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**CASE REPORT**
*Coronary intervention*

# Consequences and management of guidewire fracture—entrapment in the left circumflex artery: a case report

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**Background** Entrapment and fracture of the coronary guidewire are rare but major complications of percutaneous coronary intervention (PCI). The incidence of these complications is reported to be <1%.

**Case summary** A 52-year-old male patient with diabetes and dyslipidaemia presented with posterior wall myocardial infarction. An angiogram revealed occlusion in the left circumflex (LCX) artery. Attempts to pass a guidewire through the lesion led to its entrapment and eventual fracture. Several techniques and manoeuvres failed to retrieve the fractured guidewire, which remained lodged in the LCX. An endovascular snare catheter also proved unsuccessful. The fragment was eventually removed using the triple-wire technique, although this caused coronary perforation and dissection. The perforation was identified and stented. A subsequent stent addressed a dissection in the left main/left ascending artery area, likely caused by the coronary snare. These interventions were crucial in stabilizing the patient's condition, leading to recovery with a left ventricular ejection fraction of 50% and a viable LCX artery. The patient exhibited an uneventful progression at the 1-year follow-up.

**Discussion** Coronary guidewire fracture during PCI is a rare event often associated with coronary calcifications. Percutaneous removal remains the mainstay treatment for fragment removal; however, it carries risks. The triple-wire technique, a newer method that entangles and extracts the fractured guidewire without specialized equipment, was effective in removing the fragmented guidewire. If asymptomatic, leaving the wire *in situ* is documented as a favourable approach. This case highlights that the triple-wire technique can effectively be used for the extraction of fractured guidewire fragments from the coronary vessels.

**Keywords** Guidewire fracture • Guidewire entrapment • Retained guidewire remnant • Guidewire retrieval • Triple-wire technique • Snare catheter • PCI • Case report

**ESC curriculum** 3.4 Coronary angiography • 7.5 Cardiac surgery

## Learning points

- Entrapment and fracture of the coronary guidewire are rare but significant complications associated with percutaneous coronary intervention procedures.
- Triple-wire technique was successfully used to extract the fractured guidewire fragments from the coronary vessels.

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## Introduction

Entrapment and fracture of the coronary guidewire are rare; however, they are one of the major complications of percutaneous coronary intervention (PCI). The incidence of these complications has been reported to be less than 1%.[1] Despite the advancements and innovations in flexible guidewire technology over time, such complications continue to be encountered.[2] The literature reports several management strategies, including PCI or surgical methods, for addressing these complications.[3,4] In a report of 66 patients, surgical extraction was performed in 44% of patients, percutaneous therapy was used in 42% of patients, and 15% of patients received conservative therapy.[4] The percutaneous techniques generally used to retrieve guidewire entrapments include snare loop, double- or triple-wire technique, deep guide catheter wedge with balloon inflation, tornus microcatheter, and pigtail catheter.[4] Other techniques, such as stenting over the guidewire fragments or conventional follow-up, have also been reported.[5] Guidewire remnants left in the coronary vessel may result in thrombus formation and subsequent thromboembolization, as well as other complications such as vessel occlusion and perforation.[6,7] Therefore, to mitigate the risk of unfavourable complications, it is crucial to eliminate any remaining guidewire fragments. Herein, the case of a broken and entrapped guidewire in a coronary vessel during PCI is presented, highlighting the associated risks and the technique for managing such a complication.

