

Distal ‘buddy-in-jail’ technique: a complementary ‘Jail with stent’ method for stent delivery

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Delivery of coronary stents can be challenging, but the use of a second or ‘buddy’ wire helps the progression of equipment through tortuous and rigid vessels. We successfully positioned a coronary stent in a distal lesion, intentionally jailing the buddy wire during stent delivery. The jailed wire was then used to proceed further with proximal coronary stenting. We report 10 cases using either the jailed or the non-jailed wire for this modified ‘buddy-in-jail’ technique.

Keywords: Coronary artery disease, angioplasty, stents, guidewire, buddy wiring

Introduction

During percutaneous coronary intervention, ‘buddy wiring’ is an inexpensive and routinely used technique, helping the progression of balloons and stents through tortuous coronary vessels (1): a second or ‘buddy’ wire is placed parallel to the wire, which is used to guide catheter-balloons and stents. Usual practice involves removing the buddy wire as soon as a stent is positioned in the target lesion, thus before stent delivery. Published in 2007 by Kaluski et al. (2), the method of intentionally ‘burying’ or ‘jailing’ a buddy wire by stenting a proximal lesion was again described by Bagnall and Spratt in 2009 (3). The ‘buddy in jail’ wire secures the guiding catheter and provides a better support. It subsequently makes treatment of distal lesions easier, as the balloon(s) and stent(s) being advanced over the non-buddy, non-jailed wire.

In a first difficult case, involving a calcified and tortuous large right coronary artery (RCA) with a stenosis on both proximal and mid segments, the buddy wire technique allowed us to reach the more distal lesion with a 4–15 mm stent through a 5F left transradial access. Given the subsequent need for a longer stent at the proximal level and given the extreme difficulties we encountered during the first stent positioning within the more distal lesion, we decided to leave the buddy wire and to jail it during the stent deployment. The newly jailed wire was then loaded with a second stent (4–18 mm), leaving the other wire free and, therefore, in the ‘buddy position’. The stent advancement was easier and was facilitated by the presence of a ‘buddy’ wire (better traction)

and the support and stability provided by the distally jailed wire. Before delivery of this proximal stent, the second and still free (‘buddy’) wire was removed.

Given the ease of the process and its successful outcome, we decided to re-use the same distal ‘stent jail (or trap)’ technique. Between September 2011 and September 2012 amongst 180 consecutive PCIs, the technique was successfully applied to 10 male patients with challenging anatomies due to multifocal, complex, atherosclerotic lesions involving one coronary artery. For cases 7, 9 and 10, after distal stent deployment resulted in jailing the buddy wire, the second stent was advanced over the non-jailed wire. For these cases, we had to position the second stent in direct continuity with the distal one. However the stent-balloon-catheter tip would have been stopped at the entry of the deployed stent if loaded over the jailed wire. Therefore, the desired direct apposition would not have been possible because of a gap the size of the balloon-catheter nose. Table I summarizes the main clinical and procedural characteristics of the 10 cases. Standard guidewires were used. Size 5 or 6F guiding catheters (RRAD, EBU Launcher® and special order 5F VDL Sherpa® from Medtronic, 6F Voda RunWay® from Boston Scientific, 6F VDR heartrail II™ from Terumo as special order) allowed successful stenting in all cases by a transradial access (left for 3 cases). Usually, all our cases would have been classified as difficult and challenging due to combination of calcifications, bends, tortuosities, as well as the length and severity of the diseased segments. 7 cases were *ad hoc* PCIs and 3 were elective procedures. Mean age was 69 (min 39, max 85), mean BMI was 28 ± 4 , mean fluoroscopy time was 12 min 24 s (± 7 min 45 s) and mean volume of contrast was 214 ml (± 74). 6 right coronary arteries, 1 Circumflex and 3 left coronary arteries were treated. Hospital stays were uneventful after all PCIs. Case 6 depicts the use of the jailed wire for the second stenting. Figure 1 depicts the distal ‘buddy-in-jail’ technique using either the jailed or the non-jailed wire.

Case report: Case no. 6 (Figure 2)

A 60-year-old male, heavy smoker and hypercholesterolemic was admitted for NSTEMI. Performed by 5F right transradial access, the coronary angiogram showed severe multifocal

Table I. Clinical and procedural characteristics.

