JACC: CASE REPORTS VOL. 30, NO. 3, 2025

CORONARY, PERIPHERAL, AND STRUCTURAL INTERVENTIONS

HOW WE DID IT

When the Shaft Breaks

Managing a Cath Lab Nightmare

Catarina Oliveira, MD,[a] Miguel Raposo, MD,[a] José Marques da Costa, MD,[a] Fausto J. Pinto,[a,b] João Silva Marques, MD[a,b]

ABSTRACT

OBJECTIVE We describe the case of a 57-year-old male patient with anterior ST-segment elevation myocardial infarction in cardiogenic shock. Coronary angiography revealed severe left main (LM) and triple-vessel disease, and the patient was refused for surgery due to lack of distal grafting landing zone. A shaft fracture occurred during LM percutaneous coronary intervention, leaving the fractured stent hanging in the aorta. This case highlights the successful retrieval of the fractured stent shaft using a snare technique.Key steps include coronary protection and bailout fixing with a stent in LM artery and use of snare technique to retrieve the shaft from the aorta.

POTENTIAL PITFALLS Operators should avoid pulling the system when stent entrapment occurs.

TAKE-HOME MESSAGES Bailout access through the Impella sheath can be used in complication management. When stent entrapment occurs, use balloon trapping instead of pulling the entire system and protect coronary arteries with guidewires before proceeding with shaft extraction. (JACC Case Rep. 2025;30:103123) © 2025 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Balloon/stent shaft fracture is rare but it is a serious complication that can lead to myocardial infarction, coronary and systemic embolization, or even death.[1-3] There are few cases described in the published reports,[1-6] and usually this complication occurs in complex procedures with highly calcified lesions.[1] There are several risk factors that may contribute to this complication, namely operator's factors (such as excessive pushing or inadequate lesions preparation), patient factors (calcified or tortuous vessel), or manufacturing defects.[2] With the development of several retrieval devices, most cases can be managed with a nonsurgical approach, and knowledge of correct bailout techniques is essential to a good outcome.[1]

TAKE-HOME MESSAGES

- Careful lesion preparation and device handling are crucial in preventing severe complications such as shaft fracture, and when stent entrapment occurs, avoid pulling the entire system (use a balloon trapping technique within the guiding catheter to retrieve the fractured stent or shaft safely).
- In the event of shaft fracture, prioritize coronary protection (place guidewires to maintain patency before attempting to remove the fractured shaft) and nonsurgical approaches can be successful, even in complex scenarios, as demonstrated in this case.

From the [a]Serviço de Cardiologia, Departamento de Coração e Vasos, Centro Hospitalar Universitário de Lisboa Norte Hospital de Santa Maria, Av Prof Egas Moniz, Lisboa, Portugal; and the [b]Structural and Coronary Heart Disease Unit, Cardiovascular Center of the University of Lisbon (CCUL@RISE), Faculdade de Medicina, Universidade de Lisboa, Av Prof Egas Moniz, Lisboa, Portugal.
The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

Manuscript received October 16, 2024; accepted October 24, 2024.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2024.103123

ABBREVIATIONS AND ACRONYMS

Cx = circumflex (artery)

LAD = left anterior descending (artery)

LM = left main (artery)

CASE SUMMARY

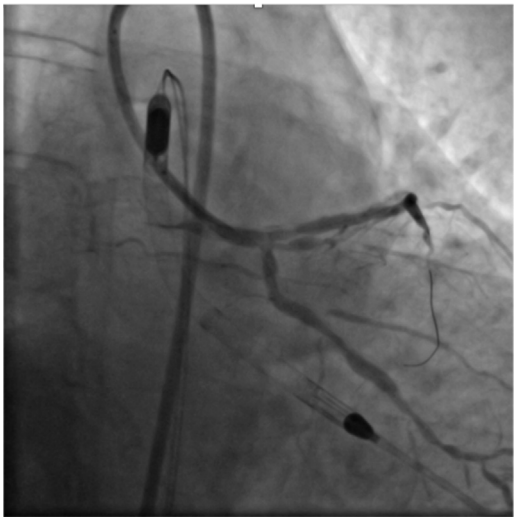
A 57-year-old man with a history of ischemic heart disease, dyslipidemia, and a non-ST-segment elevation myocardial infarction 14 years before with percutaneous coronary intervention with a drug-eluting stent in the left anterior descending (LAD) artery, presented to our hospital with an acute anterior ST-segment elevation myocardial infarction and cardiogenic shock.