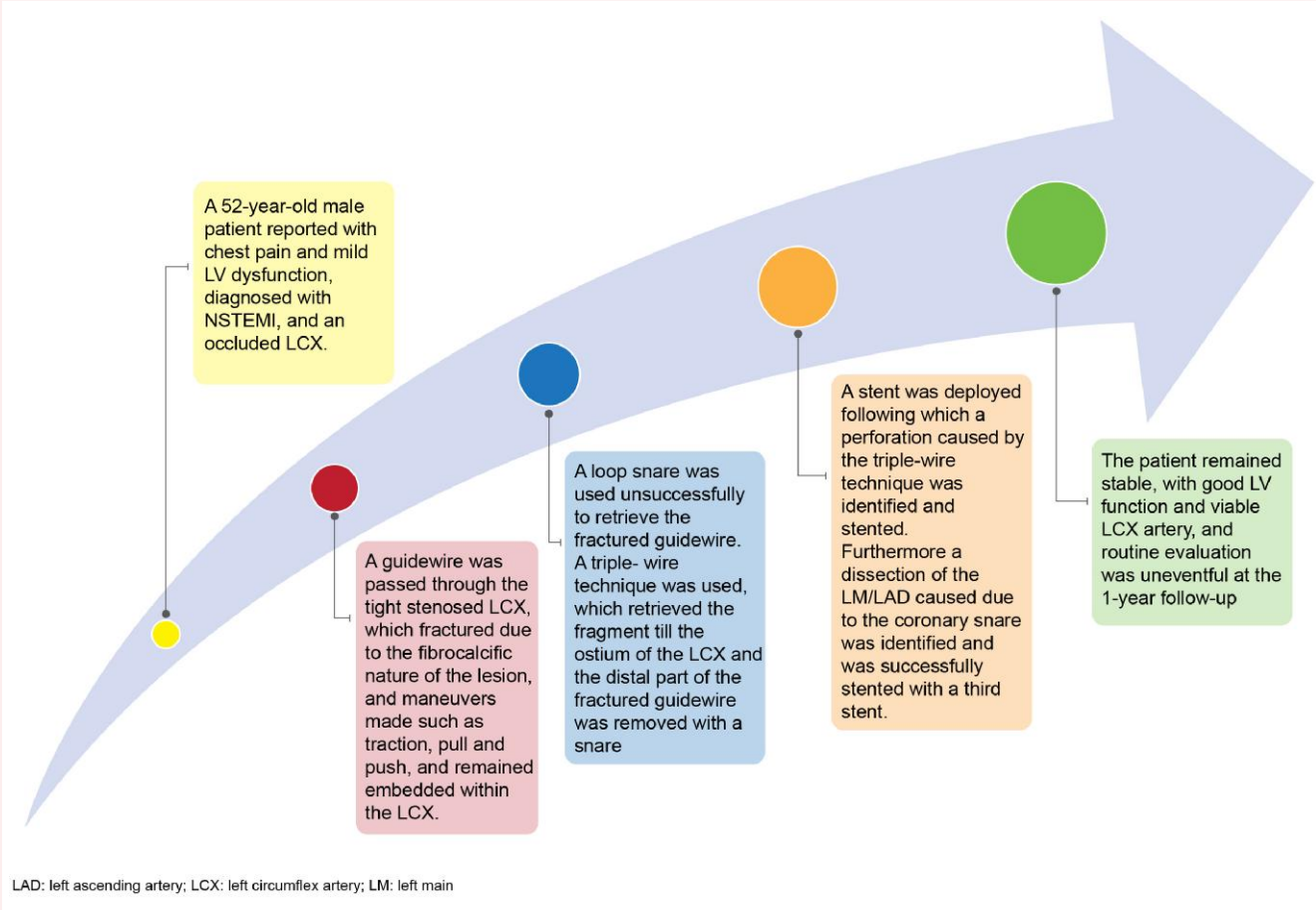
## Case report

A 52-year-old male patient with a history of diabetes and hyperlipidaemia presented with chest pain and posterior wall myocardial infarction (non-ST elevation myocardial infarction). The patient also reported mild left ventricular (LV) dysfunction. Coronary angiography revealed an occluded left circumflex (LCX) artery, which was identified as the culprit vessel, whereas the left ascending artery (LAD) exhibited only mild disease (*Figure 1A*).

