Crusade Case Report

KANEKA
MEDICAL
PRODUCTS

CONTENTS

Usefulness of Crusade in Complex PCI

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Effectiveness of Crusade

Crusade is a guidewire supporting catheter for coronary artery having two guidewire lumens. It enables high guidewire maneuverability and easy access to side branches.

Crusade is frequently used in percutaneous coronary interventions for complex lesions (complex PCI) mainly because its use of two wires stabilizes PCI. It helps stabilize the guiding catheter, is effective in landmarking the bifurcation and protecting the side branch, and enables secure stent deployment in combination with intravascular ultrasound (IVUS), reduction in contrast medium, and a smooth kissing balloon technique (KBT) after stent deployment. It is also effective in penetrating a calcified lesion and treating chronic total occlusion (CTO), dissection, and perforation (**Fig. 1**).

Example uses of Crusade are reported below:

- **Stabilization of the guiding catheter**
- **Landmarking the bifurcation**
  - Protection of the side branch
  - KBT after stent deployment
  - Stent deployment under the guide of IVUS
  - Reduction in contrast medium
- **Improvement in the stent (balloon) success rate**
  - Calcified lesions, diffuse lesions, and bend lesions
- **CTO lesions**
- **Treatment of various complications**
  - Dissection, perforation

Fig. 1 Significance of using Crusade in complex PCI.

Case 1: Stent deployment in a calcified lesion (post CABG)

This is a case having a past history of diabetes in which the bypass to the left anterior descending branch (LAD) was occluded after coronary artery bypass grafting (CABG). 75% stenosis in the left coronary artery main trunk (LMT) (**Fig. 2A**) and 90% stenosis along with calcification in LAD #7 (**Fig. 2B**) were observed. The saphenous vein graft to the left circumflex branch (LCX) was patent.

After the wire was crossed, the balloon was inflated but ruptured and a PET balloon was used and inflated. The LAD was highly calcified and it was difficult to insert the stent and advance the second wire distally (**Fig. 2C**). Crusade was thus used so that the wires would not be entangled Two wires were additionally placed, one into the septal branch and one into the diagonal branch, proximally to the lesion (**Fig. 2D**), and the stent was successfully inserted with those three wires.

In this kind of procedure, it is important to maintain the fixation of the wires using a trapping method with a 2.5-mm balloon when Crusade is withdrawn.

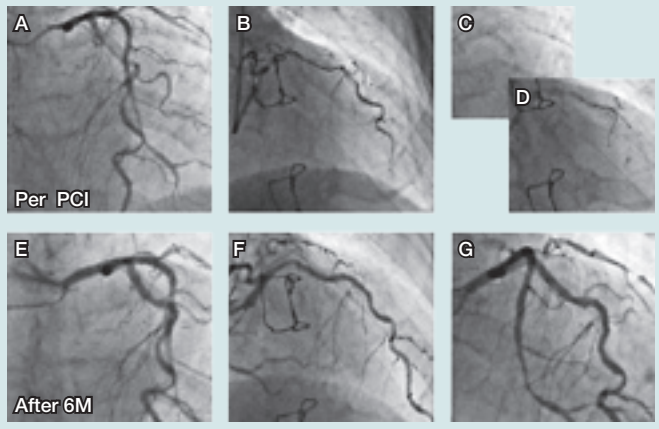


Fig. 2 Case 1: Calcification is observed in the LAD. CABG has been performed.

Case 2: Reduction of contrast medium in diabetic nephropathy

The patient was an elderly woman aged 87 years with unstable angina pectoris and cardiac failure accompanied by hypertension, diabetic nephropathy, and peripheral arterial disease (PAD). Decreased renal function with a serum creatinine level of 1.3 mg/dL was observed and the goal was set to suppress the dose of contrast medium.

99% and 90% stenoses were observed in the circumflex branch (CX) (**Fig. 3A**). After angiography, the wire was crossed up to the end of the stenosis site, and Crusade was used to pass a marker wire additionally to the distal branch (**Fig. 3B**). The bifurcation was marked using the two wires and IVUS and distal positioning and sizing of the stent were performed. Appropriate stent deployment without unnecessary angiography was possible (**Fig. 3C, Da, Db**). The final dose of contrast medium was about 15 mL and successfully minimized.

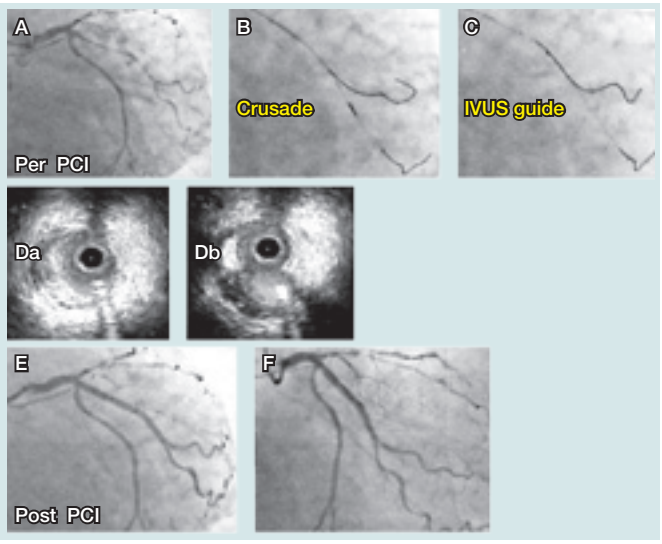


Fig. 3 Case 2: An elderly woman with unstable angina pectoris. Decreased renal function was observed.

This is a case in which the use of Crusade enabled the distal bifurcation to be reached without entanglement of the wires for a complex lesion and subsequent procedures were facilitated.

■ Case 3: Complex PCI

The patient was an elderly man aged 74 years. This is a very complicated case with triple vessel disease (TVD) and CTO in the RCA. 90% stenosis in #1 and CTO in #2 were observed (**Fig. 4A, B**). Significant stenosis was observed at the bifurcation of the LAD and first diagonal branch (D1) (**Fig. 4C**), the retrograde approach was considered difficult, and therefore an antegrade approach was selected.

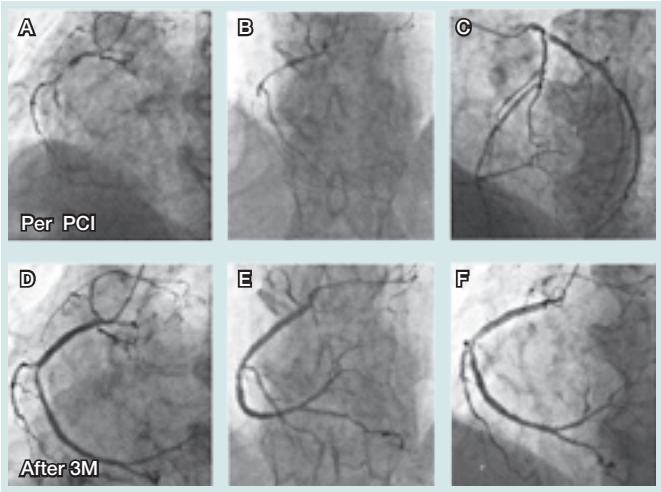


Fig. 4 Case 3: A case with CTO in RCA.

Episode 1: For CTO in the RCA (**Fig. 5A**), the right ventricular branch (RV) was secured by the first wire, an ordinary microcatheter was successfully penetrated into #2, and the wire was advanced to the acute marginal branch (AM) (**Fig. 5B**). Selection of the path to RCA main vessel #3 was difficult but by having Crusade placed over the wire, which had been advanced to the AM (**Fig. 5C**), and the second wire manipulated through the side hole of Crusade, the change of the direction to the main vessel was made possible relatively easily.

The wire was changed to X-treme and crossing to the direction of the posterior descending branch (4PD) was successful but the flow in the direction of the posterolateral branch (4AV) was delayed after plain old balloon angioplasty (POBA).

Crusade was again used to cross the wire in the 4AV (**Fig. 5Ea**). After DES insertion into #3-#1 (**Fig. 5Eb-Ed**), the use of Crusade facilitated recrossing into the 4AV and additional inflation without entanglement of the wires despite the manipulation over the stent struts (**Fig. 5Fa, Fb**).

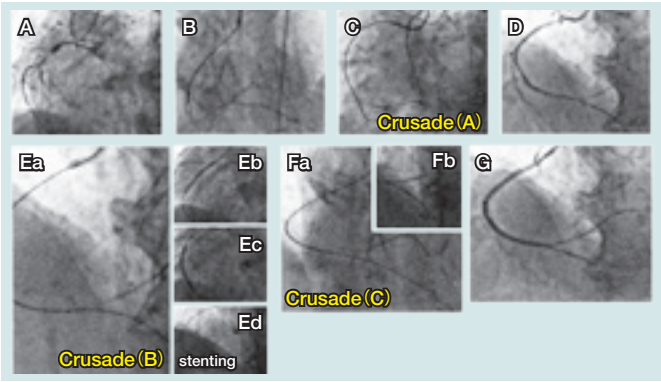


Fig. 5 Case 3: Episode 1

Episode 2: During the procedure of episode 1, slight wire perforation occurred in part of the 4PD to the septal branches (**Fig. 6Aa, Ab**). Crusade was also effective in coil embolization for this perforation. With the wire placed in the PD, Crusade was placed over and another wire was advanced to the bleeding site (**Fig. 6B**). This was then switched over to a microcatheter (**Fig. 6Ca**), a coil was placed (**Fig. 6Cb**), and hemostasis was successfully obtained (**Fig. 6D, E**).

This was a complicated case but Crusade incorporated into as part of the procedure allowed stable manipulation, completion of treatment while maintaining general health, and good patency in the chronic phase (**Fig. 4D-F**).

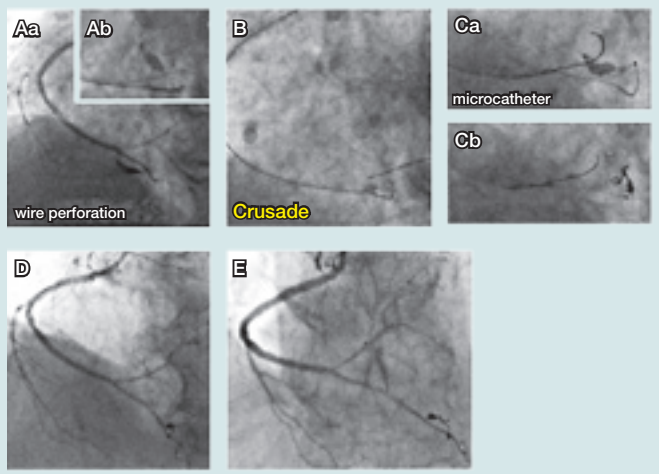


Fig. 6 Case 3: Episode 2

■ Features of Crusade and points to keep in mind

The greatest advantage of using Crusade is the ability to secure the side branch without entanglement of the wires, which helps to achieve the aforementioned double-wire method for complex PCI securely.

However, since the interval between the tip of Crusade and the guide wire port is about 20 cm, careful attention is required during withdrawal. Key steps are as follows: First, apply 12-15 atms using the inflator. Use a fluoroscopic monitor to confirm that the wire will not move. Then withdraw the wire to the monorail lumen. Apply slight pressure, check the position of the wire again by fluoroscopy, and confirm the tip of Crusade coming out of the Y-connector. Fix two wires firmly outside the body, and finally withdraw Crusade.

Practical usage of Crusade

Dr. Satoru Sumitsuji
Associate Professor, Osaka University

Reverse Wire Technique

In the treatment of chronic total occlusion (CTO), I perform wire insertion into the side branch using a procedure called the reverse wire technique. The reverse wire technique has been performed by Dr. Osamu Kato in live cases and was reported by Dr. Tomohiro Kawasaki in the CCI journal. I was taught the procedure by Dr. Yoichi Nozaki. I then applied it to CTO-PCI. I always use Crusade in CTOPCI and obtain good results.

I will first explain the ordinary reverse wire technique. In Dr. Kawasaki's original method, the site 2-3 cm from the tip of the wire (Dr. Kawasaki reported 5 cm but the guidewire may be fractured with 5 cm. I have reconfirmed that Dr. Kawasaki actually uses bending of 2-3 cm.) is bent in a hairpin shape and the wire is inserted without the use of Crusade. When the technique is applied to CTO, however, the wire needs to be advanced into the occlusion site in a bending state and therefore Crusade is required (**Fig. 1**). I use a bending site about 30 mm from the tip and an angle of about 45° (**Fig. 1** ②). As stated above, if the distance from the tip is too far, the wire may break and careful attention is required.

The wire in the main branch is passed through the first lumen of Crusade and the reverse wire is passed through the second lumen (**Fig. 1** ③) with the wires inserted while folded over (**Fig. 1** ④).

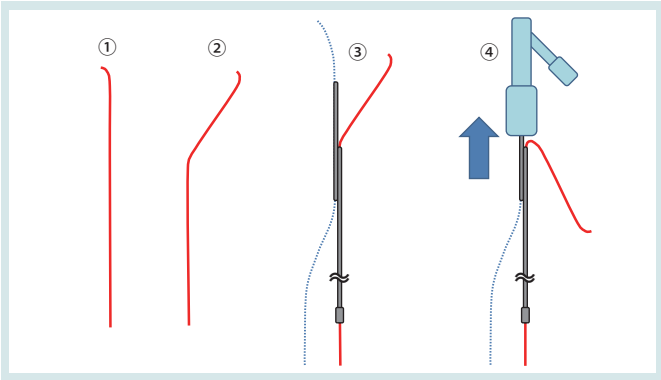


Fig. 1 Method of bending the wire and inserting it into Crusade.

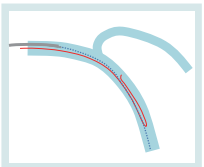


Fig. 2 Withdraw Crusade while the reverse wire is left distal to the bifurcation.

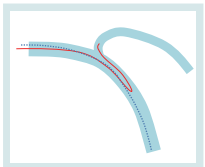


Fig. 3 Pull the wire and place the tip into the side branch.

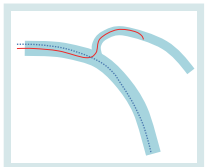


Fig. 4 Gradually withdraw the wire further.

When the reverse wire is beyond the bifurcation, Crusade is withdrawn (**Fig. 2**), the wire is pulled and its tip is inserted into the side branch while rotary manipulation is sometimes performed (**Fig. 3**). Then the wire is slowly pulled to advance the tip forward (**Fig. 4**).

This method is very useful for wire crossing when the side branch is sharply bent and is reversed to a hairpin shape. The following case presentation explains how the reverse wire technique is applied to CTO-PCI:

Case 1

This is a case with CTO in right coronary artery (RCA) #1 (**Fig. 5A**).

The wire was not easily passed but the right ventricular branch was just barely caught. However, it was confirmed that the wire was crossed in the true lumen of the slightly distal site to the right ventricular branch instead of the tip of the true lumen of the distal site (**Fig. 5B**). Another wire was used to try wire crossing into the true lumen of the RCA main branch but it was inserted into the false lumen and could not be advanced (**Fig. 5C**). Thus, the reverse wire technique with Crusade was used to try wire crossing into the true lumen of the RCA main branch.

