# Guide Catheter Selection for Transradial PCI

Choosing the proper guide catheter size and shape can help ease the transition to radial adoption.

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The transradial approach (TRA) has gone through significant changes and improvements since it was first described by Dr. Campeau in the late 1980s. TRA has also been proven to be a very suitable method for performing coronary catheterization and percutaneous coronary intervention (PCI), as it provides a decrease in access site bleeding[1,2] and mortality.[3,4] Nonetheless, it is still underutilized in the cardiac interventional community because of some perceived drawbacks that make it unappealing to femorally trained operators.

The major drawback is centered around the learning curve for many interventionists. The higher incidence of anatomical variations seen in the upper limbs and the innominate-arch junction could render coronary angiography and PCI difficult and trickier to perform. Furthermore, the use of smaller-sized equipment (ie, sheaths, catheters) makes TRA unattractive because of a false perception that certain techniques are not feasible. However, these apparent drawbacks can easily be overcome by a trained TRA operator. It is the purpose of this article to review and discuss guiding catheter sizes and shapes to be used for transradial PCI.

## CHOOSING THE APPROPRIATE SIZE

Radial artery diameter is of a smaller caliber than the femoral artery (normal diameter of the radial artery lumen is 2.4 mm [range, 1.8–3 mm]), making tool selection and manipulation for TRA entirely different compared to the femoral approach. PCI cases have been previously described using guides as small as 4 F[5] and as big as 8 F.[6] However, the majority of TRA interventions performed today can be successfully accomplished with 5- or 6-F guiding catheters,[7] as all of our current stents can be delivered through these guides for the treatment of simple or even the most complex lesions (ie, bifurcation or chronic total occlusion). Furthermore, bulky equipment, such as rotational atherectomy or intravascular ultrasound, can be performed safely and adequately with these guides. Nonetheless, certain disadvantages can present with smaller-sized guides (Table 1) but usually do not hinder the ability to successfully perform coronary interventions.

## CHOOSING THE APPROPRIATE GUIDE

For optimal stent delivery, good guide support (also known as *backup support*) is necessary. Good guide support revolves around the ability of the guide catheter to remain in position and to provide appropriate stability for the advancement of interventional equipment. Two types of backup support exist: passive and active backup. Passive backup usually relies on the property of the shaft and tip to maintain position at the ostium. Support is provided by either the aortic root or valve or by the catheter shape.[8] These catheters usually require minimal manipulation and rarely deep-seats the coronary ostium. On the other hand, active backup catheters use the aortic root to accomplish a desired shape and to provide support, which requires a fair amount of active manipulation by the operator to obtain

| TABLE 1. DEVICES AND TECHNIQUES AVAILABLE FOR TRANSRADIAL PCI | | |
|---|---|---|
| **Catheter Size** | **Devices** | **Technique** |
| 5 F | • Balloon ≤ 5 mm<br>• Stent ≤ 4.5 mm<br>• Intravenous ultrasound (Eagle Eye catheter, Volcano Corporation, San Diego, CA; OptiCross coronary imaging catheter, Boston Scientific Corporation, Natick, MA)<br>• Cutting balloon 2.5 mm<br>• Rotablator 1.25 mm (Boston Scientific Corporation) | Two wires allowed for bifurcation but no kissing balloons (only for slender techniques in Japan[a]) |
| 6 F | • All balloon sizes<br>• All stent sizes<br>• Intravenous ultrasound (Eagle Eye and Revolution catheters, Volcano Corporation)<br>• Optical coherence tomography<br>• Cutting balloon > 2.5 mm<br>• Rotablator ≤ 1.5 mm<br>• Thrombectomy devices<br>• Saphenous vein graft protection devices<br>• Mother-child<br>• GuideLiner | Kissing balloon |
| 7 F[b] | Rotablator > 1.75 mm | Kissing stents |

[a]*Note, the "slender technique" is an approach used in Japan to minimize the diameter of guide catheters, guidewires, and puncture sites.*
[b]*An alternative to 7–8 F outside the United States is to use Asahi sheathless 6.5- or 7.5-F devices (Asahi Intecc USA, Inc., Santa Ana, CA).*

a stable position coaxially. With the transradial approach, active support of the guiding catheter plays a more important role than with the standard femoral approach.

Both active and passive backup support can be achieved with 6-F catheters. With 5-F guiding catheters, active support is required in a number of cases. Catheters ≥ 7 F will provide better passive support at the expense of minimal active support and the inability of deep coronary engagement. Conversely, 5-F catheters provide good active support and are able to be deep-seated into the coronary artery, therefore providing guide "extension" and accordingly provide better support and coaxial alignment during coronary interventions. Furthermore, long Brite Tip catheters (Cordis Corporation, Bridgewater, NJ), primarily those with longer and softer tips, can also be employed and provide greater safety during deep-seating maneuvers.

