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CASE REPORT

ADVANCED

TECHNICAL CORNER

Successful Treatment of Spontaneous Coronary Artery Dissection With Subintimal Tracking and Re-Entry Technique

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ABSTRACT

Percutaneous coronary intervention (PCI) remains necessary in patients with spontaneous coronary dissection (SCAD) with ongoing ischemia. However, PCI in SCAD is associated with poor results. Fenestration with a cutting balloon has been described to release the extraluminal compression. The authors describe 2 cases managed successfully with another fenestration technique—the subintimal tracking and re-entry technique. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2019;1:553–9)

Spontaneous coronary artery dissection (SCAD) leading to intramural hematoma and true lumen compression is responsible for up to one-fourth of all myocardial infarction cases in women younger than 50 years old (1). Guidelines support conservative management for lower-risk patients with SCAD because spontaneous healing usually occurs within weeks after the event (2). However, in case of ongoing ischemia, revascularization is often required to maximize myocardial salvage. However, although percutaneous coronary intervention (PCI) is usually the first revascularization option in these patients, it is associated with a much lower success rate, below 70% (1), compared with PCI for coronary artery disease and can result in unpredictable complications.

Because the goal in the presence of a subocclude or occluded coronary artery is to re-establish Thrombolysis In Myocardial Infarction (TIMI) flow grade 3 with minimal side branch loss, the fenestration technique has emerged as an attractive option to treat SCAD. After fenestrating the dissection plane into the true lumen, the hematoma can be evacuated,

LEARNING OBJECTIVES

- In case of SCAD with ongoing ischemia, revascularization is advocated to maximize myocardial salvage, but traditional PCI techniques have been associated with poor results in this setting due to the risk of propagating the intramural hematoma.
- Fenestration techniques allow evacuation of the intramural hematoma, relief of luminal compression, and improvement of distal bed flow.
- We describe a new fenestration technique derived from chronic total occlusion PCI-STAR. STAR for SCAD involves intentional penetration of a subintimal hematoma with a guidewire followed with exchange for a polymer-jacketed guidewire knuckled and pushed to re-enter into the true lumen.

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Informed consent was obtained for this case.

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ABBREVIATIONS AND ACRONYMS

OCT = optical coherence tomography

PCI = percutaneous coronary intervention

RCA = right coronary artery

SCAD = spontaneous coronary artery dissection

STAR = subintimal tracking and re-entry

TIMI = Thrombolysis In Myocardial Infarction

luminal compression relieved, distal bed flow improved, and the risk of hematoma propagation or displacement with stenting reduced. The use of a cutting balloon has been described as a feasible option to create fenestrations (3–5). We report the first 2 cases managed with another fenestration technique—the subintimal tracking and re-entry (STAR) technique.

CASE 1

PRESENTATION. A 54-year-old woman without any risk factors was admitted for non-ST-segment elevation myocardial infarction with an electrocardiogram showing T-wave inversion in inferior leads and recent chest pain. Echocardiography revealed an inferior hypokinesis. Coronary angiography showed an angiographically normal left system, with faint collateral to the posterior descending and posterolateral branches of the right coronary artery (RCA) (**Figure 1A**). The RCA had angiographic appearance of type 2 SCAD in the mid- to distal segment with TIMI flow grade 0 (**Figure 1B**).