The LCX lesion was crossed with a hydrophilic workhorse guidewire (Oxford, 0.014″ runthrough NS extra floppy guidewire) and passed through a tight stenotic area within 1 h after the patient presented with chest pain. A workhorse guidewire employs a double barrel construction design that exhibits improved push transmission and good tactility when deployed for calcified or fibrotic plaques.[8] An attempt to advance the guidewire through the occlusion was unsuccessful, perhaps due to the tight fibrocalcific nature of the lesion. The manoeuvres, such as traction, pull and push, and back-and-forth vibration, resulted in the fracture of the guidewire, leaving a fragment embedded in the LCX artery (*Figure 1B*; Supplementary material online, *Video S1*).

Following pre-dilatation, a Lifetech SeQure™ Snare System (loop diameter: 7 mm; snare length: 2000 mm; catheter size: 3 Fr; catheter length: 1750 mm) was used to extract the fractured guidewire; however, the snare slipped (see Supplementary material online, *Video S2*). Therefore, a triple-wire technique was chosen for the management of the guidewire fracture.

## Summary figure




LAD: left ascending artery; LCX: left circumflex artery; LM: left main

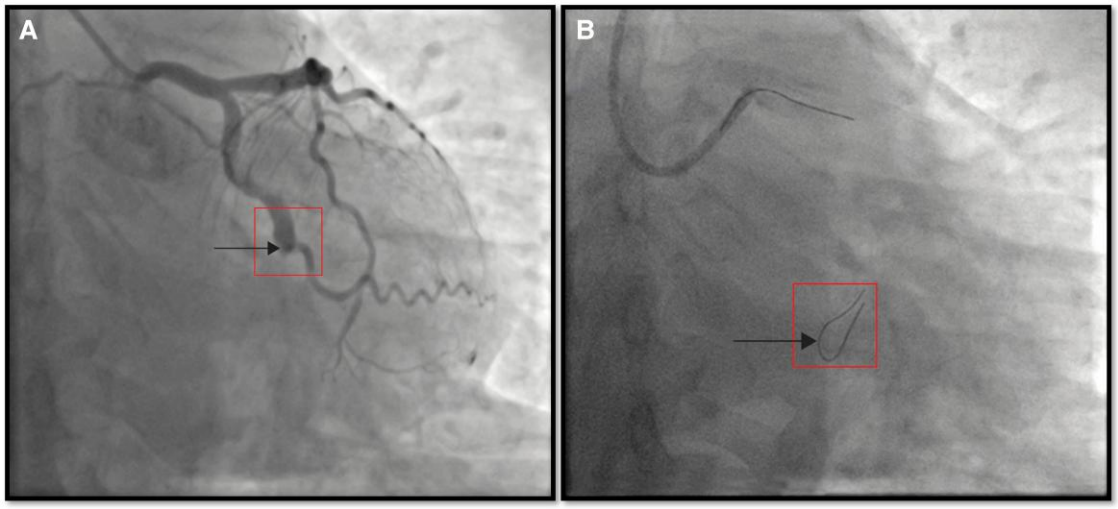



**Figure 1** (*A*) Coronary angiogram showing occlusion in the left circumflex artery. (*B*) Coronary angiogram showing the fractured and entrapped guidewire, leaving a part in the left circumflex artery.