As explained earlier, the reverse wire that crossed in the right ventricular branch together with Crusade was used and advanced to the right ventricular branch. When Crusade was then withdrawn and the reverse wire was retracted, the tip of the reverse wire began to advance easily into the true lumen of the RCA main branch (**Fig. 5D**). The reverse wire was further retracted while being rotated, the bending portion of the reverse wire was advanced into the true lumen of the RCA main branch, and the wire was advanced easily into the true lumen of the distal site of the RCA thereafter (**Fig. 5E**).

Final angiography confirmed that no large dissection was produced and good results were obtained (**Fig. 5F**). The reverse wire technique using Crusade may be very useful in situations like this case.

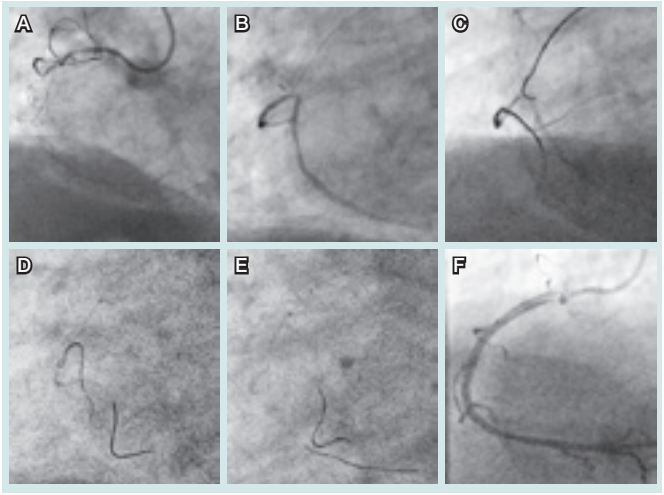


Fig. 5 Case 1: A case with CTO in the RCA.

Case 2

CTO in #3. A case of CTO with a large side branch at the proximal end of the distal true lumen as in Case 1 (**Fig. 6A**).

The wire was passed through the posterior descending branch (PDA) (**Fig. 6B**) but it was confirmed from the cranial view that the wire was crossed in the true lumen more than 2 mm distal to the proximal end of the distal true lumen (**Fig. 6C**). Proceeding as normal would require repeated wire manipulation to the occlusion site and therefore reverse wiring (reverse wire technique) using Crusade was selected. Careful attention is needed in a case like this because changing the direction of the wire tip is relatively easy but departure or damping may occur when the wire extends from the position shown in **Fig. 6E**.

Since reverse wiring dilates the branch so as to push away plaque on the proximal side of the bifurcation, the entrance of the side branch is often dilated cleanly and in this case the entrance of the PDA showed good dilation (**Fig. 6F**).

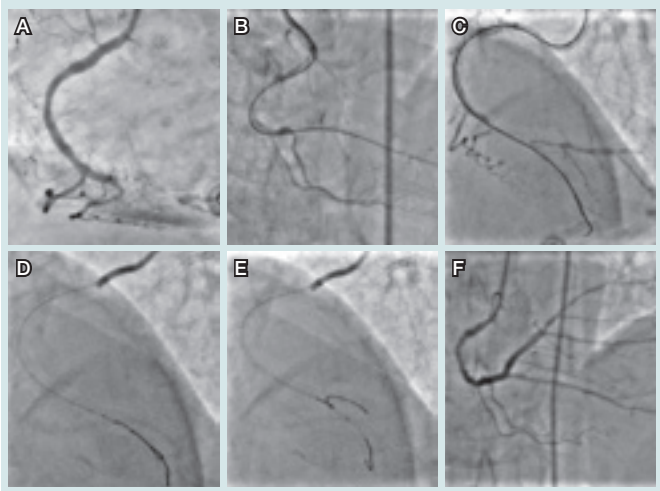


Fig. 6 Case 2: A case with CTO in #3.

Case 3

A troublesome case of reverse wiring is presented. This was a CTO lesion at a site distal to RCA (**Fig. 7A**).

X-treme wire was advanced relatively smoothly and passed through the true lumen of the PDA at a site more distal to the end of the distal true lumen but it was difficult to pass the wire through the site distal to RCA and therefore reverse wiring was performed. When trying to extend the reverse wire, an abnormality was felt and confirmation revealed that the wire broke off (**Fig. 7B**). The cause of the break was considered due to the distance from the tip of the wire to the bending site being 55 mm, which is clearly longer than the usual 20-30 mm.

The broken wire was withdrawn by inserting two wires and rolling it up.

The reverse wire bent at an appropriate position was then crossed at the site distal to RCA, the stent was placed, and treatment was completed (**Fig. 7C**).

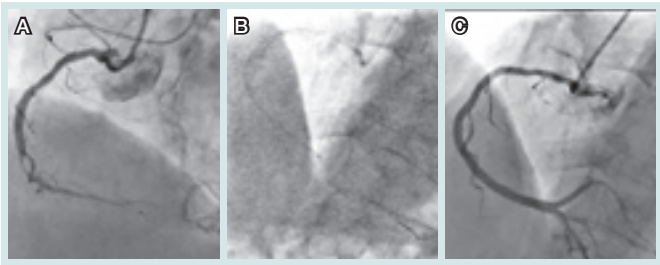


Fig. 7 Case 3: A case with a CTO lesion at a site distal to RCA.

The key to successful Crusade withdrawal

As this has already been explained by Dr. Otani, I will be brief in my description.

I usually use the Nanto method because the use of an extension wire requires an assistant and much labor.

The important point to follow when pulling Crusade by applying pressure is to always switch the right and left hands when it is caught once at the port exit of the monorail lumen (Fig. 8A, B).

Dr. Otani used a method in which he temporarily reduced pressure, but I withdraw it at 10-15 atms since no problems occur if I switch my right and left hands calmly.

Finally, Crusade is a necessity for me. It is not so popular in foreign countries but I always place it in my suitcase so it is ready to be use.

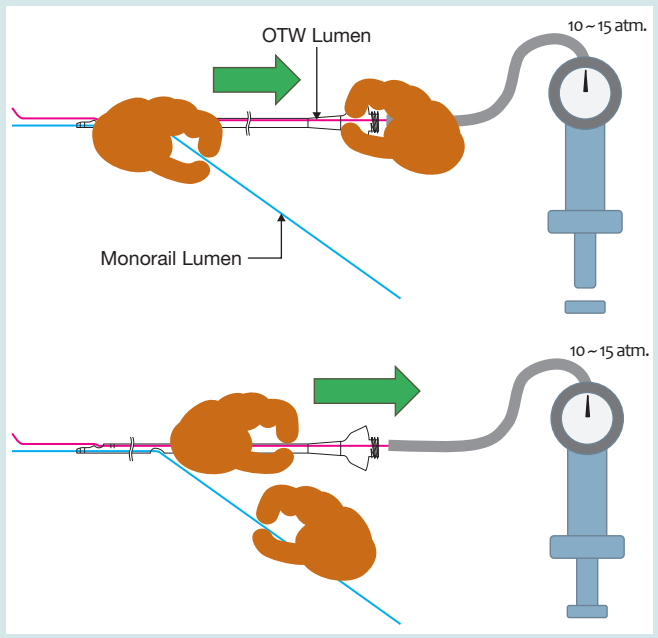


Fig. 8 Withdrawal of Crusade using the Nanto method. Pull Crusade by applying pressure and switch the right and left hands when it is caught at the port exit.

Crusade™

TAKUMI
"Decision at Bifurcation"

Dr. Osamu Katoh
Adviser, Kusatsu Heart Center

Before Crusade became available, I used the multiprobing sheath but it was discontinued. The advantages of having replaced the multiprobing sheath with Crusade include better sliding of the wire in the OTW lumen, better maneuverability, and its relative ease of use.

I will describe here the usefulness of Crusade, focusing on (1) wire exchange, (2) coaxial backup for guidewire handling, and (3) multiple wire technique, from among the technical issues experienced in modern percutaneous coronary intervention for complex lesions (complex PCI) (**Fig. 1-3**).

- **wire exchange, reshaping wire tip during procedure**
- **co-axial backup for guide wire handling**
- **multiple wire technique**
  - buddy wire technique
  - side branch protection in bifurcation stenting
  - SPRIT stenting
  - parallel wire technique

Fig. 1 Technical Issues in Moderm Complex PCI - need for Crusade -

- **to put another wire leaving the prior wire**
- **unable to deliver a catheter for exchange beyond the lesion**
- **key to success**
  - avoid wire twisting
  - minimize damage of the 2nd wire

Fig. 2 Wire exchange/Reshaping

- **prevention of wire twisting**
- **co-axial backup to the 2nd wire for better maneuverability**
- **easy wire exchange**

Fig. 3 Usefulness of Crusade in multiple wire technique

■ Wire exchange

The number of wires that use polymer materials has increased recently but these wires need to be exchanged with a coil wire during the procedure because of possible complications such as perforation. In wire exchange or reshaping the wire tip, the wire is withdrawn once and a new wire is reinserted but the new wire may give out before it reaches the target site.

The use of Crusade enables the wire to be quickly exchanged, twisting in the second wire insertion to be avoided and wire damage prevention.

■ Coaxial backup

In cases where sufficient backup to the guide catheter is not obtained, coaxial backup to the guidewire is not obtained and the guidewire becomes unstable and cannot be minutely controlled. In this case, Crusade is often used to give coaxial backup to the second wire for better maneuverability.

In simple PCI, the wire advances easily and no special attention is required. However, when sophisticated guidewire manipulation is required, Crusade is an indispensable device and one cannot underestimate its importance in improving the technical level of PCI.

First, the outline of procedures followed when not using Crusade is illustrated. As an example, when the left circumflex branch (LCX) bends outward from the left coronary main trunk (LMT) and there is a lesion ahead of it (**Fig. 4A**), the guide catheter stays pointing slightly left and the wire will bend and advance into the LCX. When the guidewire is inserted into the side branch proximal to the lesion and the guide catheter and the branch are extended, the curve of the LCX origin straightens slightly and the guide is slightly stabilized (**Fig. 4B**). However, this is not yet sufficient. If manipulation of second wire advancement is performed in this condition, the wire becomes looped or extended, hindering maneuverability (**Fig. 4C**).

In contrast, by using Crusade (**Fig. 5A**), the second wire can be fixed at the LCX origin (**Fig. 5B**), the origin of wire manipulation is secured, and the manipulation is stabilized (**Fig. 5C**). This perfectly illustrates the advantage of using Crusade and forms the basis of its usefulness.

■ Multiple wire technique

Complex PCI requires a multiple wire technique, for which Crusade is useful because it prevents wire twisting, provides coaxial backup, and makes wire exchange easy.

Main techniques include the buddy wire technique, side branch protection in bifurcation stenting, SPRIT stenting, the parallel wire technique, and a special technique presented by Dr. Sumitsuji.

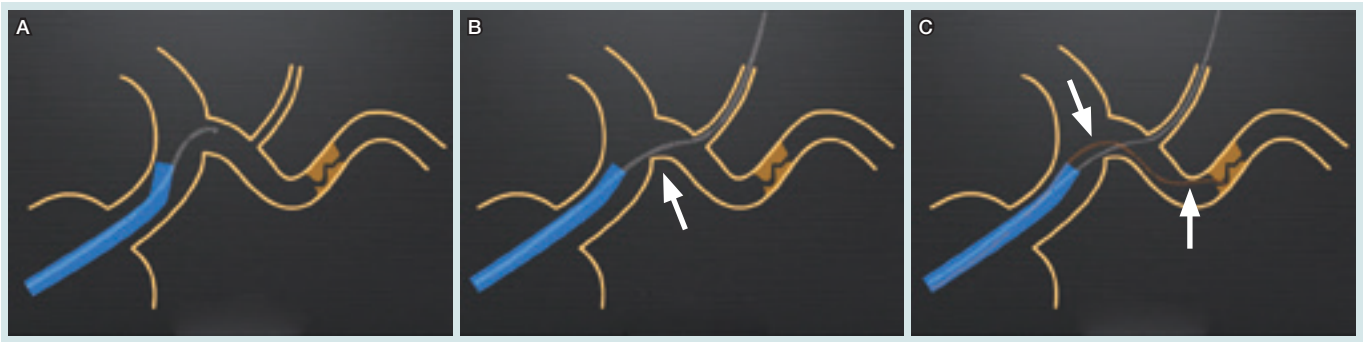


Fig. 4 Second-wire manipulation in coaxial backup not using Crusade.

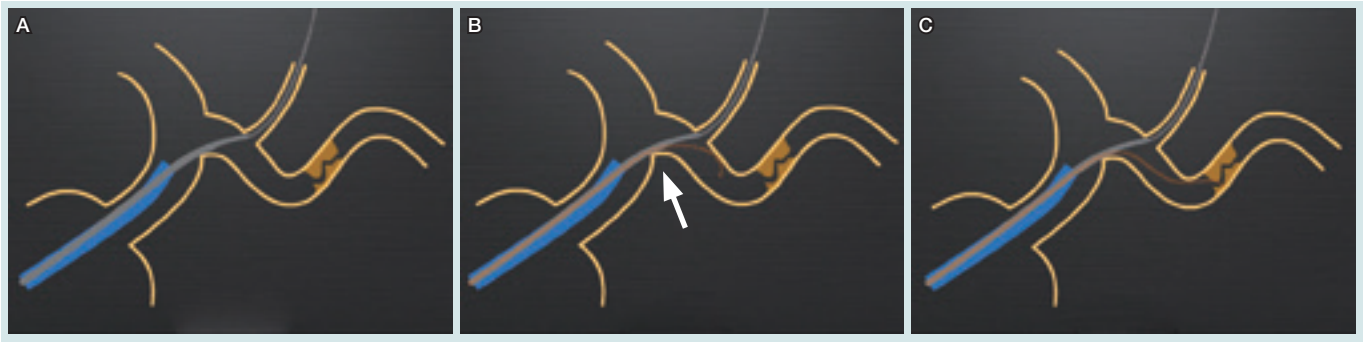


Fig. 5 Second-wire manipulation in coaxial backup using Crusade.

Getting familiar with using Crusade

It seems there are many doctors nowadays who are familiar with bare wire and feel that using Crusade takes too much time. However, if you get familiar with the procedure, it takes only one or two minutes. As stated earlier, if you want to enhance your skills to the next technical level, you should get familiar with how to use it. If you use only the bare wire for the procedure, your technique will not improve.

As was emphasized by Dr. Otani and Dr. Sumitsuji, withdrawal of Crusade using the Nanto method requires some special maneuvering. The Nanto method is convenient but wire twisting during withdrawal may occur and it is quite difficult to be resolved once it does. I withdraw it by balloon trapping method almost 100% of the time.

When Crusade is used in CTO, digging with a parallel wire is often performed. I perform a delicate procedure that allows no displacement of the position of the wire tip in the CTO portion. It is not uncommon for the wire to come out in the Nanto method, but balloon trapping method ensures wire fixation and there is no displacement of the tip position. I think a 2.5-mm balloon is appropriate for an 8 Fr guiding catheter. I often use this size balloon in the procedures I perform. It is more convenient than the Nanto method and I recommend it.

In the special usage (reverse wire technique) reported by Dr. Sumitsuji, if the tip of the second wire bends at a sharp angle and creates a kink, the wire may break or it may become more difficult to extend and bring the wire to a part farther in while rotating after insertion. To avoid this, it is desirable to bend the tip of the wire not completely but at about three points so as to form a small loop.

Case presentation

A case of step-by-step crossing using Crusade is presented. A subtotal occlusion lesion in the LCX is diffusely observed (**Fig. 6**).