MANAGEMENT. We wired the true lumen with a Samuraï guidewire (Boston Scientific, Marlborough, Massachusetts) (**Figure 1C**) and assessed our position with an injection through a Finecross microcatheter (Terumo, Shibuya, Tokyo, Japan) delivered on a second guidewire. The first optical coherence tomographic (OCT) (DragonFly, Abbott, Abbott Park, Illinois) imaging confirmed the presence of a large compressive intramural hematoma extending from the mid-RCA to the distal bifurcation of the RCA (**Figure 2**, run 1). We performed a contrast-guided STAR to fenestrate the false lumen; we accessed the subadventitial space with a medium stiffness polymer-jacketed guidewire (Pilot 200, Abbott) (**Figure 1D**) and followed with the Finecross microcatheter We injected 1 to 2 ml contrast to confirm the subadventitial location (**Figure 1E**). Then, a low-tip load, polymer-jacketed, and tapered guidewire (FielderXT, Asahi-Intecc, Nagoya, Japan) was pushed in the subadventitial space until a knuckle was formed (**Figure 1F**) and was advanced further down aiming to re-enter into the true lumen distally from the distal edge of the hematoma, creating a fenestration. The re-entry occurred before the distal bifurcation of the RCA (**Figure 1G**) and was confirmed by an instantaneous washout of the subadventitial contrast. The patient developed a transient ST-segment elevation and chest pain, likely attributable to the embolization of the false lumen content into the distal microcirculation. TIMI