JACC: CASE REPORTS VOL. 3, NO. 17, 2021

STRUCTURAL INTERVENTIONS

ADVANCED

CASE REPORT: CLINICAL CASE SERIES

Wire Cutting Method Using Rotational Atherectomy for Stretched Spring Wire During Coronary Intervention

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ABSTRACT

During removal of an entrapped guidewire, the core wire can fracture, allowing stretching of the spring wire while the distal guidewire is still entrapped. We resolved this issue with rotational atherectomy, allowing cutting of the spring wire at the intended site, regardless of the proximal spring wire fracture. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2021;3:1842–1848) © 2021 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

During percutaneous coronary interventions (PCI). the guidewire occasionally becomes entrapped inside the coronary artery. The first important point is to retrieve the entrapped guidewire gently. In addition to pulling gently, it is also important to advance a small-diameter balloon or microcatheter into the gap between the vessel wall and the stent to reduce friction in the gap, if necessary (1). However, even with such careful treatment, the core wire will occasionally be fractured, and the spring wire will be stretched in some cases. The proximal part of the spring wire can be removed by pulling with a snare, but it is difficult to control the cutting site. Surgical removal may be required if the spring wire cutting site is in the aorta.

LEARNING OBJECTIVES

- To understand the disadvantages of pulling with a snare to cut the stretched spring wire after a core wire fracture.
- To understand the RA procedures involving cutting of the stretched spring wire at the intended site.

The entrapped guidewire can be cut with a rotational atherectomy (RA) device (Boston Scientific), followed by stenting to fix the residual part of the guidewire against the vessel wall (2). However, there have been no reports regarding the effectiveness of RA to cut the stretched spring wire after a core wire fracture. Here, we present 2 cases in which RA was used to cut the stretched spring wire after a core wire fracture resulting from guidewire entrapment within a coronary artery during PCI. We also examined the disadvantages when pulling out the spring wire with a snare using an experimental model.

CASE 1

PRESENTATION AND MEDICAL HISTORY. A 91-year-old man with effort angina was admitted to our hospital because cardiac computed tomography showed

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

Manuscript received September 24, 2021; accepted September 29, 2021.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2021.09.018

significant stenosis in the left circumflex coronary artery (LCX).