With one wire already inserted (**Fig. 7**), Crusade was used to give coaxial backup to the second wire (**Fig. 7**).

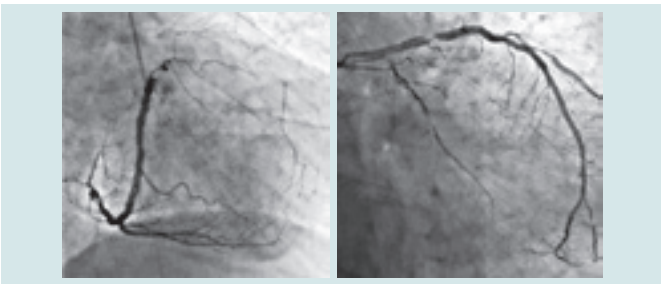


Fig. 6 Subtotal occlusion lesion in LCX.

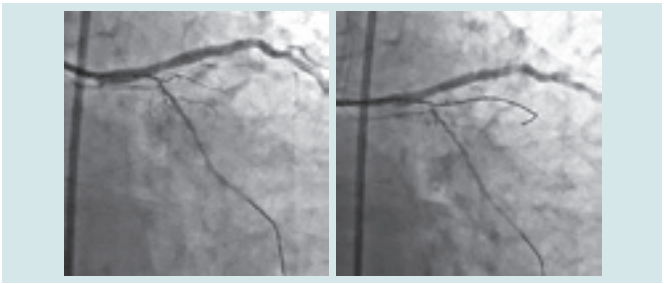


Fig. 7 Crusade was used to give backup to the second wire.

Since this case was complicated, the bifurcation site was again confirmed by IVUS and another wire was advanced using Crusade (**Fig. 8, right**). Eventually, three wires were brought in parallel (**Fig. 9**).

When insertion and withdrawal of Crusade are repeated, the conventional method takes time but the use of balloon trapping method (**Fig. 10**) facilitates withdrawal with no displacement of the wire tip. Thus, it is considered that Crusade is indispensable in step-by-step procedures as well.

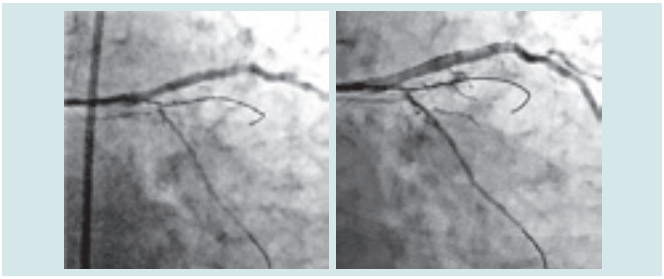


Fig. 8 One more wire was inserted using Crusade.

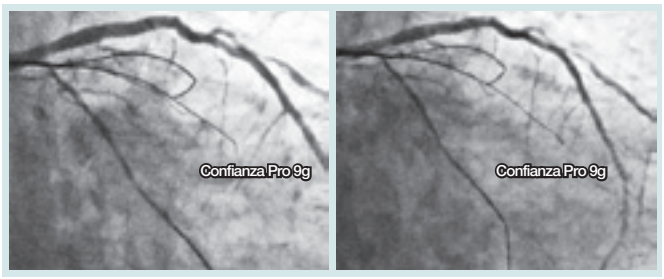


Fig. 9 Parallel wire technique.

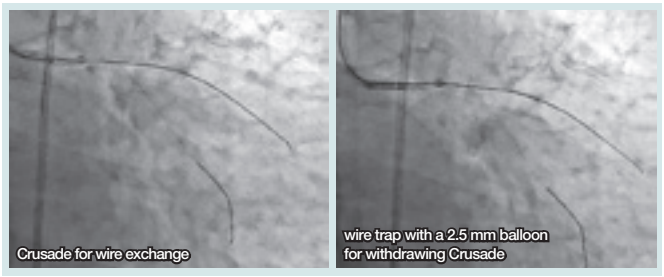


Fig. 10 Withdrawal of Crusade by balloon trapping method.

Successful re-crossing of the stent placed at the LMT bifurcation using the Crusade

Dr. Tomonobu Okuno
Medical Director, Department of Cardiology, IMS Katsushika Heart Center

Case

Case: 93-year-old female

Chief complaint/diagnosis: unstable angina

Clinical history: The patient developed chest pain at rest at home on July 25, 2012, and visited a nearby hospital. She was referred to our hospital with the diagnosis of unstable angina.

Coronary risk factors: hypertension

CAG findings: LMT segment 5, 50%; LAD segment 6, 99%; segment 7, 90%

Therapeutic approach and devices used

Treated sites: LMT segment 5, LAD segments 6 and 7

Approach site: right femoral artery

Guiding catheter: 7 Fr Launcher SL 4.5

Guidewire: SION blue (LAD), Runthrough Extra Floppy → Fielder FC (LCX)

Balloon catheter: Lacrosse NSE 3.0/13 mm, TREK 4.0/15 mm, i-bp22 3.5/15 mm

Stent: Nobori 3.5/18 mm

Intravascular ultrasound: View It

Treatment progress

The patient, who was elderly and had a high surgical risk, wished to be treated by PCI. IVUS was performed by passing SION blue through the LAD and Runthrough Extra Floppy through the LCX. Since almost no plaque was found in the proximal LCX, we decided to treat the mid LAD after treating the LMT to LAD with single stent + KBT. After pre-dilation of the proximal LAD using Lacrosse NSE 3.0/13 mm (**Figure 2**), Nobori 3.5/18 mm was placed in the LMT to LAD (**Figure 3**). Since apposition of the stent in the LMT was expected to be incomplete, for re-crossing the wire to the LCX, we used the Crusade to pass the Fielder FC through it. KBT (8 atm) was performed using the i-bp22 3.5/15 mm for the LAD and the TREK 4.0/15 mm for the LCX, and good dilation was achieved (**Figure 4**). After that, a Xience Prime 2.5/18 mm was placed in the mid LAD to complete the procedure (**Figure 5**).

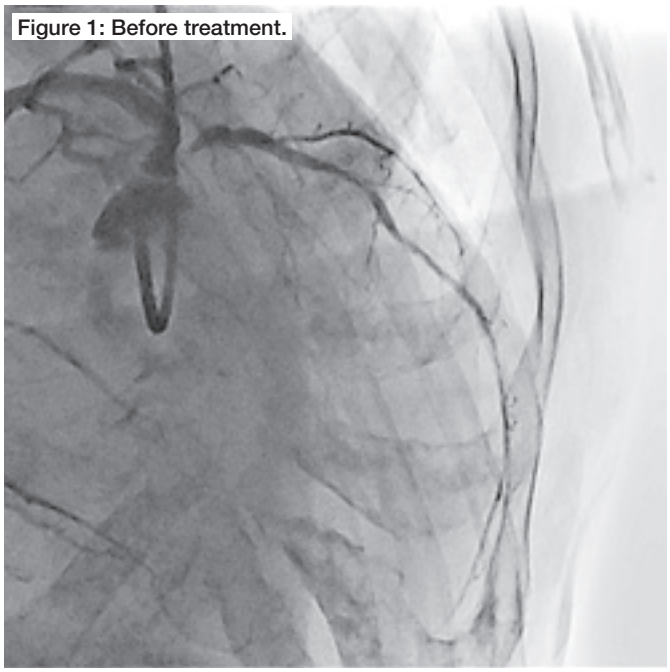


Figure 1: Before treatment.

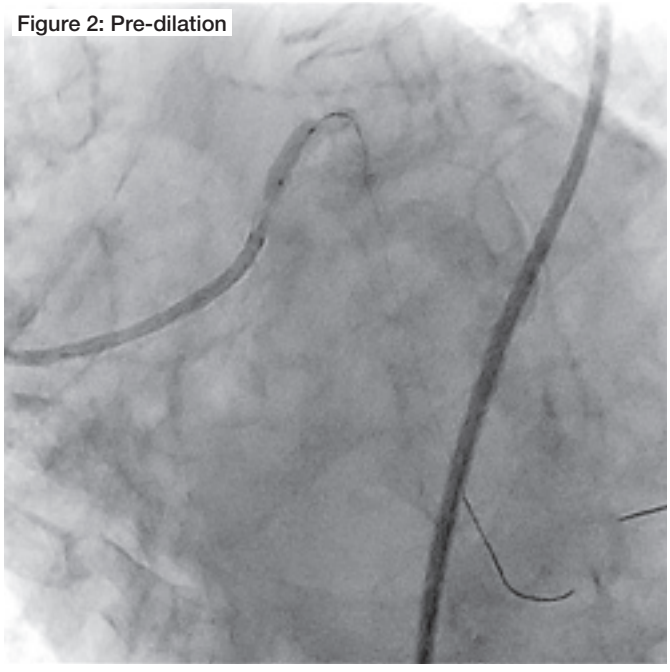


Figure 2: Pre-dilation

Treatment strategy points

In wire re-crossing after stent placement in a bifurcation lesion, the wire may easily pass through outside the stent wall where the apposition of the stent to the vessel wall is incomplete. If the wire passes properly inside the stent is difficult to verify by X-ray fluoroscopy alone, and may require confirmation by IVUS. By using the Crusade, it is possible to securely pass the wire inside the stent. It can also avoid twisting of the wire, allowing the smooth performance of subsequent procedures. Especially in the treatment of LMT bifurcation lesions, we use the Crusade in almost all cases for wire re-crossing, because delay in procedures and balloon inflation at inappropriate sites may cause serious troubles. In addition, the use of the Crusade allows to repeatedly perform the procedure to target the distal stent selectively. The application of the Crusade for wire re-crossing after stent placement in a bifurcation lesion is a very fundamental method, which we believe is already adopted by many surgeons, and we will strongly recommend trying this technique for surgeons with little experiences to use the Crusade.

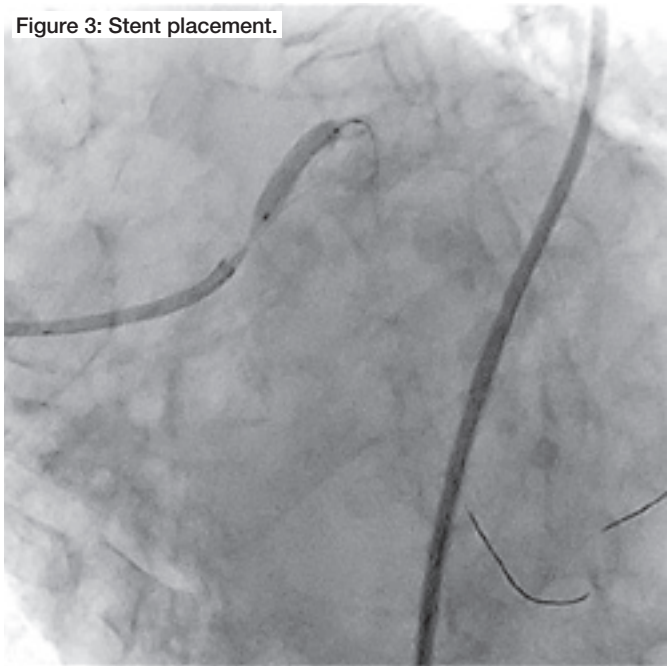


Figure 3: Stent placement.

Figure 4: During KBT.

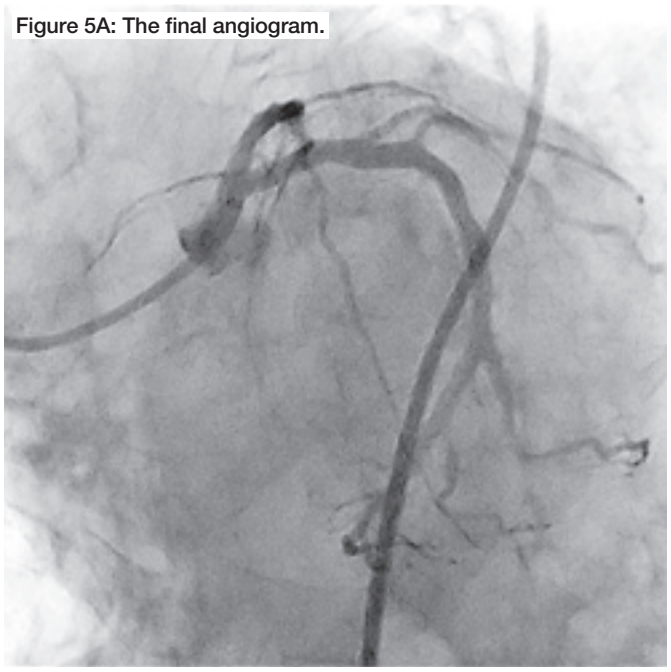


Figure 5A: The final angiogram.

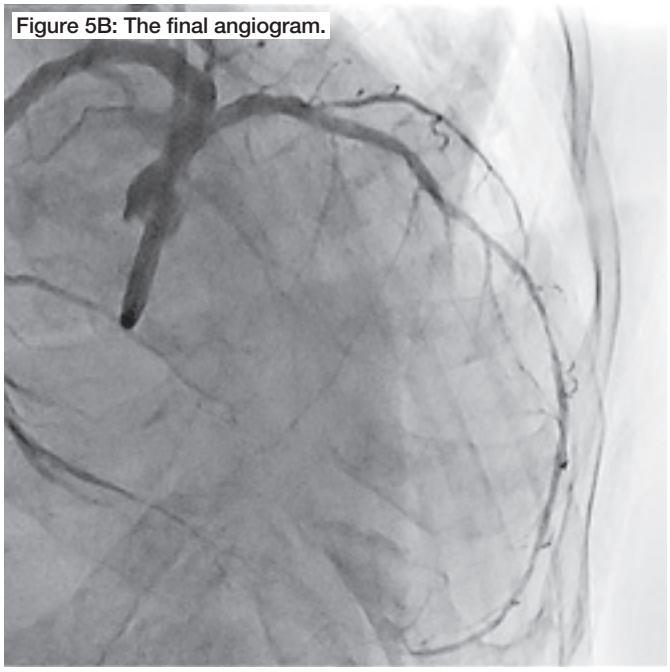


Figure 5B: The final angiogram.

A case of severe stenosis in the circumflex artery in which the Crusade was useful for passing the wire through the lesion

Dr. Shinichi Takeda
Vice-director, Department of Cardiology, Ijinkai Takeda General Hospital

Case

Case: 59-year-old female

Chief complaint/diagnosis: angina pectoris

Clinical history: The patient is currently under treatment for hypertension and hyperlipidemia at a nearby hospital. Reduced wall movement in the posterior wall region was detected by echocardiography. She was referred and admitted to our hospital for detailed examination and treatment.

Coronary risk factors: abnormal glucose tolerance, hyperlipidemia, smoking history

CAG findings: LCX segment 13, 99% delay (**Figure 1**)

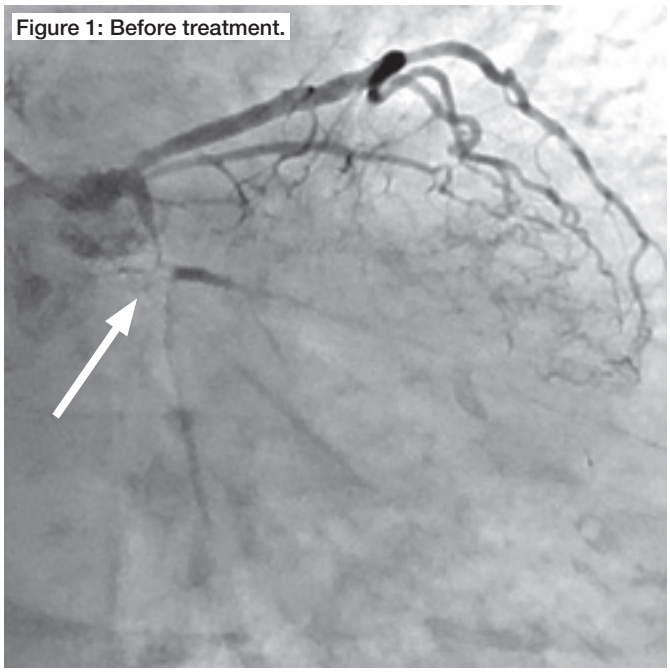


Figure 1: Before treatment.

