# Rescue by Retrograde Techniques after Rotational Atherectomy in False Lumen

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## Abstract

Balloon-uncrossable lesions are lesions that cannot be crossed with small balloons despite successful guidewire crossing. Several methods can be used to overcome the situation, whereby rotational atherectomy is the most powerful. Before performing rotational atherectomy, the operator should make sure that the guidewire is in the distal true lumen and has short subintima tracking, to reduce the risk of the false lumen created by rotablation not healing but instead expanding, further impairing distal flow. Our case demonstrated that the huge false lumen created by subintimal rotablation progressively expanded, compromising distal flow. The true lumen was rescued by retrograde techniques despite weeks of external compression of the long and huge false lumen.

**Key words:** rotational atherectomy, subintimal rotablation, false lumen, retrograde

## Case report

A 62-year-old male presented to our hospital with intermittent effort angina and exertional dyspnea, ongoing for months. The patient's medical history included hypertension and endovascular aneurysm repair (EVAR) for abdominal aortic aneurysm (AAA). The myocardial perfusion imaging with technetium-99m sestamibi SPECT revealed stress-induced myocardial ischemia in the apical and inferior wall (Figure 1). Coronary angiography revealed significant stenosis in the proximal left descending artery (LAD) (Figure 2A), total occlusion in the obtuse marginal branch of the left circumflex artery (LCX) (Figure 2B) and severe stenosis in the middle segment of the right coronary artery (RCA) (Figure 2C and 2D). We recommended coronary artery bypass grafting (CABG) but the patient declined. The patient went to another hospital for percutaneous coronary intervention (PCI).

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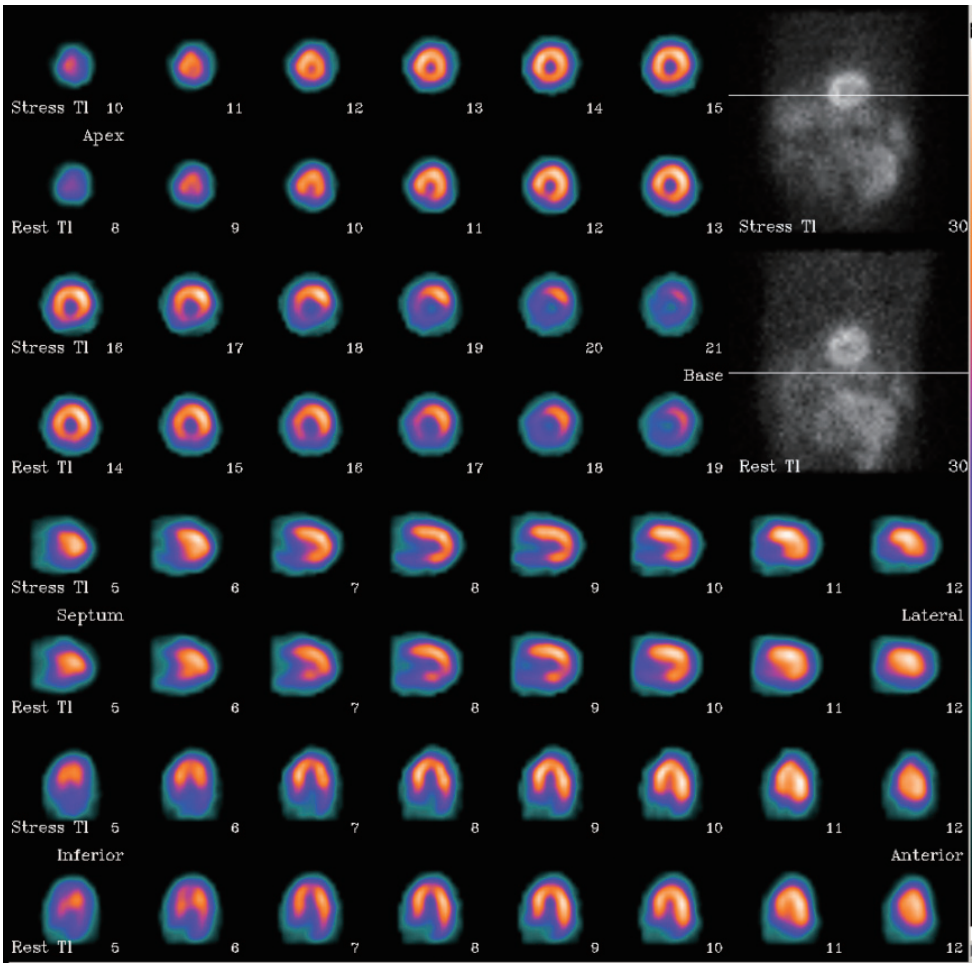