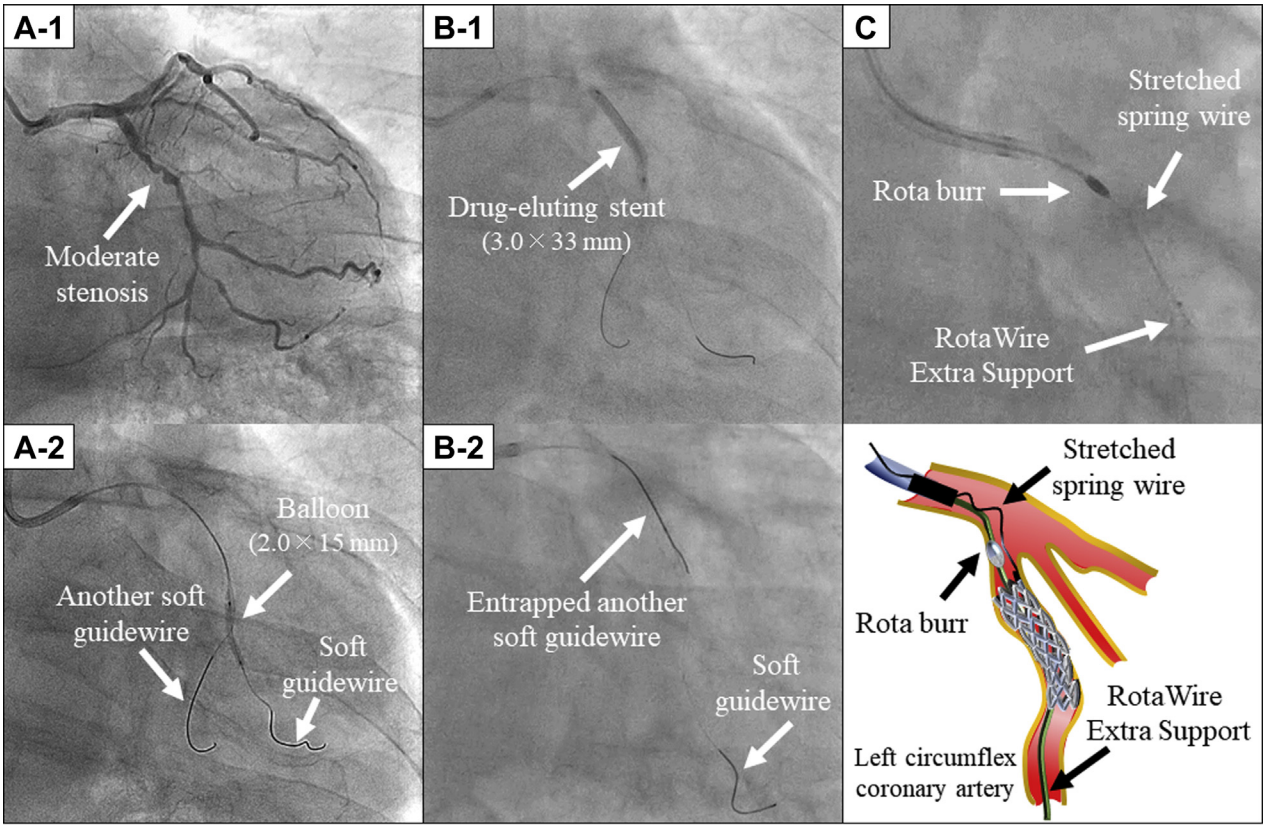
MANAGEMENT AND FOLLOW-UP. PCI was performed for the middle and distal stenotic lesions in the LCX (Figure 1A-1). Because the distal stenotic lesion was the bifurcation site, a 0.014-inch soft guidewire was advanced to the distal lesion of the LCX, and another soft guidewire was advanced to protect the side branch (Figure 1A-2). After dilation with a 2.0-mm balloon, there might have been dissection at the distal lesion; therefore, the guidewire protecting the side branch was left in. Through the guidewire advanced to the main branch, a 3.0- × 33-mm drug-eluting stent (DES) was advanced and implanted at the middle lesion (Figure 1B-1). This caused the guidewire protecting the side branch to become entrapped between the stent struts and vessel wall (Figure 1B-2).

Using balloons and microcatheters, the entrapped guidewire was pulled back to some extent, but it became entrapped again at the middle of the stent. The core wire fractured, and the spring wire began to stretch while being pulled. Intravascular ultrasound (IVUS) examination through the guidewire showed that the stretched spring wire started from the proximal part of the stent and continued to 10 cm into the guiding catheter but did not fracture. Surgical removal would have been required if the spring wire had fractured in the aorta. Therefore, we tried to cut the spring wire 1 cm proximal from the stent proximal edge to avoid ablation of the stent. A 0.009-inch RotaWire Extra Support (Boston Scientific) was advanced to the distal LCX through the stent. A 1.5-mm burr was delivered just before the implanted stent without using Dynaglide mode. RA was performed while the guidewire was pulled back for the spring wire to hit the burr. The spring wire was cut just before the stent, and the