Therapeutic approach and devices used

Treated sites: LCX segment 13

Treatment strategy: DES placement

Approach site: left radial artery

Guiding catheter: Launcher 6 Fr EBU4.0 SH (+)

Guidewire: Runthrough Hypercoat → X-treme

Penetration catheter: Corsair → Crusade

Balloon catheter: Lacrosse 2.75/15 mm, 2.25/15 mm

Stent: PROMUS 2.5/23 mm

Intravascular ultrasound: Eagle eye gold

Treatment progress

First, wiring was performed for the segment 13 lesion using the Corsair microcatheter and Runthrough Hypercoat guidewire, but the wire could not be kept coaxial with the lesion and could not easily pass through it (**Figure 2**).
Therefore, we advanced the Runthrough Hypercoat guidewire into segment 12 to approach the segment 13 lesion using the Crusade and X-treme guidewire (**Figure 3**). Backup and coaxiality remarkably improved, and thus we successfully passed the wire through the lesion with ease.
After that, the Crusade was replaced with the Corsair. After passing the Corsair through the lesion, balloon dilation was performed using the Lacrosse 2.25/15 mm; then, wiring was performed also for segment 14; PROMUS 2.5/23 mm stent was placed in segment 13; and KBT was performed for segments 13 and 14 using the Lacrosse 2.75/15 mm and 2.25/15 mm, respectively, to complete the procedures (**Figures 4 and 5**).

■ Treatment strategy points

In a case of an acute angle between the left main trunk (LMT) and the circumflex artery, when passing a wire through the circumflex artery, it may be difficult to maintain coaxiality and transmit the torque. Even in cases in which it is difficult to securee backup and coaxiality using a conventional microcatheter, by passing the monorail lumen wire through the branch using the Crusade and approaching the lesion with the OTW lumen wire, it may be possible to easily secure backup and coaxiality, thus facilitating wiring. Such cases are a good example of the useful application of the Crusade.

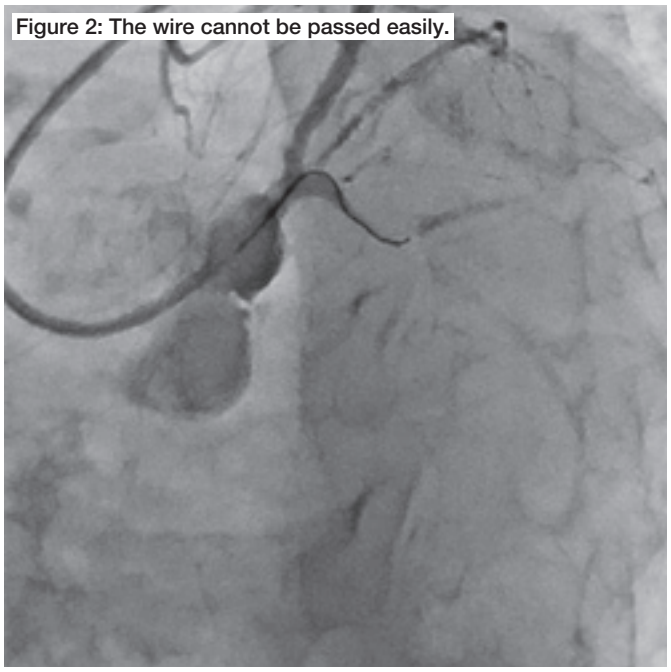


Figure 2: The wire cannot be passed easily.

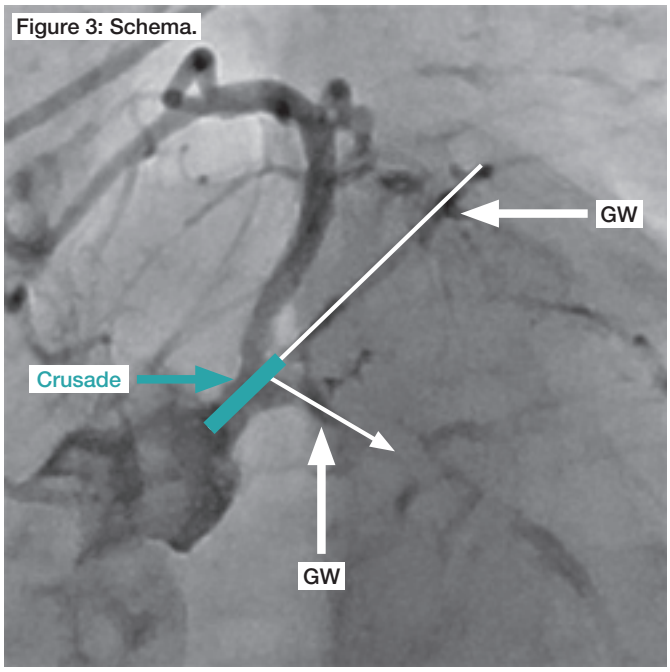


Figure 3: Schema.

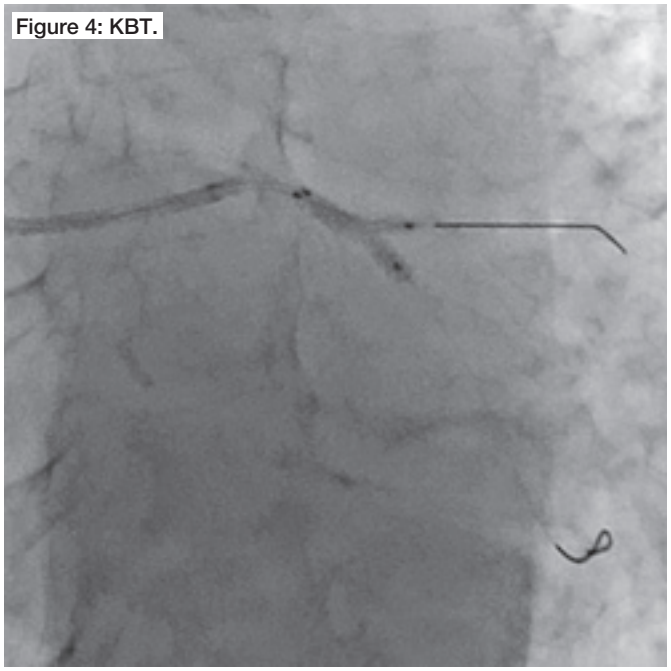


Figure 4: KBT.

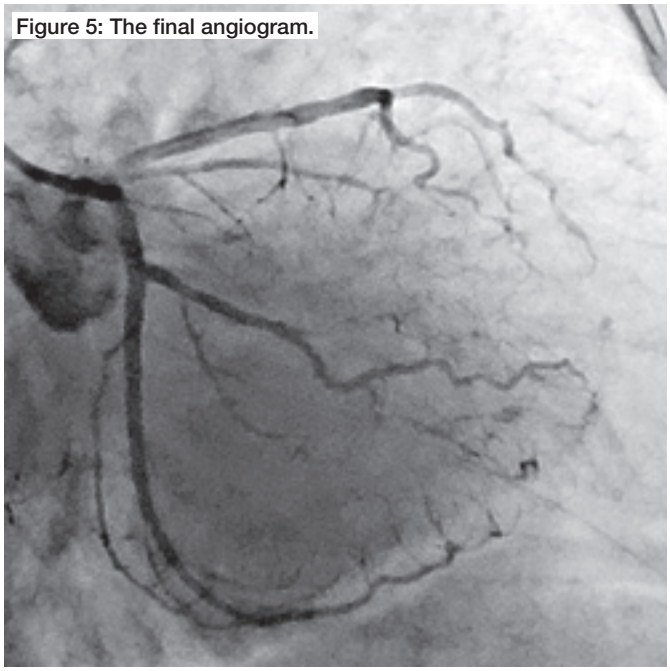


Figure 5: The final angiogram.

Application of the Crusade in ipsilateral retrograde PCI

Dr. Wataru Nagamatsu
Director, Cardiac Catheterization Laboratory, Hokusetsu General Hospital

Case

Case: female in her 80th
Chief complaint/diagnosis: heart failure
Clinical history: Myocardial ischemia was diagnosed by electrocardiogram and echocardiography. After CAG, PCI was performed.
Coronary risk factors: hyperlipidemia, hypertension
CAG findings: CTO in the LAD segment 7

Therapeutic approach and devices used

Treated sites: LAD segment 7
Treatment strategy: DES placement
Approach site: right radial artery
Guiding catheter: 6-Fr Britetip XB 3.5
Guidewire: Fielder FC, X-treme, Miracle 3, Miracle 12, Conquest Pro
Penetration catheter: Finecross MG (130 & 150 cm), Crusade
Balloon catheter: Apex push 1.5/15 mm, Quantum Maverick 2.5/15 mm
Stent: Cypher 2.5/28 mm
Intravascular ultrasound: Eagle eye gold

Treatment progress

A 4-Fr diagnostic sheath placed in the right radial artery was replaced with a 6-Fr sheath (ad hoc PCI) for a 6-Fr back-up support catheter. While we started the procedure with the antegrade technique using the X-treme guidewire, the so-called micro-channel was not clear. A very hard CAP was assumed, because even a stiff wire could not pass through it by a wire manipulation targeting the true lumen.

Multiple collateral pathways from the LAD septal branch, conus branch and segment 4 PD were observed and the retrograde method by using the septal (ipsilateral) should be secured, and therefore, we chose this technique. Fielder FC was passed through the proximal of the septal by Fielder FC, X-tream was passed through the distal of the septal and reached the CTO distal. We decided to perform the reverse CART. A preparation was carried out in advance. The antegrade penetration catheter, Finecross MG, in the CTO false lumen was advanced to touch the retrograde wire to complete CART without using a balloon (Kind reverse CART) (**Figure 2-1, 2**). In addition, in order to use only one guiding catheter as a less invasive procedure, the antegrade and retrograde Finecross MG catheters were positioned opposed to each other in the guiding catheter, and the wire was passed from the antegrade into the retrograde Finecross MG catheter (rendezvous technique).

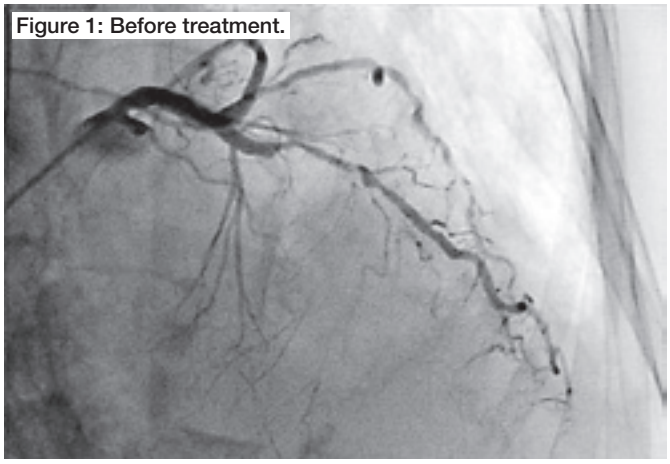


Figure 1: Before treatment.

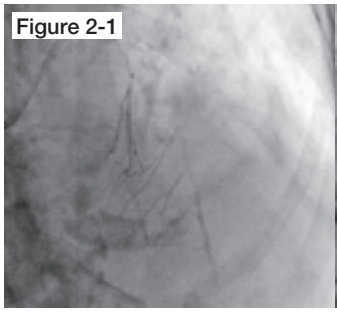


Figure 2-1

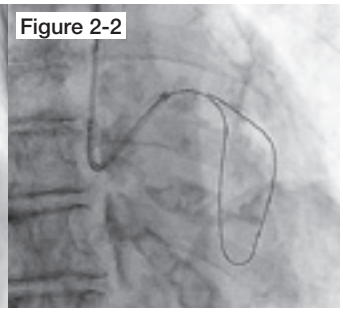
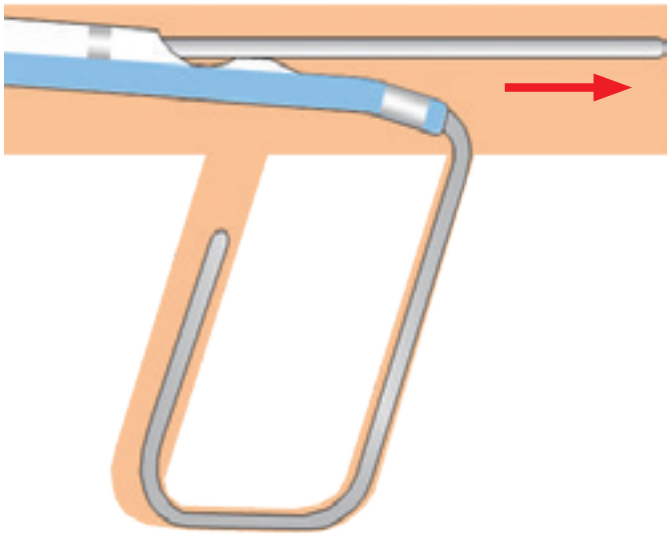


Figure 2-2



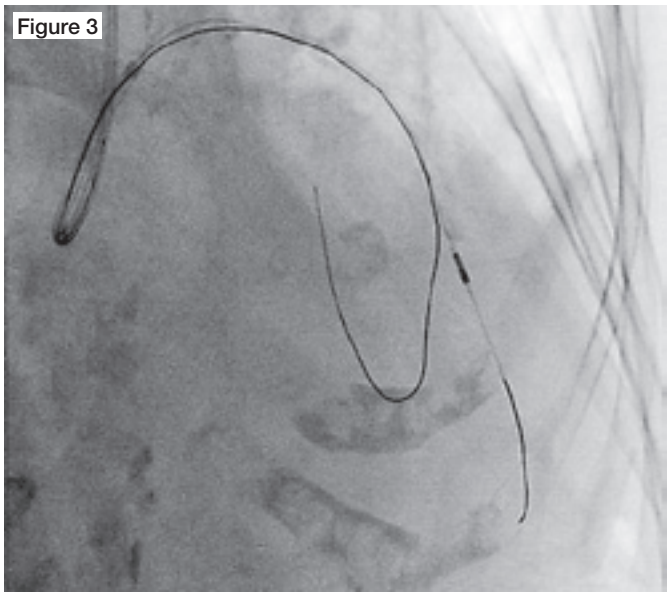


Figure 3

After removal of the Finecross MG catheter, dilation was performed using the Apex push 1.5/15 mm balloon catheter. We used the Crusade to securely pass through the same route as the first wire to reach the target distal to the retro channel (**Figure 3**).

