

Summary of Bifurcation Stenting Strategies and Outcomes in Women

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Abstract

Several studies have examined the efficacy of drug-eluting stents in acute and chronic coronary syndromes and demonstrated benefit in both men and women. However, the effect of gender on percutaneous coronary intervention (PCI) outcomes in more complex disease including bifurcation disease is less well-known. In particular, a two-stent or provisional strategy, for both left Main and non-Left Main bifurcation lesions, has been variable across the different studies. In addition, there is a notable geographic preference whereby a stepwise provisional strategy with culotte as a bailout technique is preferred in Europe while in Asia there is a predilection to DK Crush for a 2-stent strategy. Many of these trials, however, are underpowered to conduct subgroup analysis for outcomes in women. To date, the evidence suggests women have better outcomes with coronary artery bypass grafting in complex disease. The higher events in women undergoing PCI are largely driven by bleeding. Studies dedicated to evaluating outcomes after complex revascularization in women are desperately needed with long-term follow-up. This review examines the current landmark trials as they pertain to outcomes in women.

Keywords

- ▶ bifurcations
- ▶ percutaneous coronary intervention
- ▶ outcomes
- ▶ women
- ▶ sex

Introduction

Several studies have examined the efficacy of drug-eluting stents (DES) in acute and chronic coronary syndromes and demonstrated benefit in both men and women.^{1–4} However, the effect of gender on percutaneous coronary intervention (PCI) outcomes in more complex disease is less well-known. The Women in Innovations-Drug Eluting Stent collaborative provided data on the safety and efficacy of DES for the

treatment of complex lesions in women. Complexity was defined as a stent length >30 mm, two or more stents, two or more lesions, and bifurcations.⁵ Women undergoing complex PCI had a higher 3-year risk of major adverse cardiac events (MACE) (adjusted hazard ratio [HR]: 1.63; 95% confidence interval [CI]: 1.45–1.83; $p < 0.0001$).⁵

Nicolas et al retrospectively analyzed data of patients with complex PCI according to sex. The primary outcome was MACE, a composite of all-cause death, myocardial infarction (MI), and

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target vessel revascularization (TVR), at 1 year.⁶ The study included 20,419 patients among whom 5,004 (24.5%) had complex PCI, of whom 25.6% were women. Although women had more comorbidities, they had less complex coronary anatomy. MACE at 1 year was higher in women (14 vs. 11.6%, $p = 0.02$), yet, after multivariable adjustment, MACE at 1 year did not differ according to sex (HR:1.04, 95% CI: 0.85–1.26, $p = 0.71$), without significant interaction between the complexity of the procedure and sex (p -interaction = 0.96). The risk of MI was higher in women (HR:1.63, 95% CI:1.12–2.38, $p = 0.01$). The authors concluded that there is significant interaction between sex and PCI complexity for the outcome of MACE at 30 days, such that women were at a higher risk of cardiac events than men following complex PCI. This association was attenuated at 1 year. Of note, bifurcation lesions were recorded in 32.3% of men versus 33.8% of women in this analysis.⁶

Outcomes of coronary bifurcation stenting were extracted from the National Readmission Database by Osman et al who evaluated 25,050 patients of whom 7,480 were women.⁷ Propensity score matching revealed that women had higher in-hospital major adverse event rates compared with men (7 vs. 5.2%, $p < 0.01$), major bleeding (1.8 vs. 0.8%, $p < 0.01$), post-procedural bleeding (6.1 vs. 3.4%, $p < 0.01$), blood transfusion (6.4 vs. 4.2%, $p < 0.01$), longer length of hospital stay (3 days [interquartile range, IQR: 2–6] vs. 3 days [IQR: 2–5], $p < 0.01$), and higher 30-day readmission rate (14.2 vs. 11.5%, $p < 0.01$). In all comers with an acute coronary syndrome, women had a higher event rate driven largely by bleeding.⁷ Recently, Schamroth Pravda et al reported a single-center prospective analysis of patients undergoing PCI for bifurcation disease.⁸ A total of 1,209 patients were enrolled of whom 261 (21.6%) were women. In