Case	1	2	3	4	5	6	7	8	9	10
Age (years)	80	64	85	69	81	60	70	82	66	39
Clinical picture	Severe angina	Unstable angina	Unstable Angina	Recurrent angina	Chronic angina	NSTEMI	NSTEMI	Recurrent angina	Dyspnea	Recurrent angina
Co- morbidity	Severe aortic stenosis, PVD	(-)	LIMA graft to CX art.	CABG surgery, on dialysis	COPD CRF	(-)	Severe COPD	85% OM2	COPD, 100% RCA	Smoker hyperlipemia
Diabetes	Y			Y						
Vascular access	Left TRA	R TRA	Left TRA	R TRA	R TRA	R TRA	R TRA	R TRA	R TRA	Left TRA
Target vessel	RCA	RCA	LAD art.	RCA	RCA	RCA	LAD art.	LAD art.	CX art.	RCA
Target lesions (% stenosis)	50% prox 85% mid	70% prox to mid, 90% mid	70% prox to mid, 85% mid, 70% x 2 distal	75% prox 70% mid	70% prox to mid, 70 + 85% mid to distal, 85% PDa	60% prox to mid, 90% distal	90% mid to distal	60, 90 and 75% distal LAD art, 90% apical	70% mid Cx 90% distal Cx (OM3)	60% mid, 75% mid to distal
Calcified Vx	+++	+++	+++	++	++	++	+++	++	++	+
Tortuosity	+++	++	+	±	+	++	+++	+	+	++
Guiding catheter	5F 'VDL' Sherpa NX	6F 'VDR' Heartrail II	5F EBU Launcher	5F RRAD Launcher	5F RRAD Launcher	5F RRAD Launcher	6F VODA RunWay	5F EBU Launcher	5F VDL 14 Sherpa NX	5F VDL 12 Sherpa NX
Guidewire	Pilot 50®	Pilot 50®	Asahi Sion	Asahi Sion	Asahi Sion	Asahi Sion	Asahi Sion	Pilot 50®	Asahi Sion	Asahi Sion
Buddy wire	Choice Floppy	Pilot 150®	BMW®	Asahi Sion	Asahi Sion	BMW®	Asahi Sion	Asahi Sion	BMW®	BMW®
Balloon's sizes pre-stenting	2-15 3.5-15	2-10, 2.5-20 3.5-20 4-20	2.5-15	2.5-20	2-15	2-10 2.75-10 3-10	2-10 2.5-12 2.5-08	1.2-08 2-12	1.5-10 2.5-15	2.5-10
Distal stent type/size	BMS 4-15	BMS 4-15	BMS 3-13	DES 2.75-24	DES 2.25-15	DES 2.75-09	BMS 2.5-09	DES 2-08	BMS 3-09	DES 3.5-30
Prox stent type/size	BMS 4-18	BMS 4.5-15	BMS 3-26	DES 3-18	DES 3-28 BMS 3.5-13	BMS 3-18	BMS 2.5-13 BMS 3-13	DES 2.5-12 2.5-16	BMS 3-20	BMS 4-13
Elective vs. <i>ad hoc</i> PCI	Elective	Elective	<i>Ad hoc</i>	Elective	<i>Ad hoc</i>	<i>Ad hoc</i>	<i>Ad hoc</i>	<i>Ad hoc</i>	<i>Ad hoc</i>	<i>Ad hoc</i>
Fluoroscopy time (min)	20 min	19 min 10 s	16 min 18 s	6 min 30 s	20 min 11 s	14 min 12 s	35 min	18 min 24 s	12 min 18 s	19 min 15 s
Contrast volume (ml)	109	141	200	146	253	247	321	335	188	192

PVD, peripheral vascular disease; CRF, chronic renal failure; TRA, transradial access; BMS, bare metal stent; DES, drug-eluting stent; PCI, percutaneous coronary intervention; 'VDL' and 'VDR' are special order shaped guiding catheters.

