

CASE REPORT

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# Transradial retrograde percutaneous coronary intervention of chronic total occlusion using a single guiding catheter: a case report

Georgi Goranov<sup>1\*</sup> and Petko Petrov<sup>2</sup>

## Abstract

**Background** With the development of specialized equipment and the retrograde technique, success rates for percutaneous coronary intervention of chronic total occlusions have increased from 60 to 90% in the past 10 years. Performing percutaneous coronary intervention via a collateral channel from the contralateral artery, using two guiding catheters, is usually the preferred approach to retrograde chronic total occlusion-percutaneous coronary intervention. In the case described in this report, we performed successful retrograde revascularization of chronic total occlusion of dominant left circumflex artery via the ipsilateral septal collateral artery from the left anterior descending artery. The procedure was performed successfully through radial artery access using a single guiding catheter.

**Case summary** An 85-year-old white Bulgarian Caucasian male patient, with a history of lateral and inferior myocardial infarction 20 years ago and previous percutaneous coronary intervention, underwent a planned coronary arteriography owing to his complaints of typical angina symptoms. Coronary angiography revealed three-vessel coronary artery disease with patent implanted drug-eluting stents in the mid-left anterior descending artery and in the proximal right coronary artery and chronic total occlusion of dominant left circumflex artery. A septal branch in the midsegment of left anterior descending artery was supplying the distal left circumflex artery retrogradely. After repeated failed attempts at antegrade percutaneous coronary intervention for the left circumflex artery's chronic total occlusion, the retrograde approach was tried. This intervention finally succeeded through the ipsilateral septal collateral. It was performed via a single radial artery access throughout the whole process. Postoperatively, the patient had no complications and was stable at the 6-month follow-up.

**Conclusion** The transradial approach to retrograde percutaneous coronary intervention for chronic total occlusions via an ipsilateral septal collateral using a single guiding catheter is feasible and safe in appropriately selected cases.

**Keywords** Chronic total occlusion, Percutaneous coronary intervention, Retrograde approach, Radial artery access, Case report

## Introduction

Successful percutaneous coronary intervention (PCI) of chronic total occlusions (CTOs) has been associated with a reduced need for coronary artery bypass graft surgery (CABG), improvements in left ventricular function, and better long-term survival [1]. With the development of specialized equipment and the retrograde technique, success rates for recanalization of CTOs have increased from 60 to 90% in the past 10 years [2, 3]. The advantages

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of the retrograde approach in CTO-PCI have been observed in many clinical cases. Using septal collaterals from the contralateral artery as an access route shows a high success rate in retrograde CTO-PCI. However, not all CTO cases are well suited for using the contralateral septal collateral as an access route. In some cases of CTO of left circumflex artery (LCX), only the ipsilateral septal collateral is observed to supply the distal recipient artery. Femoral arterial access is usually the preferred approach to CTO-PCI because of its ability to firmly support a larger guiding catheter (7 French), but in several recent reports, radial access has been demonstrated to be possible, safe, and effective [4]. We present a case of LCX CTO recanalization performed successfully via an ipsilateral septal collateral, using a single guiding catheter that was positioned in the radial artery.

Case presentation

An 85-year-old white Bulgarian Caucasian male patient was admitted to the department of cardiology with progressive angina and dyspnea at minimal exertion in the last year. The patient’s past medical history included lateral and inferior myocardial infarction in 2004. In 2017, a permanent pacemaker was implanted because of complete atrioventricular block (AV block). Coronary angiography performed in 2024 revealed three-vessel coronary artery disease with significant stenosis mid left anterior descending artery (LAD) and proximal right coronary artery (RCA) and CTO of dominant distal LCX. The Synergy between PCI with Taxus and Cardiac Surgery (SYNTAX) score was 23.5. Coronary artery bypass graft (CABG) surgery was advised for the patient according to the coronary angiography. The patient was thoroughly informed of the risks of PCI; he refused CABG surgery and accepted the risks of PCI. Successful PCI with implantation of one drug-eluting stent (DES) in mid-LAD and one DES in proximal RCA was performed in a single procedure. Arterial hypertension is the only known comorbidity. The patient was on several medications last month before the procedure, including clopidogrel, aspirin, atorvastatin, metoprolol, zofenopril, torsemide, and spironolactone. The physical examination was notable for mild lower extremity edema. On hospital admission, heart rate was 60 beats per minute, and blood pressure was 120/75 mm/Hg. The remainder of the physical examination was unremarkable. The electrocardiogram showed pacemaker spikes and left bundle branch block (LBBB). Transthoracic echocardiography showed mildly reduced left ventricular function (ejection fraction (EF)=48% measured using Simpsons Biplane), normal sizes and volumes of left ventricle, and mild mitral regurgitation. Baseline troponin I was slightly elevated (Table 1).