**Figure 1.** Myocardial perfusion imaging with technetium-99m sestamibi SPECT revealed stress-induced myocardial ischemia in the apical and inferior wall.

The operator at the other hospital attempted to open the RCA first. The RCA was engaged with a 7 Fr Kimny guider (Boston Scientific). The operator attempted to cross antegradely using several guidewires including Fielder FC and Fielder XTA guidewire (Asahi Intecc) with the support of a Finecross microcatheter (Terumo) but was unsuccessful. Finally, a Sion black guidewire (Asahi Intecc) reached the true lumen of the distal RCA, as confirmed by contralateral injection (Figure 3A). However, the operator encountered difficulty delivering equipment to the distal RCA. Despite the use of a Guideliner® 6F guide-extension catheter (Vascular Solutions Inc., Minneapolis, Minnesota, United States), none of the available microcatheters and small balloons could be passed through the lesion (Figure 3B). The operator decided for rotational atherectomy. After much effort, the operator finally succeeded in positioning a Rota-floppy wire (Boston Scientific) in the distal RCA. The rotablation was performed with a 1.25 mm burr at 180,000 rpm (Figure 3C). However, after the burr passed through the lesion, the distal flow was not restored. The operator noted extensive subintima tracking by the Rota-floppy wire from the middle RCA to the crus (Figure 3D), whereby the rotablation was performed entirely within subintima space. The distal flow was completely obstructed as a result of the subintimal rotablation, which expanded the