A "mother-child" hybrid system has also been proposed as a way to enhance the backup support of 6-F catheters and at the same time permit the use of smaller guide catheters to perform deep intubation maneuvers. Takahashi et al[9] first described the five-in-six system in which a 5-F, 120-cm-long guide catheter was inserted into a 6-F, 100-cm-long guide catheter. Subsequently, a four-in-six system was attempted[10]; this technique revealed superior trackability because of the 4-F child catheter and higher backup support, which ultimately resulted in a higher stenting success rate (> 90%) for lesions in which conventional techniques had been unsuccessful. Another option is the use of the GuideLiner device (Vascular Solutions, Inc., Minneapolis, MN), which also provides additional support with 6-F guiding catheters and is particularly helpful in complex PCIs, such as heavily calcified vessels and distal lesions, tortuous vessels, or chronic total occlusions.[11-13]

## THE TRANSRADIAL APPROACH

### Accessing the Ascending Aorta

In most cases, accessing the ascending aorta via the right or left radial artery is easily done and does not pose any major challenges. In certain cases, this important step could be hampered and is usually a result of an anatomic difficulty. From the left radial approach, the regular 0.035-inch J-wire could preferentially enter the descending aorta; however, this nuisance could be easily corrected with a deep inspiration, with or without a counterclockwise catheter rotation, to re-orient the wire. On the other hand, the right radial approach might provide more difficulty because of the higher incidence of right subclavian artery tortuosity and innominate arch junction distortion. Once again, a deep inspiration could partially help in the unfolding of the tortuosity. Other options include the use of a hydrophilic guidewire (HydroSteer, St. Jude Medical, Inc., St. Paul, MN), as it may slip itself more easily into the ascending aorta.

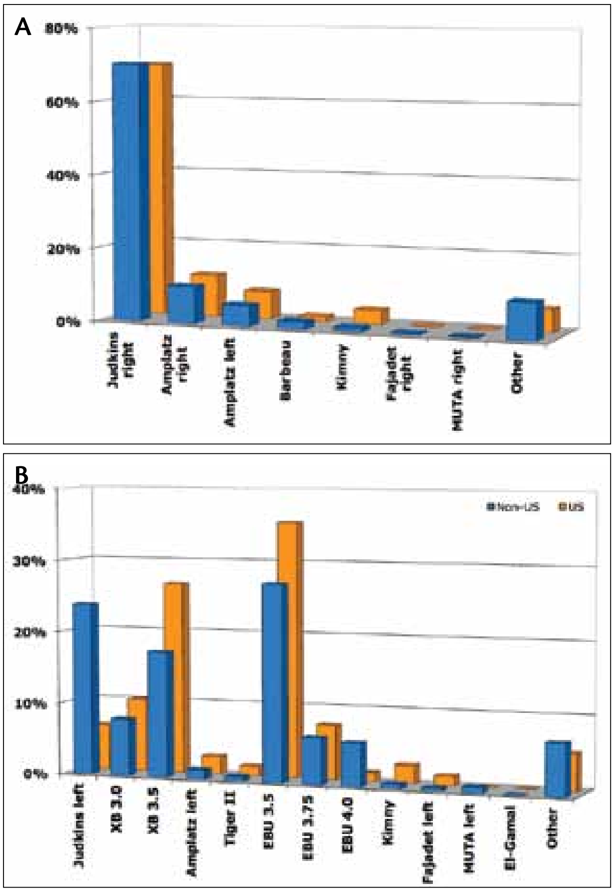


**Figure 1. A breakdown of the different PCI guiding catheters used with TRA. Right coronary artery (A). Left coronary artery (B).**

Guide catheter kinking while maneuvering into the coronary ostia may also occur. Deep inspiration or leaving the J-wire within the catheter to enhance torqueability is usually sufficient to correct this matter. This maneuver, albeit simple, is probably the single most critical one in TRA because it may help in both cannulating the coronary ostia and improving guide catheter support.