flow grade 3 was restored (**Figure 1H**), and OCT imaging showed an increased true lumen area secondary to decompression of the hematoma (**Figure 2**, run 2.A and 2.B). Based on the OCT findings, we implanted two 3.5 × 38-mm drug-eluting stents. The final OCT imaging revealed well-apposed stents and a very short residual intramural hematoma distal to the edge of the stent (**Figure 1I**). The posterior descending artery and posterolateral branches were free of hematoma (**Figure 2**, run 3.C).

FOLLOW-UP. The patient recovered uneventfully at 6 months.

CASE 2

PRESENTATION. An 82-year-old woman with a previous history of left carotid aneurysm, hypertension, and transient ischemic attack was admitted for sudden onset of chest pain. Electrocardiography showed an inferolateral ST-segment elevation. Urgent coronary angiography showed a distal occlusion of the second obtuse marginal branch with an appearance of type 2 SCAD (**Figure 3A**).

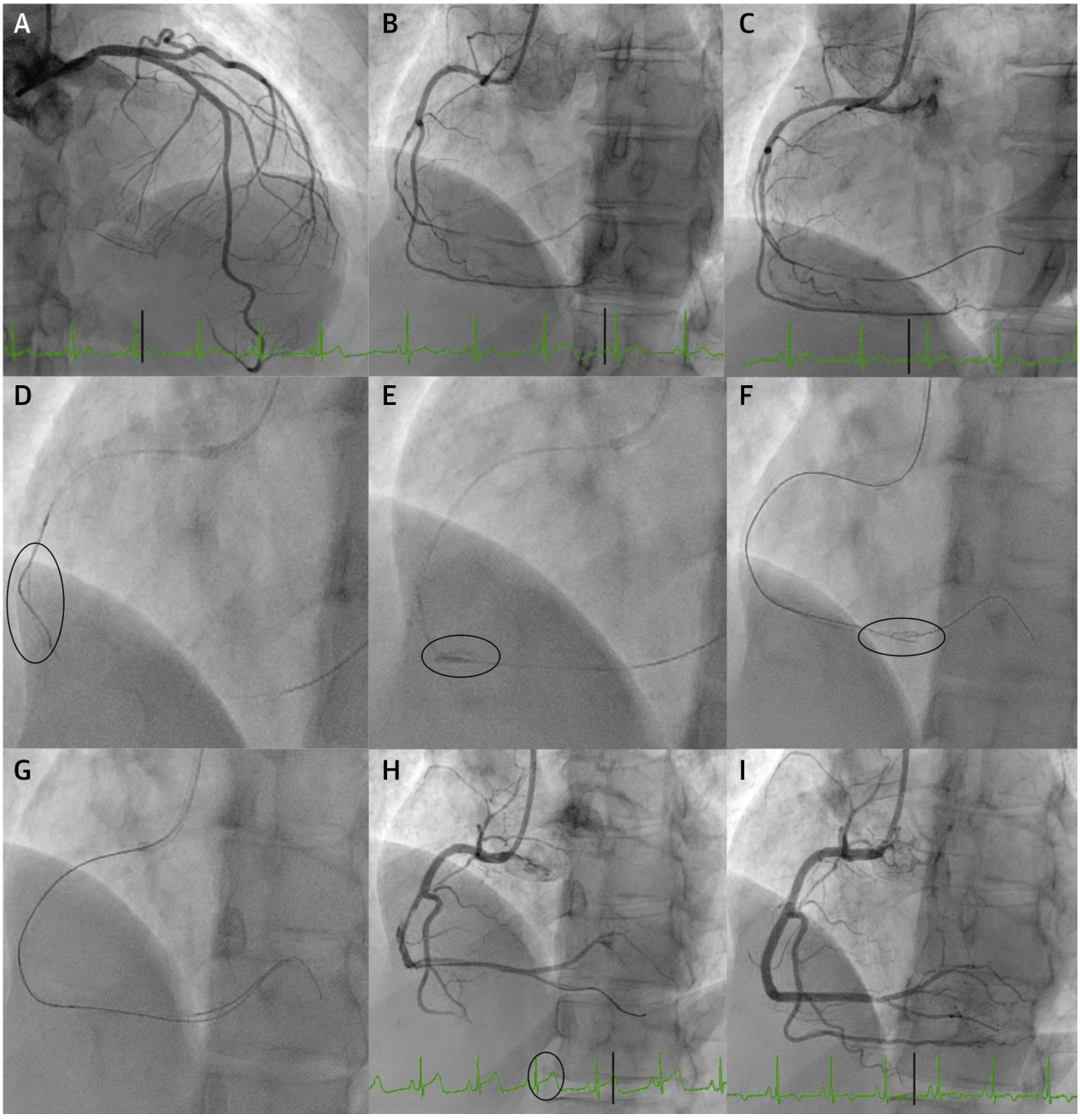
MANAGEMENT. It was impossible to place a workhorse guidewire (BMW, Abbott) into the true lumen. Therefore, a STAR technique was performed using a polymer-jacketed Whisper MS guidewire (Abbott) knuckled and pushed (**Figure 3B**) up to re-entry into the distal vessel (**Figure 3C**). Then, a 2.0 × 12-mm balloon was used to seal the proximal edge of the dissection. The final angiography showed a TIMI flow grade 3 (**Figure 3D**). Given the small size of the artery, no stent was implanted.