Table 1 Baseline Laboratory Assay Results

Laboratory assay	On hospital admission
Hemoglobin [g/L]	123.0
Hematocrit [L/L]	0.397
Platelets [10 <sup>9</sup> /L]	137
Creatinine [μmol/L]	102.0
Troponin I [ng/mL]	0.28
Creatine kinase MB [U/L]	11.0

The patient was diagnosed with coronary heart disease with unstable angina and decompensated heart failure. After receiving intensive anti-anginal and anti-heart failure medications, the patient underwent planned coronary arteriography. Coronary angiography showed patent stents in proximal RCA (Fig. 1A) and in the mid-LAD and CTO of distal LCX (Fig. 1B). A septal branch was supplying the distal LCX retrogradely (Fig. 2A, B).

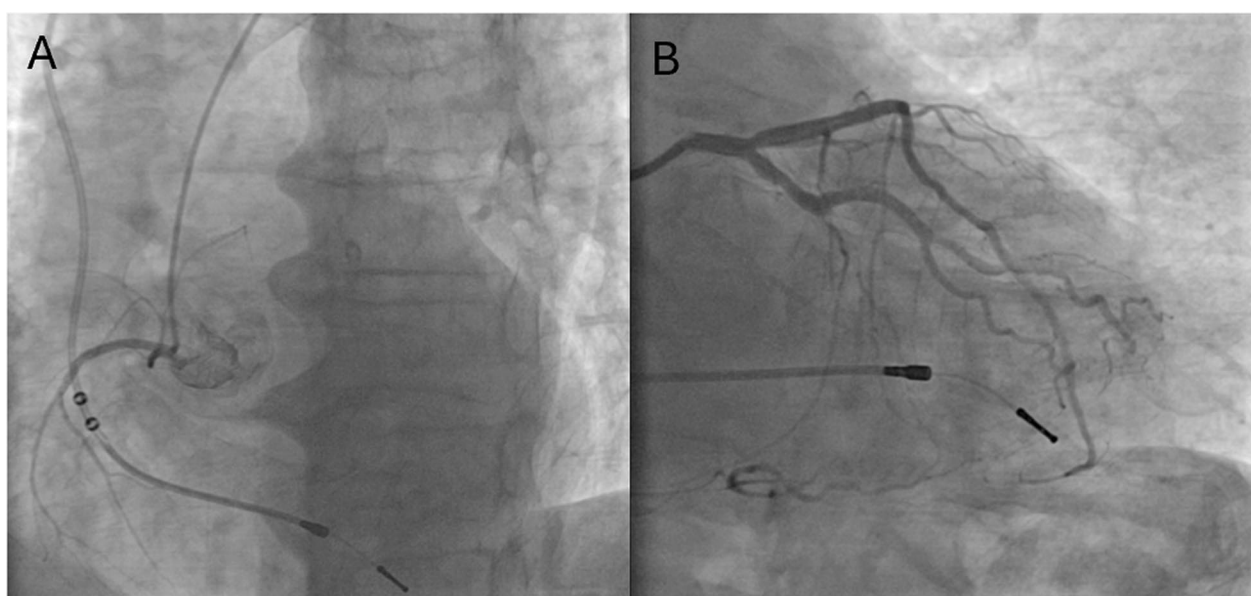
PCI for the LCX CTO was attempted. A 6-French (Fr) XB 4.0 guiding catheter via radial access was used. After repeated attempts at antegrade access failed, the retrograde approach was tried. The retrograde wire (SION black 190, Asahi) was advanced through the septal collateral with the microcatheter (Finecross, Terumo), reaching the distal CTO lesion (Fig. 3A). Then, the retrograde Sion wire was exchanged for a Gaia First (Asahi) wire (Fig. 3B).

It crossed the CTO segment successfully, entered the true lumen of proximal segment of LCX and left main (LM) artery (Fig. 4), and was threaded into the guide catheter with microcatheter retrogradely.