this cohort, women were older with a mean age of 69.7 ± 11 years. Men were younger with a mean age of 63.1 ± 11 years ($p < 0.01$). Women also had more comorbidities and more complex disease with a higher rate of angiographically determined calcification (38.1 vs. 30.1%, $p = 0.017$). At 1 year, there was no significant difference in MACE (18.8 vs. 15.2%, $p = 0.183$) or all-cause mortality (5.7 vs. 3.9%, $p = 0.242$) between men and women. Yet at 3 years, women had a significantly higher rate of MACE compared with men (29.1 vs. 22.5%, $p = 0.026$). This was driven by a higher all-cause mortality (13.8 vs. 6.5%, $p < 0.01$) attributed to an overall higher risk score.⁸

Although these datasets explore outcomes in women in various registries, small cohorts, and meta-analyses, the landmark trials on bifurcation stenting strategies grossly under-represented women (► **Figs. 1** and **2**). The most relevant trials demarcating the different two stent strategies are summarized in ► **Table 1**. Briefly, the most common two-stent strategies are culotte, crush, and T and small protrusion (TAP). These techniques are either executed as an a priori strategy or stepwise provisional. A two-stent strategy is generally reserved for bailout. However, in certain scenarios, an upfront two stent strategy is preferred including true bifurcations with a Medina (111,011,101) particularly if the side branch (SB) lesion extends > 5 to 10 mm beyond the ostium and the SB diameter is > 2.5 mm. Another reason for an a priori 2-stent strategy is a large SB with a poor myocardial reserve, high jeopardy score, and hemodynamic compromise is anticipated. Finally, if the angle to the SB making access too difficult. Differences between these techniques are summarized in ► **Table 2**.

The DEFINITION II trial compared two-stent technique versus provisional stenting in complex bifurcation lesions.