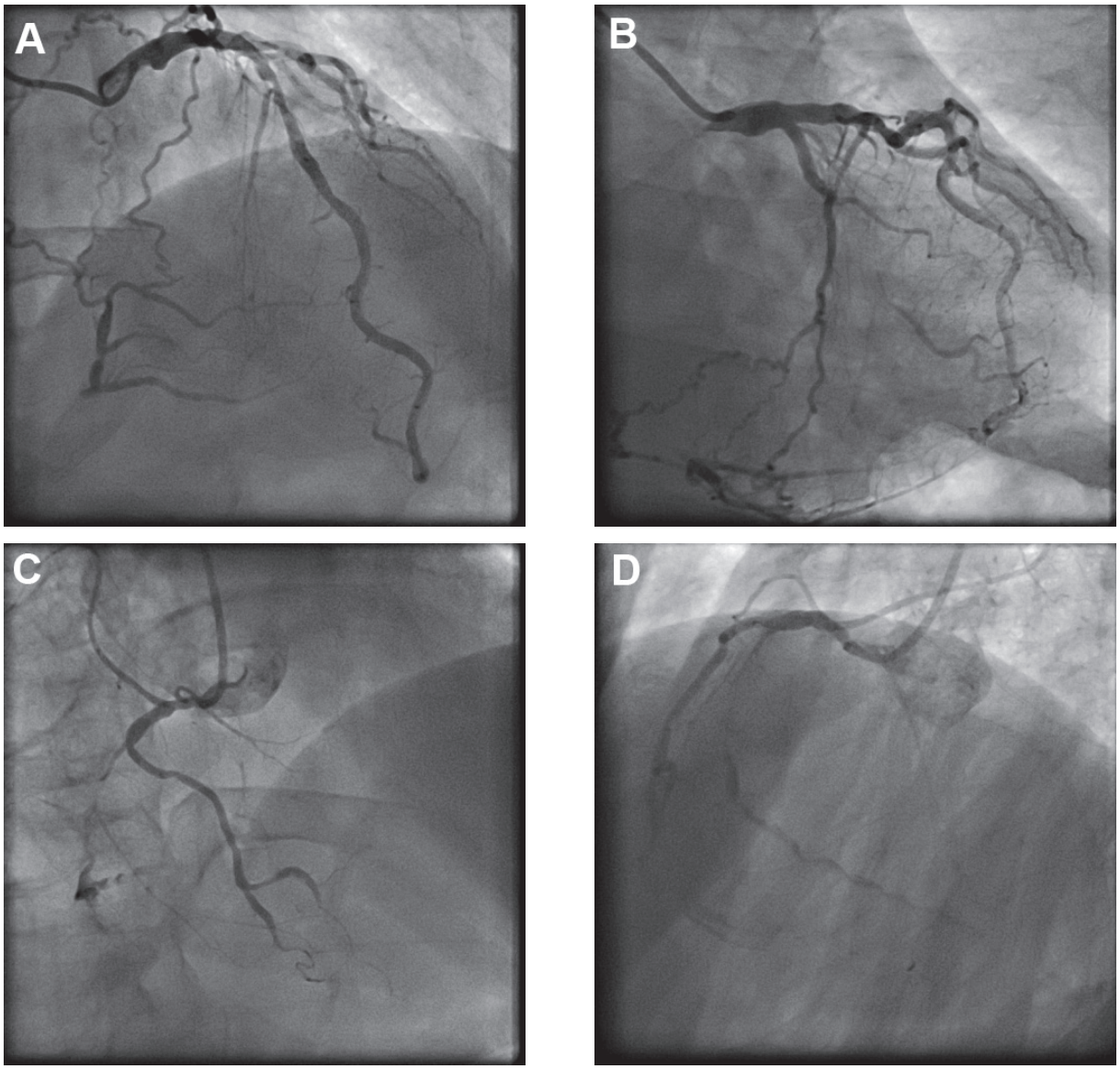


**Figure 2.** Coronary angiography.
**Figure 2A.** Coronary angiography revealed significant stenosis in the proximal left descending artery (LAD).
**Figure 2B.** Total occlusion in the obtuse marginal branch of the left circumflex artery.
**Figure 2C.** Severe stenosis in the middle segment of the right coronary artery (RCA).
**Figure 2D.** Severe stenosis in the middle segment of the right coronary artery (RCA).

subintima space and compressed the true lumen. The procedure was hence stopped. Weeks later, the patient still suffered symptoms of effort angina so he came to our hospital for a second attempt.

Follow-up coronary angiography revealed that a huge false lumen from the middle RCA to both the posterior descending artery (PDA) and the posterolateral (PL) branches compressed the true lumen, almost obstructing the antegrade flow (Figure 4A and 4B). A retrograde rescue intervention was decided upon, by accessing the left femoral artery and inserting a 7 Fr sheath and a 7 Fr EBU 3.5 guiding catheter (Launcher, Medtronic). During left coronary artery injection,