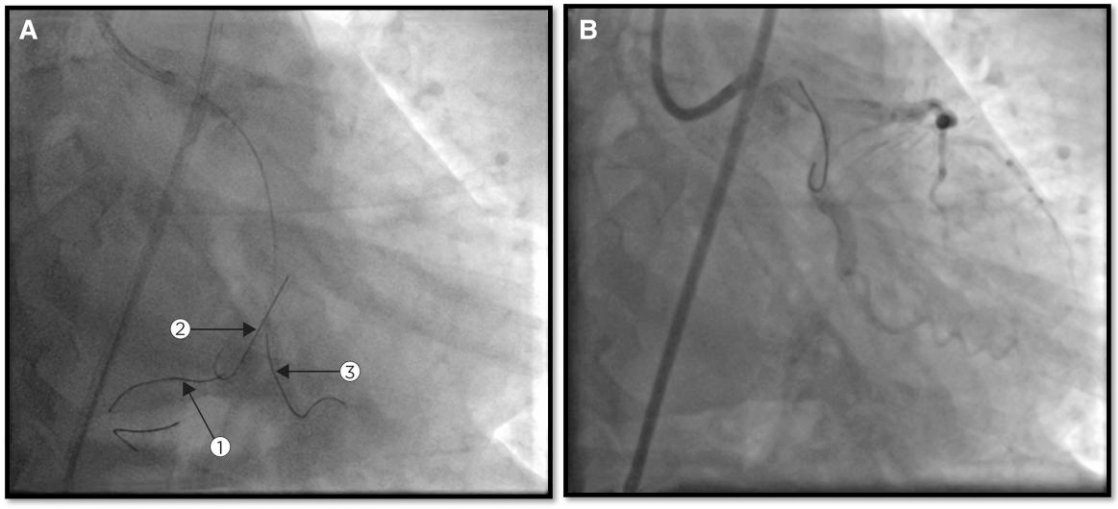



**Figure 2** (*A*) Coronary angiogram showing guidewire retrieval using the triple-wire technique. (*B*) Coronary angiogram showing fragment retrieval up to the ostium of the left circumflex artery.

Three floppy wires (Terumo™; Warren, New Jersey, USA) were advanced next to the guidewire fragment and rotated repeatedly to 'encase' the fragment (see Supplementary material online, *Video S3*). The distal part of the wires was placed in three distal vessels, and torque was applied (*Figure 2A*). In this process, the broken wire could be trapped within the three wires; however, it could only be retrieved till the ostium part of the circumflex [left main (LM) to LAD plain] (*Figure 2B*). Another snare was used to get a hold of the distal part and successfully removed the fractured guidewire (*Figure 3*; Supplementary material online, *Video S4*).

A stent (3.0 mm × 18 mm Xience Xpedition Stent) was successfully deployed (*Figure 4A*). Subsequently, a perforation was identified in the distal vessels, which could have resulted from the triple-wire technique (*Figure 4B*; Supplementary material online, *Video S5*). This perforation was successfully stented with a 2.8 × 19 GRAFTMASTER™ (Abbott Vascular, Santa Clara, CA, USA) (*Figure 4B*). Furthermore, a dissection LM/LAD was found, probably caused by a coronary snare in the proximal part of the circumflex (see Supplementary material online, *Video S6*). This was managed by a third stent (4.0 mm × 23 mm Xience Xpedition Stent) positioned from LM to LAD (*Figure 5*; Supplementary material online, *Video S7*).

The patient remained stable and symptomless after the procedure, with a decreased LV ejection fraction of 50% and a viable LCX artery.

He visited the hospital periodically for routine evaluation and was uneventful at the 1-year follow-up.

## Discussion

The occurrence of coronary guidewire fracture during PCI is an extremely infrequent complication, with its incidence ranging from 0.2–0.8%.[9] Coronary calcification has been suggested as a possible predictor of breakage in cases involving jailed wires during cardiologic procedures.[10] Other risk factors for guidewire entrapment and fracture may include guidewire jailing, deformation, excessive or repeated manoeuvres, use of multiple guidewires, guidewire over-rotation, atherectomy over the kinked wire, lesion complexity, lesion calcification, and presence of tortuous vessels.[4,11] To our knowledge, the various manoeuvres employed resulted in the fracture of the guidewire in the present case.

