

Pushing Equipment to the Limits: Guidewire Fracture

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Abstract

Guidewire fracture during percutaneous coronary intervention is very rare (0.08%).¹ High risk percutaneous coronary intervention, severely calcified long lesions, severe in-stent stenosis, and total coronary vessel occlusion increase the risk of guidewire fracture.² Fracture may lead to significant morbidity including life-threatening complications such as embolization, thrombus formation, vessel closure, and perforation.³⁻⁵ It may require surgical removal combined with coronary artery bypass.^{6,7} We present a case of guidewire fracture during angioplasty of a right coronary artery chronic total occlusion due to in-stent restenosis.

The risk of guidewire fracture (GWF) during percutaneous coronary intervention (PCI) increases with higher procedure complexity. In the Balance Middleweight Universal (BMW) coronary guidewire (Abbott Vascular), the junction between the flexible distal 3-cm tip and the shaft is the most fragile and easily fatigable area, making it the most common location for fracture.⁸ Over-rotation of the guidewire tip, entrapment of the wire distal to the lesion, and delivery of a bulky device across a severely stenotic lesion with high resistance may result in GWF.¹ The management of patients with wire fragments retained within the coronary arteries is challenging. In most cases, percutaneous retrieval

is the recommended initial approach. If this fails, it may be reasonable under some circumstances to leave the fragment of fractured wire within the coronary vasculature. Wire fragments that are retained for long periods of time are highly likely to cause distal vessel occlusion due to the highly thrombogenic nature of wire material and/or migration with blood flow. Surgical removal with potential bypass may be recommended if percutaneous retrieval is unsuccessful.

Case Report

A 64-year-old male presented with a 3-week history of accelerated angina. Past medical history was significant for diabetes, hypertension, hyperlipidemia, obesity, and coronary artery disease. Previously he had PCI of the proximal, mid, and distal right coronary artery (RCA). Cardiovascular examination was unremarkable. Coronary angiography revealed an in-stent chronic total occlusion (CTO) of the proximal RCA (Figure 1). Antianginal medications were optimized according to clinical practice guidelines; however, the patient continued to have persistent symptoms. Myocardial perfusion imaging revealed a large-sized area of severe ischemia involving the inferior wall. Echocardiography demonstrated a left ventricular ejection fraction of 55%-60% without significant valvular heart disease. Due to persistent angina, a RCA CTO PCI was performed.

For dual coronary injection, an 8 French (Fr) arterial sheath in the right femoral artery and a 6 Fr arterial sheath in the left femoral artery were inserted. An 8 Fr Amplatz Left 0.75 guide catheter was used to engage the RCA and a 5 Fr Judkins Left 4 diagnostic catheter engaged the left coronary artery (LCA). A Pilot 200 (Abbott Vascular) guidewire was initially used unsuccessfully, followed by a MiracleBros 6 (Asahi Intecc) guidewire, which crossed the CTO and was placed in the right posterolateral (RPL) branch (Figure 2). A BMW guidewire replaced the MiracleBros guidewire through an over-the-wire balloon. After multiple high-pressure balloon inflations of all RCA segments, there were still difficulties with delivering a stent to the RPL. A two-GuideLiner (GL) (Teleflex) technique ("mother-daughter-granddaughter" system) was used to maximize the support (a 6 Fr GL in an 8 Fr GL through an 8 Fr Amplatz Left catheter, Figure 3).^{9,10} A 2.25 mm x 30 mm Resolute stent (Medtronic) was implanted in the RPL branch. A 3 mm x 22 mm Resolute stent and a 3 mm x 30 mm Resolute stent were implanted distal to the proximal RCA, but there was a very high resistance noted upon advancement of the stents. There was also resistance to pulling out the last stent balloon and BMW guidewire, which had to be pulled out together as a unit. During this process, the BMW wire fractured at the junction of the distal tip and shaft. Fortunately, the fractured BMW segment was within 2 GLs; thus, these were removed together with the wire and the balloon without further complications (Figure 4). The final result of the PCI was satisfactory (Figure 5).

Discussion

The incidence of GWF during PCI has significantly declined in recent years due to advances in wire design, the low profile of balloons and stents, and

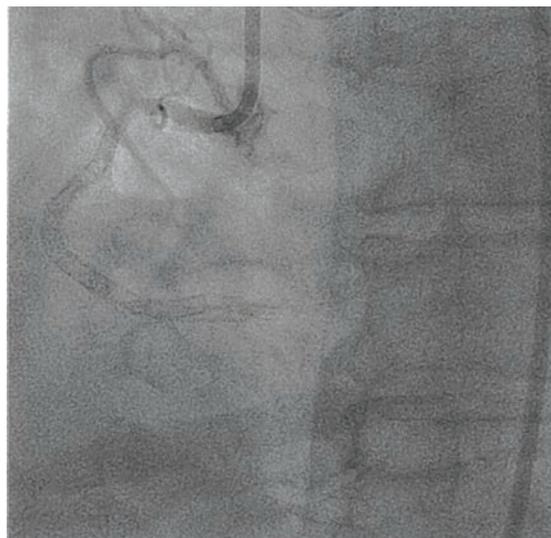


Figure 1. Left oblique view (LAO). A dual injection system with an 8 French (Fr) arterial sheath in the right femoral artery and a 6 Fr arterial sheath in the left femoral artery revealed a chronic total occlusion (CTO) of the proximal right coronary artery (RCA) (in-stent occlusion, "full metal jacket").