On emergency coronary angiography, the patient was found to have left main (LM) artery and 3-vessel disease, with a SYNTAX score of 74, indicating complex coronary anatomy. Due to the absence of adequate grafting landing zones, coronary artery bypass graft surgery was declined by an informal, urgent heart team meeting. Percutaneous coronary intervention of the mid-distal LAD artery and LM bifurcation using a Culotte 2-stent technique was planned.

To provide hemodynamic support, an Impella device (Abiomed) was placed. The LM artery was catheterized using an 8-F XB 3.5 guiding catheter, and 2 guidewires (Runthrough, Terumo Interventional Systems) were advanced into the distal LAD artery and the obtuse marginal branch. After lesion preparation with Ryurei balloons (2.0 mm and 2.5 mm × 15 mm, Terumo), an Ultimaster Nagomi stent (2.5 mm × 33 mm, Terumo) was implanted in the mid-distal LAD artery.

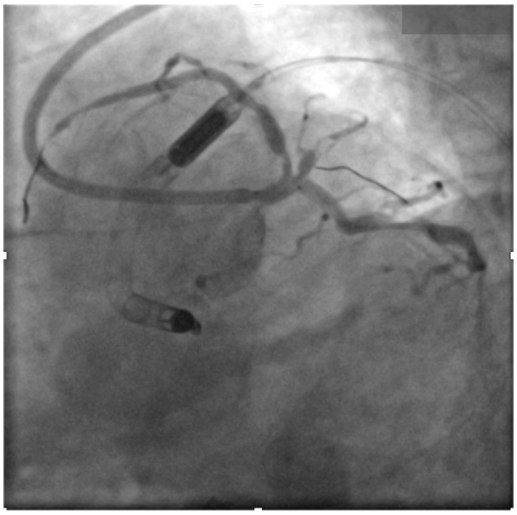
For the bifurcation, a buddy-wire technique was employed, with an Ultimaster Nagomi stent

FIGURE 2 Coronary Arteries Ostia Dissection



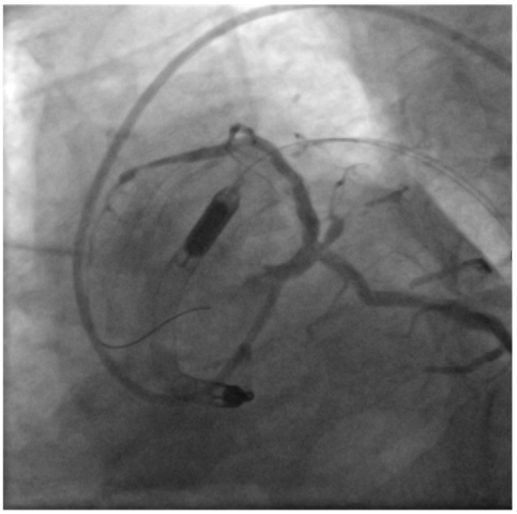
Left anterior descending and circumflex arteries dissection after attempting to pass a second stent into the proximal left anterior descending artery.