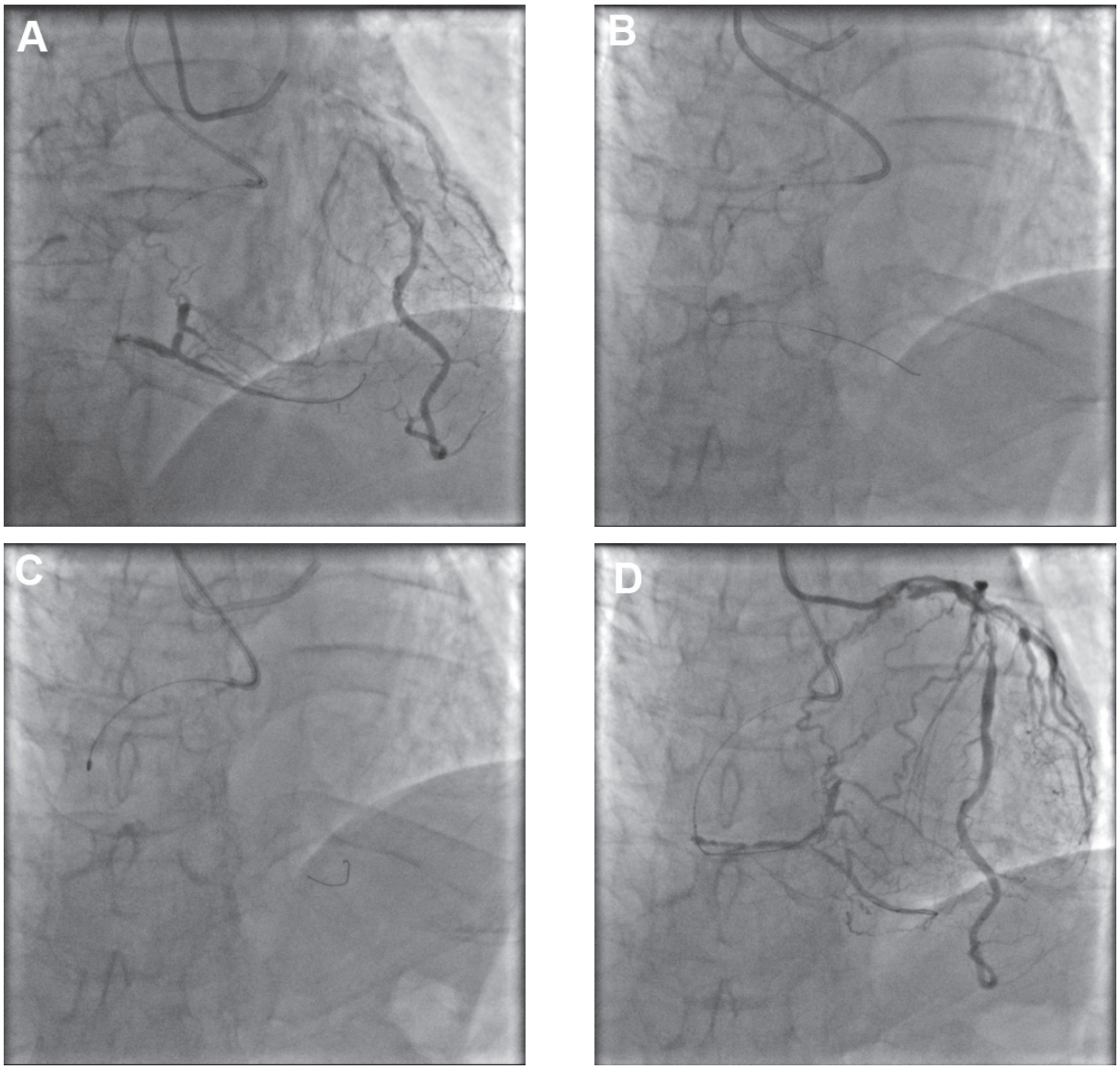


**Figure 3.** Percutaneous coronary intervention (PCI) at another institution.
**Figure 3A.** The guidewire could reach the true lumen of the distal RCA, as confirmed by contralateral injection.
**Figure 3B.** None of the available microcatheters and small balloons could pass through the lesion.
**Figure 3C.** The rotablation was performed with 1.25 mm burr at 180,000 rpm.
**Figure 3D.** Contralateral injection revealed long distance subintima tracking by Rota-floppy wire from the middle RCA to crus. The rotablation was entirely performed in the subintima space.