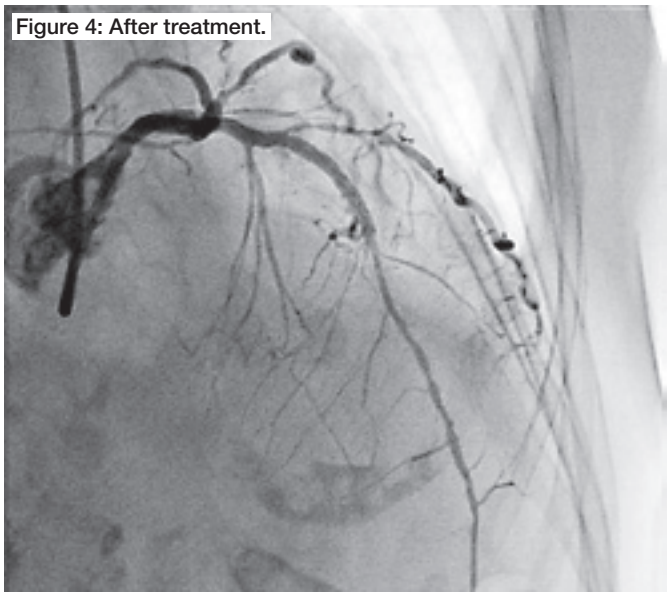
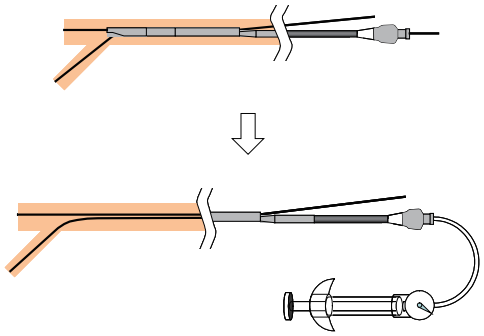


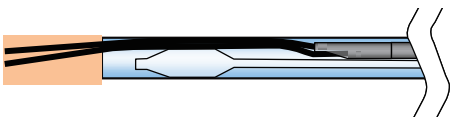
Figure 4: After treatment.

Then, after IVUS observation, a balloon dilation was added and a stent was placed to complete successfully the dilatation of the lesion. No injury was observed in the retro channel. The volume of contrast media used for the CTO PCI procedure was 15 mL, and it was 50 mL as a total including the amount used for diagnostic angiography.

■ How to remove the Crusade (Nanto method or Trapping method)



Nanto method is used when 6-Fr guiding catheter is used.
Precaution: Check the behavior of the side branch wire by cineradiography during the procedure



Trapping method, by using a bare balloon to trap RX and OTW wires, is used when 7-Fr or 8-Fr guiding catheter is used..

■ Treatment strategy points

When adding another wire after passing the wire through the CTO lesion, it is important to ensure that the second wire passes through the same route as the first wire. When this is attempted without using the Crusade, the wire may deviate from the intended route and advance into a false lumen or cause detachment. As in the present case, when adding a wire targeted at the distal to the retro channel in Retrograde PCI, the Crusade seemed to be an essential tool to securely capture the same route.

The parallel wire technique using the Crusade in CTO–PCI

Dr. Masaki Tanabe
Medical Director, Cardiovascular Department, Heart Center,
Daini Okamoto General Hospital

Case

Case: 67-year-old male

Chief complaint/diagnosis: angina pectoris after infarction

Clinical history: The patient had previously been hospitalized for acute myocardial infarction at 40 years of age (conservative treatment). Since then, he had been treated by a nearby physician with oral therapies, but he occasionally had chest symptoms associated with exercise. He was referred and admitted to our hospital for detailed examination and treatment.

Coronary risk factors: hypertension, dyslipidemia

CAG findings: segment 7, CTO; segment 14, CTO

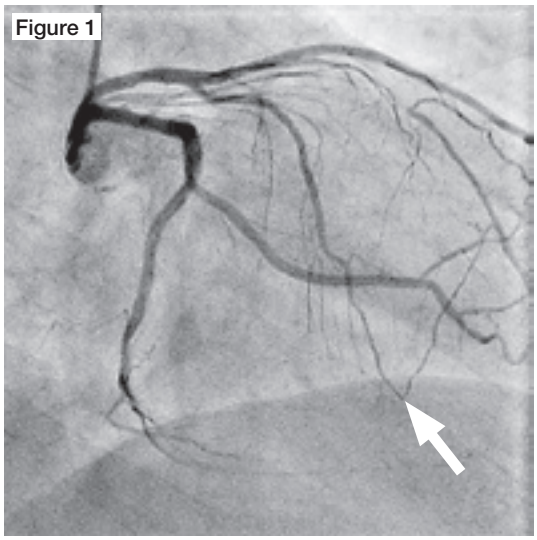


Figure 1

Therapeutic approach and devices used

Treated sites: LAD segment 7, CTO

Treatment strategy: Ipsilateral retrograde approach, POBA+DES placement

Approach site: right femoral artery

Guiding catheter: 8-Fr Mach 1 CLS 3.5 SH

Guidewire: SION, SION blue, X-treme, RG 3, Fielder FC

Penetration catheter: Corsair 150 cm, Crusade

Balloon catheter: Lifespear 1.2/6 mm, IKAZUCHI Rev 2.0/15 mm, Powered Lacrosse 2.5/12 mm

Stent: Xience V 2.5/28 mm, 3.0/28 mm

Intravascular ultrasound: Eagle eye Platinum

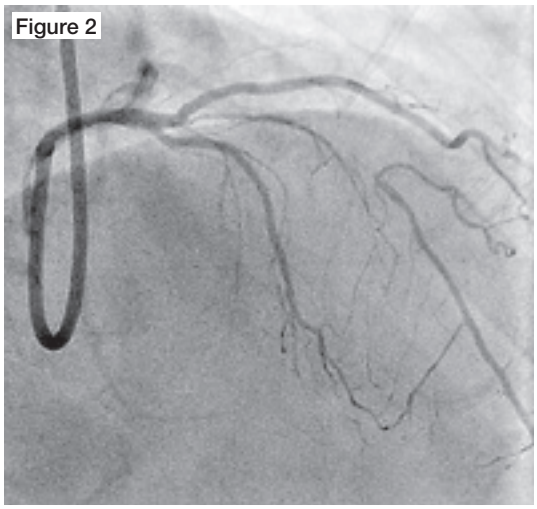


Figure 2

Treatment progress

Since the segment 7 CTO was occluded at the bifurcation between the LCX and D1 (**Figure 1, 2**) with a blunt stump, we decided to start with the retrograde approach via ipsilateral collateral (septal to septal) connection. Although we started wiring using the Corsair + SION blue, the Corsair could not cross the acute-angle segment (**Figure 1, arrow**). Therefore, we crossed the Corsair after performing balloon dilation using the Lifespear 1.2/6 mm, and delivered it to the peripheral LAD. When we performed retrograde wiring by replacing SION blue with the X-treme (**Figure 3**), the wire could pass through the CTO lesion. To securely capture the true lumen from the CTO entrance to the proximal LAD main trunk, we performed puncture under IVUS guidance on the SION previously crossed to the D1 (**Figure 4**), and thus successfully completed retrograde wire cross. The wire could directly be stored into the guiding catheter. After that, we passed the Corsair through the guiding catheter, and performed wire externalization using the RG3.

Then, using the Crusade, we could insert the RG 3 wire into the CTO (the space where the Corsair passed retrogradely) by the antegrade approach. Using the parallel wire technique by inserting a second wire (Fielder FC) directly through the OTW lumen of the Crusade, we could successfully perform antegrade wire cross (**Figure 5**). After that, switching to the antegrade technique, the IKAZUCHI Rev 2.0/15 mm was passed through the lesion and was balloon dilated, and finally placed the Xience V 2.5/28 mm, 3.0/28 mm to complete the procedure (**Figure 6**).

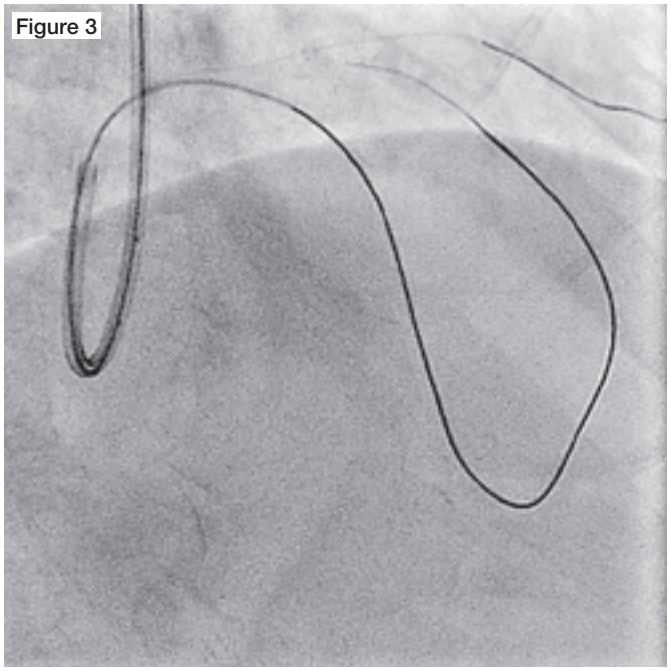


Figure 3

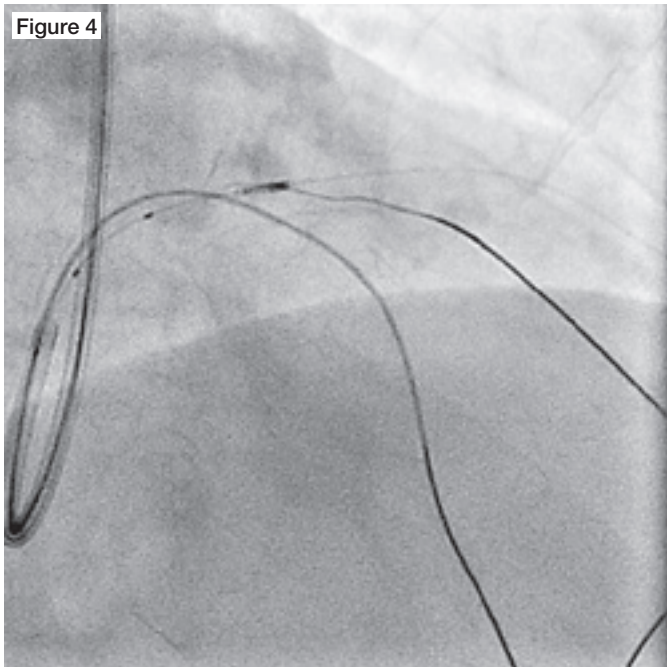


Figure 4

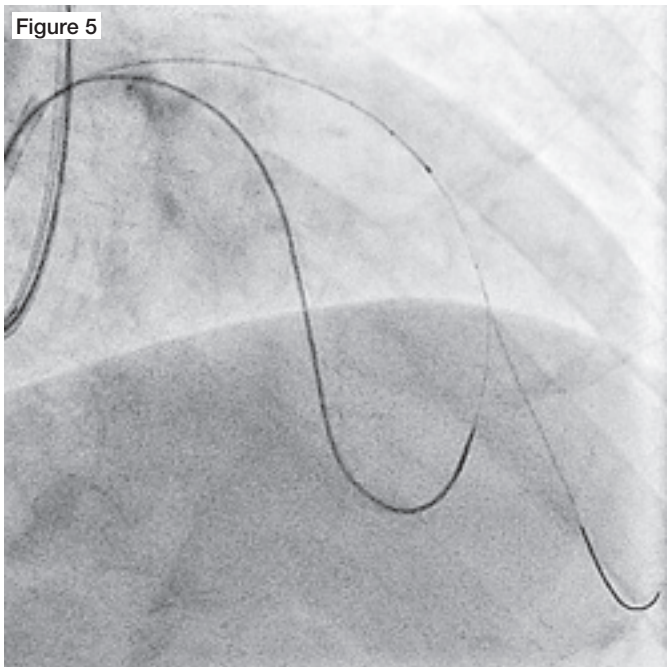


Figure 5

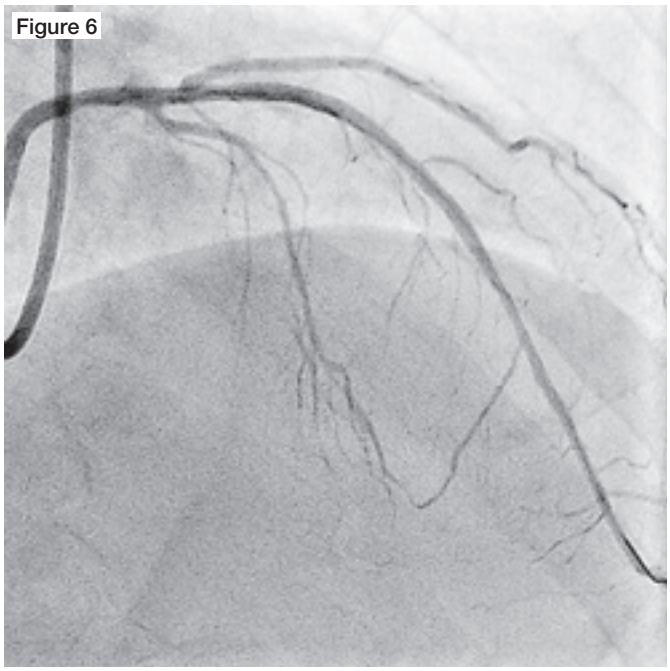


Figure 6

■ Treatment strategy points

The recent development of support devices have contributed to the increase in cases in which the LAD–CTO lesion can be accessed by the ipsilateral retrograde approach via septal to septal connection. However, as in the present case, this route often has acute-angle lesions, and it is susceptible to influence of the heartbeat. For this reason, there is a risk that the channel is damaged when a troublesome technique is employed. Therefore, in the present case, we switched to antegrade wiring to perform the procedure more safely and avoid damage to the channel. In such a case, the parallel wire technique using the Crusade is considered to be very useful to improve manipulability of the second wire and provide better trackability through the lesion.

Effective use of the Crusade for the treatment of CTO lesion in the LCX ostium

Dr. Akiyoshi Kurita
Department of Cardiology, Meiyokai Medial Corporation Narita Memorial Hospital

Case

Case: 69-year-old male

Chief complaint/diagnosis: angina pectoris following chest pain and infarction

Clinical history: In June 2010, the patient who had a diagnosis of angina pectoris underwent PCI for triple-vessels disease (segment 1, 75%; segment 6, 99%; segment 7, 75%; segment 11, 75%). Since he recently developed chest pain, CAG was performed. As CTO was observed just from segment 11, we performed PCI for the LCX in September 2011.