FIGURE 1 Cx/LM Artery Stent



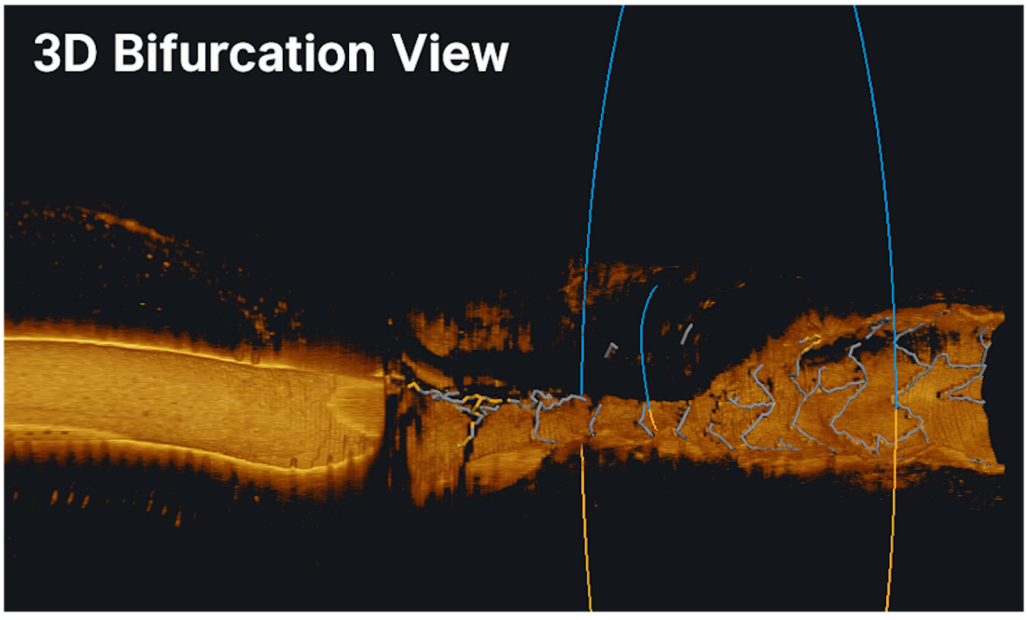
Angiographic result after stent deployment in circumflex (Cx)/left main (LM) and positioning of proximal optimization technique with the 3.5 × 10 mm balloon.

FIGURE 3 Single-Stent Strategy for the LM-LAD



Angiographic result after stent deployment from the LM into the left anterior descending (LAD) artery, followed by proximal optimization technique. Abbreviation as in Figure 3.

FIGURE 4 **Intravascular Imaging Assessment**



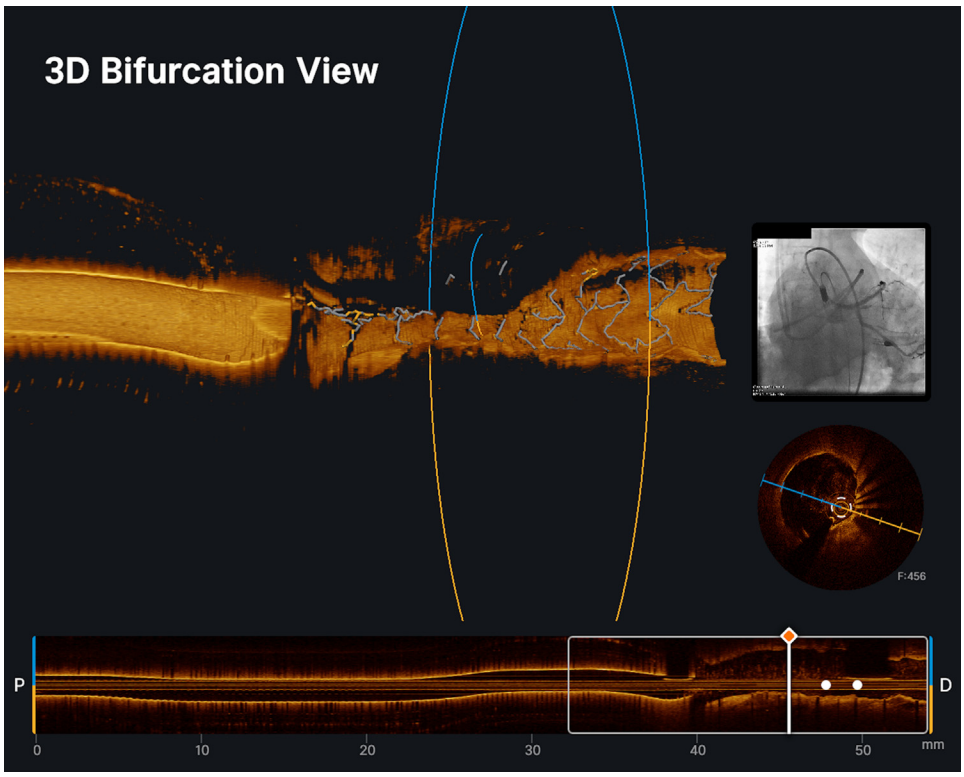
Optical coherence tomography 3-dimensional (3D) bifurcation view revealing longitudinal stent deformation.