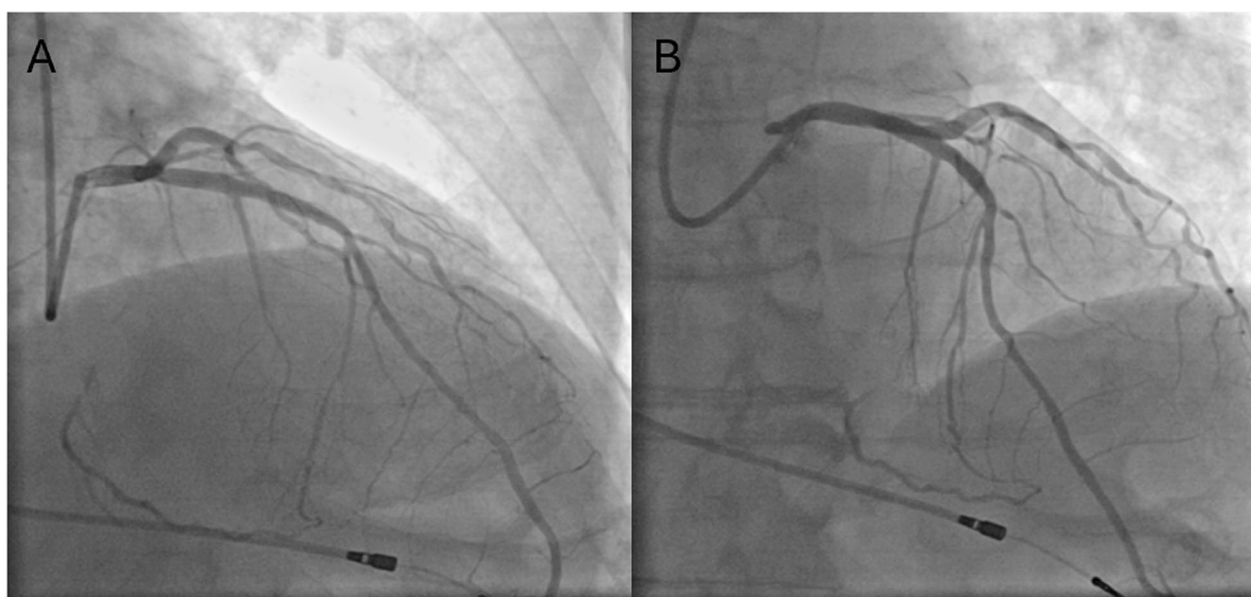
A 300-cm RG3 wire was externalized via the microcatheter. Balloon predilatation with Ryurei (Terumo) 1.25/10 mm, 1.5/10 mm, 2.0/10 mm, and 2.5/15 mm of proximal and distal LCX was performed. Two drug-eluting stents (Synergy, Boston Scientific 2.5/28 mm and 2.5/48 mm) were successfully implanted in the proximal and distal LCX with minimal overlap (Fig. 5A, B).

Postdilatation at 20 atmospheric pressure of the implanted stents with noncompliant balloon Sapphire II NC (OrbusNeich) 3.0/15 was performed. A soft wire (Runtrough, Terumo) was advanced in the distal segment of LCX antegradely, and the RG3 wire was removed with a microcatheter. The final angiogram (Fig. 6A, B) showed thrombolysis in myocardial infarction (TIMI) flow grade 3 in the distal LCX.

The patient had no periprocedural complications and continued to be treated with guideline-directed medical therapy. He was discharged home 48 hours after intervention. The patient was asymptomatic and stable over



**Fig. 1** Patent stent in proximal right coronary artery (A), patent stent in mid-left anterior descending artery and chronic total occlusion of distal left circumflex artery (B)