Recently, there has been a transformation and evolution in retrieval tools. The employment of Goose Neck™ snare or grasping forceps is a predominant percutaneous technique for retrieving guidewire fragments. The shape memory and superelastic properties of nitinol, exhibited by the loops and shaft, assist in shape maintenance and resist kinking. This results in higher treatment success rates with loops with

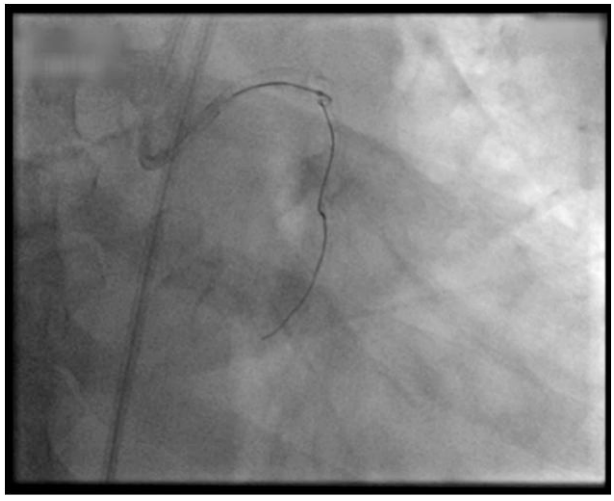


**Figure 3** Coronary angiogram showing the final snaring of the fractured guidewire.

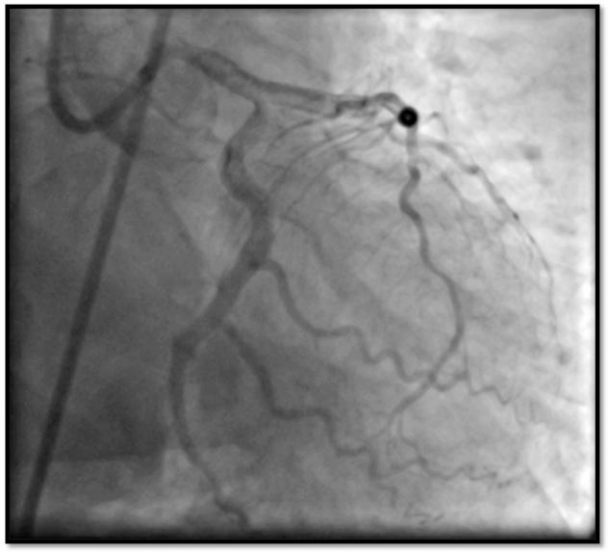


**Figure 5** Coronary angiogram showing the stent from left main to left ascending artery.

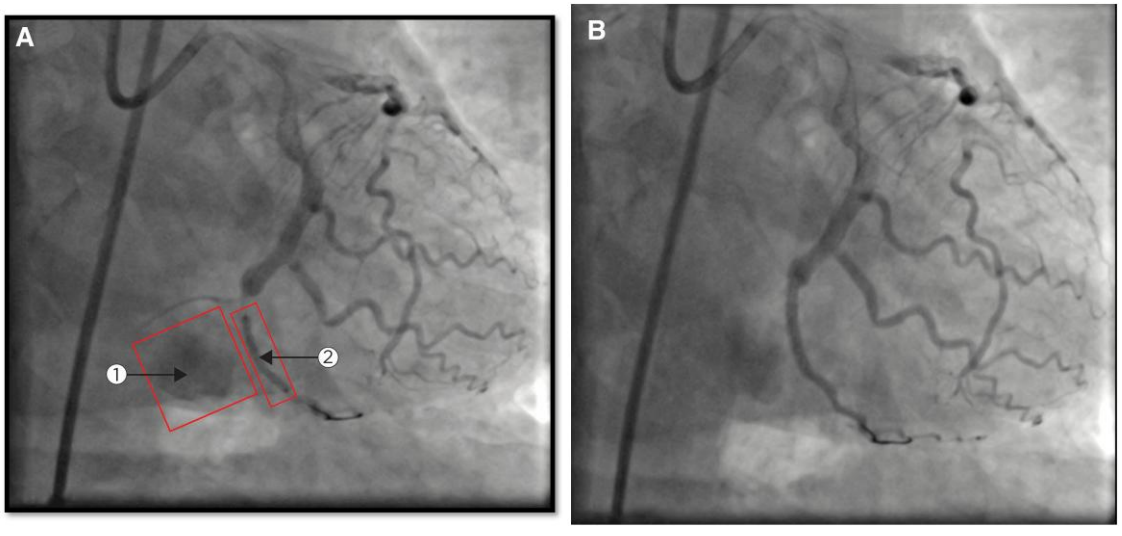



**Figure 4** (*A*) Coronary angiogram showing the (1) area of perforation and (2) position of the covered stent. (*B*) Coronary angiogram showing successful stent deployment.