septal branches collateralizing the PDA were identified. Using a Sion guidewire (Asahi Intecc) and 150 cm Corsair microcatheter (Asahi Intecc), the guidewire was advanced retrogradely through the septal branch into the PDA distal to the occlusion (Figure 5A). Initially the attempt to cross retrogradely by the Sion guidewire was unsuccessful. We escalated the Sion guidewire to a Fielder XTA guidewire (Asahi Intecc) which was directed into the antegrade guider. After the

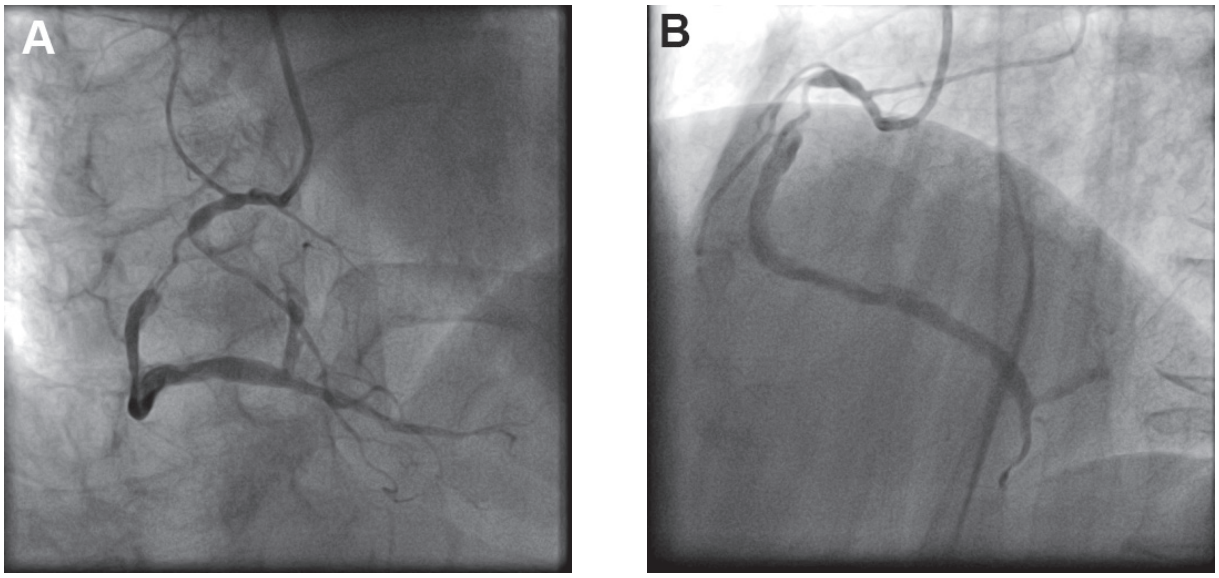


**Figure 4.** Follow-up coronary angiography weeks after the first PCI.
**Figure 4A.** Huge false lumen from the middle RCA to both posterior descending artery (PDA) and posterolateral (PL) branches compressed the true lumen, almost obstructing the antegrade flow.
**Figure 4B.** In the left anterior oblique (LAO) projection, CAG revealed huge false lumen from the middle RCA to the distal RCA.

Fielder XTA guidewire was trapped with a 2.5 mm balloon, the Corsair catheter was advanced into the guiding catheter. The Fielder XTA guidewire was exchanged for an RG3 wire (Asahi Intecc) so that a safe, continuous connection from the left to the right femoral access sites was established (Figure 5B). Following serial balloon dilatations of varying sizes, a 20 MHz phased-array intravascular ultrasound (IVUS) catheter (2.9F Eagle Eye, Volcano Therapeutics, Rancho Cordova, California) was deployed, which revealed huge intramural hematoma (IMH) from the middle to the distal RCA (Figure 6A and 6B). Antegrade dilatation was followed by implantation of two drug-eluting stents (Resolute Onyx, Medtronic) (Figure 5C and 5D). The final RCA angiogram demonstrated antegrade TIMI 3 flow with preserved PDA and PL branch patency (Figure 5E and 5F). The patient was discharged home after 2 days and did not report any further symptoms 12 months after the procedure.