Coronary risk factors: hypertension, dyslipidemia, hemodialysis (since 2004)

CAG findings: LCX segment 11, 100% (**Figure 1**)

Therapeutic approach and devices used

Treated sites: LCX segment 11, 100%

Approach site: left femoral artery

Guiding catheter: 7-Fr AXESS PB 3.5

Guidewire: Fielder FC, X-treme, ULTIMATE bros 3, Conquest pro 9, Neo's Route

Microcatheter: Prominent

Penetration catheter: Corsair, Crusade

Balloon catheter: IKAZUCHI Rev 1.2/6 mm, POWER LINE 2.0/15 mm, SIGNET NC 2.25/15 mm, DESLIP 3.0/9 mm

Stent: Cypher select 2.5/23 mm

Intravascular ultrasound: Revolution

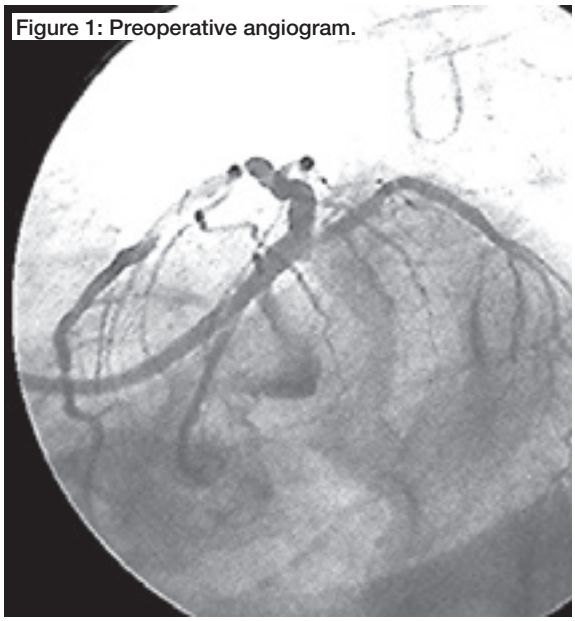


Figure 1: Preoperative angiogram.

Treatment progress

We tried to pass the wire through the CTO lesion because of stent restenosis at the LCX ostium using a conventional microcatheter. We could direct the wire tip towards the lesion at the LCX. However, the LCX bifurcation angle was more than 90 degrees and the force of the wire was directed towards the LAD main trunk so that a backup could not be secured.

For this reason, using the Crusade, which allows effective targeting of lesions at a side branch, we directed the wire towards the CTO lesion to secure better backup (**Figure 2**), and passed the wire through the CTO lesion changing the guidewire from Fielder FC to X-treme, to ULTIMATE bros 3, and then to Conquest pro 9. After crossing the wire, we replaced the Crusader with a microcatheter, but it could not pass through the lesion. Therefore, the IKAZUCHI Rev 1.2/6 mm was passed through the lesion and dilated (**Figure 3**). After that, the balloon size was gradually increased, and finally the Cypher 2.5/23 mm was overlapped on the distal segment of the previously placed Xience stent and was balloon-dilated at 16 atm (**Figure 4**). The stent was post-dilated with a high-pressure at 22atm by the DESLIP 3.0/9 mm, and the procedure was completed with good dilatation of the lesion. The final angiogram is shown (**Figure 5**).

■ Treatment strategy points

In the present case of in-stent restenosis in the LCX ostium, manipulation of the wire was difficult because of very large bifurcation angle. Using the microcatheter, which is conventionally used for CTO, although the wire tip could be directed towards the lesion, the force of the wire was directed towards the LAD main trunk because of the large LCX bifurcation angle. Furthermore, since the patient was on hemodialysis and the lesion was very hard, the wire could not be advanced without sufficient backup. For this reason, we used the Crusade to secure a backup to target the CTO at the LCX ostium, and obtained a good outcome.

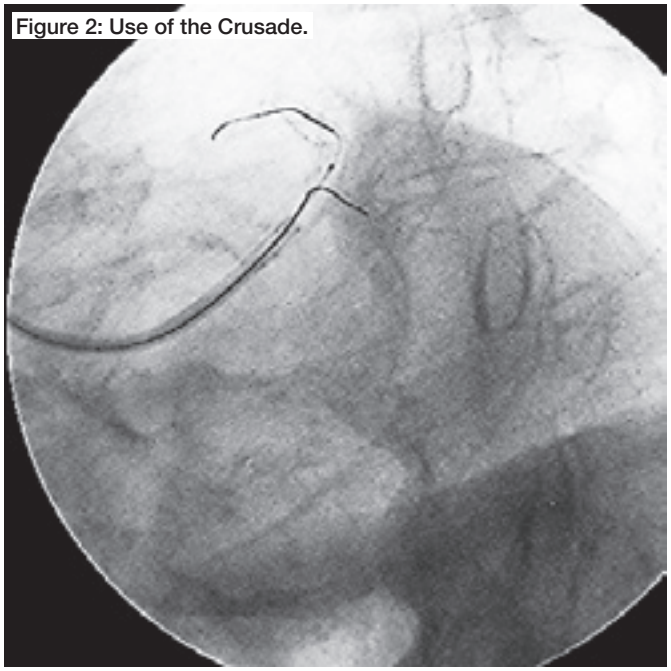


Figure 2: Use of the Crusade.

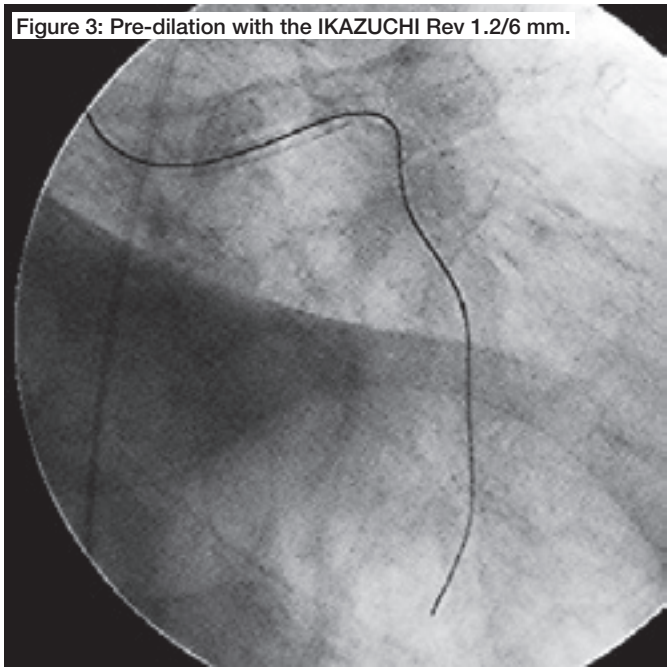


Figure 3: Pre-dilation with the IKAZUCHI Rev 1.2/6 mm.

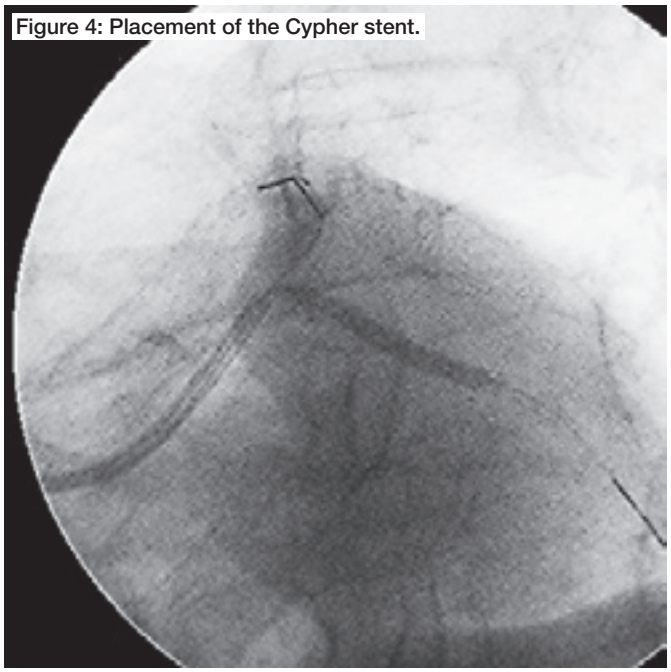


Figure 4: Placement of the Cypher stent.

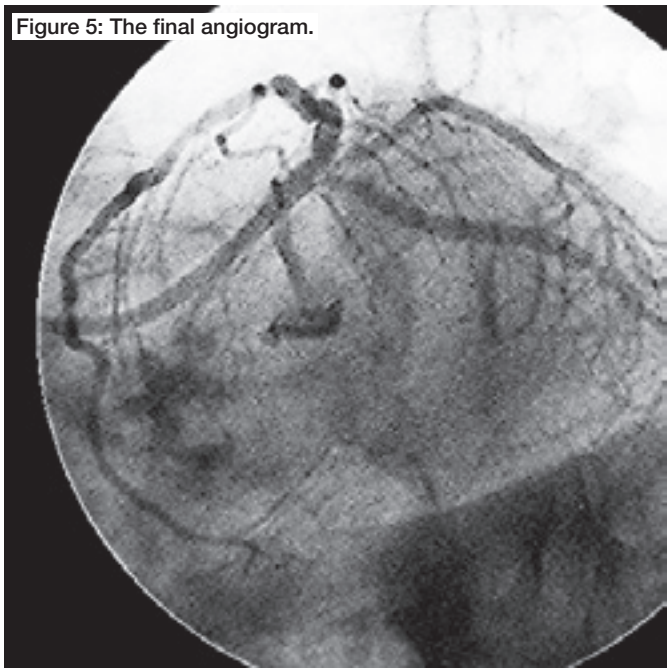


Figure 5: The final angiogram.

Use of the Crusade for passing the wire through CTO at a bifurcation

Dr. Hideki Shimomura
Vice-director, Department of Cardiology, Fukuoka Tokushukai Medical Center

■ Case

Case: 52-year-old male

Chief complaint/diagnosis: angina pectoris

Clinical history: The patient who was on maintenance hemodialysis was feeling exertional chest pressure from 5 to 6 years ago. He recently began to have symptoms even at night. Since the chest pressure sensation appeared during hemodialysis procedure, and ischemic changes were observed on ECG, he was admitted to our department.

Coronary risk factors: hypertension, type 2 diabetes mellitus, dyslipidemia, smoking

CAG findings: triple-vessels disease involving CTO in the RCA segment 2, CTO in the LCX segment 13, and 90% stenosis of the LAD segment 6 (**Figure 1**)

■ Therapeutic approach and devices used

Treated sites: CTO in the RCA segment 2, subtotal occlusion of segment 3

Treatment strategy: For the occlusion at the bifurcation with the RV branch, it seemed difficult to secure the entry point with a wire. First, the wire should be inserted into the RV branch. Then, the occlusion stump should be probed while holding the wire using the Crusade.

Approach site: left femoral artery

Guiding catheter: 7-Fr Launcher SCR4.0 SH

Guidewire: SION blue, X-treme XT-R, Wizard 3

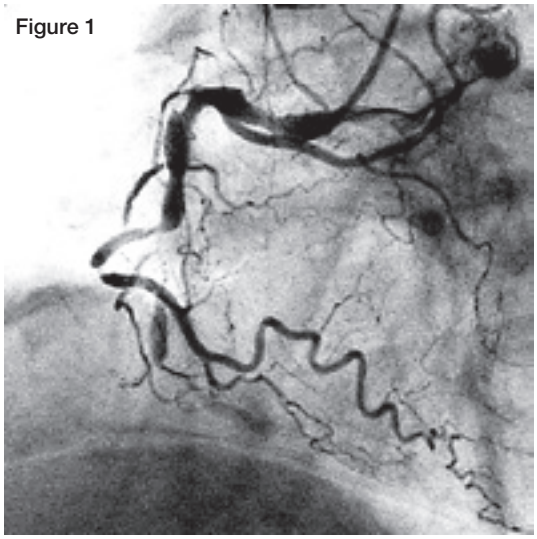
Penetration catheter: Corsair, Crusade

Balloon catheter: Sprinter Legend 1.5/6 mm, Tazuna 2.5/15 mm, Ryujin plus 4.0/15 mm

Stent: segment 3-AV; Xience V 3.5/18 mm, segments 2-3; Xience V 3.5/28 mm

Intravascular ultrasound: Intrafocus WR

Figure 1



Occlusion at the bifurcation with the RV branch. Although there seemed to be a micro-channel, it was considered difficult to capture the occlusion stump.

■ Treatment progress

We started with the Corsair penetration catheter and the SION blue guidewire, and then switched to the X-treme XT-R. Since it was difficult to secure the entry point, we replaced the wire with the Wizard 3 before probing the occlusion stump, but we could not capture it. Next, after crossing the SION blue towards the RV branch, we managed to capture the occlusion stump by probing it with the Wizard 3 using the Crusade, and we could complete the wiring towards the distal RV branch bifurcating from the middle of the occluded segment (**Figure 2**). After that, returning to the main trunk, we successfully crossed the wire to the peripheral side (**Figure 3**). By trapping with the Tazuna 2.5/15 mm, the Crusade was replaced with the Sprinter Legend 2.5/15 mm, and we tried to cross and dilate the lesion but it was difficult to cross the lesion due to insufficient backup of the guiding catheter. Then, we could successfully cross and dilate the lesion by anchoring the RV branch with a 2.0/15 mm balloon, and the flow was reopened, but 99% stenosis was observed also in the peripheral portion of segment 3 (**Figure 4**). After full dilation with the Tazuna 2.5/15 mm, we performed IVUS. The

lesions (AV: MM 4.2 × 4.1 mm; segment 3: MM 4.8 × 4.6 mm; segment 2: MM 4.8 × 5.3 mm) were partially calcified but were composed mainly of fibrous plaque, with lesion length of 17.3 mm for segment 3-AV and 27.6 mm for segments 2-3. Therefore, we placed the Xience V 3.5/18 mm stent in segment 3-AV and the Xience V 3.5/28 mm stent in segments 2-3. After that, we dilated only segment 2 with the Ryujin plus 4.0/15 mm, obtaining a minimum stent area of 9.3/11.3, and completed the procedure without any problems in the flow (**Figure 5**).

■ Treatment strategy points

Angiography revealed a CTO lesion at the RCA with the occlusion stump at the bifurcation with the RV branch. After confirming the presence of an aperture of the occlusion stump by inserting IVUS in the RV branch, we tried to cross the lesion using the Corsair/Wizard 3, but we could not capture it because of tightness of the lesion, insufficient backup of the guiding catheter and poor retention of the microcatheter. Therefore, we inserted the Crusade through the wire in the RV branch to improve retention, and retried to cross the lesion using the Wizard 3 wire with success.
We reported the present case, considering that the Crusade is useful to cross the wire through CTO lesions at bifurcation in many cases.

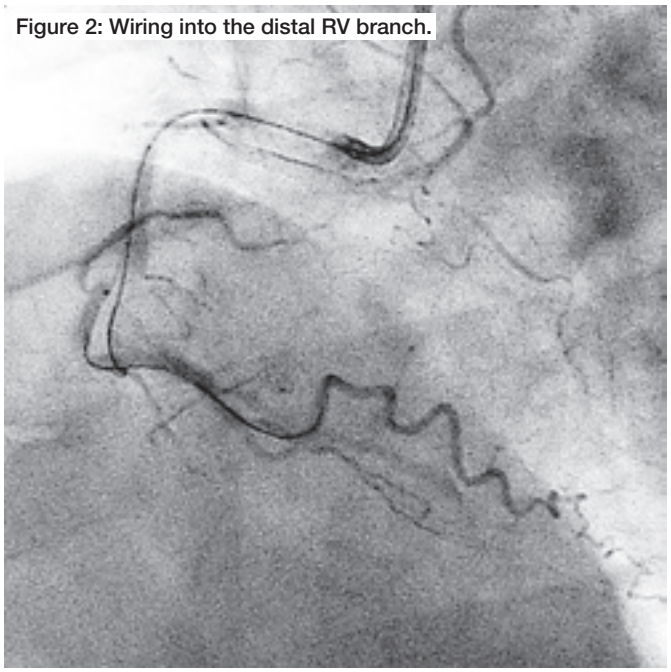


Figure 2: Wiring into the distal RV branch.