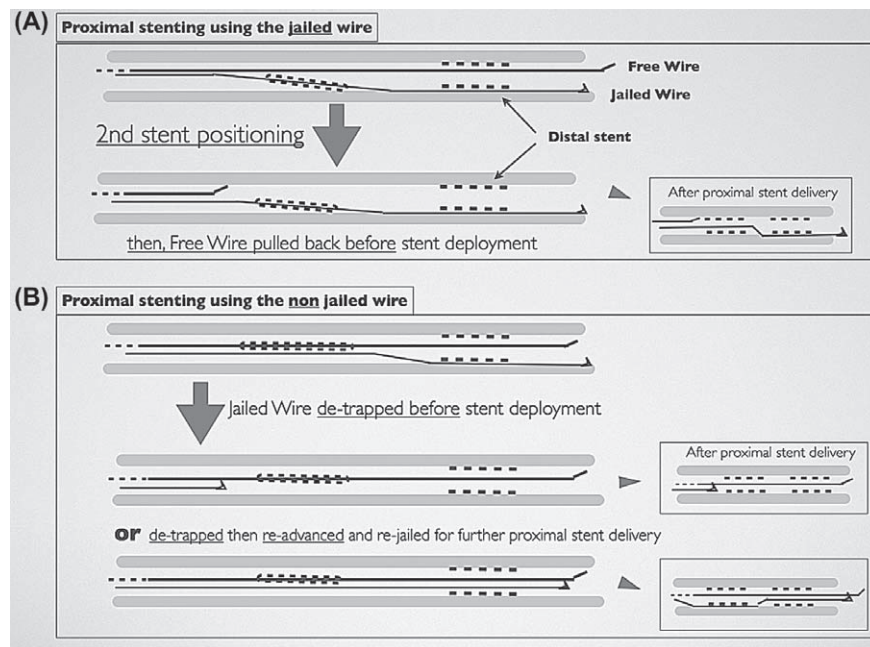


Figure 1. Diagram of the 'stent jail' technique: A. Proximal stenting using the jailed wire. B. Proximal stenting using the non-jailed wire.

RCA disease, with a highly calcified and tortuous vessel. The mid to distal segment was the most severely diseased. *Ad hoc* PCI was decided, starting with a 5F RRAD Launcher from Medtronic as guiding catheter. Buddy wiring was planned from the beginning with one SION (Asahi) as main wire and one Balance Middle Weight® (BMW) (Abbott Vascular) as

the buddy wire. Starting from the distal lesion, we then proceeded with balloon debulking: 2–10, 2.75–10 and finally 3–10 balloons (Sapphire II, OrbusNeich™) were successfully advanced and inflated through all lesions. Despite this debulking and the presence of the BMW buddy wire, a bare metal stent (BMS) 3–13 (Azule™SDS, OrbusNeich™) failed to reach

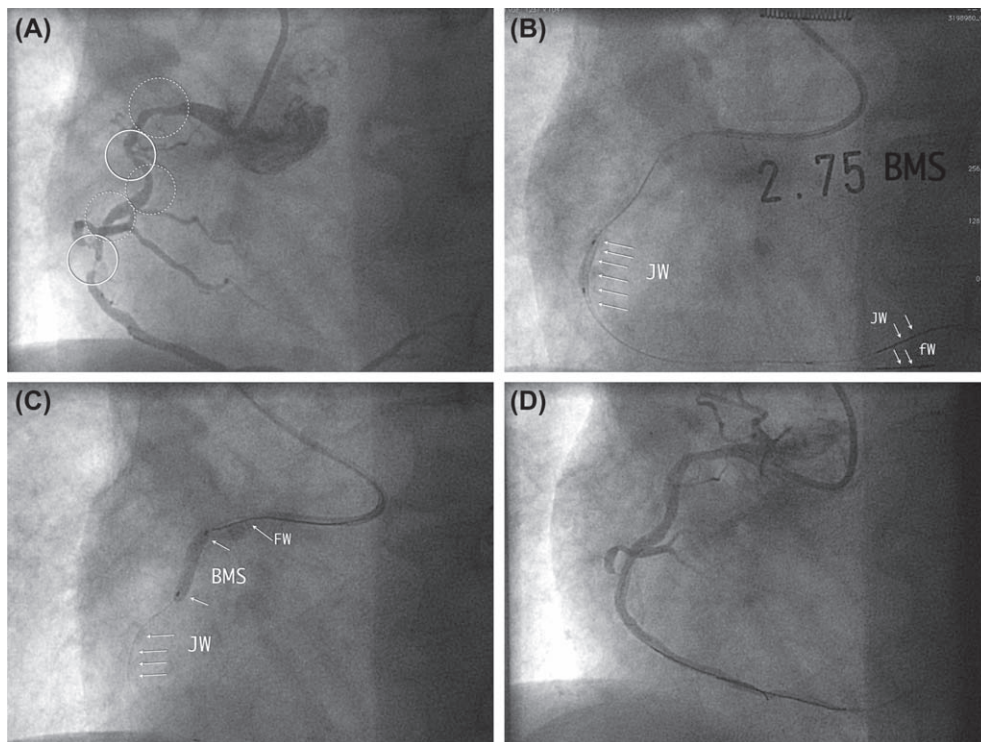


Figure 2. A. LAO view: severe multifocal right coronary artery disease, the artery being very calcified and tortuous. The distal lesion was the most severe. B. Jailing the buddy wire during distal stenting. Note the actual shape of the 5F guide catheter in a 'power position'. C. More proximal stent positioning over the jailed wire (JW), the free wire has been pulled back (FW). D. Final result.