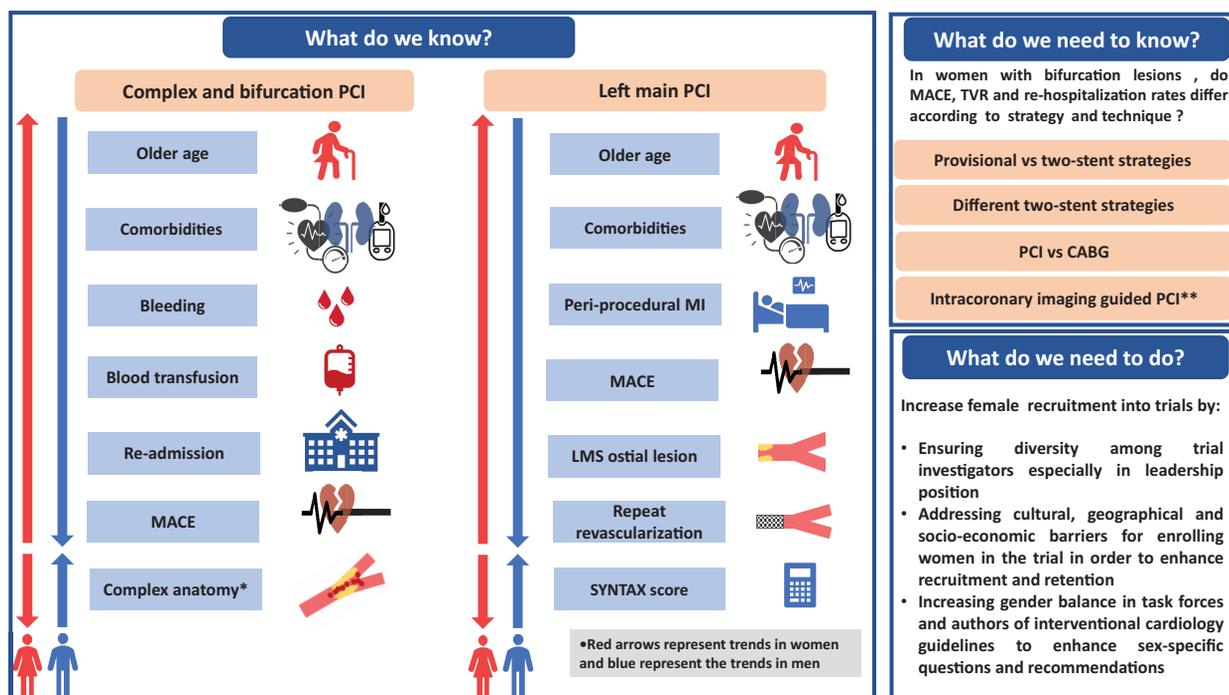


Fig. 1 Central illustration: Gaps in current knowledge and priorities for research in bifurcation percutaneous coronary intervention (PCI) in women *In bifurcation PCI, women were reported to have more complex coronary anatomy than their male counterparts,⁷ while in other complex PCI an opposite relationship is reported. **No validated references for women are published yet which represents a priority for research. CABG, coronary artery bypass grafting; MACE, major adverse cardiac event; TVR, target vessel revascularization.

Table 1 Summary of trials on two-stent bifurcation strategies

Study	Total population	Women	Design	Outcomes	Genders-specific outcomes
DK CRUSH II (2011) ¹⁵	370	21–24%	<ul style="list-style-type: none"> Compared DK-Crush to provisional stenting in symptomatic patients with a Medina 1,1,1 or 0,1,1 lesion. Primary endpoint: MACE (cardiac death, MI, TVR at 5 years) 	DK-Crush was associated with a lower 5-year MACE rate compared with provisional stenting	Not reported
DK CRUSH III (2015) ¹⁶	420	20–23%	<ul style="list-style-type: none"> Compared DK-Crush to Culotte stenting in symptomatic patients with a distal Left Main lesion that is Medina 1,1,1 or 0,1,1 Primary endpoint: composite of MACE and TVR at 3 years 	DK-Crush was associated with a lower 3-year MACE rate compared with culotte stenting	Not reported
DK CRUSH V (2017) ¹⁷	480	17–23%	<ul style="list-style-type: none"> Compared DK-Crush to provisional stenting in symptomatic patients with a distal Left Main lesion that is Medina 1,1,1 or 0,1,1 lesion Primary endpoint: TLF defined as cardiac death, Target Vessel MI and TLR at 12 months 	DK-Crush was superior at 12 months (3-year results published in 2019 confirmed persistent TLF and ST rates.)	In subgroup analysis: for women: TLF occurred in 7.3% in DK Crush vs. 16.7% in provisional stenting (HR = 0.44; 95% CI:0.13, 1.52). For men: TLF occurred in 4.5% in DK Crush vs. 9% in provisional stenting (HR = 0.5; 95%CI:0.23, 1.09). Sex was not a predictor of target lesion failure at 1 year with the DK Crush stent technique compared with provisional stenting, $p = 0.858$
Erglis et al (2009) ¹²	424	28–29%	<ul style="list-style-type: none"> Compared culotte to crush Primary endpoint: MACE, cardiac death, MI, TVR, or ST at 6 months 	Trend toward less in-segment restenosis and significantly less ISR with culotte	Not reported
NORDIC Trial (2013) ¹³	424	29%	<ul style="list-style-type: none"> Compared culotte to crush Primary endpoint: MACE, composite of cardiac death, MI, ST, or TVR at 36 months 	Culotte and crush had similar results at 36 months	Not reported
CELTIC (2018) ¹⁴	170	14–19%	<ul style="list-style-type: none"> Enrolled patients with Medina 1,1,1 lesions amenable to culotte and randomized to Xience or synergy DES Primary endpoint: MACCE defined as a composite of death, MI, CVA, TVR at 9 months 	<ul style="list-style-type: none"> MACCE with culotte is low Xience and Synergy DES had similar performance at 9 months 	Not reported
Burzotta et al (2007) ³⁷	73	25–27.9%	<ul style="list-style-type: none"> Enrolled patients with Medina 1,1,1 lesions including distal LM disease. Primary endpoint: Procedural success and clinically driven TVR 	TAP is a feasible with adequate coverage of the bifurcation	Not reported
AlRashdan et al (2009) ³²	156	23.1%	<ul style="list-style-type: none"> Enrolled patients with significant bifurcation lesions including distal LM and SVG bifurcation (with side branch large enough for 2.5 mm stent) undergone CMT Primary endpoint: procedural success and MACE defined as a composite of death, MI, CVA, TVR at 48 months 	<ul style="list-style-type: none"> CMT technique showed advantages in technical feasibility: provisional SB stenting, complete SB ostial coverage High procedural success rate, low MACE and high MACE free survival rate at 48 months 	Not reported

