

# The Dos and Don'ts of Guide Catheter Extensions

The practicalities of effective and safe application of guide catheter extensions in the cath lab.

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Contemporary percutaneous coronary intervention (PCI) involves the treatment of ever more complex lesion subsets. Current patients are older and have more comorbidities, prior coronary bypass surgery, lesion calcification, tortuosity, and chronic total occlusions (CTOs). Dealing with such lesions requires a high degree of guide catheter (GC) support to cross lesions, advance microcatheters and balloons, and deliver stents. Transradial PCI has now become the default PCI approach globally.<sup>1</sup> Current GCs were designed for use via the femoral approach. When using these guides transradially, they generally offer less support, and alternative methods of increasing GC support may be needed.<sup>2</sup> Among the options for increasing GC support is the use of a GC extension.

This article will focus on the numerous additional applications of GC extensions that have now evolved, including the bypass of calcification and tortuosity to deliver stents, contrast limitation via selective contrast

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injection, multiple applications in CTOs, engagement of aberrant-origin coronaries or bypass grafts, thrombus aspiration in ST-segment elevation myocardial infarction (STEMI), and PCI through transcatheter aortic replacement valves.<sup>3-5</sup>

## MATERIALS NEEDED

A GC extension is a monorail system. The guide extension portion is an average of 25-cm long; it is passed over the guidewire in a rapid exchange fashion and extends beyond the distal end of the GC. It is 1-F less thick than the GC and is designed to minimize trauma to the coronary artery. The proximal end of the extension is attached to a thin stainless-steel pushrod, which is used

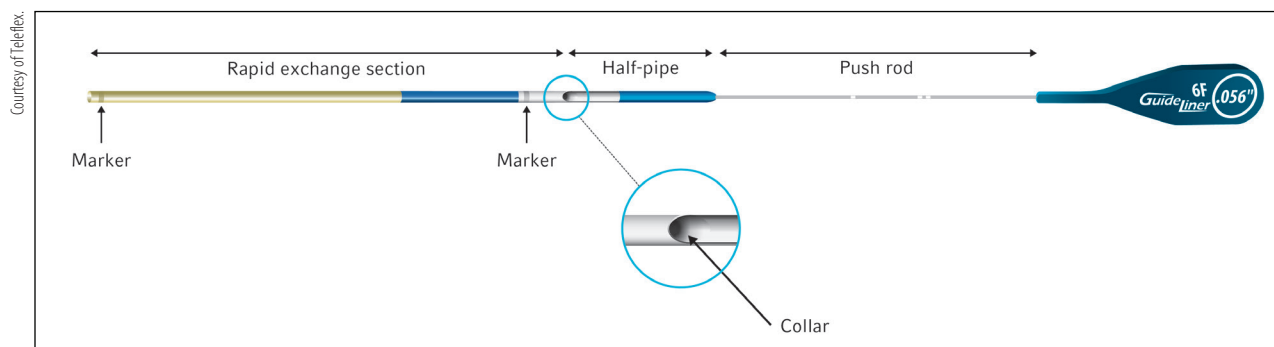


Figure 1. 6-F GuideLiner GC extension.

to push and pull the system independent of the GC and exits at the hemostatic valve. The pushrod transitions into the catheter extension as a half-pipe to orientate equipment appropriately. Commonly used systems—available in 5, 5.5, 6, 7, and 8 F—include the GuideLiner catheter (Teleflex; Figure 1), Guidezilla (Boston Scientific Corporation), Telescope (Medtronic), and Guidion (IMDS). The TrapLiner catheter (Teleflex) has a shorter, 13-cm rapid exchange catheter portion and a balloon on the pushrod that is used to trap the wire to facilitate removal and delivery of over-the-wire equipment.

To deliver a guide extension, there must be a GC and a wire in the artery. The GC extension monorail portion is passed over the wire and advanced into the hemostatic valve. The pushrod is used to pass the extension to the tip of the GC, avoiding crossing or twisting of the pushrod and the wire. Specific uses within the coronary artery are detailed below.

## APPLICATIONS OF GC EXTENSIONS

### To Increase Backup

The GC extension is advanced to the GC tip as described above (Figure 2). If the proximal coronary artery is large and there is no proximal stenosis or tortuosity, the GC extension can be advanced directly into the coronary artery. This may result in adequate backup enhancement (Figure 2).

Care needs to be taken to avoid pushing against resistance. If resistance is encountered, an uninflated balloon can be advanced ahead of the extension and the extension can then be advanced over the balloon, or an inflated balloon with half of the balloon beyond the extension tip (acting as a dilator) can help center the extension.<sup>6</sup> If needed, the balloon can be inflated just ahead of the GC extension, and the extension can be advanced over the balloon as it deflates. This keeps the extension away from the vessel wall, minimizing the risk of vessel trauma. If there is significant disease or a stenosis of the proximal

vessel, it is mandatory to use a deflating balloon ahead of the GC extension for each advancement. This can be performed in a stepwise fashion to gradually advance the extension bit by bit distally into the vessel (ie, the so-called “inchworm technique”).