## Discussion

After a successful guidewire crossing and confirmation that the guidewire is placed into the distal true lumen, a coronary lesion is considered to be balloon-uncrossable if it cannot be crossed with a balloon. These conditions can also be found in non-occlusive lesions and make up 6-9% of chronic total occlusions (CTO).[1,2] Significant calcification or tortuosity near, or at one or both ends of a lesion is frequently the reason for the blockage. Many techniques, including balloon-wedge technique and balloon-assisted microdissection can be used to approach such lesions.[3] Among these methods, rotational atherectomy is the most powerful. To perform rotational atherectomy, a wire exchange for a dedicated atherectomy guidewire is necessary, however, this may not always be performed for a balloon-uncrossable lesion. If all other attempts to cross the lesion fail, it is occasionally possible

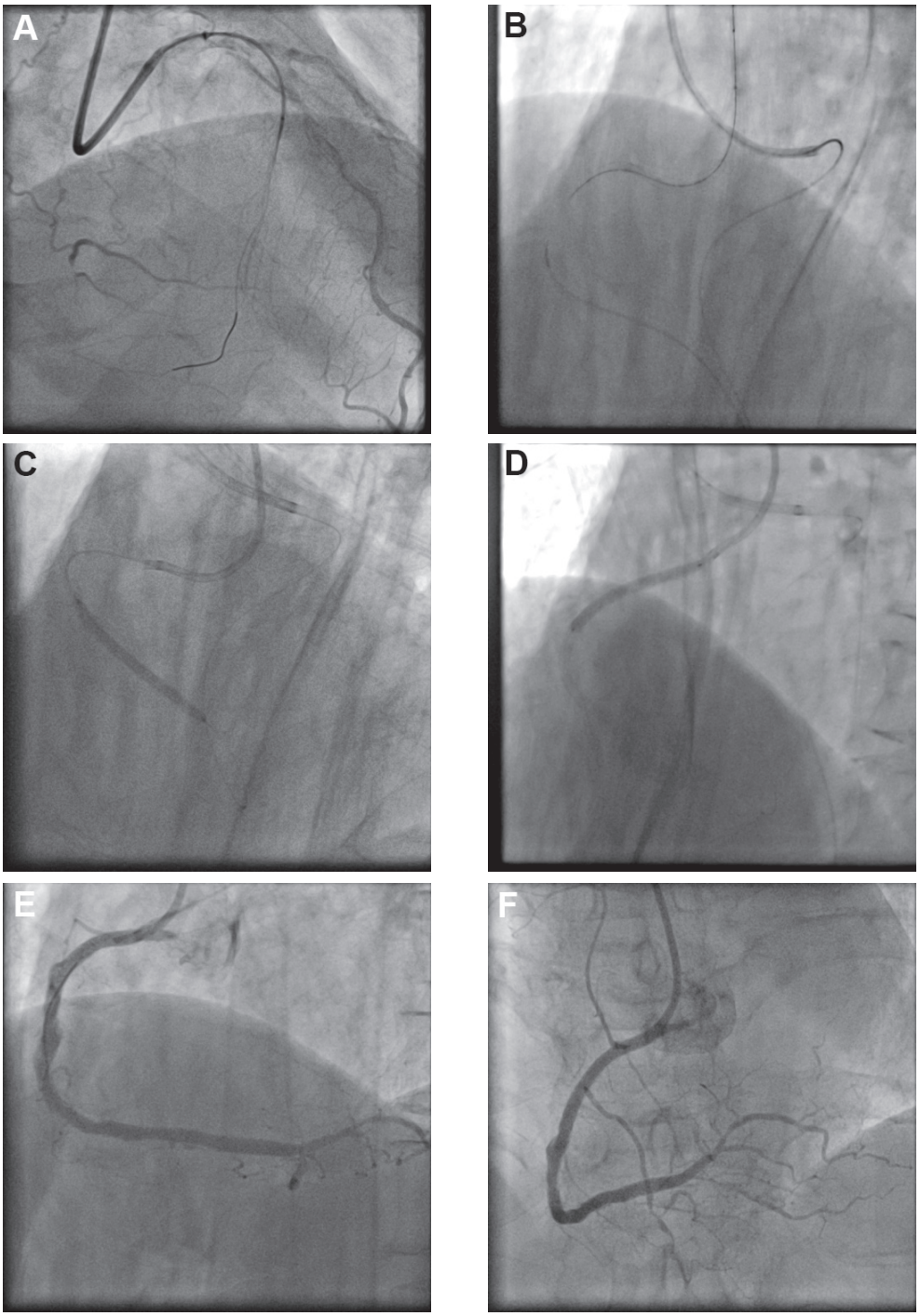