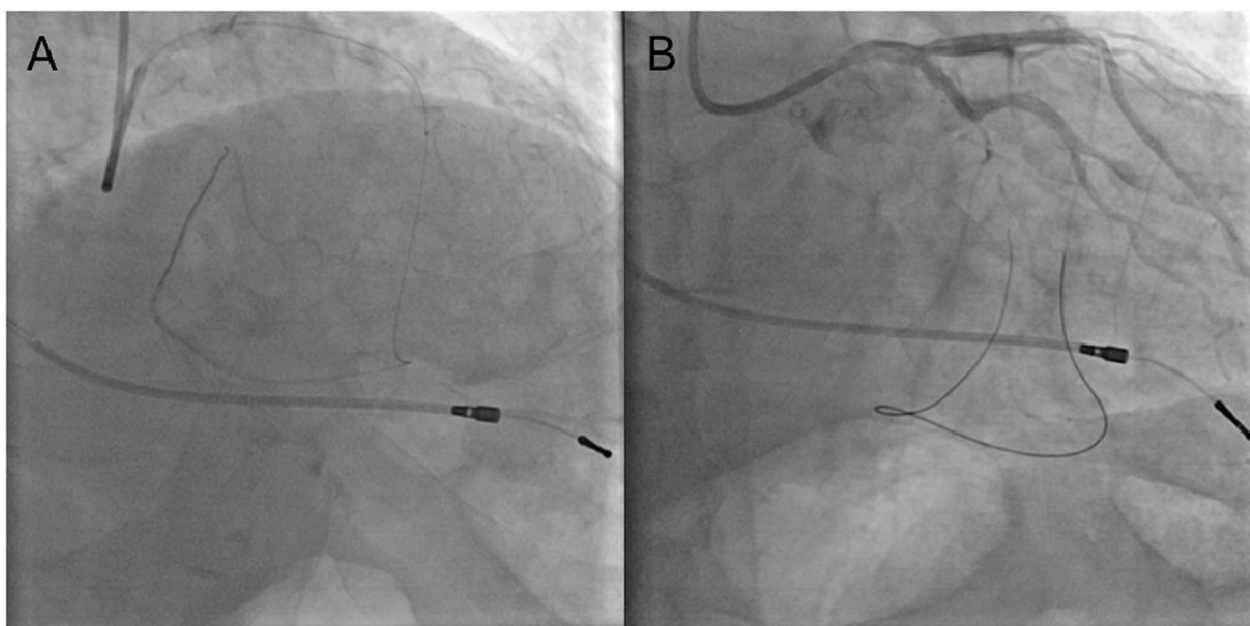
**Fig. 2** Septal branch supplying the distal left circumflex artery retrogradely (A, B)

6 months of follow-up appointments. A detailed timeline of the events and therapy of the patient is provided (Table 2).

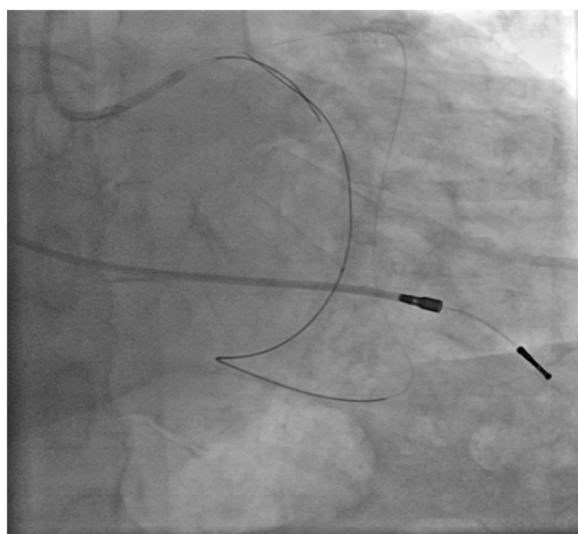
### Discussion

Chronic total occlusion (CTO) is defined as an occlusive lesion of over 3-month duration. The CTO-PCI tends to be a challenge for interventionists because of

its low success rate and lengthy procedure. The main cause of CTO-PCI failure is usually an inability to cross the lesion [5]. Improvements in the retrograde approach have helped increase the success rate. The proximal fibrous cap of a CTO lesion is characteristically harder and thicker, which may increase the failure rate and the risk of subintimal dissection, while the distal cap is thinner and tapered so that the wire can cross