(3.0 mm × 24 mm) implanted from the LM artery into the circumflex (Cx) artery. The procedure was followed by proximal optimization technique using a 3.5 mm × 10 mm noncompliant balloon (**Figure 1**).

After rewiring the LAD artery, the stent struts were dilated using a noncompliant 2.5 mm × 12 mm balloon. However, while attempting to pass a second stent (Ultimaster Nagomi 2.75 mm × 33 mm) into the LAD artery, significant resistance was encountered. The stent was retracted into the guiding catheter, but during retraction, dissection of the LAD and Cx arteries occurred (**Figure 2**), along with a shaft fracture. The fractured stent shaft was observed outside the guiding catheter, floating in the aorta.

On recognition of the shaft fracture, a bailout strategy was employed including coronary protection, shaft removal attempt, and bailout fixing with a stent in the LM artery. A BMW wire (Abbott) was placed in the distal LAD artery to secure coronary patency. Multiple attempts were made to pass a guidewire (Runthrough, Pilot 50, Abbott) into the Cx artery but were unsuccessful. Eventually, a SION guidewire (Asahi Intecc Medical), supported by a Finecross microcatheter (Terumo) was advanced into the obtuse marginal branch. However, no balloons succeeded to go across the proximal segment of the Cx, impairing proper expansion. Using a single-access approach, a 6-F introducer was placed through the Impella sheath. A multiloop snare (EN Snare 20, Merit Medical) was used to attempt retrieval of the fractured shaft but without success. Given the inability to pass a balloon into the Cx artery, a single-stent strategy for the LM-LAD segment was adopted. The lesion was prepared using Ryurei balloons, and a XIENCE Skypoint 3.0 mm × 23 mm stent (Abbott) was implanted from the LM into the LAD, followed by proximal optimization technique (**Figure 3**, Video 1). The procedure was interrupted, and angiographic reassessment was planned within 1 week.

FIGURE 5 Intravascular Imaging Assessment



Optical coherence tomography 3D bifurcation view revealing longitudinal and axial stent deformation. Abbreviation as in Figure 4.

