Achieving Optimal PCI Outcomes

Atherectomy via transradial access.

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The presence of severe calcification, a common feature in advanced coronary atherosclerotic disease, can be a formidable challenge during percutaneous treatment. Heavily calcified lesions can impede stent delivery and lead to suboptimal stent expansion and apposition, which can affect freedom from target lesion revascularization.[1] To confront these challenges, many operators invoke adjunctive treatment with mechanical atherectomy to achieve plaque modification when treating calcified coronary lesions. Historically, the femoral access route was the default for complex percutaneous coronary intervention (PCI). However, given the known increased risk of bleeding and patient discomfort from femoral access, radial-based intervention is an attractive and feasible alternative. In this article, we attempt to provide readers with an understanding of radial access as it pertains to mechanical atherectomy, the obstacles encountered with this approach, and strategies to overcome them.

Although there are multiple mechanical atherectomy devices available, we will focus on the two most commonly used devices used in coronary lesions in the United States: rotational atherectomy (Rotablator, Boston Scientific Corporation) and orbital atherectomy (Diamondback 360, Cardiovascular Systems, Inc.). Rotational atherectomy uses a diamond-encrusted elliptical burr rotating concentrically at speeds from 140,000 to 180,000 rpm using a helical drive shaft and is advanced over a guidewire. The guidewire should be positioned distal to the lesion, avoiding side branches, acute angulations, and narrow segments distally. Orbital atherectomy works on a slightly different physical principle, namely centrifugal rotational movement. The device is a diamond-coated eccentric crown, currently only available in a 1.25-mm crown size. Variation in effective cutting radius is seen when the device is spun at higher speeds, which range from 80,000 to 120,000 rpm.[2]

Although historical studies have shown that higher complication rates have been associated with mechanical atherectomy, more contemporary data suggest that mortality events are more closely linked to premorbid risk as opposed to the technique itself (given that many of these patients are elderly, have numerous comorbid conditions, and/or are often deemed too high risk for alternate revascularization).[3] Neither device has been shown to be superior to the other. It is important to note device compatibility when performing mechanical atherectomy with either device, and an understanding of this helps with procedural planning (Table 1).

TABLE 1. COMPATIBILITY WITH THE TWO MOST COMMON AND APPROVED CORONARY MECHANICAL ATHERECTOMY DEVICES*

Mechanical Atherectomy	Compatibility
Orbital Atherectomy†	
1.25-mm crown	6 F or greater
Rotational Atherectomy‡	
1.25-mm burr	6 F or greater
1.5-mm burr	6 F or greater

**These systems have been used off-label with 5-F guide catheters.*
†Diamondback 360, Cardiovascular Systems, Inc.
‡Rotablator, Boston Scientific Corporation.

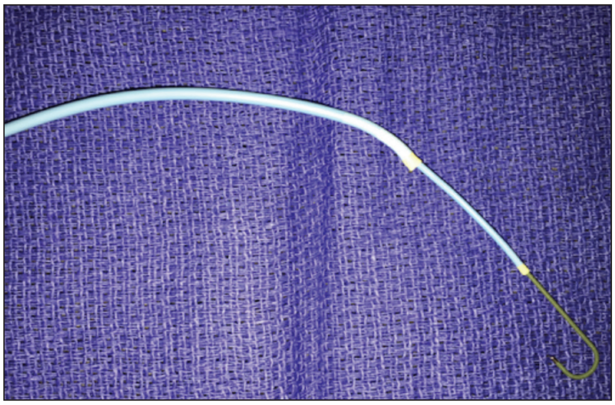

Figure 1. A 7-F JR 4 guide catheter with a 5-F multipurpose catheter over a 0.035-inch guidewire.