**Fig. 3** Crossing the septal collateral (A), penetrating the distal cap with Gaia First (B)



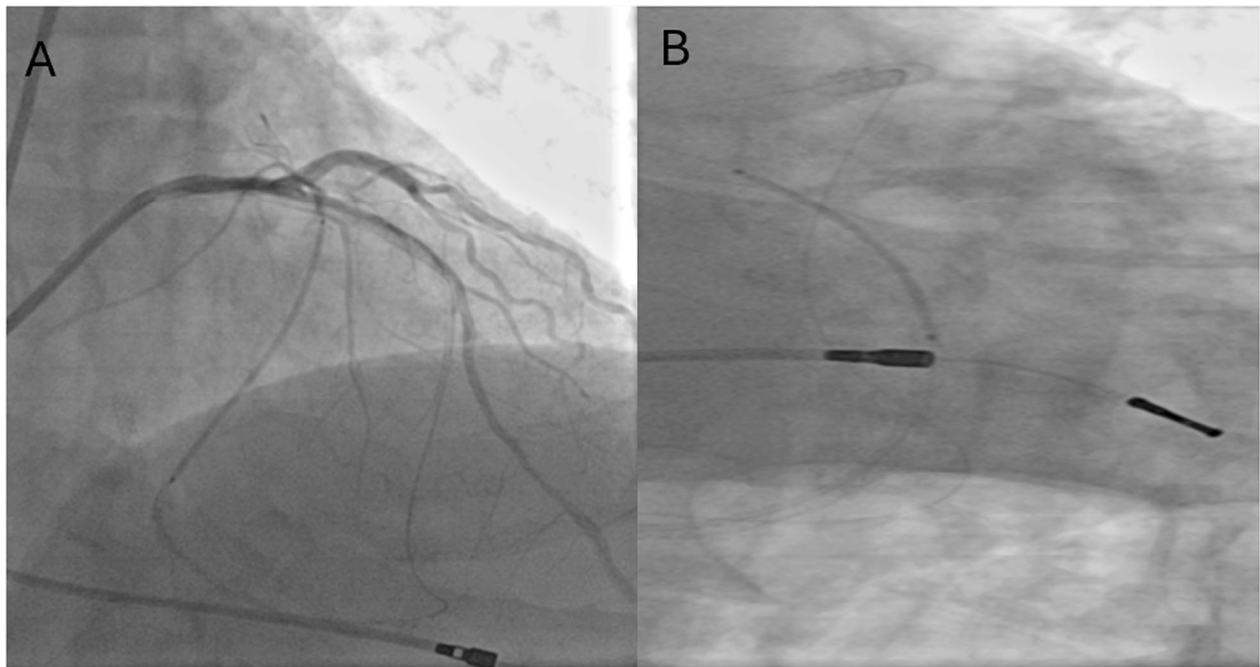
**Fig. 4** Entering the true lumen of proximal left circumflex artery with Gaia First

it easily [4]. This provides a theoretical basis for retrograde PCI.

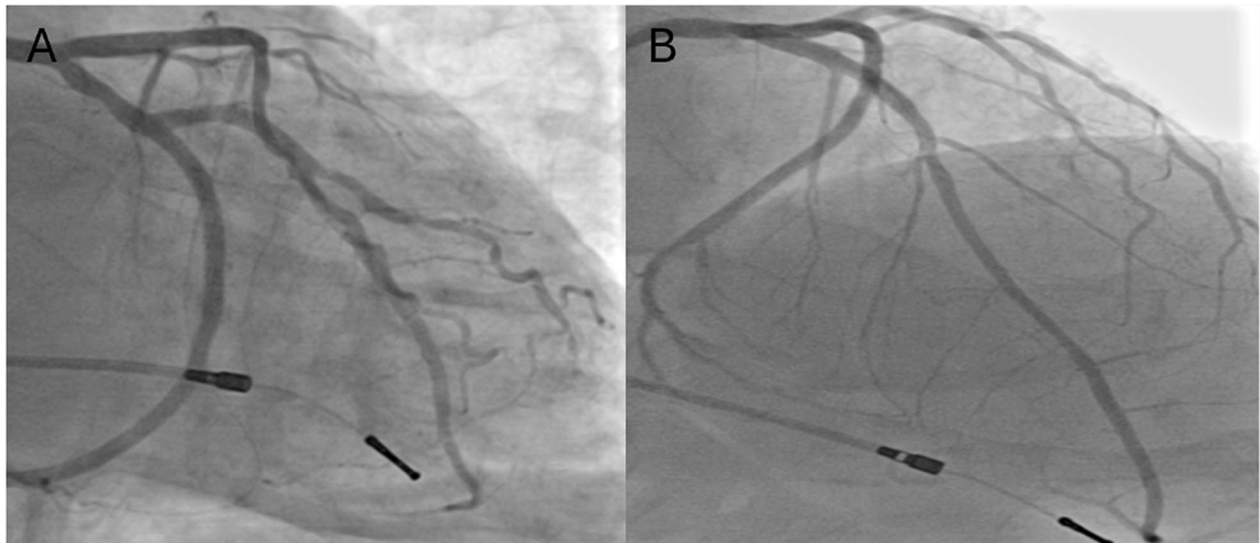
In the case described here, a dominant LCX had a long chronic total occlusion with Japanese Chronic Total Occlusion (J-CTO) score of 3. In addition, a large septal collateral arising from the mid-LAD was visible. These observations suggested that retrograde PCI would be relatively easier to accomplish when antegrade attempts failed. Selecting a suitable collateral channel is the key