(Continued)

Table 1 (Continued)

Study	Total population	Women	Design	Outcomes	Genders-specific outcomes
Burzotta et al (2009) ³³	266	N/A	<ul style="list-style-type: none"> Enrolled patients undergoing DES implantation on one major bifurcation lesion including unprotected LM (9%) using provisional TAP Primary endpoint: MACE, defined as cardiac death, MI, ST and TVR at 12 months 	Provisional TAP stenting strategy had good safety and efficacy with low rate of SB stenting	N/A
Džavík and Colombo (2014) ³⁶	8 synthetic bifurcated arterial model	N/A	<ul style="list-style-type: none"> Used synthetic bifurcated arterial model with 75 degrees bifurcation angle Compared Provisional stenting with FKB, modified T-stenting with FKB, double or 2-step crush, mini-crush, and culotte 	Modern bifurcation stenting technique can also be used using absorb BVS	N/A
EXCEL Trial Stone et al (2016), ²³ Subgroup analysis Serruys PW et al (2018) ²⁴	1905	22.5–23.8%	<ul style="list-style-type: none"> Compared PCI using everolimus-eluting stents vs. CABG in patients with unprotected left main disease with low or intermediate anatomical complexity (SYNTAX score ≤ 32) Primary endpoint was the composite of all-cause death, MI, or stroke at a median 3-year follow-up 	There was no significant difference between PCI and CABG regarding primary endpoints	Women had less coronary anatomic burden and complexity but more PCI-related complications than men. Women had higher rate of all-cause death, stroke, and MI at 30 days Multivariate analysis: Sex was not independent predictor of all-cause mortality or primary composite measure of death, stroke, or MI at 3 years
NOBLE trial ²⁶	1184	20–24%	<ul style="list-style-type: none"> Compared PCI vs. CABG in LM lesion Primary endpoint was MACCE, a composite of all-cause mortality, nonprocedural MI, repeat revascularization, and stroke 	CABG was superior to PCI for the primary composite endpoint, nonprocedural MI was higher in PCI group same as repeat revascularization	Primary outcome recorded among women in 29% in PCI group vs. 15% in CABG group (HR = 2.20, 95% CI: 1.26–3.83), and in 28% in PCI men group vs. 20% in CABG men group (HR = 1.46, 95% CI: 1.12–1.19), sex was not significant predictor for primary outcomes, $p = 0.22$
EBC Main trial ²⁷	467	21–26%	<ul style="list-style-type: none"> Compared stepwise layered provisional strategy vs. systematic dual stenting strategy in patients undergoing PCI for true bifurcation unprotected left main stem lesions (Medina type 1, 1 or 0, 1, 1) Primary endpoint was a composite of all-cause death, MI, and TLR at 12 months 	<ul style="list-style-type: none"> Composite of death, MI, and TLR at 12 months occurred less frequently (though not significant statistically) in stepwise provisional group One-fifth of patients required a second stent when provisional stepwise strategy is used 	Not reported

Abbreviations: BVS, bioabsorbable vascular scaffold; CABG, coronary artery bypass grafting; CI, confidence interval; CMT, CarinaModification Tstenting; CVA, cerebrovascular accident; DES, drug-eluting stent; FKB, final kissing balloon; HR, hazard ratio; ISR, in-stent restenosis; LM, left main; MACE, major adverse cardiac event; MACCE, major adverse cardiac or cerebrovascular events; MI, myocardial infarction; N/A, not available; PCI, percutaneous coronary intervention; SB, side branch; ST, stent thrombosis; SVG, saphenous vein graft; TAP, T and small protrusion; TLF, target lesion failure; TLR, target lesion revascularization; TVR, target vessel revascularization.