fewer resultant complications.[10] Once the nitinol is passed, balloon inflation is employed to 'trap' the guidewire within the guide catheter, enabling the operator to retrieve the guidewire remnants.[4,12] However, this technique was unsuccessful in removing the fragment in the present case; thus, the triple-wire technique was used for retrieving it.

Studies support the use of the triple-wire retrieval technique to entangle and retrieve the entrapped guidewire. This technique is handy, especially when specialized equipment is unavailable.[13]

Percutaneous removal is the preferred technique to retrieve the guidewire fragment, but it poses some risks. Extensive manipulation within the vessel during attempted fragment removal can lead to potentially life-threatening coronary dissection, perforation, vessel occlusion, rupture, embolism, or thrombosis.[14,15] An alternative approach to percutaneous guidewire retrieval is complete coverage of the wire fragment with a stent, if feasible. However, in a case report by Kim *et al.*, in which snares and endoscopy biopsy forceps were used for retrieval of the fragmented guidewire in a 72-year-old patient, the technique was found to be unsuccessful. The lesions were stented with a drug-eluting stent, which led to sub-acute stent thrombosis. After 4 days, the patient manifested chest pain and eventually succumbed on the 15th day of hospitalization.[5] In another case, after unsuccessful retrieval, the patient was put on lifelong conservative treatment with dual antiplatelet drugs and remained asymptomatic for up to 2 years.[9]

The LM/LAD dissection encountered during the procedure is a rare complication, with an incidence rate of 0.07–0.1% and a potential to progress to myocardial infarction and subsequent death. However, this complication can be averted by evaluation via intravascular ultrasound to determine the optimal size of the balloon and burr and adequate lesion preparation with the help of atherectomy devices. This can prevent inadvertent advancement of the guide tip into the LM by disengaging the guide during the removal of an interventional device and avoiding aggressive wiring.[15]

The conservative approach includes leaving the wire *in situ*, which is indicated when the risks of percutaneous techniques or surgery outweigh its benefits. Other management modalities are percutaneous retrieval of the fragmented section, deployment of a second stent to compress the wire, or resorting to open heart surgery.[16] Additionally, patients with such complications are typically prescribed dual antiplatelet therapy for 6 months and undergo follow-up during this period. The long-term outcome for patients with fractured guidewires in the coronary artery has been deemed favourable by experts. As the aim was to completely remove the fragments, stenting of the fractured component was not attempted. Moreover, the fractured guidewire may unravel, creating a nidus for thrombus formation either in the coronary artery or within the aorta. In the present case of percutaneous guidewire retrieval, coverage of the fragmented wire with a stent might have been a better choice as two additional complications, perforation and dissection, could have been avoided. Some cardiologists prefer immediate surgery. However, there are no guidelines for surgical intervention,[10] as evident in the present case, in which the patient was effectively managed without the need for surgical intervention and with an uneventful 1-year follow-up.

# Conclusion

Guidewire fractures during PCI are rare but challenging, especially with complex or stented lesions. While percutaneous techniques are often successful in retrieving wire fragments, occasionally, surgical removal may be necessary. The present case report successfully demonstrates the feasibility of the triple-wire technique (repeated rotation to 'encase' the fragment while advancing two additional guidewires alongside the guidewire fragment) for the retrieval of entrapped and fractured guidewires from the LCX without surgical intervention. Although percutaneous retrieval is often the first choice, it carries risks of complications such as coronary dissection, rupture, or thrombosis.

# Lead author biography

Dr Mathews Paul is an interventional cardiologist with qualifications MD, DM(AIMS), and FIC(AIMS).

# Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online.

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## Data availability

The data underlying this article are available in the article and its online supplementary material.

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