to the success of retrograde approach [6]. The selectable collateral channel for retrograde PCI could be a septal collateral or an epicardial collateral. Septal collaterals are preferred in majority of cases because, compared with the epicardial collaterals, they usually have a shorter and less tortuous course. Furthermore, they are less likely to cause tamponade when they are injured [7]. In this case, no septal collateral from the RCA to the LCX was observed. Instead, a septal collateral from the mid-LAD was found filling the distal LCX retrogradely, so it was chosen to serve as the retrograde access. In most retrograde PCI cases, operators use the double-guiding catheter technique [8]. In this case, single-guiding catheter was used via the radial artery. The transradial approach could lower the risk of access site complications, which include mainly hematoma and bleeding complications. In addition, it may increase patient comfort and shorten hospital stays. Nevertheless, this approach has limitations. First is the fact that smaller-size guiding catheters in the radial artery are less supportive and harder to operate. Second, when multiple devices need to be used simultaneously, a larger guiding catheter is more appropriate. Therefore, radial CTO PCI with a single guiding catheter can be effective in appropriately selected cases. Third, if the retrograde wire has difficulty crossing the CTO segment or the microcatheter is difficult to advance across the CTO segment, the controlled antegrade and retrograde tracking (CART) technique, knuckle technique, or anchor balloon technique would be needed. In such cases, a second arterial access and a large-size guiding catheter would





**Fig. 5** Implantation of two stents in the proximal and distal left circumflex artery with overlap (A, B)



**Fig. 6** Final angiogram. No residual stenosis and thrombolysis in myocardial infarction grade 3 blood flow (A, B)

be required. Fourth, compared with the RG3 wire externalization, the “rendez-vous” technique may be more efficient and safer, but it is not straightforward to perform this operation with a single, small-caliber catheter such as the 6-Fr guiding catheter [9]. Therefore, the RG3 wire externalization technique was adopted in this case. When the RG3 wire was externalized, the safest method was to pull back the microcatheter up to the distal part

of the CTO but keep covering the septal channel with the microcatheter while a new microcatheter advanced antegradely beyond the CTO segment. However, because the 6-Fr XB 4.0 guiding catheter that was used could not accommodate two microcatheters at the same time, the microcatheter was withdrawn and all the balloon predilatations and DES implantation were performed over the RG3 wire. Indeed, this procedure risked damaging the

**Table 2** Chronological Summary of Major Cardiac Events and Interventions

Year	Event/procedure description
2004	Patient experienced lateral and inferior myocardial infarction
March 2017	Permanent pacemaker implanted due to complete AV block
February 2024	Coronary angiography revealed three-vessel coronary artery disease. CABG surgery advised, but the patient refused
February 2024	PCI performed with implantation of drug-eluting stents in mid-LAD and proximal RCA
April 2024	Successful retrograde PCI of CTO of LCX with implantation of two drug-eluting stents
October 2024	6-month follow-up: no angina symptoms

uncovered septal collateral channel. To protect the septal collateral, the microcatheter was advanced to the distal LCX through the septal collateral over the wire when we removed the RG3 wire.

### Conclusion

This rare case report demonstrated that transradial approach of retrograde PCI for the CTO via an ipsilateral septal collateral using a single guiding catheter is feasible and safe in appropriately selected cases.

### Abbreviations

PCI	Percutaneous coronary intervention
CTO	Chronic total occlusion
LCX	Left circumflex artery
LAD	Left anterior descending artery
RCA	Right coronary artery
DES	Drug-eluting stent
CABG	Coronary artery bypass graft
AV-block	Atrioventricular block
LBBB	Left bundle branch block
EF	Ejection fraction
TIMI	Thrombolysis in myocardial infarction
SYNTAX	Synergy between PCI with Taxus and Cardiac Surgery

### Acknowledgements

Not applicable.

### Author contributions

Dr. Georgi Goranov was the interventional cardiologist who performed the intervention. Dr. Georgi Goranov analyzed and interpreted the patient data regarding the PCI procedure. Dr. Petko Petrov was a contributor in writing the manuscript. All authors read and approved the final manuscript.

### Funding

This case report did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

### Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

### Declarations

### Ethics approval and consent to participate

Not applicable.

### Consent for publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

### Competing interests

The authors declare that they have no competing interests.

Received: 2 January 2025 Accepted: 6 April 2025

Published online: 23 May 2025

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