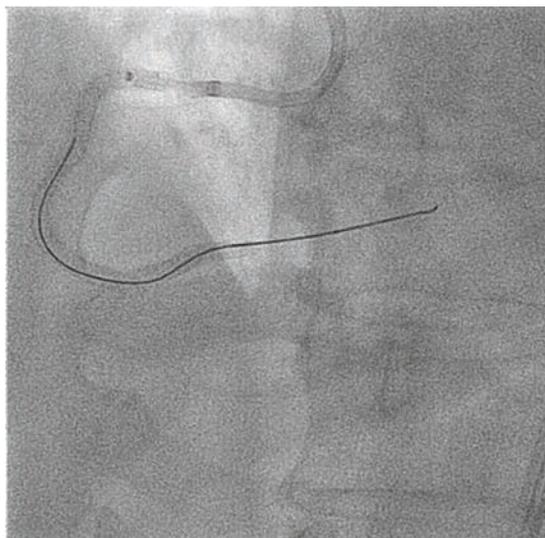


Figure 2. LAO view. MiracleBros wire (Asahi Intecc) penetrated the CTO successfully.

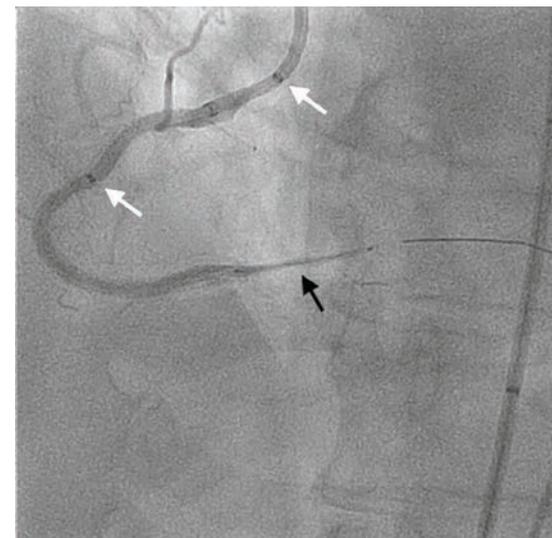


Figure 3. LAO view. Two-GuideLiner (GL) (Teleflex) technique (white arrows, tips of 6 Fr and 8 Fr GLs). The 6 Fr GL tip was later placed in distal RCA with the 8 Fr GL tip in mid RCA to deliver stents (black arrow) over the Balance Middleweight (BMW) wire (Abbott Vascular) in the right posterolateral branch.



Figure 4. A fracture occurred at the junction between the distal tip and the shaft of the BMW guidewire.

improvements in delivery techniques, including GL use.^{1,11} The most common location of wire fracture is the junction of the soft tip and shaft. Entrapment of the wire distal to the lesion and over-rotation of the guidewire tips are the most common causes of GWF. GWF occurs in approximately 0.08% of cases.¹ The risk may increase with the complexity of the intervention. When stent delivery requires maximal support, PCI entails a higher risk of wire fatigue and fracture. In our case, we used two GLs to overcome the resistance to the delivery of stents. It might be difficult to recognize wire fatigue, which is more easily recognizable when it comes to the wire tip rather than the shaft. Once fatigue is suspected, we recommend exchange for a new guidewire in order to avoid GWF. Guidewire remnants are highly thrombogenic and may result in distal coronary embolism. Percutaneous retrieval is generally the initial approach for fractured guidewires. Two or three new guidewires can be passed down the vessel distal to the broken-off guidewire segment and subsequently rotated/twisted in order to entrap the broken segment for retrieval. All the wires can then be pulled out together as a collective unit.¹² A deeply intubated GL can aid in this process. In a few case reports, an attempt at using a snare loop for retrieval is described; however, the snare might not be able to reach distal vessels.^{4,12,13} If wire retrieval is unsuccessful, stenting the fractured wire against the vessel wall may be considered an acceptable approach in order to immobilize the wire within the coronary vessel and prevent migration.^{2,11} If the percutaneous approaches fail, surgery may be warranted, especially if the wire dislodges into the ascending aorta.¹⁴ Surgical removal and coronary vessel reevaluation should then be performed urgently.

Some guidewire pieces retained in distal coronary vasculature may be immobile and stable for a long time without significant complications.¹⁵ Vascular endothelial cells may ultimately cover the wire remnant. Before leaving a guidewire in place, one

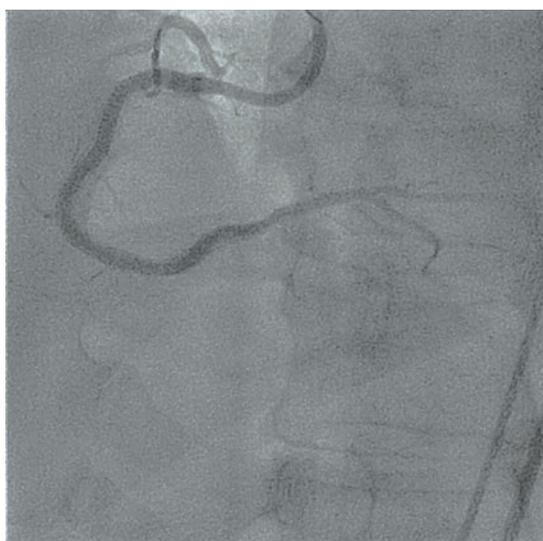


Figure 5. LAO view. Final result of the percutaneous coronary intervention of the RCA CTO.

should ascertain that no portions of the guidewire are protruding into the aorta or more proximally in the coronary artery.

Conclusion

The ideal management of fractured guidewires includes removal percutaneously or surgically. Stent implantation over the guidewire remnants may be an acceptable option if retrieval is not successful. This case illustrates the complexity of modern PCI that comes with the potential price of equipment failure. Not only did we “push the limits” of the guidewire that fractured, but we also set up a very powerful PCI support system, which resulted in successful stent delivery. This setup fatigued the guidewire to the point of fracturing, yet allowed for retrieval of the broken wire. ■

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