ABBREVIATIONS AND ACRONYMS

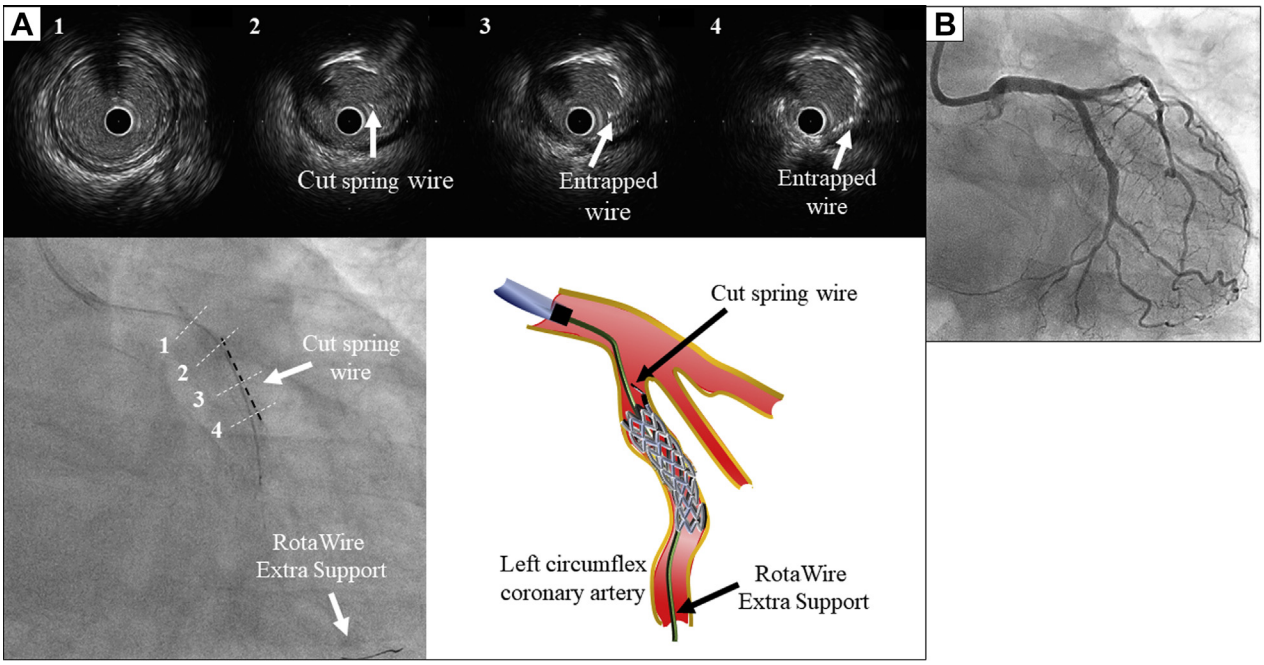
CAG = coronary angiography
DES = drug-eluting stent(s)
IVUS = intravascular ultrasound
LCX = left circumflex coronary artery
PCI = percutaneous coronary intervention
PDA = posterior descending artery
PLA = posterior lateral artery
RA = rotational atherectomy
RCA = right coronary artery

FIGURE 1 Pretreatment Angiographic Images and PCI at the Middle Part of Left Circumflex Coronary Artery



(A-1) Pretreatment angiographic images. **(A-2, B-1, B-2, C)** Angiographic images during the procedures, and corresponding illustration.

FIGURE 2 IVUS Examination After Rotational Atherectomy and Post-Treatment Angiographic Images



(A, B) Angiographic images and intravascular ultrasound (IVUS) images after the spring wire was cut, and corresponding illustration. The numbers on the angiographic image coincide with the numbered IVUS position images.