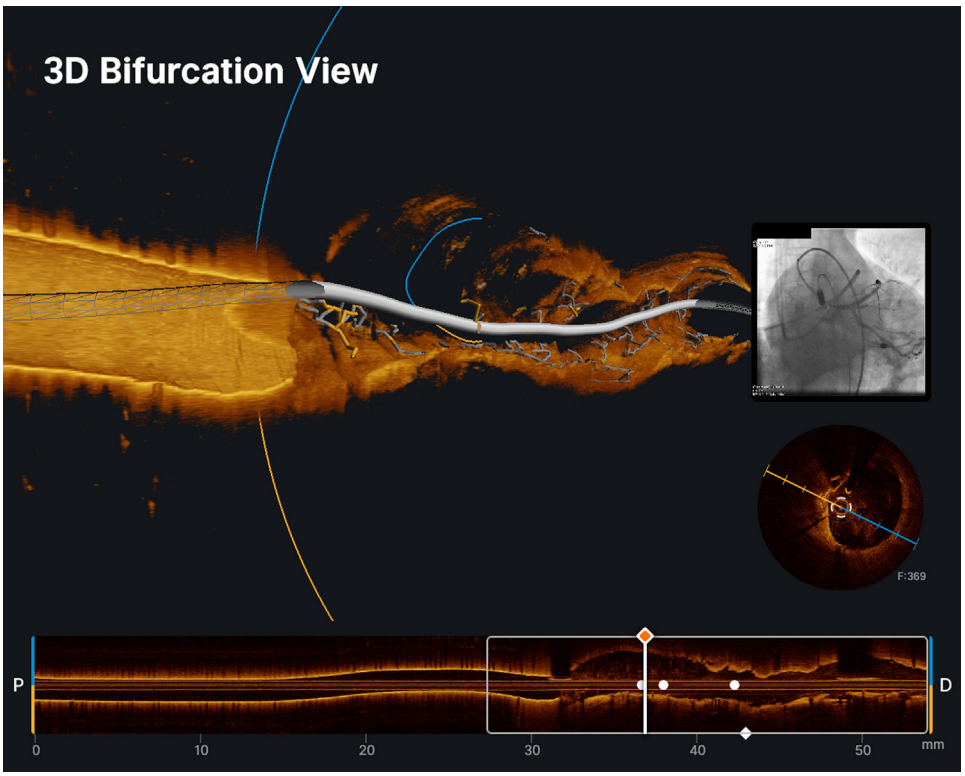
After 7 days of continued mechanical support with the Impella device, and with surgery once again declined, the patient underwent a repeat angiographic evaluation, this time using optical coherence tomography to assess the mechanism of stent entrapment. Optical coherence tomography revealed that the fractured shaft was trapped in the LM bifurcation (**Figures 4 to 6**). A second attempt at retrieval was performed using an EN Snare 20 and a JL 3.5 6-F catheter. This time, the snare successfully captured the fractured shaft, and the entire system, including the entrapped stent, was externalized (**Figures 7 to 9**, Video 2). Because the snared stent and shaft could not be retrieved through the 6-F femoral sheath, a V18 wire was advanced to secure the access for bailout closure (Video 3). After confirming the absence of femoral complications with contrast injection via an 8-F femoral sheath, the access was successfully closed using an 8-F Angio-Seal system (Terumo). The patient was discharged several days later in stable condition.

PROCEDURAL STEPS

When facing a balloon or stent shaft fracture, it is essential to determine whether the shaft is within or outside the guiding catheter.

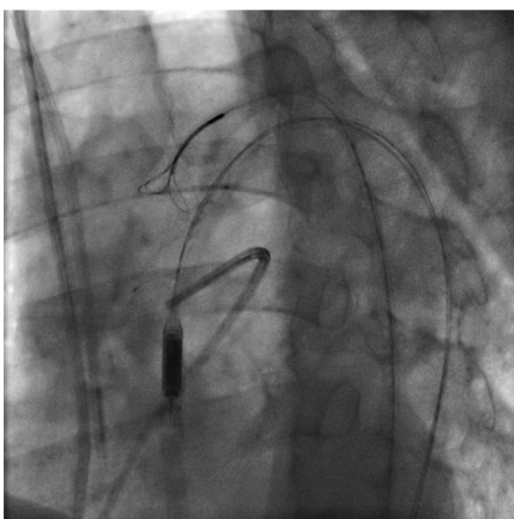
1. Shaft within the guiding catheter:
   a. Use a balloon trapping technique (inflate a small balloon within the catheter to trap the fractured segment and facilitate retrieval).
   b. Alternatively, use a secondary balloon to retrieve the shaft.
2. Shaft outside the guiding catheter:
   a. In the aorta, employ a snare technique (preferably using a trifold snare). If unsuccessful, surgery may be required.

FIGURE 6 Intravascular Imaging Assessment



Optical coherence tomography 3D bifurcation view revealing entrapment of the fractured shaft in the left main bifurcation. Abbreviation as in Figure 4.

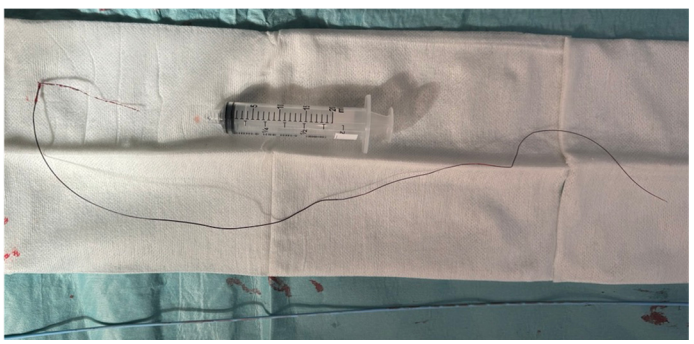
FIGURE 7 Snare Technique



Fractured shaft removal using the EN Snare.