**Guide Selection for Different Clinical Situations**

Guide selection is important because the operator must select a guide that provides good backup support, coaxiality, and stability once the ostium of the artery is intubated. It should be emphasized that most curves designed for the femoral approach are perfectly suited for transradial PCI. In fact, an international survey among radialists revealed that for the left coronary system, extra backup (EBU, Medtronic, Inc., Minneapolis, MN; or XB, Cordis Corporation) guiding catheters were the most popular, and the JR 4 remained the standard shape for the right coronary artery. Furthermore, for left-sided vein grafts, radial operators prefer Amplatz-type guiding catheters and JR 4 or multipurpose guiding catheters for the right-sided vein grafts. It remains controversial whether left TRA better suits these catheters compared to the right radial approach. Overall, radial operators use the right radial approach in 90% of cases, except for post-CABG involving the left internal mammary artery (LIMA) (Figure 1).[14] In these cases, cannulation of the LIMA is much easier from the left side, although it remains possible to cannulate the LIMA from the right radial approach.[15]

***Left coronary system.*** PCI of the left coronary system is usually accomplished with extra-backup catheters (XB or EBU); however, catheter size is usually 0.5 F smaller than what would be used in femoral procedures (3 or 3.5 F vs 3.5 or 4 F, respectively). Engagement into the left main artery is also different from the femoral approach, as the guide is usually cannulated from below the ostium with a counterclockwise movement compared to the more direct and superior cannulation if the femoral route is selected. These catheters provide all of the active support backup from the contralateral aortic wall and offer appropriate deep-seating capability. The Amplatz left catheters (AL 1 or 2 F) provide great passive backup support and are usually the catheters of choice for complex coronary interventions (ie, calcified lesions, chronic total occlusion). Finally, the Judkins left catheters do not usually provide good backup support in TRA and therefore are less frequently utilized; however, they can be useful in the setting of ostial left main stenosis where guide support is not a major concern.

***Right coronary system.*** For noncomplex or ostial lesions, a Judkins right 4-F catheter is adequate for PCI. However, this guide catheter is usually inadequate in the setting of a complex procedure or in the presence of a dilated aortic root because we lose the contralateral aortic wall active support. Furthermore, when the right coronary artery (RCA) arises from an anterior or posterior position, coaxial position is limited, and PCI is usually cumbersome. An Amplatz right (1 or 2) or Amplatz left (0.75 or 1) would be a better selection and would provide better support. However, a judicious ostial approach is always recommended with these catheters to avoid traumatic dissections. It should be noted that the respiration of the patient might induce larger back-and-forth displacements of the guiding catheter seated at the ostium of the RCA, and thus, caution should be exercised during PCI, especially with Amplatz guiding catheters.

A range of radially dedicated guide catheters has been produced (Barbeau, Kimney, Fadajet), and they are effective for RCA PCI. The Barbeau is a modified multipurpose catheter with an additional 135° curve at the tip to assist in cannulation. Cannulation of the RCA is usually performed with a clockwise "corkscrew" maneuver while coming from above the ostium. In certain instances, an inferior approach is appropriate and is done by pushing down on the cath-

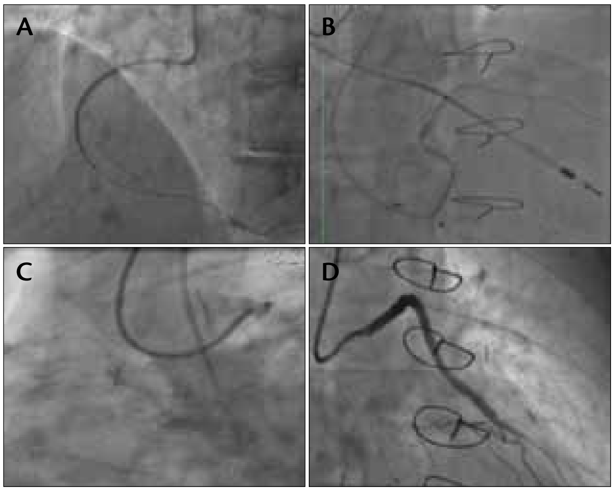


**Figure 2. Different guide catheter use in TRA. A 5-F Barbeau catheter with deep-seating of the vein graft to the RCA (A, B). Simultaneous bilateral ostia intubation during a chronic total occlusion procedure with the 6-F AL 1 from the left TRA into the RCA and a 6-F XB 3.5 from the right TRA into the left main artery (C). Use of the 6-F AL 2 catheter for a left vein graft PCI (D).**

eter, forcing the tip to bend up toward the RCA. The Barbeau also has excellent malleability and permits guide "Amplatzing" (ie, when you modify the form of a catheter into one that resembles an Amplatz catheter) and very deep coronary intubation (Figure 2).

The Kimney catheter has a 45° primary curve with a secondary curve of 90° that allows it to support itself on the contralateral aortic wall. It is common to cannulate the left coronary artery from below with this catheter while coming from a horizontal or superior position to cannulate the right. Both of these catheters provide good backup support and enable coronary intubation during PCI, especially in very tortuous arteries (ie, shepherd's hook RCA). It should be noted that these shapes designed by radial pioneers remain less frequently used than traditionally shaped guiding catheters. An exception to this statement is the left and right Ikari curve, specifically designed by Terumo Interventional Systems, Inc. (Somerset, NJ) for transradial PCI. Compared to Judkins-type guiding catheters, the Ikari curves provide more support.[8] Unfortunately, they have not yet been compared to EBU- or XB-type curves.