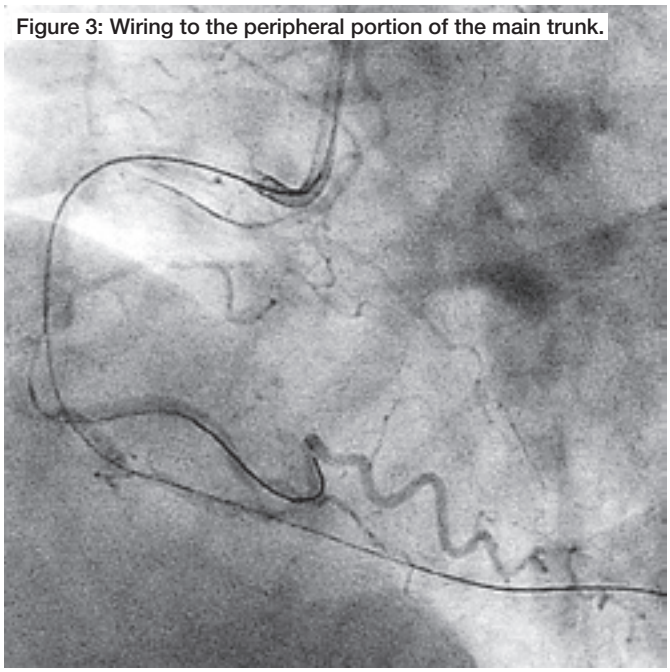


Figure 3: Wiring to the peripheral portion of the main trunk.

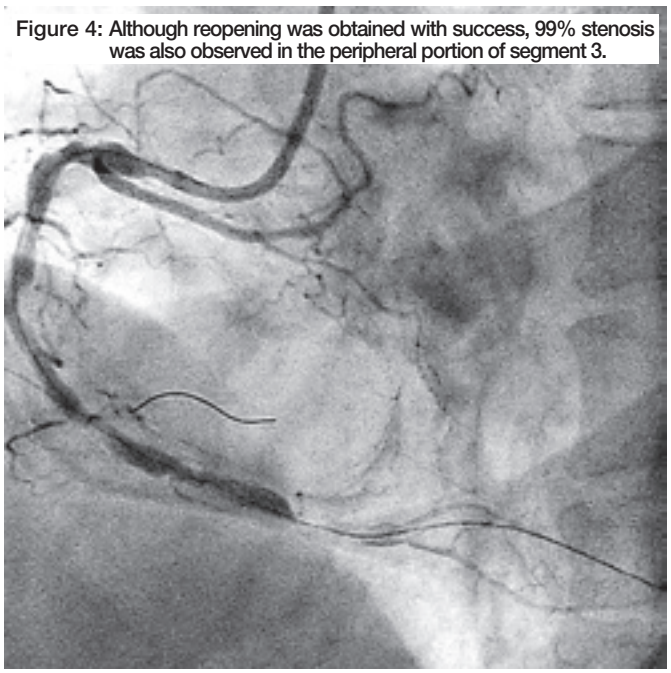


Figure 4: Although reopening was obtained with success, 99% stenosis was also observed in the peripheral portion of segment 3.

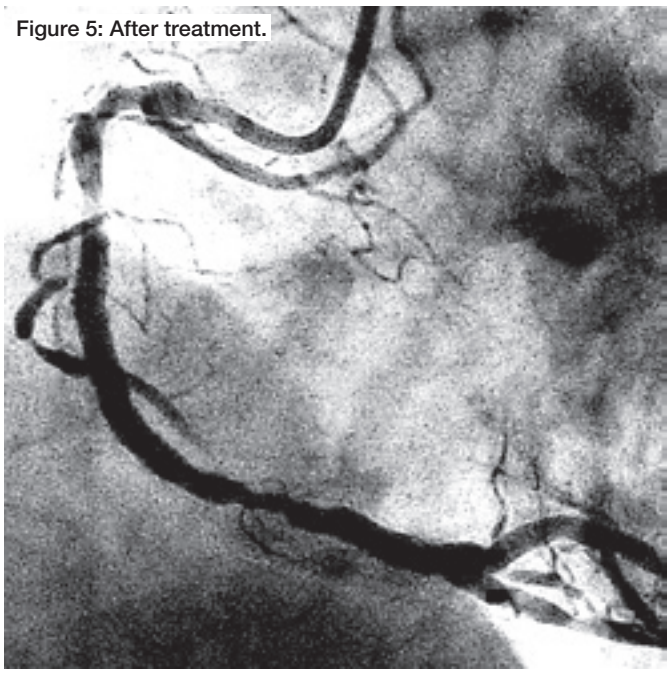


Figure 5: After treatment.

Reverse wire technique using the Crusade for severely angulated stenosis in the LAD bifurcation

Dr. Yoichi Nozaki
Director, Division of Cardiovascular Medicine, Hokko Memorial Hospital

Case

Case: 80-year-old male

Chief complaint/diagnosis: heart failure

Clinical history: none

Coronary risk factors: none

CAG findings: calcified stenosis in the mid RCA, mid LAD and LCX PL branches (Figure 1)

Therapeutic approach and devices used

Treated sites: LAD segment 6

Approach site: right radial artery

Guiding catheter: 6-Fr Heartrail II BL4.0 M

Guidewire: Fielder FC, Whisper LS

Penetration catheter: Crusade

Balloon catheter: Sprinter Legend 1.25/10 mm, 2.0/15 mm, Sapphire NC 2.75/15 mm

Debulking device: Rotablator

Stent: Cypher 2.5/28 mm

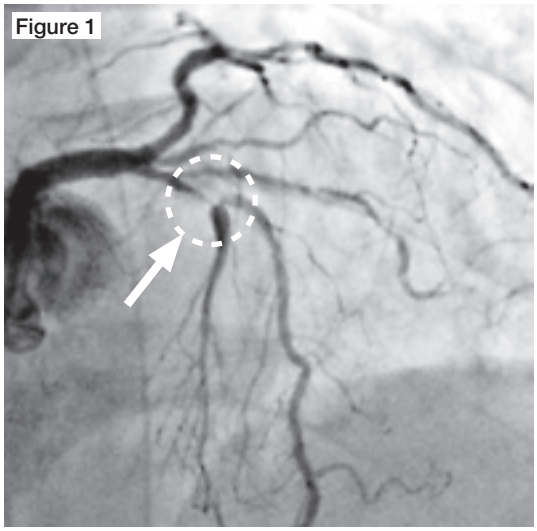


Figure 1

Treatment progress

For a very severely angulated and calcified stenosis lesion at the bifurcation between the LAD segment 6 and the septal branch, we started the procedure using the Fielder FC guidewire, but it could not be advanced to the ostium of the LAD bifurcation with an acute angle by the conventional guidewire manipulation (**Figure 2**).

For this reason, we used the reverse wire technique with a double-lumen catheter, the Crusade. The Whisper LS wire that was bent in a hairpin shape at the distal tip was passed into the Crusade, and then the Whisper LS wire was advanced in the distal direction from the ostium of the bifurcation toward the septal branch. When the Whisper LS wire was withdrawn after withdrawal of the Crusade, it began to easily advance towards the LAD, which had been difficult before. Moreover, by pulling back the Whisper LS with a rotation, it could be advanced from the hairpin bend of the wire further distally to the LAD main trunk (**Figure 3**).

After dilating the ostium of the septal branch with the Sprinter Legend 1.25/10 mm, the calcified LAD lesion was debulked with the Rotablator by switching the Rota burr from 1.25 mm to 1.5 mm, and to 1.75 mm (**Figure 4**). After pre-dilation with the Sprinter Legend 2.0/15 mm, the Cypher 2.5/28 mm was placed (**Figure 5**), and post-dilation was performed using the Sapphire NC 2.75/15 mm. The final angiogram is shown (**Figure 6**).

■ Treatment strategy points

While it is very difficult to pass the wire into the ostium of a vessel with an origin directed opposite to the running direction, it is possible to easily deliver it peripherally to the lesion by using the reverse wire technique, consisting of passing a guidewire bent in a special shape through the Crusade. As shown below in Figure 7, the procedural steps are as follows: ① **bend the guidewire in a hairpin shape;** ② **insert it into the OTW lumen of the Crusade, and advance it further through the arterial main trunk in the distal direction from the bifurcation;** ③ **withdraw only the Crusade leaving the wire distal to the bifurcation;** ④ **pull the wire in** ① **to insert its tip into the side branch;** ⑤ **continue to withdraw the wire gradually; and** ⑥ **when the hairpin bend reaches the ostium of the bifurcation, push forward the guidewire with a gentle rotation.**

Thus, the use of the Crusade allows ① the secure delivery of the guidewire that is bent in a special shape peripherally to the lesion; and ② advancement of the guidewire that is bent in a special shape from the main trunk deeper into the side branch, thanks to better support of the wire, as well as higher manipulability and backup strength during advancement of the wire. For these reasons, I consider that this technique is effective.

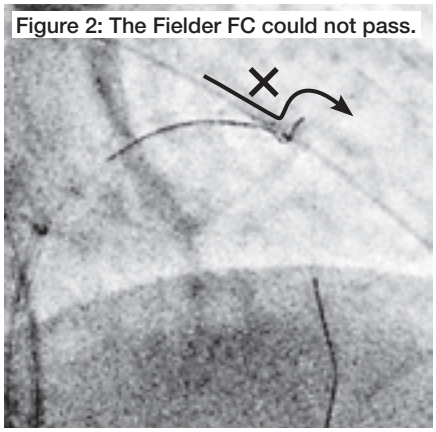


Figure 2: The Fielder FC could not pass.

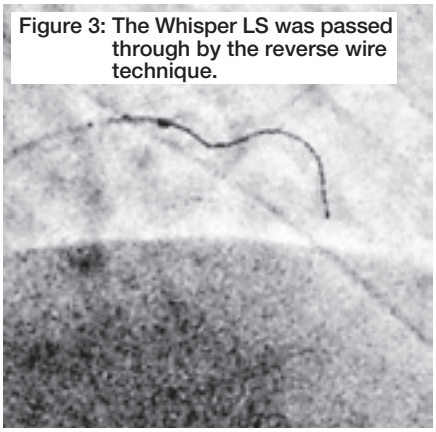


Figure 3: The Whisper LS was passed through by the reverse wire technique.

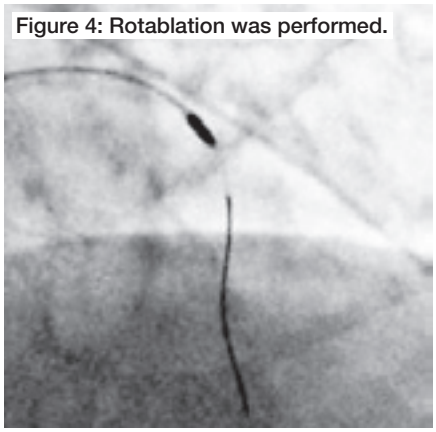


Figure 4: Rotablation was performed.

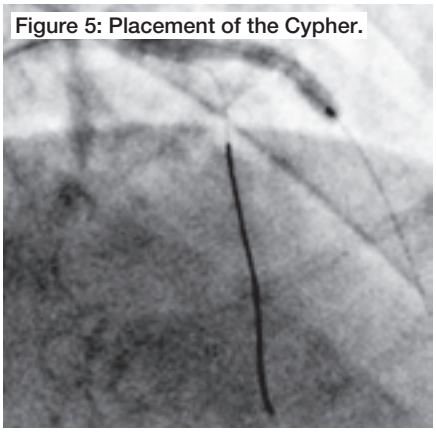


Figure 5: Placement of the Cypher.

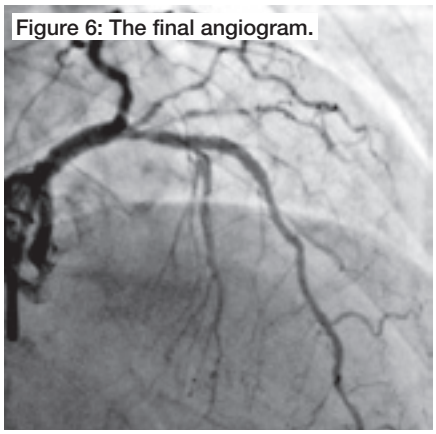
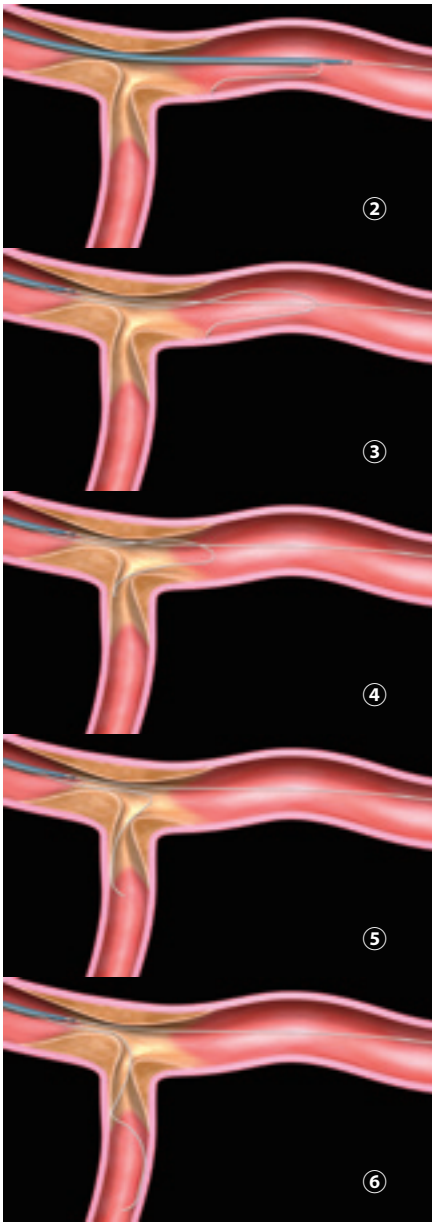


Figure 6: The final angiogram.

Figure 7

①



Practice of the guidewire trapping technique using the PTCA balloon in CTO–PCI

Dr. Kan Zen
Director, Department of Cardiology, Omihachiman Community Medical Center

Case

Case: 81-year-old male

Chief complaint/diagnosis: unstable angina

Clinical history: The patient underwent a detailed examination because the chest pressure that he had previously felt on exertion now appeared even at rest, and double-vessels CTO and severe stenosis of the right coronary artery were detected. After treatment of the right coronary artery and the circumflex artery, PCI was performed for the long CTO lesion in the left anterior descending artery.