FOLLOW-UP. The patient was event free 12 months after the procedure.

DISCUSSION

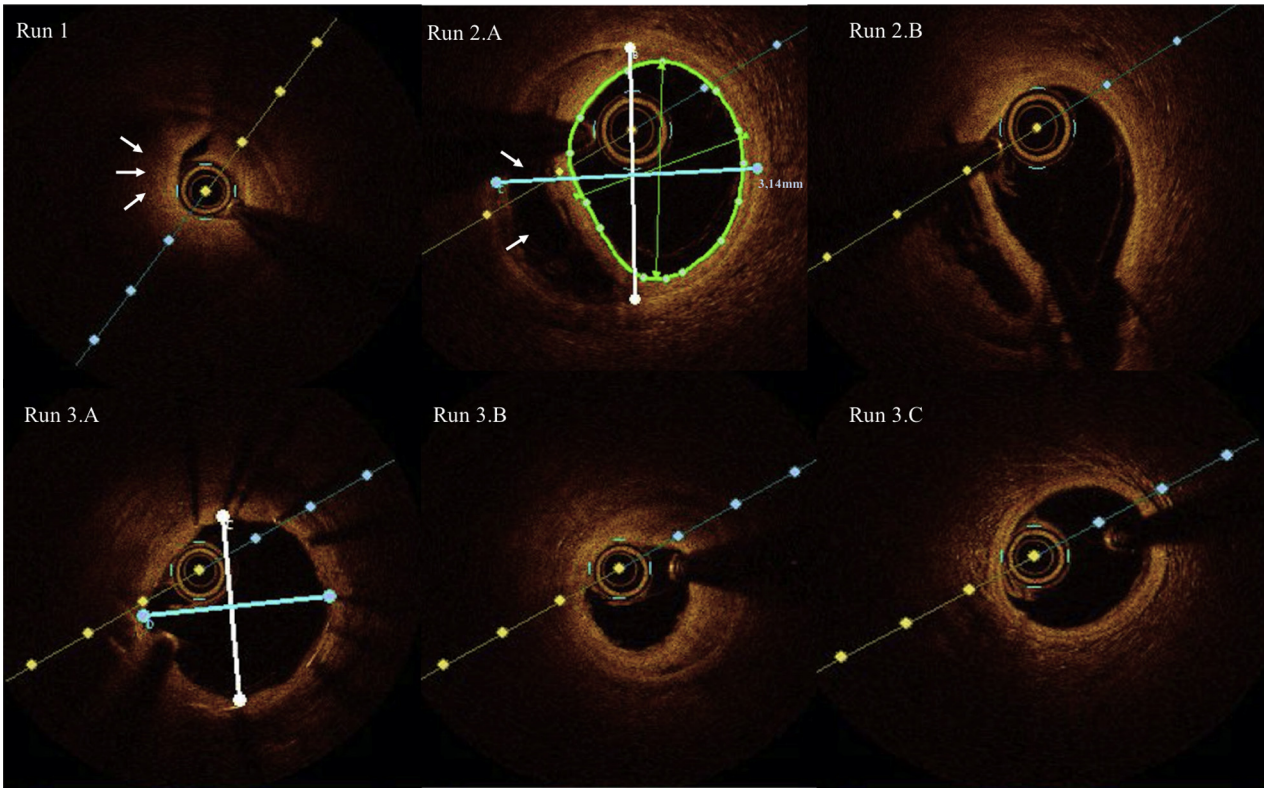
This is the first time the STAR technique was used for SCAD. This technique, used in chronic total occlusion PCI, involves intentional penetration of a subintimal plane with a guidewire followed with exchange for a polymer-jacketed guidewire knuckled and pushed to re-enter into the artery. Several variations of the original technique described by Colombo et al. (6) have been reported. Mini-STAR involves the use of a tapered 0.009-inch polymer-jacketed guidewire (7) and is associated with good long-term results in chronic total occlusion PCI. Contrast-guided STAR relies on a small amount of contrast to confirm the position of the subintimal system and subsequent re-entry (8). Two different STAR techniques were used in the 2 cases described here. In the first case, we were able to place a workhorse guidewire into the distal true lumen. Angioplasty with a small