THE RADIAL ADVANTAGE

In contemporary clinical practice, the popularity of radial access as the default access choice has gained momentum.[4] Both registry data and randomized, controlled trials have demonstrated that radial access is not only safe, but also provides the added benefit of lower bleeding and vascular complications in comparison to femoral access in both elective PCI and acute coronary syndromes.[4-6] In addition to these benefits, the radial approach also confers superior patient satisfaction, earlier postprocedure ambulation, and reduced hospital costs.[5,7] Despite these proven advantages, many operators seem to avoid radial access when treating more complex lesions, especially when performing adjunctive therapy such as mechanical atherectomy.

Radial access requires a specialized set of skills, which can increase procedural complexity. Over time, with experience and through technological advances, early radial adopters can have improved procedural success. In fact, a trend toward equalization of the femoral approach and radial approach, in regards to procedural success rates, has been demonstrated in recent years.[5] In the case of mechanical atherectomy, similar progress has been made. The need for larger burr sizes and guide catheters is much lower with newer-generation equipment, thus making the radial approach a much more appealing option than before.

One retrospective study comparing radial access with femoral access choice during atherectomy (151 patients) demonstrated that the radial approach was safe, feasible, and had fewer total access site bleeding complications.[8] Although the efficacy of the radial approach for complex PCI involving mechanical atherectomy is clear, this technique is nuanced and requires a degree of operator experience and understanding.

RADIAL APPROACH FOR MECHANICAL ATHERECTOMY: TECHNICAL CONSIDERATIONS

It is important to consider the potential anatomic variations that can affect guide catheter manipulation and choice during PCI. If severe brachiocephalic and subclavian tortuosity is present the operator should consider utilizing left radial access, which more closely approximates the anatomy encountered when using femoral access. Difficult right-sided brachiocephalic and subclavian anatomy can be predicted by the presence of short stature (height < 5 ft 5 in) and age > 75 years.[9]