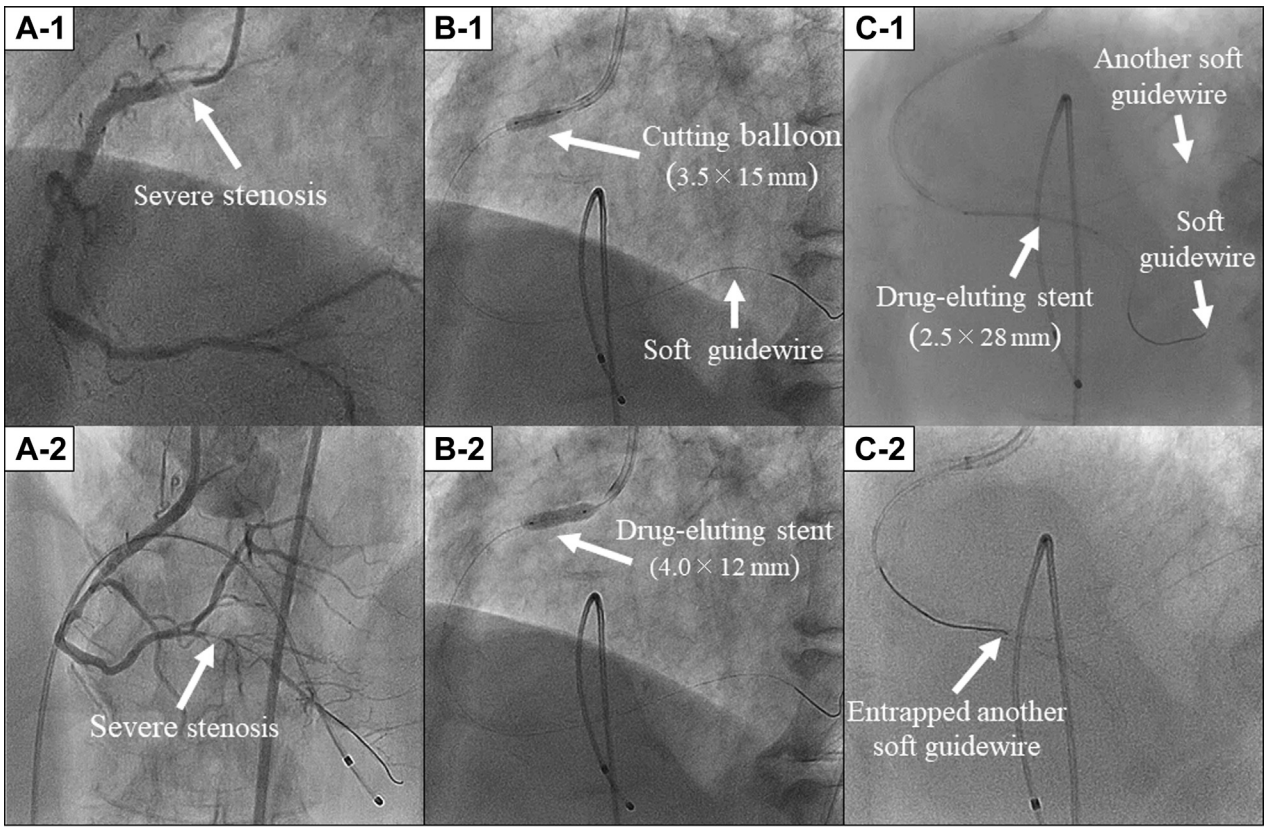
proximal part was successfully removed (Figure 1C). IVUS examination showed that the spring wire was cut just before the stent as planned (Figure 2A). Coronary angiography (CAG) showed adequate dilation of the lesions (Figure 2B). Follow-up CAG at 1 year showed no significant stenosis in the coronary arteries.

CASE 2

PRESENTATION AND MEDICAL HISTORY. A 62-year-old man with chest pain was brought to our hospital by emergency transport. A diagnosis of acute coronary syndrome without persistent ST-segment elevation was made.

MANAGEMENT AND FOLLOW-UP. CAG showed severe stenosis at the proximal site and posterior descending artery (PDA) in the right coronary artery (RCA) (Figures 3A-1 and 3A-2). A 0.014-inch soft guidewire was advanced to the PDA branch. After the IVUS examination, the stenotic lesion at the proximal RCA was dilated with a cutting balloon, followed by 4.0- × 12-mm DES implantation (Figures 3B-1 and 3B-2). The IVUS examination revealed diffuse lesions from the middle part of the RCA to the PDA branch, and our strategy was provisional stenting. Another soft guidewire was advanced to the posterior lateral artery (PLA) to protect this branch. The stenotic lesions from the middle part to the PDA branch were dilated with a 2.5-mm balloon, followed by 2.5- × 28-mm DES implantation (Figure 3C-1). The guidewire was advanced to the PLA branch to dilate the stent-jailed area with the kissing balloon technique. We attempted to remove another guidewire, but it was entrapped between the stent and the vessel wall at the middle RCA (Figure 3C-2). While the guidewire was being pulled back with balloons and microcatheters, the core wire fractured at the distal part of the guidewire, and the spring wire became stretched. The guidewire was gently pulled back to allow the spring wire to stretch enough to be cut by the snare. However, the spring wire fractured 10 cm from the entrance of the guiding catheter, which was confirmed by IVUS examination (Figure 4). To remove the fractured spring wire, we tried to cut the spring wire 1 cm proximal from the stent proximal edge to avoid ablation of the stent and to remove the proximal part of the spring wire by balloon trapping in the guiding catheter. A 1.5-mm burr was delivered to the proximal RCA without using the Dynaglide mode. The burr was advanced to hit the