Table 2 Differences of bifurcation PCI techniques

	TAP	DK-Crush	Culotte
Advantage	<ol style="list-style-type: none"> 1. Technical simplicity (one SB recross)²⁸ 2. Adequate coverage of the bifurcation²⁴ 3. Can be used as bailout technique from provisional strategy³⁸ 	<ol style="list-style-type: none"> 1. Maintained wire access in MB³⁸ 2. DK-Crush (unlike classic or mini-crush) with two KBI increased success of recross³⁸ 3. Lower incidence of MACE (especially in patients with complex bifurcation [defined by DEFINITION criteria])⁴⁰ 	<ol style="list-style-type: none"> 1. Most suited for lesion with similar caliber of SB and distal MV³⁸ 2. Good long-term outcome¹⁰
Disadvantage	Creation of a single layer stent strut neocarina ³⁹	Technically challenging (require two SB recross) ²⁸	Technically challenging (require one SB and one MV recross) ²⁸

Abbreviations: KBI, kissing balloon inflation; MACE, major adverse cardiac event; MB, main branch; MV, main vessel; PCI, percutaneous coronary intervention; SB, side branch; TAP, T and small protrusion.

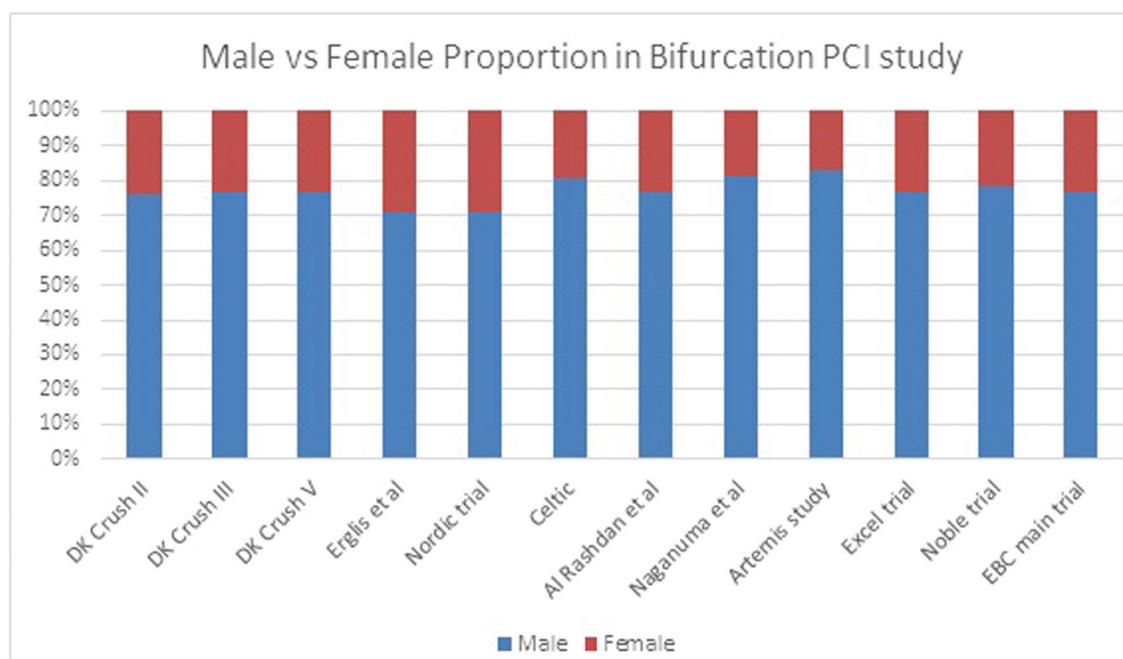


Fig. 2 Proportion of male versus female in bifurcation percutaneous coronary intervention (PCI) studies *This graph highlights the disproportionate and underrepresentation of women in landmark bifurcation PCI trials.

