technique for retrieving

entrapped rotational atherectomy devices in peripheral vessels using retrograde pedal access and sequential balloon angioplasty. This minimally invasive approach provides a viable alternative to surgical extraction, and is particularly beneficial for high-risk patients with comorbidities. The technique preserved vessel patency, enabled an immediate transition to definitive revascularization, and avoided general anesthesia.

## Disclosure of conflict of interest

None.

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