FIGURE 1 **Case 1: Angiographic Images**



(A) Normal angiographic appearance of the left coronary artery with collateral to the right coronary artery. **(B)** Type 2 SCAD with TIMI flow grade 0. **(C)** Guidewire advanced freely into distal side branches. **(D)** Access of the subadventitial space with a polymer-jacketed guidewire **(circle)**. **(E)** Distal injection in the false lumen through the microcatheter. **(F)** Subintimal tracking and re-entry (STAR) technique: knuckled polymer-jacketed guidewire pushed. **(G)** Guidewire re-entry, free into the true lumen. **(H)** Post-STAR, with TIMI flow grade 2, transient ST-segment elevation, and chest pain. **(I)** The final result after drug-eluting stent implantation.

FIGURE 2 **Case 1: Optical Coherence Tomography Images**



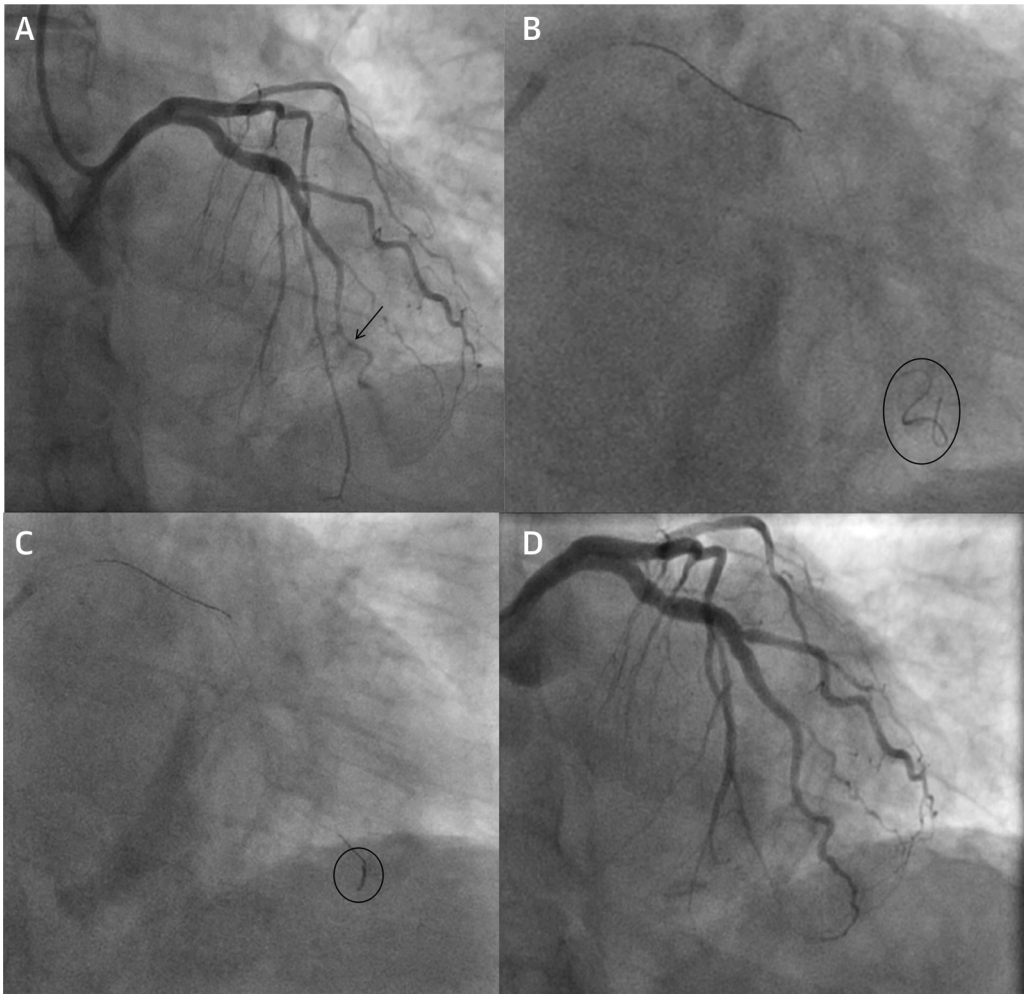
Run 1: compressive intramural hematoma **(arrows)**. Run 2: after subintimal tracking and re-entry and re-establishment of TIMI flow grade 2 (**arrows** shows false lumen, **green circle** delineates the lumen area). **(A)** Vessel sizing and **(B)** side branch connecting to the true lumen. Run 3: after drug-eluting stent implantation. **(A)** Good stent apposition, **(B)** residual hematoma at the distal stent edge, and **(C)** normal appearance of the postero-lateral branch.

balloon did not allow restoration of forward flow. Therefore, we proceeded with contrast-guided mini-STAR on a parallel system forced into the dissection plane, which fenestrated the false lumen at the edge of the hematoma, allowing the washout of the intramural content into the true lumen as evidenced by immediate clearance of contrast and subsequent TIMI flow grade 3 with transient ischemic signs. After this, we were able to adequately implant a drug-eluting stent under OCT guidance without risking hematoma propagation or stent malposition. In the second case, although wiring of the distal true lumen appeared impossible, a classic STAR bailout technique was the only remaining option besides leaving the artery closed. No further intervention was required, and TIMI flow grade 3 was achieved. Based on this initial experience, we propose our algorithm to guide operators with SCAD cases (Figure 4).

CONCLUSIONS

The STAR technique was feasible and offered good results in these 2 cases of flow-limiting SCAD. Given the suboptimal outcomes of traditional PCI techniques in patients with SCAD, hematoma fenestration with a STAR technique alone or to facilitate stenting is a novel method that can optimize PCI outcomes. Further studies are needed to assess the safety and efficacy of this technique for this indication.

FIGURE 3 **Case 2 Angiographic Images**



(A) Type 2 SCAD with obtuse marginal occlusion **(arrow)**. **(B)** Polymer-jacketed guidewire pushed to form a knuckle **(circle)**. **(C)** Distal vessel re-entry, as confirmed by free movement of the wire and closing of the loop size **(circle)**. **(D)** After balloon inflation, final TIMI flow grade 3.