### To Bypass Calcification and Tortuosity

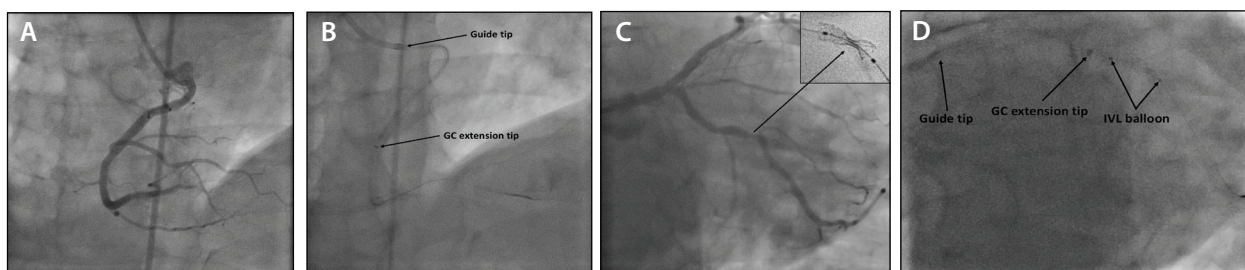
This application is similar. The main difference is that the GC extension is advanced beyond the stent landing zone. This requires good vessel and lesion preparation. The inchworm technique is used to advance the extension stepwise past the area of difficult stent passage. The stent is then unsheathed in position as the extension is pulled back before stent deployment. This may require a very distal placement of the GC extension. Care should be taken to avoid passing the proximal entry of the extension (the collar) beyond the GC tip, particularly with the TrapLiner, which has a shorter monorail.

### To Limit Contrast

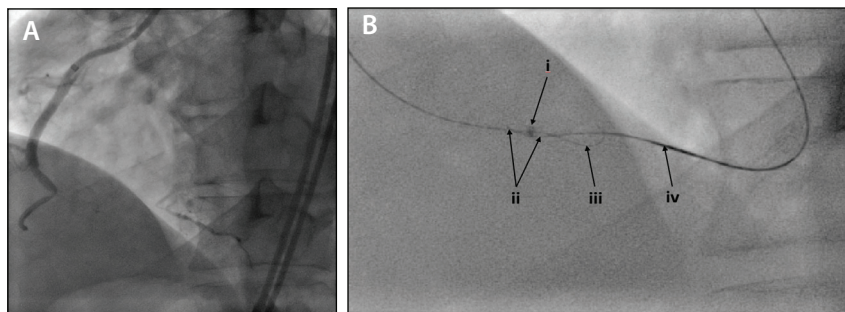
If there are contrast constraints, such as in renal compromise or heart failure, placing a GC extension beyond the origin of a major side branch limits the contrast needed to adequately image the target area. Reduced contrast flow and volume are needed to maintain safety.

### Use in CTO PCI

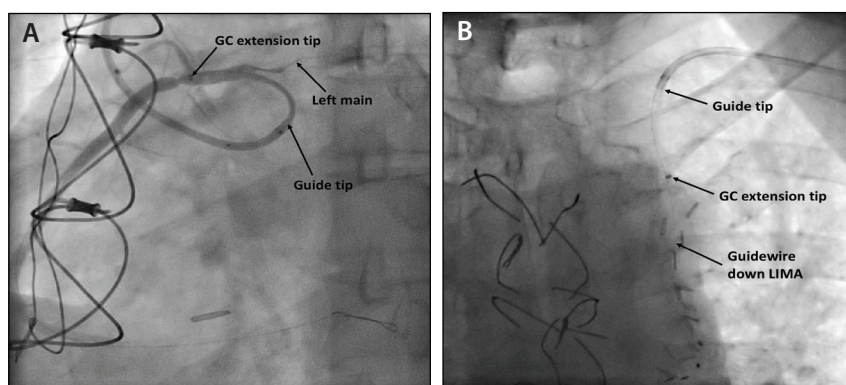
**Reverse CART CTO application.** Using a GC extension in the antegrade (occluded) vessel has a number of benefits. The extension is passed into the subintimal space in an antegrade fashion using the inchworm technique. It is essential to avoid antegrade injection at this time. The retrograde wire is then advanced into the extension, rather than requiring reentry into the GC (Figure 3). This allows antegrade balloon inflation to be performed just ahead of the extension, thus minimizing the length of subintimal space to traverse with the retrograde wire. It also allows for a standard-length retrograde GC by shortening



**Figure 2.** The low anterior origin right coronary artery (RCA) resulted in poor guide support, but deep GC extension intubation into the RCA provided enough support to cross the occluded posterior descending artery (A, B). An unexpanded stent in the second obtuse marginal branch (C). Deep intubation of a GC extension just proximal to the stent allowed delivery of an intravascular lithotripsy (IVL) balloon (D).