Coronary risk factors: hypertension (+), hyperlipidemia (+)

CAG findings: RCA segment 2, 90%; segment 3, 90%; LAD segment 6, 75%; segment 7, CTO; D1, 75%; LCX segment 11, 75%; segment 12, CTO (Figure 1)

Therapeutic approach and devices used

Treated site: LAD segment 7

Treatment strategy: DES placement

Approach site: left femoral artery

Guiding catheter: 7-Fr Heartrail BL3.5SH

Guidewire: Wizard 3,
Conquest Pro 12,
Conquest Pro 8-20

Penetration catheter: Finecross MG, Crusade

Balloon catheter: Cyclone 2.5/20 mm,
Raiden 3.0/13 mm

Stent: PROMUS 2.5/28 mm × 2, 3.0/18 mm

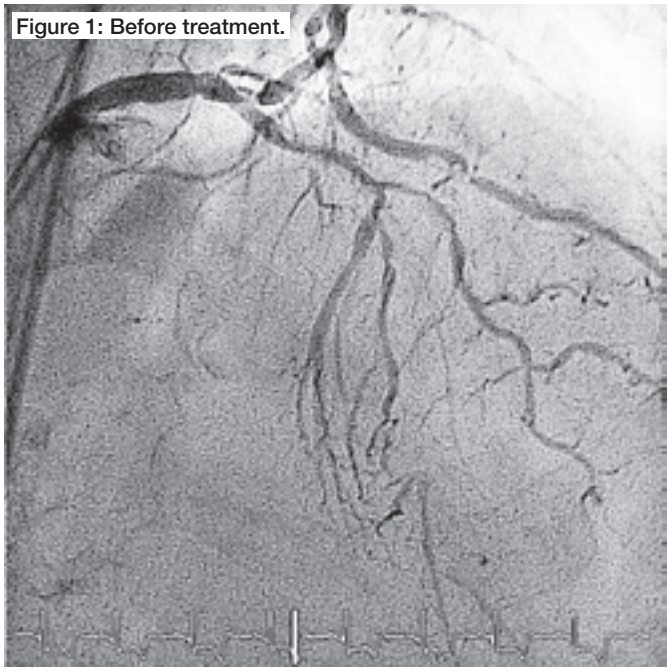


Figure 1: Before treatment.

Treatment progress

We started wiring using the Finecross MG and Wizard 3, but penetration was impossible, because it was very difficult to control the wire due to a very hard proximal fibrous cap of CTO located immediately behind the vascular angle. We replaced the Finecross MG with the Crusade to improve backup and control performance of the wire, where we used the balloon trapping technique to replace the Finecross MG with the Crusade. The Wizard 3 was inserted into the septal branch, and after retrieving back the Finecross MG into the guiding catheter (**Figure 2: arrow head**), the Cyclone 2.5/20 mm was advanced beyond the distal portion of the Finecross MG and inflated (at 12 atm) to capture the guidewire (Figure 2: arrow). After verifying the capture by applying tension on the wire, the Finecross MG was removed and the Crusade was inserted. Wiring was performed in the OTW lumen of the Crusade, and the proximal fibrous cap could finally be penetrated with the Conquest Pro 8-20 (**Figure 3**). The trapping technique was very useful also for replacing the Crusade with the Finecross MG, and switching the wire to the Wizard 3.

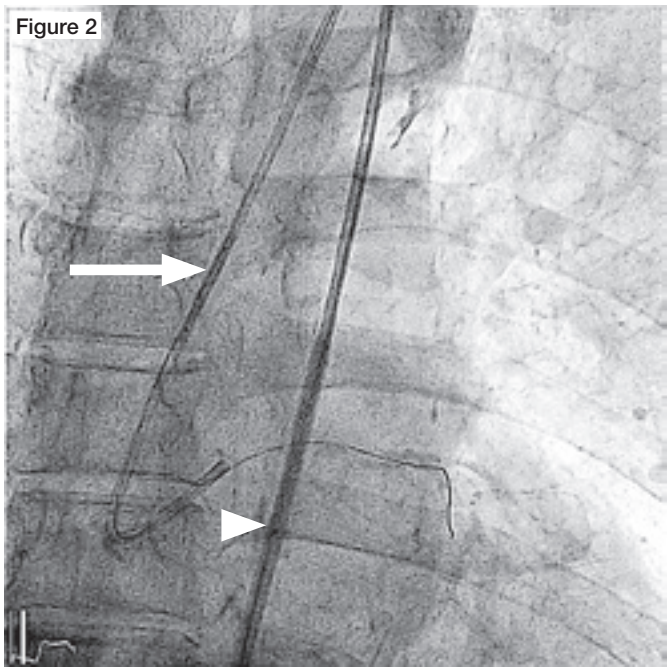


Figure 2

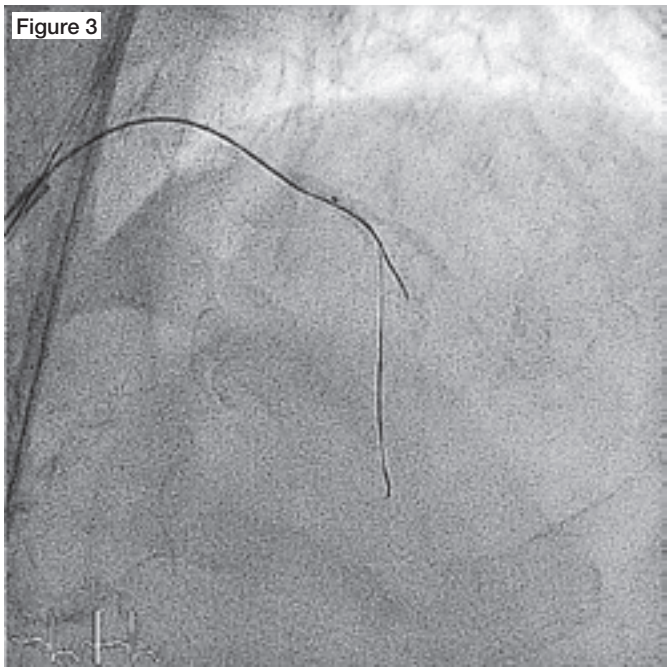


Figure 3

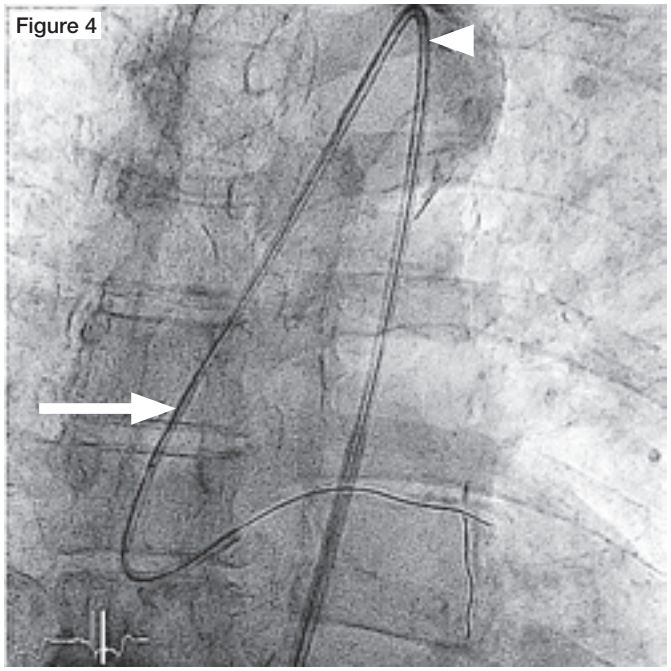


Figure 4

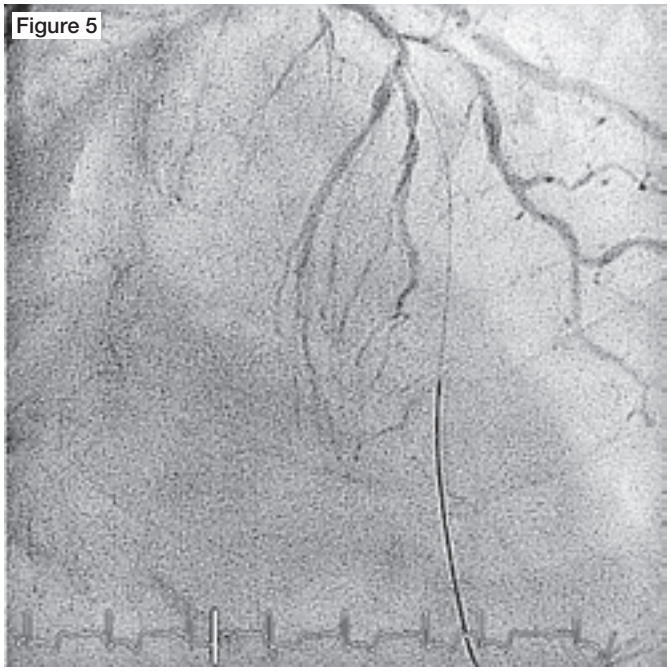


Figure 5

After fully storing the Crusade into the guiding catheter (**Figure 4: arrow head**), the 2.5-mm balloon was similarly inflated at 12 atm to capture two wires (**Figure 4: arrow**). After verifying the capture by applying tension on the two wires, the Crusade was removed, and the Finecross was inserted with the balloon left inflated. The system could be changed, while the wire did not move at all within the lesion. After switching to the Wizard 3, it became possible to perform wiring in the true lumen distal to the CTO, and the procedure was successfully completed. **(Figure 5**)

■ Treatment strategy points

PCI for CTO lesions requires frequent changes of wire support devices. Moreover, when using a wire with a heavy tip load and a sharp tip, it requires a delicate technique because of the high risk of vascular injury. It is even more difficult to perform the procedure holding two wires in the OTW and monorail lumens, as with the Crusade. When the wire gets out of the CTO lesion even minimally, it becomes difficult to insert it again. On the other hand, when the wire is advanced too deeply, it may erroneously be inserted into a false lumen, affecting the procedural success rate. For these reasons, it should be essential to use a very safe and effective trapping technique.

Crusade™

Dual lumen catheter

Két lumenes katéter

Cathéter à double lumière

Katétr se dvěma lumeny

Dual-Lumen-Katheter

Katéter s dvojitým lúmenom

Catéter de doble lumen

Çift Lümenli Kateter

Cateter de Lúmen Duplo

Kahe valendikuga kateeter

Catetere a doppio lume

Dubulta lūmena katetrs

Dubbellumenkatheter

Dvigubo spindžio kateteris

Kateter med dubbel lumen

Dvolumenski kateter

Dobbeltlumenkateter

Dvolumenski kateter

Dobbellumen-kateter

Cateter cu lumen dublu

Kaksoisluumenkatetri

Катетър с двоен лумен

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New possibility in the era of DES for bifurcation lesion.

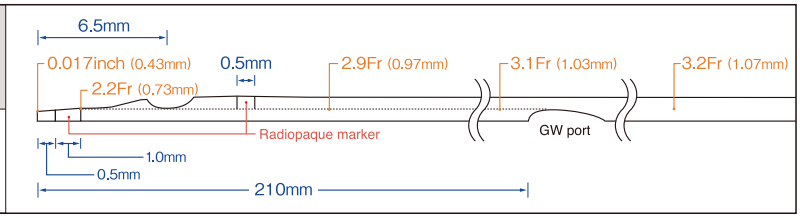
1 *Optimized configuration and material achieved high shaft maneuverability.*

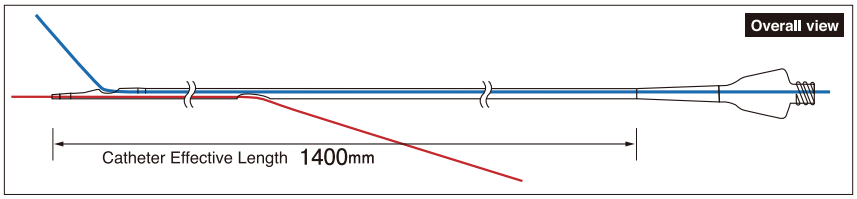
- Thin and flexible tip : **Distal shaft**
- Pliable and sturdy : **Proximal shaft**

2 *Configuration of double-layered lumens allows more flexible GW movement*

Product specifications

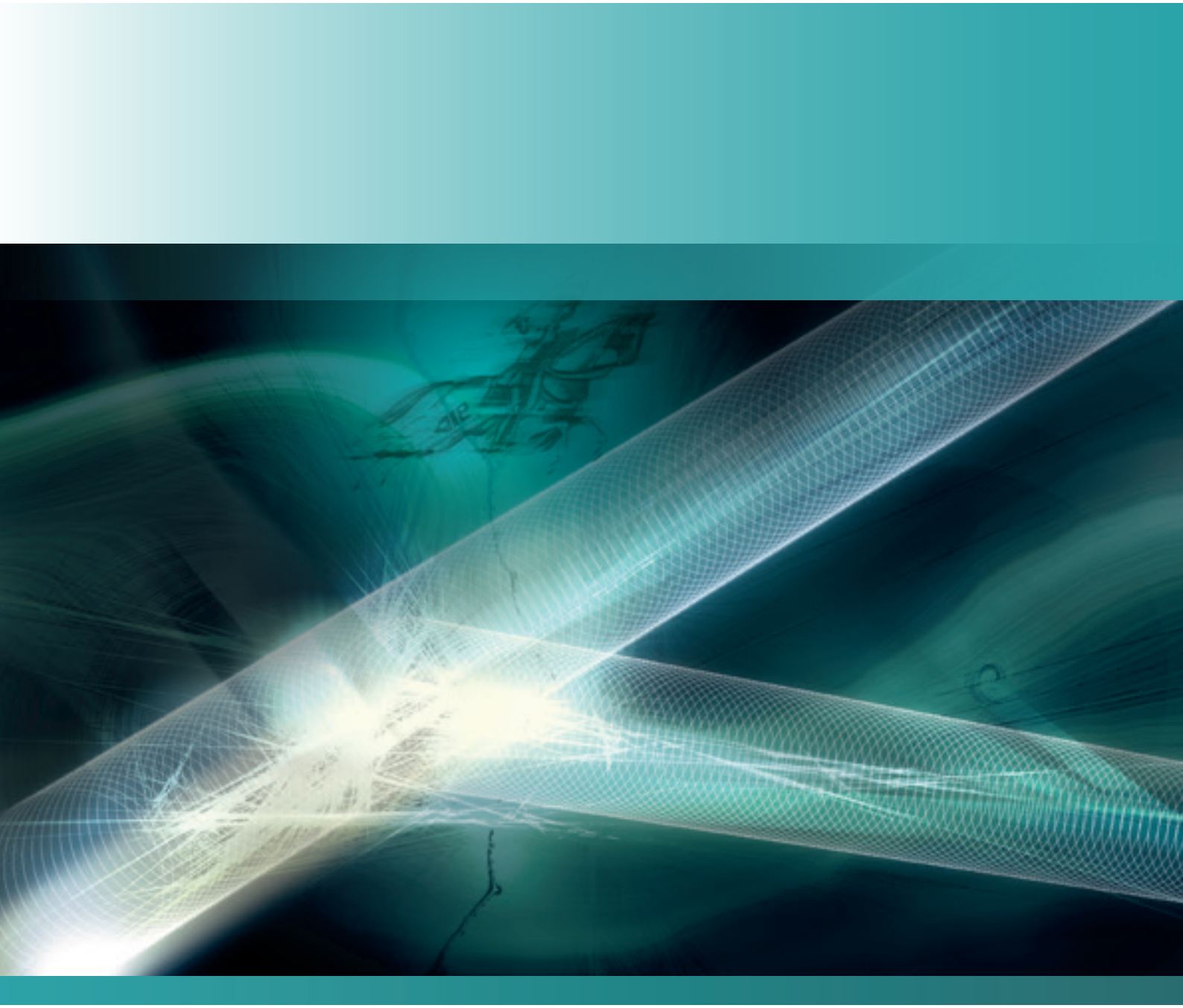
Catalogue Number	Maximum Guide Wire Outer Diameter	Catheter Effective Length
KMF0114A	0.014inch (0.36mm)	1400mm





[Precautions during use]
Inserting a highly penetrating guidewire while this catheter is left in a tortuous lesion may break the catheter shaft resulting in blood vessel injury.

Do not re-use | STERILE EO Sterilized using ethylene oxide | Consult instructions for use



CE 0123

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