The study included 653 patients with complex bifurcation lesions and women represented 22.3% of the two-stent group versus 23.1% of the provisional group; $p = 0.802$. Sex was not an independent predictor of target lesion failure (TLF). The primary endpoint was a composite of TLF at 1 year follow-up including cardiac death, target vessel MI and clinically target lesion revascularization (TLR). TLF occurred in 11.4% of the provisional versus and 6.1% of two-stent strategy at 1 year. One year after the index procedure, cardiac death occurred in 2.5% in the provisional group versus 2.1% in the two-stent group (HR: 0.86, 95% CI: 0.31–2.37; $p = 0.772$).⁹

Culotte Technique

The culotte technique, also commonly known as Y or Trouser stenting, was initially described by Chevalier et al in 1998 using bare metal stents in a small series of 50 patients.¹⁰ Two equal sized stents were deployed in the main branch (MB)

and SB with an overlapped segment in the MB before the bifurcation. Investigators reported a 94% clinical success rate with three non-Q wave MI and 24% late TLR rate.

This technique was eventually abandoned and resurfaced after the advent of DES. In 2008, Adriaenssens et al conducted a prospective randomized trial of patients undergoing culotte stenting with Cypher, Endeavor, polymer-free rapamycin-eluting or Taxus DES.¹¹ The culotte technique was employed for 134 lesions of which 92.5% were true bifurcations. Angiographic success was achieved in all cases with a 22% restenosis rate (0% in the proximal MB, 9.1% in the distal MB, and 16% in the SB). At 12 months, 21% had TLR and 1.5% had stent thrombosis (ST). Predictors of restenosis were older age, increased bifurcation angle, small SB reference diameter, and severe distal MB stenosis. Subsequently, in 2009 Erglis et al compared a priori two stent strategies, namely crush and culotte, using sirolimus-eluting stents.¹² A total of 424 patients were enrolled (crush [$n = 209$] and

culotte [$n = 215$]). At 6 months, there were no significant differences in MACE rates between both groups; crush 4.3%, culotte 3.7% ($p = 0.87$). Procedure and fluoroscopy times and contrast volumes were also similar. In-stent restenosis was 10.5 vs. 4.5% ($p = 0.046$) for crush and culotte, respectively.

The Nordic trials evaluated the culotte technique further and provided 36 months follow-up that was the longest compared with other trials.¹³ A total of 424 patients were randomized to crush or culotte techniques using sirolimus-eluting stents. At 36 months, the primary endpoint rate was 20.6 versus 16.7% ($p = 0.32$), TLR 11.5 versus 6.5% ($p = 0.09$), and ST 1.4 versus 4.7% ($p = 0.09$) in the crush and the culotte, respectively. Finally, in the CELTIC trial, the culotte technique using new generation everolimus DES, the 3-connector XIENCE, and the 2-connector SYNERGY was evaluated.¹⁴ A total of 170 patients were enrolled and technical success was noted in >96% and a MACE rate of 5.9% at 9 months. The primary endpoint was a composite of death, MI, cerebrovascular accident, target vessel failure, ST, and binary angiographic restenosis. At 9 months, the primary endpoint occurred in 19% of XIENCE group and 16% of SYNERGY group ($p = 0.003$). The CELTIC trial is representative of contemporary practices with radial access in 96%, latest generation DES, and standard proximal optimization techniques.

CRUSH Technique

The crush technique has evolved significantly over the years to a modern-day technique that entails a double kiss and a double crush (DK Crush). Most recently, the nanocrush has been described with a modification to the DK Crush and attempting a very minimal overlap while ensuring adequate scaffolding of the branch shoulders. The DK Crush II study was a randomized trial comparing DKCrush to provisional stenting in symptomatic patients with a Medina 1,1,1 or 0,1,1 lesion. One-hundred and eighty-five patients were enrolled in each arm. MACE was defined as cardiac death, MI, and TVR at 5 years. At the conclusion of the study, angiographic restenosis of the MB and SB was significantly different between the DK Crush (3.8 and 4.9%) and the provisional arms (9.7 and 22.2%, $p = 0.036$ and $p < 0.001$, respectively). SB stenting was necessary in 28.6% of those randomized to a provisional strategy. TVR was significantly lower with DK Crush compared with provisional group (6.5 and 14.6% respectively, $p = 0.017$). MACE and definite ST were similar in both groups DK Crush (10.3% and 2.2%) and provisional (17.3%, and 0.5%, $p = 0.070$ and $p = 0.372$).¹⁵