FIGURE 3 Pretreatment Angiographic Images and Percutaneous Coronary Interventions for Right Coronary Artery



(A-1, A-2) Pretreatment angiographic images. **(B-1, B-2, C-1, C-2)** Angiographic images during the procedures.

spring wire, and the spring wire was intentionally cut at the proximal RCA, which was confirmed by IVUS examination. Inasmuch as the first fracture site was still in the guiding catheter (**Figure 5**), the disconnected spring wire was fixed in the guiding catheter by balloon dilatation, and the guiding catheter was pulled out with the spring wire (**Figure 6A**). A 3.5- × 38-mm DES was implanted to compress the remaining spring wire against the coronary artery at the proximal to middle RCA (**Figures 6B-1 and 6B-2**). CAG showed adequate dilation of the lesions (**Figure 6C**), and we confirmed the retrieval of the spring wire outside the body (**Figure 6D**). Follow-up CAG at 6 months showed no significant stenosis in the coronary arteries.

EXPERIMENTAL STUDY

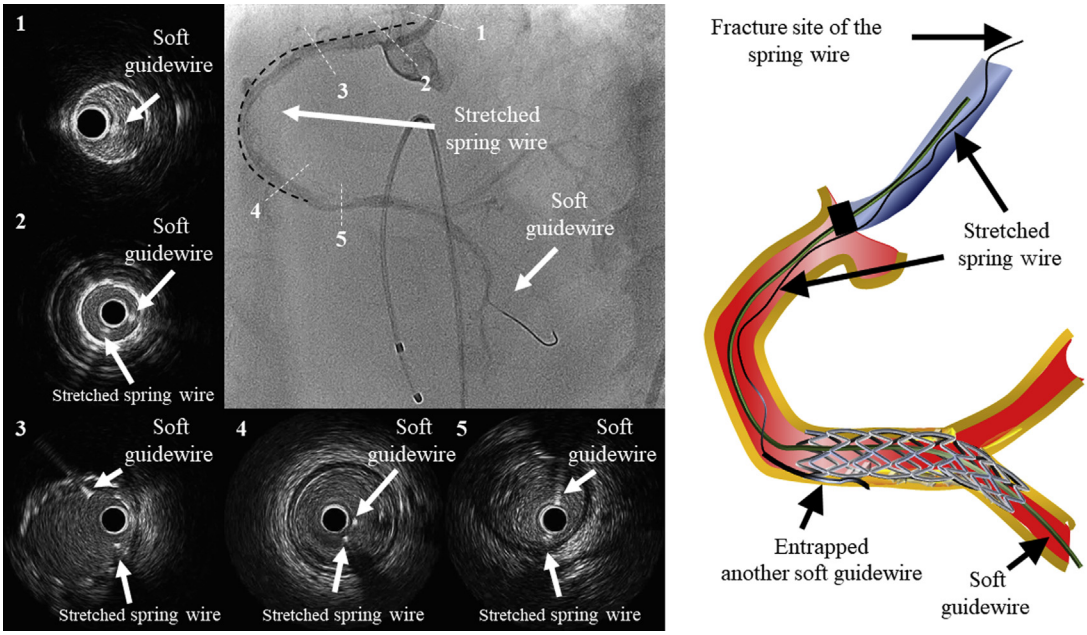
In an experimental study, we showed the disadvantages of pulling out the spring wire with a snare. First, the core wire was manually broken, and the spring wire was stretched to some extent. The apex of the tip of the wire was captured with forceps, and part of the spring wire was captured with a snare. The spring wire was pulled toward the operator and could be cut by pulling back the snare. However, the spring wire was stretched to its limit, and it was difficult to control the cutting site (Video 1). Next, a guidewire was intentionally entrapped at the distal part of the RCA in an experimental heart model as in Case 2. The core wire was manually broken, and the spring wire was stretched to some extent. The spring wire was captured with a snare and was pulled toward the operator and cut by pulling back the snare. During this process, excessive force was applied to the coronary artery from the spring wire (Video 2).