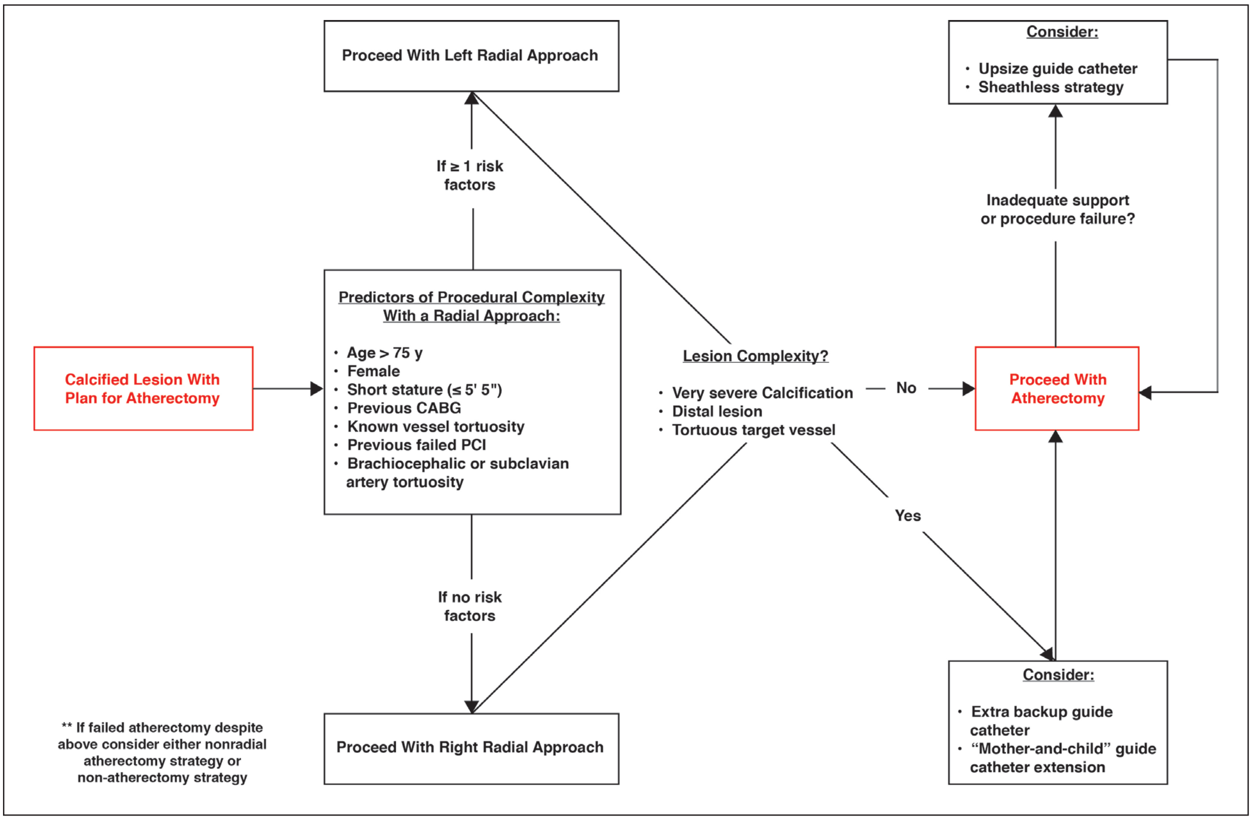

Figure 2. Proposed algorithm for mechanical atherectomy via the radial approach.

Once right versus left radial access has been determined, sheath size should be selected. Some expert operators suggest obtaining a selective radial arteriogram to gain an understanding of vessel size and diameter and to detect the presence of anatomic abnormalities, when possible. If vessel diameter is of considerable size (≥ 2 mm) and no radial abnormalities are seen, a 7-F system can be considered at the outset, thus providing more range in device options.

Generally, a 6-F system is the minimum recommended gauge for interventions requiring atherectomy. While the 1.25-mm rotational atherectomy burr and the orbital atherectomy systems can be accommodated by a 5-F system, one should consider the limitations in vessel visualization and catheter support inherent to this smaller caliber. Moreover, 5-F systems impose limitations on the ability to perform bifurcation interventions and impair the ability to use adjunctive support equipment (Table 1).

The use of a sheathless guide catheter approach is one way to increase catheter gauge while continuing to work from the radial approach. Traditional sheaths have an outer diameter as large as two French sizes greater than corresponding guide catheters, thus limiting larger-diameter equipment use via the radial approach (given the innate size of most radial arteries). A sheathless strategy can be useful when larger-diameter equipment is needed. Sheathless guide deployment is performed by using an insertion dilator within the guide and passing the catheter system over a guidewire into the radial artery. The dilator's role is to straighten the catheter tip and to eliminate the abrupt transition between the tip of guide catheter and the guidewire wire during advancement into the radial artery. Special-purpose sheathless guides are commercially available, which are generally manufactured with a hydrophilic coating to assist with catheter manipulation, as well as braiding for added support and resistance to kinking.

As a result of the sheathless approach, larger-diameter guide catheters can be used, which can accommodate larger atherectomy devices while avoiding the need for larger sheath sizes.[10] The sheathless approach can also be performed using regular 7-F guide catheters with a smaller multipurpose catheter used as the insertion dilator (Figure 1). If a sheathless guide catheter strategy is not an option, Slender Glidesheaths (Terumo Interventional Systems) are an option to consider. These offer a reduced outside diameter by one French size while the inner diameter is maintained, thus making these sheaths compatible with larger-diameter equipment and allowing for complex PCI.