The DK Crush III results were published in 2015. It randomized symptomatic patients with distal left main disease and a Medina 1,1,1 or 0,1,1 classification bifurcation to DKCrush or culotte stenting. The primary endpoint was a composite of MACE and TVR at 3 years. A total of 419 patients were followed for 3 years. At 3 years, MACE occurred in 49 patients in the culotte group and 17 patients in the DK Crush group (cumulative event rates of 23.7% and 8.2%, respectively; $p < 0.001$). This was primarily driven by a higher MI (8.2 vs. 3.4%, respectively; $p = 0.037$) and TVR (18.8 vs. 5.8%, respectively; $p < 0.001$) between groups. Definite ST rate was 3.4% in the culotte group

and 0% in the DK Crush group ($p = 0.007$). Complex bifurcation disease had a higher rate of MACE (35.3%) particularly in the culotte group (51.5 vs. 15.1%, $p < 0.001$).¹⁶

Finally, DKCrush V randomized symptomatic patients with a distal left main lesion that is Medina 1,1,1 or 0,1,1 to DKCrush or a provisional strategy in a 1:1 fashion. The primary endpoint was TLF defined as cardiac death, target vessel MI, or TLR at 12 months. At 12 months, TLF occurred in 26 patients (10.7%) in the provisional strategy group and only 12 patients (5.0%) in the DK Crush group (HR: 0.42; 95% CI: 0.21–0.85; $p = 0.02$). DK Crush had lower target vessel MI I (2.9 vs. 0.4%; $p = 0.03$) and definite or probable ST (3.3 vs. 0.4%; $p = 0.02$). Clinically driven TLR (7.9 vs. 3.8%; $p = 0.06$) and angiographic restenosis (14.6 vs. 7.1%; $p = 0.10$) were numerically lower in the DK Crush group. There was no significant difference in cardiac deaths between the groups.¹⁷ These results persisted when follow-up was continued to 3 years.¹⁸

TAP Technique

TAP is often considered the simplest of the bifurcation techniques particularly when a stepwise provisional strategy is planned. Current-day TAP is a modification of the formally known T-stenting technique. The primary limitation of the original T-stenting was missing the ostium of the SB. To avoid a geographic miss, minimal protrusion into the main vessel is performed; hence, the name TAP, T and small protrusion, was coined. Although this technique has been adopted worldwide, there are no large randomized trials with long-term outcome data to reference (→ **Table 1**).^{34–36}

Left Main PCI

This entity warrants a separate discussion particularly as the latest European Society of Cardiology guidelines on myocardial revascularization confer a Class I for a Syntax Score <22 and Class IIb for a Syntax Score 23–32.¹⁹ The DELTA (drug-eluting stent for left main (LM) coronary artery disease) Registry noted that lesions of the distal LM bifurcations reported a higher event rate that is primarily driven by repeat revascularisation.²⁰ Guo et al noted that during a follow-up of 8.2 years, PCI of ostial LM stenoses has a low MACE rate similar to coronary artery bypass grafting (CABG) with death (HR: 0.727, 95% CI: 0.335–1.578; $p = 0.421$), the composite endpoint of cardiac death, MI or stroke (HR: 0.730, 95% CI: 0.375–1.421; $p = 0.354$), major adverse cardiac or cerebrovascular events (MACCE) (HR: 1.066, 95% CI: 0.648–1.753; $p = 0.801$), MI (HR: 1.112, 95% CI: 0.414–2.987; $p = 0.833$), stroke (HR: 1.875, 95% CI: 0.528–6.659; $p = 0.331$), and repeat revascularization (HR: 1.590, 95% CI: 0.800–3.161; $p = 0.186$).²¹ These results persisted even after multivariable adjustment. Furthermore, Yildirimturk et al noted that women are more likely to have ostial lesions, that is, low Syntax Score, making PCI a reasonable option for the treatment of LM disease in women.²²