the target distal lesion: the stent was unable to cross the bend at the level of the residual mid RCA lesion. We then changed to a shorter and smaller BMS (2.75–09 PRO-kinetic Energy®, Biotronik), which fortunately reached the distal lesion. It was deployed at 18 atmospheres, jailing the BMW wire. This BMW wire, now in a jailed position, was used subsequently to load the same 3–13 Azule™ stent which had previously failed. We left the Sion wire as the buddy wire. The stent was successfully pushed forward and positioned at the mid RCA lesion. Before delivery, the Sion wire was removed. Before un-jailing the BMW wire, we further expanded the Azule stent with a non-compliant balloon. The final angiographic result was good.

Discussion

Stenting of severely and diffusely diseased coronary arteries can be technically challenging, particularly in cases of vessels with acute bending, tortuosities, or rigid segments due to calcified atherosclerotic plaques or due to previously stented segments. Reaching lesions with such rigid material as metallic coronary stents can be difficult (4). Likewise, large coronary arteries may require very large stents: this extra stiff piece of angioplasty material does not accommodate to bends found in front of a target lesion.

Optimization of angioplasty materials (guiding catheter, coronary guide-wire, balloon-catheter and coronary stent) and certain techniques (5) may help. Table II summarizes some available solutions for addressing difficult anatomies during PCI.

Amongst them, the buddy wire technique (1) is often applied: it uses a second wire forwarded into the distal bed of the target vessel alongside the main one. This 'buddy' wire acts as a track and helps the progression of the balloon or the stent towards the target lesion. The technique usually involves removal of the buddy wire as soon as the un-deployed stent is positioned in the target lesion.

Since September 2011, we have successfully used a modified 'buddy-in jail' technique (2,3) for difficult

coronary anatomies: the previously described method intentionally jails a buddy wire during the deployment of a proximal stent. The loaded wire for this proximal stenting remains free and is then used for treatment of more distal lesion(s). Rather than jailing the buddy wire in a proximal lesion, we jailed the wire during stenting of the most distant stenosis to be treated. This modified method provides two advantages. The first one is that the most distant lesion is treated and stented first, as is commonly recommended. Indeed, most operators feel uncomfortable stenting proximally at first. Being successful in stenting proximal lesion(s) does not warrant success for the distal disease. Second, this modified technique provides the benefit of two usable wires for further proximal stent delivery: both wires, either the trapped wire (when no direct apposition is required) or the free wire, may be used for further proximal ballooning or stenting (Figure 1). Of course, with the proximal 'buddy-in-jail' method initially described, only the wire used for the delivery of the proximal stent may be further used for treatment of the remaining distal lesions. The jailed buddy wire is indeed 'buried' proximally and out for further catheter-balloon loading. In both cases, the presence of a jailed wire secures the guiding catheter and gives the extra support or the guiding catheter stability required for easier distal stenting.

In circumstances requiring the buddy wiring technique and particularly when equipment advancement is difficult, it should be wise to consider our modified buddy-in jail technique rather than the classic technique. Our method consisting of distally jailing the buddy wire described herein should find its best indication in circumstances of a tortuous diseased vessel at its proximal and or mid segment combined with a discrete distal lesion: a short stent may be expected to reach the distal lesion, thanks to the buddy wire. The use of the jailed wire will subsequently facilitate proximal stenting, particularly when large and/or long stents must be delivered. The proposed method (Table III) has some limitations.

Table II. Solutions for difficult PCI.

	Solutions	Potential hazard
Guiding catheter	Larger size Extra support shape Deep seating Mother-and-child technique (Dedicated Child: GuideLiner®)	Coronary artery injury (ostium/ proximal/mid vessel) Air embolism (mother and child) Vascular access injury/bleeding with larger GC
Guidewire	Optimized material: hydrophilic, stiffer, extra support, Wiggle Wire™ Anchor wiring Buddy wiring	Coronary artery perforation Coronary artery spasm Trapped wire
Balloons	Optimized material (profile, push, flex, coating)	
Stents	Optimized material (profile, push, flex, coating)	
Guidewire + balloon	Anchor ballooning (branch or target vessel)	Coronary artery injury
Guidewire + stent	'Buddy-in-jail' (proximal jailing) Proposed 'jail and stent' technique: (distal jailing)	Coronary artery injury (ostium, proximal vessel) Trapped wire
Misc.	Deep inspiration	

Table III. Proximal versus distal buddy-in-jail techniques.