DISCUSSION

We first showed that RA could cut the stretched spring wire after the core wire became fractured as a result of

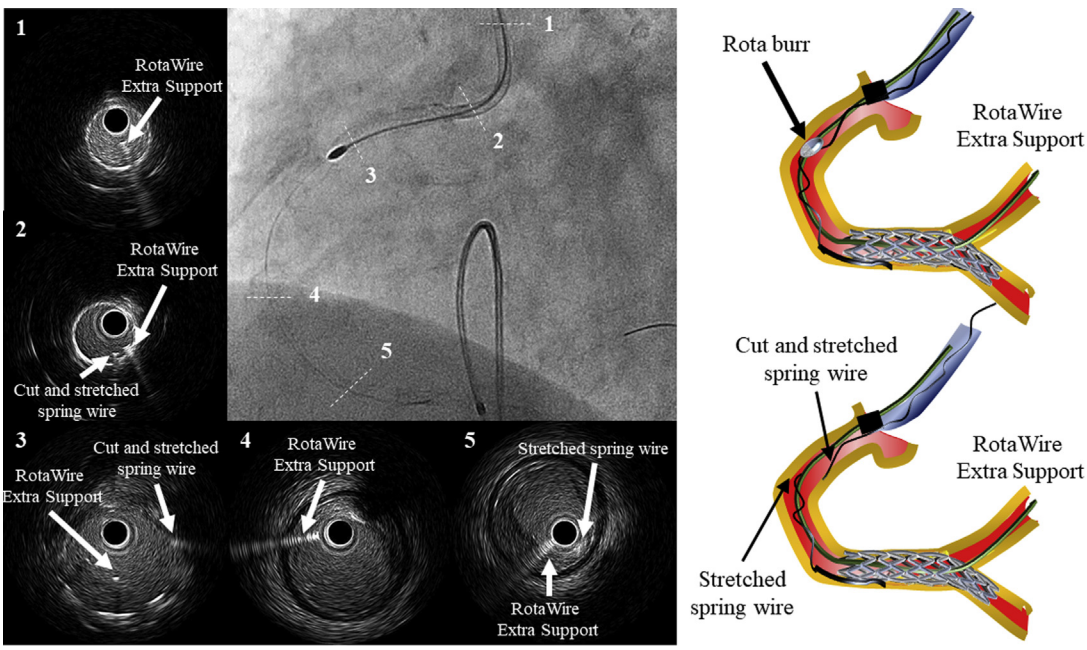
JACC: CASE REPORTS, VOL. 3, NO. 17, 2021
DECEMBER 1, 2021:1842–1848