***LIMA grafts.*** LIMAs are best approached via left TRA with a modified or nonmodified mammary catheter. Conversely, cannulation of the right internal mammary arteries is usually attempted via the right TRA and is usually harder to achieve because the ostium takeoff is at 90° to the catheter plane. Reshaping of the mammary catheter tip in the subclavian or innominate artery, by bending and collapsing the tip on itself, might provide some aid. The other possibility is to use a percutaneous guidewire (ie, balanced middle-weight [BMW], Abbott Vascular, Santa Clara, CA) to cannulate the right internal mammary artery and, thereafter, track the catheter over it.

## CONCLUSION

The majority of PCIs can be performed using 6-F guiding catheters, and 5-F guiding catheters remain particularly attractive because catheter-radial artery mismatch increases the risks of postcatheterization radial artery occlusion. Although some dedicated radial shapes have been developed, most radial operators use standard-shaped guide catheters. Apart from operator preferences, further studies will be required to determine whether universal radial catheters may offer some benefits compared to standard shapes in terms of duration of procedures, radiation exposure, and contrast volume. ■

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1. Bertrand OF, Belisle P, Joyal D, et al. Comparison of transradial and femoral approaches for percutaneous coronary interventions: a systematic review and hierarchical Bayesian meta-analysis. Am Heart J. 2012;163:632-648.
2. Joyal D, Bertrand OF, Rinfret S, et al. Meta-analysis of ten trials on the effectiveness of the radial versus the femoral approach in primary percutaneous coronary intervention. Am J Cardiol. 2012;109:813-818.
3. Jolly SS, Yusuf S, Cairns J, et al. Radial versus femoral access for coronary angiography and intervention in patients with acute coronary syndromes (RIVAL): a randomised, parallel group, multicentre trial. Lancet. 2011;377:1409-1420.
4. Romagnoli E, Biondi-Zoccai G, Sciahbasi A, et al. Radial versus femoral randomized investigation in ST-segment elevation acute coronary syndrome: the RIFLE-STEACS (Radial Versus Femoral Randomized Investigation in ST-Elevation Acute Coronary Syndrome) study. J Am Coll Cardiol. 2012;60:2481-2489.
5. Takeshita S, Shiono T, Takagi A, et al. Percutaneous coronary intervention using a novel 4-French coronary accessor. Catheter Cardiovasc Interv. 2008;72:222-227.
6. Cheng CI, Wu CJ, Fang CY, et al. Feasibility and safety of transradial stenting for unprotected left main coronary artery stenoses. Circulation. 2007;71:855-861.
7. Metz D, Meyer P, Touati C, et al. Comparison of 6F with 7F and 8F guiding catheters for elective coronary angioplasty: results of a prospective, multicenter, randomized trial. Am Heart J. 1997;134:131-137.
8. Ikari Y, Nagaoka M, Kim JY, et al. The physics of guiding catheters for the left coronary artery in transfemoral and transradial interventions. J Invasive Cardiol. 2005;17:636-641.
9. Takahashi S, Saito S, Tanaka S, et al. New method to increase a backup support of a 6 French guiding coronary catheter. Catheter Cardiovasc Interv. 2004;63:452-456.
10. Takeshita S, Shishido K, Sugitatsu K, et al. In vitro and human studies of a 4F double-coaxial technique ("mother-child" configuration) to facilitate stent implantation in resistant coronary vessels. Circulation. 2011;4:155-161.
11. Serajian A. Novel use of a GuideLiner catheter to visualize distal LAD after LIMA anastomosis in selective coronary angiography. J Invas Cardiol. 2012;24:E30-31.
12. Moynagh A, Garot P, Lefevre T, Louvard Y. Angiographic success and successful stent delivery for complex lesions using the GuideLiner five-in-six system—a case report. Am Heart Hosp J. 2011;9:E44-47.
13. Farooq V, Mamas MA, Fath-Ordoubadi F, Fraser DG. The use of a guide catheter extension system as an aid during transradial percutaneous coronary intervention of coronary artery bypass grafts. Catheter Cardiovasc Interv. 2011;78:847-863.
14. Bertrand OF, Rao SV, Pancholy S, et al. Transradial approach for coronary angiography and interventions: results of the first international transradial practice survey. JACC: Cardiovasc Interv. 2010;3:1022-1031.
15. Patel T, Shah S, Patel T. Cannulating LIMA graft using right transradial approach: two simple and innovative techniques. Catheter Cardiovasc Interv. 2012;80:316-320.