The majority of the landmark trials did not have adequate representation of women. As such, it is critical to review some of the subanalyses of the EXCEL Trial (Evaluation of XIENCE Versus Coronary Artery Bypass Surgery for

Effectiveness of LM revascularization) which concluded that at 3 years, PCI was noninferior to CABG with respect to the primary composite endpoint of death, stroke, or MI.²³ However, EXCEL also reported worse outcomes in women undergoing PCI for LM disease (19.7 vs. 14.1% for the primary composite endpoint) making CABG a more appropriate revascularization option in women. Serruys et al sought to investigate sex differences in EXCEL and noted that women were older, more likely to have atherosclerotic cardiovascular disease risk factors including diabetes mellitus, hypertension, and hypercholesterolemia. The mean Syntax score was lower in women compared with that in men (24.2 vs. 27.2; $p < 0.001$). However, women had a higher rate of periprocedural MI compared with men. Despite the aforementioned, multivariate analysis could not identify sex as an independent predictor of the primary endpoint at 3 years (HR: 1.10; 95% CI: 0.82–1.48; $p = 0.53$).²⁴ Similarly, Buchanan et al evaluated the outcomes of revascularization (PCI vs. CABG) of unprotected LM in 817 women.²⁵ Propensity matching showed no difference in death, MI, or stroke. There was a higher rate of repeat revascularization in the PCI arm.

The NOBLE trial compared PCI versus CABG in LM disease. Women represented 116 (20%) of those enrolled in the PCI group versus 140 (24%) in the CABG group; ($p = 0.09$). The primary endpoint was MACCE, a composite of all-cause mortality, nonprocedural MI, repeat revascularization, and stroke. CABG was superior to PCI for the primary composite endpoint ($p = 0.0002$). All-cause mortality occurred in 9% of the PCI group versus 9% of CABG group (HR: 1.08, 95% CI: 0.74–1.59, $p = 0.68$). Nonprocedural MI occurred in 8% of PCI versus 3% (HR: 2.99; 95% CI: 1.66–5.39; $p = 0.0002$) and repeat revascularization in 17% of PCI versus 10% (HR: 1.73, 95% CI 1.25–2.40; $p = 0.0009$).²⁶

The European Bifurcation Club main trial randomized patients with true LM bifurcation coronary lesions into provisional stepwise strategy versus systematic dual stent strategy. The study recruited 467 patients; women constituted 23.13% of those enrolled. The primary endpoints were a composite of death, MI, and TLR at 12 months that occurred in 14.7% of the stepwise provisional strategy versus 17.7% (HR: 0.8, 95% CI: 0.5–1.3; $p = 0.34$) with only one-fifth of the stepwise strategy requiring a second stent.²⁷

Intracoronary Imaging

Complex bifurcation stenting accounts for a growing number of PCIs performed on a daily basis. It is critical to master and refine the different techniques. In particular, understanding the role of intracoronary imaging to optimize the results is key. Several studies have demonstrated better outcomes when imaging is employed to guide and optimize.^{28–30} However, although much of the evidence from intracoronary imaging was able to identify features unique to women, no validated references for women have been published to date to permit appropriate optimization.²⁸

The OCTOBER trial is a randomized multicenter trial that will assess the superiority of OCT-guided stenting compared with angiographic-guided stenting in bifurcation coronary

lesions. The primary outcome will be a 2-year composite endpoint of cardiac death, target lesion MI, and ischemia-driven TLR. A prespecified subgroup analysis for gender is also planned.³¹

Conclusion

The evidence for bifurcation stenting, whether two-stent or provisional, for LM and non-LM disease has been accumulating over the last decade. The results have been variable across the different studies with a clear geographic preference and provisional in Europe with a predilection to culotte and two-stent strategy in Asia using DK Crush. Many of these trials, however, are underpowered to conduct subgroup analysis for outcomes in women. To date, the evidence suggests women have better outcomes with CABG in complex disease. The higher events in women undergoing PCI are largely driven by bleeding. Studies dedicated to evaluating outcomes after complex revascularization in women are desperately needed with long-term follow-up.

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None.

Conflict of Interest

None declared.

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