Multi lesions/multi-diseased segments	Proximal 'buddy-in-jail'	Distal 'buddy-in-jail'
Best indications	Unstable guiding catheter and proximal + distal lesion(s) Emergency: Need to fix quickly a proximal lesion (unstable patient)	Very distal discrete stenosis and more proximal long lesion(s) on a large and tortuous vessel Emergency: Ongoing PCI using small sized GC ($\leq 5F$) and anatomy more difficult than anticipated
Caution	1. Delivered proximal stent will be in the path to the distal lesion(s) 2. Unsure about success for the treatment of distal lesion(s)	1. Avoid trapping a wire twice or trapping each of the two wires 2. Control the GC tip during un-jailing
Avoid if	Distal lesion not reached/crossed	1. Unable to debulk a calcified distal lesion adequately 2. Proximal lesions easy to reach/cross

First, it requires a preliminary successful distal stenting. After delivery of a stent at the most distant lesion, often—but not always—the difficult part of the case is over and done with. Nevertheless, the disease may significantly impact several consecutive segments and each stenosis alone presents difficulties. A more 'proximal' stenosis may be located in a quite distal coronary segment as illustrated by case 5: a wire was jailed during the right posterior descending artery stenting, allowing the placement of a longer and larger stent at the mid to distal RCA segment. Moreover, treating more proximal coronary artery stenosis implies delivery of larger and thus stiffer materials. Case 6 illustrates the extra support obtained when using the jailed wire: a stent—which initially failed to cross a proximal stenosis encountered before a distal lesion despite the use of a buddy wire—was thereafter easily placed across the same lesion once loaded over a jailed wire.

Our procedures would also have been successful using standard techniques but this distal 'stent jail' technique made the proximal stenting particularly easy, rapid and uneventful for all our 10 reported cases. Furthermore, the strategy of jailing a wire after crossing proximal and distal lesions with a small short stent might provide the extra back-up allowing subsequent easy passage of larger and longer devices, otherwise impossible. This could be a real advantage in challenging anatomies, reducing the procedure time and the risk of ending up with multiple overlapping stents.

Second, concerns about potential difficulties in pulling back the distally jailed wire called for the implementation of two rules. The first is related to the distal lesion, particularly if it is calcified: the danger of unravelling a wire or not being able to remove a wire trapped between a stent and calcium makes imperative a good lesion debulking with adequately sized balloon(s) prior to stenting. The second one concerns the wires: we must carefully avoid having both wires jailed or jailing the same wire with two consecutive stents. As soon as the proximal stent is well positioned and before its release, the wire that is not loaded with the stent has to be pulled back (see Figure 1). Accordingly to the technique, we always remove only one trapped wire and a jailed wire is never

buried by two consecutive stents (Figure 1b). This process must be as easy as the pull back of the wire trapped and bent in a coronary bifurcation as commonly seen in the provisional stenting technique.

Concern about possible peeling of the hydrophilic coating during the pull-back favors using non-coated wires. From a practical point of view and in order to avoid mistakes, we also recommend to 'mark' either the buddy or the free wire on the working field (or to use wires of different colors).

Caution is also required when using the distally jailed wire for proximal stenting: the tip of the stent-balloon-catheter will be stopped at the level of the wire entrapment, leaving a gap at least equivalent in length to the size of the nose of the stent-balloon-catheter. Direct apposition is thus impossible.

Finally, the technique could possibly be limited to small sized catheters with soft tips. We performed the technique with 5F and 6F ($\times 2$) guide catheters. In some cases, the removal of the jailed wire pushed the tip of the guiding catheter forward. Even if it is well aligned with the presence of two wires, this forward move may induce vessel damage and even dissection at the coronary artery ostium and must be controlled. One possible way to minimize such a hazard is to un-jail the trapped wire with the last inflated balloon still positioned at the coronary ostium. Removing the jailed wire before expansion of the second stent may also result in a forward motion of the stent. Thus, after freeing the wire and before deploying the stent, its correct position must be checked.

Conclusion

When addressing multifocal severe atherosclerotic disease of one major coronary artery, we propose to use the technique of intentionally jailing a buddy wire when deploying a distally positioned stent, subsequently using either the jailed wire or the free wire for further proximal stenting. The jailed wire will be used for maximal support and only if the second stent does not need to be in close apposition with the distal one. When properly used, these 'stent jail' techniques have the potential to improve PCI safety through facilitated coronary stent delivery.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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