TRANSRADIAL MECHANICAL ATHERECTOMY CHALLENGES AND SOLUTIONS

The lack of guide catheter support and tracking of interventional equipment during PCI is cited as one of the more the notable reasons for procedure failure during PCI via the radial approach.[11] Without adequate guide support, the use of adjunctive therapies (such as mechanical atherectomy) can be challenging. Much like during PCI via the femoral, appropriate guide selection can be an exercise in trial and error, but efficiencies tend to improve with operator experience.[5] Most radial operators employ the use of extra backup catheters for left-sided interventions; the most commonly used guide catheters include the EBU (Medtronic) and XB series (Cordis Corporation). There are a number of radial-specific guide catheters, such as the Tiger II (Terumo Interventional Systems), Kimny (Boston Scientific Corporation), Fajadet left (Cordis Corporation), and MUTA left guide catheter (Boston Scientific Corporation). Familiarity with these guide catheter options may also serve radial operators during complex PCI.[12] For treating lesions within the right coronary distribution, guide catheter choices from the radial approach are similar to options used for the femoral approach, where an Amplatz left (various vendors) guide can allow for coaxial engagement and cusp support.

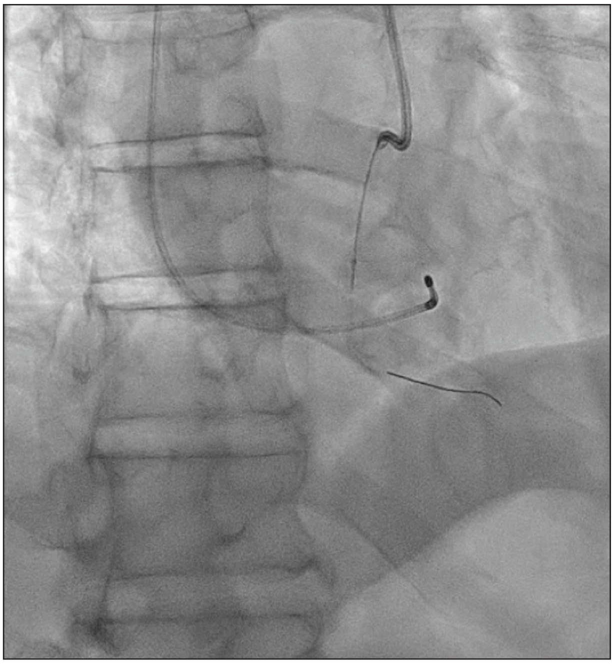

Figure 3. Orbital atherectomy of the right coronary artery using a 6-F Amplatz left 0.75 guide catheter via right radial access and a 5-F temporary venous pacing wire placed via right brachial vein access.

At times, inadequate coaxial engagement or lack of contralateral wall backup support can make interventions difficult. This can be overcome with deeper guide catheter intubation, which carries the risk of inadvertent vessel trauma. Use of a mother-and-child support catheter system, such as GuideLiner (Vascular Solutions, Inc.) or Guidezilla (Boston Scientific Corporation), can allow for safer deep vessel intubation. Interventional equipment, including atherectomy devices, can be advanced through the support catheter, thus providing an effective solution to support challenges during complex PCI (Figure 2).[13]

TEMPORARY VENOUS PACING

Temporary venous pacing continues to be recommended when performing atherectomy in the right coronary artery and dominant circumflex vessels. Traditionally, temporary venous leads are placed either via the femoral or jugular routes. An increased risk of arteriovenous fistula formation has been noted when combining femoral artery and venous access during PCI. Using the brachial vein for temporary pacing is an attractive alternative that allows for a "total arm" case. The brachial vein is easily accessed with a peripheral intravenous line prior to arrival in the catheterization lab, or it can be directly cannulated using sonographic guidance.[14] It is helpful to have the patient take a deep breath when advancing the pacing lead into the subclavian vein and onward to the superior vena cava (Figure 3).

CONCLUSION

As demonstrated in this article, mechanical atherectomy is a viable option via the radial approach and allows patients and operators to enjoy the benefits of transradial access while performing complex PCI. There are numerous effective and feasible strategies that can enable radial operators to overcome the perceived challenges of performing mechanical atherectomy via the radial approach. As our experience and understanding of performing more complex PCI via the radial approach continues to grow, we will continue to see progress in this space in the future. ■

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