FIGURE 4 Entrapped Wire was Stretched and Fractured in the Guide Catheter



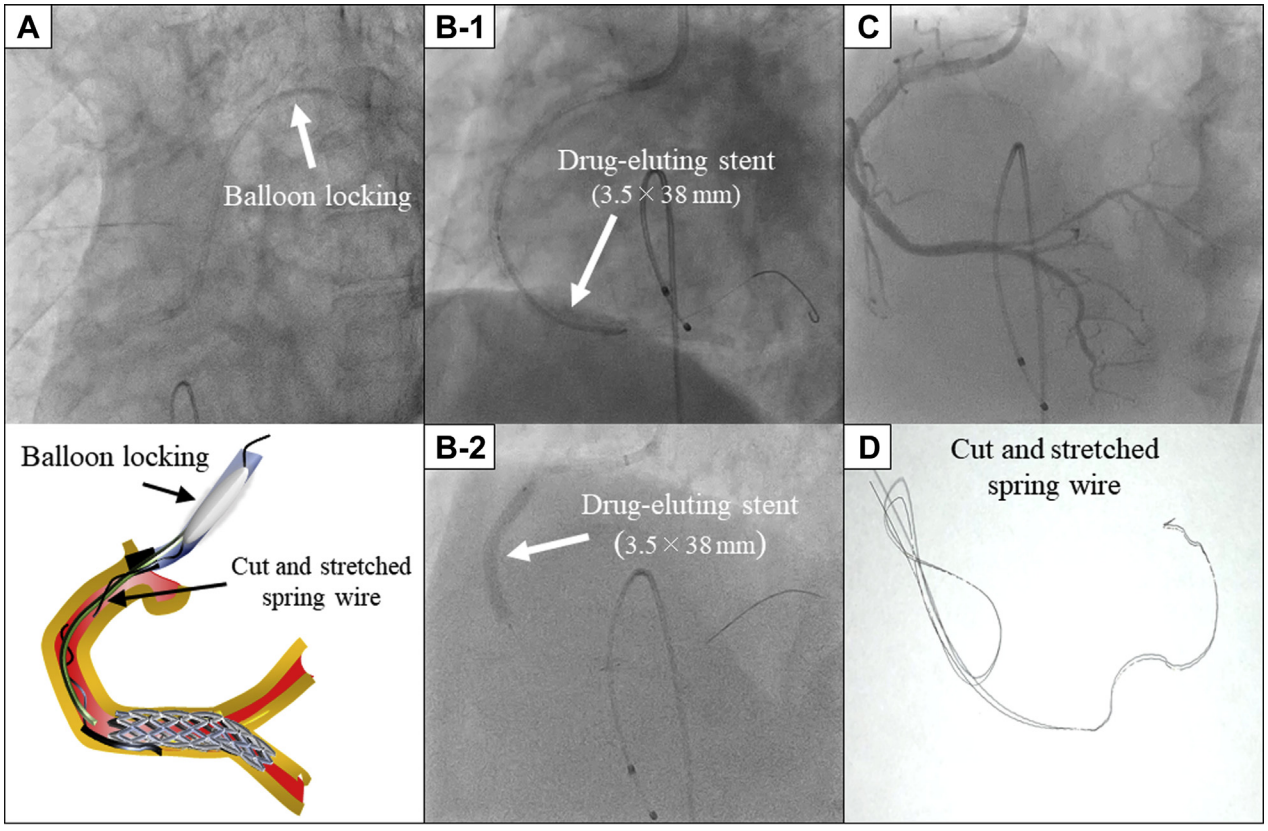
Angiographic and intravascular ultrasound (IVUS) images after the spring wire was fractured, and corresponding illustration of the angiographic image. The numbers on the angiographic image coincide with the numbered IVUS position images.

FIGURE 5 Rotational Atherectomy for the Entrapped and Stretched Spring Wire



Angiographic and intravascular ultrasound (IVUS) images during rotational atherectomy to cut the floating spring wire, and corresponding illustration of the angiographic image. The numbers on the angiographic image coincide with the numbered IVUS position images.

FIGURE 6 Balloon Lock and Post-Treatment Angiographic Images



(A, B-1, B-2) Angiographic images during the procedures, and corresponding illustration **(C)**. Post-treatment angiographic images. **(D)** The spring wire that was retrieved.

entrapment of the guidewire. In the second case, RA could cut the stretched spring wire whose proximal part was floating inside the guiding catheter. As shown in the present experimental study for cutting the stretched spring wire, the pulling method with a snare cannot control the cutting site and subjects the coronary artery to excessive force while cutting.

Next, we describe the technical points of cutting the spring wire by RA. First, the IVUS examination is important to determine the cutting site by rotational atherectomy. The IVUS catheter should be advanced while care is taken not to move the damaged guidewires. The RA burr is advanced without rotation until just before the part where the spring wire is about to be cut. The burr is then rotated and advanced while the guidewire is pulled to allow the burr to hit the spring wire. The slow advancing technique is used to cut the spring wire at the intended site instead of push-and-pull movements. If the proximal part of the spring wire is fractured and floating inside the guiding catheter, the cutting site is the part in contact with the RA wire on fluoroscopic imaging, and the burr is also slowly advanced to hit the spring wire. Note that the RA burr may get entangled in the spring wire and stuck in the coronary artery. After the cutting, the spring wire is compressed against the coronary artery, but there may be a risk of thrombosis.

LIMITATIONS

The limitation is that we have at present only 2 cases of cutting the spring wire by RA.

CONCLUSIONS

RA is recommended to treat the guidewire trapped in the coronary artery after the spring wire has been stretched as a result of a fracture of the core wire, such that the cutting site can be controlled and the

coronary artery is not subjected to excessive force compared to pulling with a snare.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS complication, guidewire fracture, rotational atherectomy, stuck guidewire

APPENDIX For supplemental videos, please see the online version of this paper.