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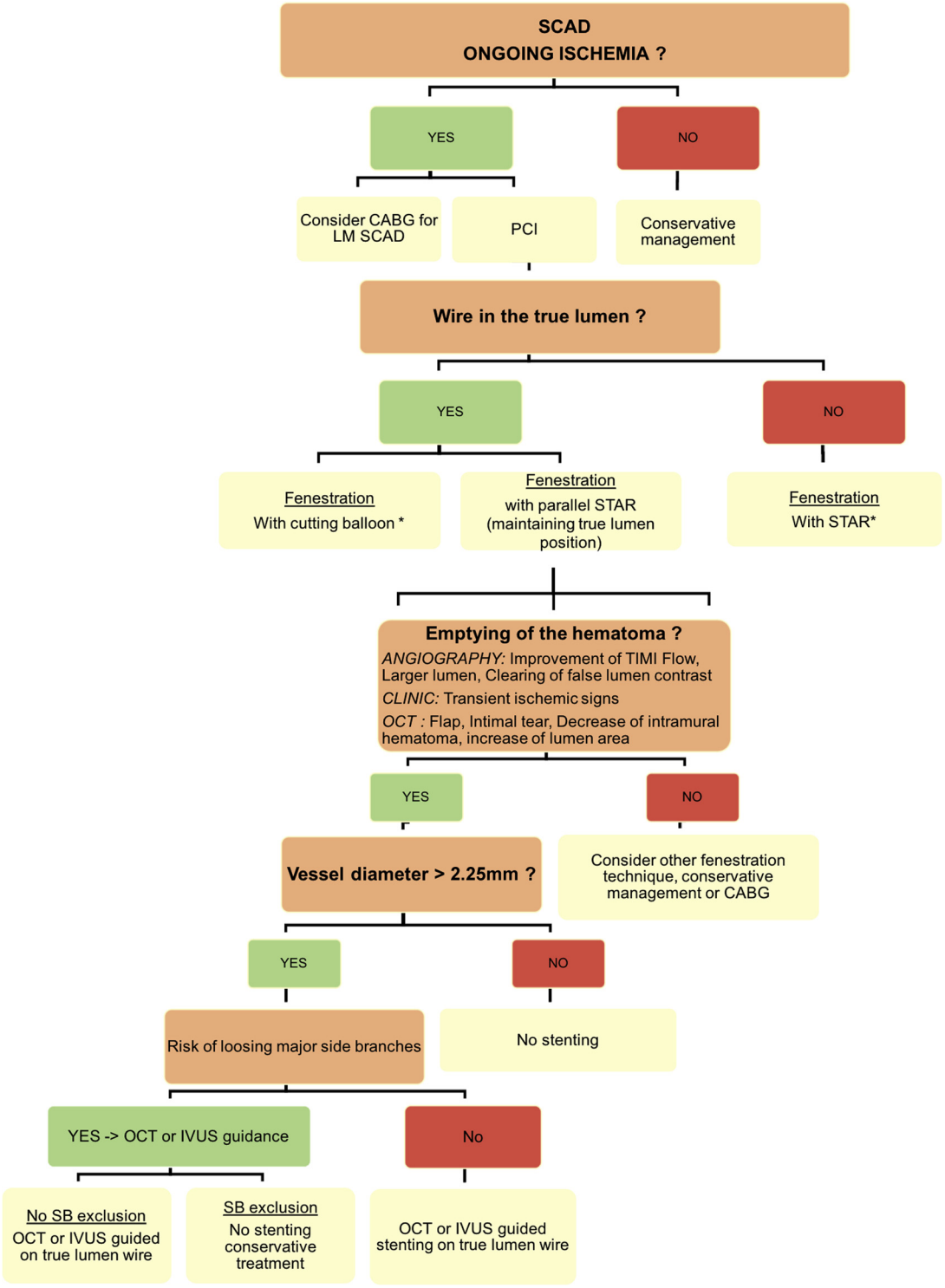
FIGURE 4 Proposed Algorithm for Management of SCAD



*In case of the presence of major side branches, a cutting balloon technique should be preferred over a STAR technique. IVUS = intravascular ultrasound; OCT = optical coherence tomography; PCI = percutaneous coronary intervention; SB = side branch; SCAD = spontaneous coronary artery dissection; STAR = subintimal tracking and re-entry.

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KEY WORDS acute coronary artery dissection, percutaneous coronary intervention, spontaneous coronary artery dissection