**Figure 5.** PCI for RCA by retrograde approach.
**Figure 5A.** Using a Sion guidewire (Asahi Intecc) and 150 cm Corsair microcatheter (Asahi Intecc), the guidewire was advanced retrogradely through the septal branch into the PDA.
**Figure 5B.** RG3 wire (Asahi Intecc) externalization was completed.
**Figure 5C.** Implantation of the first drug-eluting stent.
**Figure 5D.** Implantation of the second drug-eluting stent.
**Figure 5E.** Final coronary angiogram.
**Figure 5F.** Final coronary angiogram.

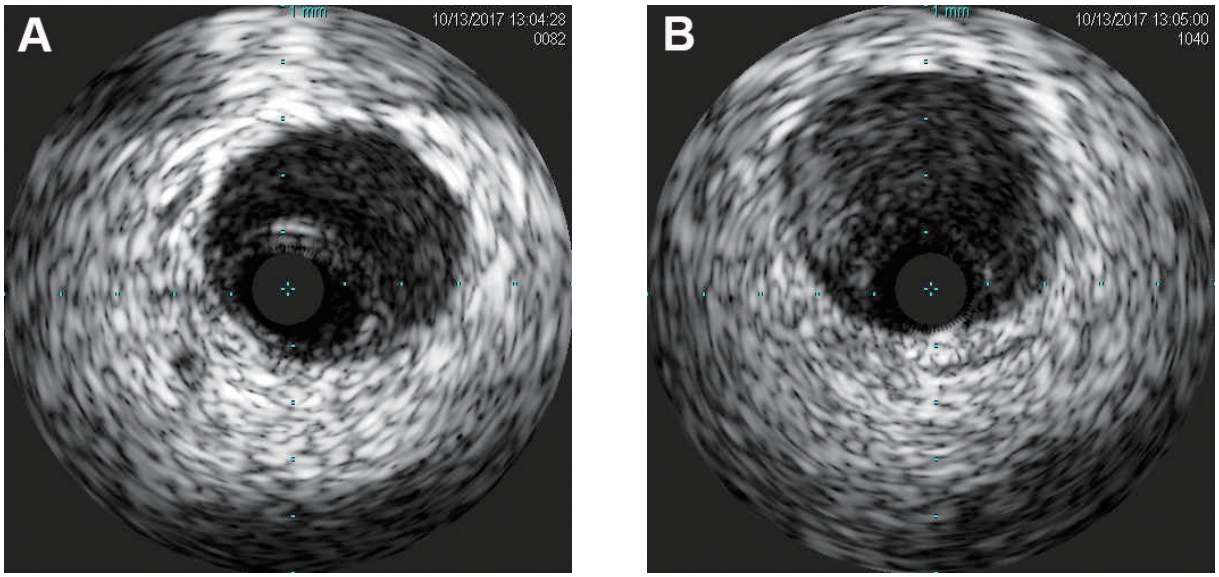


**Figure 6.** Intravascular ultrasound (IVUS) images.
**Figure 6A.** Huge intramural hematoma (IMH) in the distal RCA with IVUS catheter in the true lumen.
**Figure 6B.** Huge intramural hematoma (IMH) in the middle RCA with IVUS catheter in the true lumen.

to "bury" a microcatheter as deeply as possible inside the lesion, retrieve the wire, and try to rewire the lesion with an atherectomy guidewire. The atherectomy can be carried out if the rewiring is successful.