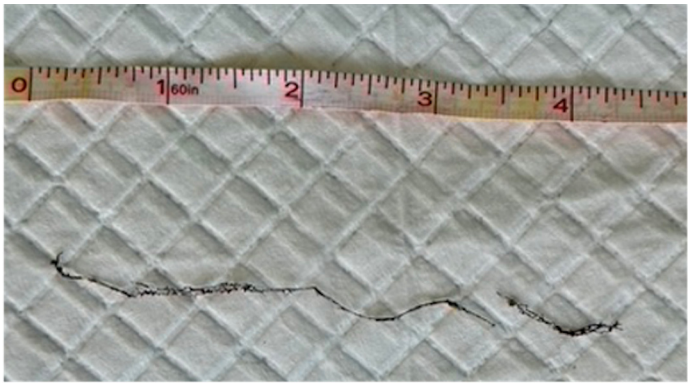
b. In the coronary artery, use an EN Snare 20 (Medtronic) or incarcerate the fragment by stenting over it. If these methods fail, surgical intervention must be considered.

FIGURE 8 Fractured Shaft and Previously Implanted Stent



Fractured shaft and previously implanted stent in the left main and left anterior descending arteries after removal.

FIGURE 9 Fractured Shaft



Length of the fractured shaft removed from the ascending aorta.

POTENTIAL PITFALLS

Forceful pulling of the system during stent entrapment increases the risk of shaft fracture and coronary dissection.

Failure to protect coronary arteries with guidewires can lead to myocardial infarction or coronary occlusion.

To avoid these complications, early recognition of equipment entrapment is critical, along with a methodical approach to retrieval using bailout techniques such as balloon trapping or snaring.

CONCLUSIONS

Balloon and stent shaft fractures, though rare, are potentially life-threatening complications that demand rapid and skillful intervention. In this case, timely recognition of the fracture and the use of a snare technique allowed successful retrieval of the fractured shaft from the aorta. Knowledge of bailout techniques, including snare retrieval, is essential to safely manage such complex percutaneous coronary intervention complications.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

This work was supported by Fundação para a Ciência e a Tecnologia (grant number UIDB/00306/2020). The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

ADDRESS FOR CORRESPONDENCE: Dr Catarina Oliveira, Serviço de Cardiologia, Avenida Professor Egas Moniz, 1649-028 Lisboa, Portugal. E-mail: catarinasdeoliveira@gmail.com.

REFERENCES

1. Chen WT, Chen MY, Wang JH. Case report: stent delivery shaft fracture during percutaneous coronary intervention and retrieval with trapping balloon method. *J Taiwan Cardiovasc Interv*. 2023;12:35-39.

2. Kharge J, Sreekumar P, Swamy K, Bharatha A, Ramegowda RT, Nanjappa MC. Balloon-assisted retrieval of a broken stent-delivery system. *Tex Heart Inst J*. 2012;39(5):644-646.

3. Brandon L, Kerr B, Armstrong R, Cosgrave J. Stent delivery shaft fracture case report: a fractured relationship. *EMJ Int Card*. 2022;10(1):47-52. https://doi.org/10.33590/emjintcardiol/21-00066

4. Tizón-Marcos H, De Larochellière R, Larose E. Breakpoint: left main stent fracture: review of the literature. *J Interv Cardiol*. 2009;22(4):362-367. https://doi.org/10.1111/j.1540-8183.2009.00484.x

5. Adlakha S, Sheikh M, Bruhl S, et al. Coronary stent fracture: a cause of cardiac chest pain? *Int J Cardiol*. 2010;141(2):e23-e25. https://doi.org/10.1016/j.ijcard.2008.11.135

6. Lee JH, Seo SM, Kim EO, et al. Stent fracture at the proximal shaft of the left main stem. *Korean Circ J*. 2011;41(12):763-765. https://doi.org/10.4070/kcj.2011.41.12.763

KEY WORDS balloon/stent shaft fracture, bailout techniques, calcified coronary lesions

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