**Figure 3.** CTO in the distal RCA (A). A GC extension in reverse CART CTO (B): GC extension in the subintimal space within the occluded segment (i), the retrograde guidewire in the subintimal space advanced into the GC extension (ii), the antegrade guidewire in the subintimal space (iii), and the retrograde microcatheter (iv).



**Figure 4.** Use of a GC extension to engage an anomalous RCA originating adjacent to the LCA (A). GC extension is used to engage a left internal mammary artery graft via the left radial artery (B). LIMA, left internal mammary artery.

the total distance for the retrograde microcatheter.<sup>4</sup> Additionally, this avoids the risk of extending the dissection into the aorta or dissecting past and occluding a major side branch, especially if the CTO is in the left coronary artery (LCA).

**Antegrade dissection reentry application.** Antegrade dissection reentry techniques require low pressure in the artery to avoid a subintimal hematoma. Using a GC extension facilitates backup but also keeps pressure low and enhances the chance of successful reentry. The TrapLiner is ideal for this because it allows exchange of the required over-the-wire equipment.

#### To Engage Aberrant-Origin Coronary Arteries or Bypass Grafts

Sometimes an aberrant-origin coronary or graft cannot be engaged with any GC, but it can be accessed with a coronary wire delivered through a diagnostic catheter or via a GC that gets close to the ostium (Figure 4). If the wire is delivered through a diagnostic catheter, the wire

should be a supportive 300-cm wire that is kept distal in the coronary and used to exchange for a GC placed in the aorta. A GC extension is advanced to the tip of the GC. An appropriately sized balloon is passed carefully and slowly into the artery and inflated. This balloon is used as an anchor to allow delivery of the GC extension into the target vessel, and the case can then be completed.

#### For Thrombus Aspiration in STEMI

In the case of failed thrombus aspiration, a GC extension can be advanced to the thrombus to facilitate more effective aspiration.

#### Use in the Presence of a Previous Transcatheter Valve

Transcatheter aortic valves may result in difficulty accessing coronary arteries at a later date. It may be necessary to cross the valve cage with a guiding catheter, which may not always be possible or could create a scenario of inadequate backup. If a wire can be delivered to the coronary

through the valve cage, it may then be possible to pass a GC extension through the valve to create direct coronary engagement. Balloon assistance may be required.

## PITFALLS/COMPLICATIONS

### Coronary Dissection

When an extension is in place, some degree of pressure damping or wedging is expected. Forceful injection may induce and propagate a hydraulic dissection. If using an automatic contrast injector, the flow rate and volume should be set to the minimum that is required for adequate imaging. Similar adjustment of manual injection is required. A wire should always be in place when using an extension to enable treatment, should dissection occur.

Guide extensions have an atraumatic tip. However, dissection can occur during advancement. Balloon-assisted delivery of the extension, as described previously, is advisable if there is any impediment to advancement.

## Wire and Pushrod Twist; Difficulty in Stent Advancement

It is important to maintain separation of the pushrod and the guidewire. Crossing the two can result in inability of devices, particularly stents, to pass the collar into the monorail section of the extension. This should be considered if there is a sudden resistance to stent advancement. Applying force can damage the stent. The solution may be to remove the extension completely and readvance it from scratch. Stent damage can also occur if stents are too bulky for the system. Large stents  $\geq 4$  mm and covered stents might not pass through smaller GC extensions.

## Rewiring

Placing a second wire through an extension can be challenging. This is particularly problematic when the extension is smaller than the GC (eg a 6-F extension in a 7-F GC). The wire needs to enter the proximal collar (opening) of the monorail portion. This may result in a twist of the wire and pushrod or wire passage between the outside of the extension and the GC. It is important to keep the collar (which usually has a marker) in view inside the GC to ensure that the wire enters the correct space.

## Ischemia

Poor flow as a result of obstruction caused by the deeply intubated extension may cause vessel ischemia. Crossing major side branches can limit side branch flow and create ischemia, particularly in the LCA when crossing the left anterior descending artery or circumflex ostium. This can limit the duration for which the extension can be kept in place.

## Air Embolism

Because of pressure damping, there may be insufficient backflow for adequately venting the catheter with an extension in place. Patience is required to ensure complete de-airing of the system to avoid air embolization.

## CONCLUSION

GC extensions have enabled many complex PCI procedures to be completed successfully and safely, allowing stents to be delivered through difficult anatomy with

lower risk of stent loss and enabling CTO procedures. With appropriate attention to detail, GC extensions are a safe and essential tool for widening the horizon of coronary anatomies that can be successfully managed by PCI. ■

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