According to Pagnotta et al., high-speed rotational atherectomy was used to treat 45/648 (7%) consecutive patients with CTOs that were refractory to recanalization by traditional methods (Rotablator group). A microcatheter was pushed against the lesion to enable the replacement of the 0.014" guidewire with the 0.009" Rotawire. In two of the 45 patients (or 4.5%) the Rotawire could not be advanced through the CTO. In 35 patients (78%), a microcatheter could be advanced to the distal segment of the occluded artery; however, in 10 patients (22%), the microcatheter encountered resistance within the occlusion and did not reach the distal cap.[4] Obviously, the most critical step in rotational atherectomy is to pass the guidewire through the lesion, which is not always easy. In the present case, although the most distal end of the Rotawire was in the true lumen, a long portion of the guidewire actually traversed subintima space. Rotational atherectomy within the subintima will expand the subintima space, compress the true lumen, and compromise the antegrade blood flow. We therefore recommend to avoid long segments of tracking within the subintima, in addition to confirming that the distal end of the Rotawire is in the true lumen, before performing rotational atherectomy.

Instead of healing, the subintimal space caused by rotablation expands, and further impairs the antegrade blood flow. The outcomes of coronary artery dissection and, consequently, the management of the condition, depend on the flow of the distal vessel and the extent of the dissection. If there is compromise to the distal artery bed, such as acute closure of the artery, urgent revascularization is imperative to prevent infarction of that myocardial territory. This may be achieved by percutaneous coronary intervention (PCI) or coronary artery bypass graft (CABG) surgery, and the decision on which revascularization method to use must be at the discretion of the operators. Successful outcomes following CABG[5,6] and coronary artery

stenting[7,8] have been reported. Most operators would advocate for antegrade dissections to be treated with PCI as soon as they are recognized. Soft-tip guidewires should be used to carefully try to reach the true lumen.[9] It may be useful to use intravascular ultrasound (IVUS) to guide the wire manipulation and confirm the position of the guidewire. However, IVUS-guided PCI requires expertise and experience. Other bail-out strategies should be taken into consideration if attempts at antegrade wiring into the true lumen are unsuccessful. The method used will depend on a number of variables, including the operator's expertise, the availability of equipment, the vessel anatomy and the degree of hemodynamic compromise. Use of the retrograde approach has been described for the treatment of catheter-induced dissection.[10] We treated this patient using retrograde CTO PCI techniques, which may be of interest for centers experienced in these techniques. However, this technique relies on crossing collateral channels that are unlikely to have developed unless there was a pre-existing severe stenosis in the dissected artery. It is possible to surf and cross invisible septal channels, but this is difficult and unpredictable. Once the wire has crossed retrogradely, direct wire crossing into the antegrade catheter should be possible.[11] We used retrograde techniques to successfully treat this rare complication.

The case we presented is the first in the literature to use retrograde techniques to treat a large false lumen caused by rotational atherectomy. Since it is the first case, it is impossible to judge how it differs from cases of balloon-induced false lumen. However, what is known from our case is that the false lumen created by rotablation may not heal, but rather expand, further compressing the true lumen and compromising distal flow. Rotablation should not be performed over a long subintima space. In this case, the true lumen was rescued by retrograde techniques even after weeks of external compression by the long and huge false lumen.

## CONFLICT OF INTEREST

All authors declare that there is no conflict of interest.

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